APPENDIX G2
WQMP

Preliminary Water Quality Management Plan

For:

Pioneer Avenue Redlands

TENTATIVE TRACT NUMBER 20528

Prepared for:

MLC Holdings, Inc.

5 Peters Canyon, Suite 310

Irvine, CA 92606

Contact:

Prepared by:

Huitt-Zollars, Inc.

2603 Main Street, Suite 400

Irvine, CA 92614

(949) 988-5815

Submittal Date: **November 10, 2022**

Revision Date:

Approval Date:______________________

Project Owner's Certification

This Preliminary Water Quality Management Plan (WQMP) has been prepared for MLC Holdings, Inc. by Huitt-Zollars, Inc. The WQMP is intended to comply with the requirements of the City of Redlands 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):		Grading Permit Number(s):	
Tract/Parcel Map Number(s):	20528	Building Permit Number(s):	
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			167-061-01

Owner's Signature			
Owner Name: Johanna Crooker			
Title	Forward Planning Manager		
Company	MLC Holdings, Inc.		
Address	5 Peters Canyon, Suite 310, Irvine, CA 92606		
Email			
Telephone #	(949) 299-3847		
Signature		Date	

Preparer's Certification

Project Data			
Permit/Application Number(s):		Grading Permit Number(s):	
Tract/Parcel Map Number(s):	20528	Building Permit Number(s):	
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			167-061-01

"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:	Jeffrey Okamoto
Title	Vice President/Managing Principal
Company	Huitt-Zollars, Inc.
Address	2603 Main Street, Suite 400, Irvine, CA 92614
Email	okamoto@huitt-zollars.com
Telephone #	(949) 988-5815
Signature	
Date	

PE Stamp Below

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Forms

Section 1 Discretionary Permit(s)

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<tr><td colspan="2">Project Name</td><td colspan="4">Pioneer Ave – City of Redlands</td></tr>
<tr><td colspan="2">Project Owner Contact Name:</td><td colspan="4">Matt Maehara</td></tr>
<tr><td>Mailing Address:</td><td>5 Peters Canyon, Suite 310, Irvine, CA 92606</td><td>E-mail Address:</td><td></td><td>Telephone:</td><td></td></tr>
<tr><td colspan="2">Permit/Application Number(s):</td><td colspan="2"></td><td>Tract/Parcel Map Number(s):</td><td>20528</td></tr>
<tr><td colspan="2">Additional Information/ Comments:</td><td colspan="4"></td></tr>
<tr><td colspan="2">Description of Project:</td><td colspan="4">The project is located in the City of Redlands, in the County of San Bernardino, California. The proposed development consists of 117 multi-story high-density single family residential lots and active open space (park) to be dedicated. The proposed tract would develop approximately 14.77 acres of land into numbered lots, park space and public streets. The existing site consists of 14.37 acres of citrus groves. The terrain predominately slopes northwesterly and westerly towards the concrete-lined channel in the west. The parcel lies on a floodplain south of the Santa Ana River in an HCOC Exempt Area. Existing onsite runoff drains via surface flow north towards the CalTrans channel to the west before being conveyed north to the Santa Ana River.

In the proposed condition, all lots will be graded for runoff to be conveyed via curb and gutter to onsite catch basins. The catch basins will be sized to capture all onsite runoff and convey it to the proposed onsite storm drain infrastructure and infiltration basin. Runoff will be infiltrated into the subsurface soils. A cross gutter will be placed at the southern entrance of the project site to allow offsite runoff to continue flowing west on Pioneer. Runoff from the extension of Domestic Ave will be captured and routed to the onsite infiltration basin.

Underlying soils are natural alluvial soils consisting of medium dense fine to medium-grained silty sands and sandy silt. These soils are classified as Hydraulic Soil Group A over the entire site by NRCS (Please see Attachment D for NRCS Soils Report). Site specific geotechnical report, including infiltration testing, have been performed to confirm the feasibility to infiltrate and is included as part of this submittal.

This project proposes the construction of on-site stormwater infrastructure including curb inlet, curb and gutter, storm drain, and an aboveground infiltration basin located in the site's northwestern parklands. Additionally, off tract public street improvements of Domestic Avenue including street widening, sidewalks, and curb and gutter are proposed as part of this project.

The project site is currently bordered on the west by a concrete lined channel. The proposed basin will have an overflow structure that discharges onto a riprap pad into this channel. To</td></tr>
</table>

	the south and to the east are citrus orchards. The main access points onto the project site will be from the south via Pioneer Avenue and from the north via Domestic Avenue. Approximately 360,023 sq. ft. of the project site will consist of impervious areas such as roofs, streets, hardscape walkways and driveways. Approximately 283,358 sq. ft. will be landscaped pervious area in parklands, open spaces, and lawns.
Provide summary of Conceptual WQMP conditions (if previously submitted and approved).	

Section 2 Project Description

2.1 Project Information

This section of the WQMP should provide the information listed below. The information provided for 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 ft² or more of impervious surface on an already developed site	☒ New development involving the creation of 10,000 ft² 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 ft² or more
☐ Hillside developments of 5,000 ft² 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 ft² 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 ft² or more exposed to storm water	☐ Retail gasoline outlets that are either 5,000 ft² 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):	643,381	3 Number of Dwelling Units:	117	4 SIC Code:	1521

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:
The City of Redlands will be responsible for the maintenance of all public streets, parkway landscaping, open space lots, LID BMPs, and underground private storm drains. The LID BMPs include an aboveground infiltration basin located in the northwest corner of the development. At the completion of the project, all streets will be publicly dedicated, and a covenant agreement will be prepared to transfer the maintenance responsibility of the LID BMPs to the City. The maintenance of private lots will be of the responsibility of private homeowners.

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 ☐	Possibility of pathogens from organic matter. Water-borne pathogen contamination are caused by various bacteria, viruses, and protozoa which cause water-borne diseases such as diarrhea and gastrointestinal illnesses.
Nutrients - Phosphorus	E ☒	N ☐	Nutrients from fertilizers. Nutrients such as phosphorus can support the excessive growth of algae an aquatic plants that can lead to eutrophication of bodies of water.
Nutrients - Nitrogen	E ☒	N ☐	Nutrients from fertilizers. Nutrients such as nitrogen can support the excessive growth of algae an aquatic plants that can lead to eutrophication of bodies of water.
Noxious Aquatic Plants	E ☐	N ☒	
Sediment	E ☒	N ☐	Some sediment from the erosion of landscaped areas is expected. Sediment can cause unwanted turbidity of water.
Metals	E ☒	N ☐	Some metals are expected from vehicles and other nonpoint sources. Heavy metals including arsenic, copper, and lead are toxic if consumed in higher levels.
Oil and Grease	E ☒	N ☐	Petroleum hydrocarbons are expected from vehicles. Oil and grease cause ecological damage in the form of lower dissolved oxygen levels with some being considered carcinogens.
Trash/Debris	E ☒	N ☐	Trash and debris is expected from residential areas. Trash and waste storage areas will be constructed to reduce pollution introduction.
Pesticides / Herbicides	E ☒	N ☐	Pesticides and herbicides cause disruptions in water quality and chemistry and are toxic to many biological organisms.
Organic Compounds	E ☒	N ☐	Vegetative debris are the most likely sources of organic contamination. Decomposition processes cause deficits in dissolved oxygen content and unwanted odors.
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]	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
☐ 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: 5% *(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

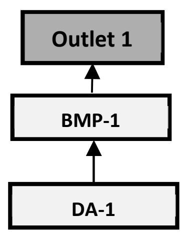
Describe the project site conditions that will facilitate the selection of BMP through an analysis of the physical conditions and limitations of the site and its receiving waters. Identify distinct drainage areas (DA) that collect flow from a portion of the site and describe how runoff from each DA (and sub-watershed DMAs) is conveyed to the site outlet(s). Refer to Section 3.2 in the TGD for WQMP. Complete form 3.2 for each DA on the project site.

Form 3-1 Site Location and Hydrologic Features

Site coordinates *take GPS measurement at approximate center of site*	Latitude 34.082512°	Longitude -117.199570°	Thomas Bros Map page 608

[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	DA 1: Runoff from all side streets and alley ways will flow onto the main Street A and Street B running primarily north-south. Curb and gutter flows will be captured by onsite catch basins and conveyed via storm water infrastructure to the proposed infiltration basin.
DA 1 to Outlet 1	Areas of all DAs total 14.77 acres. The lots and streets are designed to surface flow onsite runoff along street curbs and into a sized catch basin. Runoff captured by the catch basin is conveyed by pipe to the aboveground infiltration basin. The basin will have structures that enable overflow to flow into an overflow pipe that will discharge onto a riprap pad in the engineered channel.

Form 3-2 Existing Hydrologic Characteristics for Drainage Area

For Drainage Area 1's sub-watershed DMA, provide the following characteristics	DMA 1			
1 DMA drainage area (ft^2)	643,381			
2 Existing site impervious area (ft^2)	0			
3 Antecedent moisture condition *For valley areas, use http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf*	II			
4 Hydrologic soil group *Refer to Watershed Mapping Tool – http://permitrack.sbcounty.gov/wap/*	A			
5 Longest flowpath length (ft)	1,630			
6 Longest flowpath slope (ft/ft)	0.012			
7 Current land cover type(s) *Select from Fig C-3 of Hydrology Manual*	*Orchards, Fallow*			
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 (Please see Attachment D for image supporting the poor condition)			

Form 3-3 Watershed Description for Drainage Area

Receiving waters *Refer to Watershed Mapping Tool -* *http://permitrack.sbcounty.gov/wap/* *See 'Drainage Facilities" link at this website*	Santa Ana River, Reach 5
Applicable TMDLs *Refer to Local Implementation Plan*	Indicator Bacteria TMDL (USEPA) for Santa Ana River, Reach 3
303(d) listed impairments *Refer to Local Implementation Plan and Watershed Mapping Tool –* *http://permitrack.sbcounty.gov/wap/ and State Water Resources Control Board website –* *http://www.waterboards.ca.gov/santaana/water_issues/programs/tmdl/index.shtml*	There are no downstream drainage segments with 303(d) listed pollutants that are subject to TMDLs. Per 2010 Integrated Report (Clean Water Act Section 303(d) Report) Santa Ana River Reach 4 is 303(d) listed for pathogens Santa Ana River Reach 3 is 303(d) listed for copper, lead and pathogens Santa Ana River Reach 2 is 303(d) listed for indicator bacteria
Environmentally Sensitive Areas (ESA) *Refer to Watershed Mapping Tool –* *http://permitrack.sbcounty.gov/wap/*	None
Unlined Downstream Water Bodies *Refer to Watershed Mapping Tool –* *http://permitrack.sbcounty.gov/wap/*	None
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	☒	☐	Prior to building occupancy, builder will provide educational materials to the private homeowners to inform them of their potential impacts to downstream water quality. Should the private homeowner rent a property to a tenant, the private homeowner will be responsible to provide the educational materials to the tenant.
N2	Activity Restrictions	☒	☐	Activity restrictions to minimize potential impacts to water quality and with the purpose of protecting water quality will be preserved by the project’s Covenant, Conditions and Restrictions (CC&Rs), or other equally effective measure. Activities that violate the ordinances in Chapter 13.54 of the City of Redlands Municipal Code as well as activities for which adequate BMPs have not been provided will be restricted.
N3	Landscape Management BMPs	☒	☐	Maintenance activities for landscape areas shall be consistent with County and manufacturer guidelines for fertilizer and pesticide use. Single-family homeowners will be responsible for maintaining privately owned landscaped areas. Compliance to be ensured by the HOA. Parkways, common areas, and landscaped parking islands will be maintained by the City of Redlands.

Form 4.1-1 Non-Structural Source Control BMPs				
N4	BMP Maintenance	☒	☐	Regular inspections and removal of debris and sediment buildup, overgrown vegetation will be performed by the City at all drainage inlets, manholes, and the two infiltration basins.
N5	Title 22 CCR Compliance (How development will comply)	☐	☒	The proposed residential development will not generate waste subject to Title 22 CCR Compliance.
N6	Local Water Quality Ordinances	☒	☐	. Chapter 13.54 of the Municipal Code lists the ordinances that shall be complied with. (https://codelibrary.amlegal.com/codes/redlandsca/latest/redlands_ca/o-o-o-10848)
N7	Spill Contingency Plan	☐	☒	Spill plans are not required for single family residential lots.
N8	Underground Storage Tank Compliance	☐	☒	Underground storage tanks are not part of this project.
N9	Hazardous Materials Disclosure Compliance	☐	☒	Hazardous materials are not allowed to be stored on the site.

Form 4.1-1 Non-Structural Source Control BMPs

Identifier	Name	Check One: Included	Check One: Not Applicable	Describe BMP Implementation OR, if not applicable, state reason
N10	Uniform Fire Code Implementation	☐	☒	The proposed residential project will not store toxic or highly toxic compressed gases.
N11	Litter/Debris Control Program	☒	☐	Litter control onsite will include the use of litter patrols, violation reporting and clean up during landscaping maintenance activities and as needed to ensure good housekeeping of the project's common areas.
N12	Employee Training	☒	☐	All employees, contractors and subcontractors of the City and the HOA shall be trained on the proper use and staging of landscaping and other materials with the potential to impact runoff and proper clean-up of spills and materials.
N13	Housekeeping of Loading Docks	☐	☒	Loading Docks are not part of this project.
N14	Catch Basin Inspection Program	☒	☐	As required by the MS4 permit, at least 80% of the project's drainage facilities shall be inspected, cleaned/maintained annually by the City, with 100% of facilities inspected and maintained within a two-year period. Drainage facilities include catch basins (storm drain inlets), infiltration/detention basins, sediment chambers and open drainage channels (entire system).
N15	Vacuum Sweeping of Private Streets and Parking Lots	☐	☒	There are no private streets or parking lots in this project.
N16	Other Non-structural Measures for Public Agency Projects	☐	☒	No other non-structural measures required.
N17	Comply with all other applicable NPDES permits	☒	☐	Compliance with requirements outlined in the SWPPP including sediment and erosion control measures and housekeeping BMPs shall be followed.

Form 4.1-2 Structural Source Control BMPs

Identifier	Name	Check One: Included	Check One: Not Applicable	Describe BMP Implementation OR, If not applicable, state reason
S1	Provide storm drain system stencilling and signage (CASQA New Development BMP Handbook SD-13)	☒	☐	The stencil shall be blue on a white background with lettering 2- 1/2 " in height and reading "No Dumping – Drains to river". A fish or similar water dependent creature silhouette may be included subject to City approval. In lieu of a stencil, a catch basin curb marker, circular or rectangular, at least 4" in height or diameter, may be used. The message will be the same and is subject to City approval. A painted circular stencil shall not be bigger than 8" in diameter. Legibility will be checked and repainted annually.
S2	Design and construct outdoor material storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-34)	☐	☒	Project does not propose outdoor storage areas.
S3	Design and construct trash and waste storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-32)	☒	☐	Trash shall be consolidated at designated waste storage areas. Trash generated from parks shall be collected from available waste receptacles by the city's waste management. Designated waste storage areas and waste receptacles shall be designed per CASQA standards.
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)	☒	☐	In conjunction with routine landscaping maintenance activities, inspect irrigation for signs of leaks, overspray and repair or adjust accordingly. Adjust system cycle to accommodate seasonal fluctuations in water demand and temperatures. Ensure use of native or drought tolerant/non-invasive plant species to minimize water consumption. To reduce excessive irrigation runoff, the following methods shall be implemented: 1. Employing rain shutoff devices to prevent irrigation after precipitation. 2. Designing irrigation systems to each landscape area's specific water requirements. 3. Using flow reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines. 4. The timing and application methods of irrigation water shall be designed to minimize the runoff of excess irrigation water into the municipal storm drain system. 5. Employing other comparable, equally effective, methods to reduce irrigation water runoff. Mulches (such as wood chips or shredded wood

				products) in planter areas without ground cover minimize sediment in runoff. If any devices are battery powered, replace the batteries yearly or replace them as needed, whichever occurs first.
S5	Finish grade of landscaped areas at a minimum of 1-2 inches below top of curb, sidewalk, or pavement	☒	☐	Landscape areas are depressed. The finish grade of landscape areas is at least one to two inches below hard surfaces.
S6	Protect slopes and channels and provide energy dissipation (CASQA New Development BMP Handbook SD-10)	☒	☐	Energy dissipation measures, or riprap pads, will be installed at the storm drain inlets into the infiltration basins to protect basin slopes and bottom against erosion. Proper energy dissipation will be incorporated at the outlet of the project storm drain into the existing concrete-lined trapezoidal channel, if deemed necessary.
S7	Covered dock areas (CASQA New Development BMP Handbook SD-31)	☐	☒	Project does not propose dock areas.
S8	Covered maintenance bays with spill containment plans (CASQA New Development BMP Handbook SD-31)	☐	☒	Project does not propose maintenance bays.
S9	Vehicle wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☐	☒	Project does not propose vehicle wash areas.
S10	Covered outdoor processing areas (CASQA New Development BMP Handbook SD-36)	☐	☒	Project does not propose outdoor processing area.
S11	Equipment wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☐	☒	Project does not propose equipment wash areas.
S12	Fueling areas (CASQA New Development BMP Handbook SD-30)	☐	☒	Project does not propose fueling areas.
S13	Hillside landscaping (CASQA New Development BMP Handbook SD-10)	☐	☒	There are no hillsides in the project area.
S14	Wash water control for food preparation areas	☐	☒	Project does not propose food preparation areas.
S15	Community car wash racks (CASQA New Development BMP Handbook SD-33)	☐	☒	Project does not propose 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: Driveways, street, sidewalk, drive isle, and parking stall will be incorporated to the minimum width and length allowed by City standards. Also, the usage of vertical building (2 story) and clustered building minimizes impervious areas.

