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CITY OF CASA GRANDE
BUILDING DIVISION

CITY OF CASA GRANDE, AZ
BUILDING DIVISION
APPROVED AS NOTED
Final approval is subject
upon field inspection
All deviations from approved plans
are to be submitted for approval
Russell Jones
Authorized Bldg. Rep.



Foree & Vann, Inc.

FIELD COPY

Geotechnical Engineering • Environmental Consulting
Construction Testing & Inspection

1576 East Cottonwood Lane
Villa by Mary T Phase II
BP-R2003-779
1st submittal

Tray # 15
Bin #: 1



Foree & Vann, Inc.

Geotechnical Engineering • Environmental Consulting • Construction Testing & Inspection

July 15, 2003

Project 13588

Mr. Jerry Palmer
PALMER ARCHITECTS, LTD.
4147 North Goldwater Boulevard
Suite 105
Scottsdale, Arizona 85251

**RE: GEOTECHNICAL INVESTIGATION REPORT
PROPOSED VILLAS BY MARY T. EXPANSION
1576 EAST COTTONWOOD LANE
CASA GRANDE, ARIZONA**

Dear Mr. Palmer:

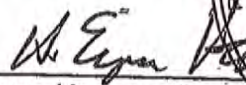
Transmitted herewith is a copy of the final report of the subsurface soil and foundation investigation on the above-mentioned project. The services performed provide an evaluation at selected locations of the subsurface soil conditions throughout the zone of significant foundation influence. As an additional service, this firm may review the project plans and structural notes for conformance to the intent of this report.

This firm possesses the capability of performing testing and inspection services during the course of construction. Such services include, but are not limited to, compaction testing as related to fill control, foundation inspections and concrete sampling. Please notify this firm if a proposal for these services is desired.

Should any questions arise concerning the content of this report, please feel free to contact this office at your earliest convenience.

Respectfully submitted,

FOREE & VANN, INC.


H. Eugene Hansen, P.E.
Senior Geotechnical Engineer

cc: Addressee (6)

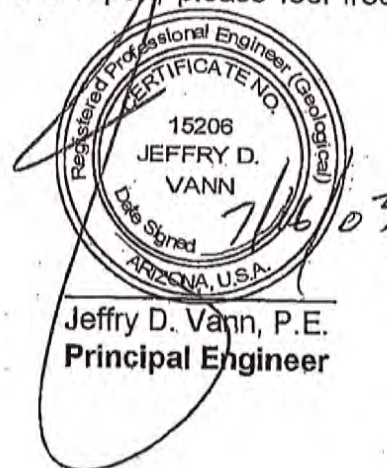
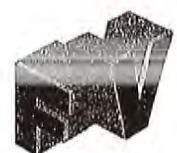


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SCOPE

This report is submitted pursuant to a geotechnical investigation conducted by this firm of the **PROPOSED VILLAS BY MARY T. EXPANSION**, to be located at 1576 East Cottonwood Lane, in Casa Grande, Arizona. The objectives of the investigation were to determine the physical characteristics of the soil underlying the site and to provide final recommendations for safe and economical foundation design and slab support. For purposes of foundation design, the maximum column and wall loads have been assumed to be as summarized below.

	Maximum Column Load (KIPS)	Maximum Wall Load (KLF)
Shallow Spread Foundations	123	7.5

Anticipated structural loads in excess of those stated above will need to be addressed in an addendum, i.e. they are not covered under the scope of work involved with this effort.

The recommendations for site grading contained in this report have not precluded the site to be free of contaminants. They are formulated from a state-of-the-art foundation engineering perspective only.

FIELD INVESTIGATION

On June 26, 2003, this firm advanced nine (9) exploratory test borings (4.5 inch continuous flight auger) for examination of the subsurface profile to a depth of 15.0 feet below the existing site grade. The locations of the test borings are depicted on the Site Plan in Section II of this report. The soils encountered were examined, visually classified, and systematically sampled. The sample intervals at each boring are noted graphically on the test boring logs included in Section II. Refer to the test boring logs in Section II for a detailed description of the subsurface soil conditions at the specified locations.

Two (2) retention percolation tests were conducted at the locations indicated on the included Site Plan. Each percolation test was initiated through the advancement of a test boring to a depth of 3.0 feet, with a diameter of 12.0 inches. The test boring was lined and presoaked, and then refilled at periodic intervals. After each refilling, the rate of water level decline was recorded until a stabilized rate had been achieved. The stabilized infiltration rate attained as a result of the third test interval was recorded as



the stabilized infiltration rate of the entire test. The results of the percolation tests are presented in Section II.

LABORATORY TESTING

Representative samples obtained during the field investigation were subjected to the following laboratory analyses:

Test	Sample(s)	Purpose
Collapse	Undisturbed native soils (8)	Foundation settlement analysis
Expansion	Remolded subgrade soils (6)	Potential for heave upon wetting
Sieve Analysis	Native subgrade soils (3)	Soil classification
Atterberg Limits	Native subgrade soils (3)	Soil classification
Hydrometer Test	Native subgrade soils (1)	Post-tension slab design parameters
Moisture Content & Dry Density	Undisturbed native soils (8)	In-situ soil conditions
Moisture Content	Native subgrade soils (10)	In-place moisture profile

Refer to Section III of this report for the complete results of the laboratory testing.

SITE CONDITIONS

General Notes:

1. Topographic relief - The site of the proposed construction is generally flat and level.
2. Fill – 1.0 feet of existing spread fill was encountered at the locations of Test Borings 3 and 5. One fill stockpile, approximately 100 feet by 75 feet in plan dimension, and 5 feet in height, straddles the south boundary of the site. An approximately 100 feet long area of end-dumped fill piles was noted at the northeast corner of the site. Two piles of aggregate base course were noted on the east side of the site, near the middle. Another pile of aggregate base course was noted on the west side of the site, also near the middle.



3. Evidence of site disturbance - The upper 12 inches of the upper native soils, at the surface or below the zone of spread fill, have been disturbed due to previous agricultural tillage.
4. Site Use - The site is currently a vacant remnant farm field. The project site is at the northeast corner of Peart Road and Cottonwood Lane. An existing housing development is located to the east of the site. An electrical substation exists on east side of the site near the middle. Miscellaneous debris was observed to be scattered across the site. Construction on other residential developments is occurring to the north and south of the project site.

GEOLOGIC HAZARDS

The following list represents a general summary of the on-site soil characteristics relative to engineering applications:

Depth to groundwater	- None encountered
Potential for soil expansion	- High, characterized by soils whose plasticity index is at least 20, and a potential expansion in excess of 4.0 percent
Potential for soil collapse	- Moderate, as indicated by the laboratory test data
Existence of loose soil at foundation bearing elevation	- Not probable
Potential for excessive differential soil movement	- High due to soil expansion
Potential for earth subsidence fissures	- Low
Presence of caliche, bedrock	- Hard and weakly to moderately cemented sandy clay soils were encountered below a depth of 1.0 feet in varying thicknesses at the locations of several test borings.
1997 UBC Soil Profile Type	- Sc

RECOMMENDATIONS

The final recommendations contained herein are based upon the properties of the surface and subsurface soils as described by the field and laboratory testing, the results of which are presented and discussed in this report. Alternate final recommendations may be possible and will be considered upon request.



Conventional Spread Foundations

Based on the high expansion potential of the surface soils across the site, two alternates have been prepared for foundations on the subject site, Alternates 1 and 2, to mitigate potential structural damage; 1) footings bearing on a minimum of 1.0 feet of imported and compacted fill, and 2) deeper foundations bearing on native undisturbed soil with a minimum foundation embedment depth of 2.5 feet.

Alternate 2 is considered by this firm to involve less risk of potential soil heave and resultant structural damage.

It is recommended that all perimeter foundations and isolated exterior foundations be embedded a minimum of 1.5 feet below the lowest adjacent finish pad grade within 5.0 feet of proposed exterior walls. Interior footings should be founded a minimum of 1.5 feet below finish floor level. **Foundations bearing on native undisturbed soil in lieu of imported controlled compacted fill must be embedded a minimum depth of 2.5 feet.** For all construction, 2.0 feet and 1.33 feet are recommended as the minimum width of spread and continuous footings, respectively.

The following tabulations may be used in the design of shallow spread (column) and continuous (wall) foundations for the proposed structures. The column labeled Bearing Stratum refers to the soil layer that the footing pad rests on, and does not mean to imply that the foundation be fully embedded into that particular stratum.

Alternate 1

Surface Level Foundations Bearing on 1.0 Feet of Imported Controlled Compacted Fill

Foundation Depth (ft)	Bearing Stratum	Allowable Soil Bearing Capacity	Allowable Load	
			Wall (KLF)	Column (KIP)
1.5	1.0 feet of imported controlled compacted fill**	1500 PSF	4.5	74
2.0	1.0 feet of imported controlled compacted fill**	1750 PSF	5.3	86
2.5	1.0 feet of imported controlled compacted fill**	2000 PSF	6.0	98



(table continued)

Foundation Depth (ft)	Bearing Stratum	Allowable Soil Bearing Capacity	Allowable Load	
			Wall (KLF)	Column (KIP)
3.0	1.0 feet of imported controlled compacted fill**	2250 PSF	6.8	110
3.5	1.0 feet of imported controlled compacted fill**	2500 PSF	7.5	123

****It is necessary that a minimum of 1.0 feet of imported controlled compacted fill lies beneath all foundations for the structures in order to utilize the bearing capacity for imported controlled compacted fill for design of foundation width. The imported controlled compacted fill should have a lateral extent of at least 2.0 feet beyond the edges of all footings. The imported fill must be comprised of low-expansion potential soil meeting the import criteria described herein. If there is less than 1.0 feet of imported controlled compacted fill beneath the footings, consider the bearing condition to be equivalent to that of native undisturbed soil.**

Alternate 2

Surface Level Foundations Bearing on Native Undisturbed Soil at a Minimum Foundation Depth of 2.5 feet

Foundation Depth (ft)	Bearing Stratum	Allowable Soil Bearing Capacity	Allowable Load	
			Wall (KLF)	Column (KIP)
2.5	Native undisturbed soil	1500 PSF	4.5	74
3.0	Native undisturbed soil	1750 PSF	5.3	86
3.5	Native undisturbed soil	2000 PSF	6.0	98
4.0	Native undisturbed soil	2250 PSF	6.8	110
4.5	Native undisturbed soil	2500 PSF	7.5	123

A mixture of 2-sack ABC/cement slurry may be utilized in the lower portions of the foundation excavations for footings bearing on native undisturbed soil. If 2-sack ABC/cement slurry is used, a minimum of 1.0 feet of the mixture should underlie a



conventional foundation depth of 1.5 feet (for an allowable soil bearing capacity of 1500 psf). The width of the mixture of 2-sack ABC/cement slurry shall equal the width of the footing.

Refer to the "Footing Schematic" in Section IV for a description of the above presented alternates and associated required earthwork.

The previously tabulated bearing values and the allowable loads associated therewith are based on a total settlement of 1/2 inch. The allowable loads are based on maximum footing sizes of 3.0 and 7.0 feet for continuous and spread footings, respectively. Greater loads and larger footings may be accommodated by the listed bearing values, if there is toleration for increased settlements. This office should be contacted if this situation should arise.

Explanations

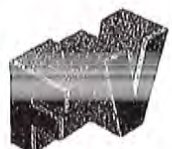
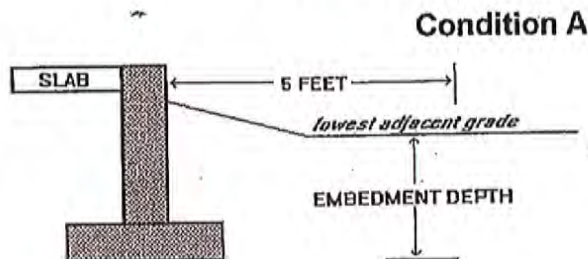
Foundation Embedment Depth - i.e.,

A) The depth below the lowest adjacent exterior pad grade within 5.0 feet of proposed exterior walls;

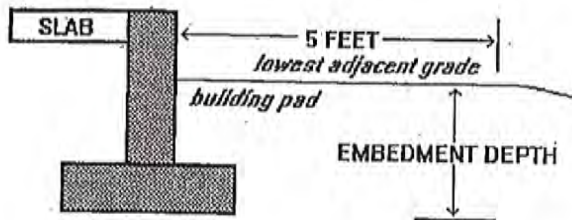
B) The depth below finish compacted pad grade provided that a sufficient pad blow-up (the lateral extent to which the building pad is constructed beyond the limits of the exterior walls or other structural elements, inclusive of exterior column foundations) has been incorporated into the grading and drainage design (5.0 feet or greater);

C) The depth below finish floor level for interior foundations.

FOUNDATION EMBEDMENT



Condition B



The weight of the foundation below grade may be neglected in dead load computations.

The previously tabulated bearing capacities should be considered allowable maximums for dead plus design live loads and may be increased by one-third when considering total loads, including wind or seismic forces or other transient loading conditions.

Retaining wall or building foundations to be constructed in close proximity to retention basins (within 5.0 feet) should be embedded 1.0 feet deeper than the stated depths in the preceding bearing capacity tables.

