23.4 SODDING

A. Lay sod within 24 hours of harvesting unless a suitable preservation method is accepted by Architect prior to delivery time. Do not lay sod if dormant or if ground is frozen or muddy.

B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to soil or sod during installation. Tamp and roll lightly to ensure contact with soil, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.

1. Lay sod across slopes exceeding 1:3.
2. Anchor sod on slopes exceeding 1:6 with wood pegs spaced as recommended by sod manufacturer but not less than two anchors per sod strip to prevent slippage.

C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches below sod.

23.5 TURF RENOVATION

A. Renovate existing turf where indicated.

B. Renovate turf damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.

1. Reestablish turf where settlement or washouts occur or where minor regrading is required.
2. Install new planting soil as required.

C. Remove sod and vegetation from diseased or unsatisfactory turf areas; do not bury in soil.

D. Remove topsoil containing foreign materials, such as oil drippings, fuel spills, stones, gravel, and other construction materials resulting from Contractor's operations, and replace with new planting soil.

E. Mow, dethatch, core aerate, and rake existing turf.

F. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.

G. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off Owner's property.

H. Till stripped, bare, and compacted areas thoroughly to a soil depth of 6 inches.

I. Apply soil amendments and initial fertilizer required for establishing new turf and mix thoroughly into top 4 inches of existing soil. Install new planting soil to fill low spots and meet finish grades.

1. Soil Amendment(s): according to requirements of Section 32 91 15 "Soil Preparation (Performance Specification)."
2. Initial Fertilizer: [**Commercial fertilizer**] [**Slow-release fertilizer**] <**Insert type**> applied according to manufacturer's recommendations.

J. Water newly planted areas and keep moist until new turf is established.

23.6 TURF MAINTENANCE

A. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.

1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.

B. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches.

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
2. Water turf with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.

C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:

1. Mow bentgrass to a height of 1/2 inch or less.
2. Mow bermudagrass to a height of 1/2 to 1 inch.
3. Mow turf-type tall fescue to a height of 2 to 3 inches.

D. Turf Postfertilization: Apply [**commercial fertilizer**] [**slow-release fertilizer**] <**Insert type**> after initial mowing and when grass is dry.

1. Use fertilizer that provides actual nitrogen of at least [**1 lb/1000 sq. ft.**] <**Insert value**> to turf area.

23.7 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by Architect:

1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.
2. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.
3. Satisfactory Plugged Turf: At end of maintenance period, the required number of plugs has been established as well-rooted, viable patches of grass, and areas between plugs are free of weeds and other undesirable vegetation.
4. Satisfactory Sprigged Turf: At end of maintenance period, the required number of sprigs has been established as well-rooted, viable plants, and areas between sprigs are free of weeds and other undesirable vegetation.

B. Use specified materials to reestablish turf that does not comply with requirements, and continue maintenance until turf is satisfactory.

23.8 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents according to requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

23.9 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.

C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

D. Remove nondegradable erosion-control measures after grass establishment period.

23.10 MAINTENANCE SERVICE

A. Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in "Turf Maintenance" Article. Begin maintenance immediately after each area is planted and continue until acceptable turf is established, but for not less than the following periods:

a. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season.

2. Sodded Turf: [**30**] **<Insert number>** days from date of [**planting completion**] [**Substantial Completion**] **<Insert starting time>**.

END OF SECTION 32 92 00

SECTION 32 93 00 - PLANTS

PART 24 - GENERAL

24.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

24.2 SUMMARY

A. Section Includes:

1. Plants.
2. Tree stabilization.

B. Related Requirements:

1. Section 01 56 39 "Temporary Tree and Plant Protection" for protecting, trimming, pruning, repairing, and replacing existing trees to remain that interfere with, or are affected by, execution of the Work.
2. Section 32 92 00 "Turf and Grasses" for turf (lawn) and hydroseeding.

24.3 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

B. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.

C. Finish Grade: Elevation of finished surface of planting soil.

D. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant. Some sources classify herbicides separately from pesticides.

E. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

F. Planting Area: Areas to be planted.

G. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 32 91 15 "Soil Preparation (Performance Specification)" for drawing designations for planting soils.

H. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.

I. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

J. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.

K. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

24.4 COORDINATION

A. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.

1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

24.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

24.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Plant Photographs: Include color photographs in digital 3 by 5-inch format of each required species and size of plant material as it will be furnished to Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. For species where more than 20 plants are required, include a minimum of three photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.

B. Samples for Verification: For each of the following:

1. Mulch: 1-quartvolume of each organic mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each

Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.

2. Mineral Mulch: 2 lbof each mineral mulch required, in sealed plastic bags labeled with source of mulch. Sample shall be typical of the lot of material to be delivered and installed on-site; provide an accurate indication of color, texture, and makeup of the material.
3. Weed Control Barrier: 12 by 12 inches
4. Root Barrier: Depth of panel by 12 inches

24.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.

B. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:

1. Manufacturer's certified analysis of standard products.
2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.

C. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

24.8 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants.

1. Experience: Three years' experience in landscape installation.
2. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
3. Pesticide Applicator: State licensed, commercial.

B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.

1. Selection of plants purchased under allowances is made by Landscape Architect, who tags plants at their place of growth before they are prepared for transplanting.

C. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.

1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container-grown stock. Measure main body of tree or shrub for height and spread;

do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inchcaliper size, and 12 inches above the root flare for larger sizes.

2. Other Plants: Measure with stems, petioles, and foliage in their normal position.

D. Plant Material Observation: Landscape Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Landscape Architect may also observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and may reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.

1. Notify Landscape Architect of sources of planting materials 14 days in advance of delivery to site.

24.9 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk materials with appropriate certificates.

C. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

D. Handle planting stock by root ball.

E. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.

1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.

F. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.

G. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

1. Do not remove container-grown stock from containers before time of planting.
2. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly wet condition.

24.10 FIELD CONDITIONS

A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

24.11 WARRANTY

A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner.
   b. Structural failures including plantings falling or blowing over.

2. Warranty Periods: From date of Substantial Completion.

   a. Trees, Shrubs, Vines, and Ornamental Grasses: 12 months.
   b. Ground Covers, Biennials, Perennials, and Other Plants: 12 months.

3. Include the following remedial actions as a minimum:

   a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
   b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
   c. A limit of one replacement of each plant is required except for losses or replacements due to failure to comply with requirements.
   d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

PART 25 - PRODUCTS

25.1 PLANT MATERIAL

A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant List, Plant Schedule, or Plant Legend indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch in diameter; or with stem girdling roots are unacceptable.
2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.

B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Landscape Architect, with a proportionate increase in size of roots or balls.

C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which begins at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

D. Labeling: Label at least one plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant.

E. If formal arrangements or consecutive order of plants is indicated on Drawings, select stock for uniform height and spread, and number the labels to assure symmetry in planting.

25.2 FERTILIZERS

A. Planting Tablets: Tightly compressed chip-type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.

1. Size: 21-gram tablets.
2. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.

25.3 MULCHES

A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:

1. Type: As indicated.
2. Color: Natural.

B. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through a 1-inchsieve; soluble-salt content of 2 to 4 dS/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

1. Organic Matter Content: 50 to 60 percent of dry weight.
2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.

25.4 PESTICIDES

A. General: Pesticide registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

25.5 TREE-STABILIZATION MATERIALS

A. Trunk-Stabilization Materials:

1. Upright and Guy Stakes: Rough-sawn, sound, new softwood with specified wood pressure-preservative treatment, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal by length indicated, pointed at one end.
2. Flexible Ties: Wide rubber or elastic bands or straps of length required to reach stakes or turnbuckles.

25.6 MISCELLANEOUS PRODUCTS

A. Wood Pressure-Preservative Treatment: AWPA U1, Use Category UC4a; acceptable to authorities having jurisdiction, and containing no arsenic or chromium.

B. Root Barrier: Black, molded, modular panels 24 inches high (deep), 85 milsthick, and with vertical root deflecting ribs protruding 3/4 inch out from panel surface; manufactured with minimum 50 percent recycled polyethylene plastic with UV inhibitors.

C. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.

PART 26 - EXECUTION

26.1 EXAMINATION

A. Examine areas to receive plants, with Installer present, for compliance with requirements and conditions affecting installation and performance of the Work.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Verify that plants and vehicles loaded with plants can travel to planting locations with adequate overhead clearance.
3. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
4. Uniformly moisten excessively dry soil that is not workable or which is dusty.

B. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Landscape Architect and replace with new planting soil.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

26.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Landscape Architect's acceptance of layout before excavating or planting. Make minor adjustments as required.

D. Lay out plants at locations directed by Landscape Architect. Stake locations of individual trees and shrubs and outline areas for multiple plantings.

26.3 PLANTING AREA ESTABLISHMENT

A. General: Prepare planting area for soil placement and mix planting soil according to Section 32 91 15 "Soil Preparation (Performance Specification)."

B. Placing Planting Soil: Blend planting soil in place.

C. Before planting, obtain Landscape Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

26.4 EXCAVATION FOR TREES AND SHRUBS

A. Planting Pits and Trenches: Excavate circular planting pits.

1. Excavate planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are unacceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
2. Excavate approximately three times as wide as ball diameter for container-grown stock.
3. Excavate at least 12 inches wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
4. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
5. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
6. Maintain angles of repose of adjacent materials to ensure stability. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
7. Maintain supervision of excavations during working hours.
8. Keep excavations covered or otherwise protected when unattended by Installer's personnel.

B. Backfill Soil: Subsoil and topsoil removed from excavations may be used as backfill soil unless otherwise indicated.

C. Obstructions: Notify Landscape Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.

1. Hardpan Layer: Drill 6-inch-diameter holes, 24 inches apart, into free-draining strata or to a depth of 10 feet whichever is less, and backfill with free-draining material.

D. Drainage: Notify Landscape Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.

E. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

26.5 TREE, SHRUB, AND VINE PLANTING

A. Inspection: At time of planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.

B. Roots: Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.

C. Container-Grown Stock: Set each plant plumb and in center of planting pit or trench with root flare 1 inch above adjacent finish grades.

1. Backfill: Planting soil. For trees, use amended excavated soil for backfill.
2. Carefully remove root ball from container without damaging root ball or plant.
3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
4. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.

    a. Quantity: As indicated on Drawings.

5. Continue backfilling process. Water again after placing and tamping final layer of soil.

26.6 TREE, SHRUB, AND VINE PRUNING

A. Remove only dead, dying, or broken branches. Do not prune for shape.

B. Prune, thin, and shape trees, shrubs, and vines as directed by Landscape Architect.

C. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Landscape Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.

D. Do not apply pruning paint to wounds.

26.7 TREE STABILIZATION

A. Trunk Stabilization by Upright Staking and Tying: Install trunk stabilization as follows unless otherwise indicated:

1. Upright Staking and Tying: Stake trees of 2- through 5-inchcaliper. Stake trees of less than 2-inchcaliper only as required to prevent wind tip out. Use a minimum of two stakes of length required to penetrate at least 18 inches below bottom of backfilled excavation

and to extend two-thirds of the tree height or lower as required to keep stakes below limbs above grade. Set vertical stakes and space to avoid penetrating root balls or root masses.

2. Upright Staking and Tying: Stake trees with two stakes for trees up to 12 feet high and 2-1/2 inches or less in caliper; three stakes for trees less than 14 feet high and up to 4 inches in caliper. Space stakes equally around trees.
3. Support trees with bands of flexible ties at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.
4. Support trees with two strands of tie wire, connected to the brass grommets of tree-tie webbing at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.

26.8 ROOT-BARRIER INSTALLATION

A. Install root barrier where trees are planted within 120 inches (10 feet) of paving or other hardscape elements, such as walls, curbs, and walkways, unless otherwise indicated on Drawings.

B. Align root barrier vertically, and run it linearly along and adjacent to the paving or other hardscape elements to be protected from invasive roots.

C. Install root barrier continuously for a distance of 120 inches (10 feet) in each direction from the tree trunk, for a total distance of 240 inches (20 feet) per tree. If trees are spaced closer, use a single continuous piece of root barrier.

1. Position top of root barrier 1/2 inch above finish grade.
2. Overlap root barrier a minimum of 12 inches at joints.
3. Do not distort or bend root barrier during construction activities.
4. Do not install root barrier surrounding the root ball of tree.

D. Where trees are located over the top of the existing 78" storm drain and either of the two 60" sewer force mains, install 'Biobarrier' root barrier, or approved equal, horizontally between bottom of tree root ball and top of utility as detailed on the plans.

26.9 GROUND COVER AND PLANT PLANTING

A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated on Drawings in even rows with triangular spacing.

B. Use planting soil for backfill.

C. Dig holes large enough to allow spreading of roots.

D. For rooted cutting plants supplied in flats, plant each in a manner that minimally disturbs the root system but to a depth not less than two nodes.

E. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.

F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

26.10 PLANTING AREA MULCHING

A. Mulch backfilled surfaces of planting areas and other areas indicated.

1. Trees in Turf Areas: Apply organic mulch ring of 3-inchaverage thickness, with 36-inch radius around trunks or stems. Do not place mulch within 3 inchesof trunks or stems.
2. Organic Mulch in Planting Areas: Apply 3-inchaverage thickness of organic mulch, and finish level with adjacent finish grades. Do not place mulch within 3 inchesof trunks or stems.
3. Decomposed Granite (Mineral) Mulch in Planting Areas: Apply 3-inchaverage thickness of mineral mulch, to finish level with adjacent finish grades. Do not place mulch within 3 inchesof trunks or stems.

26.11 PLANT MAINTENANCE

A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings.

B. Fill in, as necessary, soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.

C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices when possible to minimize use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

26.12 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents according to authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Pre-Emergent Herbicides (Selective and Nonselective): Apply to tree, shrub, and ground-cover areas according to manufacturer's written recommendations. Do not apply to seeded areas.

C. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

26.13 REPAIR AND REPLACEMENT

A. General: Repair or replace existing or new trees and other plants that are damaged by construction operations, in a manner approved by Landscape Architect.

1. Submit details of proposed pruning and repairs.
2. Perform repairs of damaged trunks, branches, and roots within 24 hours, if approved.
3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Landscape Architect.

B. Remove and replace trees that are more than 25 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that Landscape Architect determines are incapable of restoring to normal growth pattern.

1. Provide new trees of same size as those being replaced
2. Species of Replacement Trees: Same species being replaced.

26.14 CLEANING AND PROTECTION

A. During planting, keep adjacent paving and construction clean and work area in an orderly condition. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

C. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

D. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

E. At time of Substantial Completion, verify that tree-watering devices are in good working order and leave them in place. Replace improperly functioning devices.

26.15 MAINTENANCE SERVICE

A. Maintenance period includes maintenance of project site limits. Construction fence is to remain in place throughout the maintenance period.

B. Maintenance Service for Trees and Shrubs: Provide maintenance by skilled employees of landscape Installer. Maintain as required in "Plant Maintenance" Article. Begin maintenance

immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:

1. Maintenance Period:

   a. 90 days from date of Substantial Completion.
   b. 120 days from the date of Substantial Completion if hydroseeded turf.

C. Maintenance Service for Ground Cover and Other Plants: Provide maintenance by skilled employees of landscape Installer. Maintain as required in "Plant Maintenance" Article. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:

1. Maintenance Period:

   a. 90 days from date of Substantial Completion.
   b. 120 days from the date of Substantial Completion if hydroseeded turf.

END OF SECTION 32 93 00

Division 33

Utilities

Division 33

Utilities

SECTION 33 40 00 - STORM DRAINAGE SYSTEM

PART 1 - GENERAL

26.16 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

26.17 SUMMARY

A. This Section includes storm drainage outside the building.

26.18 PERFORMANCE REQUIREMENTS

A. Gravity-Flow, Nonpressure-Piping Pressure Ratings: At least equal to system test pressure.

26.19 SUBMITTALS

A. Product Data: For the following:
   1. Area drains.
   2. Pipe and fittings.

26.20 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic structures, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle precast concrete manholes and other structures according to manufacturer's written rigging instructions.

26.21 PROJECT CONDITIONS

A. Site Information: Verify existing utility locations.

B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Owner not less than three days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Owner's written permission.

PART 27 - PRODUCTS

27.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cleanouts, and Drains:

a. Josam Co.
b. Smith: Jay R. Smith Mfg. Co.
c. Zurn Industries, Inc.; Hydromechanics Div.

27.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe and fitting materials.

27.3 PIPES AND FITTINGS

A. PVC Sewer Pipe and Fittings: According to the following:

1. PVC Sewer Pipe and Fittings, NPS 15 and Smaller: ASTM D 3034, SDR 35, for solvent-cemented or gasketed joints.

a. Gaskets: ASTM F 477, elastomeric seals.

27.4 SPECIAL PIPE COUPLINGS AND FITTINGS

A. Sleeve-Type Pipe Couplings: ASTM C 1173, rubber or elastomeric sleeve and band assembly fabricated to mate with OD of pipes to be joined, for nonpressure joints.
1. Sleeve Material for Dissimilar Pipe: Compatible with pipe materials being joined.
2. Bands: Stainless steel, at least one at each pipe insert.

B. Bushing-Type Pipe Couplings: ASTM C 1173, rubber or elastomeric bushing fabricated to mate with OD of smaller pipe and ID of adjoining larger pipe, for nonpressure joints.
   1. Material for Dissimilar Pipe: Compatible with pipe materials being joined.

27.5 DRAINS

A. Gray-Iron Area Drains: ASME A112.21.1M, round, gray-iron body with anchor flange and round, secured, gray-iron grate. Include bottom outlet with inside calk or spigot connection, of sizes indicated. Use units with top-loading classifications according to the following applications:

   1. Medium Duty: In paved foot-traffic areas.
   2. Heavy Duty: In vehicle-traffic service areas.

PART 28 - EXECUTION

28.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Division 3 Section "Earth Moving".

28.2 IDENTIFICATION

A. Arrange for installing green warning tapes directly over piping and at outside edges of underground structures.

   1. Use warning tape or detectable warning tape over ferrous piping.
   2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

28.3 PIPING APPLICATIONS

A. Refer to Part 2 of this Section for detailed specifications for pipe and fitting products listed below. Use pipe, fittings, and joining methods according to applications indicated.

B. Gravity-Flow Piping: Use the following:
   1. PVC sewer pipe and fittings, gaskets and gasketed joints.

28.4 SPECIAL PIPE COUPLING AND FITTING APPLICATIONS

A. Special Pipe Couplings: Use where required to join piping and no other appropriate method is specified. Do not use instead of specified joining methods.

1. Use the following pipe couplings for nonpressure applications:

a. Sleeve type to join piping, of same size, or with small difference in OD.
b. Increaser/reducer-pattern, sleeve type to join piping of different sizes.
c. Bushing type to join piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

B. Special Pipe Fittings: Use where indicated. Include PE film, pipe encasement.

28.5 INSTALLATION, GENERAL

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab or drag in line, and pull past each joint as it is completed.

C. Use proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

28.6 PIPE JOINT CONSTRUCTION AND INSTALLATION

A. General: Join and install pipe and fittings according to installations indicated.

B. Install with top surfaces of components, except piping, flush with finished surface.

C. PVC Sewer Pipe and Fittings: As follows:

1. Join pipe and gasketed fittings with gaskets according to ASTM D 2321.
2. Install according to ASTM D 2321.

D. System Piping Joints: Make joints using system manufacturer's couplings, unless otherwise indicated.

E. Join piping made of different materials or dimensions with couplings made for this application. Use couplings that are compatible with and that fit both systems' materials and dimensions.

28.7 DRAIN INSTALLATION

A. Install type of drains in locations indicated.

B. Embed drains in 4-inch minimum depth of concrete around bottom and sides.

C. Fasten grates to drains if indicated.

D. Set drain frames and covers with tops flush with pavement surface.

28.8 TAP CONNECTIONS

A. Make connections to existing piping and underground structures so finished Work complies as nearly as practical with requirements specified for new Work.

B. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.

C. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.

D. Make branch connections from side into existing piping, NPS 21 or larger, or to underground structures by cutting opening into existing unit large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall, unless otherwise indicated. On outside of pipe or structure wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.

1. Use concrete that will attain minimum 28-day compressive strength of 3000 psi, unless otherwise indicated.
2. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

E. Protect existing piping and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

28.9 FIELD QUALITY CONTROL

A. Clear interior of piping and structures of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed.

1. In large, accessible piping, brushes and brooms may be used for cleaning.
2. Place plug in end of incomplete piping at end of day and when work stops.
3. Flush piping between manholes and other structures to remove collected debris, if required by authorities having jurisdiction.

B. Video tape the interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:

    a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
    c. Crushed, broken, cracked, or otherwise damaged piping.
    d. Infiltration: Water leakage into piping.
    e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

C. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate reports for each test.
5. Leaks and loss in test pressure constitute defects that must be repaired.
6. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

END OF SECTION 33 40 00

SUPPLEMENT SPECIAL PROVISIONS

APPENDICES A-D

Appendix	Description	Sheet
Appendix A	Geotechnical Report Earth Systems Southwest Jan. 7, 2009	
Appendix B	Supplemental Recommendations Pit Backfill Earth Systems Southwest Aug. 27, 2009	
Appendix C	**a**. Lake Skinner Spray Ground Assessment & Recommendations California Waters, June 2016.	
Appendix D	Additive and Deductive Alternates	

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Appendix A

Geotechnical Report
Earth Systems Southwest
Jan. 7, 2009

Appendix A

Geotechnical Report
Earth Systems Southwest
Jan. 7, 2009

RIVERSIDE COUNTY REGIONAL PARK
AND OPEN-SPACE DISTRICT
PARK DISTRICT HEADQUARTERS
4600 CRESTMORE ROAD
RIVERSIDE, CALIFORNIA 92509

GEOTECHNICAL ENGINEERING REPORT
LAKE SKINNER RECREATION AREA
PROPOSED
PARK IMPROVEMENTS & MULTI-USE TRAIL
VICINITY OF BOREL ROAD & WARREN ROAD
TEMECULA AREA OF RIVERSIDE COUNTY
CALIFORNIA

January 7, 2009

File No.: 50267-01
Doc. No: 09-01-723

Earth Systems
Southwest

Archibald Center
9804 Crescent Center Drive, Suite 601
Rancho Cucamonga, CA 91730
(909) 484-5455 FAX (909) 484-5995

January 7, 2009

File No.: 50267-01
Doc. No.: 09-01-723

Riverside County Regional Park and Open-Space District
Park District Headquarters
4600 Crestmore Road
Riverside, California 92509

Attention: Ms. Claire S. Clark, Senior Park Planner

Project: Lake Skinner Recreation Area
Proposed Park Improvements and Multi-Use Trail
Vicinity of Borel Road and Warren Road
Temecula Area of Riverside County, California

Subject: **GEOTECHNICAL ENGINEERING REPORT**

Earth Systems Southwest presents this Geotechnical Engineering Report for the proposed park improvements and multi-use trail generally in the area southwest of the Camp Store and northeast of Launch Ramp #2 at the Lake Skinner Recreation Area near Temecula, Riverside County, California. This report presents our findings and recommendations for site grading and foundation design, incorporating the information provided to our office. The site is suitable from a geotechnical standpoint for the proposed improvements provided the recommendations in this report are followed in design and construction.

