

**PRIORITY
WATER QUALITY MANAGEMENT PLAN
(WQMP)**

For:

**Fletcher 15
705 & 715 W. Fletcher Ave**

**Prepared for:
ADC Fletcher 15, LLC
1635 Ohms Way
Costa Mesa, CA 92627
949-791-8401**

**Prepared by:
MFKessler
Ali Monshizadeh, PE 67674
One Venture Plaza, Suite 130
Irvine, CA 92618
949-339-5330**

**Prepared July 2025
Revised November 2025**

Public Works Director

Date

City Engineer

Date

OWNER'S CERTIFICATION
WATER QUALITY MANAGEMENT PLAN
FOR
FLETCHER 15

This Water Quality Management Plan (WQMP) for "Fletcher 15" has been prepared for ADC Fletcher 15, LLC. This WQMP is intended to comply with the requirements of the City of Orange's Municipal Code requiring the preparation of a Water Quality Management Plan.

The undersigned, while it owns the subject property, is responsible for the implementation of the provisions of this plan and will ensure that this plan is amended as appropriate to reflect up-to-date conditions on the site consistent with the City of Orange Local Implementation Plan (LIP), and the intent of NPDES Permit and Waste Discharge Requirements for the City of Orange, County of Orange, Orange County Flood Control District and the incorporated Cities of Orange County within the Santa Ana Region.

This WQMP will be reviewed with the facility operator, facility supervisors, employees, tenants, maintenance and service contractors, or any other party having responsibility for implementing portions of this WQMP. Maintenance requirements within Section V and Appendix D will be adhered to with particular emphasis on maintaining the BMPs described within Sections IV and V. The Owner's Annual Self Certification Statement along with a BMP maintenance implementation table will be submitted by June 30th every year following project completion. At least one copy of the approved WQMP shall be available on the subject property in perpetuity.

Once the undersigned transfers its interest in the property, its successors-in-interest shall bear the aforementioned responsibility to implement and amend the WQMP. The City of Orange will be notified of the change of ownership and the new owner will submit a new certification.

Signature:	_____	Date:	_____
Name:	Matt Hamilton		
Title:	Manager		
Company:	ADC Fletcher 15, LLC		
Address:	1635 Ohms Way, Suite A, Costa Mesa, CA		
Telephone:	949-929-5408		

Notice of Transfer of Responsibility

Water Quality Management Plan (WQMP)

WQMP Number – As assigned by the City of Orange: _____

Submission of this Notice of Transfer of Responsibility constitutes notice to the City that responsibility for the Water Quality Management Plan (WQMP) for the subject property identified below, and implementation of that plan, is being transferred from the Previous Owner (and his/her agent) of the site (or portion thereof) to the New Owner, as further described below.

I. Owner/ Responsible Party Information

Company/ Individual: _____ Contact Person: _____

Street Address: _____ Title: _____

City _____ State _____ Zip _____ Phone: _____

II. Information about Site Relevant to WQMP

Name of Project: _____ Fletcher 15 _____

Title of WQMP applicable to site: _____ WQMP for Fletcher 15 _____

Street Address of the site: _____ 715 W Fletcher Ave _____

Date of Transfer of Responsibility: _____

III. New Owner (Upon Transfer)/ Responsible Party Information

Company/ Individual: _____ Contact Person: _____

Street Address: _____ Title: _____

City _____ State _____ Zip _____ Phone: _____

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I. Discretionary Permit Number(s), Water Quality Condition Number(s) and Conditions of Approval

Tract No 19429

Lot No. 1-15, A

GPS Coordinates: 33.8301863

-117.8600551

Water Quality Conditions (WQMP conditions listed below)

A complete copy of the signed Conditions of Approval are included as Appendix A

Conditions of Approval:

- 1) Prior to issuance of grading permits the applicant shall submit a Priority Project WQMP for review and approval to the Public Works Department that:
 - a) Prioritizes the use of Low Impact Development principles as follows: preserves natural features; minimizes runoff and reduces impervious surfaces; and utilizes infiltration of runoff as the method of pollutant treatment. Infiltration BMPs to be considered include the use of permeable materials such as concrete and concrete pavers, infiltration trenches, infiltration planters, and other infiltration BMPs as applicable,
 - b) Incorporates the applicable Site Design, Routine Source, Structural Control and Low Impact BMPs as defined in the Model Water Quality Management Plan and Technical Guidance Document,
 - c) Maintains the hydrologic characteristics of the site by matching time of concentration, runoff, velocity, volume and hydrograph for a 2-year storm event,
 - d) Minimizes the potential increase in downstream erosion and avoids downstream impacts to physical structures, aquatic and riparian habitat,
 - e) Generally describes the long-term operation and maintenance requirements for structural and Treatment Control BMPs,
 - f) Identifies the entity or employees that will be responsible for long-term operation, maintenance, repair and or replacement of the structural and Treatment Control BMPs and the training that qualifies them to operate and maintain the BMPs,
 - g) Describes the mechanism for funding the long-term operation and maintenance of all structural and Treatment Control BMPs,

- h) Includes a copy of the forms to be used in conducting maintenance and inspection activities,
 - i) Meets recordkeeping requirements (forms to be kept for 5 years).
 - j) Includes a copy of the form to be submitted annually by the project owner to the Public Works Department that certifies that the project's structural and treatment BMPs are being inspected and maintained in accordance with the project's WQMP.
- 2) Prior to issuance of certificates for use and occupancy, the applicant shall demonstrate the following to the Public Works Department:
- a) That all structural and treatment control best management practices (BMPs) described in the Project WQMP have been constructed and installed in conformance with the approved plans and specifications,
 - b) That the applicant is prepared to implement all non-structural BMPs described in the Project WQMP,
 - c) That an adequate number of copies of the project's approved final Project WQMP are available for the future occupiers.
- 3) Prior to issuance of certificates for use of occupancy or final signoff by the Public Works Department, the applicant shall demonstrate to the satisfaction of Public Works, that the preparer of the WQMP has reviewed the BMP maintenance requirements in Section V of the WQMP with the responsible person and that a copy of the WQMP has been provided to that person. A certification letter from the WQMP preparer may be used to satisfy this condition.
- 4) Prior to issuance of building permits, the applicant shall review the approved Water Quality Management Plan (WQMP) and grading plan to ensure the structure's downspouts or drainage outlet locations are consistent with those documents. Copies of the building or architectural plans specifically showing the downspouts and drainage outlets shall be submitted to the Public Works Department for review.
- 5) The project applicant shall maintain all structural, treatment and low impact development BMPs at the frequency specified in the approved WQMP. Upon transfer of ownership or management responsibilities for the project site, the applicant shall notify the City of Orange Public Works Department of the new person(s) or entity responsible for maintenance of the BMPs.

II. Project Description

Refer to Section 2.2 of the Technical Guidance Document for completion of this section.

Planning Area (Location): N/A

Project Site Area (ac): 0.72

Project Disturbed Area (ac): 0.72

SIC Code Residential Community

Project Description

The proposed development is a 31,200 square foot (0.72-acre) project consisting of 15 small-lot, 3-story single-family homes on a private drive. The site plan includes concrete sidewalks, nine guest parking spaces, a small community open space, and landscaped areas. Post-construction, the total impervious area—including rooftops, pavement, and an assumed 190 sq ft patio area per private yard—will be approximately 25,275 square feet, which constitutes 81% of the total project site. The remaining 5,925 square feet will be pervious landscaped areas.

Project Purpose and Activities

The purpose of the project is to provide housing for 15 families. The activities on-site will be consistent with a typical single-family residential development. Key activities are detailed by area and use below:

- **Residential & Recreational Activities:** Activities include daily family living within the homes. The common open space and private yards will be used for general outdoor recreation, such as family gatherings, children's play, and dog walking. Homeowners may use personal barbecue grills within their private yards.
- **Landscape & Site Maintenance:** A Homeowners Association (HOA) will manage the maintenance of common areas through a contracted landscape service. Individual homeowners will be responsible for maintaining their private yards. These activities will include routine irrigation and mowing. The application of pesticides is not anticipated for general landscape maintenance but may be used as needed for structural pest control.
- **Vehicular Activities:** The site accommodates resident and guest vehicle parking in designated spaces and circulation along the private drive. Vehicle washing is not permitted on the property.

- **Waste Management:** Solid waste management will be handled through individual trash and recycling bins for each residence. Collection will be provided by the local municipal service.

Potential Storm Water Pollutants

Below are the expected potential pollutants for a Residential project.

Suspended-Solid/ Sediment	E <input checked="" type="checkbox"/>	N <input type="checkbox"/>	Expected by proposed landscaped areas.
Nutrients	E <input checked="" type="checkbox"/>	N <input type="checkbox"/>	Expected by proposed landscaped areas.
Heavy Metals	E <input type="checkbox"/>	N <input checked="" type="checkbox"/>	Per TGD, Table 2.1 this pollutant is not expected for attached residential developments.
Pathogens (Bacteria/Virus)	E <input checked="" type="checkbox"/>	N <input type="checkbox"/>	Expected by proposed residence and pets.
Pesticides	E <input checked="" type="checkbox"/>	N <input type="checkbox"/>	Expected by proposed landscaped areas.
Oil and Grease	E <input checked="" type="checkbox"/>	N <input type="checkbox"/>	Expected by uncovered parking areas.
Toxic Organic Compounds	E <input type="checkbox"/>	N <input checked="" type="checkbox"/>	Per TGD, Table 2.1 this pollutant is not expected for attached residential developments.
Trash and Debris	E <input checked="" type="checkbox"/>	N <input type="checkbox"/>	Expected by proposed residence.

Hydrologic Conditions of Concern

A 2-year hydrologic analysis has been prepared as part of the separate hydrology study. Due to the nature of the development, the post project 2-year flow and volumes will increase slightly. Refer to Appendix F for hydrologic calculations. The project outlets to an improved channel. Fletcher Channel (E10) and the Santa Ana River (E01) are both fully engineered and are not subject to Hydrologic Conditions of Concern.

The 2-year volume from the site will be limited to that of the pre-developed condition. The difference in volume will be retained onsite within storage and infiltration chambers. An Infiltration gallery has been proposed under the main driveway. The chambers have been sized to maximum the benefits of infiltration. Landscape areas have also been depressed 2" to allow for maximum onsite retention of storm water runoff.

Post Development Drainage Characteristics

The proposed development will result in a significant alteration of the site's impervious areas. The impervious area will decrease from an existing 91% to 81% in the developed condition. To facilitate proper grading for the proposed development, the site will be slightly raised. Despite this change in topography, the drainage patterns will continue to

direct stormwater towards Fletcher Avenue, utilizing a system of street gutters, storm drain inlets, and pipes. The drainage will be collected and diverted to an underground infiltration gallery located in the main drive aisle. Before entering the chambers, the runoff will be filtered to remove large trash and other items. The underground chambers have a debris cell to also collect trash and particulates before dispersing to the rest of the chambers for infiltration. Drain boxes in the private drive will have fossil filter and trash racks to collect and treat the pavement runoff. Yard drains will connect to the infiltration chambers through the Debris Cells directly as they will not contain much trash or debris due to their locations in landscaped areas. Overflow from the system will divert to the street via sheet flow.

Residential Projects

This project will utilize the City of Orange's Small Lot Subdivision standards and the lot sizes will range from 1,372 SF to 1,760 SF. All of the units are same floor plan and will include 3-stories. The first floor will contain the 2-car garage and a bedroom with on-suite bathroom. The second floor will contain common living area such as the kitchen, dining room, and living room spaces, as well as a small powder room. The third floor has 3 bedrooms including a primary bedroom with on-suite bathroom and walk-in closet. The other 2 bedrooms will share a common bathroom. A second floor balcony is proposed on the private yard side of the house, but no rooftop decks.

The community will feature a small open space and 9 guest parking spaces. The open space will be manicured turf for a small dog park. A bench and a trash receptacle will be provided, as well as a sand dog run.

Site Ownership and any Easements

A homeowner's association will be formed to manage the common areas of the community. The residences will be owned by fee simple deeded homeowners.

III. Site Description

Refer to Section 2.3 of the Technical Guidance Document for completion of this section

Reference Location Map:

Site Address: 705 & 715 W Fletcher Ave, Orange CA

Zoning: R3 (Residential Multifamily)

Predominant Soil type: Group "B"

Pre-project percent pervious: 9% **Post-project percent pervious:** 19%

Pre-project percent impervious: 91% **Post-project percent impervious:** 81%

Percent Change in Impermeable Surfaces: -10%

Site Characteristics

The existing vacant site, but most recently was used for a commercial business (buildings, vehicle parking, office, material storage, small amount of landscaping near the front) is relatively flat with drainage towards Fletcher Ave. A small drainage basin was constructed in the southwest corner potentially to capture the runoff from the undeveloped site.

From a depth of 1 foot to 10 feet, fill material was encountered from past uses as an orchard. Below the fill, young alluvium soil deposits common to the area as it is in the Santa Ana River floodplain. Groundwater was not encountered during the Geotechnical exploration, but historical records show groundwater could be found at a depth of 15 feet or more.

Watershed Characteristics

Watershed: Orange County Flood Control Watershed E Lower Santa Ana River

Downstream Receiving Waters: Fletcher Channel, Santa Ana River Reach 1

Water Quality Impairments (if applicable): None.

Identify hydromodification susceptibility: All receiving watercourses are concrete lined or reinforced, therefore no hydromodification susceptibility is possible.

Identify watershed management priorities: None.

IV. Best Management Practices

This section describes the selection of BMPs for the project and how they are able to treat the pollutants targeted. Refer to Section 2.4 of the Technical Guidance Document for additional information.

For any selected BMP with the potential to have nuisance water (standing water) within the BMP please discuss the process to address this potential problem in the vector control paragraph IV.6

IV.1 Site Design and Drainage Characteristics

**Table 1
Site Design BMPs**

Technique	Included?		If no, state justification.
	Yes	No	
Minimize Directly Connected Impervious Areas (DCIAs) (C-Factor Reduction)	X		
Create Reduced or "Zero Discharge" Areas (Runoff Volume Reduction) ¹	X		
Minimize Impervious Area/Maximize Permeability (C-Factor Reduction) ²	X		
Conserve Natural Areas (C-Factor Reduction)		X	No natural areas exist on the site.

1 Detention and retention areas incorporated into landscape design provide areas for retaining and detaining stormwater flows, resulting in lower runoff rates and reductions in volume due to limited infiltration and evaporation. Such Site Design BMPs may reduce the size of Treatment Control BMPs.

2 The "C Factor" is a representation of the ability of a surface to produce runoff. Surfaces that produce higher volumes of runoff are represented by higher C Factors. By incorporating more pervious, lower C Factor surfaces into a development, lower volumes of runoff will be produced. Lower volumes and rates of runoff translate directly to lowering treatment requirements.

Minimize Directly Connected Impervious Areas (DCIAs)

Site has been designed so that impervious areas such as roofs and pavement will drain directly to pervious areas. The proposed pervious areas will consist of landscape planters with area drain inlet spaced apart to allow the runoff to filter through and infiltrate in the planters. Roof downspouts will be directly connected to the proposed planters.

Create Reduced or "Zero Discharge" Areas

The proposed infiltration gallery will promote infiltration with the use of stormwater detention below the ground. Infiltration will recharge the subsurface groundwater, therefore providing an overall runoff volume reduction.

Minimize Impervious Areas/ Maximize Permeability

To the extent possible, the project will maximize the amount of pervious surfaces.

IV.2 Source Control BMPs

IV.2.1 Routine Non-Structural BMPs

**Table 2
Routine Non-Structural BMPs**

BMP No.	Name	Check One		If not applicable, state brief reason.
		Included	Not Applicable	
N1	Education for Property Owners, Tenants and Occupants	X		
N2	Activity Restriction	X		
N3	Common Area Landscape Management	X		
N4	BMP Maintenance	X		
N5	Title 22 CCR Compliance		X	Not applicable to this project
N6	Local Water Quality Permit Compliance		X	This BMP is not applicable. The City of Orange does not issue water quality permits.
N7	Spill Contingency Plan		X	Not applicable to project
N8	Underground Storage Tank Compliance		X	Not applicable to project
N9	Hazardous Materials Disclosure Compliance		X	Not applicable to project
N10	Uniform Fire Code Implementation		X	Not applicable to project
N11	Common Area Litter Control	X		
N12	Employee Training		X	Not applicable to project
N13	Housekeeping of Loading Docks		X	Not applicable to project
N14	Common Area Catch Basin Inspection	X		
N15	Street Sweeping Private Streets and Parking Lots	X		

N1. Education for Employees and Occupants

Practical informational materials will be provided to owners, occupants and employees on general good housekeeping practices that contribute to protection of storm water quality. Among other things, these materials will describe the use of chemicals (including household type) that should be limited to the property, with no discharge of specified wastes via hosing or other direct discharge to gutters, catch basins and storm drains. The property owner will provide these materials. Thereafter, such materials will be available through the property owner education program. This program must be maintained, enforced, and updated periodically by the property owner. Educational materials including, but not limited to, the materials included in the Appendix B section of this plan will be made available to the employees and contractors of the property owner.

N2. Activity Restrictions

CC&Rs will be recorded for the subject site and will implement all restrictions as conditions. These will also cover any restrictions as denoted in the final set of conditions of approve as provided by the subject site. Restrictions shall include, but not limited to car washing, washing of any hard pavement such as sidewalks, parking lots, streets, mandatory pet waste management, etc.

N3. Common Area Landscape Management

Management programs will be designed and established by the property owner, who will maintain the common areas within the project site. These programs will include how to mitigate the potential dangers of fertilizer and pesticide usage (refer to the Maintenance and Frequency Table – See project Operations and Maintenance Plan). Ongoing maintenance will be consistent with the City of Orange Model Water-Efficient Landscape Ordinance. Fertilizer and pesticide usage shall be consistent with City of Orange Guidelines for use of Fertilizers and Pesticides.

N4. BMP Maintenance

The appointed Home Owner’s Association (HOA) through use of their management contractors will be responsible for maintenance each of the BMPs detailed in this plan. Maintenance operations should be logged in Appendix D.

N11. Common Area Litter Control

The HOA and the contracted maintenance company will perform required common area litter control to remove any accumulated trash, debris and other litter.

N14. Catch Basin Inspection

The HOA will maintain the drainage systems, including catch basins and detention systems. The HOA is required to have catch basins inspected and, if necessary, cleaned prior to the storm season, no later than October 1st each year. These duties may be contracted out to the landscape maintenance firm hired by the property owner. Please see Appendix D for maintenance program. Maintenance operations should be logged in Appendix.

N15. Street Sweeping

The HOA shall have all streets swept on a weekly basis. This procedure will be intensified around October 15th of each year prior to the “first flush” storm. Use of mechanical (vacuum regenerative air) sweepers is recommended. All wash-water should be collected by the sweeper and treated before discharge to an approved discharge point.

IV.2.2 Routine Structural BMPs

Table 3
Routine Structural BMPs

Name	Check One		If not applicable, state brief reason
	Included	Not Applicable	
Provide storm drain system stenciling and signage- "No Dumping – Drains to Ocean"	X		
Design and construct outdoor material storage areas to reduce pollution introduction		X	Not applicable to project
Design and construct trash and waste storage areas to reduce pollution introduction		X	Not applicable to project
Use efficient irrigation systems & landscape design	X		
Protect slopes and channels and provide energy dissipation		X	There are no slopes or channels.
Incorporate requirements applicable to individual project features			
a. Dock areas		X	Not applicable to project
b. Maintenance bays		X	Not applicable to project
c. Vehicle or community wash areas		X	Not applicable to project
d. Outdoor processing areas		X	Not applicable to project
e. Equipment wash areas		X	Not applicable to project
f. Fueling areas		X	Not applicable to project
g. Hillside landscaping		X	Not applicable to project
h. Wash water control for food preparation areas		X	Not applicable to project
			Not applicable to project

Catch Basin Stenciling

Phrase "No Dumping – Drains to Ocean" to be stenciled on catch basins to alert the public to the destination of pollutants discharged into storm water. This stenciling will be inspected and re-stenciled on a periodic basis by the HOA. Please see Table (8) for maintenance frequency.

Efficient Irrigation

As part of the design of all common area landscape irrigation shall employ water conservation principals, including, but not limited to, such provisions as water sensors, programmable irrigation times (for short cycles), etc., will be used. Such common areas will be maintained by the HOA.

Runoff-Minimizing Landscape Design

As part of the design of all common area landscape areas, similar planting material with similar water requirements will be used in order to reduce excess irrigation runoff and promote surface filtration. Such common areas will be maintained by the home owners/HOA.

IV.3 Low Impact Development BMP Selection

Refer to Section 2.4.2.3 and 4.1 in the TGD for selecting LID BMPs.

IV.3.1 Hydrologic Source Controls

Select from the following table all hydrologic source control BMPs that are used by the project and identify in Site Plan. See Section 4.2 of Technical Guidance Document for additional information.

**Table 4
Hydrologic Source Control BMPs**

Name	Check If Used
Localized on-lot infiltration	<input checked="" type="checkbox"/>
Impervious area dispersion (e.g. roof top disconnection)	<input type="checkbox"/>
Street trees (canopy interception)	<input type="checkbox"/>
Residential rain barrels (not actively managed)	<input type="checkbox"/>
Green roofs/Brown roofs	<input type="checkbox"/>
Blue roofs	<input type="checkbox"/>
Other:	<input type="checkbox"/>

Downspouts from roof drains will be directed to landscape areas or connected to the underground infiltration gallery where landscape planters are not located.

IV.3.2 Infiltration BMPs

Identify infiltration BMPs to be used in project. See Section 2.4.2.4 of the Technical Guidance Document for infiltration infeasibility criteria and 4.3 for information of BMP selection.

**Table 5
Infiltration BMPs**

Name	Check If Used
Bioretention without underdrains	<input type="checkbox"/>
Rain gardens	<input type="checkbox"/>
Porous landscaping	<input type="checkbox"/>
Infiltration planters	<input type="checkbox"/>
Retention swales	<input type="checkbox"/>
Infiltration trenches	<input type="checkbox"/>
Infiltration basins	<input type="checkbox"/>
Drywells	<input type="checkbox"/>
Subsurface infiltration galleries	<input checked="" type="checkbox"/>
French drains	<input type="checkbox"/>
Permeable asphalt	<input type="checkbox"/>
Permeable concrete	<input type="checkbox"/>
Permeable concrete pavers	<input type="checkbox"/>
Other:	<input type="checkbox"/>
Other:	<input type="checkbox"/>

Infiltration galleries capture and store stormwater underground and infiltrate the runoff over a longer period of time allowing more volume to be detained on site. The catch basins located in the driveway will have pre-treatment filters installed to capture large particulates and some oils and grease present in the runoff.

IV.3.3 Evapotranspiration, Rainwater Harvesting BMPs

Identify any evapotranspiration and/or, rainwater harvesting BMPs used by the project. See Section 4.4 and 4.4 of the Technical Guidance Document for additional information. (Delete if not used).

Table 6
Evapotranspiration, Rainwater Harvesting BMP

Name	Check If Used
<i>All HSCs; See Section IV.3.1</i>	<input type="checkbox"/>
Surface-based infiltration BMPs	<input type="checkbox"/>
Biotreatment BMPs	<input type="checkbox"/>
Above-ground cisterns and basins	<input type="checkbox"/>
Underground detention	<input type="checkbox"/>
Other:	<input type="checkbox"/>
Other:	<input type="checkbox"/>
Other:	<input type="checkbox"/>

None.

IV.3.4 Biotreatment BMPs

Describe any biotreatment BMPs used in the project and include separate sections for selection, suitability, sizing, and infeasibility, as applicable. See Section 4.6 of the Technical Guidance Document for additional information.

**Table 7
Biotreatment BMPs**

Name	
Bioretention with underdrains	<input type="checkbox"/>
Storm water planter boxes with underdrains	<input type="checkbox"/>
Rain gardens with underdrains	<input type="checkbox"/>
Constructed wetlands	<input type="checkbox"/>
Vegetated swales	<input type="checkbox"/>
Vegetated filter strips	<input type="checkbox"/>
Proprietary vegetated biotreatment systems	<input type="checkbox"/>
Wet extended detention basin	<input type="checkbox"/>
Dry extended detention basins	<input type="checkbox"/>
Other:	<input type="checkbox"/>
Other:	<input type="checkbox"/>

None.

IV.3.5 Hydromodification Control BMPs

None.

IV.3.6 Regional/Sub-Regional LID BMPs

None.

IV.3.7 Treatment Control BMPs

Pre-filter BMPs are used in each catch basin within the driveway to capture any debris and to filter out oils and grease from runoff before entering the infiltration gallery.

IV.4 Water Quality Credits

None.

IV.5 Alternative Compliance Plan

None.

IV.6 Vector Control

Stored runoff will be held underground and infiltrated within 48 hours, therefore vector issues should not be a problem.

IV.7 Drainage Management Area (DMA)

Describe each DMA used in project, the BMPs in each DMA and the area treated.

DMA Number	BMPs	Area Treated (ac)
1	StormTech Flo-gard	0.72
Total Area		0.72

IV.8 Calculations

Please see calculation worksheets located in Appendix C.

V. Implementation, Maintenance and Inspection Responsibility for BMPs (O&M Plan)

Responsible Party Information (Local Contact Information)

Name: Matt Hamilton Title: Manager

Company: ADC Fletcher 15, LLC Phone Number: 949-791-8401

Table 8 - Frequency Inspection Matrix

BMP	Responsible Party	*Maintenance Activity	*Inspection/Maintenance Frequency
Source Control BMPs (Structural and Non-structural)			
N1. Education for Property Owners, Tenants, Occupants & Employees	Owner/ HOA	Owner/ HOA to provide education material, a copy of the approved WQMP and Operation & Maintenance Plan (O&M) to new property owners, tenants, occupants & employees.	Each new homeowner will receive information along with the CC&Rs.
N2. Activity Restrictions	Owner/ HOA	No vehicle maintenance or equipment washing will be permitted.	Restrictions shall be enforced daily.
N3. Common Area Landscape Management	Owner/ HOA	Owner/ HOA to appoint professional landscape company to conduct maintenance of landscaping to meet current water efficiency and keep plants healthy and bio areas maintained with proper soil amendments. Ensure erosion from downspouts does not impact planters (add splash blocks or rock	Regular maintenance once a week and monthly inspection to determine deficiencies.