Shallow foundations that are adjacent to lower foundation areas must be stepped down so that their base is below the lower backfill materials, and below a line projected upward from the nearest lower foundation edge at a 45 degree angle. In no case should ancillary structures be designed or constructed, whose foundations will bear into deeper, non-verified backfills.

It is anticipated that differential settlement of foundation systems will be limited to $\frac{1}{4}$ inch if construction is performed in accordance with locally accepted standards and the recommendations contained herein. The anticipated differential movement between slabs and footings is anticipated to be on the order of $\frac{1}{2}$ inch due to the effects of expansive soils.

This firm recommends that continuous footings and stem walls be reinforced, and bearing walls be constructed with frequent joints to better distribute stresses in the event of localized foundation movements. Similarly, all masonry walls should be constructed with both vertical and horizontal reinforcement. It is strongly recommended that all foundation excavations be inspected (prior to the placement of reinforcing steel) by a representative of the project geotechnical engineer to ensure that they are free of loose soil which may have blown or sloughed into the excavations, the embedment depth is adequate, and the dimensions are in accordance with the project requirements. It will also be necessary for the geotechnical engineer to verify that the



footings will bear upon one of the bearing strata described above, at a minimum foundation depth of 1.5 feet for foundations bearing on 1.0 feet of imported controlled compacted fill (2.5 feet for foundations bearing on native undisturbed soil).

A minimum of MAG B (2500 PSI), or equivalent, concrete should be used for footings, stem walls and floor slabs. A maximum 4.0 inch slump should be used for footings and stem walls and a maximum 6.0 inch slump should be used for floor slabs. Type II cement is commercially available and should be utilized in all concrete to resist corrosion.

Post-Tension Slab Soil Criteria Based on the UBC

The following parameters and assumptions can be used by the Project Structural Engineer in the design of an economical post-tension slab design in accordance with UBC criteria:

Soil Properties

Thornthwaite Moisture Index	-30
Percent Clay	40
Clay Type	Montmorillonite
Moisture Velocity	0.7 inches/month
Design Soil Suction	3.6
Depth to Constant Suction	3.0 feet
Edge Moisture Variation Distance, e_m	
Center Lift Condition	5.5 feet
Edge Lift Condition	2.5 feet
Differential Soil Movement, y_m	
Center Lift Conditions	1.215 inches
Edge Lift Conditions	0.139 inches
Subgrade Friction Coefficient	1.25 – compacted pad soil 1.00 – sand base 0.75 – polyethylene sheeting
Soil Modulus of Elasticity	750 psi
Modulus of Subgrade Reaction	250 psi/inch on 12" controlled compacted fill; 150 psi/inch on native undisturbed soil

Our review of the applicable parameters suggests that a maximum differential soil movement on the order of 1.215 inches may be anticipated at the subject site.



The minimum recommended foundation/beam depths/thicknesses for interior and perimeter conditions are **6.0 and 18.0 inches**, respectively, in conjunction with an allowable soil bearing capacity of **1000 psf (moderate collapse)**. Embedment depth for post-tensioned slabs is referenced from finish floor for both interior and perimeter footings.

The perimeter foundation embedment/thickness may be reduced to 12.0 inches, if a uniform thickness slab is to be constructed with a minimum thickness of 7.5 inches.

Foundation and floor slab systems incorporating post-tensioned slabs should utilize a minimum of MAG B (2500 PSI), or equivalent, concrete utilizing Type II cement.

For each 6.0-inch thickness of controlled compacted fill to be placed beneath the foundations, or for each additional 6.0-inch increase in foundation depth, the allowable soil bearing capacity will increase by 250 psf.

Thickness of controlled compacted fill beneath proposed post-tensioned slab footings (6.0 to 18.0 inch embedment depth as described above)	Allowable Bearing Capacity
Bearing on native undisturbed clay soil	1000 PSF
6.0 inches	1250 PSF
12.0 inches	1500 PSF

For a minimum 4.0-inch post-tensioned slab system, with 6.0 to 18.0 inch embedded footings bearing on 12.0 inches of controlled compacted fill, an allowable bearing capacity of 1500 PSF may be assumed.

It is this firm's understanding that monolithic foundations may be utilized, with no internal vertical edges. Foundation and floor slab systems incorporating post-tensioned slabs should utilize a minimum of MAG B (2500 PSI), or equivalent, concrete utilizing Type II cement.

Lateral Stability Analyses

The following tabulation presents final recommendations for lateral stability analyses:

^a Foundation Toe Pressures 1.33 x max. Allowable



	Native Undisturbed Soil	Imported Controlled / Compacted Fill
^b Lateral Backfill Pressures:		
Unrestrained walls	40 psf/ft.	34 psf/ft.
Restrained wall ^c	58 psf/ft.	52 psf/ft.
Lateral Passive Pressures For Surficial Soils:		
Continuous walls/footings	204 psf/ft.	240 psf/ft.
Spread columns/footings	305 psf/ft.	358 psf/ft.
Coefficient of Base Friction For Surficial Soils:		
Independent of passive resistance	0.53	0.62
In conjunction with passive resistance	0.36	0.42

Superscript Explanations

^aIncrease in allowable foundation bearing pressure (previously stated) for foundation toe pressures due to eccentric or lateral loading.

^bEquivalent fluid pressures for vertical walls and horizontal backfill surfaces (maximum 12.0 feet in height). Pressures do not include temporary forces during compaction of the backfill, expansion pressures developed by overcompacted clayey backfill, hydrostatic pressures from inundation of backfill, or surcharge loads. Walls should be suitably braced during backfilling to prevent damage and excessive deflection.

^cThe backfill pressure can be reduced to the unrestrained value if the backfill zone between the wall and cut slope is a narrow wedge (width less than one-half height).

Drainage

In unpaved areas it is suggested that finished slopes extend a minimum of 5.0 feet horizontally from building walls and have a minimum vertical fall of 3.0 inches. Minimum grades of 2.0 percent should be maintained where the horizontal slope distance exceeds 5.0 feet. **In no case should long-term ponding be allowed near structures.** Backfill against footings, exterior walls, retaining walls and in utility trenches should be well compacted to minimize the possibility of moisture infiltration through loose soil.



Special note for conventional systems: Where granular soils are utilized as imported controlled compacted fill, a moisture barrier must be installed around the perimeter of the structures to prevent water migration into the granular fill. Such measures may include vertical or horizontal grout or concrete barriers.

Conventional Slab Support

Site grading within the building areas should be accomplished as recommended herein. 4.0 inches of aggregate base course (ABC) floor fill should immediately underlie interior grade floor slabs with a typical thickness of 4.0 inches. The aggregate base material should conform to the requirements of Section 702 under Sub-section 702.2 "Crushed Aggregate" of the "Uniform Standard Specifications for Public Works Construction" sponsored by the Maricopa Association of Governments and all supplements which require a particle size grading as follows:

Sieve Size	Percent Passing
1-1/4"	100
#4	38-65
#8	25-60
#30	10-40
#200	3-12

Maximum Plasticity Index - 5

Aggregate base course shall not be required beneath post-tensioned slabs.

Special note for conventional systems: Due to the highly expansive nature of the surface soils, it is recommended that 1.0 feet of low expansion potential import soils lie beneath the ABC for all conventional interior and exterior slabs which are not post-tensioned. As such, the native site soils with a plasticity index greater than or equal to 20 should not be utilized in the upper 1.0 feet of the building pads and surrounding fills. In other words, exterior slabs, curbs, gutters, and sidewalks must be underlain by 12.0 inches of non-expansive import soil (beneath any ABC).

Special Note: To further reduce the potential for conventional slab related damage, we recommend the following for conventional systems:

1. Placement of effective control joints on relatively close centers.
2. Proper moisture and density control during placement of subgrade fills.
3. Provision for adequate drainage in areas adjoining the slabs.



4. Use of designs which allow for the differential vertical movement described herein between the slabs and adjoining structural elements, i.e. $\frac{1}{2}$ inch.
5. 2-sack ABC/cement slurry should be utilized as backfill at the intersection of utility trenches with the building perimeter.

As an alternate to the utilization of imported soil beneath the exterior conventional slabs, this firm is submitting a table of alternative recommendations entitled "Recommendations for Concrete on Expansive Soils," wherein imported soil would not be required beneath such slabs. Instead, a combination of reinforcement, deep soil preparation and increased slab thickness may be considered. Please keep in mind that increased slab thicknesses, deep soil preparation and reinforcement will not be necessary, as an alternative, if the original recommendation to place 12.0 inches of imported fill beneath the slabs is adhered to.

Refer to Section IV for further recommendations and guidelines pertaining to conventional-type concrete slabs over expansive soils. Relative to the subject site, the Expansion Index (EI) is considered by this firm to be in the range of 91-130. In cases where slight conflicts between the chart in Section IV and the content of Section I arise, the content of Section I shall govern, i.e. Pre-Soaking Depth requirements. At the subject site, recommendations contained under the column entitled "Reinforcement" will not be required.

With regard to the table, this firm is providing the following very general definitions to the following terms:

1. Isolated and Meandering – Refer to the same general condition. They are two different ways to describe sidewalks which are not immediately adjoining a structure (isolated from the immediate periphery of the structure). In other words, this would include sidewalks which connect different buildings or traverse portions of the site not occupied by buildings (but do not specifically surround buildings as described by #2 below).
2. Not Isolated – Refers to sidewalks that are in immediate proximity to the proposed structures. Typically, these include only those that are to be constructed within the original pad, "pad blow-up" or extension beyond the limits the proposed building envelope, say 5.0 feet, normally (usually any sidewalk within 5.0 feet of the periphery of the building, intending to surround the building).

In the absence of utilizing imported soil beneath exterior slabs, i.e. exterior concrete slabs bearing on native clay soils (with or without a thin section of ABC), recommendations contained in the table in Section IV may be considered as an alternate to using imported soil. Such recommendations involve semi-deep soil



preparation (to a depth of 24.0 inches) with moisture contents maintained in excess of the optimum water content. As indicated by the table, a 4.0 inch thick exterior slab may be utilized if a thickened edge is incorporated into the design and construction. The thicknesses of the edge may vary depending upon the intended use of the concrete (refer to the table). For example, an 18.0 inch thickened edge may be constructed for common sidewalks, not isolated. For patios, the minimum thickened edge should be 18.0 inches. In any case, the thickness of the edge should be not be less that 18.0 inches (for a 4.0 inch exterior slab).

In the absence of thickened edges, conventional exterior slabs with uniform thicknesses of 6.0 inches may be considered to account for the highly expansive characteristics at the site (expansion between 4.0 and 5.0 percent).

This firm is aware that the buildings may be constructed utilizing post-tensioned slab construction; **however, the slabs outside the limits of the actual buildings are not intended to be post-tensioned. As such, they fall into the category of conventional slabs, necessitating the implementation of the recommendations pertaining to conventional systems, i.e. slabs bearing on imported controlled compacted fill or slabs on native soil designed on the basis of the table entitled "Recommendations for Concrete on Expansive Soil."**

Pavement Design

Site grading within pavement areas should provide requisite subgrade support for flexible pavements. A compacted subgrade of on-site soils or soils with comparable properties is assumed. Pavement materials and placement requirements should be in accordance with the Maricopa Association of Government Standard Specifications, or equivalent. Asphaltic concrete surfacing should be MAG type 19 mm placed in a single lift.

The stability of compacted pavement subgrade soils is reduced under conditions of increased soil moisture. Therefore, base course or pavement materials should not be placed when the surface is in a wet condition. Adequate surface drainage should be provided away from the edge of paved areas to minimize lateral moisture transmission into the subgrade. The following presents minimum recommended pavement sections for anticipated traffic conditions.



Light Vehicles or Low Volume Traffic Areas

Alternate	Prepared Subgrade (Inches)	ABC (Inches)	Asphaltic Concrete (Inches)	Concrete Pavement (Inches)
A ^a	12.0	6.0	2.0	
B ^a	12.0		4.0	
C ^b	12.0			5.5*

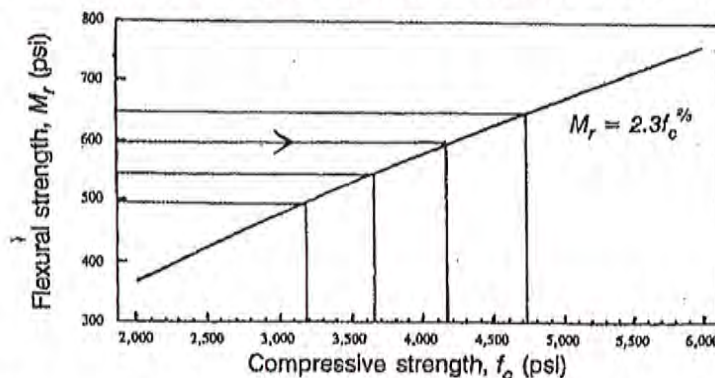
Heavy Vehicle Areas

Alternate	Prepared Subgrade (Inches)	ABC (Inches)	Asphaltic Concrete (Inches)	Concrete Pavement (Inches)
A ^a	12.0	6.0	3.0	
B ^a	12.0		5.0	
C ^b	12.0			6.5*

^a - 10 to 15 year design life, with typical maintenance

^b - 20 year design life, with typical maintenance

*The above thicknesses for Portland Cement concrete pavement are based on a modulus of rupture of 600 PSI. The recommended concrete thicknesses should be increased in increments of 0.5 inch for every 50 PSI decrease in the modulus of rupture. The following chart relates rupture modulus to compressive strength.



Specifications for ABC should be as previously stated under "Slab Support." Compaction of subbase fill and base course materials should be accomplished to the density criteria listed under "Final Compaction and Moisture Content Recommendations". Compaction of asphalt should be accomplished to the following density criteria:



Material	Percent Compaction 75-blow method
Asphalt Surfacing	95 minimum

Site Preparation

The following final recommendations are presented as a guide in the compilation of construction specifications. The final recommendations are not comprehensive contract documents and should not be utilized as such.

It is recommended that any vegetation, miscellaneous debris, and any other deleterious materials be removed at the commencement of site grading activities. None of these removed materials will be suitable for use as structural fill material.

Following the removal of the above listed items, it shall be necessary to strip all existing spread fill soils, stockpiled fill soils, and end-dumped piles of fill soils or aggregate base course from proposed structure and pavement areas at the commencement of site grading activities. According to the results of the test drilling effort, the excavation of roughly 1.0 of spread fill soils may be required at the locations of Test Borings 3 and 5. **All removed spread fill soils, stockpiled fill soils, and end-dumped piles of fill soils or aggregate base course may be reused as structural fill material beneath asphalt pavement or landscape areas only, provided that it is free of vegetation, debris, and oversized rock particles (greater than 6.0 inches), unless it is determined from laboratory testing that the spread fill soils have a low to moderate expansion potential and that the plasticity index for the removed spread fill soils is lower than 20.** If both are determined, the removed fill soils may also be reused as structural fill beneath proposed structure and exterior concrete slab areas provided it is free of vegetation, debris, and oversized rock particles (greater than 6.0 inches).

Following removal of the spread fill, stockpiled fill, end-dumped fill, and any required subexcavation, the uppermost 12.0 inches of the existing site surface native soils should be scarified, moisture processed and properly compacted in accordance with the section on compaction and moisture content recommendations in all areas (i.e. slab support areas and proposed pavement areas), prior to the placement of structural fill or resultant in a cut situation and should incorporate a minimum pad blow-up of 5.0 feet in all proposed building areas.

Special note for conventional systems: Due to the highly expansive nature of the surface soils at this site, 1.0 feet of **imported** controlled compacted fill soil should underlie all conventional spread-type foundations (for the applicable alternate). It shall



be required that the surface soils, in foundation areas, be subexcavated to a depth that is 1.0 feet below the bottom of proposed foundations. The overexcavations shall extend laterally beyond the edges of all footings a distance of 2.0 feet. All removed native soil is considered by this firm to be suitable in limited areas for use as engineered fill (i.e. not in the upper 1.0 feet of the building pads and other affected walkways (if the plasticity index is equal to or greater than 20). The base of the zone of subexcavation shall require scarification, moisture processing, and limited compaction. **The replacement fill must be comprised of low-expansion potential soil meeting the import criteria described herein.**

The above requirement shall not apply to deeper conventional spread foundations bearing directly on native undisturbed soil (with a corresponding soil bearing capacity), or the implementation of post-tensioned slabs with an allowable soil bearing capacity of 1000 psf.

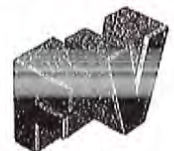
Subgrade preparation in post-tensioned slab areas must consist of at least 12.0 inches of processed native soil, prior to the placement of additional fill soil, or resultant in a proposed cut situation. The pads may also be constructed of native soil.

Suitable on-site native soil shall be defined as any soil whose plasticity index is less than 20. However, suitable on-site native soils were not encountered above a depth of 12.0 feet at the locations of the test borings. The use of native soils in areas requiring imported controlled compacted fill is not recommended unless it is tested.

Special note for conventional systems: The base of any zone of subexcavation (subexcavation cut surface below foundations or upon which import fill is placed for support of conventional floor slabs) shall be properly prepared to a depth of 12.0 inches. Proper preparation shall include adequate high moisture processing and limited compaction.

Special note for conventional systems: Where granular soils are utilized as imported controlled compacted fill (in the case of conventional spread foundations), a moisture barrier must be installed around the perimeter of the structures to prevent water migration into the granular fill. Such measures may include vertical or horizontal grout or concrete barriers.

Special note for conventional systems: It is also recommended that 12.0 inches of low-expansion potential import soils lie beneath the ABC for conventional interior and exterior slabs on grade. As such, the native clay soils with a plasticity index greater than or equal to 20 should not be utilized in the upper 12.0 inches of the building pads and surrounding fills which will support exterior



concrete slabs. They should be replaced with import soil satisfying the criteria herein.

Refer to the "Footing Schematic" in Section IV for a description of the above presented conventional foundation system alternates and associated required earthwork.

Complete removal and cleaning of any undesirable materials and proper backfilling of depressions will be necessary to develop support for the proposed facilities. Widen all depressions as necessary to accommodate compaction equipment and provide a level base for placing any fill. All fill shall be properly moistened and compacted as specified in the section on compaction and moisture content final recommendations.

All subbase fill required to bring the structure areas up to subgrade elevation should be placed in horizontal lifts not exceeding 6.0 inches compacted thickness or in horizontal lifts with thickness compatible with the compaction equipment utilized.

It is the understanding of this firm that various utility trenches may traverse the completed pad. The backfill of all utility trenches, if not in conformance with this report, may adversely impact the integrity of the completed pad. This firm recommends that all utility trench backfill crossing the pad be inspected and tested to ensure full conformance with this report. Untested utility trench backfill will nullify any as-built grading report regarding the existence of controlled compacted fill beneath the proposed building foundations and place the owner at greater risk in terms of potential unwanted foundation and floor slab movement.

Compaction and Moisture Content Recommendations

Compaction of backfill, subgrade soil, subbase fill, and base course materials should be accomplished to the following density criteria:

<u>Material</u>	<u>Percent Compaction (ASTM D698)</u>
On-site native and fill soils used as subbase fill or backfill for structural or pavement support (cohesive, $PI \geq 20$):	
Building areas above foundation level, and at the base of any zone of subexcavation	85-90
(Not to be used in the upper 1.0 feet of the building pads or below conventional foundations to a depth of 1.0 feet)	
Below asphalt pavements	95 min.



(table continued)

Material	Percent Compaction (ASTM D698)
On-site native and fill soils used as subbase fill or backfill for structural or pavement support (cohesive, $12 \leq PI < 20$):	
Building areas below foundation level	95 min.
Building areas above foundation level	87-92
Below asphalt pavements	95 min.
On-site native and fill soils used as subbase fill or backfill for structural or pavement support (cohesionless, $PI < 12$):	
Building areas below foundation level	95 min.
Building areas above foundation level	90 min.
Below asphalt pavements	95 min.
Imported subbase fill or backfill for structural or pavement support:	
Building areas below foundation level	95 min.
Building areas above foundation level	90 min.
Below asphalt pavements	95 min.
Base course:	
Below asphalt pavements	100 min.
Below interior concrete slabs	95 min.

During construction and prior to concrete placement, moisture contents should be controlled as follows:

Material	Compaction Moisture Content Range
On-site native and fill soils (cohesive, $PI \geq 20$):	
Above foundation level, and at the base of any zone of subexcavation	optimum to optimum +4%
(Not to be used in the upper 1.0 feet of the building pads or below conventional foundations to a depth of 1.0 feet)	
Below asphalt pavements	optimum -3 to optimum +1%
On-site native and fill soils (cohesive, $12 \leq PI < 20$):	
Below foundation level	optimum -1 to optimum +3%
Above foundation level	optimum to optimum +4%
Below asphalt pavements	optimum -3 to optimum +1%
On-site native and fill soils (cohesionless, $PI < 12$):	
Below foundation level	optimum -2 to optimum +2%
Above foundation level	optimum -2 to optimum +2%
Below asphalt pavements	optimum -2 to optimum +2%
Imported fill material:	
Below foundation level	optimum -2 to optimum +2%
Above foundation level	optimum -2 to optimum +2%
Below asphalt pavements	optimum -2 to optimum +2%



Note: The final recommendations previously tabulated under the heading entitled "Above Foundation Level" also apply to the subgrade in exterior slab, sidewalk, curb, gutter, and pool deck areas.

Compaction recommendations for the subgrade native soil beneath post-tensioned slabs should also generally conform to the above foundation level requirements.

Any soil disturbed during construction shall be compacted to the applicable percent compaction as specified herein. Increase the required degree of compaction to a minimum of 95 percent for fill materials greater than 5.0 feet below final grade.

Natural undisturbed soils or compacted soils subsequently disturbed or removed by construction operations should be replaced with materials compacted as specified above. All imported fill material to be used as structural supporting fill should be free of vegetation, debris and other deleterious material and meet the following requirements:

Maximum Particle Size	6.0 inches
Maximum Plasticity Index	15
Maximum Passing #200 Sieve	60 percent
Maximum Expansion	1.5 %*

* - Performed on a sample remolded to 95 percent of the maximum ASTM D698 density at roughly 2.0 percent below the optimum moisture content, under a 100 psf surcharge.

Water settling and/or slurry shall not, in any case, be used to compact or settle surface soils, fill material, or trench backfill within 10.0 feet of any proposed structure.

Shrinkage

Assuming that the average degree of compaction will approximate 95 percent of the standard maximum density, the approximate shrinkage of the reworked native soils should be 20-25 percent. This may result in a vertical elevation change of approximately 0.20 to 0.25 feet following the precompaction effort.

Excavating Conditions

In most cases, excavations into the site surface and subsurface soils, extending to a depth of 15.0 feet, should be possible with conventional excavating equipment.



At some locations, heavier excavating equipment may be required below a depth of 1.0 feet due to the presence of varying thicknesses of hard and weakly to moderately cemented sandy clay soils encountered at several of the test boring locations.

Excavations greater than 4.0 feet should be sloped or braced as required to provide personnel safety and satisfy local safety code regulations.

Fill Slope Stability

The maximum fill slopes may conform to a 1.75:1 (horizontal:vertical) ratio if fill is placed in accordance with the final recommendations contained herein.

Construction Observation

Foree & Vann, Inc. should be retained to provide documentation that the recommendations set forth in this report are met. These include but are not limited to documentation of site clearing activities, verification of fill suitability and compaction, and inspection of footing excavations. Relative to field density testing, a minimum of 1 field density test should be taken for every 2500 square feet of building area, per 6.0 inch layer of compacted fill.

LIMITATIONS OF LIABILITY

Since our investigation is based upon review of background data, the site materials observed, selected laboratory testing and engineering analysis, the conclusions and recommendations are professional opinions. Our professional services have been performed using that degree and skill ordinarily exercised, under similar circumstances, by reputable geotechnical engineers practicing in this or similar localities. These opinions have been derived in accordance with current standards of practice and no other warranty, express or implied, is made.

Neither Foree & Vann, Inc. nor their agents or employees shall be jointly, severally or individually liable to the client or owner in excess of the compensation to be paid pursuant to this agreement, by any reason of any act or omission, including breach of contract or negligence not amounting to willful or intentional wrong.

This report is not intended as a bidding document, and any contractor reviewing this report must draw his own conclusions regarding specific construction techniques to be used on this project.



The scope of services carried out by this firm does not include an evaluation pertaining to environmental issues. If these services are required by the lender, we would be most pleased to discuss the varying degrees of environmental site assessments.

The materials encountered on the subject site and utilized in our laboratory analysis are believed to be representative of the total area; however, soil and rock materials do vary in character between points of investigation. The recommendations contained in this report are based on the assumption that the soil conditions do not deviate appreciably from those disclosed by the investigation. Should unusual material or conditions be encountered during construction, the soil engineer must be notified so that he may make supplemental recommendations if they should be required.

This report is issued with the understanding that it is the responsibility of the owner to see that its provisions are carried out or brought to the attention of those concerned. In the event that any changes of the proposed project are planned, the conclusions and recommendations contained in this report shall be reviewed and the report shall be modified or supplemented as necessary.

Prior to construction, we recommend the following:

1. Consultation with the design team in all areas that concern soils and rocks to ensure a clear understanding of all key elements contained within this report.
2. Review of the General Structural Notes to confirm compliance to this report and determination of which allowable soil bearing capacity has been selected by the project structural engineer (this directly affects the extent of earthwork and foundation preparation at the site).
3. This firm be notified of all specific areas to be treated as special inspection items (designated by the architect, structural engineer or governmental agency).

Relative to this firm's involvement with the project during the course of construction, we offer the following recommendations:

1. The site or development owner should be directly responsible for the selection of the geotechnical consultant to provide testing and observation services during the course of construction.
2. This firm should be contracted by the owner to provide the course of construction testing and observation services for this project, as we are most familiar with the interpretation of the methodology followed herein.
3. All parties concerned should understand that there exists a priority surrounding the testing and observation services completed at the site. From



a geotechnical perspective, it is imperative to understand the following priority list, presented in order of decreasing priority.

- A. Fill control for building pads (verification of overexcavation depths and lateral extents, compaction testing, and the general monitoring of fill placement).
- B. Foundation observations (compliance with the General Structural Notes, depths, bearing strata, etc.).
- C. Basement, structural or retaining wall backfill testing.
- D. Utility trench backfill
- E. Special inspections as dictated by the local municipality.
- F. Concrete sampling and testing for footings, stem walls and floor slabs.
- G. Subgrade testing for proposed pavement areas.
- H. ABC testing for proposed pavement areas.
- I. Asphaltic concrete testing for proposed pavement areas.
- J. Subgrade preparation for on-site sidewalk areas
- K. Grout sampling and testing, where applicable.
- L. Mortar sampling and testing, where applicable.
- M. Off-site subgrade, ABC, asphalt, curb, gutter and sidewalk testing.

Please understand that Item A above is the only area where this firm has control on-site (once it has started) to verify or deny compliance with applicable standards, without the need for any entity to schedule testing activities with this office. Other than Item A, it shall be another entity's responsibility to schedule all testing and observation services, to coincide with the progress of construction. Since this firm is not a contributor to the construction schedule, we do not possess an inherent knowledge as to when our services shall be needed or required.



DEFINITION OF TERMINOLOGY

Allowable Soil Bearing Capacity	The recommended maximum contact stress developed at the interface of the foundation element and the supporting material.
Allowable Foundation Pressure	
Aggregate Base Course (ABC)	A sand and gravel mixture of specified gradation, used for slab and pavement support.
Backfill	A specified material placed and compacted in a confined area.
Base Course	A layer of specified material placed on a subgrade or subbase.
Base Course Grade	Top of base course.
Bench	A horizontal surface in a sloped deposit.
Caisson	A concrete foundation element cased in a circular excavation, which may have an enlarged base. Sometimes referred to as a cast-in-place pier.
Concrete Slabs-on-Grade	A concrete surface layer cast directly upon a base, subbase, or subgrade.
Controlled Compacted Fill	Engineered Fill. Specific material placed and compacted to specified density and/or moisture conditions under observation of a representative of a soil engineer.
Differential Settlement	Unequal settlement between or within foundation elements of a structure.
Existing Fill	Materials deposited through the action of man prior to exploration of the site.
Expansive Potential	The potential of a soil to increase in volume due to the absorption of moisture.
Fill	Materials deposited by the action of man.
Finish Grade	The final grade created as a part of the project.
Heave	Upward movement due to expansion or frost action.
Native Grade	The naturally occurring ground surface.
Native Soil	Naturally occurring on-site soil.
Overexcavate	Lateral extent of subexcavation.
Rock	A natural aggregate of mineral grains connected by strong and permanent cohesive forces. Usually requires drilling, wedging, blasting, or other methods of extraordinary force for excavation.
Scarify	To mechanically loosen soil or break down the existing soil structure.
Settlement	Downward movement of the soil mass and structure due to vertical loading.
Soil	Any unconsolidated material composed of disintegrated vegetable or mineral matter, which can be separated by gentle mechanical means, such as agitation in water.
Strip	To remove from present location.
Subbase	A layer of specified material between the subgrade and base course.
Subexcavate	Vertical zone of soil removal and recompaction required for adequate foundation or slab support
Subgrade	Prepared native soil surface.

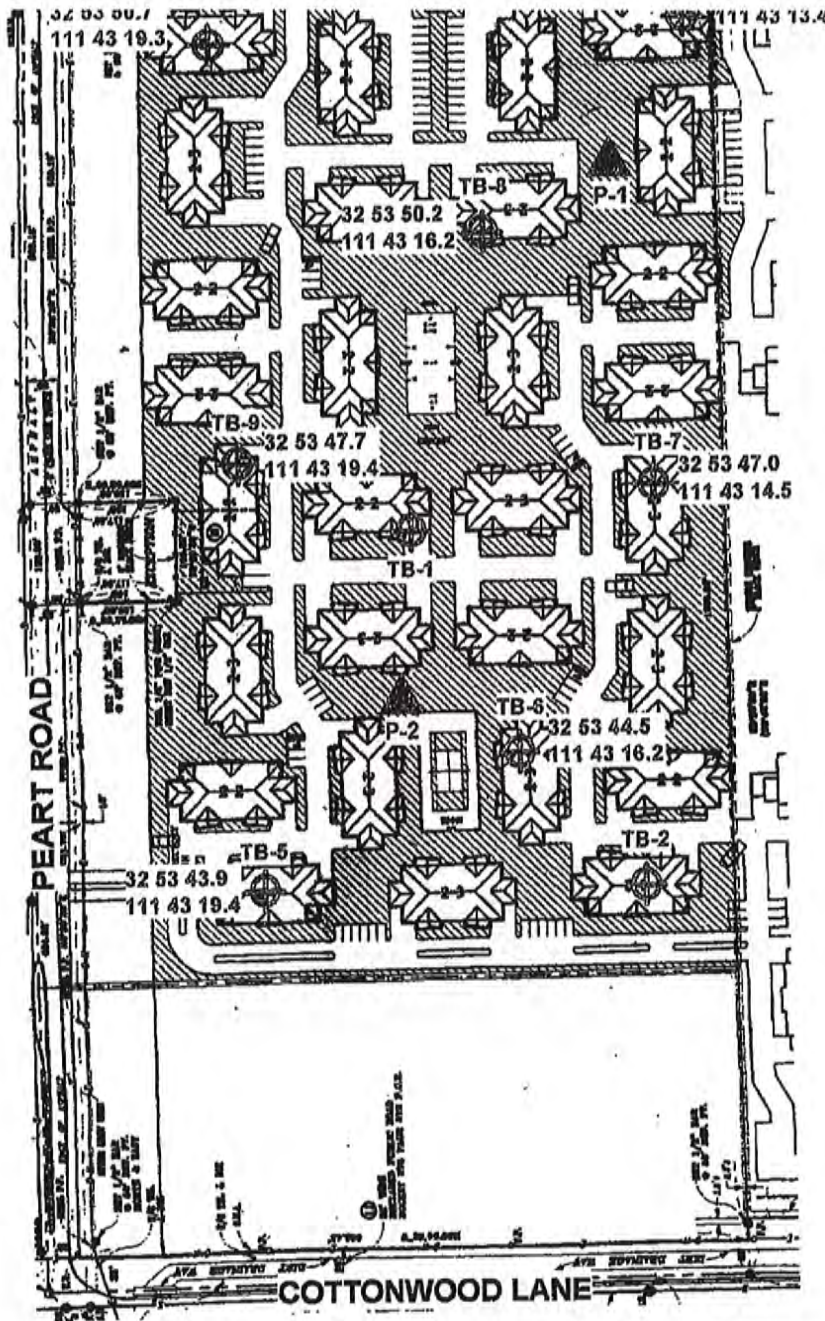


TABLE OF

SECTION II

SECTION III

SECTION IV



LEGEND:



TEST BORING LOCATIONS



PERCOLATION TEST LOCATIONS

SITE PLAN

SCALE: N.T.S.

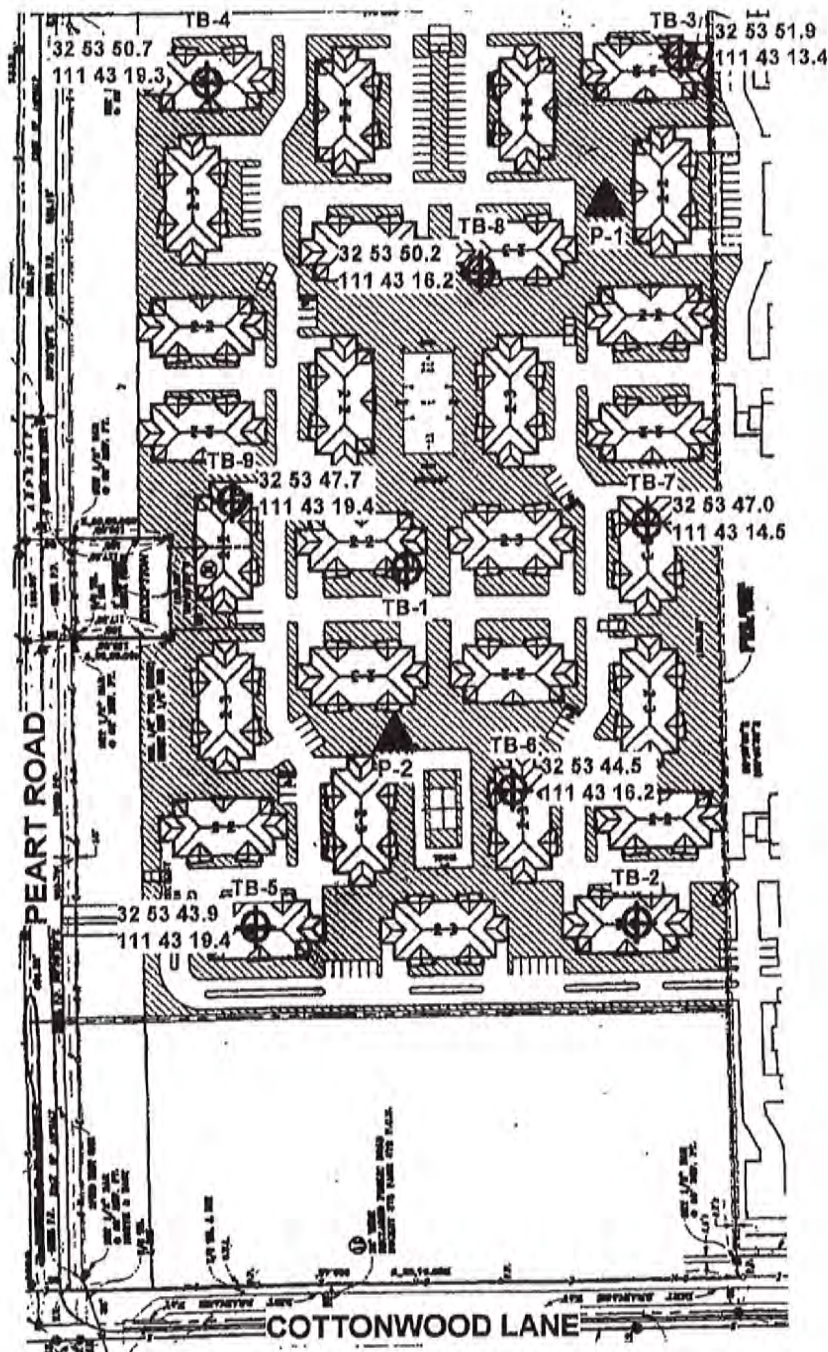
DATE: 07-14-03

PREPARED BY: YSW

PROPOSED VILLAS BY MARY T. EXPANSION
1576 EAST COTTONWOOD LANE
CASA GRANDE, ARIZONA

PROJECT 13588


Foree & Vann, Inc.



Print
in
Color

LEGEND:



TEST BORING LOCATIONS



PERCOLATION TEST LOCATIONS

SITE PLAN

SCALE: N.T.S.

DATE: 07-14-03

PREPARED BY: YSW

PROPOSED VILLAS BY MARY T. EXPANSION
1576 EAST COTTONWOOD LANE
CASA GRANDE, ARIZONA

PROJECT 13588

Foree & Vann, Inc.

TB-1

Water Table	Remarks	Moisture (%)	Blow Counts	Sample Type	Depth
12" Tillage					0
					5
					10
					15
					20
					25
					30
					35

Boring Location:

Boring Date: 06/26/03

Hole Diameter: 4.5 Inches

Logged By: Z. Wright

CL

SANDY CLAY - vesicular, brown, slightly damp, 25% sand, 75% fines, poorly graded, subangular to angular coarse-grained particles, soft, plasticity index of 21, non-cemented

stiff, very weak to weak cementation below 1.0 feet

very stiff below 2.0 feet

light brown, weak to medium nodular cementation below 3.0 feet

weak cementation below 10.0 feet

END

DISCONTINUED TEST BORING AT 15.0 FEET



Foree & Vann, Inc.

Proposed Villas By Mary T. Expansion
Project No. 13588

TB-2

Boring Location:

Boring Date: 06/26/03

Hole Diameter: 4.5 inches

Logged By: Z. Wright

Water Table	Remarks	Moisture (%)	Blow Counts	Sample Type	Depth
GW not encountered		21/50		CL	0
					5
					10
				SC	15
				END	15.0
					20
					25
					30
					35

SANDY CLAY- vesicular, brown, slightly damp, 40% sand, 60% fines, poorly graded, subangular to angular coarse-grained particles, soft, plasticity index of 20, non-cemented

hard, very weak to weak cementation below 1.0 feet

light brown, very stiff, weak to medium cementation below 4.0 feet

Increase in gravel, weak cementation below 10.0 feet

GRAVELLY CLAYEY SAND- light brown, slightly damp, 35% gravel, 40% sand, 25% fines, poorly graded, subangular to angular coarse-grained particles, dense, plasticity index ranges from 16 to 18, weak cementation

DISCONTINUED TEST BORING AT 15.0 FEET



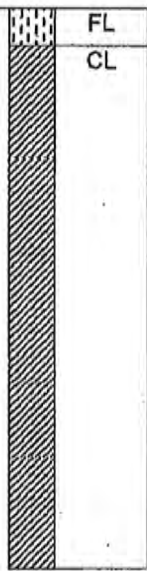
Foree & Vann, Inc.

Proposed Villas By Mary T. Expansion
Project No. 13588

TB-3

Boring Location:
 Boring Date: 06/26/03
 Hole Diameter: 4.5 inches
 Logged By: Z. Wright

Water Table	Remarks	Moisture (%)	Blow Counts	Sample Type	Depth
GWT not encountered		15/25			0
					5
					10
					15
					20
					25
					30
					35



SPREAD FILL- comprised of sandy clay, brown, slightly damp, 25% sand, 75% fines, poorly graded, subangular to angular coarse-grained particles, soft, plasticity index ranges from 20 to 22, non-cemented

SANDY CLAY- vesicular, brown, slightly damp, 40% sand, 60% fines, poorly graded, subangular to angular coarse-grained particles, very stiff, plasticity index ranges from 20 to 22, very weak to weak cementation light brown, hard below 2.0 feet

weak to medium cementation below 5.0 feet

weak cementation below 10.0 feet

END DISCONTINUED TEST BORING AT 15.0 FEET



Foree & Vann, Inc.

Proposed Villas By Mary T. Expansion
 Project No. 13588

TB-4

Water Table	Remarks	Moisture (%)	Blow Counts	Sample Type	Depth
12" Tillage		18/ 36			0
					5
					10
					15
					20
					25
					30
					35

Boring Location:
Boring Date: 06/26/03
Hole Diameter: 4.5 inches
Logged By: Z. Wright

CL

SANDY CLAY- vesicular, brown, slightly damp, 25% sand, 75% fines, poorly graded, subangular to angular coarse-grained particles, soft, plasticity index of 20, non-cemented
hard, weak cementation below 1.0 feet
light brown, very stiff, weak cementation below 4.0 feet

increase in sand and gravel below 13.0 feet

END

DISCONTINUED TEST BORING AT 15.0 FEET



Foree & Vann, Inc.

Proposed Villas By Mary T. Expansion
Project No. 13588

TB-5

Water Table	Remarks	Moisture (%)	Blow Counts	Sample Type	Depth
		15/ 21			0
					5
					10
					15
					20
					25
					30
					35

Boring Location:
 Boring Date: 06/26/03
 Hole Diameter: 4.5 inches
 Logged By: Z. Wright

FL	SPREAD FILL- comprised of sandy clay, brown, slightly damp, 40% sand, 60% fines, poorly graded, subangular to angular coarse-grained particles, soft, plasticity index ranges from 20 to 22, non-cemented
CL	SANDY CLAY- vesicular, brown, slightly damp, 40% sand, 60% fines, poorly graded, subangular to angular coarse-grained particles, very stiff, plasticity index ranges from 20 to 22, weak cementation light brown, hard below 2.0 feet
SC	slightly damp, 35% gravel, 40% sand, 25% fines, poorly graded, subangular to angular coarse-grained particles, dense, plasticity index ranges from 16 to 18, weak cementation
END	DISCONTINUED TEST BORING AT 15.0 FEET

TB-6

Water Table	Remarks	Moisture (%)	Blow Counts	Sample Type	Depth	Boring Location: Boring Date: 06/26/03 Hole Diameter: 4.5 inches Logged By: Z. Wright	
						CL	SANDY CLAY- vesicular, brown, slightly damp, 30% sand, 70% fines, poorly graded, subangular to angular coarse-grained particles, soft, plasticity index ranges from 20 to 22, non- cemented hard, very weak to weak cementation below 1.0 feet light brown, very stiff, weak to medium nodular cementation below 3.5 feet
GW not encountered	12" Tillage	26/ 44			0		
					5		
					10		weak cementation below 10.0 feet
					15	SC	GRAVELLY CLAYEY SAND- light brown, slightly damp, 35% gravel, 40% sand, 25% fines, poorly graded, subangular to angular coarse-grained particles, dense, plasticity index ranges from 14 to 16, weak cementation
					15.0	END	DISCONTINUED TEST BORING AT 15.0 FEET
					20		
					25		
					30		
					35		



Foree & Vann, Inc.

Proposed Villas By Mary T. Expansion
Project No. 13588

TB-7

Water Table	Remarks	Moisture (%)	Blow Counts	Sample Type	Depth
12" Tillage		26/ 34	█	CL	0
					5
					10
					15
					20
					25
					30
					35

Boring Location:
 Boring Date: 06/26/03
 Hole Diameter: 4.5 inches
 Logged By: Z. Wright

SANDY CLAY- vesicular, brown, slightly damp, 40% sand,
 60% fines, poorly graded, subangular to angular
 coarse-grained particles, soft, plasticity index ranges from 20
 to 22, non- cemented
 light brown, hard, weak cementation below 1.0 feet

weak to medium cementation below 5.0 feet

weak cementation below 10.0 feet

Increase in sand and gravel below 13.0 feet

END DISCONTINUED TEST BORING AT 15.0 FEET



Foree & Vann, Inc.

Proposed Villas By Mary T. Expansion
 Project No. 13588

TB-8

Water Table	Remarks	Moisture (%)	Blow Counts	Sample Type	Depth
-------------	---------	--------------	-------------	-------------	-------

Boring Location:
 Boring Date: 06/26/03
 Hole Diameter: 4.5 inches
 Logged By: Z. Wright

12" Tillage		16/ 20		CL	0
					5
					10
					15
					20
					25
					30
					35

SANDY CLAY- vesicular, brown, slightly damp, 30% sand, 70% fines, poorly graded, subangular to angular coarse-grained particles, soft, plasticity index ranges from 20 to 22, non- cemented
 very stiff, weak cementation below 1.0 feet
 light brown, very stiff, weak nodular cementation below 4.0 feet

END DISCONTINUED TEST BORING AT 15.0 FEET



Foree & Vann, Inc.

Proposed Villas By Mary T. Expansion
 Project No. 13588

TB-9

Boring Location:

Boring Date: 06/26/03

Hole Diameter: 4.5 Inches

Logged By: Z. Wright

Water Table	Remarks	Moisture (%)	Blow Counts	Sample Type	Depth
12" Tillage		7/10		CL	0
					5
					10
					15
					20
					25
					30
					35

SANDY CLAY- brown, slightly damp, 25% sand, 75% fines, poorly graded, subangular to angular coarse-grained particles, soft, plasticity Index ranges from 20 to 22, non-cemented
stiff, very weak to weak cementation below 1.0 feet
very stiff below 2.0 feet
light brown, weak cementation below 3.0 feet

increase in sand and gravel below 13.0 feet

END

DISCONTINUED TEST BORING AT 15.0 FEET



Foree & Vann, Inc.

Proposed Villas By Mary T. Expansion

Project No. 13588

PERCOLATION TEST RESULTS

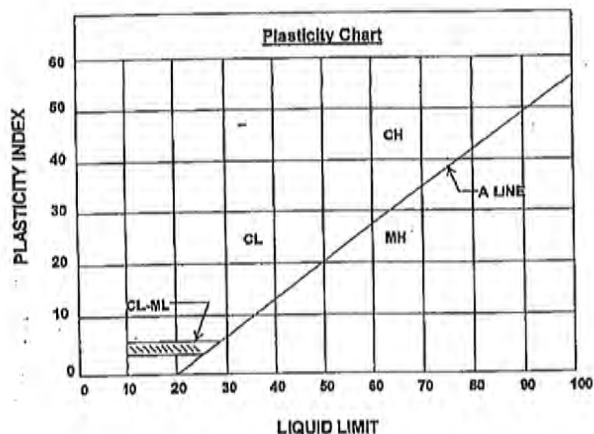
PROPOSED VILLAS BY MARY T. EXPANSION
1576 EAST COTTONWOOD LANE
CASA GRANDE, ARIZONA

Test Location	Test Interval (feet)	Stabilized Infiltration Rate
P-1	2.0-3.0	48.9 minutes/inch
P-2	2.0-3.0	62.2 minutes/inch

LEGEND

Major Divisions				Group Symbol	Typical Names
Coarse-Grained Soils (Less than 50% passes No. 200 sieve)	Gravels (50% or less or coarse fraction passes No. 4 sieve)	Clean Gravels (Less than 5% passes No. 200 sieve)		GW	Well graded gravels, gravel-sand mixtures, or sand-gravel-cobble mixtures.
				GP	Poorly graded gravels, gravel-sand mixtures, or sand-gravel-cobble mixtures.
		Gravels with Fines (More than 12% passes No. 200 sieve)	Limits plot below "A" line & hatched zone on Plasticity Chart.	GM	Silty gravels, gravel-sand-silt mixtures.
			Limits plots above "A" line & hatched zone on Plasticity Chart.	GC	Clayey gravels, gravel-sand-clay mixtures.
	Sands (More than 50% of coarse fraction passes No. 4 sieve)	Clean Sands (Less than 5% passes No. 200 sieve)		SW	Well graded sands, gravelly sands.
				SP	Poorly graded sands, gravelly sands.
		Sands with Fines (More than 12% passes No. 200 sieve)	Limits plots below "A" line & hatched zone on Plasticity Chart.	SM	Silty sands, sand-silt mixtures.
			Limits plots above "A" line & hatched zone on Plasticity Chart.	SC	Clayey sands, sand-clay mixtures.
Fine-Grained Soils (50% or more passes No. 200 sieve)	Silt-Plot below "A" line & hatched zone on Plasticity Chart	Silts of Low Plasticity (Liquid Limit Less Than 50)		ML	Inorganic silts, clayey silts with slight plasticity.
		Silts of High Plasticity (Liquid Limit More Than 50)		MH	Inorganic silts, micaceous or diatomaceous silty soils, elastic silts.
	Clays-Plot above "A" line & hatched zone on Plasticity Chart	Clays of Low Plasticity (Liquid Limit Less Than 50)		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
		Clays of High Plasticity (Liquid Limit More Than 50)		CH	Inorganic clays of high plasticity, fat clays, sandy clays of high plasticity.

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



DEFINITIONS OF SOIL FRACTIONS

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

TEST DRILLING EQUIPMENT & PROCEDURES

Drilling Equipment

FOREE & VANN, INC. uses a CME-55 drill-rig capable of auger drilling to depths of 150 feet in southwestern soils. The drill is truck-mounted for rapid, low cost mobilization to the jobsite and on the jobsite. The CME-55 owned by this firm is powered by a 300 cubic inch, 6-cylinder Ford Industrial engine that produces 124 horsepower. This energy is transmitted through a rugged mechanical drive that provides 7,000 foot-lbs of torque on the drillstring. Two 72-inch hydraulic cylinders develop 16,000 lbs of downward thrust and 24,000 lbs of retractive force. Two hydraulic cable hoists and a mechanical cathead allow downhole sampling and testing at any depth to be accomplished with great speed and accuracy. For drilling operations, the truck is stabilized with platform mounted vertical hydraulic jacks with a 48-inch stroke. Drilling through soil or softer rock is performed with 6¾ inch O.D. hollow-stem, or 4½-inch continuous flight auger. Carbide insert teeth are normally used on the auger bits so they can often penetrate rock or very strongly cemented soils that require blasting or very heavy equipment for excavation. The operation of well-maintained equipment by an experienced crew allows FOREE & VANN, INC. to complete any type of drilling job with minimum downtime and maximum efficiency.

Sampling Procedures

Dynamically driven tube samples are usually obtained at selected intervals in the borings by the ASTM D1586 procedure. In many cases, 2 inch O.D., 1⅜-inch I.D. samplers are used to obtain the standard penetration resistance. "Undisturbed" samples of firmer soils are often obtained with 3-inch O.D. samplers lined with 2.42 inch I.D. brass rings. The driving energy is generally recorded as a number of blows of a 140-pound hammer, utilizing a 30-inch free fall drop, per foot of penetration. However, in stratified soils, driving resistance is sometimes recorded in 2 or 3-inch increments so that soil changes and the presence of scattered gravel or cemented layers can be readily detected and the realistic penetration values obtained for consideration in design. These values are expressed in blows per foot on the logs. Undisturbed sampling of softer soils is sometimes performed with thin-walled Shelby tubes (ASTM D1587). Tube samples are labeled and placed in watertight containers to maintain field moisture contents for testing from auger cuttings.

Continuous Penetration Tests

Continuous penetration tests are performed by driving a 2-inch O.D. blunt nosed penetrometer adjacent to or in the bottom of test borings. The penetrometer is attached to 1⅝-inch O.D. drill rods to provide clearance and thus minimize side friction so that penetration values are as nearly as possible a measure of end resistance. Penetration values are recorded as the number of blows of a 140 pound hammer, utilizing a 30-inch drop required to advance the penetrometer in one foot increments or less.

As an alternate, Cone Penetration Testing may be utilized in an effort to determine the point capacity of the cone tip, and skin friction measured on the cone sleeve.

Boring Records

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

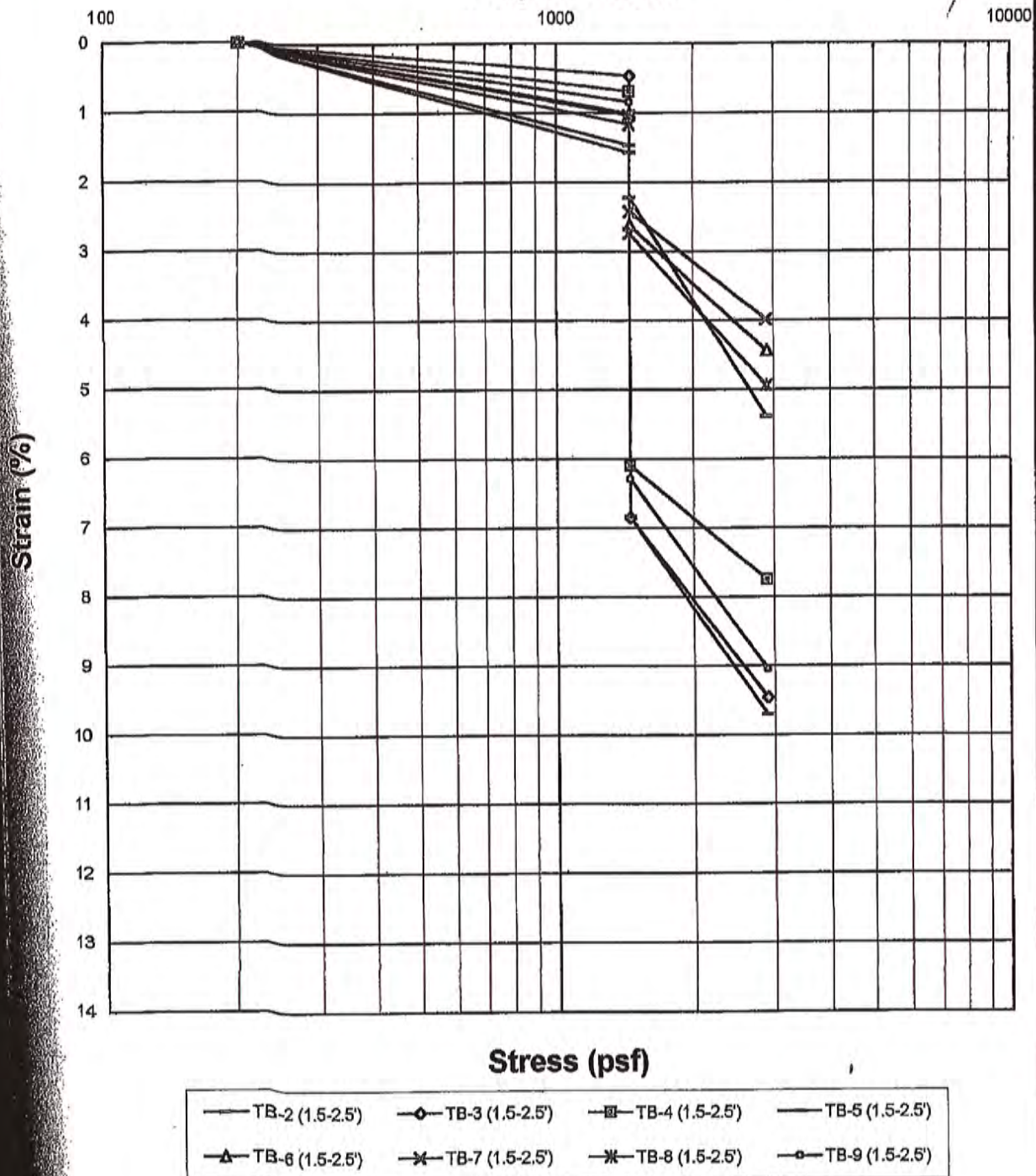
SECTION I

SECTION III

SECTION IV

Collapse Test Data

Project 13588

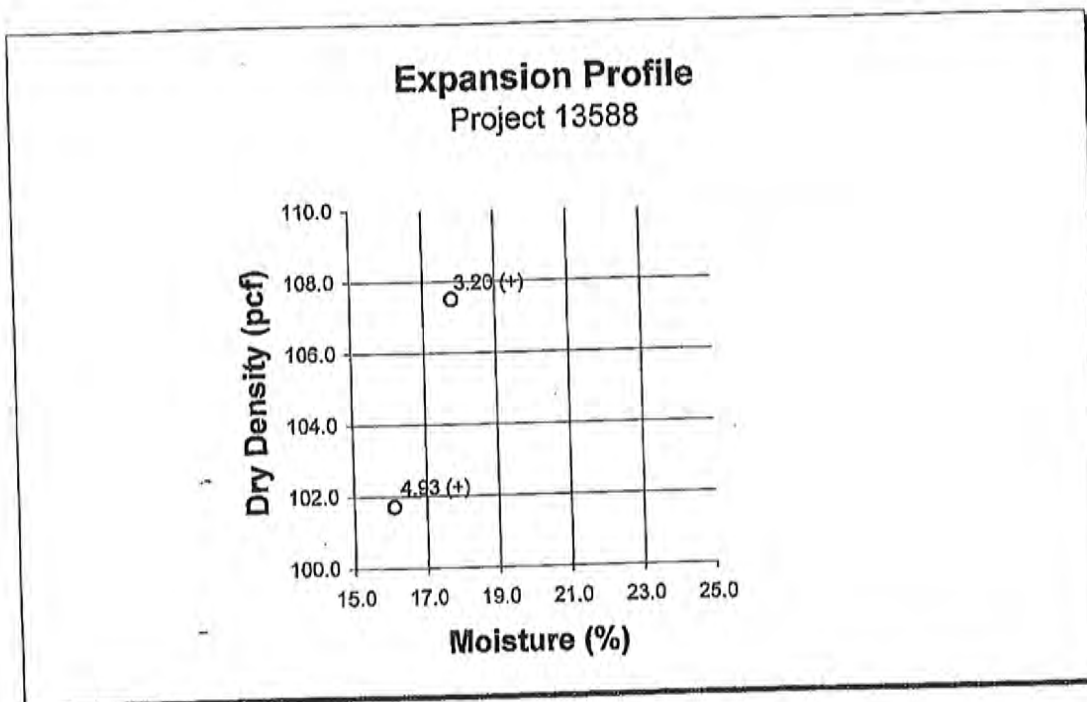


EXPANSION TEST DATA

PROPOSED VILLAS BY MARY T. EXPANSION
1576 EAST COTTONWOOD LANE
CASA GRANDE, ARIZONA

Sample Location	Remolded Moisture Content (%)	Dry Density (PCF)	Volume Change After Saturation (%)	Adjusted Volume Change After Saturation (%)
TB-1 (1.0-2.0')	17.8	107.5	3.20 (+)	3.20 (+)
TB-1 (1.0-2.0')	16.1	101.7	4.93 (+)	4.93 (+)

(+) denotes expansion
(-) denotes compression



Project 13588
Foree & Vann, Inc. - Phoenix, Arizona

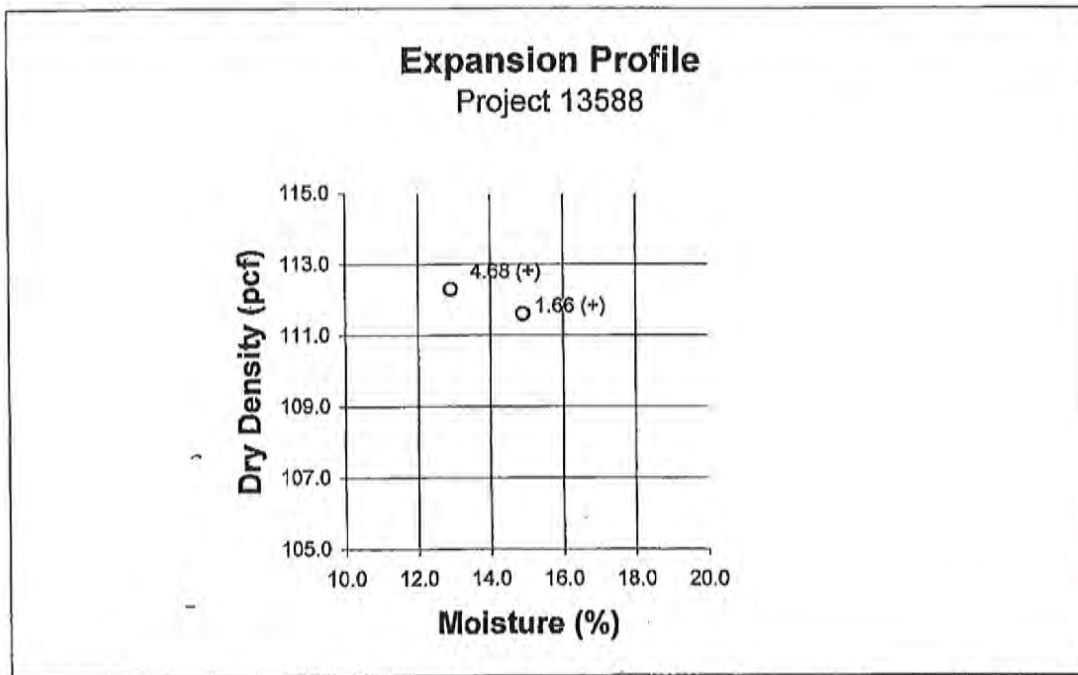
EXPANSION TEST DATA

PROPOSED VILLAS BY MARY T. EXPANSION
1576 EAST COTTONWOOD LANE
CASA GRANDE, ARIZONA

Sample Location	Remolded Moisture Content (%)	Dry Density (PCF)	Volume Change After Saturation (%)	Adjusted Volume Change After Saturation (%)
TB-2 (1.0-2.0')	14.9	111.6	1.66 (+)	1.66 (+)
TB-2 (1.0-2.0')	12.9	112.3	4.68 (+)	4.68 (+)

(+) denotes expansion

(-) denotes compression



Project 13588

Foree & Vann, Inc. - Phoenix, Arizona

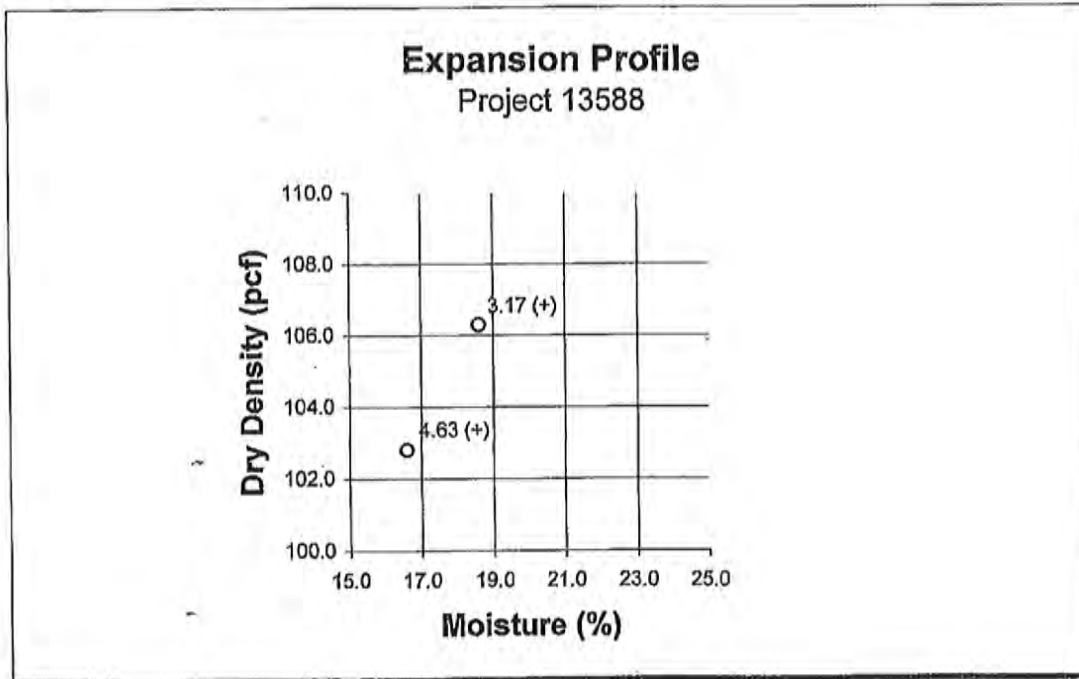
EXPANSION TEST DATA

PROPOSED VILLAS BY MARY T. EXPANSION
1576 EAST COTTONWOOD LANE
CASA GRANDE, ARIZONA

Sample Location	Remolded Moisture Content (%)	Dry Density (PCF)	Volume Change After Saturation (%)	Adjusted Volume Change After Saturation (%)
TB-4 (1.0-2.0')	18.6	106.3	3.17 (+)	3.17 (+)
TB-4 (1.0-2.0')	16.6	102.8	4.63 (+)	4.63 (+)

(+) denotes expansion

(-) denotes compression



CLASSIFICATION TEST DATA

PROPOSED VILLAS BY MARY T. EXPANSION
1576 EAST COTTONWOOD LANE
CASA GRANDE, ARIZONA

Sample Location	Sieve Analysis (% Passing Sieve Size)								Atterberg Limits		
	3"	1"	1/2"	#4	#10	#40	#100	#200	LL	PI	USCS
TB-1 (1.0-2.0')	100	100	100	100	100	96	81	73	36	21	CL
TB-2 (1.0-2.0')	100	100	100	100	99	92	71	62	35	20	CL
TB-4 (1.0-2.0')	100	100	100	100	100	96	82	75	37	20	CL

Project 13588
Foree & Vann, Inc. - Phoenix, Arizona

HYDROMETER TEST DATA

PROPOSED VILLAS BY MARY T. EXPANSION
1576 EAST COTTONWOOD LANE
CASA GRANDE, ARIZONA

Sample Location	Sample Depth	Actual Percent Finer Than 0.002 mm	Percent Clay to be used in the 1997 UBC
TB-2	1.0-2.0 FEET	24.0	40

MOISTURE/DENSITY TEST DATA

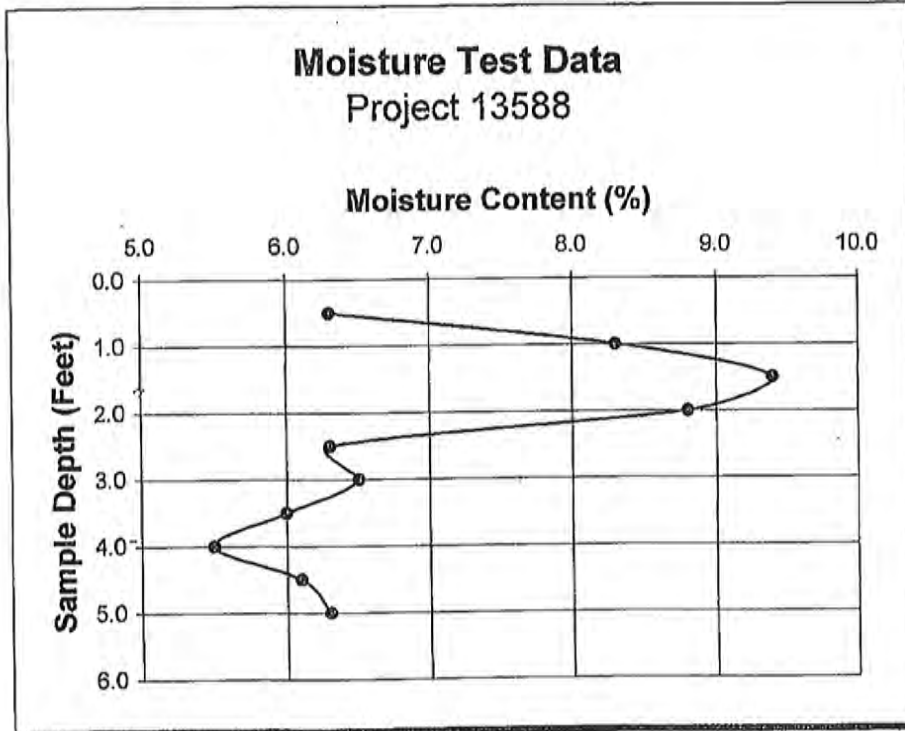
PROPOSED VILLAS BY MARY T. EXPANSION
1576 EAST COTTONWOOD LANE
CASA GRANDE, ARIZONA

Sample Location	Moisture Content (%)	Wet Density (PCF)	Dry Density (PCF)
TB-2 (1.5-2.5')	5.1	105.3	100.2
TB-3 (1.5-2.5')	3.7	109.4	105.5
TB-4 (1.5-2.5')	4.0	109.4	105.2
TB-5 (1.5-2.5')	6.7	104.4	97.8
TB-6 (1.5-2.5')	5.1	105.6	100.4
TB-7 (1.5-2.5')	5.5	107.1	101.5
TB-8 (1.5-2.5')	9.0	105.6	96.9
TB-9 (1.5-2.5')	6.0	101.0	95.3

MOISTURE TEST DATA

PROPOSED VILLAS BY MARY T. EXPANSION
1576 EAST COTTONWOOD LANE
CASA GRANDE, ARIZONA

Sample Location	Sample Depth Feet	In-Place Moisture (%)
TB-1	0.5	6.3
	1.0	8.3
	1.5	9.4
	2.0	8.8
	2.5	6.3
	3.0	6.5
	3.5	6.0
	4.0	5.5
	4.5	6.1
	5.0	6.3



Project 13588
Foree Vann, Inc. - Phoenix, Arizona

RECOMMENDATIONS FOR CONCRETE ON EXPANSIVE SOIL

Description	Minimum Concrete Thickness (inches)	Pre-Soaking Depth	Reinforcement	Cutoff Barrier or Edge Thickness (inches)	Joint (1) Spacing (Max)	Base
Common Sidewalks - Isolated or Meandering EI < 21 EI 21-50 EI 51-90 EI 91-130 EI > 130	4 (Nominal) 4 (Nominal) 4 (Nominal) 4 (Nominal) 4 (Nominal)	Optimum to 12" 120% of Optimum to 12" 120% of Optimum to 18" 130% of Optimum to 18" 140% of Optimum to 18"	N.R.	N.R.	4-5 Feet	N.R.
Common Sidewalks Not Isolated EI < 21 EI 21-50 EI 51-90 EI 91-130 EI > 130	4 (Nominal) 4 (Nominal) 4 (Nominal) 4 (Nominal) 4 (Full)	Optimum to 12" 120% of Optimum to 12" 120% of Optimum to 18" 130% of Optimum to 24" 140% of Optimum to 24"	N.R.	N.R. N.R. 18 18 24	4-5 Feet	N.R.
City Sidewalks	4 (Nominal) or C.S.	Same as Common Sidewalk Not Isolated	N.R. or City Standard	Same as Common Sidewalk Not Isolated	4-5 Feet	N.R.
Private Drives (1 Unit)	4 (Full)	Same as common Sidewalk Not Isolated	6X6 - 6X6 Mesh	Same as Common Sidewalk Not Isolated	10 Feet	N.R.
Shared Drives (2 Units)	5 (full)	Same as Common Sidewalk Not Isolated	6X6 - 6X6 Mesh	Same as Common Sidewalk Not Isolated	10 Feet	N.R.
Courts or Enhanced Concrete (for more than 2 Units) EI < 21 EI 21-50 EI 51-90 EI 91-130 EI > 130	7 (Full) 7 (Full) 7 (Full) 7 (Full) 7.5 (Full)	Optimum to 12" 120% of Optimum to 12" 120% of Optimum to 18" 130% of Optimum to 24" 140% of Optimum to 24"	6X6 - 10X10 Mesh 6X6 - 6X6 Mesh #3 @ 18" OC #3 @ 12" OC #4 @ 12" OC	N.R. N.R. 15 24 24	10 Feet 10 Feet 10 Feet 10 Feet 8 Feet	2" Leveling Course
Concrete Streets	7.5 (Full)	Same as for Courts	Same as for Courts	Same as for Courts	10 Feet	2" Leveling Course
Pavements and Entryways EI < 21 EI 21-50 EI 51-90	4 (Nominal) 4 (Nominal) 4 (Nominal)	Optimum to 12" 120% of Optimum to 12" 120% of Optimum to 18"	6X6 - 10X10 Mesh 6X6 - 6X6 Mesh #3 @ 24" OC #3 @ 18" OC #3 @ 12" OC	N.R. N.R. 12 18 24	10 Feet 10 Feet 10 Feet 10 Feet 5 Feet	N.R.
EI 91-130 EI > 130	4 (Nominal) 4 (Full)	130% of Optimum to 24" 140% of Optimum to 24"				

Other Considerations:

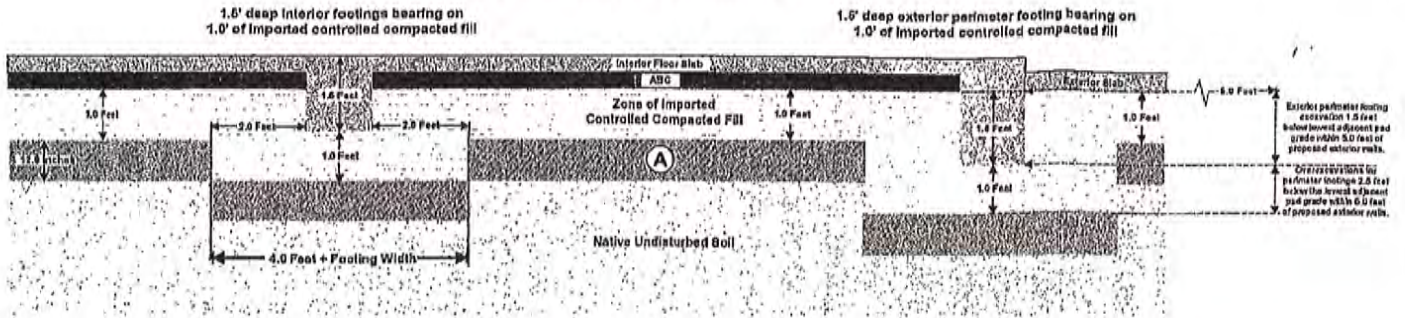
Square concrete panels when possible.

Maintain positive drainage for concrete flatwork.

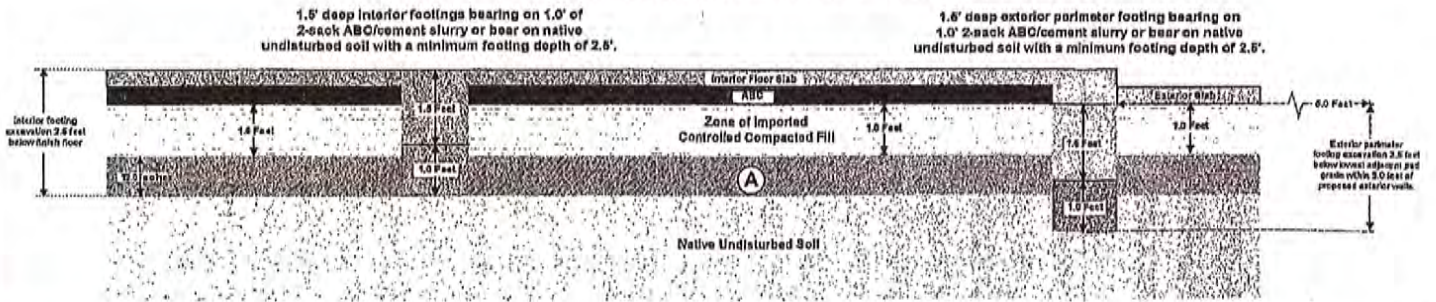
N.R. = Not Required; C.S. = City Standard

(1) Joint at curves or angle points.

Alternate 1 for the Minimum Stated Allowable Soil Bearing Capacity



Alternate 2 for the Minimum Stated Allowable Soil Bearing Capacity



(A) The base of any zone of subexcavation (i.e. cut surface below foundations and floor slabs) shall be properly prepared to a depth of 12.0 inches. Proper preparation shall include adequate high moisture processing and grouted compaction.	Footing Schematic		Concrete Aggregate Base Course (ABC) Zone of Imported Controlled Compacted Fill	Refer to (A) Native Undisturbed Soil 2-Sack ABC/Cement Slurry
	Note: Adhere to recommendations pertaining to drainage and the use of granular fill.	Prepared By: HES	$4.0\% \leq \text{Measured Expansion} < 5.0\%$	Scale: NTS

Print
in
color



City of Casa Grande, Development Center, 510 E. Florence Blvd, Casa Grande, AZ 85122 (520) 421-8630

SITE DEVELOPMENT PERMIT APPLICATION

(Permit authorizing the construction of site improvements including any of the following)

1. Construction of new retention or other drainage facilities
2. Grading of areas in excess of 4350 square feet
3. Construction of new utility underground infrastructure

(Electronic Version Available at: <https://casagrandeaz.gov/documents/#252-engineering-permits>)

Email: DCPermits@casagrandeaz.gov

Request Type:

- ☒ **Full Site Development** (per approved Site Dev. Plan) ☐ **Preliminary At Risk Site Grading**¹ ☐ **Final Grading**
☐ **Site Drainage Facilities** ☐ **Parking Lot & Drive Aisle Construction** ☐ **Site Utility Infrastructure**^{2,3}
☐ **Located in Public Right of Way (Include Right of Way Encroachment Plan Note)**
☐ **Other** (specify): _____

¹ At Risk grades are subject to modification with approval of the Final Grading Permit. This application for a grading at owner's risk permit is made prior to plan approval and is done solely at the risk of the owner. Any changes required by the plan review process will be complied with by the owner at his expense. Owner hereby agrees to hold the City of Casa Grande harmless from any and all actions of any kind which result from the issuance of this permit.

² Water mains for public water supply requires the filing of an ADEQ Approval to Construct Drinking Water Facilities to accompany this application form. City of Casa Grande has Delegated Authority for the approval of this ADEQ form.

³ Wastewater mains designed to carry more than 3000 gpd, include manholes or lift stations requires the filing of an ADEQ Notice of Intent to Discharge Sewage Collection System to accompany this application form. City of Casa Grande has Delegated Authority for the approval of this ADEQ form.

1. **PROJECT NAME:** Villas Plus by Mary T.
2. **SITE LOCATION:** Intersection of E Cottonwood Lane & North Peart Road
3. **APPLICANT:**
 Name Mary T, Inc.
 Address 1555 118th Lane NW City Coon Rapids State MN Zip Code 55448
 Phone 763.862.5484 Fax _____ Email Address MaryT@marytinc.com
4. **CIVIL ENGINEER:**
 Name Paul Mogle / Horrocks Engineers, Inc.
 Address 555 South Bluff Street #101 City St. George State UT Zip Code 84770
 Phone 435-986-7888 Fax _____ Email Address PaulM@horrocks.com
5. **CONTRACTOR:**
 Name TBD
 Address _____ City _____ State _____ Zip Code _____
 Phone _____ Fax _____ Email Address _____

Applicants may receive clarification regarding the specific steps included in processing this application as well as information regarding any code, regulation or policy relevant to the processing of this application by contacting one of the following review Engineers:

Cesar Adamos – cadamos@casagrandeaz.gov, 520-421-8630, Ext. 3019

CITY INTAKE:

Date Accepted & Logged In: _____

Assigned DC Engineer: _____



City of Casa Grande, Development Center, 510 E. Florence Blvd, Casa Grande, AZ 85122 (520) 421-8630

Submittal Requirements:

1. **Civil Plans** (1 set with initial submittal; 3 sets once approved for signature; requires City of Casa Grande signature format, see attachment Note: As-Built plans for all private site development improvements must be provided and approved prior to City final approval and issuance of Certificate of Occupancy unless otherwise waived by the Public Works Inspector). Submitted 4/2018
2. **Stormwater Pollution Prevention Plan (SWPPP)** Submitted in plan set 4/2018
3. **Reports** (1 set labeled "Draft" with initial submittal; 3 sets labeled "Final" once approved for signature)

	Required	Waived
a. Drainage Design Report	☒ submitted 4/2018	☐
b. Wastewater Design Report	☒ submitted 4/2018	☐
c. Water Design Report	☒ submitted 4/2018	☐
d. Geotechnical Soil Report	☒ Enclosed / Previously submitted August 2003	
4. **Traffic Control Plan** (1 set with initial submittal; 3 sets once approved for signature) Enclosed
5. **Floodplain information, including the following:**
 - a. Flood area designation and the regulatory flood elevation if located within a special flood hazard area: 49053C0769G
6. **Engineer's Cost Estimate (See Attached)** Enclosed
7. **Electronic Files in PDF Format**
8. **Application Review Fees** (Mary T to pay directly to City: \$5,439)
 - a. Development Center Engineering review fee \$125.00 per Civil Plan page
 - b. Public Works Engineering review fee \$165.00 per Civil Plan page
 - c. Base Fee \$250.00
 - d. Final Drainage Reports: \$560.00 each
 - e. Wastewater Reports: \$560.00 each
 - f. Public Works Inspection Fee: 2% of Construction Costs; \$10,000 maximum
 - g. Technology Recovery Fee: 5% of Total Permit Fees

REQUIRED SIGNATURE BLOCK FORMAT

City of Casa Grande Plan Approval Recommended

Civil Engineer _____
 Date: _____ Expiration Date: _____ The
 City approves these plans in concept only. The City
 accepts no responsibility for errors or omissions.

City of Casa Grande Plan Approval

City Engineer _____ Date: _____
 _____ Expiration Date: _____

The City approves these drawings in concept only.
 The City accepts no responsibility for errors or omissions.

"As-Built Certification"

Accepted by:

City Engineering Inspector _____ Date _____

City Engineer _____ Date _____



City of Casa Grande, Development Center, 510 E. Florence Blvd, Casa Grande, AZ 85122 (520) 421-8630

Over-All Review Time-Frames for Engineering Permits^{1,7,8}

Permit Classification	Administrative Completeness Review (CR) of Initial Submittal ²	Review of Initial Submittal and Staff Decision to Approve or Issue a Review Letter ^{4,8}	CR Review of Re-Submittal	Review of Resubmittal ^{5,7,8} and Staff Decision to Approve/Deny	Over-All Review Timeframe ^{6,7,8}
Site Development (E-16)	2	30	2	30	64

¹All times are maximum timeframes in business days (Mon-Fri., excluding City Holidays). Shorter review times will be accomplished where possible.

²Completeness Review timeframes are calculated from date of application submittal to date of acceptance or rejection of the application as administratively complete.

³Substantive Review timeframes are calculated from date of acceptance of application for Substantive Review, or upon receipt of re-submittal of revised plans/reports, to the date of issuance of a comprehensive review letter, or final administrative decision.

⁴ Review of initial submittal limited to determination of compliance with ordinances, codes, regulations or policy relevant to the specific permit or project application. The review comments on the initial submittal may be amended to address code/policy requirements that City staff failed to include in the 1st comprehensive review document.

⁵ Review of resubmittal shall be limited to:

- a) Addressing 1st review comments that the applicant failed to adequately address in their resubmittal; or
- b) Addressing new review issues arising from modifications the applicant has made to the design and/or technical reports. In this case the City may issue an additional review letter addressing the new design.

⁶Over-All Review timeframe is the sum of the Completeness, Initial & Resubmittal Substantive Review timeframes.

⁷ If an applicant requests significant changes, alterations, additions or amendments to an application that are not in response to the request for corrections, the City may make **one additional comprehensive written request for corrections (i.e., review of 2nd resubmittal)**. Said additional request for correction shall not exceed 50% of the Substantive Review time frame for the specific type of permit.

⁸The Substantive Review timeframe and the Overall Review timeframe may be extended by mutual consent of the applicant and the City. Said extension shall not exceed 50% of the Over-All timeframe.

⁹Indicates that the Project will require a public hearing and Board/Commission and/or City Council approval. For these Projects the Substantive Review period ends when staff schedules the application for the public hearing and Board/Commission/City Council action.

In accordance with the Regulatory Bill of Rights (ARS 9-835) the City of Casa Grande will typically make an administrative decision on each permit application after one (1) comprehensive staff review. However, from time to time a 2nd review is necessary to resolve code/policy compliance issues associated with a permit. In accordance with ARS 9-835.I., by mutual agreement, the applicant and the City may engage in a 2nd review of an application as long as said 2nd review does not exceed the over-all time frame by 50%. The specific 1st and 2nd and over-all review timeframes for this application are provided above. Applicants may sign below, consenting to a 2nd review if necessary, within the stated prescribed timeframe. Your consent is not required at time of application submittal. Applicants who do not sign below will be contacted by City staff if a 2nd review is determined to be necessary prior to making an administrative decision on this application. Applications denied after the completion of the review cycle are eligible for re-application to address the code/policy deficiencies which were the basis for the application denial with the payment of a fee equal to 25% of original application fee amount. Said re-application shall occur within 90 days of the application denial.

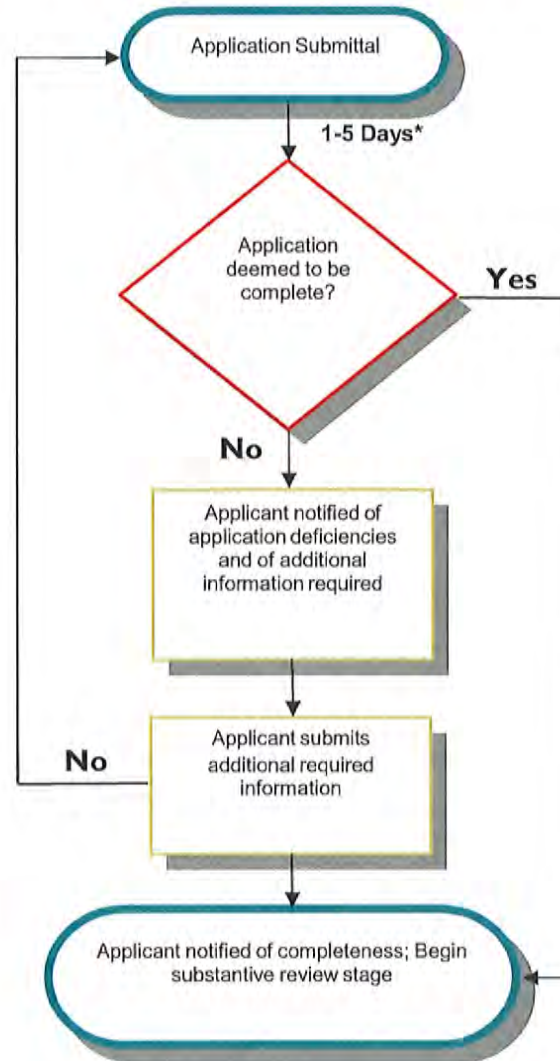
I hereby consent to an extension of the stated Substantive Review timeframe for a maximum of _____ additional days.

Applicant

Agreed to by City



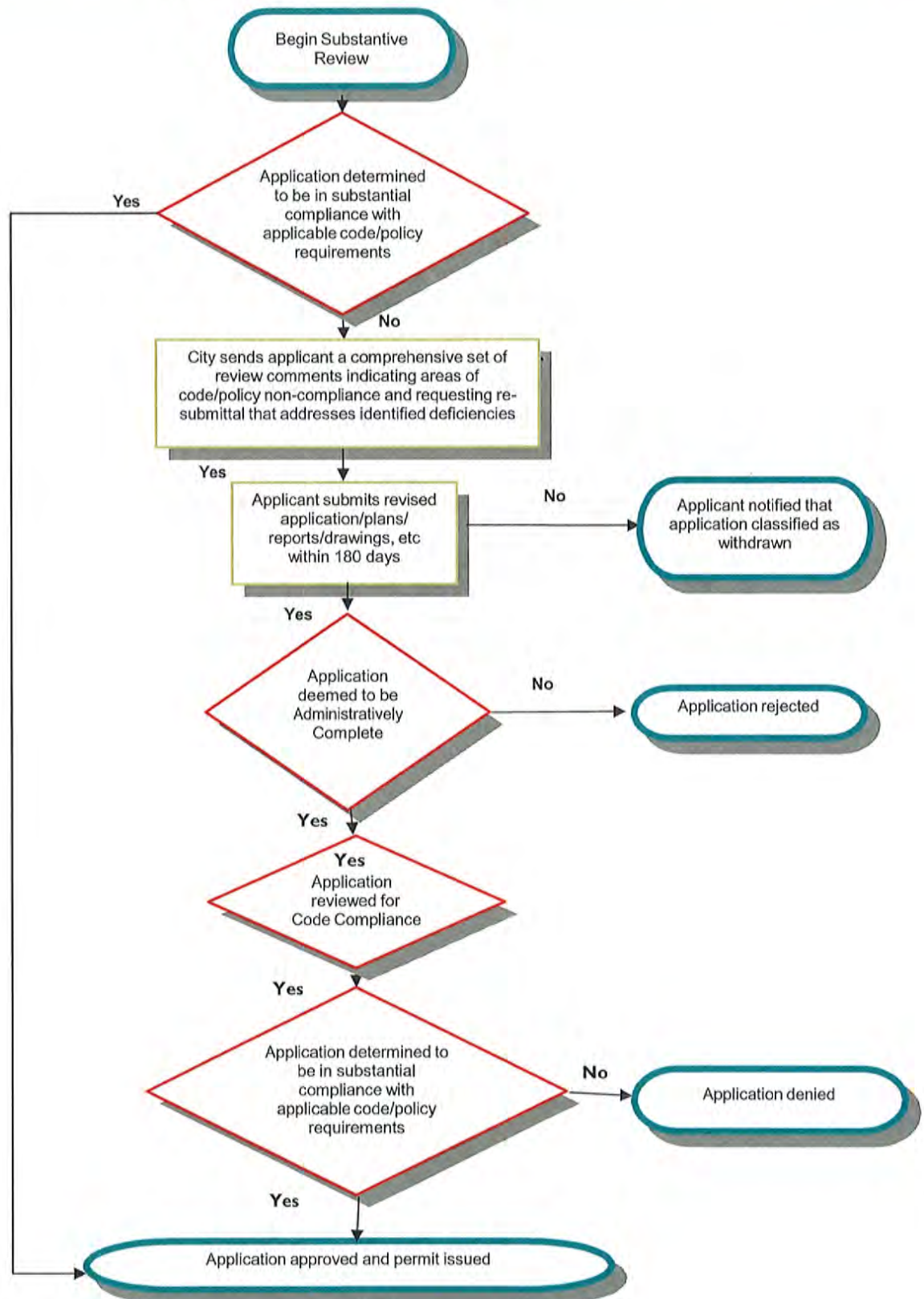
Administrative Completeness Review Process



** All time frames are listed as business days.*



Substantive Review Process



**APPLICATION COMPLETENESS REVIEW CHECKLIST**

	DC Engineer
1) Civil Plans: (One set)	☒
2) Drainage Design Report	☒
3) Wastewater Design Report	☒
4) Water Design Report	☒
5) Geotechnical Report	☒
6) Stormwater Pollution Prevention Plan (SWPPP):	☒
7) Floodplain information	☒
8) Line Item Cost Estimate for all improvements: (signed by contractor)	☒
9) Traffic Control Plan: (if applicable)	☒
10) Road Closure Plan:	☒ N/A
11) ADEQ Application to Construct Water Facilities (if applicable)	☒ N/A
12) ADEQ Notice of Intent to Discharge Sewage (if applicable)	☒ Once built
13) CD of all Civil Drawings and Reports:	☒
14) Application Review Fees	☒
a. Development Center Engineering review fee: \$125.00 per Civil Plan page	
b. Public Works Engineering review fee: \$165.00 per Civil Plan page	
c. Base fee: \$250.00	
d. Final Drainage Reports: \$560.00 each	
e. Wastewater Reports: \$560.00 each	
f. Public Works Inspection Fee: 2% of Construction Costs; \$10,000 maximum	
g. Technology Recovery Fee: 5% of Total Permit Fees	