In general, due to the non-uniformity of the near surface soils and presence of undocumented fill, some over-excavation and re-compaction of the upper soils is recommended to improve bearing capacity and reduce settlement of foundations, pavements, and other planned improvements. Near surface soils near the proposed building areas have moderate degrees of corrosivity due to electrical resistivity and very low expansion potentials. The primary geologic hazard is strong ground shaking from earthquakes originating on regional faults. This report should stand as a whole, and no part of the report should be excerpted or used to the exclusion of any other part.

This report completes our scope of services in accordance with our agreements, dated November 20 and December 29, 2008. Other services that may be required, such as plan review and grading observation, are additional services and will be billed according to our Fee Schedule in effect at the time services are provided. Unless requested in writing, the client is responsible for distributing this report to the appropriate agencies or other members of the design team.

We appreciate the opportunity to provide our professional services. Please contact our office if there are any questions or comments concerning this report or its recommendations.

Respectfully submitted,
EARTH SYSTEMS SOUTHWEST

Lutz Kunze, P.E. C-25801, G.E. 493
Associate Geotechnical Engineer

Mark S. Spykerman, EG #1174
Associate Engineering Geologist

SER/lk/mss/mr

Distribution: 6/Riverside County Regional Parks
1/RC File
2/BD File

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EXECUTIVE SUMMARY

The project area is situated at the eastern margin of Lake Skinner within the currently improved portion of the recreation area. The proposed development will consist of multiple structures including an outdoor stage, splash park, and restroom facility. Other improvements are to include parking areas, picnic areas, and a multi-use loop trail. We anticipate that the proposed structures will be either masonry block or wood-frame/stucco construction supported on engineered fill with perimeter wall foundations and concrete slabs-on-grade. A moderate amount of site grading is anticipated with cut and fills expected to be less than 10 feet.

The proposed project may be constructed, provided that the recommendations in this report are incorporated in the final design and construction. Site development will include clearing of existing utilities and turf, site grading, building pad preparation, underground utility installation, parking lot paving, and construction of the perimeter multi-use trail. Based of the non-uniform nature of the near surface soils, remedial site grading is recommended to provide uniform support for the structures, foundations, and pavements.

Geologically, the site is located in the Perris block, a structural highland of low mountains and intervening valleys characteristic of the Peninsular Ranges. The site has been mass-graded for accommodation of the existing park with shallow fills overlying Quaternary older alluvium. No active faults or landslides are thought to exist within or adjacent to the project. On-site soils exhibit very low to low potentials for consolidation or expansion, and moderate potentials for corrosion to metallic piping.

We consider the most significant geologic hazard to the project to be the potential for moderate to severe seismic shaking that is likely to occur during the design life of the proposed structures. The project site is located in the highly seismic Southern California region within the influence of several fault systems that are considered to be active or potentially active. Structures should be designed in accordance with values and parameters given in the 2007 California Building Code (CBC) and ASCE 7-05. The seismic design parameters are presented in the following table and within the report.

SUMMARY OF RECOMMENDATIONS

Design Item	Recommended Parameter	Reference Section No.
Shallow Foundations		
Allowable Bearing Pressure Continuous wall footings Pad (Column) footings	 1,500 psf 2,000 psf	5.5
Foundation Type	Spread Footing	5.5
Bearing Materials	Engineered fill	5.1
Allowable Passive Pressure	250 psf per foot	5.5
Allowable Coefficient of Friction	0.35	5.5
Soil Expansion Potential	Very Low (EI<20)	3.1
Geologic and Seismic Hazards		
Liquefaction Potential	Moderate	3.4
Significant Fault and Magnitude	Elsinore, M7.0	3.4
Fault Type and Distance	A, 13.6 km	3.4
Seismic Design Category	D	3.4
Site Class	D	3.4
Maximum Considered Earthquake (MCE)		
Short Period Spectral Response, S_s	1.50 g	3.4
Second Spectral Response, S_1	0.60 g	3.4
Site Coefficient, F_a	1.00	3.4
Site Coefficient, F_v	1.50	3.4
S_{Ds}	1.00 g	3.4
S_{D1}	0.60 g	3.4
Pavement		
TI equal to 4.0 (Light Traffic)	2.5" AC / 5.0" AB	5.10
TI equal to 7.0 (Heavy Traffic)	4.0" AC / 11.0" AB	5.10
Slabs		
Building Floor Slab	On engineered fill	5.7
Modulus of Subgrade Reaction	200 pci	5.3
Existing Site Conditions		
Existing Fill	≈ 1-5 feet	3.1
Soil Corrosivity	Low sulfates Low chlorides Moderate resistivity	5.8
Groundwater Depth	≈ 20 feet	3.2
Estimated Over-excavation and Re-compaction for Structure Pads	≈ 3-5 feet	5.1

The recommendations contained within this report are subject to the limitations presented in Section 6.0 of this report. We recommend that all individuals using this report read the limitations.

Section 1
INTRODUCTION

1.1 Project Description

This Geotechnical Engineering Report has been prepared for the proposed park improvements for the Lake Skinner Recreation Area near Temecula, Riverside County, California. The proposed improvements will consist of new parking lots, an outdoor stage, a new restroom facility, new recreation water features (Splash Park), picnic areas, and hiking/biking trails. We anticipate that the proposed structures will be either masonry block or wood-frame/stucco construction supported on engineered fill with perimeter wall foundations and concrete slabs-on-grade.

Site development may include demolition of the existing paved parking areas, pool area, and pool maintenance building, site grading, building pad preparation, underground utility installation, and formation of new parking areas in the vicinity of the existing pool area. Other improvement will include grading and installation of access roads, trails, and construction of entry monuments. The multi-use trail extends to the east, circling behind the current campgrounds and open parking areas located east and south of the Camp Store.

A moderate amount of site grading is anticipated to accommodate the proposed improvements. Cut and fill depths are expected to be less than 10 feet.

We assumed maximum column loads of 20 kips per column and maximum wall loadings of 2 kips per linear foot as a basis for the foundation recommendations. All loading is assumed to be dead plus actual live load. If the actual structural loading exceeds these assumed values, we would need to reevaluate the given recommendations.

1.2 Site Description

The proposed park improvements are located within the Lake Skinner Recreation Area within approximately 16 acres situated east of the reservoir and southwest of the Camp Store in the immediate vicinity of the existing pool. The project is primarily within the south half of Section 1, T7S, R2W, SBBM. The coordinates near the center of the park improvements are 33.5881°N and 117.0415°W. Access to the project area is via the primary park entry way (Warren Road), a paved improved street. The approximate site location is shown on Figure 1, Vicinity Map in Appendix A.

Topographically, the park improvement area consists of moderately to gently rolling ground with low swales, knolls, and two small ponds. Elevations vary from approximately 1,500 to 1,530 feet above mean sea level. Slopes are generally very gentle with some 3:1 (horizontal to vertical) slopes southerly of the planned new restroom. Drainage is predominantly by sheet flow to the southwest into well-defined grass lined swales and culverts. Two small ponds exist along the eastern margin of the park improvement area, just north and east of the new water park.

Current park site improvements include turf areas, asphalt concrete parking areas and drives, a playground with play structures, a pool recreation area, restroom, and picnic areas. Underground utilities include water, sewer, power, communications, and irrigation systems. Vegetation

consists of turf, ornamental trees, and some native trees. The multi-use trail will extend along the margins of currently paved roads and campgrounds and through some currently unimproved areas containing native scrub and brush.

The history of past use and development of the property was not investigated as part of our scope of services although we were advised that most of the current park improvements were constructed in the 1970's. Previous geotechnical reports for the park were reported by the Client's representative to not be readily available.

1.3 Purpose and Scope of Services

The purpose for our services was to evaluate the site soil conditions and to provide professional opinions and recommendations regarding the proposed development of the site. The scope of services included the following:

- A general reconnaissance of the site.
- Shallow subsurface exploration by drilling 16 exploratory borings to depths ranging from 6.5 to 51.5 feet.
- Laboratory testing of selected soil samples obtained from the exploratory borings.
- Review of selected published technical literature pertaining to the site.
- Engineering analysis and evaluation of the acquired data from the exploration and testing programs.
- A summary of our findings and recommendations in this written report.

This report contains the following:

- Discussions on subsurface soil and groundwater conditions.
- Discussions on regional and local geologic conditions.
- Discussions on geologic and seismic hazards.
- Graphic and tabulated results of laboratory tests and field studies.
- Recommendations regarding:
  - Site development and grading criteria,
  - Excavation conditions and buried utility installations,
  - Structure foundation types and design,
  - Allowable foundation bearing capacity and expected total and differential settlements,
  - Concrete slabs-on-grade,
  - Lateral earth pressures and coefficients,
  - Mitigation of the potential corrosivity of site soils to concrete and steel reinforcement,
  - Seismic design parameters,
  - Preliminary pavement sections.

Not Contained In This Report: Although available through Earth Systems Southwest, the current scope of our services does not include:

- A corrosive study to determine cathodic protection of concrete or buried pipes.
- An environmental assessment.
- Investigation for the presence or absence of wetlands, hazardous or toxic materials in the soil, surface water, groundwater, or air on, below, or adjacent to the subject property.

Section 2
METHODS OF EXPLORATION AND TESTING

2.1 Field Exploration

Sixteen exploratory borings were drilled to depths ranging from approximately 6.5 to 51.5 feet below the existing ground surface to observe soil profiles and obtain samples for laboratory testing. The borings were drilled on December 8, 2008 using 8-inch outside diameter hollow-stem augers, and powered by a CME 75 truck-mounted drilling rig. The boring locations are shown on the boring location map, Figure 2, Site Plan and Boring Location Map in Appendix A. The locations shown are approximate, established by pacing and sighting from existing features.

Samples were obtained within the test borings using a Standard Penetration (SPT) sampler (ASTM D 1586) and a Modified California (MC) ring sampler (ASTM D 3550 with shoe similar to ASTM D 1586). The SPT sampler has a 2-inch outside diameter and a 1.38-inch inside diameter. The MC sampler has a 3-inch outside diameter and a 2.37-inch inside diameter. The samples were obtained by driving the sampler with a 140-pound automatic hammer, dropping 30 inches in general accordance with ASTM D 1586. Recovered soil samples were sealed in containers and returned to the laboratory. Bulk samples were also obtained from auger cuttings, representing a mixture of soils encountered at the depths noted.

The final logs of the borings represent our interpretation of the contents of the field logs and the results of laboratory testing performed on the samples obtained during the subsurface exploration. The final logs are included in Appendix A of this report. The stratification lines represent the approximate boundaries between soil types although the transitions, however, may be gradational.

2.2 Laboratory Testing

Samples were reviewed along with field logs to select those that would be analyzed further. Those selected for laboratory testing include soils that would be exposed and used during grading, and those deemed to be within the influence of the proposed improvements. Test results are presented in graphic and tabular form in Appendix B of this report. The tests were conducted in general accordance with the procedures of the American Society for Testing and Materials (ASTM) or other standardized methods as referenced below. Our testing program consisted of the following:

- In-situ Moisture Content and Unit Dry Weight for the ring samples (ASTM D 2937).
- Maximum density tests were performed to evaluate the moisture-density relationship of typical soils encountered (ASTM D 1557).
- No. 200 Sieve Wash (ASTM D 1140) to determine the amount of material finer than 75 Mm (#200 sieve) by washing.
- Consolidation (Collapse Potential) to evaluate the compressibility and hydroconsolidation (collapse) potential of the soil.

- Direct Shear (ASTM D 3080) to evaluate the relative frictional strength of the soils. Remolded specimens were placed in contact with water before testing and were then sheared under normal loads ranging from 0.5 to 2.0 kips per square foot.

- R-Value test to evaluate the soil subgrade support for pavement design.

- Chemical Analyses (Soluble Sulfates & Chlorides, pH, and Electrical Resistivity) to evaluate the potential adverse effects of the soil on concrete and steel.

Section 3
DISCUSSION

3.1 Soil Conditions

The field exploration indicates that the site soils consist primarily of clayey sands and silty sands overlying igneous bedrock (gabbro) of the southern California batholith. The upper soils are sandy fill and appear poorly to well compact (SM and SC soil types per the Unified Soil Classification System). Fill thicknesses at the points of exploration are estimated to range from approximately 1 to 5 feet. The underlying older alluvium consists of medium dense to dense silty and clayey sands (SM, SC, and SP-SM soil types). The shallow fill and native soils have "very low" expansion potentials (EI < 20) and low potentials for corrosion from sulfate and chloride contents. Resistivity tests suggest a moderate potential for corrosion of metal. Fill soils appeared poorly to moderately compact, were non-uniform, and were moist to wet.

The boring logs provided in Appendix A include more detailed descriptions of the soils encountered. The soils are classified to be in the "very low" expansion (EI < 20) category in accordance with Table 18A-I-B of the California Building Code.

3.2 Groundwater

Free groundwater was encountered in the borings during exploration. The highest anticipated depth to groundwater in the area is approximately 20 below the ground surface and is predominantly controlled by the adjacent lake level. Groundwater levels may fluctuate with precipitation, irrigation, drainage, regional pumping from wells, and site grading. Groundwater should not be a major factor in design or construction at this site, although the wet conditions may result from accumulated landscape irrigation. Wet soils may be more difficult to grade.

3.3 Geologic Setting

Regional Geology: The site is situated in the north-central area of the landward portion of the Peninsular Ranges Geomorphic Province of California. The Peninsular Ranges Province is a distinct geomorphic region characterized as a complex series of northwest-southeast oriented mountain ranges and valleys generally sub-parallel to faults composing the San Andreas rift zone. The Peninsular Ranges Province is further described by sub-units, which include the Perris Block, the San Ana Mountains, and the San Jacinto Mountains.

The Perris Block is characterized as a broad area of intermixed valleys and low mountain ranges situated between the Elsinore and San Jacinto fault zones. In the Temecula area, the regional geomorphology is dominated by the Elsinore trough, Elsinore fault zone, Santa Ana Mountains, and elevated highlands east of the Elsinore fault. The project site is located within the central portion of the Perris Block in an area of elevated bedrock highlands and low mountain ranges, including Bachelor Mountain, Oat Mountain, Black Mountain, Magee Hills, Buck Mesa, French Valley, and Los Alamos Valley. The park improvement area is geomorphically situated on an old alluvial fan surface within Auld Valley, southeast of Bachelor Mountain and west of the Tucalota Hills.

Regional earth units consist predominantly of igneous rocks of the southern California batholith and Mesozoic metamorphic rocks of the Bedford Canyon formation. Regional active and potentially active faults in the vicinity of the project site include the Elsinore, San Jacinto, and Murrieta Hot Springs fault zones.

Local Geology: The site is within an area of exposed intrusive igneous rocks of the southern California batholith overlain by Quaternary sediments, including Pleistocene older alluvium and artificial fill. Gabbro bedrock outcrops within the hills located just north of the park improvement area. Deposits of older alluvium overlie the bedrock. Younger, unconsolidated sediments exist within the primary drainage courses with shallow artificial fills associated with the previous site grading and park construction. Poorly to moderately compact artificial fill exists along some of the roadway margins, especially east of the camp store, along the proposed trail alignment. Refer to Figure 2 for general limits of the identified units.

No major faults have been mapped within the project limits. The site is not located within a currently designated Alquist-Priolo Earthquake fault zone. The nearest mapped active or potentially active fault is the Murrieta Hot Springs fault zone located approximately 3.4 miles southwest of the site and the Elsinore fault zone located approximately 8 miles southwest of the park.

3.4 Geologic Hazards

Geologic hazards that may affect the region include seismic hazards (ground shaking, surface fault rupture, soil liquefaction, and other secondary earthquake-related hazards), slope instability, flooding, ground subsidence, and erosion. A discussion follows on the specific hazards to this site.

3.4.1 Seismic Hazards

Seismic Sources: Several active faults or seismic zones lie within 50 miles (80 kilometers) of the project site as shown on Table 1 in Appendix A. The primary seismic hazard to the site is strong ground shaking from earthquakes along regional faults including the Elsinore, San Jacinto, and San Andreas faults. The Maximum Magnitude Earthquake (M_{max}) listed is from published geologic information available for each fault (Cao et. al, CGS, 2003). The M_{max} corresponds to the maximum earthquake believed to be tectonically possible. The Murrieta Hot Springs fault, considered to be potentially active, trends off the Elsinore fault near Murrieta and extends easterly to the vicinity of Skunk Hollow, approximately 3 miles southwest of the park. This fault, while a viable seismic source, is not thought to be as significant a seismic risk as the nearby Elsinore or San Jacinto faults.

Surface Fault Rupture: The project site does not lie within a currently delineated State of California, *Alquist-Priolo* Earthquake Fault Zone (Hart, 1997) or Riverside County fault zone. Well-documented active faults related to the Elsinore and San Jacinto fault zones are several miles from the park. Therefore, active fault rupture is unlikely to occur at the project site. While fault rupture would most likely occur along previously established fault traces, future fault rupture could occur at other locations.

Historic Seismicity: The project area is within seismically active southern California where large numbers of earthquakes are recorded each year. Approximately 25 earthquakes of magnitude 5.5 or greater have occurred within 50 miles of the site since 1800. The closest significant earthquake has been the 1918 6.8 magnitude San Jacinto earthquake centered approximately 11 miles from the site.

Intense ground motion at the site should be expected from regionally occurring earthquakes. Estimated ground shaking accelerations based upon data presented by the California Geologic Survey suggest that peak ground accelerations of approximately 0.44 g, with a 10% probability of being exceeded in 50 years, should be anticipated.

Seismic Risk: While accurate earthquake predictions are not possible, various agencies have conducted statistical risk analyses. In 2008, the California Geological Survey (CGS) and the United States Geological Survey (USGS) completed the latest generation of probabilistic seismic hazard maps. We have used these maps in our evaluation of the seismic risk at the site. The primary seismic risk at the site is potential earthquakes along the Elsinore and San Jacinto fault zones.

The primary seismic risks at the site are potential earthquakes along the Elsinore and San Jacinto fault zones located approximately 8 and 12 miles, respectively, from the site. The Murrieta Hot Springs fault zone, considered part of the Elsinore Fault zone, is located approximately 3.4 miles southwest of the project site. According to updated California Geologic Survey information (CGS Special Report 203), there is an approximately 11% chance that a major earthquake will occur on the Elsinore fault in the next 30 years. Likewise, there is an approximate 31% chance that a major earthquake will occur on the San Jacinto fault in the same time period.

Site Acceleration: The potential intensity of ground motion may be estimated by the horizontal peak ground acceleration (PGA), measured in "g" forces. Included in Table 1 are deterministic estimates of site acceleration from possible earthquakes at nearby faults. Ground motions are dependent primarily on the earthquake magnitude and distance to the seismogenic (rupture) zone. Accelerations are also dependent upon attenuation by rock and soil deposits, direction of rupture, and type of fault. For these reasons, ground motions may vary considerably in the same general area. This variability can be expressed statistically by a standard deviation about a mean relationship. Important factors influencing the structural performance are the duration and frequency of strong ground motion, local subsurface conditions, soil-structure interaction, and structural details.

The following table provides the probabilistic estimate of the PGA taken from the 2003 California Geologic Survey seismic hazard maps.

Estimate of PGA from 2003 CGS Probabilistic Seismic Hazard Maps

Risk	Equivalent Return Period (years)	PGA (g) [1]
10% exceedance in 50 years	475	≈ 0.44

Note: 1. Based on an alluvial site, Site Classification D..

2007 CBC Seismic Coefficients: The California Building Code (CBC) seismic design parameters criteria are based on a Design Earthquake that has an earthquake ground motion $^2/_3$ of the lesser of 2% probability of occurrence in 50 years or 150% of mean deterministic limit. The PGA estimate given above is provided for information on the seismic risk inherent in the CBC design. The *minimum* seismic design should comply with the 2007 edition of the California Building Code and ASCE 7-05 using the seismic coefficients given in the table below.

2007 CBC (ASCE 7-05) Seismic Parameters

		Reference
Seismic Category:	D	Table 1613.5.6
Seismic Class:	D	Table 1613.5.2
Maximum Considered Earthquake (MCE) Ground Motion		
Short Period Spectral Response S_s:	1.50 g	Figure 1613.5
1 second Spectral Response, S_1:	0.60 g	Figure 1613.5
Site Coefficient, F_a:	1.00	Table 1613.5.3(1)
Site Coefficient, F_v:	1.50	Table 1613.5.3(2)
Design Earthquake Ground Motion		
Short Period Spectral Response, S_{DS}	1.00 g	
1 second Spectral Response, S_{D1}	0.60 g	

The intent of the CBC lateral force requirements is to provide a structural design that will resist collapse to provide reasonable life safety from a major earthquake, but may experience some structural and nonstructural damage. A fundamental tenet of seismic design is that inelastic yielding is allowed to adapt to the seismic demand on the structure. In other words, *damage is allowed*. The CBC lateral force requirements should be considered a *minimum* design. The owner and the designer may evaluate the level of risk and performance that is acceptable. Performance based criteria could be set in the design. The design engineer should exercise special care so that all components of the design are fully met with attention to providing a continuous load path. An adequate quality assurance and control program is urged during project construction to verify that the design plans and good construction practices are followed. This is especially important for sites lying close to the major seismic sources.

Estimated peak horizontal site accelerations based upon a probabilistic analysis (10% probability of occurrence in 50 years) is approximately 0.44 g for an alluvial site. Actual accelerations may be more or less than estimated. Vertical accelerations are typically ⅓ to ⅔ of the horizontal accelerations, but can equal or exceed the horizontal accelerations, depending upon the local site effects and amplification.

3.4.2 Secondary Hazards

Secondary seismic hazards related to ground shaking include soil liquefaction, ground subsidence, tsunamis, and seiches. The site is far enough inland so the hazard from tsunamis is considered non-existent. The park improvements are at elevations of approximately 1,500 feet whereas the adjacent lake level is approximately 1,475 feet. Hazards from seiches are considered

low in the vicinity of the proposed park improvements with estimated seich runup heights adjacent to the reservoir anticipated to be less than 5 feet.

Soil Liquefaction: Liquefaction is the loss of soil strength from sudden shock (usually earthquake shaking), causing the soil to become a fluid mass. In general, for the effects of liquefaction to be manifested at the surface, groundwater levels must be within 50 feet of the ground surface and the soils within the saturated zone must also be susceptible to liquefaction. The potential for liquefaction to occur at this site is considered moderate because the highest anticipated depth of groundwater beneath the site is approximately 20 feet. Anticipated settlement due to liquefaction, based on the design earthquake is approximately 2 inches. In addition, the project lies in a zone designated by Riverside County as low susceptibility for liquefaction.