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		pads).	
N4. BMP Maintenance	Owner/ HOA	Owner/ HOA to hire professional BMP maintenance company to conduct regular inspections, repairs and cleanings per specifications stated in this manual.	A minimum 2 inspections/ cleanings per year starting on or near October 1st (before the rainy season)
N11. Common Area Litter Control	Owner/ HOA	Owner/ HOA to provide litter removal of site parking lot and landscape areas and to empty common area trash bins.	Once per week.
N12. Employee Training	HOA	HOA to provide proper employee training for all site concerns.	At the time of employment or when there is a policy change.
N14. Common Area Catch Basin Inspection	Owner/ HOA	Common inspections should occur weekly or prior to any significant storm events by method of clearing any trash/ debris from the catch basin.	On a weekly basis.
N15. Street Sweeping	HOA	Sweeping should occur once per week.	On a weekly basis.
S1. Storm Drain System Stenciling & Signage	Owner/ HOA	Owner/ HOA to inspect and repair as needed all on-site storm drain stenciling & signage.	Inspection should occur at minimum twice per year.
S2. Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control	Owner/ HOA	Owner/ HOA to provide maintenance of landscaping to meet current water efficiency standards, and keep plants healthy.	Regular maintenance once a week and monthly inspection to determine deficiencies.
Low Impact Development and Treatment BMPs			
Infiltration Gallery (StormTech)	Owner/ HOA	Inspect, clean, repair and replace as needed, annually.	Inspections/ Cleanings should occur at least once per year and before the start of the rainy season (October 1st). Refer to

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			Attachment C for additional information and manufacturer's specifications.
Pre-treatment Catch Basin Filters (FloGard)	Owner/ HOA	Inspect, clean, repair and replace as needed.	Inspection shall occur a minimum of three times per year and a change of filter media once per year. Any repairs/ replacement needed shall be conducted immediately.

*Attached in appendix additional inspection, maintenance and operations information if required.

Regulatory Permits

None.

Funding

Funding will be through the HOA dues collected from each homeowner and as appointed by the HOA.

OWNER SELF CERTIFICATION STATEMENT

As the owner representative of the “Fletcher 15” for which a Water Quality Management Plan (WQMP) was approved by the City, I hereby certify under penalty of law that all Best Management Practices contained within the approved Project WQMP have been maintained and inspected in accordance with the schedule and frequency outlined in the approved WQMP Maintenance Table.

The maintenance activities and inspections conducted are shown in the attached table and have been performed by qualified and knowledgeable individuals. Structural Treatment BMPs have been inspected and certified by a Licensed Professional Engineer.

To the best of my knowledge, the information submitted is true and accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and citations for violating water quality regulations.

Signature: _____ Date: _____
Name: _____
Title: _____
Company: _____
Address: _____
Telephone: _____

BMP Implementation Tracking Table

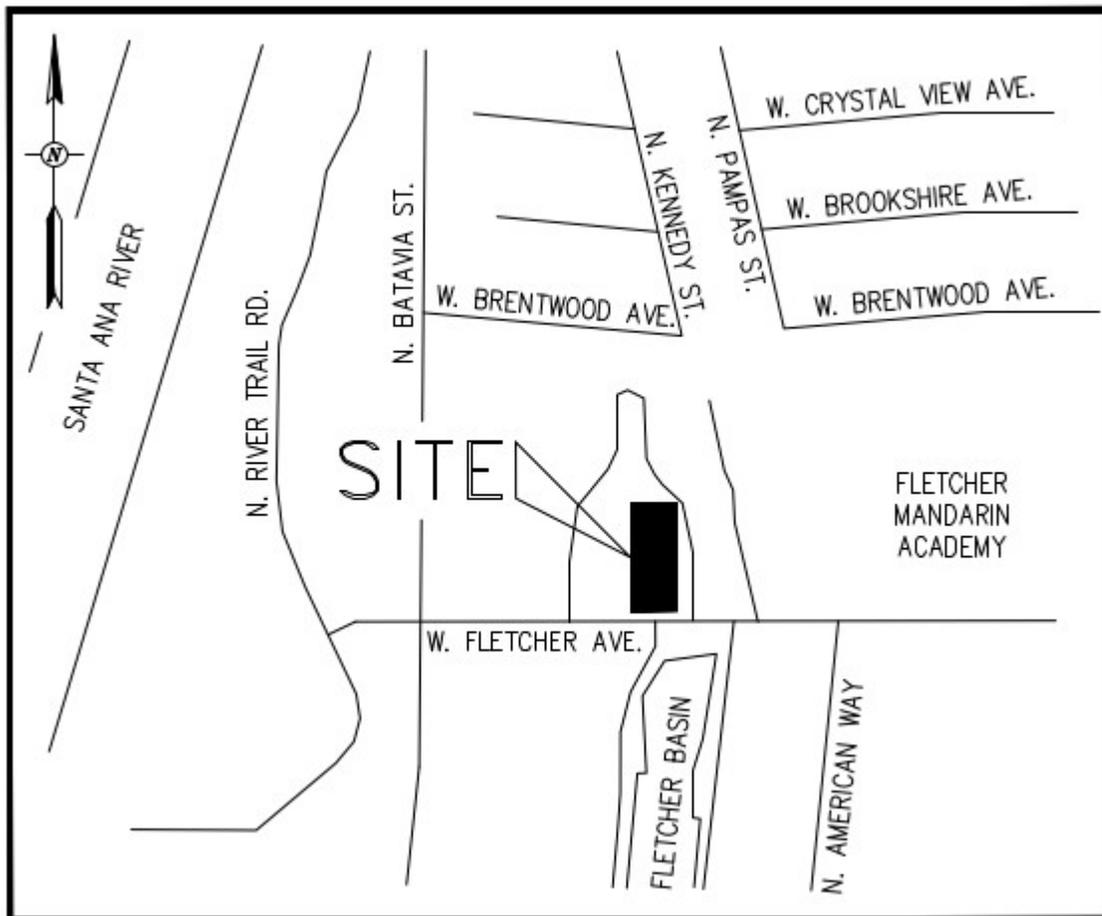
BMP	Activity	Completion Dates or Frequency	Initial
Source Control BMPs (Structural and Nonstructural)			
N1. Education for Property Owners, Tenants & Occupants	Owner/ HOA to provide education material, a copy of the approved WQMP and Operation & Maintenance Plan (O&M) to new property owners, tenants, occupants & employees.		
N2. Activity Restriction	No vehicle maintenance or equipment washing will be permitted.		
N3. Common Area Landscaped Management	Owner/ HOA to appoint professional landscape company to conduct maintenance of landscaping to meet current water efficiency and keep plants healthy and bio areas maintained with proper soil amendments.		
N4. BMP Maintenance	Owner/ HOA to hire professional BMP maintenance company to conduct regular inspections, repairs and cleanings per specifications stated in this manual.		
N11. Common Area Litter Control	Owner/ HOA to provide litter removal of site parking lot and landscape areas and to empty common area trash bins.		
N12. Employee Training	HOA to provide proper employee training for all site concerns.		
N14. Common Area Catch Basin Inspection	Common inspections should occur weekly or prior to any significant storm events by method of clearing any trash/ debris from the catch basin.		
N15. Street Sweeping	Sweeping should occur once per week.		
S1. Storm Drain System Stenciling & Signage	Owner/ HOA to inspect and repair as needed all on-site storm drain stencilling & signage.		
S2. Use Efficient Irrigation Systems	Owner/ HOA to provide maintenance of landscaping to meet current water efficiency standards, and keep plants		

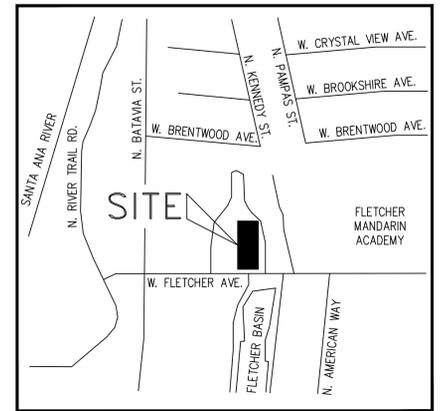
& Landscape Design	healthy.		
Low Impact Development and Treatment BMPs			
Infiltration Gallery (StormTech)	Inspect, clean, repair and replace as needed, annually.		
Pre-treatment Catch Basin filters (FloGard)	Inspect, clean, repair and replace as needed, annually.		

(Please make a copy of these sheets before completing)

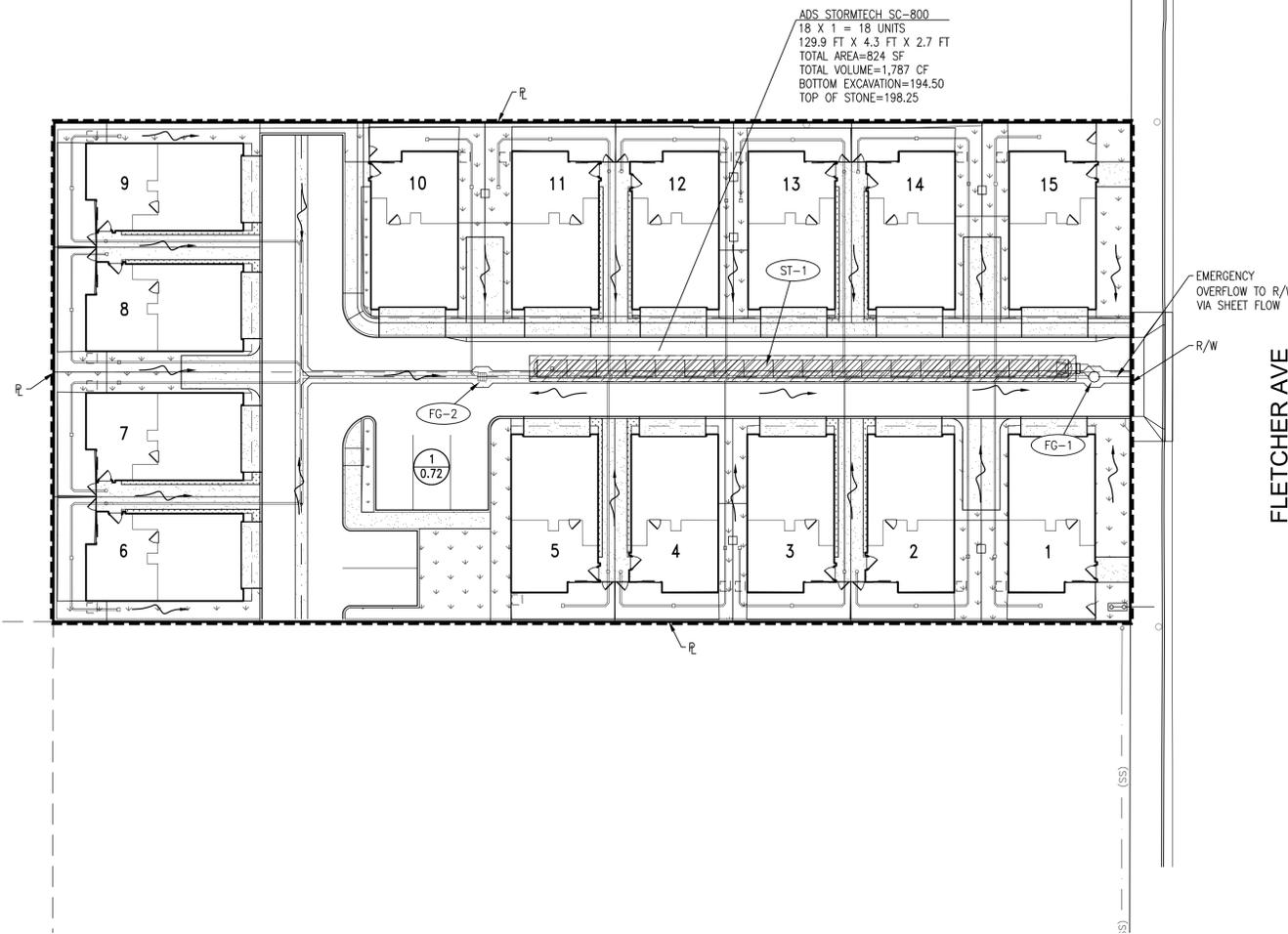
- * This sheet is to be submitted annually with the Owner Self Certification Statement.
- ** Structural Treatment BMPs should be certified by a Licensed Professional Engineer.

VI. Location Map, Site Plan, and BMP Details





VICINITY MAP
NTS



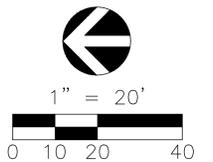
DMA ID	DMA AREA (AC.)	DMA SURFACE TYPE	DMA TREATMENT TYPE	BMP ID	BMP TYPE	BMP DIMENSIONS L x W x D (FT)
DMA-1	0.72	LANDSCAPE + HARDSCAPE	DRAINS TO BMP	FG-1/FG-2	PRE-TREATMENT	N/A
				ST-1	UNDERGROUND STORAGE W/ INF	130 X 4.3 X 2.7

STORMWATER BMP STATEMENT

STORMWATER BMPs ON THIS PROJECT ARE DESIGNED FOR COMPLIANCE WITH LOCAL, STATE, AND FEDERAL WATER QUALITY REQUIREMENTS. BMP DESIGN MUST NOT BE CHANGED WITHOUT PRIOR APPROVAL BY THE DESIGN ENGINEER AND CITY OF ORANGE. ADDITIONAL REPORTS, DOCUMENTS, OR DESIGNS WILL BE REQUIRED WITH IMPLEMENTATION OF CHANGES.

LEGEND:

- GENERAL FLOW DIRECTION
- DMA BOUNDARY
- PROPERTY BOUNDARY
- DMA ID
DMA AREA (AC)
- UNDERGROUND STORAGE W/ INFILTRATION (STORMTECH)
- FILTER TREATMENT DEVICE (FLOGARD)
- LANDSCAPE AREA
- INFILTRATION GALLERY



REVISIONS			
NO.	DATE	DESCRIPTION	APPROVED

DIGALERT

 DIAL TOLL FREE
 811 or
 1-800-422-4133
 AT LEAST TWO DAYS
 BEFORE YOU DIG
 UNDERGROUND SERVICE ALERT(USA) OF SOUTHERN CALIFORNIA

PREPARED BY:
MFKessler
 Civil Engineering, Land Planning, Surveying
 ONE VENTURE, STE. 130
 IRVINE, CA 92618
 PHONE: (949) 339-5330
 CONTACT: ALI MONSHIZADEH



CITY OF ORANGE
 OFFICE OF THE CITY ENGINEER
BMP EXHIBIT
 WATER QUALITY MANAGEMENT PLAN
 SCALE: HORIZ.: SEE PLAN
 VERT.: SEE PLAN
 SHEET No. 1 OF 1
 DRAWN BY: STAFF
 PROJECT NUMBER
 CHECKED BY: AM

ALI MONSHIZADEH, R.C.E. No. C67674

DATE

PROJECT INFORMATION	
ENGINEERED PRODUCT MANAGER	
ADS SALES REP	
PROJECT NO.	



FLETCHER 15

ORANGE, CA, USA

SC-800 STORMTECH CHAMBER SPECIFICATIONS

- CHAMBERS SHALL BE STORMTECH SC-800.
- CHAMBERS SHALL BE ARCH-SHAPED AND SHALL BE MANUFACTURED FROM VIRGIN, IMPACT-MODIFIED POLYPROPYLENE COPOLYMERS.
- CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
- CHAMBER ROWS SHALL PROVIDE CONTINUOUS, UNOBSTRUCTED INTERNAL SPACE WITH NO INTERNAL SUPPORTS THAT WOULD IMPEDE FLOW OR LIMIT ACCESS FOR INSPECTION.
- THE STRUCTURAL DESIGN OF THE CHAMBERS, THE STRUCTURAL BACKFILL, AND THE INSTALLATION REQUIREMENTS SHALL ENSURE THAT THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, SECTION 12.12, ARE MET FOR: 1) LONG-DURATION DEAD LOADS AND 2) SHORT-DURATION LIVE LOADS, BASED ON THE AASHTO DESIGN TRUCK WITH CONSIDERATION FOR IMPACT AND MULTIPLE VEHICLE PRESENCES.
- CHAMBERS SHALL BE DESIGNED AND ALLOWABLE LOAD CONFIGURATIONS DETERMINED IN ACCORDANCE WITH ASTM F2787, "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS". LOAD CONFIGURATIONS SHALL INCLUDE: 1) INSTANTANEOUS (<1 MIN) AASHTO DESIGN TRUCK LIVE LOAD ON MINIMUM COVER 2) MAXIMUM PERMANENT (75-YR) COVER LOAD AND 3) ALLOWABLE COVER WITH PARKED (1-WEEK) AASHTO DESIGN TRUCK.
- REQUIREMENTS FOR HANDLING AND INSTALLATION:
 - TO MAINTAIN THE WIDTH OF CHAMBERS DURING SHIPPING AND HANDLING, CHAMBERS SHALL HAVE INTEGRAL, INTERLOCKING STACKING LUGS.
 - TO ENSURE A SECURE JOINT DURING INSTALLATION AND BACKFILL, THE HEIGHT OF THE CHAMBER JOINT SHALL NOT BE LESS THAN 2".
 - TO ENSURE THE INTEGRITY OF THE ARCH SHAPE DURING INSTALLATION, a) THE ARCH STIFFNESS CONSTANT SHALL BE GREATER THAN OR EQUAL TO 700 LBS/FT/%. THE ASC IS DEFINED IN SECTION 6.2.8 OF ASTM F2418. AND b) TO RESIST CHAMBER DEFORMATION DURING INSTALLATION AT ELEVATED TEMPERATURES (ABOVE 73° F / 23° C), CHAMBERS SHALL BE PRODUCED FROM REFLECTIVE GOLD OR YELLOW COLORS.
- ONLY CHAMBERS THAT ARE APPROVED BY THE SITE DESIGN ENGINEER WILL BE ALLOWED. UPON REQUEST BY THE SITE DESIGN ENGINEER OR OWNER, THE CHAMBER MANUFACTURER SHALL SUBMIT A STRUCTURAL EVALUATION FOR APPROVAL BEFORE DELIVERING CHAMBERS TO THE PROJECT SITE AS FOLLOWS:
 - THE STRUCTURAL EVALUATION SHALL BE SEALED BY A REGISTERED PROFESSIONAL ENGINEER.
 - THE STRUCTURAL EVALUATION SHALL DEMONSTRATE THAT THE SAFETY FACTORS ARE GREATER THAN OR EQUAL TO 1.95 FOR DEAD LOAD AND 1.75 FOR LIVE LOAD, THE MINIMUM REQUIRED BY ASTM F2787 AND BY SECTIONS 3 AND 12.12 OF THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS FOR THERMOPLASTIC PIPE.
 - THE TEST DERIVED CREEP MODULUS AS SPECIFIED IN ASTM F2418 SHALL BE USED FOR PERMANENT DEAD LOAD DESIGN EXCEPT THAT IT SHALL BE THE 75-YEAR MODULUS USED FOR DESIGN.
- CHAMBERS AND END CAPS SHALL BE PRODUCED AT AN ISO 9001 CERTIFIED MANUFACTURING FACILITY.
- MANIFOLD SIZE TO BE DETERMINED BY SITE DESIGN ENGINEER. SEE TECH NOTE #6.32 FOR MANIFOLD SIZING GUIDANCE. DUE TO THE ADAPTATION OF THIS CHAMBER SYSTEM TO SPECIFIC SITE AND DESIGN CONSTRAINTS, IT MAY BE NECESSARY TO CUT AND COUPLE ADDITIONAL PIPE TO STANDARD MANIFOLD COMPONENTS IN THE FIELD.
- ADS DOES NOT DESIGN OR PROVIDE MEMBRANE LINER SYSTEMS. TO MINIMIZE THE LEAKAGE POTENTIAL OF LINER SYSTEMS, THE MEMBRANE LINER SYSTEM SHOULD BE DESIGNED BY A KNOWLEDGEABLE GEOTEXTILE PROFESSIONAL AND INSTALLED BY A QUALIFIED CONTRACTOR.

IMPORTANT - NOTES FOR THE BIDDING AND INSTALLATION OF THE SC-800 SYSTEM

- STORMTECH SC-800 CHAMBERS SHALL NOT BE INSTALLED UNTIL THE MANUFACTURER'S REPRESENTATIVE HAS COMPLETED A PRE-CONSTRUCTION MEETING WITH THE INSTALLERS.
- STORMTECH SC-800 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH SC-310/SC-740/SC-800/DC-780 CONSTRUCTION GUIDE".
- CHAMBERS ARE NOT TO BE BACKFILLED WITH A DOZER OR AN EXCAVATOR SITUATED OVER THE CHAMBERS. STORMTECH RECOMMENDS 3 BACKFILL METHODS:
 - STONESHOOTER LOCATED OFF THE CHAMBER BED.
 - BACKFILL AS ROWS ARE BUILT USING AN EXCAVATOR ON THE FOUNDATION STONE OR SUBGRADE.
 - BACKFILL FROM OUTSIDE THE EXCAVATION USING A LONG BOOM HOE OR EXCAVATOR.
- THE FOUNDATION STONE SHALL BE LEVELED AND COMPACTED PRIOR TO PLACING CHAMBERS.
- JOINTS BETWEEN CHAMBERS SHALL BE PROPERLY SEATED PRIOR TO PLACING STONE.
- MAINTAIN MINIMUM - 3" (75 mm) SPACING BETWEEN THE CHAMBER ROWS.
- EMBEDMENT STONE SURROUNDING CHAMBERS MUST BE A CLEAN, CRUSHED, ANGULAR STONE OR RECYCLED CONCRETE; AASHTO M43 #3, 357, 4, 467, 5, 56, OR 57.
- THE CONTRACTOR MUST REPORT ANY DISCREPANCIES WITH CHAMBER FOUNDATION MATERIALS BEARING CAPACITIES TO THE SITE DESIGN ENGINEER.
- ADS RECOMMENDS THE USE OF "FLEXSTORM CATCH IT" INSERTS DURING CONSTRUCTION FOR ALL INLETS TO PROTECT THE SUBSURFACE STORMWATER MANAGEMENT SYSTEM FROM CONSTRUCTION SITE RUNOFF.

NOTES FOR CONSTRUCTION EQUIPMENT

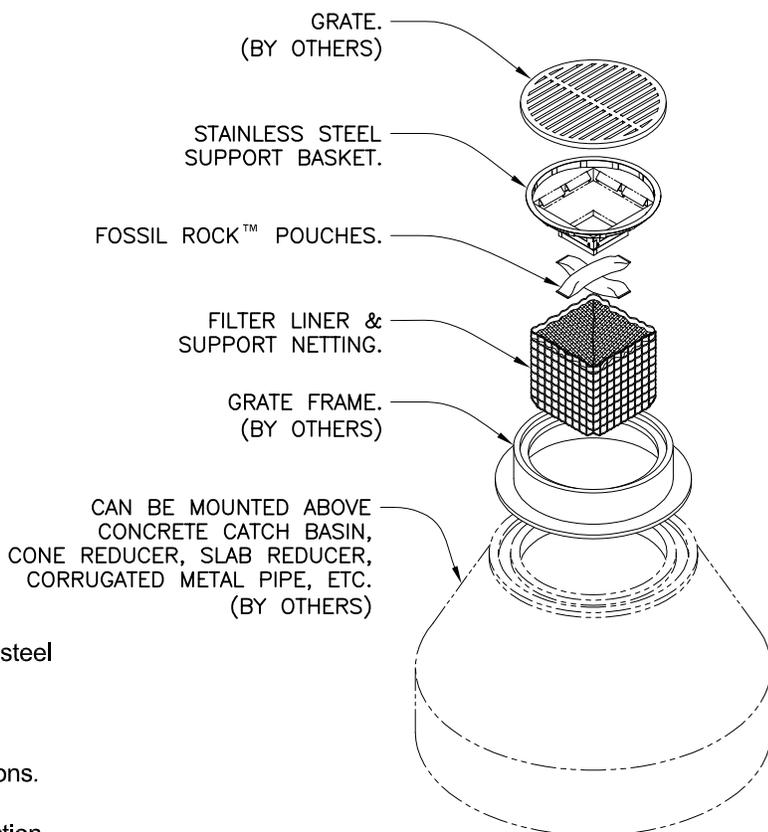
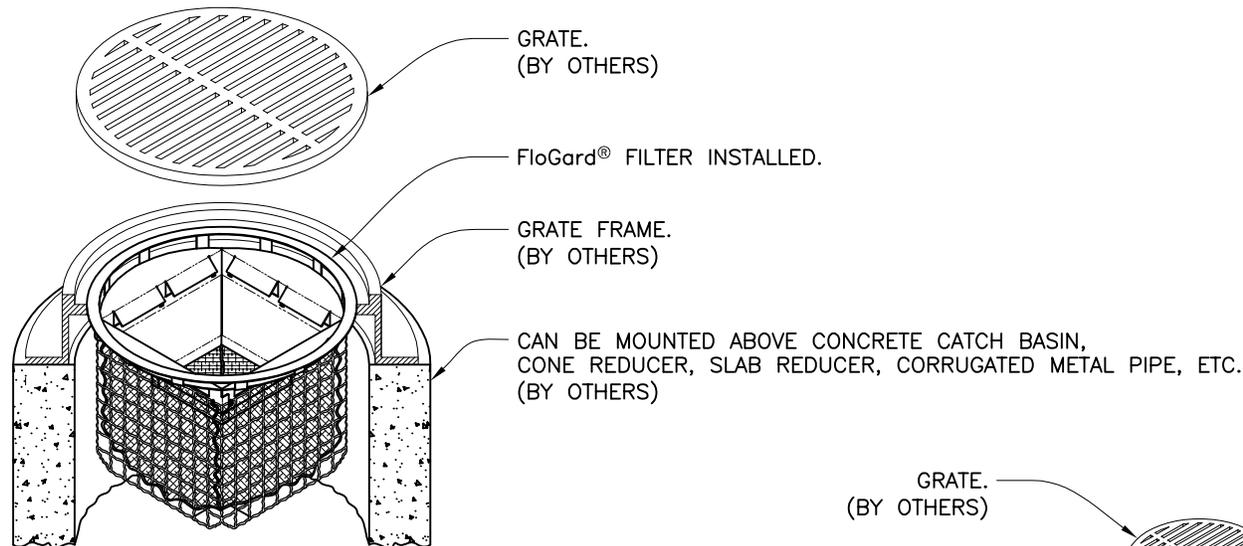
- STORMTECH SC-800 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH SC-310/SC-740/SC-800/DC-780 CONSTRUCTION GUIDE".
- THE USE OF CONSTRUCTION EQUIPMENT OVER SC-800 CHAMBERS IS LIMITED:
 - NO EQUIPMENT IS ALLOWED ON BARE CHAMBERS.
 - NO RUBBER Tired LOADERS, DUMP TRUCKS, OR EXCAVATORS ARE ALLOWED UNTIL PROPER FILL DEPTHS ARE REACHED IN ACCORDANCE WITH THE "STORMTECH SC-310/SC-740/SC-800/DC-780 CONSTRUCTION GUIDE".
 - WEIGHT LIMITS FOR CONSTRUCTION EQUIPMENT CAN BE FOUND IN THE "STORMTECH SC-310/SC-740/SC-800/DC-780 CONSTRUCTION GUIDE".
- FULL 36" (900 mm) OF STABILIZED COVER MATERIALS OVER THE CHAMBERS IS REQUIRED FOR DUMP TRUCK TRAVEL OR DUMPING.

