PRELIMINARY GEOTECHNICAL SERVICES REPORT PROPOSED THOMPSON PROPERTY SUBDIVISION EIGHT MILE ROAD AT RIO BLANCO ROAD STOCKTON, CALIFORNIA

PREPARED FOR: A. G. SPANOS CORPORATION
1341 WEST ROBINHOOD DRIVE, SUITE B2
STOCKTON, CA 95207

BY: KLEINFELDER, INC.
2825 E. MYRTLE STREET
STOCKTON, CA 95205

DATE: SEPTEMBER 29, 2003

KLEINFELDER
An employee owned company

File No. 35623.G01
September 29, 2003

Mr. Jim Panagopoulos
A.G. Spanos Corporation
1341 West Robinhood Drive, Suite B2
Stockton, CA 95207

Subject: **PRELIMINARY GEOTECHNICAL SERVICES REPORT**
PROPOSED THOMPSON PROPERTY SUBDIVISION
EIGHT MILE ROAD AT RIO BLANCO ROAD
STOCKTON, CALIFORNIA

Dear Mr. Panagopoulos:

Kleinfelder is pleased to present the results of our preliminary geotechnical services performed for the proposed Thompson Property subdivision to be located in Stockton, California. The accompanying report includes background information regarding the anticipated construction, the purpose of our services, and scope of services provided. In addition, discussions regarding our investigative procedures and the site conditions encountered during our field exploration are presented. Finally, preliminary geotechnical conclusions and recommendations are provided for project design and construction. The appendix of the report includes logs of borings and a summary of laboratory tests. We have also included an information sheet published by ASFE. Our firm is a member of ASFE, and we feel this sheet will help you better understand geotechnical engineering reports.

We appreciate the opportunity of providing our services for this project. If you have questions regarding this report or if we may be of further assistance, please contact our office.

Respectfully submitted,

KLEINFELDER, INC.

Ronald E. Loutzenhiser, C.E.
Staff Professional

REGISTERED PROFESSIONAL ENGINEER RONALD ERIC LOUTZENHISER No. 64089 EXP. 9-06 CIVIL STATE OF CALIFORNIA

Reviewed by:

Ron Heinzen, G.E.
Senior Principal

REGISTERED PROFESSIONAL ENGINEER RONALD TERRY HEINZEN No. 388 Exp. 3-31-07 GEOTECHNICAL STATE OF CALIFORNIA

REL:lr
4c: Client

KLEINFELDER 2825 East Myrtle Street, Stockton, CA 95205-4794 (209) 948-1345 (209) 948-0621 fax

TABLE OF CONTENTS

PRELIMINARY GEOTECHNICAL SERVICES REPORT
PROPOSED THOMPSON PROPERTY SUBDIVISION
EIGHT MILE ROAD AT RIO BLANCO ROAD
STOCKTON, CALIFORNIA

1. INTRODUCTION

In this report we present the results of our preliminary geotechnical services performed for the proposed Thompson Property subdivision to be located in Stockton, California. The site location relative to existing streets and topographic features is shown on Plate 1.

We understand that design of the proposed development is currently underway and final criteria is unavailable as of this writing. On a preliminary basis, we understand the subject site will be subdivided into individual lots for single-family residences. Appurtenant construction will include paved streets, various concrete flatwork, and buried utilities. We anticipate the proposed homes will be one- and/or two-story, wood-frame structures supported by shallow spread foundations or post-tensioned slabs. Structural loading is anticipated to be relatively light, typical for small to medium-sized residential structures. For the purpose of our evaluation, maximum column and bearing wall loads (dead-plus-live) in the range of 20 kips and 1 kip per linear foot, respectively, were assumed. In addition, a maximum post-tensioned slab load of 800 pounds per square foot (psf) was assumed.

Grading plans were not available at the time this report was prepared. Since the site topography is relatively level, however, we anticipate that cuts and fills in building pad areas will be limited to less than 1 and 2 feet in vertical extent, respectively. Furthermore, we anticipate that streets will be cut 1 to 2 feet below existing grade, and the soils removed will be placed primarily on the building pads. We anticipate that the largest fills will be located in areas where drainage ditches and canals cross the site. The largest cuts (estimated to possibly range from 8 to 11 feet below existing site grade) will occur in any proposed lake areas. Excavations for underground utilities are not anticipated to exceed 20 feet below final site grade.

In the event these structural or grading details are inconsistent with the final design criteria, our firm should be contacted prior to final design in order that we may update our recommendations as needed.

Kleinfelder has performed several geotechnical investigations in the project area, including the property immediately to the east and south for residential development for Pulte Homes (see Plate 2) and the levee to the west for a levee study for Bishop Tract (see Plate 3).

2. PURPOSE AND SCOPE OF SERVICES

The purpose of our services was to explore and evaluate the subsurface conditions at various locations on the site in order to develop recommendations related to the geotechnical aspects of project design and construction.

The scope of our services included the following:

- A visual site reconnaissance to investigate the surface conditions at the project site;
- A review of our previous studies in the project area;
- A field investigation that consisted of drilling borings within the area of the proposed development to explore the subsurface conditions at the project site;
- Laboratory testing of representative samples obtained during the field investigation to evaluate relevant physical and engineering parameters of the subsurface soils;
- Evaluation of the data obtained and an engineering analysis to develop our geotechnical conclusions and recommendations;
- Preparation of this report which includes:
  - ➢ A description of the proposed project;
  - ➢ A description of the field and laboratory investigations;
  - ➢ A description of the surface and subsurface conditions encountered during our field investigation;
  - ➢ Conclusions and recommendations related to the geotechnical aspects of:
  - ➢ Concrete floor slabs;
    - Foundation design and construction;
    - Exterior concrete flatwork;
    - Earth retaining walls;
    - Asphalt concrete pavements;
    - Site surface drainage; and
    - General earthwork addressing site preparation, fill materials, engineered fill, temporary excavations, and wet/unstable subgrade mitigation.
  - ➢ An appendix that includes logs of borings and a summary of laboratory tests.

3. FIELD AND LABORATORY INVESTIGATIONS

Field Investigation

The subsurface conditions at the site were explored on September 18, 2003, by drilling six borings to depths ranging from about 11 to 16½ feet below existing grade. The borings were drilled using a Simco 2400 truck-mounted drill rig equipped with 4-inch O.D. solid-stem auger. The approximate boring locations are presented on Plate 1.

During the drilling operations, penetration tests were performed in accordance with ASTM D-1586 at regular intervals using a Modified California Sampler to evaluate the relative density of coarse-grained (cohesionless) soil and to retain soil samples for laboratory testing. The penetration tests were performed by initially driving the sampler 6 inches into the bottom of the bore hole using a 140 pound trip-hammer falling 30 inches to penetrate loose soil cuttings and "seat" the sampler. Thereafter, the sampler was progressively driven an additional 12 inches, with the results recorded as the corresponding number of blows required to advance the sampler 12 inches, or any part thereof. A pocket penetrometer was used to evaluate the consistency of fine-grained (cohesive) soil samples retained. In the absence of pocket penetrometer test results, the consistency of fine-grained soils was estimated from penetration tests. A representative with our firm maintained a log of the borings and visually classified the soils encountered according to the Unified Soil Classification System (see Plate A-1 of the appendix). Soil samples obtained from the borings were packaged and sealed in the field to reduce moisture loss and disturbance and brought to our Stockton laboratory for testing.

A key to the Logs of Borings is presented on Plate A-2 of the appendix. The Logs of Borings are presented on Plates A-3 through A-8 of the appendix. Please note that the borings were located in the field by visual sighting and/or pacing from existing site features. Therefore, the locations of borings shown on Plate 1 should be considered highly approximate and may vary from that indicated on the plate.

Laboratory Investigation

Laboratory tests were performed in accordance with current ASTM standards on selected soil samples to evaluate their physical characteristics and engineering properties. The laboratory testing program was formulated with emphasis on the evaluation of natural moisture content, in-place density, grain-size distribution, plasticity, and organic content of the materials encountered. In addition, one set of pH, minimum resistivity, sulfate and chloride tests were performed on a composite near-surface soil sample to evaluate the corrosivity of the soils to buried concrete and ferrous metals.

The results of laboratory tests are summarized on Plate A-9 in the appendix. This information, along with the field observations, was used to prepare the final test boring logs.

4. SITE CONDITIONS

Surface Conditions

At the time of our investigation, the relatively-level site was composed of disced agricultural fields. The site was bordered to the north by Eight Mile Road, to the east and south by irrigation ditches and farm roads, and to the west by the Bishop Cut levee, which is topped by Rio Blanco Road.

Subsurface Conditions

Based on our findings, the subsurface soils encountered consisted predominately of approximately 2 feet of compressible and weak peat/organic silt, underlain by interbedded strata of very-loose to medium-dense silty and clayey sand and stiff to hard sandy clay to the maximum depth explored. The result of a loss on ignition test performed on a sample of the near-surface, organic soil was 23 percent organic content by dry weight. This single test result is slightly higher than the 10 to 21 percent organic content we encountered for the Pulte Homes study.

The test borings were checked for the presence of groundwater during and immediately following drilling operations. Groundwater or seepage was encountered at depths of between approximately 3½ and 5 feet below existing site grade. It should be noted that groundwater elevations and soil moisture conditions within the project area will vary depending on seasonal rainfall, irrigation practices, land use, and/or runoff conditions not apparent at the time of our field investigation. The evaluation of such factors is beyond the scope of this investigation.

Detailed descriptions of the subsurface conditions encountered during our field investigation are presented on the Logs of Borings, Plates A-3 through A-8 of the appendix.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 General

Based on our findings, it is our professional opinion that the site should be suitable from a geotechnical standpoint for development of the proposed project provided the recommendations contained herein are incorporated into the project design. Given our findings, several geotechnical considerations will need to be addressed from a development standpoint. The primary considerations include: 1) the shrink-swell (expansion) characteristics of the near-surface organic soil and the potential for post-construction heave of concrete slabs and lightly loaded foundations, 2) the weak and highly compressible nature of the organic silt and clay encountered in the southwestern portion of the site, and 3) shallow groundwater. Specific conclusions and recommendations addressing these geotechnical considerations, as well as general recommendations regarding the geotechnical aspects of design and construction, are presented in the following sections.

5.2 Concrete Floor Slabs

Expansive Soil

Based on our findings, the near-surface soils underlying the site consist predominately of low to moderately-plastic organic soils. Our experience has been that these soils, when compacted, can exhibit shrink-swell (expansion) characteristics with variations in moisture content and pose a risk for post-construction heave and cracking of concrete slabs, as well as lightly loaded foundations and pavements. To reduce this risk, the proposed residences could be supported on post-tensioned slab foundations designed to resist and/or span the expansive soils. Recommendations for post-tensioned slabs are presented in Section 5.5. If conventional concrete floor slabs are preferred over post-tensioned slabs, several slab support options are available depending on the degree of risk assumed by the owner, among other factors.

