

**Appendix F:
Preliminary Water Quality Management Plan**



CA ENGINEERING

CENTRAL AVENUE INDUSTRIAL PROJECT

270 E. Central Avenue
San Bernardino, CA 92408

Water Quality Management Plan



Prepared By:

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Prepared For:

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Date Prepared: December 15, 2015

Water Quality Management Plan

For:

Central Avenue Industrial Project

270 E. Central Avenue

San Bernardino, CA 92408

APN: 0136-401-11-0-000

Prepared for:

Central XC, LLC

Gretchen Sauer, Member

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Approval Date: _____



Project Owner's Certification

This Water Quality Management Plan (WQMP) has been prepared for Central XC, LLC by CA Engineering, Inc. . The WQMP is intended to comply with the requirements of the City of San Bernardino and the NPDES Areawide Stormwater Program requiring the preparation of a WQMP. 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 San Bernardino County's Municipal Storm Water Management Program and the intent of the NPDES Permit for San Bernardino County and the incorporated cities of San Bernardino County within the Santa Ana Region. Once the undersigned transfers its interest in the property, its successors in interest and the city/county shall be notified of the transfer. The new owner will be informed of its responsibility under this WQMP. A copy of the approved WQMP shall be available on the subject site in perpetuity.

"I certify under a penalty of law that the provisions (implementation, operation, maintenance, and funding) of the WQMP have been accepted and that the plan will be transferred to future successors."

Project Data			
Permit/Application Number(s):	Pending	Grading Permit Number(s):	Pending
Tract/Parcel Map Number(s):	Parcel 1 of Parcel Map No. 5582	Building Permit Number(s):	Pending
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			APN: 0136-401-11-0-000
Owner's Signature			
Owner Name: Central XC, LLC			
Title	Gretchen Sauer, Member		
Company	Central XC, LLC		
Address	3010 Old Ranch Parkway, Suite 470, Seal Beach, CA 90740		
Email	gretchens@xebecrealty.com		
Telephone #	(562) 795-0270		
Signature			Date

Preparer's Certification

Project Data			
Permit/Application Number(s):	Pending	Grading Permit Number(s):	Pending
Tract/Parcel Map Number(s):	Parcel 1 of Parcel Map No. 5582	Building Permit Number(s):	Pending
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			APN: 0136-401-11-0-000

“The selection, sizing and design of stormwater treatment and other stormwater quality and quantity control measures in this plan were prepared under my oversight and meet the requirements of Regional Water Quality Control Board Order No. R8-2010-0036.”

Engineer: Fred Cornwell, P.E.		PE Stamp Below
Title	Principal	
Company	CA Engineering, Inc.	
Address	3002 Dow Avenue, Suite 122, Tustin, CA 92780	
Email	fcornwell@ca-eng.net	
Telephone #	(949) 724-9480 (x2012)	
Signature	<i>[Handwritten Signature]</i>	
Date	12-22-2015	

Table of Contents

Section 1 Discretionary Permits.....	1-1
Section 2 Project Description.....	2-1
2.1 Project Information.....	2-1
2.2 Property Ownership / Management	2-2
2.3 Potential Stormwater Pollutants	2-3
2.4 Water Quality Credits	2-4
Section 3 Site and Watershed Description	3-1
Section 4 Best Management Practices	4-1
4.1 Source Control BMP	4-1
4.1.1 Pollution Prevention.....	4-1
4.1.2 Preventative LID Site Design Practices	4-6
4.2 Project Performance Criteria.....	4-7
4.3 Project Conformance Analysis	4-12
4.3.1 Site Design Hydrologic Source Control BMP	4-14
4.3.2 Infiltration BMP	4-16
4.3.3 Harvest and Use BMP	4-18
4.3.4 Biotreatment BMP.....	4-19
4.3.5 Conformance Summary	4-23
4.3.6 Hydromodification Control BMP	4-24
4.4 Alternative Compliance Plan (if applicable)	4-25
Section 5 Inspection & Maintenance Responsibility Post Construction BMPs.....	5-1
Section 6 Site Plan and Drainage Plan	6-1
6.1. Site Plan and Drainage Plan.....	6-1
6.2 Electronic Data Submittal.....	6-1

Forms

Form 1-1 Project Information.....	1-1
Form 2.1-1 Description of Proposed Project	2-1
Form 2.2-1 Property Ownership/Management	2-2
Form 2.3-1 Pollutants of Concern	2-3
Form 2.4-1 Water Quality Credits	2-4
Form 3-1 Site Location and Hydrologic Features	3-1
Form 3-2 Hydrologic Characteristics	3-2
Form 3-3 Watershed Description.....	3-3
Form 4.1-1 Non-Structural Source Control BMP	4-2
Form 4.1-2 Structural Source Control BMP.....	4-4
Form 4.1-3 Site Design Practices Checklist	4-6
Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume	4-7
Form 4.2-2 Summary of HCOC Assessment.....	4-8

Form 4.2-3 HCOC Assessment for Runoff Volume	4-9
Form 4.2-4 HCOC Assessment for Time of Concentration.....	4-10
Form 4.2-5 HCOC Assessment for Peak Runoff.....	4-11
Form 4.3-1 Infiltration BMP Feasibility	4-13
Form 4.3-2 Site Design Hydrologic Source Control BMP	4-14
Form 4.3-3 Infiltration LID BMP	4-17
Form 4.3-4 Harvest and Use BMP	4-18
Form 4.3-5 Selection and Evaluation of Biotreatment BMP	4-19
Form 4.3-6 Volume Based Biotreatment – Bioretention and Planter Boxes w/Underdrains	4-20
Form 4.3-7 Volume Based Biotreatment- Constructed Wetlands and Extended Detention	4-21
Form 4.3-8 Flow Based Biotreatment	4-22
Form 4.3-9 Conformance Summary and Alternative Compliance Volume Estimate	4-23
Form 4.3-10 Hydromodification Control BMP	4-24
Form 5-1 BMP Inspection and Maintenance	5-1

Section 1 Discretionary Permit(s)

Form 1-1 Project Information					
Project Name		Central Avenue Industrial Project			
Project Owner Contact Name:		Gretchen Sauer			
Mailing Address:	3010 Old Ranch Parkway, Suite 470 Seal Beach, CA 90740	E-mail Address:	gretchens@xebecrealty.com	Telephone:	(562) 795-0270
Permit/Application Number(s):		Pending	Tract/Parcel Map Number(s):	Parcel 1 of Parcel Map No. 5582	
Additional Information/ Comments:		N/A			
Description of Project:		<p>The project site encompasses approximately 5.24 acres (228,387 square feet). The rectangular-shaped parcel is essentially flat and is vacant and undeveloped. The ground surface cover consists of exposed soil with moderate native grass and weed growth. The site is bounded to the north by an existing commercial/industrial building, to the east by an office complex and self-storage facility, to the south by East Central Avenue, and to the west by a commercial/industrial building.</p> <p>The proposed project will consist of one large industrial building and associated truck loading docks, parking areas, drive aisles, driveways and walkways. The proposed building will have a total footprint area of 115,570 square feet, and the drive aisles, parking areas and remaining hardscape will occupy 98,821 square feet, for a total impervious area of 214,391 square feet, or 93.8% of the project site. The proposed project will also include 13,996 square feet of ornamental landscaping, for a total pervious area of 6.2% of the project site.</p> <p>There are two proposed trash enclosures which will be located as identified on the WQMP Site Plan included in Section 6 (Attachment B). No streets, roads, or highway projects are planned to be constructed as part of the proposed project. There are no known materials or wastes that are anticipated to be used or produced at the proposed development that would be classified as "hazardous." Further, none of the materials to be used at the proposed development will be stored outside.</p> <p>The project will not violate any water quality standards because the project will be required to meet the City's NPDES permit discharge requirements. The development is proposing to install a subsurface infiltration system for onsite water quality treatment. The subsurface infiltration system will be constructed under the parking lot and drive aisles located along the east side of the building, adjacent to the loading dock area. The design infiltration rate is 1.5"/hr. The surface flows will enter the system via catch basins and will be conveyed to a hydrodynamic separator (see CDS specifications contained in Section 6) that will remove sediment and debris before the flows enter the infiltration system. The infiltration system consists of four 60" perforated HDPE pipes that will be placed on a 28' wide gravel bed. Two areas totaling 0.18 acres at the northern and southern borders of the project site will be self-retaining, depressed landscaped areas, and the flows from these areas will not be directed to the subsurface infiltration system.</p>			

Water Quality Management Plan (WQMP)

Provide summary of Conceptual WQMP conditions (if previously submitted and approved). Attach complete copy.	N/A

Section 2 Project Description

2.1 Project Information

This section of the WQMP should provide the information listed below. The information provided for Conceptual/ Preliminary WQMP should give sufficient detail to identify the major proposed site design and LID BMPs and other anticipated water quality features that impact site planning. Final Project WQMP must specifically identify all BMP incorporated into the final site design and provide other detailed information as described herein.

The purpose of this information is to help determine the applicable development category, pollutants of concern, watershed description, and long term maintenance responsibilities for the project, and any applicable water quality credits. This information will be used in conjunction with the information in Section 3, Site Description, to establish the performance criteria and to select the LID BMP or other BMP for the project or other alternative programs that the project will participate in, which are described in Section 4.

Form 2.1-1 Description of Proposed Project

¹ Development Category (Select all that apply):

<input type="checkbox"/> Significant re-development involving the addition or replacement of 5,000 ft ² or more of impervious surface on an already developed site	<input checked="" type="checkbox"/> New development involving the creation of 10,000 ft ² or more of impervious surface collectively over entire site	<input type="checkbox"/> Automotive repair shops with standard industrial classification (SIC) codes 5013, 5014, 5541, 7532- 7534, 7536-7539	<input type="checkbox"/> Restaurants (with SIC code 5812) where the land area of development is 5,000 ft ² or more
<input type="checkbox"/> Hillside developments of 5,000 ft ² or more which are located on areas with known erosive soil conditions or where the natural slope is 25 percent or more	<input type="checkbox"/> Developments of 2,500 ft ² of impervious surface or more adjacent to (within 200 ft) or discharging directly into environmentally sensitive areas or waterbodies listed on the CWA Section 303(d) list of impaired waters.	<input checked="" type="checkbox"/> Parking lots of 5,000 ft ² or more exposed to storm water	<input type="checkbox"/> Retail gasoline outlets that are either 5,000 ft ² or more, or have a projected average daily traffic of 100 or more vehicles per day

Non-Priority / Non-Category Project *May require source control LID BMPs and other LIP requirements. Please consult with local jurisdiction on specific requirements.*

² Project Area (ft ²):	220,416 (5.06 acres)* *Two small areas (at the northern and southern borders of the site) measuring a total of 7,971 square feet will be self-retaining, depressed landscaped areas, and are not include in the Project Area.	³ Number of Dwelling Units:	N/A	⁴ SIC Code:	1541
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⁵ Is Project going to be phased? Yes No *If yes, ensure that the WQMP evaluates each phase as a distinct DA, requiring LID BMPs to address runoff at time of completion.*

⁶ Does Project include roads? Yes No *If yes, ensure that applicable requirements for transportation projects are addressed (see Appendix A of TGD for WQMP)*

2.2 Property Ownership/Management

Describe the ownership/management of all portions of the project and site. State whether any infrastructure will transfer to public agencies (City, County, Caltrans, etc.) after project completion. State if a homeowners or property owners association will be formed and be responsible for the long-term maintenance of project stormwater facilities. Describe any lot-level stormwater features that will be the responsibility of individual property owners.

Form 2.2-1 Property Ownership/Management

Describe property ownership/management responsible for long-term maintenance of WQMP stormwater facilities:

All portions of the project and site are owned by Central XC, LLC. The individual at Central XC, LLC responsible for this project and all related water quality issues is a member of the entity, Gretchen Sauer. Ms. Sauer's contact information is as follows: 3010 Old Ranch Parkway, Suite 470, Seal Beach, CA 90740; phone number (562) 795-0270; gretchens@xebecrealty.com. All maintenance responsibilities, including the implementation and maintenance of BMPs for the Central Avenue Industrial Project, shall be performed by Central XC, LLC until such time as ownership of the property is transferred, at which time all BMP implementation and maintenance responsibilities shall be transferred to the new owner. No infrastructure will be transferred to a public agency after the project is complete. A property owner's association (POA) will not be formed for long-term maintenance of project stormwater facilities.

2.3 Potential Stormwater Pollutants

Determine and describe expected stormwater pollutants of concern based on land uses and site activities (refer to Table 3-3 in the TGD for WQMP).

Form 2.3-1 Pollutants of Concern

Pollutant	Please check: E=Expected, N=Not Expected		Additional Information and Comments
	E <input checked="" type="checkbox"/>	N <input type="checkbox"/>	
Pathogens (Bacterial / Virus)	E <input checked="" type="checkbox"/>	N <input type="checkbox"/>	Bacteria and viruses are ubiquitous microorganisms that thrive under certain environmental conditions. Their proliferation is typically caused by the transport of animal or human fecal wastes from the watershed.
Phosphorous	E <input checked="" type="checkbox"/>	N <input type="checkbox"/>	Nutrients are inorganic substances, such as nitrogen and phosphorus. Primary sources of nutrients in urban runoff are fertilizers and eroded soils.
Nitrogen	E <input checked="" type="checkbox"/>	N <input type="checkbox"/>	Nutrients are inorganic substances, such as nitrogen and phosphorus. Primary sources of nutrients in urban runoff are fertilizers and eroded soils.
Sediment	E <input checked="" type="checkbox"/>	N <input type="checkbox"/>	Sediments are solid materials that are eroded from the land surface.
Metals	E <input checked="" type="checkbox"/>	N <input type="checkbox"/>	The primary source of metal pollution in stormwater is typically commercially available metals and metal products, as well as emissions from brake pad and tire tread wear associated with driving. Primary metals of concern include cadmium, chromium, copper, lead, mercury, and zinc. Lead and chromium have been used as corrosion inhibitors in primer coatings and cooling tower systems. Metals are also raw material components in non-metal products such as fuels, adhesives, paints, and other coatings.
Oil and Grease	E <input checked="" type="checkbox"/>	N <input type="checkbox"/>	Primary sources of oil and grease are petroleum hydrocarbon products, motor products from leaking vehicles, esters, oils, fats, waxes, and high molecular-weight fatty acids.
Trash/Debris	E <input checked="" type="checkbox"/>	N <input type="checkbox"/>	Trash (such as paper, plastic, polystyrene packing foam, and aluminum materials) and biodegradable organic matter (such as leaves, grass cuttings, and food waste) are general waste products on the landscape.
Pesticides / Herbicides	E <input checked="" type="checkbox"/>	N <input type="checkbox"/>	Pesticides and herbicides are organic compounds used to destroy and/or prevent insects, rodents, fungi, weeds, etc.
Organic Compounds	E <input checked="" type="checkbox"/>	N <input type="checkbox"/>	Organic compounds are carbon-based. Commercially available or naturally occurring organic compounds are found in solvents and hydrocarbons. When rinsing off objects, toxic levels of solvents and cleaning compounds can be discharged to storm drains. Sources of organic compounds may include waste handling areas and vehicle or landscape maintenance areas.
Other:	E <input type="checkbox"/>	N <input type="checkbox"/>	
Other:	E <input type="checkbox"/>	N <input type="checkbox"/>	
Other:	E <input type="checkbox"/>	N <input type="checkbox"/>	
Other:	E <input type="checkbox"/>	N <input type="checkbox"/>	
Other:	E <input type="checkbox"/>	N <input type="checkbox"/>	
Other:	E <input type="checkbox"/>	N <input type="checkbox"/>	

2.4 Water Quality Credits

A water quality credit program is applicable for certain types of development projects if it is not feasible to meet the requirements for on-site LID. Proponents for eligible projects, as described below, can apply for water quality credits that would reduce project obligations for selecting and sizing other treatment BMP or participating in other alternative compliance programs. Refer to Section 6.2 in the TGD for WQMP to determine if water quality credits are applicable for the project.

Form 2.4-1 Water Quality Credits			
¹ Project Types that Qualify for Water Quality Credits: <i>Select all that apply</i>			
<input type="checkbox"/> Redevelopment projects that reduce the overall impervious footprint of the project site. [Credit = % impervious reduced]	Higher density development projects <input type="checkbox"/> Vertical density [20%] <input type="checkbox"/> 7 units/ acre [5%]	<input type="checkbox"/> Mixed use development, (combination of residential, commercial, industrial, office, institutional, or other land uses which incorporate design principles that demonstrate environmental benefits not realized through single use projects) [20%]	<input type="checkbox"/> Brownfield redevelopment (redevelop real property complicated by presence or potential of hazardous contaminants) [25%]
<input type="checkbox"/> Redevelopment projects in established historic district, historic preservation area, or similar significant core city center areas [10%]	<input type="checkbox"/> Transit-oriented developments (mixed use residential or commercial area designed to maximize access to public transportation) [20%]	<input type="checkbox"/> In-fill projects (conversion of empty lots & other underused spaces < 5 acres, substantially surrounded by urban land uses, into more beneficially used spaces, such as residential or commercial areas) [10%]	<input type="checkbox"/> Live-Work developments (variety of developments designed to support residential and vocational needs) [20%]
² Total Credit % N/A (Total all credit percentages up to a maximum allowable credit of 50 percent)			
Description of Water Quality Credit Eligibility (if applicable)	N/A		

Section 3 Site and Watershed Description

Describe the project site conditions that will facilitate the selection of BMP through an analysis of the physical conditions and limitations of the site and its receiving waters. Identify distinct drainage areas (DA) that collect flow from a portion of the site and describe how runoff from each DA (and sub-watershed DMAs) is conveyed to the site outlet(s). Refer to Section 3.2 in the TGD for WQMP. The form below is provided as an example. Then complete Forms 3.2 and 3.3 for each DA on the project site. ***If the project has more than one drainage area for stormwater management, then complete additional versions of these forms for each DA / outlet.***

Form 3-1 Site Location and Hydrologic Features			
Site coordinates <i>take GPS measurement at approximate center of site</i>	Latitude 34.087217	Longitude -117.280382	Thomas Bros Map page 606
¹ San Bernardino County climatic region: <input checked="" type="checkbox"/> Valley <input type="checkbox"/> Mountain			
² Does the site have more than one drainage area (DA): Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> <i>If no, proceed to Form 3-2. If yes, then use this form to show a conceptual schematic describing DMAs and hydrologic feature connecting DMAs to the site outlet(s). An example is provided below that can be modified for proposed project or a drawing clearly showing DMA and flow routing may be attached</i>			
<pre> graph TD DA1_DMA_C[DA1 DMA C] --> DA1_DMA_A[DA1 DMA A] DA1_DMA_A --> Outlet_1[Outlet 1] DA1_DMA_B[DA1 DMA B] --> Outlet_1 DA2[DA2] --> Outlet_2[Outlet 2] </pre>			
Example only – modify for project specific WQMP using additional form			
Conveyance	Briefly describe on-site drainage features to convey runoff that is not retained within a DMA		
DA1 DMA C flows to DA1 DMA A	<i>Ex. Bioretention overflow to vegetated bioswale with 4' bottom width, 5:1 side slopes and bed slope of 0.01. Conveys runoff for 1000' through DMA 1 to existing catch basin on SE corner of property</i>		
DA1 DMA A to Outlet 1			
DA1 DMA B to Outlet 1			
DA2 to Outlet 2			

Form 3-2 Existing Hydrologic Characteristics for Drainage Area 1				
For Drainage Area 1's sub-watershed DMA, provide the following characteristics	DMA A	DMA B	DMA C	DMA D
¹ DMA drainage area (ft ²)	220,416			
² Existing site impervious area (ft ²)	0			
³ Antecedent moisture condition <i>For desert areas, use http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf</i>	AMC II			
⁴ Hydrologic soil group <i>Refer to Watershed Mapping Tool – http://sbcounty.permitrack.com/WAP</i>	HSG A			
⁵ Longest flowpath length (ft)	1003			
⁶ Longest flowpath slope (ft/ft)	0.005			
⁷ Current land cover type(s) <i>Select from Fig C-3 of Hydrology Manual</i>	Barren	Barren		
⁸ Pre-developed pervious area condition: <i>Based on the extent of wet season vegetated cover good >75%; Fair 50-75%; Poor <50% Attach photos of site to support rating</i>	Poor	Poor		

Form 3-2 Existing Hydrologic Characteristics for Drainage Area 1 (use only as needed for additional DMA w/in DA 1)				
For Drainage Area 1's sub-watershed DMA, provide the following characteristics	DMA E	DMA F	DMA G	DMA H
1 DMA drainage area (ft ²)				
2 Existing site impervious area (ft ²)				
3 Antecedent moisture condition <i>For desert areas, use</i> http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf				
4 Hydrologic soil group <i>Refer to Watershed Mapping Tool –</i> http://sbcounty.permitrack.com/WAP				
5 Longest flowpath length (ft)				
6 Longest flowpath slope (ft/ft)				
7 Current land cover type(s) <i>Select from Fig C-3 of Hydrology Manual</i>				
8 Pre-developed pervious area condition: <i>Based on the extent of wet season vegetated cover good >75%; Fair 50-75%; Poor <50% Attach photos of site to support rating</i>				

Form 3-3 Watershed Description for Drainage Area	
Receiving waters <i>Refer to Watershed Mapping Tool -</i> http://sbcounty.permitrack.com/WAP See "Drainage Facilities" link at this website	City Storm Drain System to the following receiving waters in the order listed: Twin Creek Channel, Santa Ana River Reach 5, Santa Ana River Reach 4, Santa Ana River Reach 3, Prado Dam, Santa Ana River Reach 2, Santa Ana River Reach 1, Pacific Ocean.
Applicable TMDLs <i>Refer to Local Implementation Plan</i>	Santa Ana River Reach 3--TMDL for Pathogens, Nitrate Prado Dam--TMDL for Pathogens
303(d) listed impairments <i>Refer to Local Implementation Plan and Watershed Mapping Tool -</i> http://sbcounty.permitrack.com/WAP and State Water Resources Control Board website - http://www.waterboards.ca.gov/santaana/water_issues/programs/tmdl/index.shtml	Santa Ana River Reach 4--Pathogens; Santa Ana River Reach 3--Copper, Lead and Pathogens; Santa Ana River Reach 2--Indicator Bacteria
Environmentally Sensitive Areas (ESA) <i>Refer to Watershed Mapping Tool -</i> http://sbcounty.permitrack.com/WAP	N/A
Unlined Downstream Water Bodies <i>Refer to Watershed Mapping Tool -</i> http://sbcounty.permitrack.com/WAP	Santa Ana River Reach 3 and 1
Hydrologic Conditions of Concern	<input type="checkbox"/> Yes Complete Hydrologic Conditions of Concern (HCOC) Assessment. Include Forms 4.2-2 through Form 4.2-5 and Hydromodification BMP Form 4.3-10 in submittal <input checked="" type="checkbox"/> No
Watershed-based BMP included in a RWQCB approved WAP	<input type="checkbox"/> Yes Attach verification of regional BMP evaluation criteria in WAP <ul style="list-style-type: none"> • More Effective than On-site LID • Remaining Capacity for Project DCV • Upstream of any Water of the US • Operational at Project Completion • Long-Term Maintenance Plan <input checked="" type="checkbox"/> No

Section 4 Best Management Practices (BMP)

4.1 Source Control BMP

4.1.1 Pollution Prevention

Non-structural and structural source control BMP are required to be incorporated into all new development and significant redevelopment projects. Form 4.1-1 and 4.1-2 are used to describe specific source control BMPs used in the WQMP or to explain why a certain BMP is not applicable. Table 7-3 of the TGD for WQMP provides a list of applicable source control BMP for projects with specific types of potential pollutant sources or activities. The source control BMP in this table must be implemented for projects with these specific types of potential pollutant sources or activities.

The preparers of this WQMP have reviewed the source control BMP requirements for new development and significant redevelopment projects. The preparers have also reviewed the specific BMP required for project as specified in Forms 4.1-1 and 4.1-2. All applicable non-structural and structural source control BMP shall be implemented in the project.

Form 4.1-1 Non-Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, if not applicable, state reason
		Included	Not Applicable	
N1	Education of Property Owners, Tenants and Occupants on Stormwater BMPs	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The owner will provide practical information materials to the first occupants/tenants on general housekeeping practices for retail commercial developments that contribute to the protection of stormwater quality. (See Attachment G for the applicable BMP Educational Materials.)
N2	Activity Restrictions	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The owner will implement use /activity restrictions for the project for the purpose of surface water quality protection through the use of lease terms. For example, automobile washing, maintenance, and repairs will not be allowed at the project site.
N3	Landscape Management BMPs	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The owner will identify on-going landscape maintenance requirements consistent with applicable local ordinances that may include fertilizer and/or pesticide usage.
N4	BMP Maintenance	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The owner will be responsible for implementation of each non- structural BMP and scheduled cleaning and/or maintenance of all structural BMP facilities.
N5	Title 22 CCR Compliance (How development will comply)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Not applicable. No hazardous wastes are anticipated to be produced at the proposed project.
N6	Local Water Quality Ordinances	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The owner will comply with any applicable local water quality ordinances.
N7	Spill Contingency Plan	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The owner will prepare a Spill Contingency Plan based on specified types of building or suite occupancies. The Plan will mandate stockpiling of cleanup materials, notification of responsible agencies, disposal of cleanup materials, documentation, etc.
N8	Underground Storage Tank Compliance	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Not applicable. No underground storage tanks are proposed.
N9	Hazardous Materials Disclosure Compliance	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Not applicable. No hazardous materials are anticipated to be used or produced at the proposed project.

Form 4.1-1 Non-Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, if not applicable, state reason
		Included	Not Applicable	
N10	Uniform Fire Code Implementation	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Not applicable. No hazardous materials are anticipated at the proposed project.
N11	Litter/Debris Control Program	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The owner will implement trash management and litter control procedures in the common areas aimed at reducing pollution of drainage water. The owner may contract with its landscape maintenance firm to provide this service during regularly scheduled maintenance, which should consist of litter patrol, emptying of trash receptacles in common areas, and noting/reporting trash disposal violations by tenants or businesses.
N12	Employee Training	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The owner will prepare an education program manual (see N11) for future employees of businesses at the project, and will train the employees on such matters as the proper storage and use of pesticides and implementation of hazardous spill contingency plans.
N13	Housekeeping of Loading Docks	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Keep all fluids indoors. Clean up spills immediately and keep spills from entering storm drain system. No direct discharges into the storm drain system. Area shall be inspected weekly for proper containment and practices with spills cleaned up immediately and disposed of properly.
N14	Catch Basin Inspection Program	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The catch basins will be inspected, cleaned and maintained on an annual basis, in the early fall prior to the start of the rainy season, and before and after all major storms.
N15	Vacuum Sweeping of Private Streets and Parking Lots	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The owner will ensure that the project's parking lots will be swept on a monthly basis, or more often if necessary, using a vacuum assisted sweeper.
N16	Other Non-structural Measures for Public Agency Projects	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Not applicable. The project is not a Public Agency Project.
N17	Comply with all other applicable NPDES permits	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The owner shall comply with other NPDES permits such as General Industrial permits, etc., to include BMPs that are required as part of a SWPPP.

Form 4.1-2 Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP implementation OR, if not applicable, state reason
		Included	Not Applicable	
S1	Provide storm drain system stenciling and signage (CASQA New Development BMP Handbook SD-13)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Stencil or label storm drain inlets and catch basins with prohibitive language (such as: "No Dumping – Flows to Creek"). Maintain legibility of stencils and signs.
S2	Design and construct outdoor material storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-34)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Not applicable. No outdoor material storage areas are proposed.
S3	Design and construct trash and waste storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-32)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Trash storage areas will be paved with an impervious surface, designed to not allow run-on from adjoining areas, designed to divert drainage from adjoining roofs and pavements around the area, screened or walled to prevent off-site transport of trash, and provide solid roof or awning.
S4	Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control (Statewide Model Landscape Ordinance; CASQA New Development BMP Handbook SD-12)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Irrigation systems shall include reducers or shut off valves triggered by a pressure drop. Timers will be used to avoid over watering and watering cycles shall be adjusted seasonally. Plants with similar watering requirements will be grouped, and native or drought tolerant species will be used where appropriate.
S5	Finish grade of landscaped areas at a minimum of 1-2 inches below top of curb, sidewalk, or pavement	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Landscaped areas will be finish-graded at a minimum of 1-2 inches below top of curb or sidewalk for increased retention of stormwater/irrigation water.
S6	Protect slopes and channels and provide energy dissipation (CASQA New Development BMP Handbook SD-10)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Not applicable. The site has no slopes or channels.
S7	Covered dock areas (CASQA New Development BMP Handbook SD-31)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Finished goods being loaded and unloaded at the docks do not have the potential to contribute to stormwater pollution. No direct connections will be made to MS4.
S8	Covered maintenance bays with spill containment plans (CASQA New Development BMP Handbook SD-31)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Not applicable. No maintenance bays are proposed.
S9	Vehicle wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Not applicable. No vehicle wash areas are proposed.

S10	Covered outdoor processing areas (CASQA New Development BMP Handbook SD-36)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Not applicable. No outdoor processing areas are proposed.
Form 4.1-2 Structural Source Control BMPs				
Identifier	Name	Check One		Describe BMP Implementation OR, if not applicable, state reason
		Included	Not Applicable	
S11	Equipment wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Not applicable. No equipment wash areas are proposed.
S12	Fueling areas (CASQA New Development BMP Handbook SD-30)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Not applicable. No fueling areas are proposed.
S13	Hillside landscaping (CASQA New Development BMP Handbook SD-10)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Not applicable. No hillside landscaping is proposed (the site has no hills).
S14	Wash water control for food preparation areas	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Not applicable. No food preparation areas are proposed.
S15	Community car wash racks (CASQA New Development BMP Handbook SD-33)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Not applicable. No community car wash racks are proposed.

4.1.2 Preventative LID Site Design Practices

Site design practices associated with new LID requirements in the MS4 Permit should be considered in the earliest phases of a project. Preventative site design practices can result in smaller DCV for LID BMP and hydromodification control BMP by reducing runoff generation. Describe site design and drainage plan including:

- * A narrative of site design practices utilized or rationale for not using practices
- * A narrative of how site plan incorporates preventive site design practices
- * Include an attached Site Plan layout which shows how preventative site design practices are included in WQMP

Refer to Section 5.2 of the TGD for WQMP for more details.

Form 4.1-3 Preventative LID Site Design Practices Checklist
<p>Site Design Practices <i>If yes, explain how preventative site design practice is addressed in project site plan. If no, other LID BMPs must be selected to meet targets</i></p>
<p>Minimize impervious areas: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Explanation: The width of the drive aisles and sidewalks for the proposed development have been reduced to the maximum extent practicable. Further, landscaping is planned to be installed to the maximum extent practicable.</p>
<p>Maximize natural infiltration capacity: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Explanation: The site consists of soils with a infiltration rate of 3.0 inches per hour, and all stormwater flows will be infiltrated on-site via underground infiltration chambers (after pretreatment in a hydrodynamic separator).</p>
<p>Preserve existing drainage patterns and time of concentration: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Explanation: The existing drainage patterns have been preserved.</p>
<p>Disconnect impervious areas: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Explanation: Landscaped areas are planned around parking areas and at the southern side of the proposed building which will disconnect impervious areas.</p>
<p>Protect existing vegetation and sensitive areas: Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Explanation: There is essentially no existing vegetation at the site.</p>
<p>Re-vegetate disturbed areas: Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Explanation: There is essentially no existing vegetation at the site. However, landscaping is proposed to the maximum extent practicable.</p>
<p>Minimize unnecessary compaction in stormwater retention/infiltration basin/trench areas: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Explanation: These areas where the underground infiltration chambers are to be located will not be compacted more than is necessary.</p>
<p>Utilize vegetated drainage swales in place of underground piping or imperviously lined swales: Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Explanation: No vegetated drainage swales are proposed since the design stormwater flows for the project will be infiltrated on-site via underground infiltration chambers (after pretreatment).</p>
<p>Stake off areas that will be used for landscaping to minimize compaction during construction : Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Explanation: The proposed landscape areas will not be compacted more than is necessary.</p>

4.2 Project Performance Criteria

The purpose of this section of the Project WQMP is to establish targets for post-development hydrology based on performance criteria specified in the MS4 Permit. These targets include runoff volume for water quality control (referred to as LID design capture volume), and runoff volume, time of concentration, and peak runoff for protection of any downstream waterbody segments with a HCOC. ***If the project has more than one outlet for stormwater runoff, then complete additional versions of these forms for each DA / outlet.***

Methods applied in the following forms include:

- For LID BMP Design Capture Volume (DCV), the San Bernardino County Stormwater Program requires use of the P₆ method (MS4 Permit Section XI.D.6a.ii) – Form 4.2-1
- For HCOC pre- and post-development hydrologic calculation, the San Bernardino County Stormwater Program requires the use of the Rational Method (San Bernardino County Hydrology Manual Section D). Forms 4.2-2 through Form 4.2-5 calculate hydrologic variables including runoff volume, time of concentration, and peak runoff from the project site pre- and post-development using the Hydrology Manual Rational Method approach. For projects greater than 640 acres (1.0 mi²), the Rational Method and these forms should not be used. For such projects, the Unit Hydrograph Method (San Bernardino County Hydrology Manual Section E) shall be applied for hydrologic calculations for HCOC performance criteria.

Refer to Section 4 in the TGD for WQMP for detailed guidance and instructions.

Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume (DA 1)		
1 Project area DA 1 (ft ²): 220,416 (5.06 acres)	2 Imperviousness after applying preventative site design practices (Imp%): 96%	3 Runoff Coefficient (Rc): <u>0.82</u> $R_c = 0.858(\text{Imp}\%)^{0.3} - 0.78(\text{Imp}\%)^{0.2} + 0.774(\text{Imp}\%) + 0.04$
4 Determine 1-hour rainfall depth for a 2-year return period P _{2yr-1hr} (in): 0.502 http://hdsc.nws.noaa.gov/hdsc/pfds/so/sca_pfds.html		
5 Compute P ₆ , Mean 6-hr Precipitation (inches): 0.743 <i>P₆ = Item 4 * C₁, where C₁ is a function of site climatic region specified in Form 3-1 Item 1 (Valley = 1.4807; Mountain = 1.909; Desert = 1.2371)</i>		
6 Drawdown Rate <i>Use 48 hours as the default condition. Selection and use of the 24 hour drawdown time condition is subject to approval by the local jurisdiction. The necessary BMP footprint is a function of drawdown time. While shorter drawdown times reduce the performance criteria for LID BMP design capture volume, the depth of water that can be stored is also reduced.</i>		24-hrs <input type="checkbox"/> 48-hrs <input checked="" type="checkbox"/>
7 Compute design capture volume, DCV (ft ³): 21,968 <i>DCV = 1/12 * [Item 1 * Item 3 * Item 5 * C₂], where C₂ is a function of drawdown rate (24-hr = 1.582; 48-hr = 1.963)</i> <i>Compute separate DCV for each outlet from the project site per schematic drawn in Form 3-1 Item 2</i>		

Form 4.2-2 Summary of HCOC Assessment (DA 1)

Does project have the potential to cause or contribute to an HCOC in a downstream channel: Yes No

Go to: <http://sbcounty.permitrack.com/WAP>

If "Yes", then complete HCOC assessment of site hydrology for 2yr storm event using Forms 4.2-3 through 4.2-5 and insert results below
(Forms 4.2-3 through 4.2-5 may be replaced by computer software analysis based on the San Bernardino County Hydrology Manual)

If "No," then proceed to Section 4.3 Project Conformance Analysis

Condition	Runoff Volume (ft ³)	Time of Concentration (min)	Peak Runoff (cfs)
Pre-developed	1 <i>Form 4.2-3 Item 12</i>	2 <i>Form 4.2-4 Item 13</i>	3 <i>Form 4.2-5 Item 10</i>
Post-developed	4 <i>Form 4.2-3 Item 13</i>	5 <i>Form 4.2-4 Item 14</i>	6 <i>Form 4.2-5 Item 14</i>
Difference	7 <i>Item 4 – Item 1</i>	8 <i>Item 5 – Item 2</i>	9 <i>Item 6 – Item 3</i>
Difference (as % of pre-developed)	10 % <i>Item 7 / Item 1</i>	11 % <i>Item 8 / Item 2</i>	12 % <i>Item 9 / Item 3</i>

Form 4.2-3 HCOC Assessment for Runoff Volume (DA 1)

Form 4.2-3 HCOC Assessment for Runoff Volume (DA 1)								
Weighted Curve Number Determination for: Pre-developed DA	DMA A	DMA B	DMA C	DMA D	DMA E	DMA F	DMA G	DMA H
1a Land Cover type								
2a Hydrologic Soil Group (HSG)								
3a DMA Area, ft ² sum of areas of DMA should equal area of DA								
4a Curve Number (CN) use Items 1 and 2 to select the appropriate CN from Appendix C-2 of the TGD for WQMP								
Weighted Curve Number Determination for: Post-developed DA	DMA A	DMA B	DMA C	DMA D	DMA E	DMA F	DMA G	DMA H
1b Land Cover type								
2b Hydrologic Soil Group (HSG)								
3b DMA Area, ft ² sum of areas of DMA should equal area of DA								
4b Curve Number (CN) use Items 5 and 6 to select the appropriate CN from Appendix C-2 of the TGD for WQMP								
5 Pre-Developed area-weighted CN:	7 Pre-developed soil storage capacity, S (in): $S = (1000 / \text{Item 5}) - 10$				9 Initial abstraction, I _a (in): $I_a = 0.2 * \text{Item 7}$			
6 Post-Developed area-weighted CN:	8 Post-developed soil storage capacity, S (in): $S = (1000 / \text{Item 6}) - 10$				10 Initial abstraction, I _a (in): $I_a = 0.2 * \text{Item 8}$			
11 Precipitation for 2 yr, 24 hr storm (in): Go to: http://hdsc.nws.noaa.gov/hdsc/pfds/so/sca_pfds.html								
12 Pre-developed Volume (ft ³): $V_{pre} = (1 / 12) * (\text{Item sum of Item 3}) * [(\text{Item 11} - \text{Item 9})^2 / ((\text{Item 11} - \text{Item 9} + \text{Item 7}))]$								
13 Post-developed Volume (ft ³): $V_{pre} = (1 / 12) * (\text{Item sum of Item 3}) * [(\text{Item 11} - \text{Item 10})^2 / ((\text{Item 11} - \text{Item 10} + \text{Item 8}))]$								
14 Volume Reduction needed to meet HCOC Requirement, (ft ³): $V_{HCOC} = (\text{Item 13} * 0.95) - \text{Item 12}$								

Form 4.2-4 HCOC Assessment for Time of Concentration (DA 1)

Compute time of concentration for pre and post developed conditions for each DA (For projects using the Hydrology Manual complete the form below)

Variables	Pre-developed DA1 <i>Use additional forms if there are more than 4 DMA</i>				Post-developed DA1 <i>Use additional forms if there are more than 4 DMA</i>			
	DMA A	DMA B	DMA C	DMA D	DMA A	DMA B	DMA C	DMA D
1 Length of flowpath (ft) <i>Use Form 3-2 Item 5 for pre-developed condition</i>								
2 Change in elevation (ft)								
3 Slope (ft/ft), $S_o = \text{Item 2} / \text{Item 1}$								
4 Land cover								
5 Initial DMA Time of Concentration (min) <i>Appendix C-1 of the TGD for WQMP</i>								
6 Length of conveyance from DMA outlet to project site outlet (ft) <i>May be zero if DMA outlet is at project site outlet</i>								
7 Cross-sectional area of channel (ft ²)								
8 Wetted perimeter of channel (ft)								
9 Manning's roughness of channel (n)								
10 Channel flow velocity (ft/sec) $V_{ps} = (1.49 / \text{Item 9}) * (\text{Item 7} / \text{Item 8})^{0.67} * (\text{Item 3})^{10.5}$								
11 Travel time to outlet (min) $T_t = \text{Item 6} / (\text{Item 10} * 60)$								
12 Total time of concentration (min) $T_c = \text{Item 5} + \text{Item 11}$								
13 Pre-developed time of concentration (min):	<i>Minimum of Item 12 pre-developed DMA</i>							
14 Post-developed time of concentration (min):	<i>Minimum of Item 12 post-developed DMA</i>							
15 Additional time of concentration needed to meet HCOC requirement (min):	$T_{C-HCOC} = (\text{Item 14} * 0.95) - \text{Item 13}$							

Form 4.2-5 HCOC Assessment for Peak Runoff (DA 1)

Compute peak runoff for pre- and post-developed conditions

Variables	Pre-developed DA to Project Outlet (Use additional forms if more than 3 DMA)			Post-developed DA to Project Outlet (Use additional forms if more than 3 DMA)		
	DMA A	DMA B	DMA C	DMA A	DMA B	DMA C
1 Rainfall Intensity for storm duration equal to time of concentration $I_{peak} = 10^{(LOG \text{ Form 4.2-1 Item 4} - 0.6 \text{ LOG Form 4.2-4 Item 5} / 60)}$						
2 Drainage Area of each DMA (ft ²) <i>For DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)</i>						
3 Ratio of pervious area to total area <i>For DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)</i>						
4 Pervious area infiltration rate (in/hr) <i>Use pervious area CN and antecedent moisture condition with Appendix C-3 of the TGD for WQMP</i>						
5 Maximum loss rate (in/hr) $F_m = \text{Item 3} * \text{Item 4}$ <i>Use area-weighted F_m from DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)</i>						
6 Peak Flow from DMA (cfs) $Q_p = \text{Item 2} * 0.9 * (\text{Item 1} - \text{Item 5})$						
7 Time of concentration adjustment factor for other DMA to site discharge point <i>Form 4.2-4 Item 12 DMA / Other DMA upstream of site discharge point (If ratio is greater than 1.0, then use maximum value of 1.0)</i>	DMA A	n/a		n/a		
	DMA B		n/a		n/a	
	DMA C		n/a			n/a
8 Pre-developed Q_p at T_c for DMA A: $Q_p = \text{Item } 6_{DMAA} + \{ \text{Item } 6_{DMAB} * (\text{Item } 1_{DMAA} - \text{Item } 5_{DMAB}) / (\text{Item } 1_{DMAB} - \text{Item } 5_{DMAB}) * \text{Item } 7_{DMAA/2} \} + \{ \text{Item } 6_{DMAC} * (\text{Item } 1_{DMAA} - \text{Item } 5_{DMAC}) / (\text{Item } 1_{DMAC} - \text{Item } 5_{DMAC}) * \text{Item } 7_{DMAA/3} \}$	9 Pre-developed Q_p at T_c for DMA B: $Q_p = \text{Item } 6_{DMAB} + \{ \text{Item } 6_{DMAA} * (\text{Item } 1_{DMAB} - \text{Item } 5_{DMAA}) / (\text{Item } 1_{DMAA} - \text{Item } 5_{DMAA}) * \text{Item } 7_{DMAB/1} \} + \{ \text{Item } 6_{DMAC} * (\text{Item } 1_{DMAB} - \text{Item } 5_{DMAC}) / (\text{Item } 1_{DMAC} - \text{Item } 5_{DMAC}) * \text{Item } 7_{DMAB/3} \}$			10 Pre-developed Q_p at T_c for DMA C: $Q_p = \text{Item } 6_{DMAC} + \{ \text{Item } 6_{DMAA} * (\text{Item } 1_{DMAC} - \text{Item } 5_{DMAA}) / (\text{Item } 1_{DMAA} - \text{Item } 5_{DMAA}) * \text{Item } 7_{DMAC/1} \} + \{ \text{Item } 6_{DMAB} * (\text{Item } 1_{DMAC} - \text{Item } 5_{DMAB}) / (\text{Item } 1_{DMAB} - \text{Item } 5_{DMAB}) * \text{Item } 7_{DMAC/2} \}$		
10 Peak runoff from pre-developed condition confluence analysis (cfs): <i>Maximum of Item 8, 9, and 10 (including additional forms as needed)</i>						
11 Post-developed Q_p at T_c for DMA A: <i>Same as Item 8 for post-developed values</i>	12 Post-developed Q_p at T_c for DMA B: <i>Same as Item 9 for post-developed values</i>			13 Post-developed Q_p at T_c for DMA C: <i>Same as Item 10 for post-developed values</i>		
14 Peak runoff from post-developed condition confluence analysis (cfs): <i>Maximum of Item 11, 12, and 13 (including additional forms as needed)</i>						
15 Peak runoff reduction needed to meet HCOC Requirement (cfs): $Q_{p-HCOC} = (\text{Item } 14 * 0.95) - \text{Item } 10$						

4.3 Project Conformance Analysis

Complete the following forms for each project site DA to document that the proposed LID BMPs conform to the project DCV developed to meet performance criteria specified in the MS₄ Permit (WQMP Template Section 4.2). For the LID DCV, the forms are ordered according to hierarchy of BMP selection as required by the MS₄ Permit (see Section 5.3.1 in the TGD for WQMP). The forms compute the following for on-site LID BMP:

- Site Design and Hydrologic Source Controls (Form 4.3-2)
- Retention and Infiltration (Form 4.3-3)
- Harvested and Use (Form 4.3-4) or
- Biotreatment (Form 4.3-5).

At the end of each form, additional fields facilitate the determination of the extent of mitigation provided by the specific BMP category, allowing for use of the next category of BMP in the hierarchy, if necessary.

The first step in the analysis, using Section 5.3.2.1 of the TGD for WQMP, is to complete Forms 4.3-1 and 4.3-3) to determine if retention and infiltration BMPs are infeasible for the project. For each feasibility criterion in Form 4.3-1, if the answer is “Yes,” provide all study findings that includes relevant calculations, maps, data sources, etc. used to make the determination of infeasibility.

Next, complete Forms 4.3-2 and 4.3-4 to determine the feasibility of applicable HSC and harvest and use BMPs, and, if their implementation is feasible, the extent of mitigation of the DCV.

If no site constraints exist that would limit the type of BMP to be implemented in a DA, evaluate the use of combinations of LID BMPs, including all applicable HSC BMPs to maximize on-site retention of the DCV. If no combination of BMP can mitigate the entire DCV, implement the single BMP type, or combination of BMP types, that maximizes on-site retention of the DCV within the minimum effective area.

If the combination of LID HSC, retention and infiltration, and harvest and use BMPs are unable to mitigate the entire DCV, then biotreatment BMPs may be implemented by the project proponent. If biotreatment BMPs are used, then they must be sized to provide sufficient capacity for effective treatment of the remainder of the volume-based performance criteria that cannot be achieved with LID BMPs (TGD for WQMP Section 5.4.4.2).

Under no circumstances shall any portion of the DCV be released from the site without effective mitigation and/or treatment.

Form 4.3-1 Infiltration BMP Feasibility (DA 1)

Feasibility Criterion – Complete evaluation for each DA on the Project Site

1 Would infiltration BMP pose significant risk for groundwater related concerns? Yes No

Refer to Section 5.3.2.1 of the TGD for WQMP

If Yes, Provide basis: (attach)

2 Would installation of infiltration BMP significantly increase the risk of geotechnical hazards? Yes No

(Yes, if the answer to any of the following questions is yes, as established by a geotechnical expert):

- The location is less than 50 feet away from slopes steeper than 15 percent
- The location is less than eight feet from building foundations or an alternative setback.
- A study certified by a geotechnical professional or an available watershed study determines that stormwater infiltration would result in significantly increased risks of geotechnical hazards.

If Yes, Provide basis: (attach)

3 Would infiltration of runoff on a Project site violate downstream water rights? Yes No

If Yes, Provide basis: (attach)

4 Is proposed infiltration facility located on hydrologic soil group (HSG) D soils or does the site geotechnical investigation indicate presence of soil characteristics, which support categorization as D soils? Yes No

If Yes, Provide basis: (attach)

5 Is the design infiltration rate, after accounting for safety factor of 2.0, below proposed facility less than 0.3 in/hr (accounting for soil amendments)? Yes No

If Yes, Provide basis: (attach)

6 Would on-site infiltration or reduction of runoff over pre-developed conditions be partially or fully inconsistent with watershed management strategies as defined in the WAP, or impair beneficial uses? Yes No

See Section 3.5 of the TGD for WQMP and WAP

If Yes, Provide basis: (attach)

7 Any answer from Item 1 through Item 3 is "Yes": Yes No

If yes, infiltration of any volume is not feasible onsite. Proceed to Form 4.3-4, Harvest and Use BMP. If no, then proceed to Item 9 below.

8 Any answer from Item 4 through Item 6 is "Yes": Yes No

If yes, infiltration is permissible but is not required to be considered. Proceed to Form 4.3-2, Hydrologic Source Control BMP.

If no, then proceed to Item 9, below.

9 All answers to Item 1 through Item 6 are "No":

Infiltration of the full DCV is potentially feasible, LID infiltration BMP must be designed to infiltrate the full DCV to the MEP.

Proceed to Form 4.3-2, Hydrologic Source Control BMP.

4.3.1 Site Design Hydrologic Source Control BMP

Section XI.E. of the Permit emphasizes the use of LID preventative measures; and the use of LID HSC BMPs reduces the portion of the DCV that must be addressed in downstream BMPs. Therefore, all applicable HSC shall be provided except where they are mutually exclusive with each other, or with other BMPs. Mutual exclusivity may result from overlapping BMP footprints such that either would be potentially feasible by itself, but both could not be implemented. Please note that while there are no numeric standards regarding the use of HSC, if a project cannot feasibly meet BMP sizing requirements or cannot fully address HCOCs, feasibility of all applicable HSC must be part of demonstrating that the BMP system has been designed to retain the maximum feasible portion of the DCV. Complete Form 4.3-2 to identify and calculate estimated retention volume from implementing site design HSC BMP. Refer to Section 5.4.1 in the TGD for more detailed guidance.

Form 4.3-2 Site Design Hydrologic Source Control BMPs (DA)

1 Implementation of Impervious Area Dispersion BMP (i.e. routing runoff from impervious to pervious areas), excluding impervious areas planned for routing to on-lot infiltration BMP: Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> If yes, complete Items 2-5; If no, proceed to Item 6	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type <i>(Use additional forms for more BMPs)</i>
2 Total impervious area draining to pervious area (ft ²)			
3 Ratio of pervious area receiving runoff to impervious area			
4 Retention volume achieved from impervious area dispersion (ft ³) $V = \text{Item 2} * \text{Item 3} * (0.5/12)$, assuming retention of 0.5 inches of runoff			
5 Sum of retention volume achieved from impervious area dispersion (ft ³): $V_{\text{retention}} = \text{Sum of Item 4 for all BMPs}$			
6 Implementation of Localized On-lot Infiltration BMPs (e.g. on-lot rain gardens): Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> If yes, complete Items 7-13 for aggregate of all on-lot infiltration BMP in each DA; If no, proceed to Item 14	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type <i>(Use additional forms for more BMPs)</i>
7 Ponding surface area (ft ²)			
8 Ponding depth (ft)			
9 Surface area of amended soil/gravel (ft ²)			
10 Average depth of amended soil/gravel (ft)			
11 Average porosity of amended soil/gravel			
12 Retention volume achieved from on-lot infiltration (ft ³) $V_{\text{retention}} = (\text{Item 7} * \text{Item 8}) + (\text{Item 9} * \text{Item 10} * \text{Item 11})$			
13 Runoff volume retention from on-lot infiltration (ft ³): $V_{\text{retention}} = \text{Sum of Item 12 for all BMPs}$			

Form 4.3-2 cont. Site Design Hydrologic Source Control BMPs (DA)

14 Implementation of evapotranspiration BMP (green, brown, or blue roofs): Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> <i>If yes, complete Items 15-20. If no, proceed to Item 21</i>	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type <i>(Use additional forms for more BMPs)</i>
15 Rooftop area planned for ET BMP (ft ²)			
16 Average wet season ET demand (in/day) <i>Use local values, typical ~ 0.1</i>			
17 Daily ET demand (ft ³ /day) <i>Item 15 * (Item 16 / 12)</i>			
18 Drawdown time (hrs) <i>Copy Item 6 in Form 4.2-1</i>			
19 Retention Volume (ft ³) <i>V_{retention} = Item 17 * (Item 18 / 24)</i>			
20 Runoff volume retention from evapotranspiration BMPs (ft ³): <i>V_{retention} = Sum of Item 19 for all BMPs</i>			
21 Implementation of Street Trees: Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> <i>If yes, complete Items 20-2. If no, proceed to Item 24</i>	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type <i>(Use additional forms for more BMPs)</i>
22 Number of Street Trees			
23 Average canopy cover over impervious area (ft ²)			
24 Runoff volume retention from street trees (ft ³) <i>V_{retention} = Item 22 * Item 23 * (0.05/12) assume runoff retention of 0.05 inches</i>			
25 Runoff volume retention from street tree BMPs (ft ³): <i>V_{retention} = Sum of Item 24 for all BMPs</i>			
26 Implementation of residential rain barrels/cisterns: Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> <i>If yes, complete Items 27-28; If no, proceed to Item 29</i>	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type <i>(Use additional forms for more BMPs)</i>
27 Number of rain barrels/cisterns			
28 Runoff volume retention from rain barrels/cisterns (ft ³) <i>V_{retention} = Item 27 * 3</i>			
29 Runoff volume retention from residential rain barrels/Cisterns (ft ³): <i>V_{retention} = Sum of Item 28 for all BMPs</i>			
30 Total Retention Volume from Site Design Hydrologic Source Control BMPs: <i>Sum of Items 5, 13, 20, 25 and 29</i>			

4.3.2 Infiltration BMPs

Use Form 4.3-3 to compute on-site retention of runoff from proposed retention and infiltration BMPs. Volume retention estimates are sensitive to the percolation rate used, which determines the amount of runoff that can be infiltrated within the specified drawdown time. The infiltration safety factor reduces field measured percolation to account for potential inaccuracy associated with field measurements, declining BMP performance over time, and compaction during construction. Appendix D of the TGD for WQMP provides guidance on estimating an appropriate safety factor to use in Form 4.3-3.

If site constraints limit the use of BMPs to a single type and implementation of retention and infiltration BMPs mitigate no more than 40% of the DCV, then they are considered infeasible and the Project Proponent may evaluate the effectiveness of BMPs lower in the LID hierarchy of use (Section 5.5.1 of the TGD for WQMP)

If implementation of infiltrations BMPs is feasible as determined using Form 4.3-1, then LID infiltration BMPs shall be implemented to the MEP (section 4.1 of the TGD for WQMP).

Form 4.3-3 Infiltration LID BMP - including underground BMPs (DA 1)

1 Remaining LID DCV not met by site design HSC BMP (ft³): 21,968 $V_{unmet} = \text{Form 4.2-1 Item 7} - \text{Form 4.3-2 Item 30}$

BMP Type <i>Use columns to the right to compute runoff volume retention from proposed infiltration BMP (select BMP from Table 5-4 in TGD for WQMP) - Use additional forms for more BMPs</i>	DA BMP Type	DMA	DA BMP Type	DMA	DA BMP Type <i>(Use additional forms for more BMPs)</i>	DMA
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2 Infiltration rate of underlying soils (in/hr) *See Section 5.4.2 and Appendix D of the TGD for WQMP for minimum requirements for assessment methods*

3.0

3 Infiltration safety factor *See TGD Section 5.4.2 and Appendix D*

2.0

4 Design percolation rate (in/hr) $P_{design} = \text{Item 2} / \text{Item 3}$

1.5

5 Poned water drawdown time (hr) *Copy Item 6 in Form 4.2-1*

48

6 Maximum ponding depth (ft) *BMP specific, see Table 5-4 of the TGD for WQMP for BMP design details*

6.0

7 Ponding Depth (ft) $d_{BMP} = \text{Minimum of } (1/12 * \text{Item 4} * \text{Item 5}) \text{ or Item 6}$

3.54

8 Infiltrating surface area, SA_{BMP} (ft²) *the lesser of the area needed for infiltration of full DCV or minimum space requirements from Table 5.7 of the TGD for WQMP*

5,264

9 Amended soil depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 in the TGD for WQMP for reference to BMP design details*

N/A

10 Amended soil porosity

N/A

11 Gravel depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 of the TGD for WQMP for BMP design details*

2.5

12 Gravel porosity

0.35

13 Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*

3

14 Above Ground Retention Volume (ft³) $V_{retention} = \text{Item 8} * [\text{Item 7} + (\text{Item 9} * \text{Item 10}) + (\text{Item 11} * \text{Item 12}) + (\text{Item 13} * (\text{Item 4} / 12))]$

N/A

15 Underground Retention Volume (ft³) *Volume determined using manufacturer's specifications and calculations*

22,582

16 Total Retention Volume from LID Infiltration BMPs: 22,582 *(Sum of Items 14 and 15 for all infiltration BMP included in plan)*

17 Fraction of DCV achieved with infiltration BMP: 100% $\text{Retention\%} = \text{Item 16} / \text{Form 4.2-1 Item 7}$

18 Is full LID DCV retained on-site with combination of hydrologic source control and LID retention and infiltration BMPs? Yes No
If yes, demonstrate conformance using Form 4.3-10; If no, then reduce Item 3, Factor of Safety to 2.0 and increase Item 8, Infiltrating Surface Area, such that the portion of the site area used for retention and infiltration BMPs equals or exceeds the minimum effective area thresholds (Table 5-7 of the TGD for WQMP) for the applicable category of development and repeat all above calculations.

4.3.3 Harvest and Use BMP

Harvest and use BMP may be considered if the full LID DCV cannot be met by maximizing infiltration BMPs. Use Form 4.3-4 to compute on-site retention of runoff from proposed harvest and use BMPs.

Volume retention estimates for harvest and use BMPs are sensitive to the on-site demand for captured stormwater. Since irrigation water demand is low in the wet season, when most rainfall events occur in San Bernardino County, the volume of water that can be used within a specified drawdown period is relatively low. The bottom portion of Form 4.3-4 facilitates the necessary computations to show infeasibility if a minimum incremental benefit of 40 percent of the LID DCV would not be achievable with MEP implementation of on-site harvest and use of stormwater (Section 5.5.4 of the TGD for WQMP).

Form 4.3-4 Harvest and Use BMPs (DA 1)			
1 Remaining LID DCV not met by site design HSC or infiltration BMP (ft ³): 0 <i>V_{unmet} = Form 4.2-1 Item 7 - Form 4.3-2 Item 30 - Form 4.3-3 Item 16</i>			
BMP Type(s) <i>Compute runoff volume retention from proposed harvest and use BMP (Select BMPs from Table 5-4 of the TGD for WQMP) - Use additional forms for more BMPs</i>	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type <i>(Use additional forms for more BMPs)</i>
2 Describe cistern or runoff detention facility			
3 Storage volume for proposed detention type (ft ³) <i>Volume of cistern</i>			
4 Landscaped area planned for use of harvested stormwater (ft ²)			
5 Average wet season daily irrigation demand (in/day) <i>Use local values, typical ~ 0.1 in/day</i>			
6 Daily water demand (ft ³ /day) <i>Item 4 * (Item 5 / 12)</i>			
7 Drawdown time (hrs) <i>Copy Item 6 from Form 4.2-1</i>			
8 Retention Volume (ft ³) <i>V_{retention} = Minimum of (Item 3) or (Item 6 * (Item 7 / 24))</i>			
9 Total Retention Volume (ft ³) from Harvest and Use BMP <i>Sum of Item 8 for all harvest and use BMP included in plan</i>			
<hr style="border-top: 1px dashed black;"/> 10 Is the full DCV retained with a combination of LID HSC, retention and infiltration, and harvest and use BMPs? Yes <input type="checkbox"/> No <input type="checkbox"/> <i>If yes, demonstrate conformance using Form 4.3-10. If no, then re-evaluate combinations of all LID BMP and optimize their implementation such that the maximum portion of the DCV is retained on-site (using a single BMP type or combination of BMP types). If the full DCV cannot be mitigated after this optimization process, proceed to Section 4.3.4.</i>			

4.3.4 Biotreatment BMP

Biotreatment BMPs may be considered if the full LID DCV cannot be met by maximizing retention and infiltration, and harvest and use BMPs. A key consideration when using biotreatment BMP is the effectiveness of the proposed BMP in addressing the pollutants of concern for the project (see Table 5-5 of the TGD for WQMP).

Use Form 4.3-5 to summarize the potential for volume based and/or flow based biotreatment options to biotreat the remaining unmet LID DCV w. Biotreatment computations are included as follows:

- Use Form 4.3-6 to compute biotreatment in small volume based biotreatment BMP (e.g. bioretention w/underdrains);
- Use Form 4.3-7 to compute biotreatment in large volume based biotreatment BMP (e.g. constructed wetlands);
- Use Form 4.3-8 to compute sizing criteria for flow-based biotreatment BMP (e.g. bioswales)

Form 4.3-5 Selection and Evaluation of Biotreatment BMP (DA 1)		
1 Remaining LID DCV not met by site design HSC, infiltration, or harvest and use BMP for potential biotreatment (ft ³): 0 Form 4.2-1 Item 7 - Form 4.3-2 Item 30 - Form 4.3-3 Item 16- Form 4.3-4 Item 9		List pollutants of concern Copy from Form 2.3-1.
2 Biotreatment BMP Selected <i>(Select biotreatment BMP(s) necessary to ensure all pollutants of concern are addressed through Unit Operations and Processes, described in Table 5-5 of the TGD for WQMP)</i>	Volume-based biotreatment <i>Use Forms 4.3-6 and 4.3-7 to compute treated volume</i>	Flow-based biotreatment <i>Use Form 4.3-8 to compute treated volume</i>
	<input type="checkbox"/> Bioretention with underdrain <input type="checkbox"/> Planter box with underdrain <input type="checkbox"/> Constructed wetlands <input type="checkbox"/> Wet extended detention <input type="checkbox"/> Dry extended detention	<input type="checkbox"/> Vegetated swale <input type="checkbox"/> Vegetated filter strip <input type="checkbox"/> Proprietary biotreatment
3 Volume biotreated in volume based biotreatment BMP (ft ³): Form 4.3-6 Item 15 + Form 4.3-7 Item 13	4 Compute remaining LID DCV with implementation of volume based biotreatment BMP (ft ³): Item 1 - Item 3	5 Remaining fraction of LID DCV for sizing flow based biotreatment BMP: % Item 4 / Item 1
6 Flow-based biotreatment BMP capacity provided (cfs): Use Figure 5-2 of the TGD for WQMP to determine flow capacity required to provide biotreatment of remaining percentage of unmet LID DCV (Item 5), for the project's precipitation zone (Form 3-1 Item 1)		
7 Metrics for MEP determination: <ul style="list-style-type: none"> • Provided a WQMP with the portion of site area used for suite of LID BMP equal to minimum thresholds in Table 5-7 of the TGD for WQMP for the proposed category of development: <input type="checkbox"/> If maximized on-site retention BMPs is feasible for partial capture, then LID BMP implementation must be optimized to retain and infiltrate the maximum portion of the DCV possible within the prescribed minimum effective area. The remaining portion of the DCV shall then be mitigated using biotreatment BMP. 		

