MOJAVE RIVER WATERSHED

Water Quality Management Plan

For:

Ohana Alliance - Mojave Drive Self Storage

PSUB20-00014 / APN: 3128-621-04

Prepared for:

Mr. Billy Phong

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Elk Grove, CA 95758

Tel: (916) 743-1145

Prepared by:

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Submittal Date: July 31, 2020

Revision No. and Date: _____

Revision No. and Date: _____

Revision No. and Date: _____

Revision No. and Date: _____

Revision No. and Date: _____

Final Approval Date:_____

Project Owner's Certification

This Mojave River Watershed Water Quality Management Plan (WQMP) has been prepared for Mr. Billy Phong by Toal Engineering, Inc. The WQMP is intended to comply with the requirements of the City of Victorville and the Phase II Small MS4 General Permit for the Mojave River Watershed. The undersigned, while it owns the subject property, is responsible for the implementation of the provisions of this plan and will ensure that this plan is amended as appropriate to reflect up-to-date conditions on the site consistent with the Phase II Small MS4 Permit and the intent of San Bernardino County (unincorporated areas of Phelan, Oak Hills, Spring Valley Lake and Victorville) and the incorporated cities of Hesperia and Victorville and the Town of Apple Valley. Once the undersigned transfers its interest in the property, its successors in interest and the city/county/town shall be notified of the transfer. The new owner will be informed of its responsibility under this WQMP. A copy of the approved WQMP shall be available on the subject site in perpetuity.

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

Project Data			
Permit/Application Number(s):	PSUB20-00014	Grading Permit Number(s):	
Tract/Parcel Map Number(s):	Parcel 3, PMB 2092	Building Permit Number(s):	
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			APN: 3128-621-04

Owner's Signature			
Owner Name: Mr. Billy Phong			
Title			
Company			
Address	9105 Bruceville Road, Suite 6A, Elk Grove, CA 95758		
Email	billyphong@gmail.com		
Telephone #	(916) 743-1145		
Signature		Date	

Preparer's Certification

Project Data			
Permit/Application Number(s):	PSUB20-00014	Grading Permit Number(s):	
Tract/Parcel Map Number(s):	Parcel 3, PMB 2092	Building Permit Number(s):	
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			APN: 3128-621-04

"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 the California State Water Resources Control Board Order No. 2013-0001-DWQ.

Engineer: Caleb O. Rios, PE		PE Stamp Below
Title	Principal Engineer	
Company	Toal Engineering, Inc.	
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Signature		
Date		

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Section I – Introduction

This WQMP template has been prepared specifically for the Phase II Small MS4 General Permit in the Mojave River Watershed. This location is within the jurisdiction of the Lahontan Regional Water Quality Control Board (LRWQCB). This document should not be confused with the WQMP template for the Santa Ana Phase I area of San Bernardino County.

WQMP preparers must refer to the MS4 Permit for the Mojave Watershed WQMP template and Technical Guidance (TGD) document found at: http://cms.sbcounty.gov/dpw/Land/NPDES.aspx to find pertinent arid region and Mojave River Watershed specific references and requirements.

Section 1 Discretionary Permit(s)

Form 1-1 Project Information

Project Name	Ohana Alliance - Mojave Drive Self Storage				
Project Owner Contact Name:	Mr. Billy Phong				
Mailing Address:	9105 Brucevill Road, Suite 6A Elk Grove, CA 95758	E-mail Address:	billyphong@gmail.com	Telephone:	(916) 743-1145
Permit/Application Number(s):	PSUB20-00014		Tract/Parcel Map Number(s):	Parcel 3, PMB 2092	
Additional Information/ Comments:					
Description of Project:	The project consists of a new self-storage facility on a previously vacant 8.57-acre parcel. The proposed development includes several storage buildings around the property perimeter and a paved area for RV storage at the center of the lot. Drainage improvements retain and treat stormwater on-site, prior to controlled off-site discharge. Street improvements on Mojave Drive and Mesa Linda Avenue cover 73,000 sq. ft. (1.68 acres), and shall be constructed per City of Victorville standards (and utilize US EPA Green Streets guidance as directed by the City of Victorville).				
Provide summary of Conceptual WQMP conditions (if previously submitted and approved). Attach complete copy.	N/A - No Conceptual WQMP has been submitted.				

Section 2 Project Description

2.1 Project Information

The WQMP shall 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.

2.1.1 Project Sizing Categorization

If the Project is greater than 5,000 square feet, and not on the excluded list as found on Section 1.4 of the TGD, the Project is a Regulated Development Project.

If the Project is creating and/or replacing greater than 2,500 square feet but less than 5,000 square feet of impervious surface area, then it is considered a Site Design Only project. This criterion is applicable to all development types including detached single family homes that create and/or replace greater than 2,500 square feet of impervious area and are not part of a larger plan of development.

Form 2.1-1 Description of Proposed Project

1 Regulated Development Project Category (Select all that apply):

☒ #1 New development involving the creation of 5,000 ft² or more of impervious surface collectively over entire site	☐ #2 Significant re-development involving the addition or replacement of 5,000 ft² or more of impervious surface on an already developed site	☐ #3 Road Project – any road, sidewalk, or bicycle lane project that creates greater than 5,000 square feet of contiguous impervious surface	☐ #4 LUPs – linear underground/overhead projects that has a discrete location with 5,000 sq. ft. or more new constructed impervious surface

☐ Site Design Only (Project Total Square Feet > 2,500 but < 5,000 sq.ft.) *Will require source control Site Design Measures. Use the "PCMP" Template. Do not use this WQMP Template.*

2 Project Area (ft2):	373,268	**3** Number of Dwelling Units:	1	**4** SIC Code:	4225

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.*

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:
The property is owned and managed by Mr. Billy Phong.

2.3 Potential Stormwater Pollutants

Best Management Practices (BMP) measures for pollutant generating activities and sources shall be designed consistent with recommendations from the CASQA Stormwater BMP Handbook for New Development and Redevelopment (or an equivalent manual). Pollutant generating activities must be considered when determining the overall pollutants of concern for the Project as presented in Form 2.3-1.