Maximize natural infiltration capacity: Yes ☒ No ☐

Explanation: Infiltration basins are implemented where feasible. The unnecessary compaction of soils will be minimized during construction activities by minimizing the construction footprint and staking off the perimeter of the infiltration basins.

Preserve existing drainage patterns and time of concentration: Yes ☒ No ☐

Explanation: The drainage patterns of the project area will generally not be modified due to development. Flows will still be directed towards the concrete channel located between TTM 20336 and the Freeway. Since an onsite underground storm drainage system is proposed, existing drainage patterns might be altered at the scale of a cluster. However, the time of concentration resulting from the project improvements will be mitigated through detention by the proposed infiltration/detention basins, as well as providing additional protection against flooding.

Disconnect impervious areas: Yes ☒ No ☐

Explanation: Runoff from the roofs is collected by downspouts and discharged over pervious areas.

Protect existing vegetation and sensitive areas: Yes ☐ No ☒

Explanation: The existing vegetation on the project site will not be protected as the entire site will be graded to allow for new construction. There are no sensitive areas within the limits of grading.

Re-vegetate disturbed areas: Yes ☒ No ☐

Explanation: This project proposes the installation of landscaped park space as well as landscaped lots to the maximum extent practicable. Minimum impervious improvements will be incorporated, such as pedestrian walkways, a parking lot, and amenities.

Minimize unnecessary compaction in stormwater retention/infiltration basin/trench areas: Yes ☒ No ☐

Explanation: Construction plans will identify that heavy equipment is prohibited in the vicinity of the proposed infiltration chambers.

Utilize vegetated drainage swales in place of underground piping or imperviously lined swales: Yes ☐ No ☒

Explanation: The entirety of the project site (excluding public streets Street N and Domestic Ave) will drain to the proposed infiltration/detention basin. Because of the significant grade differential between the east and west boundaries of the project, as well as the potential for flooding onto residential properties, the implementation of vegetated swales is not included as part of the design.

Stake off areas that will be used for landscaping to minimize compaction during construction : Yes ☒ No ☐

Explanation: The use of heavy machinery is not anticipated during construction due to the minimal earthwork. Construction equipment with low bearing loads will be used in the vicinity of the two infiltration basins. The perimeter of the infiltration basins shall be staked off during construction.

4.2 Project Performance Criteria

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

Methods applied in the following forms include:

♣ For LID BMP Design Capture Volume (DCV), the San Bernardino County Stormwater Program requires use of the P6 method (MS4 Permit Section XI.D.6a.ii) – Form 4.2-1

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

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

Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume (DA 1)		
1 Project area DA 1 (ft^2): 643,381	2 Imperviousness after applying preventative site design practices (Imp%): 56%	3 Runoff Coefficient (Rc): 0.380 *R_c = 0.858(Imp%)^3-0.78(Imp%)^2+0.774(Imp%)+0.04*
4 Determine 1-hour rainfall depth for a 2-year return period $P_{2yr-1hr}$ (in): 0.480 *http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html*		
5 Compute P_6, Mean 6-hr Precipitation (inches): 0.711 *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): 28,435 *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://permitrack.sbcounty.gov/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 2 – Item 5*	**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								
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								
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: N/A	**7** Pre-developed soil storage capacity, S (in): N/A *S = (1000 / Item 5) - 10*	**9** Initial abstraction, I_a (in): N/A *I_a = 0.2 * Item 7*
6 Post-Developed area-weighted CN: N/A	**8** Post-developed soil storage capacity, S (in): N/A *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): N/A
Go to: http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html

12 Pre-developed Volume (ft^3): N/A
*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): N/A
*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): N/A
*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 DA 1 *Use additional forms if there are more than 4 DMA*				Post-developed DA 1 *Use additional forms if there are more than 4 DMA*				
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) $V_{fps} = (1.49 / \text{Item 9}) * (\text{Item 7}/\text{Item 8})^{0.67} * (\text{Item 3})^{0.5}$									
11 Travel time to outlet (min) $T_t = \text{Item 6} / (\text{Item 10} * 60)$									
12 Total time of concentration (min) $T_c = \text{Item 5} + \text{Item 11}$									
13 Pre-developed time of concentration (min): *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): 5.7 $T_{C-HCOC} = (\text{Item 13} * 0.95) - \text{Item 14}$									

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

Compute peak runoff for pre- and post-developed conditions

Variables		Pre-developed DMA to Project Outlet			Post-developed DMA to Project Outlet		
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 (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)*							
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)*	DA 1	n/a	n/a	n/a	n/a	n/a	n/a
	DA 2	n/a	n/a	n/a	n/a	n/a	n/a
	DA 3	n/a	n/a	n/a	n/a	n/a	n/a

8 Pre-developed Q_p at T_c for DMA A: n/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: n/a *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: n/a *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: n/a *Same as Item 9 for post-developed values*	13 Post-developed Q_p at T_c for DMA C: n/a *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-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

Feasibility Criterion – Complete evaluation for each DA on the Project Site: DA1
[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) Note that the groundwater plume is upstream of drainage area. No risk anticipated.
[2] Would installation of infiltration BMP significantly increase the risk of geotechnical hazards? Yes ☐ No ☒ (Yes, if the answer to any of the following questions is yes, as established by a geotechnical expert): • The location is less than 50 feet away from slopes steeper than 15 percent • The location is less than eight feet from building foundations or an alternative setback. • A study certified by a geotechnical professional or an available watershed study determines that stormwater infiltration would result in significantly increased risks of geotechnical hazards.
If Yes, Provide basis: (attach)
[3] Would infiltration of runoff on a Project site violate downstream water rights? Yes ☐ No ☒
If Yes, Provide basis: (attach)
[4] Is proposed infiltration facility located on hydrologic soil group (HSG) D soils or does the site geotechnical investigation indicate presence of soil characteristics, which support categorization as D soils? Yes ☐ No ☒
If Yes, Provide basis: (attach)
[5] Is the design infiltration rate, after accounting for safety factor of 2.0, below proposed facility less than 0.3 in/hr (accounting for soil amendments)? Yes ☐ No ☒
If Yes, Provide basis: (attach)
[6] Would on-site infiltration or reduction of runoff over pre-developed conditions be partially or fully inconsistent with watershed management strategies as defined in the WAP, or impair beneficial uses? Yes ☐ No ☒ *See Section 3.5 of the TGD for WQMP and WAP*
If Yes, Provide basis: (attach)
[7] Any answer from Item 1 through Item 3 is “Yes”: Yes ☐ No ☒ *If yes, infiltration of any volume is not feasible onsite. Proceed to Form 4.3-4, Harvest and Use BMP. If no, then proceed to Item 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, 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 DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
2 Total impervious area draining to pervious area (ft²)			
3 Ratio of pervious area receiving runoff to impervious area			
4 Retention volume achieved from impervious area dispersion (ft³) *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 (ft³): 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 DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
7 Ponding surface area (ft²)			
8 Ponding depth (ft)			
9 Surface area of amended soil/gravel (ft²)			
10 Average depth of amended soil/gravel (ft)			
11 Average porosity of amended soil/gravel			
12 Retention volume achieved from on-lot infiltration (ft³) *$V_{retention}$ = (Item 7 *Item 8) + (Item 9 * Item 10 * Item 11)*			
13 Runoff volume retention from on-lot infiltration (ft³): 0 $V_{retention}$ *=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 DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
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 22-25. If no, proceed to Item 26*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
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 barrel/cisterns: Yes☐ No ☒ *If yes, complete Items 27-29; If no, proceed to Item 30*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
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): $V_{retention}$ *=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).

Form 4.3-3 Infiltration LID BMP - including underground BMPs

1 Remaining LID DCV not met by site design HSC BMP (ft^3): *V_{unmet} = 18,388 ft^3 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 BMP Type Above ground infiltration basin		
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*	2.8		
3 Infiltration safety factor *See TGD Section 5.4.2 and Appendix D*	4.5		
4 Design percolation rate (in/hr) *P_{design} = Item 2 / Item 3*	0.622		
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*	4.0		
7 Ponding Depth (ft) *d_{BMP} = Minimum of (1/12*Item 4*Item 5) or Item 6*	2.5		
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*	11,331		
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		
10 Amended soil porosity	0		
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*	0		
12 Gravel porosity	0		
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))]*	32,010		
15 Underground Retention Volume (ft^3) *Volume determined using manufacturer's specifications and calculations*	0		
16 Total Retention Volume from LID Infiltration BMPs: 32,010 *(Sum of Items 14 and 15 for all infiltration BMP included in plan)*			
17 Fraction of DCV achieved with infiltration BMP: 112.6% *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.*			

4.3.3 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 is not applicable.

Form 4.3-4 Harvest and Use BMPs (All DAs)			
1 Remaining LID DCV not met by site design HSC or infiltration BMP (ft^3): 0 *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 DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
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 *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 & 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);
- Use Form 4.3-8 to compute sizing criteria for flow-based biotreatment BMP (e.g. bioswales)

Form 4.3-5 is not applicable.

Form 4.3-5 Selection and Evaluation of Biotreatment BMP (All DAs)			
1 Remaining LID DCV not met by site design HSC, infiltration, or harvest and use BMP for potential biotreatment (ft^3): 0 *Form 4.2-1 Item 7 - Form 4.3-2 Item 30 – Form 4.3-3 Item 16- Form 4.3-4 Item 9*	List pollutants of concern *Copy from Form 2.3-1.*		
2 Biotreatment BMP Selected *(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): *Form 4.3-6 Item 15 + Form 4.3-7 Item 13*	4 Compute remaining LID DCV with implementation of volume based biotreatment BMP (ft^3): *Item 1 – Item 3*	5 Remaining fraction of LID DCV for sizing flow based biotreatment BMP: % *Item 4 / Item 1*	
6 Flow-based biotreatment BMP capacity provided (cfs): *Use Figure 5-2 of the TGD for WQMP to determine flow capacity required to provide biotreatment of remaining percentage of unmet LID DCV (Item 5), for the project's precipitation zone (Form 3-1 Item 1)*			
7 Metrics for MEP determination: • 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 4.3-6 is not applicable.

Form 4.3-6 Volume Based Biotreatment (All DAs) – 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 4.3-7 is not applicable.

<table>
<tr><th colspan="5">Form 4.3-7 Volume Based Biotreatment (All DAs) –
Constructed Wetlands and Extended Detention</th></tr>
<tr><td rowspan="2">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.</td><td colspan="2">DA DMA
BMP Type</td><td colspan="2">DA DMA
BMP Type
(Use additional forms for more BMPs)</td></tr>
<tr><td>Forebay</td><td>Basin</td><td>Forebay</td><td>Basin</td></tr>
<tr><td>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</td><td></td><td></td><td></td><td></td></tr>
<tr><td>2 Bottom width (ft)</td><td></td><td></td><td></td><td></td></tr>
<tr><td>3 Bottom length (ft)</td><td></td><td></td><td></td><td></td></tr>
<tr><td>4 Bottom area (ft^2) A_{bottom} = Item 2 * Item 3</td><td></td><td></td><td></td><td></td></tr>
<tr><td>5 Side slope (ft/ft)</td><td></td><td></td><td></td><td></td></tr>
<tr><td>6 Depth of storage (ft)</td><td></td><td></td><td></td><td></td></tr>
<tr><td>7 Water surface area (ft^2)
$A_{surface}$ =(Item 2 + (2 * Item 5 * Item 6)) * (Item 3 + (2 * Item 5 * Item 6))</td><td></td><td></td><td></td><td></td></tr>
<tr><td>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]</td><td></td><td></td><td></td><td></td></tr>
<tr><td>9 Drawdown Time (hrs) Copy Item 6 from Form 2.1</td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td>10 Outflow rate (cfs) Q_{BMP} = (Item $8_{forebay}$ + Item 8_{basin}) / (Item 9 * 3600)</td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td>11 Duration of design storm event (hrs)</td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td>12 Biotreated Volume (ft^3)
$V_{biotreated}$ = (Item $8_{forebay}$ + Item 8_{basin}) +(Item 10 * Item 11 * 3600)</td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td colspan="5">13 Total biotreated volume from constructed wetlands, extended dry detention, or extended wet detention :
(Sum of Item 12 for all BMP included in plan)</td></tr>
</table>

Form 4.3-8 is not applicable.

Form 4.3-8 Flow Based Biotreatment (All DAs)			
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 4.3-9 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): 28,435 *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): 32,010 *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 *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)

1 Volume reduction needed for HCOC performance criteria (ft^3): *n/a (no HCOC)* *(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): 0 *Item 1 – Item 2*	4 Volume capture provided by incorporating additional on-site or off-site retention BMPs (ft^3): 0 *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.

The City of Redlands shall be responsible for the maintenance and long-term funding of BMP maintenance. BMPs shall be maintained throughout the year, and inspection and maintenance activities shall be documented as part of this WQMP.

The City shall retain operations, inspections and maintenance records for these BMPs, and be made available upon request. All records shall be maintained by the City for at least five years after the recorded inspection date.

Before the transfer of responsibilities to the City, the Owner shall be responsible for the maintenance of BMPs.

Form 5-1 BMP Inspection and Maintenance (use additional forms as necessary)			
Non-Structural Source Control BMPs			
BMP	Reponsible Party(s)	Inspection/ Maintenance Activities Required	Minimum Frequency of Activities
N-1 - Education of Property Owners, Tenants and Occupants on Stormwater BMPs	HOA to send pamphlets to Tenants / Homeowners	Distribution of educational material from the County of San Bernardino stormwater website (https://sbcountystormwater.org/) to occupants. Pamphlets to be provided to occupants on an annual basis and HOA to provide review of the pamphlets to make sure the pamphlets are up to date.	Within two months of occupancy and yearly thereafter
N-2 Activity Restrictions	City for Public Right-Of-Way and Landscaping HOA for Tenants / Homeowners	The HOA and the City will prescribe restrictions to protect water quality, through a Covenant, Condition and Restriction (CC&R's) agreement, or other equally effective measure, for the property.	Weekly or when observed.