Form 4.3-6 Volume Based Biotreatment (DA 1) – Bioretention and Planter Boxes with Underdrains

Biotreatment BMP Type <i>(Bioretention w/underdrain, planter box w/underdrain, other comparable BMP)</i>	DA BMP Type	DMA	DA BMP Type	DMA BMP Type	DA DMA BMP Type <i>(Use additional forms for more BMPs)</i>
1 Pollutants addressed with BMP <i>List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in Table 5-5 of the TGD for WQMP</i>					
2 Amended soil infiltration rate <i>Typical ~ 5.0</i>					
3 Amended soil infiltration safety factor <i>Typical ~ 2.0</i>					
4 Amended soil design percolation rate (in/hr) $P_{design} = \text{Item 2} / \text{Item 3}$					
5 Ponded water drawdown time (hr) <i>Copy Item 6 from Form 4.2-1</i>					
6 Maximum ponding depth (ft) <i>see Table 5-6 of the TGD for WQMP for reference to BMP design details</i>					
7 Ponding Depth (ft) $d_{BMP} = \text{Minimum of } (1/12 * \text{Item 4} * \text{Item 5}) \text{ or Item 6}$					
8 Amended soil surface area (ft ²)					
9 Amended soil depth (ft) <i>see Table 5-6 of the TGD for WQMP for reference to BMP design details</i>					
10 Amended soil porosity, <i>n</i>					
11 Gravel depth (ft) <i>see Table 5-6 of the TGD for WQMP for reference to BMP design details</i>					
12 Gravel porosity, <i>n</i>					
13 Duration of storm as basin is filling (hrs) <i>Typical ~ 3hrs</i>					
14 Biotreated Volume (ft ³) $V_{biotreated} = \text{Item 8} * \{(\text{Item 7}/2) + (\text{Item 9} * \text{Item 10}) + (\text{Item 11} * \text{Item 12}) + (\text{Item 13} * (\text{Item 4} / 12))\}$					
15 Total biotreated volume from bioretention and/or planter box with underdrains BMP: <i>Sum of Item 14 for all volume-based BMPs included in this form</i>					

Form 4.3-7 Volume Based Biotreatment (DA 1) – Constructed Wetlands and Extended Detention

Biotreatment BMP Type <i>Constructed wetlands, extended wet detention, extended dry detention, or other comparable proprietary BMP. If BMP includes multiple modules (e.g. forebay and main basin), provide separate estimates for storage and pollutants treated in each module.</i>	DA DMA BMP Type		DA DMA BMP Type <i>(Use additional forms for more BMPs)</i>	
	Forebay	Basin	Forebay	Basin
1 Pollutants addressed with BMP forebay and basin <i>List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in Table 5-5 of the TGD for WQMP</i>				
2 Bottom width (ft)				
3 Bottom length (ft)				
4 Bottom area (ft ²) <i>A_{bottom} = Item 2 * Item 3</i>				
5 Side slope (ft/ft)				
6 Depth of storage (ft)				
7 Water surface area (ft ²) <i>A_{surface} = (Item 2 + (2 * Item 5 * Item 6)) * (Item 3 + (2 * Item 5 * Item 6))</i>				
8 Storage volume (ft ³) <i>For BMP with a forebay, ensure fraction of total storage is within ranges specified in BMP specific fact sheets, see Table 5-6 of the TGD for WQMP for reference to BMP design details</i> <i>V = Item 6 / 3 * [Item 4 + Item 7 + (Item 4 * Item 7)^{0.5}]</i>				
9 Drawdown Time (hrs) <i>Copy Item 6 from Form 2.1</i>				
10 Outflow rate (cfs) <i>Q_{BMP} = (Item 8_{forebay} + Item 8_{basin}) / (Item 9 * 3600)</i>				
11 Duration of design storm event (hrs)				
12 Biotreated Volume (ft ³) <i>V_{biotreated} = (Item 8_{forebay} + Item 8_{basin}) + (Item 10 * Item 11 * 3600)</i>				
13 Total biotreated volume from constructed wetlands, extended dry detention, or extended wet detention : <i>(Sum of Item 12 for all BMP included in plan)</i>				

Form 4.3-8 Flow Based Biotreatment (DA 1)			
Biotreatment BMP Type <i>Vegetated swale, vegetated filter strip, or other comparable proprietary BMP</i>	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type <i>(Use additional forms for more BMPs)</i>
1 Pollutants addressed with BMP <i>List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in TGD Table 5-5</i>			
2 Flow depth for water quality treatment (ft) <i>BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details</i>			
3 Bed slope (ft/ft) <i>BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details</i>			
4 Manning's roughness coefficient			
5 Bottom width (ft) $b_w = (\text{Form 4.3-5 Item 6} * \text{Item 4}) / (1.49 * \text{Item 2}^{1.67} * \text{Item 3}^{0.5})$			
6 Side Slope (ft/ft) <i>BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details</i>			
7 Cross sectional area (ft ²) $A = (\text{Item 5} * \text{Item 2}) + (\text{Item 6} * \text{Item 2}^2)$			
8 Water quality flow velocity (ft/sec) $V = \text{Form 4.3-5 Item 6} / \text{Item 7}$			
9 Hydraulic residence time (min) <i>Pollutant specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details</i>			
10 Length of flow based BMP (ft) $L = \text{Item 8} * \text{Item 9} * 60$			
11 Water surface area at water quality flow depth (ft ²) $SA_{top} = (\text{Item 5} + (2 * \text{Item 2} * \text{Item 6})) * \text{Item 10}$			

4.3.5 Conformance Summary

Complete Form 4.3-9 to demonstrate how on-site LID DCV is met with proposed site design hydrologic source control, infiltration, harvest and use, and/or biotreatment BMP. The bottom line of the form is used to describe the basis for infeasibility determination for on-site LID BMP to achieve full LID DCV, and provides methods for computing remaining volume to be addressed in an alternative compliance plan. If the project has more than one outlet, then complete additional versions of this form for each outlet.

Form 4.3-9 Conformance Summary and Alternative Compliance Volume Estimate (DA 1)	
1	Total LID DCV for the Project DA-1 (ft ³): 21,968 <i>Copy Item 7 in Form 4.2-1</i>
2	On-site retention with site design hydrologic source control LID BMP (ft ³): 0 <i>Copy Item 30 in Form 4.3-2</i>
3	On-site retention with LID infiltration BMP (ft ³): 21,968 <i>Copy Item 16 in Form 4.3-3</i>
4	On-site retention with LID harvest and use BMP (ft ³): 0 <i>Copy Item 9 in Form 4.3-4</i>
5	On-site biotreatment with volume based biotreatment BMP (ft ³): 0 <i>Copy Item 3 in Form 4.3-5</i>
6	Flow capacity provided by flow based biotreatment BMP (cfs): 0 <i>Copy Item 6 in Form 4.3-5</i>
7	<p>LID BMP performance criteria are achieved if answer to any of the following is "Yes":</p> <ul style="list-style-type: none"> • Full retention of LID DCV with site design HSC, infiltration, or harvest and use BMP: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> <i>If yes, sum of Items 2, 3, and 4 is greater than Item 1</i> • Combination of on-site retention BMPs for a portion of the LID DCV and volume-based biotreatment BMP that address all pollutants of concern for the remaining LID DCV: Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> <i>If yes, a) sum of Items 2, 3, 4, and 5 is greater than Item 1, and Items 2, 3 and 4 are maximized; or b) Item 6 is greater than Form 4.3-5 Item 6 and Items 2, 3 and 4 are maximized</i> • On-site retention and infiltration is determined to be infeasible and biotreatment BMP provide biotreatment for all pollutants of concern for full LID DCV: Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> <i>If yes, Form 4.3-1 Items 7 and 8 were both checked yes</i>
8	<p>If the LID DCV is not achieved by any of these means, then the project may be allowed to develop an alternative compliance plan. Check box that describes the scenario which caused the need for alternative compliance:</p> <ul style="list-style-type: none"> • Combination of HSC, retention and infiltration, harvest and use, and biotreatment BMPs provide less than full LID DCV capture: <input type="checkbox"/> <i>Checked yes for Form 4.3-5 Item 7, Item 6 is zero, and sum of Items 2, 3, 4, and 5 is less than Item 1. If so, apply water quality credits and calculate volume for alternative compliance, $V_{alt} = (Item\ 1 - Item\ 2 - Item\ 3 - Item\ 4 - Item\ 5) * (100 - Form\ 2.4-1\ Item\ 2)\%$</i> • An approved Watershed Action Plan (WAP) demonstrates that water quality and hydrologic impacts of urbanization are more effective when managed in at an off-site facility: <input type="checkbox"/> <i>Attach appropriate WAP section, including technical documentation, showing effectiveness comparisons for the project site and regional watershed</i>

4.3.6 Hydromodification Control BMP

Use Form 4.3-10 to compute the remaining runoff volume retention, after LID BMP are implemented, needed to address HCOC, and the increase in time of concentration and decrease in peak runoff necessary to meet targets for protection of waterbodies with a potential HCOC. Describe hydromodification control BMP that address HCOC, which may include off-site BMP and/or in-stream controls. Section 5.6 of the TGD for WQMP provides additional details on selection and evaluation of hydromodification control BMP.

Form 4.3-10 Hydromodification Control BMPs (DA 1)	
<p>1 Volume reduction needed for HCOC performance criteria (ft³): N/A, the project does not have the potential to cause or contribute to an HCOC in a downstream channel <i>(Form 4.2-2 Item 4 * 0.95) – Form 4.2-2 Item 1</i></p>	<p>2 On-site retention with site design hydrologic source control, infiltration, and harvest and use LID BMP (ft³): <i>Sum of Form 4.3-9 Items 2, 3, and 4 Evaluate option to increase implementation of on-site retention in Forms 4.3-2, 4.3-3, and 4.3-4 in excess of LID DCV toward achieving HCOC volume reduction</i></p>
<p>3 Remaining volume for HCOC volume capture (ft³): <i>Item 1 – Item 2</i></p>	<p>4 Volume capture provided by incorporating additional on-site or off-site retention BMPs (ft³): <i>Existing downstream BMP may be used to demonstrate additional volume capture (if so, attach to this WQMP a hydrologic analysis showing how the additional volume would be retained during a 2-yr storm event for the regional watershed)</i></p>
<p>5 If Item 4 is less than Item 3, incorporate in-stream controls on downstream waterbody segment to prevent impacts due to hydromodification <input type="checkbox"/> <i>Attach in-stream control BMP selection and evaluation to this WQMP</i></p>	
<p>6 Is Form 4.2-2 Item 11 less than or equal to 5%: Yes <input type="checkbox"/> No <input type="checkbox"/> <i>If yes, HCOC performance criteria is achieved. If no, select one or more mitigation options below:</i></p> <ul style="list-style-type: none"> • Demonstrate increase in time of concentration achieved by proposed LID site design, LID BMP, and additional on-site or off-site retention BMP <input type="checkbox"/> <i>BMP upstream of a waterbody segment with a potential HCOC may be used to demonstrate increased time of concentration through hydrograph attenuation (if so, show that the hydraulic residence time provided in BMP for a 2-year storm event is equal or greater than the addition time of concentration requirement in Form 4.2-4 Item 15)</i> • Increase time of concentration by preserving pre-developed flow path and/or increase travel time by reducing slope and increasing cross-sectional area and roughness for proposed on-site conveyance facilities <input type="checkbox"/> • Incorporate appropriate in-stream controls for downstream waterbody segment to prevent impacts due to hydromodification, in a plan approved and signed by a licensed engineer in the State of California <input type="checkbox"/> 	
<p>7 Form 4.2-2 Item 12 less than or equal to 5%: Yes <input type="checkbox"/> No <input type="checkbox"/> <i>If yes, HCOC performance criteria is achieved. If no, select one or more mitigation options below:</i></p> <ul style="list-style-type: none"> • Demonstrate reduction in peak runoff achieved by proposed LID site design, LID BMPs, and additional on-site or off-site retention BMPs <input type="checkbox"/> <i>BMPs upstream of a waterbody segment with a potential HCOC may be used to demonstrate additional peak runoff reduction through hydrograph attenuation (if so, attach to this WQMP, a hydrograph analysis showing how the peak runoff would be reduced during a 2-yr storm event)</i> • Incorporate appropriate in-stream controls for downstream waterbody segment to prevent impacts due to hydromodification, in a plan approved and signed by a licensed engineer in the State of California <input type="checkbox"/> 	

4.4 Alternative Compliance Plan (if applicable)

Describe an alternative compliance plan (if applicable) for projects not fully able to infiltrate, harvest and use, or biotreat the DCV via on-site LID practices. A project proponent must develop an alternative compliance plan to address the remainder of the LID DCV. Depending on project type some projects may qualify for water quality credits that can be applied to reduce the DCV that must be treated prior to development of an alternative compliance plan (see Form 2.4-1, Water Quality Credits). Form 4.3-9 Item 8 includes instructions on how to apply water quality credits when computing the DCV that must be met through alternative compliance. Alternative compliance plans may include one or more of the following elements:

- On-site structural treatment control BMP - All treatment control BMP should be located as close to possible to the pollutant sources and should not be located within receiving waters;
- Off-site structural treatment control BMP - Pollutant removal should occur prior to discharge of runoff to receiving waters;
- Urban runoff fund or In-lieu program, if available

Depending upon the proposed alternative compliance plan, approval by the executive officer may or may not be required (see Section 6 of the TGD for WQMP).

Section 5 Inspection and Maintenance Responsibility for Post Construction BMP

All BMP included as part of the project WQMP are required to be maintained through regular scheduled inspection and maintenance (refer to Section 8, Post Construction BMP Requirements, in the TGD for WQMP). Fully complete Form 5-1 summarizing all BMP included in the WQMP. Attach additional forms as needed. The WQMP shall also include a detailed Operation and Maintenance Plan for all BMP and may require a Maintenance Agreement (consult the jurisdiction's LIP). If a Maintenance Agreement is required, it must also be attached to the WQMP.

Form 5-1 BMP Inspection and Maintenance (use additional forms as necessary)			
BMP	Responsible Party(s)	Inspection/ Maintenance Activities Required	Minimum Frequency of Activities
N1. Education of Property Owners, Tenants and Occupants on Storm-water BMPs	Central XC, LLC (Owner)	<p>The owner will provide practical information materials to the first occupants/tenants on general housekeeping practices for retail commercial developments that contribute to the protection of stormwater quality. (See Attachment H to the WQMP for the applicable BMP Educational Materials.) Thereafter such materials will be available through the local jurisdiction's stormwater education program. 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 wastes via hosing or other direct discharge to gutters, catch basins and storm drains. Educational materials are available from the San Bernardino Stormwater Program and can be downloaded at: http://www.sbcountystormwater.org/gov_out.html.</p>	Frequency: Upon occupancy
N2. Activity Restrictions	Central XC, LLC (Owner)	<p>The owner will implement use /activity restrictions for the project for the purpose of surface water quality protection through the use of lease terms. For example, automobile washing, maintenance, and repairs will not be allowed at the project site.</p>	Frequency: Continuous

Water Quality Management Plan (WQMP)

N3. Landscape Management BMPs	Central XC, LLC (Owner)	The owner will identify on-going landscape maintenance requirements consistent with applicable local ordinances that may include fertilizer and/or pesticide usage.	Frequency: Continuous
N4. BMP Maintenance	Central XC, LLC (Owner)	The owner will be responsible for implementation of each non- structural BMP and scheduled cleaning and/or maintenance of all structural BMP facilities.	Frequency: Continuous
N6. Local Water Quality Ordinances	Central XC, LLC (Owner)	The owner will comply with any applicable local water quality ordinances.	Frequency: Continuous
N7. Spill Contingency Plan	Central XC, LLC (Owner)	The owner will prepare a Spill Contingency Plan based on specified types of building or suite occupancies. The Plan will mandate stockpiling of cleanup materials, notification of responsible agencies, disposal of cleanup materials, documentation, etc.	Frequency: Upon Occupancy
N11. Litter / Debris Control Program	Central XC, LLC (Owner)	The owner will implement trash management and litter control procedures in the common areas aimed at reducing pollution of drainage water. The owner may contract with its landscape maintenance firm to provide this service during regularly scheduled maintenance, which should consist of litter patrol, emptying of trash receptacles in common areas, and noting trash disposal violations by tenants or businesses and reporting the violations to the owner for investigation.	Frequency: Weekly
N12. Employee Training	Central XC, LLC (Owner)	The owner will prepare an education program manual (see N1) for future employees of individual businesses at the project, and will train the employees on such matters as the proper storage and use of pesticides and the implementation of hazardous spill contingency plans.	Frequency: Upon hire, and annually thereafter

**Form 5-1 BMP Inspection and Maintenance
(use additional forms as necessary)**

BMP	Responsible Party(s)	Inspection/ Maintenance Activities Required	Minimum Frequency of Activities
N13. House-keeping of Loading Docks	Central XC, LLC (Owner)	Keep all fluids indoors. Clean up spills immediately and keep spills from entering storm drain system. No direct discharges into the storm drain system. Area shall be inspected weekly for proper containment and practices with spills cleaned up immediately and disposed of properly.	Frequency: Continuous
N14. Catch Basin Inspection Program	Central XC, LLC (Owner)	The catch basins will be inspected, cleaned and maintained on an annual basis, in the early fall prior to the start of the rainy season, and before and after all major storms.	Frequency: Annually, and before and after all major storms
N15. Vacuum Sweeping of Private Streets and Parking Lots	Central XC, LLC (Owner)	The owner will ensure that the project's parking lots will be swept on a monthly basis, or more often if necessary, using a vacuum assisted sweeper.	Frequency: Monthly, or more often if necessary
N17. Comply With All Other Applicable NPDES Permits	Central XC, LLC (Owner)	The owner shall comply with other NPDES permits such as General Industrial permits, etc., to include BMPs that are required as part of a SWPPP.	Frequency: Continuous
S1. Storm Drain System Stenciling and Signage	Central XC, LLC (Owner)	Stencil or label storm drain inlets and catch basins with prohibitive language (such as: "No Dumping - Flows to Creek"). Maintain legibility of stencils and signs.	Frequency: Annually

<p>S3. Design and Construct Trash and Waste Storage Areas to Reduce Pollution Introduction</p>	<p>Central XC, LLC (Owner)</p>	<p>Trash storage areas will be paved with an impervious surface, designed to not allow run-on from adjoining areas, designed to divert drainage from adjoining roofs and pavements around the area, screened or walled to prevent off-site transport of trash, and provide solid roof or awning.</p>	<p>Frequency: Continuous</p>
<p>S4. Use Efficient Irrigation Systems & Landscape Design</p>	<p>Central XC, LLC (Owner)</p>	<p>Irrigation systems shall include reducers or shut off valves triggered by a pressure drop. Timers will be used to avoid over watering and watering cycles shall be adjusted seasonally. Plants with similar watering requirements will be grouped, and native or drought tolerant species will be used where appropriate.</p>	<p>Frequency: Continuous</p>
<p>S5. Finish Grade of Land-scaped Areas at a Minimum of 1-2 Inches Below Top of Curb, Sidewalk or Pavement</p>	<p>Central XC, LLC (Owner)</p>	<p>Landscaped areas will be finish-graded at a minimum of 1-2 inches below top of curb or sidewalk for increased retention of stormwater/irrigation water.</p>	<p>Frequency: Continuous</p>

**Form 5-1 BMP Inspection and Maintenance
(use additional forms as necessary)**

BMP	Responsible Party(s)	Inspection/ Maintenance Activities Required	Minimum Frequency of Activities
LID BMP #1— Onsite Infiltration (Underground Chamber)	Central XC, LLC (Owner)	Quarterly inspections of the underground infiltration BMPs shall be conducted utilizing the designed manholes/inspection ports. The BMPs shall be cleaned when inspection reveals that accumulated sediment or trash is clogging the system. Accumulated sediment and trash can be evacuated through the manholes.	Frequency: Quarterly And Immediately After Major Storm Events
LID BMP #2— Treatment Control Measure (Proprietary Hydrodynamic Separation Device— Pretreatment for Onsite Infiltration) Contech	Central XC, LLC (Owner)	Twice a year, prior to and after the rainy season, and after major storm events, the hydrodynamic separation device shall be visually inspected for damage, obstructions in the inlet and separation screen, and accumulation of pollutants in the system. The device should be cleaned when the sediment has reached 75% of capacity in the isolated sump or when an appreciable level of hydrocarbons and trash has accumulated. Accumulated pollutants can be evacuated through the manholes.	Frequency: Every Six Months (Approximately April 1st and October 1st) and Immediately After Major Storm Events
\			

Section 6 WQMP Attachments

6.1. Site Plan and Drainage Plan

Include a site plan and drainage plan sheet set containing the following minimum information:

- Project location
- Site boundary
- Land uses and land covers, as applicable
- Suitability/feasibility constraints
- Structural Source Control BMP locations
- Site Design Hydrologic Source Control BMP locations
- LID BMP details
- Drainage delineations and flow information
- Drainage connections

6.2 Electronic Data Submittal

Minimum requirements include submittal of PDF exhibits in addition to hard copies. Format must not require specialized software to open. If the local jurisdiction requires specialized electronic document formats (as described in their local Local Implementation Plan), this section will describe the contents (e.g., layering, nomenclature, geo-referencing, etc.) of these documents so that they may be interpreted efficiently and accurately.

6.3 Post Construction

Attach all O&M Plans and Maintenance Agreements for BMP to the WQMP.

6.4 Other Supporting Documentation

- BMP Educational Materials
- Activity Restriction – C, C&R's & Lease Agreements

LIST OF ATTACHMENTS

Attachment A: Project Vicinity Map

Attachment B: WQMP Site Plan

Attachment C: Geotechnical Investigation Reports

- **Geotechnical Investigation, Proposed Commercial/Industrial Building, 270 E. Central Avenue, San Bernardino, California, dated October 14, 2015**
- **Results of Infiltration Testing, Proposed Commercial/Industrial Building, 270 E. Central Avenue, San Bernardino, California, dated October 21, 2015**

Attachment D: LID BMP Design Details and Specifications

- **INF-7: Underground Infiltration Fact Sheet from Orange County TGD for Project WQMPs**
- **Contech Hydrodynamic Separation Device Standard Detail / Specifications / Maintenance (Pretreatment for Onsite Infiltration)**

Attachment E: Operation and Maintenance (O & M) Plan

Attachment F: Water Quality Management Plan and Stormwater BMP Transfer, Access and Maintenance Agreement

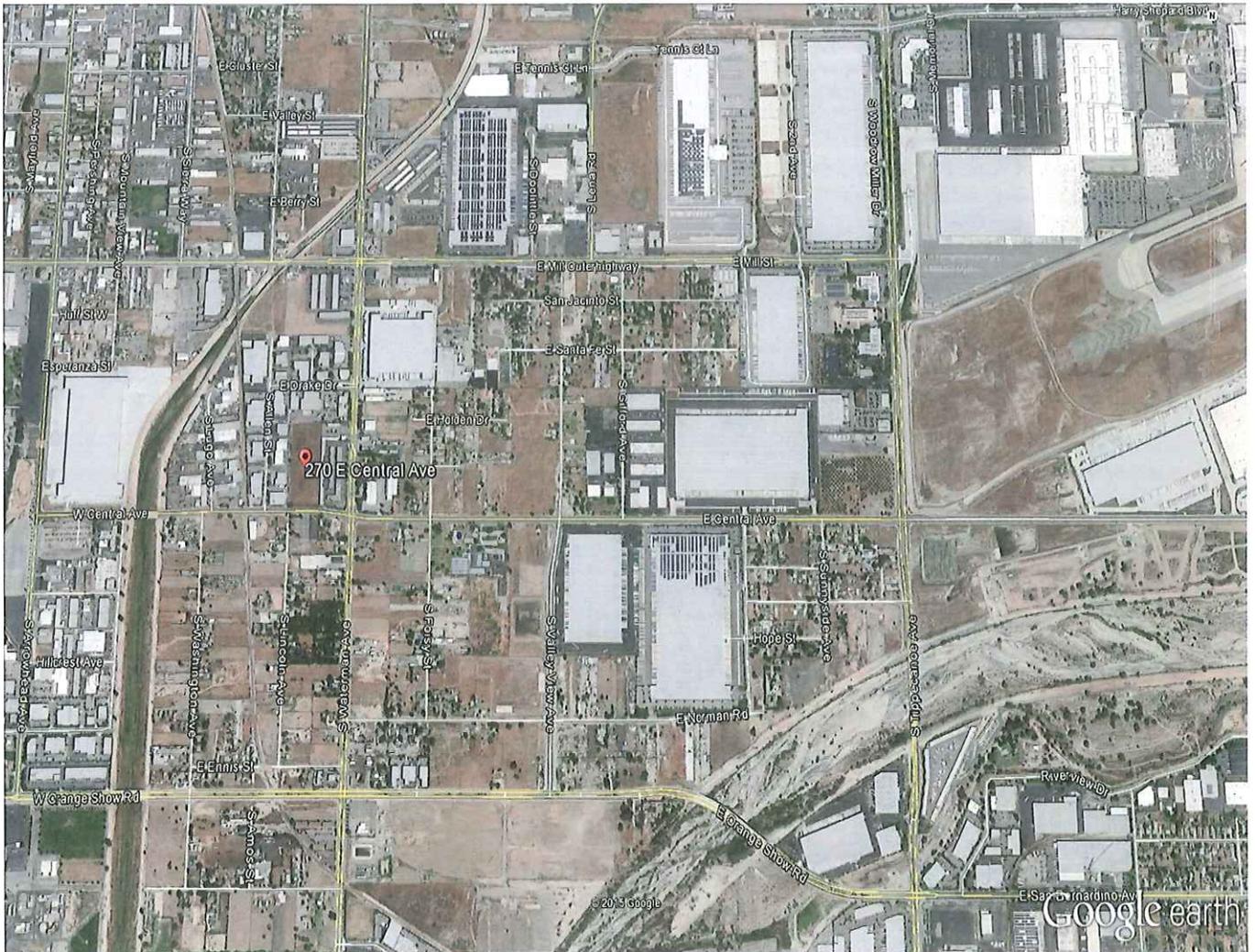
Attachment G: BMP Educational Materials

- 1. Industrial and Commercial Facilities Brochure (San Bernardino County Website)**
- 2. Commercial Landscape Maintenance Fact Sheet (San Bernardino County Website)**
- 3. Stormwater Management Practices for Commercial Landscape Maintenance Brochure (San Bernardino County Website)**
- 4. Commercial Trash Enclosures Brochure (San Bernardino County Website)**
- 5. Construction & Development Fact Sheet (San Bernardino County Website)**
- 6. Regulatory Information Fact Sheet (San Bernardino County Website)**
- 7. SC-11 Spill Prevention, Control & Cleanup**
- 8. SC-30 Outdoor Loading / Unloading**

9. SC-34 Waste Handling & Disposal
10. SC-41 Building & Grounds Maintenance
11. SC-42 Building Repair and Construction
12. SC-43 Parking / Storage Area Maintenance
13. SC-44 Drainage System Maintenance
14. SC-60 Housekeeping Practices
15. SC-71 Plaza and Sidewalk Cleaning
16. SC-73 Landscape Maintenance
17. SD-12 Efficient Irrigation
18. SD-13 Storm Drain Signage
19. SD-31 Maintenance Bays & Docks
20. SD-32 Trash Storage Areas
21. MP-51 Vortex Separator
22. TC-60 Multiple Systems

ATTACHMENT A

Project Vicinity Map

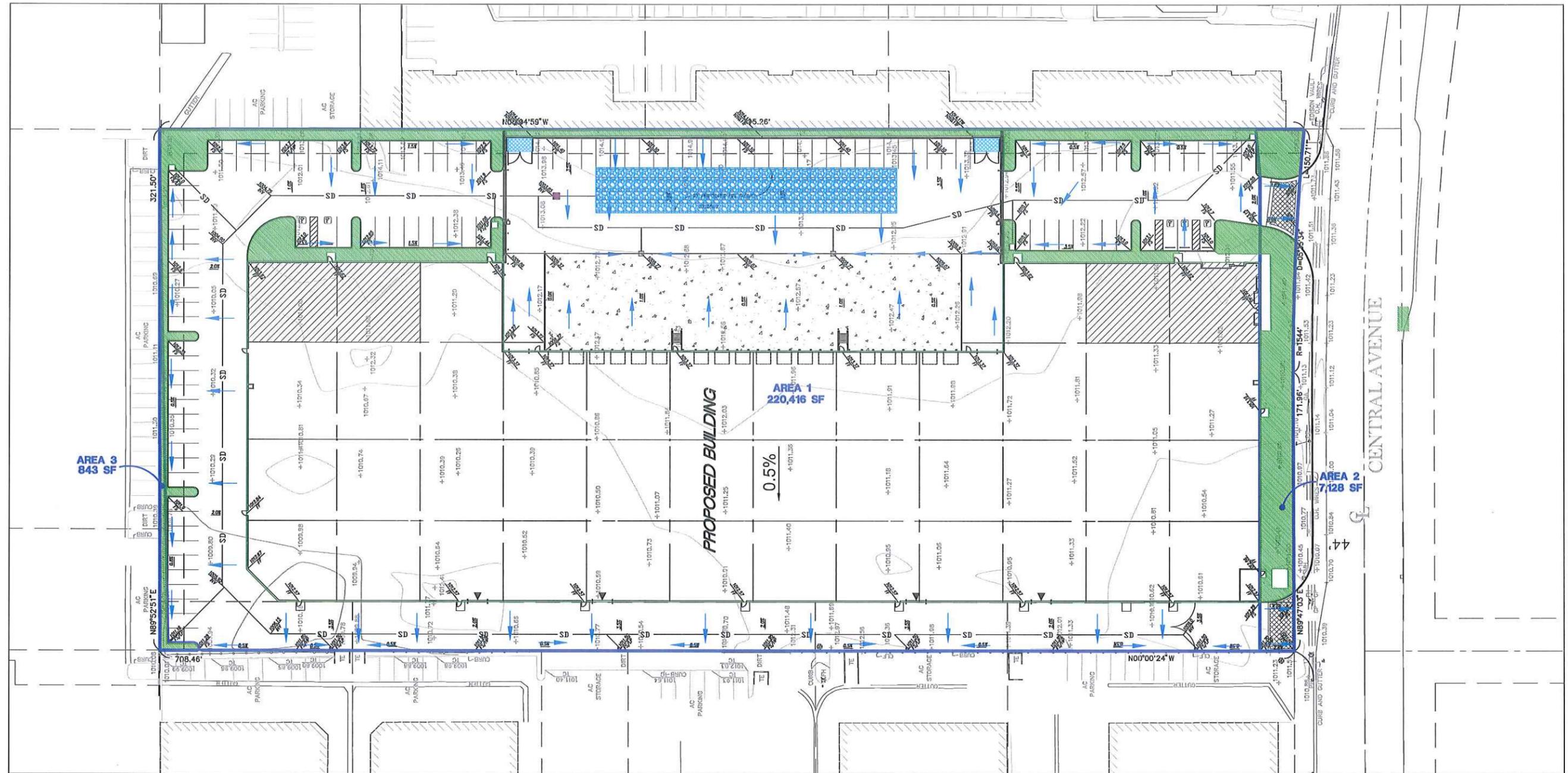


VICINITY MAP

**270 East Central Avenue
San Bernardino, CA**

ATTACHMENT B

WQMP Site Plan



AREAS 2 & 3

AREAS 2 AND 3 WILL BE DEPRESSED AND SELF CONTAINING.

AREA 3 IS WHERE THE EXISTING FLOWS EXIT THE SITE AND THE FLOWS WILL BE GREATLY REDUCED DUE TO THE DEVELOPMENT OF THIS SITE.

AREA 2 WILL BE SLIGHTLY DEPRESSED AT THE RIGHT OF WAY TO ALLOW THE SMALL AMOUNT OF FLOWS TO INFILTRATE.

LID DCV CALCULATION

AREA 1

AREA - 220,416 SF / 5.06 AC
 RUNOFF COEFFICIENT (96% IMPERVIOUS)
 $C = 0.858 * (96\%)^3 - 0.78 * (96\%)^2 + 0.774 * (96\%) + 0.04 = 0.82$
 2YR 1 HR STORM - 0.502 IN
 $P_6 = 1.4807 * 0.502 = 0.743$ IN
 $DCV = 220,416 \text{ SF} * 0.82 * 0.743 \text{ IN} / 12 \text{ IN/FT} * 1.963 = 21,968 \text{ CF}$

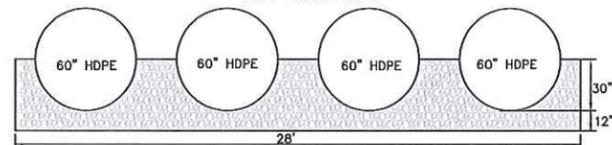
BMP VOLUME CALCULATION

BMP VOLUME
 PIPE CROSS SECTIONAL AREA - $4 * (19.63 \text{ SF/LF}) = 78.52 \text{ SF/LF}$
 ROCK CROSS SECTIONAL AREA - $58.73 \text{ SF ROCK AREA} * .35 = 20.55 \text{ SF/LF}$
 TOTAL CROSS SECTIONAL AREA - 99.07 SF/LF
 EFFECTIVE DEPTH $99.07 \text{ SF/LF} / 28 \text{ LF WIDTH} = 3.54'$
 $V_{ret} = (P_{design} / 12 * S_{Ainf} * T_{fill}) + (S_{Ares} * D_{res} * N_{agg})$
 $P_{design} = 3.0"$ MEASURED / 2 S.F. = $1.5"/HR$
 $S_{Ainf} = 28'W * 188LF = 5,264 \text{ SF}$
 $S_{Ares} = 28'W * 188LF = 5,264 \text{ SF}$
 $T_{fill} = 3 \text{ HRS}$
 $D_{res} = \text{EFFECTIVE DEPTH} = 3.54'$
 $N_{agg} = 1.0$ (EFFECTIVE DEPTH ACCOUNTED FOR ROCK)
 $V_{ret} = (3.0/12 * 5,264 * 3) + (5,264 * 3.54 * 1.0) = 22,582 \text{ CF}$
 BMP VOLUME > DCV VOLUME

AREA	TOTAL AREA	L.S. AREA	% IMPERVIOUS
A1	220,416 SF	8,829 SF	96%
A2	7,128 SF	4,324 SF	39.3%
A3	843 SF	843 SF	0%
TOTAL	228,387 SF	13,996 SF	93.8%

INFILTRATION BMP CROSS SECTION

N.T.S.
 188 LF BASIN LENGTH



LEGEND STRUCTURAL / TREATMENT BMPS

- LANDSCAPE AREA EFFICIENT IRRIGATION
- LANDSCAPE AREA RUNOFF-MINIMIZING DESIGN
- PROPRIETARY HYDRODYNAMIC SEPARATOR
- UNDERGROUND INFILTRATION
- TRASH ENCLOSURE
- FLOW PATTERN
- DRAINAGE AREAS **AREA 1**

NON-STRUCTURAL BMPS

- STREET SWEEPING
- PROJECT DATA:
- TOTAL SITE AREA OF PROPOSED DEVELOPMENT: 5.24 AC (228,387 SF)
- BUILDING AREA: 115,570 SF
- WALKWAYS/SIDEWALK AREAS: 1,000 SF
- DRIVEWAYS / DRIVE AISLES: 97,821 SF
- 13,996 SF LANDSCAPING PROVIDED (6.2% PERVIOUS AREA)
- CURRENT USE: VACANT
- PROPOSED USE: INDUSTRIAL
- WATERSHED: LOS ANGELES RIVER



SCALE
 1 inch = 20 ft.

PREPARED BY:
CA ENGINEERING, INC.
 Planning • Engineering • Surveying
 3008 DOW AVE. STE 122
 TUSTIN, CA 92780
 949-724-9480 949-724-9484 FAX

WQMP
 270 E. CENTRAL AVE.
BMP EXHIBIT (SITE PLAN)
 SAN BERNARDINO, CALIFORNIA

ATTACHMENT C

Geotechnical Investigation Reports

- **Geotechnical Investigation, Proposed Commercial/Industrial Building, 270 E. Central Avenue, San Bernardino, California, dated October 14, 2015**
- **Results of Infiltration Testing, Proposed Commercial/Industrial Building, 270 E. Central Avenue, San Bernardino, California, dated October 21, 2015**

**Geotechnical Investigation, Proposed
Commercial/Industrial Building, 270 E. Central
Avenue, San Bernardino, California, dated October
14, 2015**

**GEOTECHNICAL INVESTIGATION
PROPOSED COMMERCIAL/INDUSTRIAL
BUILDING**

270 East Central Avenue
San Bernardino, California
for
Xebec Realty



**SOUTHERN
CALIFORNIA
GEOTECHNICAL**
A California Corporation

October 14, 2015

Xebec Realty
3010 Old Ranch Parkway, Suite 470
Seal Beach, California 90740



**SOUTHERN
CALIFORNIA
GEOTECHNICAL**
A California Corporation

Attention: Mr. Jason Chen, Financial Analyst

Project No.: **15G190-1**

Subject: **Geotechnical Investigation**
Proposed Commercial/Industrial Building
270 East Central Avenue
San Bernardino, California

Reference: Geotechnical Investigation and Liquefaction Evaluation, Proposed Commercial/Industrial Development, Central Avenue, West of Waterman Avenue, San Bernardino, California, prepared by Southern California Geotechnical, Inc. (SCG) for First Industrial Realty Trust, SCG Project No. 06G181-1, dated June 13, 2006.

Gentlemen:

In accordance with your request, we have conducted a geotechnical investigation and liquefaction evaluation at the subject site. We are pleased to present this report summarizing the conclusions and recommendations developed from our investigation.

We sincerely appreciate the opportunity to be of service on this project. We look forward to providing additional consulting services during the course of the project. If we may be of further assistance in any manner, please contact our office.

Respectfully Submitted,
SOUTHERN CALIFORNIA GEOTECHNICAL, INC.


Ricardo Frias
Staff Engineer


Daniel W. Nielsen, RCE 77915
Project Engineer


John A. Seminara, CEG 2125
Principal Geologist

Distribution: (2) Addressee

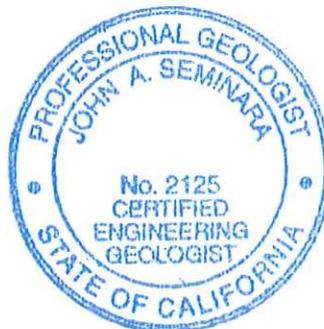


TABLE OF CONTENTS

1.0 EXECUTIVE SUMMARY	1
2.0 SCOPE OF SERVICES	3
3.0 SITE AND PROJECT DESCRIPTION	4
3.1 Site Conditions	4
3.2 Proposed Development	4
3.3 Previous Studies	5
4.0 SUBSURFACE EXPLORATION	6
4.1 Scope of Exploration/Sampling Methods	6
4.2 Geotechnical Conditions	6
5.0 LABORATORY TESTING	8
6.0 CONCLUSIONS AND RECOMMENDATIONS	10
6.1 Seismic Design Considerations	10
6.2 Geotechnical Design Considerations	13
6.3 Site Grading Recommendations	15
6.4 Construction Considerations	17
6.5 Foundation Design and Construction	18
6.6 Floor Slab Design and Construction	20
6.7 Retaining Wall Design and Construction	21
6.8 Pavement Design Parameters	23
7.0 GENERAL COMMENTS	26
8.0 REFERENCES	27
APPENDICES	
A Plate 1: Site Location Map Plate 2: Boring Location Plan	
B Boring Logs	
C Laboratory Test Results	
D Grading Guide Specifications	
E Seismic Design Parameters	
F Liquefaction Evaluation Spreadsheets	
G Previous Study Borings and Laboratory Test Results	

1.0 EXECUTIVE SUMMARY

Presented below is a brief summary of the conclusions and recommendations of this investigation. Since this summary is not all inclusive, it should be read in complete context with the entire report.

Site Preparation

- Initial site preparation should include stripping of any surficial vegetation. Vegetation including grass and weed growth, trees, and any organic soils should be properly disposed of off-site. Root balls associated with the trees should be removed in their entirety, and the resultant excavations should be backfilled with compacted structural fill soils.
- The near-surface soils at this site generally consist of artificial fill and alluvium. The fill soils extend to depths of 2½ to 5± feet and possess variable strengths and densities and a moderate potential for collapse. The near surface alluvial soils also possess variable strengths and densities.
- Remedial grading is recommended to be performed within the proposed building area in order to remove all of the artificial fill soils and the upper portion of the alluvial soils. The existing soils within the proposed building area should be overexcavated to a depth of 5 feet below existing grade and to a depth of at least 5 feet below proposed building pad subgrade elevation. The depth of overexcavation should also be sufficient to remove any existing fill soils.
- The proposed foundation influence zones should be overexcavated to a depth of 3 feet below proposed foundation bearing grade.
- Following evaluation of the subgrade by the geotechnical engineer, the exposed subgrade soils should be scarified, moisture conditioned to 2 to 4 percent above optimum, and recompacted. The resulting soils may be replaced as compacted structural fill.

Liquefaction

- Our site-specific liquefaction evaluation indicates that some of the on-site soils are subject to liquefaction during the design seismic event.
- The liquefaction analysis indicates total dynamic settlements on the order of 3.13 to 3.19± inches at Boring Nos. B-11 and B-12, respectively. The liquefaction-induced differential settlements within the building area are expected to be on the order of 1½± inches. Assuming that this settlement occurs across a distance of 50± feet, a maximum angular distortion of 0.0025± inches per inch would result.
- Standard practice dictates that the proposed building can be supported on a shallow foundation system, with the understanding that some cosmetic distress could occur due to liquefaction. Such distress will be typical of buildings of this type, in this area, in the event of a large earthquake.

Building Foundations

- Conventional shallow foundations, supported in newly placed compacted fill.
- 2,500 lbs/ft² maximum allowable soil bearing pressure.

- Reinforcement consisting of at least six (6) No. 5 rebars (3 top and 3 bottom) in strip footings due to the presence of potentially liquefiable soils. Additional reinforcement may be necessary for structural considerations.

Building Floor Slab

- Conventional Slab-on-Grade, 5 inches thick.
- Minimum reinforcement of the floor slab should consist of No. 3 bars at 18-inches on center in both directions, due to the presence of potentially liquefiable soils. The actual floor slab reinforcement should be determined by the structural engineer, based on the imposed slab loading.
- Modules of Subgrade Reaction: 150 psi/in

Pavements

ASPHALT PAVEMENTS (R = 50)					
Materials	Thickness (inches)				
	Parking Stalls (TI = 4.0)	Auto Drive Lanes (TI = 5.0)	Truck Traffic		
			(TI = 6.0)	(TI = 7.0)	(TI = 8.0)
Asphalt Concrete	3	3	3½	4	5
Aggregate Base	3	3	4	5	5
Compacted Subgrade	12	12	12	12	12

PORTLAND CEMENT CONCRETE PAVEMENTS			
Materials	Thickness (inches)		
	Autos Parking and Light Truck Traffic (TI = 5.0 & 6.0)	Truck Traffic	
		(TI = 7.0)	(TI = 8.0)
PCC	5	6	7
Compacted Subgrade (95% minimum compaction)	12	12	12

2.0 SCOPE OF SERVICES

The scope of services performed for this project was in accordance with our Proposal No. 15P356, dated August 25, 2015. The scope of services included a visual site reconnaissance, subsurface exploration, field and laboratory testing, and geotechnical engineering analysis to provide criteria for preparing the design of the building foundations, building floor slab, and parking lot pavements along with site preparation recommendations and construction considerations for the proposed development. Based on the location of the subject site, this investigation also included a site specific liquefaction evaluation. The evaluation of the environmental aspects of this site was beyond the scope of services for this geotechnical investigation.

3.0 SITE AND PROJECT DESCRIPTION

3.1 Site Conditions

The subject site is located on the north side of East Central Avenue, approximately 290 feet west of the intersection of East Central Avenue and South Waterman Avenue, at the street address of 270 East Central Avenue in San Bernardino, California. The site is bounded to the north by an existing commercial/industrial building, to the east by an office complex and self-storage facility, to the south by East Central Avenue, and to the west by a commercial/industrial building. The general location of the site is illustrated on the Site Location Map, included as Plate 1 in Appendix A of this report.

The site consists of a rectangular-shaped parcel, 5.24± acres in size. The site is currently vacant and undeveloped. The ground surface cover consists of exposed soil with moderate native grass and weed growth. Several trees and dense grass and weed growth are present along the southern property line.

Topographic information was not available at the time of this report. Based on visual observations made at the time of our subsurface investigation, the site topography dips gently downward to the west at an estimated gradient of less than 1 percent. There appears to be less than 4± feet of elevation differential across the subject site.

3.2 Proposed Development

Based on the overall site plan prepared by HPA Architecture, the site will be developed with one (1) commercial/industrial building. The building will occupy the majority of the site and will be 106,375± ft² in size. Dock high doors and a truck court will be constructed along the eastern side of the building. The building will be surrounded by asphaltic concrete pavements for parking and drive lanes and Portland cement concrete (PCC) in the truck court areas. Landscape planters will be located along the perimeter of the site and within the parking lot areas.

Detailed structural information was not available at the time. It is assumed that the new building will be concrete tilt-up construction, presumably supported on conventional shallow foundations and a concrete slab-on-grade floor. Based on the assumed construction, maximum column and wall loads are expected to be on the order of 100 kips and 3 to 4 kips per linear foot, respectively.

No significant amounts of below grade construction, such as basements or crawl spaces, are expected to be included in the proposed development. Based on the assumed topography, cuts and fills of up to 3 to 4± feet are expected to be necessary to achieve the proposed building pad grades.

3.3 Previous Studies

Southern California Geotechnical, Inc. (SCG) previously performed the referenced geotechnical investigation for the subject site, dated June 13, 2006. At the time of the referenced report, the proposed development comprised a total of ten (10) new commercial buildings ranging from 7,100± to 14,255± ft² in size. The referenced report was developed using the 1997 Uniform Building Code (UBC) and 2001 California Building Code (CBC). The results of the geotechnical investigation are documented in the referenced report.

During the subsurface exploration for this study, a total of ten (10) borings were drilled to depths of 10 to 50± feet below existing site grades. Artificial fill soils were encountered at most of the boring locations extending to depths up to 5± feet. The fill soils consisted of loose to medium dense silty fine sands and fine to medium sands. Native alluvium was encountered beneath the fill soils or at the ground surface at all of the boring locations. The native alluvium consisted of loose to medium dense silty fine sands and fine sandy silts extending to depths of 10± feet. At greater depths, the alluvium consisted of medium dense to dense sands with varying silt and gravel content, extending to the maximum depth explored of 50± feet. Groundwater was not encountered during the previous drilling operation and groundwater was considered to have been present at a depth in excess of 50± feet. However, the depth to the historic high groundwater in the area is 10± feet (Matti and Carson). The boring logs and some of the laboratory test results from the previous report are included in the Appendix G of this report.

4.0 SUBSURFACE EXPLORATION

4.1 Scope of Exploration/Sampling Methods

The subsurface exploration conducted for this project consisted of two (2) borings advanced to depths of 50± feet below currently existing site grades. Both of the borings were logged during drilling by a member of our staff. In addition, ten (10) borings were also performed at the subject site as part of the referenced geotechnical investigation.

The borings were advanced with hollow-stem augers, by a conventional truck-mounted drilling rig. Representative bulk and relatively undisturbed soil samples were taken during drilling. Relatively undisturbed soil samples were taken with a split barrel "California Sampler" containing a series of one inch long, 2.416± inch diameter brass rings. This sampling method is described in ASTM Test Method D-3550. In-situ samples were also taken using a 1.4± inch inside diameter split spoon sampler, in general accordance with ASTM D-1586. Both of these samplers are driven into the ground with successive blows of a 140-pound weight falling 30 inches. The blow counts obtained during driving are recorded for further analysis. Bulk samples were collected in plastic bags to retain their original moisture content. The relatively undisturbed ring samples were placed in molded plastic sleeves that were then sealed and transported to our laboratory.

The approximate locations of the borings are indicated on the Boring Location Plan, included as Plate 2 in Appendix A of this report. The Boring Logs, which illustrate the conditions encountered at the boring locations, as well as the results of some of the laboratory testing, are included in Appendix B. Boring logs for the referenced previous study are included in Appendix G.

4.2 Geotechnical Conditions

Alluvium

Native alluvial soils were encountered at the ground surface at both of the boring locations. The alluvium generally consists of loose to dense silty fine sands, fine to medium sands and fine sandy silts extending to the maximum depth explored of 50 feet. Boring No. B-11 encountered a layer of very dense fine to coarse sandy gravel between depths of 17 and 22± feet. Both borings also encountered layers of stiff to very stiff silty clays and clayey silts between depths of 24 and 32± feet.

Groundwater

Wet soils were encountered at Boring No. B-12 between depths of 33½ to 37± feet below existing site grades. However, samples taken below this depth possess a drier appearance without free water and samples obtained below 42± feet possess relatively low moisture contents. Therefore groundwater encountered between depths of 33½ to 37± feet is considered

to be perched groundwater. As previously mentioned, the historic high groundwater in the area (Matti and Carson) is 10± feet.

5.0 LABORATORY TESTING

The soil samples recovered from the subsurface exploration were returned to our laboratory for further testing to determine selected physical and engineering properties of the soils. The tests are briefly discussed below. It should be noted that the test results are specific to the actual samples tested, and variations could be expected at other locations and depths.

Classification

All recovered soil samples were classified using the Unified Soil Classification System (USCS), in accordance with ASTM D-2488. Field identifications were then supplemented with additional visual classifications and/or by laboratory testing. The USCS classifications are shown on the Boring Logs and are periodically referenced throughout this report.

Dry Density and Moisture Content

The density has been determined for selected relatively undisturbed ring samples. These densities were determined in general accordance with the method presented in ASTM D-2937. The results are recorded as dry unit weight in pounds per cubic foot. The moisture contents are determined in accordance with ASTM D-2216, and are expressed as a percentage of the dry weight. These test results are presented on the Boring Logs.

Consolidation

Selected soil samples have been tested to determine their consolidation potential, in accordance with ASTM D-2435. The testing apparatus is designed to accept either natural or remolded samples in a one-inch high ring, approximately 2.416 inches in diameter. Each sample is then loaded incrementally in a geometric progression and the resulting deflection is recorded at selected time intervals. Porous stones are in contact with the top and bottom of the sample to permit the addition or release of pore water. The samples are typically inundated with water at an intermediate load to determine their potential for collapse or heave. The results of the consolidation testing are plotted on Plates C-1 through C-4 in Appendix C of this report.

Grain Size Analysis

Limited grain size analyses have been performed on several selected samples, in accordance with ASTM D-1140. These samples were washed over a #200 sieve to determine the percentage of fine-grained material in each sample, which is defined as the material which passes the #200 sieve. The weight of the portion of the sample retained on each screen is recorded and the percentage finer or coarser of the total weight is calculated. The results of these laboratory tests are shown on the attached boring logs.

Atterberg Limits

Atterberg Limits testing (ASTM D-4318) was performed on selected samples of various soil strata encountered at the site. This test is used to determine the Liquid Limit and Plastic Limit of the

soil. The Plasticity Index is the difference between the two limits. Plasticity Index is a general indicator of the expansive potential of the soil, with higher numbers indicating higher expansive potential. Soils with a PI greater than 25 are considered to have a high plasticity, and a high expansion potential. Soils with a PI greater than 18 are not considered to be susceptible to liquefaction when the moisture content of the soil is less than 80 percent of the liquid limit. The results of the Atterberg Limits testing are presented on the boring logs.

Soluble Sulfates

Representative samples of the near-surface soils were submitted to a subcontracted analytical laboratory for determination of soluble sulfate content. Soluble sulfates are naturally present in soils, and if the concentration is high enough, can result in degradation of concrete which comes into contact with these soils. The results of the soluble sulfate testing are presented below, and are discussed further in a subsequent section of this report.

<u>Sample Identification</u>	<u>Soluble Sulfates (%)</u>	<u>ACI Classification</u>
B-11 @ 0 to 5 feet	0.002	Negligible
B-12 @ 0 to 5 feet	0.009	Negligible

Maximum Dry Density and Optimum Moisture Content

A representative bulk sample was tested for its maximum dry density and optimum moisture content. The results have been obtained using the Modified Proctor procedure, per ASTM D-1557. These tests are generally used to compare the in-situ densities of undisturbed field samples, and for later compaction testing. Additional testing of other soil type or soil mixes may be necessary at a later date. The results of the testing are plotted on Plate C-5 in Appendix C of this report.

6.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the results of our review, field exploration, laboratory testing and geotechnical analysis, the proposed development is considered feasible from a geotechnical standpoint. The recommendations contained in this report should be taken into the design, construction, and grading considerations. The recommendations are contingent upon all grading and foundation construction activities being monitored by the geotechnical engineer of record. The Grading Guide Specifications, included as Appendix D, should be considered part of this report, and should be incorporated into the project specifications. The contractor and/or owner of the development should bring to the attention of the geotechnical engineer any conditions that differ from those stated in this report, or which may be detrimental for the development.

6.1 Seismic Design Considerations

The subject site is located in an area which is subject to strong ground motions due to earthquakes. The performance of a site specific seismic hazards analysis was beyond the scope of this investigation. However, numerous faults capable of producing significant ground motions are located near the subject site. Due to economic considerations, it is not generally considered reasonable to design a structure that is not susceptible to earthquake damage. Therefore, significant damage to structures may be unavoidable during large earthquakes. The proposed structure should, however, be designed to resist structural collapse and thereby provide reasonable protection from serious injury, catastrophic property damage and loss of life.

Faulting and Seismicity

Research of available maps indicates that the subject site is not located within an Alquist-Priolo Earthquake Fault Zone. Therefore, the possibility of significant fault rupture on the site is considered to be low.

Seismic Design Parameters

The 2013 California Building Code (CBC) was adopted by all municipalities within Southern California on January 1, 2014. The CBC provides procedures for earthquake resistant structural design that include considerations for on-site soil conditions, occupancy, and the configuration of the structure including the structural system and height. The seismic design parameters presented below are based on the soil profile and the proximity of known faults with respect to the subject site.

The 2013 CBC Seismic Design Parameters have been generated using U.S. Seismic Design Maps, a web-based software application developed by the United States Geological Survey. This software application, available at the USGS web site, calculates seismic design parameters in accordance with the 2013 CBC, utilizing a database of deterministic site accelerations at 0.01 degree intervals. The table below is a compilation of the data provided by the USGS application. A copy of the output generated from this program is included as Plate E-1 in Appendix E of this report. A copy of the Design Response Spectrum, as generated by the USGS application is also

included in Appendix E. Based on this output, the following parameters may be utilized for the subject site:

2013 CBC SEISMIC DESIGN PARAMETERS

Parameter		Value
Mapped Spectral Acceleration at 0.2 sec Period	S_S	2.291
Mapped Spectral Acceleration at 1.0 sec Period	S_1	1.046
Site Class	---	F*
Site Modified Spectral Acceleration at 0.2 sec Period	S_{MS}	2.291
Site Modified Spectral Acceleration at 1.0 sec Period	S_{M1}	1.568
Design Spectral Acceleration at 0.2 sec Period	S_{DS}	1.527
Design Spectral Acceleration at 1.0 sec Period	S_{D1}	1.046

*The 2013 CBC requires that Site Class F be assigned to any profile containing soils vulnerable to potential failure or collapse under seismic loading, such as liquefiable soils. For Site Class F, the site coefficients are to be determined in accordance with Section 11.4.7 of ASCE 7-10. However, Section 20.3.1 of ASCE 7-10 indicates that for sites with structures having a fundamental period of vibration equal to or less than 0.5 seconds, the site coefficient factors (F_a and F_v) may be determined using the standard procedures. The seismic design parameters tabulated above were calculated using the site coefficient factors for Site Class D, assuming that the fundamental period of the structure is less than 0.5 seconds. However, the results of the liquefaction evaluation indicate that the subject site is underlain by potentially liquefiable soils. Therefore, if the proposed structure has a fundamental period greater than 0.5 seconds, a site specific seismic hazards analysis would be required and additional subsurface exploration would be necessary.

Ground Motion Parameters

For the purposes of the updated liquefaction analysis performed for this study, we utilized a site acceleration consistent with maximum considered earthquake ground motions, as required by the 2013 CBC. The peak ground acceleration (PGA) was determined in accordance with Section 11.8.3 of ASCE 7-10. The parameter PGA_M is the maximum considered earthquake geometric mean (MCE_G) PGA, multiplied by the appropriate site coefficient from Table 11.8-1 of ASCE 7-10. The web-based software application U.S. Seismic Design Maps (described in the previous section) was used to determine PGA_M , which is 0.882g. A portion of the program output is included as Plate 2 of this report. An associated earthquake magnitude was obtained from the 2008 USGS Interactive Deaggregation application available on the USGS website. The deaggregated modal magnitude is 7.6, based on the peak ground acceleration and NEHRP soil classification D.

Liquefaction

The California Geological Survey (CGS) has not yet conducted detailed seismic hazards mapping in the area of the subject site. The general liquefaction susceptibility of the site was determined by research of the San Bernardino County Official Land Use Plan, General Plan, Geologic Hazard Overlay. Map FH30C for the San Bernardino South Quadrangle indicates that the subject site is located within a zone of high liquefaction susceptibility. Therefore, the scope of this geotechnical investigation was expanded to include a site-specific liquefaction evaluation.

Liquefaction is the loss of strength in generally cohesionless, saturated soils when the pore-water pressure induced in the soil by a seismic event becomes equal to or exceeds the overburden pressure. The primary factors which influence the potential for liquefaction include

groundwater table elevation, soil type and plasticity characteristics, relative density of the soil, initial confining pressure, and intensity and duration of ground shaking. The depth within which the occurrence of liquefaction may impact surface improvements is generally identified as the upper 50 feet below the existing ground surface. Liquefaction potential is greater in saturated, loose, poorly graded fine sands with a mean (d_{50}) grain size in the range of 0.075 to 0.2 mm (Seed and Idriss, 1971). Non-sensitive clayey (cohesive) soils which possess a plasticity index of at least 18 (Bray and Sancio, 2006) are generally not considered to be susceptible to liquefaction, nor are those soils which are above the historic static groundwater table.

The liquefaction analysis was conducted in accordance with the requirements of Special Publication 117A (CDMG, 2008), and currently accepted practice (SCEC, 1997). The liquefaction potential of the subject site was evaluated using the empirical method developed by Boulanger and Idriss (Boulanger and Idriss, 2008). This method predicts the earthquake-induced liquefaction potential of the site based on a given design earthquake magnitude and peak ground acceleration at the subject site. This procedure essentially compares the cyclic resistance ratio (CRR) [the cyclic stress ratio required to induce liquefaction for a cohesionless soil stratum at a given depth] with the earthquake-induced cyclic stress ratio (CSR) at that depth from a specified design earthquake (defined by a peak ground surface acceleration and an associated earthquake moment magnitude). CRR is determined as a function of the corrected SPT N-value (N_1)_{60-cs}, adjusted for fines content. The factor of safety against liquefaction is defined as CRR/CSR. Based on Special Publication 117A, a factor of safety of at least 1.3 is required in order to demonstrate that a given soil stratum is non-liquefiable. Additionally, in accordance with Special Publication 117A, clayey soils which do not meet the criteria for liquefiable soils defined by Bray and Sancio (2006), loose soils with a plasticity index (PI) less than 12 and moisture content greater than 85% of the liquid limit, are considered to be insusceptible to liquefaction. Non-sensitive soils with a PI greater than 18 are also considered non-liquefiable.

As part of the liquefaction evaluation, Boring Nos. B-11 and B-12 were extended to depths of 50± feet. The historic high groundwater depth was obtained from Liquefaction Susceptibility in the San Bernardino Valley and Vicinity, Southern California-A Regional Evaluation, USGS Bulletin 1898 (Matti and Carson), which indicates a historic high groundwater depth at the subject site of approximately 10 feet. Therefore, the historic high groundwater table was considered to be 10 feet for the liquefaction evaluation.

The liquefaction analysis procedure is tabulated on the spreadsheet forms included in Appendix F of this report. The liquefaction potential of the site was analyzed utilizing a PGA_M of 0.882g for a magnitude 7.6 seismic event.

If liquefiable soils are identified, the potential settlements that could occur as a result of liquefaction are determined using the equation for volumetric strain due to post-cyclic reconsolidation (Yoshimine et. al, 2006). This procedure uses an empirical relationship between the induced cyclic shear strain and the corrected N-value to determine the expected volumetric strain of saturated sands subjected to earthquake shaking. This analysis is also documented on the spreadsheets included in Appendix F.

Conclusions and Recommendations

The results of the liquefaction analysis have identified potentially liquefiable soils at the site. Several potentially liquefiable strata are located at various depths between 9½ and 44½± feet at both borings. Soils which are located above the historic groundwater table, or possess factors of safety in excess of 1.3 are considered non-liquefiable. The silty clay and clayey silt strata encountered between depths of 27 to 32± feet at Boring No B-11 and at depths of 24 to 27 and 29 to 32± feet at Boring No. B-12 are considered non-liquefiable due to their cohesive characteristics and the results of the Atterberg limits testing with respect to the criteria of Bray and Sancio (2006). Settlement analyses were conducted for each of the potentially liquefiable strata.

Based on the settlement analysis (also tabulated on the spreadsheets in Appendix F) total dynamic (liquefaction induced) settlements of 3.13 to 3.19± inches are expected at Boring Nos. B-11 and B-12, respectively, during the design level earthquake. Based on similar settlements at both boring locations, the site is generally expected to settle somewhat uniformly during a liquefaction inducing seismic event. However, based on standard engineering practice, differential settlements of up to 1½± inches should be considered at the site. The estimated differential settlement could be assumed to occur across a distance of 50 feet, indicating a maximum angular distortion of approximately 0.0025 inches per inch. These settlements are considered to be within the structural tolerances of a typical building supported on a shallow foundation system. However, it should be noted that minor to moderate repairs, including repair of damaged drywall and stucco, etc., could be required after the occurrence of liquefaction-induced settlements.

The use of a shallow foundation system, as described in this report, is typical for buildings of this type, where they are underlain by the extent of liquefiable soils encountered at this site. The post-liquefaction damage that could occur within the building proposed for this site will also be typical of similar buildings in the vicinity of this project. However, if the owner determines that this level of potential damage is not acceptable, other geotechnical and structural options are available, including the use of ground improvement, deep foundations or a mat foundation.

6.2 Geotechnical Design Considerations

General

The near surface soils consist of artificial fill materials and native alluvial soils. Artificial fill materials extend to depths of 2½ to 5± feet at the boring locations. The near-surface fill and alluvium possess variable strengths and densities and are therefore not considered suitable for support of the proposed structure in their current state. Additionally, based on the results of consolidation/collapse testing, the undocumented fill soils possess a moderate potential for collapse. Based on these conditions, remedial grading is considered warranted within the proposed building area in order to remove the artificial fill in its entirety and replace the upper portion of the alluvial soils as compacted structural fill.

As discussed in a previous section of this report, potentially liquefiable soils were identified at this site. The presence of the recommended layer of newly placed compacted structural fill above these liquefiable soils will help to reduce surface manifestations that could occur as a result of liquefaction. The foundation design recommendations presented in the subsequent sections of this report also contain recommendations to provide additional rigidity in order to reduce the potential effects of differential settlement that could occur as a result of liquefaction.

Settlement

The recommended remedial grading will remove the collapsible, variable density, undocumented fill soils and a portion of the near-surface variable strength alluvial soils. These materials will be replaced as compacted structural fill. The native soils that will remain in place below the recommended depth of overexcavation generally possess favorable consolidation characteristics and will not be subject to significant load increases from the foundations of the new structure. Provided that the recommended remedial grading is completed, the post-construction static settlement of the proposed structure is expected to be within tolerable limits.

Expansion

The results of expansion index testing indicates that the near-surface soils possess a very low expansion potential ($EI = 0$). Based on these test results, no design considerations related to expansive soils are considered warranted for this site. All imported fill soils should have very low expansive characteristics.

Soluble Sulfates

The results of the soluble sulfate testing indicate that the selected samples of the on-site soils contain negligible concentrations of soluble sulfates, in accordance with American Concrete Institute (ACI) guidelines. Therefore, specialized concrete mix designs are not considered to be necessary, with regard to sulfate protection purposes. It is, however, recommended that additional soluble sulfate testing be conducted at the completion of rough grading to verify the soluble sulfate concentrations of the soils which are present at pad grade within the building area.

Shrinkage/Subsidence

Removal and recompaction of the near surface native soils is estimated to result in an average shrinkage of 10 to 15 percent. Minor ground subsidence is expected to occur in the soils below the zone of removal, due to settlement and machinery working. The subsidence is estimated to be $0.1 \pm$ feet. This estimate may be used for grading in areas that are underlain by native alluvial soils.

These estimates are based on previous experience and the subsurface conditions encountered at the boring locations. The actual amount of subsidence is expected to be variable and will be dependant on the type of machinery used, repetitions of use, and dynamic effects, all of which are difficult to assess precisely.

Grading and Foundation Plan Review

Grading and foundation plans were not available at the time of this report. It is therefore recommended that we be provided with copies of the preliminary grading and foundation plans, when they become available, for review with regard to the conclusions, recommendations, and assumptions contained within this report.

6.3 Site Grading Recommendations

The grading recommendations presented below are based on the subsurface conditions encountered at the boring locations and our understanding of the proposed development. We recommend that all grading activities be completed in accordance with the Grading Guide Specifications included as Appendix D of this report, unless superseded by site-specific recommendations presented below.

Site Stripping

Initial site stripping should include removal of any surficial vegetation. This should include any weeds, grasses, shrubs, and trees. Root balls associated with the trees should be removed in their entirety, and the resultant excavation should be backfilled with compacted structural fill soils. The actual extent of site stripping should be determined in the field by the geotechnical engineer, based on the organic content and stability of the materials encountered.

Treatment of Existing Soils: Building Pad

Remedial grading should be performed within the proposed building area in order to remove the artificial fill materials and the upper portion of the alluvial soils. Based on conditions encountered at the boring locations, the existing soils within the proposed building area are recommended to be overexcavated to a depth of at least 5 feet below the proposed building pad subgrade elevation and to a depth of at least 5 feet below existing grade, whichever is greater. The depth of the overexcavation should also extend to a depth sufficient to remove all artificial fill soils. Within the influence zones of the new foundations, the overexcavation should extend to a depth of at least 3 feet below proposed foundation bearing grade.

The overexcavation areas should extend at least 5 feet beyond the building perimeter and foundations, and to an extent equal to the depth of fill below the new foundations. If the proposed structure incorporates any exterior columns (such as for a canopy or overhang) the overexcavation should also encompass these areas.