A common option, representing the highest risk/lowest cost procedure, is to moisture condition the upper 18 inches of subgrade soils to a moisture content ranging from 0 to 5 percent above its optimum moisture content. The organic soil should be compacted to between 90 and 95 percent relative compaction. Following earthwork, the subgrade soils usually dry because the building pads are exposed to sun and wind for a period of time. Accordingly, it is necessary to wet or pre-soak the subgrade soils in order to uniformly raise the soils moisture content to at least 5 percentage points above its optimum moisture content or at least 2 percentage points above its plastic limit, whichever is less. Pre-soaking is usually performed using liberal sprinkling, flooding, or other suitable method. The zone of moisture-conditioned soils should extend laterally at least 5 feet outside the perimeter of the structures. A representative of our firm should perform a field check of the soils moisture content and consistency prior to placement of slab concrete. The compaction control during earthwork serves to reduce the expansion characteristics of the upper organic soil and the pre-soaking swells the soils prior to placement of slab concrete, thus decreasing the potential for post-construction movement. It should be noted, however, that moisture conditioning expansive soils does not necessarily eliminate swell potential. Poor drainage adjacent to homes and broken or leaking water or sewer lines can still trigger heaving of the on-site soils as the moisture content of these soils nears saturation. Accordingly, there remains a modest risk for isolated heaving and subsequent movement and cosmetic cracking of floor slabs and wall finishes with the first option.

Weather conditions at the time of construction will determine the amount of time allowed between the pre-soaking and slab placement. Generally, slab concrete should be placed no more than three days after the final field-testing. In hot and/or windy weather, slab concrete should be placed within 24 hours of the final field-testing. The time required for pre-soaking could vary from a few days to over a week depending on the condition of the subgrade soils. If the building pads are kept moist or wet following earthwork, the amount and time required for pre-soaking is often reduced. Likewise, restricting vehicle or equipment traffic on the pads following earthwork will decrease the potential for over-compacting the soils and reducing the ability for water to penetrate. A representative of our firm should perform a field check of the soils moisture content and consistency prior to placement of concrete.

A higher performance standard and reduced level of risk can be achieved by supporting conventional concrete floor slabs on at least 12 inches of imported non-expansive soil that is placed by removing the native organic soil, raising the building pads above existing site grade or a combination of both. The nonexpansive fill should be compacted as engineered fill. This procedure serves to replace the near-surface organic soil most susceptible to expansion, increase the dead-load imposed on the underlying expansive soils to resist up-lift forces, and produce a more uniform heave pattern, with less differential movement, should the underlying soils swell. The zone of non-expansive engineered soil should extend laterally at least 5-feet outside the perimeter of the structures.

Prior to placement of the non-expansive soil, the exposed organic soils should be scarified to a minimum depth of at least 6 inches, uniformly moisture conditioned to between 3 and 5 percentage points above the optimum moisture content, and compacted to between 90 and 95 percent relative compaction. The moisture content of the native soils should be maintained until placement of the non-expansive soil.

It is possible, depending on the cuts and fills planned during earthwork, that nonexpansive sand could be exposed at the surface, making the recommendations discussed above unwarranted. Following rough grading operations, we suggest that Kleinfelder perform organic soil surveys within lot or subdivision areas to document the presence or absence of organic soil within the upper 1.5 feet of final grade and evaluate the need for the remedial measures discussed above.

Organic Soil

In addition to being potentially expansive when compacted, the organic soil encountered is compressible in an uncompacted and undisturbed state. Organic silt is referenced herein as a material with a consistency of a fine-grained soil and an organic content less than 25 percent by dry weight.

It is our professional opinion that these organic soils in their current condition are unsuitable for support of the proposed structures. If the proposed structures will be supported on post-tensioned slab foundations, it has been our experience at the Brookside development that these soils do not need to be replaced provided they are compacted as engineered fill. This process could consist of scarifying and compacting the soils in-place, removing and then placing and compacting the soils, or a combination of both. The post-tensioned slabs should provide a sufficiently stiff foundation to reduce structural settlements and/or distortions if the compacted organic soils were to creep or consolidate following construction. Recommendations for post-tensioned slabs are presented in Section 5.5.

If conventional concrete floor slabs are preferred over post-tensioned slabs, the organic soils should be removed and replaced with an approved fill, or the organic soils should be mixed with low-organic native soils or import fill. The zone of removal and replacement or mixing should extend horizontally at least 5 feet outside the perimeters of the structures. The amount of mixing required will depend on the amount of vegetation present in the organic soils. Results of loss-on-ignition tests performed on the organic soils encountered during a study on the property to the south and east of the subject property indicated organic contents ranging from 10 to 21 percent. When the organic silt was mixed with low organic clay at application rates of 10 percent by volume, the organic content of the mixtures was 3 to 4 percent by dry weight, respectively. When the organic silt was mixed with the low organic clay at application rates of 20 percent by volume, the organic content of the mixtures was 5 to 7 percent by dry weight. Our experience with mixing operations at the Brookside development and the Discovery Bay development located west of Stockton has been that a mixed soil organic content of 8 percent would be suitable provided the organic soil volume does not exceed 20 percent.

During previous studies, highly organic and fibrous peat was encountered south and east of the site adjacent to the Bishop Tract levees. If peat is encountered within the proposed building areas during earthwork, this material should be removed entirely within 10 feet of the proposed structures and replaced with approved, compacted fill.

A representative from Kleinfelder should observe the compaction, removal, and/or mixing of the organic soils during earthwork. If mixing operations are performed, loss-on-ignition tests should be performed periodically to document that the organic content of the mixed soil does not exceed 8 percent.

Slab Support

In accordance with industry standards, floor slabs that will be covered with moisture-sensitive floor coverings should be underlain by at least 4 inches of compacted crushed rock or "clean" coarse sand. In the event that omission of the crushed rock layer is considered, Kleinfelder should evaluate the proposed "clean" coarse sand to assess its suitability for use in slab support. Furthermore, the gravel or "clean" coarse sand layer should be overlain by a moisture-proofing membrane, such as minimum 10-mil polyethylene sheeting, "Moiststop," or similar product, that is properly lapped and sealed to provide a vapor-tight barrier. The membrane should in-turn be overlain by a 1- to 2-inch thick layer of fine-to-medium-grained sand to promote uniform curing of the slab concrete, protect of the membrane during construction, and provide a leveling course. This sand should be moistened prior to concrete placement. However, if the sand has been allowed to become wet (due to precipitation or excessive moistening) or if standing water is present above the membrane, the concrete should not be placed.

If the crushed gravel or "clean" coarse sand layer will serve as a capillary break, the layer should be free draining and graded so that 100 percent passes the 1-inch sieve and less than 5 percent passes the No. 4 sieve.

As noted, the slab support discussed above is currently the industry standard. This system, however, may not be completely effective in preventing floor slab moisture vapor transmission. Furthermore, this system will not necessarily assure that floor slab moisture transmission rates will meet floor-covering manufacturer standards and that indoor humidity levels will not inhibit mold growth. These post-construction conditions should be addressed separately by qualified specialists with local knowledge of slab moisture protection systems, flooring design and other potential components that may be influenced by moisture. Our study addresses present subgrade conditions only and does not evaluate future potential conditions for support of slabs unless specifically stated otherwise.

Additional Considerations

The project Structural Engineer should provide the final design floor slab thickness and reinforcement requirements. Care should be taken to place and cure concrete in accordance with American Concrete Institute (ACI) standards and criteria. As previously discussed, the subgrade soils are anticipated to consist of low to moderately expansive soil. The intent of the subgrade preparation recommendations presented above is to provide alternatives that are typically considered cost-effective and that reduce associated risks to generally acceptable performance standards. The degree of risk varies depending on the alternative selected. The level of risk can be reduced and a higher performance standard can be achieved by stiffening the floor slabs, e.g., thickening the slab and/or reinforcing it with steel bars, or isolating the floor slabs from potential soil movement. For example, some projects have specified the use of 5- to 7-inch thick slabs and/or the placement of No. 3 or 4 reinforcement bars placed at 18 to 24 inches on-center each way within the middle third of the slabs. Kleinfelder can provide alternative recommendations and design criteria if it is desired to pursue these options further.

We have found that construction and trenching activities following rough grading often loosen or disturb the subgrade soils. On occasion, this disturbance can lead to isolated movement of the subgrade soils following construction and cracking of the overlying slabs. Accordingly, loose/disturbed areas should be repaired and trench backfill should be properly compacted prior to placement of concrete.

5.3 Exterior Flatwork

Like interior floor slabs, exterior concrete flatwork supported directly on native organic soils may be subject to the same heaving or settlement. Incorporating the subgrade preparation options discussed above in Section 5.2 can reduce some of the adverse effects.

From an expansive soil standpoint, moisture conditioning is the most common/least costly option used in the Stockton area, but this option also carries a modest to moderate risk for post-construction cracking and movement. The non-expansive fill option is more costly but will provide a higher performance standard, less maintenance and, thus, less risk. It should be noted that even with proper subgrade preparation, edge effects, i.e., modest differential heave and cracking along the outside portions of flatwork, can and often does develop following construction. Unlike interior floor slabs, sidewalks and the like do not have perimeter footings that serve as a cutoff or barrier to reduce seasonal or man-made wetting and drying below the slabs. Several supplemental options can be considered to reduce this risk depending on the performance level desired by the owner among other factors. Consideration could be given to increasing the strength of the flatwork by thickening the sidewalks and/or reinforcing the slabs with steel bars rather than wire mesh. Where flatwork is located adjacent to exposed soils or irrigated lawn and planters, lateral cutoffs, such as inverted curbs, heavy plastic membranes, or manufactured composite drains, have proven successful in the past for reducing wetting and drying of the subgrade soils below the flatwork. The cutoffs should be located along the outside edge of the flatwork and extend below the depth of non-expansive fill or moisture-conditioned native soils. Prior to finalization, our firm should review cutoff details.

As a minimum, smooth dowels should be provided at all joints to reduce tripping hazards. The dowels should be at least 24 inches in length, greased or sleeved at one end, and spaced at a maximum lateral spacing of 18 inches. Expansion joints should also be frequent within the slabs, typically 6 to 8 feet spacing horizontally.

Flatwork, such as sidewalks, patios, and planter boxes, should not be attached to proposed buildings. These structures should be allowed to "float" with the changes in volume of the soil.

5.4 Spread Foundations

The proposed structures may be supported on shallow, reinforced concrete spread footings founded on undisturbed, non-organic native soil, mixed compacted organic soil, or a combination of both. Recommendations for soil mixing are presented in Section 5.2 within the subsection titled "Organic Soil". A net allowable bearing pressure of 1,500 pounds per square foot (psf) for dead plus sustained live loading may be used to size column and continuous footings supported by these materials. A one-third increase in the allowable bearing pressure may be applied when considering short-term loading due to wind or seismic forces. Even though computed footing dimensions may be less, continuous and column spread footings should have minimum widths of 12 and 24 inches, respectively, to facilitate hand cleaning of the footing excavations and reduce the potential for localized punching shear failure.

Due to expansive soil considerations as discussed in Section 5.2, all footings should be embedded at least 18 inches below the lowest final adjacent subgrade[1]. At this depth, foundations should be supported below the critical zone of seasonal moisture fluctuations where soil shrink-swell cycles are most severe. In addition, perimeter continuous foundations would serve as a horizontal moisture break, reducing the potential for seasonal or man-made wetting and drying below the structures. Accordingly, continuous foundations should extend the entire perimeter of the buildings, including door and garage openings. If building pads are

[1] *Within this report, subgrade refers to the top surface of undisturbed native soil, native soil compacted during site preparation, or engineered fill.*

underlain by compacted organic soils (as discussed in Section 5.2 under the subsection titled *Organic Soil*), the footings should be deepened below the organic soil and at least 12 inches into the underlying non-organic native soil, where possible, with a maximum footing depth of 30 inches.