Method of Analysis: We have conducted a liquefaction analysis of the subsurface soils at the project site using the 1997 NCEER Liquefaction Workshop method that modifies the Seed, et. al. 1985 method. This method is an empirical approach to quantify the liquefaction hazard using SPT blow counts from the site exploration and magnitude and PGA estimates from the seismic hazard analysis. The resistance to liquefaction is plotted on a chart of cyclic shear stress ratio versus a corrected blow count $N_{1(60)}$. Induced ground subsidence from soil liquefaction has been estimated using the 1987 Tokimatsu and Seed method by a computer spreadsheet, Liquefy.xls (Stringer, 1999). The blow counts were adjusted to an equivalent clean sand blow count, $N_{1(60)\text{-}cs}$ according to the estimated fines content of the soil.

The results of the analysis are the site soil is moderately liquefiable during the peak ground acceleration taken as $S_{DS}/2.5 = 0.44$ g ground motion by the Tokimatsu and Seed method. The results are summarized in the table below and in Appendix C. The potentially liquefiable layers may be more or less extensive than revealed by our evaluation.

SUMMARY OF LIQUEFACTION ANALYSES
Design Earthquake (7.4 Magnitude, $S_{DS}/2.5 = 0.44$ g PGA)

Boring	Safety Factor Against Liquefaction	Thickness of the Liquefied Zone (feet)	Depth To First Liquefied Zone (feet)	Estimated Induced Subsidence (inches)
B-1	0.35	5	30	2.0

Our analyses further indicate the site has probably never experienced liquefaction from earthquakes (Magnitudes 5.9 to 7.3) occurring this century in the vicinity of the project site. The likely triggering mechanism for liquefaction appears to be strong ground shaking (0.2g or greater) associated with the future rupture of the Elsinore, San Jacinto and distant San Andreas faults.

Slope Instability: The site is relatively flat. Therefore, potential hazards from slope instability, landslides, or debris flows are considered negligible.

Flooding: The project site does not lie within a designated FEMA 100-year flood plain, the project site may be in an area where sheet flooding could occur, however local drainage is controlled by existing swales and culverts. If significant changes are proposed for the site, appropriate project design, construction, and maintenance can minimize the site sheet flooding potential.

Seismic Hazard Zones: The primary park structures and immediate proximity **do not lie** within a currently delineated Alquist-Priolo Earthquake Fault Zone as defined by the State of California. The park site does lie within the Riverside County designated zones for "Low" Liquefaction and "Susceptible" subsidence zones.

Section 4
CONCLUSIONS

The following is a summary of our conclusions and professional opinions based on the data obtained from a review of selected technical literature and the site evaluation.

General:

- From a geotechnical perspective, the site is suitable for the proposed development provided the recommendations in this report are followed in the design and construction of this project.

- Two foundation system options are presented for the support of structures, shallow foundations on engineered fill or alternate pier foundations (for entry monuments and the climbing wall).

- The clayey sand soils in the vicinity of the planned parking lots exhibit medium R-Values. These clay containing soils have poor pavement bearing characteristics and may be difficult to grade and compact, due to high moisture contents.

Geotechnical Constraints and Mitigation:

- The primary geologic hazard is severe ground shaking from earthquakes originating on regional faults. A major earthquake above magnitude 6.5 originating on regional faults including the Elsinore and San Jacinto faults would be the critical seismic events that may affect the site within the design life of the proposed development. Other earthquakes originating on other regional southern California faults could also generate damaging ground motions in the site vicinity. Engineered design and earthquake-resistant construction increase safety and allow development of seismic areas.

- The underlying geologic condition for seismic design is Site Class D. The site is about 13.5 km from a Type A seismic source as defined in the California Geological Survey. A qualified professional should design any permanent structure constructed on the site. The *minimum* seismic design should comply with the 2007 edition of the California Building Code.

- Ground subsidence from seismic events is a potential hazard. Adherence to the grading and structural recommendations in this report should reduce potential settlement problems from seismic forces, heavy rainfall or irrigation, flooding, and the weight of the intended structures.

- Seismic induced settlement from liquefaction and subsidence is considered likely with estimated total seismic induced settlement of approximately 2 inches. Differential settlement is about 1 inch.

- Other geologic hazards including fault rupture, seismically induced flooding and landslides are considered negligible or low on this site.

- The shallow fill and native soils were found to be loose to medium dense sands, silty sands, and clayey sands and are unsuitable in their present condition to support structures, fill, and hardscape. The soils within the building and structural areas will require moisture conditioning, over excavation, and recompaction to improve bearing capacity and reduce settlement from static loading. Soils can be readily cut by normal grading equipment. Most of the soils were observed to be moist to wet. Wet soils are more difficult to grade.

- The upper soils exhibit "very low" expansion potentials.

- The upper soils were found to have low sulfate ion concentrations (13-90 ppm) and low chloride ion concentrations (7-36 ppm). Sulfate ions can attack the cementitious material in concrete, causing weakening of the cement matrix and eventual deterioration by raveling. Chloride ions can cause corrosion of reinforcing steel. Electrical resistivity (2985-7813 ohm-cm) testing of the soil suggests that the site soils may present a moderate potential for metal loss from electrochemical corrosion processes.

Section 5
RECOMMENDATIONS

5.1 Site Development-Grading

A representative of Earth Systems Southwest (ESSW) should observe site clearing, grading, and the bottom of excavations before placing fill. Local variations in soil conditions may warrant increasing the depth of recompaction and over-excavation. Utilities will need to be removed and re-routed around the footprints of the proposed buildings or other improvements.

Clearing and Grubbing: At the start of site grading, existing vegetation, trees, large roots, pavements, foundations, non-engineered fill, construction debris, trash, and abandoned underground utilities should be removed from the proposed building, structural, trail, and pavement areas. The surface should be stripped of organic growth and removed from the construction area. Areas disturbed during demolition and clearing should be properly backfilled and compacted as described below. Dust control should also be implemented during construction. Site grading should be in strict compliance with the requirements of the South Coast Air Quality Management District (SCAQMD).

Site Preparation: Because of the relatively non-uniform nature of the upper soils on site, we recommend over-excavation and recompaction of soils in the building/improvement areas as follows:

Park Entry Monuments: In the event that shallow foundations are selected for support of the monument structures, the existing surface soils within the improvement and foundation areas should be over-excavated to a minimum depth of 2 feet below existing soil subgrade, finished grade, or a minimum of 1 foot below the footing level (whichever is lower). Underlying fill soils should be verified to be a minimum of 90% relative compaction. The over-excavation should extend for 5 feet beyond the outer edge of exterior footings.

The bottom of the sub-excavation should be reviewed by the geotechnical consultant for uniformity, density, and consistency, and then scarified; moisture conditioned, and recompacted to at least 90% relative compaction (ASTM D 1557) for an additional depth of 6-inches. Moisture penetration to near optimum moisture should extend at least 18 inches below existing grade and be verified by testing. **Compaction should be verified by testing.**

Rock Climbing Wall: In the event that shallow foundations are selected for support of the climbing wall structure, the existing surface soils within the foundation area should be over-excavated to a minimum depth of 2 feet below existing soil subgrade, finished grade, or a minimum of 1 foot below the footing level (whichever is lower). Underlying fill soils should be verified to be a minimum of 90% relative compaction. The over-excavation should extend for 5 feet beyond the outer edge of exterior footings.

The bottom of the sub-excavation should be reviewed by the geotechnical consultant for uniformity, density, and consistency, and then scarified; moisture conditioned, and recompacted to at least 90% relative compaction (ASTM D 1557) for an additional depth of 6-inches.

Moisture penetration to near optimum moisture should extend at least 18 inches below existing grade and be verified by testing. **Compaction should be verified by testing.**

Splash Parks: The existing surface soils within the improvement area and foundation areas should be over-excavated to a minimum depth of 2 feet below existing soil subgrade, finished grade, or a minimum of 1 foot below the footing level (whichever is lower). Underlying fill soils should be verified to be a minimum of 90% relative compaction. The over-excavation should extend for 5 feet beyond the outer edge of the improvements area.

The bottom of the sub-excavation should be reviewed by the geotechnical consultant for uniformity, density, and consistency, and then scarified; moisture conditioned, and recompacted to at least 90% relative compaction (ASTM D 1557) for an additional depth of 6-inches. Moisture penetration to near optimum moisture should extend at least 18 inches below existing grade and be verified by testing. **Compaction should be verified by testing.**

Water Faucet Play Area: The existing surface soils within the improvement and foundation areas should be over-excavated to a minimum depth of 2 feet below existing soil subgrade, finished grade, or a minimum of 1 foot below the footing level (whichever is lower). Underlying fill soils should be verified to be a minimum of 90% relative compaction. The over-excavation should extend for 5 feet beyond the outer edge of the improvements area.

The bottom of the sub-excavation should be reviewed by the geotechnical consultant for uniformity, density, and consistency, and then scarified; moisture conditioned, and recompacted to at least 90% relative compaction (ASTM D 1557) for an additional depth of 6-inches. Moisture penetration to near optimum moisture should extend at least 18 inches below existing grade and be verified by testing. **Compaction should be verified by testing.**

Outdoor Amphitheater/Performance Stage: The existing surface soils within the improvement area, building pad, and foundation areas should be over-excavated to a minimum depth of 2 feet below existing soil subgrade, finished grade, or a minimum of 1 foot below the footing level (whichever is lower). Underlying fill soils should be verified to be a minimum of 90% relative compaction. The over-excavation should extend for 5 feet beyond the outer edge of exterior footings or stage.

The bottom of the sub-excavation should be reviewed by the geotechnical consultant for uniformity, density, and consistency, and then scarified; moisture conditioned, and recompacted to at least 90% relative compaction (ASTM D 1557) for an additional depth of 6-inches. Moisture penetration to near optimum moisture should extend at least 18 inches below existing grade and be verified by testing. **Compaction should be verified by testing.**

Portable Stage Area: The existing surface soils within the improvement area should be over-excavated to a minimum depth of 2 feet below existing soil subgrade, finished grade, or a minimum of 1 foot below the footing level (whichever is lower). Underlying fill soils should be verified to be a minimum of 90% relative compaction. The over-excavation should extend for 5 feet beyond the outer edge of exterior footings or stage area.

The bottom of the sub-excavation should be reviewed by the geotechnical consultant for uniformity, density, and consistency, and then scarified; moisture conditioned, and recompacted to at least 90% relative compaction (ASTM D 1557) for an additional depth of 6-inches. Moisture penetration to near optimum moisture should extend at least 18 inches below existing grade and be verified by testing. **Compaction should be verified by testing.**

ADA Restroom: The existing surface soils within the improvement area, building pad, and foundation areas should be over-excavated to a minimum depth of 3.5 feet below existing soil subgrade, finished grade, or a minimum of 2.5 foot below the footing level (whichever is lower). Underlying fill soils should be verified to be a uniform and firm. The over-excavation should extend for 5 feet beyond the outer edge of exterior footings.

The bottom of the sub-excavation should be reviewed by the geotechnical consultant for uniformity, density, and consistency, and then scarified; moisture conditioned, and recompacted to at least 90% relative compaction (ASTM D 1557) for an additional depth of 6-inches. **Compaction should be verified by testing.**

Access Roads and Walkways: The subgrade should be over-excavated, scarified, moisture conditioned, and compacted to at least 90% relative compaction (ASTM D 1557) for a depth of 1.5 feet below finished subgrade. Prior to compaction, the subgrade should be proof-rolled by the grading equipment to verify that no soft or overly wet soil zones or pumping subgrade exists. If soft or wet soils are encountered, these soils should be removed until firm and unyielding soils are encountered. **Compaction should be verified by testing.** Alternately, if soft soils are encountered, stabilization with geogrid reinforcing may be considered.

Multi-Use Trail: The subgrade should be scarified, moisture conditioned, and compacted to at least 90% relative compaction (ASTM D 1557) for a depth of 0.5 foot below finished subgrade. Prior to compaction, the subgrade should be proof-rolled by the grading equipment to verify that no soft soil zones or pumping subgrade exists. If soft soils are encountered, these soils should be removed until firm and unyielding soils are encountered. **Compaction should be verified by testing.**

Decomposed granite fill used for trail surfaces should be initially compacted to a minimum of 90% relative compaction, per ASTM D 1557. Trail surfaces should be inspected intermittently and surfaces restored and recompacted as needed to maintain trail integrity.

Auxiliary Structures Subgrade Preparation: Auxiliary structures such as garden or retaining walls should have the foundation subgrade prepared similar to the closest building pad recommendations given above. The lateral extent of the over-excavation needs to extend at least 2 feet beyond the face of the footing.

Subgrade Preparation: In areas to receive fill or hardscape, the subgrade should be scarified; moisture conditioned, and compacted to at least 90% relative compaction (ASTM D 1557) for a depth of 1 foot below finished subgrade. **Compaction should be verified by testing.**

Engineered Fill Soils: The existing shallow sandy soil is suitable for use as engineered fill and utility trench backfill provided it is free of significant organic or deleterious matter. The native soil should be placed in maximum 8-inch lifts (loose) and compacted to at least 90% relative compaction (ASTM D 1557) near its optimum moisture content. **Compaction should be verified by testing**. Rocks larger than 4 inches in greatest dimension should be removed from fill or backfill material.

Imported fill soils (if needed) should be non-expansive, granular soils meeting the USCS classifications of SM, SP-SM, or SW-SM with a maximum rock size of 3 inches and 5 to 35% passing the No. 200 sieve. The geotechnical engineer should evaluate the import fill soils before hauling to the site. However, because of the potential variations within the borrow source, import soil will not be prequalified by ESSW. The imported fill should be placed in lifts no greater than 8 inches in loose thickness and compacted to at least 90% relative compaction (ASTM D 1557) near optimum moisture content.

Shrinkage: The shrinkage factor for earthwork is expected to range from 10 to 25 percent for the upper excavated or scarified *site* soils. This estimate is based on compactive effort to achieve an average relative compaction of about 92% and may vary with contractor methods. Subsidence is estimated to range from 0.1 to 0.2 feet. Losses from site clearing and removal of existing site improvements may affect earthwork quantity calculations and should be considered.

Site Drainage: Positive drainage should be maintained away from the structures (5% for 5 feet minimum) to prevent ponding and subsequent saturation of the foundation soils. Gutters and downspouts should be considered as a means to convey water away from foundations. Drainage should be maintained for paved areas. Water should not pond on or near paved areas.

5.2 Excavations and Utility Trenches

Excavations should be made in accordance with CalOSHA requirements. Our site exploration and knowledge of the general area indicates there is a potential for caving of site excavations (utilities, footings, etc.), especially as some soils are wet and loose. Excavations within sandy soil should be kept moist, but not saturated, to reduce the potential of caving or sloughing. Where excavations over 4 feet deep are planned, lateral bracing or appropriate cut slopes of 1.5:1 (horizontal: vertical) should be provided. No surcharge loads from stockpiled soils or construction materials should be allowed within a horizontal distance measured from the top of the excavation slope, equal to the depth of the excavation.

Utility Trenches: Backfill of utilities within road or public right-of-ways should be placed in conformance with the requirements of the governing agency (water district, public works department, etc.) Utility trench backfill within private property should be placed in conformance with the provisions of this report. In general, service lines extending inside of property may be backfilled with native soils compacted to a minimum of 90% relative compaction. Backfill operations should be observed and tested to monitor compliance with these recommendations.

STRUCTURES

5.5 Foundations

In our professional opinion, structure foundations may be supported on either shallow foundations bearing on a zone of properly prepared and compacted soils placed as recommended in **Section 5.1** or on a deep foundation system such as piers. The recommendations that follow are based on "very low" expansion category soils.

Conventional Shallow Spread Foundations: Footing design of widths, depths, and reinforcing are the responsibility of the Structural Engineer, considering the structural loading and the geotechnical parameters given in this report. A minimum footing depth of 12 inches below lowest adjacent grade should be maintained. A representative of ESSW should observe foundation excavations before placement of reinforcing steel or concrete. Loose soil or construction debris should be removed from footing excavations before placement of concrete.

Allowable soil bearing pressures are given below for foundations bearing on recompacted soils as described in Section 5.1. Allowable bearing pressures are net (weight of footing and soil surcharge may be neglected).

- Continuous wall foundations, 12-inch minimum width and 12 inches below grade:
  1500 psf for dead plus design live loads
  Allowable increases of 300 psf per each foot of additional footing width and 300 psf for each additional 0.5 foot of footing depth may be used up to a maximum value of 3000 psf.

- Isolated pad foundations, 2 x 2 foot minimum in plan and 18 inches below grade:
  2000 psf for dead plus design live loads
  Allowable increases of 200 psf per each foot of additional footing width and 400 psf for each additional 0.5 foot of footing depth may be used up to a maximum value of 3000 psf.

A one-third (⅓) increase in the bearing pressure may be used when calculating resistance to wind or seismic loads. The allowable bearing values indicated are based on the anticipated maximum loads stated in Section 1.1 of this report. If the anticipated loads exceed these values, the geotechnical engineer must reevaluate the allowable bearing values and the grading requirements.
Minimum reinforcement for continuous wall footings should be two, No. 4 steel reinforcing bars, one placed near the top and one placed near the bottom of the footing. This reinforcing is not intended to supersede any structural requirements provided by the structural engineer.

Expected Settlement: Estimated total static settlement should be less than 1 inch, based on footings founded on firm soils as recommended. Differential settlement between exterior and interior bearing members should be less than ½-inch, expressed in a post-construction angular distortion ratio of 1:480 or less. Seismic induced differential settlement between exterior and interior bearing members should be less than 1-inch, expressed in a post-construction angular distortion ratio of 1:240 or less.

Frictional and Lateral Coefficients: Lateral loads may be resisted by soil friction on the base of foundations and by passive resistance of the soils acting on foundation walls. An allowable coefficient of friction of 0.35 of dead load may be used. An allowable passive equivalent fluid pressure of 250 pcf may also be used. These values include a factor of safety of 1.5. Passive resistance and frictional resistance may be used in combination if the friction coefficient is reduced by one-third. A one-third (⅓) increase in the passive pressure may be used when calculating resistance to wind or seismic loads. Lateral passive resistance is based on the assumption that backfill next to foundations is properly compacted.

5.6 Optional Deep Foundations for Entry Monuments or Climbing Wall

Drilled Piers: Cast-in-place drilled piers with a minimum diameter of 18 inches are recommended for supporting foundation loads. We recommend a minimum depth of 15 feet for the piers. We also recommend continuous observation by the geotechnical engineer or his representative during drilled pier construction. The piers should be constructed in accordance with ACI 336.IR-98.

Drilled piers may require temporary casing during installation because of caving soil. The contractor should be prepared to accommodate drilling in such conditions. Before placing concrete, a clean-out bucket should be used to remove loose soil from the bottom of the drilled pier excavation. Alternatively, drilling fluid (mud) may be used to stabilize the drill holes. If the drilled piers are poured with drilling fluids in the hole, the concrete should be tremied to the bottom. The tremie can be withdrawn as the concrete fills the hole, but should be kept a minimum of several feet below the top of concrete (embedded into fresh concrete).

Recommended design parameters for drilled piers are presented on the table given below. The drilled piers or auger-cast piers should be designed as friction bearing only.

Recommended design parameters for drilled piers without and with steel casing are presented on the following tables. The lateral load capacity of the drilled piers may be designed using the UBC non-constrained formula of Section 1806.8.2.

DRILLED PIER FOUNDATION (WITHOUT STEEL CASING) DESIGN PARAMETERS

Assumed Pier Diameter 1.5 ft or 2 ft
Allowable Vertical (Axial Downward) Bearing Capacity
End bearing at depth of 4 diameters and below 12 ksf

Range in anticipated depth to tip	Allowable Positive Skin Friction per foot of depth	Allowable Uplift Skin Friction per foot of depth
8 feet	14 psf/ft	9 psf/ft

Allowable Lateral Soil Pressure per foot of depth 130 psf/ft

DRILLED PIER FOUNDATION (WITH STEEL CASING) DESIGN PARAMETERS

Assumed Pier Diameter 1.5 ft or 2 ft
Allowable Vertical (Axial Downward) Bearing Capacity
End bearing at depth of 4 diameters and below 12 ksf

Range in anticipated depth to tip	Allowable Positive Skin Friction per foot of depth	Allowable Uplift Skin Friction per foot of depth
8 feet	12 psf/ft	8 psf/ft

Allowable Lateral Soil Pressure per foot of depth 130 psf/ft

Drilled Pier Installation: Any "slough" or loose soils in the bottom must be removed or thoroughly tamped and compacted prior to setting rebar cages and placing concrete. Extreme care must be exercised to carefully position reinforcing steel cages and place concrete without disturbing the sidewalls of the drilled shafts. Where vertical support is by skin friction only, it is not necessary to remove minor amounts of loose soils and slough from the bottoms drilled pier excavations. It is recommended that pier excavations not be left open overnight and concrete should be placed the same day.

The site soils may be subject to caving. Casing or other means may be required to prevent caving. Drilled pier foundations may be constructed by the dry method, the casing method, or by other methods, selected by the contractor, such as the slurry displacement method when accepted by the structural engineer and by the geotechnical consultant. The dry method is for concrete placed directly in a dry, drilled hole where no caving, squeezing or sloughing of soils has occurred. The casing method may be used in caving soils, when excessive water collects in the drilled hole, or if other difficulties arise during construction of the foundation. The slurry displacement method incorporates a drilling fluid to the full depth of the drilled hole to minimize caving and sloughing

of earth materials. Concrete is placed by pumping or tremie methods so that the concrete mix displaces the drilling fluid.

Dry Method: Normally, drilled pier excavations should be made without the use of water. If necessary, water may be used to facilitate removal of cuttings, unless it aggravates caving problems. Any added water that may accumulate at the bottom of the hole should be removed from the drilled hole prior to placing the concrete. Each excavation should be completed in a continuous operation and the concrete should be placed without undue delay.

If caving conditions are encountered, no further drilling should be allowed until the contractor selects a method, subject to acceptance by the engineer, to prevent ground movement. The contractor may elect to place casing by approved means or advance the excavation by stabilizing the hole using a fluid of appropriate density, or other appropriate means. The contractor should use such appropriate means to clean the bottom of the excavation so that no loose material is present at the base of the pier where end bearing is utilized. The excavation should be protected with a platform to prevent the collar of the excavation from caving during placing of the concrete. Prior to placing the concrete, any water in the hole should be removed.

Casing Method: Approved casing, when employed, should be of ample strength to withstand handling stresses and the external pressure of the caving soil. The outside diameter of the casing should not be less than the specified diameter of the drilled shaft. Casing should preferably not be left in the ground. Where casing cannot be withdrawn, the skin friction capacity is theoretically reduced, as are passive resistance and stiffness. The amount of reduction is subject to assessment by the geotechnical consultant.

Protection of Adjacent Structures and Holes: If spacing is closer than five diameters, center-to-center, adjacent drilled shafts should be drilled and concreted alternately, allowing at least eight hours between concrete placement in one drilled pier and drilling of an adjacent drilled pier. When the slurry method is used, the steel cage should be positioned and the concrete placed before proceeding to the next hole.