USE OF A DOZER TO PUSH EMBEDMENT STONE BETWEEN THE ROWS OF CHAMBERS MAY CAUSE DAMAGE TO THE CHAMBERS AND IS NOT AN ACCEPTABLE BACKFILL METHOD. ANY CHAMBERS DAMAGED BY THE "DUMP AND PUSH" METHOD ARE NOT COVERED UNDER THE STORMTECH STANDARD WARRANTY.

CONTACT STORMTECH AT 1-800-821-6710 WITH ANY QUESTIONS ON INSTALLATION REQUIREMENTS OR WEIGHT LIMITS FOR CONSTRUCTION EQUIPMENT.

SPECIFIER CHART

MODEL NUMBER	INLET ID (Ø INCHES)	GRATE OD (Ø INCHES)	SOLIDS STORAGE CAPACITY (CU FT)	FILTERED FLOW (CFS)	TOTAL BYPASS CAPACITY (CFS)
FGP-RF15F	16	18	0.3	0.4	2.8
FGP-RF18F	18	20	0.8	0.7	4.7
FGP-RF20F	20	23	0.8	0.7	4.7
FGP-RF21F	21	23.5	0.8	0.7	4.7
FGP-RF22F	22	24	0.8	0.7	4.7
FGP-RF24F	24	26	0.8	0.7	4.7
FGP-RF30F	30	32	2.2	1.5	6.1
FGP-RF36F	36	39	3.6	2.0	8.1



EXPLODED VIEW

SCALE: 1/2

NOTES:

1. Filter insert shall have a high flow bypass feature.
2. Filter support frame shall be constructed from stainless steel Type 304.
3. Filter medium shall be *Fossil Rock™*, installed and maintained in accordance with manufacturer specifications.
4. Storage capacity reflects 80% of maximum solids collection prior to impeding filtering bypass.



Inlet Filtration

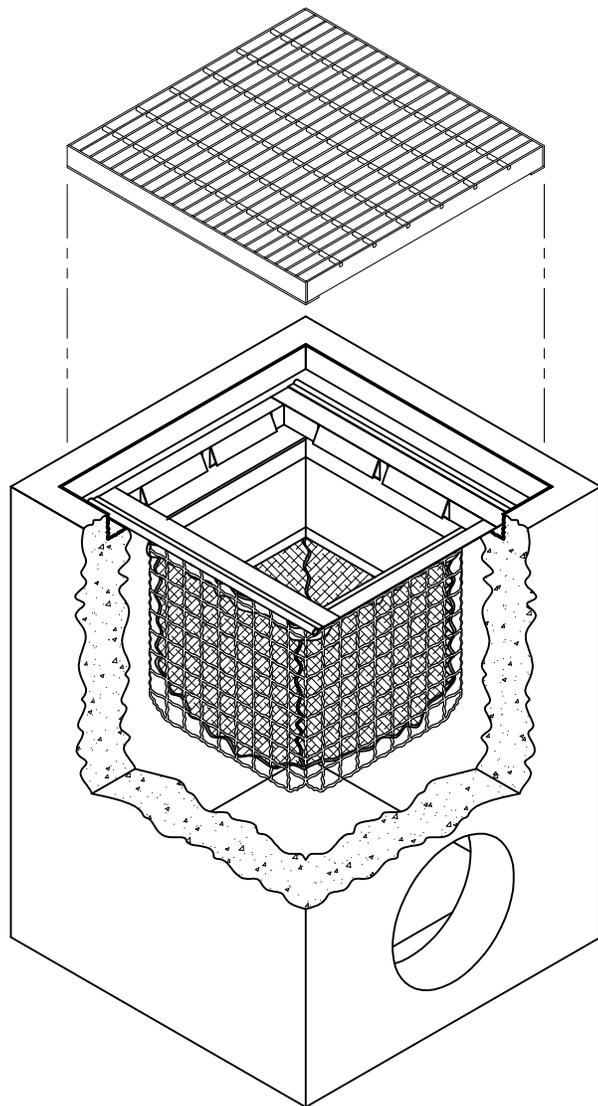
FloGard®
Catch Basin Insert Filter
Circular Frame Style



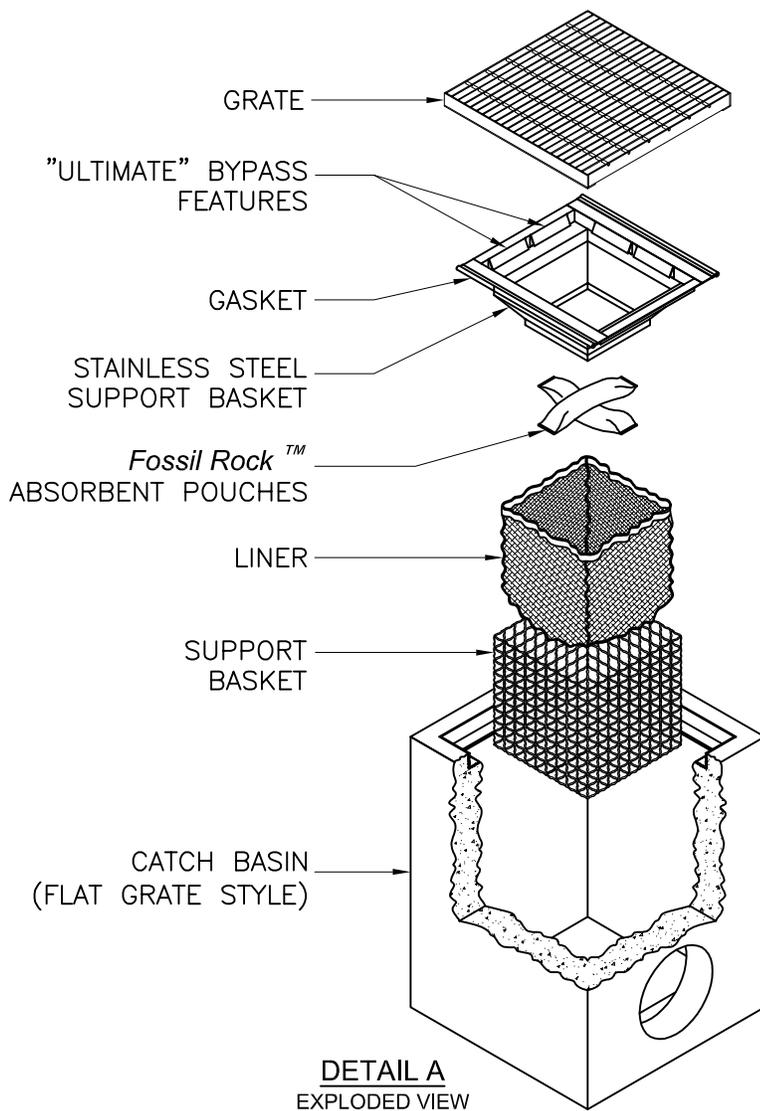
Oldcastle®
Stormwater Solutions

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DRAWING NO. FGP-0003	REV D	ECO ECO-0142	DATE JPR 7/13/16	DATE JPR 4/4/07	SHEET 1 OF 1
-------------------------	----------	-----------------	---------------------	--------------------	--------------



FloGard® FILTER
-INSTALLED INTO CATCH BASIN-



DETAIL A
EXPLODED VIEW

NOTES:

1. Filter insert shall have a high flow bypass feature.
2. Filter support frame shall be constructed from stainless steel Type 304.
3. Filter medium shall be *Fossil Rock™*, installed and maintained in accordance with manufacturer specifications.
4. Storage capacity reflects 80% of maximum solids collection prior to impeding filtering bypass.

U.S. PATENT # 6,00,023 & 6,877,029



Inlet
Filtration

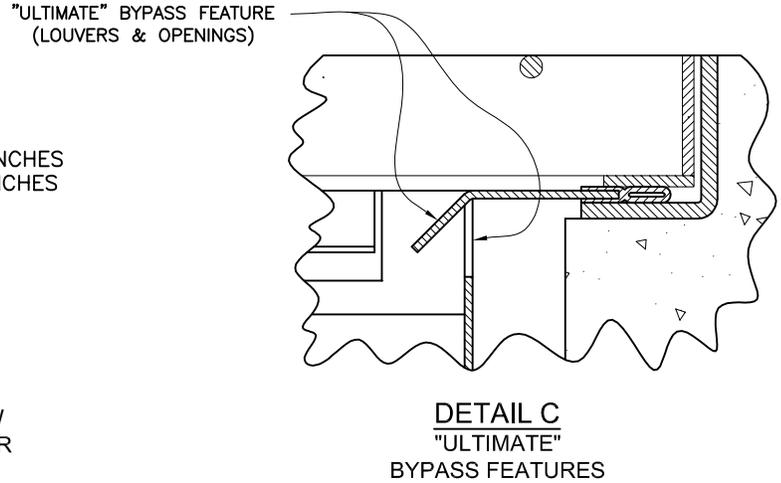
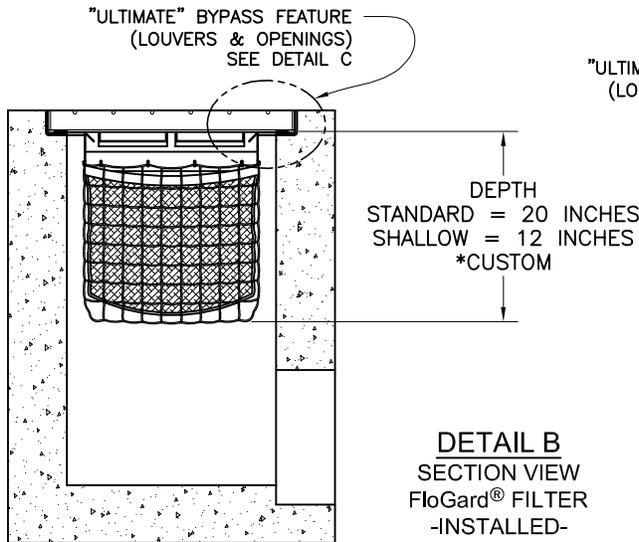
FloGard®
Catch Basin Insert Filter
Grated Inlet Style



Oldcastle®
Stormwater Solutions

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DRAWING NO. FGP-0001	REV G	ECO ECO-0142	DATE JPR 7/13/16	DATE JPR 11/3/06	SHEET 1 OF 2
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* MANY OTHER STANDARD & CUSTOM SIZES & DEPTHS AVAILABLE UPON REQUEST.

SPECIFIER CHART								
MODEL NO. STANDARD DEPTH	STANDARD & SHALLOW DEPTH (Data In these columns Is the same for both STANDARD & SHALLOW versions)			STANDARD DEPTH -20 Inches-		MODEL NO. SHALLOW DEPTH	SHALLOW DEPTH -12 Inches-	
	INLET ID Inside Dimension (inch x inch)	GRATE OD Outside Dimension (inch x inch)	TOTAL BYPASS CAPACITY (cu. ft. / sec.)	SOLIDS STORAGE CAPACITY (cu. ft.)	FILTERED FLOW (cu. ft. / sec.)		SOLIDS STORAGE CAPACITY (cu. ft.)	FILTERED FLOW (cu. ft. / sec.)
FGP-12F	12 X 12	12 X 14	2.8	0.3	0.4	FGP-12F8	.15	.25
FGP-16F	16 X 16	16 X 19	4.7	0.8	0.7	FGP-16F8	.45	.4
FGP-18F	18 X 18	18 X 20	4.7	0.8	0.7	FGP-18F8	.45	.4
FGP-1824F	16 X 22	18 X 24	5.0	1.5	1.2	FGP-1824F8	.85	.7
FGP-1836F	18 X 36	18 X 40	6.9	2.3	1.6	FGP-1836F8	1.3	.9
FGP-2024F	18 X 22	20 X 24	5.9	1.2	1.0	FGP-2024F8	.7	.55
FGP-21F	22 X 22	22 X 24	6.1	2.2	1.5	FGP-21F8	1.25	.85
→ FGP-24F	24 X 24	24 X 27	6.1	2.2	1.5	FGP-24F8	1.25	.85
FGP-2430F	24 X 30	26 X 30	7.0	2.8	1.8	FGP-2430F8	1.6	1.05
FGP-2436F	24 X 36	24 X 40	8.0	3.4	2.0	FGP-2436F8	1.95	1.15
FGP-2448F	24 X 48	26 X 48	9.3	4.4	2.4	FGP-2448F8	2.5	1.35
FGP-28F	28 X 28	32 X 32	6.3	2.2	1.5	FGP-28F8	1.25	.85
FGP-30F	30 X 30	30 X 34	8.1	3.6	2.0	FGP-30F8	2.05	1.15
FGP-36F	36 X 36	36 X 40	9.1	4.6	2.4	FGP-36F8	2.65	1.35
FGP-3648F	36 X 48	40 X 48	11.5	6.8	3.2	FGP-3648F8	3.9	1.85
FGP-48F	48 X 48	48 X 54	13.2	9.5	3.9	FGP-48F8	5.45	2.25
FGP-SD24F	24 X 24	28 X 28	6.1	2.2	1.5	FGP-SD24F8	1.25	.85



FloGard®
Catch Basin Insert Filter
Grated Inlet Style



Oldcastle®
Stormwater Solutions

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DRAWING NO. FGP-0001	REV G	ECO ECO-0142	DATE JPR 7/13/16	DATE JPR 11/3/06	SHEET 2 OF 2
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VII. Educational Materials

Refer to the City’s website www.cityoforange.org or the Orange County Stormwater Program (h2oc.org) for a library of materials available. Attach *only* the educational materials specifically applicable to the project.

Education Materials			
Residential Material (h2oc.org)	Check If Applicable	Business Material (h2oc.org)	Check If Applicable
The Ocean Begins at Your Front Door	<input checked="" type="checkbox"/>	Tips for the Automotive Industry	<input type="checkbox"/>
Tips for Car Wash Fund-raisers	<input type="checkbox"/>	Tips for Using Concrete and Mortar	<input type="checkbox"/>
Tips for the Home Mechanic	<input type="checkbox"/>	Tips for the Food Service Industry	<input type="checkbox"/>
Homeowners Guide for Sustainable Water Use	<input checked="" type="checkbox"/>	Proper Maintenance Practices for Your Business	<input type="checkbox"/>
Household Tips	<input checked="" type="checkbox"/>	Other Material	Check If Attached
Proper Disposal of Household Hazardous Waste	<input checked="" type="checkbox"/>		
Recycle at Your Local Used Oil Collection Center (North County)	<input checked="" type="checkbox"/>		<input type="checkbox"/>
Recycle at Your Local Used Oil Collection Center (Central County)	<input type="checkbox"/>		<input type="checkbox"/>
Recycle at Your Local Used Oil Collection Center (South County)	<input type="checkbox"/>		<input type="checkbox"/>
Tips for Maintaining a Septic Tank System	<input type="checkbox"/>		<input type="checkbox"/>
Responsible Pest Control	<input checked="" type="checkbox"/>		<input type="checkbox"/>
Sewer Spill Response	<input checked="" type="checkbox"/>		<input type="checkbox"/>
Tips for the Home Improvement Projects	<input checked="" type="checkbox"/>		<input type="checkbox"/>
Tips for Horse Care	<input type="checkbox"/>		<input type="checkbox"/>
Tips for Landscaping and Gardening	<input checked="" type="checkbox"/>		<input type="checkbox"/>
Tips for Pet Care	<input checked="" type="checkbox"/>		<input type="checkbox"/>
Tips for Pool Maintenance	<input type="checkbox"/>		<input type="checkbox"/>
Tips for Residential Pool, Landscape and Hardscape Drains	<input type="checkbox"/>		<input type="checkbox"/>
Tips for Projects Using Paint	<input checked="" type="checkbox"/>		<input type="checkbox"/>

Appendix A:
Conditions of Approval

Appendix B:

Educational Material

Below is a list of Educational Resource websites relevant to the project:

<https://h2oc.org/resources/view-order-brochures/business-brochures/>

<https://h2oc.org/resources/view-order-brochures/resident-brochures/>

<https://h2oc.org/resources/low-impact-development/low-impact-development-for-businesses/>

Appendix C:

BMP Details

SUBJECT TO FURTHER REVISION

LEGEND

- Orange County Precipitation Stations
- 24 Hour, 85th Percentile Rainfall (Inches)
- - - 24 Hour, 85th Percentile Rainfall (Inches) - Extrapolated
- City Boundaries

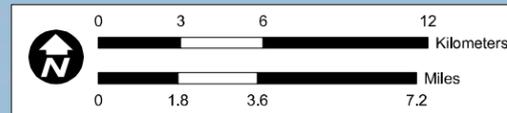
Rainfall Zones

Design Capture Storm Depth (inches)

- 0.65"
- 0.7
- 0.75
- 0.80
- 0.85
- 0.90
- 0.95
- 1.00
- 1.10"

Note: Events defined as 24-hour periods (calendar days) with greater than 0.1 inches of rainfall.
For areas outside of available data coverage, professional judgment shall be applied.

PROJECT SITE = 0.90"



RAINFALL ZONES

ORANGE COUNTY
TECHNICAL GUIDANCE
DOCUMENT

SCALE	1" = 1.8 miles
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	04/22/10
JOB NO.	9626-E



FIGURE
XVI-1

SUBJECT TO FURTHER REVISION

LEGEND

City Boundaries

Hydrologic Soil Groups

A Soils

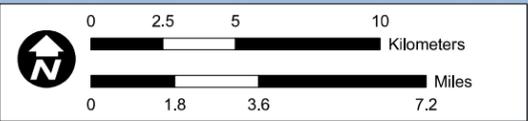
B Soils

C Soils

D Soils

Source:
Soils: Natural Resources Conservation Service (NRCS)
Soil Survey - soil_ca678, Orange County & Western Riverside
Date of publication: 2006-02-08
<http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm>

PROJECT SITE
B Soils



NRCS HYDROLOGIC
SOILS GROUPS

ORANGE COUNTY
INFILTRATION STUDY

SCALE	1" = 1.8 miles
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	02/09/11
JOB NO.	9526-E



FIGURE
XVI-2a

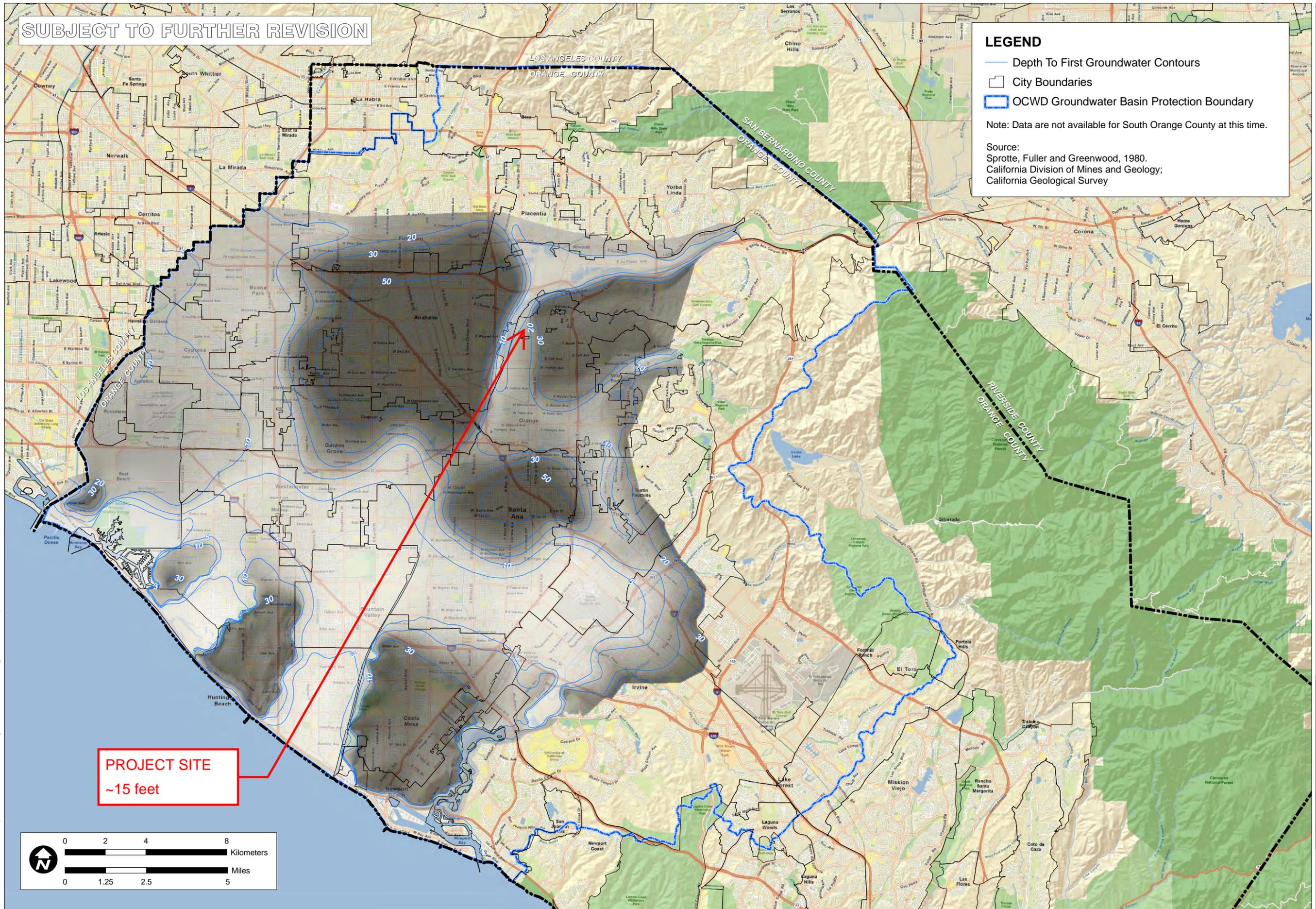
SUBJECT TO FURTHER REVISION

LEGEND

-  Depth To First Groundwater Contours
-  City Boundaries
-  OCWD Groundwater Basin Protection Boundary

Note: Data are not available for South Orange County at this time.