Determine and describe expected stormwater pollutants of concern based on land uses and site activities (refer to Table 3-2 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 ☐	
Nutrients - Phosphorous	E ☒	N ☐	
Nutrients - Nitrogen	E ☒	N ☐	
Noxious Aquatic Plants	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 ☐	

Section 3 Site and Watershed Description

Describe the project site conditions that will facilitate the selection of BMPs 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 Drainage Management Areas (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. A map presenting the DMAs must be included as an appendix to the WQMP document.***

Form 3-1 Site Location and Hydrologic Features

Site coordinates *take GPS measurement at approximate center of site*	Latitude 34.529526	Longitude -117.390128	Thomas Bros Map page 4295
1 San Bernardino County climatic region: ☒ Desert			
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
DA1 DMA C flows to DA1 DMA A	*Ex. Bioretention overflow to vegetated bioswale with 4' bottom width, 5:1 side slopes and bed slope of 0.01. Conveys runoff for 1000' through DMA 1 to existing catch basin on SE corner of property*
DA1 DMA A to Outlet 1	
DA1 DMA B to Outlet 1	
DA2 to Outlet 2	

Form 3-2 Existing Hydrologic Characteristics for Drainage Area 1

For Drainage Area 1's sub-watershed DMA, provide the following characteristics	DMA A	DMA B	DMA C	DMA D
1 DMA drainage area (ft^2)	373,260			
2 Existing site impervious area (ft^2)	0			
3 Antecedent moisture condition *For desert areas, use* *http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf*	2			
4 Hydrologic soil group *Refer to County Hydrology Manual Addendum for Arid Regions – http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_addendum.pdf*	B			
5 Longest flowpath length (ft)	700			
6 Longest flowpath slope (ft/ft)	0.014			
7 Current land cover type(s) *Select from Fig C-3 of Hydrology Manual*	Barren (CN=86)			
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***	Poor			

Form 3-2 Existing Hydrologic Characteristics for Drainage Area 1 (use only as needed for additional DMA w/in DA 1)				
For Drainage Area 1's sub-watershed DMA, provide the following characteristics	DMA E	DMA F	DMA G	DMA H
1 DMA drainage area (ft^2)				
2 Existing site impervious area (ft^2)				
3 Antecedent moisture condition *For desert areas, use http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf*				
4 Hydrologic soil group *County Hydrology Manual Addendum for Arid Regions – http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_addendum.pdf*				
5 Longest flowpath length (ft)				
6 Longest flowpath slope (ft/ft)				
7 Current land cover type(s) *Select from Fig C-3 of Hydrology Manual*				
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*				

Form 3-3 Watershed Description for Drainage Area

Receiving waters Refer to SWRCB site: http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml	Mojave River (below Lower Narrows)
Applicable TMDLs *http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml*	N/A - no TMDLs listed for the Mojave River (below Lower Narrows)
303(d) listed impairments *http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml*	N/A - no 303(d) listed impairments for Mojave River (below Lower Narrows)
Environmentally Sensitive Areas (ESA) *Refer to Watershed Mapping Tool –* *http://sbcounty.permitrack.com/WAP*	N/A - no ESA shown from site to Mojave River on Watershed Mapping Tool
Hydromodification Assessment	☒ Yes *Complete Hydromodification Assessment. Include Forms 4.2-2 through Form 4.2-5 and Hydromodification BMP Form 4.3-9 in submittal* ☐ No

Section 4 Best Management Practices (BMP)

4.1 Source Control BMPs and Site Design BMP Measures

The information and data in this section are required for both Regulated Development and Site Design Only Projects. Source Control BMPs and Site Design BMP Measures are the basis of site-specific pollution management.

4.1.1 Source Control BMPs

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.

The identified list of source control BMPs correspond to the CASQA Stormwater BMP Handbook for New Development and Redevelopment.

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	☒	☐	Tenants shall be made aware of storm water quality goals for the property and the City of Victorville at time of contract, and via signage posted on the property.
N2	Activity Restrictions	☒	☐	Any pollutant sources stored on-site shall be properly marked and contained. RV waste shall be discharged to the on-site disposal facility and not into the storm drain.
N3	Landscape Management BMPs	☒	☐	Landscaping shall be continuously maintained by the property owner (via maintenance company).
N4	BMP Maintenance	☒	☐	All BMPs shall be maintained by the property owner (via maintenance company), and in accordance with manufacturer recommendations (where applicable)
N5	Title 22 CCR Compliance (How development will comply)	☐	☒	No hazardous waste storage shall be permitted.
N6	Local Water Quality Ordinances	☐	☒	There are no anticipated site discharges other than controlled storm sewer waste and storm water effluent.
N7	Spill Contingency Plan	☒	☐	A spill contingency plan shall be in place for leaking containers from any individual storage unit, as well as for uncontrolled discharge at the RV waste station.
N8	Underground Storage Tank Compliance	☒	☐	The underground storm water retention system shall comply with all water quality and enviromental health regulations at time of permit.
N9	Hazardous Materials Disclosure Compliance	☐	☒	Tenants shall be made aware that no hazardous waste storage shall be permitted.

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	☐	☐	Tenants shall be made aware that no hazardous waste storage shall be permitted.
N11	Litter/Debris Control Program	☒	☐	Litter and debris shall be collected and properly disposed of during scheduled routine site maintenance, or as needed.
N12	Employee Training	☒	☐	All employees shall be made aware of on-site storm water quality BMPs and design goals, as well as spill contingency plans for unplanned non-storm water discharges.
N13	Housekeeping of Loading Docks	☐	☒	No loading docks.
N14	Catch Basin Inspection Program	☒	☐	All on-site inlets shall be inspected semi-annually to ensure the grates are clear and functioning properly.
N15	Vacuum Sweeping of Private Streets and Parking Lots	☒	☐	Site shall be swept periodically; schedule to be based upon rate of debris build-up post-construction.
N16	Other Non-structural Measures for Public Agency Projects	☐	☒	N/A
N17	Comply with all other applicable NPDES permits	☒	☐	Water quality improvements shall comply with NPDES permit(s).

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)	☒	☐	On-site storm drain inlets shall be stenciled per City standards.
S2	Design and construct outdoor material storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-34)	☐	☒	No material storage areas for this facility.
S3	Design and construct trash and waste storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-32)	☒	☐	Trash and waste storage areas shall comply with BMP SD-32.
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)	☒	☐	See landscape and irrigation plans for compliance with BMP SD-12 and pertinent landscape ordinances.
S5	Finish grade of landscaped areas at a minimum of 1-2 inches below top of curb, sidewalk, or pavement	☒	☐	All landscape areas slope away from building foundations, allowing for finish grade to be set 1-2 inches lower than the sidewalk or pavement.
S6	Protect slopes and channels and provide energy dissipation (CASQA New Development BMP Handbook SD-10)	☒	☐	Rip-rap or other means of energy dissipation will be provided at all locations of project storm water discharge.
S7	Covered dock areas (CASQA New Development BMP Handbook SD-31)	☐	☒	There are no docks on this site.
S8	Covered maintenance bays with spill containment plans (CASQA New Development BMP Handbook SD-31)	☐	☒	There are no maintenance bays on this site.
S9	Vehicle wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☒	☐	Any on-site RV vehicle wash area shall be equipped with barriers to prevent wash water from entering the storm drain system, and comply with BMP SD-33.
S10	Covered outdoor processing areas (CASQA New Development BMP Handbook SD-36)	☐	☒	There are no outdoor processing areas on this site.