Total settlement of an individual foundation will vary depending on the plan dimensions of the foundation and the actual load supported. Based on the assumed foundation dimensions and loads, we estimate maximum total and differential foundation settlements should be on the order of ½-inch or less.

Prior to placing steel or concrete, footing excavations should be cleaned of all debris, loose or soft soil, and water. If shrinkage cracks appear in the footing excavations, the excavations should be thoroughly moistened to close all cracks prior to placement of concrete. All footing excavations should be observed by the project Geotechnical Engineer just prior to placing steel or concrete to confirm that the recommendations contained herein are implemented during construction.

The structural engineer should evaluate footing configurations and reinforcement requirements to account for loading, shrinkage, and temperature stresses. As a minimum, continuous footings should be reinforced with at least two No. 4 reinforcement bars, one top and one bottom, to provide structural continuity and permit spanning of local subgrade irregularities.

Resistance to lateral loads (including those due to wind or seismic forces) may be determined using an at-rest coefficient of friction of 0.5 between the bottom of cast-in-place concrete foundations and the underlying soils. Lateral resistance for foundations can alternatively be provided by the passive soil pressure acting against the vertical face of the footings. The passive pressures available in compacted low organic fill, compacted organic fill, and undisturbed native soil may be taken as equivalent to pressures exerted by fluids weighing 400, 200 and 300 pounds per cubic foot (pcf), respectively. These two modes of resistance can be combined. However, since horizontal movement is required to mobilize passive resistance, the allowable at-rest frictional resistance should be reduced by 50 percent.

Lateral resistance parameters provided above are ultimate values. Therefore, a suitable factor of safety should be applied for design purposes. For static and seismic loading conditions, factors of safety of at least 1.5 and 1.15, respectively, should be used for design. The appropriate factor of safety will depend on the design condition and should be determined by the project Structural Engineer.

5.5 Post-Tensioned Slab Foundations

In lieu of modifying the subgrade conditions as discussed in Section 5.2 under the subsection titled "Organic Soil" and using conventional spread foundations and floor slabs, the proposed structures may be supported by minimum 10-inch thick post-tensioned slab foundations. Organic soils should still be compacted as engineered fill. Slab edges and beams should be thickened to at least 12-inches. In accordance with procedures presented in Section 1816 of the 1997 Uniform Building Code (UBC), the following design parameters are recommended:

	Swelling Mode	
	Center Lift	**Edge Lift**
Edge Moisture Variation Distance (e_m), ft.	5.4	2.6
Differential Soil Movement (y_m), inches	2.4	0.40
Slab-Subgrade Friction Coefficient	0.75	
Net Allowable Bearing Capacity (dead-plus-live)	1,000 psf	

If post-tensioned slabs will be supported by greater than 1 foot of compacted organic soils, the slabs should also be designed to span a soil condition where a 6-foot diameter void is present anywhere within the slab.

Prior to placement of slab concrete, the upper 12 inches of subgrade soils below the slab foundations should be uniformly moisture conditioned to between 0 and 4 percentage points above the optimum moisture content and compacted to between 85 and 95 percent relative compaction. If the slab is underlain by organic soil, the degree of relative compaction should be increased to between 90 and 95 percent. Following earthwork, it is often necessary to wet or pre-soak the subgrade soils in order to again raise the soils moisture content to at least 5 percentage points above its optimum moisture content or at least 2 percentage points above its plastic limit, whichever is less. Pre-soaking is usually performed using liberal sprinkling, flooding, or other suitable method. A representative of our firm should perform a field check of the soils' moisture content and consistency within three days of concrete placement. The moisture conditioning/compaction control during earthwork serves to reduce the expansion characteristics of the organic soils and the pre-soaking swells the soils prior to placement of slab concrete, thus reducing the potential for post-construction movement. The time required for pre-soaking could vary from a few days to over a week depending on the condition of the subgrade soils. If the building pads are kept moist or wet following earthwork, the amount and time required for pre-soaking is often reduced. Likewise, restricting vehicle or equipment traffic on the pads, following earthwork will decrease the potential for over-compacting the soils and reducing the ability for water to penetrate.

A rock capillary break, vapor barrier, and fine to medium grained sand should underlie slab foundations as recommended in Section 7.2. The rock capillary break can be omitted provided a second vapor barrier is placed over the first and precautions are taken to carefully overlap, seal, and repair the vapor barrier during construction. As an alternative, the vapor barrier and rock capillary break can be substituted by using a moisture proofing membrane, such as "Moistop" or an equivalent substitute, installed per the manufacturer's recommendations.

5.6 Retaining Walls

Retaining walls should be designed to resist the earth pressure exerted by the retained, compacted backfill plus any additional lateral force due to surcharge loading, i.e., construction equipment, foundations, roadways, etc., at or near the wall. The following equivalent fluid earth pressures are recommended assuming wall heights of 10 feet or less and a fully drained backfill condition:

Earth Pressure Condition	Backfill Slope	Lateral Earth Pressure (pcf)
Active	Level	35
At-Rest	Level	55

Retaining walls capable of deflecting a minimum of 0.1 percent of their height at the top may be designed using the active earth pressure. Retaining walls incapable of this deflection or that are fully constrained against deflection should be designed for the at-rest earth pressure. Where uniform surcharge loads are located within a lateral distance from constrained and unconstrained retaining walls equal to the wall height, 45 and 30 percent of the surcharge load, respectively, should be applied uniformly over the entire height of the wall.

Retaining wall backfill should be free draining, and provisions should be made to collect and dispose of excess water away from the wall. Wall drainage may be provided by either a minimum 1-foot wide layer of clean drainrock/gravel enclosed by geosynthetic filter fabric or by prefabricated drainage panels (such as Miradrain, Enkadrain, or an equivalent substitute) installed per the manufacturer's recommendations. In either case, drainage should be collected by perforated pipes and directed to a sump, storm drain, weep holes, or other suitable location for disposal. Drainrock should consist of clean, durable stone having 100 percent passing the 1-inch sieve and zero percent passing the No. 4 sieve. Synthetic filter fabric should conform to the requirement in Section 88 "Engineering Fabrics" of the Caltrans Standard Specifications. Caltrans Class 2 Permeable Material meeting the requirements of Section 68-1.025 of the Standard Specifications can be substituted for the clean drainrock and filter fabric following review and approval by the Geotechnical Engineer. The upper 12 inches of engineered backfill above the wall drainage should consist of native soils, concrete, asphalt-concrete, or similar backfill to reduce surface drainage into the wall drain system.

If retaining walls are 4 feet or less in height, the perforated pipe may be omitted in lieu of weep holes on 4-foot, center-to-center maximum spacing. The weep holes should consist of 4-inch or larger diameter holes (concrete walls) or unmortered head joints (masonry walls). They should be placed as low as possible but not be higher than 18 inches above the lowest adjacent grade. Two 8-inch square overlapping patches of geosynthetic filter fabric should be affixed to the rear wall openings of each weep hole to retard soil piping.

All backfill should be placed and compacted in accordance with recommendations provided herein for engineered fill. During grading and backfilling adjacent to any walls, heavy equipment should not be allowed to operate within a lateral distance of 5 feet from the wall or within a lateral distance equal to the wall height, whichever is greater, to avoid overstressing of the wall. Within this zone, only hand operated equipment ("whackers," vibratory plates, or pneumatic compactors) should be used to compact backfill soils.

Expansive soils, i.e., organic soils, plastic silts, and/or clayey sands, should not be used for backfill against retaining walls unless approved by the geotechnical engineer. The wedge of nonexpansive backfill material should extend from the bottom of each retaining wall outward and upward at a slope of 1(h):1(v) or flatter.

5.7 Asphalt Concrete Pavements

Subgrade Preparation

As discussed in Section 5.2, the near-surface soils encountered consisted of potentially expansive organic soils that pose a risk for post-construction heave and cracking of pavements. Furthermore, the organic silts and clays encountered in the western portion of the site are relative weak and highly compressible.

To improve the pavements service life, the subgrade soils in expansive soil areas should be scarified to a minimum depth of 12 inches below the finished subgrade elevation and uniformly moisture conditioned to between 2 and 4 percentage points above the optimum moisture content. During or following moisture conditioning, the upper 6 inches of soil should be compacted as engineered fill to at least 95 percent relative compaction. The underlying 6 inches of soil should be compacted to at least 90 percent relative compaction. Any organic soils present below the upper 12 inch of pavement subgrade should be either overexcavated and replaced with approved fill or compacted to at least 90 percent relative compaction. The subgrade soils should be in a stable, non-pumping condition at the time aggregate base materials are placed and compacted. The moisture content of the soils should be maintained until placement of aggregate base by liberal sprinkling with water or other suitable method. To further reduce drying, the aggregate base should also be periodically sprinkled or wetted prior to placement of asphalt-concrete. A representative from our firm should perform a field check of the soil moisture content and relative compaction prior to placement of aggregate base.

With the presence of relatively high groundwater, expansive soils, and compressible organic soils, consideration should given to stabilizing the subgrade soils by mixing them with lime. The use of lime stabilization will need prior approval from the City of Stockton. This procedure would significantly strengthen the subgrade soils, reduce the expansion characteristics of the clays and, thus, tends to reduce the potential for future maintenance problems. In areas where organic soils are not present at the subgrade level or the thickness of organic soils is 6 inches or less, aggregate base sections can be thinner than for conventional pavements, thus reducing the relative cost of the lime stabilization. Based on saturation and strength testing on mixtures of lime and native low organic native soil performed for the adjacent Pulte Homes study, 4 percent high calcium or dolomitic quick lime by dry weight of the soil can be assumed for estimating purposes based on a soil dry unit weight of 110 pcf. Based on previous experience at the Brookside development in Stockton, 6 percent high calcium or dolomitic quick lime by dry weight of the soil can be assumed for estimating purposes in pavement areas that will be underlain by organic soils based on a soil dry unit weight of 90 pcf. Prior to or during lime stabilization, the untreated clay soils underlying the stabilized section should also be checked for moisture content. Since lime-stabilized soil is stronger than non-expansive fill, the moisture content and density of the underlying soils are less critical. However, some heaving or swelling could still occur if these underlying soils are not at least in an over-optimum moisture condition.

Lime stabilization should conform to the specifications stated in Section 24 of the Caltrans Standard Specifications, latest edition. The zone of lime-stabilized soils should extend laterally at least 2 feet beyond the perimeter of the pavements. In non-organic soil areas and areas were the thickness of organic soils is 6 inches or less, the depth required for lime stabilization is presented in the following subsection and varies depending on the design traffic index (TI) and subsequent pavement section. Where organic soils extend greater than 6 inches below the pavement subgrade, lime stabilization should extend to a minimum depth of 16 inches. The lime-stabilized subgrade soils should be uniformly moisture conditioned as necessary and compacted to at least 95 percent relative compaction. Prior to earthwork operations, our firm should review the lime contractor's proposed stabilization scheme to evaluate if the intent of our geotechnical recommendations has been properly addressed and the proposed procedure is adequate. If this option is considered in organic soil areas, laboratory tests should be performed at least two weeks prior to construction to confirm or revise the required application rate for lime.