Existing adjacent structures, underground utilities and other construction should be protected from damage caused by or related to the drilled pier installation operations. The contractor should provide surveyed elevation benchmarks and horizontal location monitoring points on any adjacent structures that might potentially be damaged before commencing work. Measurements of each bench mark and monitoring point should be recorded and reported at least twice a day while drilled pier installation is in progress, or at intervals proposed by the contractor and accepted by the engineer. Should measurements indicate any displacement, operations should be halted until corrective action has been selected by the contractor and is acceptable to the geotechnical consultant.

Concrete Quality and Placement: Concrete placement should begin within four hours after completion of drilling. Concrete placement should be continuous without interruption, and at such a rate that fresh concrete will not be deposited on concrete that has hardened sufficiently to form cold joints or planes of weakness.

The concrete mix for a dry hole should be as accepted by the structural engineer, with a 4 to 6-inch slump. Concrete slump for use in cased holes should be 6 to 8 inches. If casing is required,

it should be withdrawn as the concrete is being placed, maintaining a 3-foot minimum head of concrete within the casing. This is to prevent reduction in the diameter of the drilled shaft due to earth pressure on the fresh concrete, and to prevent extraneous material from falling in from the sides and mixing with the concrete. Concrete placement should continue in this manner until suitable concrete extends to the top of the excavation or forms.

Pier Inspections: Drilled pier operations should be performed in the presence of the geotechnical consultant or his representative to confirm that suitable materials for pier support are penetrated, that the dimensions of the installed piers meet the design dimensions, and that the installation has been performed as specified herein. Prior to the placement of steel, and again prior to placement of concrete, the excavation must be examined by the geotechnical consultant before proceeding with construction. The contractor should provide all aid and assistance required by the geotechnical and geologic consultants for field monitoring of the drilled pier operations.

Drilled piers are accepted or rejected based on visual observation and testing during construction. The contractor should not allow nor cause any of his work to be permanently enclosed or covered up until it has been observed, tested, and accepted by the geotechnical engineer and all legally constituted authorities having jurisdiction.

5.7 Slab-on-Grade

The following minimum slab recommendations are intended to address geotechnical concerns such as potential variations of the subgrade and are not to be construed as superceding any structural design.

Subgrade: Concrete slabs-on-grade and flatwork should be supported by compacted soil placed in accordance with Section 5.1 of this report.

Vapor Retarder: In areas of moisture sensitive floor coverings, an appropriate vapor retarder should be installed to reduce moisture transmission from the subgrade soil to the slab. For these areas an impermeable membrane (10-mil thickness) should underlie the floor slabs. The membrane should be covered with 2 inches of sand to help protect it during construction and to aide in concrete curing. The sand should be lightly moistened just prior to placing the concrete. Low-slump concrete should be used to help reduce the potential for concrete shrinkage. The effectiveness of the membrane is dependent upon its quality, method of overlapping, its protection during construction, and the successful sealing around utility lines.

Slab Thickness and Reinforcement: Slab thickness and reinforcement of slabs-on-grade are contingent on the recommendations of the structural engineer or architect and the expansion index of the supporting soil. Based upon our findings, a modulus of subgrade reaction of approximately 200 pounds per cubic inch can be used in concrete slab design for the expected very low expansion subgrade.

Concrete slabs and flatwork should be a minimum of 4 inches thick (actual, not nominal). We suggest that the concrete slabs be reinforced with a minimum of No. 3 rebars at 18-inch centers, both horizontal directions, placed at slab mid-height to resist cracking. Concrete floor slabs may either be monolithically placed with the foundations or doweled after footing placement. The

thickness and reinforcing given are not intended to supersede any structural requirements provided by the structural engineer. The project architect or geotechnical engineer should continually observe all reinforcing steel in slabs during placement of concrete to check for proper location within the slab.

Control Joints: Control joints should be provided in all concrete slabs-on-grade at a maximum spacing of 36 times the slab thickness (12 feet maximum on-center, each way) as recommended by American Concrete Institute (ACI) guidelines. All joints should form approximately square patterns to reduce the potential for randomly oriented, contraction cracks. Contraction joints in the slabs should be tooled at the time of the pour or saw cut (¼ of slab depth) within 8 hours of concrete placement. Construction (cold) joints should consist of thickened butt joints with one-half inch dowels at 18-inches on center or a thickened keyed-joint to resist vertical deflection at the joint. All construction joints in exterior flatwork should be sealed to reduce the potential of moisture or foreign material intrusion. These procedures will reduce the potential for randomly oriented cracks, but may not prevent them from occurring.

Curing and Quality Control: The contractor should take precautions to reduce the potential of curling of slabs in this arid desert region using proper batching, placement, and curing methods. Curing is highly effected by temperature, wind, and humidity. Quality control procedures *may* be used including trial batch mix designs, batch plant inspection, and on-site special inspection and testing. Typically, for this type of construction and using 2500-psi concrete, many of these quality control procedures are not required.

Seepage/Drainage Control: For the water play areas, subdrain systems below the concrete play surfaces are recommended to reduce the potential for subgrade saturation and instability. Use of conventional gravel drains, french drains, or drainage fabrics should be considered.

5.8 Mitigation of Soil Corrosivity on Concrete

Selected chemical analyses for corrosivity were conducted on soil samples from the project site as shown in Appendix B. The native soils were found to have a low sulfate ion concentration (13-90 ppm) and a low chloride ion concentration (7-36 ppm). Sulfate ions can attack the cementitious material in concrete, causing weakening of the cement matrix and eventual deterioration by raveling. Chloride ions can cause corrosion of reinforcing steel. The California Building Code does not require any special provisions for concrete for these low concentrations as tested.

A minimum concrete cover of three (3) inches should be provided around steel reinforcing or embedded components exposed to native soil or landscape water. Additionally, the concrete should be thoroughly vibrated during placement.

Electrical resistivity testing of the soil (2,985-7,813 ppm) suggests that the site soils may present a moderate potential for potential for metal loss from electrochemical corrosion processes. Corrosion protection of steel can be achieved by using epoxy corrosion inhibitors; asphalt coatings, cathodic protection, or encapsulating with densely consolidated concrete.

Earth Systems does not practice corrosion engineering. We recommend that a qualified corrosion engineer evaluate the corrosion potential on metal construction materials and concrete at the site to provide mitigation of corrosive effects.

5.9 Seismic Design Criteria

This site is subject to strong ground shaking due to potential fault movements along regional faults including the San Jacinto and Elsinore faults. Engineered design and earthquake-resistant construction increase safety and allow development of seismic areas. The *minimum* seismic design should comply with the 2007 edition of the California Building Code and ASCE 7-05 using the seismic coefficients given in the table below

2007 CBC (ASCE 7-05) Seismic Parameters

		Reference
Seismic Category:	D	Table 1613.5.6
Seismic Class:	D	Table 1613.5.2
Maximum Considered Earthquake (MCE) Ground Motion		
Short Period Spectral Response S_s:	1.50 g	Figure 1613.5
1 second Spectral Response, S_1:	0.60 g	Figure 1613.5
Site Coefficient, F_a:	1.00	Table 1613.5.3(1)
Site Coefficient, F_v:	1.50	Table 1613.5.3(2)
Design Earthquake Ground Motion		
Short Period Spectral Response, S_{DS}	1.00 g	
1 second Spectral Response, S_{D1}	0.60 g	

The CBC seismic coefficients are based on scientific knowledge, engineering judgment, and compromise. If further information on seismic design is needed, a site-specific probabilistic seismic analysis should be conducted.

The intent of the CBC lateral force requirements is to provide a structural design that will resist collapse to provide reasonable life safety from a major earthquake, but may experience some structural and nonstructural damage. A fundamental tenet of seismic design is that inelastic yielding is allowed to adapt to the seismic demand on the structure. In other words, *damage is allowed.* The CBC lateral force requirements should be considered a *minimum* design. The owner and the designer should evaluate the level of risk and performance that is acceptable. Performance based criteria could be set in the design. The design engineer should exercise special care so that all components of the design are all fully met with attention to providing a continuous load path. An adequate quality assurance and control program is urged during project construction to verify that the design plans and good construction practices are followed. This is especially important for sites lying close to the major seismic sources. Estimated peak (mean plus one standard deviation) horizontal site accelerations based upon a probabilistic analysis (10% probability of exceedence in 50 years) is approximately 0.44 g for an alluvial site. Actual accelerations may be more or less than estimated. Vertical accelerations are typically 1/3 to 2/3 of the horizontal accelerations, but can equal or exceed the horizontal accelerations depending upon the local site effects and amplification.

5.10 Pavements

Pavement Subgrade Preparation: In areas to receive fill for pavements* the subgrade should be scarified; moisture conditioned, and compacted to at least 90% relative compaction (ASTM D 1557) for a depth of 1 foot below existing grade or finished subgrade, whichever is lower. **Compaction should be verified by testing.**

***Note: the surficial soils in the areas to be paved are wet and will require either drying by aeration or removal and replacement with a granular engineered fill material.**

Since no traffic loading was provided by the design engineer or owner, we have assumed traffic loading for comparative evaluation. The design engineer or owner should decide the appropriate traffic conditions for the pavements. Maintenance of proper drainage is advised to prolong the service life of the pavements. Water should not pond on or near paved areas. The following table provides our prelimimary recommendations for pavement sections. Final pavement sections recommendations should be based on design traffic indices and R-value tests conducted during grading after actual subgrade soils are exposed.

PRELIMINARY RECOMMENDED PAVEMENTS SECTIONS

R-Value Subgrade Soils - 24 (as tested) Design Method – CALTRANS 1995

Traffic Index (Assumed)	Pavement Use	Flexible Pavements		Rigid Pavements	
		Asphaltic Concrete Thickness (Inches)	Aggregate Base Thickness (Inches)	Portland Cement Concrete (Inches)	Aggregate Base Thickness (Inches)
4.0	Auto Parking Areas	2.5	5.0	4.0	4.0
5.0	Access Roads	3.0	6.5	5.0	5.0
7.0	Bus and Truck Access	4.0	11.0	6.0	6.0

Notes:

1. Asphaltic concrete should be Caltrans, Type B, ½-in. or ¾-in. maximum-medium grading and compacted to a minimum of 95% of the 75-blow Marshall Density (ASTM D 1559) or equivalent.
2. Aggregate base should be Caltrans Class 2 (¾ in. maximum) and compacted to a minimum of 95% of ASTM D1557 maximum dry density near its optimum moisture.
3. All pavements should be placed on 12 inches of moisture-conditioned subgrade, compacted to a minimum of 90% of ASTM D 1557 maximum dry density near its optimum moisture.
4. Portland cement concrete should have a minimum of 3250 psi compressive strength @ 28 days.
5. Equivalent Standard Specifications for Public Works Construction (Green Book) may be used instead of Caltrans specifications for asphaltic concrete and aggregate base.

SECTION 6
LIMITATIONS AND ADDITIONAL SERVICES

6.1 Uniformity of Conditions and Limitations

Our findings and recommendations in this report are based on selected points of field exploration, laboratory testing, and our understanding of the proposed project. Furthermore, our findings and recommendations are based on the assumption that soil conditions do not vary significantly from those found at specific exploratory locations. Variations in soil or groundwater conditions could exist between and beyond the exploration points. The nature and extent of these variations may not become evident until construction. Variations in soil or groundwater may require additional studies, consultation, and possible revisions to our recommendations.

Findings of this report are valid as of the issued date of the report. However, changes in conditions of a property can occur with passage of time whether they are from natural processes or works of man on this or adjoining properties. In addition, changes in applicable standards occur whether they result from legislation or broadening of knowledge. Accordingly, findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and should not be relied upon after a period of one year.

In the event that any changes in the nature, design, or location of structures are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of this report are modified or verified in writing.

This report is issued with the understanding that the owner, or the owner's representative, has the responsibility to bring the information and recommendations contained herein to the attention of the architect and engineers for the project so that they are incorporated into the plans and specifications for the project. The owner, or the owner's representative, also has the responsibility to verify that the general contractor and all subcontractors follow such recommendations. It is further understood that the owner or the owner's representative is responsible for submittal of this report to the appropriate governing agencies.

As the Geotechnical Engineer of Record for this project, Earth Systems Southwest (ESSW) has striven to provide our services in accordance with generally accepted geotechnical engineering practices in this locality at this time. No warranty or guarantee is express or implied. This report was prepared for the exclusive use of the Client and the Client's authorized agents.

ESSW should be provided the opportunity for a general review of final design and specifications in order that earthwork and foundation recommendations may be properly interpreted and implemented in the design and specifications. If ESSW is not accorded the privilege of making this recommended review, we can assume no responsibility for misinterpretation of our recommendations.

Although available through ESSW, the current scope of our services does not include an environmental assessment, or investigation for the presence or absence of wetlands, hazardous or toxic materials in the soil, surface water, groundwater or air on, below, or adjacent to the subject property.

6.2 Additional Services

This report is based on the assumption that an adequate program of client consultation, construction monitoring, and testing will be performed during the final design and construction phases to check compliance with these recommendations. Maintaining ESSW as the geotechnical consultant from beginning to end of the project will provide continuity of services. *The geotechnical engineering firm providing tests and observations shall assume the responsibility of Geotechnical Engineer of Record.*

Construction monitoring and testing would be additional services provided by our firm. The costs of these services are not included in our present fee arrangements, but can be obtained from our office. The recommended review, tests, and observations include, but are not necessarily limited to the following:

- Consultation during the final design stages of the project.
- Review of the building and grading plans to observe that recommendations of our report have been properly implemented into the design.
- Observation and testing during site preparation, grading and placement of engineered fill as required by CBC Sections 1701 and 3317 or local grading ordinances.
- Consultation as needed during construction.

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Appendices as cited are attached and complete this report.

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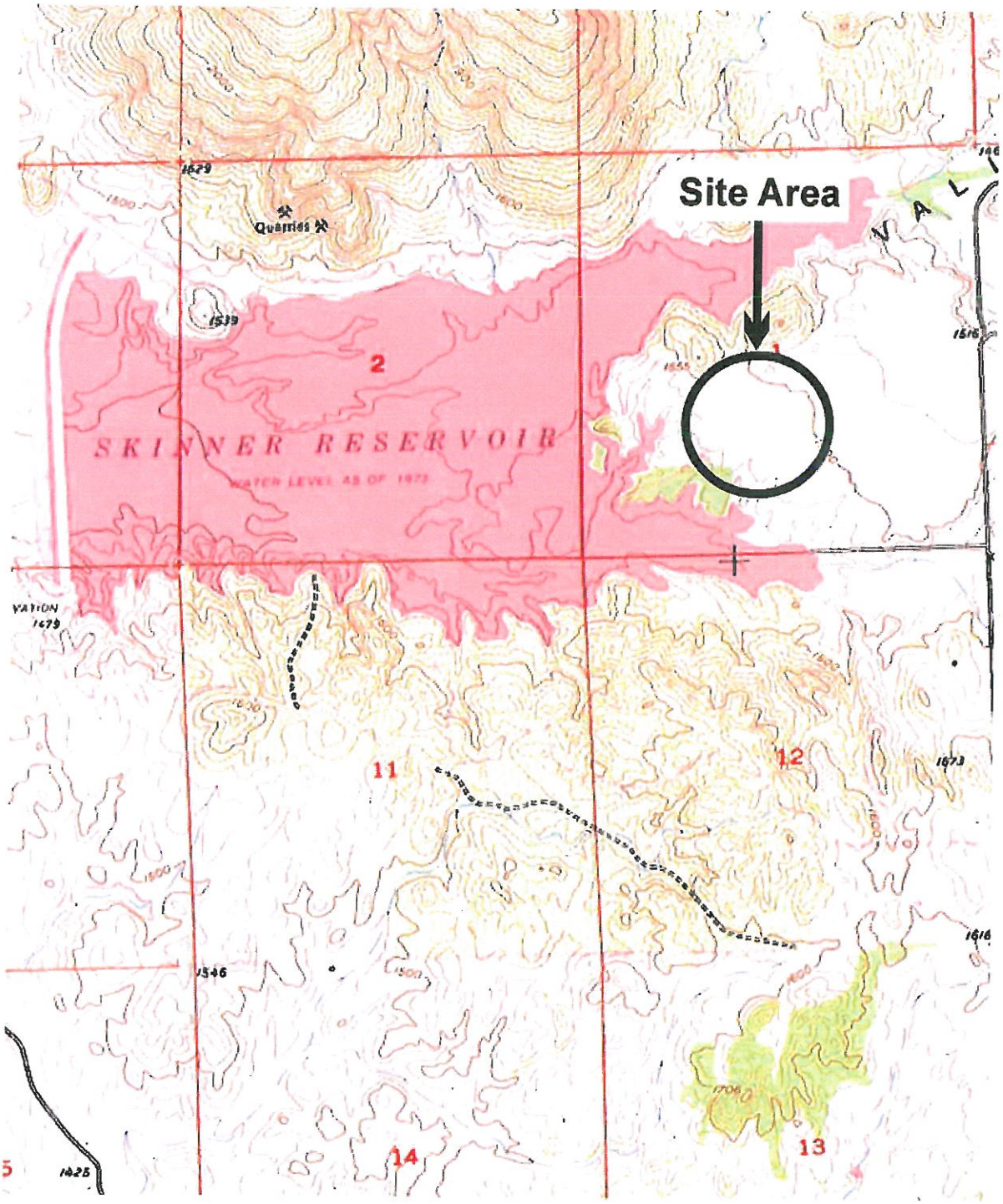
APPENDIX A

Figure 1 - Site Location Map
Figure 2 - Boring Locations Map
Figure 3 - Multi-Use Trail Site Plan
Table 1 Fault Parameters
Logs of Borings



Base Map: U.S.G.S. 7.5 Minute Quadrangles, Bachelor Mtn., California (1953, photorevised 1973).

Approximate Scale: 1" = 2,000'

0 2,000' 4,000'

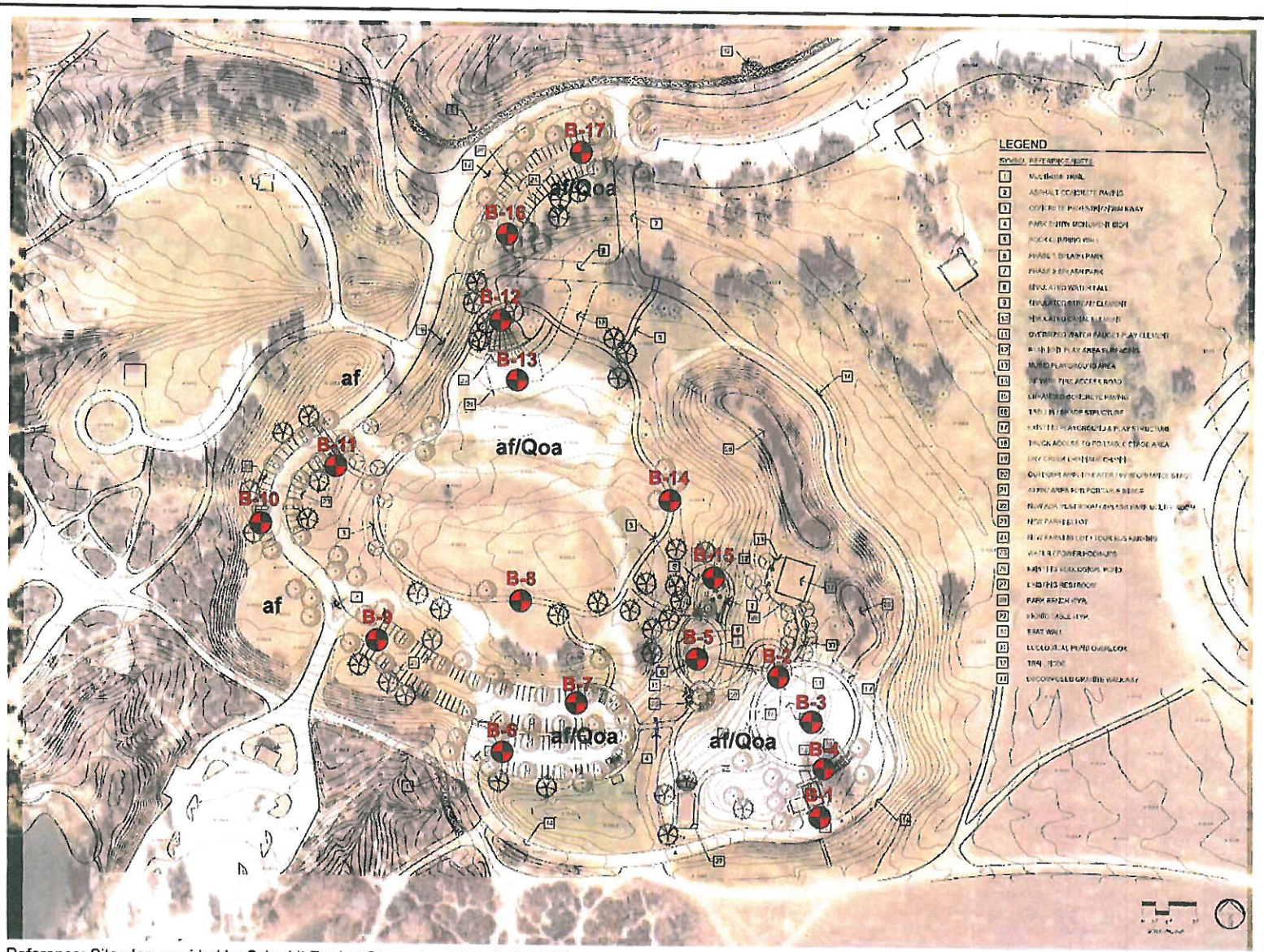
N

Figure 1
Site Location Map

Lake Skinner Recreation Area
Temecula, Riverside County, California

Earth Systems
Southwest

01/07/09	50267-01



LEGEND

B-1	Number and approximate location of exploration boring
af	Artificial Fill
af/Qoa	Fill over Quaternary Older Alluvium

Reference: Site plan provided by Schmidt Design Group, Inc., Dated 10.10.08
Base Map: Google Earth, 2008

Approximate Scale: 1" = 150'

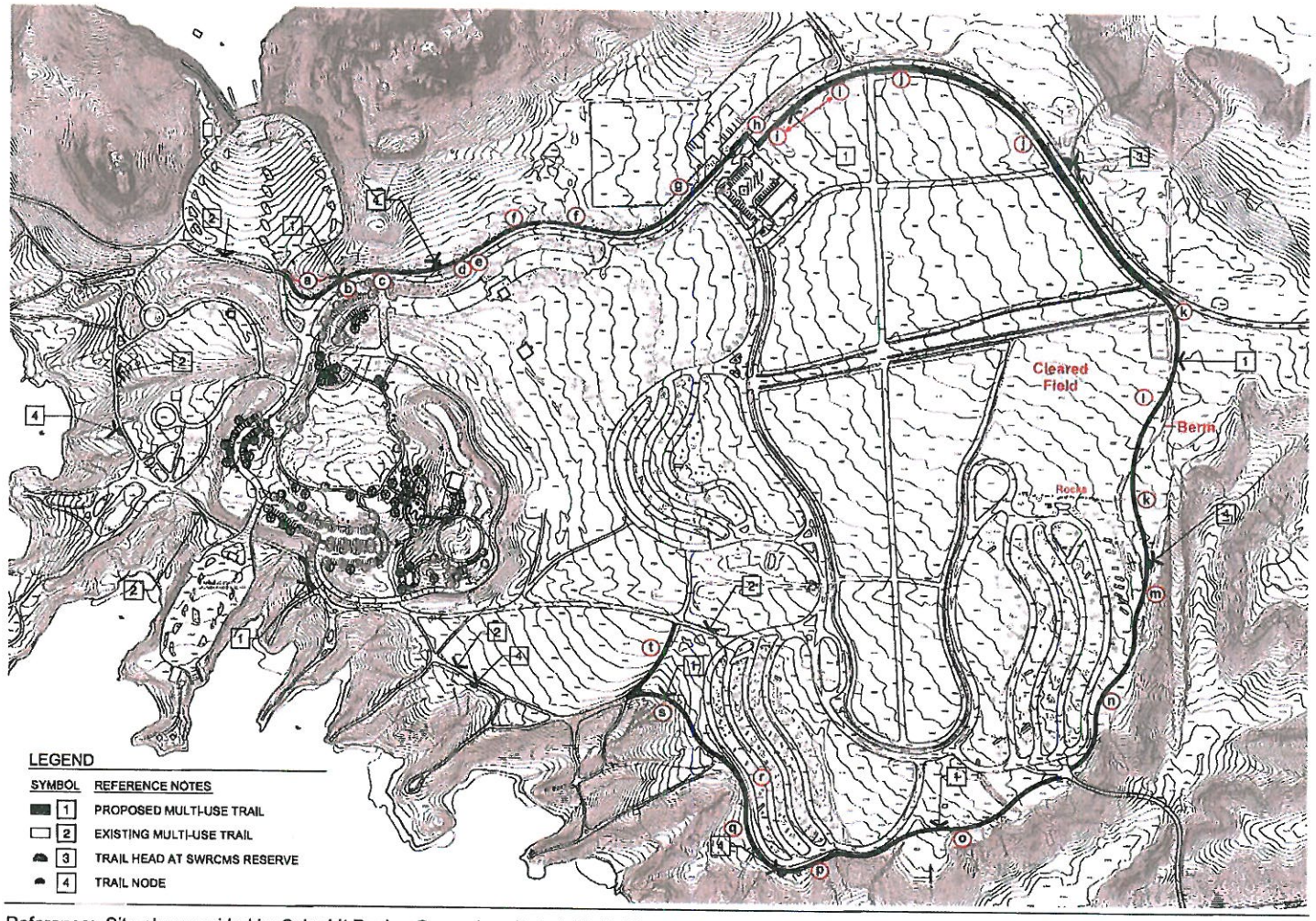
0 150' 300'

N

Figure 2
Boring Locations Map
Lake Skinner Recreation Area
Park Site Plan
Temecula, Riverside County, California

Earth Systems Southwest

01/07/09	50267-01



LEGEND

- (a) Lawn, soft to firm subgrade
- (b) Lawn, soft to firm subgrade
- (c) Lawn and bare ground, firm
- (d) Culvert
- (e) Firm subgrade
- (f) Fill, poorly compacted and soft
- (g) Firm subgrade
- (h) Cross over on pavement
- (i) Firm subgrade
- (j) Approximately 2 foot high uncompacted fill pile, loose to medium dense
- (k) Open field with native vegetation
- (l) Cleared field, compact
- (m) Mix of native vegetation and surface landscaping waste
- (n) Cleared field, compact subgrade
- (o) Thick vegetation
- (p) Loose fill; landscaping waste, boulders, and pine trees
- (q) Vegetation and leaf waste
- (r) Drainage, filled with rocks, firm
- (s) Soft subgrade
- (t) Existing trail, firm subgrade

Reference: Site plan provided by Schmidt Design Group, Inc., Dated 10.10.08

Approximate Scale: 1" = 400'

0 400' 800'

N

Figure 3
Multi-Use Trail Site Plan

Lake Skinner Recreation Area
Temecula, Riverside County, California

Earth Systems Southwest

01/07/09	50267-01

Table 1
Fault Parameters

Fault Section Name	Distanee (miles)	(km)	Avg Dip Angle (deg.)	Avg Dip Direction (deg.)	Avg Rake (deg.)	Trace Length (km)	Fault Type	Mean Mag	Mean Return Interval (years)	Slip Rate (mm/yr)
Elsinore (Temecula) rev	8.4	13.5	90	230	180	40	A	7.4	431	5
San Jacinto (Anza) rev	12.3	19.8	90	216	180	46	A	7.6	151	18
San Jacinto (Stepovers Combined)	12.6	20.3	90	229	180	25	B'	6.7		
San Jacinto (Anza, stepover)	12.7	20.5	90	224	180	25	A	7.6	151	9
Elsinore (Glen Ivy stepover)	13.7	22.0	90	216	180	11	A	7.1	322	2.5
Elsinore (Stepovers Combined)	13.9	22.3	90	224	180	12	B'	6.3		
Elsinore (Temecula stepover)	13.9	22.3	90	212	180	12	A	7.6	725	2.5
San Jacinto (San Jacinto Valley, stepover)	14.0	22.6	90	224	180	24	A	7.4	199	9
Elsinore (Julian)	17.2	27.6	84	36	180	75	A	7.6	725	3
Earthquake Valley (No Extension)	18.3	29.4	90	221	180	33	B'	6.9		
Elsinore (Glen Ivy) rev	20.2	32.5	90	218	180	26	A	7.0	222	5
San Jacinto (San Jacinto Valley) rev	22.0	35.4	90	223	180	18	A	7.4	199	18
San Gorgonio Pass	24.7	39.8	60	11	na	29	B'	6.9		
San Andreas (San Gorgonio Pass-Garnet Hill)	28.5	45.8	58	20	180	56	A	7.6	219	10
San Andreas (San Bernardino S)	28.6	46.0	90	210	180	43	A	7.6	150	16
San Jacinto (Coyote Creek)	29.9	48.0	90	223	180	43	A	7.3	259	4
San Jacinto (Clark) rev	31.2	50.1	90	214	180	47	A	7.6	211	14
Mission Creek	31.3	50.3	65	5	180	31	B'	6.9		
San Jacinto (San Bernardino)	31.7	51.0	90	225	180	45	A	7.4	205	6
Chino, alt 2	34.2	55.1	65	234	150	29	B	6.7		1
San Andreas, (North Branch, Mill Creek)	34.8	56.0	76	204	180	106	A	7.5	110	17
Whittier, alt 1	35.6	57.3	70	24	150	46	A	7.1	530	2.5
Whittier, alt 2	35.6	57.3	75	24	150	46	A	7.1	530	2.5
Newport-Inglewood (Offshore)	36.3	58.4	90	227	180	66	B	6.9		1.5
San Joaquin Hills	36.4	58.6	23	204	90	27	B	7.0		0.5
Chino, alt 1	36.7	59.1	50	236	150	24	B	6.6		1
Pinto Mtn	37.1	59.8	90	175	0	74	B	7.2		2.5
Earthquake Valley	38.5	62.0	90	217	180	20	B	6.7		2
Rose Canyon	39.0	62.7	90	68	180	70	B	6.8		1.5
San Andreas (San Bernardino N)	40.2	64.6	90	212	180	35	A	7.5	103	22
Fontana (Seismicity)	41.8	67.2	80	313	na	24	B'	6.7		
Peralta Hills	43.7	70.3	50	3	na	14	B'	6.5		
Oceanside	44.3	71.2	23	69	na	120	B'	7.5		
Burnt Mtn	44.4	71.4	67	265	180	21	B	6.7		0.6
Carlsbad	45.2	72.8	37	71	na	33	B'	6.6		
Yorba Linda	45.5	73.3	90	153	na	18	B'	6.5		
Cucamonga	46.8	75.4	45	347	90	28	B	6.6		5
Eureka Peak	47.7	76.7	90	75	180	19	B	6.6		0.6
San Andreas (Coachella) rev	47.7	76.8	90	224	180	69	A	7.2	69	20
Riehfield	47.8	76.9	28	353	na	6	B'	6.2		

Reference: USGS OFR 2007-1437 (CGS SP 203)

Mean Magnitude for Type A Faults based on 0.1 weight for unsegmented section, 0.9 weight for segmented model (weighted by probability of each scenario with section listed as given on Table 3 of Appendix G in OFR 2007-1437). Mean magnitude is average of Ellsworths-B and Hanks & Bakun moment area relationship.

Earth Systems
Southwest

Boring No: B-1
Project Name: Lake Skinner Recreation area, Temecula, CA
File Number: 50267-01
Boring Location: See Figure 2 (New Restroom)

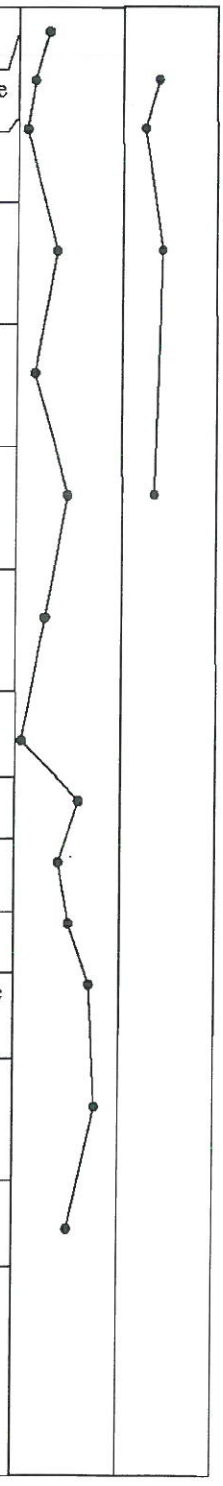
Drilling Date: December 12, 2008
Drilling Method: 7" HSA
Drill Type: B-61 Mobil w/auto hammer
Logged By: Rachelle Herlihy

Description of Units

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Graphic Trend
Blow Count Dry Density

Depth (Ft.)	Sample Type (Bulk / SPT / MOD Calif.)	Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description of Units
0				AC			ASPHALT CONCRETE: 4 inches asphalt concrete, no base
		7,14,18		SM			
		15,10,8			119	12	SILTY SAND: brown, compact, moist, fine to coarse sand with some gravel, Fill
5		4,5,5		SM	112	6	SILTY SAND: brown, loose, moist, fine to coarse grained sand with some silt and gravel
				SC			CLAYEY SAND: olive brown, medium dense, wet fine to medium grained sand with clay
10		7,13,18			121	14	
				SM			SILTY SAND: brown, medium dense, moist, fine to coarse grained sand and trace of clay
15		5,5,6					
				SM			SILTY SAND: brown, dense, wet, fine to coarse grained sand with silt and some gravel
20		12,15,17			117	16	
				SM			SILTY SAND: brown, medium dense, wet, fine to medium grained sand with silt and clay
25		7,8,10					
				SM			SILTY SAND: brown, loose, fine to coarse grained sand
30		2,2,2					
		10,16,24		SM			SILTY SAND: brown, fine to coarse grained sand with silt
35		5,9,18		SM			SILTY SAND: olive brown, dense, wet, fine to coarse grained sand
		7,13,21		SM			SILTY SAND: brown to olive brown, dense, wet, fine to coarse grained sand
40		6,18,29		SM			SILTY SAND: brown, very dense, wet, fine to coarse grained sand
				SM			SILTY SAND: brown, very dense, wet, olive brown, fine to coarse grained sand with traces of fine sand
45		19,19,32					
				SP/SM			SAND WITH SILT: brown, dense, wet, fine to coarse grained sand with some silt
50		6,12,22					
55							Boring completed at 51.5 feet Backfilled with cuttings Groundwater encountered at 20 feet Approximate elevation 1493 feet
60							



Earth Systems
Southwest

Boring No: B-2
Project Name: Lake Skinner Recreation area, Temecula, CA
File Number: 50267-01
Boring Location: See Figure 2 (Water Play Element)

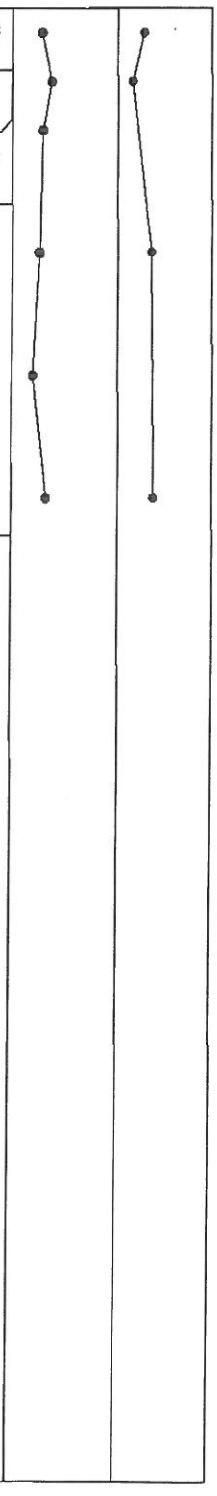
Drilling Date: December 12, 2008
Drilling Method: 7" HSA
Drill Type: B-61 Mobil w/auto hammer
Logged By: Rachelle Herlihy

Description of Units

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Graphic Trend
Blow Count Dry Density

Depth (Ft.)	Sample Type (Bulk / SPT / MOD Calif.)	Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pef)	Moisture Content (%)	Description
0							
	MOD Calif.	9,14,17		SM	114	5	SILTY SAND: brown, compact, moist, fine to coarse grained sand with some gravel, FILL
5	MOD Calif.	9,14,27		SM	108	4	SILTY SAND: brown to olive brown, medium dense, moist, fine to coarse grained sand
	MOD Calif.	11,12,20		SP/SM			SAND: light brown to grayish brown, medium dense, moist, fine to coarse grained sand with some silt
10	MOD Calif.	10,14,15		SM	118	12	SILTY SAND: brown, medium dense, wet, fine to medium grained sand
15	MOD Calif.	7,9,13					
20	MOD Calif.	3,9,23			119	15	
25							Boring completed at 21.5 feet Backfilled with cuttings Groundwater encountered at 20 feet Approximate elevation 1495 feet
30							
35							
40							
45							
50							
55							
60							



Earth Systems
Southwest

Boring No: B-3
Project Name: Lake Skinner Recreation area, Temecula, CA
File Number: 50267-01
Boring Location: See Figure 2 (Splash Park)

Drilling Date: December 12, 2008
Drilling Method: 7" HSA
Drill Type: B-61 Mobil w/auto hammer
Logged By: Rachelle Herlihy

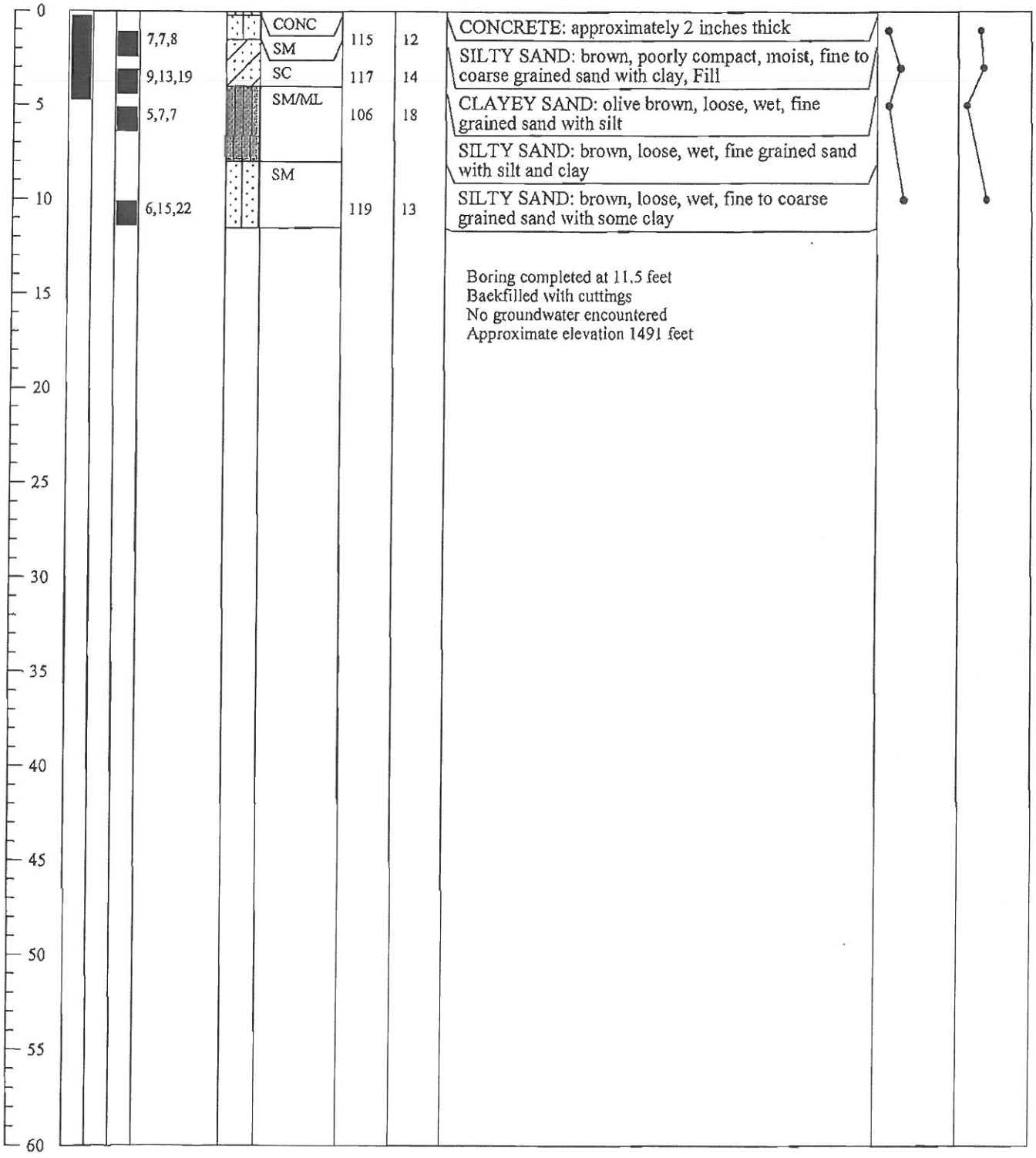
Description of Units

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Graphic Trend
Blow Count Dry Density

Depth (Ft.)	Sample Type (Bulk / SPT / MOD Calif.)	Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description
0				CONC			CONCRETE: approximately 2 inches thick
		7,7,8		SM	115	12	SILTY SAND: brown, poorly compact, moist, fine to coarse grained sand with clay, Fill
		9,13,19		SC	117	14	CLAYEY SAND: olive brown, loose, wet, fine grained sand with silt
5		5,7,7		SM/ML	106	18	SILTY SAND: brown, loose, wet, fine grained sand with silt and clay
				SM			SILTY SAND: brown, loose, wet, fine to coarse grained sand with some clay
10		6,15,22			119	13	

Boring completed at 11.5 feet
Backfilled with cuttings
No groundwater encountered
Approximate elevation 1491 feet



Earth Systems
Southwest

Boring No: B-4
Project Name: Lake Skinner Recreation area, Temecula, CA
File Number: 50267-01
Boring Loeation: See Figure 2 (New Restroom)

Drilling Date: December 12, 2008
Drilling Method: 7" HSA
Drill Type: B-61 Mobil w/auto hammer
Logged By: Rachelle Herlihy

Page 1 of 1

Description of Units

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Graphic Trend
Blow Count Dry Density

Depth (Ft.)	Sample Type (Bulk, SPT, MOD Calif.)	Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description
0							
	SPT	5,6,8		ML	107	18	SANDY SILT: brown, poorly compact, wet, fine grained sandy silt, Fill
	SPT	6,9,13		SM	109	15	SILTY SAND: brown, fine to coarse grained sand with traces of clay
5	SPT	7,14,28		SP	110	17	SAND: brown, fine to medium grained sand with trace of silt
				ML			SILT: brown, wet, with some clay and fine grained sand
10	SPT	8,9,13			114	17	
							Boring completed at 11.5 feet Backfilled with cuttings No groundwater encountered Approximate elevaiton 1494 feet
15							
20							
25							
30							
35							
40							
45							
50							
55							
60							

Earth Systems
Southwest

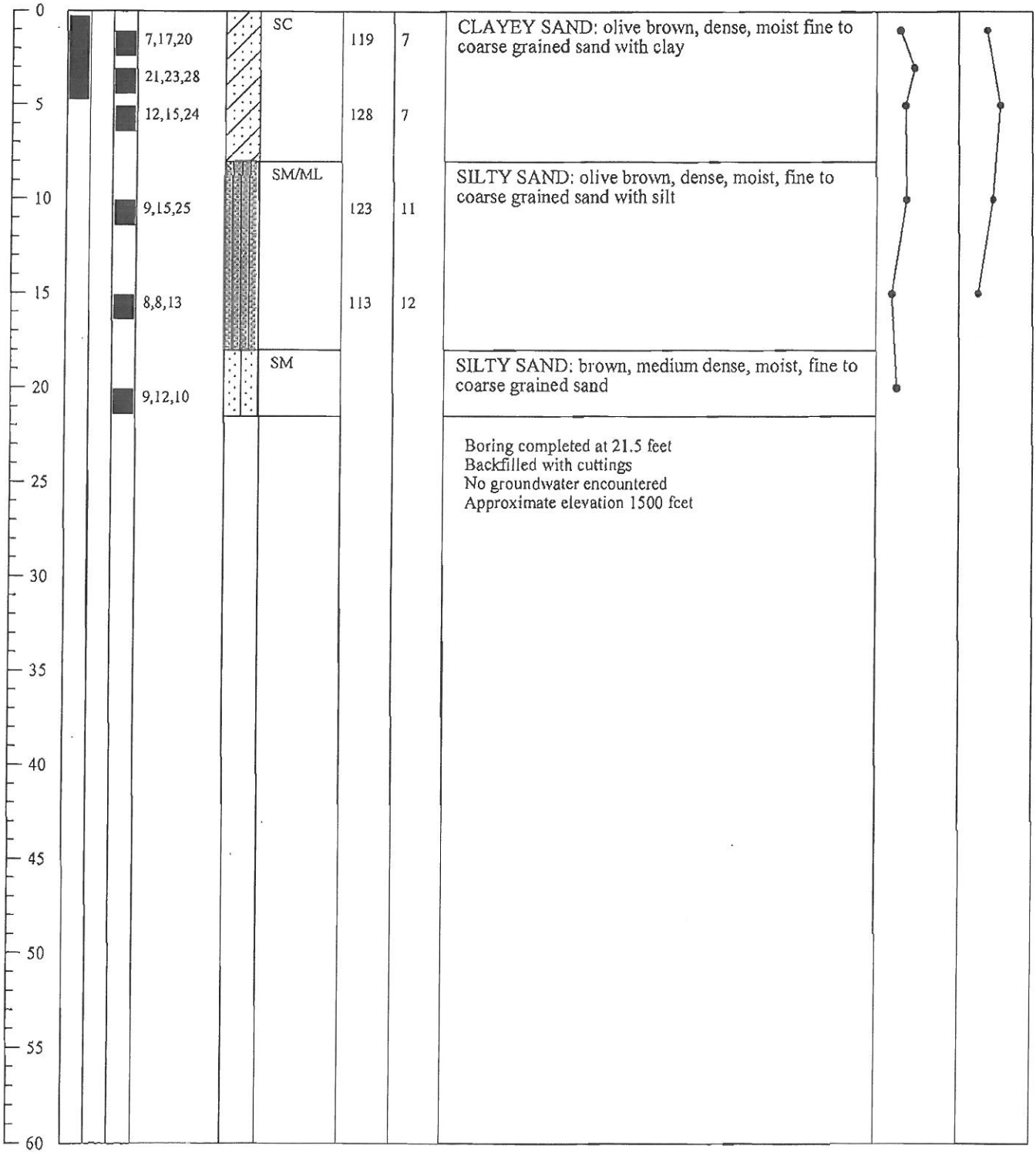
Boring No: B-5
Project Name: Lake Skinner Recreation area, Temecula, CA
File Number: 50267-01
Boring Location: See Figure 2 (Splash Park)

Drilling Date: December 12, 2008
Drilling Mcthod: 7" HSA
Drill Type: B-61 Mobil w/auto hammer
Logged By: Rachelle Herlihy

Description of Units

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Graphic Trend
Blow Count Dry Density



Earth Systems
Southwest

Boring No: B-6

Project Name: Lake Skinner Recreation area, Temecula, CA
File Number: 50267-01
Boring Location: See Figure 2 (Parking Lot)

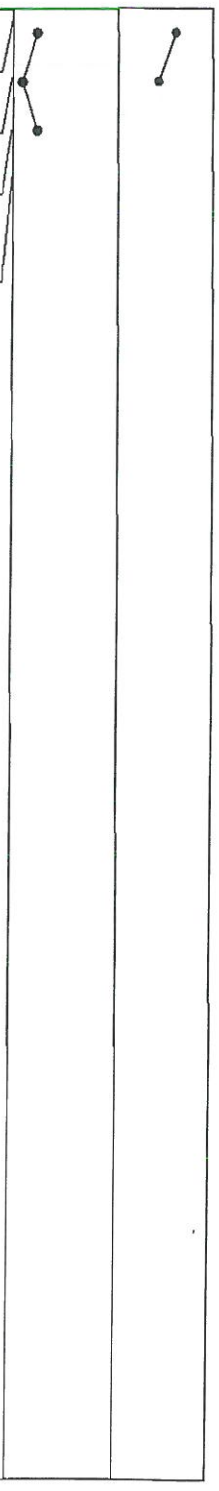
Drilling Date: December 12, 2008
Drilling Method: 7" HSA
Drill Type: B-61 Mobil w/auto hammer
Logged By: Rachelle Herlihy

Depth (Ft.)	Sample Type (Bulk, SPT, MOD Calif.)	Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description of Units
0							
		12,13,13		AC / SC	130	8	ASPHALT CONCRETE: 3 inches of asphalt concrete, no base
		5,5,5		SM/ML	121	8	CLAYEY SAND: olive brown, compact, moist, fine to coarse grained sand with clay, Fill
5		5,11,14		SM			SILTY SAND: dark brown, loose, moist, fine to medium grained sand with silt
							SILTY SAND: olive brown to brown, medium dense, moist, fine to medium grained sand with traces of clay
10							
15							
20							
25							
30							
35							
40							
45							
50							
55							
60							

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Boring completed at 6.5 feet
Backfilled with cuttings
No groundwater encountered
Approximate elevation 1500 feet

Graphic Trend
Blow Count Dry Density



Earth Systems
Southwest

Boring No: B-7
Project Name: Lake Skinner Recreation area, Temecula, CA
File Number: 50267-01
Boring Location: See Figure 2 (Parking Lot)

Drilling Date: December 12, 2008
Drilling Method: 7" HSA
Drill Type: B-61 Mobil w/auto hammer
Logged By: Rachelle Herlihy

Page 1 of 1

Depth (Ft.)	Sample Type (Bulk, SPT, MOD Calif.)	Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description of Units
0				AC			ASPHALT CONCRETE: 3 inches of asphalt concrete
	MOD Calif.	7,9,10		SM	122	14	SILTY SAND: brown, compact, wet, fine to coarse grained sand, Fill
5	MOD Calif.	4,4,5		SM/ML	121	10	SILTY SAND: brown to dark brown, loose, moist fine to medium grained sand with silt
	MOD Calif.	4,5,6		SM			SILTY SAND: brown, loose, moist, fine to medium grained sand with trace of clay
10							Boring completed at 6.5 feet Backfilled with cuttings No groundwater encountered Approximate elevation 1501 feet
15							
20							
25							
30							
35							
40							
45							
50							
55							
60							

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Graphic Trend
Blow Count Dry Density

Earth Systems
Southwest

Boring No: B-8
Project Name: Lake Skinner Recreation area, Temecula, CA
File Number: 50267-01
Boring Location: See Figure 2 (Walkway)

Drilling Date: December 12, 2008
Drilling Method: 7" HSA
Drill Type: B-61 Mobil w/auto hammer
Logged By: Rachelle Herlihy

Description of Units

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Graphic Trend
Blow Count Dry Density

Depth (Ft.)	Sample Type (Bulk / SPT / MOD Calif.)	Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description
0							
	MOD Calif.	11,18,23		SM/ML	127	9	SILTY SAND: brown to dark brown, dense, moist, fine to coarse grained sand with silt
5	MOD Calif.	13,17,19		SM	128	9	SILTY SAND: brown, medium dense, moist, fine to coarse grained sand with silt and some gravel
	MOD Calif.	12,14,17		SM			SILTY SAND: brown, medium dense, moist, fine to coarse grained sand with trace of gravel
10							Boring completed at 6.5 feet Backfilled with cuttings No groundwater encountered Approximate elevation 1508 feet
15							
20							
25							
30							
35							
40							
45							
50							
55							
60							

Earth Systems
Southwest

Boring No: B-9
Project Name: Lake Skinner Recreation area, Temecula, CA
File Number: 50267-01
Boring Location: See Figure 2 (Parking Lot)

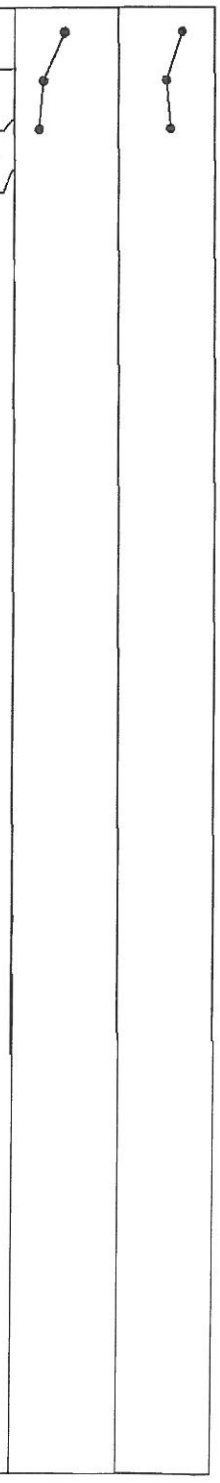
Drilling Date: Deeember 12, 2008
Drilling Method: 7" HSA
Drill Type: B-61 Mobil w/auto hammer
Logged By: Rachelle Herlihy

Description of Units

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Graphic Trend
Blow Count Dry Density

Depth (Ft.)	Sample Type (Bulk, SPT, MOD Calif.)	Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description
0							
	MOD Calif.	12,23,30		SM	133	8	SILTY SAND: dark brown, dense, moist, fine to medium grained sand with clay
	MOD Calif.	9,13,18		SM	125	10	SILTY SAND: dark brown, medium dense, moist, fine to medium grained sand with clay
5	MOD Calif.	12,13,14		SC	127	9	CLAYEY SAND: brown, medium dense, moist, fine to coarse grained sand with clay
							Boring completed at 6.5 feet Backfilled with cuttings No groundwater encountered Approximate elevation 1504 feet
10							
15							
20							
25							
30							
35							
40							
45							
50							
55							
60							



Earth Systems
Southwest

Boring No: B-10
Project Name: Lake Skinner Recreation area, Temeeula, CA
File Number: 50267-01
Boring Location: See Figure 2 (Parking Lot)

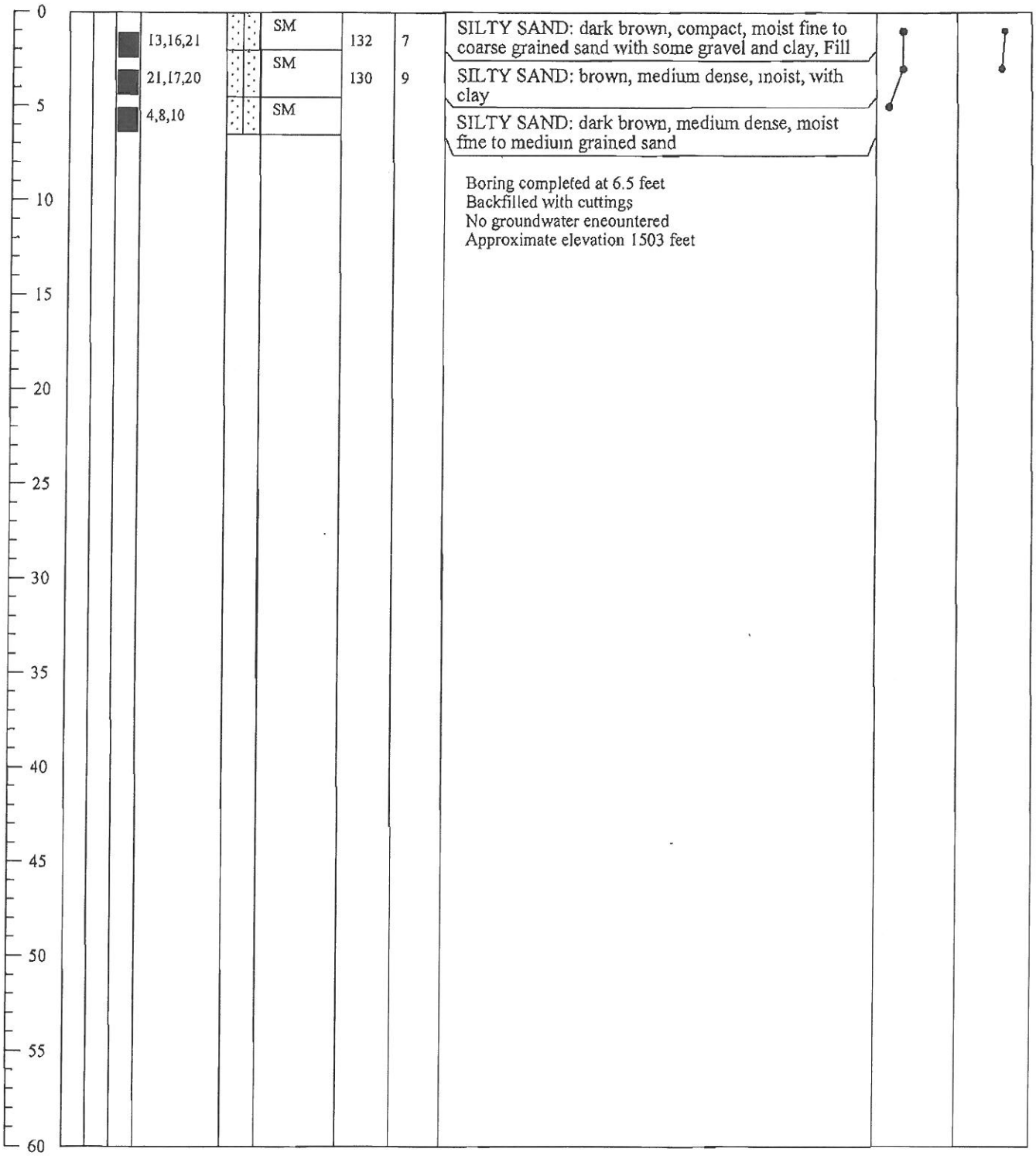
Drilling Date: December 12, 2008
Drilling Method: 7" HSA
Drill Type: B-61 Mobil w/auto hammer
Logged By: Raehelle Herlihy

Description of Units

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Graphic Trend
Blow Count Dry Density

Depth (Ft.)	Sample Type (Bulk, SPT, MOD Calif.)	Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description
0							
		13,16,21		SM	132	7	SILTY SAND: dark brown, compact, moist fine to coarse grained sand with some gravel and clay, Fill
		21,17,20		SM	130	9	SILTY SAND: brown, medium dense, moist, with clay
5		4,8,10		SM			SILTY SAND: dark brown, medium dense, moist fine to medium grained sand
10							Boring completed at 6.5 feet Backfilled with cuttings No groundwater encountered Approximate elevation 1503 feet
15							
20							
25							
30							
35							
40							
45							
50							
55							
60							



Earth Systems
Southwest

Boring No: B-11
Project Name: Lake Skinner Recreation area, Temecula, CA
File Number: 50267-01
Boring Location: See Figure 2 (Parking Lot)

Drilling Date: December 12, 2008
Drilling Method: 7" HSA
Drill Type: B-61 Mobil w/auto hammer
Logged By: Rachelle Herlihy

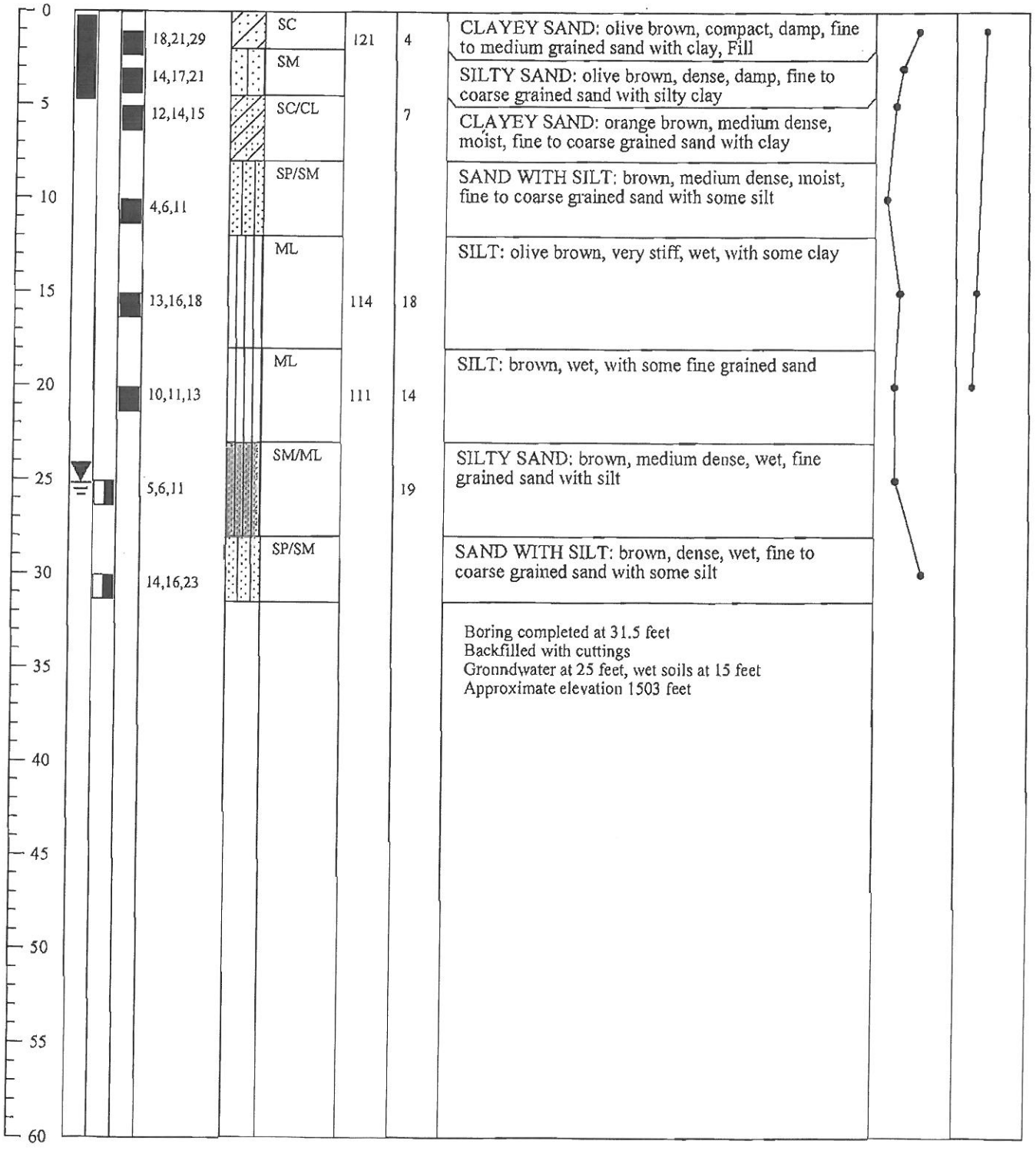
Depth (Ft.)	Sample Type (Bulk, SPT, MOD Calif.)	Penetration Resistanee (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description of Units	Graphie Trend: Blow Count / Dry Density
0								
		4,6,10		SM	126	12	SILTY SAND: brown to dark brown, loose, wet, fine to medium grained sand with traees of gravel and clay	
		4,4,4		SM	122	13		
5		4,4,5			123	12	SILTY SAND: brown to dark brown, loose, wet, fine to medium grained sand with trace clay	
				SP/SM				
10		12,14,22					SAND WITH SILT: brown, medium dense, moist fine to coarse grained sand with some silt	
							Boring completed at 11.5 feet Backfilled with cuttings No groundwater encountered Approximate elevation 1501 feet	
15								
20								
25								
30								
35								
40								
45								
50								
55								
60								

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Earth Systems
Southwest

Boring No: B-12
Project Name: Lake Skinner Reereation area, Temecula, CA
File Number: 50267-01
Boring Location: See Figure 2 (Amphitheater)

Drilling Date: December 12, 2008
Drilling Method: 7" HSA
Drill Type: B-61 Mobil w/auto hammer
Logged By: Rachelle Herlihy



Earth Systems
Southwest

Boring No: B-13
Project Name: Lake Skinner Recreation area, Temecula, CA
File Number: 50267-01
Boring Location: See Figure 2 (Portable Stage Area)

Drilling Date: December 12, 2008
Drilling Method: 7" HSA (Portable Stage Area)
Drill Type: B-61 Mobil w/auto hammer
Logged By: Rachelle Herlihy

Depth (Ft.)	Sample Type (Bulk / SPT / MOD Calif.)	Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description of Units
0				AC			ASPHALT CONCRETE: 3 inches of asphalt concrete, no base
	MOD Calif.	9,6,4		SM	124	11	SILTY SAND: brown to dark brown, poorly compact, coarse grained sand with silt, Fill
5	MOD Calif.	6,7,10			122	12	
	MOD Calif.	8,8,11		SC			CLAYEY SAND: olive brown, medium dense, wet, fine to coarse grained sand with clay
10	MOD Calif.	6,12,16		SM			SILTY SAND: brown, medium dense, moist, fine to coarse grained sand
15							Boring completed at 11.5 feet Backfilled with cuttings No groundwater encountered Approximate elevation 1503 feet
20							
25							
30							
35							
40							
45							
50							
55							
60							

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Graphic Trend
Blow Count Dry Density

Earth Systems
Southwest

Boring No: B-14
Project Name: Lake Skinner Recreation area, Temecula, CA
File Number: 50267-01
Boring Location: See Figure 2 (Walkway)

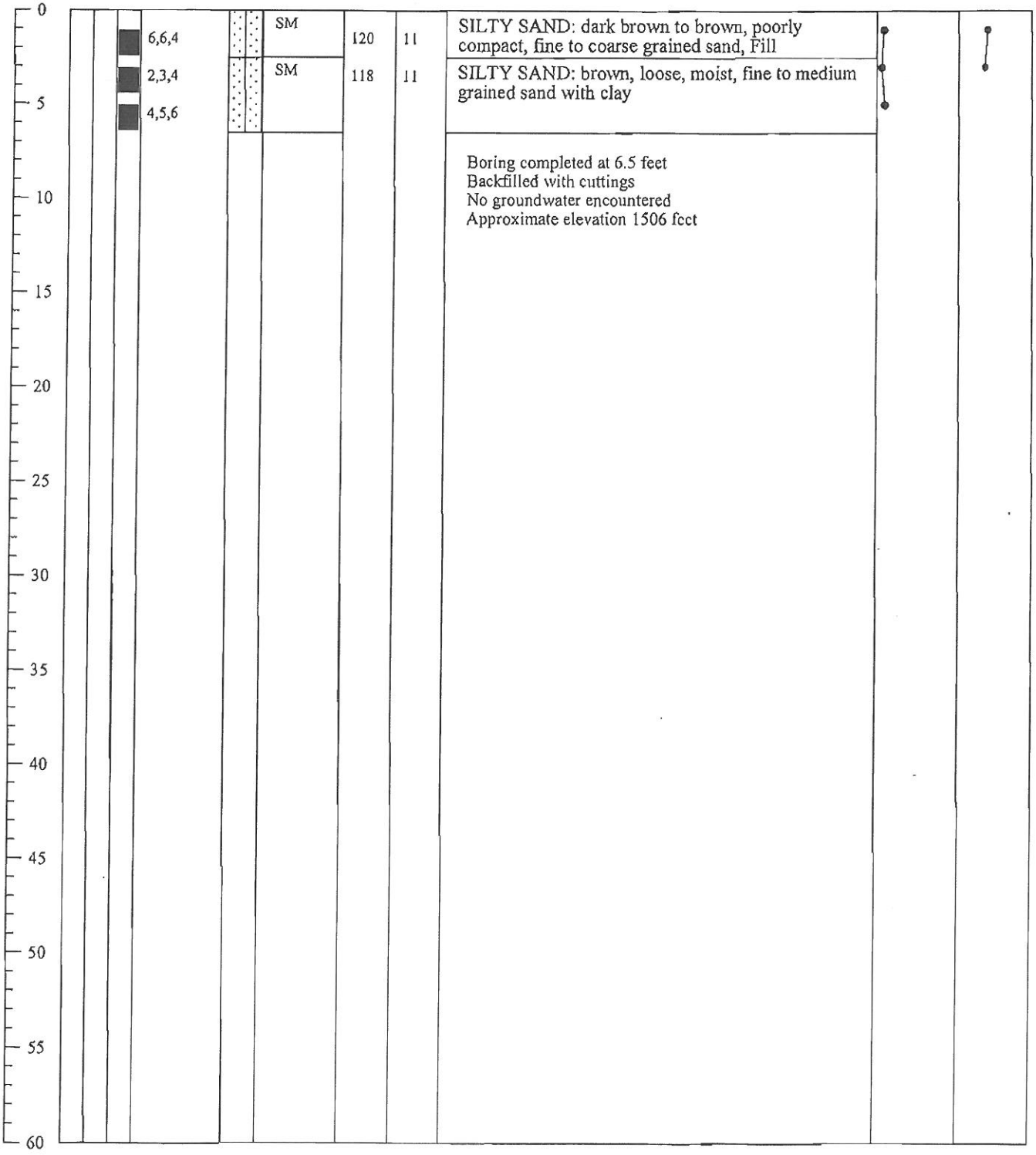
Drilling Date: December 12, 2008
Drilling Method: 7" HSA
Drill Type: B-61 Mobil w/auto hammer
Logged By: Rachelle Herlihy

Description of Units

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Graphic Trend
Blow Count Dry Density

Depth (Ft.)	Sample Type (Bulk / SPT / MOD Calif.)	Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description
0	MOD Calif.	6,6,4		SM	120	11	SILTY SAND: dark brown to brown, poorly compact, fine to coarse grained sand, Fill
5	MOD Calif.	2,3,4		SM	118	11	SILTY SAND: brown, loose, moist, fine to medium grained sand with clay
	MOD Calif.	4,5,6					
10							Boring completed at 6.5 feet Backfilled with cuttings No groundwater encountered Approximate elevation 1506 feet
15							
20							
25							
30							
35							
40							
45							
50							
55							
60							



Earth Systems
Southwest

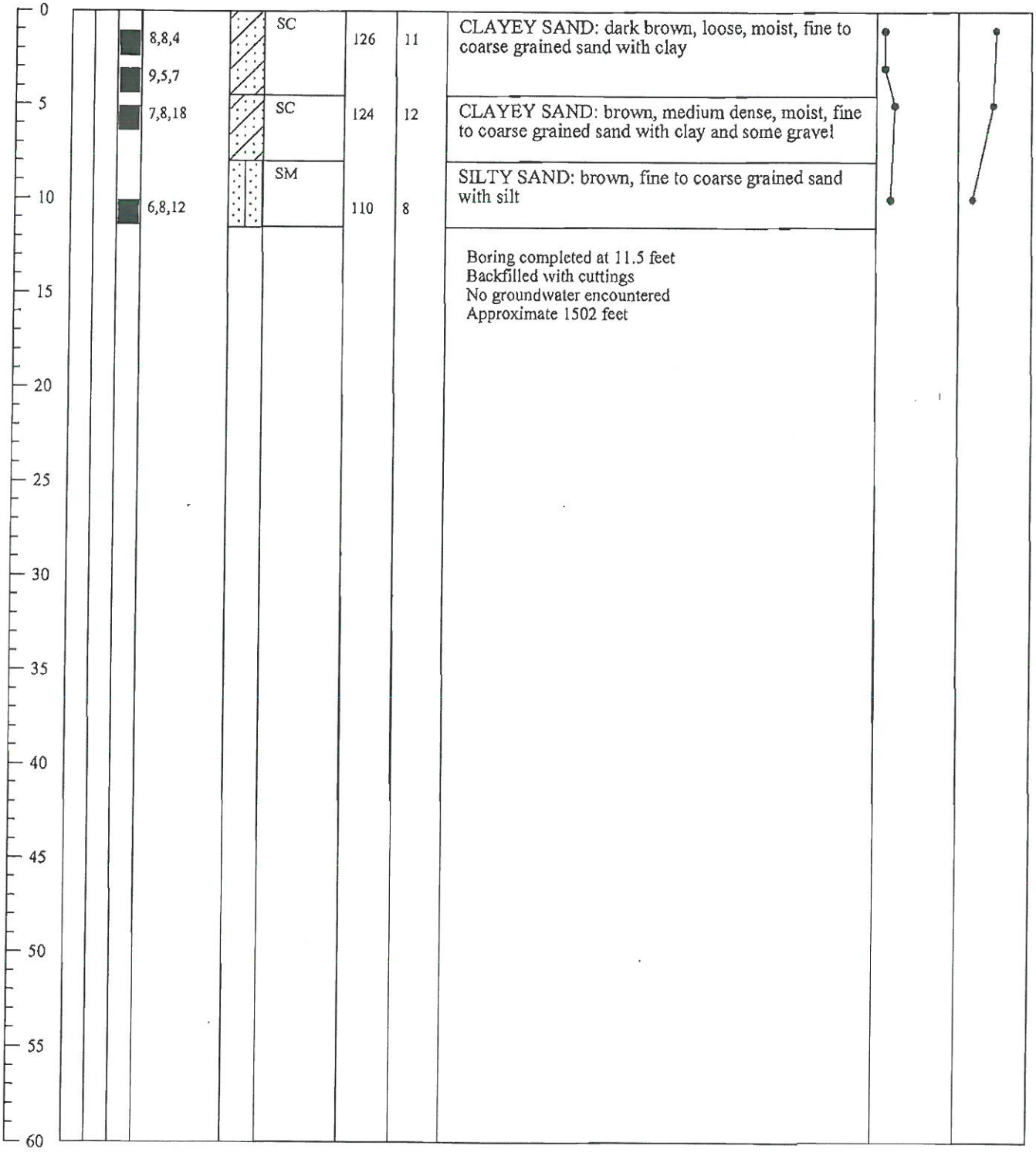
Boring No: B-15
Project Name: Lake Skinner Recreation area, Temecula, CA
File Number: 50267-01
Boring Location: See Figure 2 (Play Area)

Drilling Date: December 12, 2008
Drilling Method: 7" HSA
Drill Type: B-61 Mobil w/auto hammer
Logged By: Rachelle Herlihy

Description of Units

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

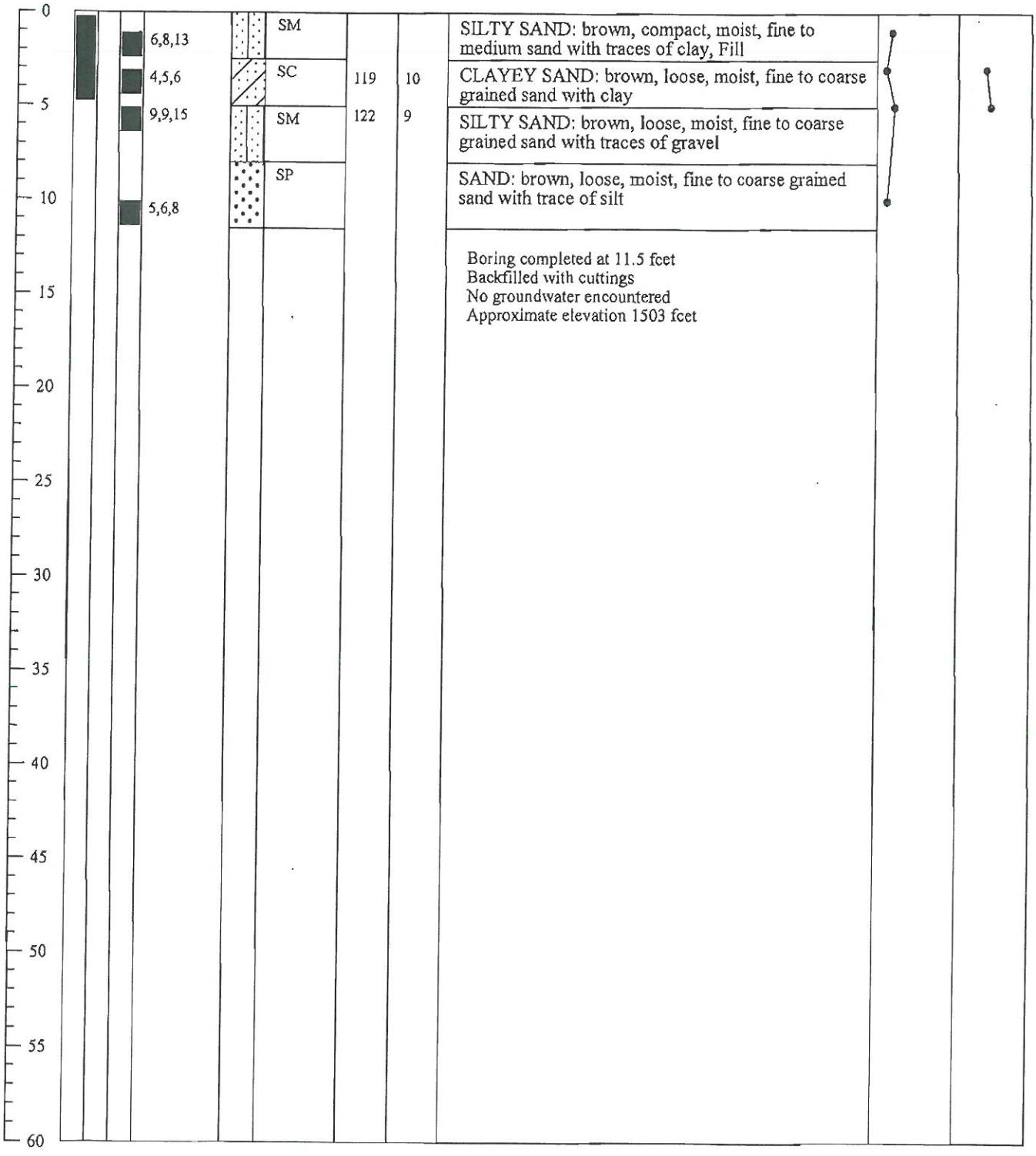
Graphic Trend
Blow Count Dry Density



Earth Systems
Southwest

Boring No: B-16
Project Name: Lake Skinner Recreation area, Temecula, CA
File Number: 50267-01
Boring Location: See Figure 2 (Parking Lot)

Drilling Date: December 12, 2008
Drilling Method: 7" HSA
Drill Type: B-61 Mobil w/auto hammer
Logged By: Rachelle Herlihy



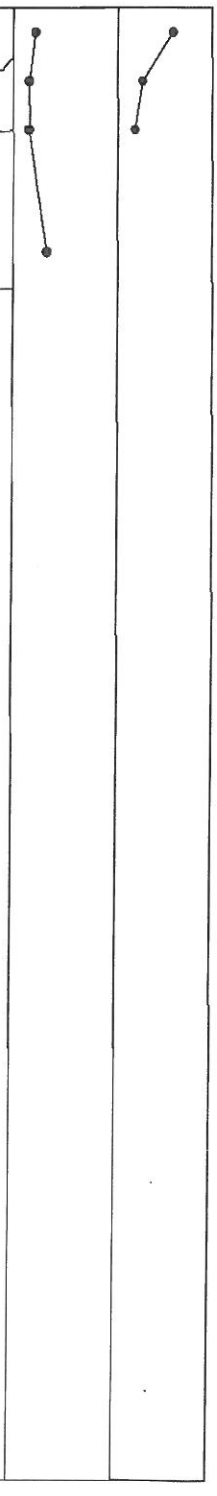
Earth Systems
Southwest

Boring No: B-17
Project Name: Lake Skinner Recreation area, Temecula, CA
File Number: 50267-01
Boring Location: See Figure 2 (Parking Lot)

Drilling Date: December 12, 2008
Drilling Method: 7" HSA
Drill Type: B-61 Mobil w/auto hammer
Logged By: Rachelle Herlihy

Depth (Ft.)	Sample Type (Bulk, SPT, MOD Calif.)	Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description of Units
0							Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.
		4,9,14		SC	129	13	CLAYEY SAND: brown, medium dense, wet, with fine to coarse grained sand
		4,5,9		SM	113	9	SILTY SAND: brown, loose, moist, fine to coarse grained sand with some clay
5		5,7,10		SP/SM	109	7	SAND WITH SILT: brown, stiff, moist, fine to coarse gained sand with some silt
10		6,13,22					
							Boring completed at 11.5 feet Backfilled with cuttings No groundwater encountered Approximate elevation 1503 feet
15							
20							
25							
30							
35							
40							
45							
50							
55							
60							

Graphic Trend
Blow Count Dry Density



Earth Systems
Southwest

Boring No: B-17

Project Name: Lake Skinner Recreation area, Temecula, CA
File Number: 50267-01
Boring Location: See Figure 2 (Parking Lot)

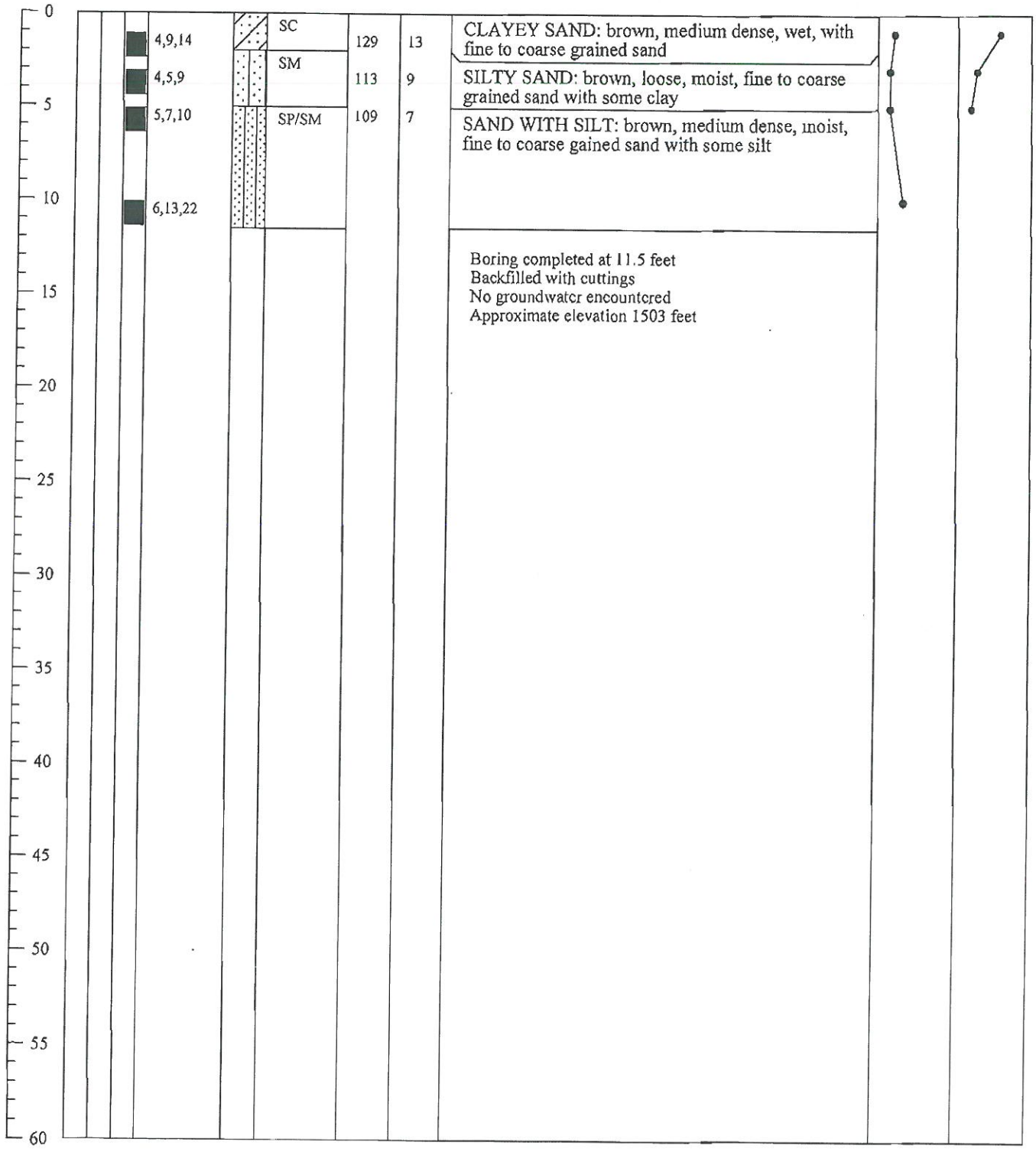
Drilling Date: December 12, 2008
Drilling Method: 7" HSA
Drill Type: B-61 Mobil w/auto hammer
Logged By: Rachelle Herlihy

Description of Units

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Graphic Trend
Blow Count Dry Density

Depth (Ft.)	Sample Type (Bulk / SPT / MOD Calif.)	Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description
0							
		4,9,14		SC	129	13	CLAYEY SAND: brown, medium dense, wet, with fine to coarse grained sand
		4,5,9		SM	113	9	SILTY SAND: brown, loose, moist, fine to coarse grained sand with some clay
5		5,7,10		SP/SM	109	7	SAND WITH SILT: brown, medium dense, moist, fine to coarse gained sand with some silt
10		6,13,22					
							Boring completed at 11.5 feet Backfilled with cuttings No groundwater encountered Approximate elevation 1503 feet
15							
20							
25							
30							
35							
40							
45							
50							
55							
60							



APPENDIX B

Laboratory Test Results

File No.: 50267-01

January 7, 2009

Lab No.: R-08-089

UNIT DENSITIES AND MOISTURE CONTENT

ASTM D2937 & D2216

Job Name: Lake Skinner Recreation Area

Sample Location	Depth (feet)	Unit Dry Density (pcf)	Moisture Content (%)	USCS Group Symbol
B1	3	119	12	SM
B1	5	112	6	SM
B1	10	121	14	SC
B1	20	117	16	SM
B2	3	114	5	SM
B2	5	108	4	SP/SM
B2	10	118	12	SM
B2	20	119	15	SM
B3	1	115	12	SM
B3	3	117	14	SC
B3	5	106	18	SM/ML
B3	10	119	13	SM
B4	1	107	18	ML
B4	3	109	15	SM
B4	5	110	17	SP
B4	10	114	17	ML
B5	3	119	7	SC
B5	5	128	7	SC
B5	10	123	11	SM/ML
B5	15	113	12	SM/ML
B6	1	130	8	SC
B6	3	121	8	SM/ML
B7	1	122	14	SM
B7	3	121	10	SM/ML
B8	1	127	9	SM/ML

File No.: 50267-01

Lab No.: R-08-089

January 7, 2009

UNIT DENSITIES AND MOISTURE CONTENT

ASTM D2937 & D2216

Job Name: Lake Skinner Recreation Area

Sample Location	Depth (feet)	Unit Dry Density (pcf)	Moisture Content (%)	USCS Group Symbol
B8	3	128	9	SM
B9	1	133	8	SM
B9	3	125	10	SM
B9	5	127	9	SC
B10	1	132	7	CL
B10	3	130	9	CL
B11	1	126	12	SM
B11	3	122	13	SM
B11	5	123	12	SM
B12	1	121	4	SC
B12	3	122	7	SM
B12	5	---	7	SC/CL
B12	10	115	6	SP/SM
B12	15	114	18	ML
B12	20	111	14	ML
B12	25	---	19	SM/ML
B13	1	124	11	SM
B13	3	128	10	SM
B13	5	122	12	SC
B14	1	120	11	SM
B14	3	118	11	SM
B15	1	126	11	SC
B15	3	122	12	SC
B15	5	124	12	SC
B15	10	110	8	SM

File No.: 50267-01

January 7, 2009

Lab No.: R-08-089

UNIT DENSITIES AND MOISTURE CONTENT

ASTM D2937 & D2216

Job Name: Lake Skinner Recreation Area

Sample Location	Depth (feet)	Unit Dry Density (pcf)	Moisture Content (%)	USCS Group Symbol
B16	3	119	10	SC
B16	5	122	9	SM
B17	1	124	13	CL
B17	3	113	9	SM
B17	5	109	7	SP/SM

File No.: 50267-01

Job Name: Lake Skinner Recreation Area

Lab Number: R-08-089

January 7, 2009

AMOUNT PASSING NO. 200 SIEVE

ASTM D 1140

Sample Location	Depth (feet)	Fines Content (%)	USCS Group Symbol
B1	0-5	23	SM
B1	35	29	SM
B2	5	8	SP/SM
B5	0-5	31	SC
B5	5	32	SC
B9	0-5	37	SM
B11	0-5	38	SM
B12	0-5	33	SC
B15	0-5	40	SC
B16	0-5	32	SM/SC

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PARTICLE SIZE ANALYSIS

ASTM D-422

Job Name: Lake Skinner Recreation Area

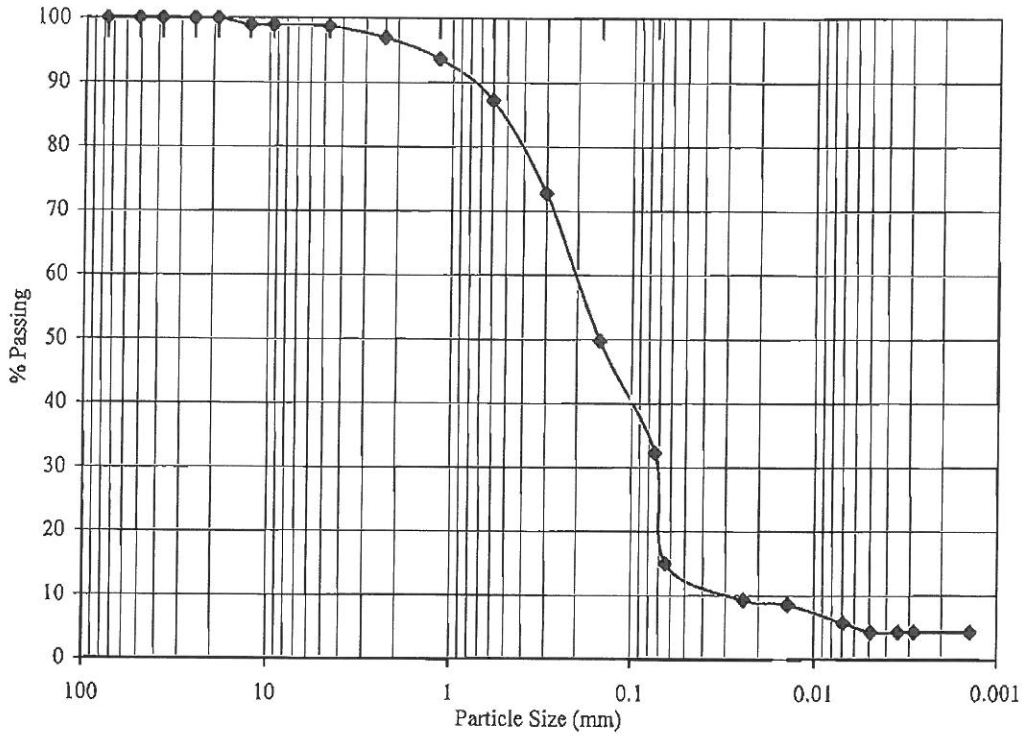
Sample ID: **B1 @ 25 feet**

Description: **Silty Sand (SM)**

Sieve Size	% Passing
3"	100
2"	100
I-1/2"	100
1"	100
3/4"	100
1/2"	99
3/8"	99
#4	99
#8	97
#16	94
#30	87
#50	73
#100	50
#200	32