		Inspection/maintenance to be conducted during litter patrols or landscaping activities. Violations to be reported to the HOA and the City.	
N-3 Landscape Management BMPs	City	Scheduled by the City. Maintenance activities for landscape areas shall be consistent with County and manufacturer guidelines for fertilizer and pesticide use. Inspections of the health of the landscape, erosion detection, irrigation system checks for leaks and operability. Maintenance includes trimming, weeding , removing and replacing and dead and dying plants, debris removal, erosion repair, fixing irrigation system leaks, and vegetation planting and replacement. Stockpiled materials during maintenance activities shall be placed away from drain inlets and runoff conveyance devices. Wastes shall be properly disposed of or recycled. Maintenance for common areas and landscape parking islands is scheduled by the City	Weekly or as determined by City staff
N-4 BMP Maintenance	City	Scheduled by the City for cleaning of all (structural and non-structural) BMP facilities. This includes regularly checking drain inlets for debris build-up, infiltration basin for noxious weed growth, trash, or erosion. Infiltration Basin BMPs shall be regularly mowed and maintained. Maintenance of BMP's implemented at the project site shall be performed at the frequency prescribed in the final WQMP. Records of inspections and BMP maintenance shall be maintained by the City and documented in the final WQMP, and shall be available for review upon request.	Weekly or as determined by city staff

N-11 Litter/Debris Control Program	HOA/City	Litter patrol, violation inspections, reporting and other litter control activities shall be in conjunction with maintenance activities to ensure good housekeeping of the project's common areas. Litter collection and removal shall be performed on a weekly basis.	Weekly
N-12 Employee Training	HOA/City	All employees, contractors and subcontractors of the City and/or the HOA shall receive training on the proper use and staging of landscaping and other materials with the potential to impact runoff and proper clean-up of spills, materials and good housekeeping.	Monthly
N-14 Common Area Catch Basin Inspection	City	To be scheduled by the City as required by the TGD, at least 80% of the project's private drainage facilities shall be inspected annually, and cleaned/maintained monthly, with 100% of facilities inspected and maintained within a two-year period. Drainage facilities include catch basins (storm drain inlets), detention basins, retention basins, sediment basins and open drainage channels.	Once a month to clean debris and silt in the bottom of drainage facilities. Intensified around October 1st of each year prior to the "first flush" storm.
N-15 Vacuum Sweeping of Public Streets and Parking Lots	City	The project's private streets and parking lots shall be swept, at minimum, prior to the start of the traditional rainy season and as needed.	Annually as needed
Structural Source Control BMPs			
S-1 Provide storm drain system stenciling and signage (CASQA New Development BMP Handbook SD-13)	City	Inspection of storm drain stencils or catch basin curb markers shall occur annually. Replacement shall occur when the stencils or catch basin curb markers become illegible.	Inspect for re-stenciling needs and re-stencil as necessary annually. Re-stencil every other year.
S-4 Use efficient irrigation systems & landscape design,	City for Public Parks and Trails	In conjunction with routine landscaping maintenance activities, inspect irrigation for signs of leaks, overspray and repair or	Inspections must be made weekly at a minimum.

water conservation, smart controllers, and source control (Statewide Model Landscape Ordinance; CASQA New Development BMP Handbook SD-12)	HOA for Private (SFR) Landscaping	adjust accordingly. Adjust system cycle to accommodate seasonal fluctuations in water demand and temperatures. Ensure use of native or drought tolerant/non-invasive plant species to minimize water consumption.	
S-5 Finish grade of landscaped areas at a minimum of 1-2 inches below top of curb, sidewalk, or pavement	HOA/City	Landscaped areas will be depressed in order to increase retention of stormwater/irrigation water and promote infiltration.	Ongoing
S-6 Protect slopes and channels and provide energy dissipation (CASQA New Development BMP Handbook SD-10)	City	Implement the design principles incorporated in this PWQMP including: avoiding disturbance of existing CDFW channel, construction of infiltration basin.	Ongoing

	LID BMPs Infiltration Basin				
Infiltration Basin	**Routine Action**	**Maintenance Indicator**	**Inspection Frequency**	**Maintenance Frequency**	**Maintenance Activity**
	Trash and Debris	Trash and Debris present	Annually, before wet season starts	Annually	Remove and dispose of trash and debris
	Sediment Management (Short term)	Sediment depth exceeds 10% of the forebay or drain time exceed 72 hours. If there is standing water after 48 hours the basin/s will require maintenance.	The basin shall be inspected after each rain storm and at least once during the summer months	After a rain event and once during the summer	Sediment shall be removed and the surface shall be scarified to a minimum depth of 12 "
	General Maintenance Inspection	Inlet/outlet structures, side slopes or other features damaged, erosion, burrows, emergence of trees or woody vegetation, graffiti or vandalism, fence damage, etc.	Annually, before wet season starts	Annually and/or after heavy rain event	Corrective action before wet season. Consult engineers if immediate solution is not evident.
	Sediment Management (Long Term)	Sediment depth exceeds 10% of the forebay or standing water for more than 72 hours	Annually, 72 hours after a target storm event	After a rain event and once during the summer	Remove and properly dispose of sediment. Regrade if necessary.

	Performance Inspection	Inspected 48 hours after any rainfall. There shall be no standing water after that time. Standing water is an indication the basin needs maintenance.	48 hours after any rainfall	Adjust as needed	Corrective action before wet season. Consult engineers if immediate solution is not evident.

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. (See Attachment C)

6.4 Other Supporting Documentation

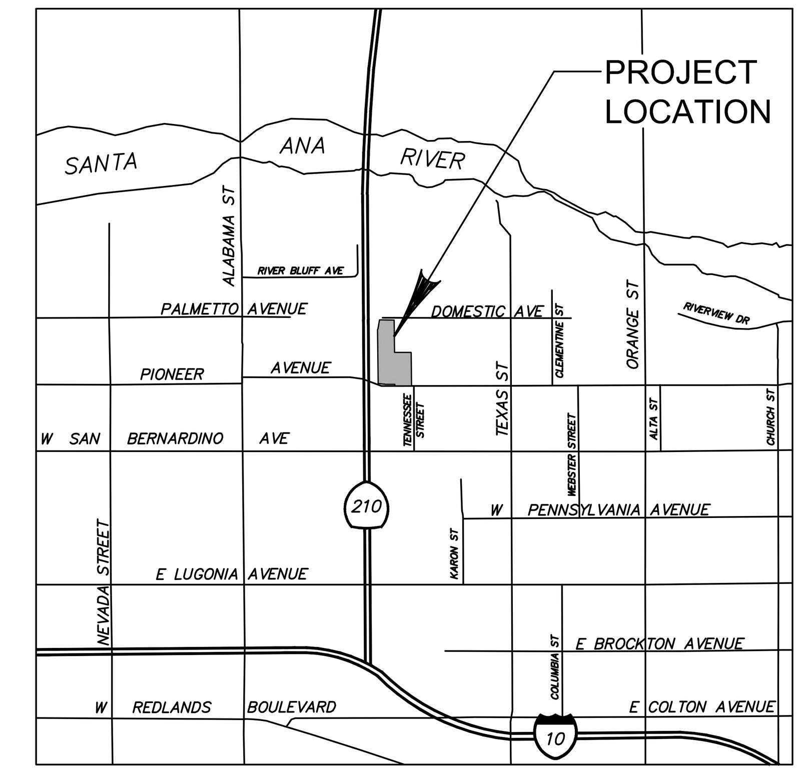
- BMP Educational Materials
- Activity Restriction – C, C&R's & Lease Agreements

Attachment A

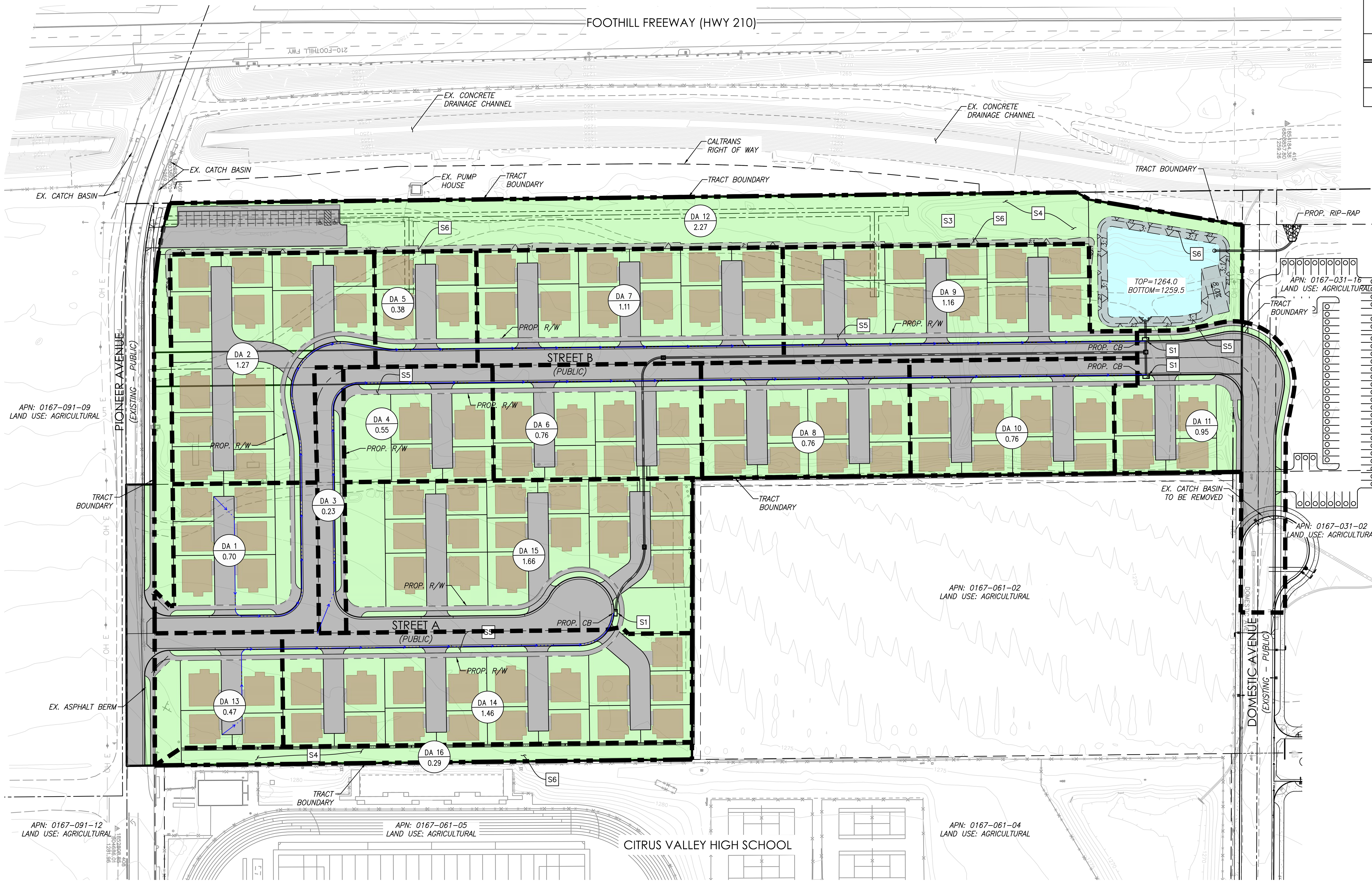
Existing Conditions and WQMP Exhibits

WATER QUALITY MANAGEMENT PLAN EXHIBIT

CITY OF REDLANDS,
IN THE COUNTY OF SAN BERNARDINO,
STATE OF CALIFORNIA



VICINITY MAP
NOT TO SCALE



LEGEND

PERVIOUS AREA (LANDSCAPE, OPEN SPACE, PARK)

PAVED AREA (DRIVEWAY, SIDEWALK, ALLEY)

BASINS

SUBAREA DESTINATION – DA X
SUBAREA ACREAGE – XX.XX

HYDROLOGIC SUBAREA BOUNDARY

PROPOSED TRACT BOUNDARY

DRAINAGE DELINEATIONS/FLOW-PATHS

STRUCTURAL SOURCE CONTROL BMPS

S1	PROVIDE STORM DRAIN SYSTEM STENCELLING AND SIGNAGE
S3	DESIGN AND CONSTRUCT TRASH AND WASTE STORAGE AREAS TO REDUCE POLLUTION INTRODUCTION
S4	USE EFFECIENT IRRIGATION SYSTEMS AND LANDSCAPE DESIGN, WATER CONSERVATION, SMART CONTROLLERS, AND SOURCE CONTROL.
S5	FINISH GRADE OF LANDSCAPE AREAS AT A MINIMUM OF 1-2 INCHES BELOW TOP OF CURB, SIDEWALKS, OR PAVEMENT
S6	PROTECT SLOPES AND CHANNELS AND PROVIDE ENERGY DISSIPATION

ACREAGE SUMMARY

IMPERVIOUS AREA = 5.32 AC APPROX.
PERVIOUS AREA = 4.59 AC APPROX.
TOTAL ONSITE DRAINAGE AREA TO CHANNEL=9.91 AC

60 0 30 60 120
SCALE 1" = 60'

SEAL-DESIGN ENGINEER
REGISTERED PROFESSIONAL ENGINEER
JEFFREY T OKAMOTO
No. 46049
Expiration 12-31-22
CIVIL
STATE OF CALIFORNIA

OWNER:
MLC Holdings, Inc.
5 PETERS CANYON, SUITE 310
IRVINE, CA 92606
CONTACT: JOHANNA CROOKER (949) 299-3847

PREPARED BY:
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Huitt-Zollars, Inc. Irvine
2603 Main Street, Suite 400
Irvine, California 92614-4250
Phone (949) 988-5815 Fax (949) 988-5820

DESIGNED BY HZ
DRAWN BY NL
CHECKED BY JTO
DATE 5/9/22

CITY OF REDLANDS
WQMP EXHIBIT

SHEET 1 OF 1 SHEETS
JOB NO. R314340.01

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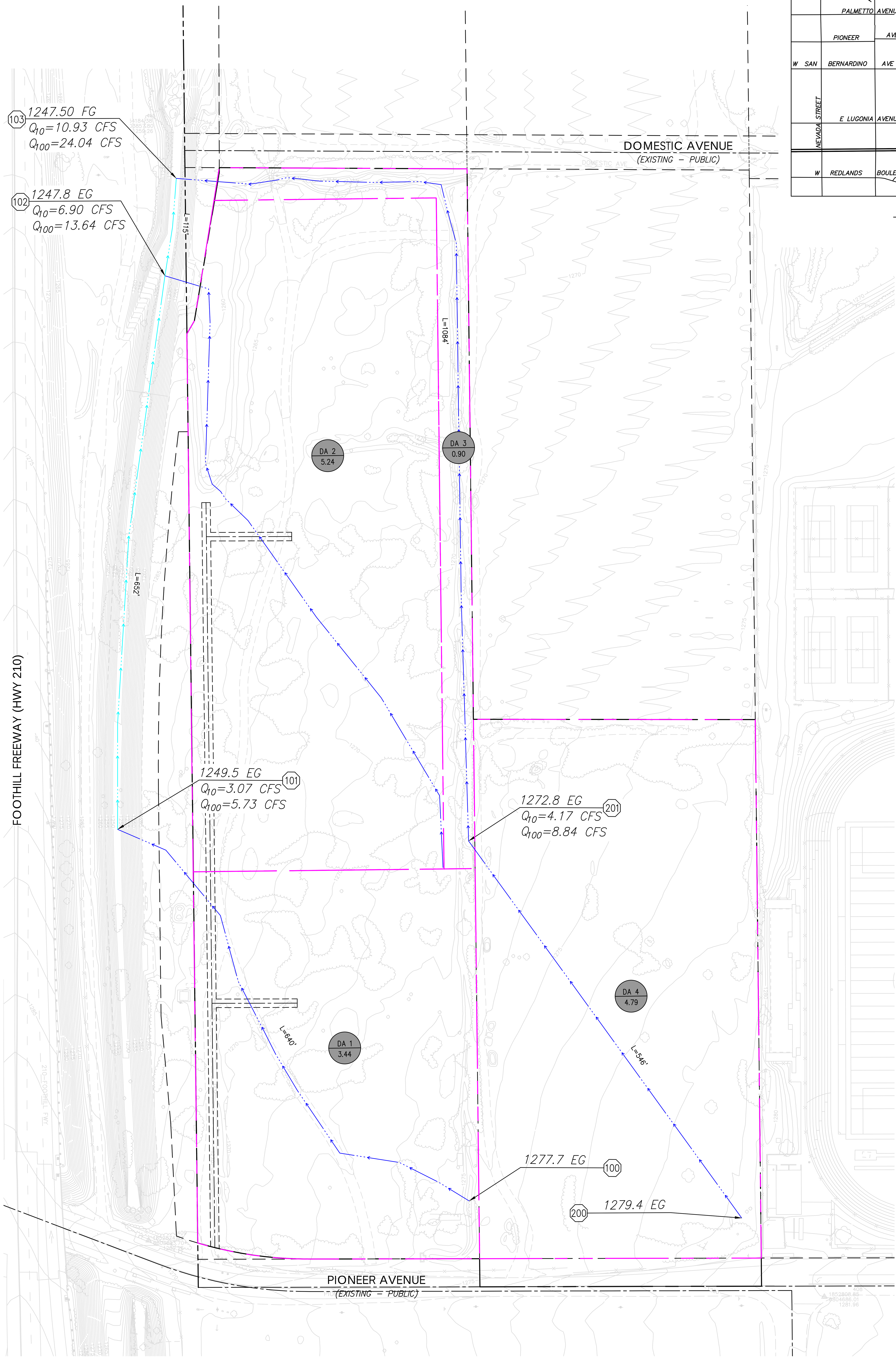
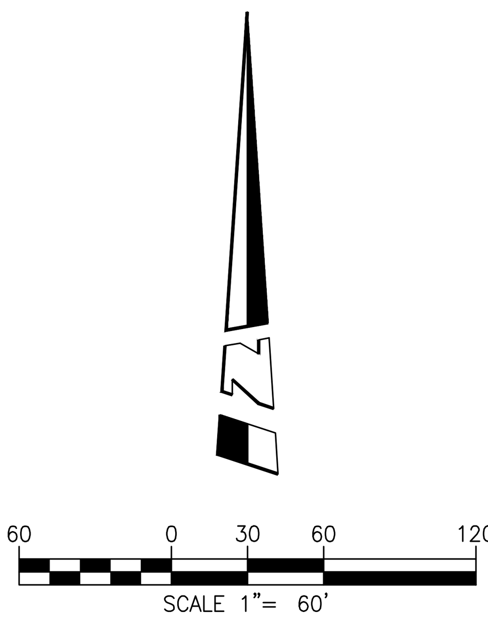
VICINITY MAP
NOT TO SCALE



EXISTING DRAINAGE EXHIBIT



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PREPARED FOR:
MLC Holdings, Inc.