Pavement Sections

Based on our experience at Brookside and the adjacent Spanos West, Pavilion Apartments, Park West and Pulte Homes developments, the surface materials within the project limits generally provide poor support for pavements. There have been isolated areas where R-value greater than 5 have been identified. In the past, it has been impractical to delineate where these zones of higher quality material exist. Therefore, we recommend that a design R-value of 5 be used for this project.

The pavement sections[2] presented below for pavements supported on non-stabilized low organic soil, compacted organic soils, and lime-stabilized organic soils (greater than 6 inches in thickness) are based on current Caltrans design procedures and traffic indices ranging from 4.0 to 9.0. The traffic index (TI) is a measure of traffic wheel loading frequency and intensity of anticipated traffic. For comparison, TI's between 4.0 and 5.0 are often suitable for design of average residential streets and minor or secondary collectors. TI's of between 5.5 and 6.5 are commonly used for design of major or primary collectors between minor collectors and major

[2] *Caltrans design procedures for asphalt concrete pavements provide sections in units of inches, rounded up to the nearest 1/2-inch. Sections provided above include a Gravel Equivalent Safety Factor of 0.2 (as recommended by Caltrans).*

arterials. TI's of 7.0 and greater are common for design of commercial roads, connector roads, or major streets with heavy traffic. The project Owner and Civil Engineer should review the TI's assumed above to evaluate their suitability for this project

Traffic Index	Asphalt-Concrete (inches)	Class 2 Aggregate Base (inches)
4.0	2.0	9.0
4.5	2.0	10.5
5.0	2.0	12.0
5.5	2.0	14.0
6.0	2.5	15.0
6.5	2.5	16.5
7.0	3.0	17.5
8.0	5.0	17.5
9.0	5.5	20.5

The pavement sections presented below are for lime stabilized low organic clays and silts and lime stabilized organic soils that are 6-inches or less in thickness based on our previous experience and the following criteria:

- A minimum lime-stabilized soil compressive strength of 200 psi.
- Lime-stabilized soil will provide a minimum R-value of 50.
- Gravel equivalency factor for the lime-stabilized soil of 1.1.
- Minimum depth of lime-stabilized soil will be 12 inches.
- Maximum depth of lime-stabilized soil will be 18 inches.
- It is typically difficult to achieve the required minimum compaction near the bottom of thick, lime-stabilized sections. Furthermore, the native soils underlying the lime-stabilized section are not compacted. To compensate for these factors, 3 inches of lime-stabilized soil has been added to the calculated pavement section.

We note that placing asphalt concrete directly on lime-stabilized soil has been successful on some projects in the Stockton area. However, on several projects, isolated shrinkage cracking of the lime-stabilized soils has occurred, resulting in minor or narrow reflection cracking of the overlying asphalt concrete. Although the cracking has not been significant, we have found that a "bridging layer" consisting of at least 4 inches of compacted aggregate base has performed well to reduce this cracking. Accordingly, at least 4 inches of aggregate base is recommended and included in the table presented below. As an option, the aggregate base can be eliminated provided the thickness of the asphalt concrete layer is increased and a reinforcing asphalt fabric, such as Petromat or a substitute with equivalent physical properties, is used between the asphalt lifts. Our office should be contacted to provide supplemental recommendations if this option is considered.

Traffic Index	Asphalt-Concrete (inch)	Class 2 Aggregate Base (inch)	Lime Stabilized Soil (inch)
4.0	2.0	4	12 (minimum)
4.5	2.0	4	12 (minimum)
5.0	2.0	4	12 (minimum)
5.5	2.0	4	13
6.0	2.5	4	14
6.5	2.5	4	16
7.0	3.5	4	17
8.0	5.0	4	17
9.0	5.5	5.5	18

The pavement sections provided are contingent on the following recommendations being implemented during and following construction.

- Aggregate base and aggregate subbase materials should conform to the specifications stated in Section 25 and 26 of the Caltrans Standard Specifications and be compacted as engineered fill to at least 95 percent relative compaction.
- Asphalt paving materials and placement methods should conform to the specifications stated in Section 39 of the Caltrans Standard Specifications, latest edition.
- Adequate drainage (both surface and subsurface) should be provided such that the subgrade soils and aggregate base materials are not allowed to become wet. All concrete curbs separating pavement and landscaped areas should extend into the subgrade and below the bottom of adjacent, aggregate base materials.
- Proper curing of the lime-stabilized soils is critically important. Continual sprinkling with water to keep the surface damp, combined with light rolling to keep the surface knitted together, has proven to be reasonably successful. Often the pavement subgrade is covered with aggregate base or crushed rock within 2 to 3 days of lime stabilization to reduce drying. Periodic sprinkling is still required to keep the surface damp. Alternatively, the stabilized soil is either sealed with one shot of cutback asphalt (0.2 to 0.4 gal/sq.yd.) within one day after final rolling or primed with increments of asphalt emulsion applied several times during the curing period.
- Periodic maintenance should be performed to repair degraded areas and seal cracks with appropriate filler.

Pavement sections provided above are preliminary only and are based on the soil conditions encountered during our field investigation, our assumptions regarding final site grades, and limited laboratory testing. Due to grading operations at the site, the actual pavement subgrade materials may be significantly different than those tested for this study. Representative subgrade samples should be obtained following rough grading and additional R-value tests performed. Should the results of these tests indicate a significant difference, the design pavement sections provided above will need to be revised.

5.8 Site Drainage

Foundation and slab performance depends greatly on how well runoff water drains from the site. Accordingly, positive drainage should be provided away from building pad and pavement areas toward appropriate drop inlets or other surface drainage devices without ponding. The drainage should be maintained both during construction and over the life span of the project. Landscaping after construction should not promote ponding of water adjacent to the structures. Roof draining should be installed with appropriate downspout extensions outfalling on splash blocks so that water is directed a minimum of 5 feet horizontally away from the structures or be connected to the storm drain system for the development. This method of roof runoff containment has the advantage of protection from owner alterations.

Because of post-construction heave considerations, homeowners should be made aware of the risks associated with expansive soils and the importance of maintaining positive drainage and the use of properly placed drains to transport excess landscape water and run off away from the structures. Homeowners should also be made aware that potential man-made water sources such as buried pipelines, drains, swimming pools, garden ponds and the like should be periodically tested and/or examined for signs of leakage or damage. Any such leakage or damage should be promptly repaired.

5.9 Permanent Dewatering

Groundwater measured during our study ranged from about 3.5 to 5 feet. Shallow groundwater may prove to be the most significant consideration from a construction and maintenance standpoint. In addition to problems associated with uncontrolled nuisance water, groundwater, as it encroaches within about 2 to 3 feet of building pad and street subgrade, could lead to subgrade instability. For this reason, the use of permanent dewatering systems is gaining widespread acceptance in the central valley. For example, Manteca currently requires a passive drain system in all street areas for several developments south of the Highway 120 Bypass where relatively high groundwater conditions exist. Based on our past experience, a temporary trench dewatering drain system can often be converted to a permanent drain system by installing sumps to pump water into the storm drain system during high groundwater periods. Otherwise, a perforated drainpipe enclosed in Caltrans Class 2 permeable rock and/or clean gravel and geotextile filter fabric is often placed at a depth of 5 to 8 feet in utility trenches. Similar to trench drains, the water collected is then diverted to sumps or gravity fed into storm drain manholes. The drain system is intended to keep the groundwater surface approximately 4 to 5 feet below grade in street areas and 6 to 7 feet below grade at adjacent residential lots. We understand that the City of Stockton may require that any dewatering system be completely separated from the eventual City-maintained storm water system. For your information, drain systems in several Manteca developments have been slightly deeper, primarily to lessen the need for dewatering during the installation of swimming pools.

The drain system discussed above will have little impact on groundwater levels near the existing levee. Our firm has completed geotechnical studies for numerous projects adjacent to levees in San Joaquin County. The majority of challenges with high groundwater impacting residential homes have occurred primarily during the winter months when the adjacent river or slough is at an elevated level. Observations and computer modeling have consistently shown that the majority of water is from "underseepage." A recently completed study of the levees bordering the Weston Ranch subdivision in south Stockton indicated that the majority (over 95 percent) of water traveling through and under the relatively-sandy levees of Reclamation District 17 was intercepted by a toe drain extending 4 to 6 feet below the levee toe. This depth allowed seepage to gravity flow to storm lines in the streets. Without the presence of the toe drain, there would definitely be levee seepage near the toe, as well as higher groundwater levels under those homes closest to the levees. In summary, it is our opinion that a levee toe drain extending 4 to 6 feet below grade is a reasonable approach to significantly reduce the risk of high groundwater near the levees.

5.10 Community Lakes

In our professional opinion, conventional excavation equipment should be suitable for construction of any proposed lake features. Given the soil conditions encountered and the potential for varying water level or loading conditions within the lake, we estimate the lake embankments should not exceed an inclination of 3(h):1(v). Embankments can be steepened, however, this may require the use of small retaining walls, soil cement, gunite or other methods to maintain stability. Once specific details for the lake have been developed, our firm should review the plans and provide supplemental recommendations for stable embankment construction, if warranted.

Based on our previous experience, a 12-inch thick, low-permeability clay liner is often suitable for residential lake construction. However, a consultant who specializes in lake construction should provide the final design. During construction, the exposed subgrade soils and clay liner material should be prepared and compacted as engineered fill in accordance with the general earthwork requirements presented in Section 5.13. During earthwork, a representative from Kleinfelder should observe the removal and stockpiling of any clay material at the site to visually observe that the stockpiled material is suitable and document that the clays are not contaminated with underlying sands, gravel, and silt. Once the clay liner materials are compacted, in-place tests, such as double-ring infiltrometers, can be performed in the field to evaluate the permeability characteristics of the compacted material or block samples can be removed, hand trimmed, and tested in the laboratory for permeability.

Exposed clay liners can shrink and crack after placement. If such cracks penetrate the liner, they can significantly reduce the water-holding capacity of the liner. Thus it will be necessary to sprinkle the surface of the liner to help retain moisture until a permanent pool is impounded. In higher reaches of the lake embankments where water levels may vary or are infrequently flooded by the lake, a thicker liner may be required so that cracks will not fully penetrate the liner, or the liner should be overlain by non-expansive soils that will protect the liner and reduce the potential for cyclic drying.

5.11 UBC Seismic Design Criteria

The project site lies within Seismic Zone 3 as shown on Figure 16-2 of the 1997 UBC. The nearest Seismic Source Type A fault is mapped greater than 15 kilometers (km) from the project site and the nearest Seismic Source Type B fault is mapped greater than 10 km from the site. Accordingly, near-source amplification factors do not need to be considered for design per Table 16-S and 16-T of the 1997 UBC. The upper 100 feet of soil underlying the site should meet the criteria for soil profile type S_D as defined in Table 16-J of the 1997 UBC.

5.12 Corrosion Potential

Chemical tests performed on a selected organic subgrade sample indicated a pH of 7.5, a water-soluble sulfate content of 140 parts per million (milligrams per kilogram), and a chloride concentration of 260 ppm. The ACI Manual of Concrete Practice, Section 201.2R-92, recommends using a Type I or II cement for foundations placed in these soils. In accordance with California Test 532, "if the chloride concentration is determined to be less than 500 ppm," "the influence of the chloride-ion at this level is considered to be non-corrosive."