Following completion of the overexcavation, the subgrade soils within the building area should be evaluated by the geotechnical engineer to verify their suitability to serve as the structural fill subgrade, as well as to support the foundation loads of the new structure. This evaluation should include proofrolling and probing to identify any soft, loose or otherwise unstable soils that must be removed. Some localized areas of deeper excavation may be required if additional fill materials or loose, porous, or low density native soils are encountered at the base of the overexcavation.

A zone of moist to very moist silty clay and clayey silt was encountered at Boring No. B-9, at depths of 6½ to 8½ feet. Similar soils may be present at other locations that were not explored by the borings. If these soils are exposed during grading, some subgrade instability may result. Drying of these soils may be feasible, if grading occurs during a period of relatively dry weather. If not, additional overexcavation and/or stabilization may be required.

After a suitable overexcavation subgrade has been achieved, the exposed soils should be scarified to a depth of at least 12 inches, moisture treated to 2 percent above optimum moisture content. The subgrade soils should then be recompacted to at least 90 percent of the ASTM D-1557 maximum dry density. The previously excavated soils may then be replaced as compacted structural fill.

Treatment of Existing Soils: Retaining Walls and Site Walls

The existing soils within the areas of any proposed retaining and site walls should be overexcavated to a depth of 2 feet below foundation bearing grade and replaced as compacted structural fill as discussed above for the proposed building pad. Any undocumented fill soils within any of these foundation areas should be removed in their entirety. The overexcavation subgrade soils should be evaluated by the geotechnical engineer prior to scarifying, moisture conditioning, and recompacting the upper 12 inches of exposed subgrade soils, as discussed for the building areas. The previously excavated soils may then be replaced as compacted structural fill.

Treatment of Existing Soils: Parking and Drive Areas

Based on economic considerations, overexcavation of the existing soils in the new parking and drive areas is not considered warranted, with the exception of areas where lower strength, or unstable, soils are identified by the geotechnical engineer during grading. Subgrade preparation in the new parking and drive areas should initially consist of removal of all soils disturbed during stripping and demolition operations.

The geotechnical engineer should then evaluate the subgrade to identify any areas of additional unsuitable soils. Any such materials should be removed to a level of firm and unyielding soil. The exposed subgrade soils should then be scarified to a depth of 12± inches, moisture conditioned to at least 2 to 4 percent above the optimum moisture content, and recompacted to at least 90 percent of the ASTM D-1557 maximum dry density. Based on the presence of variable strength surficial soils throughout the site, it is expected that some isolated areas of additional overexcavation may be required to remove zones of lower strength, unsuitable soils.

The grading recommendations presented above for the proposed parking area assume that the owner and/or developer can tolerate minor amounts of settlement within the proposed parking areas. The grading recommendations presented above do not completely mitigate the extent of undocumented fill soils or collapsible native alluvium in the parking areas. As such, settlement and associated pavement distress could occur. Typically, repair of such distressed areas involves significantly lower costs than completely mitigating these soils at the time of construction. If the owner cannot tolerate the risk of such settlements, the parking area should be graded in a manner similar to that described for the building area.

Fill Placement

- Fill soils should be placed in thin (6± inches), near-horizontal lifts, moisture conditioned to 2 to 4 percent above the optimum moisture content, and compacted.
- On-site soils may be used for fill provided they are cleaned of any debris to the satisfaction of the geotechnical engineer.
- All grading and fill placement activities should be completed in accordance with the requirements of the 2013 CBC and the grading code of the City of San Bernardino.
- All fill soils should be compacted to at least 90 percent of the ASTM D-1557 maximum dry density. Fill soils should be well mixed.
- Compaction tests should be performed periodically by the geotechnical engineer as random verification of compaction and moisture content. These tests are intended to aid the contractor. Since the tests are taken at discrete locations and depths, they may not be indicative of the entire fill and therefore should not relieve the contractor of his responsibility to meet the job specifications.

Imported Structural Fill

All imported structural fill should consist of very low expansive ($EI < 20$), well graded soils possessing at least 10 percent fines (that portion of the sample passing the No. 200 sieve). Additional specifications for structural fill are presented in the Grading Guide Specifications, included as Appendix D.

Utility Trench Backfill

In general, all utility trench backfill soils should be compacted to at least 90 percent of the ASTM D-1557 maximum dry density. As an alternative, a clean sand (minimum Sand Equivalent of 30) may be placed within trenches and compacted in place (jetting or flooding is not recommended). It is recommended that materials in excess of 3 inches in size not be used for utility trench backfill. Compacted trench backfill should conform to the requirements of the local grading code, and more restrictive requirements may be indicated by City of San Bernardino. All utility trench backfills should be witnessed by the geotechnical engineer. The trench backfill soils should be compaction tested where possible; probed and visually evaluated elsewhere.

Utility trenches which parallel a footing, and extending below a 1h:1v plane projected from the outside edge of the footing should be backfilled with structural fill soils, compacted to at least 90 percent of the ASTM D-1557 standard. Pea gravel backfill should not be used for these trenches.

6.4 Construction Considerations

Excavation Considerations

The near surface soils generally consist of fine sands and silty sands. These materials will likely be subject to caving within shallow excavations. Where caving occurs within shallow excavations, flattened excavation slopes may be sufficient to provide excavation stability. On a preliminary basis, the inclination of temporary slopes should not exceed 2h:1v. Deeper

excavations may require some form of external stabilization such as shoring or bracing. Maintaining adequate moisture content within the near-surface soils will improve excavation stability. All excavation activities on this site should be conducted in accordance with Cal-OSHA regulations.

Groundwater

The static groundwater table at this site is considered to be present at a depth in excess of 50± feet and perched groundwater was present at depths greater than 32± feet. Therefore, groundwater is not expected to impact the grading or foundation construction activities.

6.5 Foundation Design and Construction

Based on the preceding grading recommendations, it is assumed that the new building pad will be underlain by structural fill soils used to replace existing fill and near surface alluvial soils. These new structural fill soils are expected to extend to depths of at least 3 feet below proposed foundation bearing grade, underlain by 1± foot of additional soil that has been densified and moisture conditioned in place. Based on this subsurface profile, the proposed structure may be supported on shallow foundations.

Foundation Design Parameters

New square and rectangular footings may be designed as follows:

- Maximum, net allowable soil bearing pressure: 2,500 lbs/ft².
- Minimum wall/column footing width: 14 inches/24 inches.
- Minimum longitudinal steel reinforcement within strip footings: Six (6) No. 5 rebars (3 top and 3 bottom) in strip footings, due to the presence of potentially liquefiable soils.
- Minimum foundation embedment: 12 inches into suitable structural fill soils, and at least 18 inches below adjacent exterior grade. Interior column footings may be placed immediately beneath the floor slab.
- It is recommended that the perimeter building foundations be continuous across all exterior doorways. Any flatwork adjacent to the exterior doors should be doweled into the perimeter foundations in a manner determined by the structural engineer.

The allowable bearing pressures presented above may be increased by 1/3 when considering short duration wind or seismic loads. The minimum steel reinforcement recommended above is based on standard geotechnical practice. Additional rigidity may be necessary for structural considerations, or to resist the effects of the liquefaction-induced differential settlements, as discussed in Section 6.1. The actual design of the foundations should be determined by the structural engineer.

Foundation Construction

The foundation subgrade soils should be evaluated at the time of overexcavation, as discussed in Section 6.3 of this report. It is further recommended that the foundation subgrade soils be evaluated by the geotechnical engineer immediately prior to steel or concrete placement. Soils suitable for direct foundation support should consist of newly placed structural fill, compacted to at least 90 percent of the ASTM D-1557 maximum dry density. Any unsuitable materials should be removed to a depth of suitable bearing compacted structural fill, with the resulting excavations backfilled with compacted fill soils. As an alternative, lean concrete slurry (500 to 1,500 psi) may be used to backfill such isolated overexcavations.

The foundation subgrade soils should also be properly moisture conditioned to 2 to 4 percent above the Modified Proctor optimum, to a depth of at least 12 inches below bearing grade. Since it is typically not feasible to increase the moisture content of the floor slab and foundation subgrade soils once rough grading has been completed, care should be taken to maintain the moisture content of the building pad subgrade soils throughout the construction process.

Estimated Foundation Settlements

Post-construction total and differential settlements of shallow foundations designed and constructed in accordance with the previously presented recommendations are estimated to be less than 1.0 and 0.5 inches, respectively. Differential movements are expected to occur over a 30-foot span, thereby resulting in an angular distortion of less than 0.002 inches per inch. These settlements are in addition to the liquefaction-induced settlements previously discussed in Section 6.1 of this report. However, the likelihood of these two settlements combining is considered remote. The static settlements are expected to occur in a relatively short period of time after the building loads being applied to the foundations, during and immediately subsequent to construction. It should be noted that the projected potential dynamic settlement is related to a major seismic event and a conservative historic high groundwater level.

Lateral Load Resistance

Lateral load resistance will be developed by a combination of friction acting at the base of foundations and slabs and the passive earth pressure developed by footings below grade. The following friction and passive pressure may be used to resist lateral forces:

- Passive Earth Pressure: 300 lbs/ft³
- Friction Coefficient: 0.30

These are allowable values, and include a factor of safety. When combining friction and passive resistance, the passive pressure component should be reduced by one-third. These values assume that footings will be poured directly against compacted structural fill. The maximum allowable passive pressure is 2500 lbs/ft².

6.6 Floor Slab Design and Construction

Subgrades which will support new floor slabs should be prepared in accordance with the recommendations contained in the ***Site Grading Recommendations*** section of this report. Based on the anticipated grading which will occur at this site, the floor of the new structure may be constructed as a conventional slab-on-grade supported on newly placed structural fill, extending to a depth of at least 5 feet below proposed finished pad grade. Based on geotechnical considerations, the floor slab may be designed as follows:

- Minimum slab thickness: 6 inches.
- Modulus of Subgrade Reaction: $k = 150$ psi/in.
- Minimum slab reinforcement: Minimum slab reinforcement: No. 3 bars at 18 inches on-center, in both directions, due to the liquefaction potential of the encountered soils. The actual floor slab reinforcement should be determined by the structural engineer, based on the imposed loading.
- Slab underlayment: A moisture vapor barrier should be constructed below the entire slab area of the proposed building. The moisture vapor barrier should meet or exceed the Class A rating as defined by ASTM E 1745-97 and have a permeance rating less than 0.01 perms as described in ASTM E 96-95 and ASTM E 154-88. The moisture vapor barrier should be properly constructed in accordance with all applicable manufacturer specifications. Given that a rock free subgrade is anticipated and that a capillary break is not required, sand below the barrier is not required. The need for sand and/or the amount of sand above the moisture vapor barrier should be specified by the structural engineer or concrete contractor. The selection of sand above the barrier is not a geotechnical engineering issue and hence outside our purview.
- Moisture condition the floor slab subgrade soils to 2 to 4 percent above the Modified Proctor optimum moisture content, to a depth of 12 inches. The moisture content of the floor slab subgrade soils should be verified by the geotechnical engineer within 24 hours prior to concrete placement.
- Proper concrete curing techniques should be utilized to reduce the potential for slab curling or the formation of excessive shrinkage cracks.

The actual design of the floor slab should be completed by the structural engineer to verify adequate thickness and reinforcement. The steel reinforcement recommendations presented above are based on standard geotechnical practice, given the magnitude of predicted liquefaction-induced settlements, and the structure type proposed for the site. Additional rigidity may be necessary for structural considerations, or to resist the effects of the liquefaction-induced differential settlements discussed in Section 6.1.

6.7 Retaining Wall Design and Construction

Although not indicated on the site plan, the proposed development may require some small retaining walls (less than 5± feet in height) to facilitate the new site grades and in loading dock areas.

Retaining Wall Design Parameters

Based on the soil conditions encountered at the boring locations, the following parameters may be used in the design of new retaining walls for this site. We have provided parameters assuming the use of on-site soils for retaining wall backfill. The near surface soils generally consist of fine sands and silty fine sands. Based on their classifications, the sand and silty sand materials are expected to possess a friction angle of at least 30 degrees when compacted to 90 percent of the ASTM-1557 maximum dry density.

If desired, SCG could provide design parameters for an alternative select backfill material behind the retaining walls. The use of select backfill material could result in lower lateral earth pressures. In order to use the design parameters for the imported select fill, this material must be placed within the entire active failure wedge. This wedge is defined as extending from the heel of the retaining wall upwards at an angle of approximately 60° from horizontal. If select backfill material behind the retaining wall is desired, SCG should be contacted for supplementary recommendations.

RETAINING WALL DESIGN PARAMETERS

Design Parameter		Soil Type
		On-Site Sands and Silty Sands
Internal Friction Angle (ϕ)		30°
Unit Weight		120 lbs/ft ³
Equivalent Fluid Pressure:	Active Condition (level backfill)	40 lbs/ft ³
	Active Condition (2h:1v backfill)	65 lbs/ft ³
	At-Rest Condition (level backfill)	60 lbs/ft ³

Regardless of the backfill type, the walls should be designed using a soil-footing coefficient of friction of 0.30 and an equivalent passive pressure of 300 lbs/ft³. The structural engineer should incorporate appropriate factors of safety in the design of the retaining walls.

The active earth pressure may be used for the design of retaining walls that do not directly support structures or support soils that in turn support structures and which will be allowed to deflect. The at-rest earth pressure should be used for walls that will not be allowed to deflect such as those which will support foundation bearing soils, or which will support foundation loads directly.

Where the soils on the toe side of the retaining wall are not covered by a "hard" surface such as a structure or pavement, the upper 1 foot of soil should be neglected when calculating passive resistance due to the potential for the material to become disturbed or degraded during the life of the structure.

Seismic Lateral Earth Pressures

In accordance with the 2013 CBC, any retaining walls more than 6 feet in height must be designed for seismic lateral earth pressures. If walls 6 feet or more are required for this site, the geotechnical engineer should be contacted for supplementary seismic lateral earth pressure recommendations.

Retaining Wall Foundation Design

The retaining wall foundations should be supported within newly placed compacted structural fill, extending to a depth of at least 2 feet below the proposed bearing grade. Foundations to support new retaining walls should be designed in accordance with the general Foundation Design Parameters presented in a previous section of this report.

Backfill Material

On-site soils may be used to backfill the retaining walls. However, all backfill material placed within 3 feet of the back wall face should have a particle size no greater than 3 inches. The retaining wall backfill materials should be well graded.

It is recommended that a properly installed prefabricated drainage composite such as the MiraDRAIN 6000XL (or approved equivalent), which is specifically designed for use behind retaining walls be used. If the drainage composite material is not covered by an impermeable surface, such as a structure or pavement, a 12-inch thick layer of a low permeability soil should be placed over the backfill to reduce surface water migration to the underlying soils. The drainage composite should be separated from the backfill soils by a suitable geotextile, approved by the geotechnical engineer.

All retaining wall backfill should be placed and compacted under engineering controlled conditions in the necessary layer thicknesses to ensure an in-place density between 90 and 93 percent of the maximum dry density as determined by the Modified Proctor test (ASTM D1557). Care should be taken to avoid over-compaction of the soils behind the retaining walls, and the use of heavy compaction equipment should be avoided.

Subsurface Drainage

As previously indicated, the retaining wall design parameters are based upon drained backfill conditions. Consequently, some form of permanent drainage system will be necessary in conjunction with the appropriate backfill material. Subsurface drainage may consist of either:

- A weep hole drainage system typically consisting of a series of 4-inch diameter holes in the wall situated slightly above the ground surface elevation on the exposed side of the wall and at an approximate 8-foot on-center spacing. The weep holes should

include a one cubic foot gravel pocket surrounded by a suitable geotextile at each weep hole location.

- A 4-inch diameter perforated pipe surrounded by 2 cubic feet of gravel per linear foot of drain placed behind the wall, above the retaining wall footing. The gravel layer should be wrapped in a suitable geotextile fabric to reduce the potential for migration of fines. The footing drain should be extended to daylight or tied into a storm drainage system.

6.8 Pavement Design Parameters

Site preparation in the pavement area should be completed as previously recommended in the ***Site Grading Recommendations*** section of this report. The subsequent pavement recommendations assume proper drainage and construction monitoring, and are based on either PCA or CALTRANS design parameters for a twenty (20) year design period. However, these designs also assume a routine pavement maintenance program to obtain the anticipated 20-year pavement service life.

Pavement Subgrades

It is anticipated that the new pavements will be primarily supported on a layer of compacted structural fill, consisting of scarified, thoroughly moisture conditioned and recompacted existing soils. The near-surface soils generally consist of silty sands and fine sands. These soils are considered to possess good pavement support characteristics with estimated R-values of 50 to 60. Since R-value testing was not included in the scope of services for this project, the subsequent pavement design is based upon a conservatively assumed R-value of 50. Any fill material imported to the site should have support characteristics equal to or greater than that of the on-site soils and be placed and compacted under engineering controlled conditions. It is recommended that R-value testing be performed after completion of rough grading. Depending upon the results of the R-value testing, it may be feasible to use thinner pavement sections in some areas of the site.

Asphaltic Concrete

Presented below are the recommended thicknesses for new flexible pavement structures consisting of asphaltic concrete over a granular base. The pavement designs are based on the traffic indices (TI's) indicated. The client and/or civil engineer should verify that these TI's are representative of the anticipated traffic volumes. If the client and/or civil engineer determine that the expected traffic volume will exceed the applicable traffic index, we should be contacted for supplementary recommendations. The design traffic indices equate to the following approximate daily traffic volumes over a 20 year design life, assuming six operational traffic days per week.

Traffic Index	No. of Heavy Trucks per Day
4.0	0
5.0	1
6.0	3
7.0	11
8.0	35

For the purpose of the traffic volumes indicated above, a truck is defined as a 5-axle tractor trailer unit with one 8-kip axle and two 32-kip tandem axles. All of the traffic indices allow for 1,000 automobiles per day.

ASPHALT PAVEMENTS (R = 50)					
Materials	Thickness (inches)				
	Parking Stalls (TI = 4.0)	Auto Drive Lanes (TI = 5.0)	Truck Traffic		
			(TI = 6.0)	(TI = 7.0)	(TI = 8.0)
Asphalt Concrete	3	3	3½	4	5
Aggregate Base	3	3	4	5	5
Compacted Subgrade	12	12	12	12	12

The aggregate base course should be compacted to at least 95 percent of the ASTM D-1557 maximum dry density. The asphaltic concrete should be compacted to at least 95 percent of the Marshall maximum density, as determined by ASTM D-2726. The aggregate base course may consist of crushed aggregate base (CAB) or crushed miscellaneous base (CMB), which is a recycled gravel, asphalt and concrete material. The gradation, R-Value, Sand Equivalent, and Percentage Wear of the CAB or CMB should comply with appropriate specifications contained in the current edition of the "Greenbook" Standard Specifications for Public Works Construction.

Portland Cement Concrete

The preparation of the subgrade soils within concrete pavement areas should be performed as previously described for proposed asphalt pavement areas. The minimum recommended thicknesses for the Portland Cement Concrete pavement sections are as follows:

PORTLAND CEMENT CONCRETE PAVEMENTS			
Materials	Thickness (inches)		
	Autos Parking and Light Truck Traffic (TI = 5.0 & 6.0)	Truck Traffic	
		(TI = 7.0)	(TI = 8.0)
PCC	5	6	7
Compacted Subgrade (95% minimum compaction)	12	12	12

The concrete should have a 28-day compressive strength of at least 3,000 psi. The maximum joint spacing within all of the PCC pavements is recommended to be equal to or less than 30 times the pavement thickness.

7.0 GENERAL COMMENTS

This report has been prepared as an instrument of service for use by the client, in order to aid in the evaluation of this property and to assist the architects and engineers in the design and preparation of the project plans and specifications. This report may be provided to the contractor(s) and other design consultants to disclose information relative to the project. However, this report is not intended to be utilized as a specification in and of itself, without appropriate interpretation by the project architect, civil engineer, and/or structural engineer. The reproduction and distribution of this report must be authorized by the client and Southern California Geotechnical, Inc. Furthermore, any reliance on this report by an unauthorized third party is at such party's sole risk, and we accept no responsibility for damage or loss which may occur. The client(s)' reliance upon this report is subject to the Engineering Services Agreement, incorporated into our proposal for this project.

The analysis of this site was based on a subsurface profile interpolated from limited discrete soil samples. While the materials encountered in the project area are considered to be representative of the total area, some variations should be expected between boring locations and sample depths. If the conditions encountered during construction vary significantly from those detailed herein, we should be contacted immediately to determine if the conditions alter the recommendations contained herein.

This report has been based on assumed or provided characteristics of the proposed development. It is recommended that the owner, client, architect, structural engineer, and civil engineer carefully review these assumptions to ensure that they are consistent with the characteristics of the proposed development. If discrepancies exist, they should be brought to our attention to verify that they do not affect the conclusions and recommendations contained herein. We also recommend that the project plans and specifications be submitted to our office for review to verify that our recommendations have been correctly interpreted.

The analysis, conclusions, and recommendations contained within this report have been promulgated in accordance with generally accepted professional geotechnical engineering practice. No other warranty is implied or expressed.

8.0 REFERENCES

Blake, Thomas F., FRISKSP, A Computer Program for the Probabilistic Estimation of Peak Acceleration and Uniform Hazard Spectra Using 3-D Faults as Earthquake Sources, Version 4.00, 2000.

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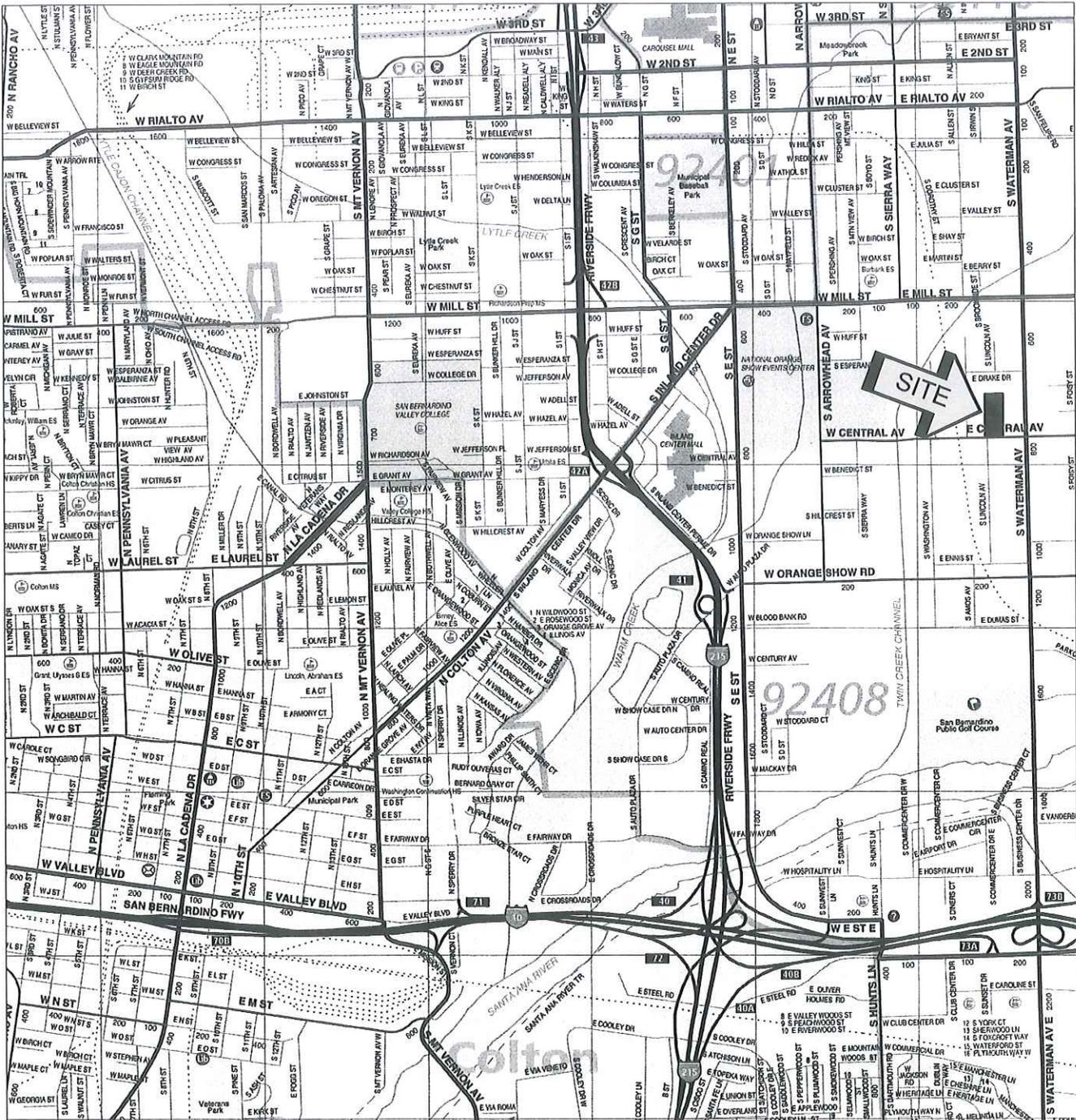
Southern California Earthquake Center (SCEC), University of Southern California, "Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Liquefaction in California," Committee formed 1997.

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Youd, T. L. and Idriss, I. M. (Editors), "Proceedings of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils," Salt Lake City, UT, January 5-6 1996, NCEER Technical Report NCEER-97-0022, Buffalo, NY.

APPENDIX A



SOURCE: SAN BERNARDINO COUNTY
THOMAS GUIDE, 2013

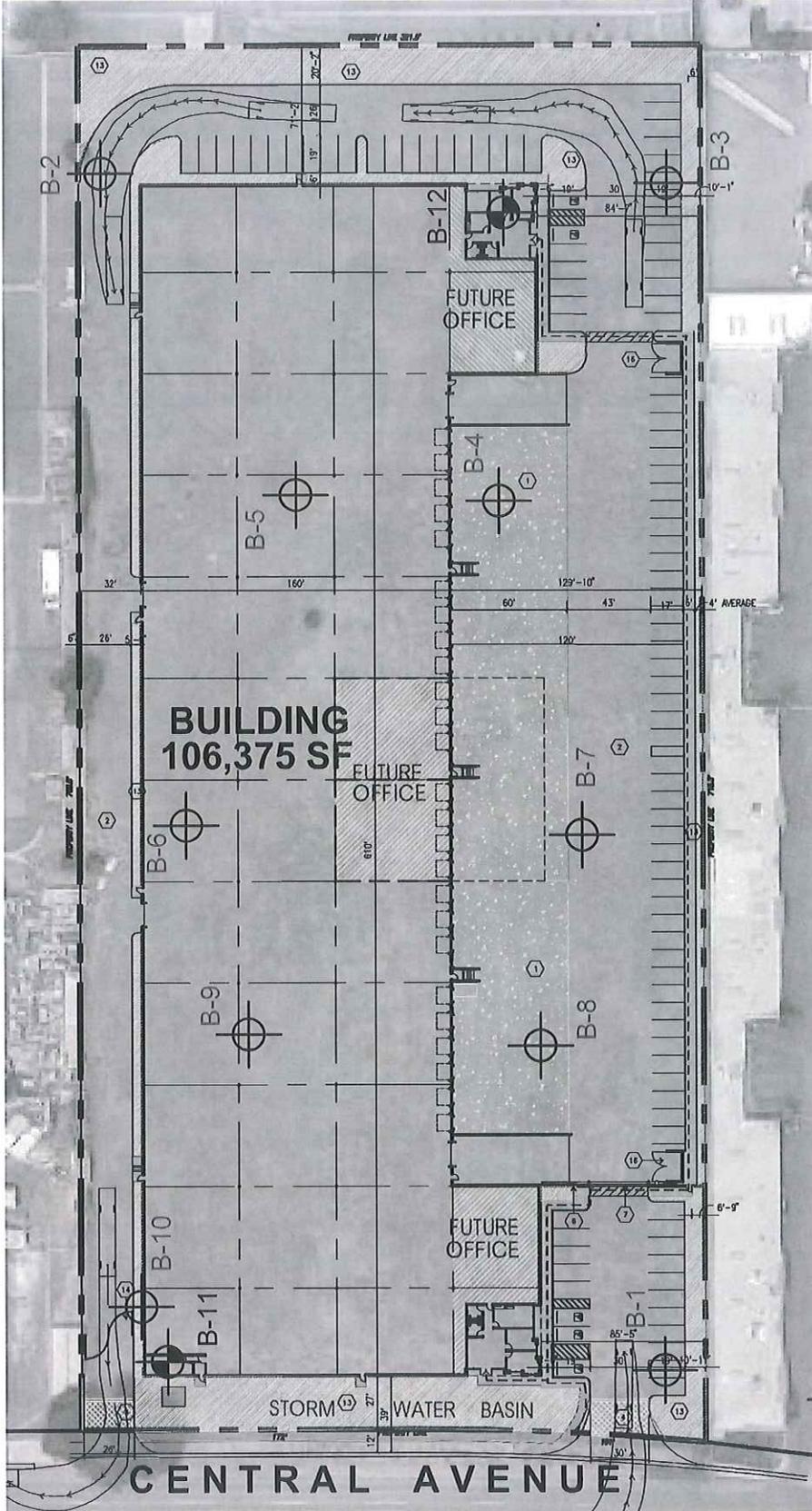


SITE LOCATION MAP
PROPOSED COMMERCIAL/INDUSTRIAL BUILDING
SAN BERNARDINO, CALIFORNIA

SCALE: 1" = 2400'
 DRAWN: MRM
 CHKD: JAS
 SCG PROJECT
 15G190-1
 PLATE 1



SOUTHERN CALIFORNIA GEOTECHNICAL



GEOTECHNICAL LEGEND

- APPROXIMATE BORING LOCATION
- APPROXIMATE BORING LOCATION FROM PREVIOUS STUDY (SCG PROJECT NO. 06G181-1)

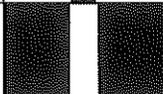
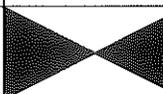
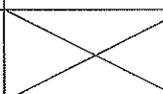


NOTE: BASE SITE MAP PREPARED BY HPA ARCHITECTURE.

BORING LOCATION PLAN	
PROPOSED COMMERCIAL/INDUSTRIAL BUILDING SAN BERNARDINO, CALIFORNIA	
SCALE: 1" = 60'	 SOUTHERN CALIFORNIA GEOTECHNICAL
DRAWN: MRM	
CHKD: JAS	
SCG PROJECT 155325-1	
PLATE 2	

APPENDIX B

BORING LOG LEGEND

SAMPLE TYPE	GRAPHICAL SYMBOL	SAMPLE DESCRIPTION
AUGER		SAMPLE COLLECTED FROM AUGER CUTTINGS, NO FIELD MEASUREMENT OF SOIL STRENGTH. (DISTURBED)
CORE		ROCK CORE SAMPLE: TYPICALLY TAKEN WITH A DIAMOND-TIPPED CORE BARREL. TYPICALLY USED ONLY IN HIGHLY CONSOLIDATED BEDROCK.
GRAB		SOIL SAMPLE TAKEN WITH NO SPECIALIZED EQUIPMENT, SUCH AS FROM A STOCKPILE OR THE GROUND SURFACE. (DISTURBED)
CS		CALIFORNIA SAMPLER: 2-1/2 INCH I.D. SPLIT BARREL SAMPLER, LINED WITH 1-INCH HIGH BRASS RINGS. DRIVEN WITH SPT HAMMER. (RELATIVELY UNDISTURBED)
NSR		NO RECOVERY: THE SAMPLING ATTEMPT DID NOT RESULT IN RECOVERY OF ANY SIGNIFICANT SOIL OR ROCK MATERIAL.
SPT		STANDARD PENETRATION TEST: SAMPLER IS A 1.4 INCH INSIDE DIAMETER SPLIT BARREL, DRIVEN 18 INCHES WITH THE SPT HAMMER. (DISTURBED)
SH		SHELBY TUBE: TAKEN WITH A THIN WALL SAMPLE TUBE, PUSHED INTO THE SOIL AND THEN EXTRACTED. (UNDISTURBED)
VANE		VANE SHEAR TEST: SOIL STRENGTH OBTAINED USING A 4 BLADED SHEAR DEVICE. TYPICALLY USED IN SOFT CLAYS-NO SAMPLE RECOVERED.

COLUMN DESCRIPTIONS

- DEPTH:** Distance in feet below the ground surface.
- SAMPLE:** Sample Type as depicted above.
- BLOW COUNT:** Number of blows required to advance the sampler 12 inches using a 140 lb hammer with a 30-inch drop. 50/3" indicates penetration refusal (>50 blows) at 3 inches. WH indicates that the weight of the hammer was sufficient to push the sampler 6 inches or more.
- POCKET PEN.:** Approximate shear strength of a cohesive soil sample as measured by pocket penetrometer.
- GRAPHIC LOG:** Graphic Soil Symbol as depicted on the following page.
- DRY DENSITY:** Dry density of an undisturbed or relatively undisturbed sample in lbs/ft³.
- MOISTURE CONTENT:** Moisture content of a soil sample, expressed as a percentage of the dry weight.
- LIQUID LIMIT:** The moisture content above which a soil behaves as a liquid.
- PLASTIC LIMIT:** The moisture content above which a soil behaves as a plastic.
- PASSING #200 SIEVE:** The percentage of the sample finer than the #200 standard sieve.
- UNCONFINED SHEAR:** The shear strength of a cohesive soil sample, as measured in the unconfined state.

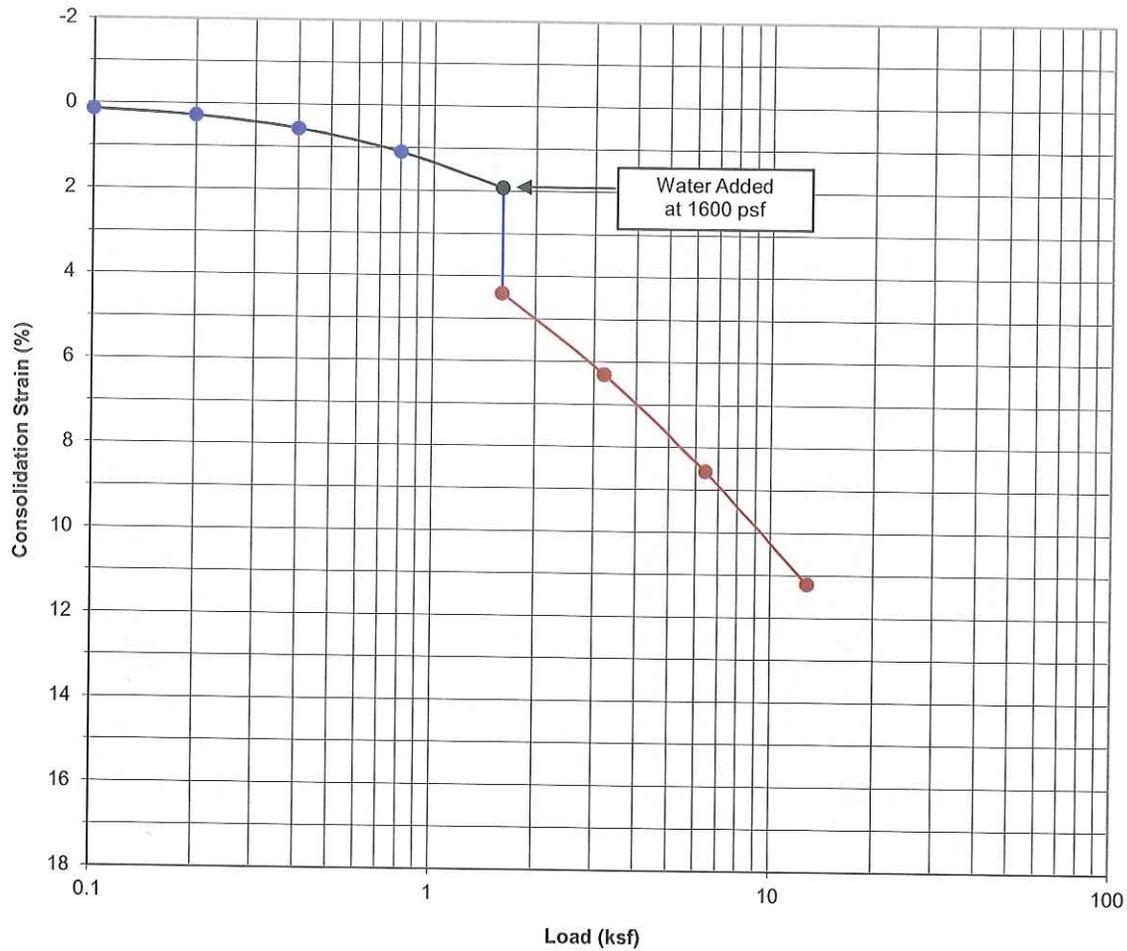
SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
<p>COARSE GRAINED SOILS</p> <p>MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE</p>	<p>GRAVEL AND GRAVELLY SOILS</p> <p>MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE</p>	<p>CLEAN GRAVELS</p> <p>(LITTLE OR NO FINES)</p>		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		<p>GRAVELS WITH FINES</p> <p>(APPRECIABLE AMOUNT OF FINES)</p>		GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		<p>CLEAN SANDS</p> <p>(LITTLE OR NO FINES)</p>		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
		<p>SANDS WITH FINES</p> <p>(APPRECIABLE AMOUNT OF FINES)</p>		GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	<p>SAND AND SANDY SOILS</p> <p>MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE</p>	<p>CLEAN SANDS</p> <p>(LITTLE OR NO FINES)</p>		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		<p>SANDS WITH FINES</p> <p>(APPRECIABLE AMOUNT OF FINES)</p>		SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		<p>SANDS WITH FINES</p> <p>(APPRECIABLE AMOUNT OF FINES)</p>		SM	SILTY SANDS, SAND - SILT MIXTURES
		<p>SANDS WITH FINES</p> <p>(APPRECIABLE AMOUNT OF FINES)</p>		SC	CLAYEY SANDS, SAND - CLAY MIXTURES
<p>FINE GRAINED SOILS</p> <p>MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE</p>	<p>SILTS AND CLAYS</p> <p>LIQUID LIMIT LESS THAN 50</p>		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	
	<p>SILTS AND CLAYS</p> <p>LIQUID LIMIT GREATER THAN 50</p>		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS	
			CH	INORGANIC CLAYS OF HIGH PLASTICITY	
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS	
<p>HIGHLY ORGANIC SOILS</p>				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

APPENDIX C

Consolidation/Collapse Test Results



Classification: ALLUVIUM: Light Gray Brown fine Sand, trace medium Sand

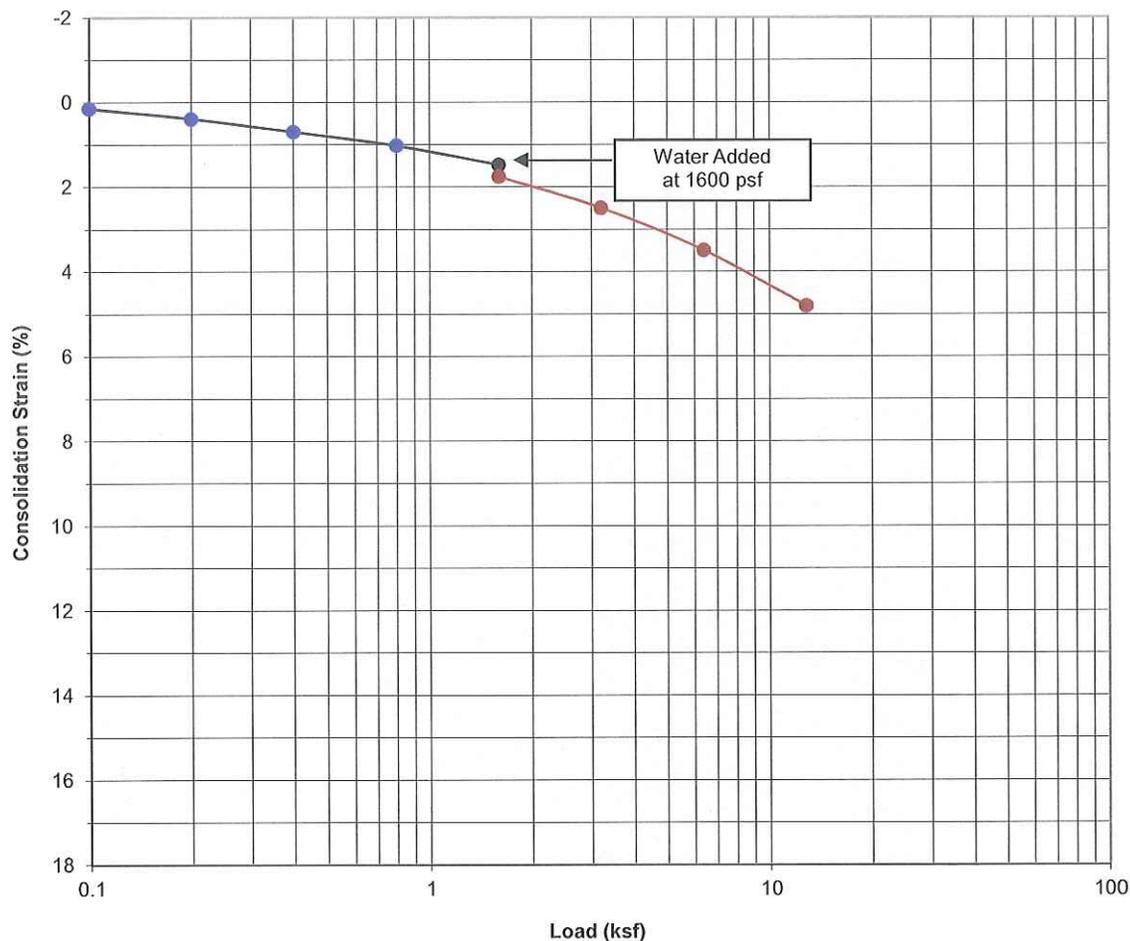
Boring Number:	B-12	Initial Moisture Content (%)	5
Sample Number:	---	Final Moisture Content (%)	21
Depth (ft)	3 to 4	Initial Dry Density (pcf)	90.1
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	101.0
Specimen Thickness (in)	1.0	Percent Collapse (%)	2.49

Proposed Commercial/Industrial Building
 San Bernardino, California
 Project No. 15G190
PLATE C- 1



**SOUTHERN
 CALIFORNIA
 GEOTECHNICAL**
A California Corporation

Consolidation/Collapse Test Results



Classification: Brown fine Sandy Silt, trace medium Sand

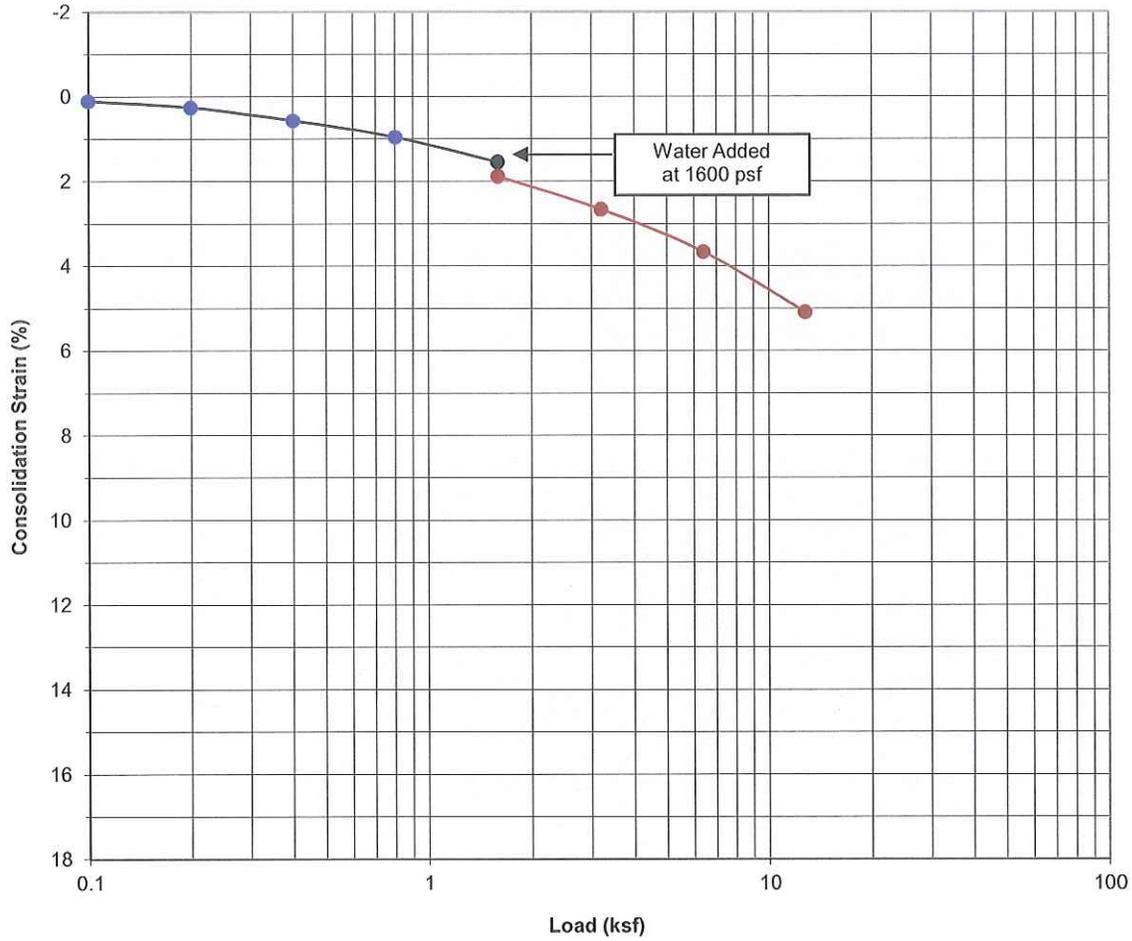
Boring Number:	B-12	Initial Moisture Content (%)	15
Sample Number:	---	Final Moisture Content (%)	23
Depth (ft)	5 to 6	Initial Dry Density (pcf)	88.1
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	86.9
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.28

Proposed Commercial/Industrial Building
 San Bernardino, California
 Project No. 15G190
PLATE C- 2



**SOUTHERN
 CALIFORNIA
 GEOTECHNICAL**
A California Corporation

Consolidation/Collapse Test Results



Classification: Light Gray Brown fine Sand, little Sand

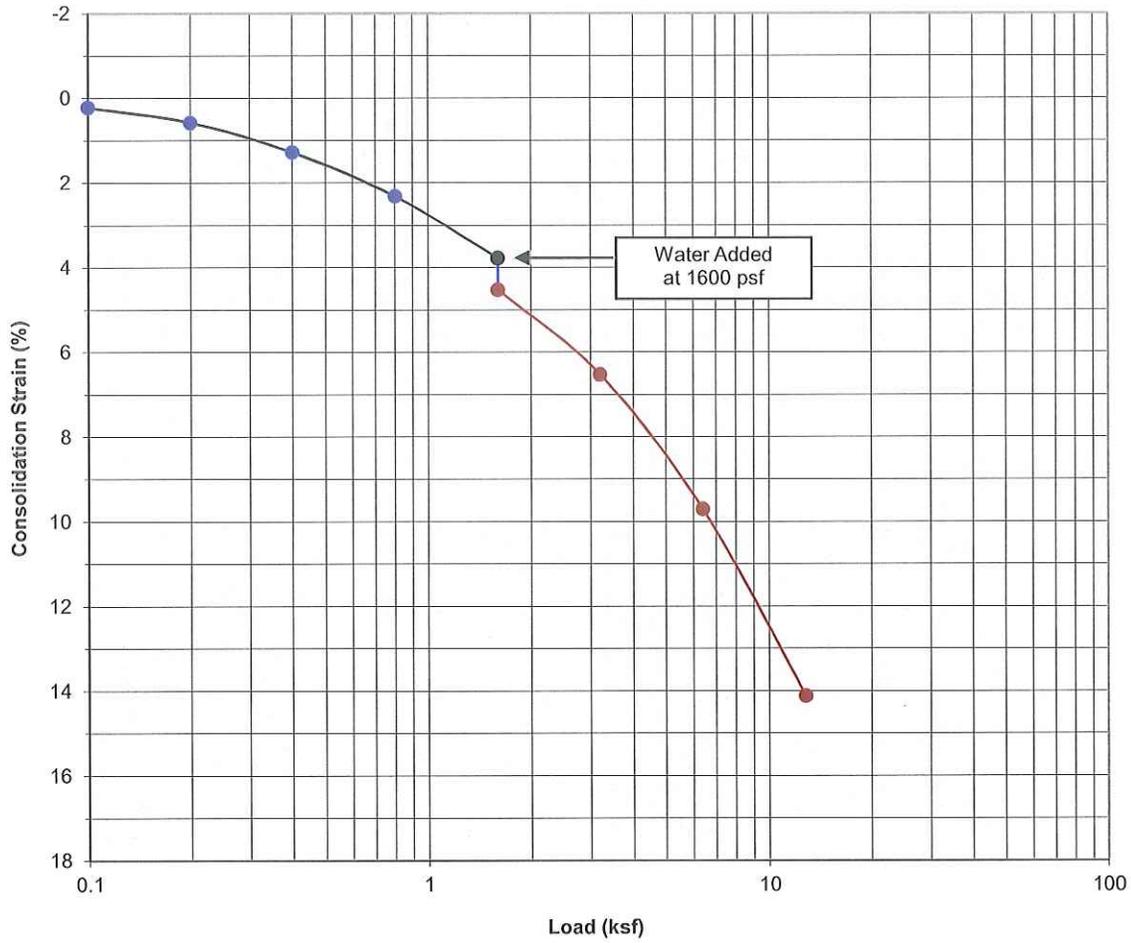
Boring Number:	B-12	Initial Moisture Content (%)	5
Sample Number:	---	Final Moisture Content (%)	27
Depth (ft)	7 to 8	Initial Dry Density (pcf)	82.6
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	90.0
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.34

Proposed Commercial/Industrial Building
 San Bernardino, California
 Project No. 15G190
PLATE C- 3



**SOUTHERN
 CALIFORNIA
 GEOTECHNICAL**
A California Corporation

Consolidation/Collapse Test Results



Classification: Light Gray Brown Silty fine Sand

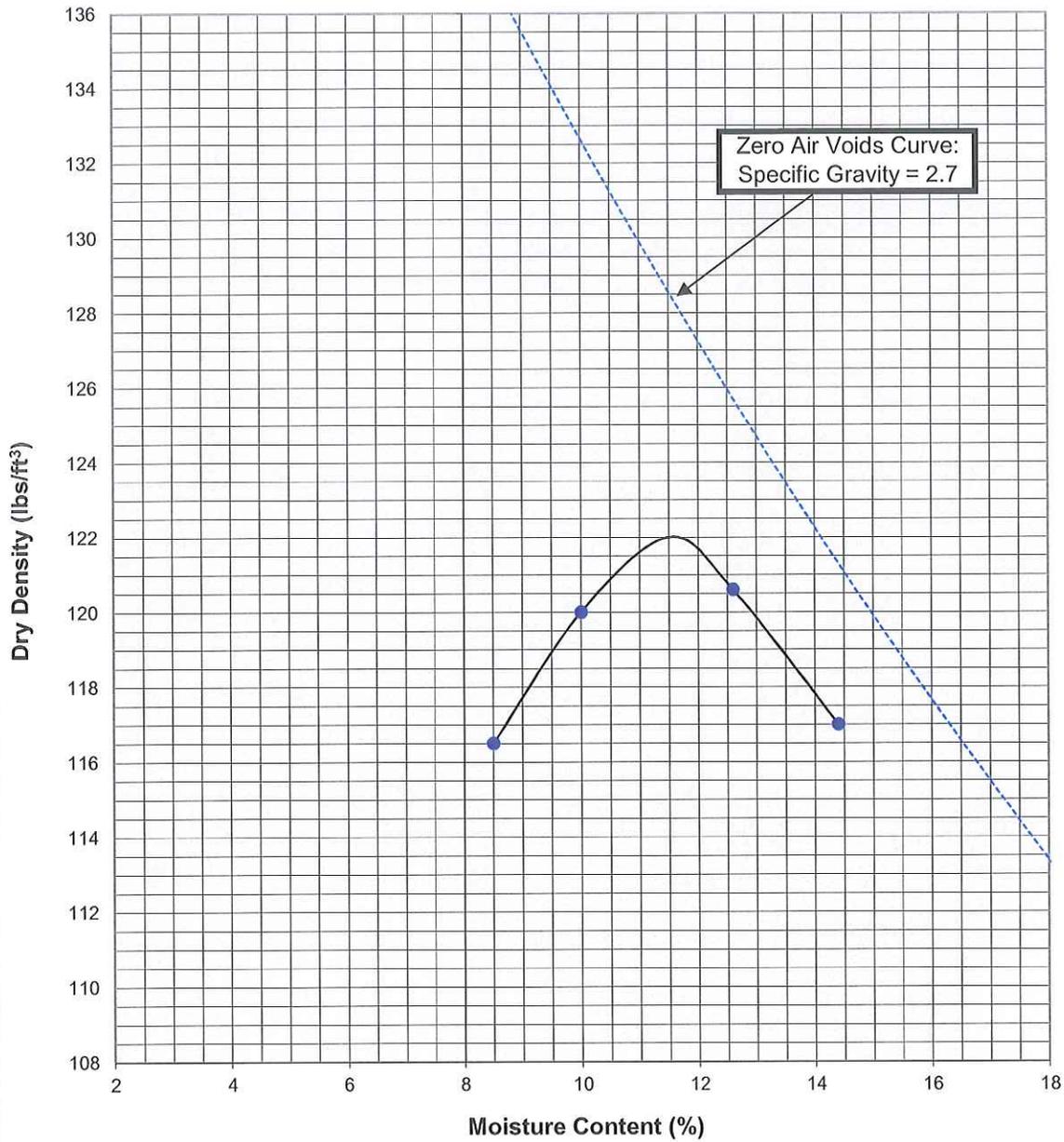
Boring Number:	B-12	Initial Moisture Content (%)	15
Sample Number:	---	Final Moisture Content (%)	23
Depth (ft)	9 to 10	Initial Dry Density (pcf)	81.2
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	92.2
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.75

Proposed Commercial/Industrial Building
 San Bernardino, California
 Project No. 15G190
PLATE C- 4



**SOUTHERN
 CALIFORNIA
 GEOTECHNICAL**
A California Corporation

**Moisture/Density Relationship
ASTM D-1557**



Soil ID Number	B-11 @ 0 to 5'
Optimum Moisture (%)	11.5
Maximum Dry Density (pcf)	122
Soil Classification	Brown Silty fine Sand, trace medium Sand

Proposed Commercial/Industrial Building
 San Bernardino, California
 Project No. 15G190
PLATE C-5



SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

APPENDIX

GRADING GUIDE SPECIFICATIONS

These grading guide specifications are intended to provide typical procedures for grading operations. They are intended to supplement the recommendations contained in the geotechnical investigation report for this project. Should the recommendations in the geotechnical investigation report conflict with the grading guide specifications, the more site specific recommendations in the geotechnical investigation report will govern.

General

- The Earthwork Contractor is responsible for the satisfactory completion of all earthwork in accordance with the plans and geotechnical reports, and in accordance with city, county, and applicable building codes.
- The Geotechnical Engineer is the representative of the Owner/Builder for the purpose of implementing the report recommendations and guidelines. These duties are not intended to relieve the Earthwork Contractor of any responsibility to perform in a workman-like manner, nor is the Geotechnical Engineer to direct the grading equipment or personnel employed by the Contractor.
- The Earthwork Contractor is required to notify the Geotechnical Engineer of the anticipated work and schedule so that testing and inspections can be provided. If necessary, work may be stopped and redone if personnel have not been scheduled in advance.
- The Earthwork Contractor is required to have suitable and sufficient equipment on the job-site to process, moisture condition, mix and compact the amount of fill being placed to the approved compaction. In addition, suitable support equipment should be available to conform with recommendations and guidelines in this report.
- Canyon cleanouts, overexcavation areas, processed ground to receive fill, key excavations, subdrains and benches should be observed by the Geotechnical Engineer prior to placement of any fill. It is the Earthwork Contractor's responsibility to notify the Geotechnical Engineer of areas that are ready for inspection.
- Excavation, filling, and subgrade preparation should be performed in a manner and sequence that will provide drainage at all times and proper control of erosion. Precipitation, springs, and seepage water encountered shall be pumped or drained to provide a suitable working surface. The Geotechnical Engineer must be informed of springs or water seepage encountered during grading or foundation construction for possible revision to the recommended construction procedures and/or installation of subdrains.

Site Preparation

- The Earthwork Contractor is responsible for all clearing, grubbing, stripping and site preparation for the project in accordance with the recommendations of the Geotechnical Engineer.
- If any materials or areas are encountered by the Earthwork Contractor which are suspected of having toxic or environmentally sensitive contamination, the Geotechnical Engineer and Owner/Builder should be notified immediately.

- Major vegetation should be stripped and disposed of off-site. This includes trees, brush, heavy grasses and any materials considered unsuitable by the Geotechnical Engineer.
- Underground structures such as basements, cesspools or septic disposal systems, mining shafts, tunnels, wells and pipelines should be removed under the inspection of the Geotechnical Engineer and recommendations provided by the Geotechnical Engineer and/or city, county or state agencies. If such structures are known or found, the Geotechnical Engineer should be notified as soon as possible so that recommendations can be formulated.
- Any topsoil, slopewash, colluvium, alluvium and rock materials which are considered unsuitable by the Geotechnical Engineer should be removed prior to fill placement.
- Remaining voids created during site clearing caused by removal of trees, foundations basements, irrigation facilities, etc., should be excavated and filled with compacted fill.
- Subsequent to clearing and removals, areas to receive fill should be scarified to a depth of 10 to 12 inches, moisture conditioned and compacted
- The moisture condition of the processed ground should be at or slightly above the optimum moisture content as determined by the Geotechnical Engineer. Depending upon field conditions, this may require air drying or watering together with mixing and/or discing.

Compacted Fills

- Soil materials imported to or excavated on the property may be utilized in the fill, provided each material has been determined to be suitable in the opinion of the Geotechnical Engineer. Unless otherwise approved by the Geotechnical Engineer, all fill materials shall be free of deleterious, organic, or frozen matter, shall contain no chemicals that may result in the material being classified as "contaminated," and shall be very low to non-expansive with a maximum expansion index (EI) of 50. The top 12 inches of the compacted fill should have a maximum particle size of 3 inches, and all underlying compacted fill material a maximum 6-inch particle size, except as noted below.
- All soils should be evaluated and tested by the Geotechnical Engineer. Materials with high expansion potential, low strength, poor gradation or containing organic materials may require removal from the site or selective placement and/or mixing to the satisfaction of the Geotechnical Engineer.
- Rock fragments or rocks less than 6 inches in their largest dimensions, or as otherwise determined by the Geotechnical Engineer, may be used in compacted fill, provided the distribution and placement is satisfactory in the opinion of the Geotechnical Engineer.
- Rock fragments or rocks greater than 12 inches should be taken off-site or placed in accordance with recommendations and in areas designated as suitable by the Geotechnical Engineer. These materials should be placed in accordance with Plate D-8 of these Grading Guide Specifications and in accordance with the following recommendations:
 - Rocks 12 inches or more in diameter should be placed in rows at least 15 feet apart, 15 feet from the edge of the fill, and 10 feet or more below subgrade. Spaces should be left between each rock fragment to provide for placement and compaction of soil around the fragments.
 - Fill materials consisting of soil meeting the minimum moisture content requirements and free of oversize material should be placed between and over the rows of rock or

concrete. Ample water and compactive effort should be applied to the fill materials as they are placed in order that all of the voids between each of the fragments are filled and compacted to the specified density.

- Subsequent rows of rocks should be placed such that they are not directly above a row placed in the previous lift of fill. A minimum 5-foot offset between rows is recommended.
- To facilitate future trenching, oversized material should not be placed within the range of foundation excavations, future utilities or other underground construction unless specifically approved by the soil engineer and the developer/owner representative.
- Fill materials approved by the Geotechnical Engineer should be placed in areas previously prepared to receive fill and in evenly placed, near horizontal layers at about 6 to 8 inches in loose thickness, or as otherwise determined by the Geotechnical Engineer for the project.
- Each layer should be moisture conditioned to optimum moisture content, or slightly above, as directed by the Geotechnical Engineer. After proper mixing and/or drying, to evenly distribute the moisture, the layers should be compacted to at least 90 percent of the maximum dry density in compliance with ASTM D-1557-78 unless otherwise indicated.
- Density and moisture content testing should be performed by the Geotechnical Engineer at random intervals and locations as determined by the Geotechnical Engineer. These tests are intended as an aid to the Earthwork Contractor, so he can evaluate his workmanship, equipment effectiveness and site conditions. The Earthwork Contractor is responsible for compaction as required by the Geotechnical Report(s) and governmental agencies.
- Fill areas unused for a period of time may require moisture conditioning, processing and recompaction prior to the start of additional filling. The Earthwork Contractor should notify the Geotechnical Engineer of his intent so that an evaluation can be made.
- Fill placed on ground sloping at a 5-to-1 inclination (horizontal-to-vertical) or steeper should be benched into bedrock or other suitable materials, as directed by the Geotechnical Engineer. Typical details of benching are illustrated on Plates D-2, D-4, and D-5.
- Cut/fill transition lots should have the cut portion overexcavated to a depth of at least 3 feet and rebuilt with fill (see Plate D-1), as determined by the Geotechnical Engineer.
- All cut lots should be inspected by the Geotechnical Engineer for fracturing and other bedrock conditions. If necessary, the pads should be overexcavated to a depth of 3 feet and rebuilt with a uniform, more cohesive soil type to impede moisture penetration.
- Cut portions of pad areas above buttresses or stabilizations should be overexcavated to a depth of 3 feet and rebuilt with uniform, more cohesive compacted fill to impede moisture penetration.
- Non-structural fill adjacent to structural fill should typically be placed in unison to provide lateral support. Backfill along walls must be placed and compacted with care to ensure that excessive unbalanced lateral pressures do not develop. The type of fill material placed adjacent to below grade walls must be properly tested and approved by the Geotechnical Engineer with consideration of the lateral earth pressure used in the design.

Foundations

- The foundation influence zone is defined as extending one foot horizontally from the outside edge of a footing, and proceeding downward at a ½ horizontal to 1 vertical (0.5:1) inclination.
- Where overexcavation beneath a footing subgrade is necessary, it should be conducted so as to encompass the entire foundation influence zone, as described above.
- Compacted fill adjacent to exterior footings should extend at least 12 inches above foundation bearing grade. Compacted fill within the interior of structures should extend to the floor subgrade elevation.

Fill Slopes

- The placement and compaction of fill described above applies to all fill slopes. Slope compaction should be accomplished by overfilling the slope, adequately compacting the fill in even layers, including the overfilled zone and cutting the slope back to expose the compacted core
- Slope compaction may also be achieved by backrolling the slope adequately every 2 to 4 vertical feet during the filling process as well as requiring the earth moving and compaction equipment to work close to the top of the slope. Upon completion of slope construction, the slope face should be compacted with a sheepsfoot connected to a sideboom and then grid rolled. This method of slope compaction should only be used if approved by the Geotechnical Engineer.
- Sandy soils lacking in adequate cohesion may be unstable for a finished slope condition and therefore should not be placed within 15 horizontal feet of the slope face.
- All fill slopes should be keyed into bedrock or other suitable material. Fill keys should be at least 15 feet wide and inclined at 2 percent into the slope. For slopes higher than 30 feet, the fill key width should be equal to one-half the height of the slope (see Plate D-5).
- All fill keys should be cleared of loose slough material prior to geotechnical inspection and should be approved by the Geotechnical Engineer and governmental agencies prior to filling.
- The cut portion of fill over cut slopes should be made first and inspected by the Geotechnical Engineer for possible stabilization requirements. The fill portion should be adequately keyed through all surficial soils and into bedrock or suitable material. Soils should be removed from the transition zone between the cut and fill portions (see Plate D-2).