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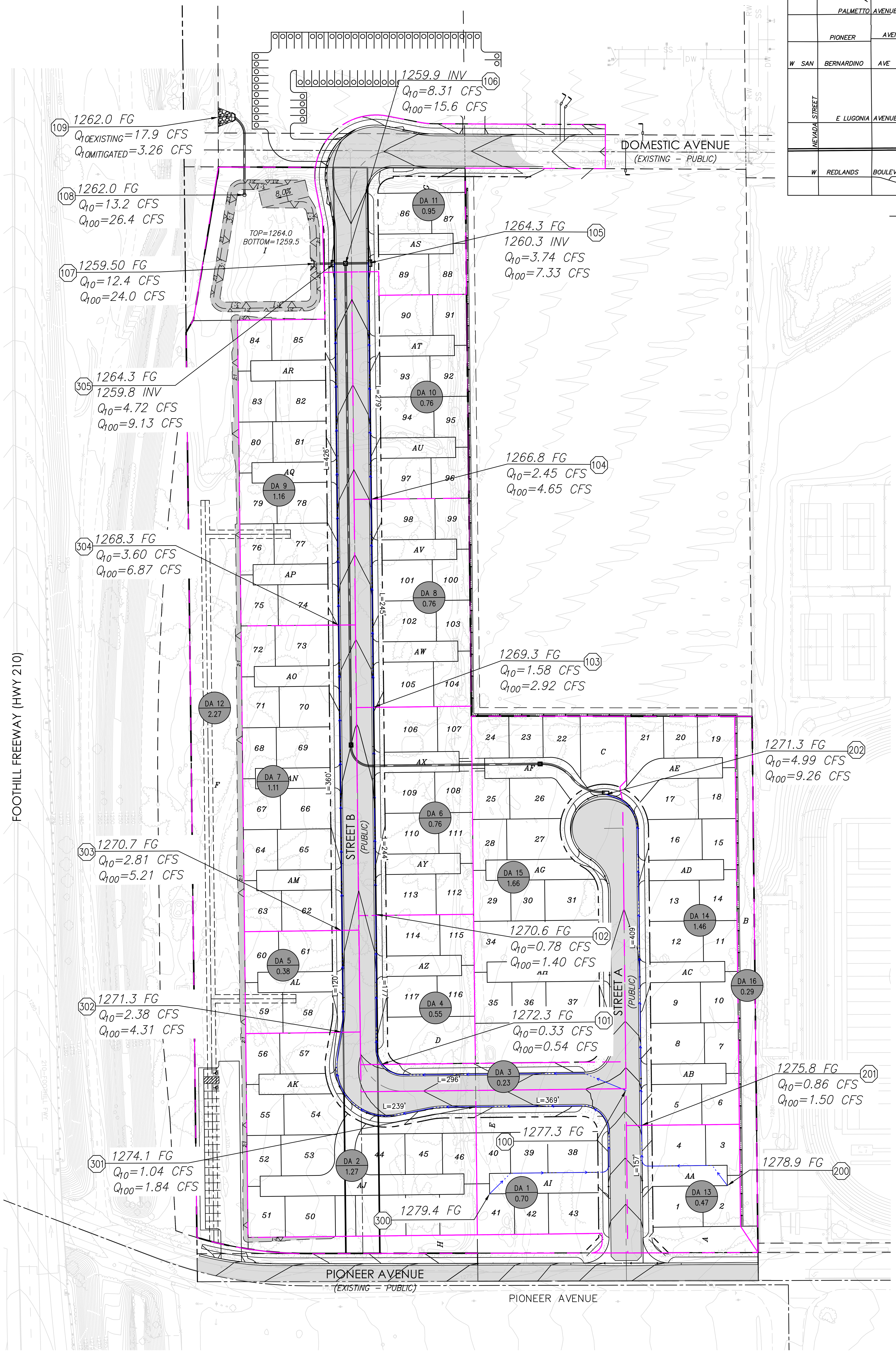
VICINITY MAP

NOT TO SCALE



PROPOSED DRAINAGE EXHIBIT

- FEMA FLOOD ZONE: ZONE X
- FEMA FLOOD MAP: 06071C8704H
- EXISTING ZONING DESIGNATION: EVSP/SRP (EAST VALLEY SPECIFIC PLAN/ SCIENCE RESEARCH PARK)
- PROPOSED ZONING DESIGNATION: N/A
- NUMBER OF LOTS (SFR–MOTORCOURT): 75
- AVERAGE LOT SIZE (SFR–MOTORCOURT): 2,521 SF
- EXISTING LAND USE: AGRICULTURAL
- PROPOSED LAND USE: SINGLE FAMILY RESIDENTIAL
- EXISTING GENERAL PLAN DESIGNATION: LOW DENSITY RESIDENTIAL
- EXISTING SPECIFIC PLAN IDENTIFICATION: EVCSP (EAST VALLEY CORRIDOR SPECIFIC PLAN)
- EXISTING LOT – 9.56 ACRES
- PROPOSED OPEN SPACE – 2.08 ACRES

OPEN SPACE

60 0 30 60 120

SCALE 1"= 60'

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PREPARED FOR:
MLC Holdings, Inc.

Q:\R314340.01 – MLC Redlands ALTA\10 CADD & BIM\10.13 Civil\EX\HHWQ\Proposed DA.dwg, Layout: PROP HYDRO, Nov 10 2022 3:19pm