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)	☐	☒	There are no equipment wash areas on this site.
S12	Fueling areas (CASQA New Development BMP Handbook SD-30)	☐	☒	There are no fueling areas on this site.
S13	Hillside landscaping (CASQA New Development BMP Handbook SD-10)	☐	☒	There are no hillsides on this site, or in close proximity to the project.
S14	Wash water control for food preparation areas	☐	☒	There are no food preparation areas on this site.
S15	Community car wash racks (CASQA New Development BMP Handbook SD-33)	☐	☐	There are no community car was racks on this site.

4.1.2 Site Design BMPs

As part of the planning phase of a project, the site design practices associated with new LID requirements in the Phase II Small MS4 Permit must be considered. Site design BMP measures can result in smaller Design Capture Volume (DCV) to be managed by both LID and hydromodification control BMPs by reducing runoff generation.

As is stated in the Permit, it is necessary to evaluate site conditions such as soil type(s), existing vegetation and flow paths will influence the overall site design.

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 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: For planning purposes, the parking lot and RV storage spaces are shown as impervious areas; to be discussed with architect and client for Final WQMP.
Maximize natural infiltration capacity; Including improvement and maintenance of soil: Yes ☒ No ☐ Explanation: The project intends to use subsurface retention for dispersion of stormwater via infiltration. On-site soils are classifed as Type B per County of San Bernardino online resources.
Preserve existing drainage patterns and time of concentration: Yes ☒ No ☐ Explanation: Drainage improvements convey project runoff and off-site run-on away from buildings and back into the existing natural drainage channels at the site perimeter. All property runoff ultimately joins together further downstream.
Disconnect impervious areas. Including rerouting of rooftop drainage pipes to drain stormwater to storage or infiltration BMPs instead of to storm drain : Yes ☒ No ☐ Explanation: The project will utilize an undergrouind storm water retention chamber for on-site infiltration.
Use of Porous Pavement.: Yes ☐ No ☒ Explanation: For planning purposes, the parking lot and RV storage are shown as impervious; to be discussed with soils engineer for Final WQMP.
Protect existing vegetation and sensitive areas: Yes ☐ No ☒ Explanation: There is little to no existing vegetation, nor are there any sensitive areas on-site.
Re-vegetate disturbed areas. Including planting and preservation of drought tolerant vegetation. : Yes ☒ No ☐ Explanation: Areas within the front setbacks bordering public streets will be planted; see landscape and irrigation plans.

Minimize unnecessary compaction in stormwater retention/infiltration basin/trench areas: Yes ☒ No ☐ Explanation: The soil surrounding the proposed underground storm water retention chamber shall be excavated, placed, and compacted per manufacturer recommendations and BMP guidelines; surface compaction shall meet parking lot standards.
Utilize naturalized/rock-lined drainage swales in place of underground piping or imperviously lined swales: Yes ☐ No ☒ Explanation: Due to on-site swales having minimal slopes and being located in the proposed drive aisles, natural or rock swales will not be used.
Stake off areas that will be used for landscaping to minimize compaction during construction : Yes ☐ No ☒ Explanation: Landscaping will occur along the project perimeter and measures ~10' in width; staking the area is not practical.
Use of Rain Barrels and Cisterns, Including the use of on-site water collection systems.: Yes ☒ No ☐ Explanation: As previously mentioned, storm water will be collected within a subsurface retention chamber and treated via on-site infiltration.
Stream Setbacks. Includes a specified distance from an adjacent steam: : Yes ☐ No ☒ Explanation: There are no adjacent streams that require this type of protection.

It is noted that, in the Phase II Small MS4 Permit, site design elements for green roofs and vegetative swales are required. Due to the local climatology in the Mojave River Watershed, proactive measures are taken to maximize the amount of drought tolerant vegetation. It is not practical in this region to have green roofs or vegetative swales. As part of site design the project proponent should utilize locally recommended vegetation types for landscaping. Typical landscaping recommendations are found in following local references:

San Bernardino County Special Districts:

Guide to High Desert Landscaping -
http://www.specialdistricts.org/Modules/ShowDocument.aspx?documentid=795

Recommended High-Desert Plants -
http://www.specialdistricts.org/modules/showdocument.aspx?documentid=553

Mojave Water Agency:

Desert Ranch: http://www.mojavewater.org/files/desertranchgardenprototype.pdf

Summertree: http://www.mojavewater.org/files/Summertree-Native-Plant-Brochure.pdf

Thornless Garden: http://www.mojavewater.org/files/thornlessgardenprototype.pdf

Mediterranean Garden: http://www.mojavewater.org/files/mediterraneangardenprototype.pdf

Lush and Efficient Garden: http://www.mojavewater.org/files/lushandefficientgardenprototype.pdf

Alliance for Water Awareness and Conservation (AWAC) outdoor tips – http://hdawac.org/save-outdoors.html

4.2 Treatment BMPs

After implementation and design of both Source Control BMPs and Site Design BMP measures, any remaining runoff from impervious DMAs must be directed to one or more on-site, treatment BMPs (LID or biotreatment) designed to infiltrate, evaportranspire, and/or bioretain the amount of runoff specified in Permit Section E.12.e (ii)(c) Numeric Sizing Criteria for Storm Water Retention and Treatment.

4.2.1 Project Specific Hydrology Characterization

The purpose of this section of the Project WQMP is to establish targets for post-development hydrology based on performance criteria specified in Section E.12.e.ii.c and Section E.12.f of the Phase II Small 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 from hydromodification.

If the project has more than one outlet for stormwater runoff, then complete additional versions of these forms for each DA / outlet.

It is noted that in the Phase II Small MS4 Permit jurisdictions, the LID BMP Design Capture Volume criteria is based on the 2-year rain event. The hydromodification performance criterion is based on the 10-year rain event.