Source:
 Sprotte, Fuller and Greenwood, 1980.
 California Division of Mines and Geology;
 California Geological Survey



PROJECT SITE
 ~15 feet



NORTH ORANGE COUNTY
 MAPPED DEPTH TO FIRST
 GROUNDWATER

ORANGE COUNTY
 INFILTRATION STUDY

SCALE	1" = 1.25 miles
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	02/09/11
JOB NO.	9526-E



FIGURE
XVI-2d

P:\9526E\6-GIS\Mxds\Reports\Infiltration\Feasibility_20110215\9526E_FigureXVI-2d_DepthToGroundwaterOverview_20110215.mxd

SUBJECT TO FURTHER REVISION

LEGEND

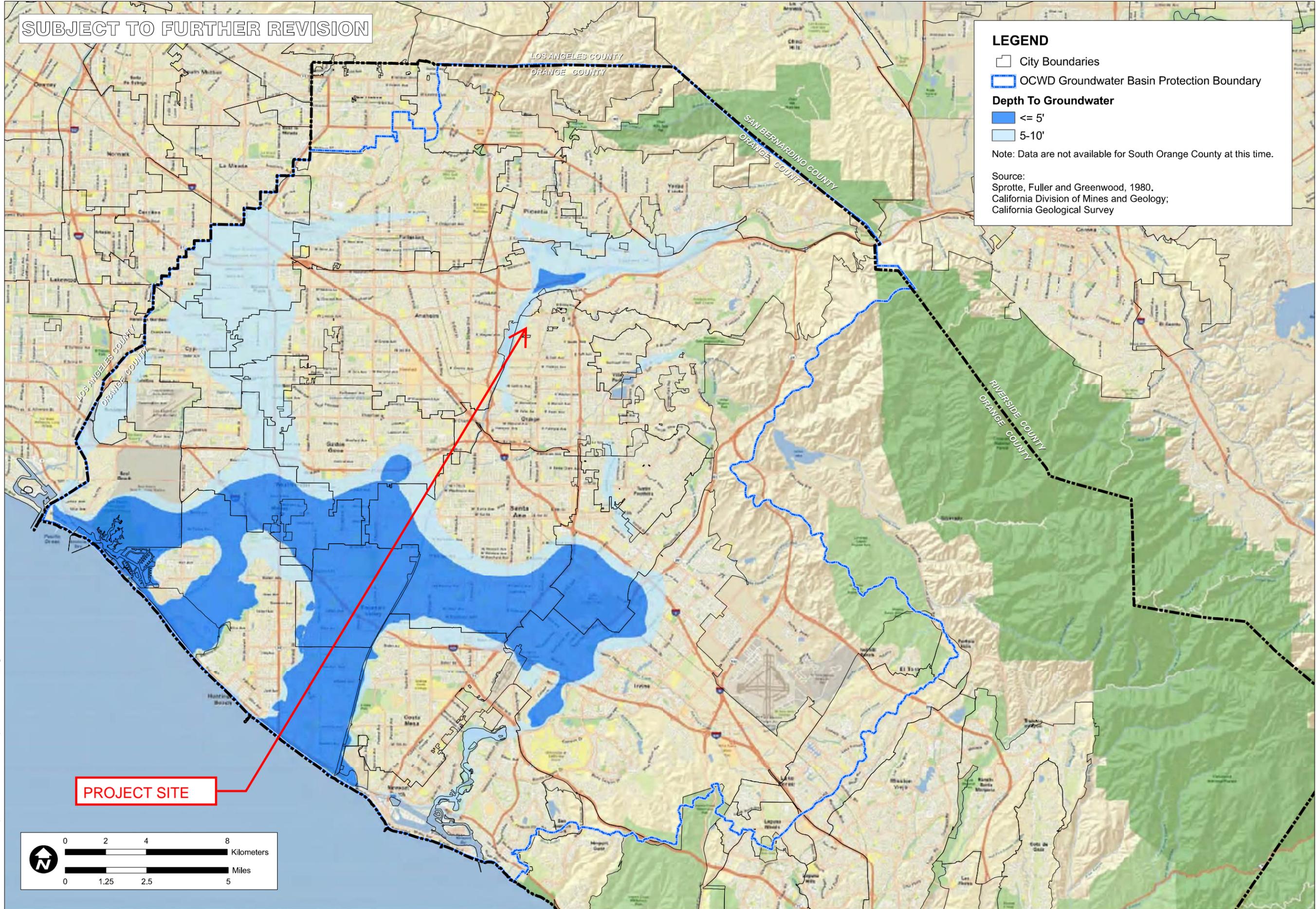
- City Boundaries
- OCWD Groundwater Basin Protection Boundary

Depth To Groundwater

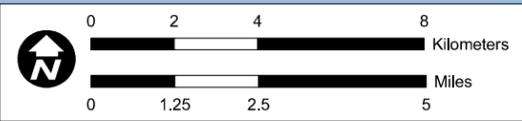
- <= 5'
- 5-10'

Note: Data are not available for South Orange County at this time.

Source:
Sprotte, Fuller and Greenwood, 1980.
California Division of Mines and Geology;
California Geological Survey



PROJECT SITE



TITLE
NORTH ORANGE COUNTY
MAPPED SHALLOW GROUNDWATER

JOB
ORANGE COUNTY
INFILTRATION STUDY
ORANGE CO. CA

SCALE	1" = 1.25 miles
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	02/09/11
JOB NO.	9526-E



FIGURE
XVI-2e

P:\9526E\6-CIS\Mxd\Reports\Infiltration\Feasibility_20110215\9526E_FigureXVI-2e_DepthToGroundwater15ft_20110215.mxd

SUBJECT TO FURTHER REVISION

LEGEND

- OCWD Groundwater Basin Protection Boundary
- City Boundaries

Infiltration Constraints

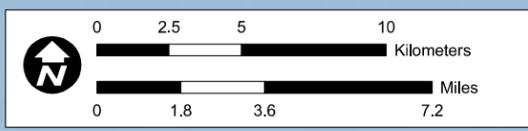
- 1 Constraint
- 2 Overlapping Constraints
- 3 Overlapping Constraints
- 4 Overlapping Constraints

Analysis Layers Included: 1. Hydrologic Soil Group D, 2. Landslide Hazard Zone, 3. Groundwater Protection Areas 4. Approximate Selenium Area, 5. Depth to Groundwater <= 5'

Note: Screening datasets are not exhaustive. The applicant should always conduct a review of available site-specific information relative to infiltration constraints as part of assessing the feasibility of stormwater infiltration.

Source;
Infiltration Constraint Analysis: PACE/Geosyntec

PROJECT SITE



INFILTRATION ANALYSIS
OVERLAPPING CONSTRAINT
LOCATIONS

ORANGE COUNTY
INFILTRATION STUDY

SCALE	1" = 1.8 miles
DESIGNED	TH
DRAWING	TH
CHECKED	BMP
DATE	04/22/10
JOB NO.	9526-E



FIGURE
XVI-2g

P:\9526E\6-CIS\Mxd\Reports\Infiltration\Feasibility_20110215\9526E_FigureXVI-2g_InfiltrationFinal_20110215.mxd

NOTICE

This drainage map has been prepared for information purposes only. The listed facilities have been determined from available information provided by public agencies, but may not be exact or up to date. The user of this map is responsible for verifying exact location, ownership and maintenance responsibilities of the drainage facilities. Additional information may be obtained from public plans and recorded deeds. Neither the County of Orange nor the Orange County Flood Control District (OCFCD) assumes any liabilities for inaccuracy of this map.

WATERSHED E

CITIES IN THE WATERSHED:

- ANAHEIM
- BREA
- COSTA MESA
- FOUNTAIN VALLEY
- GARDEN GROVE
- HUNTINGTON BEACH
- ORANGE
- PLACENTIA
- SANTA ANA
- UNINCORPORATED
- VILLA PARK
- YORBA LINDA

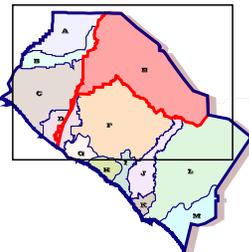
Project Site

- E01 Santa Ana River Channel
- E01P01 Prado Infiltration Line
- E01P02 Harbor-Edinger Storm Drain
- E01P14 Esperanza Road Storm Drain
- E01P63 Yorba Park Storm Drain
- E01P79 Southpark Storm Drain
- E01P80 Harbor Storm Drain
- E01PS1 Harbor-Edinger Pump Station
- E01PS2 Southpark Pump Station
- E01S01 East Richfield Storm Drain
- E01S02 Chantilly Storm Channel
- E01S04 Deerfield Storm Channel
- E01S09 Walnut Canyon Storm Channel
- E01S13 Eucalyptus Storm Channel

- E0S01 Center Street Storm Drain
- E07 Mesa Drive Storm Drain
- E07S01 El Modena Storm Drain
- E07S02 Cambridge Storm Drain
- E07S03 Chapman Grande Storm Drain
- E08P47 Lemon-Taft Storm Drain
- E08S01 Walnut Storm Channel
- E08S02 Alameda Storm Channel
- E08S06 Handy Creek Storm Channel
- E09 Gypsum Creek Channel
- E10 Fletcher Channel
- E10B01 Fletcher Retarding Basin
- E10P01 Fletcher Street Storm Drain
- E11 Bitterbush Channel
- E12 Southeast Anaheim Channel
- E12P01 State College Storm Drain
- E13 Telegraph Canyon
- E14 Limestone Canyon
- E15 Black Star Canyon
- E17 Silverado Canyon
- E18 Ladd Canyon
- E19 Modjeska Canyon
- E20 Fremont Canyon
- E21 Weir Canyon
- E22 Blind Canyon

- E02 Carbon Creek Diver Channel
- E02B01 Miller Retarding Basin
- E03 Carbon Canyon Channel
- E03D01 Carbon Canyon Dam
- E03P01 Palm-Valencia Storm Drain
- E03S01 Rose Storm Channel
- E04 Atwood Channel
- E04D01 Yorba Linda Reservoir
- E04P01 Glenview Storm Drain
- E05 Richfield Channel
- E07S05 Nixon Storm Drain
- E08 Carlton Storm Drain
- E08B01 Esperanza Channel
- E08D01 Blue Mud Storm Channel
- E08D02 Collins Channel
- E08P01 Chapman-Beach Storm Drain
- E08P02 Marlboro Storm Channel
- E08P03 Wanda Storm Channel
- E08P04 Buckeye Storm Channel
- E08P06 Santiago Creek Channel
- E08P12 Santiago Creek Retarding Basin
- E08P14 Villa Park Dam
- E05P02 Santiago Dam
- E05P07 La Veta Storm Drain
- E06 Villa Park Storm Drain

UNINCORPORATED



Ultimate discharge point

11500 0 11500 Feet

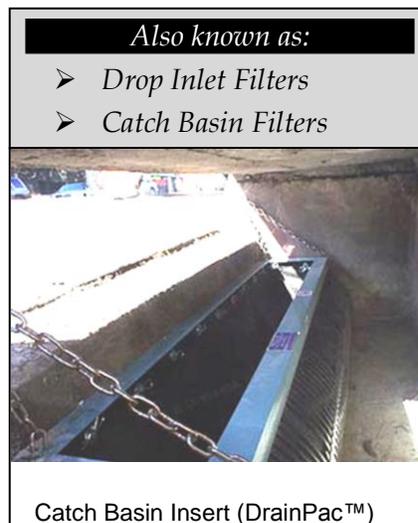
DESIGNED AND PRODUCED BY:
 GIS Mapping Unit
 Public Facilities and Planning Department
 - Orange Coast District

DATA SOURCE:
 Geographic Information System Division
 2008, Aerials 2011

DATE: March 10, 2005

PRE-2: Catch Basin Insert Fact Sheet

Catch basin inserts are manufactured filters or fabric placed in a drop inlet to remove sediment and debris and may include sorbent media (oil absorbent pouches) to remove floating oils and grease. Catch basin inserts are selected specifically based upon the orientation of the inlet and the expected sediment and debris loading.



Opportunity Criteria

- Catch basin inserts come in such a wide range of configurations that it is practically impossible to generalize the expected performance. Inserts should mainly be used for catching coarse sediments and floatable trash and are effective as pretreatment in combination with other types of structures that are recognized as water quality treatment BMPs. Trash and large objects can greatly reduce the effectiveness of catch basin inserts with respect to sediment and hydrocarbon capture.
- Catch basin inserts are applicable for drainage area that include parking lots, vehicle maintenance areas, and roadways with catch basins that discharge directly to a receiving water.

OC-Specific Design Criteria and Considerations

- Frequent maintenance and the use of screens and grates to keep trash out may decrease the likelihood of clogging and prevent obstruction and bypass of incoming flows.
- Consult proprietors for specific criteria concerning the design of catch basin inserts.
- Catch basin inserts can be installed with specific media for pollutants of concern.

Proprietary Manufacturer / Supplier Websites

- **Table XIV.2** is a list of manufacturers that provide catch basin inserts. The inclusion of these manufacturers does not represent an endorse of their products. Other devices and manufacturers may be acceptable for pretreatment.

Table XIV.2: Proprietary Catch Basin Insert Manufacturer Websites

Device	Manufacturer	Website
AbTech Industries Ultra-Urban Filter™	AbTech Industries	www.abtechindustries.com
Aquashield Aqua-Guardian™ Catch Basin Insert	Aquashield™ Inc.	www.aquashieldinc.com
Bowhead StreamGuard™	Bowhead Environmental & Safety, Inc.	http://www.shopbowhead.com/
Contech® Triton Catch Basin Filter™	Contech® Construction Products Inc.	www.contech-cpi.com
Contech® Triton Curb Inlet Filter™	Contech® Construction Products Inc.	www.contech-cpi.com

Table XIV.2: Proprietary Catch Basin Insert Manufacturer Websites

Device	Manufacturer	Website
Contech® Triton Basin StormFilter™	Contech® Construction Products Inc.	www.contech-cpi.com
Contech® Curb Inlet StormFilter™	Contech® Construction Products Inc.	www.contech-cpi.com
Curb Inlet Basket	SunTree Technologies Inc.	www.suntreetech.com
Curb Inlet Grates	EcoSense International™	http://www.ecosenseint.com/
DrainPac™	United Storm Water, Inc.	http://www.unitedstormwater.com
Grate Inlet Skimmer Box	SunTree Technologies Inc.	www.suntreetech.com
KriStar FloGard+PLUS®	KriStar Enterprises Inc.	www.kristar.com
KriStar FloGard®	KriStar Enterprises Inc.	www.kristar.com
KriStar FloGard LoPro Matrix Filter®	KriStar Enterprises Inc.	www.kristar.com
Nyloplast Storm-PURE Catch Basin Insert	Nyloplast Engineered Surface Drainage Products	www.nyloplast-us.com
StormBasin®	FabCo® Industries Inc.	www.fabco-industries.com
Stormdrain Solutions Interceptor	FabCo® Industries Inc.	www.fabco-industries.com
Stormdrain Solutions Inceptor®	Stormdrain Solutions	www.stormdrains.com
StormPod®	FabCo® Industries Inc.	www.fabco-industries.com
Stormwater Filtration Systems	EcoSense International™	http://www.ecosenseint.com/
Ultra-CurbGuard®	UltraTech International Inc.	www.spillcontainment.com
Ultra-DrainGuard®	UltraTech International Inc.	www.spillcontainment.com
Ultra-GrateGuard®	UltraTech International Inc.	www.spillcontainment.com
Ultra-GutterGuard®	UltraTech International Inc.	www.spillcontainment.com
Ultra-InletGuard®	UltraTech International Inc.	www.spillcontainment.com

INF-7: Underground Infiltration

Underground infiltration is a vault or chamber with an open bottom that used to store runoff and percolate into the subsurface. A number of vendors offer proprietary infiltration products that allow for similar or enhanced rates of infiltration and subsurface storage while offering durable prefrabricated structures. There are many varieties of proprietary infiltration BMPs that can be used for roads and parking lots, parks and open spaces, single and multi-family residential, or mixed-use and commercial uses.



Also known as:

- *Infiltration vault*
- *Recharge vault*

Underground Infiltration

Source: <http://www.contech-cpi.com>

Feasibility Screening Considerations

- Infiltration bays shall pass infeasible screening criteria to be considered for use.
- Underground infiltration galleries pose a potential risk of groundwater contamination; pretreatment should be used.

Opportunity Criteria

- Soils are adequate for infiltration or can be amended to provide an adequate infiltration rate.
- Appropriate for sites with limited surface space.
- Can be placed beneath roads, parking lots, parks, and athletic fields.
- Potential for groundwater contamination can be mitigated through isolation of pollutant sources, pretreatment of inflow, and/or demonstration of adequate treatment capacity of underlying soils.
- Infiltration is into native soil, or depth of engineered fill is ≤ 5 feet from the bottom of the facility to native material and infiltration into fill is approved by a geotechnical professional.
- Tributary area land uses include mixed-use and commercial, single-family and multi-family, roads and parking lots, and parks and open spaces. High pollutant land uses should not be tributary to infiltration BMPs.

OC-Specific Design Criteria and Considerations

- Placement of BMPs should observe geotechnical recommendations with respect to geological hazards (e.g. landslides, liquefaction zones, erosion, etc.) and set-backs (e.g., foundations, utilities, roadways, etc.)
- Minimum separation to mounded seasonally high groundwater of 10 feet shall be observed.
- Minimum pretreatment should be provided upstream of the infiltration facility, and water bypassing pretreatment should not be directed to the facility.
- Underground infiltration should not be used for drainage areas with high sediment production potential unless preceded by full treatment control with a BMP effective for sediment removal.
- Design infiltration rate should be determined as described in [Appendix VII](#).
- Inspection ports or similar design features shall be provided to verify continued system performance and identify need for major maintenance.

- For infiltration facilities beneath roads and parking areas, structural requirements should meet H-20 load requirements.

Computing Underground Infiltration Device Size

Underground infiltration devices vary by design and by proprietary designs. The sizing method selected for use must be based on the BMP type it most strongly resembles.

- For underground infiltration devices with open pore volume (e.g., vaults, crates, pipe sections, etc), sizing will be most similar to infiltration basins.
- For underground infiltration devices with pore space (e.g., aggregate reservoirs), sizing will be most similar to permeable pavement.

Additional References for Design Guidance

- Los Angeles Unified School District (LAUSD) Stormwater Technical Manual, Chapter 5:
http://www.laschools.org/employee/design/fs-studies-and-reports/download/white_paper_report_material/Storm_Water_Technical_Manual_2009-opt-red.pdf?version_id=76975850

Worksheet B: Simple Design Capture Volume Sizing Method

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter design capture storm depth from Figure III.1, d (inches)	$d=$	0.9	inches
2	Enter the effect of provided HSCs, d_{HSC} (inches) (Worksheet A)	$d_{HSC}=$	0	inches
3	Calculate the remainder of the design capture storm depth, $d_{remainder}$ (inches) (Line 1 - Line 2)	$d_{remainder}=$	0.9	inches
Step 2: Calculate the DCV				
1	Enter Project area tributary to BMP (s), A (acres)	$A=$	0.716	acres
2	Enter Project Imperviousness, imp (unitless)	$imp=$	0.810	
3	Calculate runoff coefficient, $C= (0.75 \times imp) + 0.15$	$C=$	0.758	
4	Calculate runoff volume, $V_{design}= (C \times d_{remainder} \times A \times 43560 \times (1/12))$	$V_{design}=$	1,773	cu-ft
Step 3: Design BMPs to ensure full retention of the DCV				
Step 3a: Determine design infiltration rate				
1	Enter measured infiltration rate, $K_{observed}^1$ (in/hr) (Appendix VII)	$K_{observed}=$	75	In/hr
2	Enter combined safety factor from Worksheet H, S_{total} (unitless)	$S_{total}=$	3	
3	Calculate design infiltration rate, $K_{design} = K_{observed} / S_{total}$	$K_{design}=$	25	In/hr
Step 3b: Determine minimum BMP footprint				
4	Enter drawdown time, T (max 48 hours)	$T=$	1	Hours
5	Calculate max retention depth that can be drawn down within the drawdown time (feet), $D_{max} = K_{design} \times T \times (1/12)$	$D_{max}=$	2.1	feet
6	Calculate minimum area required for BMP (sq-ft), $A_{min} = V_{design} / d_{max}$	$A_{min}=$	851	sq-ft

¹ $K_{observed}$ is the vertical infiltration measured in the field, before applying a factor of safety. If field testing measures a rate that is different than the vertical infiltration rate (for example, three-dimensional borehole percolation rate), then this rate must be adjusted by an acceptable method (for example, Porchet method) to yield the field estimate of vertical infiltration rate, $K_{observed}$. See Appendix VII.

Appendix D:

BMP Maintenance Information

FloGard Plus Replacement and Repair

Parts of the FloGard Plus Inlet Filter-

1. FloGard Stainless Steel Support Frame
2. Fossil Rock Absorbent Pouches
3. Liner
4. GeoGrid Support Basket & Cable

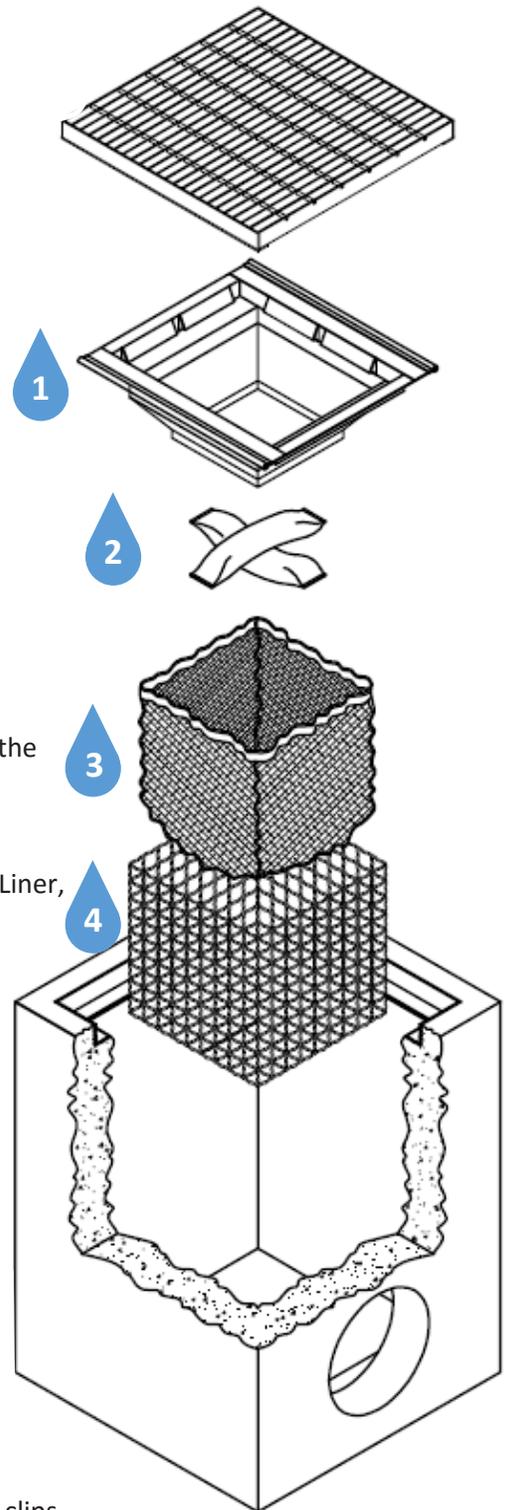
* Grate and Basin NOT INCLUDED

Disassembly:

1. Clear FloGard of any existing debris by hand or vacuum.
2. Unclip and remove the Fossil Rock pouches from the inside Liner.
3. Lift the FloGard from the catch basin.
4. Using a slotted screw driver, carefully pry open the metal tabs holding the GeoGrid and Cable in place. Separate the GeoGrid and Liner from the FloGard frame.
5. Unclip the Liner from the inside of the GeoGrid. If you are reusing the Liner, rinse thoroughly with water and inspect for tears. (If torn, mend with stainless steel wire or replace the Liner).
6. Rinse and inspect the GeoGrid Basket and the reinforcing cable. (If torn, mend with stainless steel wire or replace the GeoGrid).
7. Rinse and inspect the Stainless Steel FloGard frame.

Reassembly:

1. Fully expand the GeoGrid Basket and orient to the FloGard frame. Hook cable and GeoGrid to the FloGard frame metal tabs and close the tabs using slotted screwdriver. Move around the FloGard until all tabs are closed and GeoGrid is secured to the Frame.
2. Expand and orient the Liner, locating the clips at each corner and side. Push the Liner through the center of the FloGard frame and secure the clips to the GeoGrid Basket close to the top support cable. Push the Liner to expand inside of the basket.
3. Clip new Fossil Rock Rubberizer pouches to the inside of the Liner.
4. Lower FloGard back into the basin, replace grate.



Isolator[®] Row Plus

O&M Manual



The Isolator[®] Row Plus

Introduction

An important component of any Stormwater Pollution Prevention Plan is inspection and maintenance. The StormTech Isolator Row Plus is a technique to inexpensively enhance Total Suspended Solids (TSS), Total Phosphorus (TP), Total Petroleum Hydrocarbons (TPH) and Total Nitrogen (TN) removal with easy access for inspection and maintenance.

The Isolator Row Plus

The Isolator Row Plus is a row of StormTech chambers, either SC-160, SC-310, DC-780, SC-800, MC-3500, MC-4500 or MC-7200 models, are lined with filter fabric and connected to a closely located manhole for easy access. The fabric lined chambers provide for sediment settling and filtration as stormwater rises in the Isolator Row Plus and passes through the filter fabric. The open bottom chambers allow stormwater to flow vertically out of the chambers. Sediments are captured in the Isolator Row Plus protecting the adjacent stone and chambers storage areas from sediment accumulation.

ADS Isolator Row and Plus fabric are placed between the stone and the Isolator Row Plus chambers. The woven geotextile provides a media for stormwater filtration, a durable surface for maintenance, prevents scour of the underlying stone and remains intact during high pressure jetting.

The Isolator Row Plus is designed to capture the “first flush” runoff and offers the versatility to be sized on a volume basis or a flow-rate basis. An upstream manhole provides access to the Isolator Row Plus and includes a high/low concept such that stormwater flow rates or volumes that exceed the capacity of the Isolator Row Plus bypass through a manifold to the other chambers. This is achieved with an elevated bypass manifold or a high-flow weir. This creates a differential between the Isolator Row Plus row of chambers and the manifold to the rest of the system, thus allowing for settlement time in the Isolator Row Plus. After Stormwater flows through the Isolator Row Plus and into the rest of the chamber system it is either exfiltrated into the soils below or passed at a controlled rate through an outlet manifold and outlet control structure.

The Isolator Row Plus Flamp™ is a flared end ramp apparatus attached to the inlet pipe on the inside of the chamber end cap. The FLAMP provides a smooth transition from pipe invert to fabric bottom. It is configured to improve chamber function performance by enhancing outflow of solid debris that would otherwise collect at the chamber's end, or more difficult to remove and require confined space entry into the chamber area. It also serves to improve the fluid and solid flow into the access pipe during maintenance and cleaning and to guide cleaning and inspection equipment back into the inlet pipe when complete.

The Isolator Row Plus may be part of a treatment train system. The treatment train design and pretreatment device selection by the design engineer is often driven by regulatory requirements. Whether pretreatment is used or not, StormTech recommend using the Isolator Row Plus to minimize maintenance requirements and maintenance costs.