Attachment B

LID BMP Sizing

```
****************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
          (Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
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             Ver. 21.0  Release Date: 06/01/2014  License ID 1202

                           Analysis prepared by:

                            Huitt-Zollars, Inc.
                        2603 Main Street, Irvine CA
                                 Suite 400
                                949-988-9815

 ************************** DESCRIPTION OF STUDY **************************
* PIONEER AVENUE REDLANDS EXISTING HYDROLOGY                               *
* 10 YEAR STORM EVENT                                                      *
* RYAN KIM HC 05/09/22                                                     *
 **************************************************************************

  FILE NAME: PIO10E.DAT
  TIME/DATE OF STUDY: 14:08 05/09/2022
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                   --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   10.00
  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*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.4680
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 0.7500

  *ANTECEDENT MOISTURE CONDITION (AMC) II 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    100.00 TO NODE    101.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   640.00
  ELEVATION DATA: UPSTREAM(FEET) =   1277.70  DOWNSTREAM(FEET) =   1265.80
```

```
  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   15.444
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  1.415
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  AGRICULTURAL POOR COVER
  "FALLOW"                   A        3.44      0.43     1.000    77   15.44
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.43
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA RUNOFF(CFS) =      3.04
  TOTAL AREA(ACRES) =      3.44   PEAK FLOW RATE(CFS) =      3.04

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1249.50  DOWNSTREAM(FEET) =   1247.80
  CHANNEL LENGTH THRU SUBAREA(FEET) =   652.00   CHANNEL SLOPE =  0.0026
  CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =   1.500
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =  10.00
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  1.200
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        0.84      0.98     0.100    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.98
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.46
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.67
  AVERAGE FLOW DEPTH(FEET) =   0.20   TRAVEL TIME(MIN.) =   6.52
  Tc(MIN.) =   21.96
  SUBAREA AREA(ACRES) =     0.84       SUBAREA RUNOFF(CFS) =    0.83
  EFFECTIVE AREA(ACRES) =      4.28     AREA-AVERAGED Fm(INCH/HR) =   0.37
  AREA-AVERAGED Fp(INCH/HR) =   0.45  AREA-AVERAGED Ap =   0.82
  TOTAL AREA(ACRES) =        4.3         PEAK FLOW RATE(CFS) =       3.21

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.19   FLOW VELOCITY(FEET/SEC.) =   1.61
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =    1292.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    102.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   21.96
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  1.200
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  AGRICULTURAL POOR COVER
  "FALLOW"                   A        5.24      0.43     1.000    77
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.43
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA AREA(ACRES) =    5.24      SUBAREA RUNOFF(CFS) =    3.61
  EFFECTIVE AREA(ACRES) =      9.52   AREA-AVERAGED Fm(INCH/HR) =  0.40
  AREA-AVERAGED Fp(INCH/HR) =  0.44  AREA-AVERAGED Ap =  0.92
  TOTAL AREA(ACRES) =        9.5       PEAK FLOW RATE(CFS) =      6.82
```

```
****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    103.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1247.80  DOWNSTREAM(FEET) =   1247.50
  CHANNEL LENGTH THRU SUBAREA(FEET) =   115.00   CHANNEL SLOPE =  0.0026
  CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =   1.500
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =  10.00
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  1.179
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp        Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        0.13      0.98     0.100    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.98
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      6.88
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.19
  AVERAGE FLOW DEPTH(FEET) =   0.30   TRAVEL TIME(MIN.) =   0.87
  Tc(MIN.) =   22.84
  SUBAREA AREA(ACRES) =     0.13       SUBAREA RUNOFF(CFS) =    0.13
  EFFECTIVE AREA(ACRES) =      9.65     AREA-AVERAGED Fm(INCH/HR) =   0.40
  AREA-AVERAGED Fp(INCH/HR) =   0.44  AREA-AVERAGED Ap =   0.91
  TOTAL AREA(ACRES) =        9.7         PEAK FLOW RATE(CFS) =      6.82
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.30   FLOW VELOCITY(FEET/SEC.) =   2.17
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    103.00 =    1407.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    103.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    200.00 TO NODE    201.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   546.00
  ELEVATION DATA: UPSTREAM(FEET) =   1279.40  DOWNSTREAM(FEET) =   1272.80

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   15.797
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  1.401
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp        Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  AGRICULTURAL POOR COVER
  "FALLOW"                   A        4.79      0.43     1.000    77   15.80
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.43
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA RUNOFF(CFS) =      4.17
  TOTAL AREA(ACRES) =      4.79   PEAK FLOW RATE(CFS) =      4.17

****************************************************************************
```

```
  FLOW PROCESS FROM NODE    201.00 TO NODE    103.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1272.80  DOWNSTREAM(FEET) =   1260.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =  1084.00   CHANNEL SLOPE =  0.0118
  CHANNEL FLOW THRU SUBAREA(CFS) =       4.17
  FLOW VELOCITY(FEET/SEC) =   2.20 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   8.22   Tc(MIN.) =   24.02
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    103.00 =    1630.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    103.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   24.02
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  1.151
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  NATURAL POOR COVER
  "BARREN"                   A        0.90      0.42     1.000    78
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA AREA(ACRES) =    0.90      SUBAREA RUNOFF(CFS) =    0.60
  EFFECTIVE AREA(ACRES) =      5.69   AREA-AVERAGED Fm(INCH/HR) =  0.43
  AREA-AVERAGED Fp(INCH/HR) =  0.43  AREA-AVERAGED Ap =  1.00
  TOTAL AREA(ACRES) =        5.7       PEAK FLOW RATE(CFS) =       4.17
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    103.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        4.17   24.02    1.151  0.43( 0.43) 1.00       5.7     200.00
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    103.00 =    1630.00 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        6.82   22.84    1.179  0.44( 0.40) 0.91       9.7     100.00
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    103.00 =    1407.00 FEET.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       10.93   22.84    1.179  0.44( 0.41) 0.94      15.1     100.00
      2       10.75   24.02    1.151  0.44( 0.41) 0.94      15.3     200.00
    TOTAL AREA(ACRES) =        15.3

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       10.93  Tc(MIN.) =   22.835
  EFFECTIVE AREA(ACRES) =     15.06  AREA-AVERAGED Fm(INCH/HR) =  0.41
  AREA-AVERAGED Fp(INCH/HR) =  0.44  AREA-AVERAGED Ap =  0.94
```

```
  TOTAL AREA(ACRES) =       15.3
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    103.00 =    1630.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    103.00 IS CODE =  12
----------------------------------------------------------------------------
  >>>>>CLEAR MEMORY BANK # 1 <<<<<
============================================================================
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =       15.3  TC(MIN.) =     22.84
  EFFECTIVE AREA(ACRES) =     15.06  AREA-AVERAGED Fm(INCH/HR)=  0.41
  AREA-AVERAGED Fp(INCH/HR) =  0.44  AREA-AVERAGED Ap = 0.942
  PEAK FLOW RATE(CFS)   =      10.93

  ** PEAK FLOW RATE TABLE **
   STREAM      Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       10.93   22.84    1.179  0.44( 0.41) 0.94      15.1     100.00
      2       10.75   24.02    1.151  0.44( 0.41) 0.94      15.3     200.00
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************
              RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
           (Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
          (c) Copyright 1983-2014 Advanced Engineering Software (aes)
              Ver. 21.0  Release Date: 06/01/2014  License ID 1202

                            Analysis prepared by:

                             Huitt-Zollars, Inc.
                         2603 Main Street, Irvine CA
                                  Suite 400
                                 949-988-9815

 ************************** DESCRIPTION OF STUDY **************************
* PIONEER AVENUE REDLANDS EXISTING HYDROLOGY                               *
* 100 YEAR STORM EVENT                                                     *
* RYAN KIM HC 05/09/22                                                     *
 **************************************************************************

  FILE NAME: PIO100E.DAT
  TIME/DATE OF STUDY: 14:14 05/09/2022
============================================================================
  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*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.4680
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.2000

  *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    100.00 TO NODE    101.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   640.00
  ELEVATION DATA: UPSTREAM(FEET) =   1277.70  DOWNSTREAM(FEET) =   1265.80
```

```
  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   15.444
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.265
  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.)
  AGRICULTURAL POOR COVER
  "FALLOW"                   A        3.44      0.19     1.000    92   15.44
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.19
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA RUNOFF(CFS) =      6.42
  TOTAL AREA(ACRES) =      3.44   PEAK FLOW RATE(CFS) =      6.42

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1249.50  DOWNSTREAM(FEET) =   1247.80
  CHANNEL LENGTH THRU SUBAREA(FEET) =   652.00   CHANNEL SLOPE =  0.0026
  CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =   1.500
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =  10.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  1.991
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        0.84      0.74     0.100    52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.74
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       7.15
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.22
  AVERAGE FLOW DEPTH(FEET) =   0.31   TRAVEL TIME(MIN.) =   4.90
  Tc(MIN.) =   20.34
  SUBAREA AREA(ACRES) =     0.84       SUBAREA RUNOFF(CFS) =    1.45
  EFFECTIVE AREA(ACRES) =      4.28     AREA-AVERAGED Fm(INCH/HR) =   0.17
  AREA-AVERAGED Fp(INCH/HR) =   0.20  AREA-AVERAGED Ap =   0.82
  TOTAL AREA(ACRES) =        4.3         PEAK FLOW RATE(CFS) =       7.02

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.30   FLOW VELOCITY(FEET/SEC.) =   2.22
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =    1292.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    102.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   20.34
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  1.991
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  AGRICULTURAL POOR COVER
  "FALLOW"                   A        5.24      0.19     1.000    92
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.19
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA AREA(ACRES) =    5.24      SUBAREA RUNOFF(CFS) =    8.49
  EFFECTIVE AREA(ACRES) =      9.52   AREA-AVERAGED Fm(INCH/HR) =  0.18
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.92
  TOTAL AREA(ACRES) =        9.5       PEAK FLOW RATE(CFS) =      15.52
```

```
****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    103.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1247.80  DOWNSTREAM(FEET) =   1247.50
  CHANNEL LENGTH THRU SUBAREA(FEET) =   115.00   CHANNEL SLOPE =  0.0026
  CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =   1.500
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =  10.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  1.962
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        0.13      0.74     0.100    52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.74
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      15.63
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.96
  AVERAGE FLOW DEPTH(FEET) =   0.49   TRAVEL TIME(MIN.) =   0.65
  Tc(MIN.) =   20.99
  SUBAREA AREA(ACRES) =     0.13       SUBAREA RUNOFF(CFS) =    0.22
  EFFECTIVE AREA(ACRES) =      9.65     AREA-AVERAGED Fm(INCH/HR) =   0.18
  AREA-AVERAGED Fp(INCH/HR) =   0.20  AREA-AVERAGED Ap =   0.91
  TOTAL AREA(ACRES) =        9.7         PEAK FLOW RATE(CFS) =      15.52
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.49   FLOW VELOCITY(FEET/SEC.) =   2.94
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    103.00 =    1407.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    103.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    200.00 TO NODE    201.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   546.00
  ELEVATION DATA: UPSTREAM(FEET) =   1279.40  DOWNSTREAM(FEET) =   1272.80

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   15.797
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.241
  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.)
  AGRICULTURAL POOR COVER
  "FALLOW"                   A        4.79      0.19     1.000    92   15.80
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.19
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA RUNOFF(CFS) =      8.84
  TOTAL AREA(ACRES) =      4.79   PEAK FLOW RATE(CFS) =      8.84

****************************************************************************
```

```
  FLOW PROCESS FROM NODE    201.00 TO NODE    103.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1272.80  DOWNSTREAM(FEET) =   1260.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =  1084.00   CHANNEL SLOPE =  0.0118
  CHANNEL FLOW THRU SUBAREA(CFS) =      8.84
  FLOW VELOCITY(FEET/SEC) =   2.63 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   6.86   Tc(MIN.) =   22.66
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    103.00 =    1630.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    103.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   22.66
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  1.893
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  NATURAL POOR COVER
  "BARREN"                   A        0.90      0.18     1.000    93
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.18
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA AREA(ACRES) =    0.90      SUBAREA RUNOFF(CFS) =    1.39
  EFFECTIVE AREA(ACRES) =      5.69   AREA-AVERAGED Fm(INCH/HR) =  0.19
  AREA-AVERAGED Fp(INCH/HR) =  0.19  AREA-AVERAGED Ap =  1.00
  TOTAL AREA(ACRES) =        5.7       PEAK FLOW RATE(CFS) =      8.84
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    103.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        8.84   22.66    1.893  0.19( 0.19) 1.00       5.7     200.00
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    103.00 =    1630.00 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       15.52   20.99    1.962  0.20( 0.18) 0.91       9.7     100.00
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    103.00 =    1407.00 FEET.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       24.04   20.99    1.962  0.19( 0.18) 0.94      14.9     100.00
      2       23.76   22.66    1.893  0.19( 0.18) 0.94      15.3     200.00
    TOTAL AREA(ACRES) =        15.3

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       24.04  Tc(MIN.) =   20.990
  EFFECTIVE AREA(ACRES) =     14.92  AREA-AVERAGED Fm(INCH/HR) =  0.18
  AREA-AVERAGED Fp(INCH/HR) =  0.19  AREA-AVERAGED Ap =  0.94
```

```
  TOTAL AREA(ACRES) =       15.3
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    103.00 =    1630.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    103.00 IS CODE =  12
----------------------------------------------------------------------------
  >>>>>CLEAR MEMORY BANK # 1 <<<<<
============================================================================
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =       15.3  TC(MIN.) =     20.99
  EFFECTIVE AREA(ACRES) =     14.92  AREA-AVERAGED Fm(INCH/HR)=  0.18
  AREA-AVERAGED Fp(INCH/HR) =  0.19  AREA-AVERAGED Ap = 0.941
  PEAK FLOW RATE(CFS)   =      24.04

  ** PEAK FLOW RATE TABLE **
   STREAM      Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       24.04   20.99    1.962  0.19( 0.18) 0.94      14.9     100.00
      2       23.76   22.66    1.893  0.19( 0.18) 0.94      15.3     200.00
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
          (Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
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             Ver. 21.0  Release Date: 06/01/2014  License ID 1202

                           Analysis prepared by:

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 ************************** DESCRIPTION OF STUDY **************************
* PIONEER AVENUE REDLANDS HYDROLOGY                                        *
* 10 YEAR STORM EVENT PROPOSED CONDITION                                   *
* RYAN KIM HC 05/06/22                                                     *
 **************************************************************************

  FILE NAME: PIO10P.DAT
  TIME/DATE OF STUDY: 16:57 05/06/2022
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                  --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   10.00
  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*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.4680
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 0.7500

  *ANTECEDENT MOISTURE CONDITION (AMC) II 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     17.8    0.020/0.020/ ---    0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.67 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (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    100.00 TO NODE    101.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   282.00
  ELEVATION DATA: UPSTREAM(FEET) =   1277.30  DOWNSTREAM(FEET) =   1272.30
```

```
  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.505
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.122
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 A       0.18      0.98     0.100    32    6.50
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.97
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      0.33
  TOTAL AREA(ACRES) =      0.18   PEAK FLOW RATE(CFS) =      0.33

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1272.30  DOWNSTREAM ELEVATION(FEET) = 1271.00
  STREET LENGTH(FEET) =   124.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  17.80
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.57
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.22
    HALFSTREET FLOOD WIDTH(FEET) =    3.18
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.95
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.43
  STREET FLOW TRAVEL TIME(MIN.) =   1.06   Tc(MIN.) =    7.56
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  1.977
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A       0.06      0.98     0.100    32
  PUBLIC PARK                A       0.13      0.98     0.850    32
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"      A       0.17      0.98     0.400    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.98
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.512
  SUBAREA AREA(ACRES) =    0.36      SUBAREA RUNOFF(CFS) =    0.48
  EFFECTIVE AREA(ACRES) =      0.54    AREA-AVERAGED Fm(INCH/HR) =  0.37
  AREA-AVERAGED Fp(INCH/HR) =  0.98  AREA-AVERAGED Ap =  0.38
  TOTAL AREA(ACRES) =        0.5       PEAK FLOW RATE(CFS) =      0.78

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.25   HALFSTREET FLOOD WIDTH(FEET) =   4.65
  FLOW VELOCITY(FEET/SEC.) =  1.93   DEPTH*VELOCITY(FT*FT/SEC.) =   0.48
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =     406.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    103.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
```

```
==========================================================================
  UPSTREAM ELEVATION(FEET) = 1271.00  DOWNSTREAM ELEVATION(FEET) = 1269.80
  STREET LENGTH(FEET) =   240.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  17.80
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.25
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.32
    HALFSTREET FLOOD WIDTH(FEET) =    7.99
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.51
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.48
  STREET FLOW TRAVEL TIME(MIN.) =   2.66   Tc(MIN.) =   10.22
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  1.717
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        0.11      0.98     0.100    32
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"      A        0.64      0.98     0.400    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.98
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.356
  SUBAREA AREA(ACRES) =    0.75      SUBAREA RUNOFF(CFS) =    0.92
  EFFECTIVE AREA(ACRES) =      1.29    AREA-AVERAGED Fm(INCH/HR) =  0.35
  AREA-AVERAGED Fp(INCH/HR) =  0.98  AREA-AVERAGED Ap =  0.36
  TOTAL AREA(ACRES) =        1.3        PEAK FLOW RATE(CFS) =       1.58

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.34   HALFSTREET FLOOD WIDTH(FEET) =   9.03
  FLOW VELOCITY(FEET/SEC.) =  1.57   DEPTH*VELOCITY(FT*FT/SEC.) =   0.53
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    103.00 =     646.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    104.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
==========================================================================
  UPSTREAM ELEVATION(FEET) = 1269.80  DOWNSTREAM ELEVATION(FEET) = 1266.80
  STREET LENGTH(FEET) =   317.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  17.80
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.11
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.34
    HALFSTREET FLOOD WIDTH(FEET) =    8.92
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.15
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.72
```

```
  STREET FLOW TRAVEL TIME(MIN.) =   2.46   Tc(MIN.) =   12.68
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  1.552
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A       0.15      0.98     0.100    32
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"      A       0.83      0.98     0.400    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.97
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.354
  SUBAREA AREA(ACRES) =    0.98      SUBAREA RUNOFF(CFS) =    1.06
  EFFECTIVE AREA(ACRES) =      2.27    AREA-AVERAGED Fm(INCH/HR) =  0.35
  AREA-AVERAGED Fp(INCH/HR) =  0.98  AREA-AVERAGED Ap =  0.36
  TOTAL AREA(ACRES) =        2.3        PEAK FLOW RATE(CFS) =       2.45

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.35   HALFSTREET FLOOD WIDTH(FEET) =   9.57
  FLOW VELOCITY(FEET/SEC.) =  2.22   DEPTH*VELOCITY(FT*FT/SEC.) =   0.78
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    104.00 =     963.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    104.00 TO NODE    105.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1266.80  DOWNSTREAM ELEVATION(FEET) = 1264.30
  STREET LENGTH(FEET) =   279.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  17.80
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.83
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.37
    HALFSTREET FLOOD WIDTH(FEET) =   10.34
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.25
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.82
  STREET FLOW TRAVEL TIME(MIN.) =   2.07   Tc(MIN.) =   14.75
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  1.446
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A       0.13      0.98     0.100    32
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"      A       0.63      0.98     0.400    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.98
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.349
  SUBAREA AREA(ACRES) =    0.76      SUBAREA RUNOFF(CFS) =    0.76
  EFFECTIVE AREA(ACRES) =      3.03    AREA-AVERAGED Fm(INCH/HR) =  0.35
  AREA-AVERAGED Fp(INCH/HR) =  0.98  AREA-AVERAGED Ap =  0.36
  TOTAL AREA(ACRES) =        3.0        PEAK FLOW RATE(CFS) =       3.00

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.37   HALFSTREET FLOOD WIDTH(FEET) =  10.61
  FLOW VELOCITY(FEET/SEC.) =  2.28   DEPTH*VELOCITY(FT*FT/SEC.) =   0.84
```

```
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    105.00 =    1242.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    105.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   14.75
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  1.446
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A       0.18      0.98     0.100    32
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"      A       0.38      0.98     0.400    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.98
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.304
  SUBAREA AREA(ACRES) =    0.56      SUBAREA RUNOFF(CFS) =    0.58
  EFFECTIVE AREA(ACRES) =      3.59   AREA-AVERAGED Fm(INCH/HR) =  0.34
  AREA-AVERAGED Fp(INCH/HR) =  0.98  AREA-AVERAGED Ap =  0.35
  TOTAL AREA(ACRES) =        3.6       PEAK FLOW RATE(CFS) =      3.58

****************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    105.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   14.75
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  1.446
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                A       0.29      0.98     0.850    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.98
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  SUBAREA AREA(ACRES) =    0.29      SUBAREA RUNOFF(CFS) =    0.16
  EFFECTIVE AREA(ACRES) =      3.88   AREA-AVERAGED Fm(INCH/HR) =  0.38
  AREA-AVERAGED Fp(INCH/HR) =  0.98  AREA-AVERAGED Ap =  0.39
  TOTAL AREA(ACRES) =        3.9       PEAK FLOW RATE(CFS) =      3.74

****************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    106.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1260.30  DOWNSTREAM(FEET) =  1259.90
  FLOW LENGTH(FEET) =    31.90   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   9.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.64
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.74
  PIPE TRAVEL TIME(MIN.) =   0.09    Tc(MIN.) =   14.84
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    106.00 =    1273.90 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    106.00 TO NODE    106.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================
```

```
****************************************************************************
  FLOW PROCESS FROM NODE    200.00 TO NODE    201.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   157.00
  ELEVATION DATA: UPSTREAM(FEET) =   1278.90  DOWNSTREAM(FEET) =   1275.80

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.037
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.391
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 A        0.06      0.98     0.100    32    5.04
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"      A        0.41      0.98     0.400    32    6.20
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.98
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.362
  SUBAREA RUNOFF(CFS) =      0.86
  TOTAL AREA(ACRES) =      0.47   PEAK FLOW RATE(CFS) =      0.86

****************************************************************************
  FLOW PROCESS FROM NODE    201.00 TO NODE    202.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1275.80  DOWNSTREAM ELEVATION(FEET) = 1271.30
  STREET LENGTH(FEET) =   409.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  17.80
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.89
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.32
    HALFSTREET FLOOD WIDTH(FEET) =    8.10
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.24
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.72
  STREET FLOW TRAVEL TIME(MIN.) =   3.05   Tc(MIN.) =    8.08
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  1.916
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        0.15      0.98     0.100    32
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"      A        1.31      0.98     0.400    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.98
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.369
  SUBAREA AREA(ACRES) =    1.46      SUBAREA RUNOFF(CFS) =    2.05
  EFFECTIVE AREA(ACRES) =      1.93    AREA-AVERAGED Fm(INCH/HR) =  0.36
  AREA-AVERAGED Fp(INCH/HR) =  0.98  AREA-AVERAGED Ap =  0.37
  TOTAL AREA(ACRES) =       1.9       PEAK FLOW RATE(CFS) =       2.71
```

```
  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.35   HALFSTREET FLOOD WIDTH(FEET) =   9.68
  FLOW VELOCITY(FEET/SEC.) =  2.40   DEPTH*VELOCITY(FT*FT/SEC.) =   0.85
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    202.00 =     566.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    202.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    8.08
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  1.916
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE           GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                A       0.19      0.98     0.100    32
  PUBLIC PARK               A       0.26      0.98     0.850    32
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"     A       1.25      0.98     0.400    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.98
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.435
  SUBAREA AREA(ACRES) =    1.70      SUBAREA RUNOFF(CFS) =    2.28
  EFFECTIVE AREA(ACRES) =      3.63   AREA-AVERAGED Fm(INCH/HR) =  0.39
  AREA-AVERAGED Fp(INCH/HR) =  0.98  AREA-AVERAGED Ap =  0.40
  TOTAL AREA(ACRES) =        3.6       PEAK FLOW RATE(CFS) =      4.99

****************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    106.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1267.30  DOWNSTREAM(FEET) =  1259.90
  FLOW LENGTH(FEET) =   894.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  15.0 INCH PIPE IS  10.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.26
  ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       4.99
  PIPE TRAVEL TIME(MIN.) =   2.83    Tc(MIN.) =   10.91
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    106.00 =    1460.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    106.00 TO NODE    106.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        4.99   10.91    1.665  0.98( 0.39) 0.40       3.6     200.00
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    106.00 =    1460.00 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        3.74   14.84    1.442  0.98( 0.38) 0.39       3.9     100.00
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    106.00 =    1273.90 FEET.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
```

```
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        8.31   10.91    1.665  0.97( 0.38) 0.39       6.5     200.00
      2        7.85   14.84    1.442  0.98( 0.38) 0.39       7.5     100.00
    TOTAL AREA(ACRES) =         7.5

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =        8.31  Tc(MIN.) =   10.914
  EFFECTIVE AREA(ACRES) =      6.48  AREA-AVERAGED Fm(INCH/HR) =  0.38
  AREA-AVERAGED Fp(INCH/HR) =  0.97  AREA-AVERAGED Ap =  0.39
  TOTAL AREA(ACRES) =        7.5
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    106.00 =    1460.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    106.00 TO NODE    106.00 IS CODE =  12
----------------------------------------------------------------------------