Cut Slopes

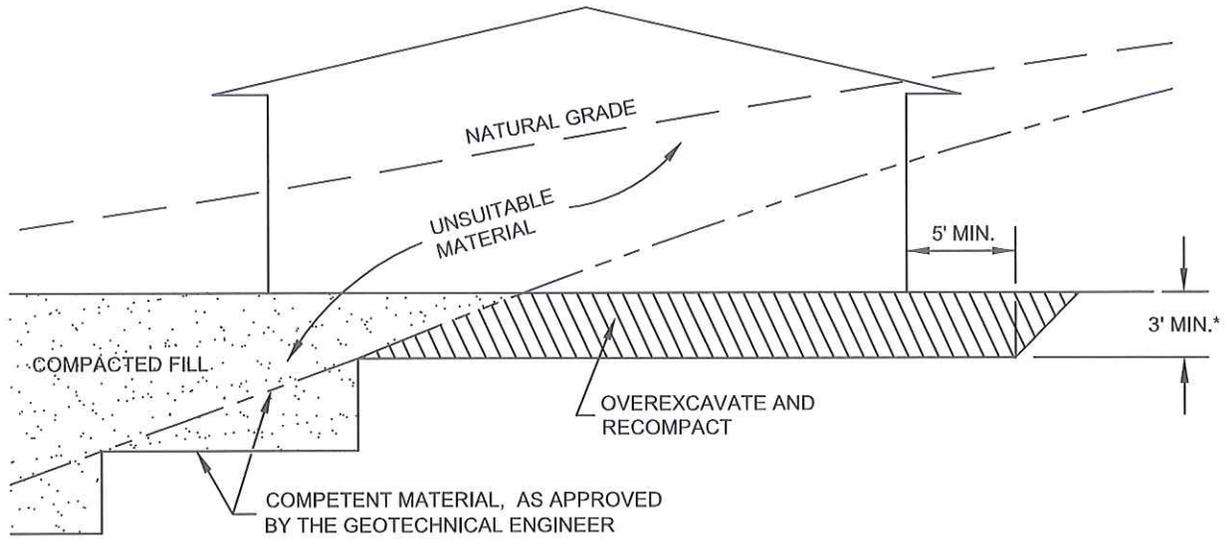
- All cut slopes should be inspected by the Geotechnical Engineer to determine the need for stabilization. The Earthwork Contractor should notify the Geotechnical Engineer when slope cutting is in progress at intervals of 10 vertical feet. Failure to notify may result in a delay in recommendations.
- Cut slopes exposing loose, cohesionless sands should be reported to the Geotechnical Engineer for possible stabilization recommendations.
- All stabilization excavations should be cleared of loose slough material prior to geotechnical inspection. Stakes should be provided by the Civil Engineer to verify the location and dimensions of the key. A typical stabilization fill detail is shown on Plate D-5.

- Stabilization key excavations should be provided with subdrains. Typical subdrain details are shown on Plates D-6.

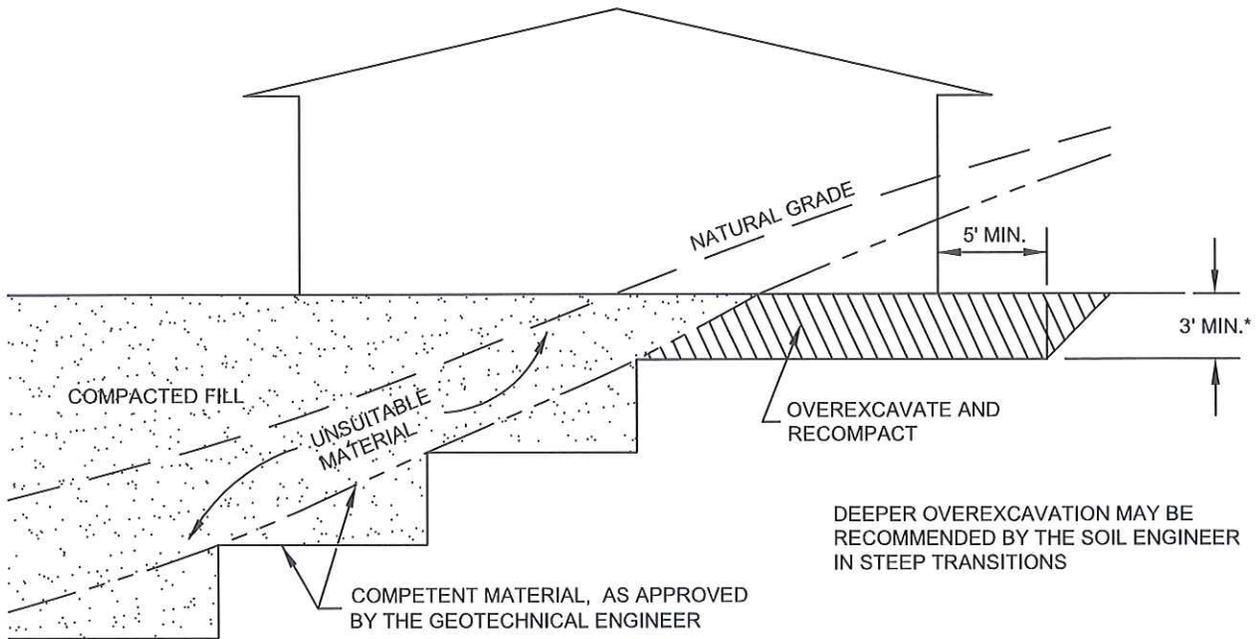
Subdrains

- Subdrains may be required in canyons and swales where fill placement is proposed. Typical subdrain details for canyons are shown on Plate D-3. Subdrains should be installed after approval of removals and before filling, as determined by the Soils Engineer.
- Plastic pipe may be used for subdrains provided it is Schedule 40 or SDR 35 or equivalent. Pipe should be protected against breakage, typically by placement in a square-cut (backhoe) trench or as recommended by the manufacturer.
- Filter material for subdrains should conform to CALTRANS Specification 68-1.025 or as approved by the Geotechnical Engineer for the specific site conditions. Clean $\frac{3}{4}$ -inch crushed rock may be used provided it is wrapped in an acceptable filter cloth and approved by the Geotechnical Engineer. Pipe diameters should be 6 inches for runs up to 500 feet and 8 inches for the downstream continuations of longer runs. Four-inch diameter pipe may be used in buttress and stabilization fills.

CUT LOT



CUT/FILL LOT (TRANSITION)



DEEPER OVEREXCAVATION MAY BE RECOMMENDED BY THE SOIL ENGINEER IN STEEP TRANSITIONS

*SEE TEXT OF REPORT FOR SPECIFIC RECOMMENDATION. ACTUAL DEPTH OF OVEREXCAVATION MAY BE GREATER.

TRANSITION LOT DETAIL

GRADING GUIDE SPECIFICATIONS

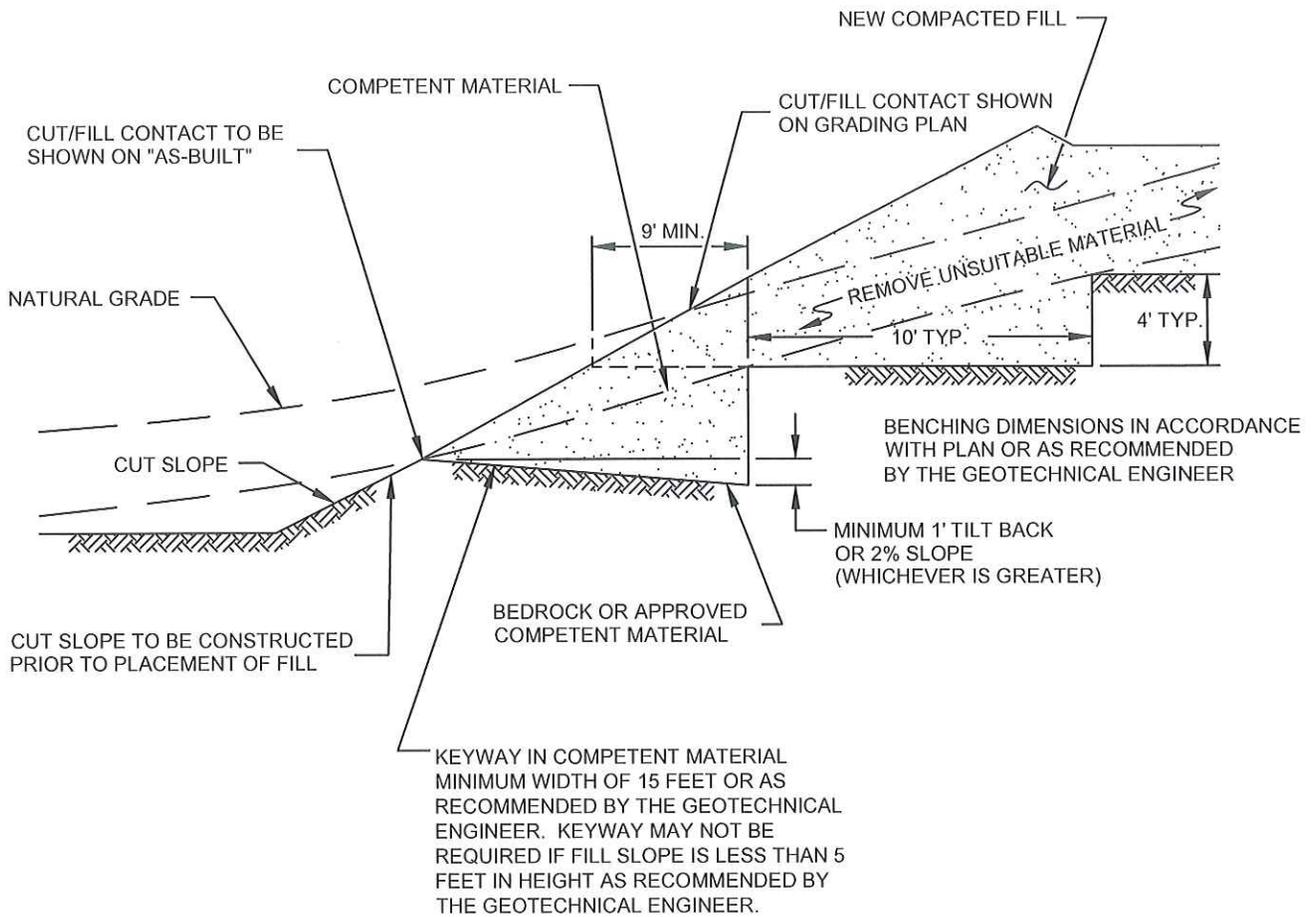
NOT TO SCALE

DRAWN: JAS
CHKD: GKM

PLATE D-1



SOUTHERN CALIFORNIA GEOTECHNICAL



FILL ABOVE CUT SLOPE DETAIL
GRADING GUIDE SPECIFICATIONS

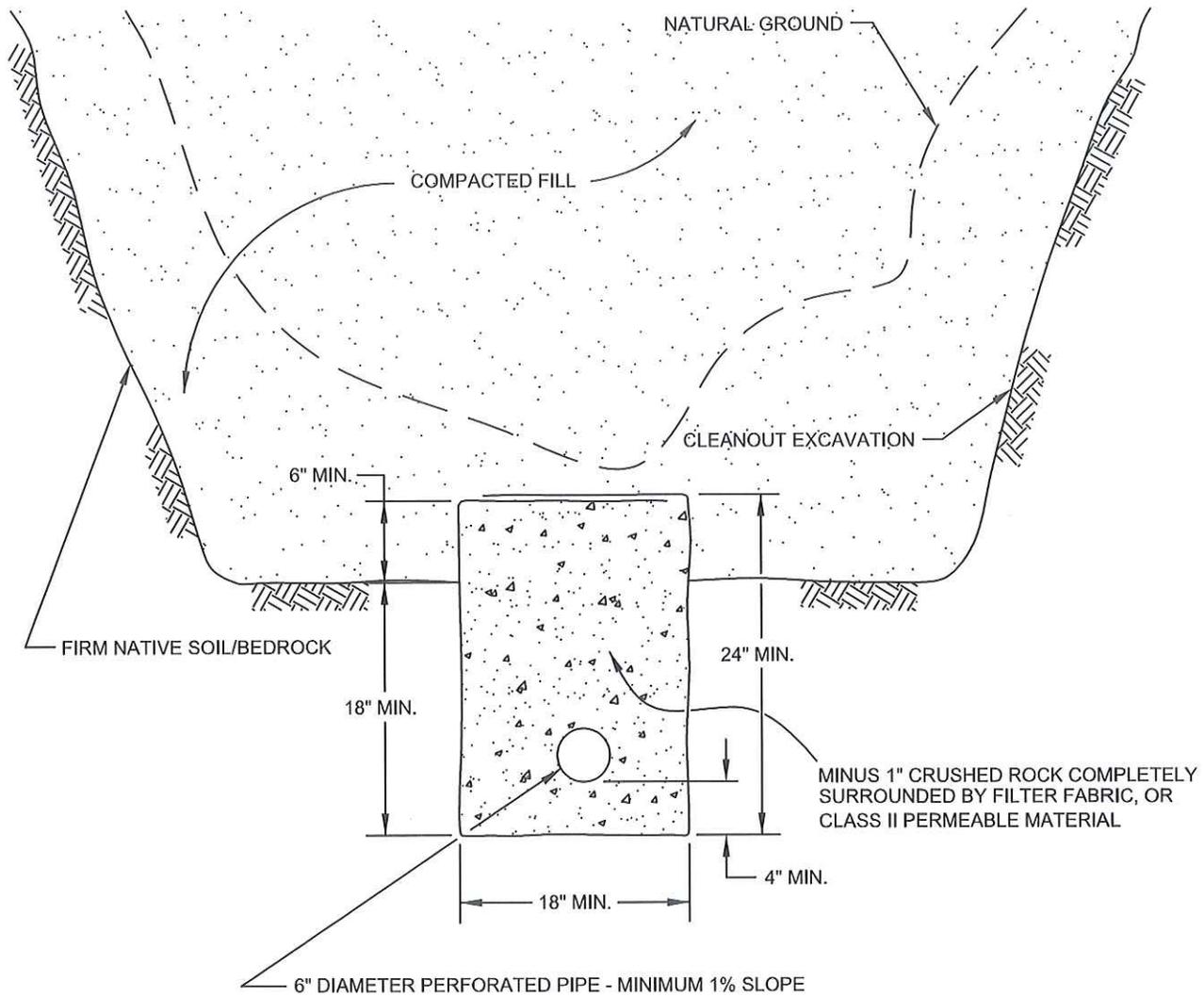
NOT TO SCALE

DRAWN: JAS
 CHKD: GKM

PLATE D-2



SOUTHERN CALIFORNIA GEOTECHNICAL



PIPE MATERIAL	DEPTH OF FILL OVER SUBDRAIN
ADS (CORRUGATED POLETHYLENE)	8
TRANSITE UNDERDRAIN	20
PVC OR ABS: SDR 35	35
SDR 21	100

SCHEMATIC ONLY
NOT TO SCALE

CANYON SUBDRAIN DETAIL
GRADING GUIDE SPECIFICATIONS

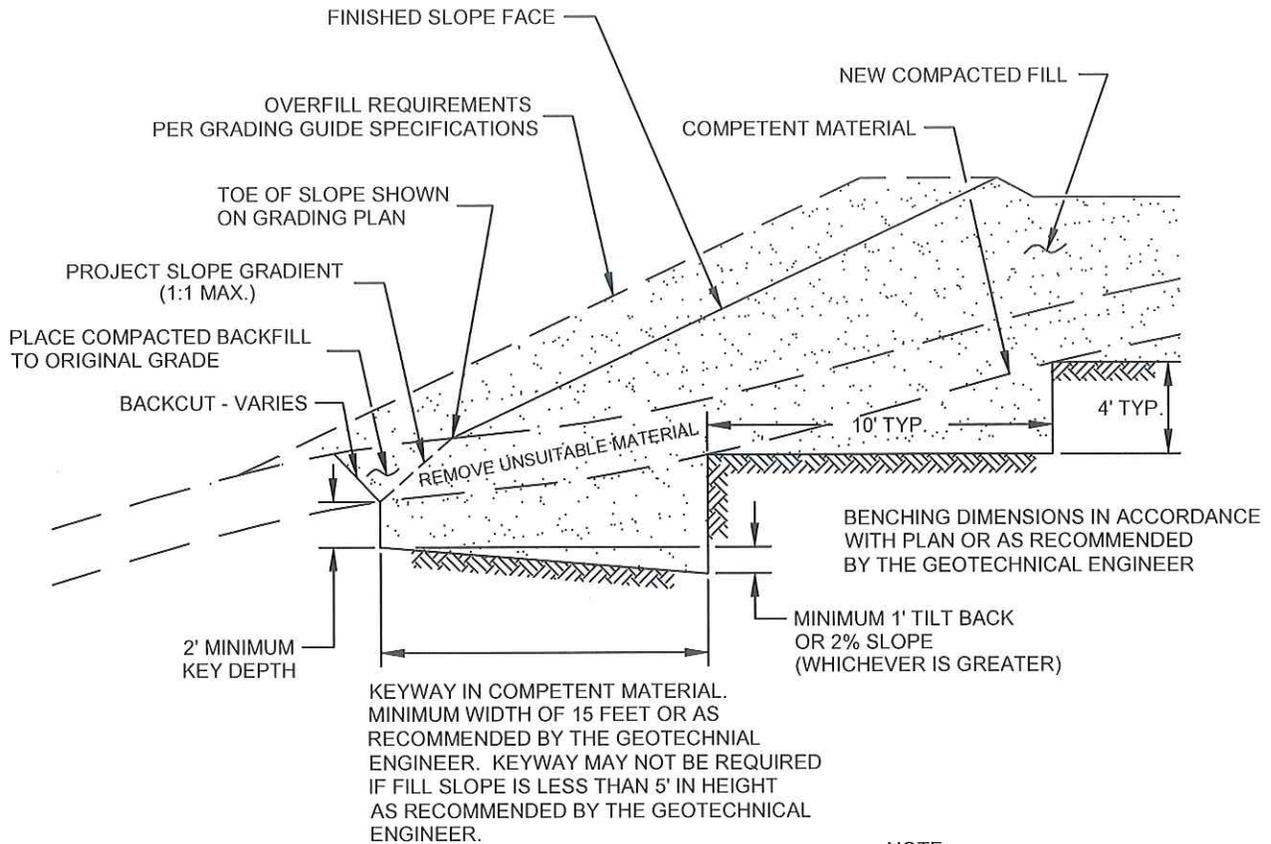
NOT TO SCALE

DRAWN: JAS
CHKD: GKM

PLATE D-3



SOUTHERN CALIFORNIA GEOTECHNICAL



NOTE:
 BENCHING SHALL BE REQUIRED
 WHEN NATURAL SLOPES ARE
 EQUAL TO OR STEEPER THAN 5:1
 OR WHEN RECOMMENDED BY
 THE GEOTECHNICAL ENGINEER.

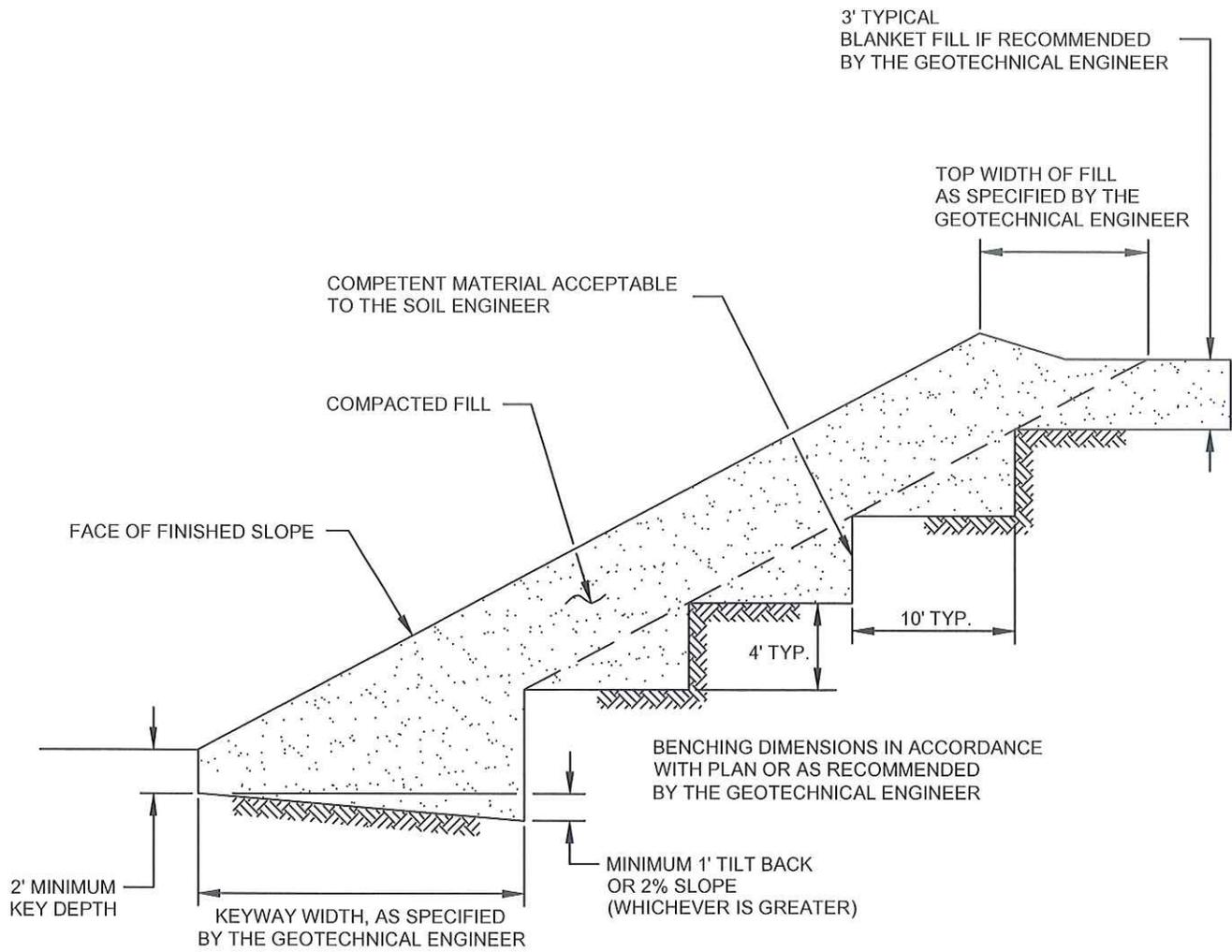
FILL ABOVE NATURAL SLOPE DETAIL
GRADING GUIDE SPECIFICATIONS

NOT TO SCALE
 DRAWN: JAS
 CHKD: GKM

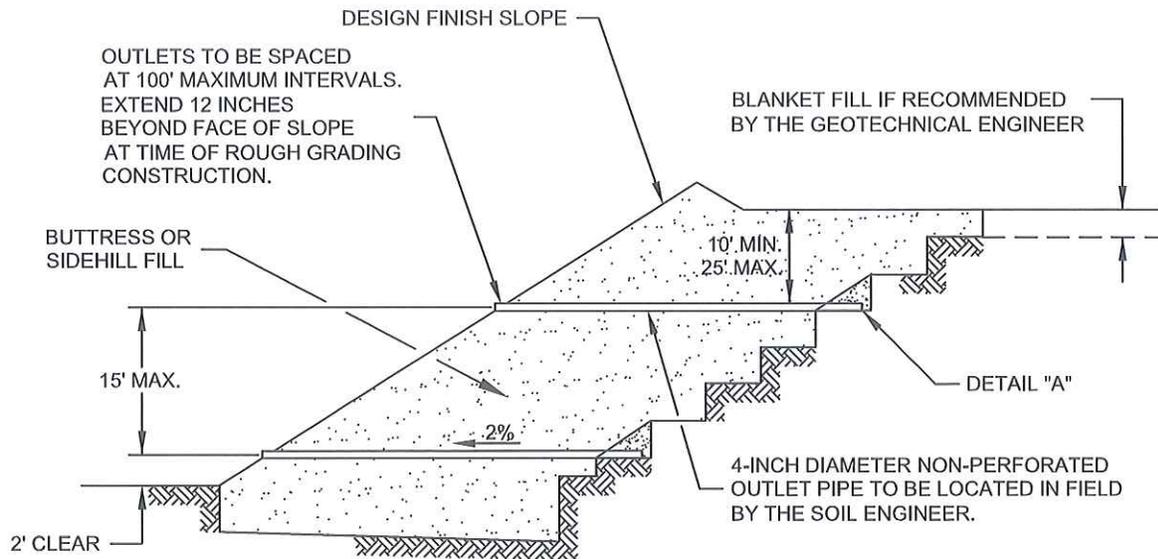
PLATE D-4



**SOUTHERN
 CALIFORNIA
 GEOTECHNICAL**



STABILIZATION FILL DETAIL	
GRADING GUIDE SPECIFICATIONS	
NOT TO SCALE	 SOUTHERN CALIFORNIA GEOTECHNICAL
DRAWN: JAS CHKD: GKM	
PLATE D-5	



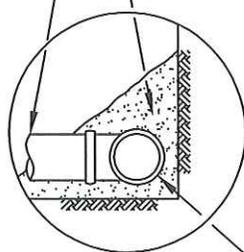
"FILTER MATERIAL" TO MEET FOLLOWING SPECIFICATION OR APPROVED EQUIVALENT: (CONFORMS TO EMA STD. PLAN 323)

SIEVE SIZE	PERCENTAGE PASSING
1"	100
3/4"	90-100
3/8"	40-100
NO. 4	25-40
NO. 8	18-33
NO. 30	5-15
NO. 50	0-7
NO. 200	0-3

"GRAVEL" TO MEET FOLLOWING SPECIFICATION OR APPROVED EQUIVALENT:

SIEVE SIZE	MAXIMUM PERCENTAGE PASSING
1 1/2"	100
NO. 4	50
NO. 200	8
SAND EQUIVALENT = MINIMUM OF 50	

OUTLET PIPE TO BE CONNECTED TO SUBDRAIN PIPE WITH TEE OR ELBOW



DETAIL "A"

FILTER MATERIAL - MINIMUM OF FIVE CUBIC FEET PER FOOT OF PIPE. SEE ABOVE FOR FILTER MATERIAL SPECIFICATION.

ALTERNATIVE: IN LIEU OF FILTER MATERIAL FIVE CUBIC FEET OF GRAVEL PER FOOT OF PIPE MAY BE ENCASED IN FILTER FABRIC. SEE ABOVE FOR GRAVEL SPECIFICATION.

FILTER FABRIC SHALL BE MIRAFI 140 OR EQUIVALENT. FILTER FABRIC SHALL BE LAPPED A MINIMUM OF 12 INCHES ON ALL JOINTS.

MINIMUM 4-INCH DIAMETER PVC SCH 40 OR ABS CLASS SDR 35 WITH A CRUSHING STRENGTH OF AT LEAST 1,000 POUNDS, WITH A MINIMUM OF 8 UNIFORMLY SPACED PERFORATIONS PER FOOT OF PIPE INSTALLED WITH PERFORATIONS ON BOTTOM OF PIPE. PROVIDE CAP AT UPSTREAM END OF PIPE. SLOPE AT 2 PERCENT TO OUTLET PIPE.

NOTES:

- TRENCH FOR OUTLET PIPES TO BE BACKFILLED WITH ON-SITE SOIL.

SLOPE FILL SUBDRAINS
GRADING GUIDE SPECIFICATIONS

NOT TO SCALE

DRAWN: JAS
CHKD: GKM

PLATE D-6



SOUTHERN CALIFORNIA GEOTECHNICAL

MINIMUM ONE FOOT THICK LAYER OF LOW PERMEABILITY SOIL IF NOT COVERED WITH AN IMPERMEABLE SURFACE

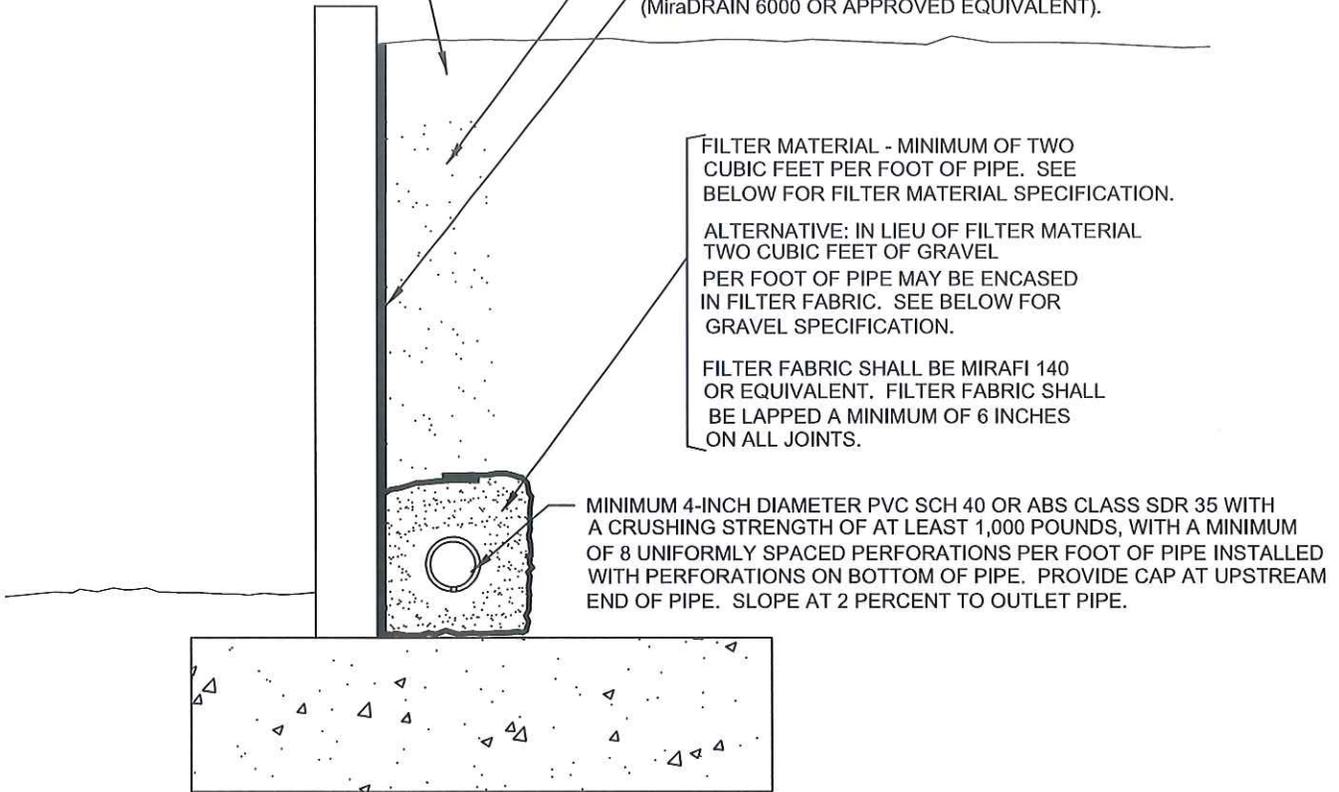
MINIMUM ONE FOOT WIDE LAYER OF FREE DRAINING MATERIAL (LESS THAN 5% PASSING THE #200 SIEVE) OR PROPERLY INSTALLED PREFABRICATED DRAINAGE COMPOSITE (MiraDRAIN 6000 OR APPROVED EQUIVALENT).

FILTER MATERIAL - MINIMUM OF TWO CUBIC FEET PER FOOT OF PIPE. SEE BELOW FOR FILTER MATERIAL SPECIFICATION.

ALTERNATIVE: IN LIEU OF FILTER MATERIAL TWO CUBIC FEET OF GRAVEL PER FOOT OF PIPE MAY BE ENCASED IN FILTER FABRIC. SEE BELOW FOR GRAVEL SPECIFICATION.

FILTER FABRIC SHALL BE MIRAFI 140 OR EQUIVALENT. FILTER FABRIC SHALL BE LAPPED A MINIMUM OF 6 INCHES ON ALL JOINTS.

MINIMUM 4-INCH DIAMETER PVC SCH 40 OR ABS CLASS SDR 35 WITH A CRUSHING STRENGTH OF AT LEAST 1,000 POUNDS, WITH A MINIMUM OF 8 UNIFORMLY SPACED PERFORATIONS PER FOOT OF PIPE INSTALLED WITH PERFORATIONS ON BOTTOM OF PIPE. PROVIDE CAP AT UPSTREAM END OF PIPE. SLOPE AT 2 PERCENT TO OUTLET PIPE.



"FILTER MATERIAL" TO MEET FOLLOWING SPECIFICATION OR APPROVED EQUIVALENT: (CONFORMS TO EMA STD. PLAN 323)

SIEVE SIZE	PERCENTAGE PASSING
1"	100
3/4"	90-100
3/8"	40-100
NO. 4	25-40
NO. 8	18-33
NO. 30	5-15
NO. 50	0-7
NO. 200	0-3

"GRAVEL" TO MEET FOLLOWING SPECIFICATION OR APPROVED EQUIVALENT:

SIEVE SIZE	MAXIMUM PERCENTAGE PASSING
1 1/2"	100
NO. 4	50
NO. 200	8
SAND EQUIVALENT = MINIMUM OF 50	

**RETAINING WALL BACKDRAINS
GRADING GUIDE SPECIFICATIONS**

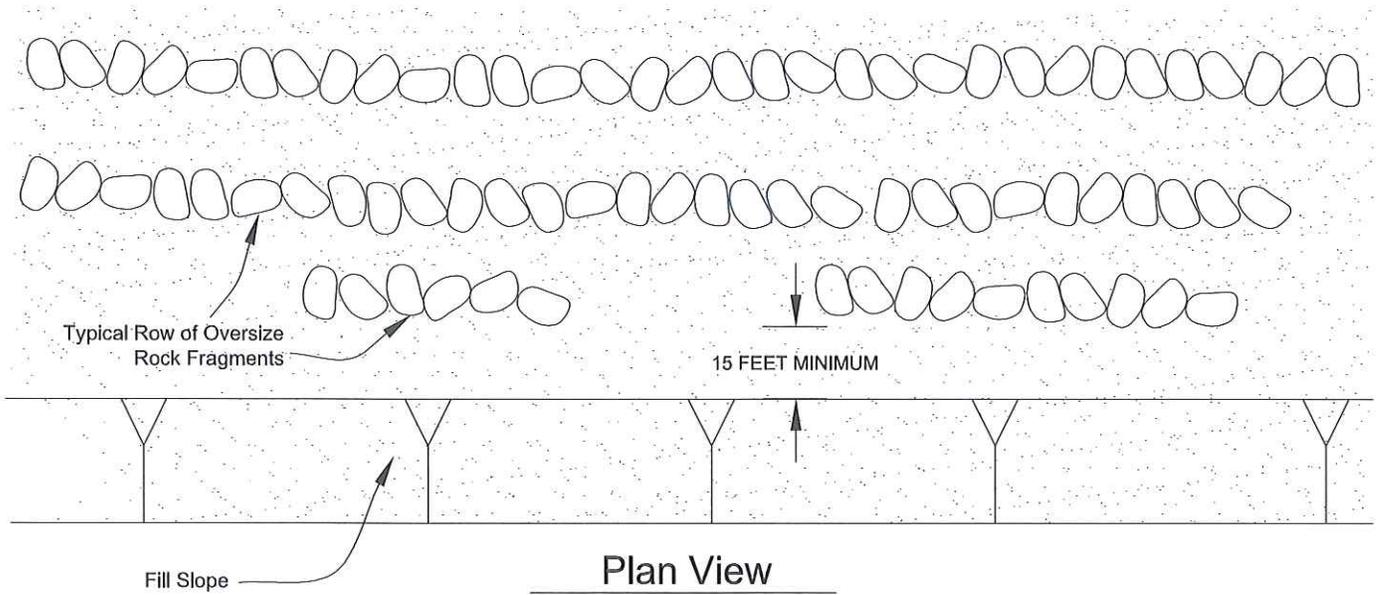
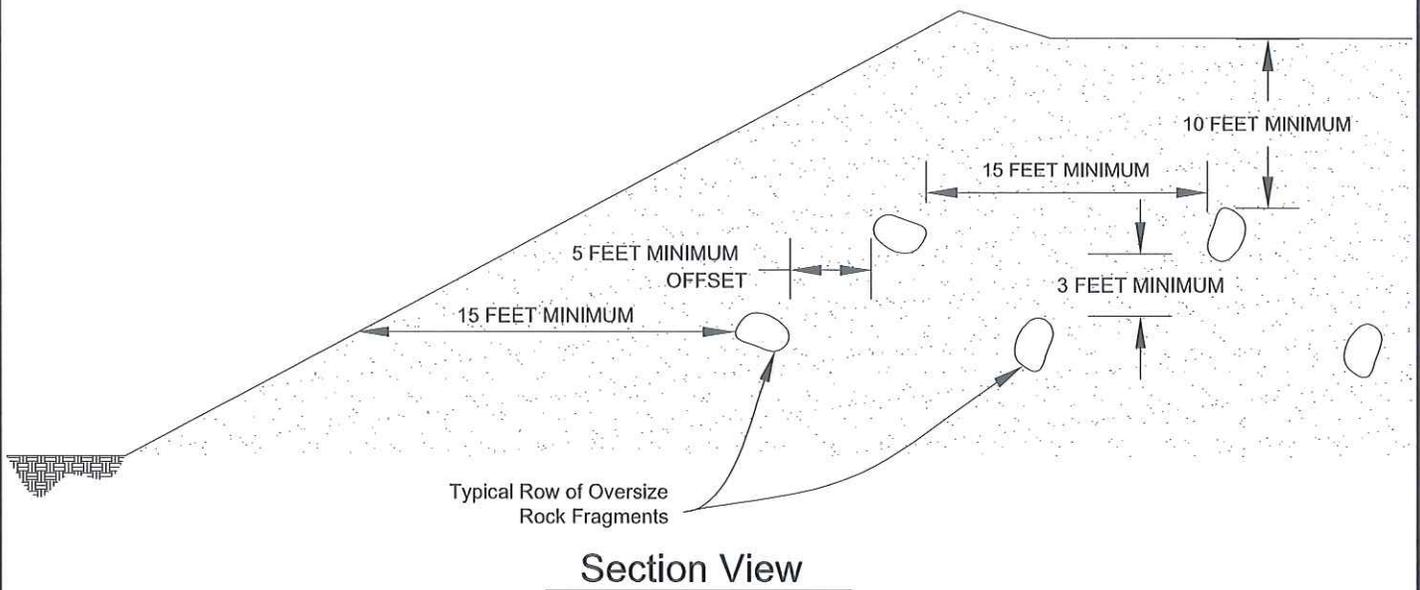
NOT TO SCALE

DRAWN: JAS
CHKD: GKM

PLATE D-7



**SOUTHERN
CALIFORNIA
GEOTECHNICAL**



**PLACEMENT OF OVERSIZED MATERIAL
GRADING GUIDE SPECIFICATIONS**

NOT TO SCALE

DRAWN: PM
CHKD: GKM

PLATE D-8



**SOUTHERN
CALIFORNIA
GEOTECHNICAL**

APPENDIX E

USGS Design Maps Summary Report

User-Specified Input

Report Title Proposed Commercial/Industrial Building
Wed September 16, 2015 21:25:14 UTC

Building Code Reference Document ASCE 7-10 Standard
(which utilizes USGS hazard data available in 2008)

Site Coordinates 34.08729°N, 117.28039°W

Site Soil Classification Site Class D - "Stiff Soil"

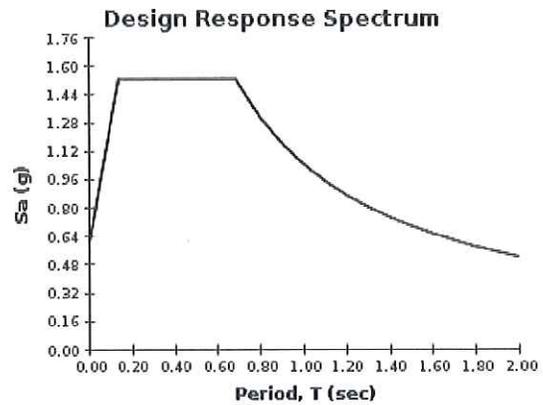
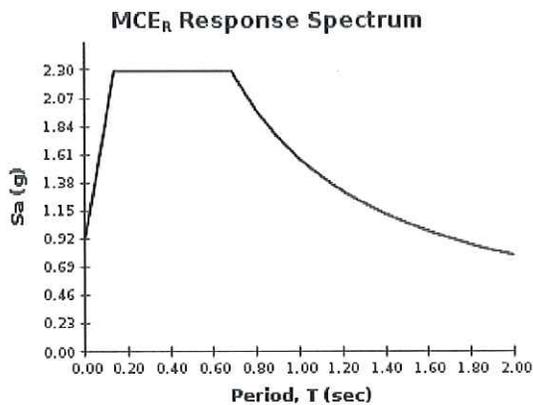
Risk Category I/II/III



USGS-Provided Output

$S_s = 2.291 \text{ g}$ $S_{MS} = 2.291 \text{ g}$ $S_{DS} = 1.527 \text{ g}$
 $S_1 = 1.046 \text{ g}$ $S_{M1} = 1.568 \text{ g}$ $S_{D1} = 1.046 \text{ g}$

For information on how the S_s and S_1 values above have been calculated from probabilistic (risk-targeted) and deterministic ground motions in the direction of maximum horizontal response, please return to the application and select the "2009 NEHRP" building code reference document.



SOURCE: U.S. GEOLOGICAL SURVEY (USGS)
<<http://geohazards.usgs.gov/designmaps/us/application.php>>



SEISMIC DESIGN PARAMETERS	
PROPOSED COMMERCIAL/INDUSTRIAL BUILDING	
SAN BERNARDINO, CALIFORNIA	
DRAWN: MRM	 SOUTHERN CALIFORNIA GEOTECHNICAL
CHKD: JAS	
SCG PROJECT 15G190-1	
PLATE E-1	

Section 11.8.3 — Additional Geotechnical Investigation Report Requirements for Seismic Design Categories D through F

From **Figure 22-7** ^[4]

$$PGA = 0.882$$

Equation (11.8-1):

$$PGA_M = F_{PGA} PGA = 1.000 \times 0.882 = 0.882 \text{ g}$$

Table 11.8-1: Site Coefficient F_{PGA}

Site Class	Mapped MCE Geometric Mean Peak Ground Acceleration, PGA				
	PGA ≤ 0.10	PGA = 0.20	PGA = 0.30	PGA = 0.40	PGA ≥ 0.50
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7 of ASCE 7				

Note: Use straight-line interpolation for intermediate values of PGA

For Site Class = D and PGA = 0.882 g, $F_{PGA} = 1.000$

Section 21.2.1.1 — Method 1 (from Chapter 21 – Site-Specific Ground Motion Procedures for Seismic Design)

From **Figure 22-17** ^[5]

$$C_{RS} = 1.015$$

From **Figure 22-18** ^[6]

$$C_{R1} = 0.967$$

SOURCE: U.S. GEOLOGICAL SURVEY (USGS)
<http://geohazards.usgs.gov/designmaps/us/application.php>

MCE PEAK GROUND ACCELERATION	
PROPOSED COMMERCIAL/INDUSTRIAL BUILDING	
SAN BERNARDINO, CALIFORNIA	
DRAWN: MRM CHKD: JAS SCG PROJECT 15G190-1 PLATE E-2	 SOUTHERN CALIFORNIA GEOTECHNICAL

A P P E N D I X F

LIQUEFACTION EVALUATION

Project Name	Proposed Comm./Ind. Building
Project Location	San Bernardino, CA
Project Number	15G190
Engineer	DWN

MCE_G Design Acceleration
 Design Magnitude
 Historic High Depth to Groundwater
 Depth to Groundwater at Time of Drilling
 Borehole Diameter

0.882 (g)
7.6
10 (ft)
60 (ft)
6 (in)

Boring No.	Sample Depth (ft)	Depth to Top of Layer (ft)	Depth to Bottom of Layer (ft)	Depth to Midpoint (ft)	Uncorrected SPT N-Value	Unit Weight of Soil (pcf)	Fines Content (%)	Energy Correction	C _B	C _S	C _N	Rod Length Correction	(N ₁) ₆₀	(N ₁) _{60CS}	Overburden Stress (σ _v) (psf)	Eff. Overburden Stress (Hist. Water) (σ _v ') (psf)	Eff. Overburden Stress (Curr. Water) (σ _v ') (psf)	Stress Reduction Coefficient (r _d)	MSF	Ks	Cyclic Resistance Ratio (M=7.5)	Cyclic Resistance Ratio (M=7.6)	Cyclic Stress Ratio Induced by Design Earthquake	Factor of Safety	Comments
7	0	10	5	16	120	1.3	1.05	1.3	1.54	0.75	32.8	32.8	600	600	1.00	0.96	1.1	0.74	N/A	0.78	N/A	N/A	Above Water Table		
9.5	10	12	11	16	120	1.3	1.05	1.25	1.21	0.75	24.6	25.3	1320	1258	0.98	0.98	1.08	0.30	0.32	0.59	0.54	Liquefiable			
14.5	12	16	14	15	120	1.3	1.05	1.24	1.10	0.85	23.6	24.3	1680	1430	0.97	0.98	1.06	0.28	0.29	0.65	0.44	Liquefiable			
19.5	16	22	19	58	120	1.3	1.05	1.3	1.00	0.95	97.6	97.6	2280	1718	0.96	0.96	1.06	2.00	2.00	0.73	2.75	Non-Liquefiable			
24.5	22	24	23	32	120	1.3	1.05	1.3	0.94	0.95	50.6	50.6	2760	1949	0.94	0.96	1.02	2.00	1.96	0.76	2.57	Non-Liquefiable			
24.5	24	27	25.5	32	120	1.3	1.05	1.3	0.91	0.95	49.3	49.3	3060	2093	0.93	0.96	1	2.00	1.92	0.78	2.46	Non-Liquefiable			
29.5	27	32	29.5	9	120	1.3	1.05	1.1	0.78	0.95	10.0	15.6	3540	2323	0.92	0.99	0.99	0.16	0.16	N/A	N/A	Non-Liq: PL>12 w<.8*LL			
34.5	32	34.5	33.3	16	120	1.3	1.05	1.2	0.76	1	19.9	20.6	3990	2539	0.90	0.98	0.97	0.21	0.20	0.81	0.25	Liquefiable			
34.5	34.5	36	35.3	16	120	1.3	1.05	1.19	0.75	1	19.4	22.0	4230	2654	0.89	0.98	0.97	0.23	0.22	0.82	0.27	Liquefiable			
39.5	36	39	37.5	29	120	1.3	1.05	1.3	0.83	1	42.6	48.2	4500	2784	0.88	0.96	0.92	2.00	1.76	0.82	2.15	Non-Liquefiable			
39.5	39	43	41	29	120	1.3	1.05	1.3	0.78	1	40.2	40.9	4920	2986	0.87	0.96	0.9	2.00	1.72	0.82	2.10	Non-Liquefiable			
44.5	43	46	44.5	17	120	1.3	1.05	1.19	0.69	1	19.0	24.5	5340	3187	0.85	0.98	0.93	0.28	0.26	0.82	0.31	Liquefiable			
49.5	46	50	48	53	120	1.3	1.05	1.3	0.94	1	88.4	88.4	5760	3389	0.84	0.96	0.86	2.00	1.65	0.82	2.02	Non-Liquefiable			

Notes:

- (1) Energy Correction for N₆₀ of automatic hammer to standard N₆₀
- (2) Borehole Diameter Correction (Skempton, 1986)
- (3) Correction for split-spoon sampler with room for liners, but liners are absent. (Seed et al., 1984, 2001)
- (4) Overburden Correction. Calculated by Eq. 39 (Boulanger and Idriss, 2008)
- (5) Rod Length Correction for Samples <10 m in depth
- (6) N-value corrected for energy, borehole diameter, sampler with absent liners, rod length, and overburden
- (7) N-value corrected for fines content per Eqs. 75 and 76 (Boulanger and Idriss, 2008)
- (8) Stress Reduction Coefficient calculated by Eq. 22 (Boulanger and Idriss, 2008)
- (9) Magnitude Scaling Factor calculated by Eqns. A.8 & A.10 (Boulanger and Idriss, 2014)
- (10) Overburden Correction Factor calculated by Eq. 54 (Boulanger and Idriss, 2008)
- (11) Calculated by Eq. 70 (Boulanger and Idriss, 2008)
- (12) Calculated by Eq. 72 (Boulanger and Idriss, 2008)
- (13) Calculated by Eq. 25 (Boulanger and Idriss, 2008)

LIQUEFACTION INDUCED SETTLEMENTS

Project Name	Proposed Comm./Ind. Building
Project Location	San Bernardino, CA
Project Number	15G190
Engineer	DWN

Sample Depth (ft)	Depth to Top of Layer (ft)	Depth to Bottom of Layer (ft)	Depth to Midpoint (ft)	$(N_1)_{60}$	DN for fines content	$(N_1)_{60-CS}$	Liquefaction Factor of Safety	Limiting Shear Strain γ_{min}	Parameter $F\alpha$	Maximum Shear Strain γ_{max}	Height of Layer	Vertical Reconsolidation Strain ϵ_v	Total Deformation of Layer (in)	Comments
7	0	10	5	32.8	0.0	32.8	N/A	0.03	-0.28	0.00	10.00	0.000	0.00	Above Water Table
9.5	10	12	11	24.6	0.7	25.3	0.54	0.09	0.21	0.09	2.00	0.019	0.45	Liquefiable
14.5	12	16	14	23.6	0.7	24.3	0.44	0.10	0.27	0.10	4.00	0.019	0.93	Liquefiable
19.5	16	22	19	97.6	0.0	97.6	2.75	0.00	-5.84	0.00	6.00	0.000	0.00	Non-Liquefiable
24.5	22	24	23	50.6	0.0	50.6	2.57	0.00	-1.64	0.00	2.00	0.000	0.00	Non-Liquefiable
24.5	24	27	25.5	49.3	0.0	49.3	2.46	0.00	-1.53	0.00	3.00	0.000	0.00	Non-Liquefiable
29.5	27	32	29.5	10.0	5.6	15.6	N/A	0.26	0.73	0.00	5.00	0.000	0.00	Non-Liq: $PI > 12$ w<8%L
34.5	32	34.5	33.3	19.9	0.7	20.6	0.25	0.15	0.49	0.15	2.50	0.023	0.68	Liquefiable
34.5	34.5	36	35.3	19.4	2.5	22.0	0.27	0.13	0.41	0.13	1.50	0.021	0.38	Liquefiable
39.5	36	39	37.5	42.6	5.6	48.2	2.15	0.00	-1.44	0.00	3.00	0.000	0.00	Non-Liquefiable
39.5	39	43	41	40.2	0.7	40.9	2.10	0.01	-0.87	0.00	4.00	0.000	0.00	Non-Liquefiable
44.5	43	46	44.5	19.0	5.5	24.5	0.31	0.09	0.26	0.09	3.00	0.019	0.69	Liquefiable
49.5	46	50	48	88.4	0.0	88.4	2.02	0.00	-4.97	0.00	4.00	0.000	0.00	Non-Liquefiable
Total Deformation (in)													3.13	

Notes:

- (1) $(N_1)_{60}$ calculated previously for the individual layer
- (2) Correction for fines content per Equation 76 (Boulanger and Idriss, 2008)
- (3) Corrected $(N_1)_{60}$ for fines content
- (4) Factor of Safety against Liquefaction, calculated previously for the individual layer
- (5) Calculated by Eq. 86 (Boulanger and Idriss, 2008)
- (6) Calculated by Eq. 89 (Boulanger and Idriss, 2008)
- (7) Calculated by Eqs. 90, 91, and 92 (Boulanger and Idriss, 2008)
- (8) Volumetric Strain Induced in a Liquefiable Layer, Calculated by Eq. 96 (Boulanger and Idriss, 2008)
(Strain N/A if Factor of Safety against Liquefaction > 1.3)

LIQUEFACTION EVALUATION

Project Name	Proposed Comm./Ind. Building
Project Location	San Bernardino, CA
Project Number	15G190
Engineer	DWN

MCE_G Design Acceleration
 Design Magnitude
 Historic High Depth to Groundwater
 Depth to Groundwater at Time of Drilling
 Borehole Diameter

0.882 (g)
7.6 (ft)
10 (ft)
60 (ft)
6 (in)

Boring No.	Sample Depth (ft)	Depth to Top of Layer (ft)	Depth to Bottom of Layer (ft)	Depth to Midpoint (ft)	Uncorrected SPT N-Value	Unit Weight of Soil (pcf)	Fines Content (%)	Energy Correction	C _B	C _S	C _N	Rod Length Correction	(N ₁) ₆₀	(N ₁) _{60CS}	Overburden Stress (σ _v) (psf)	Eff. Overburden Stress (Hist. Water) (σ _v ') (psf)	Eff. Overburden Stress (Curr. Water) (σ _v ') (psf)	Stress Reduction Coefficient (r _d)	MSF	Ks	Cyclic Resistance Ratio (M=7.5)	Cyclic Resistance Ratio (M=7.6)	Cyclic Stress Ratio Induced by Design Earthquake	Factor of Safety	Comments
								(1)	(2)	(3)	(4)	(5)	(6)	(7)				(8)	(9)	(10)	(11)	(12)	(13)		
	7	0	10	5		120		1.3	1.05	1.1	1.70	0.75	0.0	0.0	600	600	600	1.00	1.00	1.07	0.06	0.06	N/A	N/A	Above Water Table
	9.5	10	11	10.5	6	120	8	1.3	1.05	1.1	1.33	0.75	9.0	9.3	1260	1229	1260	0.98	0.99	1.05	0.11	0.12	0.58	0.21	Liquefiable
	14.5	11	18	14.5	21	120	8	1.3	1.05	1.3	1.07	0.85	33.8	34.2	1740	1459	1740	0.97	0.96	1.09	0.94	0.99	0.66	1.49	Non-Liquefiable
	19.5	18	22	20	22	120	8	1.3	1.05	1.3	0.96	0.95	35.6	36.0	2400	1776	2400	0.95	0.96	1.05	1.37	1.38	0.74	1.87	Non-Liquefiable
	24.5	22	24	23	9	120	10	1.3	1.05	1.11	0.87	0.95	11.3	12.5	2760	1949	2760	0.94	0.99	1.01	0.14	0.14	0.76	0.18	Liquefiable
	24.5	24	27	25.5	9	120	90	1.3	1.05	1.11	0.84	0.95	10.9	16.4	3060	2093	3060	0.93	0.99	1	0.17	0.17	N/A	N/A	Non-Liq: PI>18
	29.5	27	29	28	14	120	8	1.3	1.05	1.17	0.81	0.95	17.2	17.5	3360	2237	3360	0.92	0.99	0.99	0.18	0.18	0.79	0.22	Liquefiable
	34.5	29	32	30.5	14	120	84	1.3	1.05	1.18	0.80	1	18.0	23.5	3660	2381	3660	0.91	0.98	0.98	0.26	0.25	N/A	N/A	Non-Liq: PI>18
	34.5	32	34	33	24	120	82	1.3	1.05	1.3	0.83	1	35.5	41.0	3960	2525	3960	0.90	0.96	0.95	2.00	1.82	0.81	2.24	Non-Liquefiable
	39.5	34	38	36	24	120	18	1.3	1.05	1.3	0.80	1	34.2	38.2	4320	2698	4320	0.89	0.96	0.93	2.00	1.78	0.82	2.18	Non-Liquefiable
	39.5	38	42	40	10	120	52	1.3	1.05	1.1	0.68	1	10.2	15.8	4800	2928	4800	0.87	0.99	0.96	0.16	0.15	0.82	0.19	Liquefiable
	44.5	42	44	43	27	120	21	1.3	1.05	1.3	0.77	1	37.1	41.7	5160	3101	5160	0.86	0.96	0.89	2.00	1.70	0.82	2.07	Non-Liquefiable
	49.5	44	47	45.5	27	120	9	1.3	1.05	1.3	0.74	1	35.3	36.0	5460	3245	5460	0.85	0.96	0.88	1.37	1.16	0.82	1.41	Non-Liquefiable
	50.5	47	50	48.5	43	120	4	1.3	1.05	1.3	0.84	1	64.4	64.4	5820	3418	5820	0.84	0.96	0.86	2.00	1.65	0.82	2.01	Non-Liquefiable

Notes:

- (1) Energy Correction for N₆₀ of automatic hammer to standard N₆₀
- (2) Borehole Diameter Correction (Skempton, 1986)
- (3) Correction for split-spoon sampler with room for liners, but liners are absent. (Seed et al., 1984, 2001)
- (4) Overburden Correction, Calculated by Eq. 39 (Boulanger and Idriss, 2008)
- (5) Rod Length Correction for Samples <10 m in depth
- (6) N-value corrected for energy, borehole diameter, sampler with absent liners, rod length, and overburden
- (7) N-value corrected for fines content per Eqs. 75 and 76 (Boulanger and Idriss, 2008)
- (8) Stress Reduction Coefficient calculated by Eq. 22 (Boulanger and Idriss, 2008)
- (9) Magnitude Scaling Factor calculated by Eqns. A.8 & A.10 (Boulanger and Idriss, 2014)
- (10) Overburden Correction Factor calculated by Eq. 54 (Boulanger and Idriss, 2008)
- (11) Calculated by Eq. 70 (Boulanger and Idriss, 2008)
- (12) Calculated by Eq. 72 (Boulanger and Idriss, 2008)
- (13) Calculated by Eq. 25 (Boulanger and Idriss, 2008)

LIQUEFACTION INDUCED SETTLEMENTS

Project Name	Proposed Comm./Ind. Building
Project Location	San Bernardino, CA
Project Number	15G190
Engineer	DWN

Sample Depth (ft)	Depth to Top of Layer (ft)	Depth to Bottom of Layer (ft)	Depth to Midpoint (ft)	$(N_1)_{60}$	DN for fines content	$(N_1)_{60-CS}$	Liquefaction Factor of Safety	Limiting Shear Strain γ_{min}	Parameter F_d	Maximum Shear Strain γ_{max}	Height of Layer	Vertical Reconsolidation Strain ϵ_v	Total Deformation of Layer (in)	Comments
7	0	10	5	0.0	0.0	0.0	N/A	0.50	0.95	0.00	10.00	0.000	0.00	Above Water Table
9.5	10	11	10.5	9.0	0.4	9.3	0.21	0.50	0.93	0.50	1.00	0.039	0.47	Liquefiable
14.5	11	18	14.5	33.8	0.4	34.2	1.49	0.03	-0.38	0.01	7.00	0.000	0.00	Non-Liquefiable
19.5	18	22	20	35.6	0.4	36.0	1.87	0.02	-0.51	0.00	4.00	0.000	0.00	Non-Liquefiable
24.5	22	24	23	11.3	1.1	12.5	0.18	0.36	0.85	0.36	2.00	0.033	0.78	Liquefiable
24.5	24	27	25.5	10.9	5.5	16.4	N/A	0.24	0.70	0.00	3.00	0.000	0.00	Non-Liq: $PI > 18$
29.5	27	29	28	17.2	0.4	17.5	0.22	0.21	0.64	0.21	2.00	0.026	0.61	Liquefiable
34.5	29	32	30.5	18.0	5.5	23.5	N/A	0.11	0.32	0.00	3.00	0.000	0.00	Non-Liq: $PI > 18$
34.5	32	34	33	35.5	5.5	41.0	2.24	0.01	-0.88	0.00	2.00	0.000	0.00	Non-Liquefiable
39.5	34	38	36	34.2	4.1	38.2	2.18	0.01	-0.67	0.00	4.00	0.000	0.00	Non-Liquefiable
39.5	38	42	40	10.2	5.6	15.8	0.19	0.25	0.72	0.25	4.00	0.028	1.33	Liquefiable
44.5	42	44	43	37.1	4.6	41.7	2.07	0.01	-0.93	0.00	2.00	0.000	0.00	Non-Liquefiable
49.5	44	47	45.5	35.3	0.7	36.0	1.41	0.02	-0.51	0.02	3.00	0.000	0.00	Non-Liquefiable
50.5	47	50	48.5	64.4	0.0	64.4	2.01	0.00	-2.80	0.00	3.00	0.000	0.00	Non-Liquefiable
Total Deformation (in)													3.19	

Notes:

- (1) $(N_1)_{60}$ calculated previously for the individual layer
- (2) Correction for fines content per Equation 76 (Boulanger and Idriss, 2008)
- (3) Corrected $(N_1)_{60}$ for fines content
- (4) Factor of Safety against Liquefaction, calculated previously for the individual layer
- (5) Calculated by Eq. 86 (Boulanger and Idriss, 2008)
- (6) Calculated by Eq. 89 (Boulanger and Idriss, 2008)
- (7) Calculated by Eqs. 90, 91, and 92 (Boulanger and Idriss, 2008)
- (8) Volumetric Strain Induced in a Liquefiable Layer, Calculated by Eq. 96 (Boulanger and Idriss, 2008)
(Strain N/A if Factor of Safety against Liquefaction > 1.3)

APPENDIX G

JOB NO.: 06G181	DRILLING DATE: 5/30/06	WATER DEPTH: Dry
PROJECT: Central Ave Site B	DRILLING METHOD: Hollow Stem Auger	CAVE DEPTH: 38 feet
LOCATION: San Bernardino, California	LOGGED BY: Daryl Kas	READING TAKEN: At Completion

FIELD RESULTS					DESCRIPTION	LABORATORY RESULTS					COMMENTS	
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG		DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)		UNCONFINED SHEAR (TSF)
SURFACE ELEVATION: --- MSL												
					FILL: Gray to Dark Gray Brown Silty fine Sand, loose-damp	88	6					EI = 0 @ 0 to 5'
		8										
					FILL: Dark Brown fine Sand, trace medium Sand, little Silt, trace Brick and Asphalt fragments, loose-dry	94	6					
5		14										
					ALLUVIUM: Orange Brown fine Sand, slightly porous, loose-damp	90	5					
		11										
					Dark Gray Brown Silty fine Sand, trace Iron oxide staining, medium dense-damp	97	9					
		19			ALLUVIUM: Light Brown fine Sand, medium dense-dry to damp							
10		22				101	4					
					Brown Silty fine Sand, medium dense-damp							
							9		21			
15		19										
					ALLUVIUM: Gray Brown fine to medium Sand, trace fine Gravel, medium dense-dry					4		
20		27					3					
					ALLUVIUM: Gray to Green Gray Silty Clay, some fine Sand, stiff-very moist					59		
25		9	1.0				55					
					ALLUVIUM: Interbedded Dark Gray Clayey Silt with Silty fine Sand, very stiff to medium dense-very moist					50		
30		25					44					
					ALLUVIUM: Brown Silty fine Sand, medium dense-damp to moist					19		
34							12					

TBL 06G181.GPJ_SOCALGEO.GDT 8/13/06

FIELD RESULTS					DESCRIPTION							LABORATORY RESULTS					COMMENTS	
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	(Continued)							DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)		UNCONFINED SHEAR (TSF)
40	X	20		[Symbol: Dotted pattern]	<u>ALLUVIUM</u> : Brown Silty fine Sand, medium dense-damp to moist													
45	X	20		[Symbol: Dotted pattern]	<u>ALLUVIUM</u> : Orange Brown fine to medium Sand, medium dense-damp to moist								15				7	
50	X	26		[Symbol: Dotted pattern]	<u>ALLUVIUM</u> : Gray fine Sandy Silt to Silty fine Sand, medium dense-moist								24				36	
50					Boring Terminated at 50'													

TEL. 06G181.GPJ SOCALGEO.GDT 8/13/06

FIELD RESULTS				DESCRIPTION	LABORATORY RESULTS					COMMENTS	
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)		GRAPHIC LOG	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT		PASSING #200 SIEVE (%)
				SURFACE ELEVATION: --- MSL							
		11		[Symbol]	FILL: Brown Silty fine Sand, trace medium Sand, trace fine Gravel, loose-dry to damp	111	3				
		11		[Symbol]	@ 3 to 3½ feet, Dark Gray Brown fine Sandy Clay, medium stiff-damp	82					
5		17		[Symbol]	ALLUVIUM: Light Brown fine to medium Sand, loose-dry	122	2				
		22		[Symbol]	ALLUVIUM: Light Brown fine to coarse Sand and fine to coarse Gravel, Iron oxide staining, medium dense-dry	110	1				
10		38		[Symbol]		121	1				
		27		[Symbol]			3		8		
15		30		[Symbol]	ALLUVIUM: Light Brown to Orange Brown fine Sand, medium dense-dry		3		4		
20		14		[Symbol]	ALLUVIUM: Dark Gray fine Sandy Silt to Silty fine Sand, trace Clay, medium dense-moist to very moist		24		44		
25		17		[Symbol]			27		54		
30		16		[Symbol]	ALLUVIUM: Dark Gray Silty fine Sand, medium dense-very moist		25		15		
		0.75		[Symbol]	ALLUVIUM: Dark Gray Clayey Silt, little fine Sand, stiff-very	66			81		

TBL_06G181.GPJ SOCALGEO.GDT 6/13/06

JOB NO.: 06G181	DRILLING DATE: 5/30/06	WATER DEPTH: Dry
PROJECT: Central Ave Site B	DRILLING METHOD: Hollow Stem Auger	CAVE DEPTH: 34 feet
LOCATION: San Bernardino, California	LOGGED BY: Daryl Kas	READING TAKEN: At Completion

FIELD RESULTS					LABORATORY RESULTS							COMMENTS				
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION					DRY DENSITY (PCF)	MOISTURE CONTENT (%)		LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)
					(Continued)											
40	X	10	3.0		moist <u>ALLUVIUM</u> : Dark Gray Clayey Silt, little fine Sand, stiff-very moist						41			72		
45	X	14			<u>ALLUVIUM</u> : Dark Gray Silty Clay, some fine Sand, stiff to very stiff-very moist											
45	X	14			<u>ALLUVIUM</u> : Dark Gray Silty fine Sand, medium dense-very moist						25			31		
50	X	45			<u>ALLUVIUM</u> : Light Brown fine to medium Sand, trace fine Gravel, dense-dry to damp						3			4		
					Boring Terminated at 50'											

TBL 06G181.GPJ SOCALGEO.GDT 6/13/06

JOB NO.: 06G181				DRILLING DATE: 5/30/06				WATER DEPTH: Dry								
PROJECT: Central Ave Site B				DRILLING METHOD: Hollow Stem Auger				CAVE DEPTH: 12 feet								
LOCATION: San Bernardino, California				LOGGED BY: Daryl Kas				READING TAKEN: At Completion								
FIELD RESULTS					LABORATORY RESULTS											
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION					DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	COMMENTS
					SURFACE ELEVATION: --- MSL											
				[Symbol]	FILL: Brown Silty fine Sand, trace fine root fibers, loose-damp						10					
				[Symbol]	POSSIBLE FILL: Brown Silty fine Sand to fine Sandy Silt, loose-dry						8					
				[Symbol]	ALLUVIUM: Light Brown Silty fine Sand, loose-dry to damp						6					
				[Symbol]	ALLUVIUM: Gray Brown fine Sandy Silt, little Clay, loose-moist						31					
				[Symbol]	ALLUVIUM: Light Brown fine Sand, medium dense-dry						2					
15					Boring Terminated at 15'											

TBL_06G181.GPJ SOCIALGEO.GDT 6/13/06

JOB NO.: 06G181	DRILLING DATE: 5/30/06	WATER DEPTH: Dry
PROJECT: Central Ave Site B	DRILLING METHOD: Hollow Stem Auger	CAVE DEPTH: 13 feet
LOCATION: San Bernardino, California	LOGGED BY: Daryl Kas	READING TAKEN: At Completion

FIELD RESULTS					DESCRIPTION	LABORATORY RESULTS						COMMENTS
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG		DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	
					SURFACE ELEVATION: --- MSL							
	X	7		[Symbol]	<u>POSSIBLE FILL:</u> Brown Silty fine Sand, loose-dry to damp		9					
	X	8		[Symbol]	<u>ALLUVIUM:</u> Gray Brown to Red Brown Silty fine Sand, loose-dry		6					
5	X	10		[Symbol]	<u>ALLUVIUM:</u> Orange Brown fine Sand, trace Silt, dense-damp to moist		5					
10	X	10		[Symbol]			16					
15	X	41		[Symbol]	<u>ALLUVIUM:</u> Gray Brown fine to medium Sand, occasional fine to coarse Gravel, dense-damp		3					
20	X	39		[Symbol]			4					
					Boring Terminated at 20'							

TBL_06G181.GPJ SOCALGEO.GDT 6/13/06

JOB NO.: 06G181	DRILLING DATE: 5/30/06	WATER DEPTH: Dry
PROJECT: Central Ave Site B	DRILLING METHOD: Hollow Stem Auger	CAVE DEPTH: 11 feet
LOCATION: San Bernardino, California	LOGGED BY: Daryl Kas	READING TAKEN: At Completion

FIELD RESULTS					DESCRIPTION	LABORATORY RESULTS						COMMENTS
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG		DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	
					SURFACE ELEVATION: --- MSL							
	X	21		[Pattern]	<u>FILL</u> : Gray Brown to Orange Brown Silty fine Sand, trace medium Sand, trace fine root fibers, medium dense-damp to moist	109	6					
	X	14		[Pattern]	<u>FILL</u> : Dark Gray fine Sandy Silt mixed with Light Gray Brown fine to medium Sand, loose-moist	83	24					
5	X	21		[Pattern]	<u>ALLUVIUM</u> : Light Gray fine Sand, medium dense-dry	96	3					
	X	15		[Pattern]	Gray Brown to Orange Brown fine Sand, some Silt, trace fine Gravel, medium dense-damp to moist	94	10					
10	X	17		[Pattern]		97	6					
	X	27		[Pattern]	<u>ALLUVIUM</u> : Gray Brown Silty fine Sand, Iron oxide staining, medium dense-damp to moist		10					
	X	50/4"		[Pattern]	Sample Lost-No Recovery							
20	X			[Pattern]	Boring Terminated at 20'							

TBL 06G181.GPJ_SOCAL.GEO.GDT 6/13/06

JOB NO.: 06G181	DRILLING DATE: 5/30/06	WATER DEPTH: Dry
PROJECT: Central Ave Site B	DRILLING METHOD: Hollow Stem Auger	CAVE DEPTH: 17 feet
LOCATION: San Bernardino, California	LOGGED BY: Daryl Kas	READING TAKEN: At Completion

FIELD RESULTS					DESCRIPTION	LABORATORY RESULTS						COMMENTS
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG		DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	
					SURFACE ELEVATION: --- MSL							
	4				<u>POSSIBLE FILL</u> : Gray Brown Silty fine Sand, loose-damp to moist		15					
	8				<u>ALLUVIUM</u> : Gray Brown Silty fine Sand, occasional iron oxide staining, loose-dry to damp		8					
5	10				<u>ALLUVIUM</u> : Orange Brown fine Sand, medium dense-dry to damp		6					
	13				@ 8 to 10 feet, 1 1/2 inch lense of Gray fine Sandy Silt, moist to very moist		29					
10	17				<u>ALLUVIUM</u> : Gray Brown Silty fine to medium Sand, trace fine Gravel, medium dense-damp		10					
15	20				<u>ALLUVIUM</u> : Light Brown fine Sand, very dense-dry to damp		8					
20	58						2					
25					Boring Terminated at 25'							

TBL_06G181.GPJ_SOCALGEO.GDT 6/13/06

JOB NO.: 06G181				DRILLING DATE: 5/30/06				WATER DEPTH: Dry				
PROJECT: Central Ave Site B				DRILLING METHOD: Hollow Stem Auger				CAVE DEPTH: 18 feet				
LOCATION: San Bernardino, California				LOGGED BY: Daryl Kas				READING TAKEN: At Completion				
FIELD RESULTS					LABORATORY RESULTS							
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	COMMENTS
					SURFACE ELEVATION: --- MSL							
5	5			[Symbol]	FILL: Light Gray Silty fine Sand, loose-damp	94	6					
	19			[Symbol]	FILL: Gray Brown Silty fine Sand, trace organic debris, medium dense-damp	91	6					
	12			[Symbol]	ALLUVIUM: Orange Brown fine Sand, trace Silt, loose-dry to damp	96	5					
	19			[Symbol]	Light Brown fine Sand, trace Silt, medium dense-dry	95	4					
	23			[Symbol]	Brown fine Sand, trace medium Sand, Iron oxide staining, medium dense-dry to damp	104	4					
	32			[Symbol]	Gray Brown fine Sand, little Silt, medium dense-damp to moist	100	7					
	51			[Symbol]	Light Gray Brown fine to medium Sand, little fine Gravel, dense-dry to damp							Disturbed Sample
20					Boring Terminated at 20'							

TEL. 06G181.GPJ_SOCAL.GEO.GDT 6/13/06

INC.