Methods applied in the following forms include:

- For LID BMP Design Capture Volume (DCV), San Bernardino County requires use of the P_6 method (Form 4.2-1) For pre- and post-development hydrologic calculation, San Bernardino County 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 hydromodification 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): 373,268	**2** Imperviousness after applying preventative site design practices (Imp%): 94.7	**3** Runoff Coefficient (Rc): _0.80 *$R_c = 0.858(Imp\%)^{\wedge 3} - 0.78(Imp\%)^{\wedge 2} + 0.774(Imp\%) + 0.04$*
4 Determine 1-hour rainfall depth for a 2-year return period $P_{2yr\text{-}1hr}$ (in): 0.359 *http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html*		
5 Compute P_6, Mean 6-hr Precipitation (inches): 0.444 *P_6 = Item 4 *C_1, where C_1 is a function of site climatic region specified in Form 3-1 Item 1 (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): 21,688 *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 Hydromodification Assessment (DA 1)

Is the change in post- and pre- condition flows captured on-site? : Yes ☒ No ☐

If "Yes", then complete Hydromodification assessment of site hydrology for 10yr 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- Addendum 1)*

If "No," then proceed to Section 4.3 BMP Selection and Sizing

Condition	Runoff Volume (ft^3)	Time of Concentration (min)	Peak Runoff (cfs)
Pre-developed	**1** 34,524 *Form 4.2-3 Item 12*	**2** 17.0 *Form 4.2-4 Item 13*	**3** 21.54 *Form 4.2-5 Item 10*
Post-developed	**4** 56,044 *Form 4.2-3 Item 13*	**5** 17.6+ *Form 4.2-4 Item 14*	**6** 21.46 *Form 4.2-5 Item 14*
Difference	**7** *21,520* *Item 4 – Item 1*	**8** *<0* *Item 2 – Item 5*	**9** *<0* *Item 6 – Item 3*
Difference (as % of pre-developed)	**10** *62.3%* *Item 7 / Item 1*	**11** *<0%* *Item 8 / Item 2*	**12** *<0%* *Item 9 / Item 3*

Form 4.2-3 Hydromodification 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	Barren							
2a Hydrologic Soil Group (HSG)	B							
3a DMA Area, ft^2 *sum of areas of DMA should equal area of DA*	373,268							
4a Curve Number (CN) *use Items 1 and 2 to select the appropriate CN from Appendix C-2 of the TGD for WQMP*	86							
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	Business							
2b Hydrologic Soil Group (HSG)	B							
3b DMA Area, ft^2 *sum of areas of DMA should equal area of DA*	373,268							
4b Curve Number (CN) *use Items 5 and 6 to select the appropriate CN from Appendix C-2 of the TGD for WQMP*	95							

5 Pre-Developed area-weighted CN: 86	**7** Pre-developed soil storage capacity, S (in): 1.63 *S = (1000 / Item 5) - 10*	**9** Initial abstraction, I_a (in): 0.33 *I_a = 0.2 * Item 7*
6 Post-Developed area-weighted CN: 95	**8** Post-developed soil storage capacity, S (in): 0.53 *S = (1000 / Item 6) - 10*	**10** Initial abstraction, I_a (in): 0.11 *I_a = 0.2 * Item 8*

11 Precipitation for 10 yr, 24 hr storm (in): 2.34
Go to: http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html

12 Pre-developed Volume (ft^3): 34,524
*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): 56,044
*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 hydromodification requirement, (ft^3): 18,718
*Vhydro = (Item 13 * 0.95) – Item 12*

Form 4.2-4 Hydromodification 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*	See Appendix A				See Appendix A			
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): 17.0 per Pre-Project Calc in Appendix A *Minimum of Item 12 pre-developed DMA*

14 Post-developed time of concentration (min): 17.6+ per Post-Project Calc in Appendix A *Minimum of Item 12 post-developed DMA*

15 Additional time of concentration needed to meet hydromodification requirement (min): <0 $T_{C\text{-}Hydro}$ *= (Item 13 * 0.95) – Item 14*

Form 4.2-5 Hydromodification 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 - 0.7 LOG Form 4.2-4 Item 5 /60)*		See			See		
2 Drainage Area of each DMA (Acres) *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)*		Appendix			Appendix		
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)*		A			A		
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): 21.54 *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): 21.46 *Maximum of Item 11, 12, and 13 (including additional forms as needed)*		
15 Peak runoff reduction needed to meet Hydromodification Requirement (cfs): <0 *$Q_{p\text{-}hydro}$ = (Item 14 * 0.95) – Item 10*		

4.3 BMP Selection and Sizing

Complete the following forms for each project site DA to document that the proposed treatment (LID/Bioretention) BMPs conform to the project DCV developed to meet performance criteria specified in the Phase II Small 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 Phase II Small MS4 Permit (see Section 5.3 in the TGD for WQMP). The forms compute the following for on-site LID BMP:

- Site Design Measures (Form 4.3-2)
- Retention and Infiltration BMPs (Form 4.3-3) or
- Biotreatment BMPs (Form 4.3-4).

> Please note that the selected BMPs may also be used as dual purpose for on-site, hydromodification mitigation and management.

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 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 Form 4.3-2 to determine the feasibility of applicable Site Design 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 Site Design 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 site design, retention and/or infiltration BMPs is unable to mitigate the entire DCV, then the remainder of the volume-based performance criteria that cannot be achieved with site design, retention and/or infiltration BMPs must be managed through biotreatment BMPs. If biotreatment BMPs are used, then they must be sized to provide equivalent effectiveness based on Template Section 4.3.4.

4.3.1 Exceptions to Requirements for Bioretention Facilities

Contingent on a demonstration that use of bioretention or a facility of equivalent effectiveness is infeasible, other types of biotreatment or media filters (such as tree-box-type biofilters or in-vault media filters) may be used for the following categories of Regulated Projects:

1) Projects creating or replacing an acre or less of impervious area, and located in a designated pedestrian-oriented commercial district (i.e., smart growth projects), and having at least 85% of the entire project site covered by permanent structures;

2) Facilities receiving runoff solely from existing (pre-project) impervious areas; and

3) Historic sites, structures or landscapes that cannot alter their original configuration in order to maintain their historic integrity.

Form 4.3-1 Infiltration BMP Feasibility (DA 1)
Feasibility Criterion – Complete evaluation for each DA on the Project Site
[1] Would infiltration BMP pose significant risk for groundwater related concerns? Yes ☐ No ☒ *Refer to Section 5.3.2.1 of the TGD for WQMP*
If Yes, Provide basis: (attach)
[2] Would installation of infiltration BMP significantly increase the risk of geotechnical hazards? Yes ☐ No ☒ (Yes, if the answer to any of the following questions is yes, as established by a geotechnical expert): • The location is less than 50 feet away from slopes steeper than 15 percent • The location is less than ten feet from building foundations or an alternative setback. • A study certified by a geotechnical professional or an available watershed study determines that stormwater infiltration would result in significantly increased risks of geotechnical hazards.
If Yes, Provide basis: (attach)
[3] Would infiltration of runoff on a Project site violate downstream water rights? Yes ☐ No ☒
If Yes, Provide basis: (attach)
[4] Is proposed infiltration facility located on hydrologic soil group (HSG) D soils or does the site geotechnical investigation indicate presence of soil characteristics, which support categorization as D soils? Yes ☐ No ☒
If Yes, Provide basis: (attach)
[5] Is the design infiltration rate, after accounting for safety factor of 2.0, below proposed facility less than 0.3 in/hr (accounting for soil amendments)? Yes ☐ No ☒
If Yes, Provide basis: (attach)
[6] Would on-site infiltration or reduction of runoff over pre-developed conditions be partially or fully inconsistent with watershed management strategies as defined in the WAP, or impair beneficial uses? Yes ☐ No ☒ *See Section 3.5 of the TGD for WQMP and WAP*
If Yes, Provide basis: (attach)
[7] Any answer from Item 1 through Item 3 is "Yes": Yes ☐ No ☒ *If yes, infiltration of any volume is not feasible onsite. Proceed to Form 4.3-4, Selection and Evaluation of Biotreatment BMP.* *If no, then proceed to Item 8 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, Site Design 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, Site Design BMPs.*

4.3.2 Site Design BMP

Section E.12.e. of the Small Phase II MS4 Permit emphasizes the use of LID preventative measures; and the use of Site Design Measures reduces the portion of the DCV that must be addressed in downstream BMPs. Therefore, all applicable Site Design Measures 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 Site Design BMPs. If a project cannot feasibly meet BMP sizing requirements or cannot fully address hydromodification, feasibility of all applicable Site Design BMPs 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 BMP. Refer to Section 5.4 in the TGD for more detailed guidance.

Form 4.3-2 Site Design 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 1 BMP Type N/A	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
2 Total impervious area draining to pervious area (ft^2)	N/A		
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):		$V_{retention}$ *=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 1 BMP Type N/A	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
7 Ponding surface area (ft^2)	N/A		
8 Ponding depth (ft) (min. 0.5 ft.)			
9 Surface area of amended soil/gravel (ft^2)			
10 Average depth of amended soil/gravel (ft) (min. 1 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 BMPs (DA 1)

14 Implementation of Street Trees: Yes ☐ No ☐ *If yes, complete Items 14-18. If no, proceed to Item 19*	DA 1 DMA 1 BMP Type N/A	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
15 Number of Street Trees			
16 Average canopy cover over impervious area (ft^2)			
17 Runoff volume retention from street trees (ft^3) $V_{retention}$ *= Item 15 * Item 16 * (0.05/12) assume runoff retention of 0.05 inches*			
18 Runoff volume retention from street tree BMPs (ft^3):	$V_{retention}$ *= Sum of Item 17 for all BMPs*		
19 Total Retention Volume from Site Design BMPs: N/A *Sum of Items 5, 13 and 18*			

4.3.3 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 C 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 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).

4.3.3.1 Allowed Variations for Special Site Conditions

The bioretention system design parameters of this Section may be adjusted for the following special site conditions:

1) Facilities located within 10 feet of structures or other potential geotechnical hazards established by the geotechnical expert for the project may incorporate an impervious cutoff wall between the bioretention facility and the structure or other geotechnical hazard.

2) Facilities with documented high concentrations of pollutants in underlying soil or groundwater, facilities located where infiltration could contribute to a geotechnical hazard, and facilities located on elevated plazas or other structures may incorporate an impervious liner and may locate the underdrain discharge at the bottom of the subsurface drainage/storage layer (this configuration is commonly known as a “flow-through planter”).

3) Facilities located in areas of high groundwater, highly infiltrative soils or where connection of underdrain to a surface drain or to a subsurface storm drain are infeasible, may omit the underdrain.

4) Facilities serving high-risk areas such as fueling stations, truck stops, auto repairs, and heavy industrial sites may be required to provide adequate pretreatment to address pollutants of concern unless these high-risk areas are isolated from storm water runoff or bioretention areas with no chance of spill migration.

.

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

1 Remaining LID DCV not met by site design BMP (ft^3): 21,688 *V_{unmet} = Form 4.2-1 Item 7 - Form 4.3-2 Item19*

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 1 BMP Type 5.4.2.6	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
2 Infiltration rate of underlying soils (in/hr) *See Section 5.4.2 and Appendix C of the TGD for WQMP for minimum requirements for assessment methods*	TBD		
3 Infiltration safety factor *See TGD Section 5.4.2 and Appendix D*	TBD		
4 Design percolation rate (in/hr) *P_{design} = Item 2 / Item 3*	TBD		
5 Ponded water drawdown time (hr) *Copy Item 6 in Form 4.2-1*	48		
6 Maximum ponding depth (ft) *BMP specific, see Table 5-4 of the TGD for WQMP for BMP design details*	N/A		
7 Ponding Depth (ft) *d_{BMP} = Minimum of (1/12*Item 4*Item 5) or Item 6*	N/A		
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*	TBD		
9 Amended soil depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 in the TGD for WQMP for reference to BMP design details*	N/A		
10 Amended soil porosity	N/A		
11 Gravel depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 of the TGD for WQMP for BMP design details*	N/A		
12 Gravel porosity	N/A		
13 Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*	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))]*	N/A		
15 Underground Retention Volume (ft^3) *Volume determined using manufacturer's specifications and calculations*	21,688		

16 Total Retention Volume from LID Infiltration BMPs: 21,688 *(Sum of Items 14 and 15 for all infiltration BMP included in plan)*

17 Fraction of DCV achieved with infiltration BMP: 100% *Retention% = Item 16 / Form 4.2-1 Item 7*

18 Is full LID DCV retained onsite with combination of hydrologic source control and LID retention/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.