  >>>>>CLEAR MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    106.00 TO NODE    305.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1259.90  DOWNSTREAM(FEET) =  1259.80
  FLOW LENGTH(FEET) =     7.80   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  11.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.13
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       8.31
  PIPE TRAVEL TIME(MIN.) =   0.02    Tc(MIN.) =   10.93
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    305.00 =    1467.80 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    305.00 TO NODE    305.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 2 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    300.00 TO NODE    301.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   369.00
  ELEVATION DATA: UPSTREAM(FEET) =   1279.40  DOWNSTREAM(FEET) =   1274.10

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.555
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  1.978
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 A       0.15      0.98     0.100    32    7.55
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"      A       0.55      0.98     0.400    32    9.29
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.97
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.336
  SUBAREA RUNOFF(CFS) =      1.04
  TOTAL AREA(ACRES) =      0.70   PEAK FLOW RATE(CFS) =      1.04
```

```
****************************************************************************
  FLOW PROCESS FROM NODE    301.00 TO NODE    302.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1274.10  DOWNSTREAM ELEVATION(FEET) = 1271.50
  STREET LENGTH(FEET) =   176.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  17.80
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.75
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.30
    HALFSTREET FLOOD WIDTH(FEET) =    7.17
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.49
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.75
  STREET FLOW TRAVEL TIME(MIN.) =   1.18   Tc(MIN.) =    8.73
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  1.848
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A       0.07      0.98     0.100    32
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"      A       1.00      0.98     0.400    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.98
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.380
  SUBAREA AREA(ACRES) =    1.07      SUBAREA RUNOFF(CFS) =    1.42
  EFFECTIVE AREA(ACRES) =      1.77    AREA-AVERAGED Fm(INCH/HR) =  0.35
  AREA-AVERAGED Fp(INCH/HR) =  0.98  AREA-AVERAGED Ap =  0.36
  TOTAL AREA(ACRES) =        1.8        PEAK FLOW RATE(CFS) =       2.38

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.33   HALFSTREET FLOOD WIDTH(FEET) =   8.43
  FLOW VELOCITY(FEET/SEC.) =  2.65   DEPTH*VELOCITY(FT*FT/SEC.) =   0.87
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    302.00 =     545.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    302.00 TO NODE    303.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1271.50  DOWNSTREAM ELEVATION(FEET) = 1270.70
  STREET LENGTH(FEET) =   183.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  17.80
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
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    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.72
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.40
    HALFSTREET FLOOD WIDTH(FEET) =   11.93
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.69
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.67
  STREET FLOW TRAVEL TIME(MIN.) =   1.81   Tc(MIN.) =   10.54
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  1.693
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A       0.09      0.98     0.100    32
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"      A       0.47      0.98     0.400    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.98
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.352
  SUBAREA AREA(ACRES) =    0.56      SUBAREA RUNOFF(CFS) =    0.68
  EFFECTIVE AREA(ACRES) =      2.33    AREA-AVERAGED Fm(INCH/HR) =  0.35
  AREA-AVERAGED Fp(INCH/HR) =  0.98  AREA-AVERAGED Ap =  0.36
  TOTAL AREA(ACRES) =        2.3        PEAK FLOW RATE(CFS) =       2.81

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.40   HALFSTREET FLOOD WIDTH(FEET) =  12.09
  FLOW VELOCITY(FEET/SEC.) =  1.70   DEPTH*VELOCITY(FT*FT/SEC.) =   0.68
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    303.00 =     728.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    303.00 TO NODE    304.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1270.70  DOWNSTREAM ELEVATION(FEET) = 1268.30
  STREET LENGTH(FEET) =   360.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  17.80
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.39
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.40
    HALFSTREET FLOOD WIDTH(FEET) =   11.98
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.09
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.83
  STREET FLOW TRAVEL TIME(MIN.) =   2.87   Tc(MIN.) =   13.41
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  1.512
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A       0.16      0.98     0.100    32
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"      A       0.95      0.98     0.400    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.98
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.357
  SUBAREA AREA(ACRES) =    1.11      SUBAREA RUNOFF(CFS) =    1.16
  EFFECTIVE AREA(ACRES) =      3.44    AREA-AVERAGED Fm(INCH/HR) =  0.35
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  AREA-AVERAGED Fp(INCH/HR) =  0.98  AREA-AVERAGED Ap =  0.36
  TOTAL AREA(ACRES) =        3.4        PEAK FLOW RATE(CFS) =       3.60

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.40   HALFSTREET FLOOD WIDTH(FEET) =  12.31
  FLOW VELOCITY(FEET/SEC.) =  2.11   DEPTH*VELOCITY(FT*FT/SEC.) =   0.85
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    304.00 =    1088.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    304.00 TO NODE    305.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1268.30  DOWNSTREAM ELEVATION(FEET) = 1264.30
  STREET LENGTH(FEET) =   426.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  17.80
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       4.14
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.40
    HALFSTREET FLOOD WIDTH(FEET) =   12.14
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.49
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.00
  STREET FLOW TRAVEL TIME(MIN.) =   2.85   Tc(MIN.) =   16.27
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  1.382
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        0.19      0.98     0.100    32
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"      A        0.97      0.98     0.400    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.98
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.351
  SUBAREA AREA(ACRES) =    1.16      SUBAREA RUNOFF(CFS) =    1.09
  EFFECTIVE AREA(ACRES) =      4.60    AREA-AVERAGED Fm(INCH/HR) =  0.35
  AREA-AVERAGED Fp(INCH/HR) =  0.98  AREA-AVERAGED Ap =  0.36
  TOTAL AREA(ACRES) =        4.6        PEAK FLOW RATE(CFS) =       4.28

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.40   HALFSTREET FLOOD WIDTH(FEET) =  12.31
  FLOW VELOCITY(FEET/SEC.) =  2.51   DEPTH*VELOCITY(FT*FT/SEC.) =   1.02
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    305.00 =    1514.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    305.00 TO NODE    305.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   16.27
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  1.382
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
```

```
  COMMERCIAL                 A        0.38      0.98     0.100    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.98
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.38      SUBAREA RUNOFF(CFS) =    0.44
  EFFECTIVE AREA(ACRES) =      4.98   AREA-AVERAGED Fm(INCH/HR) =  0.33
  AREA-AVERAGED Fp(INCH/HR) =  0.98  AREA-AVERAGED Ap =  0.34
  TOTAL AREA(ACRES) =        5.0       PEAK FLOW RATE(CFS) =      4.72

****************************************************************************
  FLOW PROCESS FROM NODE    305.00 TO NODE    305.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 2 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        4.72   16.27    1.382  0.98( 0.33) 0.34       5.0     300.00
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    305.00 =    1514.00 FEET.

  ** MEMORY BANK #  2 CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        8.31   10.93    1.664  0.97( 0.38) 0.39       6.5     200.00
      2        7.85   14.86    1.441  0.98( 0.38) 0.39       7.5     100.00
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    305.00 =    1467.80 FEET.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       12.33   10.93    1.664  0.98( 0.36) 0.37       9.8     200.00
      2       12.41   14.86    1.441  0.98( 0.36) 0.37      12.1     100.00
      3       12.13   16.27    1.382  0.98( 0.36) 0.37      12.5     300.00
    TOTAL AREA(ACRES) =        12.5

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       12.41  Tc(MIN.) =   14.859
  EFFECTIVE AREA(ACRES) =     12.06  AREA-AVERAGED Fm(INCH/HR) =  0.36
  AREA-AVERAGED Fp(INCH/HR) =  0.98  AREA-AVERAGED Ap =  0.37
  TOTAL AREA(ACRES) =       12.5
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    305.00 =    1514.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    305.00 TO NODE    305.00 IS CODE =  12
----------------------------------------------------------------------------
  >>>>>CLEAR MEMORY BANK # 2 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    305.00 TO NODE    107.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1259.80  DOWNSTREAM(FEET) =  1259.50
  FLOW LENGTH(FEET) =    24.70   MANNING'S N =  0.013
  DEPTH OF FLOW IN  21.0 INCH PIPE IS  13.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.72
  ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      12.41
  PIPE TRAVEL TIME(MIN.) =   0.05    Tc(MIN.) =   14.91
```

```
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    107.00 =    1538.70 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    107.00 TO NODE    108.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   14.91
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  1.439
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                A       2.27      0.98     0.850    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.98
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  SUBAREA AREA(ACRES) =    2.27      SUBAREA RUNOFF(CFS) =    1.25
  EFFECTIVE AREA(ACRES) =     14.33   AREA-AVERAGED Fm(INCH/HR) =  0.44
  AREA-AVERAGED Fp(INCH/HR) =  0.98  AREA-AVERAGED Ap =  0.45
  TOTAL AREA(ACRES) =       14.8       PEAK FLOW RATE(CFS) =      12.93

  ** PEAK FLOW RATE TABLE **
   STREAM      Q      Tc   Intensity   Fp(Fm)     Ap     Ae    HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       13.16   10.99    1.660  0.98( 0.45) 0.46      12.1     200.00
      2       12.93   14.91    1.439  0.98( 0.44) 0.45      14.3     100.00
      3       12.57   16.32    1.379  0.98( 0.43) 0.44      14.8     300.00
  NEW PEAK FLOW DATA ARE:
  PEAK FLOW RATE(CFS) =      13.16  Tc(MIN.) =   10.99
  AREA-AVERAGED Fm(INCH/HR) =  0.45  AREA-AVERAGED Fp(INCH/HR) =  0.98
  AREA-AVERAGED Ap =  0.46  EFFECTIVE AREA(ACRES) =      12.10
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =       14.8  TC(MIN.) =     10.99
  EFFECTIVE AREA(ACRES) =     12.10  AREA-AVERAGED Fm(INCH/HR)=  0.45
  AREA-AVERAGED Fp(INCH/HR) =  0.98  AREA-AVERAGED Ap = 0.464
  PEAK FLOW RATE(CFS)   =      13.16

  ** PEAK FLOW RATE TABLE **
   STREAM      Q      Tc   Intensity   Fp(Fm)     Ap     Ae    HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       13.16   10.99    1.660  0.98( 0.45) 0.46      12.1     200.00
      2       12.93   14.91    1.439  0.98( 0.44) 0.45      14.3     100.00
      3       12.57   16.32    1.379  0.98( 0.43) 0.44      14.8     300.00
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************
              RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
           (Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
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              Ver. 21.0  Release Date: 06/01/2014  License ID 1202

                            Analysis prepared by:

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 ************************* DESCRIPTION OF STUDY **************************
* PIONEER AVENUE REDLANDS HYDROLOGY                                        *
* 100 YEAR STORM EVENT PROPOSED CONDITION                                  *
* RYAN KIM HC 05/06/22                                                     *
 **************************************************************************

  FILE NAME: PIO100P.DAT
  TIME/DATE OF STUDY: 17:19 05/06/2022
============================================================================
  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*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.4680
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.2000

  *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     17.8    0.020/0.020/ ---    0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.67 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (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    100.00 TO NODE    101.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   282.00
  ELEVATION DATA: UPSTREAM(FEET) =   1277.30  DOWNSTREAM(FEET) =   1272.30
```

```
  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.505
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.394
  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                 A       0.18      0.74     0.100    52    6.50
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.74
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      0.54
  TOTAL AREA(ACRES) =      0.18   PEAK FLOW RATE(CFS) =      0.54

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1272.30  DOWNSTREAM ELEVATION(FEET) = 1271.00
  STREET LENGTH(FEET) =   124.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  17.80
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.99
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.27
    HALFSTREET FLOOD WIDTH(FEET) =    5.58
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.97
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.53
  STREET FLOW TRAVEL TIME(MIN.) =   1.05   Tc(MIN.) =    7.55
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.165
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A       0.06      0.74     0.100    52
  PUBLIC PARK                A       0.13      0.74     0.850    52
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"      A       0.17      0.74     0.400    52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.74
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.512
  SUBAREA AREA(ACRES) =    0.36      SUBAREA RUNOFF(CFS) =    0.90
  EFFECTIVE AREA(ACRES) =      0.54    AREA-AVERAGED Fm(INCH/HR) =  0.28
  AREA-AVERAGED Fp(INCH/HR) =  0.74  AREA-AVERAGED Ap =  0.38
  TOTAL AREA(ACRES) =        0.5        PEAK FLOW RATE(CFS) =       1.40

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.30   HALFSTREET FLOOD WIDTH(FEET) =   7.00
  FLOW VELOCITY(FEET/SEC.) =  2.06   DEPTH*VELOCITY(FT*FT/SEC.) =   0.62
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =     406.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    103.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
```

```
============================================================================
  UPSTREAM ELEVATION(FEET) = 1271.00  DOWNSTREAM ELEVATION(FEET) = 1269.80
  STREET LENGTH(FEET) =   240.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  17.80
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.26
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.37
    HALFSTREET FLOOD WIDTH(FEET) =   10.67
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.70
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.63
  STREET FLOW TRAVEL TIME(MIN.) =   2.35   Tc(MIN.) =    9.91
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.788
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        0.11      0.74     0.100    52
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"      A        0.64      0.74     0.400    52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.74
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.356
  SUBAREA AREA(ACRES) =    0.75      SUBAREA RUNOFF(CFS) =    1.70
  EFFECTIVE AREA(ACRES) =      1.29    AREA-AVERAGED Fm(INCH/HR) =  0.27
  AREA-AVERAGED Fp(INCH/HR) =  0.74  AREA-AVERAGED Ap =  0.36
  TOTAL AREA(ACRES) =        1.3        PEAK FLOW RATE(CFS) =       2.92

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.40   HALFSTREET FLOOD WIDTH(FEET) =  11.98
  FLOW VELOCITY(FEET/SEC.) =  1.80   DEPTH*VELOCITY(FT*FT/SEC.) =   0.72
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    103.00 =     646.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    104.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1269.80  DOWNSTREAM ELEVATION(FEET) = 1266.80
  STREET LENGTH(FEET) =   317.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  17.80
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.93
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.39
    HALFSTREET FLOOD WIDTH(FEET) =   11.82
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.48
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.98
```

```
  STREET FLOW TRAVEL TIME(MIN.) =   2.13   Tc(MIN.) =   12.04
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.545
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        0.15      0.74     0.100    52
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"      A        0.83      0.74     0.400    52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.74
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.354
  SUBAREA AREA(ACRES) =    0.98      SUBAREA RUNOFF(CFS) =    2.01
  EFFECTIVE AREA(ACRES) =      2.27    AREA-AVERAGED Fm(INCH/HR) =  0.27
  AREA-AVERAGED Fp(INCH/HR) =  0.74  AREA-AVERAGED Ap =  0.36
  TOTAL AREA(ACRES) =        2.3        PEAK FLOW RATE(CFS) =       4.65

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.41   HALFSTREET FLOOD WIDTH(FEET) =  12.75
  FLOW VELOCITY(FEET/SEC.) =  2.57   DEPTH*VELOCITY(FT*FT/SEC.) =   1.06
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    104.00 =     963.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    104.00 TO NODE    105.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1266.80  DOWNSTREAM ELEVATION(FEET) = 1264.30
  STREET LENGTH(FEET) =   279.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  17.80
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       5.38
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.43
    HALFSTREET FLOOD WIDTH(FEET) =   13.73
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.59
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.12
  STREET FLOW TRAVEL TIME(MIN.) =   1.79   Tc(MIN.) =   13.83
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.385
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        0.13      0.74     0.100    52
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"      A        0.63      0.74     0.400    52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.74
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.349
  SUBAREA AREA(ACRES) =    0.76      SUBAREA RUNOFF(CFS) =    1.45
  EFFECTIVE AREA(ACRES) =      3.03    AREA-AVERAGED Fm(INCH/HR) =  0.26
  AREA-AVERAGED Fp(INCH/HR) =  0.74  AREA-AVERAGED Ap =  0.36
  TOTAL AREA(ACRES) =        3.0        PEAK FLOW RATE(CFS) =       5.78

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.44   HALFSTREET FLOOD WIDTH(FEET) =  14.11
  FLOW VELOCITY(FEET/SEC.) =  2.65   DEPTH*VELOCITY(FT*FT/SEC.) =   1.17
```

```
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    105.00 =    1242.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    105.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   13.83
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.385
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A       0.18      0.74     0.100    52
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"      A       0.38      0.74     0.400    52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.74
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.304
  SUBAREA AREA(ACRES) =    0.56      SUBAREA RUNOFF(CFS) =    1.09
  EFFECTIVE AREA(ACRES) =      3.59   AREA-AVERAGED Fm(INCH/HR) =  0.26
  AREA-AVERAGED Fp(INCH/HR) =  0.74  AREA-AVERAGED Ap =  0.35
  TOTAL AREA(ACRES) =        3.6       PEAK FLOW RATE(CFS) =      6.87

****************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    105.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   13.83
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.385
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                A       0.29      0.74     0.850    52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.74
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  SUBAREA AREA(ACRES) =    0.29      SUBAREA RUNOFF(CFS) =    0.46
  EFFECTIVE AREA(ACRES) =      3.88   AREA-AVERAGED Fm(INCH/HR) =  0.29
  AREA-AVERAGED Fp(INCH/HR) =  0.74  AREA-AVERAGED Ap =  0.39
  TOTAL AREA(ACRES) =        3.9       PEAK FLOW RATE(CFS) =      7.33

****************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    106.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1260.30  DOWNSTREAM(FEET) =  1259.90
  FLOW LENGTH(FEET) =    31.90   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  10.5 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.88
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       7.33
  PIPE TRAVEL TIME(MIN.) =   0.08    Tc(MIN.) =   13.91
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    106.00 =    1273.90 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    106.00 TO NODE    106.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================
```

```
****************************************************************************
  FLOW PROCESS FROM NODE    200.00 TO NODE    201.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   157.00
  ELEVATION DATA: UPSTREAM(FEET) =   1278.90  DOWNSTREAM(FEET) =   1275.80

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.037
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.826
  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                 A        0.06      0.74     0.100    52    5.04
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"      A        0.41      0.74     0.400    52    6.20
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.74
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.362
  SUBAREA RUNOFF(CFS) =      1.50
  TOTAL AREA(ACRES) =      0.47   PEAK FLOW RATE(CFS) =      1.50

****************************************************************************
  FLOW PROCESS FROM NODE    201.00 TO NODE    202.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1275.80  DOWNSTREAM ELEVATION(FEET) = 1271.30
  STREET LENGTH(FEET) =   409.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  17.80
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.39
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.37
    HALFSTREET FLOOD WIDTH(FEET) =   10.72
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.53
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.94
  STREET FLOW TRAVEL TIME(MIN.) =   2.69   Tc(MIN.) =    7.73
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.131
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        0.15      0.74     0.100    52
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"      A        1.31      0.74     0.400    52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.74
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.369
  SUBAREA AREA(ACRES) =    1.46      SUBAREA RUNOFF(CFS) =    3.75
  EFFECTIVE AREA(ACRES) =      1.93    AREA-AVERAGED Fm(INCH/HR) =  0.27
  AREA-AVERAGED Fp(INCH/HR) =  0.74  AREA-AVERAGED Ap =  0.37
  TOTAL AREA(ACRES) =        1.9        PEAK FLOW RATE(CFS) =       4.97
```

```
  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.41   HALFSTREET FLOOD WIDTH(FEET) =  12.69
  FLOW VELOCITY(FEET/SEC.) =  2.76   DEPTH*VELOCITY(FT*FT/SEC.) =   1.14
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    202.00 =     566.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    202.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    7.73
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.131
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE           GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                A        0.19      0.74     0.100    52
  PUBLIC PARK               A        0.26      0.74     0.850    52
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"     A        1.25      0.74     0.400    52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.74
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.435
  SUBAREA AREA(ACRES) =    1.70      SUBAREA RUNOFF(CFS) =    4.30
  EFFECTIVE AREA(ACRES) =      3.63   AREA-AVERAGED Fm(INCH/HR) =  0.30
  AREA-AVERAGED Fp(INCH/HR) =  0.74  AREA-AVERAGED Ap =  0.40
  TOTAL AREA(ACRES) =        3.6       PEAK FLOW RATE(CFS) =       9.26

****************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    106.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1267.30  DOWNSTREAM(FEET) =  1259.90
  FLOW LENGTH(FEET) =   894.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  14.7 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.01
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       9.26
  PIPE TRAVEL TIME(MIN.) =   2.48    Tc(MIN.) =   10.21
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    106.00 =    1460.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    106.00 TO NODE    106.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        9.26   10.21    2.749  0.74( 0.30) 0.40       3.6     200.00
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    106.00 =    1460.00 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        7.33   13.91    2.379  0.74( 0.29) 0.39       3.9     100.00
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    106.00 =    1273.90 FEET.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
```

```
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       15.59   10.21    2.749  0.74( 0.29) 0.39       6.5     200.00
      2       15.19   13.91    2.379  0.74( 0.29) 0.39       7.5     100.00
    TOTAL AREA(ACRES) =        7.5

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       15.59  Tc(MIN.) =   10.207
  EFFECTIVE AREA(ACRES) =      6.48  AREA-AVERAGED Fm(INCH/HR) =  0.29
  AREA-AVERAGED Fp(INCH/HR) =  0.74  AREA-AVERAGED Ap =  0.39
  TOTAL AREA(ACRES) =        7.5
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    106.00 =    1460.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    106.00 TO NODE    106.00 IS CODE =  12
----------------------------------------------------------------------------
  >>>>>CLEAR MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    106.00 TO NODE    305.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1259.90  DOWNSTREAM(FEET) =  1259.80
  FLOW LENGTH(FEET) =     7.80   MANNING'S N =  0.013
  DEPTH OF FLOW IN  21.0 INCH PIPE IS  15.5 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.22
  ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      15.59
  PIPE TRAVEL TIME(MIN.) =   0.02    Tc(MIN.) =   10.22
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    305.00 =    1467.80 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    305.00 TO NODE    305.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 2 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    300.00 TO NODE    301.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   369.00
  ELEVATION DATA: UPSTREAM(FEET) =   1279.40  DOWNSTREAM(FEET) =   1274.10

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.555
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.165
  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                 A       0.15      0.74     0.100    52    7.55
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"      A       0.55      0.74     0.400    52    9.29
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.74
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.336
  SUBAREA RUNOFF(CFS) =      1.84
  TOTAL AREA(ACRES) =      0.70   PEAK FLOW RATE(CFS) =      1.84
```

```
****************************************************************************
  FLOW PROCESS FROM NODE    301.00 TO NODE    302.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1274.10  DOWNSTREAM ELEVATION(FEET) = 1271.50
  STREET LENGTH(FEET) =   176.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  17.80
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.14
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.35
    HALFSTREET FLOOD WIDTH(FEET) =    9.68
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.78
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.98
  STREET FLOW TRAVEL TIME(MIN.) =   1.05   Tc(MIN.) =    8.61
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.977
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A       0.07      0.74     0.100    52
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"      A       1.00      0.74     0.400    52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.74
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.380
  SUBAREA AREA(ACRES) =    1.07      SUBAREA RUNOFF(CFS) =    2.60
  EFFECTIVE AREA(ACRES) =      1.77    AREA-AVERAGED Fm(INCH/HR) =  0.27
  AREA-AVERAGED Fp(INCH/HR) =  0.74  AREA-AVERAGED Ap =  0.36
  TOTAL AREA(ACRES) =        1.8        PEAK FLOW RATE(CFS) =       4.31

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.38   HALFSTREET FLOOD WIDTH(FEET) =  11.16
  FLOW VELOCITY(FEET/SEC.) =  3.01   DEPTH*VELOCITY(FT*FT/SEC.) =   1.15
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    302.00 =     545.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    302.00 TO NODE    303.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1271.50  DOWNSTREAM ELEVATION(FEET) = 1270.70
  STREET LENGTH(FEET) =   183.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  17.80
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
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```
    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       4.94
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.47
    HALFSTREET FLOOD WIDTH(FEET) =   15.37
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.94
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.90
  STREET FLOW TRAVEL TIME(MIN.) =   1.58   Tc(MIN.) =   10.18
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.752
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A       0.09      0.74     0.100    52
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"      A       0.47      0.74     0.400    52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.74
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.352
  SUBAREA AREA(ACRES) =    0.56      SUBAREA RUNOFF(CFS) =    1.26
  EFFECTIVE AREA(ACRES) =      2.33    AREA-AVERAGED Fm(INCH/HR) =  0.27
  AREA-AVERAGED Fp(INCH/HR) =  0.74  AREA-AVERAGED Ap =  0.36
  TOTAL AREA(ACRES) =        2.3        PEAK FLOW RATE(CFS) =       5.21

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.47   HALFSTREET FLOOD WIDTH(FEET) =  15.70
  FLOW VELOCITY(FEET/SEC.) =  1.96   DEPTH*VELOCITY(FT*FT/SEC.) =   0.93
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    303.00 =     728.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    303.00 TO NODE    304.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1270.70  DOWNSTREAM ELEVATION(FEET) = 1268.30
  STREET LENGTH(FEET) =   360.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  17.80
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       6.32
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.47
    HALFSTREET FLOOD WIDTH(FEET) =   15.59
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.41
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.13
  STREET FLOW TRAVEL TIME(MIN.) =   2.49   Tc(MIN.) =   12.67
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.484
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A       0.16      0.74     0.100    52
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"      A       0.95      0.74     0.400    52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.74
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.357
  SUBAREA AREA(ACRES) =    1.11      SUBAREA RUNOFF(CFS) =    2.22
  EFFECTIVE AREA(ACRES) =      3.44    AREA-AVERAGED Fm(INCH/HR) =  0.27
```