FIELD RESULTS					DESCRIPTION							LABORATORY RESULTS					COMMENTS		
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	SURFACE ELEVATION: --- MSL							DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)		UNCONFINED SHEAR (TSF)	
					<u>POSSIBLE FILL:</u> Gray Silty fine Sand, loose-damp								8						
5	X	6			<u>ALLUVIUM:</u> Gray Brown Silty fine Sand, trace fine Gravel, loose-dry to damp								7						
	X	10			<u>ALLUVIUM:</u> Orange Brown fine Sand, trace Silt, Iron oxide staining, loose to medium dense-dry to damp								5						
10	X	9											7						
15	X	19			Boring Terminated at 15'								5						

TBL 06G181.GPJ SOCALGEO.GDT 6/13/06

FIELD RESULTS				DESCRIPTION	LABORATORY RESULTS						COMMENTS	
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)		GRAPHIC LOG	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)		UNCONFINED SHEAR (TSF)
SURFACE ELEVATION: --- MSL												
7	X	7		[Symbol]	FILL: Gray Silty fine Sand, trace Asphalt fragments, loose-damp	94	10					
11	X	11		[Symbol]	FILL: Dark Gray Brown Silty fine Sand to fine Sand Silt, occasional Iron oxide staining, loose-damp	93	10					
5	X	15		[Symbol]	ALLUVIUM: Orange Brown fine Sand, little Silt, medium dense-damp	102	4					
12	X	12	2.5	[Symbol]	Gray Brown Silty Clay to Clayey Silt, extensive Iron oxide staining, stiff-moist	94	13					
10	X	36		[Symbol]	ALLUVIUM: Light Orange Brown fine Sand, trace Silt, medium dense-dry to damp	104	4					
15	X	12		[Symbol]	Gray Brown Silty fine Sand, medium dense-damp		11					
20	X	50/3"		[Symbol]	Brown fine to medium Sand, some fine to coarse Gravel, dense to very dense-dry to damp		2					
Boring Terminated at 20'												

TBL_06G181.GPJ_SOCAL.GEO.GDT 6/13/06

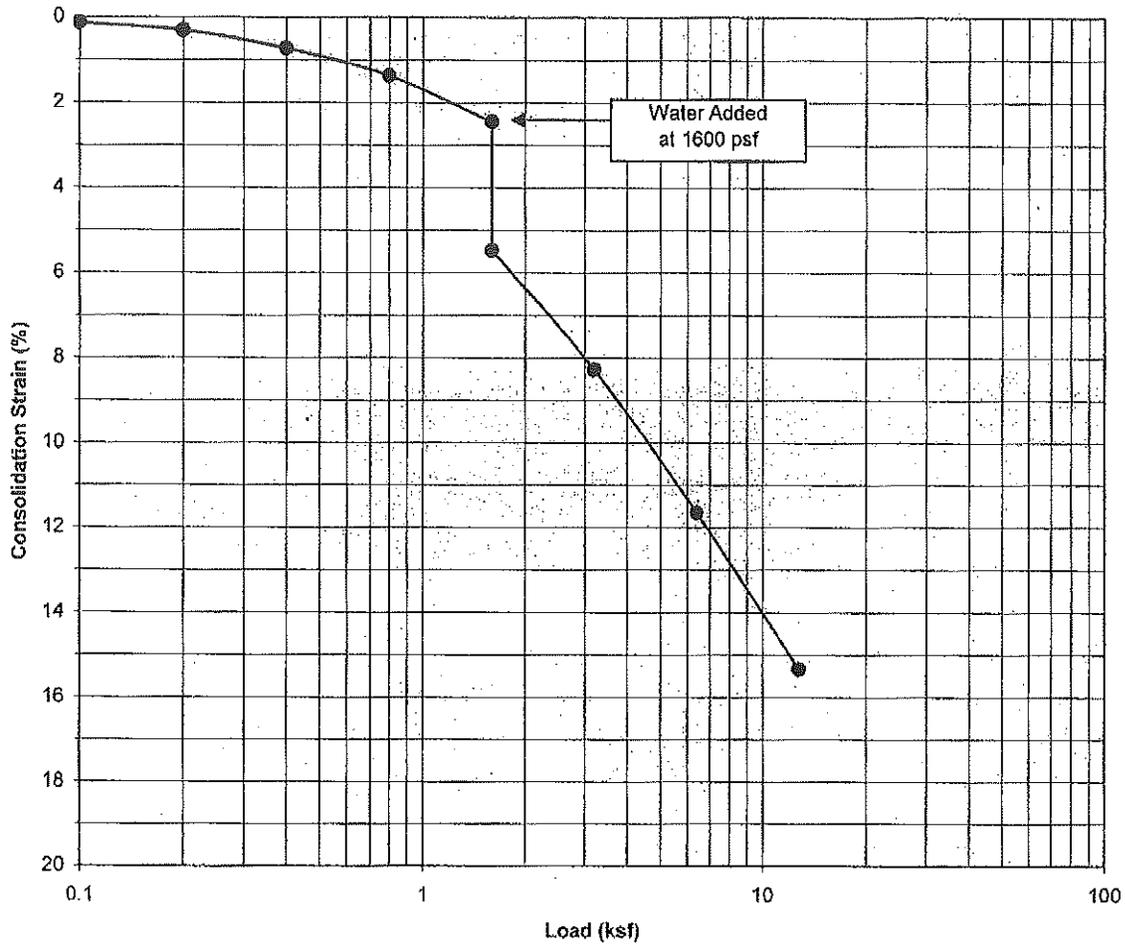
INC.

JOB NO.: 06G181	DRILLING DATE: 6/7/06	WATER DEPTH: Dry
PROJECT: Central Ave Site B	DRILLING METHOD: Hand Auger	CAVE DEPTH: 10 feet
LOCATION: San Bernardino, California	LOGGED BY: Daryl Kas	READING TAKEN: At Completion

FIELD RESULTS					DESCRIPTION	LABORATORY RESULTS						COMMENTS
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG		DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	
					SURFACE ELEVATION: --- MSL							
5	▲				ALLUVIUM: Light Brown Silty fine Sand, loose-dry to damp	87	5					
	▲				@ 3 to 4 feet, loose	97	6					
	▲				ALLUVIUM: Brown to Light Brown fine Sand, some Oxidation staining, little Silt, loose-dry to damp	90	6					
	▲					99	2					
	▲					99	7					
10					Boring Terminated at 10'							

TEL 06G181.GPJ SOCALGEO.GDT 6/13/06

Consolidation/Collapse Test Results



Classification: FILL: Gray to Dark Gray Brown Silty fine Sand

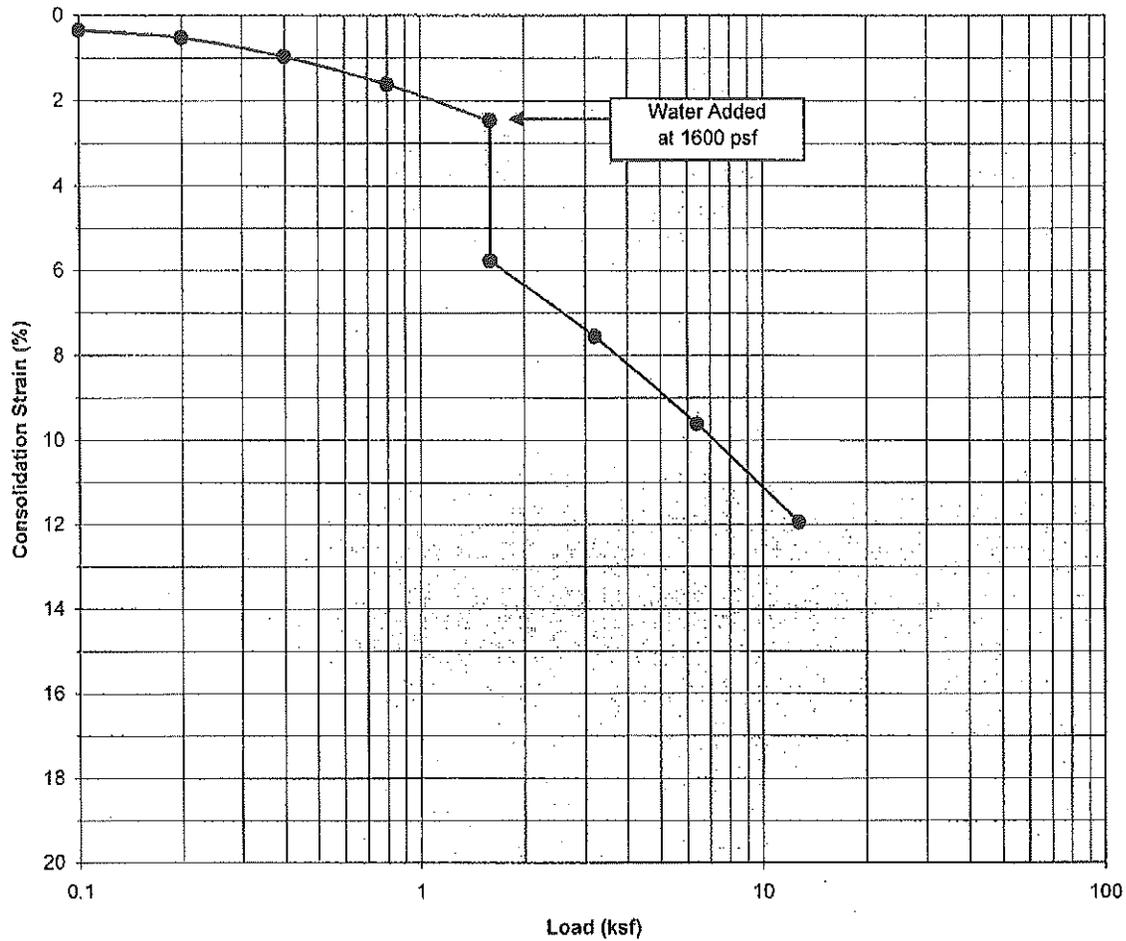
Boring Number:	B-1	Initial Moisture Content (%)	7
Sample Number:	---	Final Moisture Content (%)	24
Depth (ft)	1 to 2	Initial Dry Density (pcf)	87.5
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	103.1
Specimen Thickness (in)	1.0	Percent Collapse (%)	3.03

Central Avenue Site B
 San Bernardino, California
 Project No. 06G181
PLATE C- 1

Southern California Geotechnical

1260 North Hancock Street, Suite 101
 Anaheim, California 92807
 Phone: (714) 777-0333 Fax: (714) 777-0398

Consolidation/Collapse Test Results



Classification: FILL: Dark Brown fine Sand, trace medium Sand, little Silt

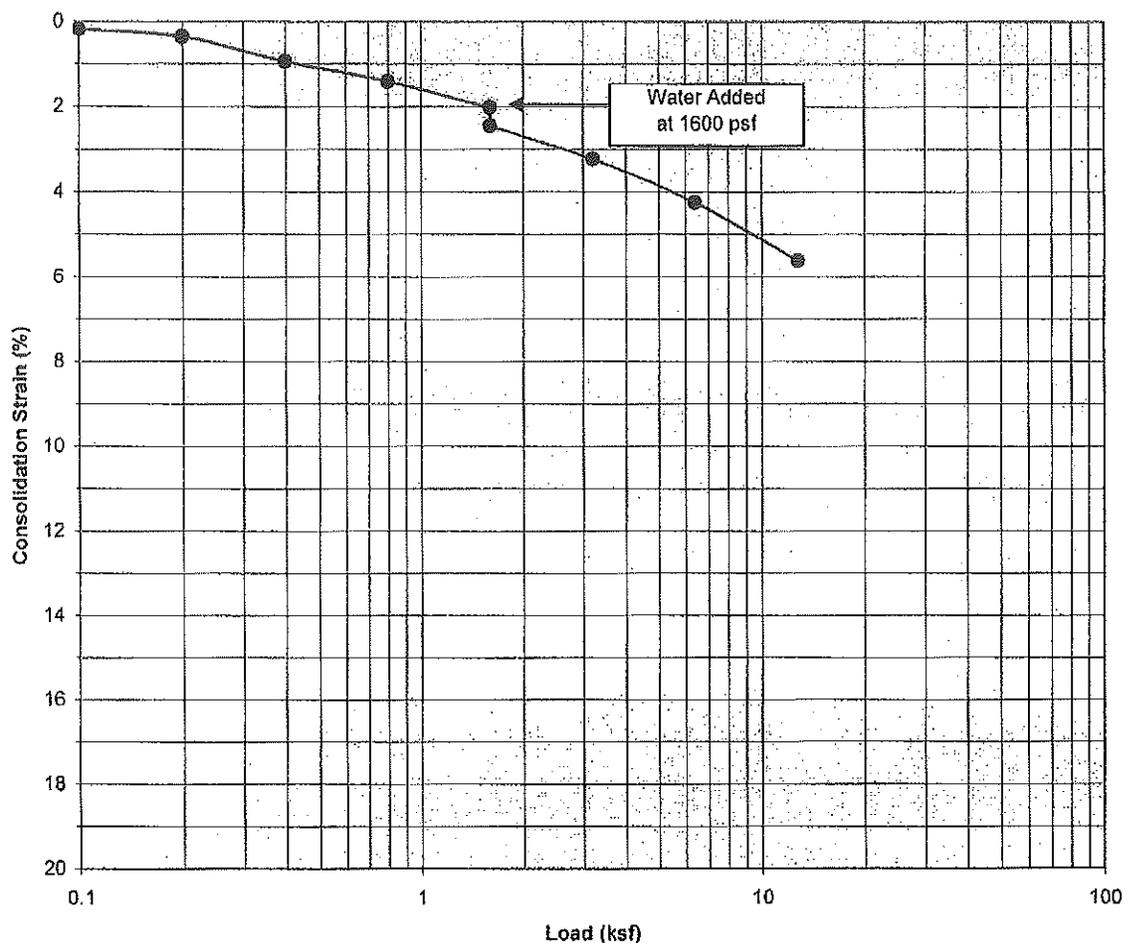
Boring Number:	B-1	Initial Moisture Content (%)	5
Sample Number:	---	Final Moisture Content (%)	19
Depth (ft)	3 to 4	Initial Dry Density (pcf)	92.9
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	105.8
Specimen Thickness (in)	1.0	Percent Collapse (%)	3.30

Central Avenue Site B
 San Bernardino, California
 Project No. 06G181
PLATE C- 2

Southern California Geotechnical

1260 North Hancock Street, Suite 101
 Anaheim, California 92807
 Phone: (714) 777-0333 Fax: (714) 777-0398

Consolidation/Collapse Test Results



Classification: ALLUVIUM: Orange Brown fine Sand

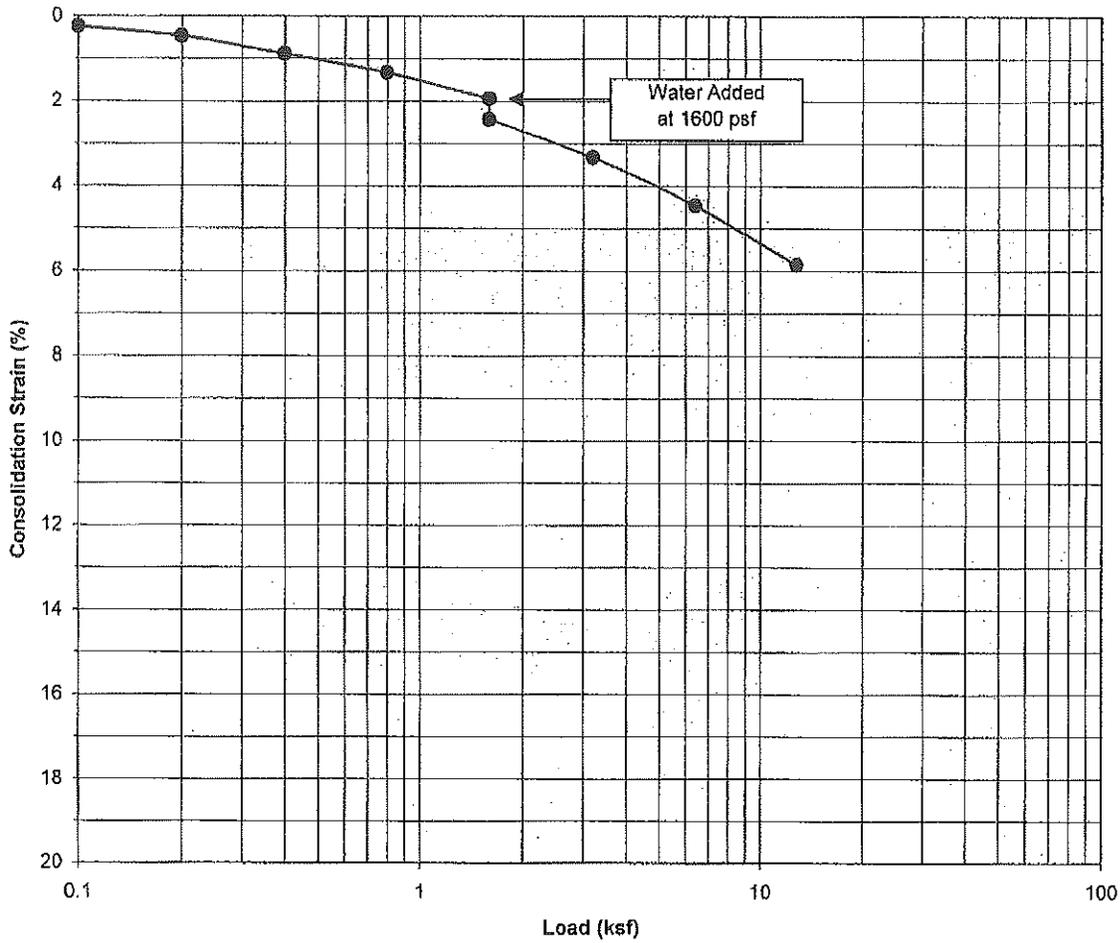
Boring Number:	B-1	Initial Moisture Content (%)	6
Sample Number:	---	Final Moisture Content (%)	23
Depth (ft)	5 to 6	Initial Dry Density (pcf)	90.3
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	95.7
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.43

Central Avenue Site B
 San Bernardino, California
 Project No. 06G181
PLATE C- 3

Southern California Geotechnical

1260 North Hancock Street, Suite 101
 Anaheim, California 92807
 Phone: (714) 777-0333 Fax: (714) 777-0398

Consolidation/Collapse Test Results



Classification: Dark Gray Brown Silty fine Sand

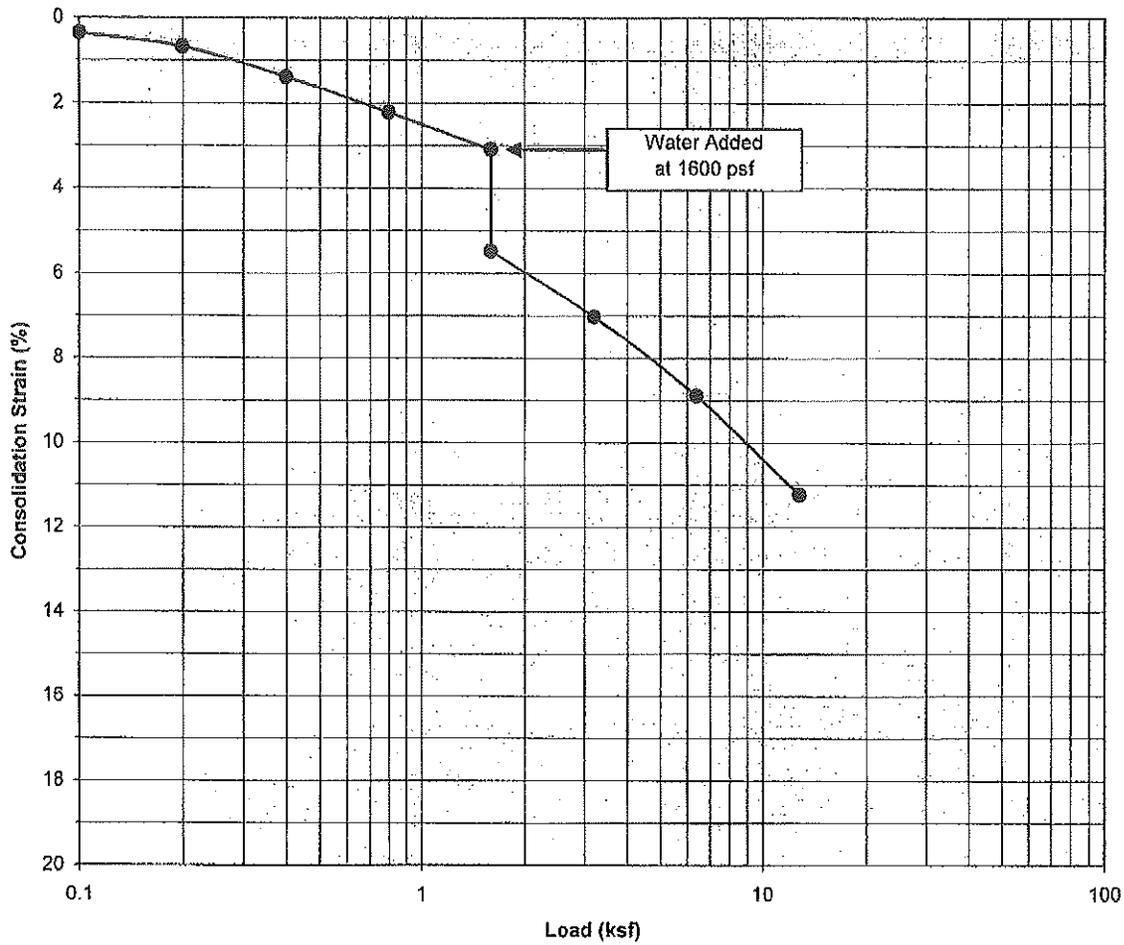
Boring Number:	B-1	Initial Moisture Content (%)	8
Sample Number:	---	Final Moisture Content (%)	18
Depth (ft)	7 to 8	Initial Dry Density (pcf)	97.3
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	103.2
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.49

Central Avenue Site B
 San Bernardino, California
 Project No. 06G181
PLATE C- 4

Southern California Geotechnical

1260 North Hancock Street, Suite 101
 Anaheim, California 92807
 Phone: (714) 777-0333 Fax: (714) 777-0398

Consolidation/Collapse Test Results



Classification: FILL: Brown Silty fine Sand, trace medium Sand, trace fine Gravel

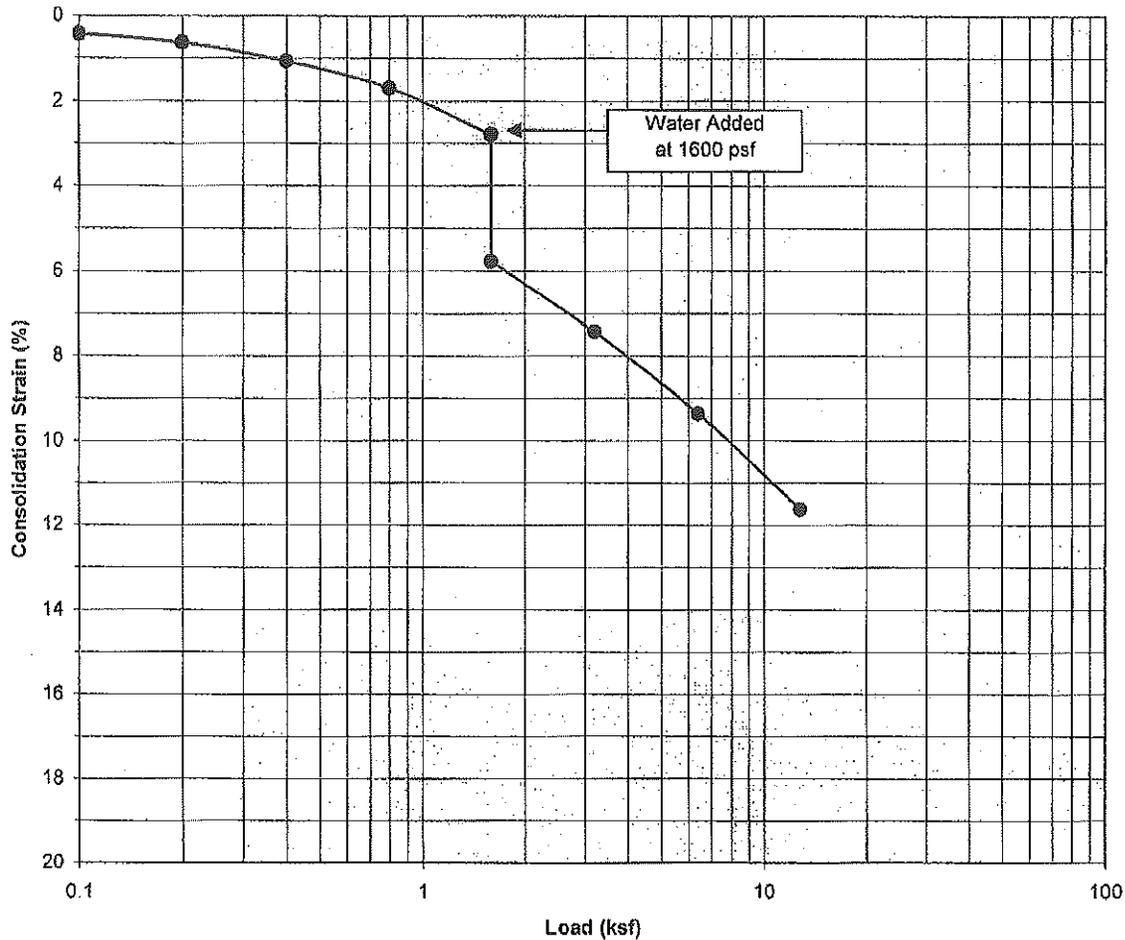
Boring Number:	B-2	Initial Moisture Content (%)	7
Sample Number:	---	Final Moisture Content (%)	17
Depth (ft)	1 to 2	Initial Dry Density (pcf)	107.5
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	121.1
Specimen Thickness (in)	1.0	Percent Collapse (%)	2.39

Central Avenue Site B
 San Bernardino, California
 Project No. 06G181
PLATE C- 5

Southern California Geotechnical

1260 North Hancock Street, Suite 101
 Anaheim, California 92807
 Phone: (714) 777-0333 Fax: (714) 777-0398

Consolidation/Collapse Test Results



Classification: ALLUVIUM: Light Brown fine to medium Sand

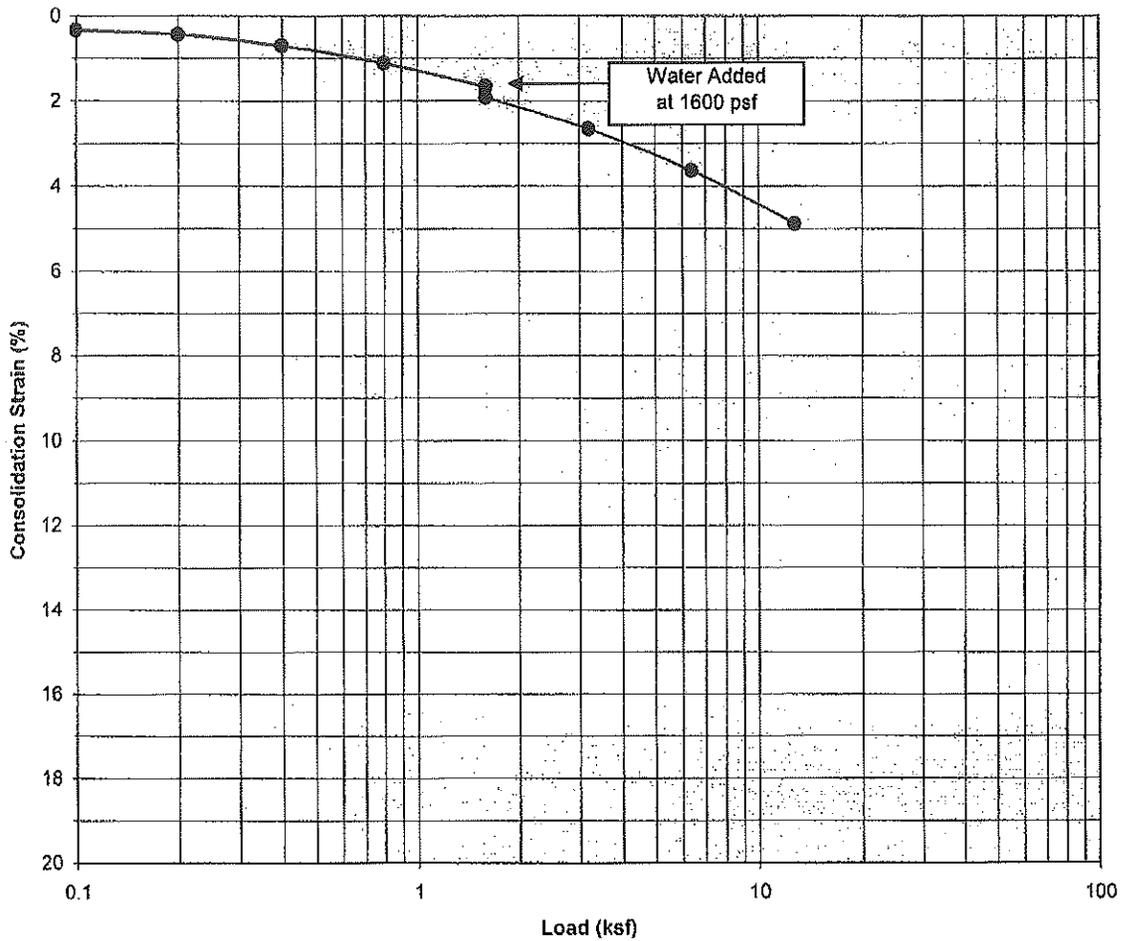
Boring Number:	B-2	Initial Moisture Content (%)	3
Sample Number:	---	Final Moisture Content (%)	17
Depth (ft)	3 to 4	Initial Dry Density (pcf)	91.3
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	103.4
Specimen Thickness (in)	1.0	Percent Collapse (%)	2.99

Central Avenue Site B
 San Bernardino, California
 Project No. 06G181
PLATE C- 6

Southern California Geotechnical

1260 North Hancock Street, Suite 101
 Anaheim, California 92807
 Phone: (714) 777-0333 Fax: (714) 777-0398

Consolidation/Collapse Test Results



Classification: ALLUVIUM: Light Brown fine to coarse Sand and fine to coarse Gravel

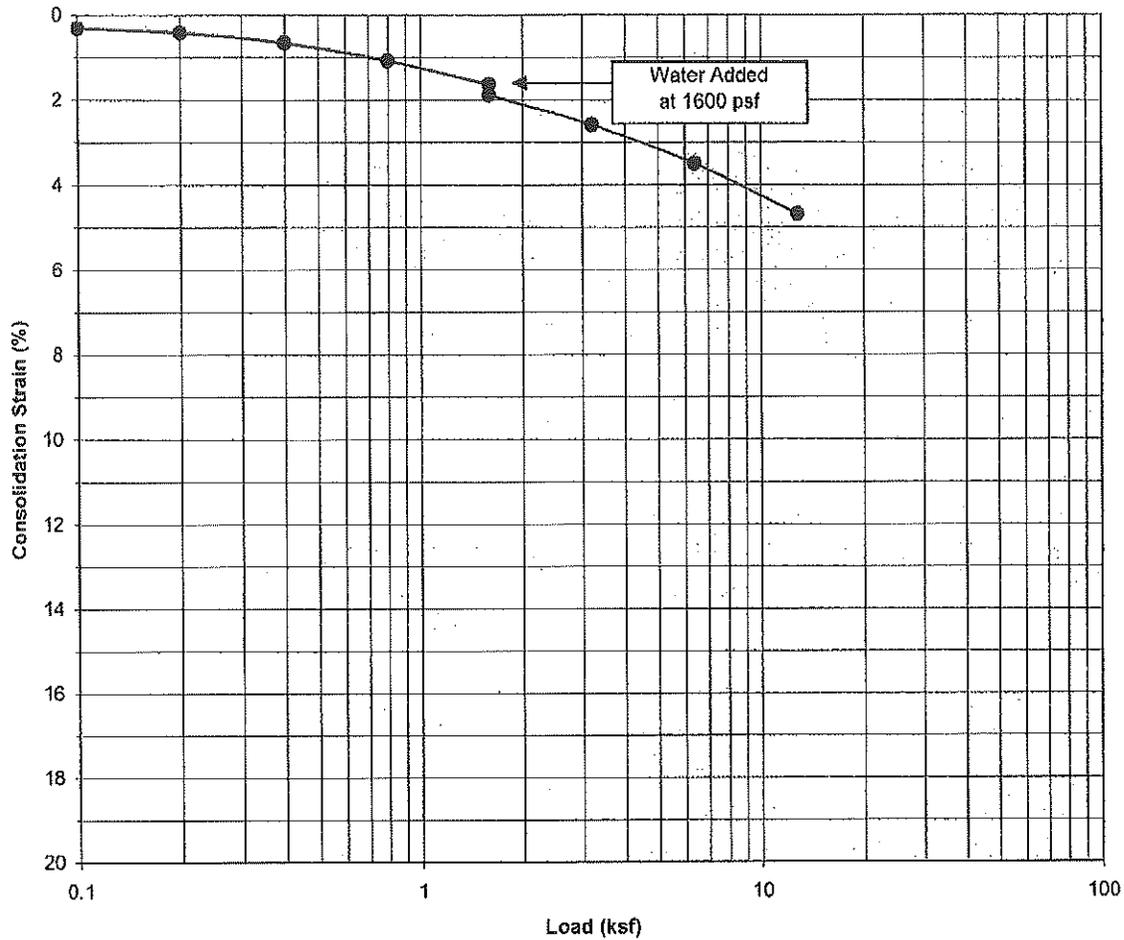
Boring Number:	B-2	Initial Moisture Content (%)	1
Sample Number:	---	Final Moisture Content (%)	11
Depth (ft)	5 to 6	Initial Dry Density (pcf)	117.4
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	123.2
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.25

Central Avenue Site B
 San Bernardino, California
 Project No. 06G181
PLATE C-7

Southern California Geotechnical

1260 North Hancock Street, Suite 101
 Anaheim, California 92807
 Phone: (714) 777-0333 Fax: (714) 777-0398

Consolidation/Collapse Test Results



Classification: ALLUVIUM: Light Brown fine to coarse Sand and fine to coarse Gravel

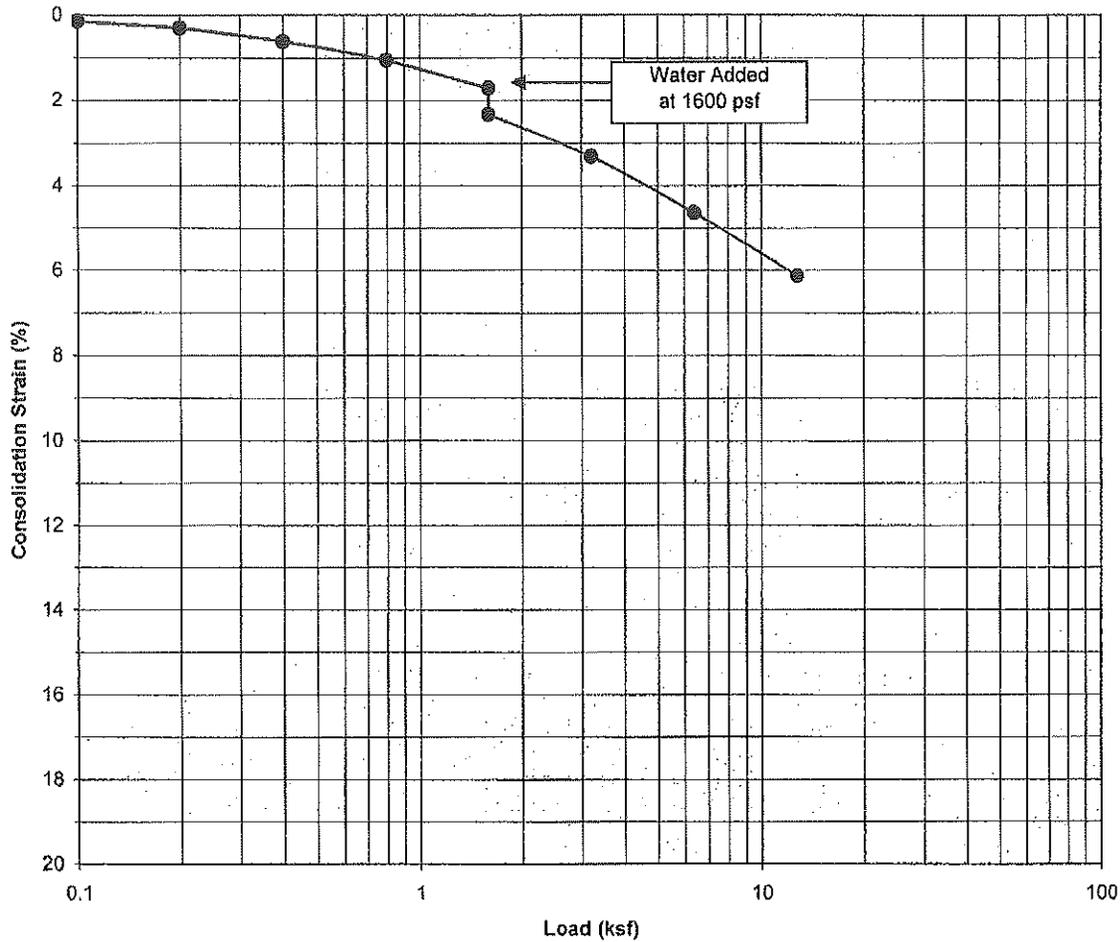
Boring Number:	B-2	Initial Moisture Content (%)	1
Sample Number:	---	Final Moisture Content (%)	16
Depth (ft)	7 to 8	Initial Dry Density (pcf)	109.0
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	115.2
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.25

Central Avenue Site B
 San Bernardino, California
 Project No. 06G181
PLATE C- 8

Southern California Geotechnical

1260 North Hancock Street, Suite 101
 Anaheim, California 92807
 Phone: (714) 777-0333 Fax: (714) 777-0398

Consolidation/Collapse Test Results



Classification: FILL: Gray Silty fine Sand

Boring Number:	B-9	Initial Moisture Content (%)	10
Sample Number:	---	Final Moisture Content (%)	29
Depth (ft)	1 to 2	Initial Dry Density (pcf)	94.4
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	100.0
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.61

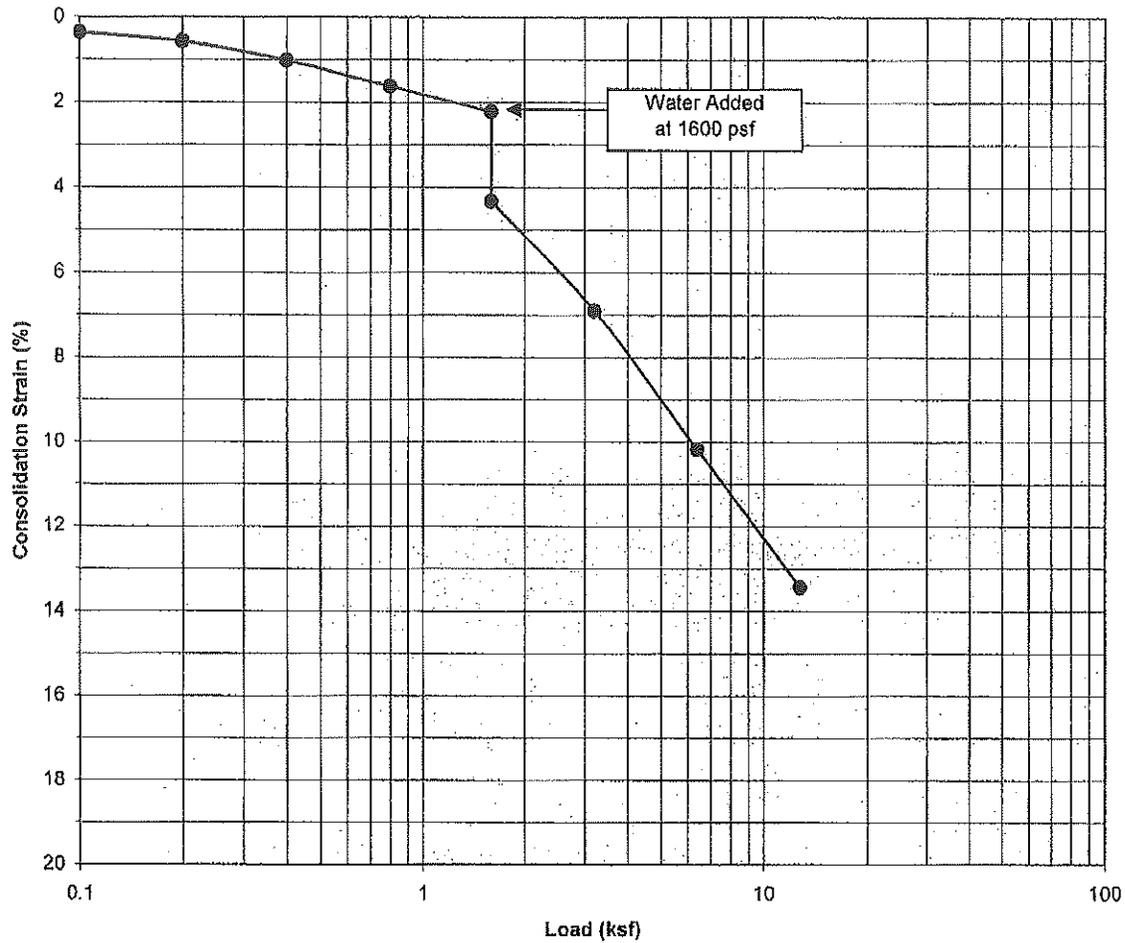
Central Avenue Site B
San Bernardino, California
Project No. 06G181

PLATE C- 9

Southern California Geotechnical

1280 North Hanesok Street, Suite 101
Anaheim, California 92807
Phone: (714) 777-0333 Fax: (714) 777-0398

Consolidation/Collapse Test Results



Classification: FILL: Dark Gray Brown Silty fine Sand to fine Sand Silt

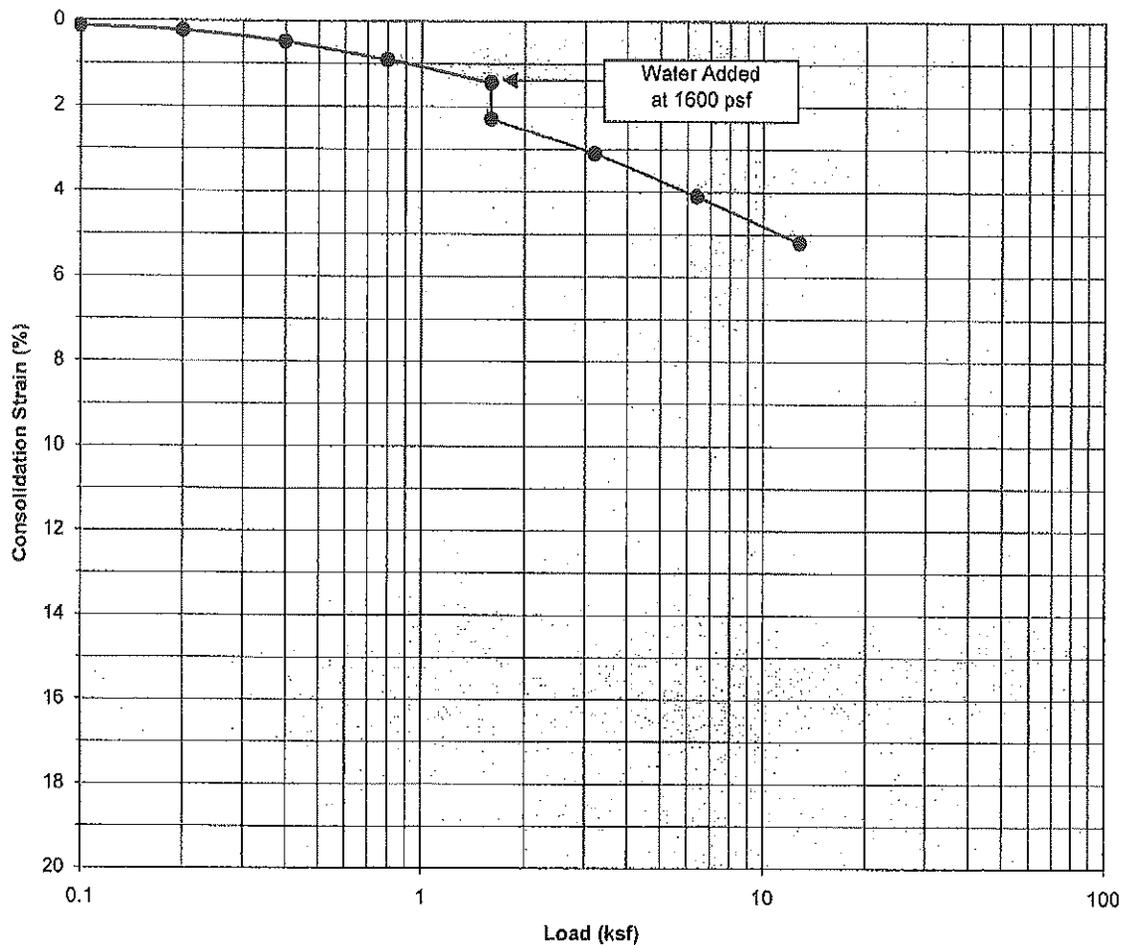
Boring Number:	B-9	Initial Moisture Content (%)	10
Sample Number:	---	Final Moisture Content (%)	20
Depth (ft)	3 to 4	Initial Dry Density (pcf)	92.7
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	107.9
Specimen Thickness (in)	1.0	Percent Collapse (%)	2.11

Central Avenue Site B
 San Bernardino, California
 Project No. 06G181
PLATE C- 10

Southern California Geotechnical

1280 North Hancock Street, Suite 101
 Anaheim, California 92807
 Phone: (714) 777-0333 Fax: (714) 777-0398

Consolidation/Collapse Test Results



Classification: ALLUVIUM: Orange Brown fine Sand, little Silt

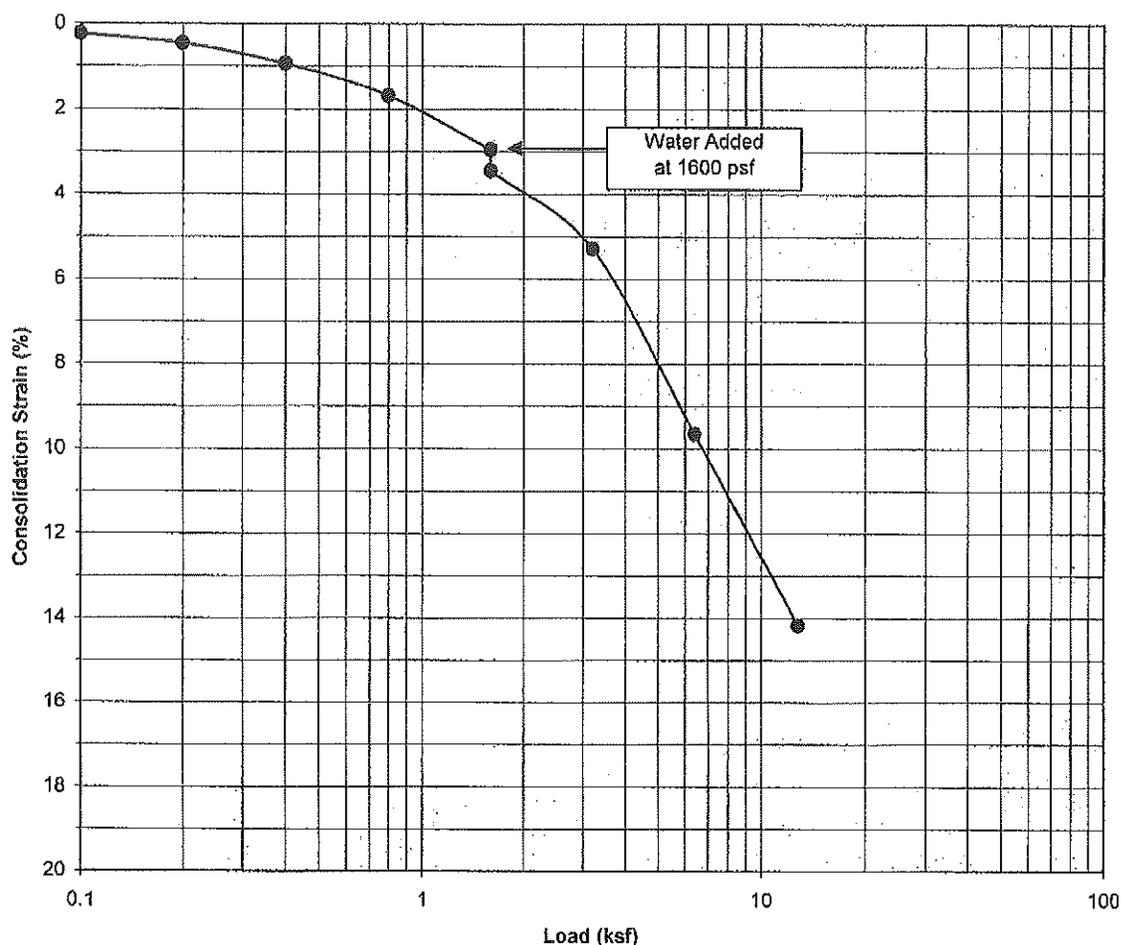
Boring Number:	B-9	Initial Moisture Content (%)	5
Sample Number:	---	Final Moisture Content (%)	20
Depth (ft)	5 to 6	Initial Dry Density (pcf)	100.1
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	105.5
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.85

Central Avenue Site B
 San Bernardino, California
 Project No. 06G181
PLATE C- 11

Southern California Geotechnical

1280 North Hancock Street, Suite 101
 Anaheim, California 92807
 Phone: (714) 777-0333 Fax: (714) 777-0398

Consolidation/Collapse Test Results



Classification: Gray Brown Silty Clay to Clayey Silt

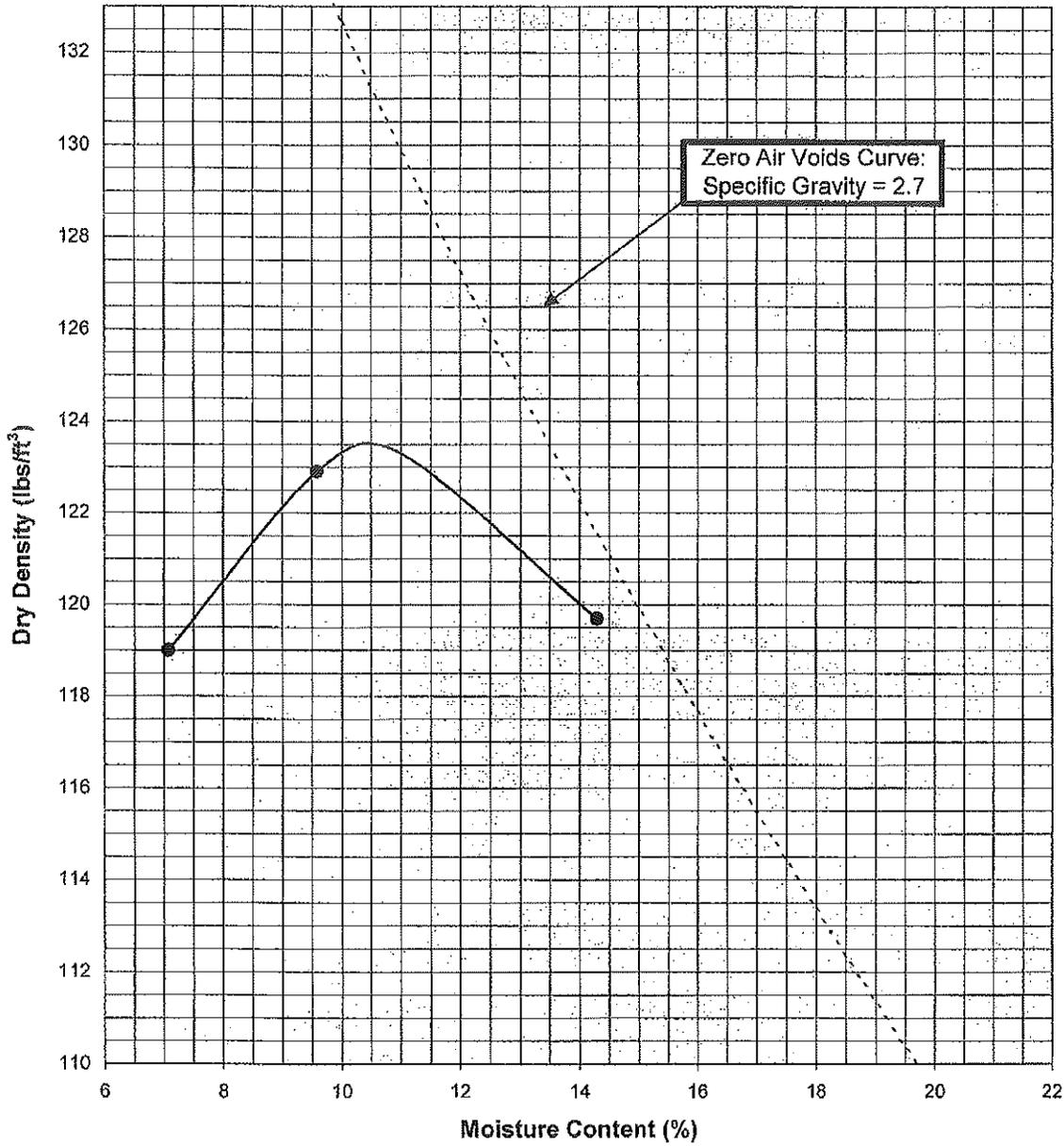
Boring Number:	B-9	Initial Moisture Content (%)	17
Sample Number:	---	Final Moisture Content (%)	24
Depth (ft)	7 to 8	Initial Dry Density (pcf)	80.4
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	93.8
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.50

Central Avenue Site B
 San Bernardino, California
 Project No. 06G181
PLATE C- 12

Southern California Geotechnical

1260 North Hancock Street, Suite 101
 Anaheim, California 92807
 Phone: (714) 777-0333 Fax: (714) 777-0398

**Moisture/Density Relationship
ASTM D-1557**



Soil ID Number	B-1 @ 0 to 5'
Optimum Moisture (%)	10.5
Maximum Dry Density (pcf)	123.5
Soil Classification	Gray Brown fine to medium Sandy Silt, trace fine Gravel

Central Avenue Site B
San Bernardino, California
Project No. 06G181
PLATE C-13

Southern California Geotechnical

1260 North Hancock Street, Suite 101
Anaheim, California 92807
Phone: (714) 777-0333 Fax: (714) 777-0398

October 21, 2015

Xebec Realty
3010 Old Ranch Parkway, Suite 470
Seal Beach, California



**SOUTHERN
CALIFORNIA
GEOTECHNICAL**
A California Corporation

Attention: Mr. Jason Chen
Financial Analyst

Project No.: **15G190-2**

Subject: **Results of Infiltration Testing**
Proposed Commercial/Industrial Building
270 East Central Avenue
San Bernardino, California

References: 1) Geotechnical Investigation and Liquefaction Evaluation, Proposed Commercial/Industrial Development, Central Avenue, West of Waterman Avenue, San Bernardino, California, prepared by Southern California Geotechnical, Inc. (SCG) for First Industrial Realty Trust, SCG Project No. 06G181-1, dated June 13, 2006.

2) Geotechnical Investigation, Proposed Commercial/Industrial Building, 270 East Central Avenue, San Bernardino, California, prepared by SCG for Xebec Realty, SCG Project No. 15G190-1, dated October 14, 2015.

Gentlemen:

In accordance with your request, we have conducted infiltration testing at the subject site. We are pleased to present this report summarizing the results of the infiltration testing and our design recommendations.

Scope of Services

The scope of services performed for this project was in Proposal No. 15P356-2, dated September 18, 2015. The scope of services included a surface reconnaissance, subsurface exploration, field testing, and geotechnical engineering analysis to determine the infiltration rate of the onsite soils. The infiltration testing was performed in general accordance with ASTM Test Method D-3385-03, Standard Test Method for Infiltration Rate of Soils in Field Using Double Ring Infiltrometer.

Site and Project Description

The subject site is located on the north side of East Central Avenue, approximately 290 feet west of the intersection of East Central Avenue and South Waterman Avenue, at the street address of 270 East Central Avenue in San Bernardino, California. The site is bounded to the north by an existing commercial/industrial building, to the east by an office complex and self-storage facility, to the south by East Central Avenue, and to the west by a commercial/industrial building. The general location of the site is illustrated on the Site Location Map, included as Plate 1 of this report.

The site consists of a rectangular-shaped parcel, 5.24± acres in size. The site is currently vacant and undeveloped. The ground surface cover consists of exposed soil with moderate native grass and

weed growth. Several trees and dense grass and weed growth are present along the southern property line.

Topographic information was not available at the time of this report. Based on visual observations made at the time of our subsurface investigation, the site topography dips gently downward to the south at an estimated gradient of 1 percent. There appears to be less than 4± feet of elevation differential across the subject site.

Proposed Development

Based on an overall site plan prepared by HPA Architecture, the site will be developed with one (1) commercial/industrial building. The building will occupy the majority of the site and will be 106,375± ft² in size. Dock high doors and a truck court will be constructed along the eastern side of the building. The building will be surrounded by asphaltic concrete pavements for parking and drive lanes and Portland cement concrete (PCC) in the truck court areas. Landscape planters will be located along the perimeter of the site and within the parking lot areas.

Based on conversations with Mr. Fred Cornwell of CA Engineering, Inc., the project civil engineer, we understand that the site will utilize on-site infiltration to dispose of storm water. The infiltration system will consist of one (1) below grade chamber system located in the east-central area of the site. The bottom of the infiltration system will be approximately 8 feet below the existing site grades.