4.3.4 Biotreatment BMP

Biotreatment BMPs may be considered if the full LID DCV cannot be met by maximizing retention and infiltration. 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 4.3-4 to summarize the potential for volume based and/or flow based biotreatment options to biotreat the remaining unmet LID DCV. Biotreatment computations are included as follows:

- Use Form 4.3-5 to compute biotreatment in small volume based biotreatment BMP (e.g. bioretention w/underdrains);
- Use Form 4.3-6 to compute biotreatment in large volume based biotreatment BMP (e.g. constructed wetlands);
- Use Form 4.3-7 to compute sizing criteria for flow-based biotreatment BMP (e.g. bioswales)

Form 4.3-4 Selection and Evaluation of Biotreatment BMP (DA 1)

1 Remaining LID DCV not met by site design , or infiltration, BMP for potential biotreatment (ft^3): 0 *Form 4.2-1 Item 7 - Form 4.3-2 Item 19 – Form 4.3-3 Item 16*	List pollutants of concern *Copy from Form 2.3-1.*	
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 4.3-5 and 4.3-6 to compute treated volume*	Flow-based biotreatment *Use Form 4.3-7 to compute treated flow*
	☐ 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): *Form 4.3-5 Item 15 + Form 4.3-6 Item 13*	**4** Compute remaining LID DCV with implementation of volume based biotreatment BMP (ft^3): *Item 1 – Item 3*	**5** Remaining fraction of LID DCV for sizing flow based biotreatment BMP: % *Item 4 / Item 1*
6 Flow-based biotreatment BMP capacity provided (cfs): *Use Figure 5-2 of the TGD for WQMP to determine flow capacity required to provide biotreatment of remaining percentage of unmet LID DCV (Item 5), for the project's precipitation zone (Form 3-1 Item 1)*		
7 Metrics for MEP determination: • 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.*		

Form 4.3-5 Volume Based Biotreatment (DA 1) – Bioretention and Planter Boxes with Underdrains

Biotreatment BMP Type *(Bioretention w/underdrain, planter box w/underdrain, other comparable BMP)*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
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*			
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 4.3-6 Volume Based Biotreatment (DA 1) – 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 4.3-7 Flow Based Biotreatment (DA 1)

Biotreatment BMP Type *Vegetated swale, vegetated filter strip, or other comparable proprietary BMP*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
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*			
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*			
3 Bed slope (ft/ft) *BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
4 Manning's roughness coefficient			
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*			
7 Cross sectional area (ft^2) *A = (Item 5 * Item 2) + (Item 6 * Item 2^2)*			
8 Water quality flow velocity (ft/sec) *V = Form 4.3-5 Item 6 / Item 7*			
9 Hydraulic residence time (min) *Pollutant specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
10 Length of flow based BMP (ft) *L = Item 8 * Item 9 * 60*			
11 Water surface area at water quality flow depth (ft^2) SA_{top} *= (Item 5 + (2 * Item 2 * Item 6)) * Item 10*			

4.3.5 Conformance Summary

Complete Form 4.3-8 to demonstrate how on-site LID DCV is met with proposed site design, infiltration, 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 4.3-8 Conformance Summary and Alternative Compliance Volume Estimate (DA 1)

1 Total LID DCV for the Project DA-1 (ft^3): 21,688 *Copy Item 7 in Form 4.2-1*

2 On-site retention with site design BMP (ft^3): 0 *Copy Item18 in Form 4.3-2*

3 On-site retention with LID infiltration BMP (ft^3): 21,688 *Copy Item 16 in Form 4.3-3*

4 On-site biotreatment with volume based biotreatment BMP (ft^3): 0 *Copy Item 3 in Form 4.3-4*

5 Flow capacity provided by flow based biotreatment BMP (cfs): 0 *Copy Item 6 in Form 4.3-4*

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

- Full retention of LID DCV with site design or infiltration 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; therefore biotreatment BMP provides 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

7 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 Site Design, retention and infiltration, , and biotreatment BMPs provide less than full LID DCV capture: ☐
  Checked yes if Form 4.3-4 Item 7is checked yes, Form 4.3-4 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)%*

- Facilities, or a combination of facilities, of a different design than in Section E.12.e.(ii)(f) may be permitted if all of the following Phase II Small MS4 General Permit 2013-0001-DWQ 55 February 5, 2013 measures of equivalent effectiveness are demonstrated:
  1) Equal or greater amount of runoff infiltrated or evapotranspired; ☐
  2) Equal or lower pollutant concentrations in runoff that is discharged after biotreatment; ☐
  3) Equal or greater protection against shock loadings and spills; ☐
  4) Equal or greater accessibility and ease of inspection and maintenance. ☐

4.3.6 Hydromodification Control BMP

Use Form 4.3-9 to compute the remaining runoff volume retention, after Site Design BMPs are implemented, needed to address hydromodification, and the increase in time of concentration and decrease in peak runoff necessary to meet targets for protection of waterbodies with a potential hydromodification. Describe the proposed hydromodification treatment control BMP. Section 5.6 of the TGD for WQMP provides additional details on selection and evaluation of hydromodification control BMP.

Form 4.3-9 Hydromodification Control BMPs (DA 1)

1 Volume reduction needed for hydromodification performance criteria (ft^3): 21,520 *(Form 4.2-2 Item 4 * 0.95) – Form 4.2-2 Item 1*	**2** On-site retention with site design and infiltration, BMP (ft^3): 21,688 *Sum of Form 4.3-8 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 hydromodification volume reduction*
3 Remaining volume for hydromodification volume capture (ft^3): <0 *Item 1 – Item 2*	**4** Volume capture provided by incorporating additional on-site BMPs (ft^3): N/A

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

If yes, hydromodification 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 BMP ☐
- 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 ☐

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

If yes, hydromodification 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 retention BMPs ☐

4.4 Alternative Compliance Plan (if applicable)

Describe an alternative compliance plan (if applicable) for projects not fully able to infiltrate, 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 Designs — Facilities, or a combination of facilities, of a different design than in Permit Section E.12.e.(ii)(f) may be permitted if all of the following measures of equivalent effectiveness are demonstrated:

1) Equal or greater amount of runoff infiltrated or evapotranspired;

2) Equal or lower pollutant concentrations in runoff that is discharged after biotreatment;

3) Equal or greater protection against shock loadings and spills;

4) Equal or greater accessibility and ease of inspection and maintenance.

The Project Proponent will need to obtain written approval for an alternative design from the Lahontan Regional Water Board Executive Officer (see Section 6 of the TGD for WQMP).

Section 5 Inspection and Maintenance Responsibility for Post Construction BMP

All BMPs 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 a Maintenance Agreement. The Maintenance Agreement must also be attached to the WQMP.

Note that at time of Project construction completion, the Maintenance Agreement must be completed, signed, notarized and submitted to the County Stormwater Department

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

BMP	Reponsible Party(s)	Inspection/ Maintenance Activities Required	Minimum Frequency of Activities

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 Implementation Plan), this section will describe the contents (e.g., layering, nomenclature, geo-referencing, etc.) of these documents so that they may be interpreted efficiently and accurately.