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  AREA-AVERAGED Fp(INCH/HR) =  0.74  AREA-AVERAGED Ap =  0.36
  TOTAL AREA(ACRES) =        3.4        PEAK FLOW RATE(CFS) =       6.87

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.48   HALFSTREET FLOOD WIDTH(FEET) =  16.14
  FLOW VELOCITY(FEET/SEC.) =  2.46   DEPTH*VELOCITY(FT*FT/SEC.) =   1.18
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    304.00 =    1088.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    304.00 TO NODE    305.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1268.30  DOWNSTREAM ELEVATION(FEET) = 1264.30
  STREET LENGTH(FEET) =   426.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  17.80
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       7.93
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.48
    HALFSTREET FLOOD WIDTH(FEET) =   15.97
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.89
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.38
  STREET FLOW TRAVEL TIME(MIN.) =   2.46   Tc(MIN.) =   15.13
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.287
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A       0.19      0.74     0.100    52
  RESIDENTIAL
  "8-10 DWELLINGS/ACRE"      A       0.97      0.74     0.400    52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.74
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.351
  SUBAREA AREA(ACRES) =    1.16      SUBAREA RUNOFF(CFS) =    2.12
  EFFECTIVE AREA(ACRES) =      4.60    AREA-AVERAGED Fm(INCH/HR) =  0.26
  AREA-AVERAGED Fp(INCH/HR) =  0.74  AREA-AVERAGED Ap =  0.36
  TOTAL AREA(ACRES) =        4.6        PEAK FLOW RATE(CFS) =       8.37

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.48   HALFSTREET FLOOD WIDTH(FEET) =  16.30
  FLOW VELOCITY(FEET/SEC.) =  2.94   DEPTH*VELOCITY(FT*FT/SEC.) =   1.42
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    305.00 =    1514.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    305.00 TO NODE    305.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   15.13
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.287
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
```

```
  COMMERCIAL                 A        0.38      0.74     0.100    52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.74
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.38      SUBAREA RUNOFF(CFS) =    0.76
  EFFECTIVE AREA(ACRES) =      4.98   AREA-AVERAGED Fm(INCH/HR) =  0.25
  AREA-AVERAGED Fp(INCH/HR) =  0.74  AREA-AVERAGED Ap =  0.34
  TOTAL AREA(ACRES) =        5.0       PEAK FLOW RATE(CFS) =       9.13

****************************************************************************
  FLOW PROCESS FROM NODE    305.00 TO NODE    305.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 2 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        9.13   15.13    2.287  0.74( 0.25) 0.34       5.0     300.00
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    305.00 =    1514.00 FEET.

  ** MEMORY BANK #  2 CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       15.59   10.22    2.747  0.74( 0.29) 0.39       6.5     200.00
      2       15.19   13.92    2.377  0.74( 0.29) 0.39       7.5     100.00
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    305.00 =    1467.80 FEET.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       23.16   10.22    2.747  0.74( 0.28) 0.37       9.8     200.00
      2       23.97   13.92    2.377  0.74( 0.28) 0.37      12.1     100.00
      3       23.66   15.13    2.287  0.74( 0.27) 0.37      12.5     300.00
    TOTAL AREA(ACRES) =        12.5

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       23.97  Tc(MIN.) =   13.923
  EFFECTIVE AREA(ACRES) =     12.09  AREA-AVERAGED Fm(INCH/HR) =  0.28
  AREA-AVERAGED Fp(INCH/HR) =  0.74  AREA-AVERAGED Ap =  0.37
  TOTAL AREA(ACRES) =       12.5
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    305.00 =    1514.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    305.00 TO NODE    305.00 IS CODE =  12
----------------------------------------------------------------------------
  >>>>>CLEAR MEMORY BANK # 2 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    305.00 TO NODE    107.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1259.80  DOWNSTREAM(FEET) =  1259.50
  FLOW LENGTH(FEET) =    24.70   MANNING'S N =  0.013
  DEPTH OF FLOW IN  24.0 INCH PIPE IS  19.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.82
  ESTIMATED PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      23.97
  PIPE TRAVEL TIME(MIN.) =   0.05    Tc(MIN.) =   13.97
```

```
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    107.00 =    1538.70 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    107.00 TO NODE    108.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   13.97
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.374
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                A       2.27      0.74     0.850    52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.74
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  SUBAREA AREA(ACRES) =    2.27      SUBAREA RUNOFF(CFS) =    3.56
  EFFECTIVE AREA(ACRES) =     14.36   AREA-AVERAGED Fm(INCH/HR) =  0.33
  AREA-AVERAGED Fp(INCH/HR) =  0.74  AREA-AVERAGED Ap =  0.45
  TOTAL AREA(ACRES) =       14.8       PEAK FLOW RATE(CFS) =      26.39
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =       14.8  TC(MIN.) =     13.97
  EFFECTIVE AREA(ACRES) =     14.36  AREA-AVERAGED Fm(INCH/HR)=  0.33
  AREA-AVERAGED Fp(INCH/HR) =  0.74  AREA-AVERAGED Ap = 0.447
  PEAK FLOW RATE(CFS)   =      26.39

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       26.14   10.27    2.741  0.74( 0.34) 0.46      12.1     200.00
      2       26.39   13.97    2.374  0.74( 0.33) 0.45      14.4     100.00
      3       25.96   15.17    2.283  0.74( 0.33) 0.44      14.8     300.00
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************
          NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
                    AND LOW LOSS FRACTION ESTIMATIONS
============================================================================
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                         Analysis prepared by:

                          Huitt-Zollars, Inc.
                    2603 Main Street, Irvine CA
                             Suite 400
                            949-988-9815

****************************************************************************
----------------------------------------------------------------------------

 Problem Descriptions:
  PIONEER AVENUE FLOOD ROUTING
  10 YEAR STORM EVENT
  RYAN KIM HC 05/09/22
============================================================================
*** NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
    AND LOW LOSS FRACTION ESTIMATIONS FOR AMC II:

    TOTAL 24-HOUR DURATION RAINFALL DEPTH =     3.23 (inches)

    SOIL-COVER     AREA      PERCENT OF    SCS CURVE    LOSS RATE
       TYPE      (Acres)   PERVIOUS AREA     NUMBER    Fp(in./hr.)    YIELD
         1          1.85       10.00           98.        0.000       0.928
         2          2.56       85.00           58.        0.724       0.232
         3         10.36       40.00           58.        0.724       0.600

    TOTAL AREA (Acres) =     14.77
                             _
    AREA-AVERAGED LOSS RATE, Fm (in./hr.) =  0.310
```

```
                                                  _
    AREA-AVERAGED LOW LOSS FRACTION, Y = 0.422
============================================================================

 Problem Descriptions:
  PIONEER AVENUE FLOOD ROUTING
  10 YEAR STORM EVENT
  RYAN KIM HC 05/09/22
----------------------------------------------------------------------------