By Hydrometer Method:

Particle Size	% Passing
64 Micron	15
24 Micron	9
14 Micron	9
7 Micron	6
5 Micron	4
3.5 Micron	4
2.8 Micron	4
1.4 Micron	4
% Gravel:	**1**
% Sand:	**66**
% Silt:	**28**
% Clay (3 micron):	**4**



File No.: 50267-01 January 7, 2009

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PARTICLE SIZE ANALYSIS

ASTM D-422

Job Name: Lake Skinner Recreation Area

Sample ID: **B12 at 3 feet**

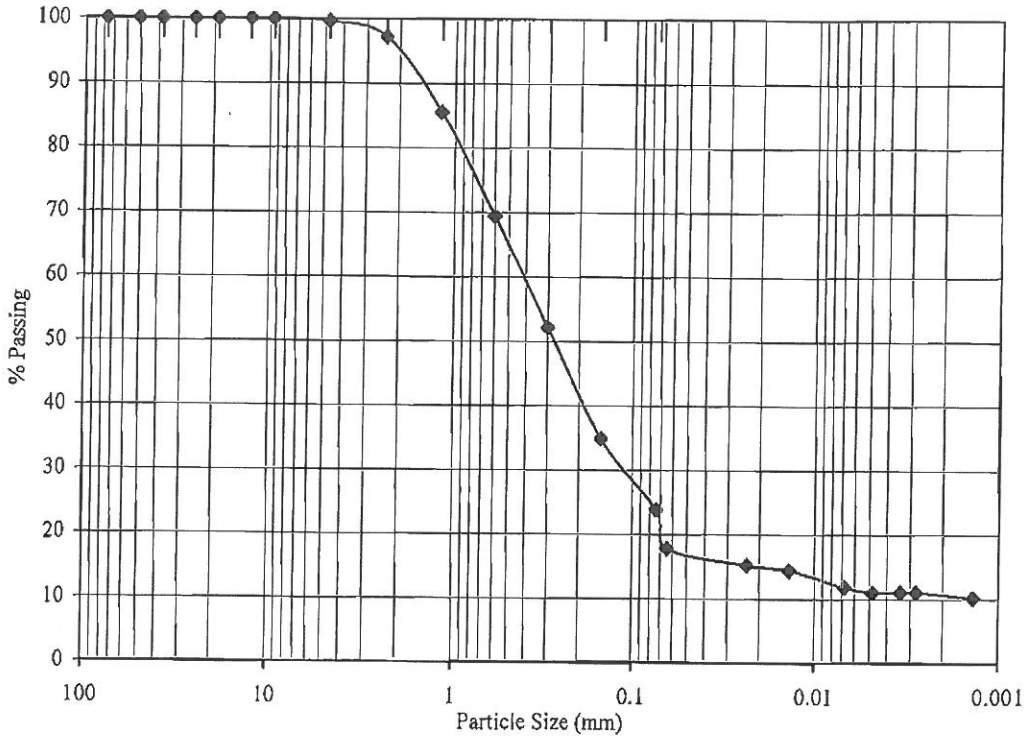
Description: **Silty Sand With Clay (SM)**

Sieve Size	% Passing
3"	100
2"	100
1-1/2"	100
1"	100
3/4"	100
1/2"	100
3/8"	100
#4	100
#8	97
#16	86
#30	69
#50	52
#100	35
#200	24

By Hydrometer Method:

Particle Size	% Passing
64 Micron	18
24 Micron	15
14 Micron	14
7 Micron	12
5 Micron	11
3.4 Micron	11
2.8 Micron	11
1.4 Micron	10

% Gravel:	**0**
% Sand:	**76**
% Silt:	**13**
% Clay (3 micron):	**11**



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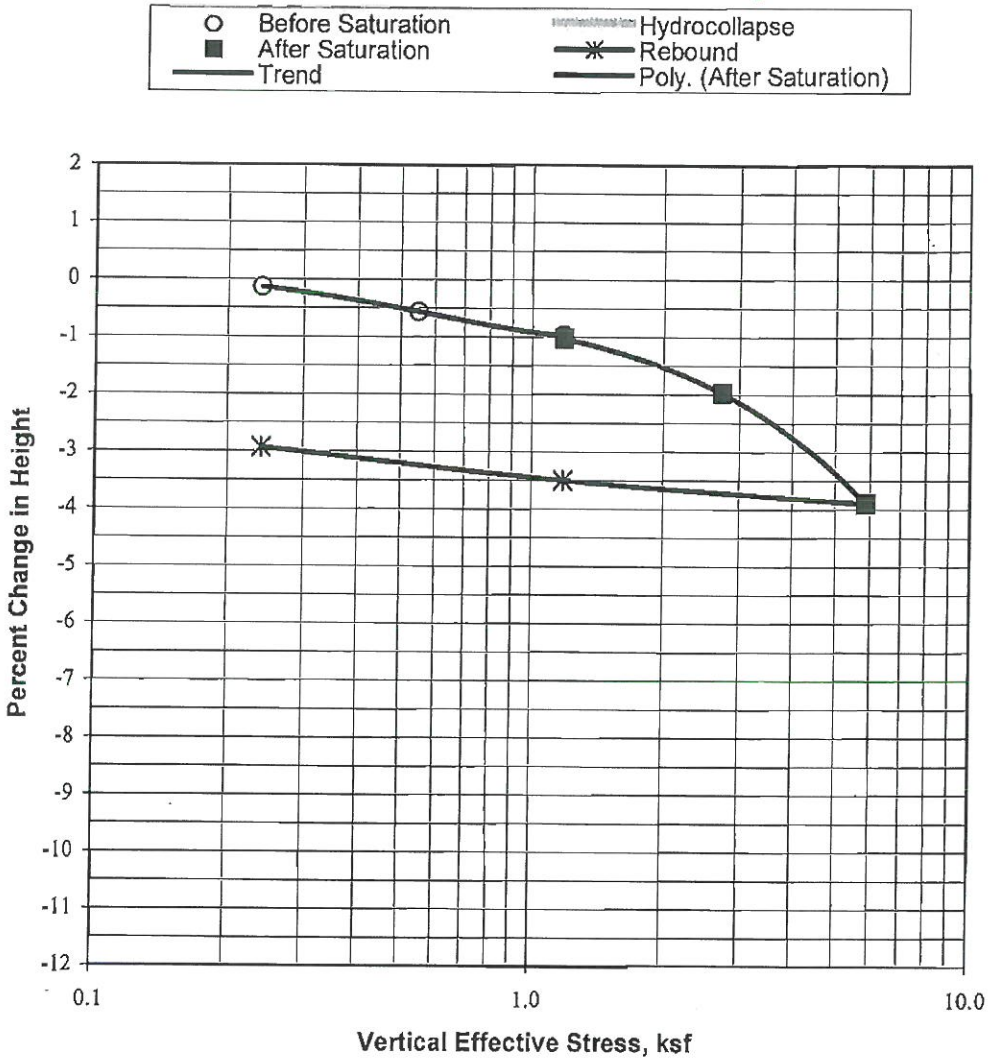
CONSOLIDATION TEST

ASTM D 2435

Lake Skinner Recreation Area
B1 @ 3 Feet
Brown silty f-c sand with some clay (SM)
Ring Sample

Initial Dry Density: 117.9 pcf
Initial Moisture, %: 12.0%
Specific Gravity (assumed): 2.75
Initial Void Ratio: 0.456

% Change in Height vs Normal Presssure Diagram



File No.: 50267-01
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CONSOLIDATION TEST

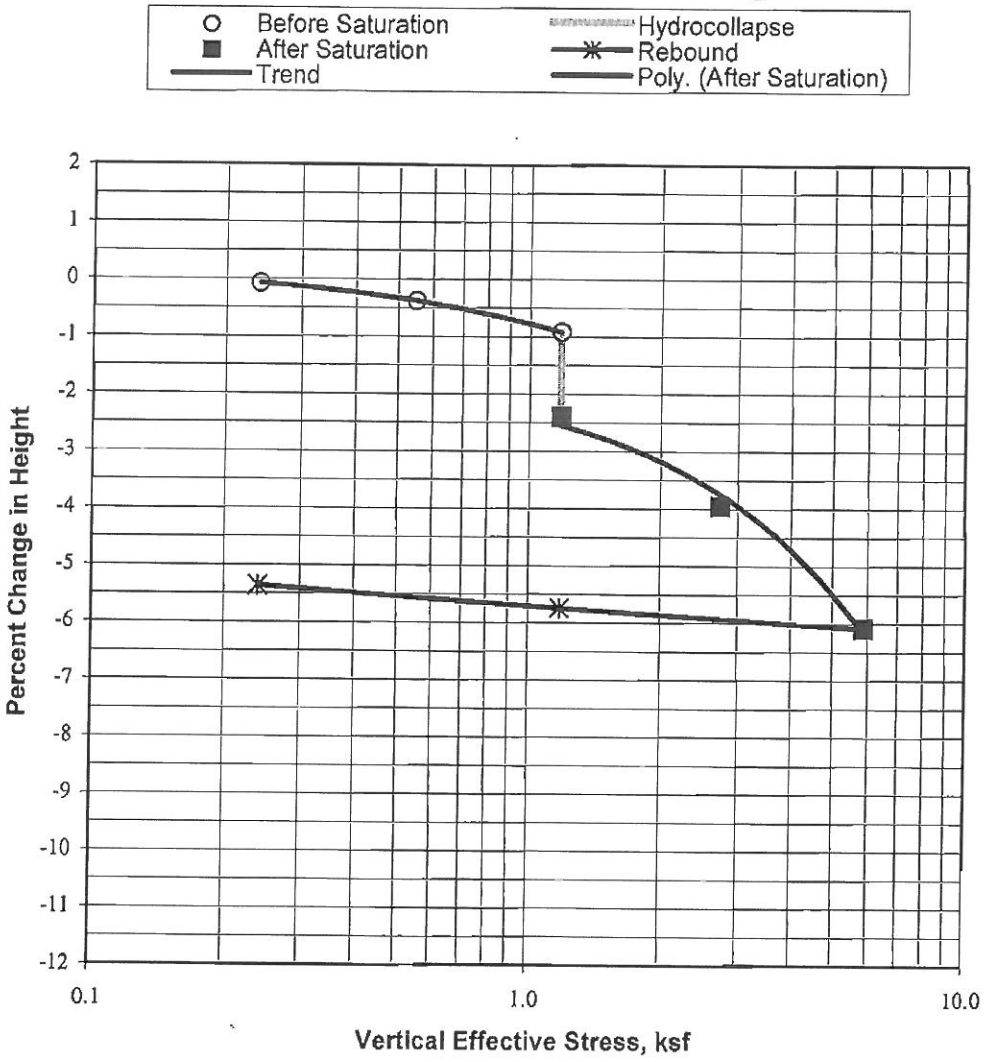
ASTM D 2435 & D 5333

Lake Skinner Recreation Area
B1 @ 5 feet
Brown silty f-c sand with some gravel (SM)
Ring Sample

Initial Dry Density: 107.1 pcf
Initial Moisture, %: 6.0%
Specific Gravity (assumed): 2.75
Initial Void Ratio: 0.603

Hydrocollapse: 1.5% @ 1.2 ksf

% Change in Height vs Normal Presssure Diagram



File No.: 50267-01
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CONSOLIDATION TEST

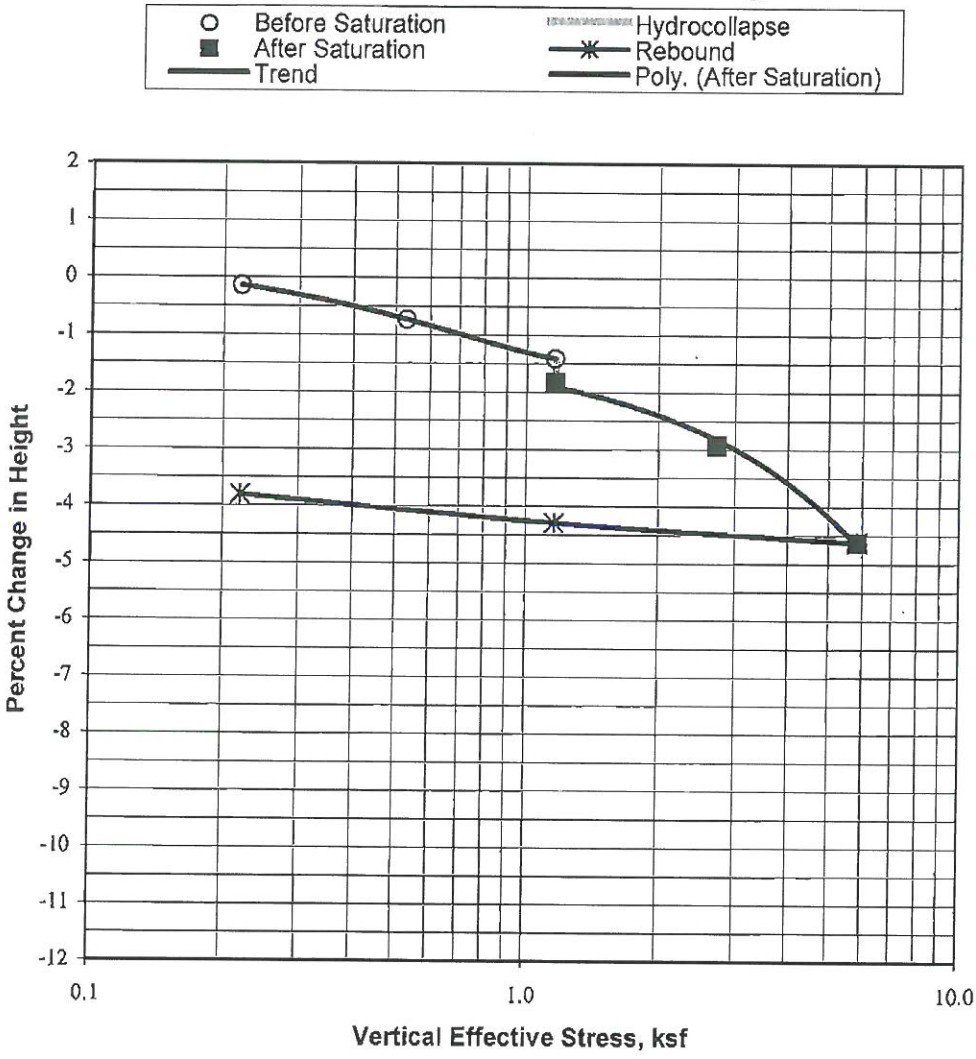
ASTM D 2435 & D 5333

Lake Skinner Recreation Area
B4 @ 1 Foot
Brown fine sandy silt (ML)
Ring Sample

Initial Dry Density: 104.3 pcf
Initial Moisture, %: 18.0%
Specific Gravity (assumed): 2.75
Initial Void Ratio: 0.646

Hydrocollapse: 0.4% @ 1.2 ksf

% Change in Height vs Normal Presssure Diagram



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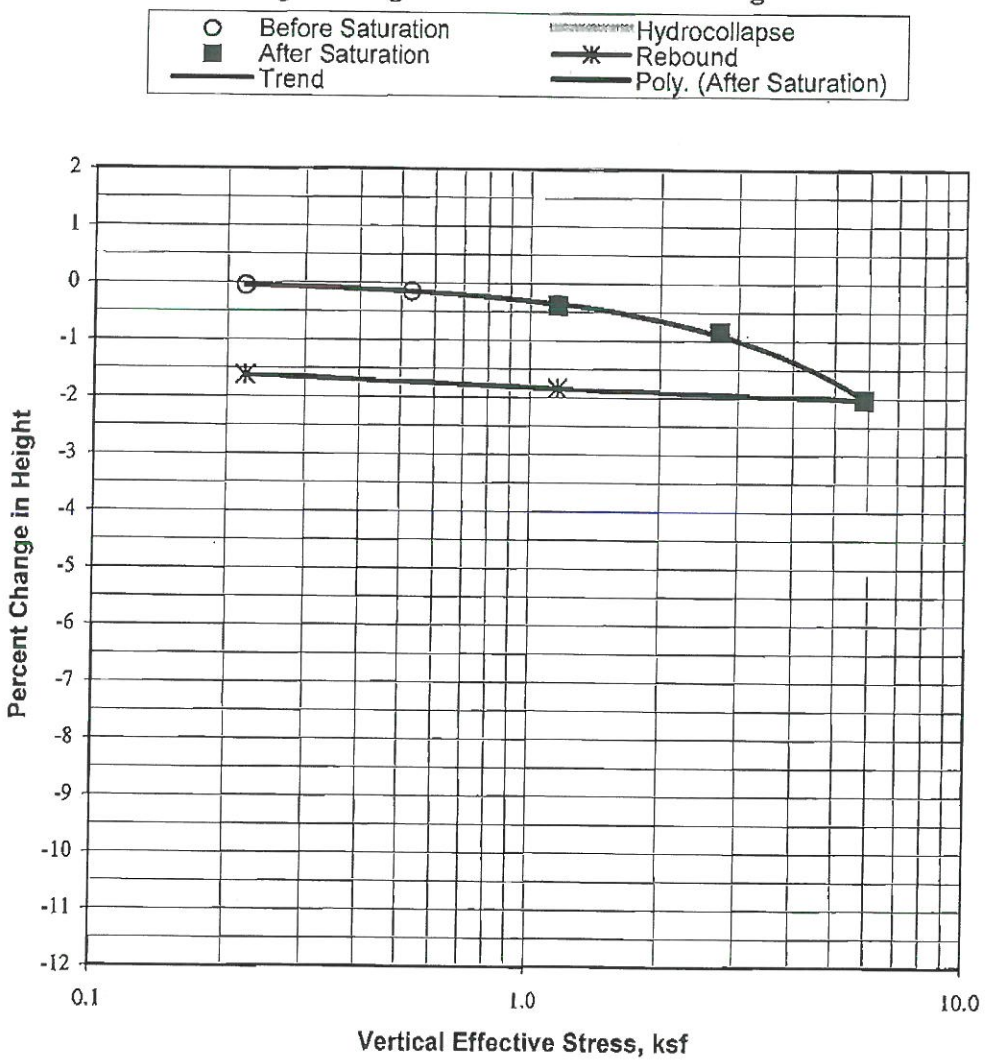
CONSOLIDATION TEST

ASTM D 2435

Lake Skinner Recreation Area
B4 @ 5 Feet
Brown f-m sand with little to no silt (SP)
Ring Sample

Initial Dry Density: 105.8 pcf
Initial Moisture, %: 17.0%
Specific Gravity (assumed): 2.75
Initial Void Ratio: 0.622

% Change in Height vs Normal Presssure Diagram



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CONSOLIDATION TEST

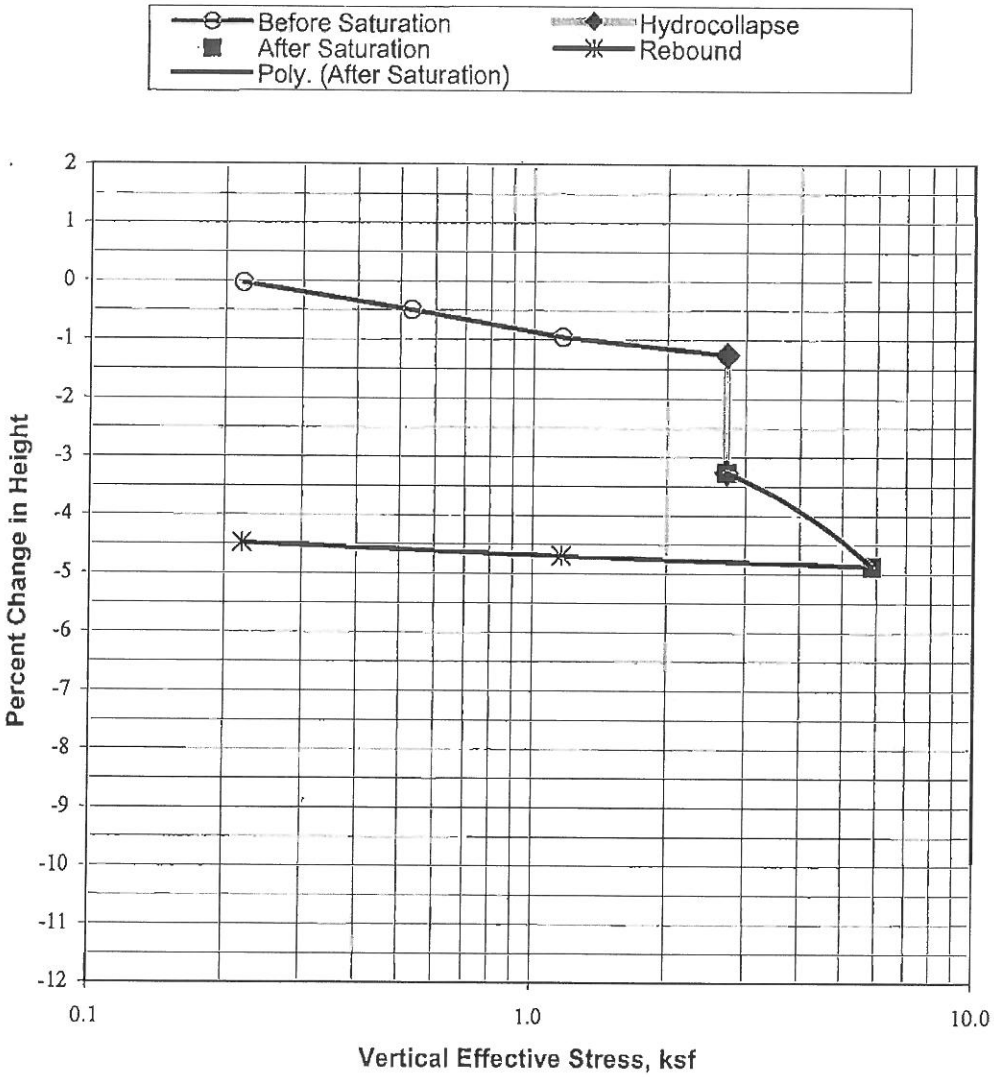
ASTM D 2435 & D 5333

Lake Skinner Recreation Area
B12 at 10 feet
Brown f-c sand with gravel and silt (SP/SM)
Ring Sample

Initial Dry Density: 112.9 pcf
Initial Moisture, %: 6.5%
Specific Gravity (assumed): 2.75
Initial Void Ratio: 0.520

Hydrocollapse: 2.0% @ 2.7 ksf

% Change in Height vs Normal Presssure Diagram



File No.: 50267-01
Lab No.: R-08-089

January 7, 2009

CONSOLIDATION TEST

ASTM D 2435

Lake Skinner Recreation Area
B13 at 3 feet
Dark brown f-c sandy clay (CL)
Ring Sample

Initial Dry Density: 127.6 pcf
Initial Moisture, %: 9.7%
Specific Gravity (assumed): 2.75
Initial Void Ratio: 0.346

% Change in Height vs Normal Presssure Diagram