Minimum resistivity tests performed on the same soil sample indicated that the soil is corrosive to buried metal objects as indicated by a result of 1,054 ohm-centimeters. A commonly accepted correlation between soil resistivity and corrosivity towards ferrous metals is provided below:

Soil Resistivity	Corrosivity
0 to 1,000 ohm-cm	Severely corrosive
1,000 to 2,000 ohm-cm	Corrosive
2,000 to 10,000 ohm-cm	Moderately corrosive
Over 10,000 ohm-cm	Mildly corrosive

Kleinfelder has performed these soil corrosivity tests as requested by the client. These tests are only an indicator of soil corrosivity. A competent corrosion engineer should be retained to design corrosion protection systems appropriate for the project.

5.13 General Earthwork

The following presents recommendations for <u>general</u> earthwork criteria. Previous sections should be reviewed for specific or supplemental earthwork recommendations.

5.13.1 Site Stripping

Prior to general site grading, surface vegetation, organic topsoil, and any debris should be removed and disposed of outside the construction limits. Depending on the concentration of vegetation, it may be possible to mow and rake off the surface vegetation and disc the remaining roots into the surface during subgrade preparation. The organic content of the disked soil (as determined by loss-on-ignition tests) should not exceed 5 percent by weight. Deep stripping may be required where concentrations of organic soils or tree roots are encountered during site grading. Furthermore, sediments and organic-laden dredge material encountered in and adjacent to the existing ditches and canals that cross the site should be removed to firm, undisturbed native soil. The depth of stripping and/or disking should be determined in the field by a representative of Kleinfelder prior to earthwork. Upon approval of the owner and/or landscape architect, stripped topsoil (less any debris) may be stockpiled and placed in landscape areas. This material, however, should not be incorporated into any engineered fill.

It is possible that buried objects such as abandoned utility lines, septic tanks, cesspools, wells, foundations, etc., may exist on site. If encountered within the area of construction, these items should be removed and disposed of off-site. Existing wells should be abandoned in accordance with applicable regulatory requirements. Existing utility pipelines that extend beyond the limits of the proposed construction and will be abandoned in-place should be plugged with cement grout to prevent migration of soil and/or water. All excavations resulting from removal activities should be cleaned of loose or disturbed material and dish-shaped with sides sloped 3(h):1(v) or flatter to permit access for compaction equipment.

5.13.2 Subgrade Preparation

Previous sections discuss specific subgrade preparation recommendations related to concrete floor slabs, foundations, exterior flatwork, and pavements. Where not specifically addressed by these previous sections, all subgrade areas that will receive engineered fill or support of structures should be scarified to a depth of at least 6 inches, uniformly moisture conditioned to between 2 and 4 percentage points above the optimum moisture content, and compacted as engineered fill to at least 90 percent relative compaction.

In-place scarification and compaction may not be adequate to densify all disturbed soil within areas grubbed or otherwise disturbed below a depth of about 6 inches. Therefore, overexcavation of disturbed soil, scarification and compaction of the exposed subgrade, and replacement with engineered fill may be required to sufficiently densify all disturbed soil.

5.13.3 Temporary Excavations

Construction site safety generally is the sole responsibility of the Contractor, who shall also be solely responsible for the means, methods, and sequencing of construction operations. The Contractor should be aware that slope height, slope inclination, or excavation depths (including utility trench excavations) should in no case exceed those specified in local, state, and/or federal safety regulations (e.g., OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926, or successor regulations). Flatter slopes and/or trench shields may be required if loose, cohesionless soils and/or water are encountered along the slope face. Heavy construction equipment, building materials, excavated soil, and vehicular traffic should not be allowed within a lateral distance equal to 1/3 the slope height from the top of any excavation. During wet weather, earthen berms or other methods should be used to prevent runoff water from entering all excavations. All runoff water, seepage and/or groundwater encountered within excavations should be collected and disposed of outside the construction limits.

5.13.4 Construction Dewatering

Proposed utility trench and lake excavations will likely extend below groundwater levels at the site and into the underlying clay and sand. At the nearby Spanos West development, we found that if these soils, particularly the sand, are exposed below the groundwater level, they could become unstable or even "quick" due to upward seepage forces, loosing their ability to maintain stabile excavation and trench slopes. Therefore, we anticipate that dewatering will be necessary to permit stable construction. The groundwater should be lowered and continuously maintained at least 2 to 3 feet below the bottom of the proposed excavation until the structure and backfill weight is adequate to provide uplift resistance and backfill is complete at least 3 feet above the normal stabilized water level.

Temporary dewatering of the excavations can be accomplished using several methods. Where excavations are relatively shallow, gravel filled gravity-ditches containing filtered, perforated pipes that extend 3 to 4 feet or more below the bottom of the excavation have been effective. The collected water then drains to sumps and is pumped out. Satisfactory dewatering with ditch drains often entails several successive trails and may require excavating additional ditches or deepening initial ditches before the groundwater is satisfactorily lowered. The main disadvantages of this method are the slowness in draining the excavation slopes, continuous wet conditions, and space limitations within the excavation.

Well point systems that are installed around the periphery of the excavation worked well at the Spanos West development and are the most common dewatering systems in use today to permit stable construction in the dry. The well points are small screen wells attached to riser pipes and connected at the surface by a common header that is further attached to a well point pump that pumps out the water that drains to the well points. A single stage of well points will lower the water table approximately 15 feet. The most practical use of the conventional well point is where the excavation is less than about 25 to 30 feet deep and no artesian pressures are encountered. Pumping is by means of turbines or submersible pumps. The primary disadvantage of this method over gravity ditches is typically cost.

The dewatering system for the project should be designed by an experienced consultant to appropriately filter the native soils and reduce any dispersion, piping, and associated loss of ground. The consultant should also account for any improvements near the project, such as structures, buried pipelines, etc. The lowering of the groundwater table produces additional effective stresses on the soils below the original water table. These additional pressures may cause consolidation of the soils and settlement of the nearby improvements or levees. It is often appropriate to institute a survey program before and during dewatering to monitor settlements in adjacent improvements, and/or require recharge wells to reduce the effects of settlement.

During initial earthwork, we have found that that the exposed soils at the base of the excavations are often not fully drained by the dewatering and are wet and/or pliant. To facilitate construction, the contractor may need to cover the bottom of the excavations with a 6- to 12-inch thick stabilizing layer of clean, crushed gravel that is firmly tamped into place. The crushed gravel can also serve as a collection medium for rainwater or seepage that can be removed by pumping from shallow sumps. If the gravel will provide foundation support following construction, the material should be wrapped entirely with a geotextile filter fabric, such as Mirafi 140N or an equivalent substitute, to reduce the potential for soil infiltration into the gravel and loss of ground. Highly wet and/or unstable soils encountered should be removed and replaced with compacted crushed rock, bedding material, or dryer soil. A second option would be to place a reinforcing geotextile fabric, such as Mirafi 500X or substitute with equivalent tensile strength, between the subgrade soils and crushed gravel in accordance with the manufacturer's recommendations. Our firm should be consulted prior to implementing any remedial measure to observe the subgrade condition and provide site-specific recommendations.

5.13.5 Fill Materials

The native soils encountered in our borings, minus organics, debris and/or other deleterious materials, should be suitable for use as engineered fill in proposed building areas. However, the native organic soils are considered potentially expansive. Therefore, fills composed of expansive soils that are placed and prepared in floor slab, flatwork, retaining wall, or pavement areas should be addressed as previously discussed in the appropriate sections of this report.

All import fill soils should be nearly free of organic or other deleterious debris, essentially non-plastic, and less than 3 inches in maximum dimension. In general, well-graded mixtures of gravel, sand, non-plastic silt, and small quantities of cobbles, rock fragments, and/or clay are acceptable for use as import fill. All imported fill materials to be used for engineered fill should be sampled and tested by the project Geotechnical Engineer prior to being transported to the site. Specific requirements for import fill are provided below.

Gradation (ASTM C136)	
Sieve Size	**Percent Passing**
3-inch	100
No. 4	50 – 100
No. 200	15 – 70
Plasticity (ASTM D4318)	
Liquid Limit	**Plasticity Index**
Less than 30	Less than 12
Organic Content (ASTM D2974)	
Less than 5 percent	

Trench backfill and bedding placed within existing or future city right-of-ways should meet or exceed the requirements outlined in the current city specifications. Trench backfill or bedding placed outside existing or future right-of-ways could consist of native or imported soil that meets the requirements for fill material provided above. However, coarse-grained sand and/or gravel should be avoided for pipe bedding or trench zone backfill unless the material is fully enclosed in a geotextile filter fabric such as Mirafi 140N or an equivalent substitute. In a very moist or saturated condition, fine-grained soil can migrate into the coarse sand or gravel voids and cause "loss of ground" or differential settlement along and/or adjacent to the trenches; thereby leading to pipe joint displacement and pavement distress. Consideration should be given to using watertight joints where pipes and culverts are placed below groundwater and in highly erodible soils, i.e., silty sands and silts.

Where access for compaction testing in deep trenching operations is limited by trench stability, safety, and other access concerns, a cement slurry backfill or controlled low strength material may be used for backfill as long as adequate pipe anchoring measures to prevent pipe floating are employed. The slurry should be adequately vibrated into position under the spring line of the pipe.

Utility trenches backfilled with sand or other permeable material can act as a conduit for exterior surface water to enter below structures. Accordingly, native clayey soils or lean concrete should be used as backfill for a minimum lateral distance of 2 feet on each side of the exterior building line to act as a "plug."

Trench backfill recommendations provided above should be considered minimum requirements only. More stringent material specifications may be required to fulfill bedding requirements for specific types of pipe. The project Civil Engineer should develop these material specifications based on planned pipe types, bedding conditions, and other factors beyond the scope of this study.

5.13.6 Engineered Fill

All fill soils, either native or imported, required to bring the site to final grade should be compacted as engineered fill. Fill soils or native subgrade composed of non-expansive sands and silts, and import fill should be uniformly moisture conditioned to between 0 and 4 percentage points above the optimum moisture content, placed in horizontal lifts less than 8 inches in loose thickness, and compacted to at least 90 percent of the maximum dry density as determined by ASTM Test Method D 1557[3]. Unless otherwise noted in previous sections, fill soils or native subgrade composed of potentially expansive clay or organic soil should be uniformly moisture conditioned to between 0 and 5 percentage points above the optimum moisture content, placed in horizontal lifts less than 8 inches in loose thickness, and compacted to between 90 and 95 percent of the maximum dry density. Additional fill lifts should not be placed if the previous lift did not meet the required dry density or if soil conditions are not stable. Disking and/or blending may be required to uniformly moisture condition soils used for engineered fill.

All trench backfill in building or other structural areas should be placed and compacted in accordance with recommendations provided above for engineered fill. During backfill, mechanical compaction of engineered fill is recommended. Jetting may be performed on trench backfill placed outside the building areas. This procedure typically consists of filling the utility trenches with backfill soils to within 3 feet of finished grade. The soils are then thoroughly jetted with water by inserting the jetting rods at a spacing of about 4 to 6 feet along the trench. The jetted soils are then allowed to "rest" for a period of time (typically 2 to 3 days) to allow excess water to drain and consolidation to occur. Following the rest period, the backfill soils are then rolled with a sheepsfoot attached to the arm of an excavator to further consolidate the upper few feet of soil and detect any excessively soft or pliant areas. Once the jetted trench backfill has adequately consolidated, the upper 3 feet of trench backfill should be placed at a moisture content of at least 2 percent above the optimum moisture content and mechanically compacted as engineered fill.