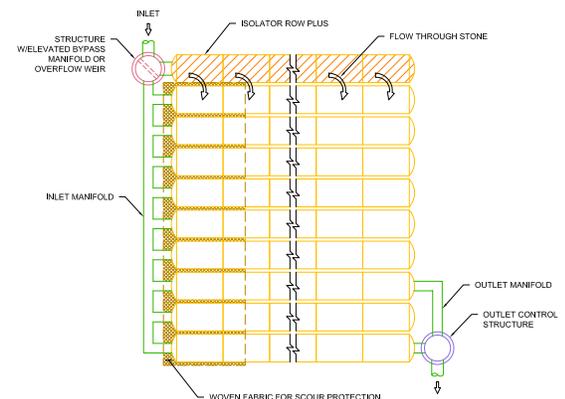
Note: See the StormTech Design Manual for detailed information on designing inlets for a StormTech system, including the Isolator Row Plus.



Looking down the Isolator Row Plus from the manhole opening, ADS Plus Fabric is shown between the chamber and stone base.



StormTech Isolator Row Plus with Overflow Structure (not to scale)



Isolator Row Plus Inspection/Maintenance

Inspection

The frequency of inspection and maintenance varies by location. A routine inspection schedule needs to be established for each individual location based upon site specific variables. The type of land use (i.e. industrial, commercial, residential), anticipated pollutant load, percent imperviousness, climate, etc. all play a critical role in determining the actual frequency of inspection and maintenance practices.

At a minimum, StormTech recommends annual inspections. Initially, the Isolator Row Plus should be inspected every 6 months for the first year of operation. For subsequent years, the inspection should be adjusted based upon previous observation of sediment deposition.

The Isolator Row Plus incorporates a combination of standard manhole(s) and strategically located inspection ports (as needed). The inspection ports allow for easy access to the system from the surface, eliminating the need to perform a confined space entry for inspection purposes.

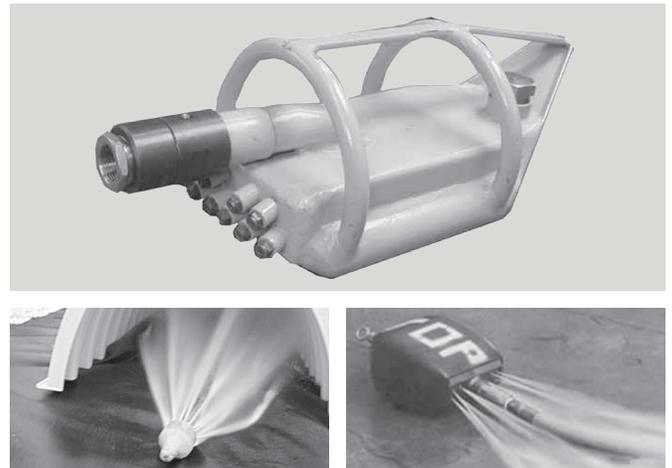
If upon visual inspection it is found that sediment has accumulated, a stadia rod should be inserted to determine the depth of sediment. When the average depth of sediment exceeds 3" (75 mm) throughout the length of the Isolator Row Plus, clean-out should be performed.

Maintenance

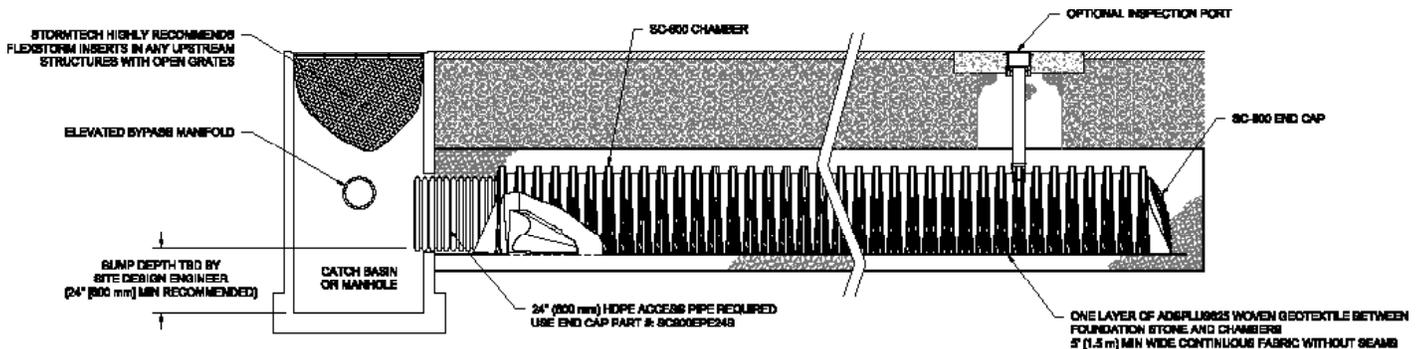
The Isolator Row Plus was designed to reduce the cost of periodic maintenance. By "isolating" sediments to just one row, costs are dramatically reduced by eliminating the need to clean out each row of the entire storage bed. If inspection indicates the potential need for maintenance, access is provided

via a manhole(s) located on the end(s) of the row for cleanout. If entry into the manhole is required, please follow local and OSHA rules for a confined space entry.

Maintenance is accomplished with the JetVac process. The JetVac process utilizes a high pressure water nozzle to propel itself down the Isolator Row Plus while scouring and suspending sediments. As the nozzle is retrieved, the captured pollutants are flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/JetVac combination vehicles. Selection of an appropriate JetVac nozzle will improve maintenance efficiency. Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear facing jets with an effective spread of at least 45" are best. StormTech recommends a maximum nozzle pressure of 2000 psi be utilized during cleaning. JetVac reels can vary in length. For ease of maintenance, ADS recommends Isolator Row Plus lengths up to 200' (61 m). **The JetVac process shall only be performed on StormTech Isolator Row Plus that have ADS Plus Fabric (as specified by StormTech) over their angular base stone.**



StormTech Isolator Row Plus (not to scale)



Isolator Row Plus Step By Step Maintenance Procedures

Step 1

Inspect Isolator Row Plus for sediment.

- A) Inspection ports (if present)
 - i. Remove lid from floor box frame
 - ii. Remove cap from inspection riser
 - iii. Using a flashlight and stadia rod, measure depth of sediment and record results on maintenance log.
 - iv. If sediment is at or above 3 inch depth, proceed to Step 2. If not, proceed to Step 3.
- B) All Isolator Row Plus
 - i. Remove cover from manhole at upstream end of Isolator Row Plus
 - ii. Using a flashlight, inspect down Isolator Row Plus through outlet pipe
 - 1. Mirrors on poles or cameras may be used to avoid a confined space entry
 - 2. Follow OSHA regulations for confined space entry if entering manhole
 - iii. If sediment is at or above the lower row of sidewall holes (approximately 3 inches), proceed to Step 2. If not, proceed to Step 3.

Step 2

Clean out Isolator Row Plus using the JetVac process.

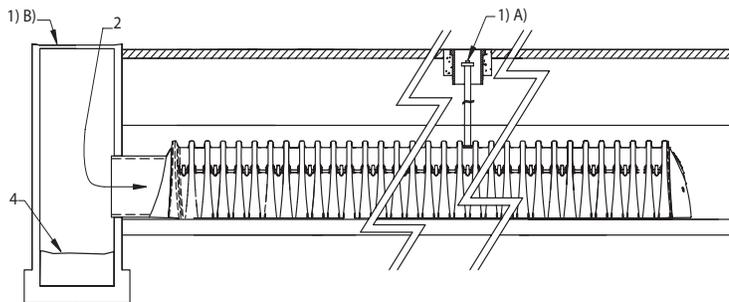
- A) A fixed floor cleaning nozzle with rear facing nozzle spread of 45 inches or more is preferable
- B) Apply multiple passes of JetVac until backflush water is clean
- C) Vacuum manhole sump as required

Step 3

Replace all caps, lids and covers, record observations and actions.

Step 4

Inspect & clean catch basins and manholes upstream of the StormTech system.



Sample Maintenance Log

Date	Stadia Rod Readings		Sedi-ment Depth (1)-(2)	Observations/Actions	Inspector
	Fixed point to chamber bottom (1)	Fixed point to top of sediment (2)			
3/15/11	6.3 ft	none		New installation. Fixed point is CI frame at grade	DJM
9/24/11		6.2	0.1 ft	Some grit felt	SM
6/20/13		5.8	0.5 ft	Mucky feel, debris visible in manhole and in Isolator Row Plus, maintenance due	NV
7/7/13	6.3 ft		0	System jetted and vacuumed	DJM

adspipe.com
800-821-6710

Appendix E:

Geotechnical Information

(Storm water infiltration BMP evaluation)

NorCal Engineering

Soils and Geotechnical Consultants
Los Alamitos, California 90720
(562) 799-9469

September 10, 2025

Project Number 25305-25

Keusder Homes, Inc.
3184 Airway Avenue, Suite B
Costa Mesa, California 92626

Attn: Mr. Wes Keusder

RE: **Soil Infiltration Assessment** - Proposed Residential Development - Located at 705 W. Fletcher Avenue, in the City of Orange, California

Dear Mr. Keusder:

This firm has reviewed our "Geotechnical Engineering Investigation" report dated May 29, 2025 for the above referenced residential project. Based on our referenced report, the site is underlain by Young Alluvium soil deposits predominately classified as fine to course grained, silty to gravelly sands with intermingled deep layers of sandy to clayey silts. The sandy soils within the upper 20 feet below ground surface was noted to be unform throughout the entire property.

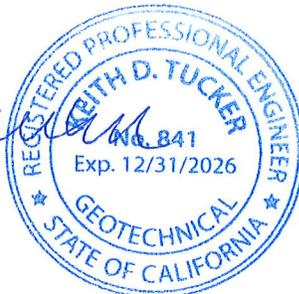
A small isolated area where an abandoned underground storage tank was previously removed and backfilled with sandy soils to a depth of 10 feet was encountered towards the center of the property within a proposed building area. It is assumed that a majority of the grading for the proposed development will include cuts and fill procedures on the order of a few feet to achieve finished grade elevations.

The infiltration test results were noted to be favorable with rates of 25 and 50 inches/hour and are consistent with the soil classification encountered in our exploratory borings. The drainage disposal system shall utilize design infiltration rates based on the safety factor required by the city/county standard. All systems must meet the latest city and/or county specifications and the California Regional Water Quality Control Board (CRWQCB) requirements.

Respectfully submitted,
NORCAL ENGINEERING



Keith D. Tucker
Project Engineer
R.G.E. 841



Scott D. Spensiero
Project Manager

Geotechnical Engineering Investigation
Proposed Residential Development
705 W. Fletcher Avenue
Orange, California

Keusder Homes, Inc.
3184 Airway Avenue, Suite B
Costa Mesa, CA 92626

Attn: Mr. Wes Keusder

Project Number 25305-25
May 29, 2025

NorCal Engineering

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NorCal Engineering
Soils and Geotechnical Consultants
10641 Humbolt Street Los Alamitos, CA 90720
(562) 799-9469

May 29, 2025

Project Number 25305-25

Keusder Homes, Inc.
3184 Airway Avenue, Suite B
Costa Mesa, California 92626

Attn.: Mr. Wes Keusder

RE: Geotechnical Engineering Investigation - Proposed Residential Development -
Located at 705 W. Fletcher Avenue, in the City of Orange, California

Dear Mr. Keusder:

Pursuant to your request, this firm has performed a Geotechnical Engineering Investigation for the above referenced project in accordance with your approval of our proposal dated February 11, 2025. The purpose of this investigation is to evaluate the geotechnical conditions of the subject site and to provide recommendations for the proposed residential development. The scope of work included the following: 1) site reconnaissance; 2) subsurface geotechnical exploration and sampling; 3) laboratory testing; 4) soil infiltration study; 5) engineering analysis of field and laboratory data; 5) preparation of a geotechnical engineering report.

1.0 Project Description

It is proposed to construct fifteen (15) detached single family residences as shown on the attached Site Plan. The proposed three-story residences will be supported by a conventional slab-on-grade foundation system with perimeter-spread footings and isolated interior footings. Other improvements will consist of a concrete/asphalt paved interior street, hardscape and landscaping. It is assumed that the proposed grading for the development will include cuts on the order of a few feet with minor fill procedures on to achieve finished grade elevations. Final building plans shall be reviewed by this firm prior to submittal for city approval to determine the need for any additional study and revised recommendations pertinent to the proposed development, if necessary.

2.0 Site Description

The 120' x 260' subject property is located within the west 700 block and north side of Fletcher Avenue, in the City of Orange. The generally rectangular-shaped parcel is elongated in a north to south direction with topography of the relatively level property descending slightly from back to front on the order of a few feet. The site is currently an undeveloped lot that is currently occupied by a few metal storage containers and parked motor home.

3.0 Site Exploration

The investigation consisted of the placement of nine (9) subsurface exploratory borings by a truck mounted hollow stem hand operated auger to depths ranging between 5 and 50 feet below current ground elevations. The explorations were visually classified and logged by a field engineer with locations of the subsurface explorations shown on the attached Site Plan. The field explorations revealed the existing earth materials to consist of fill and alluvium soil. Detailed descriptions of the subsurface conditions are listed on the boring logs in Appendix A. It should be noted that the transition from one soil type to another as shown on the boring logs is approximate and may in fact be a gradual transition. The soils encountered are described as follows:

Fill: A fill soil classifying as a brown, fine to medium grained, silty SAND with occasional gravel was encountered to depths ranging from 1 to 10 feet below ground surface. These soils were noted to be loose and dry to damp. Exploratory Boring B-8 appears to have been placed within a former underground tank excavation backfill area.

Alluvium: An undisturbed Young Alluvium soil deposit classifying as a light brown fine to coarse grained, slightly silty SAND with occasional gravel and cobble was encountered beneath the fill soils. These soils were observed to be medium dense to dense and damp. Deeper soils consisted of a fine to coarse grained, gravelly SAND do sandy to clayey SILT which were noted to be dense to medium stiff and damp to moist.

The overall engineering characteristics of the earth material were relatively uniform with each excavation. Groundwater was not encountered to the depths of our borings and some caving occurred in the deeper cohesionless soils.

4.0 **Laboratory Tests**

Relatively undisturbed samples of the subsurface soils were obtained to perform laboratory testing and analysis for direct shear, consolidation tests, and to determine in-place moisture/densities. These relatively undisturbed ring samples were obtained by driving a thin-walled steel sampler lined with one-inch long brass rings with an inside diameter of 2.42 inches into the undisturbed soils. Bulk bag samples were obtained in the upper soils for expansion index tests and maximum density tests.

Standard penetration tests were obtained by driving a steel sampler unlined with an inside diameter of 1.5 inches into the soils. This standard penetrometer sampler was driven a total of eighteen inches with blow counts tallied every six inches. Blow count data is given on the Boring Logs in Appendix A. All test results are included in Appendix B, unless otherwise noted.

- 4.1 **Field Moisture Content** (ASTM: D 2216) and the dry density of the ring samples were determined in the laboratory. This data is listed on the logs of explorations.
- 4.2 **Sieve analyses** (ASTM: D 422-63) and the percent by weight of soil finer than the No. 200 sieve (ASTM: 1140) were performed on selected soil samples. These results are shown later within the body of this report.
- 4.3 **Maximum Density tests** (ASTM: D 1557) were performed on typical samples of the upper soils. Results of these tests are shown on Table I.
- 4.4 **Expansion Index tests** (ASTM: D 4829) were performed on remolded samples of the upper soils to determine expansive characteristics. Results of these tests are provided on Table II.
- 4.5 **Atterberg Limits** (ASTM: D 4318) consisting of liquid limit, plastic limit and plasticity index were performed on representative soil samples. Results are shown on Table III.
- 4.6 **Corrosion tests** consisting of sulfate, pH, resistivity and chloride analysis to determine potential corrosive effects of soils on concrete and underground utilities. Test results are provided on Table IV.

- 4.7 **Direct Shear tests** (ASTM: D 3080) were performed on undisturbed and/or remolded samples of the subsurface soils. The test is performed under saturated conditions at loads of 1,000 lbs./sq.ft., 2,000 lbs./sq.ft., and 3,000 lbs./sq.ft. with results shown on Plate A.
- 4.8 **Consolidation tests** (ASTM: D 2435) were performed on undisturbed samples to determine the differential and total settlement which may be anticipated based upon the proposed loads. Water was added to the samples at a surcharge of one KSF and the settlement curves are plotted on Plates B and C.

5.0 Seismicity Evaluation

The proposed development lies outside of any Alquist Priolo Special Studies Zone and the potential for damage due to direct fault rupture is considered unlikely. The nearest fault is located about 10 kilometers from the site and is capable of producing a Magnitude 6.8 earthquake. Ground shaking originating from earthquakes along other active faults in the region is expected to induce lower horizontal accelerations due to smaller anticipated earthquakes and/or greater distances to other faults.

The following seismic design acceleration parameters for the project site are provided below based on the ASCE/SEI 7-16 American Society of Civil Engineers (ASCE) website, <https://asce7hazardtool.online/> and is attached in Appendix C.

Seismic Design Acceleration Parameters

Latitude	33.830
Longitude	-117.860
Site Class	D
Risk Category	II
Mapped Spectral Response Acceleration	$S_S = 1.501$ $S_1 = 0.531$
Adjusted Maximum Acceleration	$S_{MS} = 1.501$
Design Spectral Response Acceleration Parameters	$S_{DS} = 1.001$
Peak Ground Acceleration	$PGA_M = 0.698$

Use of these values is dependent on requirements of Section 11-4.8, ASCE 7 exception 2 that requires the value of the seismic response coefficient C_s be determined by Equation 12.8.2 for values of $T \leq 1.5T_s$ and taken as equal to 1.5 times the value computed in accordance with either 12.8-3 for $T_L \geq T \geq 1.5T_s$ or Equation 12.8-4 for $T > T_L$. Computations and verification of these conditions is referred to the structural engineer.

6.0 Liquefaction Evaluation

The site is expected to experience ground shaking and earthquake activity that is typical of Southern California area. It is during severe ground shaking that loose, granular soils below the groundwater table can liquefy. A review of the exploratory boring log and the laboratory test results on selected soil samples obtained indicate the following soil classifications, field blowcounts and amounts of fines passing through the No. 200 sieve.

Field Blowcount and Gradation Data

Boring No.	Classification	Blowcounts (blows/ft)	Relative Density	% Passing No. 200 Sieve
B-3 @ 5'	SW	7	Medium Dense	5
B-3 @ 10'	SW	10	Dense	9
B-3 @ 15'	SW	17	Dense	5
B-3 @ 20'	SW	20	Dense	2
B-3 @ 25'	ML	10	Medium Stiff	61
B-3 @ 30'	SW	69	Very Dense	16
B-3 @ 35'	SW	58	Very Dense	9
B-3 @ 40'	ML	18	Medium Stiff	63
B-3 @ 45'	SW	85	Very Dense	5
B-3 @ 50'	SW	67	Very Dense	7

Based upon information in the California Division of Mines and Geology "Seismic Hazard Zone Map – Orange Quadrangle" (1997), the subject site is situated in an area of historic occurrence of liquefaction, or local geological, geotechnical and groundwater conditions to indicate a potential for permanent ground displacement.

Our liquefaction evaluation utilized the nearest mode of predominate Magnitude 6.8 Mw earthquake. Review of the *California Department of Conservation – Division of Mines and Geology Open File Report 97-03, Plate 1.2*, indicates a historic high groundwater level greater than 25 feet below ground surface.

The results of our analysis indicates the liquefaction potential at this site to be low based upon the historic groundwater depth and a Peak Ground Acceleration (PGA_M) of 0.698g. The associated seismic-induced settlements would be less than one inch and would occur rather uniformly across the site. Differential settlements would be on the order of 1/2 inch over a 50-foot (horizontal) distance. Our seismic settlement calculations are included in Appendix C.

7.0 Infiltration Characteristics

Infiltration tests were performed in accordance with the Orange County Technical Guidance Document (OCTGD) Appendix VII – Infiltration Rate Evaluation Protocol and Factor of Safety Recommendations with field infiltration rates calculated using the Porchet Method (aka Inverse Borehole Method).

A truck mounted Simco 2800 Drill Rig equipped with a hollow stem auger was used to excavate the exploratory borings (B-1 and B-2) to depths of 5 and 10 feet below existing ground surface. The infiltration test borings consisted of six-inch diameter test holes. A three-inch diameter perforated PVC casing with solid end cap was installed in each boring and then surrounded with gravel materials to prevent caving. The infiltration holes were carefully filled with clean water and refilled after two initial readings.

Based upon the initial rates of infiltration at each location, test measurements were measured at selected maximum intervals thereafter. Measurements were obtained by using an electronic tape measure with 1/16-inch divisions and timed with a stopwatch. The field data sheets are provided in Appendix D.

The drainage disposal system shall utilize design infiltration rates based on the safety factor required by the county standard. A total reduction factor of 3.0 should be used to calculate the design infiltration rates, as listed below.

$RF_t = 1.0$ for small diameter borings

$RF_v = 1.0$ for site variability

$RF_s = 1.0$ for long-term siltation plugging and maintenance. The subsurface soils are likely to have some plugging and regular maintenance of storm water discharge devices is required.

Boring/Test No.	Depth	Soil Classification	Field Infiltration Rate	Design Rate
B-1/TH-1	5'	SAND	75 in/hr	25 in/hr
B-2/TH-2	10'	SAND	150 in/hr	50 in/hr

All systems must meet the latest city and/or county specifications and the California Regional Water Quality Control Board (CRWQCB) requirements. It is recommended that foundations shall be setback a minimum distance of 10 feet from the drainage disposal system and the bottom of footing shall be a minimum of 10 feet from the expected zone of saturation. The boundary of the zone of saturation may be assumed to project downward from the top of the permeable portion of the disposal system at an inclination of 1 to 1 or flatter, as determined by the geotechnical engineer.

8.0 **Conclusions and Recommendations**

Based upon our evaluations, the proposed development is acceptable from a geotechnical engineering standpoint. By following the recommendations and guidelines set forth in our report, the structures will be safe from excessive settlements under the anticipated design loadings and conditions. The proposed development shall meet all requirements of the City Building Ordinance and will not impose any adverse effect on existing adjacent structures.

The following recommendations are based upon soil conditions encountered in our field investigation; these near-surface soil conditions could vary across the site. Variations in the soil conditions may not become evident until the commencement of grading operations for the proposed development and revised recommendations from the geotechnical engineer may be necessary based upon the conditions encountered.

It is recommended that site inspections be performed by a representative of this firm during all grading and construction of the development to verify the findings and recommendations documented in this report. Any unusual conditions which may be encountered in the course of the project development may require the need for additional study and revised recommendations.

8.1 **Site Grading Recommendations**

Any vegetation and/or demolition debris shall be removed and hauled from proposed grading areas prior to the start of grading operations. Existing vegetation shall not be mixed or disced into the soils. Any removed soils may be reutilized as compacted fill once any deleterious material or oversized materials (in excess of eight inches) is removed. Grading operations shall be performed in accordance with the attached *Specifications for Placement of Compacted Fill*.

All disturbed soils and/or fill (about 1 to 10 feet below ground surface) shall be removed to competent alluvium material, the exposed surface scarified to a depth of 12 inches, brought to within 2% of optimum moisture content and compacted to a minimum of 90% of the laboratory standard (ASTM: D 1557) prior to placement of any additional compacted fill soils, foundations, slabs-on-grade and pavement. Grading shall extend a minimum of five horizontal feet outside the edges of foundations or equidistant to the depth of fill placed, whichever is greater.

Due to the potential for differential settlement of foundations placed on compacted fill and alluvium, it is recommended that building foundations including floor slab areas be underlain by a uniform compacted fill blanket at least two feet in thickness. This fill blanket shall extend a minimum of five horizontal feet outside the edges of foundations or equidistant to the depth of fill placed, whichever is greater.

It is possible that isolated areas of undiscovered fill not described in this report are present on site; if found, these areas should be treated as discussed earlier. A diligent search shall also be conducted during grading operations in an effort to uncover any underground structures, irrigation or utility lines. If encountered, these structures and lines shall be either removed or properly abandoned prior to the proposed construction.

Any imported fill material should be preferably soil similar to the upper soils encountered at the subject site. All soils shall be approved by this firm prior to importing at the site and will be subjected to additional laboratory testing to assure concurrence with the recommendations stated in this report.

Care should be taken to provide or maintain adequate lateral support for all adjacent improvements and structures at all times during the grading operations and construction phase. Adequate drainage away from the structures, pavement and slopes should be provided at all times.

8.2 **Temporary Excavations**

Temporary unshored excavations in the existing site materials may be made at vertical inclinations up to 4 feet in height unless cohesionless soils are encountered. In areas where soils with little or no binder are encountered, where adverse geological conditions are exposed, or where excavations are adjacent to existing structures, shoring or flatter excavations may be required. Additional recommendations regarding specific excavations may be provided once typical detail sections are made available.

The temporary cut slope gradients given above do not preclude local raveling and sloughing. All excavations shall be made in accordance with the requirements of the soils engineer, CAL-OSHA and other public agencies having jurisdiction. Care should be taken to provide or maintain adequate lateral support for all adjacent improvements and structures at all times during the grading operations and construction phase.

8.3 **Foundation Design**

All foundations for the proposed residences may be designed utilizing an allowable bearing capacity of 2,000 psf for an embedded depth of 24 inches into approved engineered fill. A one-third increase may be used when considering short-term loading and seismic forces. Any foundations for smaller structures (site walls, etc.) located along property line may utilize an allowable bearing capacity of 2,000 psf and embedded a minimum depth of 18 inches and into competent native soils. A representative of this firm shall inspect all foundation excavations prior to pouring concrete.