Previous Studies

SCG previously performed a geotechnical investigation for the subject site (Reference No. 1). At the time of the referenced report, the proposed development comprised a total of ten (10) new commercial buildings ranging from 7,100± to 14,255± ft² in size. The referenced report was developed using the 1997 Uniform Building Code (UBC) and 2001 California Building Code (CBC). The results of the geotechnical investigation are documented in the referenced report.

During the subsurface exploration for this study, a total of ten (10) borings were drilled to depths of 10 to 50± feet below existing site grades. Artificial fill soils were encountered at most of the boring locations extending to depths up to 5± feet. The fill soils consisted of loose to medium dense silty fine sands and fine to medium sands. Native alluvium was encountered beneath the fill soils or at the ground surface at all of the boring locations. The native alluvium consisted of loose to medium dense silty fine sands and fine sandy silts extending to depths of 10± feet. At greater depths, the alluvium consisted of medium dense to dense sands with varying silt and gravel content, extending to the maximum depth explored of 50± feet. Groundwater was not encountered during the previous drilling operation and groundwater was considered to have been present at a depth in excess of 50± feet. However, the depth to the historic high groundwater in the area is 10± feet (Matti and Carson).

Concurrent Study

SCG is currently conducting a geotechnical investigation at the subject site (Reference No. 2). As part of this investigation, a total of two (2) borings advanced to depths 50± feet below currently existing site grades.

Native alluvial soils were encountered at the ground surface at both of the boring locations. The alluvial soils generally consisted of loose to dense silty fine sands, fine to medium sands and fine sandy silts extending to the maximum depth explored of 50 feet. A layer of very dense fine to coarse

sandy gravel was encountered between depths of 17 and 22± feet. Both borings also encountered layers of stiff clayey silts between depths of 24 and 32± feet.

Wet soils were encountered at one of the boring locations between depths of 33½ to 37± feet. However, samples taken below this depth possess a drier appearance without free water. Therefore, the groundwater encountered was considered to be perched groundwater.

Subsurface Exploration

Scope of Exploration

The subsurface exploration for the infiltration study consisted of two (2) backhoe excavated trenches, extending to depths of 9± feet below current existing site grades. The trenches were logged during excavation by a member of our staff. The approximate locations of the infiltration tests (identified as I-1 and I-2) are indicated on the Infiltration Test Location Plan, enclosed as Plate 2 of this report.

Geotechnical Conditions

Artificial fill soils were encountered at the ground surface at both of the infiltration test locations, extending to depths of 1 to 2½± feet below existing site grades. The fill soils generally consist of loose silty fine sands.

Native alluvial soils were encountered beneath the artificial fill soils at both of the infiltration test locations, extending to at least the maximum depth explored of 9± feet below current existing grades. These soils generally consist of loose to medium dense fine silty fine sands, silty fine to medium sands, and fine sandy silts. Trench logs, which illustrate the conditions encountered at the trench locations, are included with this report.

Infiltration Testing

We understand that the results of the testing will be used to prepare a preliminary design for the storm water infiltration systems that will be used to store and/or dispose of storm water at the subject site. The infiltration testing was performed in general accordance with ASTM Test Method D-3385-03, Standard Test Method for Infiltration Rate of Soils in Field Using Double Ring Infiltrometer.

Two stainless steel infiltration rings were used for the infiltration testing. The outer infiltration ring is 2 feet in diameter and 20 inches in height. The inner infiltration ring is 1 foot in diameter and 20 inches in height. At each test location, the outer ring was driven 3± inches into the soil at the base of the trench. The inner ring was centered inside the outer ring and subsequently driven 3± inches into the soil at the base of the trench. The rings were driven into the soil using a ten pound sledge hammer. The soil surrounding the wall of the infiltration rings was only slightly disturbed during the driving process.

Infiltration Testing Procedure

The infiltration testing was performed at Infiltration Trench Nos. I-1 and I-2. The infiltration testing consisted of filling the inner ring and the annular space (the space between the inner and outer rings) with water, approximately 3 to 4± inches above the soil. To prevent the flow of water from

one ring to the other, the water level in both the inner ring and the annular space between the rings were maintained using constant-head float valves. The volume of water that was added to maintain a constant head in the inner ring and the annular space during each time interval was determined and recorded. A cap was placed over the rings to minimize the evaporation of water during the test.

The schedule for readings was determined based on the observed soil type at the base of each backhoe excavated trench. Due to the clay content of the soils at each infiltration test location, the volumetric measurements were made at increments of 15 to 30 minutes. The water volume measurements are presented on the spreadsheets enclosed with this report. The infiltration rates for each of the timed intervals are also tabulated on these spreadsheets. The infiltration rates for all the tests are calculated in centimeters per hour and then converted to inches per hour. These rates are summarized below:

<u>Infiltration Test No.</u>	<u>Soil Description</u>	<u>Infiltration Rate (inches/hour)</u>
I-1	Fine to medium Sandy Silt	2.9
I-2	Fine Sandy Silt, some medium Sand	6.9

Laboratory Testing

Grain Size Analysis

The grain size distribution of selected soils from the base of each infiltration test trench has been determined using a range of wire mesh screens. These tests were performed in general accordance with ASTM D-422 and/or ASTM D-1140. The weight of the portion of the sample retained on each screen is recorded and the percentage finer or coarser of the total weight is calculated. The results of these tests are presented at the end of this report.

Design Recommendations

A total of two (2) infiltration tests were performed at the subject site. As noted above, the calculated infiltration rates at the infiltration locations range from 2.9 to 6.9 inches per hour.

Based on the infiltration test results, a design infiltration rate of 3 inches per hour is recommended for the design of the below ground chamber system.

The design of the storm water infiltration systems should be performed by the project civil engineer, in accordance with the city of San Bernardino and/or San Bernardino county guidelines. It is recommended that the project civil engineer apply an appropriate factor of safety. It is recommended that the systems be constructed so as to facilitate removal of silt and clay, or other deleterious materials from any water that may enter the systems. The presence of such materials would decrease the effective infiltration rates. The infiltration rates recommended above are based on the assumption that only clean water will be introduced to the subsurface profile. Any fines, debris, or organic materials could significantly impact the infiltration rates. It should be noted that the recommended infiltration rates are based on infiltration testing at two (2) discrete locations and that the overall infiltration rate of the proposed detention basin could vary considerably.

Infiltration versus Permeability

Infiltration rates are based on unsaturated flow. As water is introduced into soils by infiltration, the soils become saturated and the wetting front advances from the unsaturated zone to the saturated zone. Once the soils become saturated, infiltration rates become zero, and water can only move through soils by hydraulic conductivity at a rate determined by pressure head and soil permeability. The infiltration rates presented herein were determined in accordance with the ASTM Test Method D-3385-03 standard, and are considered valid for the time and place of the actual test. Changes in soil moisture content will affect these infiltration rates. Infiltration rates should be expected to decrease until the soils become saturated. Soil permeability values will then govern groundwater movement. Permeability values may be on the order of 10 to 20 times less than infiltration rates. The system designer should incorporate adequate factors of safety and allow for overflow design into appropriate traditional storm drain systems, which would transport storm water off-site.

Location of Infiltration Systems

The use of on-site storm water infiltration systems carries a risk of creating adverse geotechnical conditions. Increasing the moisture content of the soil can cause the soil to lose internal shear strength and increase its compressibility, resulting in a change in the designed engineering properties. Structures and pavements adjacent to the infiltration areas could potentially be damaged due to saturation of subgrade soils.

If possible, all of the proposed infiltration systems for this site should be located at least 25 feet away from any structures, including retaining walls. Even with this provision of locating the infiltration systems at least 25 feet from any structures, it is possible that infiltrating water into the subsurface soils could have an adverse effect on the proposed structures. It should also be noted that utility trenches which happen to collect storm water can also serve as conduits to transmit storm water toward the structure, depending on the slope of the utility trench. Therefore, consideration should also be given to the proposed locations of underground utilities which may pass near the proposed infiltration systems.

General Comments

This report has been prepared as an instrument of service for use by the client in order to aid in the evaluation of this property and to assist the architects and engineers in the design and preparation of the project plans and specifications. This report may be provided to the contractor(s) and other design consultants to disclose information relative to the project. However, this report is not intended to be utilized as a specification in and of itself, without appropriate interpretation by the project architect, structural engineer, and/or civil engineer. The design of the infiltration system is the responsibility of the civil engineer. The role of the geotechnical engineer is limited to determination of infiltration rate only. By using the design infiltration rates contained herein, the civil engineer agrees to indemnify, defend, and hold harmless the geotechnical engineer for all aspects of the design and performance of the infiltration system. The reproduction and distribution of this report must be authorized by the client and Southern California Geotechnical, Inc. Furthermore, any reliance on this report by an unauthorized third party is at such party's sole risk, and we accept no responsibility for damage or loss which may occur.

The analysis of this site was based on a subsurface profile interpolated from limited discrete soil samples. While the materials encountered in the project area are considered to be representative of the total area, some variations should be expected between trench locations and testing depths. If

the conditions encountered during construction vary significantly from those detailed herein, we should be contacted immediately to determine if the conditions alter the recommendations contained herein.

This report has been based on assumed or provided characteristics of the proposed development. It is recommended that the owner, client, architect, structural engineer, and civil engineer carefully review these assumptions to ensure that they are consistent with the characteristics of the proposed development. If discrepancies exist, they should be brought to our attention to verify that they do not affect the conclusions and recommendations contained herein. We also recommend that the project plans and specifications be submitted to our office for review to verify that our recommendations have been correctly interpreted.

The analysis, conclusions, and recommendations contained within this report have been promulgated in accordance with generally accepted professional geotechnical engineering practice. No other warranty is implied or expressed.

Closure

We sincerely appreciate the opportunity to be of service on this project. We look forward to providing additional consulting services during the course of the project. If we may be of further assistance in any manner, please contact our office.

Respectfully Submitted,

SOUTHERN CALIFORNIA GEOTECHNICAL, INC.

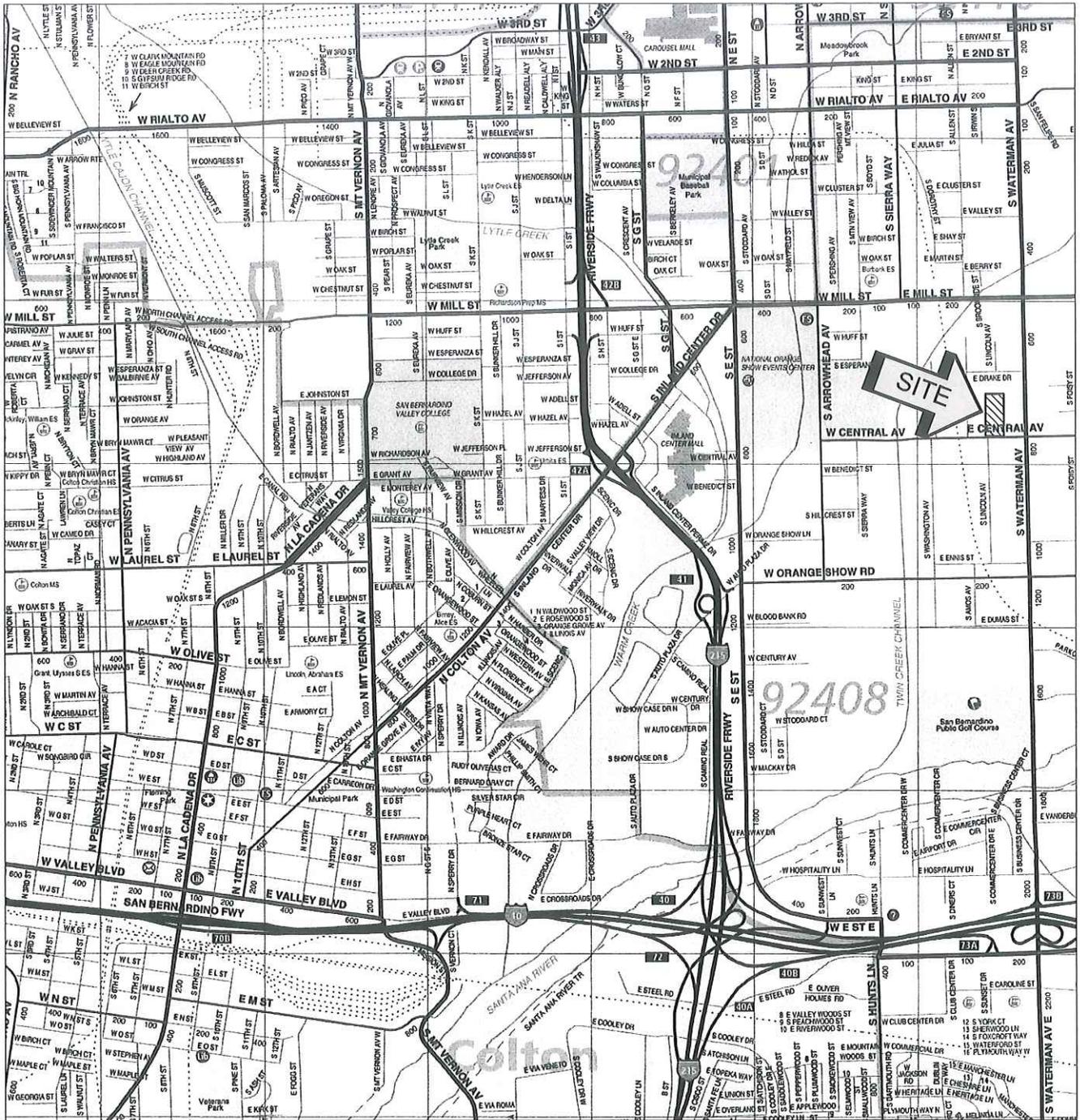
Kevin Smith
Staff Engineer

John A. Seminara, GE 2294
Principal Engineer



Distribution: (1) Addressee
(1) CA Engineering, Attn: Fred Cornwell

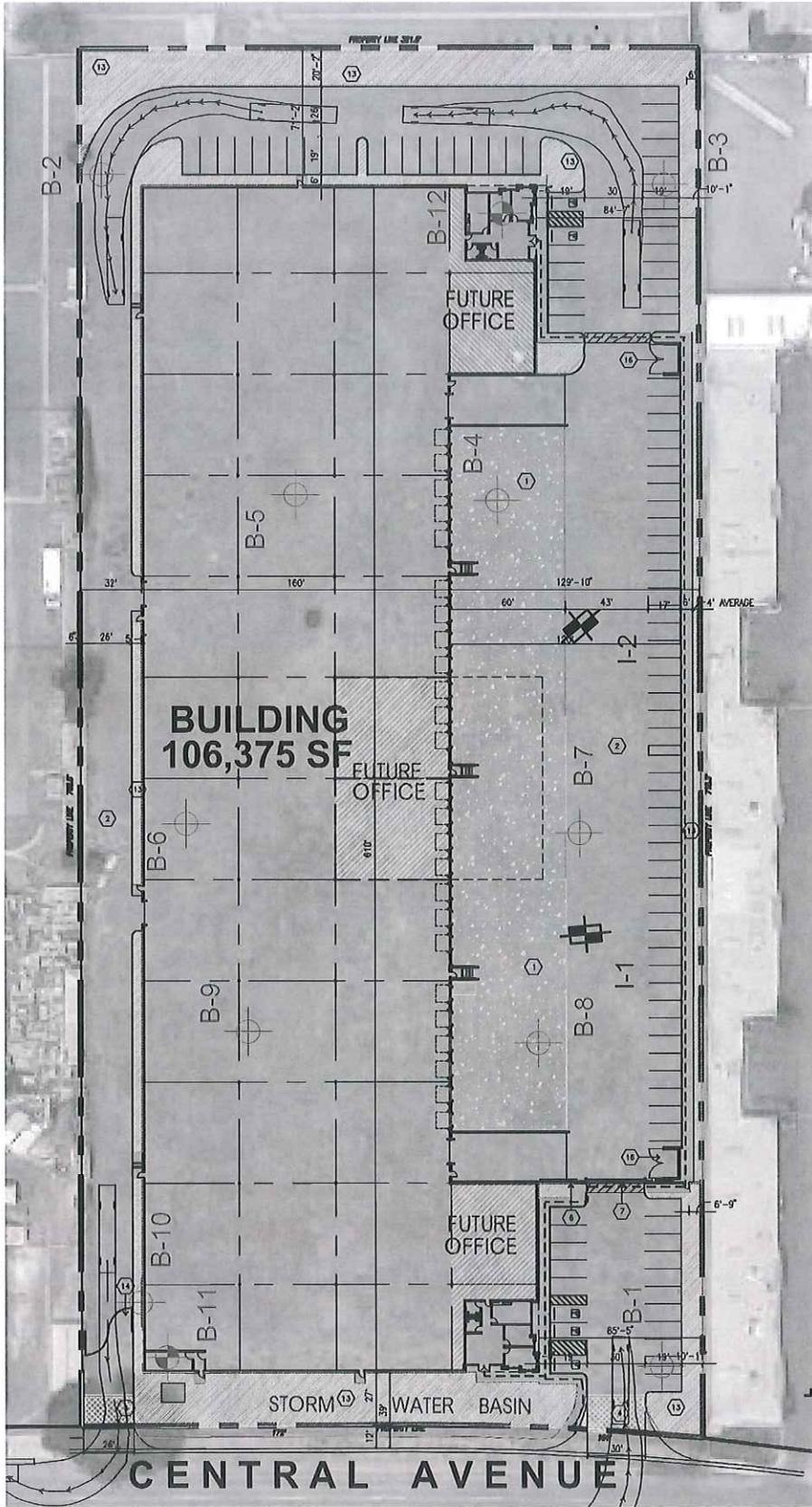
Enclosures: Plate 1 Site Location Map
Plate 2 Infiltration Test Location Plan
Trench Logs (2 pages)
Infiltration Test Results Spreadsheets (2 pages)
Grain Size Analysis Graphs (2 pages)



SOURCE: SAN BERNARDINO COUNTY
THOMAS GUIDE, 2013



SITE LOCATION MAP	
PROPOSED COMMERCIAL/INDUSTRIAL BUILDING	
SAN BERNARDINO, CALIFORNIA	
SCALE: 1" = 2400'	 SOUTHERN CALIFORNIA GEOTECHNICAL
DRAWN: MRM	
CHKD: JAS	
SCG PROJECT 15G190-2	
PLATE 1	



GEOTECHNICAL LEGEND

-  APPROXIMATE INFILTRATION TEST LOCATION
-  APPROXIMATE BORING LOCATION FROM CONCURRENT STUDY (SCG PROJECT NO. 15G190-1)
-  APPROXIMATE BORING LOCATION FROM PREVIOUS STUDY (SCG PROJECT NO. 06G181-1)



NOTE: BASE SITE MAP PREPARED BY HPA ARCHITECTURE.

INFLTRATION TEST LOCATION PLAN	
PROPOSED COMMERCIAL/INDUSTRIAL BUILDING	
SAN BERNARDINO, CALIFORNIA	
	
SOUTHERN CALIFORNIA GEOTECHNICAL	
SCALE: 1" = 40'	
DRAWN: KS	
CHKD: JAS	
SCG PROJECT: 15G190-1	
PLATE 2	

INFILTRATION CALCULATIONS

Project Name	Proposed Commercial/Industrial Building
Project Location	San Bernardino, CA
Project Number	15G190-2
Engineer	Kevin Smith

Infiltration Test No I-1

Constants			
	Diameter (ft)	Area (ft ²)	Area (cm ²)
Inner	1	0.79	730
Anlr. Spac	2	2.36	2189

*Note: The infiltration rate was calculated based on current time interval

Test Interval		Time (hr)	Interval Elapsed (min)	Flow Readings				Infiltration Rates			
				Inner Ring (ml)	Ring Flow (cm ³)	Annular Ring (ml)	Space Flow (cm ³)	Inner Ring* (cm/hr)	Annular Space* (cm/hr)	Inner Ring* (in/hr)	Annular Space* (in/hr)
1	Initial	9:09 AM	30	200	3025	0	9400	8.29	8.59	3.26	3.38
	Final	9:39 AM	30	3225		9400					
2	Initial	9:40 AM	30	0	2850	100	9500	7.81	8.68	3.08	3.42
	Final	10:10 AM	61	2850		9600					
3	Initial	10:12 AM	30	0	2800	100	9400	7.68	8.59	3.02	3.38
	Final	10:42 AM	93	2800		9500					
4	Initial	10:44 AM	30	0	2750	0	9300	7.54	8.50	2.97	3.35
	Final	11:14 AM	125	2750		9300					
5	Initial	11:16 AM	30	0	2750	100	9300	7.54	8.50	2.97	3.35
	Final	11:46 AM	155	2750		9400					
6	Initial	11:48 AM	30	100	2725	0	9300	7.47	8.50	2.94	3.35
	Final	12:18 PM	185	2825		9300					

INFILTRATION CALCULATIONS

Project Name	Proposed Commercial/Industrial Building
Project Location	San Bernardino, CA
Project Number	15G190-2
Engineer	Kevin Smith

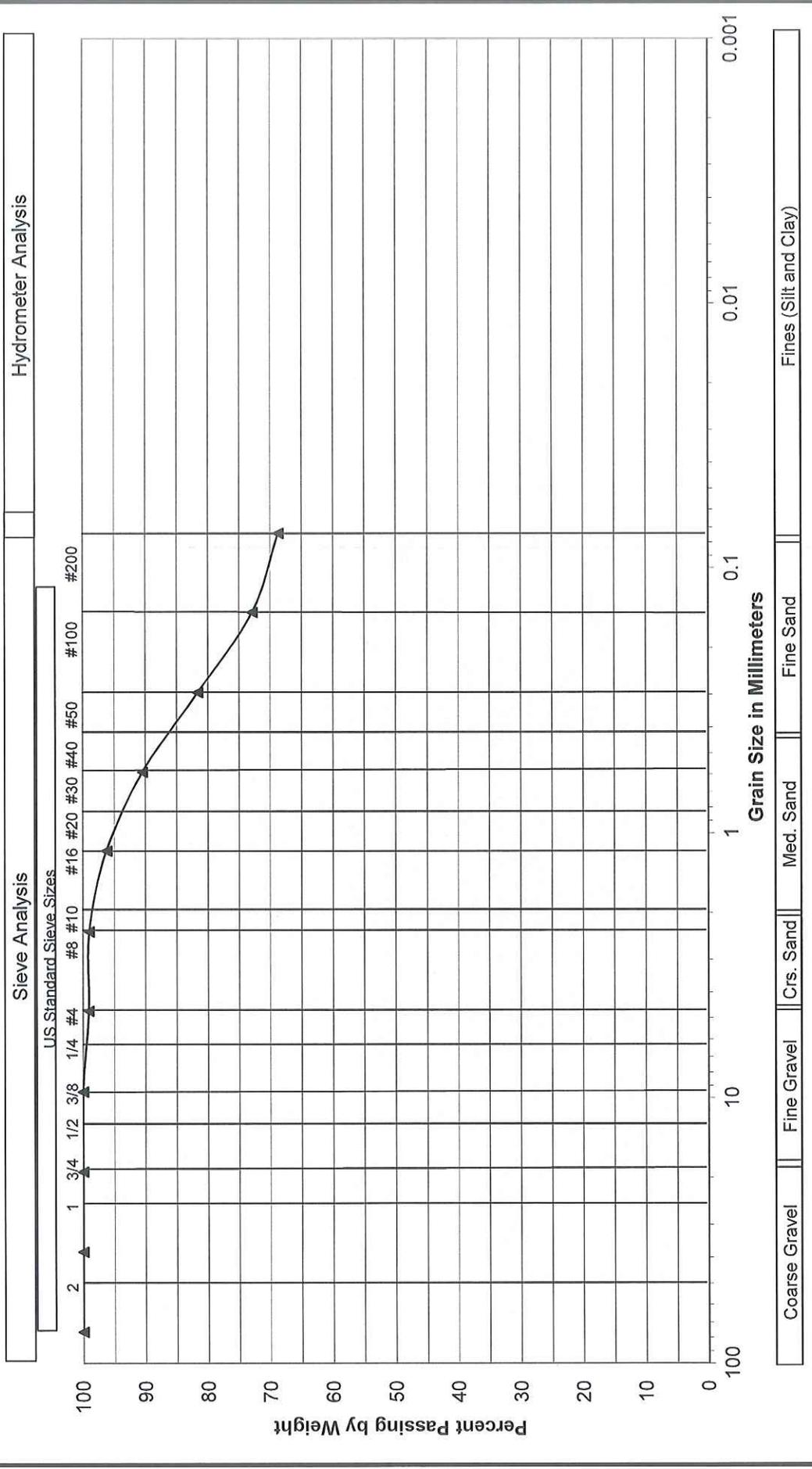
Infiltration Test No I-2

Constants			
	Diameter (ft)	Area (ft ²)	Area (cm ²)
Inner	1	0.79	730
Anlr. Spac	2	2.36	2189

*Note: The infiltration rate was calculated based on current time interval

Test Interval		Time (hr)	Interval Elapsed (min)	Flow Readings				Infiltration Rates			
				Inner Ring (ml)	Ring Flow (cm ³)	Annular Ring (ml)	Space Flow (cm ³)	Inner Ring* (cm/hr)	Annular Space* (cm/hr)	Inner Ring* (in/hr)	Annular Space* (in/hr)
1	Initial	12:30 PM	15	50	3375	100	10200	18.50	18.64	7.28	7.34
	Final	12:45 PM	15	3425	10300						
2	Initial	12:47 PM	15	25	3350	50	9850	18.37	18.00	7.23	7.09
	Final	1:02 PM	32	3375	9900						
3	Initial	1:03 PM	15	25	3300	200	9750	18.09	17.82	7.12	7.01
	Final	1:18 PM	48	3325	9950						
4	Initial	1:19 PM	15	0	3250	0	9700	17.82	17.73	7.01	6.98
	Final	1:34 PM	63	3250	9700						
5	Initial	1:36 PM	15	0	3200	100	9700	17.54	17.73	6.91	6.98
	Final	1:51 PM	80	3200	9800						
6	Initial	1:55 PM	15	0	3175	50	9650	17.41	17.63	6.85	6.94
	Final	2:10 PM	99	3175	9700						
7	Initial	2:11 PM	15	0	3175	0	9600	17.41	17.54	6.85	6.91
	Final	2:26 PM	114	3175	9600						
8	Initial	2:27 PM	15	25	3175	200	9600	17.41	17.54	6.85	6.91
	Final	2:42 PM	130	3200	9800						

Grain Size Distribution



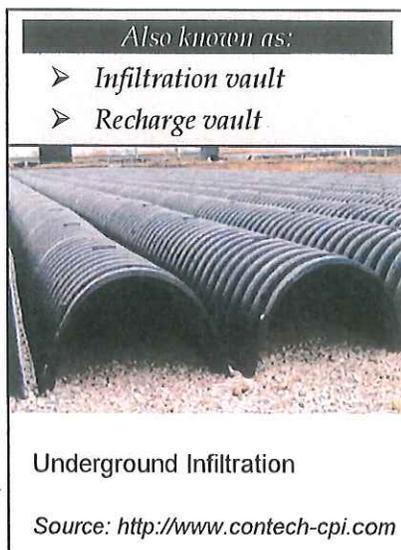
ATTACHMENT D

LID BMP Design Details and Specifications

- **INF-7: Underground Infiltration Fact Sheet from Orange County TGD for Project WQMPs**
- **Contech Hydrodynamic Separation Device Standard Detail / Specifications / Maintenance (Pretreatment for Onsite Infiltration)**

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

UrbanGreen® Hydrodynamic Separation Pretreatment for Green Stormwater Solutions



Before CDS®



After CDS®



HDS Benefits

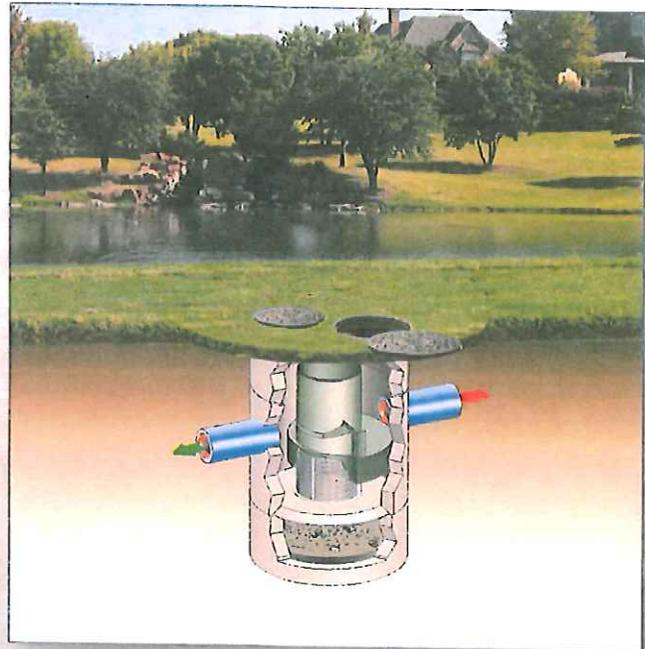
- Cost-effective method of gross pollutant removal
- Pretreatment reduces size and increases longevity of land based BMPs
- Variety of sizes to meet range of applications and flows
- Easy, low-cost maintenance

HDS Applications

- Pre-treatment for rainwater harvesting/stormwater reuse
- Pre-treatment for infiltration and bioretention
- Urban retrofit/redevelopment
- Sediment and trash protection for ponds/lakes
- Pump protection

CDS Features

- Captures and retains 100% of floatables and neutrally buoyant debris 2.4 mm or larger
- Proven removal of solids, oil and grease
- Patented indirect screening capability keeps screen from clogging
- Retention of all captured pollutants, even at high flows
- Easy access to remove captured pollutants
- Performance verified by NJCAT and WA Ecology
- Flexible design
 - Allows for multiple inlet pipes
 - In-line, grate and curb inlet configurations
 - Easily installed in existing storm drain



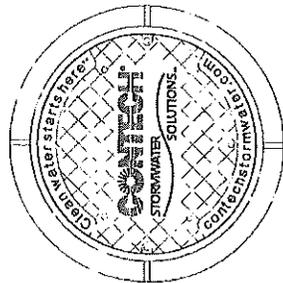
CDS2015-4 DESIGN NOTES

CDS2015-4 RATED TREATMENT CAPACITY IS 0.7 CFS, OR PER LOCAL REGULATIONS. MAXIMUM HYDRAULIC INTERNAL BYPASS CAPACITY IS 10.0 CFS. IF THE SITE CONDITIONS EXCEED 10.0 CFS, AN UPSTREAM BYPASS STRUCTURE IS REQUIRED.

THE STANDARD CDS2015-4 CONFIGURATION IS SHOWN. ALTERNATE CONFIGURATIONS ARE AVAILABLE AND ARE LISTED BELOW. SOME CONFIGURATIONS MAY BE COMBINED TO SUIT SITE REQUIREMENTS.

DESIGNATION (MODEL SUFFIX)	CONFIGURATION DESCRIPTION
G	GRADED INLET ONLY (NO INLET PIPE)
GP	GRADED INLET WITH INLET PIPE OR PIPES
K	CURB INLET ONLY (NO INLET PIPE)
KP	CURB INLET WITH INLET PIPE OR PIPES

SITE SPECIFIC DATA REQUIREMENTS	
STRUCTURE ID	*
WATER QUALITY FLOW RATE (CFS)	*
PEAK FLOW RATE (CFS)	*
RETURN PERIOD OF PEAK FLOW (YRS)	*
SCREEN APERTURE (2400 OR #70D)	*
PIPE DATA: I.E. MATERIAL	DIAMETER
INLET PIPE 1	*
INLET PIPE 2	*
OUTLET PIPE	*
RIM ELEVATION	*
ANTI-FLOTATION BALLAST	WIDTH
	HEIGHT
NOTES/SPECIAL REQUIREMENTS:	
* PER ENGINEER OF RECORD	



FRAME AND COVER
(DIAMETER VARIES)
N.T.S.

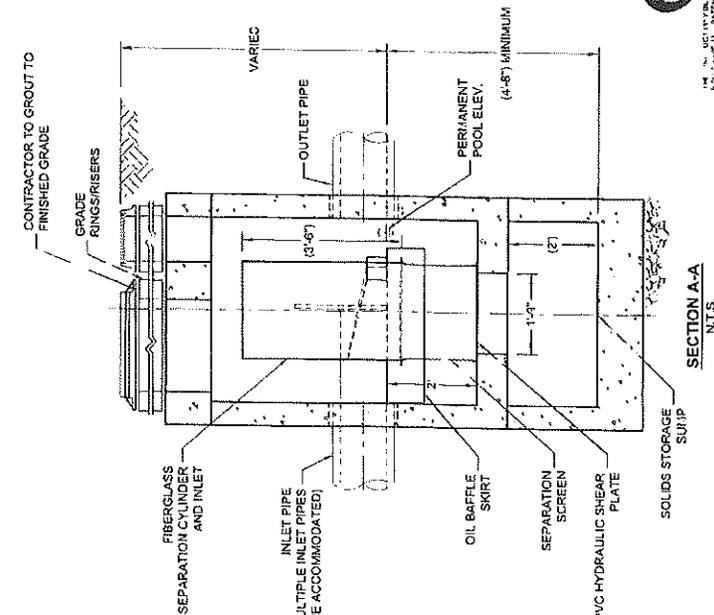
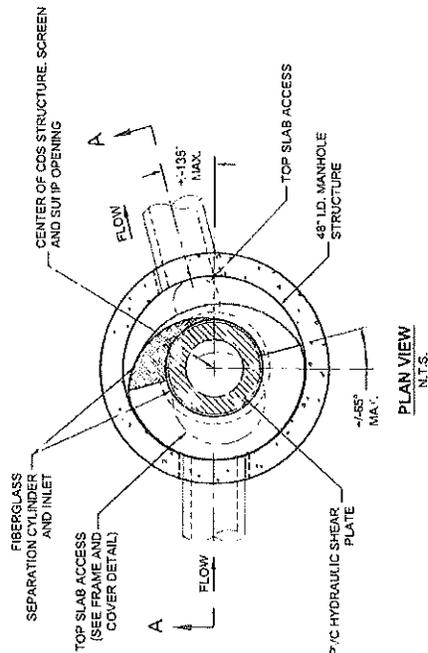
- GENERAL NOTES**
- CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
 - DIMENSIONS MARKED WITH () ARE REFERENCE DIMENSIONS. ACTUAL DIMENSIONS MAY VARY.
 - FOR FABRICATION DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH STORMWATER SOLUTIONS REPRESENTATIVE. www.contechstormwater.com
 - CDS WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
 - STRUCTURE AND CASTINGS SHALL MEET AASHTO H220 LOAD RATING.
 - PVC HYDRAULIC SHEAR PLATE IS PLACED ON SHELF AT BOTTOM OF SCREEN CYLINDER. REMOVE AND REPLACE AS NECESSARY DURING MAINTENANCE CLEANING.

INSTALLATION NOTES

- ANY SUBBASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
- CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CDS MANHOLE STRUCTURE (LIFTING CLUTCHES PROVIDED).
- CONTRACTOR TO ADD JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS, AND ASSEMBLE STRUCTURE.
- CONTRACTOR TO PROVIDE, INSTALL, AND GROUT PIPES. MATCH PIPE INVERTS WITH ELEVATIONS SHOWN.
- CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT. HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.



GDS
11400 W. 15TH AVENUE, DENVER, CO 80202
TEL: 303.751.1100 FAX: 303.751.1101
WWW.GDS-CORP.COM



SECTION A-A
N.T.S.

SECTION A-A
N.T.S.

SECTION A-A
N.T.S.

SECTION [____]
STORMWATER TREATMENT DEVICE

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope

The Contractor shall furnish all labor, equipment and materials necessary to install the stormwater treatment device(s) (SWTD) and appurtenances specified in the Drawings and these specifications.

B. Related Sections

Section 02240: Dewatering
Section 02260: Excavation Support and Protection
Section 02315: Excavation and Fill
Section 02340: Soil Stabilization

1.2 QUALITY ASSURANCES

A. Inspection

All components shall be subject to inspection by the Engineer at the place of manufacture and/or installation. All components are subject to be rejected or identified for repair if the quality of materials and manufacturing do not comply with the requirements of this specification. Components which have been identified as defective may be subject for repair. Final acceptance of the component is contingent upon the discretion of the Engineer.

B. Warranty

The manufacturer shall guarantee the SWTD components against all manufacturer originated defects in materials or workmanship for a period of twelve (12) months from the date the components are delivered to the owner for installation. The manufacturer shall be notified of repair/replacement issues in writing within the referenced warranty period. The manufacturer shall, upon its determination of repair, correct or replace any manufacturer originated defects identified by written notice within the referenced warranty period. The use of SWTD components shall be limited to the application for which it was specifically designed.

C. Manufacturer's Performance Certificate

The SWTD manufacturer shall submit to the Engineer of Record a "Manufacturer's Performance Certification" certifying that each SWTD is capable of achieving the specified removal efficiencies as listed in these specifications. The certification shall be supported by independent third-party research.

1.3 SUBMITTALS

A. Shop Drawings

The contractor shall prepare and submit shop drawings in accordance with Section [_____] of the contract documents. The shop drawings shall detail horizontal and vertical dimensioning, reinforcement and joint type and locations.

PART 2 – PRODUCTS

2.1 MATERIALS AND DESIGN

A. Precast Concrete Components

Precast concrete components shall conform to applicable sections of ASTM C 478, ASTM C 857 and ASTM C 858 and the following:

1. Concrete shall achieve a minimum 28-day compressive strength of 4,000 pounds per square-inch (psi);
2. Unless otherwise noted, the precast concrete sections shall be designed to withstand lateral earth and AASHTO H-20 traffic loads;
3. Cement shall conform to ASTM C 150;
4. Aggregates shall conform to ASTM C 33;
5. Reinforcing steel shall be deformed billet-steel bars, welded steel wire or deformed welded steel wire conforming to ASTM A 615, A 185 or A 497, respectively;
6. Joints shall be sealed with preformed joint sealing compound conforming to ASTM C 990 and
7. Shipping of components shall not be initiated until a minimum compressive strength of 4,000 psi is attained or five (5) calendar days after fabrication has expired, whichever occurs first.

B. Internal Components and Appurtenances

Internal Components and appurtenances shall conform to the following:

1. Screen and support structure shall be manufactured of Type 316 and 316L stainless steel conforming to ASTM F 1267-01;
2. Hardware shall be manufactured of Type 316 stainless steel conforming to ASTM A 320;
3. Fiberglass components shall conform to the National Bureau of Standards PS-15 and coated with an isophalic polyester gelcoat and
4. Access system(s) conform to the following:
 - a. Manhole castings shall be designed to withstand AASHTO H-20 loadings and manufactured of cast-iron conforming to ASTM A 48 Class 30.

- b. Hatch systems shall be designed to withstand AASHTO H-20 loadings. Hatch systems not subject to direct traffic shall be manufactured of Grade 5086 aluminum. Hatch systems subject to direct traffic loads shall be manufactured of steel conforming to ASTM A36-93a, supplied with a hot-dip galvanized finish conforming to ASTM A 123 and access doors bolted to the frame.

2.2 PERFORMANCE

A. Removal Efficiencies

1. The SWTD shall be capable of achieving an 80 percent average annual reduction in the total suspended solid load.
2. The SWTD shall be capable of capturing and retaining 100 percent of pollutants greater than or equal to [4.7 millimeters (mm) or 2.4 millimeters (mm)] regardless of the pollutant's specific gravity (i.e.: floatable and neutrally buoyant materials) for flows up to the device's rated-treatment capacity. The SWTD shall be designed to retain all previously captured pollutants addressed by this subsection under all flow conditions.
3. The SWTD shall be capable of capturing and retaining total petroleum hydrocarbons. The SWTD shall be capable of achieving a removal efficiency of 92 and 78 percent when the device is operating at 25 and 50 percent of its rated-treatment capacity. These removal efficiencies shall be based on independent third-party research for influent oil concentrations representative of storm water runoff (20 ± 5 mg/L). The SWTD shall be greater than 99 percent effective in controlling dry-weather accidental oil spills.

The SWTD shall be capable of utilizing sorbent media to enhance removal and retention of petroleum based pollutants.

B. Hydraulic Capacity

1. The SWTD shall provide a rated-treatment capacity, which is consistent with governing water treatment regulations. At its rated-treatment capacity, the device shall be capable of achieving greater than 65 percent removal of particles typically found in roadside sediments. This removal efficiency shall be supported by independent third-party research utilizing samples consistent with the NURP gradation or finer.
2. The SWTD shall maintain the peak conveyance capacity of the drainage network as defined by the Engineer.

C. Storage Capacity

1. The SWTD shall be designed with a sump chamber for the storage of captured sediments and other negatively buoyant pollutants in between maintenance cycles. The minimum storage capacity provided by the sump chamber shall be in accordance with the volume listed in Table 1. The boundaries of the sump chamber shall be limited to that which do not degrade the SWTD's treatment efficiency as captured pollutants accumulate. The sump chamber shall be separate from the treatment processing portion(s) of the SWTD to minimize the probability of fine

particle re-suspension. In order to not restrict the Owner's ability to maintain the SWTD, the minimum dimension providing access from the ground surface to the sump chamber shall be 20 inches in diameter.

2. The SWTD shall be designed to capture and retain Total Petroleum Hydrocarbons generated by wet-weather flow and dry-weather gross spills. The minimum storage capacity provided by the SWTD shall be in accordance with the volume listed in Table 1 below.

TABLE 1

CDS Model	Treatment Capacity (cfs)/(L/s)	Minimum Sump Storage Capacity (yd ³)/(m ³)	Minimum Oil Storage Capacity (gal)/(L)
CDS2015-G	0.7 (19.8)	0.5 (0.4)	70 (265)
CDS2015-4	0.7 (19.8)	0.5 (1.4)	70 (265)
CDS2015	0.7(19.8)	1.3 (1.0)	92 (348)
CDS2020	1.1 (31.2)	1.3 (1.0)	131 (496)
CDS2025	1.6 (45.3)	1.3 (1.0)	143 (541)
CDS3020	2.0 (56.6)	2.1 (1.6)	146 (552)
CDS3030	3.0 (85.0)	2.1 (1.6)	205 (776)
CDS3035	3.8 (106.2)	2.1 (1.6)	234 (885)
CDS4030	4.5 (127.4)	5.6 (4.3)	407 (1540)
CDS4040	6.0 (169.9)	5.6 (4.3)	492 (1862)
CDS4045	7.5 (212.4)	5.6 (4.3)	534 (2012)
CDS2020-D	1.1 (31.2)	1.3 (1.0)	131 (495)
CDS3020-D	2.0 (56.6)	2.1 (1.6)	146 (552)
CDS3030-D	3.0 (85.0)	2.1 (1.6)	205 (776)
CDS3035-D	3.8 (106.2)	2.1 (1.6)	234 (885)
CDS4030-D	4.5 (127.4)	4.3 (3.3)	328 (1241)
CDS4040-D	6.0 (169.9)	4.3 (3.3)	396 (1499)
CDS4045-D	7.5 (212.4)	4.3 (3.3)	430 (1627)
CDS5640-D	9.0 (254.9)	5.6 (4.3)	490 (1854)
CDS5653-D	14.0 (396.5)	5.6 (4.3)	599 (2267)
CDS5668-D	19.0 (538.1)	5.6 (4.3)	733 (2774)
CDS5678-D	25.0 (708.0)	5.6 (4.3)	814 (3081)
CDS3030-DV	3.0 (85.0)	2.1 (1.6)	205 (776)
CDS5042-DV	9.0 (254.9)	1.9 (1.5)	294 (1112)
CDS5050-DV	11.0 (311.5)	1.9 (1.5)	367 (1389)
CDS7070-DV	26.0 (736.3)	3.3 (2.5)	914 (3459)
CDS10060-DV	30.0 (849.6)	5.0 (3.8)	792 (2997)
CDS10080-DV	50.0 (1416.0)	5.0 (3.8)	1057 (4000)
CDS100100-DV	64.0 (1812.5)	5.0 (3.8)	1320 (4996)

D. Alternate Treatment Technologies and Sizing Criteria

The sizing criteria for treatment systems must conform to the recommended loading rate and 3rd party testing data requirements as mentioned below:

1. CDS Screening Systems – designed for full treatment of the runoff rate at a loading rate not to exceed the critical flow in the inlet, in order to achieve 80% TSS removal efficiency. (80% TSS removal based on a average particles size of 63 micron)
2. Vortex separation systems – designed for full treatment of the runoff rate at a loading rate not to exceeding 24 gpm/ft², in order to achieve 80% TSS removal efficiency. The hydraulic capacity should not exceed a loading rate of 100 gpm/ft² to prevent scouring of previously captured particles. 80% TSS removal based on a average particles size of 63 micron)
3. Gravity systems – designed for full treatment of the runoff rate at a loading rate not to exceeding 10 gpm/ft², in order to achieve 80% TSS removal efficiency. The gravity units will not exceed luminar flow condition parameters in the treatment unit but will provide a bypass system to prevent turbulence from accruing in the system. (See “Stokes Law” for gravity settling requirements of particles. 80% TSS removal based on a average particles size of 63 micron)

Additionally, the performance of the unit must be evaluated by a third party and verified in a program that allows a more-or-less direct comparison to other technologies. Performance should be third party verified, and removal efficiencies across the spectrum of particle sizes reported, at a range of hydraulic loading rates varying over a range of at least 25 to 125% of the manufacturer’s advertised ‘water treatment’ loading rate.

2.3 MANUFACTURER

The manufacturer of the SWTD shall be one that is regularly engaged in the engineering design and production of systems deployed for the treatment of storm water runoff for at least five (5) years and which have a history of successful production, acceptable to the Engineer. In accordance with the Drawings, the SWTD(s) shall be a CDS[®] device manufactured by:

**Contech Engineered Solutions
9025 Centre Pointe Dr., Suite 400
West Chester, OH 45069
(800) 338-1122**

PART 3 – EXECUTION

3.1 HANDLING AND STORAGE

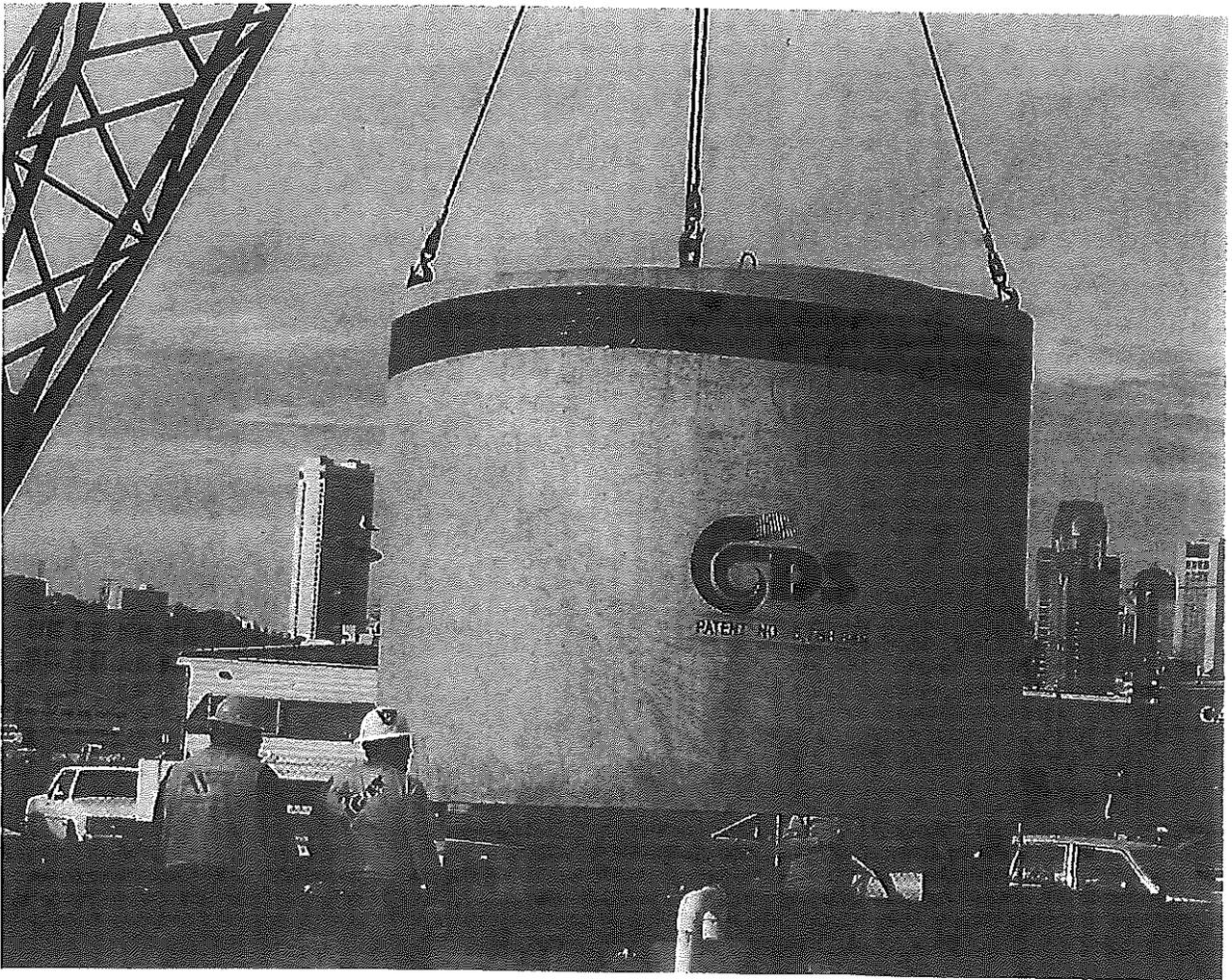
1. The contractor shall exercise care in the storage and handling of the SWTD components prior to and during installation. Any repair or replacement costs associated with events occurring after delivery is accepted and unloading has commenced shall be born by the contractor.

3.2 INSTALLATION

1. The SWTD shall be installed in accordance with the manufacturer's recommendations and related sections of the contract documents. The manufacturer shall provide the contractor installation instructions and offer on-site guidance during the important stages of the installation as identified by the manufacturer at no additional expense. A minimum of 72 hours notice shall be provided to the manufacturer prior to their performance of the services included under this subsection.
2. The contractor shall fill all voids associated with lifting provisions provided by the manufacturer. These voids shall be filled with non-shrinking grout providing a finished surface consistent with adjacent surfaces. The contractor shall trim all protruding lifting provisions flush with the adjacent concrete surface in a manner which leaves no sharp points or edges.

END OF SECTION

CDS[®] Inspection and Maintenance Guide



Maintenance

The CDS system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size of the unit. For example, unstable soils or heavy winter sanding will cause the grit chamber to fill more quickly but regular sweeping of paved surfaces will slow accumulation.

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant transport and deposition may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (e.g. spring and fall) however more frequent inspections may be necessary in climates where winter sanding operations may lead to rapid accumulations, or in equipment washdown areas. Installations should also be inspected more frequently where excessive amounts of trash are expected.

The visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet and separation screen. The inspection should also quantify the accumulation of hydrocarbons, trash, and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument. If absorbent material is used for enhanced removal of hydrocarbons, the level of discoloration of the sorbent material should also be identified during inspection. It is useful and often required as part of an operating permit to keep a record of each inspection. A simple form for doing so is provided.

Access to the CDS unit is typically achieved through two manhole access covers. One opening allows for inspection and cleanout of the separation chamber (cylinder and screen) and isolated sump. The other allows for inspection and cleanout of sediment captured and retained outside the screen. For deep units, a single manhole access point would allow both sump cleanout and access outside the screen.

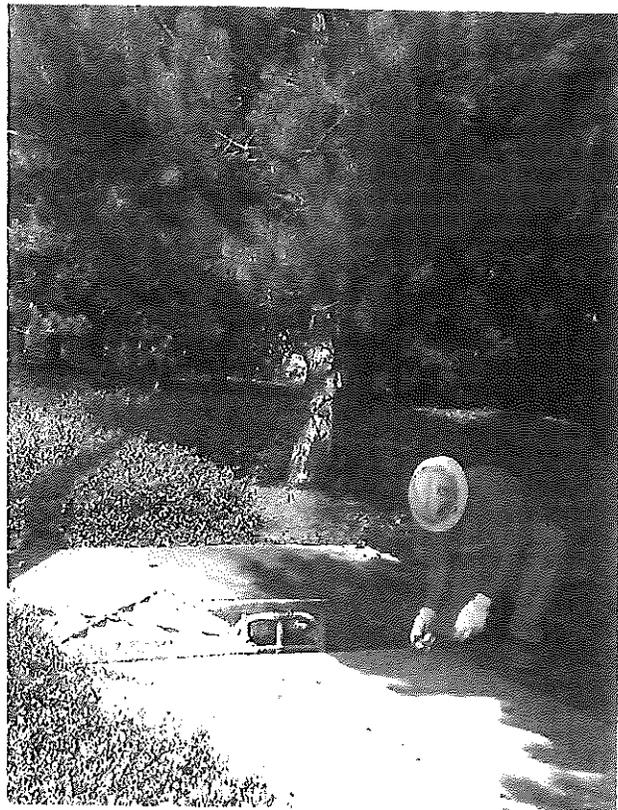
The CDS system should be cleaned when the level of sediment has reached 75% of capacity in the isolated sump or when an appreciable level of hydrocarbons and trash has accumulated. If absorbent material is used, it should be replaced when significant discoloration has occurred. Performance will not be impacted until 100% of the sump capacity is exceeded however it is recommended that the system be cleaned prior to that for easier removal of sediment. The level of sediment is easily determined by measuring from finished grade down to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Particles at the top of the pile typically offer less resistance to the end of the rod than consolidated particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the as-built drawing for the unit to determine whether the height of the sediment pile off the bottom of the sump floor exceeds 75% of the total height of isolated sump.

Cleaning

Cleaning of a CDS system should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Simply remove the manhole covers and insert the vacuum hose into the sump. The system should be completely drained down and the sump fully evacuated of sediment. The area outside the screen should also be cleaned out if pollutant build-up exists in this area.

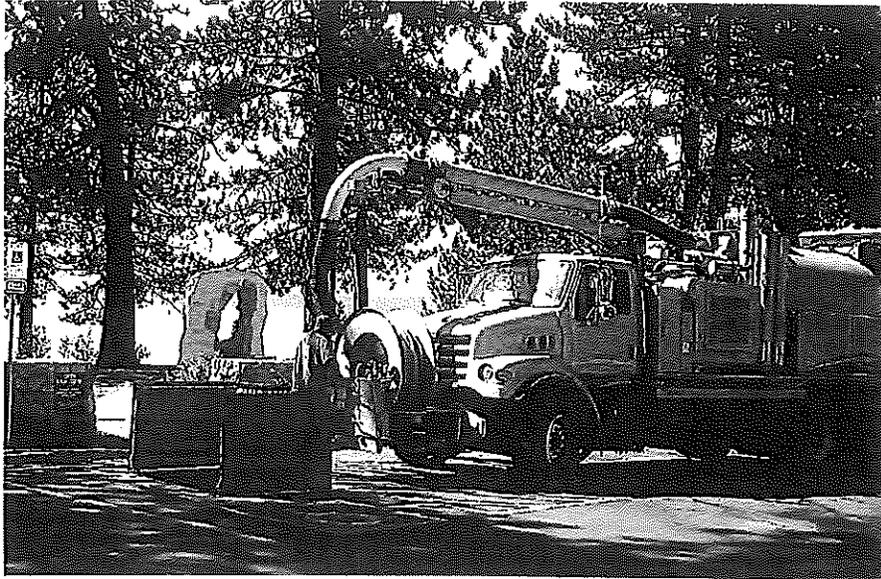
In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill should be cleaned out immediately. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use absorbent pads since they are usually less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Trash and debris can be netted out to separate it from the other pollutants. The screen should be power washed to ensure it is free of trash and debris.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure that proper safety precautions have been followed. Confined space entry procedures need to be followed if physical access is required. Disposal of all material removed from the CDS system should be done in accordance with local regulations. In many jurisdictions, disposal of the sediments may be handled in the same manner as the disposal of sediments removed from catch basins or deep sump manholes.



CDS Model	Diameter		Distance from Water Surface to Top of Sediment Pile		Sediment Storage Capacity	
	ft	m	ft	m	yd ³	m ³
CDS2015-4	4	1.2	3.0	0.9	0.5	0.4
CDS2015	5	1.5	3.0	0.9	1.3	1.0
CDS2020	5	1.5	3.5	1.1	1.3	1.0
CDS2025	5	1.5	4.0	1.2	1.3	1.0
CDS3020	6	1.8	4.0	1.2	2.1	1.6
CDS3030	6	1.8	4.6	1.4	2.1	1.6
CDS3035	6	1.8	5.0	1.5	2.1	1.6
CDS4030	8	2.4	4.6	1.4	5.6	4.3
CDS4040	8	2.4	5.7	1.7	5.6	4.3
CDS4045	8	2.4	6.2	1.9	5.6	4.3

Table 1: CDS Maintenance Indicators and Sediment Storage Capacities



Support

- Drawings and specifications are available at www.contechstormwater.com.
- Site-specific design support is available from our engineers.

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CONTECH Construction Products Inc. provides site solutions for the civil engineering industry. CONTECH's portfolio includes bridges, drainage, sanitary sewer, stormwater and earth stabilization products. For information on other CONTECH division offerings, visit contech-cpi.com or call 800.338.1122.

Nothing in this catalog should be construed as an expressed warranty or an implied warranty of merchantability or fitness for any particular purpose. See the CONTECH standard quotation or acknowledgement for applicable warranties and other terms and conditions of sale.

The product(s) described may be protected by one or more of the following US patents: 5,322,629; 5,624,576; 5,707,527; 5,759,415; 5,788,848; 5,985,157; 6,027,639; 6,350,374; 6,406,218; 6,641,720; 6,511,595; 6,649,048; 6,991,114; 6,998,038; 7,186,058; 7,296,692; 7,297,266; 7,517,450 related foreign patents or other patents pending.

ATTACHMENT E

Operation and Maintenance (O & M) Plan

OPERATION AND MAINTENANCE (O&M) PLAN

**Water Quality Management Plan
for**

Central Avenue Industrial Project

**270 E. Central Avenue
San Bernardino, CA 92408**

Attachment E, Operation and Maintenance Plan
 Note: OWNER = Central XC, LLC

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Non-Structural Source Control BMPs			
Y	<p>N1. Education of Property Owners, Tenants and Occupants on Stormwater BMPs</p> <p>The owner will provide practical information materials to the first occupants/tenants on general housekeeping practices for retail commercial developments that contribute to the protection of stormwater quality. (See Attachment H to the WQMP for the applicable BMP Educational Materials.) Thereafter such materials will be available through the local jurisdiction's stormwater education program. 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 wastes via hosing or other direct discharge to gutters, catch basins and storm drains. Educational materials are available from the San Bernardino Stormwater Program and can be downloaded at: http://www.sbcountystormwater.org/gov_out.html.</p>	<p>Frequency: Upon occupancy</p>	<p>Central XC, LLC 3010 Old Ranch Parkway, Ste. 470 Seal Beach, CA 90740 (562) 795-0270 gretchens@xebecrealty.com</p>
Y	<p>N2. Activity Restrictions</p> <p>The owner will implement use /activity restrictions for the project for the purpose of surface water quality protection through the use of lease terms. For example, automobile washing, maintenance, and repairs will not be allowed at the project site.</p>	<p>Frequency: Continuous</p>	<p>Central XC, LLC 3010 Old Ranch Parkway, Ste. 470 Seal Beach, CA 90740 (562) 795-0270 gretchens@xebecrealty.com</p>

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Y	<p>N3. Landscape Management BMPs The owner will identify on-going landscape maintenance requirements consistent with applicable local ordinances that may include fertilizer and/or pesticide usage.</p>	<p>Frequency: Continuous</p>	<p>Central XC, LLC 3010 Old Ranch Parkway, Ste. 470 Seal Beach, CA 90740 (562) 795-0270 gretchens@xebecreality.com</p>
Y	<p>N4. BMP Maintenance The owner will be responsible for implementation of each non- structural BMP and scheduled cleaning and/or maintenance of all structural BMP facilities.</p>	<p>Frequency: Continuous</p>	<p>Central XC, LLC 3010 Old Ranch Parkway, Ste. 470 Seal Beach, CA 90740 (562) 795-0270 gretchens@xebecreality.com</p>
N	<p>N5. Title 22 CCR Compliance</p>		
Y	<p>N6. Local Water Quality Ordinances The owner will comply with any applicable local water quality ordinances.</p>	<p>Frequency: Continuous</p>	<p>Central XC, LLC 3010 Old Ranch Parkway, Ste. 470 Seal Beach, CA 90740 (562) 795-0270 gretchens@xebecreality.com</p>
Y	<p>N7. Spill Contingency Plan The owner will prepare a Spill Contingency Plan based on specified types of building or suite occupancies. The Plan will mandate stockpiling of cleanup materials, notification of responsible agencies, disposal of cleanup materials, documentation, etc.</p>	<p>Frequency: Upon occupancy</p>	<p>Central XC, LLC 3010 Old Ranch Parkway, Ste. 470 Seal Beach, CA 90740 (562) 795-0270 gretchens@xebecreality.com</p>

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
N	N8. Underground Storage Tank Compliance		
N	N9. Hazardous Materials Disclosure Compliance		
N	N10. Uniform Fire Code Implementation		
Y	<p>N11. Litter/Debris Control Program The owner will implement trash management and litter control procedures in the common areas aimed at reducing pollution of drainage water. The owner may contract with its landscape maintenance firm to provide this service during regularly scheduled maintenance, which should consist of litter patrol, emptying of trash receptacles in common areas, and noting trash disposal violations by tenants or businesses and reporting the violations to the owner for investigation.</p>	<p>Frequency: Weekly</p>	<p>Central XC, LLC 3010 Old Ranch Parkway, Ste. 470 Seal Beach, CA 90740 (562) 795-0270 gretchens@xebecrealty.com</p>
Y	<p>N12. Employee Training The owner will prepare an education program manual (see N1) for future employees of individual businesses at the project, and will train the employees on such matters as the proper storage and use of pesticides, the proper disposal of fats, oil and grease, and the implementation of hazardous spill contingency plans.</p>	<p>Frequency: Upon hire, and annually thereafter</p>	<p>Central XC, LLC 3010 Old Ranch Parkway, Ste. 470 Seal Beach, CA 90740 (562) 795-0270 gretchens@xebecrealty.com</p>
Y	<p>N13. Housekeeping of Loading Docks Keep all fluids indoors. Clean up spills immediately and keep spills from entering storm drain system. No direct discharges into the storm drain system. Area shall be inspected weekly for proper containment and practices with spills cleaned up immediately and disposed of properly.</p>	<p>Frequency: Continuous</p>	<p>Central XC, LLC 3010 Old Ranch Parkway, Ste. 470 Seal Beach, CA 90740 (562) 795-0270 gretchens@xebecrealty.com</p>

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Y	<p>N14. Catch Basin Inspection Program The catch basins will be inspected, cleaned and maintained on an annual basis, in the early fall prior to the start of the rainy season, and before and after all major storms.</p>	<p>Frequency: Annually, and before and after all major storms</p>	<p>Central XC, LLC 3010 Old Ranch Parkway, Ste. 470 Seal Beach, CA 90740 (562) 795-0270 gretchens@xebecrealty.com</p>
Y	<p>N15. Vacuum Sweeping of Private Streets and Parking Lots The owner will ensure that the project's parking lots will be swept on a monthly basis, or more often if necessary, using a vacuum assisted sweeper.</p>	<p>Frequency: Monthly, or more often if necessary</p>	<p>Central XC, LLC 3010 Old Ranch Parkway, Ste. 470 Seal Beach, CA 90740 (562) 795-0270 gretchens@xebecrealty.com</p>
N	<p>N16. Other Non-structural Measures for Public Agency Projects</p>		
Y	<p>N17. Comply With All Other Applicable NPDES Permits The owner shall comply with other NPDES permits such as General Industrial permits, etc., to include BMPs that are required as part of a SWPPP.</p>	<p>Frequency: Continuous</p>	<p>Central XC, LLC 3010 Old Ranch Parkway, Ste. 470 Seal Beach, CA 90740 (562) 795-0270 gretchens@xebecrealty.com</p>

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Structural Source Control BMPs			
Y	<p>S1. Provide Storm Drain System Stenciling and Signage</p> <p>Storm drain stencils are highly visible source control messages, typically placed directly adjacent to storm drain inlets. The stencils contain a brief statement that prohibits the dumping of improper materials into the MS4. Graphical icons, either illustrating anti-dumping symbols or images of receiving water fauna, are effective supplements to the anti-dumping message. Stencils and signs alert the public to the destination of pollutants discharged into stormwater. The following requirements will be included in the project design and shown on the project plans:</p> <ul style="list-style-type: none"> - Provide stenciling or labeling of all storm drain inlets and catch basins, constructed or modified, within the project area with prohibitive language (such as: "No Dumping – Flows to Creek") and/or graphical icons to discourage illegal dumping. - Maintain legibility of stencils and signs. 	<p>Frequency: Annually</p>	<p>Central XC, LLC 3010 Old Ranch Parkway, Ste. 470 Seal Beach, CA 90740 (562) 795-0270 gretchens@xebecreality.com</p>
N	<p>S2. Design and Construct Outdoor Material Storage Areas to Reduce Pollution Introduction</p>		

Attachment E, Operation and Maintenance Plan
 Page 6 of 11

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Y	<p>S3. Design and Construct Trash and Waste Storage Areas to Reduce Pollution Introduction</p> <p>Trash storage areas will be designed to reduce pollutant introduction. All trash container areas will meet the following requirements:</p> <ul style="list-style-type: none"> - Paved with an impervious surface, designed to not allow run-on from adjoining areas, designed to divert drainage from adjoining roofs and pavements around the area, screened or walled to prevent off-site transport of trash; and - Provide solid roof or awning to prevent exposure to direct precipitation. - No trash area drains will be connected to the MS4. 	<p>Frequency: Continuous</p>	<p>Central XC, LLC 3010 Old Ranch Parkway, Ste. 470 Seal Beach, CA 90740 (562) 795-0270 gretchens@xebecrealty.com</p>

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Y	<p>S4. Use Efficient Irrigation Systems & Landscape Design, Water Conservation, Smart Controllers, and Source Control</p> <p>The following methods to reduce excessive irrigation runoff and pollutant introduction will be incorporated for all landscaped areas where applicable: (1) employing rain shutoff devices to prevent irrigation after precipitation; (2) designing irrigation systems to each landscape area's specific water requirements; (3) using flow reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines; (4) the timing and application methods of irrigation water shall be designed to minimize the runoff of excess irrigation water into the municipal storm drain system; (5) employing other comparable, equally effective, methods to reduce irrigation water runoff; grouping plants with similar water requirements in order to reduce excess irrigation runoff and promote surface filtration; (6) choosing plants with low irrigation requirements (for example, native or drought tolerant species); (7) using mulches (such as wood chips or shredded wood products) in planter areas without ground cover to minimize sediment in runoff; (8) installing appropriate plant materials for the location, in accordance with amount of sunlight and climate, and using native plant material where possible and/or as recommended by the landscape architect; (9) leaving a vegetative barrier along the property boundary and interior watercourses, to act as a pollutant filter, where appropriate and feasible; and (10) choosing plants that minimize or eliminate the use of fertilizer or pesticides to sustain growth.</p>	<p>Frequency: Continuous</p>	<p>Central XC, LLC 3010 Old Ranch Parkway, Ste. 470 Seal Beach, CA 90740 (562) 795-0270 gretchens@xebecreality.com</p>

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Y	<p>S5. Finish Grade of Landscaped Areas at a Minimum of 1-2 Inches Below Top of Curb, Sidewalk or Pavement</p> <p>All landscape pockets, fingers, setback areas, parkway strips, street medians, etc., will be finish-graded at a minimum of 1-2 inches below top of curb or sidewalk for increased retention/infiltration of stormwater and irrigation water.</p>	<p>Frequency: Continuous</p>	<p>Central XC, LLC 3010 Old Ranch Parkway, Ste. 470 Seal Beach, CA 90740 (562) 795-0270 gretchens@xebecreality.com</p>
N	<p>S6. Protect Slopes and Channels and Provide Energy Dissipation</p>		
N	<p>S7. Covered Dock Areas</p>		
N	<p>S8. Covered Maintenance Bays With Spill Containment Plans</p>		

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
N	S9. Vehicle Wash Areas With Spill Containment Plans		
N	S10. Covered Outdoor Processing Areas		
N	S11. Equipment Wash Areas With Spill Containment Plans		
N	S12. Fueling Areas		
N	S13. Hillside Landscaping		
N	S14. Wash Water Control for Food Preparation Areas		
N	S15. Community Car Wash Racks		

BMP Applicable? Yes/No	BMP Name and BMP Implementation, Maintenance and Inspection Procedures	Implementation, Maintenance, and Inspection Frequency and Schedule	Person or Entity with Operation & Maintenance Responsibility
Low Impact Development BMPs			
Y	<p>LID BMP #1— Onsite Infiltration (Underground Chamber) Quarterly inspections of the underground infiltration BMPs shall be conducted utilizing the designed manholes/inspection ports. The BMPs shall be cleaned when inspection reveals that accumulated sediment or trash is clogging the system. Accumulated sediment and trash can be evacuated through the manholes.</p>	<p>Frequency: Quarterly And Immediately After Major Storm Events</p>	<p>Central XC, LLC 3010 Old Ranch Parkway, Ste. 470 Seal Beach, CA 90740 (562) 795-0270 gretchens@xebecreality.com</p>
Y	<p>LID BMP #2— Proprietary Treatment Control Measure (Proprietary Hydrodynamic Separation Device— Pretreatment for Onsite Infiltration) (Contech Hydrodynamic Separation Device or Approved Equivalent) Twice a year, prior to and after the rainy season, and after major storm events, the hydrodynamic separation device shall be visually inspected for damage, obstructions in the inlet and separation screen, and accumulation of pollutants in the system. The device should be cleaned when the sediment has reached 75% of capacity in the isolated sump or when an appreciable level of hydrocarbons and trash has accumulated. Accumulated pollutants can be evacuated through the manholes.</p>	<p>Frequency: Every Six Months (Approximately April 1st and October 1st) and Immediately After Major Storm Events</p>	<p>Central XC, LLC 3010 Old Ranch Parkway, Ste. 470 Seal Beach, CA 90740 (562) 795-0270 gretchens@xebecreality.com</p>

Required Permits

No permits are required for the implementation, operation, and maintenance of the BMPs described in this plan.

Recordkeeping

All records must be maintained for at least five (5) years and must be made available for review upon request.

ATTACHMENT F

Water Quality Management Plan and Stormwater BMP Transfer, Access and Maintenance Agreement

City Clerk
City of San Bernardino
300 N. "D" Street, 2nd Floor
San Bernardino, CA 92418

SPACE ABOVE THIS LINE FOR RECORDERS USE

WATER QUALITY MANAGEMENT PLAN AND STORMWATER BMP TRANSFER, ACCESS AND MAINTENANCE AGREEMENT

CITY OF SAN BERNARDINO, COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA

This Agreement is made this 15th day of December, 2015, by and between the City of San Bernardino, a municipal corporation, hereinafter referred to as CITY, and Central XC, LLC hereinafter referred to as OWNER.

WHEREAS, the Owner is the legal property owner of the real property situated in the State of California, County of San Bernardino, located at 270 E. Central Avenue in the City of San Bernardino, more commonly referred to as San Bernardino Tax Assessor Parcel Nos. 0136-401-11-0-000, and more particularly described in Exhibit A attached hereto and incorporated herein by reference.

WHEREAS, at the time of initial approval of the development project known as the Central Avenue Industrial Project within the Property described herein, the City required the project to employ Best Management Practices, hereinafter referred to as "BMPs," to minimize pollutants in urban runoffs; and

WHEREAS, in order to minimize pollutants in urban runoff and to minimize other adverse impacts of urban runoff, the Owner has chosen to install and/or implement BMPs as described in the Water Quality Management Plan, on file with the City, hereinafter referred to as "WQMP", a copy of which (excluding all attachments other than the WQMP Site Plan and Operation and Maintenance (O&M) Plan) is attached hereto as Exhibit B and incorporated herein by reference; and

WHEREAS, said WQMP has been certified by the Owner and reviewed and approved by the City; and

WHEREAS, said BMPs, with installation and/or implementation on private property and draining only private property, are part of a private facility with all maintenance or replacement therefore, the sole responsibility of the Owner in accordance with the terms of this Agreement;

WHEREAS, the Owner is aware that periodic and continuous maintenance, including, but not necessarily limited to, filter material replacement and sediment removal, is required to assure peak performance of all BMPs in the WQMP and that, furthermore, such maintenance activity will require compliance with all Local, State, or Federal Laws and regulations, including those pertaining to confined space and waste disposal methods, in effect at the time such maintenance occurs;

NOW THEREFORE, it is mutually stipulated and agreed as follows:

1. The Owner hereby provides the City or the City's designee complete access, of any duration, to the BMPs and their immediate vicinity at any time, upon reasonable notice, or in the event of emergency, as determined by City's Director of Public Works or designee, with no advance notice for the purpose of inspection, sampling, testing of the Device, and in case of emergency, to undertake all necessary repairs or other preventative measures at owner's expense as provided in paragraph 3 below. The City shall make every effort at all times to minimize or avoid interference with Owner's use of the Property.

2. The Owner shall use its best efforts diligently to maintain all BMPs in a manner assuring peak performance at all times. All reasonable precautions shall be exercised by the Owner and the Owner's representative or contractor in the removal and extraction of any material(s) from the BMPs and the ultimate disposal of the material(s) in a manner consistent with all relevant laws and regulations in effect at the time. As may be requested from time to time by the City, the Owner shall provide the City with documentation identifying the material(s) removed, the quantity, and disposal destination.

3. In the event the Owner, or its successors or assigns, fails to accomplish the necessary maintenance contemplated by this Agreement, within five (5) days of being given written notice by the City, the City is hereby authorized to cause any maintenance necessary to be done and charge the entire cost and expense to the Owner or the Owner's successors or assigns, including administrative costs, attorneys' fees and interest thereon at the maximum rate authorized by the law from the date of the notice of expense until paid in full.

4. The City may require the Owner to post security in a form and for a time period satisfactory to the City to guarantee the performance of the obligations stated herein. Should the Owner fail to perform the obligations under this Agreement, the City may, in the case of a cash bond, act for the Owner using the cash proceeds, or in the case of a surety bond, require the sureties to perform the obligations of this Agreement. As an additional remedy, the Director may reasonably withdraw any previous stormwater-related approval with respect to the property on which BMPs have been improperly installed, modified without permission of the City and/or inadequately implemented and maintained until such time as the Owner repays to the City its reasonable costs incurred in accordance with paragraph 3 above.

5. This Agreement shall be recorded by the Owner in the Office of the Recorder of San Bernardino County, California, at the expense of the Owner and shall constitute notice to all successors and assigns of the title to said Property of the obligation herein set forth, and also a lien in such amount as will fully reimburse the City, including interest as herein above set forth, subject to foreclosure in event of default in payment.

6. In event of legal action occasioned by any default or action of the Owner, or its successors or assigns, then the Owner and its successors or assigns agree(s) to pay all costs incurred by the City in enforcing the terms of this Agreement, including reasonable attorney's fees and costs, and that the same shall become a part of the lien against said Property.

7. It is the intent of the parties hereto that burdens and benefits herein undertaken shall constitute covenants that run with said Property and constitute a lien against the Property.

8. The obligations herein undertaken shall be binding upon the heirs, successors, executors, administrators and assigns of the parties hereto. The term "Owner" shall include not only the present Owner, but also its heirs, successors, executors, administrators, and assigns. The Owner shall notify any successor to title of all or part of the Property about the existence of this Agreement. The Owner shall provide such notice prior to such successor obtaining an interest in all or part of the Property. The Owner shall provide a copy of such notice to the City at the same time such notice is provided to the successor.

9. Time is of the essence in the performance of this Agreement.

10. Any notice to a party required or called for in this Agreement shall be served in person, or by deposit in the U.S. Mail, first class postage prepaid, to the address set forth below. Notice(s) shall be deemed effective upon receipt, or seventy-two (72) hours after deposit in the U.S. Mail, whichever is earlier. A party may change a notice address only by providing written notice thereof to the other party.

IF TO CITY:

City of San Bernardino

300 N. "D" Street, 2nd Floor

San Bernardino, CA 92418

IF TO OWNER

Central XC, LLC

3010 Old Ranch Parkway, Suite 470

Seal Beach, CA 90740

IN WITNESS THEREOF, the parties hereto have affixed their signatures as of the date first written above.

APPROVED AS TO CONTENT:

By: _____
Public Works Director/City Engineer

OWNER:

Central XC, LLC

By: _____
(Signature and Date)

Name: Gretchen Sauer
(Please Print or Type Name)

Title: _____
(Please Print or Type Title)

ATTEST:

Georgeann Hanna, Deputy City Clerk

Exhibit A

Legal Description of Property

THE LAND REFERRED TO HEREIN BELOW IS SITUATED IN THE CITY OF SAN BERNARDINO, IN THE COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, AND IS DESCRIBED AS FOLLOWS:

PARCEL 1 OF PARCEL MAP NO. 5582, IN THE CITY OF SAN BERNARDINO, COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, AS PER MAP RECORDED IN BOOK 54 OF PARCEL MAPS, PAGES 30 AND 31 OF MAPS, RECORDS OF SAID COUNTY.

APN: 0136-401-11-0-000

Exhibit B

Project WQMP

(Excluding Attachments With the Exception of the WQMP Site Plan)

ATTACHMENT G

BMP Educational Materials

- 1. Industrial and Commercial Facilities Brochure (San Bernardino County Website)**
- 2. Commercial Landscape Maintenance Fact Sheet (San Bernardino County Website)**
- 3. Stormwater Management Practices for Commercial Landscape Maintenance Brochure (San Bernardino County Website)**
- 4. Commercial Trash Enclosures Brochure (San Bernardino County Website)**
- 5. Construction & Development Fact Sheet (San Bernardino County Website)**
- 6. Regulatory Information Fact Sheet (San Bernardino County Website)**
- 7. SC-11 Spill Prevention, Control & Cleanup**
- 8. SC-30 Outdoor Loading / Unloading**
- 9. SC-34 Waste Handling & Disposal**
- 10. SC-41 Building & Grounds Maintenance**
- 11. SC-42 Building Repair and Construction**
- 12. SC-43 Parking / Storage Area Maintenance**
- 13. SC-44 Drainage System Maintenance**
- 14. SC-60 Housekeeping Practices**
- 15. SC-71 Plaza and Sidewalk Cleaning**
- 16. SC-73 Landscape Maintenance**
- 17. SD-12 Efficient Irrigation**
- 18. SD-13 Storm Drain Signage**
- 19. SD-31 Maintenance Bays & Docks**
- 20. SD-32 Trash Storage Areas**
- 21. MP-51 Vortex Separator**
- 22. TC-60 Multiple Systems**

STORMWATER Pollution Prevention

Important Phone Numbers

San Bernardino County Flood Control
(909) 387-8112

County of San Bernardino
(909) 387-8109

City of Big Bear Lake
(909) 866-5831

City of Chino (909) 591-9850

City of Chino Hills (909) 364-2722

City of Colton (909) 370-6128

City of Fontana (909) 350-6772

City of Grand Terrace
(909) 824-6671 x 226

City of Highland (909) 864-8732 x 230

City of Loma Linda (909) 799-4405

City of Montclair (909) 625-9470

City of Ontario (909) 395-2025

City of Rancho Cucamonga
(909) 477-2740 x 4063

City of Redlands (909) 798-7655

City of Rialto (909) 421-4921

City of San Bernardino (909) 384-5154

City of Upland (909) 931-4370

City of Yucaipa (909) 797-2489 x 243

STORMWATER Pollution Prevention

INDUSTRIAL AND COMMERCIAL FACILITIES



**San Bernardino County
Stormwater Program**
825 East Third Street • Room 201
San Bernardino, CA 94215-0835



Pollution Prevention

To reduce the amount of pollutants reaching our storm drain system, which leads to the Santa Ana River and Pacific Ocean, the San Bernardino County Stormwater Program has developed Best Management Practices (BMPs) for Industrial and Commercial Facilities. City and County ordinances require that businesses comply with these BMPs, where applicable, to protect local water quality. Local cities and the County are required to verify implementation of these BMPs by performing regular facility inspections.

Prohibited Discharges

- Discontinue all non-stormwater discharges to the storm drain system. It is prohibited to discharge any chemicals, wastes or wastewater into the gutter, street or storm drain.

Outdoor Storage

- Install covers and secondary containment areas for all hazardous materials and wastes stored outdoors in accordance with County and/or City standards.
- Keep all temporary waste containers covered, except when in direct use.
- Sweep outdoor areas instead of using a hose or pressure washer.

Outdoor Processes

- Move all process operations including vehicle and equipment maintenance inside of the building or into a covered and contained area.
- Wash equipment and vehicles in a contained and covered wash bay which is closed-loop or connected to a clarifier sized to city standards, then discharged to a sanitary sewer or take them to a commercial car wash.

Spills and Clean Ups

- Clean up spills immediately when they occur, using dry clean up methods such as absorbent materials and followed by proper disposal of materials.
- Always have a spill kit available near chemical loading dock doors, vehicle maintenance and fueling areas.
- Follow your Business Emergency Plan, as filed with the County Fire Department at (909) 386-8401.

Industrial and Commercial Facilities

- Report all prohibited discharges and non-implementation of BMPs to your local Stormwater Coordinator either at (800) CLEANUP or as listed at www.sbcounty.gov/stormwater.
- Report hazardous materials spills to (800) 33 TOXIC and your local Fire Department Hazmat Team at 911.

Training

Train employees in spill response procedures and prohibited discharges to the storm drain system, as prescribed in your local Stormwater Ordinance and in applicable Best Management Practices available at www.cabmphandbooks.com and www.sbcounty.gov/stormwater.

Permitting

Stormwater discharges associated with specific categories of commercial and industrial facilities are regulated by the State Water Resources Control Board (SWRCB) through an Industrial Storm Water General Permit. A copy of the General Permit and application forms are available at: www.waterboards.ca.gov/stormwtr/industrial.html

To report illegal dumping or for more information on stormwater pollution prevention, call:

1 (800) CLEANUP

or visit our websites at:

www.sbcounty.gov/stormwater

www.1800cleanup.org



Prevención de Contaminación AL SISTEMA DE DRENAJE

Números de Teléfono Importantes

San Bernardino County Flood Control
(909) 387-8112

County of San Bernardino
(909) 387-8109

City of Big Bear Lake
(909) 866-5831

City of Chino (909) 591-9850

City of Chino Hills (909) 364-2722

City of Colton (909) 370-6128

City of Fontana (909) 350-6772

City of Grand Terrace
(909) 824-6671 x 226

City of Highland (909) 864-8732 x 230

City of Loma Linda (909) 799-4405

City of Montclair (909) 625-9470

City of Ontario (909) 395-2025

City of Rancho Cucamonga
(909) 477-2740 x 4063

City of Redlands (909) 798-7655

City of Rialto (909) 421-4921

City of San Bernardino (909) 384-5154

City of Upland (909) 931-4370

City of Yucaipa (909) 797-2489 x 243

Prevención de Contaminación AL SISTEMA DE DRENAJE

INSTALACIONES INDUSTRIALES Y COMERCIALES



San Bernardino County
Stormwater Program
825 East Third Street • Room 201
San Bernardino, CA 94215-0835



Prevención de Contaminación AL SISTEMA DE DRENAJE

Para reducir la cantidad de contaminantes que alcanzan nuestro sistema de aguas pluviales, las cuales desembocan en el Río Santa Ana y el Océano Pacífico, el Programa del Condado de San Bernardino ha desarrollado las pautas de Mejores Prácticas de Manejo (BMPs), por sus siglas en inglés) para instalaciones industriales y comerciales. Los decretos de la ciudad y del condado establecen que todas las empresas deben de cumplir con estas BMPs, cuando corresponda, para proteger la calidad del agua local. Las ciudades locales y el condado tienen la obligación de verificar la implementación de estas BMPs al llevar a cabo inspecciones regulares en sus instalaciones.

Desagües Prohibidos

- Descontinúe todo desagüe de aguas no pluviales al sistema de drenaje de aguas pluviales. Está prohibido descargar cualquier sustancia química, residuo o agua residual a los drenajes de la cuneta, de la calle o de aguas pluviales.

Almacenamiento al Aire Libre

- Instale cubiertas y áreas de retención secundarias para todos los materiales peligrosos y residuos almacenados al aire libre, estas instalaciones deberán de cumplir con los estándares establecidos por el condado y/o la ciudad.
- Mantenga todos los recipientes temporales de residuos cubiertos, con la excepción de cuando se estén utilizando directamente.
- Barra todas las áreas al aire libre en lugar de usar una manguera o un equipo de limpieza con agua a alta presión.

Procesos al Aire Libre

- Reubique todos los procesos u operaciones, incluyendo el mantenimiento de vehículos y equipo, dentro de un edificio en una área cubierta e independiente.
- Lave el equipo y los vehículos en una fosa de lavado independiente que tenga un anillo cerrado o bien, esté conectada a un clarificador del tamaño de los estándares municipales. Luego elimine los residuos en un drenaje sanitario o llévelos a un lavador de carros comercial.

Derrames y Limpieza

- Limpie los derrames inmediatamente, utilice métodos de limpieza en seco como son el uso de materiales absorbentes y elimine estos materiales de la manera adecuada.
- Siempre tenga a la mano un estuche para derrames cerca de las puertas de los muelles de carga de sustancias químicas, en las áreas de mantenimiento de vehículos y en las áreas de combustible.

• Siga su Plan de Emergencia Comercial, como lo registró con el Departamento de Bomberos del

Instalaciones Industriales y Comerciales

Condado marcando al (909) 386-8401.

- Reporte todos los desagües prohibidos y cualquier punto no implementado de las BMPs a su coordinador local de Aguas Pluviales llamando al (800) CLEANUP o como se indica en el enlace www.sbcounty.gov/stormwater.
- Reporte cualquier derrame peligroso al (800) 33 TOXIC y al equipo Hazmat de su departamento local de bomberos marcando al 911.

Capacitación

Capacite a los empleados sobre los procedimientos de respuesta ante un derrame y los desagües prohibidos al sistema de aguas pluviales, como lo indica el decreto local de aguas pluviales de Mejores Prácticas de Manejo (BMPs) disponibles en el sitio www.cabmphandbooks.com y www.sbcounty.gov/stormwater.

Autoridad Competente

Los desagües de aguas pluviales relacionados con categorías específicas de instalaciones comerciales e industriales están regulados por la Junta Estatal de Control de Recursos Acuáticos (State Water Resources Control Board, SWRCB) a través de un permiso industrial general de aguas pluviales. Para obtener una copia de este permiso general y una solicitud, visite el sitio: www.waterboards.ca.gov/stormwtr/industrial.html

Para reportar el desagüe de residuos ilegales o para obtener información adicional sobre la prevención de contaminación a las aguas pluviales, llame a:

1 (800) CLEANUP

o visite nuestro sitio:

www.sbcounty.gov/stormwater

www.1800cleanup.org



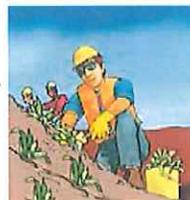


SAN BERNARDINO COUNTY STORMWATER POLLUTION PREVENTION

■ Commercial landscape maintenance:

Yard waste, sediments and toxic lawn and garden chemicals used in commercial landscape maintenance often make their way into the San Bernardino County storm drain system and do not get treated before reaching the Santa Ana River. This pollutes our drinking water and contaminates local waterways, making them unsafe for people and wildlife. Follow these best management practices to prevent pollution, protect public health and avoid fines or legal action.

- **Recycle Yard Waste:** Recycle leaves, grass clippings and other yard waste. Do not blow, sweep, rake or hose yard waste into the street. Let your customers know about grass cycling --the natural recycling of grass by leaving clippings on the lawn when mowing instead of using a grass catcher. Grass clippings will quickly decompose, returning valuable nutrients to the soil. You can get more information at www.ciwmb.ca.gov/Organics.
- **Use Fertilizers, Herbicides & Pesticides Safely:** Fertilizers, herbicides and pesticides are often carried into the storm drain system by sprinkler runoff. Use natural, non-toxic alternatives to traditional garden chemicals. If you must use chemical fertilizers, herbicides, or pesticides spot apply rather than blanketing entire areas, avoid applying near curbs and driveways and never apply before a rain.
- **Recycle Hazardous Waste:** Pesticides, fertilizers, herbicides and motor oil contaminate landfills and should be disposed of through a Hazardous Waste Facility. For information on proper disposal, call (909) 386-8401.
- **Use Water Wisely:** Conserve water and prevent runoff by controlling the amount of water and direction of sprinklers. Sprinklers should be on long enough to allow water to soak into the ground but not so long as to cause runoff. Periodically inspect, fix leaks and realign sprinkler heads.
- **Planting:** Plant native vegetation to reduce the need of water, fertilizers, herbicides and pesticides.
- **Prevent Erosion:** Erosion washes sediments, debris and toxic runoff into the storm drain system, polluting waterways. Prevent erosion and sediment runoff by using ground cover, berms and vegetation down-slope to capture runoff. Avoid excavation or grading during wet weather.
- **Store Materials Safely:** Keep landscaping materials and debris away from the street, gutter and storm drains. On-site stockpiles of materials should be covered with plastic sheeting to protect from rain, wind and runoff.



For more information about how you can prevent stormwater pollution:

www.sbcountystormwater.org

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San Bernardino County Stormwater Program
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San Bernardino, CA 94215-0835



STORMWATER Pollution Prevention

LANDSCAPE MAINTENANCE



Pollution ^{STORMWATER} Prevention

Stormwater Management Practices for Commercial Landscape Maintenance

Yard waste, sediments, and toxic lawn/garden chemicals used in commercial landscape maintenance often make their way into the San Bernardino County storm drain system and do not get treated before reaching the Santa Ana River. This pollutes our drinking water and contaminates local waterways, making them unsafe for people and wildlife. Following these best management practices will prevent pollution, comply with regulations and protect public health.

Recycle Yard Waste

Recycle leaves, grass clippings and other yard waste. Do not blow, sweep, rake or hose yard waste into the street. Try grasscycling - the natural recycling of grass by leaving clippings on the lawn when mowing. Grass clippings will quickly decompose, returning valuable nutrients to the soil. Further information can be obtained at www.ciwmb.ca.gov/Organics.

Use Fertilizers, Herbicides and Pesticides Safely

Fertilizers, herbicides and pesticides are often carried into the storm drain system by sprinkler runoff. Use of natural, non-toxic alternatives to the traditional fertilizers, herbicides and pesticides is highly recommended. If you must use chemical fertilizers, herbicides, or pesticides:

- Spot apply pesticides and herbicides, rather than blanketing entire areas.
- Avoid applying near curbs and driveways, and never apply before a rain.
- Apply fertilizers as needed, when plants can best use it, and when the potential for it being carried away by runoff is low.

Recycle Hazardous Waste

Pesticides, fertilizers, herbicides and motor oil contaminate landfills and should be disposed of through a Hazardous Waste Facility, which accepts these types of materials. For information on proper disposal call, (909) 386-8401.

Use Water Wisely

Conserve water and prevent runoff by controlling the amount of water and direction of sprinklers. Sprinklers should be on long enough to allow water to soak into the ground but not so long as to cause runoff. Periodically inspect, fix leaks and realign sprinkler heads. Plant native vegetation to reduce the need of water, fertilizers, herbicides, and pesticides.

Prevent Erosion

Erosion washes sediments, debris and toxic runoff into the storm drain system, polluting waterways.

- Prevent erosion and sediment runoff by using ground cover, berms and vegetation down-slope to capture runoff.
- Avoid excavation or grading during wet weather.

Store Materials Safely

Keep landscaping materials and debris away from the street, gutter and storm drains. On-site stockpiles of materials must be covered with plastic sheeting to protect from rain, wind and runoff.

To report illegal dumping call
(877) WASTE18
or visit our website:
sbcountystormwater.org



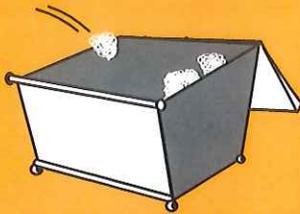
COMMERCIAL TRASH ENCLOSURES

FOLLOW THESE REQUIREMENTS TO KEEP OUR WATERWAYS CLEAN

Trash enclosures, such as those found in commercial and apartment complexes, typically contain materials that are intended to find their way to a landfill or a recycling facility. **These materials are NOT meant to go into our local lakes and rivers.**

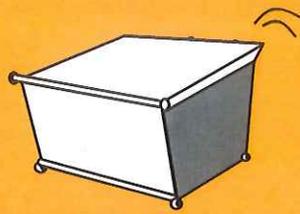
PROTECT WATER QUALITY BY FOLLOWING THESE SIMPLE STEPS

PUT TRASH INSIDE



Place trash inside the bin (preferably in sealed bags)

CLOSE THE LID



Prevent rain from entering the bin in order to avoid leakage of polluted water runoff

KEEP TOXICS OUT



- Paint
- Grease, fats and used oils
- Batteries, electronics and fluorescent lights

SOME ADDITIONAL GUIDELINES, INCLUDE

✓ SWEEP FREQUENTLY

Sweep trash enclosure areas frequently, instead of hosing them down, to prevent polluted water from flowing into the streets and storm drains.

✓ FIX LEAKS

Address trash bin leaks immediately by using dry clean up methods and report to your waste hauler to receive a replacement.

✓ CONSTRUCT ROOF

Construct a solid cover roof over the existing trash enclosure structure to prevent rainwater from coming into contact with trash and garbage. Check with your local City/County for Building Codes.

In San Bernardino County, stormwater pollution is caused by food waste, landscape waste, chemicals and other debris that are washed into storm drains and end up in our waterways - untreated! You can be part of the solution by maintaining a water-friendly trash enclosure.

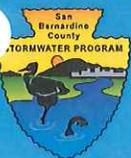
THANK YOU FOR HELPING TO KEEP SAN BERNARDINO COUNTY CLEAN AND HEALTHY!

To report illegal dumping (**877-WASTE18**) or

to find a household hazardous waste facility (800-OILY CAT): sbcountystormwater.org

To dispose of hazardous waste call the San Bernardino County Fire Dept. - CUPA Program (**909**) 386-8401

Big Bear • Chino • Chino Hills • Colton • Fontana • Grand Terrace • Highland • Loma Linda • Montclair • Ontario • Rancho Cucamonga • Redlands • Rialto • San Bernardino • San Bernardino County • San Bernardino County Flood Control District • Upland • Yucaipa



CONTENEDORES COMERCIALES PARA LA BASURA

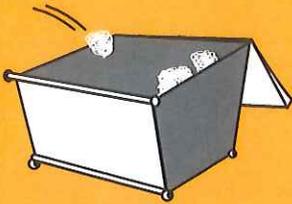
SIGA ESTOS PASOS PARA MANTENER LIMPIAS NUESTRAS VÍAS FLUVIALES

Los contenedores de basura, tales como aquellos que se encuentran en las unidades comerciales y departamentos, generalmente contienen materiales que están destinados a los rellenos sanitarios o en algún establecimiento de reciclaje.

Estos materiales **NO** deben ser vertidos en nuestros lagos y ríos locales.

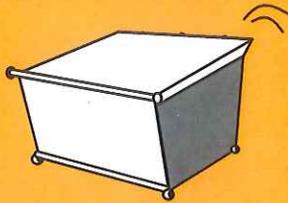
SIGA ESTOS PASOS PARA PROTEGER LA CALIDAD DEL AGUA

COLOQUE LA BASURA ADENTRO



Coloque la basura adentro del contenedor (preferentemente en bolsas selladas)

CIERRE LA TAPA



Evite que la lluvia ingrese al contenedor para evitar un escape de escorrentía contaminada

MANTENGA LOS PRODUCTOS TÓXICOS AFUERA



- Pintura
- Lubricante, grasas y aceites usados
- Baterías, componentes electrónicos y luces fluorescentes

ALGUNAS GUÍAS ADICIONALES, LAS CUALES INCLUYEN

✓ BARRER CON FRECUENCIA

Barra con frecuencia las áreas de los recintos para la basura, en lugar de lavarlas con una manguera, para evitar que el agua contaminada se vierta en las calles y los desagües de lluvia.

✓ REPARE LAS GOTERAS

Ocúpese inmediatamente de las goteras en los contenedores de basura. Use los métodos de limpieza en seco e infórmele a su recolector de basura para que reciba un reemplazo.

✓ CONSTRUYA UN TECHO

Construya un techo de cubierta sólida sobre la estructura actual del recinto para la basura a fin de evitar que el agua de lluvia entre en contacto con los desechos y la basura. Consulte con su Ciudad/Condado para conocer los Códigos de Construcción.

En el Condado de San Bernardino, los desechos de alimentos y jardines, los productos químicos y otros restos que se vierten en los desagües de aguas pluviales y que terminan en nuestras vías fluviales sin tratamiento alguno provocan la contaminación de estas aguas. Usted puede ser parte de la solución si mantiene un recinto para la basura que no contamine el agua.

¡MUCHAS GRACIAS POR AYUDAR A MANTENER EL CONDADO DE SB LIMPIO Y SIN CONTAMINACIÓN!



Para informar acerca del vertedero ilegal, llame a **(877-WASTE18)**, o para encontrar un establecimiento donde arrojar los residuos peligrosos del hogar, llame a **(800-OILY CAT)**: sbcountystormwater.org
Para deshacerse de los residuos peligrosos llame al Condado de San Bernardino Departamento de Bomberos - programa CUPA **(909) 386-8401**

Big Bear • Chino • Chino Hills • Colton • Fontana • Grand Terrace • Highland • Loma Linda • Montclair • Ontario • Rancho Cucamonga • Redlands • Rialto • San Bernardino • San Bernardino County • San Bernardino County Flood Control District • Upland • Yucaipa

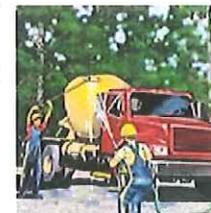


SAN BERNARDINO COUNTY STORMWATER POLLUTION PREVENTION

■ Construction & development:

Soil, cement wash, asphalt, oil and other hazardous debris from construction sites often make their way into the San Bernardino County storm drain system, and flow untreated into local waterways. Follow these best management practices to prevent pollution, protect public health and avoid fines or legal action.

- **Store Materials Safely:** Keep construction materials and debris away from the street, gutter and storm drains. Cover exposed stockpiles of soil, sand or gravel and excavated material with plastic sheeting, protected from rain, wind and runoff.
- **Preventing Erosion:** Avoid excavation or grading during wet weather. Plant temporary vegetation or add hydro mulch on slopes where construction is not immediately planned, and permanent vegetation once excavation and grading are complete. Construct diversion dikes to channel runoff to a detention basin and around the construction site. Use gravel approaches where truck traffic is frequent to reduce soil compaction and limit the tracking of sediment into the streets. For more information on erosion control, call (909) 799-7407.
- **Cleaning & Preventing Spills:** Use a drip pan and funnel when draining or pouring fluids. Sweep up dry spills, instead of hosing. Be ready for spills by preparing and using spill containment and cleanup kits that include safety equipment and dry cleanup materials such as kitty litter or sawdust. To report serious spills, call 911.
- **Maintaining Vehicles & Equipment:** Maintain and refuel vehicles and equipment at a single location on-site, away from the street, gutter and storm drains. Perform major equipment repairs and washings off-site. Inspect vehicles and equipment frequently for leaks, and prevent leaks from stored vehicles by draining gas, hydraulic oil, transmission, and brake and radiator fluids.
- **Ordering Materials & Recycling Waste:** Reduce waste by ordering only the amounts of materials needed for the job. Use recycled or recyclable materials whenever possible. You can recycle broken asphalt, concrete, wood, and cleared vegetation. Dispose of hazardous materials through a hazardous waste hauler or other means in accordance with the construction permit. Non-recyclable materials should be taken to a landfill or disposed of as hazardous waste. For recycling and disposal information, call (909) 386-8401.
- **Concrete and mortar application:** Never dispose of cement washout into driveways, streets, gutters or drainage ditches. Wash concrete mixers and equipment only in specified washout areas, where the water flows into lined containment ponds. Cement wash water can be recycled by pumping it back into cement mixers for reuse.



For more information about how you can prevent stormwater pollution:

www.sbcountystormwater.org



SAN BERNARDINO COUNTY STORMWATER POLLUTION PREVENTION

■ Regulatory information

The Federal Water Pollution Control Act prohibits the discharge of any pollutant to navigable waters from a point source unless the discharge is authorized by a National Pollutant Discharge Elimination System (NPDES) permit. The 1987 passage of the Water Quality Act established NPDES permit requirements for discharges of storm water. The NPDES permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States.

Industrial facilities and construction sites are regulated by the Regional Water Quality Control Board and State Water Resources Control Board, through general storm water permits. Most industrial, manufacturing or transportation businesses that store materials, products or equipment outdoors, or conduct vehicle washing or process operations outdoors are required to obtain coverage under the State Water Resources Control Board's General Industrial Activities Stormwater Permit. For more information about this permit, visit www.swrcb.ca.gov/stormwtr/industrial.html or contact your local storm water coordinator.

If your business conducts construction activities, including clearing, grading, stockpiling or excavation that results in soil disturbances of at least one acre, you are subject to the State Water Resources Control Board's General Construction Activities Stormwater Permit. To find out more about this storm water permit for construction, visit: www.swrcb.ca.gov/stormwtr/construction.html.

Cities and counties are regulated through permits issued by the Regional Boards. Since 1990, operators of large storm drain systems such as San Bernardino County's have been required to:

- Develop a storm water management program designed to prevent harmful pollutants from being dumped or washed by storm water runoff, into the storm water system, then discharged into local water bodies; and
- Obtain a National Pollutant Discharge Elimination System (NPDES) permit.

The NPDES permit programs in California are administered by the State Water Resources Control Board and by nine regional boards that issue NPDES permits and enforce regulations within their respective region.

San Bernardino County lies within the jurisdiction of the Santa Ana Region. This regional board issues a permit to the San Bernardino County Permittees, which includes the County of San Bernardino, San Bernardino County Flood Control District and incorporated cities of San Bernardino County. Since the program's inception, the County of San Bernardino has served as the principal permittee.



SAN BERNARDINO COUNTY STORMWATER POLLUTION PREVENTION

Documents & reports:

The following documents describe the regulations and programs for water quality in San Bernardino County. You can review the latest Basin Plan, National Pollutant Discharge Elimination System (NPDES) Permit and Drainage Area Management Plan (DAMP).

- **Basin Plans:** The document for each region of the State Water Quality Board's jurisdiction, including Santa Ana, is the Water Quality Control Plan, commonly referred to as the Basin Plan. It is the foundation for the regulatory programs of each regional board. The Basin Plan documents the beneficial uses of the region's ground and surface waters, existing water quality conditions, problems, and goals, and actions by the regional board and others that are necessary to achieve and maintain water quality standards.
 - ▶ [Water Control Plan for the Santa Ana River Basin](#)
- **Municipal National Pollutant Discharge Elimination System (NPDES) Permits:** The permits of each region outline additional steps for a storm water management program and specify requirements to help protect the beneficial uses of the receiving waters. They require permittees to develop and implement Best Management Practices (BMPs) to control/reduce the discharge of pollutants to waters of the United States to the maximum extent practicable (MEP).
 - ▶ [Santa Ana Regional Water Quality Control Board Municipal NPDES Permit Order No. R8-2002-0012](#)
- **Report of Waste Discharge:** The Report of Waste Discharge (ROWD) describes the San Bernardino Stormwater Program, implemented by the County and cities to comply with their jointly held stormwater permit. It is the principle policy and guidance document for the NPDES Stormwater Program.
 - ▶ [Report of Waste Discharge 2000](#)
- **San Bernardino County Storm Water Program Annual Status Report:** The Annual Status Report is a requirement of the NPDES permit for submittal to the Regional Boards and United States Environmental Protection Agency. The report presents an analysis and assessment of permit compliance activities.
 - ▶ [Annual report](#) - will be posted soon

For more information about how you can prevent stormwater pollution:

www.sbcountystormwater.org

Spill Prevention, Control & Cleanup SC-11



Photo Credit: Geoff Brosseau

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Description

Many activities that occur at an industrial or commercial site have the potential to cause accidental or illegal spills. Preparation for accidental or illegal spills, with proper training and reporting systems implemented, can minimize the discharge of pollutants to the environment.

Spills and leaks are one of the largest contributors of stormwater pollutants. Spill prevention and control plans are applicable to any site at which hazardous materials are stored or used. An effective plan should have spill prevention and response procedures that identify potential spill areas, specify material handling procedures, describe spill response procedures, and provide spill clean-up equipment. The plan should take steps to identify and characterize potential spills, eliminate and reduce spill potential, respond to spills when they occur in an effort to prevent pollutants from entering the stormwater drainage system, and train personnel to prevent and control future spills.

Approach

Pollution Prevention

- Develop procedures to prevent/mitigate spills to storm drain systems. Develop and standardize reporting procedures, containment, storage, and disposal activities, documentation, and follow-up procedures.
- Develop a Spill Prevention Control and Countermeasure (SPCC) Plan. The plan should include:

Targeted Constituents

Sediment	
Nutrients	
Trash	
Metals	<input checked="" type="checkbox"/>
Bacteria	
Oil and Grease	<input checked="" type="checkbox"/>
Organics	<input checked="" type="checkbox"/>



SC-11 Spill Prevention, Control & Cleanup

- Description of the facility, owner and address, activities and chemicals present
- Facility map
- Notification and evacuation procedures
- Cleanup instructions
- Identification of responsible departments
- Identify key spill response personnel
- Recycle, reclaim, or reuse materials whenever possible. This will reduce the amount of process materials that are brought into the facility.

Suggested Protocols (including equipment needs)

Spill Prevention

- Develop procedures to prevent/mitigate spills to storm drain systems. Develop and standardize reporting procedures, containment, storage, and disposal activities, documentation, and follow-up procedures.
- If consistent illegal dumping is observed at the facility:
 - Post “No Dumping” signs with a phone number for reporting illegal dumping and disposal. Signs should also indicate fines and penalties applicable for illegal dumping.
 - Landscaping and beautification efforts may also discourage illegal dumping.
 - Bright lighting and/or entrance barriers may also be needed to discourage illegal dumping.
- Store and contain liquid materials in such a manner that if the tank is ruptured, the contents will not discharge, flow, or be washed into the storm drainage system, surface waters, or groundwater.
- If the liquid is oil, gas, or other material that separates from and floats on water, install a spill control device (such as a tee section) in the catch basins that collects runoff from the storage tank area.
- Routine maintenance:
 - Place drip pans or absorbent materials beneath all mounted taps, and at all potential drip and spill locations during filling and unloading of tanks. Any collected liquids or soiled absorbent materials must be reused/recycled or properly disposed.
 - Store and maintain appropriate spill cleanup materials in a location known to all near the tank storage area; and ensure that employees are familiar with the site’s spill control plan and/or proper spill cleanup procedures.
 - Sweep and clean the storage area monthly if it is paved, *do not hose down the area to a storm drain.*

Spill Prevention, Control & Cleanup SC-11

- Check tanks (and any containment sumps) daily for leaks and spills. Replace tanks that are leaking, corroded, or otherwise deteriorating with tanks in good condition. Collect all spilled liquids and properly dispose of them.
- Label all containers according to their contents (e.g., solvent, gasoline).
- Label hazardous substances regarding the potential hazard (corrosive, radioactive, flammable, explosive, poisonous).
- Prominently display required labels on transported hazardous and toxic materials (per US DOT regulations).
- Identify key spill response personnel.

Spill Control and Cleanup Activities

- Follow the Spill Prevention Control and Countermeasure Plan.
- Clean up leaks and spills immediately.
- Place a stockpile of spill cleanup materials where it will be readily accessible (e.g., near storage and maintenance areas).
- On paved surfaces, clean up spills with as little water as possible. Use a rag for small spills, a damp mop for general cleanup, and absorbent material for larger spills. If the spilled material is hazardous, then the used cleanup materials are also hazardous and must be sent to a certified laundry (rags) or disposed of as hazardous waste. Physical methods for the cleanup of dry chemicals include the use of brooms, shovels, sweepers, or plows.
- Never hose down or bury dry material spills. Sweep up the material and dispose of properly.
- Chemical cleanups of material can be achieved with the use of adsorbents, gels, and foams. Use adsorbent materials on small spills rather than hosing down the spill. Remove the adsorbent materials promptly and dispose of properly.
- For larger spills, a private spill cleanup company or Hazmat team may be necessary.

Reporting

- Report spills that pose an immediate threat to human health or the environment to the Regional Water Quality Control Board.
- Federal regulations require that any oil spill into a water body or onto an adjoining shoreline be reported to the National Response Center (NRC) at 800-424-8802 (24 hour).
- Report spills to local agencies, such as the fire department; they can assist in cleanup.
- Establish a system for tracking incidents. The system should be designed to identify the following:
 - Types and quantities (in some cases) of wastes
 - Patterns in time of occurrence (time of day/night, month, or year)

SC-11 Spill Prevention, Control & Cleanup

- Mode of dumping (abandoned containers, “midnight dumping” from moving vehicles, direct dumping of materials, accidents/spills)
- Responsible parties

Training

- Educate employees about spill prevention and cleanup.
- Well-trained employees can reduce human errors that lead to accidental releases or spills:
 - The employee should have the tools and knowledge to immediately begin cleaning up a spill should one occur.
 - Employees should be familiar with the Spill Prevention Control and Countermeasure Plan.
- Employees should be educated about aboveground storage tank requirements. Employees responsible for aboveground storage tanks and liquid transfers should be thoroughly familiar with the Spill Prevention Control and Countermeasure Plan and the plan should be readily available.
- Train employees to recognize and report illegal dumping incidents.

Other Considerations (Limitations and Regulations)

- A Spill Prevention Control and Countermeasure Plan (SPCC) is required for facilities that are subject to the oil pollution regulations specified in Part 112 of Title 40 of the Code of Federal Regulations or if they have a storage capacity of 10,000 gallons or more of petroleum. (Health and Safety Code 6.67)
- State regulations also exist for storage of hazardous materials (Health & Safety Code Chapter 6.95), including the preparation of area and business plans for emergency response to the releases or threatened releases.
- Consider requiring smaller secondary containment areas (less than 200 sq. ft.) to be connected to the sanitary sewer, prohibiting any hard connections to the storm drain.

Requirements

Costs (including capital and operation & maintenance)

- Will vary depending on the size of the facility and the necessary controls.
- Prevention of leaks and spills is inexpensive. Treatment and/or disposal of contaminated soil or water can be quite expensive.

Maintenance (including administrative and staffing)

- This BMP has no major administrative or staffing requirements. However, extra time is needed to properly handle and dispose of spills, which results in increased labor costs.

Spill Prevention, Control & Cleanup SC-11

Supplemental Information

Further Detail of the BMP

Reporting

Record keeping and internal reporting represent good operating practices because they can increase the efficiency of the facility and the effectiveness of BMPs. A good record keeping system helps the facility minimize incident recurrence, correctly respond with appropriate cleanup activities, and comply with legal requirements. A record keeping and reporting system should be set up for documenting spills, leaks, and other discharges, including discharges of hazardous substances in reportable quantities. Incident records describe the quality and quantity of non-stormwater discharges to the storm sewer. These records should contain the following information:

- Date and time of the incident
- Weather conditions
- Duration of the spill/leak/discharge
- Cause of the spill/leak/discharge
- Response procedures implemented
- Persons notified
- Environmental problems associated with the spill/leak/discharge

Separate record keeping systems should be established to document housekeeping and preventive maintenance inspections, and training activities. All housekeeping and preventive maintenance inspections should be documented. Inspection documentation should contain the following information:

- The date and time the inspection was performed
- Name of the inspector
- Items inspected
- Problems noted
- Corrective action required
- Date corrective action was taken

Other means to document and record inspection results are field notes, timed and dated photographs, videotapes, and drawings and maps.

Aboveground Tank Leak and Spill Control

Accidental releases of materials from aboveground liquid storage tanks present the potential for contaminating stormwater with many different pollutants. Materials spilled, leaked, or lost from

SC-11 Spill Prevention, Control & Cleanup

tanks may accumulate in soils or on impervious surfaces and be carried away by stormwater runoff.

The most common causes of unintentional releases are:

- Installation problems
- Failure of piping systems (pipes, pumps, flanges, couplings, hoses, and valves)
- External corrosion and structural failure
- Spills and overfills due to operator error
- Leaks during pumping of liquids or gases from truck or rail car to a storage tank or vice versa

Storage of reactive, ignitable, or flammable liquids should comply with the Uniform Fire Code and the National Electric Code. Practices listed below should be employed to enhance the code requirements:

- Tanks should be placed in a designated area.
- Tanks located in areas where firearms are discharged should be encapsulated in concrete or the equivalent.
- Designated areas should be impervious and paved with Portland cement concrete, free of cracks and gaps, in order to contain leaks and spills.
- Liquid materials should be stored in UL approved double walled tanks or surrounded by a curb or dike to provide the volume to contain 10 percent of the volume of all of the containers or 110 percent of the volume of the largest container, whichever is greater. The area inside the curb should slope to a drain.
- For used oil or dangerous waste, a dead-end sump should be installed in the drain.
- All other liquids should be drained to the sanitary sewer if available. The drain must have a positive control such as a lock, valve, or plug to prevent release of contaminated liquids.
- Accumulated stormwater in petroleum storage areas should be passed through an oil/water separator.

Maintenance is critical to preventing leaks and spills. Conduct routine inspections and:

- Check for external corrosion and structural failure.
- Check for spills and overfills due to operator error.
- Check for failure of piping system (pipes, pumps, flanger, coupling, hoses, and valves).
- Check for leaks or spills during pumping of liquids or gases from truck or rail car to a storage facility or vice versa.

Spill Prevention, Control & Cleanup SC-11

- Visually inspect new tank or container installation for loose fittings, poor welding, and improper or poorly fitted gaskets.
- Inspect tank foundations, connections, coatings, and tank walls and piping system. Look for corrosion, leaks, cracks, scratches, and other physical damage that may weaken the tank or container system.
- Frequently relocate accumulated stormwater during the wet season.
- Periodically conduct integrity testing by a qualified professional.

Vehicle Leak and Spill Control

Major spills on roadways and other public areas are generally handled by highly trained Hazmat teams from local fire departments or environmental health departments. The measures listed below pertain to leaks and smaller spills at vehicle maintenance shops.

In addition to implementing the spill prevention, control, and clean up practices above, use the following measures related to specific activities:

Vehicle and Equipment Maintenance

- Perform all vehicle fluid removal or changing inside or under cover to prevent the run-on of stormwater and the runoff of spills.
- Regularly inspect vehicles and equipment for leaks, and repair immediately.
- Check incoming vehicles and equipment (including delivery trucks, and employee and subcontractor vehicles) for leaking oil and fluids. Do not allow leaking vehicles or equipment onsite.
- Always use secondary containment, such as a drain pan or drop cloth, to catch spills or leaks when removing or changing fluids.
- Immediately drain all fluids from wrecked vehicles.
- Store wrecked vehicles or damaged equipment under cover.
- Place drip pans or absorbent materials under heavy equipment when not in use.
- Use adsorbent materials on small spills rather than hosing down the spill.
- Remove the adsorbent materials promptly and dispose of properly.
- Promptly transfer used fluids to the proper waste or recycling drums. Don't leave full drip pans or other open containers lying around.
- Oil filters disposed of in trashcans or dumpsters can leak oil and contaminate stormwater. Place the oil filter in a funnel over a waste oil recycling drum to drain excess oil before disposal. Oil filters can also be recycled. Ask your oil supplier or recycler about recycling oil filters.

SC-11 Spill Prevention, Control & Cleanup

- Store cracked batteries in a non-leaking secondary container. Do this with all cracked batteries, even if you think all the acid has drained out. If you drop a battery, treat it as if it is cracked. Put it into the containment area until you are sure it is not leaking.

Vehicle and Equipment Fueling

- Design the fueling area to prevent the run-on of stormwater and the runoff of spills:
 - Cover fueling area if possible.
 - Use a perimeter drain or slope pavement inward with drainage to a sump.
 - Pave fueling area with concrete rather than asphalt.
- If dead-end sump is not used to collect spills, install an oil/water separator.
- Install vapor recovery nozzles to help control drips as well as air pollution.
- Discourage “topping-off” of fuel tanks.
- Use secondary containment when transferring fuel from the tank truck to the fuel tank.
- Use adsorbent materials on small spills and general cleaning rather than hosing down the area. Remove the adsorbent materials promptly.
- Carry out all Federal and State requirements regarding underground storage tanks, or install above ground tanks.
- Do not use mobile fueling of mobile industrial equipment around the facility; rather, transport the equipment to designated fueling areas.
- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Train employees in proper fueling and cleanup procedures.

Industrial Spill Prevention Response

For the purposes of developing a spill prevention and response program to meet the stormwater regulations, facility managers should use information provided in this fact sheet and the spill prevention/response portions of the fact sheets in this handbook, for specific activities. The program should:

- Integrate with existing emergency response/hazardous materials programs (e.g., Fire Department)
- Develop procedures to prevent/mitigate spills to storm drain systems
- Identify responsible departments
- Develop and standardize reporting procedures, containment, storage, and disposal activities, documentation, and follow-up procedures
- Address spills at municipal facilities, as well as public areas

Spill Prevention, Control & Cleanup SC-11

- Provide training concerning spill prevention, response and cleanup to all appropriate personnel

References and Resources

California's Nonpoint Source Program Plan <http://www.swrcb.ca.gov/nps/index.html>

Clark County Storm Water Pollution Control Manual
<http://www.co.clark.wa.us/pubworks/bmpman.pdf>

King County Storm Water Pollution Control Manual <http://dnr.metrokc.gov/wlr/dss/spcm.htm>

Santa Clara Valley Urban Runoff Pollution Prevention Program <http://www.scvurppp.org>

The Stormwater Managers Resource Center <http://www.stormwatercenter.net/>



Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Description

The loading/unloading of materials usually takes place outside on docks or terminals; therefore, materials spilled, leaked, or lost during loading/unloading may collect in the soil or on other surfaces and have the potential to be carried away by stormwater runoff or when the area is cleaned. Additionally, rainfall may wash pollutants from machinery used to unload or move materials. Implementation of the following protocols will prevent or reduce the discharge of pollutants to stormwater from outdoor loading/unloading of materials.

Approach

Reduce potential for pollutant discharge through source control pollution prevention and BMP implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

Pollution Prevention

- Keep accurate maintenance logs to evaluate materials removed and improvements made.
- Park tank trucks or delivery vehicles in designated areas so that spills or leaks can be contained.
- Limit exposure of material to rainfall whenever possible.
- Prevent stormwater run-on.
- Check equipment regularly for leaks.

Targeted Constituents

Sediment	✓
Nutrients	✓
Trash	
Metals	✓
Bacteria	
Oil and Grease	✓
Organics	✓



Suggested Protocols***Loading and Unloading – General Guidelines***

- Develop an operations plan that describes procedures for loading and/or unloading.
- Conduct loading and unloading in dry weather if possible.
- Cover designated loading/unloading areas to reduce exposure of materials to rain.
- Consider placing a seal or door skirt between delivery vehicles and building to prevent exposure to rain.
- Design loading/unloading area to prevent stormwater run-on, which would include grading or berming the area, and position roof downspouts so they direct stormwater away from the loading/unloading areas.
- Have employees load and unload all materials and equipment in covered areas such as building overhangs at loading docks if feasible.
- Load/unload only at designated loading areas.
- Use drip pans underneath hose and pipe connections and other leak-prone spots during liquid transfer operations, and when making and breaking connections. Several drip pans should be stored in a covered location near the liquid transfer area so that they are always available, yet protected from precipitation when not in use. Drip pans can be made specifically for railroad tracks. Drip pans must be cleaned periodically, and drip collected materials must be disposed of properly.
- Pave loading areas with concrete instead of asphalt.
- Avoid placing storm drains in the area.
- Grade and/or berm the loading/unloading area to a drain that is connected to a deadend.

Inspection

- Check loading and unloading equipment regularly for leaks, including valves, pumps, flanges and connections.
- Look for dust or fumes during loading or unloading operations.

Training

- Train employees (e.g., fork lift operators) and contractors on proper spill containment and cleanup.
- Have employees trained in spill containment and cleanup present during loading/unloading.
- Train employees in proper handling techniques during liquid transfers to avoid spills.
- Make sure forklift operators are properly trained on loading and unloading procedures.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Contain leaks during transfer.
- Store and maintain appropriate spill cleanup materials in a location that is readily accessible and known to all and ensure that employees are familiar with the site's spill control plan and proper spill cleanup procedures.
- Have an emergency spill cleanup plan readily available.
- Use drip pans or comparable devices when transferring oils, solvents, and paints.

Other Considerations (Limitations and Regulations)

- Space and time limitations may preclude all transfers from being performed indoors or under cover.
- It may not be possible to conduct transfers only during dry weather.

Requirements

Costs

Costs should be low except when covering a large loading/unloading area.

Maintenance

- Conduct regular inspections and make repairs as necessary. The frequency of repairs will depend on the age of the facility.
- Check loading and unloading equipment regularly for leaks.
- Conduct regular broom dry-sweeping of area.

Supplemental Information

Further Detail of the BMP

Special Circumstances for Indoor Loading/Unloading of Materials

Loading or unloading of liquids should occur in the manufacturing building so that any spills that are not completely retained can be discharged to the sanitary sewer, treatment plant, or treated in a manner consistent with local sewer authorities and permit requirements.

- For loading and unloading tank trucks to above and below ground storage tanks, the following procedures should be used:
 - The area where the transfer takes place should be paved. If the liquid is reactive with the asphalt, Portland cement should be used to pave the area.
 - The transfer area should be designed to prevent run-on of stormwater from adjacent areas. Sloping the pad and using a curb, like a speed bump, around the uphill side of the transfer area should reduce run-on.

- The transfer area should be designed to prevent runoff of spilled liquids from the area. Sloping the area to a drain should prevent runoff. The drain should be connected to a dead-end sump or to the sanitary sewer. A positive control valve should be installed on the drain.
- For transfer from rail cars to storage tanks that must occur outside, use the following procedures:
 - Drip pans should be placed at locations where spillage may occur, such as hose connections, hose reels, and filler nozzles. Use drip pans when making and breaking connections.
 - Drip pan systems should be installed between the rails to collect spillage from tank cars.

References and Resources

California's Nonpoint Source Program Plan <http://www.swrcb.ca.gov/nps/index.html>

Clark County Storm Water Pollution Control Manual
<http://www.co.clark.wa.us/pubworks/bmpman.pdf>

King County Storm Water Pollution Control Manual <http://dnr.metrokc.gov/wlr/dss/spcm.htm>

Santa Clara Valley Urban Runoff Pollution Prevention Program <http://www.scvurppp.org>

The Storm Water Managers Resource Center <http://www.stormwatercenter.net/>



Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Description

Improper storage and handling of solid wastes can allow toxic compounds, oils and greases, heavy metals, nutrients, suspended solids, and other pollutants to enter stormwater runoff. The discharge of pollutants to stormwater from waste handling and disposal can be prevented and reduced by tracking waste generation, storage, and disposal; reducing waste generation and disposal through source reduction, reuse, and recycling; and preventing run-on and runoff.

Approach

Pollution Prevention

- Accomplish reduction in the amount of waste generated using the following source controls:
 - Production planning and sequencing
 - Process or equipment modification
 - Raw material substitution or elimination
 - Loss prevention and housekeeping
 - Waste segregation and separation
 - Close loop recycling
- Establish a material tracking system to increase awareness about material usage. This may reduce spills and minimize contamination, thus reducing the amount of waste produced.
- Recycle materials whenever possible.

Targeted Constituents

Sediment	
Nutrients	
Trash	
Metals	✓
Bacteria	✓
Oil and Grease	✓
Organics	✓



Suggested Protocols*General*

- Cover storage containers with leak proof lids or some other means. If waste is not in containers, cover all waste piles (plastic tarps are acceptable coverage) and prevent stormwater run-on and runoff with a berm. The waste containers or piles must be covered except when in use.
- Use drip pans or absorbent materials whenever grease containers are emptied by vacuum trucks or other means. Grease cannot be left on the ground. Collected grease must be properly disposed of as garbage.
- Check storage containers weekly for leaks and to ensure that lids are on tightly. Replace any that are leaking, corroded, or otherwise deteriorating.
- Sweep and clean the storage area regularly. If it is paved, do not hose down the area to a storm drain.
- Dispose of rinse and wash water from cleaning waste containers into a sanitary sewer if allowed by the local sewer authority. Do not discharge wash water to the street or storm drain.
- Transfer waste from damaged containers into safe containers.
- Take special care when loading or unloading wastes to minimize losses. Loading systems can be used to minimize spills and fugitive emission losses such as dust or mist. Vacuum transfer systems can minimize waste loss.

Controlling Litter

- Post “No Littering” signs and enforce anti-litter laws.
- Provide a sufficient number of litter receptacles for the facility.
- Clean out and cover litter receptacles frequently to prevent spillage.

Waste Collection

- Keep waste collection areas clean.
- Inspect solid waste containers for structural damage regularly. Repair or replace damaged containers as necessary.
- Secure solid waste containers; containers must be closed tightly when not in use.
- Do not fill waste containers with washout water or any other liquid.
- Ensure that only appropriate solid wastes are added to the solid waste container. Certain wastes such as hazardous wastes, appliances, fluorescent lamps, pesticides, etc., may not be disposed of in solid waste containers (see chemical/ hazardous waste collection section below).

- Do not mix wastes; this can cause chemical reactions, make recycling impossible, and complicate disposal.

Good Housekeeping

- Use all of the product before disposing of the container.
- Keep the waste management area clean at all times by sweeping and cleaning up spills immediately.
- Use dry methods when possible (e.g., sweeping, use of absorbents) when cleaning around restaurant/food handling dumpster areas. If water must be used after sweeping/using absorbents, collect water and discharge through grease interceptor to the sewer.

Chemical/Hazardous Wastes

- Select designated hazardous waste collection areas on-site.
- Store hazardous materials and wastes in covered containers and protect them from vandalism.
- Place hazardous waste containers in secondary containment.
- Make sure that hazardous waste is collected, removed, and disposed of only at authorized disposal areas.
- Stencil or demarcate storm drains on the facility's property with prohibitive message regarding waste disposal.

Run-on/Runoff Prevention

- Prevent stormwater run-on from entering the waste management area by enclosing the area or building a berm around the area.
- Prevent waste materials from directly contacting rain.
- Cover waste piles with temporary covering material such as reinforced tarpaulin, polyethylene, polyurethane, polypropylene or hypalon.
- Cover the area with a permanent roof if feasible.
- Cover dumpsters to prevent rain from washing waste out of holes or cracks in the bottom of the dumpster.
- Move the activity indoor after ensuring all safety concerns such as fire hazard and ventilation are addressed.

Inspection

- Inspect and replace faulty pumps or hoses regularly to minimize the potential of releases and spills.
- Check waste management areas for leaking containers or spills.

- Repair leaking equipment including valves, lines, seals, or pumps promptly.

Training

- Train staff in pollution prevention measures and proper disposal methods.
- Train employees and contractors in proper spill containment and cleanup. The employee should have the tools and knowledge to immediately begin cleaning up a spill should one occur.
- Train employees and subcontractors in proper hazardous waste management.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Have an emergency plan, equipment and trained personnel ready at all times to deal immediately with major spills
- Collect all spilled liquids and properly dispose of them.
- Store and maintain appropriate spill cleanup materials in a location known to all near the designated wash area.
- Ensure that vehicles transporting waste have spill prevention equipment that can prevent spills during transport. Spill prevention equipment includes:
 - Vehicles equipped with baffles for liquid waste
 - Trucks with sealed gates and spill guards for solid waste

Other Considerations (Limitations and Regulations)

Hazardous waste cannot be reused or recycled; it must be disposed of by a licensed hazardous waste hauler.

Requirements

Costs

Capital and O&M costs for these programs will vary substantially depending on the size of the facility and the types of waste handled. Costs should be low if there is an inventory program in place.

Maintenance

- None except for maintaining equipment for material tracking program.

Supplemental Information

Further Detail of the BMP

Land Treatment System

Minimize runoff of polluted stormwater from land application by:

- Choosing a site where slopes are under 6%, the soil is permeable, there is a low water table, it is located away from wetlands or marshes, and there is a closed drainage system

- Avoiding application of waste to the site when it is raining or when the ground is saturated with water
- Growing vegetation on land disposal areas to stabilize soils and reduce the volume of surface water runoff from the site
- Maintaining adequate barriers between the land application site and the receiving waters (planted strips are particularly good)
- Using erosion control techniques such as mulching and matting, filter fences, straw bales, diversion terracing, and sediment basins
- Performing routine maintenance to ensure the erosion control or site stabilization measures are working

Examples

The port of Long Beach has a state-of-the-art database for identifying potential pollutant sources, documenting facility management practices, and tracking pollutants.

References and Resources

California's Nonpoint Source Program Plan <http://www.swrcb.ca.gov/nps/index.html>

Clark County Storm Water Pollution Control Manual
<http://www.co.clark.wa.us/pubworks/bmpman.pdf>

Solid Waste Container Best Management Practices – Fact Sheet On-Line Resources – Environmental Health and Safety. Harvard University. 2002.

King County Storm Water Pollution Control Manual <http://dnr.metrokc.gov/wlr/dss/spcm.htm>

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA). <http://www.basmaa.org>

Santa Clara Valley Urban Runoff Pollution Prevention Program <http://www.sevurppp.org>

The Storm Water Managers Resource Center <http://www.stormwatercenter.net/>



Description

Stormwater runoff from building and grounds maintenance activities can be contaminated with toxic hydrocarbons in solvents, fertilizers and pesticides, suspended solids, heavy metals, abnormal pH, and oils and greases. Utilizing the protocols in this fact sheet will prevent or reduce the discharge of pollutants to stormwater from building and grounds maintenance activities by washing and cleaning up with as little water as possible, following good landscape management practices, preventing and cleaning up spills immediately, keeping debris from entering the storm drains, and maintaining the stormwater collection system.

Approach

Reduce potential for pollutant discharge through source control pollution prevention and BMP implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

Pollution Prevention

- Switch to non-toxic chemicals for maintenance when possible.
- Choose cleaning agents that can be recycled.
- Encourage proper lawn management and landscaping, including use of native vegetation.

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	✓
Nutrients	✓
Trash	
Metals	✓
Bacteria	✓
Oil and Grease	
Organics	



SC-41 Building & Grounds Maintenance

- Encourage use of Integrated Pest Management techniques for pest control.
- Encourage proper onsite recycling of yard trimmings.
- Recycle residual paints, solvents, lumber, and other material as much as possible.

Suggested Protocols

Pressure Washing of Buildings, Rooftops, and Other Large Objects

- In situations where soaps or detergents are used and the surrounding area is paved, pressure washers must use a water collection device that enables collection of wash water and associated solids. A sump pump, wet vacuum or similarly effective device must be used to collect the runoff and loose materials. The collected runoff and solids must be disposed of properly.
- If soaps or detergents are not used, and the surrounding area is paved, wash runoff does not have to be collected but must be screened. Pressure washers must use filter fabric or some other type of screen on the ground and/or in the catch basin to trap the particles in wash water runoff.
- If you are pressure washing on a grassed area (with or without soap), runoff must be dispersed as sheet flow as much as possible, rather than as a concentrated stream. The wash runoff must remain on the grass and not drain to pavement.

Landscaping Activities

- Dispose of grass clippings, leaves, sticks, or other collected vegetation as garbage, or by composting. Do not dispose of collected vegetation into waterways or storm drainage systems.
- Use mulch or other erosion control measures on exposed soils.

Building Repair, Remodeling, and Construction

- Do not dump any toxic substance or liquid waste on the pavement, the ground, or toward a storm drain.
- Use ground or drop cloths underneath outdoor painting, scraping, and sandblasting work, and properly dispose of collected material daily.
- Use a ground cloth or oversized tub for activities such as paint mixing and tool cleaning.
- Clean paintbrushes and tools covered with water-based paints in sinks connected to sanitary sewers or in portable containers that can be dumped into a sanitary sewer drain. Brushes and tools covered with non-water-based paints, finishes, or other materials must be cleaned in a manner that enables collection of used solvents (e.g., paint thinner, turpentine, etc.) for recycling or proper disposal.
- Use a storm drain cover, filter fabric, or similarly effective runoff control mechanism if dust, grit, wash water, or other pollutants may escape the work area and enter a catch basin. This is particularly necessary on rainy days. The containment device(s) must be in place at the beginning of the work day, and accumulated dirty runoff and solids must be collected and disposed of before removing the containment device(s) at the end of the work day.

- If you need to de-water an excavation site, you may need to filter the water before discharging to a catch basin or off-site. If directed off-site, you should direct the water through hay bales and filter fabric or use other sediment filters or traps.
- Store toxic material under cover during precipitation events and when not in use. A cover would include tarps or other temporary cover material.

Mowing, Trimming, and Planting

- Dispose of leaves, sticks, or other collected vegetation as garbage, by composting or at a permitted landfill. Do not dispose of collected vegetation into waterways or storm drainage systems.
- Use mulch or other erosion control measures when soils are exposed.
- Place temporarily stockpiled material away from watercourses and drain inlets, and berm or cover stockpiles to prevent material releases to the storm drain system.
- Consider an alternative approach when bailing out muddy water: do not put it in the storm drain; pour over landscaped areas.
- Use hand weeding where practical.

Fertilizer and Pesticide Management

- Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of fertilizers and pesticides and training of applicators and pest control advisors.
- Use less toxic pesticides that will do the job when applicable. Avoid use of copper-based pesticides if possible.
- Do not use pesticides if rain is expected.
- Do not mix or prepare pesticides for application near storm drains.
- Use the minimum amount needed for the job.
- Calibrate fertilizer distributors to avoid excessive application.
- Employ techniques to minimize off-target application (e.g., spray drift) of pesticides, including consideration of alternative application techniques.
- Apply pesticides only when wind speeds are low.
- Fertilizers should be worked into the soil rather than dumped or broadcast onto the surface.
- Irrigate slowly to prevent runoff and then only as much as is needed.
- Clean pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.
- Dispose of empty pesticide containers according to the instructions on the container label.

SC-41 Building & Grounds Maintenance

- Use up the pesticides. Rinse containers, and use rinse water as product. Dispose of unused pesticide as hazardous waste.
- Implement storage requirements for pesticide products with guidance from the local fire department and County Agricultural Commissioner. Provide secondary containment for pesticides.

Inspection

- Inspect irrigation system periodically to ensure that the right amount of water is being applied and that excessive runoff is not occurring. Minimize excess watering and repair leaks in the irrigation system as soon as they are observed.

Training

- Educate and train employees on pesticide use and in pesticide application techniques to prevent pollution.
- Train employees and contractors in proper techniques for spill containment and cleanup.
- Be sure the frequency of training takes into account the complexity of the operations and the nature of the staff.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Place a stockpile of spill cleanup materials, such as brooms, dustpans, and vacuum sweepers (if desired) near the storage area where it will be readily accessible.
- Have employees trained in spill containment and cleanup present during the loading/unloading of dangerous wastes, liquid chemicals, or other materials.
- Familiarize employees with the Spill Prevention Control and Countermeasure Plan.
- Clean up spills immediately.

Other Considerations

Alternative pest/weed controls may not be available, suitable, or effective in many cases.

Requirements

Costs

- Cost will vary depending on the type and size of facility.
- Overall costs should be low in comparison to other BMPs.

Maintenance

Sweep paved areas regularly to collect loose particles. Wipe up spills with rags and other absorbent material immediately, do not hose down the area to a storm drain.

Supplemental Information

Further Detail of the BMP

Fire Sprinkler Line Flushing

Building fire sprinkler line flushing may be a source of non-stormwater runoff pollution. The water entering the system is usually potable water, though in some areas it may be non-potable reclaimed wastewater. There are subsequent factors that may drastically reduce the quality of the water in such systems. Black iron pipe is usually used since it is cheaper than potable piping, but it is subject to rusting and results in lower quality water. Initially, the black iron pipe has an oil coating to protect it from rusting between manufacture and installation; this will contaminate the water from the first flush but not from subsequent flushes. Nitrates, poly-phosphates and other corrosion inhibitors, as well as fire suppressants and antifreeze may be added to the sprinkler water system. Water generally remains in the sprinkler system a long time (typically a year) and between flushes may accumulate iron, manganese, lead, copper, nickel, and zinc. The water generally becomes anoxic and contains living and dead bacteria and breakdown products from chlorination. This may result in a significant BOD problem and the water often smells. Consequently dispose fire sprinkler line flush water into the sanitary sewer. Do not allow discharge to storm drain or infiltration due to potential high levels of pollutants in fire sprinkler line water.

References and Resources

California's Nonpoint Source Program Plan <http://www.swrcb.ca.gov/nps/index.html>

Clark County Storm Water Pollution Control Manual
<http://www.co.clark.wa.us/pubworks/bmpman.pdf>

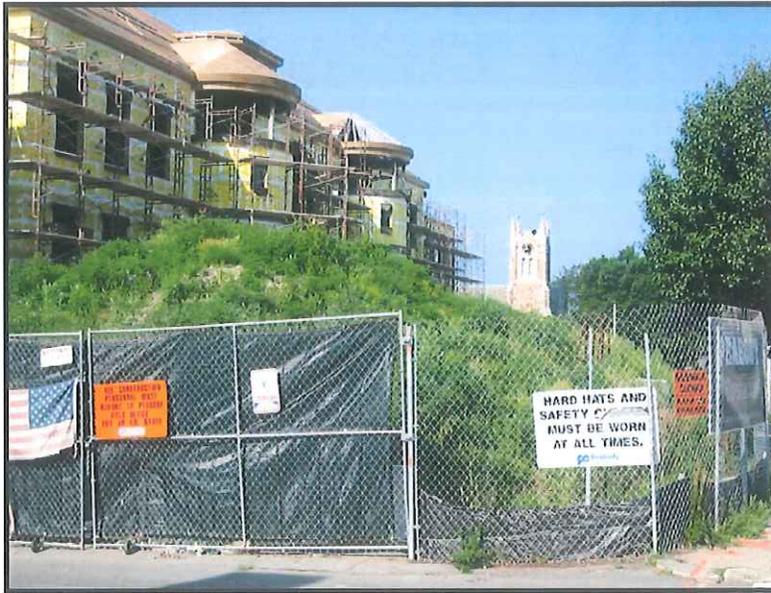
King County Storm Water Pollution Control Manual <http://dnr.metrokc.gov/wlr/dss/spcm.htm>

Mobile Cleaners Pilot Program: Final Report. 1997. Bay Area Stormwater Management Agencies Association (BASMAA). <http://www.basmaa.org/>

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA). <http://www.basmaa.org/>

Santa Clara Valley Urban Runoff Pollution Prevention Program <http://www.scvurppp.org>

The Storm Water Managers Resource Center <http://www.stormwatercenter.net/>



Description

Modifications are common particularly at large industrial sites. The activity may vary from minor and normal building repair to major remodeling, or the construction of new facilities. These activities can generate pollutants including solvents, paints, paint and varnish removers, finishing residues, spent thinners, soap cleaners, kerosene, asphalt and concrete materials, adhesive residues, and old asbestos installation. Protocols in this fact sheet are intended to prevent or reduce the discharge of pollutants to stormwater from building repair, remodeling, and construction by using soil erosion controls, enclosing or covering building material storage areas, using good housekeeping practices, using safer alternative products, and training employees.

Approach

Pollution Prevention

- Recycle residual paints, solvents, lumber, and other materials to the maximum extent practical.
- Buy recycled products to the maximum extent practical.
- Inform on-site contractors of company policy on these matters and include appropriate provisions in their contract to ensure certain proper housekeeping and disposal practices are implemented.

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Recycle

Targeted Constituents

Sediment	✓
Nutrients	
Trash	✓
Metals	✓
Bacteria	
Oil and Grease	✓
Organics	✓



SC-42 Building Repair and Construction

- Make sure that nearby storm drains are well marked to minimize the chance of inadvertent disposal of residual paints and other liquids.

Suggested Protocols

Repair & Remodeling

- Follow BMPs identified in Construction BMP Handbook.
- Maintain good housekeeping practices while work is underway.
- Keep the work site clean and orderly. Remove debris in a timely fashion. Sweep the area.
- Cover materials of particular concern that must be left outside, particularly during the rainy season.
- Do not dump waste liquids down the storm drain.
- Dispose of wash water, sweepings, and sediments properly.
- Store materials properly that are normally used in repair and remodeling such as paints and solvents.
- Sweep out the gutter or wash the gutter and trap the particles at the outlet of the downspout if when repairing roofs, small particles have accumulated in the gutter. A sock or geofabric placed over the outlet may effectively trap the materials. If the downspout is tight lined, place a temporary plug at the first convenient point in the storm drain and pump out the water with a vac truck, and clean the catch basin sump where you placed the plug.
- Properly store and dispose waste materials generated from construction activities. See Construction BMP Handbook.
- Clean the storm drain system in the immediate vicinity of the construction activity after it is completed.

Painting

- Enclose painting operations consistent with local air quality regulations and OSHA.
- Local air pollution regulations may, in many areas of the state, specify painting procedures which if properly carried out are usually sufficient to protect water quality.
- Develop paint handling procedures for proper use, storage, and disposal of paints.
- Transport paint and materials to and from job sites in containers with secure lids and tied down to the transport vehicle.
- Test and inspect spray equipment prior to starting to paint. Tighten all hoses and connections and do not overfill paint containers.
- Mix paint indoors before using so that any spill will not be exposed to rain. Do so even during dry weather because cleanup of a spill will never be 100% effective.
- Transfer and load paint and hot thermoplastic away from storm drain inlets.

- Do not transfer or load paint near storm drain inlets.
- Plug nearby storm drain inlets prior to starting painting and remove plugs when job is complete when there is significant risk of a spill reaching storm drains.
- Cover nearby storm drain inlets prior to starting work if sand blasting is used to remove paint.
- Use a ground cloth to collect the chips if painting requires scraping or sand blasting of the existing surface. Dispose the residue properly.
- Cover or enclose painting operations properly to avoid drift.
- Clean the application equipment in a sink that is connected to the sanitary sewer if using water based paints.
- Capture all cleanup-water and dispose of properly.
- Dispose of paints containing lead or tributyl tin and considered a hazardous waste properly.
- Store leftover paints if they are to be kept for the next job properly, or dispose properly.
- Recycle paint when possible. Dispose of paint at an appropriate household hazardous waste facility.

Training

Proper education of off-site contractors is often overlooked. The conscientious efforts of well trained employees can be lost by unknowing off-site contractors, so make sure they are well informed about what they are expected to do.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Place a stockpile of spill cleanup materials where it will be readily accessible.
- Clean up spills immediately.
- Excavate and remove the contaminated (stained) soil if a spill occurs on dirt.

Limitations

- This BMP is for minor construction only. The State's General Construction Activity Stormwater Permit has more requirements for larger projects. The companion "Construction Best Management Practice Handbook" contains specific guidance and best management practices for larger-scale projects.
- Hazardous waste that cannot be reused or recycled must be disposed of by a licensed hazardous waste hauler.
- Be certain that actions to help stormwater quality are consistent with Cal- and Fed-OSHA and air quality regulations.

SC-42 Building Repair and Construction

Requirements

Costs

These BMPs are generally low to modest in cost.

Maintenance

N/A

Supplemental Information

Further Detail of the BMP

Soil/Erosion Control

If the work involves exposing large areas of soil, employ the appropriate soil erosion and control techniques. See the Construction Best Management Practice Handbook. If old buildings are being torn down and not replaced in the near future, stabilize the site using measures described in SC-40 Contaminated or Erodible Areas.

If a building is to be placed over an open area with a storm drainage system, make sure the storm inlets within the building are covered or removed, or the storm line is connected to the sanitary sewer. If because of the remodeling a new drainage system is to be installed or the existing system is to be modified, consider installing catch basins as they serve as effective “in-line” treatment devices. See Treatment Control Fact Sheet TC-20 Wet Pond/Basin in Section 5 of the New Development and Redevelopment Handbook regarding design criteria. Include in the catch basin a “turn-down” elbow or similar device to trap floatables.

References and Resources

California’s Nonpoint Source Program Plan <http://www.swrcb.ca.gov/nps/index.html>

Clark County Storm Water Pollution Control Manual
<http://www.co.clark.wa.us/pubworks/bmpman.pdf>

King County Storm Water Pollution Control Manual <http://dnr.metrokc.gov/wlr/dss/spcm.htm>

Santa Clara Valley Urban Runoff Pollution Prevention Program <http://www.scvurppp.org>

The Storm Water Managers Resource Center <http://www.stormwatercenter.net/>

Parking/Storage Area Maintenance SC-43



Description

Parking lots and storage areas can contribute a number of substances, such as trash, suspended solids, hydrocarbons, oil and grease, and heavy metals that can enter receiving waters through stormwater runoff or non-stormwater discharges. The protocols in this fact sheet are intended to prevent or reduce the discharge of pollutants from parking/storage areas and include using good housekeeping practices, following appropriate cleaning BMPs, and training employees.

Approach

The goal of this program is to ensure stormwater pollution prevention practices are considered when conducting activities on or around parking areas and storage areas to reduce potential for pollutant discharge to receiving waters. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

Pollution Prevention

- Encourage alternative designs and maintenance strategies for impervious parking lots. (See New Development and Redevelopment BMP Handbook)
- Keep accurate maintenance logs to evaluate BMP implementation.

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	✓
Nutrients	
Trash	✓
Metals	✓
Bacteria	
Oil and Grease	✓
Organics	✓



SC-43 Parking/Storage Area Maintenance

Suggested Protocols

General

- Keep the parking and storage areas clean and orderly. Remove debris in a timely fashion.
- Allow sheet runoff to flow into biofilters (vegetated strip and swale) and/or infiltration devices.
- Utilize sand filters or oleophilic collectors for oily waste in low quantities.
- Arrange rooftop drains to prevent drainage directly onto paved surfaces.
- Design lot to include semi-permeable hardscape.
- Discharge soapy water remaining in mop or wash buckets to the sanitary sewer through a sink, toilet, clean-out, or wash area with drain.

Controlling Litter

- Post “No Littering” signs and enforce anti-litter laws.
- Provide an adequate number of litter receptacles.
- Clean out and cover litter receptacles frequently to prevent spillage.
- Provide trash receptacles in parking lots to discourage litter.
- Routinely sweep, shovel, and dispose of litter in the trash.

Surface Cleaning

- Use dry cleaning methods (e.g., sweeping, vacuuming) to prevent the discharge of pollutants into the stormwater conveyance system if possible.
- Establish frequency of public parking lot sweeping based on usage and field observations of waste accumulation.
- Sweep all parking lots at least once before the onset of the wet season.
- Follow the procedures below if water is used to clean surfaces:
 - Block the storm drain or contain runoff.
 - Collect and pump wash water to the sanitary sewer or discharge to a pervious surface. Do not allow wash water to enter storm drains.
 - Dispose of parking lot sweeping debris and dirt at a landfill.
- Follow the procedures below when cleaning heavy oily deposits:
 - Clean oily spots with absorbent materials.
 - Use a screen or filter fabric over inlet, then wash surfaces.

Parking/Storage Area Maintenance SC-43

- Do not allow discharges to the storm drain.
- Vacuum/pump discharges to a tank or discharge to sanitary sewer.
- Appropriately dispose of spilled materials and absorbents.

Surface Repair

- Preheat, transfer or load hot bituminous material away from storm drain inlets.
- Apply concrete, asphalt, and seal coat during dry weather to prevent contamination from contacting stormwater runoff.
- Cover and seal nearby storm drain inlets where applicable (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc. Leave covers in place until job is complete and all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered manholes and drains for proper disposal.
- Use only as much water as necessary for dust control, to avoid runoff.
- Catch drips from paving equipment that is not in use with pans or absorbent material placed under the machines. Dispose of collected material and absorbents properly.

Inspection

- Have designated personnel conduct inspections of parking facilities and stormwater conveyance systems associated with parking facilities on a regular basis.
- Inspect cleaning equipment/sweepers for leaks on a regular basis.

Training

- Provide regular training to field employees and/or contractors regarding cleaning of paved areas and proper operation of equipment.
- Train employees and contractors in proper techniques for spill containment and cleanup.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Place a stockpile of spill cleanup materials where it will be readily accessible or at a central location.
- Clean up fluid spills immediately with absorbent rags or material.
- Dispose of spilled material and absorbents properly.

Other Considerations

Limitations related to sweeping activities at large parking facilities may include high equipment costs, the need for sweeper operator training, and the inability of current sweeper technology to remove oil and grease.

SC-43 Parking/Storage Area Maintenance

Requirements

Costs

Cleaning/sweeping costs can be quite large. Construction and maintenance of stormwater structural controls can be quite expensive as well.

Maintenance

- Sweep parking lot regularly to minimize cleaning with water.
- Clean out oil/water/sand separators regularly, especially after heavy storms.
- Clean parking facilities regularly to prevent accumulated wastes and pollutants from being discharged into conveyance systems during rainy conditions.

Supplemental Information

Further Detail of the BMP

Surface Repair

Apply concrete, asphalt, and seal coat during dry weather to prevent contamination from contacting stormwater runoff. Where applicable, cover and seal nearby storm drain inlets (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc. Leave covers in place until job is complete and all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered manholes and drains for proper disposal. Only use only as much water as is necessary for dust control to avoid runoff.

References and Resources

California's Nonpoint Source Program Plan <http://www.swrcb.ca.gov/nps/index.html>

Clark County Storm Water Pollution Control Manual
<http://www.co.clark.wa.us/pubworks/bmpman.pdf>

King County Storm Water Pollution Control Manual <http://dnr.metrokc.gov/wlr/dss/spcm.htm>

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA). <http://www.basmaa.org/>

Oregon Association of Clean Water Agencies. Oregon Municipal Stormwater Toolbox for Maintenance Practices. June 1998.

Santa Clara Valley Urban Runoff Pollution Prevention Program <http://www.sevurppp.org>

The Storm Water Managers Resource Center <http://www.stormwatercenter.net/>



Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize

Description

As a consequence of its function, the stormwater conveyance system collects and transports urban runoff and stormwater that may contain certain pollutants. The protocols in this fact sheet are intended to reduce pollutants reaching receiving waters through proper conveyance system operation and maintenance.

Approach

Pollution Prevention

Maintain catch basins, stormwater inlets, and other stormwater conveyance structures on a regular basis to remove pollutants, reduce high pollutant concentrations during the first flush of storms, prevent clogging of the downstream conveyance system, restore catch basins' sediment trapping capacity, and ensure the system functions properly hydraulically to avoid flooding.

Suggested Protocols

Catch Basins/Inlet Structures

- Staff should regularly inspect facilities to ensure compliance with the following:
 - Immediate repair of any deterioration threatening structural integrity.
 - Cleaning before the sump is 40% full. Catch basins should be cleaned as frequently as needed to meet this standard.
 - Stenciling of catch basins and inlets (see SC34 Waste Handling and Disposal).

Targeted Constituents

Sediment	✓
Nutrients	
Trash	✓
Metals	
Bacteria	✓
Oil and Grease	
Organics	



SC-44 Drainage System Maintenance

- Clean catch basins, storm drain inlets, and other conveyance structures before the wet season to remove sediments and debris accumulated during the summer.
- Conduct inspections more frequently during the wet season for problem areas where sediment or trash accumulates more often. Clean and repair as needed.
- Keep accurate logs of the number of catch basins cleaned.
- Store wastes collected from cleaning activities of the drainage system in appropriate containers or temporary storage sites in a manner that prevents discharge to the storm drain.
- Dewater the wastes if necessary with outflow into the sanitary sewer if permitted. Water should be treated with an appropriate filtering device prior to discharge to the sanitary sewer. If discharge to the sanitary sewer is not allowed, water should be pumped or vacuumed to a tank and properly disposed. Do not dewater near a storm drain or stream.

Storm Drain Conveyance System

- Locate reaches of storm drain with deposit problems and develop a flushing schedule that keeps the pipe clear of excessive buildup.
- Collect and pump flushed effluent to the sanitary sewer for treatment whenever possible.

Pump Stations

- Clean all storm drain pump stations prior to the wet season to remove silt and trash.
- Do not allow discharge to reach the storm drain system when cleaning a storm drain pump station or other facility.
- Conduct routine maintenance at each pump station.
- Inspect, clean, and repair as necessary all outlet structures prior to the wet season.

Open Channel

- Modify storm channel characteristics to improve channel hydraulics, increase pollutant removals, and enhance channel/creek aesthetic and habitat value.
- Conduct channel modification/improvement in accordance with existing laws. Any person, government agency, or public utility proposing an activity that will change the natural (emphasis added) state of any river, stream, or lake in California, must enter into a Stream or Lake Alteration Agreement with the Department of Fish and Game. The developer-applicant should also contact local governments (city, county, special districts), other state agencies (SWRCB, RWQCB, Department of Forestry, Department of Water Resources), and Federal Corps of Engineers and USFWS.

Illicit Connections and Discharges

- Look for evidence of illegal discharges or illicit connections during routine maintenance of conveyance system and drainage structures:
 - Is there evidence of spills such as paints, discoloring, etc?

- Are there any odors associated with the drainage system?
- Record locations of apparent illegal discharges/illicit connections?
- Track flows back to potential dischargers and conduct aboveground inspections. This can be done through visual inspection of upgradient manholes or alternate techniques including zinc chloride smoke testing, fluorometric dye testing, physical inspection testing, or television camera inspection.
- Eliminate the discharge once the origin of flow is established.
- Stencil or demarcate storm drains, where applicable, to prevent illegal disposal of pollutants. Storm drain inlets should have messages such as “Dump No Waste Drains to Stream” stenciled next to them to warn against ignorant or intentional dumping of pollutants into the storm drainage system.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

Illegal Dumping

- Inspect and clean up hot spots and other storm drainage areas regularly where illegal dumping and disposal occurs.
- Establish a system for tracking incidents. The system should be designed to identify the following:
 - Illegal dumping hot spots
 - Types and quantities (in some cases) of wastes
 - Patterns in time of occurrence (time of day/night, month, or year)
 - Mode of dumping (abandoned containers, “midnight dumping” from moving vehicles, direct dumping of materials, accidents/spills)
 - Responsible parties
- Post “No Dumping” signs in problem areas with a phone number for reporting dumping and disposal. Signs should also indicate fines and penalties for illegal dumping.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

Training

- Train crews in proper maintenance activities, including record keeping and disposal.
- Allow only properly trained individuals to handle hazardous materials/wastes.
- Have staff involved in detection and removal of illicit connections trained in the following:
 - OSHA-required Health and Safety Training (29 CFR 1910.120) plus annual refresher training (as needed).

- OSHA Confined Space Entry training (Cal-OSHA Confined Space, Title 8 and Federal OSHA 29 CFR 1910.146).
- Procedural training (field screening, sampling, smoke/dye testing, TV inspection).

Spill Response and Prevention

- Investigate all reports of spills, leaks, and/or illegal dumping promptly.
- Clean up all spills and leaks using “dry” methods (with absorbent materials and/or rags) or dig up, remove, and properly dispose of contaminated soil.
- Refer to fact sheet SC-11 Spill Prevention, Control, and Cleanup.

Other Considerations (Limitations and Regulations)

- Clean-up activities may create a slight disturbance for local aquatic species. Access to items and material on private property may be limited. Trade-offs may exist between channel hydraulics and water quality/riparian habitat. If storm channels or basins are recognized as wetlands, many activities, including maintenance, may be subject to regulation and permitting.
- Storm drain flushing is most effective in small diameter pipes (36-inch diameter pipe or less, depending on water supply and sediment collection capacity). Other considerations associated with storm drain flushing may include the availability of a water source, finding a downstream area to collect sediments, liquid/sediment disposal, and prohibition against disposal of flushed effluent to sanitary sewer in some areas.
- Regulations may include adoption of substantial penalties for illegal dumping and disposal.
- Local municipal codes may include sections prohibiting discharge of soil, debris, refuse, hazardous wastes, and other pollutants into the storm drain system.

Requirements***Costs***

- An aggressive catch basin cleaning program could require a significant capital and O&M budget.
- The elimination of illegal dumping is dependent on the availability, convenience, and cost of alternative means of disposal. The primary cost is for staff time. Cost depends on how aggressively a program is implemented. Other cost considerations for an illegal dumping program include:
 - Purchase and installation of signs.
 - Rental of vehicle(s) to haul illegally-disposed items and material to landfills.
 - Rental of heavy equipment to remove larger items (e.g., car bodies) from channels.
 - Purchase of landfill space to dispose of illegally-dumped items and material.

- Methods used for illicit connection detection (smoke testing, dye testing, visual inspection, and flow monitoring) can be costly and time-consuming. Site-specific factors, such as the level of impervious area, the density and ages of buildings, and type of land use will determine the level of investigation necessary.

Maintenance

- Two-person teams may be required to clean catch basins with vacuum trucks.
- Teams of at least two people plus administrative personnel are required to identify illicit discharges, depending on the complexity of the storm sewer system.
- Arrangements must be made for proper disposal of collected wastes.
- Technical staff are required to detect and investigate illegal dumping violations.

Supplemental Information

Further Detail of the BMP

Storm Drain Flushing

Flushing is a common maintenance activity used to improve pipe hydraulics and to remove pollutants in storm drainage systems. Flushing may be designed to hydraulically convey accumulated material to strategic locations, such as an open channel, another point where flushing will be initiated, or the sanitary sewer and the treatment facilities, thus preventing resuspension and overflow of a portion of the solids during storm events. Flushing prevents “plug flow” discharges of concentrated pollutant loadings and sediments. Deposits can hinder the designed conveyance capacity of the storm drain system and potentially cause backwater conditions in severe cases of clogging.

Storm drain flushing usually takes place along segments of pipe with grades that are too flat to maintain adequate velocity to keep particles in suspension. An upstream manhole is selected to place an inflatable device that temporarily plugs the pipe. Further upstream, water is pumped into the line to create a flushing wave. When the upstream reach of pipe is sufficiently full to cause a flushing wave, the inflated device is rapidly deflated with the assistance of a vacuum pump, thereby releasing the backed up water and resulting in the cleaning of the storm drain segment.

To further reduce impacts of stormwater pollution, a second inflatable device placed well downstream may be used to recollect the water after the force of the flushing wave has dissipated. A pump may then be used to transfer the water and accumulated material to the sanitary sewer for treatment. In some cases, an interceptor structure may be more practical or required to recollect the flushed waters.

It has been found that cleansing efficiency of periodic flush waves is dependent upon flush volume, flush discharge rate, sewer slope, sewer length, sewer flow rate, sewer diameter, and population density. As a rule of thumb, the length of line to be flushed should not exceed 700 feet. At this maximum recommended length, the percent removal efficiency ranges between 65-75% for organics and 55-65% for dry weather grit/inorganic material. The percent removal efficiency drops rapidly beyond that. Water is commonly supplied by a water truck, but fire hydrants can also supply water. To make the best use of water, it is recommended that reclaimed water be used or that fire hydrant line flushing coincide with storm sewer flushing.

SC-44 Drainage System Maintenance

References and Resources

California's Nonpoint Source Program Plan <http://www.swrcb.ca.gov/nps/index.html>

Clark County Storm Water Pollution Control Manual
<http://www.co.clark.wa.us/pubworks/bmpman.pdf>

Ferguson, B.K. 1991. Urban Stream Reclamation, p. 324-322, Journal of Soil and Water Conservation.

King County Storm Water Pollution Control Manual <http://dnr.metrokc.gov/wlr/dss/spcm.htm>

Oregon Association of Clean Water Agencies. Oregon Municipal Stormwater Toolbox for Maintenance Practices. June 1998.

Santa Clara Valley Urban Runoff Pollution Prevention Program <http://www.sevurppp.org>

The Storm Water Managers Resource Center <http://www.stormwatercenter.net>

United States Environmental Protection Agency (USEPA). 2002. Pollution Prevention/Good Housekeeping for Municipal Operations Storm Drain System Cleaning. On line:
http://www.epa.gov/npdes/menuofbmps/poll_16.htm

Description

Promote efficient and safe housekeeping practices (storage, use, and cleanup) when handling potentially harmful materials such as fertilizers, pesticides, cleaning solutions, paint products, automotive products, and swimming pool chemicals. Related information is provided in BMP fact sheets SC-11 Spill Prevention, Control & Cleanup and SC-34 Waste Handling & Disposal.

Approach

Pollution Prevention

- Purchase only the amount of material that will be needed for foreseeable use. In most cases this will result in cost savings in both purchasing and disposal. See SC-61 Safer Alternative Products for additional information.
- Be aware of new products that may do the same job with less environmental risk and for less or the equivalent cost. Total cost must be used here; this includes purchase price, transportation costs, storage costs, use related costs, clean up costs and disposal costs.

Suggested Protocols

General

- Keep work sites clean and orderly. Remove debris in a timely fashion. Sweep the area.
- Dispose of wash water, sweepings, and sediments, properly.
- Recycle or dispose of fluids properly.
- Establish a daily checklist of office, yard and plant areas to confirm cleanliness and adherence to proper storage and security. Specific employees should be assigned specific inspection responsibilities and given the authority to remedy any problems found.
- Post waste disposal charts in appropriate locations detailing for each waste its hazardous nature (poison, corrosive, flammable), prohibitions on its disposal (dumpster, drain, sewer) and the recommended disposal method (recycle, sewer, burn, storage, landfill).
- Summarize the chosen BMPs applicable to your operation and post them in appropriate conspicuous places.

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	<input checked="" type="checkbox"/>
Nutrients	<input checked="" type="checkbox"/>
Trash	<input checked="" type="checkbox"/>
Metals	<input checked="" type="checkbox"/>
Bacteria	<input checked="" type="checkbox"/>
Oil and Grease	<input checked="" type="checkbox"/>
Organics	<input checked="" type="checkbox"/>
Oxygen Demanding	<input checked="" type="checkbox"/>



- Require a signed checklist from every user of any hazardous material detailing amount taken, amount used, amount returned and disposal of spent material.
- Do a before audit of your site to establish baseline conditions and regular subsequent audits to note any changes and whether conditions are improving or deteriorating.
- Keep records of water, air and solid waste quantities and quality tests and their disposition.
- Maintain a mass balance of incoming, outgoing and on hand materials so you know when there are unknown losses that need to be tracked down and accounted for.
- Use and reward employee suggestions related to BMPs, hazards, pollution reduction, work place safety, cost reduction, alternative materials and procedures, recycling and disposal.
- Have, and review regularly, a contingency plan for spills, leaks, weather extremes etc. Make sure all employees know about it and what their role is so that it comes into force automatically.

Training

- Train all employees, management, office, yard, manufacturing, field and clerical in BMPs and pollution prevention and make them accountable.
- Train municipal employees who handle potentially harmful materials in good housekeeping practices.
- Train personnel who use pesticides in the proper use of the pesticides. The California Department of Pesticide Regulation license pesticide dealers, certify pesticide applicators and conduct onsite inspections.
- Train employees and contractors in proper techniques for spill containment and cleanup. The employee should have the tools and knowledge to immediately begin cleaning up a spill if one should occur.

Spill Response and Prevention

- Refer to SC-11, Spill Prevention, Control & Cleanup.
- Keep your Spill Prevention Control and Countermeasure (SPCC) plan up-to-date, and implement accordingly.
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

Other Considerations

- There are no major limitations to this best management practice.
- There are no regulatory requirements to this BMP. Existing regulations already require municipalities to properly store, use, and dispose of hazardous materials

Requirements

Costs

- Minimal cost associated with this BMP. Implementation of good housekeeping practices may result in cost savings as these procedures may reduce the need for more costly BMPs.

Maintenance

- Ongoing maintenance required to keep a clean site. Level of effort is a function of site size and type of activities.

Supplemental Information

Further Detail of the BMP

- The California Integrated Waste Management Board's Recycling Hotline, 1-800-553-2962, provides information on household hazardous waste collection programs and facilities.

Examples

There are a number of communities with effective programs. The most pro-active include Santa Clara County and the City of Palo Alto, the City and County of San Francisco, and the Municipality of Metropolitan Seattle (Metro).

References and Resources

British Columbia Lake Stewardship Society. Best Management Practices to Protect Water Quality from Non-Point Source Pollution. March 2000.

<http://www.nalms.org/bclss/bmphome.html#bmp>

King County Stormwater Pollution Control Manual - <http://dnr.metrokc.gov/wlr/dss/spcm.htm>

Model Urban Runoff Program: A How-To Guide for Developing Urban Runoff Programs for Small Municipalities, Prepared by City of Monterey, City of Santa Cruz, California Coastal Commission, Monterey Bay National Marine Sanctuary, Association of Monterey Bay Area Governments, Woodward-Clyde, Central Coast Regional Water Quality Control Board. July, 1998, Revised by California Coastal Commission, February 2002.

Orange County Stormwater Program

http://www.ocwatersheds.com/stormwater/swp_introduction.asp

San Mateo STOPPP - (<http://stoppp.tripod.com/bmp.html>)



Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	<input checked="" type="checkbox"/>
Nutrients	<input checked="" type="checkbox"/>
Trash	<input checked="" type="checkbox"/>
Metals	<input checked="" type="checkbox"/>
Bacteria	<input checked="" type="checkbox"/>
Oil and Grease	<input checked="" type="checkbox"/>
Organics	<input checked="" type="checkbox"/>
Oxygen Demanding	<input checked="" type="checkbox"/>

Description

Pollutants on sidewalks and other pedestrian traffic areas and plazas are typically due to littering and vehicle use. This fact sheet describes good housekeeping practices that can be incorporated into the municipality's existing cleaning and maintenance program.

Approach

Pollution Prevention

- Use dry cleaning methods whenever practical for surface cleaning activities.
- Use the least toxic materials available (e.g. water based paints, gels or sprays for graffiti removal).

Suggested Protocols

Surface Cleaning

- Regularly broom (dry) sweep sidewalk, plaza and parking lot areas to minimize cleaning with water.
- Dry cleanup first (sweep, collect, and dispose of debris and trash) when cleaning sidewalks or plazas, then wash with or without soap.
- Block the storm drain or contain runoff when cleaning with water. Discharge wash water to landscaping or collect water and pump to a tank or discharge to sanitary sewer if allowed. (Permission may be required from local sanitation district.)



- Block the storm drain or contain runoff when washing parking areas, driveways or drive-throughs. Use absorbents to pick up oil; then dry sweep. Clean with or without soap. Collect water and pump to a tank or discharge to sanitary sewer if allowed. Street Repair and Maintenance.

Graffiti Removal

- Avoid graffiti abatement activities during rain events.
- Implement the procedures under Painting and Paint Removal in SC-70 Roads, Streets, and Highway Operation and Maintenance fact sheet when graffiti is removed by painting over.
- Direct runoff from sand blasting and high pressure washing (with no cleaning agents) into a dirt or landscaped area after treating with an appropriate filtering device.
- Plug nearby storm drain inlets and vacuum/pump wash water to the sanitary sewer if authorized to do so if a graffiti abatement method generates wash water containing a cleaning compound (such as high pressure washing with a cleaning compound). Ensure that a non-hazardous cleaning compound is used or dispose as hazardous waste, as appropriate.

Surface Removal and Repair

- Schedule surface removal activities for dry weather if possible.
- Avoid creating excess dust when breaking asphalt or concrete.
- Take measures to protect nearby storm drain inlets prior to breaking up asphalt or concrete (e.g. place hay bales or sand bags around inlets). Clean afterwards by sweeping up as much material as possible.
- Designate an area for clean up and proper disposal of excess materials.
- Remove and recycle as much of the broken pavement as possible to avoid contact with rainfall and stormwater runoff.
- When making saw cuts in pavement, use as little water as possible. Cover each storm drain inlet completely with filter fabric during the sawing operation and contain the slurry by placing straw bales, sandbags, or gravel dams around the inlets. After the liquid drains or evaporates, shovel or vacuum the slurry residue from the pavement or gutter and remove from site.
- Always dry sweep first to clean up tracked dirt. Use a street sweeper or vacuum truck. Do not dump vacuumed liquid in storm drains. Once dry sweeping is complete, the area may be hosed down if needed. Wash water should be directed to landscaping or collected and pumped to the sanitary sewer if allowed.

Concrete Installation and Repair

- Schedule asphalt and concrete activities for dry weather.

- Take measures to protect any nearby storm drain inlets and adjacent watercourses, prior to breaking up asphalt or concrete (e.g. place sand bags around inlets or work areas).
- Limit the amount of fresh concrete or cement mortar mixed, mix only what is needed for the job.
- Store concrete materials under cover, away from drainage areas. Secure bags of cement after they are open. Be sure to keep wind-blown cement powder away from streets, gutters, storm drains, rainfall, and runoff.
- Return leftover materials to the transit mixer. Dispose of small amounts of hardened excess concrete, grout, and mortar in the trash.
- Do not wash sweepings from exposed aggregate concrete into the street or storm drain. Collect and return sweepings to aggregate base stockpile, or dispose in the trash.
- Protect applications of fresh concrete from rainfall and runoff until the material has dried.
- Do not allow excess concrete to be dumped onsite, except in designated areas.
- Wash concrete trucks off site or in designated areas on site designed to preclude discharge of wash water to drainage system.

Controlling Litter

- Post “No Littering” signs and enforce anti-litter laws.
- Provide litter receptacles in busy, high pedestrian traffic areas of the community, at recreational facilities, and at community events.
- Cover litter receptacles and clean out frequently to prevent leaking/spillage or overflow.
- Clean parking lots on a regular basis with a street sweeper.

Training

- Provide regular training to field employees and/or contractors regarding surface cleaning and proper operation of equipment.
- Train employee and contractors in proper techniques for spill containment and cleanup.
- Use a training log or similar method to document training.

Spill Response and Prevention

- Refer to SC-11, Spill Prevention, Control & Cleanup.
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

Other Considerations

- Limitations related to sweeping activities at large parking facilities may include current sweeper technology to remove oil and grease.
- Surface cleaning activities that require discharges to the local sewerage agency will require coordination with the agency.
- Arrangements for disposal of the swept material collected must be made, as well as accurate tracking of the areas swept and the frequency of sweeping.

Requirements**Costs**

- The largest expenditures for sweeping and cleaning of sidewalks, plazas, and parking lots are in staffing and equipment. Sweeping of these areas should be incorporated into street sweeping programs to reduce costs.

Maintenance

Not applicable

Supplemental Information**Further Detail of the BMP**

Community education, such as informing residents about their options for recycling and waste disposal, as well as the consequences of littering, can instill a sense of citizen responsibility and potentially reduce the amount of maintenance required by the municipality.

Additional BMPs that should be considered for parking lot areas include:

- Allow sheet runoff to flow into biofilters (vegetated strip and swale) and infiltration devices.
- Utilize sand filters or oleophilic collectors for oily waste in low concentrations.
- Arrange rooftop drains to prevent drainage directly onto paved surfaces.
- Design lot to include semi-permeable hardscape.
- Structural BMPs such as storm drain inlet filters can be very effective in reducing the amount of pollutants discharged from parking facilities during periods of rain.

References and Resources

Bay Area Stormwater Management Agencies Association (BASMAA). 1996. Pollution From Surface Cleaning Folder <http://www.basmaa.org>

Model Urban Runoff Program: A How-To Guide for Developing Urban Runoff Programs for Small Municipalities. Prepared by City of Monterey, City of Santa Cruz, California Coastal Commission, Monterey Bay National Marine Sanctuary, Association of Monterey Bay Area Governments, Woodward-Clyde, Central Coast Regional Water Quality Control Board. July. 1998.

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Orange County Stormwater Program

http://www.ocwatersheds.com/stormwater/swp_introduction.asp

Santa Clara Valley Urban Runoff Pollution Prevention Program. 1997 Urban Runoff Management Plan. September 1997, updated October 2000.

Santa Clara Valley Urban Runoff Pollution Prevention Program. Maintenance Best Management Practices for the Construction Industry. Brochures: Landscaping, Gardening, and Pool; Roadwork and Paving; and Fresh Concrete and Mortar Application. June 2001.

San Diego Stormwater Co-permittees Jurisdictional Urban Runoff Management Plan. 2001. Municipal Activities Model Program Guidance. November.



Description

Landscape maintenance activities include vegetation removal; herbicide and insecticide application; fertilizer application; watering; and other gardening and lawn care practices. Vegetation control typically involves a combination of chemical (herbicide) application and mechanical methods. All of these maintenance practices have the potential to contribute pollutants to the storm drain system. The major objectives of this BMP are to minimize the discharge of pesticides, herbicides and fertilizers to the storm drain system and receiving waters; prevent the disposal of landscape waste into the storm drain system by collecting and properly disposing of clippings and cuttings, and educating employees and the public.

Approach

Pollution Prevention

- Implement an integrated pest management (IPM) program. IPM is a sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools.
- Choose low water using flowers, trees, shrubs, and groundcover.
- Consider alternative landscaping techniques such as naturescaping and xeriscaping.
- Conduct appropriate maintenance (i.e. properly timed fertilizing, weeding, pest control, and pruning) to help preserve the landscapes water efficiency.

Objectives

- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	<input checked="" type="checkbox"/>
Nutrients	<input checked="" type="checkbox"/>
Trash	<input checked="" type="checkbox"/>
Metals	
Bacteria	
Oil and Grease	
Organics	
Oxygen Demanding	<input checked="" type="checkbox"/>



- Consider grass cycling (grass cycling is the natural recycling of grass by leaving the clippings on the lawn when mowing. Grass clippings decompose quickly and release valuable nutrients back into the lawn).

Suggested Protocols

Mowing, Trimming, and Weeding

- Whenever possible use mechanical methods of vegetation removal (e.g. mowing with tractor-type or push mowers, hand cutting with gas or electric powered weed trimmers) rather than applying herbicides. Use hand weeding where practical.
- Avoid loosening the soil when conducting mechanical or manual weed control, this could lead to erosion. Use mulch or other erosion control measures when soils are exposed.
- Performing mowing at optimal times. Mowing should not be performed if significant rain events are predicted.
- Mulching mowers may be recommended for certain flat areas. Other techniques may be employed to minimize mowing such as selective vegetative planting using low maintenance grasses and shrubs.
- Collect lawn and garden clippings, pruning waste, tree trimmings, and weeds. Chip if necessary, and compost or dispose of at a landfill (see waste management section of this fact sheet).
- Place temporarily stockpiled material away from watercourses, and berm or cover stockpiles to prevent material releases to storm drains.

Planting

- Determine existing native vegetation features (location, species, size, function, importance) and consider the feasibility of protecting them. Consider elements such as their effect on drainage and erosion, hardiness, maintenance requirements, and possible conflicts between preserving vegetation and the resulting maintenance needs.
- Retain and/or plant selected native vegetation whose features are determined to be beneficial, where feasible. Native vegetation usually requires less maintenance (e.g., irrigation, fertilizer) than planting new vegetation.
- Consider using low water use groundcovers when planting or replanting.

Waste Management

- Compost leaves, sticks, or other collected vegetation or dispose of at a permitted landfill. Do not dispose of collected vegetation into waterways or storm drainage systems.
- Place temporarily stockpiled material away from watercourses and storm drain inlets, and berm or cover stockpiles to prevent material releases to the storm drain system.
- Reduce the use of high nitrogen fertilizers that produce excess growth requiring more frequent mowing or trimming.

- Avoid landscape wastes in and around storm drain inlets by either using bagging equipment or by manually picking up the material.

Irrigation

- Where practical, use automatic timers to minimize runoff.
- Use popup sprinkler heads in areas with a lot of activity or where there is a chance the pipes may be broken. Consider the use of mechanisms that reduce water flow to sprinkler heads if broken.
- Ensure that there is no runoff from the landscaped area(s) if re-claimed water is used for irrigation.
- If bailing of muddy water is required (e.g. when repairing a water line leak), do not put it in the storm drain; pour over landscaped areas.
- Irrigate slowly or pulse irrigate to prevent runoff and then only irrigate as much as is needed.
- Apply water at rates that do not exceed the infiltration rate of the soil.

Fertilizer and Pesticide Management

- Utilize a comprehensive management system that incorporates integrated pest management (IPM) techniques. There are many methods and types of IPM, including the following:
 - Mulching can be used to prevent weeds where turf is absent, fencing installed to keep rodents out, and netting used to keep birds and insects away from leaves and fruit.
 - Visible insects can be removed by hand (with gloves or tweezers) and placed in soapy water or vegetable oil. Alternatively, insects can be sprayed off the plant with water or in some cases vacuumed off of larger plants.
 - Store-bought traps, such as species-specific, pheromone-based traps or colored sticky cards, can be used.
 - Slugs can be trapped in small cups filled with beer that are set in the ground so the slugs can get in easily.
 - In cases where microscopic parasites, such as bacteria and fungi, are causing damage to plants, the affected plant material can be removed and disposed of (pruning equipment should be disinfected with bleach to prevent spreading the disease organism).
 - Small mammals and birds can be excluded using fences, netting, tree trunk guards.
 - Beneficial organisms, such as bats, birds, green lacewings, ladybugs, praying mantis, ground beetles, parasitic nematodes, trichogramma wasps, seed head weevils, and spiders that prey on detrimental pest species can be promoted.
- Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of fertilizers and pesticides and training of applicators and pest control advisors.

- Use pesticides only if there is an actual pest problem (not on a regular preventative schedule).
- Do not use pesticides if rain is expected. Apply pesticides only when wind speeds are low (less than 5 mph).
- Do not mix or prepare pesticides for application near storm drains.
- Prepare the minimum amount of pesticide needed for the job and use the lowest rate that will effectively control the pest.
- Employ techniques to minimize off-target application (e.g. spray drift) of pesticides, including consideration of alternative application techniques.
- Fertilizers should be worked into the soil rather than dumped or broadcast onto the surface.
- Calibrate fertilizer and pesticide application equipment to avoid excessive application.
- Periodically test soils for determining proper fertilizer use.
- Sweep pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.
- Purchase only the amount of pesticide that you can reasonably use in a given time period (month or year depending on the product).
- Triple rinse containers, and use rinse water as product. Dispose of unused pesticide as hazardous waste.
- Dispose of empty pesticide containers according to the instructions on the container label.

Inspection

- Inspect irrigation system periodically to ensure that the right amount of water is being applied and that excessive runoff is not occurring. Minimize excess watering, and repair leaks in the irrigation system as soon as they are observed.
- Inspect pesticide/fertilizer equipment and transportation vehicles daily.

Training

- Educate and train employees on use of pesticides and in pesticide application techniques to prevent pollution. Pesticide application must be under the supervision of a California qualified pesticide applicator.
- Train/encourage municipal maintenance crews to use IPM techniques for managing public green areas.
- Annually train employees within departments responsible for pesticide application on the appropriate portions of the agency's IPM Policy, SOPs, and BMPs, and the latest IPM techniques.

- Employees who are not authorized and trained to apply pesticides should be periodically (at least annually) informed that they cannot use over-the-counter pesticides in or around the workplace.
- Use a training log or similar method to document training.

Spill Response and Prevention

- Refer to SC-11, Spill Prevention, Control & Cleanup
- Have spill cleanup materials readily available and in a known location
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

Other Considerations

- The Federal Pesticide, Fungicide, and Rodenticide Act and California Title 3, Division 6, Pesticides and Pest Control Operations place strict controls over pesticide application and handling and specify training, annual refresher, and testing requirements. The regulations generally cover: a list of approved pesticides and selected uses, updated regularly; general application information; equipment use and maintenance procedures; and record keeping. The California Department of Pesticide Regulations and the County Agricultural Commission coordinate and maintain the licensing and certification programs. All public agency employees who apply pesticides and herbicides in “agricultural use” areas such as parks, golf courses, rights-of-way and recreation areas should be properly certified in accordance with state regulations. Contracts for landscape maintenance should include similar requirements.
- All employees who handle pesticides should be familiar with the most recent material safety data sheet (MSDS) files.
- Municipalities do not have the authority to regulate the use of pesticides by school districts, however the California Healthy Schools Act of 2000 (AB 2260) has imposed requirements on California school districts regarding pesticide use in schools. Posting of notification prior to the application of pesticides is now required, and IPM is stated as the preferred approach to pest management in schools.

Requirements

Costs

Additional training of municipal employees will be required to address IPM techniques and BMPs. IPM methods will likely increase labor cost for pest control which may be offset by lower chemical costs.

Maintenance

Not applicable

Supplemental Information***Further Detail of the BMP******Waste Management***

Composting is one of the better disposal alternatives if locally available. Most municipalities either have or are planning yard waste composting facilities as a means of reducing the amount of waste going to the landfill. Lawn clippings from municipal maintenance programs as well as private sources would probably be compatible with most composting facilities

Contractors and Other Pesticide Users

Municipal agencies should develop and implement a process to ensure that any contractor employed to conduct pest control and pesticide application on municipal property engages in pest control methods consistent with the IPM Policy adopted by the agency. Specifically, municipalities should require contractors to follow the agency's IPM policy, SOPs, and BMPs; provide evidence to the agency of having received training on current IPM techniques when feasible; provide documentation of pesticide use on agency property to the agency in a timely manner.

References and Resources

King County Stormwater Pollution Control Manual. Best Management Practices for Businesses. 1995. King County Surface Water Management. July. On-line: <http://dnr.metrokc.gov/wlr/dss/spcm.htm>

Los Angeles County Stormwater Quality Model Programs. Public Agency Activities http://ladpw.org/wmd/npdes/model_links.cfm

Model Urban Runoff Program: A How-To Guide for Developing Urban Runoff Programs for Small Municipalities. Prepared by City of Monterey, City of Santa Cruz, California Coastal Commission, Monterey Bay National Marine Sanctuary, Association of Monterey Bay Area Governments, Woodward-Clyde, Central Coast Regional Water Quality Control Board. July. 1998.

Orange County Stormwater Program http://www.ocwatersheds.com/StormWater/swp_introduction.asp

Santa Clara Valley Urban Runoff Pollution Prevention Program. 1997 Urban Runoff Management Plan. September 1997, updated October 2000.

United States Environmental Protection Agency (USEPA). 2002. Pollution Prevention/Good Housekeeping for Municipal Operations Landscaping and Lawn Care. Office of Water. Office of Wastewater Management. On-line: http://www.epa.gov/npdes/menuofbmps/poll_8.htm



Design Objectives

- Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Irrigation water provided to landscaped areas may result in excess irrigation water being conveyed into stormwater drainage systems.

Approach

Project plan designs for development and redevelopment should include application methods of irrigation water that minimize runoff of excess irrigation water into the stormwater conveyance system.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment. (Detached residential single-family homes are typically excluded from this requirement.)

Design Considerations

Designing New Installations

The following methods to reduce excessive irrigation runoff should be considered, and incorporated and implemented where determined applicable and feasible by the Permittee:

- Employ rain-triggered shutoff devices to prevent irrigation after precipitation.
- Design irrigation systems to each landscape area's specific water requirements.
- Include design featuring flow reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines.
- Implement landscape plans consistent with County or City water conservation resolutions, which may include provision of water sensors, programmable irrigation times (for short cycles), etc.



- Design timing and application methods of irrigation water to minimize the runoff of excess irrigation water into the storm water drainage system.
- Group plants with similar water requirements in order to reduce excess irrigation runoff and promote surface filtration. Choose plants with low irrigation requirements (for example, native or drought tolerant species). Consider design features such as:
 - Using mulches (such as wood chips or bar) in planter areas without ground cover to minimize sediment in runoff
 - Installing appropriate plant materials for the location, in accordance with amount of sunlight and climate, and use native plant materials where possible and/or as recommended by the landscape architect
 - Leaving a vegetative barrier along the property boundary and interior watercourses, to act as a pollutant filter, where appropriate and feasible
 - Choosing plants that minimize or eliminate the use of fertilizer or pesticides to sustain growth
- Employ other comparable, equally effective methods to reduce irrigation water runoff.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define “redevelopment” in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of “redevelopment” must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under “designing new installations” above should be followed.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.



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Description

Waste materials dumped into storm drain inlets can have severe impacts on receiving and ground waters. Posting notices regarding discharge prohibitions at storm drain inlets can prevent waste dumping. Storm drain signs and stencils are highly visible source controls that are typically placed directly adjacent to storm drain inlets.

Approach

The stencil or affixed sign contains a brief statement that prohibits dumping of improper materials into the urban runoff conveyance system. Storm drain messages have become a popular method of alerting the public about the effects of and the prohibitions against waste disposal.

Suitable Applications

Stencils and signs alert the public to the destination of pollutants discharged to the storm drain. Signs are appropriate in residential, commercial, and industrial areas, as well as any other area where contributions or dumping to storm drains is likely.

Design Considerations

Storm drain message markers or placards are recommended at all storm drain inlets within the boundary of a development project. The marker should be placed in clear sight facing toward anyone approaching the inlet from either side. All storm drain inlet locations should be identified on the development site map.

Designing New Installations

The following methods should be considered for inclusion in the project design and show on project plans:

- Provide stenciling or labeling of all storm drain inlets and catch basins, constructed or modified, within the project area with prohibitive language. Examples include "NO DUMPING



– DRAINS TO OCEAN” and/or other graphical icons to discourage illegal dumping.

- Post signs with prohibitive language and/or graphical icons, which prohibit illegal dumping at public access points along channels and creeks within the project area.

Note - Some local agencies have approved specific signage and/or storm drain message placards for use. Consult local agency stormwater staff to determine specific requirements for placard types and methods of application.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define “redevelopment” in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. If the project meets the definition of “redevelopment”, then the requirements stated under “designing new installations” above should be included in all project design plans.

Additional Information

Maintenance Considerations

- Legibility of markers and signs should be maintained. If required by the agency with jurisdiction over the project, the owner/operator or homeowner’s association should enter into a maintenance agreement with the agency or record a deed restriction upon the property title to maintain the legibility of placards or signs.

Placement

- Signage on top of curbs tends to weather and fade.
- Signage on face of curbs tends to be worn by contact with vehicle tires and sweeper brooms.

Supplemental Information

Examples

- Most MS4 programs have storm drain signage programs. Some MS4 programs will provide stencils, or arrange for volunteers to stencil storm drains as part of their outreach program.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

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Description

Several measures can be taken to prevent operations at maintenance bays and loading docks from contributing a variety of toxic compounds, oil and grease, heavy metals, nutrients, suspended solids, and other pollutants to the stormwater conveyance system.

Approach

In designs for maintenance bays and loading docks, containment is encouraged. Preventative measures include overflow containment structures and dead-end sumps. However, in the case of loading docks from grocery stores and warehouse/distribution centers, engineered infiltration systems may be considered.

Suitable Applications

Appropriate applications include commercial and industrial areas planned for development or redevelopment.

Design Considerations

Design requirements for vehicle maintenance and repair are governed by Building and Fire Codes, and by current local agency ordinances, and zoning requirements. The design criteria described in this fact sheet are meant to enhance and be consistent with these code requirements.

Designing New Installations

Designs of maintenance bays should consider the following:

- Repair/maintenance bays and vehicle parts with fluids should be indoors; or designed to preclude urban run-on and runoff.
- Repair/maintenance floor areas should be paved with Portland cement concrete (or equivalent smooth impervious surface).



- Repair/maintenance bays should be designed to capture all wash water leaks and spills. Provide impermeable berms, drop inlets, trench catch basins, or overflow containment structures around repair bays to prevent spilled materials and wash-down waters from entering the storm drain system. Connect drains to a sump for collection and disposal. Direct connection of the repair/maintenance bays to the storm drain system is prohibited. If required by local jurisdiction, obtain an Industrial Waste Discharge Permit.
- Other features may be comparable and equally effective.

The following designs of loading/unloading dock areas should be considered:

- Loading dock areas should be covered, or drainage should be designed to preclude urban run-on and runoff.
- Direct connections into storm drains from depressed loading docks (truck wells) are prohibited.
- Below-grade loading docks from grocery stores and warehouse/distribution centers of fresh food items should drain through water quality inlets, or to an engineered infiltration system, or an equally effective alternative. Pre-treatment may also be required.
- Other features may be comparable and equally effective.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define “redevelopment” in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of “redevelopment” must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under “designing new installations” above should be followed.

Additional Information

Stormwater and non-stormwater will accumulate in containment areas and sumps with impervious surfaces. Contaminated accumulated water must be disposed of in accordance with applicable laws and cannot be discharged directly to the storm drain or sanitary sewer system without the appropriate permit.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

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Description

Trash storage areas are areas where a trash receptacle (s) are located for use as a repository for solid wastes. Stormwater runoff from areas where trash is stored or disposed of can be polluted. In addition, loose trash and debris can be easily transported by water or wind into nearby storm drain inlets, channels, and/or creeks. Waste handling operations that may be sources of stormwater pollution include dumpsters, litter control, and waste piles.

Approach

This fact sheet contains details on the specific measures required to prevent or reduce pollutants in stormwater runoff associated with trash storage and handling. Preventative measures including enclosures, containment structures, and impervious pavements to mitigate spills, should be used to reduce the likelihood of contamination.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment. (Detached residential single-family homes are typically excluded from this requirement.)

Design Considerations

Design requirements for waste handling areas are governed by Building and Fire Codes, and by current local agency ordinances and zoning requirements. The design criteria described in this fact sheet are meant to enhance and be consistent with these code and ordinance requirements. Hazardous waste should be handled in accordance with legal requirements established in Title 22, California Code of Regulation.

Wastes from commercial and industrial sites are typically hauled by either public or commercial carriers that may have design or access requirements for waste storage areas. The design criteria in this fact sheet are recommendations and are not intended to be in conflict with requirements established by the waste hauler. The waste hauler should be contacted prior to the design of your site trash collection areas. Conflicts or issues should be discussed with the local agency.

Designing New Installations

Trash storage areas should be designed to consider the following structural or treatment control BMPs:

- Design trash container areas so that drainage from adjoining roofs and pavement is diverted around the area(s) to avoid run-on. This might include berming or grading the waste handling area to prevent run-on of stormwater.
- Make sure trash container areas are screened or walled to prevent off-site transport of trash.

Design Objectives

- Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey



- Use lined bins or dumpsters to reduce leaking of liquid waste.
- Provide roofs, awnings, or attached lids on all trash containers to minimize direct precipitation and prevent rainfall from entering containers.
- Pave trash storage areas with an impervious surface to mitigate spills.
- Do not locate storm drains in immediate vicinity of the trash storage area.
- Post signs on all dumpsters informing users that hazardous materials are not to be disposed of therein.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define “redevelopment” in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of “redevelopment” must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under “designing new installations” above should be followed.

Additional Information

Maintenance Considerations

The integrity of structural elements that are subject to damage (i.e., screens, covers, and signs) must be maintained by the owner/operator. Maintenance agreements between the local agency and the owner/operator may be required. Some agencies will require maintenance deed restrictions to be recorded of the property title. If required by the local agency, maintenance agreements or deed restrictions must be executed by the owner/operator before improvement plans are approved.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

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General Description

Vortex separators: (alternatively, swirl concentrators) are gravity separators, and in principle are essentially wet vaults. The difference from wet vaults, however, is that the vortex separator is round, rather than rectangular, and the water moves in a centrifugal fashion before exiting. By having the water move in a circular fashion, rather than a straight line as is the case with a standard wet vault, it is possible to obtain significant removal of suspended sediments and attached pollutants with less space. Vortex separators were originally developed for combined sewer overflows (CSOs), where it is used primarily to remove coarse inorganic solids. Vortex separation has been adapted to stormwater treatment by several manufacturers.

Inspection/Maintenance Considerations

As some of the systems have standing water that remains between storms, there is concern about mosquito breeding. Also, a loss of dissolved pollutants may occur as accumulated organic matter (e.g., leaves) decomposes in the units.

Inspection Activities	Suggested Frequency
<ul style="list-style-type: none"> Inspect for accumulated sediment/debris. 	As needed
Maintenance Activities	Suggested Frequency
<ul style="list-style-type: none"> Remove of accumulated material with an eductor truck. It may be necessary to remove and dispose the floatables separately due to the presence of petroleum product. 	Annual, or more frequent as needed

Maintenance Concerns, Objectives, and Goals

- Sediment/Debris Removal
- Vector Control

Targeted Constituents

- ✓ Sediment ▲
- ✓ Nutrients ●
- ✓ Trash
- ✓ Metals ●
- Bacteria
- ✓ Oil and Grease
- ✓ Organics

Legend (Removal Effectiveness)

- Low
- High
- ▲ Medium



General Description

A multiple treatment system uses two or more BMPs in series. Some examples of multiple systems include: settling basin combined with a sand filter; settling basin or biofilter combined with an infiltration basin or trench; extended detention zone on a wet pond.

Inspection/Maintenance Considerations

Each of the separate treatment processes will require maintenance as described in the previous fact sheets. For example, multiple system comprises of a biofilter combined with an infiltration basin would require the inspection and maintenance considerations outlined on the fact sheet for each process.

Inspection Activities	Suggested Frequency
<ul style="list-style-type: none"> Refer to individual treatment control factsheets 	As needed
Maintenance Activities	Suggested Frequency
<ul style="list-style-type: none"> Refer to individual treatment control factsheets 	As needed

Maintenance Concerns, Objectives, and Goals

May include some of the following:

- Accumulation of Metals
- Aesthetics
- Channelization of Flow
- Clogged Outlet Structures
- Endangered Species Habitat Creation
- Erosion
- Groundwater Contamination
- Hazardous Waste
- Hydraulic and Removal Efficiency
- Invasive/exotic Plant Species
- Mechanical Malfunction
- Pollutant Breakthrough
- Re-suspension of settled material
- Sediment and Trash Removal
- Sedimentation
- Vector/Pest Control
- Vegetation harvesting
- Vegetation/Landscape Maintenance

Targeted Constituents

- ✓ Sediment ■
- ✓ Nutrients ●
- ✓ Trash ■
- ✓ Metals ■
- ✓ Bacteria ▲
- ✓ Oil and Grease ■
- ✓ Organics ■

Legend (Removal Effectiveness)

- Low
- High
- ▲ Medium