The density of the jetted backfill will not typically meet compaction standards, i.e., 90 percent relative compaction. Where tested, we have found that the compaction of jetted backfill typically falls between about 84 and 88 percent. Accordingly, we recommend that a performance criterion rather than a compaction standard be specified for jetted trench backfill. The project Geotechnical Engineer or designated representative should observed the jetting operation and consolidation to document that the procedure has been adequately performed and ready for final backfill.

[3] *This test procedure should be used wherever relative compaction, maximum dry density, or optimum moisture content is referenced within this report.*

5.13.7 Wet/Unstable Subgrade Mitigation

Based on our findings, groundwater levels may rise near surface and could impede some grading operations at the site. Accordingly, dewatering will likely be required in some areas during construction. If site grading is performed during or following extended periods of rainfall, the moisture content of the near-surface soils may be significantly above optimum. Furthermore, the moisture content of soils removed from trench excavations may be well above optimum. These conditions, if encountered, could seriously delay earthwork by causing an unstable subgrade and/or fill conditions. Typical remedial measures include disking and aerating the soils during dry weather, mixing the soils with dryer materials, removing and replacing the soils with an approved fill material, stabilization with a geotextile fabric or grid, or mixing the soils with an approved hydrating agent such as a lime or cement product. Our firm should be consulted prior to implementing any remedial measure to observe the unstable subgrade condition and provide site-specific recommendations.

If construction is to proceed during the winter and spring months, one way to reduce the exposure of building pads and potential repairs is to leave the subgrade at least 1 foot above the proposed subgrade elevation, cutting it down immediately before placing the capillary break and floor slab. The cut areas should be proof-rolled at the discretion of the geotechnical engineer to identify whether undercutting of any remaining wet/unstable soils is required. Cut soils can be placed in landscape areas or disked and aerated (dried) during dry weather for placement in pavement, future pad, or other areas.

6. ADDITIONAL SERVICES

The review of plans and specifications, field observations, and testing by Kleinfelder, Inc. is an integral part of the conclusions and recommendations made in this report. If Kleinfelder, Inc. is not retained for these services, the client agrees to assume Kleinfelder, Inc.'s responsibility for any potential claims that may arise during construction. The actual tests and observations by Kleinfelder, Inc. during construction will vary depending on type of project and soil conditions. The tests and observations would be additional services provided by our firm. The costs for these services are not included in our current fee arrangements.

As a minimum, our construction services should include observation and testing during site preparation, grading, and placement of engineered fill and observation of foundation excavations prior to placement of reinforcing steel. Many of our clients are finding it helpful to have a density test, moisture test (given the soils are expansive), and concrete compressive tests on each lot even though this information may not be required by any agency. It may also be helpful to perform a floor level and crack survey of all slab-on-grade floors prior to the application of any floor covering. The floor level survey can be readily accomplished using a manometer device by the client's personnel or as an additional service by Kleinfelder. Since damage to moisture-sensitive floor covering has become more common, we suggest that a vapor transmission test also be performed on every structure. This is another test that can be performed by the client's personnel or by Kleinfelder. In locations where sulfate in soil has caused concrete distress, it would be prudent to perform a chemical test as well. We recommend that the results of all these tests be furnished to the prospective new owners of the residential buildings. Since the site is underlain by expansive soils, we recommend that a letter describing the risks of expansive soils and the need for proper subgrade preparation prior to placing any exterior concrete be provided to future homeowners. This letter should also stress the importance of maintaining positive drainage and should encourage the use of properly placed drains to transport excess landscape water and run off away from the structures. Our firm can help draft the appropriate letter, if desired.

7. LIMITATIONS

1. The conclusions and recommendations of this report are for design purposes for the Thompson Property subdivision as described in the text of this report. The conclusions and recommendations in this report are invalid if:

    - The assumed structural or grading details change
    - The report is used for adjacent or other property
    - Changes of grades and/or groundwater occur between the issuance of this report and construction
    - Any other change is implemented which materially alters the project from that proposed at the time this report was prepared

2. The conclusions and recommendations in this report are based on the borings performed for this investigation. It is possible that variations in the soil conditions exist between or beyond the points of exploration, or the groundwater elevation may change, both of which may require additional investigations, consultation, and possible design revisions.

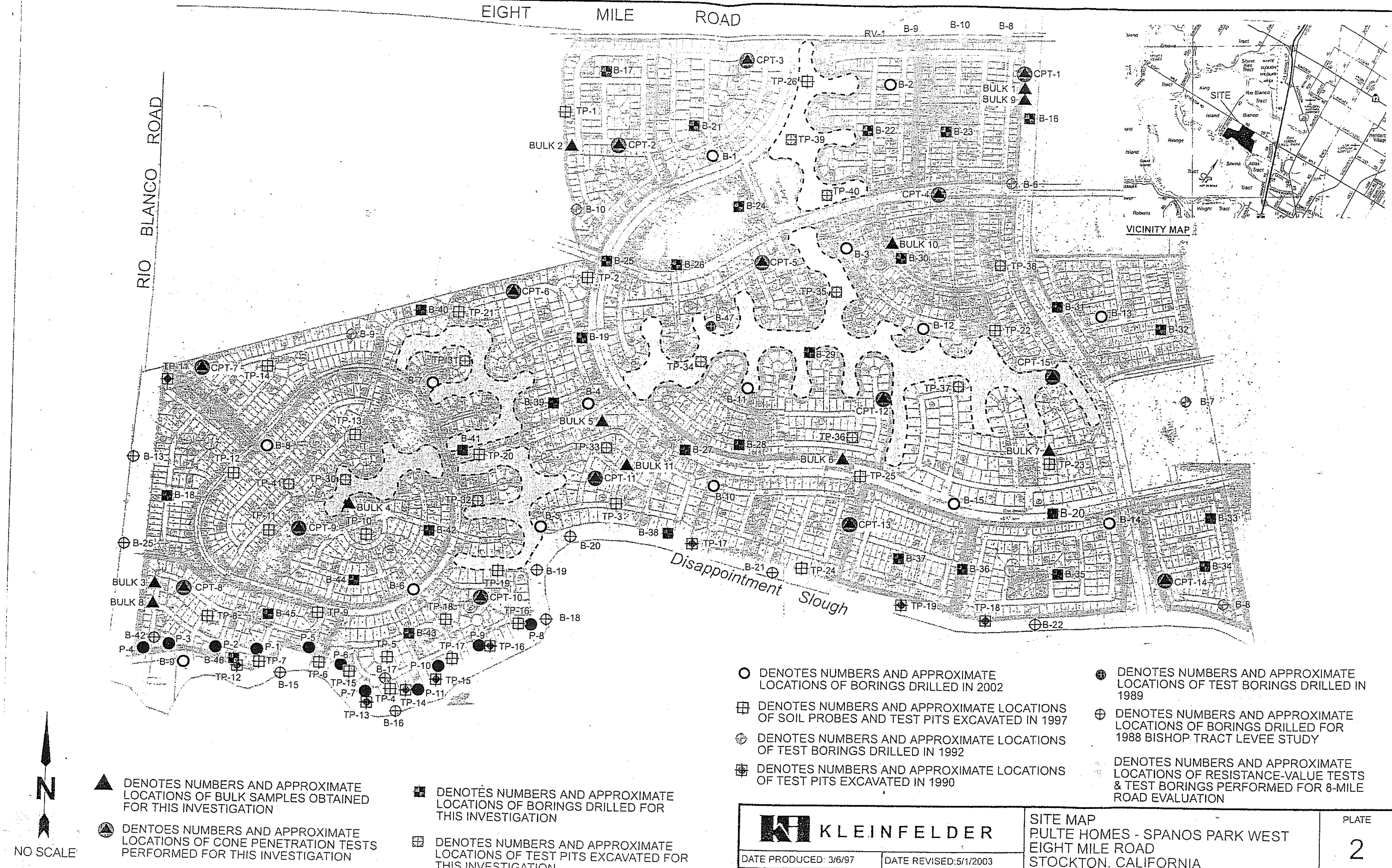
3. We are not corrosion engineers. A competent corrosion engineer should be retained to design corrosion protection systems appropriate for the project.

4. It is emphasized that we are not floor moisture proofing experts. We make no guarantee nor provide any assurance that the slab underlayment discussed in Section 5.2 will reduce concrete slab-on-grade floor moisture penetration to any specific rate or level, particularly those required by floor covering manufacturers. Qualified specialists with local knowledge of slab moisture protection systems, flooring design, and other potential components that may be influenced by moisture should be consulted.

5. This report was prepared in accordance with the generally accepted standard of practice that existed in San Joaquin County at the time the report was written. No warranty, expressed or implied, is made.

6. It is the CLIENT'S responsibility to see that all parties to the project, including the designer, contractor, subcontractor, etc., are made aware of this report in its entirety.

7. This report may be used only by the client and only for the purposes stated, within a reasonable time from its issuance. Land use, site conditions (both on site and off site) or other factors may change over time, and additional work may be required with the passage of time. Any party other than the client who wishes to use this report shall notify Kleinfelder, Inc. of such intended use. Based on the intended use of the report, Kleinfelder, Inc. may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the client or anyone else will release Kleinfelder, Inc. from any liability resulting from the use of this report by any unauthorized party.