8.4 **Settlement Analysis**

Resultant pressure curves for the consolidation tests are shown on Plates B and C. Computations utilizing these curves and the recommended allowable soil bearing capacities reveal that the foundations will experience settlements on the order of ¾ inch and differential settlements of less than ¼ inch.

8.5 **Lateral Resistance**

The following values may be utilized in resisting lateral loads imposed on the structure. Requirements of the California Building Code should be adhered to when the coefficient of friction and passive pressures are combined.

Coefficient of Friction - 0.40

Equivalent Passive Fluid Pressure = 250 lbs./cu.ft.

Maximum Passive Pressure = 2,500 lbs./cu.ft.

The passive pressure recommendations are valid only for approved compacted fill soils or competent native materials.

8.6 **Retaining Wall Design Parameters**

Active earth pressures against retaining walls will be equal to the pressures developed by the following fluid densities. These values are for **approved granular backfill material** placed behind the walls at various ground slopes above the walls.

Surface Slope of Retained Materials (Horizontal to Vertical)	Equivalent Fluid Density (lb./cu.ft.)
Level	30
5 to 1	35
4 to 1	38
3 to 1	40
2 to 1	45

Any applicable short-term construction surcharges and seismic forces should be added to the above lateral pressure values. An equivalent fluid pressure of 45 pcf may be utilized for the restrained wall condition with a level grade behind the wall.

The seismic-induced lateral soil pressure for walls greater than 6 feet may be computed using a triangular pressure distribution with the maximum value at the top of the wall. The maximum lateral pressure of $(20 \text{ pcf}) H$ where H is the height of the retained soils above the wall footing should be used in final design of retaining walls. Sliding resistance values and passive fluid pressure values may be increased by $1/3$ during short-term wind and seismic loading conditions.

All walls shall be waterproofed as needed and protected from hydrostatic pressure by a reliable permanent subdrain system. The granular backfill to be utilized immediately adjacent to retaining walls shall consist of an approved select granular soil with a sand equivalency greater than 30. This backfill zone of free draining material shall consist of a wedge beginning a minimum of one horizontal foot from the base of the wall extending upward at an inclination of no less than $3/4$ to 1 (horizontal to vertical).

8.7 **Slab Design**

All concrete slabs shall be a minimum of four inches in thickness and placed on approved subgrade soils. Any concrete slab-on-grade in pavement areas shall be a minimum of five inches in thickness reinforced and placed on approved subgrade soils. A vapor retarder (10-mil minimum thickness) should be utilized in areas which would be sensitive to the infiltration of moisture. This retarder shall meet requirements of ASTM E 96, *Water Vapor Transmission of Materials* and ASTM E 1745, *Standard Specification for Water Vapor Retarders used in Contact with Soil or Granular Fill Under Concrete Slabs*. The vapor retarder shall be installed in accordance with procedures stated in ASTM E 1643, *Standard practice for Installation of Water Vapor Retarders used in Contact with Earth or Granular Fill Under Concrete Slabs*.

The moisture retarder may be placed directly upon compacted subgrade soils conditioned to near optimum moisture levels, although one to two inches of sand beneath the membrane is desirable. The subgrade upon which the retarder is placed shall be smooth and free of rocks, gravel or other protrusions which may damage the retarder. Use of sand above the retarder is under the purview of the structural engineer; if sand is used over the retarder, it should be placed in a dry condition.

8.8 **Utility Trench and Excavation Backfill**

Trenches from installation of utility lines and other excavations may be backfilled with on-site soils or approved imported soils compacted to a minimum of 90% relative compaction. All utility lines shall be properly bedded with clean sand having a sand equivalency rating of 30 or more. This bedding material shall be thoroughly water jetted around the pipe structure prior to placement of compacted backfill soils.

8.9 **Corrosion Design Criteria**

Representative samples of the surficial soils, typical of the subgrade soils expected to be encountered within foundation excavations and underground utilities were tested for corrosion potential. The minimum resistivity value obtained for the samples tested is representative of an environment that may be severely corrosive to metals. The soil pH value was considered mildly acidic and may not have a significant effect on soil corrosivity. Consideration should be given to corrosion protection systems for buried metal such as protective coatings, wrappings or the use of PVC where permitted by local building codes.

According to Table 4.3.1 of ACI 318 Building Code and Commentary, these contents revealed negligible sulfate concentrations. Therefore, a Type II cement according to latest CBC specifications may be utilized for building foundations at this time. It is recommended that additional sulfate tests be performed at the completion of site grading to assure that the as graded conditions are consistent with the recommendations stated in this design. Corrosion test results may be found on the attached Table IV.

8.10 **Expansive Soil**

If expansive soils are encountered, special attention should be given to the project design and maintenance. The attached *Expansive Soil Guidelines* should be reviewed by the engineers, architects, owner, maintenance personnel and other interested parties and considered during the design of the project and future property maintenance.

9.0 Closure

The recommendations and conclusions contained in this report are based upon the soil conditions uncovered in our test excavations. No warranty of the soil condition between our excavations is implied. NorCal Engineering should be notified for possible further recommendations if unexpected to unfavorable conditions are encountered during construction phase. It is the responsibility of the owner to ensure that all information within this report is submitted to the Architect and appropriate Engineers for the project.

A preconstruction conference should be held between the general contractor, grading contractor, city inspector, architect, and geotechnical engineer to clarify any questions relating to the grading operations and subsequent construction. Our representative should be present during the grading operations and construction phase to certify that such recommendations are complied within the field.

This geotechnical investigation has been conducted in a manner consistent with the level of care and skill exercised by members of our profession currently practicing under similar conditions in the Southern California area. No other warranty, expressed or implied is made.

We appreciate this opportunity to be of service to you. If you have any further questions, please do not hesitate to contact the undersigned.

Respectfully submitted,
NORCAL ENGINEERING



Keith D. Tucker
Project Engineer
R.G.E. 841



Scott D. Spensiero
Project Manager

NorCal Engineering

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5. California Division of Mines and Geology, 1998, Seismic Hazard Zone for Orange 7.5-Minute Quadrangle, Orange County, California
6. California Division of Mines and Geology, 2008, Guidelines for Evaluating and Mitigating Seismic Hazards in California: Special Publication 117A.
7. Earthquake Zones of Required Investigation, Seismic Hazard Zones, Orange Quadrangle (1997) published by the California Geological Survey.
8. Orange County Technical Guidance Document (OCTGD) Appendix VII – Infiltration Rate Evaluation Protocol and Factor of Safety Recommendations dated December 20, 2013.

SPECIFICATIONS FOR PLACEMENT OF COMPACTED FILL

Excavation

Any existing low-density soils and/or saturated soils shall be removed to competent natural soil under the inspection of the Geotechnical Engineering Firm. After the exposed surface has been cleansed of debris and/or vegetation, it shall be scarified until it is uniform in consistency, brought to the proper moisture content and compacted to a minimum of 90% relative compaction (in accordance with ASTM: D 1557).

In any area where a transition between fill and native soil or between bedrock and soil are encountered, additional excavation beneath foundations and slabs will be necessary in order to provide uniform support and avoid differential settlement of the structure.

Material for Fill

The on-site soils or approved import soils may be utilized for the compacted fill provided they are free of any deleterious materials and shall not contain any rocks, brick, asphaltic concrete, concrete or other hard materials greater than eight inches in maximum dimensions. Any import soil must be approved by the Geotechnical Engineering firm a minimum of 72 hours prior to importation of site.

Placement of Compacted Fill Soils

The approved fill soils shall be placed in layers not excess of six inches in thickness. Each lift shall be uniform in thickness and thoroughly blended. The fill soils shall be brought to within 2% of the optimum moisture content, unless otherwise specified by the Soils Engineering firm. Each lift shall be compacted to a minimum of 90% relative compaction (in accordance with ASTM: D 1557) and approved prior to the placement of the next layer of soil. Compaction tests shall be obtained at the discretion of the Geotechnical Engineering firm but to a minimum of one test for every 500 cubic yards placed and/or for every 2 feet of compacted fill placed.

The minimum relative compaction shall be obtained in accordance with accepted methods in the construction industry. The final grade of the structural areas shall be in a dense and smooth condition prior to placement of slabs-on-grade or pavement areas. No fill soils shall be placed, spread or compacted during unfavorable weather conditions. When the grading is interrupted by heavy rains, compaction operations shall not be resumed until approved by the Geotechnical Engineering firm.

Grading Observations

The controlling governmental agencies should be notified prior to commencement of any grading operations. This firm recommends that the grading operations be conducted under the observation of a Soils Engineering firm as deemed necessary. A 24-hour notice must be provided to this firm prior to the time of our initial inspection.

Observation shall include the clearing and grubbing operations to assure that all unsuitable materials have been properly removed; approve the exposed subgrade in areas to receive fill and in areas where excavation has resulted in the desired finished grade and designate areas of overexcavation; and perform field compaction tests to determine relative compaction achieved during fill placement. In addition, all foundation excavations shall be observed by the Geotechnical Engineering firm to confirm that appropriate bearing materials are present at the design grades and recommend any modifications to construct footings.

EXPANSIVE SOIL GUIDELINES

The following expansive soil guidelines are provided for your project. The intent of these guidelines is to inform you, the client, of the importance of proper design and maintenance of projects supported on expansive soils. ***You, as the owner or other interested party, should be warned that you have a duty to provide the information contained in the soil report including these guidelines to your design engineers, architects, landscapers and other design parties in order to enable them to provide a design that takes into consideration expansive soils.***

In addition, you should provide the soil report with these guidelines to any property manager, lessee, property purchaser or other interested party that will have or assume the responsibility of maintaining the development in the future.

Expansive soils are fine-grained silts and clays which are subject to swelling and contracting. The amount of this swelling and contracting is subject to the amount of fine-grained clay materials present in the soils and the amount of moisture either introduced or extracted from the soils. Expansive soils are divided into five categories ranging from “very low” to “very high”. Expansion indices are assigned to each classification and are included in the laboratory testing section of this report. *If the expansion index of the soils on your site, as stated in this report, is 21 or higher, you have expansive soils.* The classifications of expansive soils are as follows:

Classification of Expansive Soil*

Expansion Index	Potential Expansion
0-20	Very Low
21-50	Low
51-90	Medium
91-130	High
Above 130	Very High

*From Table 18A-I-B of California Building Code (1988)

When expansive soils are compacted during site grading operations, care is taken to place the materials at or slightly above optimum moisture levels and perform proper compaction operations. Any subsequent excessive wetting and/or drying of expansive soils will cause the soil materials to expand and/or contract. These actions are likely to cause distress of foundations, structures, slabs-on-grade, sidewalks and pavement over the life of the structure. ***It is therefore imperative that even after construction of improvements, the moisture contents are maintained at relatively constant levels, allowing neither excessive wetting or drying of soils.***

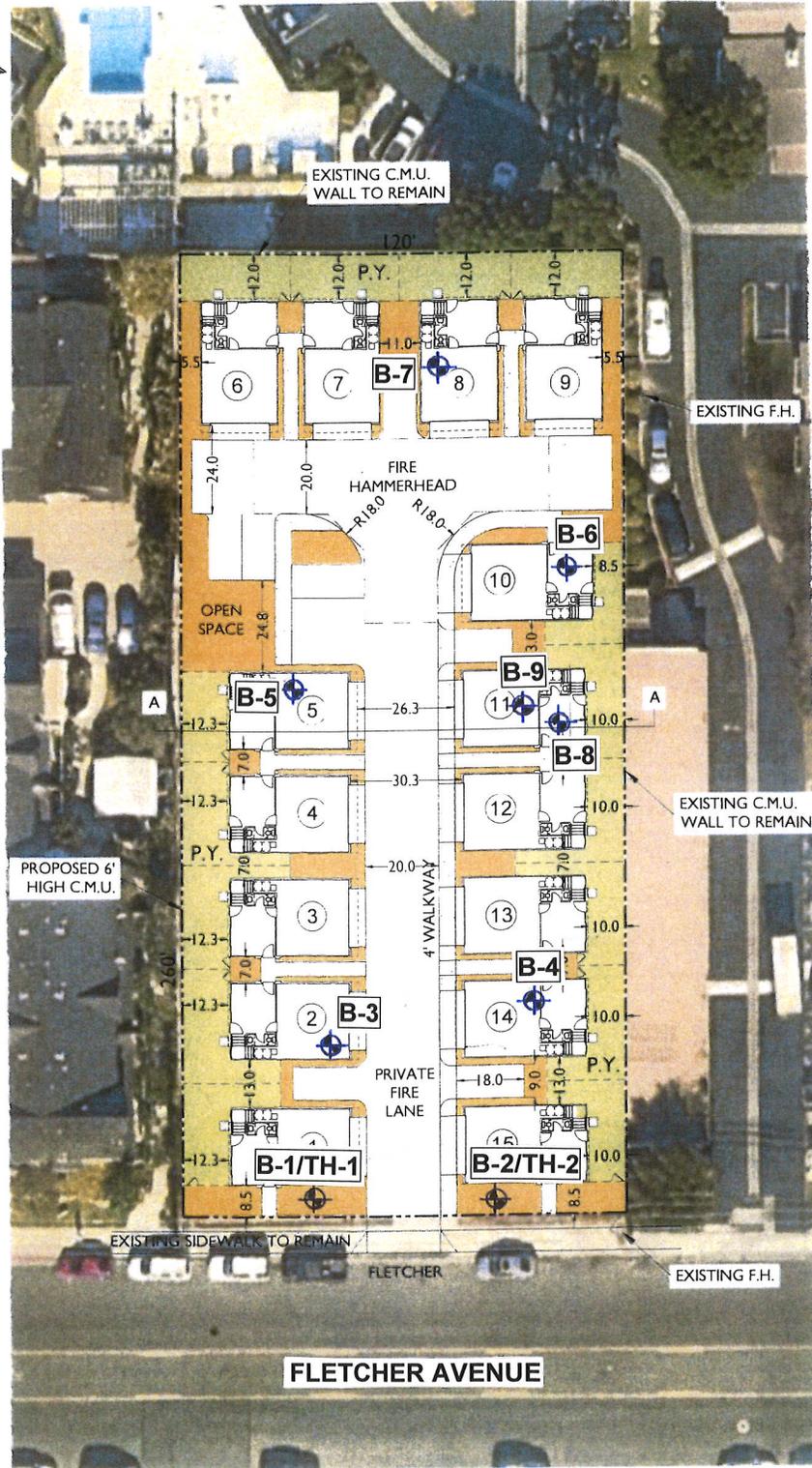
Evidence of excessive wetting of expansive soils may be seen in concrete slabs, both interior and exterior. Slabs may lift at construction joints producing a trip hazard or may crack from the pressure of soil expansion. Wet clays in foundation areas may result in lifting of the structure causing difficulty in the opening and closing of doors and windows, as well as cracking in exterior and interior wall surfaces. In extreme wetting of soils to depth, settlement of the structure may eventually result. Excessive wetting of soils in landscape areas adjacent to concrete or asphaltic pavement areas may also result in expansion of soils beneath pavement and resultant distress to the pavement surface.

Excessive drying of expansive soils is initially evidenced by cracking in the surface of the soils due to contraction. Settlement of structures and on-grade slabs may also eventually result along with problems in the operation of doors and windows.

Projects located in areas of expansive clay soils will be subject to more movement and "hairline" cracking of walls and slabs than similar projects situated on non-expansive sandy soils. There are, however, measures that developers and property owners may take to reduce the amount of movement over the life the development. The following guidelines are provided to assist you in both design and maintenance of projects on expansive soils:

- Drainage away from structures and pavement is essential to prevent excessive wetting of expansive soils. Grades should be designed to the latest building code and maintained to allow flow of irrigation and rain water to approved drainage devices or to the street. Any “ponding” of water adjacent to buildings, slabs and pavement after rains is evidence of poor drainage; the installation of drainage devices or regrading of the area may be required to assure proper drainage. Installation of rain gutters is also recommended to control the introduction of moisture next to buildings. Gutters should discharge into a drainage device or onto pavement which drains to roadways.
- Irrigation should be strictly controlled around building foundations, slabs and pavement and may need to be adjusted depending upon season. This control is essential to maintain a relatively uniform moisture content in the expansive soils and to prevent swelling and contracting. Over-watering adjacent to improvements may result in damage to those improvements. NorCal Engineering makes no specific recommendations regarding landscape irrigation schedules.
- Planting schemes for landscaping around structures and pavement should be analyzed carefully. Plants (including sod) requiring high amounts of water may result in excessive wetting of soils. Trees and large shrubs may actually extract moisture from the expansive soils, thus causing contraction of the fine-grained soils.
- Thickened edges on exterior slabs will assist in keeping excessive moisture from entering directly beneath the concrete. A six-inch thick or greater deepened edge on slabs may be considered. Underlying interior and exterior slabs with 6 to 12 inches or more of non-expansive soils and providing presaturation of the underlying clayey soils as recommended in the soil report will improve the overall performance of on-grade slabs.

- Increase the amount of steel reinforcing in concrete slabs, foundations and other structures to resist the forces of expansive soils. The precise amount of reinforcing should be determined by the appropriate design engineers and/or architects.
- Recommendations of the soil report should always be followed in the development of the project. Any recommendations regarding presaturation of the upper subgrade soils in slab areas should be performed in the field and verified by the Soil Engineer.



NORTH

 1 INCH = 50 FEET

NorCal Engineering

SOILS AND GEOTECHNICAL CONSULTANTS

SITE PLAN

PROJECT	25305-25	DATE	MAY 2025
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List of Appendices **(in order of appearance)**

Appendix A – Log of Excavations

Log of Borings B-1 to B-9

Appendix B – Laboratory Tests

Table I – Maximum Dry Density

Table II – Expansion

Table III – Atterberg Limits

Table IV – Corrosion

Plate A – Direct Shear

Plates B and C - Consolidation

Appendix C – Liquefaction Analysis

Liquefaction Calculations

Seismic Design Report

Seismic Hazard Zones Map

Geologic Map

Appendix D – Soil Infiltration Data

Field Data Sheets and Calculations

Appendix A

Log of Excavations

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

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

UNIFIED SOIL CLASSIFICATION SYSTEM

KEY:

- Indicates 2.5-inch Inside Diameter. Ring Sample.
- ⊗ Indicates 2-inch OD Split Spoon Sample (SPT).
- Indicates Shelby Tube Sample.
- Indicates No Recovery.
- Indicates SPT with 140# Hammer 30 in. Drop.
- ⊗ Indicates Bulk Sample.
- ▣ Indicates Small Bag Sample.
- Indicates Non-Standard
- ⊗ Indicates Core Run.

COMPONENT DEFINITIONS

COMPONENT	SIZE RANGE
Boulders	Larger than 12 in
Cobbles	3 in to 12 in
Gravel	3 in to No 4 (4.5mm)
Coarse gravel	3 in to 3/4 in
Fine gravel	3/4 in to No 4 (4.5mm)
Sand	No. 4 (4.5mm) to No. 200 (0.074mm)
Coarse sand	No. 4 (4.5 mm) to No. 10 (2.0 mm)
Medium sand	No. 10 (2.0 mm) to No. 40 (0.42 mm)
Fine sand	No. 40 (0.42 mm) to No. 200 (0.074 mm)
Silt and Clay	Smaller than No. 200 (0.074 mm)

COMPONENT PROPORTIONS

DESCRIPTIVE TERMS	RANGE OF PROPORTION
Trace	1 - 5%
Few	5 - 10%
Little	10 - 20%
Some	20 - 35%
And	35 - 50%

MOISTURE CONTENT

DRY	Absence of moisture, dusty, dry to the touch.
DAMP	Some perceptible moisture; below optimum
MOIST	No visible water; near optimum moisture content
WET	Visible free water, usually soil is below water table.

RELATIVE DENSITY OR CONSISTENCY VERSUS SPT N -VALUE

COHESIONLESS SOILS		COHESIVE SOILS		
Density	N (blows/ft)	Consistency	N (blows/ft)	Approximate Undrained Shear Strength (psf)
Very Loose	0 to 4	Very Soft	0 to 2	< 250
Loose	4 to 10	Soft	2 to 4	250 - 500
Medium Dense	10 to 30	Medium Stiff	4 to 8	500 - 1000
Dense	30 to 50	Stiff	8 to 15	1000 - 2000
Very Dense	over 50	Very Stiff	15 to 30	2000 - 4000
		Hard	over 30	> 4000

Keusder Homes, Inc.
25305-25

Log of Boring B-1

Boring Location: 705 W. Fletcher Avenue, Orange

Date of Drilling: 5/16/2025

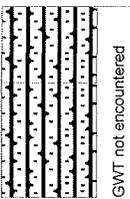
Groundwater Depth: None Encountered

Drilling Method: Simco 2800HS

Hammer Weight: 140 lbs

Drop: 30"

Surface Elevation:

Depth (feet)	Lithology	Material Description	Samples		Laboratory		
			Type	Blow Counts	Moisture	Dry Density	Fines Content %
0	 GWT not encountered	FILL Silty (fine to medium grained) SAND Brown, loose, dry; with occasional gravel Alluvium					
5		Silty (fine to coarse grained) SAND Light brown, medium dense to dense, damp; slightly silty with occasional gravel and cobble Boring completed at depth of 5'					
10							
15							
20							
25							
30							
35							

NorCal Engineering

Boring Location: 705 W. Fletcher Avenue, Orange

Date of Drilling: 5/16/2025

Groundwater Depth: None Encountered

Drilling Method: Simco 2800HS

Hammer Weight: 140 lbs

Drop: 30"

Surface Elevation:

Depth (feet)	Lithology	Material Description	Samples		Laboratory		
			Type	Blow Counts	Moisture	Dry Density	Fines Content %
0		FILL Silty (fine to medium grained) SAND Brown, loose, dry; with occasional gravel Alluvium					
5		Silty (fine to coarse grained) SAND Light brown, medium dense to dense, damp; slightly silty with occasional gravel and cobble					
10		Boring completed at depth of 10'					
15							
20							
25							
30							
35							

SuperLog CivilTech Software, USA www.civiltech.com File: C:\Superlog425305-25.log Date: 5/27/2025

Boring Location: 705 W. Fletcher Avenue, Orange

Date of Drilling: 5/16/2025

Groundwater Depth: None Encountered

Drilling Method: Simco 2800HS

Hammer Weight: 140 lbs

Drop: 30"

Surface Elevation:

Depth (feet)	Lithology	Material Description	Samples		Laboratory	
			Type	Blow Counts	Moisture	Dry Density
0		FILL Silty (fine to medium grained) SAND Brown, loose, dry; with occasional gravel Alluvium Silty (fine to coarse grained) SAND Light brown, medium dense to dense, damp; slightly silty with occasional gravel and cobble		3/3/4 4/5/5 5/7/10 4/8/12 4/5/5 20/32/37	2.0 4.8 4.1 3.4 19.9 6.3	5 9 5 2 61 16
5		Sandy SILT Light grey brown, medium stiff, moist				
10						
15						
20						
25		Gravelly (fine to coarse grained) SAND Brown, dense to very dense, slightly moist to damp; slightly silty with cobbles				
30						
35						

SuperLog CivilTech Software, USA www.civiltech.com File: C:\Superlog\25305-25.log Date: 5/29/2025

Boring Location: 705 W. Fletcher Avenue, Orange

Date of Drilling: 5/16/2025

Groundwater Depth: None Encountered

Drilling Method: Simco 2800HS

Hammer Weight: 140 lbs

Drop: 30"

Surface Elevation:

Depth (feet)	Lithology	Material Description	Samples		Laboratory	
			Type	Blow Counts	Moisture	Dry Density
35		Gravelly (fine to coarse grained) SAND Brown, dense to very dense, damp; slightly silty with cobbles		19/27/31	5.3	9
40		Clayey SILT Dark brown, medium stiff, moist		8/9/9	17.0	63
45		Gravelly (fine to coarse grained) SAND Brown, very dense, damp; slightly silty with cobbles		30/35/50	3.7	5
50		Boring completed at depth of 51.5'		30/32/35	4.2	7
55						
60						
65						
70						

SuperLog CivilTech Software, USA www.civiltech.com File: C:\Superlog4\25305-25.log Date: 5/27/2025

Boring Location: 705 W. Fletcher Avenue, Orange

Date of Drilling: 5/16/2025

Groundwater Depth: None Encountered

Drilling Method: Simco 2800HS

Hammer Weight: 140 lbs

Drop: 30"

Surface Elevation:

Depth (feet)	Lithology	Material Description	Samples		Laboratory	
			Type	Blow Counts	Moisture	Dry Density
0		FILL Silty (fine to medium grained) SAND Brown, loose, dry; with occasional gravel Alluvium Silty (fine to coarse grained) SAND Light brown, medium dense to dense, damp; slightly silty with occasional gravel and cobble				
5			█	7/7	2.8	98.2
10		Boring completed at depth of 10	█	7/10	2.0	98.0
15						
20						
25						
30						
35						

Boring Location: 705 W. Fletcher Avenue, Orange

Date of Drilling: 5/16/2025

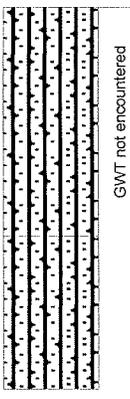
Groundwater Depth: None Encountered

Drilling Method: Simco 2800HS

Hammer Weight: 140 lbs

Drop: 30"

Surface Elevation:

Depth (feet)	Lithology	Material Description	Samples		Laboratory	
			Type	Blow Counts	Moisture	Dry Density
0	 <p>GWT not encountered</p>	FILL Silty (fine to medium grained) SAND Brown, loose, dry to moist; with occasional gravel and cobbles	█	3/3	5.9	93.3
5		Alluvium Silty (fine to coarse grained) SAND Light brown, medium dense to dense, damp; slightly silty with occasional gravel and cobble	█	2/5	4.7	95.1
10		Boring completed at depth of 10'	█	8/8	2.6	102.8
15						
20						
25						
30						
35						