6.3 Post Construction

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

6.4 Other Supporting Documentation

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

WQMP LEGEND

- DRAIN INLET / DOWNSPOUT
- RUNOFF FLOW DIRECTION
- PROPOSED DRAIN LINE
- UNDERGROUND INFILTRATION BMP

SCALE: 1"= 40'-0"

MESA LINDA AVENUE
N 00° 14' 39" W 2,650.94' (2,650.38' GRID)

N 00° 14' 39" W 1255.42'

S 00° 14' 25" E 1275.45'
S 00° 14' 25" E 1325.45'

S 89° 56' 41" W 663.59'

S 89° 56' 41" W 270.99'

N 89° 55' 40" E 290.99'

PARCEL 3
P.M. 18/52
A.P.N. 3128-621-04
+/- 8.51 ACRES

WATER QUALITY BMP: UNDERGROUND STORMWATER RETENTION W/ INFILTRATION;
DCV=21,688 CU. FT. PER PROJECT WQMP

RV. PARKING

LINE OF COVERED RV PARKING

STORAGE BUILDING 'A' 1-STORY

STORAGE BUILDING 'B' 1-STORY

STORAGE BUILDING 'C' 1-STORY

14' x50' RV. STORAGE

RV DUMP STATION (UNDERGROUND DETENTION SYSTEM BY OTHERS)

RV WASH AREA

OFFICE F.F.=3021.0

FIRE RISER

R = 20'
Δ = 89°48'50"
L = 31.35'

CONNECT TO (E) WATER MAIN

PROPOSED SEWER MAIN EXTENSION

CONNECT TO SEWER MAIN

SEPARATE WATER SERVICE AND METER W/ RP BACKFLOW FOR IRRIGATION

DOMESTIC WATER SERVICE AND METER W/ RP BACKFLOW (PER CITY STD. W-39)

PROPOSED SEWER LATERAL

PROPOSED STORM DRAIN IMPROVEMENTS PER STREET IMPROVEMENT PLAN.

PROPOSED WATER MAIN EXTENSION

PROPOSED FIRE SERVICE W/ DETECTOR CHECK ASSEMBLY

40' DRIVEWAY

8' WIDE STREET VACATION

PROPOSED MESA LINDA AVENUE R.O.W.

EXISTING MESA LINDA AVENUE R.O.W.

34' HALF-STREET R.O.W. (COLLECTOR)

12' WIDE EASEMENT OR DEDICATION FOR STREET PURPOSES

75' HALF-STREET R.O.W. (SUPER ARTERIAL)

MOJAVE DRIVE

10' SETBACK

25' WIDE DEDICATION FOR STREET PURPOSES

PROPOSED MOJAVE DRIVE R.O.W.

EXISTING MOJAVE DRIVE R.O.W.

PROPOSED 20' WIDE DRAINAGE EASEMENT

INTERIOR STEM/CURB (AS NECESSARY)

DEEPENED FOOTING (AS NECESSARY)

42'

50'

REVISIONS	BY	DATE	APVD.	DATE

PLANS PREPARED BY:

TOAL ENGINEERING, INC.

CIVIL ENGINEERING
LAND SURVEYING
STORMWATER QUALITY

139 Avenida Navarro
San Clemente, CA 92672
949.492.8586
www.toalengineering.com

CALEB RIOS
R.C.E. 57587

DATE

REGISTERED PROFESSIONAL ENGINEER
CALEB RIOS
No. 57587
CIVIL
STATE OF CALIFORNIA

MOJAVE DRIVE SELF STORAGE

WQMP SITE PLAN

PARCEL 3, PMB 2092 (APN: 3128-621-04)
NE CORNER OF MOJAVE DRIVE AND MESA LINDA AVENUE

DATE: 7/8/2020	H. SCALE: 1"=40'
SURVEY DATE: N/A	V. SCALE: N/A
DRN.: M.F.B.	DWG. NO. WQ1
CHD.: M.F.B.	
APPD.: C.R.	
JOB NO. 20091	SHEET 1 OF 1