DENOTES NUMBERS AND APPROXIMATE LOCATIONS OF BULK SAMPLES OBTAINED FOR THIS INVESTIGATION

DENTOES NUMBERS AND APPROXIMATE LOCATIONS OF CONE PENETRATION TESTS PERFORMED FOR THIS INVESTIGATION

DENOTES NUMBERS AND APPROXIMATE LOCATIONS OF BORINGS DRILLED FOR THIS INVESTIGATION

DENOTES NUMBERS AND APPROXIMATE LOCATIONS OF TEST PITS EXCAVATED FOR THIS INVESTIGATION

DENOTES NUMBERS AND APPROXIMATE LOCATIONS OF BORINGS DRILLED IN 2002

DENOTES NUMBERS AND APPROXIMATE LOCATIONS OF SOIL PROBES AND TEST PITS EXCAVATED IN 1997

DENOTES NUMBERS AND APPROXIMATE LOCATIONS OF TEST BORINGS DRILLED IN 1992

DENOTES NUMBERS AND APPROXIMATE LOCATIONS OF TEST PITS EXCAVATED IN 1990

DENOTES NUMBERS AND APPROXIMATE LOCATIONS OF TEST BORINGS DRILLED IN 1989

DENOTES NUMBERS AND APPROXIMATE LOCATIONS OF BORINGS DRILLED FOR 1988 BISHOP TRACT LEVEE STUDY

DENOTES NUMBERS AND APPROXIMATE LOCATIONS OF RESISTANCE-VALUE TESTS & TEST BORINGS PERFORMED FOR 8-MILE ROAD EVALUATION

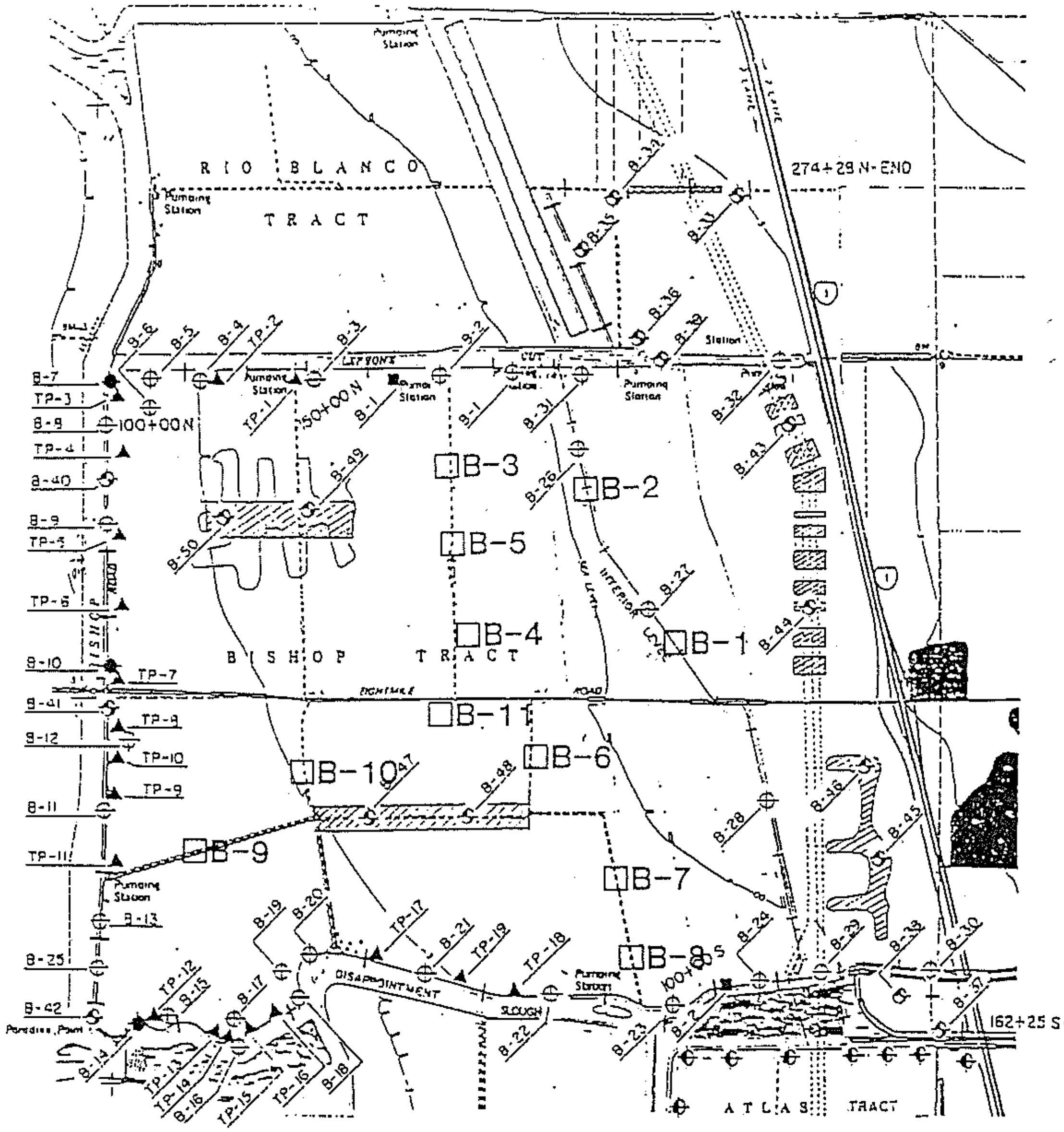
KLEINFELDER		SITE MAP PULTE HOMES - SPANOS PARK WEST EIGHT MILE ROAD STOCKTON, CALIFORNIA	PLATE 2
DATE PRODUCED: 3/6/97	DATE REVISED: 5/1/2003		
PROJ. NO. 25406.G01	FILENAME: STO3D355.FH9		

DENOTES NUMBERS AND APPROXIMATE LOCATIONS OF BORINGS DRILLED FOR THIS INVESTIGATION

DENOTES NUMBER AND APPROXIMATE LOCATION OF BULK SAMPLE

SCALE: 1" = 2000'

KLEINFELDER		SITE PLAN AND VICINITY MAP THOMPSON PROPERTY EIGHT MILE ROAD STOCKTON, CALIFORNIA	PLATE No. 1
DATE PRODUCED:9/19/2003	DATE REVISED:		
PROJ. NO.:35623.G01	FILENAME:STO3D713.FH9		



☐B-1	Denotes number and approximate location of test borings drilled July 21, 1992
▲ TP-1	DENOTES NUMBER AND APPROXIMATE LOCATION OF TEST PITS EXCAVATED ON APRIL 17, 1990
⊕ B-1	DENOTES NUMBER AND APPROXIMATE LOCATION OF TEST BORINGS DRILLED FOR JANUARY 1, 1989 INVESTIGATION
● B-7	DENOTES LOCATION OF PIEZOMETERS
■ B-1	DENOTES LOCATION OF BORINGS DRILLED FOR FEBRUARY 24, 1984 REPORT
◈ B-33	DENOTES NUMBER AND APPROXIMATE LOCATION OF TEST BORINGS DRILLED IN FEBRUARY, 1988 AND OCTOBER, 1989
⊖	LOCATION OF EXISTING TEST BORINGS FROM ATLAS TRACT AND TWIN CREEKS STUDIES

KLEINFELDER

PREVIOUS AND CURRENT TEST BORINGS FOR BISHOP TRACT STOCKTON, CALIFORNIA

PLATE 3

A-2

PROJECT NO. 20-1415-09

APPENDIX
LOGS OF BORINGS AND
SUMMARY OF LABORATORY TESTS

LIST OF ATTACHMENTS

The following plates are attached and complete this appendix.

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			*USCS SYMBOL*	*TYPICAL DESCRIPTIONS*
COARSE GRAINED SOILS (More than half of material is larger than the #200 sieve)	GRAVELS (More than half of coarse fraction is larger than the #4 sieve)	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
			GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
		GRAVELS WITH OVER 12% FINES	GM	SILTY GRAVELS, GRAVEL-SILT-SAND MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SANDS (More than half of coarse fraction is smaller than the #4 sieve)	CLEAN SANDS WITH LITTLE OR NO FINES	SW	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
			SP	POORLY-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
		SANDS WITH OVER 12% FINES	SM	SILTY SANDS, SAND-GRAVEL-SILT MIXTURES
			SC	CLAYEY SANDS, SAND-GRAVEL-CLAY MIXTURES
FINE GRAINED SOILS (More than half of material is smaller than the #200 sieve)	SILTS AND CLAYS (Liquid limit less than 50)		ML	INORGANIC SILTS & VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS, CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC SILTS & ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS (Liquid limit greater than 50)		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILT
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS & ORGANIC SILTS OF MEDIUM-TO-HIGH PLASTICITY
HIGHLY ORGANIC SOILS			PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENT

KLEINFELDER

Drafted By: GDG
Date: 9/19/2003
Project No.: 35623.G01
File Number: STO3G216

UNIFIED SOIL CLASSIFICATION SYSTEM
THOMPSON PROPERTY
EIGHT MILE ROAD
STOCKTON, CALIFORNIA

PLATE
A-1

KA-USCS STO3G216.GPJ 9/19/03

LOG SYMBOLS

BULK / BAG SAMPLE	-4 PERCENT FINER THAN THE NO. 4 SIEVE (ASTM Test Method C 136)
MODIFIED CALIFORNIA SAMPLER (2-1/2 inch outside diameter)	-200 PERCENT FINER THAN THE NO. 200 SIEVE (ASTM Test Method C 117)
CALIFORNIA SAMPLER (3 inch outside diameter)	LL LIQUID LIMIT (ASTM Test Method D 4318)
STANDARD PENETRATION SPLIT SPOON SAMPLER (2 inch outside diameter)	PI PLASTICITY INDEX (ASTM Test Method D 4318)
CONTINUOUS CORE	TXCU CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION (EM 1110-1-1906)
SHELBY TUBE	EI EXPANSION INDEX (UBC STANDARD 18-2)
ROCK CORE	COL COLLAPSE POTENTIAL
WATER LEVEL (level where first encountered)	UC UNCONFINED COMPRESSION (ASTM Test Method D 2166)
WATER LEVEL (level after completion)	
SEEPAGE	MC MOISTURE CONTENT (ASTM Test Method D 2216)

GENERAL NOTES

1. Lines separating strata on the logs represent approximate boundaries only. Actual transitions may be gradual.

2. No warranty is provided as to the continuity of soil conditions between individual sample locations.

3. Logs represent general soil conditions observed at the point of exploration on the date indicated.

4. In general, Unified Soil Classification System designations presented on the logs were evaluated by visual methods. Where laboratory tests were performed, the designations reflect the laboratory test results.

KA-LOG_KEY STO3G216.GPJ 9/19/03

KLEINFELDER

Drafted By: GDG Project No.: 35623.G01
Date: 9/19/2003 File Number: STO3G216

LOG KEY
THOMPSON PROPERTY
EIGHT MILE ROAD
STOCKTON, CALIFORNIA

PLATE A-2

Surface Conditions:	Disked alfalfa field	Date Completed:	9/18/2003
Groundwater:	Groundwater encountered at a depth of approximately 3.5 below existing site grade.	Logged By:	RBL
		Total Depth:	11.5 feet

Depth (feet)	Sample Type	Sample No.	Blows/ft	Pen (tsf)	Dry Density (pcf)	Moisture Content (%)	Liquid Limit	Plasticity Index	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests	Lithography	DESCRIPTION
		FIELD			LABORATORY								
0													(PT) PEAT - Black, moist
~3		1-2-1	9	2.0							Corrosion pH = 7.5, Min. Resistivity = 1,054 ohm-cm		(SC) CLAYEY SAND - Olive gray, moist, loose, fine grained
5													(SM) SILTY SAND - Brown, wet, medium dense, fine grained
~5.5		1-5-1	13		109	17				10			
10		1-10-1											(SC) CLAYEY SAND - Gray, wet, fine grained
11.5													Boring completed at a depth of approximately 11.5 feet below existing site grade.
15													
20													
25													

KLEINFELDER

Drafted By: GDG
Date: 9/29/2003
Project No.: 35623.G01
File Number: STO3G216

LOG OF BORING B-1
THOMPSON PROPERTY
EIGHT MILE ROAD
STOCKTON, CALIFORNIA

PLATE
1 of 1
A-3

KA_2001 STO3G216.GPJ 9/29/03

Surface Conditions: Disked alfalfa field

Groundwater: Groundwater encountered at a depth of approximately 3.5 below existing site grade.

Date Completed: 9/18/2003

Logged By: RBL

Total Depth: 16.5 feet

Depth (feet)	Sample Type	Sample No.	Blows/ft	Pen (tsf)	Dry Density (pcf)	Moisture Content (%)	Liquid Limit	Plasticity Index	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests	Lithography	DESCRIPTION
		FIELD			LABORATORY								
0												PT	(PT) **ORGANIC** - Black, dry to moist
2			19									SM	(SM) **SILTY SAND** - Light brown, moist, medium dense, fine grained
3.5											▼ (groundwater)		
5			3										Very loose
8													Grades less silt
10		2-10-1	8		84	35							
11												SC	(SC) **CLAYEY SAND** - Light brown, wet, loose, fine grained
15		2-15-1	21	4.0									
15.5												CL	(CL) **SANDY CLAY** - Light brown, moist, hard, moderate plasticity
16.5													Boring completed at a depth of approximately 16.5 feet below existing site grade.
20													
25													

KLEINFELDER

Drafted By: GDG Project No.: 35623.G01

Date: 9/29/2003 File Number: STO3G216

LOG OF BORING B-2
THOMPSON PROPERTY
EIGHT MILE ROAD
STOCKTON, CALIFORNIA

PLATE
1 of 1
A-4

KA_2001 STO3G216.GPJ 9/29/03

Surface Conditions: Disked alfalfa field

Groundwater: Groundwater encountered at a depth of approximately 4 below existing site grade.