Boring Location: 705 W. Fletcher Avenue, Orange

Date of Drilling: 5/16/2025

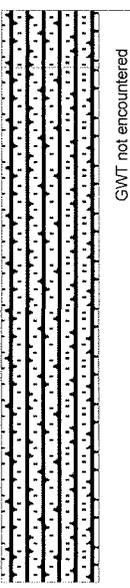
Groundwater Depth: None Encountered

Drilling Method: Simco 2800HS

Hammer Weight: 140 lbs

Drop: 30"

Surface Elevation:

Depth (feet)	Lithology	Material Description	Samples		Laboratory		
			Type	Blow Counts	Moisture	Dry Density	Fines Content %
0		FILL	█	5/8	1.5	101.8	
		Silty (fine to medium grained) SAND Brown, loose, dry; with occasional gravel					
		Alluvium					
5		Silty (fine to coarse grained) SAND Light brown, medium dense to dense, damp; slightly silty with occasional gravel and cobble					
10			█	5/6	4.2	97.0	
15			█	8/9	3.7	102.2	
Boring completed at depth of 15'							

SuperLog CivilTech Software, USA www.civiltech.com File: C:\Superlog4\25305-25.log Date: 5/27/2025

Boring Location: 705 W. Fletcher Avenue, Orange

Date of Drilling: 5/16/2025

Groundwater Depth: None Encountered

Drilling Method: Simco 2800HS

Hammer Weight: 140 lbs

Drop: 30"

Surface Elevation:

Depth (feet)	Lithology	Material Description	Samples		Laboratory	
			Type	Blow Counts	Moisture	Dry Density
0		FILL Silty (fine to medium grained) SAND Brown, loose, dry; with occasional gravel Alluvium				
5		Silty (fine to coarse grained) SAND Light brown, medium dense to dense, damp; slightly silty with occasional gravel and cobble	■	5/5	1.7	96.3
10			■	5/9	2.8	103.3
10		Boring completed at depth of 10'				
15						
20						
25						
30						
35						

Boring Location: 705 W. Fletcher Avenue, Orange

Date of Drilling: 5/16/2025

Groundwater Depth: None Encountered

Drilling Method: Hand Auger

Hammer Weight:

Drop:

Surface Elevation:

Depth (feet)	Lithology	Material Description	Samples		Laboratory		
			Type	Blow Counts	Moisture	Dry Density	Fines Content %
0	 GWT not encountered	FILL Silty (fine to medium grained) SAND Brown, loose, dry to damp; with occasional gravel	■		6.4	93.3	
5			■		5.8	94.9	
10		Alluvium Silty (fine to coarse grained) SAND Light brown, medium dense, moist; slightly silty with occasional gravel Boring completed at depth of 11'					
15							
20							
25							
30							
35							

SuperLog CivilTech Software, USA www.civiltech.com File: C:\Superlog4\25305-25.log Date: 5/27/2025

Boring Location: 705 W. Fletcher Avenue, Orange

Date of Drilling: 5/16/2025

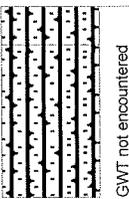
Groundwater Depth: None Encountered

Drilling Method: Hand Auger

Hammer Weight:

Drop:

Surface Elevation:

Depth (feet)	Lithology	Material Description	Samples		Laboratory	
			Type	Blow Counts	Moisture	Dry Density
0		FILL Silty (fine to medium grained) SAND Brown, loose, dry; with occasional gravel Alluvium				
5		Silty (fine to coarse grained) SAND Light brown, medium dense to dense, damp; slightly silty with occasional gravel and cobble Boring completed at depth of 5'				
10						
15						
20						
25						
30						
35						

SuperLog CivilTech Software, USA www.civiltech.com File: C:\Superlog\425305-25.log Date: 5/27/2025

Appendix B

Laboratory Tests

TABLE I
MAXIMUM DENSITY TESTS

Sample	Classification	Optimum Moisture (%)	Maximum Dry Density (lbs/cu.ft)
B-4 @ 2'	Silty SAND	9.0	112.0

TABLE II
EXPANSION TESTS

Sample	Classification	Expansion Index
B-4 @ 2'	Silty SAND	0

TABLE III
ATTERBERG LIMITS

Sample	Liquid Limit	Plastic Limit	Plasticity Index
B-3 @ 25'	26	21	5
B-3 @ 40'	30	22	8

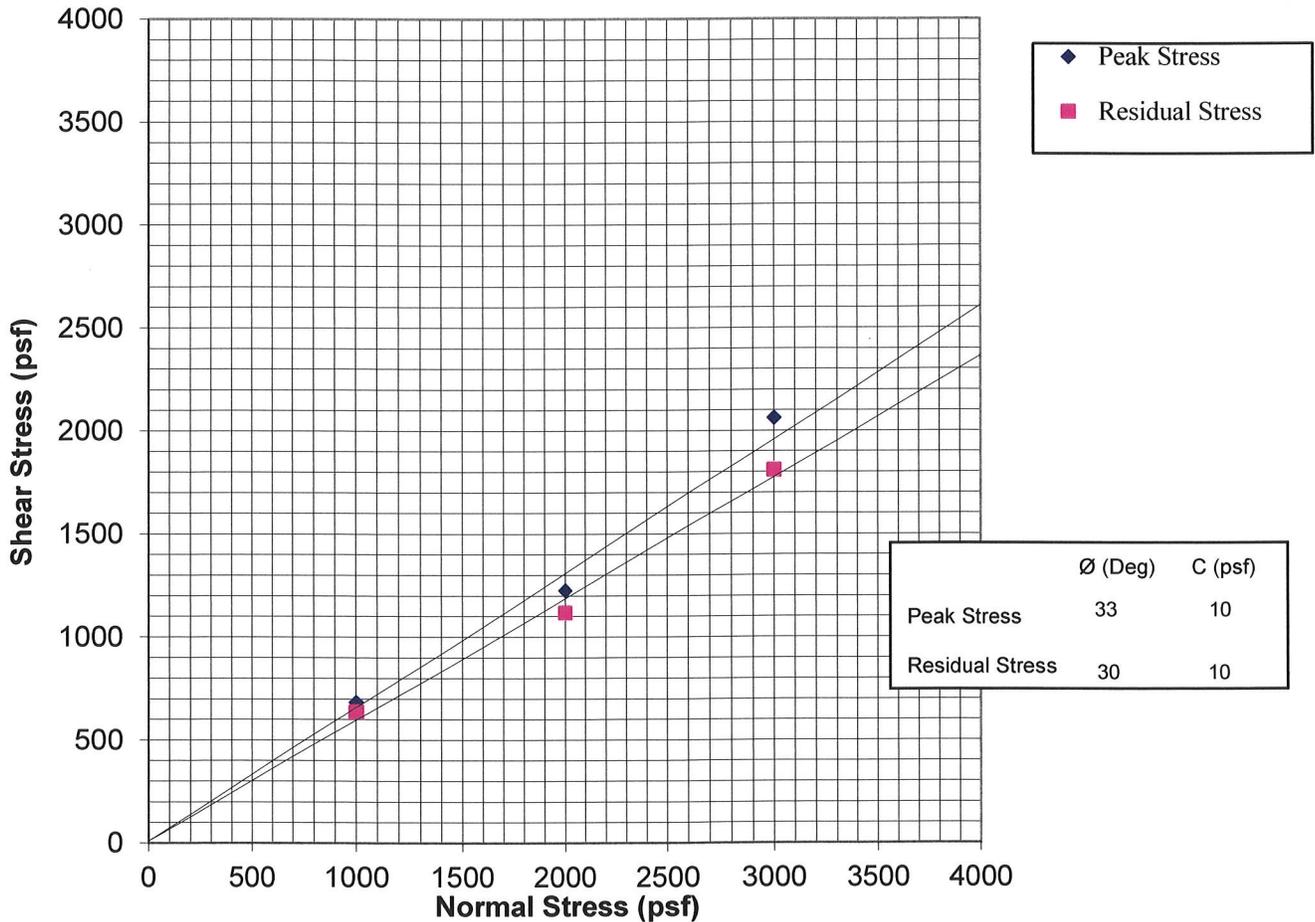
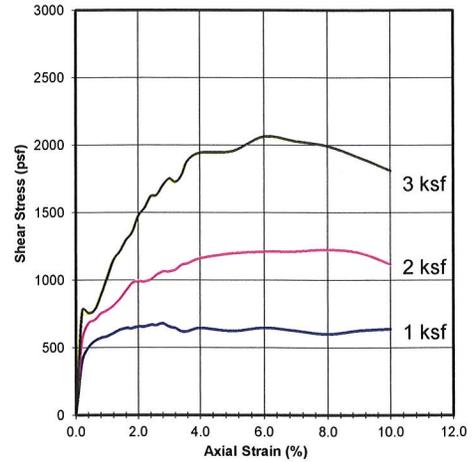
TABLE IV
CORROSION TESTS

Sample	pH	Electrical Resistivity	Sulfate (%)	Chloride (ppm)
B-4 @ 2'	6.8	7,920	0.003	210

% by weight
ppm – mg/kg

Sample No. B6@2'
 Sample Type: Undisturbed-Saturated
 Soil Description: F-M Grained Sand w/ Some Silt

		1	2	3
Normal Stress	(psf)	1000	2000	3000
Peak Stress	(psf)	684	1224	2064
Displacement	(in.)	0.070	0.200	0.150
Residual Stress	(psf)	636	1116	1812
Displacement	(in.)	0.250	0.250	0.250
Initial Dry Density	(pcf)	101.8	101.8	101.8
Initial Water Content	(%)	1.5	1.5	1.5
Strain Rate	(in./min.)	0.020	0.020	0.020



NorCal Engineering
 SOILS AND GEOTECHNICAL CONSULTANTS

Keusder Homes Inc.

PROJECT NUMBER: 25305-25

DATE: 5/29/2025

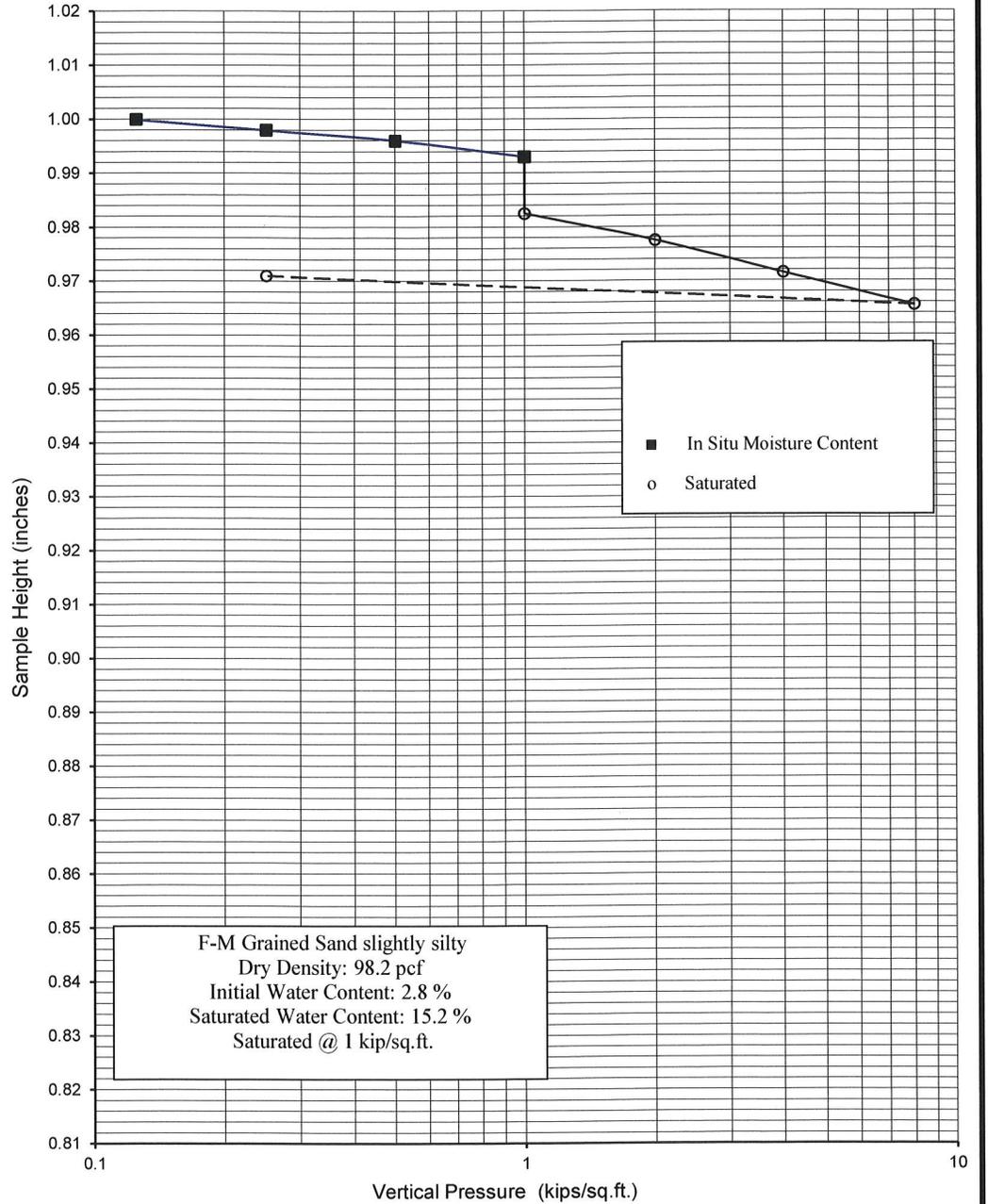
DIRECT SHEAR TEST
ASTM D3080

Plate A

Vertical Pressure (kips/sq.ft.)	Sample Height (inches)	Consolidation (percent)	Saturated	Sample No.	B4	Depth	5'	Date	5/29/2025
------------------------------------	---------------------------	----------------------------	-----------	------------	----	-------	----	------	-----------

0.125	1.0000	0.0
0.25	0.9980	0.2
0.5	0.9960	0.4
1	0.9930	0.7
1	0.9825	1.8
2	0.9775	2.3
4	0.9715	2.9
8	0.9655	3.5
0.25	0.9710	2.9

Date Tested: 5/27/2025
Sample: B4
Depth: 5'

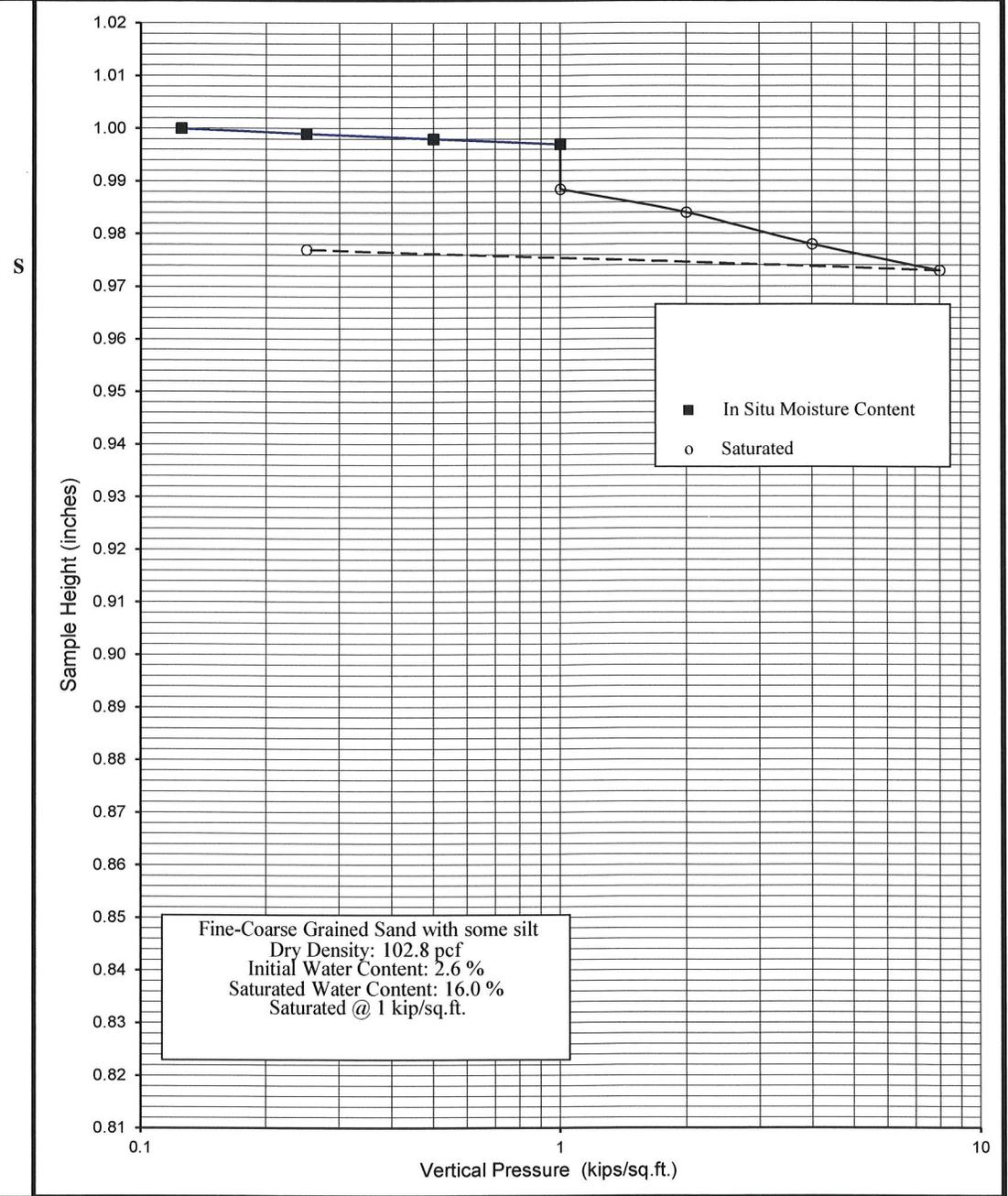


NorCal Engineering SOILS AND GEOTECHNICAL CONSULTANTS		CONSOLIDATION TEST	
Keusder Homes, Inc.		ASTM D2435	
PROJECT NUMBER: 25305-25		DATE: 5/29/2025	
		Plate B	

Vertical Pressure (kips/sq.ft.)	Sample Height (inches)	Consolidation (percent)	Saturated	Sample No. B5	Depth 10'	Date 5/29/2025
------------------------------------	---------------------------	----------------------------	-----------	---------------	-----------	----------------

0.125	1.0000	0.0
0.25	0.9990	0.1
0.5	0.9980	0.2
1	0.9970	0.3
1	0.9885	1.2
2	0.9840	1.6
4	0.9780	2.2
8	0.9730	2.7
0.25	0.9770	2.3

Date Tested: 5/27/2025
Sample: B5
Depth: 10'



NorCal Engineering SOILS AND GEOTECHNICAL CONSULTANTS		CONSOLIDATION TEST ASTM D2435 Plate C	
Keusder Homes Inc.			
PROJECT NUMBER: 25305-25	DATE: 5/29/2025		

Appendix C

Liquefaction Analysis

SITE LOCATION: _____

GEOTECHNICAL REPORT: _____

GEOLOGY REPORT: _____

DEPTH TO WATER TABLE = 25

EARTHQUAKE MAGNITUDE = 6.8

PEAK GROUND ACCELERATION = 0.70g

DEPTH BELOW FINAL GRADE (FEET)	MOIST DENSITY (PCF)	σ_0 TOTAL STRESS (PSF)	σ_0' EFFECTIVE STRESS (PSF)	σ_v/σ_0' (-)	r_d (-)	T_{H_0}/σ_0' (-)	N VALUE (BLOWS/FT)	RELATIVE DENSITY (%)	C_u (-)	C_E (-)	C_B (-)	C_R (-)	C_S (-)	(N ₁) ₆₀ (Blows/ft)	FINES (%)	CRR M=7.5	MSF (-)	CRR M=6.8	LQR. F.S.
5	100	500	Same	1.00	0.99	0.46	7	60	>1.6	1.00	1.05	0.70	1.20	>10	5	>0.11	1.4	>0.15	>0.3
10	↓	1000	↓	↓	0.96	0.44	10	65	1.4	↓	↓	↓	↓	13	9	0.17	↓	0.24	0.5
15	105	1525	↓	↓	0.92	0.42	17	75	1.15	↓	↓	↓	↓	21	5	0.23	↓	0.32	0.8
20	↓	2050	↓	↓	0.87	0.40	20	75	1.0	↓	↓	↓	↓	23	2	0.25	↓	0.35	0.9
25	↓	2575	↓	↓	0.80	0.36	10	55	0.9	↓	↓	↓	↓	11	91	>0.20	↓	>0.28	>0.8
30	↓	3100	2788	1.11	0.74	0.38	69	>90	0.83	↓	↓	↓	↓	72	16	>0.50	↓	>0.70	>1.8
35	↓	3625	3001	1.21	0.68	0.38	58	>90	0.78	↓	↓	↓	↓	57	9	>0.50	↓	>0.70	>1.8
40	↓	4150	3214	1.29	0.64	0.38	18	60	0.74	↓	↓	↓	↓	17	63	>0.30	↓	>0.42	>1.1
45	↓	4675	3427	1.36	0.61	0.38	85	>90	0.70	↓	↓	↓	↓	75	5	>0.50	↓	>0.70	>1.8
50	↓	5200	3640	1.43	0.58	0.38	67	>90	0.66	↓	↓	↓	↓	56	7	>0.50	↓	>0.70	>1.8

① INDUCED CYCLIC STRESS RATIO = $T_{ave}/\sigma_0' = 0.65 \cdot \frac{\sigma_{max}}{g} \cdot \frac{\sigma_0'}{\sigma_0}$

• C_E = Corr. - Energy Ratio = Energy Ratio / 60%

• C_B = Corr. - Borehole Dia. = 1.15 for 8" dia. borehole

• C_R = Corr. - Rod Length

• C_S = Corr. - Sampling Method

Actual Energy Ratio = 0.67-1.17 (Safety Hammer)

= 0.50-1.00 (Dowt Hammer)

Sampling Method = 1.0 Standard sampler

= 1.2 Sampler w/o liners

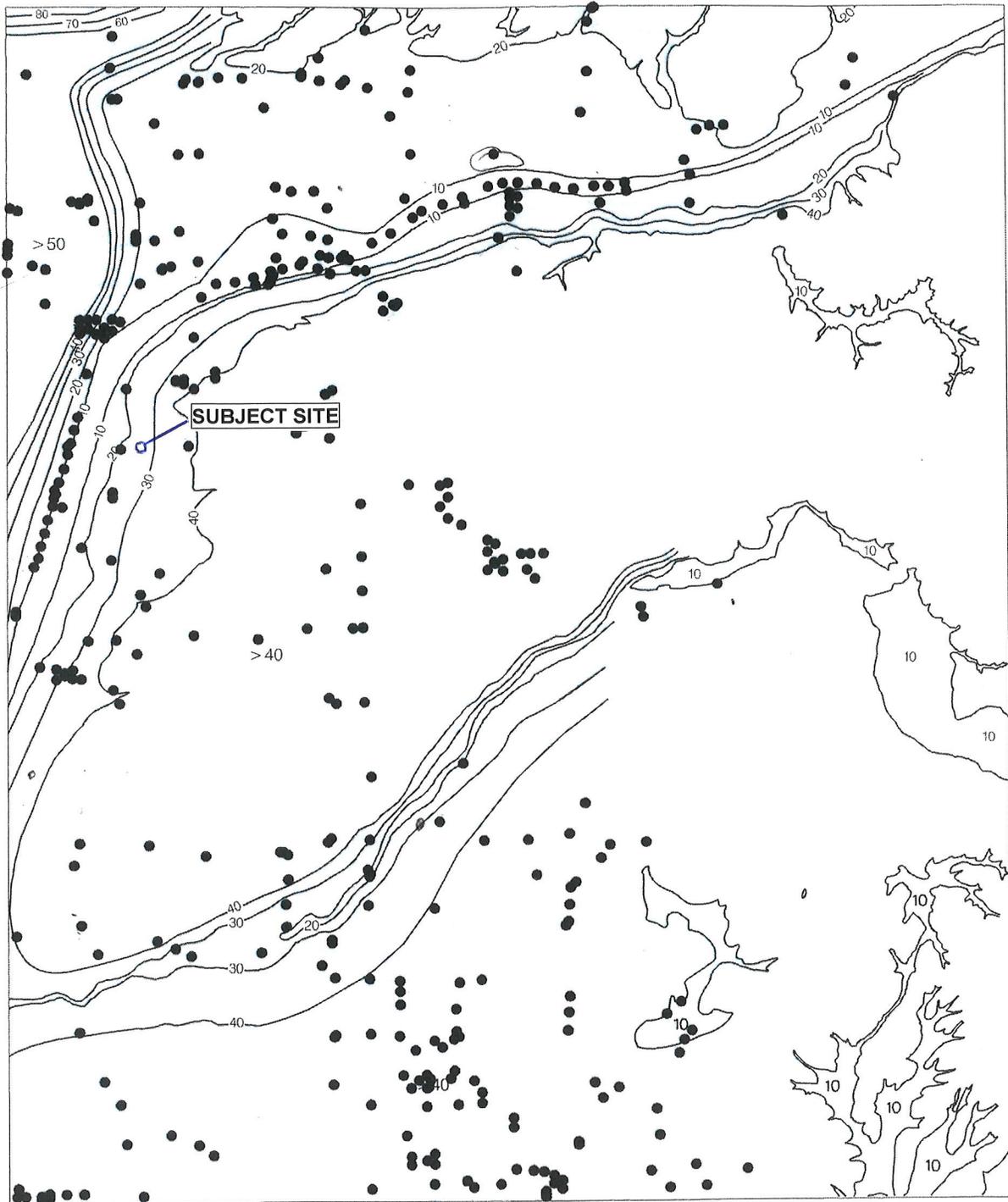
NorCal Engineering
SOILS AND GEOTECHNICAL CONSULTANTS

EVALUATION OF LIQUEFACTION POTENTIAL

PROJECT _____

DATE _____

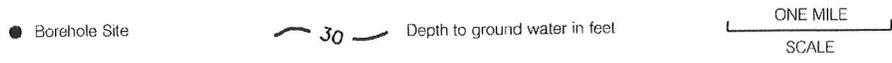
117° 52' 30"
33° 52' 30"



Base map enlarged from U.S.G.S. 30 x 60-minute series

117° 45'
33° 45'

Plate 1.2 Historically Highest Ground Water Contours and Borehole Log Data Locations, Orange 7.5-minute Quadrangle, California.



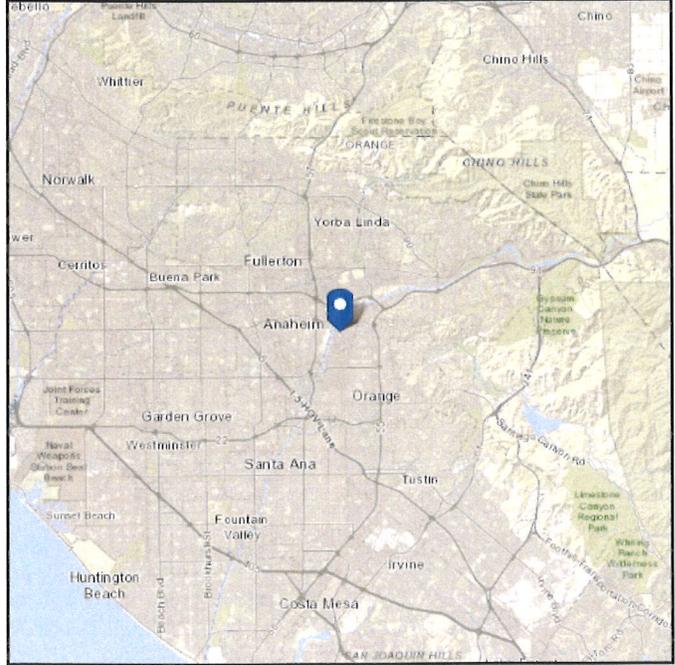
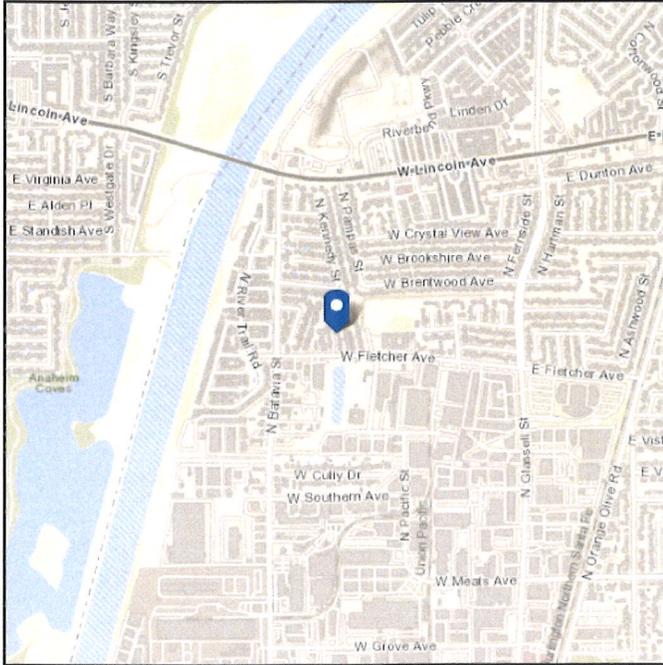


ASCE Hazards Report

Address:
705 W Fletcher Ave
Orange, California
92865

Standard: ASCE/SEI 7-16
Risk Category: II
Soil Class: D - Stiff Soil

Latitude: 33.83029
Longitude: -117.859731
Elevation: 202.4649512131302 ft
(NAVD 88)



Seismic

Site Soil Class: D - Stiff Soil

Results:

S_s :	1.501	S_{D1} :	N/A
S_1 :	0.531	T_L :	8
F_a :	1	PGA :	0.634
F_v :	N/A	PGA _M :	0.698
S_{MS} :	1.501	F_{PGA} :	1.1
S_{M1} :	N/A	I_e :	1
S_{DS} :	1.001	C_v :	1.4

Ground motion hazard analysis may be required. See ASCE/SEI 7-16 Section 11.4.8.

Data Accessed: Tue May 13 2025

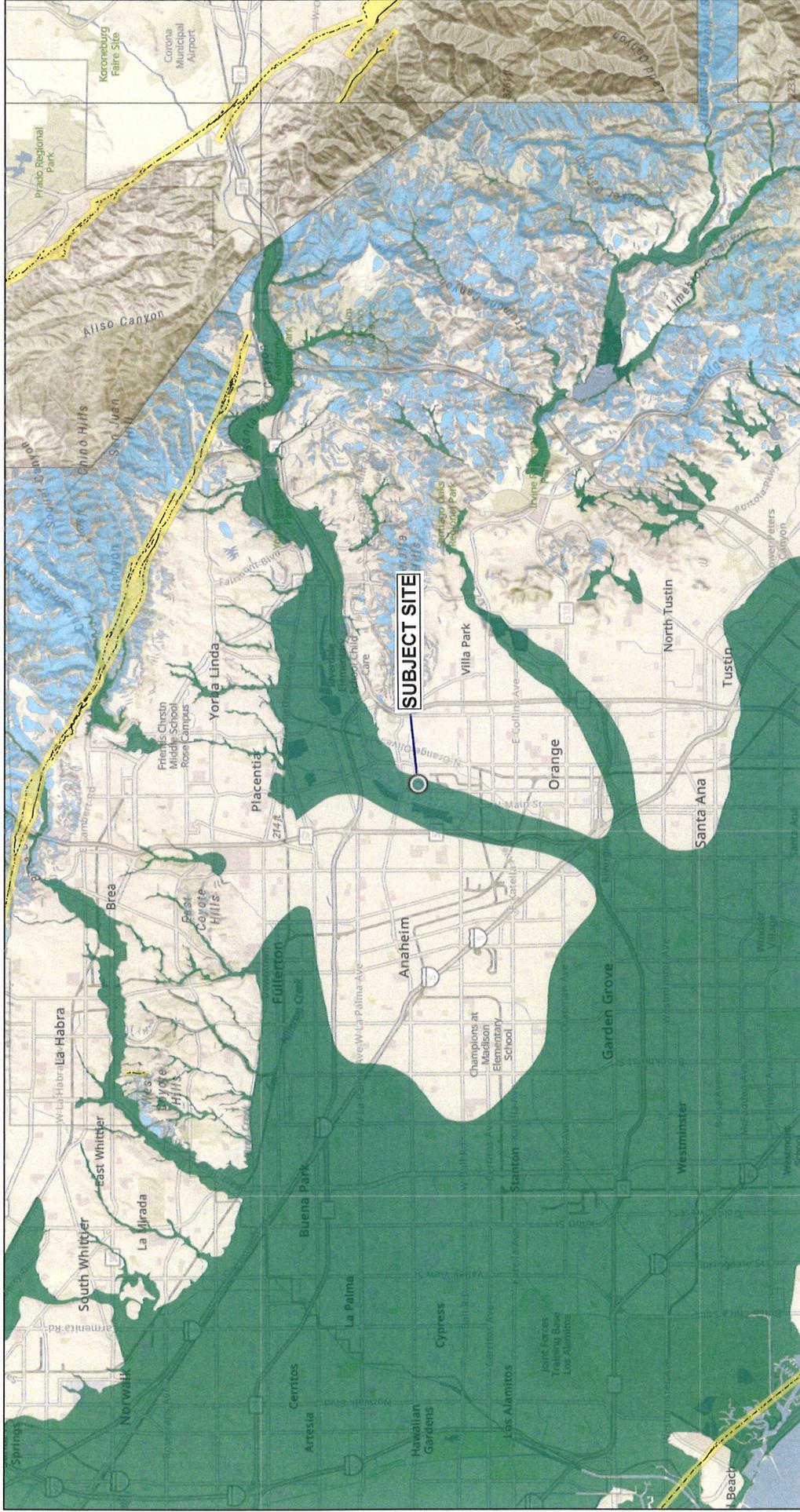
Date Source: [USGS Seismic Design Maps](#)

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ArcGIS Web Map



5/13/2025, 1:37:40 PM

CGS Alquist Priolo Fault Traces

Accurately Located

Approximately Located

Inferred

Concealed

Concealed, Queried

CGS Alquist-Priolo Fault Zones

CGS Liquefaction Zones

CGS Landslide Zones

CGS SHZ Unevaluated Areas

1:144,352

0 1.5 3 4.5 6 mi

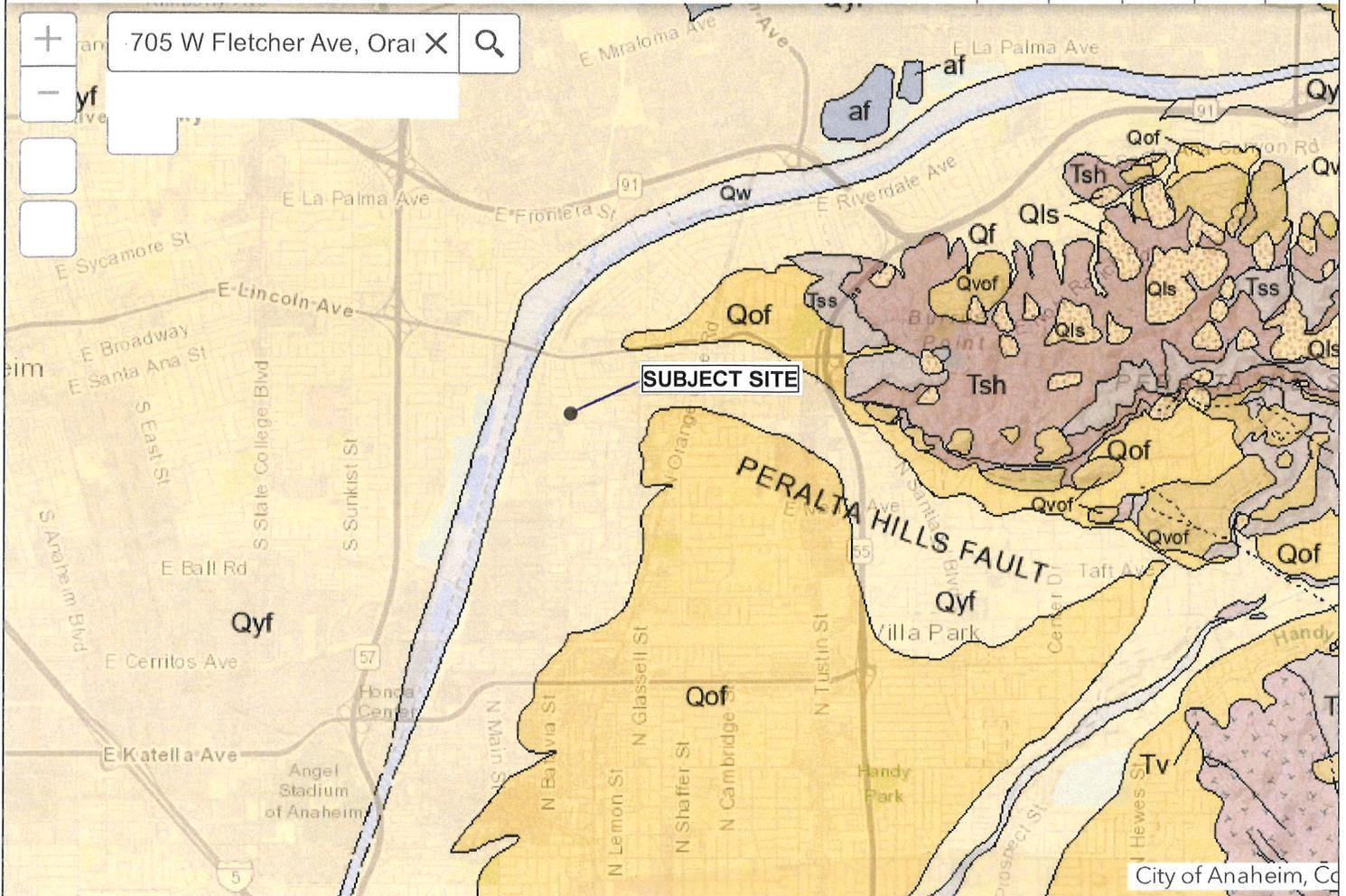
0 2.25 4.5 9 km



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Community



Compilation of Quaternary Surficial Deposits



PType	Qyf
Name	Young Alluvial Fan Deposits
Source Quadrangle	Santa Ana 30' x 60'
Source	USGS
Reference Document	santa_ana_30x60_reference.pdf



1mi

-117.805 33.827 Degrees

Appendix D

Soil Infiltration Data



SOILS AND GEOTECHNICAL CONSULTANTS

PERCOLATION TEST DATA

Client: Keusder Homes, Inc.	Date: 5/16/2025
Project No.: 25305-25	Tested By: J.S.
Test Hole: 1	USCS Soil Classification:
Depth of Test Hole: 5' (60")	Sides (if rectangular):
Diameter of Test Hole: 6"	Length:
Sandy Soil Criteria Test*:	Width:

TRIAL NO.	START TIME	STOP TIME	TIME INTERVAL (MIN)	INITIAL DEPTH TO WATER (IN)	FINAL DEPTH TO WATER (IN)	CHANGE IN WATER LEVEL (IN)	GREATER THAN OR EQUAL TO 6"
1	7:22	7:23	1	45.0	60.0	15.0	
2	7:23	7:24	1	45.0	60.0	15.0	

*If two consecutive measurements show that six inches of water seeps away in less than 25 minutes, the test shall be run for an additional hour with measurements taken every 10 minutes. Otherwise, pre-soak (fill) overnight. Obtain at least twelve measurements per hole over at least six hours (approximately 30-minute intervals) with a precision of at least 0.25".

TRIAL NO	START TIME	STOP TIME	ΔT TIME INTERVAL (MIN)	Do INITIAL DEPTH TO WATER (IN)	Df FINAL DEPTH TO WATER (IN)	ΔD CHANGE IN WATER LEVEL (IN)	PERCOLATION RATE (MIN/IN)
1	7:24	7:25	1	45.0	60.0	15.0	
2	7:25	7:26	1	45.0	60.0	15.0	
3	7:26	7:27	1	45.0	60.0	15.0	
4	7:27	7:28	1	45.0	60.0	15.0	
5	7:28	7:29	1	45.0	60.0	15.0	
6	7:29	7:30	1	45.0	60.0	15.0	
7	7:30	7:31	1	45.0	60.0	15.0	
8	7:31	7:32	1	45.0	60.0	15.0	
9	7:32	7:33	1	45.0	60.0	15.0	
10	7:33	7:34	1	45.0	60.0	15.0	
11	7:34	7:35	1	45.0	60.0	15.0	
12	7:35	7:36	1	45.0	60.0	15.0	
13	7:36	7:37	1	45.0	60.0	15.0	
14	7:37	7:38	1	45.0	60.0	15.0	
15	7:38	7:39	1	45.0	60.0	15.0	

COMMENTS:



SOILS AND GEOTECHNICAL CONSULTANTS

PERCOLATION TEST DATA

TRIAL NO	START TIME	STOP TIME	ΔT TIME INTERVAL (MIN)	Do INITIAL DEPTH TO WATER (IN)	Df FINAL DEPTH TO WATER (IN)	ΔD CHANGE IN WATER LEVEL (IN)	PERCOLATION RATE (MIN/IN)
16	7:39	7:40	1	45.0	60.0	15.0	
17	7:40	7:41	1	45.0	60.0	15.0	
18	7:41	7:42	1	45.0	60.0	15.0	
19	7:42	7:43	1	45.0	60.0	15.0	
20	7:43	7:44	1	45.0	60.0	15.0	
21	7:44	7:45	1	45.0	60.0	15.0	
22	7:45	7:46	1	45.0	60.0	15.0	
23	7:46	7:47	1	45.0	60.0	15.0	
24	7:47	7:48	1	45.0	60.0	15.0	
25	7:48	7:49	1	45.0	60.0	15.0	
26	7:49	7:50	1	45.0	60.0	15.0	
27	7:50	7:51	1	45.0	60.0	15.0	
28	7:51	7:52	1	45.0	60.0	15.0	
29	7:52	7:53	1	45.0	60.0	15.0	
30	7:53	7:54	1	45.0	60.0	15.0	
31	7:54	7:55	1	45.0	60.0	15.0	
32	7:55	7:56	1	45.0	60.0	15.0	
33	7:56	7:57	1	45.0	60.0	15.0	
34	7:57	7:58	1	45.0	60.0	15.0	
35	7:58	7:59	1	45.0	60.0	15.0	
36	7:59	8:00	1	45.0	60.0	15.0	
37	8:00	8:01	1	45.0	60.0	15.0	
38	8:01	8:02	1	45.0	60.0	15.0	
39	8:02	8:03	1	45.0	60.0	15.0	
40	8:03	8:04	1	45.0	60.0	15.0	
41	8:04	8:05	1	45.0	60.0	15.0	
42	8:05	8:06	1	45.0	60.0	15.0	
43	8:06	8:07	1	45.0	60.0	15.0	
44	8:07	8:08	1	45.0	60.0	15.0	
45	8:08	8:09	1	45.0	60.0	15.0	
46	8:09	8:11	2	45.0	60.0	15.0	
47	8:11	8:13	2	45.0	60.0	15.0	

COMMENTS:



SOILS AND GEOTECHNICAL CONSULTANTS

PERCOLATION TEST DATA

Client: Keusder Homes, Inc.	Date: 5/16/2025
Project No.: 25305-25	Tested By: J.S.
Test Hole: 2	USCS Soil Classification:
Depth of Test Hole: 10' (120")	Sides (if rectangular):
Diameter of Test Hole: 10"	Length:
Sandy Soil Criteria Test*:	Width:

TRIAL NO.	START TIME	STOP TIME	TIME INTERVAL (MIN)	INITIAL DEPTH TO WATER (IN)	FINAL DEPTH TO WATER (IN)	CHANGE IN WATER LEVEL (IN)	GREATER THAN OR EQUAL TO 6"
1	7:35	7:36	1	105.0	120.0	15.0	
2	7:36	7:37	1	105.0	120.0	15.0	

*If two consecutive measurements show that six inches of water seeps away in less than 25 minutes, the test shall be run for an additional hour with measurements taken every 10 minutes. Otherwise, pre-soak (fill) overnight. Obtain at least twelve measurements per hole over at least six hours (approximately 30-minute intervals) with a precision of at least 0.25".

TRIAL NO	START TIME	STOP TIME	ΔT TIME INTERVAL (MIN)	Do INITIAL DEPTH TO WATER (IN)	Df FINAL DEPTH TO WATER (IN)	ΔD CHANGE IN WATER LEVEL (IN)	PERCOLATION RATE (MIN/IN)
1	7:37	7:38	1	105.0	120.0	15.0	
2	7:38	7:39	1	105.0	120.0	15.0	
3	7:39	7:40	1	105.0	120.0	15.0	
4	7:40	7:41	1	105.0	120.0	15.0	
5	7:41	7:42	1	105.0	120.0	15.0	
6	7:42	7:43	1	105.0	120.0	15.0	
7	7:43	7:44	1	105.0	120.0	15.0	
8	7:44	7:45	1	105.0	120.0	15.0	
9	7:45	7:46	1	105.0	120.0	15.0	
10	7:46	7:47	1	105.0	120.0	15.0	
11	7:47	7:48	1	105.0	120.0	15.0	
12	7:48	7:49	1	105.0	120.0	15.0	
13	7:49	7:50	1	105.0	120.0	15.0	
14	7:50	7:51	1	105.0	120.0	15.0	
15	7:51	7:52	1	105.0	120.0	15.0	

COMMENTS:



SOILS AND GEOTECHNICAL CONSULTANTS

PERCOLATION TEST DATA

TRIAL NO	START TIME	STOP TIME	ΔT TIME INTERVAL (MIN)	Do INITIAL DEPTH TO WATER (IN)	Df FINAL DEPTH TO WATER (IN)	ΔD CHANGE IN WATER LEVEL (IN)	PERCOLATION RATE (MIN/IN)
16	7:52	7:53	1	105.0	120.0	15.0	
17	7:53	7:54	1	105.0	120.0	15.0	
18	7:54	7:55	1	105.0	120.0	15.0	
19	7:55	7:56	1	105.0	120.0	15.0	
20	7:56	7:57	1	105.0	120.0	15.0	
21	7:57	7:58	1	105.0	120.0	15.0	
22	7:58	7:59	1	105.0	120.0	15.0	
23	7:59	8:00	1	105.0	120.0	15.0	
24	8:00	8:01	1	105.0	120.0	15.0	
25	8:01	8:02	1	105.0	120.0	15.0	
26	8:02	8:03	1	105.0	120.0	15.0	
27	8:03	8:04	1	105.0	120.0	15.0	
28	8:04	8:05	1	105.0	120.0	15.0	
29	8:05	8:06	1	105.0	120.0	15.0	
30	8:06	8:07	1	105.0	120.0	15.0	
31	8:07	8:08	1	105.0	120.0	15.0	
32	8:08	8:09	1	105.0	120.0	15.0	
33	8:09	8:10	1	105.0	120.0	15.0	
34	8:10	8:11	1	105.0	120.0	15.0	
35	8:11	8:12	1	105.0	120.0	15.0	
36	8:12	8:13	1	105.0	120.0	15.0	
37	8:13	8:14	1	105.0	120.0	15.0	
38	8:14	8:15	1	105.0	120.0	15.0	
39	8:15	8:16	1	105.0	120.0	15.0	
40	8:16	8:17	1	105.0	120.0	15.0	
41	8:17	8:18	1	105.0	120.0	15.0	
42	8:18	8:19	1	105.0	120.0	15.0	
43	8:19	8:20	1	105.0	120.0	15.0	
44	8:20	8:21	1	105.0	120.0	15.0	
45	8:21	8:22	1	105.0	120.0	15.0	
46	8:22	8:23	1	105.0	120.0	15.0	
47	8:23	8:24	1	105.0	120.0	15.0	

COMMENTS:

SOIL INFILTRATION RATE CALCS ⇒ PORCHET METHOD

Location:	TH-1	TH-2
• Depth of Hole =	5.0'	10.0'
• Hole Radius =	3"	3"
• Drop = Δh	15"	15"
• Time = Δt Interval	2 min	1 min
• Initial Water Depth = H_0	15"	15"
• Final Water Depth = H_t	ϕ	ϕ
• Average Water Head = H_{avg}	7.5"	7.5"
• INFILTRATION RATE	75 in/hr	150 in/hr

$$\text{Infiltration Rate} = \frac{\Delta h (60)(r)}{\Delta t (r + z + H_{avg})}$$

$$\text{Average Water Head} = \frac{1}{2} (H_t - H_0)$$

Appendix F:

Hydrology Information

(Q2 – Two-year frequency storm evaluation)

RATIONAL METHOD STUDY FORM

Orange County HYDROLOGY MANUAL			STUDY NAME: 715 Fletcher Ave, Orange CA							CALCULATED BY: TCA		DATE: 09/17/25		
			Existing & Proposed Stormwater Runoff Calculations							CHECKED BY: TCA		PAGE 1 OF 1		
Design Storm Freq.	AREA (ACRES)		SOIL	Ap	Fp	Fm	Tc	I	Q	d	Vol, cf	FLOW	ELEV	HYDRAULICS AND NOTES
	SUBAREA	PERVIOUS	TYPE	%PER	IN/HR	IN/HR	MIN	IN/HR	CFS	IN	EST.	PATH, FT	DIFF	
Existing X1														
2 year	0.72	0.06	B	9%	0.300	0.03	10.3	1.50	0.95	2.05	4449	272	0.49	Assumes most recent site utilization as a business
10 year	0.72	0.06	B	9%	0.300	0.03	10.3	2.68	1.71	3.68	7987			
25 year	0.72	0.06	B	9%	0.300	0.03	10.3	3.20	2.05	4.49	9745			
100 year	0.72	0.06	B	9%	0.300	0.03	10.3	4.09	2.62	5.63	12219			
Proposed A1														
2 year	0.72	0.17	B	24%	0.300	0.07	9.8	1.54	0.95	2.05	3842	313	3.33	
10 year	0.72	0.17	B	24%	0.300	0.07	9.8	2.76	1.73	3.68	6896			
25 year	0.72	0.17	B	24%	0.300	0.07	9.8	3.30	2.08	4.49	8414			
100 year	0.72	0.17	B	24%	0.300	0.07	9.8	4.21	2.67	5.63	10550			
NOTES: I(t) = at^b per (OC) Figure B-3 ; Q = 0.9*(I - Fm)*A per (OC) Equation D.4; Fp per (OC) Table C.2; d per (OC) Table B.1														

Estimated Peak Flow	2 year	10 year	25 year	100 year	Estimated 24-hr Volume	2 year	10 year	25 year	100 year
	Pre	0.95	1.71	2.05		2.62	Pre	4,449	7,987
Post	0.95	1.73	2.08	2.67	Post	3,842	6,896	8,414	10,550
Diff	0.00	0.02	0.03	0.05	DCV	1687	1687	1687	1687
Change	-0.2%	1.2%	1.4%	1.8%	Diff	-2295	-2778	-3018	-3356
					Change	-51.6%	-34.8%	-31.0%	-27.5%

Conclusion: While the Peak flow rate in the Post-development condition exceeds the Pre-development condition, the Rational Method calculation does not take into account the reduction of flow due to the capture and infiltration of the Stormwater Quality Design Capture Volume (DCV).