8/5/2020 4:48:19 PM M:\2020\20091\Reports\WQMP\20091-wqmp-01.dwg

APPENDIX A
WQMP Hydrology Calculations

```
******************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
         (Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
        (c) Copyright 1983-2012 Advanced Engineering Software (aes)
            Ver. 18.2  Release Date: 05/08/2012  License ID 1448

                          Analysis prepared by:

                           Toal Engineering, Inc.
                            139 Avenida Navarro
                          San Clemente, CA  92672
                            Tel: (949) 492-8586


------------------------------------------------------------------------------
  FILE NAME: Existing on-site project conditions
  TIME/DATE OF STUDY: 15:34 08/05/2020
==============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==============================================================================
                     --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*
  10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  0.750
  100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  1.200
  COMPUTED RAINFALL INTENSITY DATA:
  STORM EVENT =  100.00   1-HOUR INTENSITY(INCH/HOUR) = 1.2000
  SLOPE OF INTENSITY DURATION CURVE = 0.7000

  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  ================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

******************************************************************************
  FLOW PROCESS FROM NODE      1.00 TO NODE      2.00 IS CODE =  21
------------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   710.00
  ELEVATION DATA: UPSTREAM(FEET) =   3020.75  DOWNSTREAM(FEET) =   3010.75

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   17.018
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.899
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
```

```
 DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
     LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
NATURAL POOR COVER
"BARREN"                    B        8.57      0.11      1.000    97   17.02
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.11
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
SUBAREA RUNOFF(CFS) =     21.54
TOTAL AREA(ACRES) =      8.57   PEAK FLOW RATE(CFS) =     21.54
================================================================================
END OF STUDY SUMMARY:
TOTAL AREA(ACRES)     =        8.6  TC(MIN.) =     17.02
EFFECTIVE AREA(ACRES) =      8.57  AREA-AVERAGED Fm(INCH/HR)=  0.11
AREA-AVERAGED Fp(INCH/HR) =  0.11  AREA-AVERAGED Ap = 1.000
PEAK FLOW RATE(CFS)   =      21.54
```

```
******************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
         (Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
        (c) Copyright 1983-2012 Advanced Engineering Software (aes)
            Ver. 18.2  Release Date: 05/08/2012  License ID 1448

                          Analysis prepared by:

                          Toal Engineering, Inc.
                           139 Avenida Navarro
                         San Clemente, CA  92672
                           Tel: (949) 492-8586

------------------------------------------------------------------------------
  FILE NAME: Post-Project Runoff Calculation – Entire Site
  TIME/DATE OF STUDY: 15:49 08/05/2020
==============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*
  10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  0.750
  100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  1.200
  COMPUTED RAINFALL INTENSITY DATA:
  STORM EVENT =  100.00   1-HOUR INTENSITY(INCH/HOUR) = 1.2000
  SLOPE OF INTENSITY DURATION CURVE = 0.7000

  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  ================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

******************************************************************************
  FLOW PROCESS FROM NODE     10.00 TO NODE     20.00 IS CODE =  21
------------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   330.00
  ELEVATION DATA: UPSTREAM(FEET) =   3020.40  DOWNSTREAM(FEET) =   3018.10

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.349
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.772
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
```

```
     LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL               B        0.72      0.42     0.100    76    8.35
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      3.07
  TOTAL AREA(ACRES) =      0.72   PEAK FLOW RATE(CFS) =      3.07

****************************************************************************
  FLOW PROCESS FROM NODE     20.00 TO NODE     30.00 IS CODE =  91
----------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM NODE ELEVATION(FEET) =   3018.10
  DOWNSTREAM NODE ELEVATION(FEET) =   3014.30
  CHANNEL LENGTH THRU SUBAREA(FEET) =   635.00
  "V" GUTTER WIDTH(FEET) =   3.00   GUTTER HIKE(FEET) =  0.080
  PAVEMENT LIP(FEET) =  0.040   MANNING'S N = .0150
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.01000
  MAXIMUM DEPTH(FEET) =   0.33
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.237
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
     LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL               B        1.44      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      5.13
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.71
  AVERAGE FLOW DEPTH(FEET) =   0.27   FLOOD WIDTH(FEET) =   33.35
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   6.19   Tc(MIN.) =   14.54
  SUBAREA AREA(ACRES) =    1.44       SUBAREA RUNOFF(CFS) =    4.14
  EFFECTIVE AREA(ACRES) =    2.16     AREA-AVERAGED Fm(INCH/HR) =   0.04
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.10
  TOTAL AREA(ACRES) =        2.2         PEAK FLOW RATE(CFS) =       6.21

  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.29   FLOOD WIDTH(FEET) =   36.30
  FLOW VELOCITY(FEET/SEC.) =   1.77   DEPTH*VELOCITY(FT*FT/SEC) =   0.51
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     30.00 =     965.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     30.00 TO NODE     40.00 IS CODE =  91
----------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM NODE ELEVATION(FEET) =   3014.30
  DOWNSTREAM NODE ELEVATION(FEET) =   3012.60
  CHANNEL LENGTH THRU SUBAREA(FEET) =   290.00
  "V" GUTTER WIDTH(FEET) =   3.00   GUTTER HIKE(FEET) =  0.080
  PAVEMENT LIP(FEET) =  0.040   MANNING'S N = .0150
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.02000
  MAXIMUM DEPTH(FEET) =   0.50
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.947
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
     LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL               B        2.80      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      9.86
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.32
  AVERAGE FLOW DEPTH(FEET) =   0.37   FLOOD WIDTH(FEET) =   28.46
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   2.08   Tc(MIN.) =   16.62
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  SUBAREA AREA(ACRES) =    2.80       SUBAREA RUNOFF(CFS) =    7.32
  EFFECTIVE AREA(ACRES) =    4.96     AREA-AVERAGED Fm(INCH/HR) =   0.04
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.10
  TOTAL AREA(ACRES) =        5.0         PEAK FLOW RATE(CFS) =      12.97

  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.41   FLOOD WIDTH(FEET) =   31.87
  FLOW VELOCITY(FEET/SEC.) =   2.46   DEPTH*VELOCITY(FT*FT/SEC) =   1.00
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     40.00 =    1255.00 FEET.

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  FLOW PROCESS FROM NODE     40.00 TO NODE     50.00 IS CODE =  91
----------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM NODE ELEVATION(FEET) =   3012.60
  DOWNSTREAM NODE ELEVATION(FEET) =   3012.10
  CHANNEL LENGTH THRU SUBAREA(FEET) =    77.00
  "V" GUTTER WIDTH(FEET) =   3.00   GUTTER HIKE(FEET) =  0.080
  PAVEMENT LIP(FEET) =  0.040   MANNING'S N = .0150
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.02000
  MAXIMUM DEPTH(FEET) =   0.50
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.890
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        3.07      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =     16.90
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.70
  AVERAGE FLOW DEPTH(FEET) =   0.44   FLOOD WIDTH(FEET) =   34.84
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   0.48   Tc(MIN.) =   17.10
  SUBAREA AREA(ACRES) =    3.07       SUBAREA RUNOFF(CFS) =    7.87
  EFFECTIVE AREA(ACRES) =    8.03     AREA-AVERAGED Fm(INCH/HR) =   0.04
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.10
  TOTAL AREA(ACRES) =        8.0         PEAK FLOW RATE(CFS) =      20.58

  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.47   FLOOD WIDTH(FEET) =   37.66
  FLOW VELOCITY(FEET/SEC.) =   2.82   DEPTH*VELOCITY(FT*FT/SEC) =   1.32
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     50.00 =    1332.00 FEET.

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  FLOW PROCESS FROM NODE     50.00 TO NODE     60.00 IS CODE =  91
----------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM NODE ELEVATION(FEET) =   3012.10
  DOWNSTREAM NODE ELEVATION(FEET) =   3011.80
  CHANNEL LENGTH THRU SUBAREA(FEET) =    72.00
  "V" GUTTER WIDTH(FEET) =   3.00   GUTTER HIKE(FEET) =  0.080
  PAVEMENT LIP(FEET) =  0.040   MANNING'S N = .0150
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.03000
  MAXIMUM DEPTH(FEET) =   0.67
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.837
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        0.13      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =     20.74
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  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.65
  AVERAGE FLOW DEPTH(FEET) =   0.55   FLOOD WIDTH(FEET) =   31.97
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   0.45   Tc(MIN.) =   17.55
  SUBAREA AREA(ACRES) =    0.13       SUBAREA RUNOFF(CFS) =    0.33
  EFFECTIVE AREA(ACRES) =    8.16     AREA-AVERAGED Fm(INCH/HR) =   0.04
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.10
  TOTAL AREA(ACRES) =        8.2         PEAK FLOW RATE(CFS) =      20.58
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.55   FLOOD WIDTH(FEET) =   31.82
  FLOW VELOCITY(FEET/SEC.) =   2.65   DEPTH*VELOCITY(FT*FT/SEC) =   1.46
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     60.00 =    1404.00 FEET.

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  FLOW PROCESS FROM NODE     60.00 TO NODE     60.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   17.55
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.837
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "2 DWELLINGS/ACRE"         B        0.41      0.42     0.700    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.700
  SUBAREA AREA(ACRES) =    0.41      SUBAREA RUNOFF(CFS) =    0.94
  EFFECTIVE AREA(ACRES) =      8.57   AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.13
  TOTAL AREA(ACRES) =        8.6       PEAK FLOW RATE(CFS) =      21.46
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        8.6  TC(MIN.) =     17.55
  EFFECTIVE AREA(ACRES) =      8.57  AREA-AVERAGED Fm(INCH/HR)=  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap = 0.129
  PEAK FLOW RATE(CFS)   =      21.46
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