Date Completed: 9/18/2003

Logged By: RBL

Total Depth: 11.5 feet

Depth (feet)	Sample Type	Sample No.	Blows/ft	Pen (tsf)	Dry Density (pcf)	Moisture Content (%)	Liquid Limit	Plasticity Index	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests	Lithography	DESCRIPTION
													(PT) PEAT - Black, dry to moist
		3-2-1	12								Corrosion pH = 7.5, Min. Resistivity = 1,054 ohm-cm		(SC) CLAYEY SAND - Light brown, moist to wet, loose, fine grained
5		3-5-1	10		103	22							Grades less clay
10		3-10-1	7		110	19							(SM) SILTY SAND - Light brown, wet, loose, fine grained
													Boring completed at a depth of approximately 11.5 feet below existing site grade.
15													
20													
25													

KLEINFELDER

Drafted By: GDG
Date: 9/29/2003

Project No.: 35623.G01
File Number: STO3G216

LOG OF BORING B-3
THOMPSON PROPERTY
EIGHT MILE ROAD
STOCKTON, CALIFORNIA

PLATE 1 of 1

A-5

KA_2001 STO3G216.GPJ 9/29/03

Surface Conditions: Disked alfalfa field

Groundwater: Groundwater encountered at a depth of approximately 4.5 below existing site grade.

Date Completed: 9/18/2003

Logged By: RBL

Total Depth: 16.5 feet

Depth (feet)	Sample Type	Sample No.	Blows/ft	Pen (tsf)	Dry Density (pcf)	Moisture Content (%)	Liquid Limit	Plasticity Index	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests	Lithography	DESCRIPTION
	FIELD				LABORATORY								
0												PT	(PT) PEAT - Black, dry to moist
	■	4-2-1	5		96	21				48		SC	(SC) CLAYEY SAND - Light brown, moist, loose, fine grained
5												▼	Grades less clay, wet
	■		8										
10													Grades more clay, medium dense, wet
	■	4-10-1	19										
15	■	4-15-1	30	4.5								CL	(CL) SANDY CLAY - Light brown, wet, hard, moderate plasticity
													Boring completed at a depth of approximately 16.5 feet below existing site grade.
20													
25													

KLEINFELDER

Drafted By: GDG Project No.: 35623.G01

Date: 9/29/2003 File Number: STO3G216

LOG OF BORING B-4
THOMPSON PROPERTY
EIGHT MILE ROAD
STOCKTON, CALIFORNIA

PLATE
1 of 1
A-6

KA_2001 STO3G216.GPJ 9/29/03

Surface Conditions: Disked field

Groundwater: Groundwater encountered at a depth of approximately 4.5 below existing site grade.

Date Completed: 9/18/2003

Logged By: RBL

Total Depth: 11.5 feet

Depth (feet)	Sample Type (FIELD)	Sample No. (FIELD)	Blows/ft (FIELD)	Pen (tsf) (FIELD)	Dry Density (pcf) (LABORATORY)	Moisture Content (%) (LABORATORY)	Liquid Limit (LABORATORY)	Plasticity Index (LABORATORY)	Passing #4 Sieve (%) (LABORATORY)	Passing #200 Sieve (%) (LABORATORY)	Other Tests (LABORATORY)	Lithography	DESCRIPTION
													(OH) ORGANIC CLAY - Black, dry to moist, moderate plasticity
		5-2-1	6								Corrosion pH = 7.5, Min. Resistivity = 1,054 ohm-cm		(CL) SANDY CLAY - Light brown, moist to wet, medium stiff, fine grained
5		5-5-1	6							64			
10													Gray, very stiff
		5-10-1	27										
													Boring completed at a depth of approximately 11.5 feet below existing site grade.
15													
20													
25													

KLEINFELDER

Drafted By: GDG
Date: 9/29/2003

Project No.: 35623.G01
File Number: STO3G216

LOG OF BORING B-5
THOMPSON PROPERTY
EIGHT MILE ROAD
STOCKTON, CALIFORNIA

PLATE
1 of 1

A-7

Surface Conditions: Disked field

Groundwater: Groundwater encountered at a depth of approximately 5 below existing site grade.

Date Completed: 9/18/2003

Logged By: RBL

Total Depth: 16.5 feet

Depth (feet)	Sample Type	Sample No. (FIELD)	Blows/ft (FIELD)	Pen (tsf) (FIELD)	Dry Density (pcf) (LABORATORY)	Moisture Content (%)	Liquid Limit	Plasticity Index	Passing #4 Sieve (%)	Passing #200 Sieve (%)	Other Tests	Lithography	DESCRIPTION
0													(OH) ORGANIC CLAY - Black, dry to moist, moderate plasticity
		6-2-1	12										(SC) CLAYEY SAND - Light brown, moist to wet, loose, fine grained
5		6-5-1	7	2.0	86	34	34	10				▼	
													(CL) SANDY CLAY - Light brown, wet, stiff, moderate plasticity
10		6-10-1	25										(SC) CLAYEY SAND - Light brown, wet, medium dense, fine grained
15			25										
													Boring completed at a depth of approximately 16.5 feet below existing site grade.
20													
25													

KLEINFELDER

Drafted By: GDG

Date: 9/29/2003

Project No.: 35623.G01

File Number: STO3G216

LOG OF BORING B-6
THOMPSON PROPERTY
EIGHT MILE ROAD
STOCKTON, CALIFORNIA

PLATE 1 of 1

A-8

BORING NO.	SAMPLE DEPTH (ft)	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (% of dry weight)	PARTICLE SIZE SIEVE SIZE (percent passing)						ATTERBERG LIMITS		OTHER TESTS
				3"	3/4"	#4	#10	#40	#200	L.L.	P.I.	
B-1	2.0											Corrosion pH = 7.5, Min. Resistivity = 1,054 ohm-cm
B-1	5.0	109	17						10			
B-2	10.0	84	35									
B-3	2.0											Corrosion pH = 7.5, Min. Resistivity = 1,054 ohm-cm
B-3	5.0	103	22									
B-3	10.0	110	19									
B-4	2.0	96	21						48			
B-5	2.0											Corrosion pH = 7.5, Min. Resistivity = 1,054 ohm-cm
B-5	5.0								64			
B-6	5.0	86	34							34	10	
BULK-1	0.0									69	18	Organic Content = 23%

KLEINFELDER

Drafted By: GDG
Date: 9/29/2003

Project No.: 35623.G01
File Number: STO3G216

SUMMARY OF LABORATORY TESTS
THOMPSON PROPERTY
EIGHT MILE ROAD
STOCKTON, CALIFORNIA

PLATE
1 of 1
A-9

KA-LABSUM STO3G216.GPJ 9/29/03

Sequoia Analytical

819 Striker Avenue, Suite 8
Sacramento, CA 95834
(916) 921-9600
FAX (916) 921-0100
www.sequoialabs.com

September 24 , 2003

RECEIVED
SEP 29 2003
KLEINFELDER, INC.

Emmy Allen-Crossman
Kleinfelder - Stockton
2825 East Myrtle Street
Stockton, CA 95205

RE: Spanos-Thompson Property
Work Order: S309487

Enclosed are the results of analyses for samples received by the laboratory on 09/23/03. If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Ron Chew
QA Manager / Client Services Representative

CA ELAP Certificate Number 1624

Sequoia Analytical

819 Striker Avenue, Suite 8
Sacramento, CA 95834
(916) 921-9600
FAX (916) 921-0100
www.sequoialabs.com

Kleinfelder - Stockton 2825 East Myrtle Street Stockton CA, 95205	Project: Spanos-Thompson Property Project Number: 35623.G01 Project Manager: Emmy Allen-Crossman	S309487 **Reported:** 09/24/03 14:44

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
21684	S309487-01	Soil	09/19/03 13:30	09/23/03 13:50

The results in this report apply to the samples analyzed in accordance with the chain of custody document. Unless otherwise stated, results are reported on a wet weight basis. This analytical report must be reproduced in its entirety.

Sequoia Analytical

819 Striker Avenue, Suite 8
Sacramento, CA 95834
(916) 921-9600
FAX (916) 921-0100
www.sequoialabs.com

Kleinfelder - Stockton 2825 East Myrtle Street Stockton CA, 95205	Project: Spanos-Thompson Property Project Number: 35623.G01 Project Manager: Emmy Allen-Crossman	S309487 **Reported:** 09/24/03 14:44

Anions by EPA Method 300.0

Sequoia Analytical - Sacramento

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
21684 (S309487-01) Soil	**Sampled: 09/19/03 13:30**	**Received: 09/23/03 13:50**							
Chloride	**260**	20	mg/kg	10	3090334	09/23/03	09/23/03	EPA 300.0	
Sulfate as SO4	**140**	20	"	"	"	"	"	"	

The results in this report apply to the samples analyzed in accordance with the chain of custody document. Unless otherwise stated, results are reported on a wet weight basis. This analytical report must be reproduced in its entirety.

Sequoia Analytical

819 Striker Avenue, Suite 8
Sacramento, CA 95834
(916) 921-9600
FAX (916) 921-0100
www.sequoialabs.com

Kleinfelder - Stockton 2825 East Myrtle Street Stockton CA, 95205	Project: Spanos-Thompson Property Project Number: 35623.G01 Project Manager: Emmy Allen-Crossman	S309487 **Reported:** 09/24/03 14:44

Anions by EPA Method 300.0 - Quality Control
Sequoia Analytical - Sacramento

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 3090334 - General Preparation										
Blank (3090334-BLK1)				Prepared & Analyzed: 09/23/03						
Chloride	ND	2.0	mg/kg							
Sulfate as SO4	ND	2.0	"							
Laboratory Control Sample (3090334-BS1)				Prepared & Analyzed: 09/23/03						
Chloride	50.3	2.0	mg/kg	50.0		101	80-120			
Sulfate as SO4	105	2.0	"	100		105	80-120			
Laboratory Control Sample Dup (3090334-BSD1)				Prepared & Analyzed: 09/23/03						
Chloride	50.3	2.0	mg/kg	50.0		101	80-120	0	200	
Sulfate as SO4	105	2.0	"	100		105	80-120	0	200	
Matrix Spike (3090334-MS1)	**Source: S309334-01**			Prepared & Analyzed: 09/23/03						
Chloride	179	20	mg/kg	50.0	150	58	75-125			QM-07
Sulfate as SO4	107	20	"	100	6.0	101	75-125			

819 Striker Avenue, Suite 8
Sacramento, CA 95834
(916) 921-9600
FAX (916) 921-0100
www.sequoialabs.com

Kleinfelder - Stockton 2825 East Myrtle Street Stockton CA, 95205	Project: Spanos-Thompson Property Project Number: 35623.G01 Project Manager: Emmy Allen-Crossman	S309487 **Reported:** 09/24/03 14:44

Notes and Definitions

QM-07	The spike recovery was outside control limits for the MS and/or MSD. The batch was accepted based on acceptable LCS recovery.
DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference