Preliminary Water Quality Management Plan

For:

Tract 20267

CITY ID: TT20267

Prepared for:

Crestwood Corporation

510 W. Citrus Edge Street

Glendora, CA 91740

626-914-1943

Terry Kent

Prepared by:

Encompass Associates, Inc.

5699 Cousins Place

Rancho Cucamonga, CA 91737

909-684-0093

Aaron Skeers, P.E.

Date: February 28, 2019

Approval Date:_____

Project Owner's Certification

This Water Quality Management Plan (WQMP) has been prepared for Crestwood Corporation by Encompass Associates, Inc. The WQMP is intended to comply with the requirements of the County 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."

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Project Data			
Permit/Application Number(s):	TT20267	Grading Permit Number(s):	
Tract/Parcel Map Number(s):	Tract 20267	Building Permit Number(s):	
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			Lots 1-3 (with 40 condo units)

Owner's Signature			
Owner Name:	Terry Kent		
Title	Vice President		
Company	Crestwood Corporation		
Address	510 W. Citrus Edge Street		
Email	tkent@crestwoodcommunities.com		
Telephone #	626-914-1943		
Signature		Date	

Preparer's Certification

Project Data			
Permit/Application Number(s):	TT20267	Grading Permit Number(s):	
Tract/Parcel Map Number(s):	Tract 20267	Building Permit Number(s):	
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			Lots 1-3 (with 40 condo units)

"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:	Aaron T. Skeers, P.E.	PE Stamp Below
Title	President	
Company	Encompass Associates, Inc.	
Address	5699 Cousins Place, Rancho Cucamonga, CA, 91737	
Email	askeers@encompasscivil.com	
Telephone #	909-684-0093	
Signature		
Date		

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Forms

Section 1 Discretionary Permit(s)

Form 1-1 Project Information

Project Name	Tract 20267				
Project Owner Contact Name:	Terry Kent				
Mailing Address:	510 W. Citrus Edge Street Glendora, CA 91740	E-mail Address:	tkent@crestwoodcommunities.com	Telephone:	626-914-1943
Permit/Application Number(s):	TT20267	Tract/Parcel Map Number(s):		Lots 1-3 (with 40 condo units)	
Additional Information/ Comments:	**Notice to homeowners:** removal or revision of BMPs described in this document and as constructed is prohibited. Maintenance is required and shall be conducted as described in this document.				
Description of Project:	Subdivision of 2 single-family residential lots and 40 detached condominium units on three parcels, all on an existing vacant property and former nursery on a 4.7 acre property at 5553 Mission Boulevard, on the south side between Vernon Avenue and Benson Avenue. Single-family residences exist on the west and south sides, a car wash to the west, light industrial across Mission to the north, and a mobile home park and vacant land to the east. In addition to the residential buildings, the condo site will be comprised of drives, parking, a private park with tot lot, and paseos throughout. Runoff drains to Bel Air Avenue via surface flows. For the single-family portion, runoff will surface drain off the lots onto the street. Lot runoff will be mitigated with on-lot infiltration trenches, oversized to mitigate street runoff. For the condo site, unit runoff will be collected via area drains inlets and pipes and conveyed to bioretention systems located in the landscaped areas. Discharge in excess of the water quality volume will surface drain out to Bel Air Avenue to the south.				
Provide summary of Conceptual WQMP conditions (if previously submitted and approved). Attach complete copy.					

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):

☐ Significant re-development involving the addition or replacement of 5,000 ft^2 or more of impervious surface on an already developed site	☒ New development involving the creation of 10,000 ft^2 or more of impervious surface collectively over entire site	☐ Automotive repair shops with standard industrial classification (SIC) codes 5013, 5014, 5541, 7532-7534, 7536-7539	☐ Restaurants (with SIC code 5812) where the land area of development is 5,000 ft^2 or more
☐ 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	☐ 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.	☒ Parking lots of 5,000 ft^2 or more exposed to storm water	☐ 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 (ft2):	204,619	**3** Number of Dwelling Units:	42	**4** SIC Code:	6513,6514

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:
For on-lot and parkway infiltration pits, maintenance is the responsibility of the individual property owners (SFR, lots 2-3). For the condominium portion (Lot 1, 40 units), the site will be maintained by the Homeowner's Association.

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
Pathogens (Bacterial / Virus)	E ☒	N ☐	
Phosphorous	E ☒	N ☐	
Nitrogen	E ☒	N ☐	
Sediment	E ☒	N ☐	
Metals	E ☒	N ☐	
Oil and Grease	E ☒	N ☐	
Trash/Debris	E ☒	N ☐	
Pesticides / Herbicides	E ☒	N ☐	
Organic Compounds	E ☒	N ☐	
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	

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: *Select all that apply*			
☐ Redevelopment projects that reduce the overall impervious footprint of the project site. [Credit = % impervious reduced] **50%**	Higher density development projects ☐ Vertical density [20%] ☐ 7 units/ acre [5%]	☐ 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%]	☐ Brownfield redevelopment (redevelop real property complicated by presence or potential of hazardous contaminants) [25%]
☐ Redevelopment projects in established historic district, historic preservation area, or similar significant core city center areas [10%]	☐ Transit-oriented developments (mixed use residential or commercial area designed to maximize access to public transportation) [20%]	☐ 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%]	☐ Live-Work developments (variety of developments designed to support residential and vocational needs) [20%]
2 Total Credit % **0%** *(Total all credit percentages up to a maximum allowable credit of 50 percent)*			
Description of Water Quality Credit Eligibility (if applicable)			

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 *take GPS measurement at approximate center of site*	Latitude 34°03'17.7"N	Longitude 117°41'00.7"W	Thomas Bros Map page 601

1 San Bernardino County climatic region: ☒ Valley ☐ Mountain

2 Does the site have more than one drainage area (DA): Yes ☐ No ☒ *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*

Conveyance	Briefly describe on-site drainage features to convey runoff that is not retained within a DMA

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		
1 DMA drainage area (ft^2)	164841	39778		
2 Existing site impervious area (ft^2)	0	0		
3 Antecedent moisture condition *For desert areas, use* *http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf*	1	1		
4 Hydrologic soil group *Refer to Watershed Mapping Tool –* *http://sbcounty.permitrack.com/WAP*	A	A		
5 Longest flowpath length (ft)	580	350		
6 Longest flowpath slope (ft/ft)	0.02	0.02		
7 Current land cover type(s) *Select from Fig C-3 of Hydrology Manual*	Grass	Grass		
8 Pre-developed pervious area condition: *Based on the extent of wet season vegetated cover good >75%; Fair 50-75%; Poor <50% Attach photos of site to support rating*	Fair (60%)	Fair (60%)		

Form 3-3 Watershed Description for Drainage Area

Receiving waters *Refer to Watershed Mapping Tool -* *http://sbcounty.permitrack.com/WAP* *See 'Drainage Facilities" link at this website*	Bel Air (street/surface flow) Chino Storm Drain San Antonio Channel Santa Ana River Reach 3 Santa Ana River Reach 2 Santa Ana River Reach 1 Pacific Ocean
Applicable TMDLs *Refer to Local Implementation Plan*	No TMDLs in the immediate receiving waters Santa Ana River Reach 3 for Copper and Lead still required Santa Ana River Reach 3 for Pathogens is being addressed by USEPA approved TDML.
303(d) listed impairments *Refer to Local Implementation Plan and Watershed Mapping Tool –* *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 3 is listed for bacteria and metals
Environmentally Sensitive Areas (ESA) *Refer to Watershed Mapping Tool –* *http://sbcounty.permitrack.com/WAP*	No
Unlined Downstream Water Bodies *Refer to Watershed Mapping Tool –* *http://sbcounty.permitrack.com/WAP*	No
Hydrologic Conditions of Concern	☐ 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* ☒ No
Watershed–based BMP included in a RWQCB approved WAP	☐ Yes *Attach verification of regional BMP evaluation criteria in WAP* • *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* ☒ 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	☒	☐	HOA & Homeowners to be provided with household BMP brochure
N2	Activity Restrictions	☒	☐	HOA / CC&Rs **Notice to homeowners:** removal or revision of BMPs described in this document and as constructed is prohibited. Maintenance is required and shall be conducted as described in this document.
N3	Landscape Management BMPs	☒	☐	HOA & Homeowners to be provided with household BMP brochure
N4	BMP Maintenance	☒	☐	HOA & Homeowners to be provided with household BMP brochure. County of San Bernardino to conduct periodic public BMP maintenance
N5	Title 22 CCR Compliance (How development will comply)	☐	☒	County ordinance
N6	Local Water Quality Ordinances	☒	☐	
N7	Spill Contingency Plan	☐	☒	No proposed activities with a likely possibility of spill occurrence
N8	Underground Storage Tank Compliance	☐	☒	No proposed USTs
N9	Hazardous Materials Disclosure Compliance	☐	☒	No proposed Hazardous Material generating activities

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	☐	☒	
N11	Litter/Debris Control Program	☒	☐	Monthly Street Sweeping by County of San Bernardino (public street) and HOA (private)
N12	Employee Training	☐	☒	No Employees. Contract maintenance company must demonstrate knowledge of proper methods and practice and shall be provided with this WQMP.
N13	Housekeeping of Loading Docks	☐	☒	No Loading Docks
N14	Catch Basin Inspection Program	☐	☒	No Catch Basins (on-site area drains convey runoff to bioretention BMP, not to a MS4 facility)
N15	Vacuum Sweeping of Private Streets and Parking Lots	☒	☐	HOA responsible for monthly sweeping of Private Streets and Parking Lots
N16	Other Non-structural Measures for Public Agency Projects	☐	☒	n/a
N17	Comply with all other applicable NPDES permits	☒	☐	This project will acquire WDID number to demonstrate compliance with the General Construction Permit.

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 stencilling and signage (CASQA New Development BMP Handbook SD-13)	☒	☐	No Catch Basins (on-site area drains convey runoff to bioretention BMP, not to a MS4 facility)
S2	Design and construct outdoor material storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-34)	☐	☒	No outdoor storage areas
S3	Design and construct trash and waste storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-32)	☒	☐	Trash enclosures shall be constructed per County Standard
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)	☒	☐	Efficient irrigation will be installed on lots and in public areas. The irrigation system will included devices to prevent low head drainage, overspray and runoff through the use of pressure regulating devices, check valve, flow sensors, proper spacing, low precipitation emission devices and ET or weather based devices. Landscape and irrigation shall be consistent with the State Model Water Efficient Landscape Ordinace and the County Landscape Development Standards. Landscape areas used for water quality swales or infiltration areas shall have proper plants for saturated soils, drought tolerance and erosion control qualities. Shade trees shall be used to intercept rainwater and reduce gain on paving.
S5	Finish grade of landscaped areas at a minimum of 1-2 inches below top of curb, sidewalk, or pavement	☒	☐	Basin will have retention. Landscaping in general held below hardscape to facilitate limited localized retention.
S6	Protect slopes and channels and provide energy dissipation (CASQA New Development BMP Handbook SD-10)	☐	☒	No slopes with significant runoff. Drainage discharges to bioretention at low point, so no erosion concern.
S7	Covered dock areas (CASQA New Development BMP Handbook SD-31)	☐	☒	No covered dock areas
S8	Covered maintenance bays with spill containment plans (CASQA New Development BMP Handbook SD-31)	☐	☒	No covered maintenance bays
S9	Vehicle wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☐	☒	No vehicle wash areas
S10	Covered outdoor processing areas (CASQA New Development BMP Handbook SD-36)	☐	☒	No covered outdoor processing areas

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)	☐	☒	No equipment wash areas
S12	Fueling areas (CASQA New Development BMP Handbook SD-30)	☐	☒	No fueling areas
S13	Hillside landscaping (CASQA New Development BMP Handbook SD-10)	☐	☒	No Hillside areas
S14	Wash water control for food preparation areas	☐	☒	No food preparation areas
S15	Community car wash racks (CASQA New Development BMP Handbook SD-33)	☐	☒	No community car wash racks

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

Site Design Practices *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*
Minimize impervious areas: Yes ☒ No ☐ Explanation: Street widths have been reduced.
Maximize natural infiltration capacity: Yes ☒ No ☐ Explanation: On-lot infiltration
Preserve existing drainage patterns and time of concentration: Yes ☒ No ☐ Explanation: Street flow length is longer than original, natural flow path
Disconnect impervious areas: Yes ☒ No ☐ Explanation: Lot runoff drains to infiltration BMP prior to discharge into the street
Protect existing vegetation and sensitive areas: Yes ☐ No ☒ Explanation: Optimized site layout and grading does not provide for protection of existing vegetation.
Re-vegetate disturbed areas: Yes ☒ No ☐ Explanation: Landscaping will be installed on lots and in parkways
Minimize unnecessary compaction in stormwater retention/infiltration basin/trench areas: Yes ☒ No ☐ Explanation: Infiltration BMPs are outside of the building pad, therefore compaction will be less
Utilize vegetated drainage swales in place of underground piping or imperviously lined swales: Yes ☒ No ☐ Explanation: Vegetated swales are used when conditions required by the building code allows
Stake off areas that will be used for landscaping to minimize compaction during construction : Yes ☐ No ☒ Explanation:

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 P_6 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 mi^2), 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): 106985 sf	**2** Imperviousness after applying preventative site design practices (Imp%): 50%	**3** Runoff Coefficient (Rc): 0.41 *$R_c = 0.858(Imp\%)^{\wedge 3} - 0.78(Imp\%)^{\wedge 2} + 0.774(Imp\%) + 0.04$*
4 Determine 1-hour rainfall depth for a 2-year return period $P_{2yr\text{-}1hr}$ (in): **0.60** *http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html*		
5 Compute P_6, Mean 6-hr Precipitation (inches): 0.89 *P_6 = Item 4 *C_1, where C_1 is a function of site climatic region specified in Form 3-1 Item 1 (Valley = 1.4807; Mountain = 1.909; Desert = 1.2371)*		
6 Drawdown Rate *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.*		24-hrs ☐ 48-hrs ☒
7 Compute design capture volume, DCV (ft^3): 12,214 *DCV = 1/12 * [Item 1* Item 3 *Item 5 * C_2], where C_2 is a function of drawdown rate (24-hr = 1.582; 48-hr = 1.963)* *Compute separate DCV for each outlet from the project site per schematic drawn in Form 3-1 Item 2*		

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** *Form 4.2-3 Item 12*	**2** *Form 4.2-4 Item 13*	**3** *Form 4.2-5 Item 10*
Post-developed	**4** *Form 4.2-3 Item 13*	**5** *Form 4.2-4 Item 14*	**6** *Form 4.2-5 Item 14*
Difference	**7** *Item 4 – Item 1*	**8** *Item 5 – Item 2*	**9** *Item 6 – Item 3*
Difference (as % of pre-developed)	**10** *Item 7 / Item 1*	**11** *Item 8 / Item 2*	**12** *Item 9 / Item 3*

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 / Item 5) - 10*	**9** Initial abstraction, I_a (in): *I_a = 0.2 * Item 7*
6 Post-Developed area-weighted CN:	**8** Post-developed soil storage capacity, S (in): *S = (1000 / Item 6) - 10*	**10** Initial abstraction, I_a (in): *I_a = 0.2 * Item 8*

11 Precipitation for 2 yr, 24 hr storm (in):
Go to: http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html

12 Pre-developed Volume (ft^3):
*V_{pre} =(1 / 12) * (Item sum of Item 3) * [(Item 11 – Item 9)^2 / ((Item 11 – Item 9 + Item 7)*

13 Post-developed Volume (ft^3):
*V_{pre} =(1 / 12) * (Item sum of Item 3) * [(Item 11 – Item 10)^2 / ((Item 11 – Item 10 + Item 8)*

14 Volume Reduction needed to meet HCOC Requirement, (ft^3):
*V_{HCOC} = (Item 13 * 0.95) – 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 *Use additional forms if there are more than 4 DMA*				Post-developed DA1 *Use additional forms if there are more than 4 DMA*			
	DMA A	DMA B	DMA C	DMA D	DMA A	DMA B	DMA C	DMA D
1 Length of flowpath (ft) *Use Form 3-2 Item 5 for pre-developed condition*								
2 Change in elevation (ft)								
3 Slope (ft/ft), S_o = *Item 2 / Item 1*								
4 Land cover								
5 Initial DMA Time of Concentration (min) *Appendix C-1 of the TGD for WQMP*								
6 Length of conveyance from DMA outlet to project site outlet (ft) *May be zero if DMA outlet is at project site outlet*								
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_{fps} = *(1.49 / Item 9) * (Item 7/Item 8)^0.67 * (Item 3)^0.5*								
11 Travel time to outlet (min) T_t = *Item 6 / (Item 10 * 60)*								
12 Total time of concentration (min) T_c = *Item 5 + Item 11*								
13 Pre-developed time of concentration (min): *Minimum of Item 12 pre-developed DMA*								
14 Post-developed time of concentration (min): *Minimum of Item 12 post-developed DMA*								
15 Additional time of concentration needed to meet HCOC requirement (min): $T_{C\text{-}HCOC}$ = *(Item 14 * 0.95) – 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 Form 4.2-1 Item 4 - 0.6 LOG Form 4.2-4 Item 5 /60)*							
2 Drainage Area of each DMA (ft^2) *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)*							
3 Ratio of pervious area to total area *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)*							
4 Pervious area infiltration rate (in/hr) *Use pervious area CN and antecedent moisture condition with Appendix C-3 of the TGD for WQMP*							
5 Maximum loss rate (in/hr) *F_m = Item 3 * Item 4* *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)*							
6 Peak Flow from DMA (cfs) *Q_p =Item 2 * 0.9 * (Item 1 - Item 5)*							
7 Time of concentration adjustment factor for other DMA to site discharge point *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)*	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 = Item 6_{DMAA} + [Item 6_{DMAB} * (Item 1_{DMAA} - Item 5_{DMAB})/(Item 1_{DMAB} - Item 5_{DMAB})* Item $7_{DMAA/2}$] + [Item 6_{DMAC} * (Item 1_{DMAA} - Item 5_{DMAC})/(Item 1_{DMAC} - Item 5_{DMAC})* Item $7_{DMAA/3}$]*	**9** Pre-developed Q_p at T_c for DMA B: *Q_p = Item 6_{DMAB} + [Item 6_{DMAA} * (Item 1_{DMAB} - Item 5_{DMAA})/(Item 1_{DMAA} - Item 5_{DMAA})* Item $7_{DMAB/1}$] + [Item 6_{DMAC} * (Item 1_{DMAB} - Item 5_{DMAC})/(Item 1_{DMAC} - Item 5_{DMAC})* Item $7_{DMAB/3}$]*	**10** Pre-developed Q_p at T_c for DMA C: *Q_p = Item 6_{DMAC} + [Item 6_{DMAA} * (Item 1_{DMAC} - Item 5_{DMAA})/(Item 1_{DMAA} - Item 5_{DMAA})* Item $7_{DMAC/1}$] + [Item 6_{DMAB} * (Item 1_{DMAC} - Item 5_{DMAB})/(Item 1_{DMAB} - Item 5_{DMAB})* Item $7_{DMAC/2}$]*
10 Peak runoff from pre-developed condition confluence analysis (cfs): *Maximum of Item 8, 9, and 10 (including additional forms as needed)*		
11 Post-developed Q_p at T_c for DMA A: *Same as Item 8 for post-developed values*	**12** Post-developed Q_p at T_c for DMA B: *Same as Item 9 for post-developed values*	**13** Post-developed Q_p at T_c for DMA C: *Same as Item 10 for post-developed values*
14 Peak runoff from post-developed condition confluence analysis (cfs): *Maximum of Item 11, 12, and 13 (including additional forms as needed)*		
15 Peak runoff reduction needed to meet HCOC Requirement (cfs): $Q_{p\text{-}HCOC}$ = *(Item 14 * 0.95) – 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 & 2)

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:

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)

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 ☐ No ☒ *If yes, complete Items 2-5; If no, proceed to Item 6*	DA 1 DMA A BMP Type	DA DMA BMP Type	DA DMA BMP Type
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 = Item2 * 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): 0 $V_{retention}$ *=Sum of Item 4 for all BMPs*			
6 Implementation of Localized On-lot Infiltration BMPs (e.g. on-lot rain gardens): Yes ☒ No ☐ *If yes, complete Items 7-13 for aggregate of all on-lot infiltration BMP in each DA; If no, proceed to Item 14*	DA 1 DMA A BMP Type	DA 1 DMA BMP Type	DA 1 DMA BMP Type
7 Ponding surface area (ft^2)			
8 Ponding depth (ft) (for paver voids: 10% of 4" depth)			
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) $V_{retention}$ *= (Item 7 *Item 8) + (Item 9 * Item 10 * Item 11)*			
13 Runoff volume retention from on-lot infiltration (ft^3): $V_{retention}$ *=Sum of Item 12 for all BMPs*			

Form 4.3-2 cont. Site Design Hydrologic Source Control BMPs (DA 1)

14 Implementation of evapotranspiration BMP (green, brown, or blue roofs): Yes ☐ No ☒ *If yes, complete Items 15-20. If no, proceed to Item 21*	DA 1 DMA A BMP Type	DA 1 DMA B BMP Type	DA 1 DMA C BMP Type
15 Rooftop area planned for ET BMP (ft^2)			
16 Average wet season ET demand (in/day) *Use local values, typical ~ 0.1*			
17 Daily ET demand (ft^3/day) *Item 15 * (Item 16 / 12)*			
18 Drawdown time (hrs) *Copy Item 6 in Form 4.2-1*			
19 Retention Volume (ft^3) $V_{retention}$ *= Item 17 * (Item 18 / 24)*			
20 Runoff volume retention from evapotranspiration BMPs (ft^3): 0 $V_{retention}$ *=Sum of Item 19 for all BMPs*			
21 Implementation of Street Trees: Yes ☐ No ☒ *If yes, complete Items 20-2. If no, proceed to Item 24*	DA 1 DMA A BMP Type	DA 1 DMA B BMP Type	DA 1 DMA C BMP Type
22 Number of Street Trees			
23 Average canopy cover over impervious area (ft^2)			
24 Runoff volume retention from street trees (ft^3) $V_{retention}$ *= Item 22 * Item 23 * (0.05/12) assume runoff retention of 0.05 inches*			
25 Runoff volume retention from street tree BMPs (ft^3): 0 $V_{retention}$ *= Sum of Item 24 for all BMPs*			
26 Implementation of residential rain barrels/cisterns: Yes☐ No ☒ *If yes, complete Items 27-28; If no, proceed to Item 29*	DA 1 DMA A BMP Type	DA 1 DMA B BMP Type	DA 1 DMA C BMP Type
27 Number of rain barrels/cisterns			
28 Runoff volume retention from rain barrels/cisterns (ft^3) $V_{retention}$ *= Item 27 * 3*			
29 Runoff volume retention from residential rain barrels/Cisterns (ft3): 0 $V_{retention}$ *=Sum of Item 28 for all BMPs*			
30 Total Retention Volume from Site Design Hydrologic Source Control BMPs: 0 *Sum of Items 5, 13, 20, 25 and 29*			

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).

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

1 **Remaining LID DCV not met by site design HSC BMP (ft^3):** 12,214 *V_{unmet} = Form 4.2-1 Item 7 - Form 4.3-2 Item 30*

BMP Type *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*	DA 1 DMA A BMP Type Infiltration Trench	DA 1 DMA B BMP Type On-Lot Infiltration	DA 1 DMA C BMP Type
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*	20.4	20.4	
3 Infiltration safety factor *See TGD Section 5.4.2 and Appendix D*	2	2	
4 Design percolation rate (in/hr) *P_{design} = Item 2 / Item 3*	10.2	10.2	
5 Ponded water drawdown time (hr) *Copy Item 6 in Form 4.2-1*	48	48	
6 Maximum ponding depth (ft) *BMP specific, see Table 5-4 of the TGD for WQMP for BMP design details*	0	0	
7 Ponding Depth (ft) *d_{BMP} = Minimum of (1/12*Item 4*Item 5) or Item 6*	0	0	
8 Infiltrating surface area, SA_{BMP} (ft^2) *the lesser of the area needed for infiltration of full DCV or minimum space requirements from Table 5.7 of the TGD for WQMP*	1044	262 ea (x2)= 524	
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*	0	0	
10 Amended soil porosity	0.3	0.3	
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*	9	5	
12 Gravel porosity	0.4	0.4	
13 Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*	3	3	
14 Above Ground Retention Volume (ft^3) *$V_{retention}$ = Item 8 * [Item7 + (Item 9 * Item 10) + (Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]*	4088 (9x9x116lf trench minus pipe)	1192 ea (x2)= 2384	
15 Underground Retention Volume (ft^3) *Volume determined using manufacturer's specifications and calculations*	5831 (96"x116 lf)		

16 Total Retention Volume from LID Infiltration BMPs: 12,303 *(Sum of Items 14 and 15 for all infiltration BMP included in plan)*

17 Fraction of DCV achieved with infiltration BMP: 100 % (over) *Retention% = Item 16 / 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&2)

1 Remaining LID DCV not met by site design HSC or infiltration BMP (ft^3): 0 sf

V_{unmet} = Form 4.2-1 Item 7 - Form 4.3-2 Item 30 – Form 4.3-3 Item 16

BMP Type(s) *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*	DA 1 DMA A BMP Type	DA 1 DMA B BMP Type	DA 1 DMA C BMP Type
2 Describe cistern or runoff detention facility			
3 Storage volume for proposed detention type (ft^3) *Volume of cistern*			
4 Landscaped area planned for use of harvested stormwater (ft^2)			
5 Average wet season daily irrigation demand (in/day) Use local values, typical ~ 0.1 in/day			
6 Daily water demand (ft^3/day) *Item 4 * (Item 5 / 12)*			
7 Drawdown time (hrs) *Copy Item 6 from Form 4.2-1*			
8 Retention Volume (ft^3) *$V_{retention}$ = Minimum of (Item 3) or (Item 6 * (Item 7 / 24))*			

9 Total Retention Volume (ft^3) from Harvest and Use BMP n/a *Sum of Item 8 for all harvest and use BMP included in plan*

10 Is the full DCV retained with a combination of LID HSC, retention and infiltration, and harvest and use BMPs? Yes ☒ No ☐

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.

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);

Form 4.3-5 Selection and Evaluation of Biotreatment BMP (DA 1&2)

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.* Pathogens, Nitrogen, Sediment, Oil & Grease, Trash/Debris, Pesticides/Herbicides	
2 Biotreatment BMP Selected *(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)*	Volume-based biotreatment *Use Forms 4.3-6 and 4.3-7 to compute treated volume*	Flow-based biotreatment *Use Form 4.3-8 to compute treated volume*
	☐ Bioretention with underdrain ☐ Planter box with underdrain ☐ Constructed wetlands ☐ Wet extended detention ☐ Dry extended detention	☐ Vegetated swale ☐ Vegetated filter strip ☐ Proprietary biotreatment
3 Volume biotreated in volume based biotreatment BMP (ft^3): 0 *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): 0 *Item 1 – Item 3*	**5** Remaining fraction of LID DCV for sizing flow based biotreatment BMP: 0% *Item 4 / Item 1*
6 Flow-based biotreatment BMP capacity provided (cfs): n/a *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: • 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: ☐ *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.*		

- Use Form 4.3-8 to compute sizing criteria for flow-based biotreatment BMP (e.g. bioswales)

Form 4.3-6 Volume Based Biotreatment (DA 1 & 2) – Bioretention and Planter Boxes with Underdrains

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

Form 4.3-7 Volume Based Biotreatment (DA 1 & 2) – Constructed Wetlands and Extended Detention

Biotreatment BMP Type *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.*	DA DMA BMP Type		DA DMA BMP Type *(Use additional forms for more BMPs)*	
	Forebay	Basin	Forebay	Basin
1 Pollutants addressed with BMP forebay and basin *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*				
2 Bottom width (ft)				
3 Bottom length (ft)				
4 Bottom area (ft^2) A_{bottom} = *Item 2 * Item 3*				
5 Side slope (ft/ft)				
6 Depth of storage (ft)				
7 Water surface area (ft^2) $A_{surface}$ =*(Item 2 + (2 * Item 5 * Item 6)) * (Item 3 + (2 * Item 5 * Item 6))*				
8 Storage volume (ft^3) *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* V =*Item 6 / 3 * [Item 4 + Item 7 + (Item 4 * Item 7)^0.5]*				
9 Drawdown Time (hrs) *Copy Item 6 from Form 2.1*				
10 Outflow rate (cfs) Q_{BMP} = *(Item* $8_{forebay}$ + *Item* 8_{basin}*) / (Item 9 * 3600)*				
11 Duration of design storm event (hrs)				
12 Biotreated Volume (ft^3) $V_{biotreated}$ = *(Item* $8_{forebay}$ + *Item* 8_{basin}*) +(Item 10 * Item 11 * 3600)*				
13 Total biotreated volume from constructed wetlands, extended dry detention, or extended wet detention : *(Sum of Item 12 for all BMP included in plan)*				

Form 4.3-8 Flow Based Biotreatment (DA 1)

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

Form 4.3-8 Flow Based Biotreatment (DA 2)

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

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): 12,214 *Copy Item 7 in Form 4.2-1*

2 On-site retention with site design hydrologic source control LID BMP (ft^3): 0 *Copy Item 30 in Form 4.3-2*

3 On-site retention with LID infiltration BMP (ft^3): 12,303 *Copy Item 16 in Form 4.3-3*

4 On-site retention with LID harvest and use BMP (ft^3): 0 *Copy Item 9 in Form 4.3-4*

5 On-site biotreatment with volume based biotreatment BMP (ft^3): 0 *Copy Item 3 in Form 4.3-5*

6 Flow capacity provided by flow based biotreatment BMP (cfs): 0.0 *Copy Item 6 in Form 4.3-5*

7 LID BMP performance criteria are achieved if answer to any of the following is "Yes":

- Full retention of LID DCV with site design HSC, infiltration, or harvest and use BMP: Yes ☒ No ☐
  If yes, sum of Items 2, 3, and 4 is greater than Item 1
- 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 ☒ No ☐
  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
- 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 ☒ No ☐
  If yes, Form 4.3-1 Items 7 and 8 were both checked yes

8 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:

- Combination of HSC, retention and infiltration, harvest and use, and biotreatment BMPs provide less than full LID DCV capture: ☐
  *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)%*
- 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: ☐
  Attach appropriate WAP section, including technical documentation, showing effectiveness comparisons for the project site and regional watershed

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 & 2)

1 Volume reduction needed for HCOC performance criteria (ft^3): n/a
*(Form 4.2-2 Item 4 * 0.95) – Form 4.2-2 Item 1*

2 On-site retention with site design hydrologic source control, infiltration, and harvest and use LID BMP (ft^3): *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*

3 Remaining volume for HCOC volume capture (ft^3): *Item 1 – Item 2*

4 Volume capture provided by incorporating additional on-site or off-site retention BMPs (ft^3): *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)*

5 If Item 4 is less than Item 3, incorporate in-stream controls on downstream waterbody segment to prevent impacts due to hydromodification *Attach in-stream control BMP selection and evaluation to this WQMP*

6 Is Form 4.2-2 Item 11 less than or equal to 5%: Yes No

If yes, HCOC performance criteria is achieved. If no, select one or more mitigation options below:

- Demonstrate increase in time of concentration achieved by proposed LID site design, LID BMP, and additional on-site or off-site retention BMP
  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)
- 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
- 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

7 Form 4.2-2 Item 12 less than or equal to 5%: Yes No

If yes, HCOC performance criteria is achieved. If no, select one or more mitigation options below:

- Demonstrate reduction in peak runoff achieved by proposed LID site design, LID BMPs, and additional on-site or off-site retention BMPs
  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)
- 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

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
Infiltration Trench	HOA	Inspect property, direct maintenance personnel as necessary to ensure compliance	Quarterly
Infiltration Trench	Owners	Inspect system, clean as needed	Monthly
N1: Education	HOA	Provide educational materials to new tenants and verify contract maintenance personnel are duly trained	Annually
N2: Activity Restrictions	HOA	Review CC&R's and inspect property to ensure compliance **Notice to homeowners:** removal or revision of BMPs described in this document and as constructed is prohibited. Maintenance is required and shall be conducted as described in this document.	Annually
N3: Landscape Maint.	HOA	Inspect property, direct maintenance personnel as necessary to ensure compliance	Quarterly
N4: BMP Maintenance	HOA	Inspect property, direct maintenance personnel and tenants as necessary to ensure compliance	Annually
N5: Title 22 CCR Compliance	HOA	Review ordinance and ensure compliance	Annually
N6: Local Water Quality Ordinance	HOA	Inspect property, direct maintenance personnel and tenants as necessary to ensure compliance	Annually
N11: Litter/Debris Control	HOA	Inspect property, direct maintenance personnel as necessary to ensure compliance	Quarterly
N15: Vacuum Sweeping	HOA	Inspect property, direct maintenance personnel as necessary to ensure compliance	Quarterly
N17: Other NPDES Permits	HOA	SWPPP/WDID will be terminated prior to occupancy	n/a
S3: Trash Enclosures	HOA	Inspect property, direct maintenance personnel as necessary to ensure compliance	Quarterly
S4: Efficient Irrigation	HOA	Inspect property, direct maintenance personnel as necessary to ensure compliance	Quarterly
S5: Landscaping 2" below hardscape	HOA	Inspect property, direct maintenance personnel as necessary to ensure compliance	Quarterly

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

- S.B. County Stormwater Facilities Map Tool – Site Map – Shows site in HCOC Exempt Area (shaded)
- USGS Web Soil Survey – Shows site soil capable of infiltration rates exceeding 5.1in/hr. Acceptable rates for infiltration BMPs.
- BMP Educational Materials
- Activity Restriction – C, C&R's & Lease Agreements

Attachment A

WQMP Site Plan

LID BMP B:
UNDERGROUND INFILTRATION
DCV=2374 CF
V-PROVIDED=2384 CF

LID BMP A:
UNDERGROUND PIPE INFILTRATION
DCV=9840 CF
V-PROVIDED=9919 CF

HYDRODYNAMIC SEPARATOR
PRE-TREATMENT

DMA A
3.78 AC
164,841 SF

DMA B
0.91 AC
39,778 SF

DA 1
4.70 AC
204,619 SF

BEL AIR AVE

MISSION BLVD.

SCALE: 1" = 50'

ENCOMPASS ASSOCIATES, INC.

LID BMP SITE PLAN
WATER QUALITY MANAGEMENT PLAN
TTM20267

Attachment B

BMP Factsheets/Educational Material

(will be provided in the Final WQMP)

Attachment C

WQMP Maintenance Agreement

(will be provided in the Final WQMP)

Attachment D

Supporting Documentation

WQMP Project Report

County of San Bernardino Stormwater Program

Santa Ana River Watershed Geodatabase

Friday, February 15, 2019

Note: The information provided in this report and on the Stormwater Geodatabase for the County of San Bernardino Stormwater Program is intended to provide basic guidance in the preparation of the applicant's Water Quality Management Plan (WQMP) and should not be relied upon without independent verification.

Project Site Parcel Number(s):	101135102
Project Site Acreage:	4.696
HCOC Exempt Area:	Yes. Verify that the project is completely with the HCOC exemption area.
Closest Receiving Waters: (Applicant to verify based on local drainage facilities and topography.)	**System Number** - 112 **Facility Name** - West State Street Storm Drain **Owner** - SBCFCD
Closest channel segment's susceptibility to Hydromodification:	EHM
Highest downstream hydromodification susceptibility:	High
Is this drainage segment subject to TMDLs?	No
Are there downstream drainage segments subject to TMDLs?	Yes
Is this drainage segment a 303d listed stream?	No
Are there 303d listed streams downstream?	Yes
Are there unlined downstream waterbodies?	Yes
Project Site Onsite Soil Group(s):	A
Environmentally Sensitive Areas within 200':	None
Groundwater Depth (FT):	-311
Parcels with potential septic tanks within 1000':	No
Known Groundwater Contamination Plumes within 1000':	No
Studies and Reports Related to Project Site:	Chino Basin Recharge Master Plan Chino Basin Water Master 32nd Annual Report Master Plan of Storm Drain Facilities CSDP Project No. 1 CSDP 1 Comprehensive Storm Drain CSDP Drainage Study Calculations City of Montclair MPD West San Bernardino SD Master Plan (Proof) Chino Creek Master Plan Chino & San Antonio Creek Summary Hydrology Zone 1, San Antonio and Chino San Antonio and Chino Creeks Channel

NOAA Atlas 14, Volume 6, Version 2
Location name: Ontario, California, USA*
Latitude: 34.0548°, Longitude: -117.6835°
Elevation: 938.64 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.119** (0.100-0.145)	**0.157** (0.131-0.190)	**0.207** (0.172-0.251)	**0.248** (0.204-0.304)	**0.304** (0.242-0.386)	**0.348** (0.271-0.451)	**0.393** (0.298-0.523)	**0.440** (0.324-0.603)	**0.505** (0.356-0.722)	**0.556** (0.379-0.825)
10-min	**0.171** (0.143-0.207)	**0.225** (0.188-0.273)	**0.297** (0.246-0.360)	**0.355** (0.293-0.435)	**0.436** (0.347-0.553)	**0.498** (0.388-0.647)	**0.563** (0.427-0.749)	**0.630** (0.465-0.864)	**0.723** (0.511-1.03)	**0.797** (0.543-1.18)
15-min	**0.207** (0.173-0.251)	**0.272** (0.227-0.330)	**0.359** (0.298-0.436)	**0.429** (0.354-0.526)	**0.527** (0.419-0.669)	**0.603** (0.469-0.782)	**0.681** (0.517-0.906)	**0.762** (0.562-1.05)	**0.875** (0.617-1.25)	**0.964** (0.656-1.43)
30-min	**0.307** (0.256-0.372)	**0.404** (0.337-0.490)	**0.532** (0.442-0.646)	**0.637** (0.525-0.781)	**0.781** (0.622-0.992)	**0.894** (0.696-1.16)	**1.01** (0.766-1.34)	**1.13** (0.833-1.55)	**1.30** (0.916-1.86)	**1.43** (0.973-2.12)
60-min	**0.458** (0.382-0.554)	**0.602** (0.502-0.730)	**0.793** (0.659-0.964)	**0.950** (0.782-1.16)	**1.17** (0.927-1.48)	**1.33** (1.04-1.73)	**1.51** (1.14-2.00)	**1.69** (1.24-2.31)	**1.93** (1.37-2.77)	**2.13** (1.45-3.16)
2-hr	**0.689** (0.575-0.834)	**0.902** (0.751-1.09)	**1.18** (0.978-1.43)	**1.40** (1.15-1.72)	**1.70** (1.35-2.16)	**1.93** (1.50-2.50)	**2.16** (1.64-2.88)	**2.40** (1.77-3.29)	**2.73** (1.92-3.90)	**2.98** (2.03-4.42)
3-hr	**0.872** (0.728-1.06)	**1.14** (0.948-1.38)	**1.48** (1.23-1.80)	**1.75** (1.44-2.15)	**2.12** (1.69-2.69)	**2.40** (1.87-3.12)	**2.69** (2.04-3.57)	**2.98** (2.19-4.08)	**3.37** (2.38-4.82)	**3.67** (2.50-5.45)
6-hr	**1.23** (1.03-1.49)	**1.60** (1.33-1.94)	**2.07** (1.72-2.52)	**2.45** (2.02-3.01)	**2.96** (2.36-3.76)	**3.35** (2.61-4.34)	**3.74** (2.84-4.97)	**4.13** (3.05-5.67)	**4.67** (3.29-6.68)	**5.08** (3.46-7.54)
12-hr	**1.62** (1.35-1.96)	**2.11** (1.76-2.56)	**2.75** (2.28-3.34)	**3.26** (2.69-4.00)	**3.95** (3.15-5.02)	**4.48** (3.49-5.81)	**5.01** (3.81-6.68)	**5.56** (4.10-7.62)	**6.30** (4.45-9.02)	**6.87** (4.68-10.2)
24-hr	**2.16** (1.91-2.49)	**2.84** (2.51-3.28)	**3.74** (3.29-4.32)	**4.47** (3.91-5.21)	**5.47** (4.63-6.59)	**6.24** (5.17-7.67)	**7.02** (5.69-8.85)	**7.84** (6.17-10.2)	**8.95** (6.77-12.1)	**9.82** (7.18-13.7)
2-day	**2.64** (2.34-3.04)	**3.54** (3.13-4.09)	**4.74** (4.18-5.49)	**5.74** (5.02-6.69)	**7.11** (6.02-8.57)	**8.19** (6.80-10.1)	**9.31** (7.54-11.7)	**10.5** (8.26-13.6)	**12.1** (9.16-16.3)	**13.4** (9.80-18.7)
3-day	**2.87** (2.54-3.30)	**3.89** (3.44-4.49)	**5.28** (4.65-6.11)	**6.43** (5.62-7.50)	**8.04** (6.81-9.69)	**9.31** (7.72-11.5)	**10.6** (8.61-13.4)	**12.0** (9.48-15.6)	**14.0** (10.6-18.9)	**15.5** (11.4-21.7)
4-day	**3.09** (2.74-3.57)	**4.24** (3.75-4.89)	**5.78** (5.10-6.69)	**7.07** (6.18-8.24)	**8.87** (7.51-10.7)	**10.3** (8.53-12.7)	**11.8** (9.53-14.8)	**13.3** (10.5-17.3)	**15.5** (11.7-21.0)	**17.3** (12.6-24.1)
7-day	**3.54** (3.13-4.08)	**4.89** (4.33-5.65)	**6.71** (5.92-7.77)	**8.23** (7.20-9.60)	**10.3** (8.76-12.5)	**12.0** (9.96-14.8)	**13.7** (11.1-17.3)	**15.6** (12.3-20.1)	**18.1** (13.7-24.4)	**20.1** (14.7-28.1)
10-day	**3.84** (3.40-4.43)	**5.34** (4.72-6.17)	**7.36** (6.49-8.51)	**9.03** (7.90-10.5)	**11.4** (9.62-13.7)	**13.2** (10.9-16.2)	**15.1** (12.2-19.0)	**17.1** (13.5-22.1)	**19.9** (15.0-26.8)	**22.1** (16.2-30.8)
20-day	**4.62** (4.09-5.32)	**6.49** (5.73-7.49)	**9.01** (7.94-10.4)	**11.1** (9.72-13.0)	**14.1** (11.9-17.0)	**16.4** (13.6-20.2)	**18.8** (15.3-23.7)	**21.4** (16.9-27.7)	**25.0** (18.9-33.7)	**27.9** (20.4-38.9)
30-day	**5.45** (4.83-6.29)	**7.66** (6.77-8.84)	**10.7** (9.40-12.3)	**13.2** (11.5-15.4)	**16.8** (14.2-20.2)	**19.6** (16.3-24.1)	**22.6** (18.3-28.5)	**25.8** (20.3-33.4)	**30.3** (22.9-40.8)	**33.9** (24.8-47.3)
45-day	**6.52** (5.77-7.52)	**9.08** (8.03-10.5)	**12.6** (11.1-14.6)	**15.6** (13.7-18.2)	**19.9** (16.9-24.0)	**23.4** (19.4-28.8)	**27.1** (22.0-34.2)	**31.1** (24.5-40.3)	**36.8** (27.8-49.6)	**41.4** (30.2-57.7)
60-day	**7.57** (6.70-8.73)	**10.4** (9.21-12.0)	**14.4** (12.7-16.7)	**17.8** (15.6-20.8)	**22.8** (19.3-27.5)	**26.8** (22.3-33.0)	**31.2** (25.3-39.3)	**35.9** (28.3-46.5)	**42.7** (32.3-57.6)	**48.3** (35.3-67.4)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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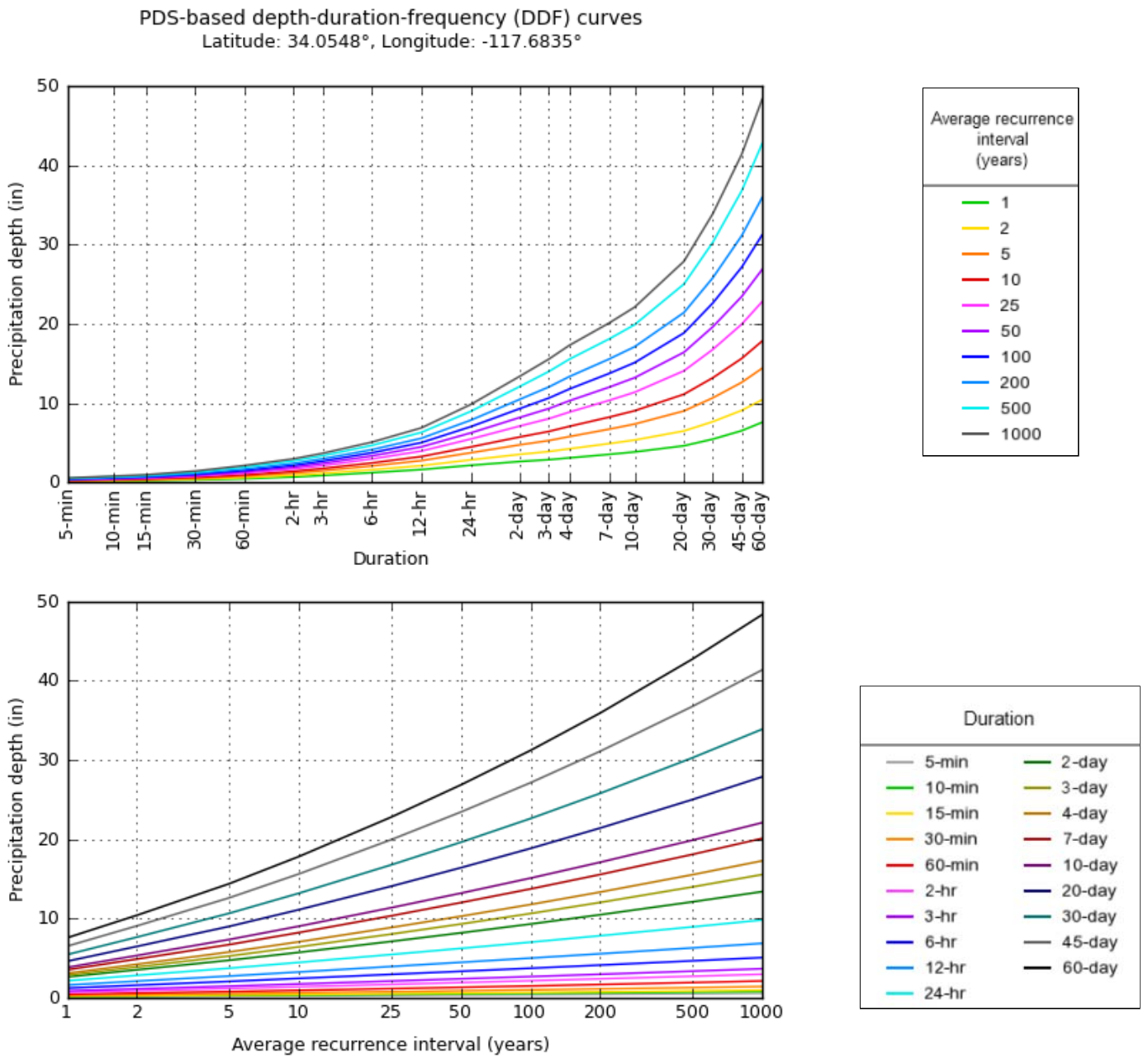
PF graphical



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Created (GMT): Fri Feb 15 18:39:51 2019

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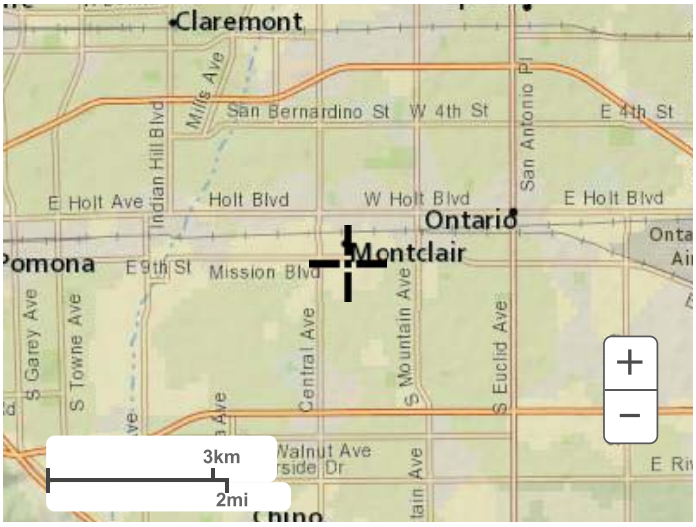
Maps & aerials

Small scale terrain



Large scale terrain

Large scale map

Large scale aerial

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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

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GEOTECHNICAL • ENVIRONMENTAL • MATERIALS TESTING • SWPPP

February 20, 2019 Project No. G19-1691-20

Mr. Patrick Diaz
Crestwood Corporation
510 Citrus Edge Street
Glendora, California 91741

Subject: ***Preliminary Infiltration Testing Investigation for Onsite Storm Water Infiltration Devices for the Proposed 42 Lot Residential Project, 5553 Mission Boulevard, Montclair Area, County of San Bernardino, California.***

Reference: *Crestwood Communities, Conceptual Site Plan, 5553 Mission Blvd., San Bernardino County, California, Scale:1" =40", Dated October 3, 2018.*

1.0 INTRODUCTION

LGC Geo-Environmental, Inc. (LGC) is pleased to present this preliminary infiltration testing investigation for the proposed onsite storm water infiltration devices relative to the storm water Best Management Practice (BMP) for the proposed 42 lot residential project, located at 5553 Mission Boulevard, Montclair Area, San Bernardino County, California. The purpose of our study was to determine the vertical infiltration rates and physical characteristics of the subsurface soils in selected areas of proposed onsite storm water infiltration BMP devices within specific portions of the subject property.

2.0 PROPERTY LOCATIONS AND DESCRIPTION

The subject site proposed to be developed is located on the south side of Mission Boulevard and west of Vernon Avenue in the Montclair area of County of San Bernardino, California. The site is currently bounded on the north by Mission Boulevard, on the west by existing single-family residential development and a car wash facility, on the south by existing single-family residential development on the east by a mobile home park and a vacant land. The general location and configuration of the site are shown on the Site Location Map (Figure 1).

The topography of the site is relatively level. Elevations range from approximately 939 feet above mean sea level (msl) in the northern portion of the site to approximately 931 feet msl in the southern portion of the site.

3.0 PROPOSED CONSTRUCTION

Based on the referenced conceptual site plan and information provided, as well as conversations with the project civil engineer, approximately 2 locations on the site are being considered for proposed storm water infiltration devices, possibly up about 4 feet to 5 feet deep.

4.0 SUBSURFACE EXPLORATION AND INFILTRATION TESTING

4.1 Subsurface Exploration

Subsurface exploration of the subject site consisted of excavating four (4) infiltration test trench locations, numbered IT-1 through IT-4, utilizing a backhoe, on January 29, 2019 within the proposed onsite storm water infiltration BMP location, at depths of approximately five (5) feet below existing grade. In addition, initial subsurface exploration at the subject site consisted of drilling four (4) exploratory borings (B-1 thru B-4) utilizing an 8-inch diameter hollow-stem auger drill rig on November 26, 2018, as part of an in progress geotechnical/geologic investigation for the site. Boring B-4 was drilled within close proximity of the proposed onsite storm water infiltration system location area to an approximate depth of 26.5 feet below existing grade. This boring was used to document subsurface material and depth to groundwater.

Earth materials encountered within the locations were classified in general accordance with the visual manual procedures of the Unified Soil Classification System (USCS). Logs of the infiltration test trenches are presented in Appendix A, and their approximate locations are depicted on the Infiltration Test Trench Location Map (Plate 1).

Prior to the subsurface exploration work, an underground utilities clearance was obtained from Underground Service Alert of Southern California. At the conclusion of the subsurface exploration, all the test trenches were backfilled with existing materials with some compactive effort. Minor settlement of the backfill soils may occur over time.

4.2 Infiltration Testing

On January 29, 2019 four (4) shallow percolation method infiltration test trenches, numbered IT-1, IT-2, IT-3, and IT-4, were excavated. Infiltration tests holes were prepared within these trenches by digging 8-inch diameter by 14-inch deep holes and placing approximately two inches of ¾-inch gravel and a 12-inch long plastic liner with perforations along the bottom. At least eight (8) inches of clean water was filled within each of the test plastic liners. From a fixed test point, the drop-in water level, in inches, was measured and recorded at consistent intervals over a period of at least six (6) readings or until the rate for two consecutive readings was within a five percent variation. The field percolation rates were reduced per the Porchet Method utilizing reduction factors of the actual field test rates. This testing methodology, utilizing reduction factor of 2.25 to 2.70, was applied to the field test rates. The results of percolation method infiltration tests are presented in the following table in section 5.3. The infiltration test data sheets are presented in Appendix A.

5.0 FINDINGS

5.1 Earth Materials

Based on our review of the data from the in progress geotechnical/geologic investigation and current exploration of the earth materials underlying the proposed onsite storm water infiltration BMP area, the materials encountered to the depths explored include topsoil and alluvial fan deposits. A description of the earth material soils encountered is described below:

Topsoil: The topsoil is comprised of silty sand and clayey sand, which is very fine to medium-grained, brown, damp to moist, loose to medium dense, with occasional coarse grains and gravel and some roots and rootlets. The topsoil, where observed in the exploratory trenches, are approximately 0.5 foot to 2.0 feet thick.

Alluvial Fan Deposits (Qf): Holocene age alluvial fan deposits were encountered below the topsoil and are comprised of poorly graded sand, with some silt, which are fine to coarse grained, reddish brown, yellowish brown and orange brown, dry to damp, medium dense to dense, with some gravel and cobbles. The alluvial fan deposits where observed in the exploratory trench, to be loose to medium dense locally in the upper 2.5 feet to and 3.5 feet. Based on previous exploration these materials are approximately 13.0 feet to 14.5 feet thick.

Older Alluvial Fan Deposits: Pleistocene age older alluvial fan deposits was present below the alluvial fan deposits, at depth of about 15.0 feet. These materials were alternating layers of silty sand, clayey silt and silty clay, which are generally very fine to medium grained, various shades of olive, grey and brown, damp to very moist, medium dense to

dense and firm to stiff, with some pinhole pores and caliche.

5.2 Groundwater

Groundwater was not encountered during the infiltration testing and previous exploratory drilling to depths of up to 26.5 feet. A review of the Chino Basin Watermaster "Depth to Groundwater Contour Map, Summer 2016"and California Department of Water Resources, Water Data Library 2017 online database (Well ID: Station 340615N1176887W001), indicates groundwater in the general site area is about 300 feet to 360 feet below the existing ground surface

California Department of Water Resources, Water Data Library 2017 online database indicates groundwater in the general site area is about 360 feet below the existing ground surface (Well ID: Station 340615N1176887W001).

5.3 Infiltration Testing Results

The shallow infiltration testing rates for design considerations for each of proposed drainage device areas which were tested are presented in the table below.

Infiltration Design Rates

TEST NO.	TEST DEPTH (Feet)	INFILTRATION RATES		SOIL DESCRIPTION (USCS)
		FIELD PERCOLATION RATE (INCHES/HOUR)	DESIGN INFILTRATION RATE (INCHES/HOUR)	
IT-1	5.0	60.00	26.67	SP
IT-2	4.5	60.00	26.67	SP
IT-3	5.0	60.00	26.67	SP
IT-4	5.0	38.21	14.15	SP/SM

6.0 CONCLUSIONS AND RECOMMENDATIONS

Shallow infiltration testing for the proposed drainage devices indicated design rates of approximately 26.67, 26.67, 38.1 0, and 14.15 inches/hour, after applying a reduction factor of 2.25 or 2.70, per the Porchet Method, at depths of approximately 4.5 feet to 5.0 feet below the existing ground surface as presented in the above infiltration design rate table, Section 5.3. Composite average design rates representing the infiltration devices proposed to be installed on LOTS 1 and 2 should be utilized for the proposed infiltration device location, as indicated on Infiltration Test Trench Location Map (Plate 1). The composite average design rate for **Lot 1 is 26.67 inches/hour** represented by testing from infiltration test trenches IT-1 and IT-2 and the composite average design rate for **Lot 2 is 20.41 inches/hour** represented by testing from infiltration test trenches IT-3 and IT-4.

The proposed infiltration devices should be placed at least five (5) feet horizontally away from or beyond a 1:1 (horizontal to vertical) projection from the base of any proposed or existing structures or walls, whichever is greater. The project geologist or engineer should observe infiltration device excavations during trenching to verify the anticipated soil units and geotechnical conditions. Since the proposed infiltration devices may be within and/or adjacent to proposed roadways, parking areas and/or sidewalks (within 5 feet) and may be up to approximately five (5) feet deep, any gravel backfill should be densified or any soil backfill should be compacted to at least 90% of the maximum dry density during placement. The project geologist or engineer should observe infiltration device excavations during trenching to verify the anticipated soil units and geotechnical conditions as well as observe, probe and/or test any densification or compaction of the infiltration trench and pit gravel and/or soil backfill.

Furthermore, based on the data presented from the California Department of Water Resources, Water Data Library well data, groundwater should be approximately 300 feet to 360 feet below the existing ground surface and should not be present within the current allowable limit of within 10 feet of the bottom of testing and/or drainage devices as set forth by the County of San Bernardino and California State requirements.

7.0 PLAN REVIEWS AND CONSTRUCTION SERVICES

This report was prepared for the exclusive use of ***Crestwood Corporation*** to assist the project civil engineer in the design of the proposed infiltration systems for the proposed development. It is recommended that LGC be engaged to review infiltration device plans, grading plans, foundation plans and the final infiltration design drawings and specifications prior to construction. This is to document that the recommendations contained in this report were properly interpreted and incorporated into the project plans and specifications from a geotechnical standpoint. Plans should be forwarded to the project geotechnical engineer and/or engineering geologist for LGC for review and comments, as deemed necessary. LGC's review of infiltration device plans, grading plans, foundation plans and the final infiltration design drawings and specifications may indicate that additional subsurface exploration, laboratory testing and analysis should be performed to address areas of concern. If LGC is not accorded the opportunity to review these documents, we cannot take responsibility for misinterpretation of our recommendations.

If the project plans change significantly (e.g., location and type of infiltration devices), LGC should be retained to review our original design recommendations and applicability to the revised construction. If conditions are encountered during construction that appears to be different from those indicated in this report, this office should be notified immediately. Design and construction revisions may be required.

The preliminary conclusions and recommendations provided in this report are based on review of previous geotechnical reports, infiltration testing, geologic field mapping, and geotechnical/geologic analyses to date. A representative of LGC should observe the interpolated subsurface conditions in the field during construction

We recommend that LGC be retained to provide geotechnical engineering services during future grading, infiltration device excavations, installation of infiltration materials, backfill of infiltration devices, or when an unusual soil condition is encountered at the site. This is to document compliance with the design, specifications or recommendations and to allow design changes in the event that subsurface conditions differ from those anticipated prior to start of construction.

8.0 INVESTIGATION LIMITATIONS

This report is based upon information provided by the client and the project civil engineer, a limited number of subsurface excavations, field observations and percolation/infiltration tests to which we applied various methods of analysis and interpretation. The materials encountered and tested in the field on the project site are believed representative of the project area, and the conclusions and recommendations contained herein are presented on that basis. However, soil materials can vary in characteristics between points of exploration, both laterally and vertically, and those variations could affect the conclusions, recommendations, and performance of the proposed storm water infiltration device BMP systems. Fluctuations in the level of groundwater may occur due to variations in rainfall, irrigation, and the other factors not in evidence at the time measurements were made. If this occurs, the changed conditions must be evaluated by the project geotechnical engineer and engineering geologist and design(s) adjusted as required or alternate design(s) recommended.

This report is issued with the understanding that it is the responsibility of the owner, or of his/her representative, to ensure that the information and recommendations contained herein are brought to the attention of the project engineer and incorporated into the plans, and the necessary steps are taken to see that the contractor and/or subcontractor properly implements the recommendations in the field.

The conclusions and opinions contained in this report are based on the results of the described geotechnical evaluations and represent our professional judgment. The findings, conclusions and recommendations contained in this report are to be considered tentative only and subject to confirmation by the undersigned during the construction process. Without this confirmation, this report is to be considered incomplete and LGC or the undersigned professionals assume no responsibility for its use.

The conclusions and opinions contained in this report are valid up to a period of 2 years from the date of this report. Changes in the conditions of a property can and do occur with the passage of time, whether they be because of natural processes or the works of man on this or adjacent properties. In addition, changes in applicable or appropriate codes or standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, if any of the above-mentioned situations occur, an update of this report should be completed.

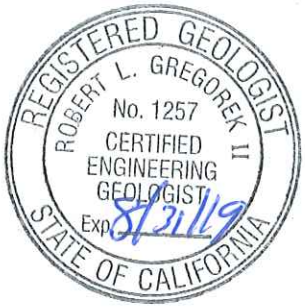
This report has not been prepared for use by parties or projects other than those named or designed above. It may not contain sufficient information for other parties or other purposes.

The opportunity to be of service is appreciated. Should you have any questions regarding the content of this report, or should you require additional information, please do not hesitate to contact this office at your earliest convenience.
Our services were performed using the degree of care and skill ordinarily exercised, under similar circumstances, by engineers and geologists practicing in this or other localities. The contents of this report are professional opinions and as such, are not to be considered a guarantee or warranty.

The opportunity to be of service is appreciated. Should you have any questions regarding the content of this report, or should you require additional information, please do not hesitate to contact this office at your earliest convenience.

Respectfully submitted,

LGC Geo-Environmental, Inc.



Robert L. Gregorek II
Certified Engineering Geologist

RGG/RLG

Distribution: (4) Addressee

Attachments: Site Location Map – Figure 1 *(Rear of Text)*
Appendix A – Infiltration Test Trench Logs and Exploratory Boring Log *(Rear of Text)*
Appendix B – Infiltration Test Results *(Rear of Text)*
Plate 1 – Infiltration Test Trench Location Map *(Pocket Enclosure)*

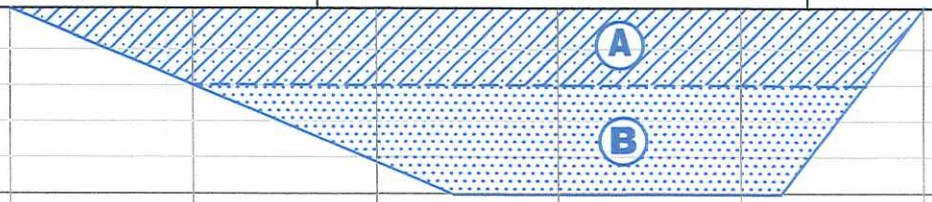
APPENDIX A

INFILTRATION TEST TRENCH LOGS AND EXPLORATORY BORING LOG

Project Name: CrestWood Corporation	Logged by: RS	LOG OF TEST TRENCH IT-1
Project Number: G18-1691-20	Elevation:	Engineering Properties
Equipment: BACKHOE	Location/Grid: SEE PLATE 1	

Depth (ft)	Date: 1/29/2019	Description:	Geologic Unit	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
0.0'-2.0'	A	TOPSOIL: Clayey SAND; brown, damp to moist, loose to medium dense, very fine- to medium-grained, roots and rootlets, occasional coarse grains and gravel		SC			
2.0'-5.0'	B	ALLUVIAL FAN DEPOSITS: Poorly Graded SAND; yellowish brown, damp, medium dense, fine- to coarse-grained, with gravel and occasional cobbles	Qfc	SP			
		Total Depth 5.0 Feet					

GRAPHICAL REPRESENTATION: East Wall	SCALE: 1" = 5'	SURFACE SLOPE:	TREND: N10W

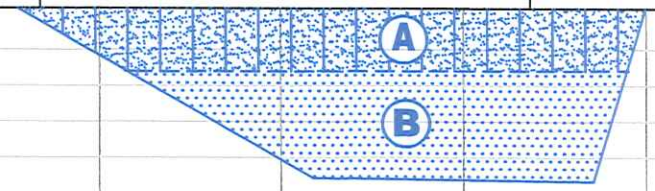


TOTAL DEPTH = 5.0 FEET
NO GROUNDWATER ENCOUNTERED

Project Name: CrestWood Corporation	Logged by: RS	LOG OF TEST TRENCH IT-2
Project Number: G18-1691-20	Elevation:	Engineering Properties
Equipment: BACKHOE	Location/Grid: SEE PLATE 1	

Depth (ft)	Date: 1/29/2019 Description:	Geologic Unit	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
0.0'-1.5'	A TOPSOIL: Silty SAND; brown, damp to moist, loose to medium dense, fine-grained, trace clay with some gravel		SM			
1.5'-4.5'	B ALLUVIAL FAN DEPOSITS: Poorly Graded SAND; yellowish brown, damp, medium dense, fine- to coarse-grained with gravel and cobbles, miceaceous	Qfc	SP			
	Total Depth 4.5 Feet					

GRAPHICAL REPRESENTATION: East Wall	SCALE: 1" = 5'	SURFACE SLOPE:	TREND: N15W

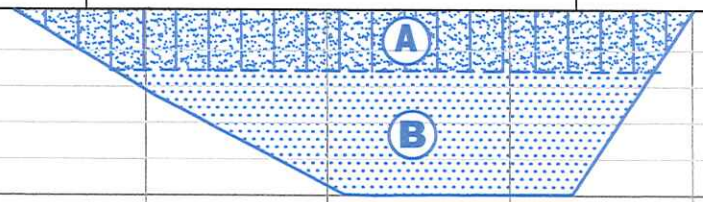


TOTAL DEPTH = 4.5 FEET
NO GROUNDWATER ENCOUNTERED

Project Name: CrestWood Corporation	Logged by: RS	LOG OF TEST TRENCH IT-3
Project Number: G18-1691-20	Elevation:	Engineering Properties
Equipment: Backhoe	Location/Grid: SEE PLATE 1	

Depth (ft)	Date: 1/29/2019 Description:	Geologic Unit	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
0.0'-1.5'	A TOPSOIL: Silty SAND; brown, moist, loose, very fine- to fine-grained, trace amounts of clay, roots and rootlets		SM			
1.5'-4.0'	B ALLUVIAL FAN DEPOSTIS: Poorly graded SAND; reddish brown, damp, loose to medium dense, fine-grained with some gravel, rootlets @ 4.5'; yellowish brown, damp, medium dense to dense, fine to medium-grained with some gravel and cobbles, micaceous	Qfc	SP			
	Total Depth 5.0 Feet					

GRAPHICAL REPRESENTATION: East Wall	SCALE: 1" = 5'	SURFACE SLOPE:	TREND: N5W

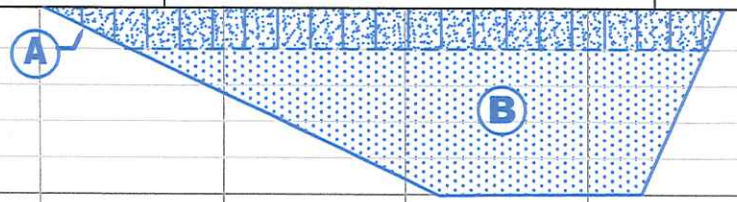


TOTAL DEPTH = 5.0 FEET
NO GROUNDWATER ENCOUNTERED

Project Name: CrestWood Corporation	Logged by: RS	LOG OF TEST TRENCH IT-4
Project Number: G18-1691-20	Elevation:	Engineering Properties
Equipment: Backhoe	Location/Grid: SEE PLATE 1	

Depth (ft)	Date: 1/29/2019 — Description:	Geologic Unit	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
0.0'-1.0'	A TOPSOIL: Silty SAND; brown, moist, loose, very fine- to fine-grained, trace clay, roots		SM			
1.0'-4.5'	B ALLUVIAL FAN DEPOSITS: Poorly graded SAND; reddish brown, damp, loose to medium dense, fine-grained, occasional gravel, rootlets @4.5'; some silt, yellowish brown, damp, medium dense to dense, fine- to medium-grained with gravels and cobbles, micaceous	Qfc	SP			
	Total Depth 5.0 Feet					

GRAPHICAL REPRESENTATION: East Wall	SCALE: 1" = 5'	SURFACE SLOPE:	TREND: N18W



TOTAL DEPTH = 5.0 FEET
NO GROUNDWATER ENCOUNTERED

Geotechnical Boring Log B-4

Date: 11-26-18	**Project Name:** Crestwood	Page 1 of 1
Project Number: G18-1691-10	**Logged By:** RS	
Drilling Company: 2R	**Type of Rig:** CME-55	
Drive Weight (lbs.): 140	**Drop (in.):** 30 **Hole Dia. (in.):** 8	
Top of Hole Elevation (ft):	**Hole Location:** See Geotechnical Map	

Elevation (MSL) and Depth (ft.)	Blow Count / 6"	Sample No.	Soil Graphic	Geologic / Group Symbol	DESCRIPTION	In-Situ Moist.(%)	Dry Density (pcf)	Standard Penetration Test SPT Depth	SPT N	CURVE 10 30 50	Type of Test
0				SP	**Topsoil**						
	6 13 21	R1		Qf SM	Poorly Graded SAND; dark brown, dry, loose, fine to medium grained, trace gravels, roots.	1.5	122.1	1.0-2.5	23		Bulk @ 2'-4'
					Alluvial Fan Deposits Silty SAND; orange brown, dry to damp, dense, fine to coar se grained, with gravels and cobbles, friable						
	7 14 20	R2		SP	Poorly Graded SAND; orange brown, dry, dense, medium to coarse grained, coarse gravel, some cobbles, friable	1.5	125.8	4.0-5.5	23		
5	17 23 42	R3		SP	@ 7'; dark orange brown, very dense	1.9	118.9	7.0-8.5	44		
10	8 15 20	R4		SP-SM	Poorly Graded SAND/Silty SAND; orange brown, damp, dense, fine to medium grained	4.5	117.1	10.0-11.5	24		
15	3 4 5	S1		Qof ML	**Older Alluvial Fan Deposits** Clayey SILT; olive brown, moist to very moist, firm, very fine grained	18.5		15.0-16.5	9		
20	7 13 17	R5		SM	Silty SAND; greyish brown, damp to moist, medium dense to dense, fine to medium grained, pinhole pores	6.5	102.7	20.0-21.5	20		
25	3 7 5	S2		CL	Silty CLAY; olive brown, moist to very moist, stiff, very fine grained, caliche stringers	18.3		25.0-26.5	12		
30					Total Depth: 26.5' No Groundwater						

Sample Legend

- SPT
- Ring Sample (CA modified)

Geotechnical Consulting

LGC

Project:	5553 Mission Blvd.	Job No.:	G18-1691-20		
Test Hole No.:	IT-1	Date Excavated:	1/29/2019		
Depth of Test Hole:	14" / Trench Depth: 5.0'	Soil Classification:	SP		
Check for Sandy Soil Criteria By:	JW	Date of Perc Test:	1/29/2019	Diameter:	8 inches

SANDY SOIL CRITERIA TEST

TIME	Time Interval (minutes)	Initial Water Level (feet)	Final Water Level (feet)	Change In Water Level (feet)

PRESOAK PERIOD

	Date	Time	Interval	Amount of Water Used
Start	1/29/2019	8:50 AM	8 minutes	5 gallons
Stop	1/29/2019	8:58 AM		

TEST PERIOD

Time	Time Interval (min.)	Total Elasped Time (min.)	Initial Water Depth (inches)	Final Water Depth (inches)	Change In Water Level (Inches)	Field Percolation Rate (minutes/inch)
9:12:00 AM 9:22:00 AM	10	10	10	0	10.00	1.00
9:23:00 AM 9:33:00 AM	10	21	10	0	10.00	1.00
9:34:00 AM 9:38:00 AM	4	26	10	0	10.00	0.40
9:39:00 AM 9:43:00 AM	4	31	10	0	10.00	0.40
9:44:00 AM 9:48:00 AM	4	36	10	0	10.00	0.40
9:49:00 AM 9:53:00 AM	4	41	10	0	10.00	0.40

Reduction Factor:	2.25
Design Infiltration Rate (in/hr):	26.67

LGC GEO-ENVIRONMENTAL, INC.

Project:	5553 Mission Blvd.	Job No.:	G18-1691-20		
Test Hole No.:	IT-2	Date Excavated:	1/29/2019		
Depth of Test Hole:	14" / Trench Depth: 4.5'	Soil Classification:	SP		
Check for Sandy Soil Criteria By:	JW	Date of Perc Test:	1/29/2019	Diameter:	8 inches

SANDY SOIL CRITERIA TEST

TIME	Time Interval (minutes)	Initial Water Level (feet)	Final Water Level (feet)	Change In Water Level (feet)

PRESOAK PERIOD

	Date	Time	Interval	Amount of Water Used
Start	1/29/2019	9:00 AM	14 minutes	5 gallons
Stop	1/29/2019	9:14 AM		

TEST PERIOD

Time	Time Interval (min.)	Total Elasped Time (min.)	Initial Water Depth (inches)	Final Water Depth (inches)	Change In Water Level (Inches)	Field Percolation Rate (minutes/inch)
9:14:00 AM	10	10	10	0	10.00	1.00
9:24:00 AM						
9:25:00 AM	10	21	10	0	10.00	1.00
9:35:00 AM						
9:36:00 AM	10	32	10	0	10.00	1.00
9:46:00 AM						
9:47:00 AM	10	43	10	0	10.00	1.00
9:57:00 AM						
9:58:00 AM	10	54	10	0	10.00	1.00
10:08:00 AM						
10:09:00 AM	10	65	10	0	10.00	1.00
10:19:00 AM						
					Reduction Factor:	2.25
					Design Infiltration Rate (in/hr):	26.67

LGC GEO-ENVIRONMENTAL, INC.

Project:	5553 Mission Blvd.	Job No.:	G18-1691-20		
Test Hole No.:	IT-4	Date Excavated:	1/29/2019		
Depth of Test Hole:	14" / Trench Depth: 5.0'	Soil Classification:	SP/SM		
Check for Sandy Soil Criteria By:	JW	Date of Perc Test:	1/29/2019	Diameter:	8 inches

SANDY SOIL CRITERIA TEST

TIME	Time Interval (minutes)	Initial Water Level (feet)	Final Water Level (feet)	Change In Water Level (feet)

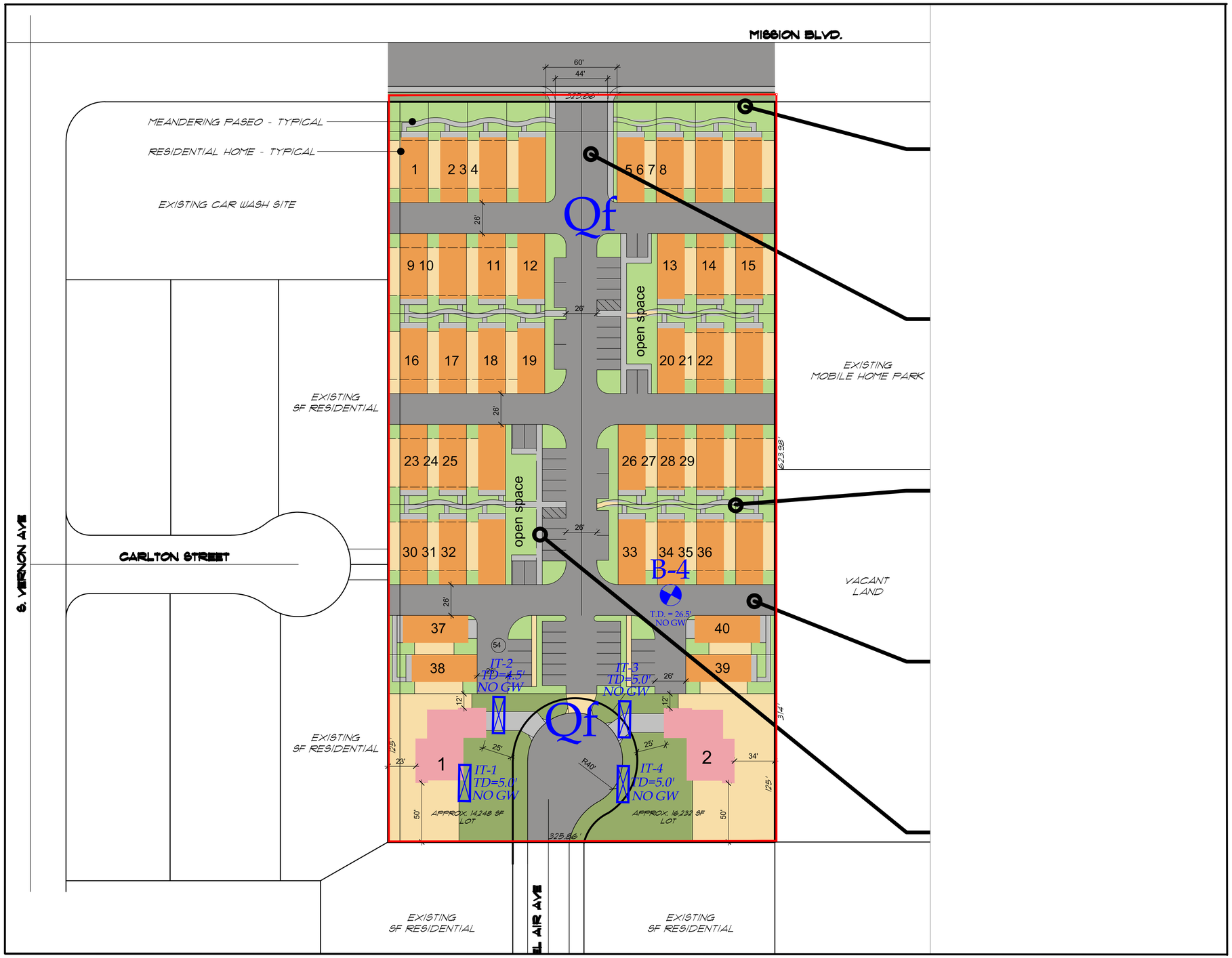
PRESOAK PERIOD

	Date	Time	Interval	Amount of Water Used
Start	1/29/2019	9:31 AM	39 minutes	5 gallons
Stop	1/29/2019	10:10 AM		

TEST PERIOD

Time	Time Interval (min.)	Total Elasped Time (min.)	Initial Water Depth (inches)	Final Water Depth (inches)	Change In Water Level (Inches)	Field Percolation Rate (minutes/inch)
10:16:00 AM 10:26:00 AM	10	10	10	3 3/8	6 5/8	1.51
10:27:00 AM 10:37:00 AM	10	21	10	3 1/2	6 1/2	1.54
10:38:00 AM 10:48:00 AM	10	32	10	3 1/2	6 1/2	1.54
10:49:00 AM 10:59:00 AM	10	43	10	3 1/2	6 1/2	1.54
11:00:00 AM 11:10:00 AM	10	54	10	3 5/8	6 3/8	1.57
11:11:00 AM 11:21:00 AM	10	65	10	3 5/8	6 3/8	1.57
					Reduction Factor:	2.70
					Design Infiltration Rate (in/hr):	14.15

LGC GEO-ENVIRONMENTAL, INC.



LEGEND
(Locations are Approximate)

Symbols

- Limits of This Report

Qf - Alluvial Fan Deposits

B-4
T.D. = 26.5'
NO GW
Exploratory Boring

IT-4
TD=5.0'
NO GW
- Infiltration Trench Location

N

0 30' 60'

LOGICAL GEOTECHNICAL CONSULTANTS
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS TESTING • SWPPP
27570 COMMERCE CENTER DR., #128, TEMECULA, CA 92590
PHONE: 951.297.2450 FAX: 951.719.2998
WWW.LGCGEOENV.COM

Robert L. Gregorek, II
Engineering Geologist

INFILTRATION TEST TRENCH LOCATION MAP

5553 Mission Boulevard
Montclair Area, County of San Bernardino, California

Name:	CrestWood Corporation
Project No.	G18-1691-20
Client:	Mr. Patrick Diaz
Scale:	1" = 30'
Date:	February 2019
Reference:	CrestWood Communities, Conceptual Site Plan - 5553 Mission Blvd., San Bernardino, California
Plate No.	1 OF 1