    RATIONAL METHOD CALIBRATION COEFFICIENT = 0.90
    TOTAL CATCHMENT AREA(ACRES) =   14.77
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.310
    LOW LOSS FRACTION = 0.422
    TIME OF CONCENTRATION(MIN.) = 10.99
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    USER SPECIFIED RAINFALL VALUES ARE USED
    RETURN FREQUENCY(YEARS) =  10
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.20
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.52
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  0.75
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  1.27
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  1.76
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  3.23

----------------------------------------------------------------------------

    TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     2.13
    TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     1.84

****************************************************************************
  TIME     VOLUME       Q    0.         5.0      10.0      15.0      20.0
 (HOURS)    (AF)      (CFS)
----------------------------------------------------------------------------
  0.06      0.0012      0.45  Q          .         .         .         .
  0.25      0.0081      0.45  Q          .         .         .         .
```

0.43	0.0150	0.46	Q	.	.	.	.
0.61	0.0219	0.46	Q	.	.	.	.
0.80	0.0289	0.46	Q	.	.	.	.
0.98	0.0360	0.47	Q	.	.	.	.
1.16	0.0430	0.47	Q	.	.	.	.
1.35	0.0502	0.47	Q	.	.	.	.
1.53	0.0574	0.48	Q	.	.	.	.
1.71	0.0646	0.48	Q	.	.	.	.
1.90	0.0719	0.48	Q	.	.	.	.
2.08	0.0792	0.49	Q	.	.	.	.
2.26	0.0866	0.49	Q	.	.	.	.
2.45	0.0941	0.49	Q	.	.	.	.
2.63	0.1016	0.50	Q	.	.	.	.
2.81	0.1092	0.50	.Q	.	.	.	.
3.00	0.1168	0.51	.Q	.	.	.	.
3.18	0.1245	0.51	.Q	.	.	.	.
3.36	0.1322	0.51	.Q	.	.	.	.
3.54	0.1400	0.52	.Q	.	.	.	.
3.73	0.1479	0.52	.Q	.	.	.	.
3.91	0.1558	0.53	.Q	.	.	.	.
4.09	0.1638	0.53	.Q	.	.	.	.
4.28	0.1719	0.53	.Q	.	.	.	.
4.46	0.1800	0.54	.Q	.	.	.	.
4.64	0.1882	0.54	.Q	.	.	.	.
4.83	0.1965	0.55	.Q	.	.	.	.
5.01	0.2049	0.55	.Q	.	.	.	.
5.19	0.2133	0.56	.Q	.	.	.	.
5.38	0.2219	0.56	.Q	.	.	.	.
5.56	0.2305	0.57	.Q	.	.	.	.
5.74	0.2391	0.58	.Q	.	.	.	.
5.93	0.2479	0.58	.Q	.	.	.	.
6.11	0.2568	0.59	.Q	.	.	.	.
6.29	0.2657	0.60	.Q	.	.	.	.
6.48	0.2748	0.60	.Q	.	.	.	.
6.66	0.2839	0.61	.Q	.	.	.	.
6.84	0.2932	0.61	.Q	.	.	.	.
7.02	0.3025	0.62	.Q	.	.	.	.

7.21	0.3120	0.63	.Q	.	.	.	.
7.39	0.3215	0.64	.Q	.	.	.	.
7.57	0.3312	0.64	.Q	.	.	.	.
7.76	0.3410	0.65	.Q	.	.	.	.
7.94	0.3509	0.66	.Q	.	.	.	.
8.12	0.3609	0.67	.Q	.	.	.	.
8.31	0.3711	0.67	.Q	.	.	.	.
8.49	0.3814	0.69	.Q	.	.	.	.
8.67	0.3919	0.69	.Q	.	.	.	.
8.86	0.4024	0.71	.Q	.	.	.	.
9.04	0.4132	0.71	.Q	.	.	.	.
9.22	0.4241	0.73	.Q	.	.	.	.
9.41	0.4351	0.73	.Q	.	.	.	.
9.59	0.4463	0.75	.Q	.	.	.	.
9.77	0.4578	0.76	.Q	.	.	.	.
9.96	0.4693	0.77	.Q	.	.	.	.
10.14	0.4811	0.78	.Q	.	.	.	.
10.32	0.4931	0.80	.Q	.	.	.	.
10.51	0.5053	0.81	.Q	.	.	.	.
10.69	0.5177	0.83	.Q	.	.	.	.
10.87	0.5304	0.84	.Q	.	.	.	.
11.05	0.5433	0.86	.Q	.	.	.	.
11.24	0.5565	0.88	.Q	.	.	.	.
11.42	0.5699	0.90	.Q	.	.	.	.
11.60	0.5837	0.91	.Q	.	.	.	.
11.79	0.5977	0.94	.Q	.	.	.	.
11.97	0.6121	0.96	.Q	.	.	.	.
12.15	0.6273	1.05	. Q	.	.	.	.
12.34	0.6435	1.08	. Q	.	.	.	.
12.52	0.6601	1.12	. Q	.	.	.	.
12.70	0.6773	1.14	. Q	.	.	.	.
12.89	0.6949	1.19	. Q	.	.	.	.
13.07	0.7131	1.21	. Q	.	.	.	.
13.25	0.7318	1.26	. Q	.	.	.	.
13.44	0.7512	1.29	. Q	.	.	.	.
13.62	0.7713	1.36	. Q	.	.	.	.
13.80	0.7921	1.40	. Q	.	.	.	.

```
13.99      0.8139      1.48  . Q       .         .         .         .
14.17      0.8367      1.54  .  Q      .         .         .         .
14.35      0.8609      1.66  .  Q      .         .         .         .
14.53      0.8865      1.72  .  Q      .         .         .         .
14.72      0.9138      1.88  .  Q      .         .         .         .
14.90      0.9429      1.97  .  Q      .         .         .         .
15.08      0.9744      2.20  .   Q     .         .         .         .
15.27      1.0087      2.34  .   Q     .         .         .         .
15.45      1.0485      2.91  .    Q    .         .         .         .
15.63      1.0963      3.40  .     Q   .         .         .         .
15.82      1.1555      4.41  .       Q .         .         .         .
16.00      1.2315      5.64  .         .Q        .         .         .
16.18      1.4096     17.89  .         .         .         .    Q    .
16.37      1.5740      3.82  .      Q  .         .         .         .
16.55      1.6221      2.52  .    Q    .         .         .         .
16.73      1.6569      2.07  .   Q     .         .         .         .
16.92      1.6861      1.80  .  Q      .         .         .         .
17.10      1.7119      1.61  .  Q      .         .         .         .
17.28      1.7349      1.44  . Q       .         .         .         .
17.47      1.7558      1.33  . Q       .         .         .         .
17.65      1.7752      1.24  . Q       .         .         .         .
17.83      1.7934      1.16  . Q       .         .         .         .
18.01      1.8105      1.10  . Q       .         .         .         .
18.20      1.8262      0.97  .Q        .         .         .         .
18.38      1.8407      0.93  .Q        .         .         .         .
18.56      1.8544      0.89  .Q        .         .         .         .
18.75      1.8676      0.85  .Q        .         .         .         .
18.93      1.8803      0.82  .Q        .         .         .         .
19.11      1.8925      0.79  .Q        .         .         .         .
19.30      1.9042      0.77  .Q        .         .         .         .
19.48      1.9156      0.74  .Q        .         .         .         .
19.66      1.9267      0.72  .Q        .         .         .         .
19.85      1.9374      0.70  .Q        .         .         .         .
20.03      1.9479      0.68  .Q        .         .         .         .
20.21      1.9581      0.66  .Q        .         .         .         .
20.40      1.9680      0.65  .Q        .         .         .         .
20.58      1.9776      0.63  .Q        .         .         .         .
```

```
  20.76      1.9871      0.62  .Q        .         .         .         .
  20.95      1.9963      0.60  .Q        .         .         .         .
  21.13      2.0054      0.59  .Q        .         .         .         .
  21.31      2.0143      0.58  .Q        .         .         .         .
  21.49      2.0229      0.57  .Q        .         .         .         .
  21.68      2.0315      0.56  .Q        .         .         .         .
  21.86      2.0398      0.55  .Q        .         .         .         .
  22.04      2.0480      0.54  .Q        .         .         .         .
  22.23      2.0561      0.53  .Q        .         .         .         .
  22.41      2.0641      0.52  .Q        .         .         .         .
  22.59      2.0719      0.51  .Q        .         .         .         .
  22.78      2.0795      0.50  .Q        .         .         .         .
  22.96      2.0871      0.50  Q         .         .         .         .
  23.14      2.0946      0.49  Q         .         .         .         .
  23.33      2.1019      0.48  Q         .         .         .         .
  23.51      2.1091      0.47  Q         .         .         .         .
  23.69      2.1163      0.47  Q         .         .         .         .
  23.88      2.1233      0.46  Q         .         .         .         .
  24.06      2.1303      0.46  Q         .         .         .         .
  24.24      2.1337      0.00  Q         .         .         .         .
 -----------------------------------------------------------------------------
-------------------------------------------------------------------------------
   TIME DURATION(minutes) OF PERCENTILES OF ESTIMATED PEAK FLOW RATE:
   (Note: 100% of Peak Flow Rate estimate assumed to have
   an instantaneous time duration)

   Percentile of Estimated                 Duration
       Peak Flow Rate                      (minutes)
   =======================                 =========
             0%                             1450.7
            10%                              142.9
            20%                               44.0
            30%                               22.0
            40%                               11.0
            50%                               11.0
            60%                               11.0
            70%                               11.0
```

80%	11.0
90%	11.0

Problem Descriptions:
PIONEER AVENUE FLOOD ROUTING
10 YEAR STORM EVENT
RYAN KIM HC 05/09/22

==

FLOW-THROUGH DETENTION BASIN MODEL

SPECIFIED BASIN CONDITIONS ARE AS FOLLOWS:
CONSTANT HYDROGRAPH TIME UNIT(MINUTES) = 10.990
DEAD STORAGE(AF) = 0.00
SPECIFIED DEAD STORAGE(AF) FILLED = 0.00
ASSUMED INITIAL DEPTH(FEET) IN STORAGE BASIN = 0.00

```
              INFLOW
                |
                |
                |
                V                   __effective depth
         -------------              |   (and volume)
         |           |        |     |
         | detention |        |....V.............
         |   basin   |<-->|         outflow
         |           |        |.........__________
         -------------        |         |   \
                |             | storage |    basin outlet
                V             -----------
             OUTFLOW
```

DEPTH-VS.-STORAGE AND DEPTH-VS.-DISCHARGE INFORMATION:

TOTAL NUMBER OF BASIN DEPTH INFORMATION ENTRIES = 5

*BASIN-DEPTH (FEET)	STORAGE (ACRE-FEET)	OUTFLOW (CFS)	**BASIN-DEPTH (FEET)	STORAGE (ACRE-FEET)	OUTFLOW (CFS) *
* 0.000	0.000	0.000**	1.000	0.251	0.163*
* 2.000	0.564	0.163**	3.500	1.100	2.930*
* 4.000	1.290	4.070**			

BASIN STORAGE, OUTFLOW AND DEPTH ROUTING VALUES:

INTERVAL NUMBER	DEPTH (FEET)	{S-O*DT/2} (ACRE-FEET)	{S+O*DT/2} (ACRE-FEET)
1	0.00	0.00000	0.00000
2	1.00	0.24977	0.25223
3	2.00	0.56277	0.56523
4	3.50	1.07782	1.12218
5	4.00	1.25919	1.32081

WHERE S=STORAGE(AF);O=OUTFLOW(AF/MIN.);DT=UNIT INTERVAL(MIN.)

DETENTION BASIN ROUTING RESULTS:

NOTE: COMPUTED BASIN DEPTH, OUTFLOW, AND STORAGE QUANTITIES OCCUR AT THE GIVEN TIME. BASIN INFLOW VALUES REPRESENT THE AVERAGE INFLOW DURING THE RECENT HYDROGRAPH UNIT INTERVAL.

TIME (HRS)	DEAD-STORAGE FILLED(AF)	INFLOW (CFS)	EFFECTIVE DEPTH(FT)	OUTFLOW (CFS)	EFFECTIVE VOLUME(AF)
0.065	0.000	0.45	0.03	0.00	0.007
0.248	0.000	0.45	0.05	0.01	0.014
0.431	0.000	0.46	0.08	0.01	0.020
0.614	0.000	0.46	0.11	0.02	0.027
0.797	0.000	0.46	0.13	0.02	0.034
0.980	0.000	0.47	0.16	0.02	0.041
1.164	0.000	0.47	0.19	0.03	0.047
1.347	0.000	0.47	0.21	0.03	0.054
1.530	0.000	0.48	0.24	0.04	0.061
1.713	0.000	0.48	0.27	0.04	0.067
1.896	0.000	0.48	0.29	0.05	0.074
2.079	0.000	0.49	0.32	0.05	0.080

2.263	0.000	0.49	0.35	0.05	0.087
2.446	0.000	0.49	0.37	0.06	0.094
2.629	0.000	0.50	0.40	0.06	0.100
2.812	0.000	0.50	0.43	0.07	0.107
2.995	0.000	0.51	0.45	0.07	0.113
3.178	0.000	0.51	0.48	0.08	0.120
3.362	0.000	0.51	0.50	0.08	0.126
3.545	0.000	0.52	0.53	0.08	0.133
3.728	0.000	0.52	0.56	0.09	0.140
3.911	0.000	0.53	0.58	0.09	0.146
4.094	0.000	0.53	0.61	0.10	0.153
4.277	0.000	0.53	0.63	0.10	0.159
4.461	0.000	0.54	0.66	0.11	0.166
4.644	0.000	0.54	0.69	0.11	0.172
4.827	0.000	0.55	0.71	0.11	0.179
5.010	0.000	0.55	0.74	0.12	0.186
5.193	0.000	0.56	0.77	0.12	0.192
5.376	0.000	0.56	0.79	0.13	0.199
5.560	0.000	0.57	0.82	0.13	0.206
5.743	0.000	0.58	0.85	0.14	0.212
5.926	0.000	0.58	0.87	0.14	0.219
6.109	0.000	0.59	0.90	0.14	0.226
6.292	0.000	0.60	0.93	0.15	0.232
6.475	0.000	0.60	0.95	0.15	0.239
6.659	0.000	0.61	0.98	0.16	0.246
6.842	0.000	0.61	1.01	0.16	0.253
7.025	0.000	0.62	1.03	0.16	0.260
7.208	0.000	0.63	1.05	0.16	0.267
7.391	0.000	0.64	1.07	0.16	0.274
7.574	0.000	0.64	1.10	0.16	0.281
7.758	0.000	0.65	1.12	0.16	0.289
7.941	0.000	0.66	1.14	0.16	0.296
8.124	0.000	0.67	1.17	0.16	0.304
8.307	0.000	0.67	1.19	0.16	0.311
8.490	0.000	0.69	1.22	0.16	0.319
8.673	0.000	0.69	1.24	0.16	0.327
8.857	0.000	0.71	1.27	0.16	0.336

9.040	0.000	0.71	1.30	0.16	0.344
9.223	0.000	0.73	1.32	0.16	0.353
9.406	0.000	0.73	1.35	0.16	0.361
9.589	0.000	0.75	1.38	0.16	0.370
9.772	0.000	0.76	1.41	0.16	0.379
9.956	0.000	0.77	1.44	0.16	0.388
10.139	0.000	0.78	1.47	0.16	0.398
10.322	0.000	0.80	1.50	0.16	0.407
10.505	0.000	0.81	1.53	0.16	0.417
10.688	0.000	0.83	1.56	0.16	0.427
10.871	0.000	0.84	1.60	0.16	0.437
11.055	0.000	0.86	1.63	0.16	0.448
11.238	0.000	0.88	1.66	0.16	0.459
11.421	0.000	0.90	1.70	0.16	0.470
11.604	0.000	0.91	1.74	0.16	0.481
11.787	0.000	0.94	1.77	0.16	0.493
11.970	0.000	0.96	1.81	0.16	0.505
12.154	0.000	1.05	1.86	0.16	0.519
12.337	0.000	1.08	1.90	0.16	0.533
12.520	0.000	1.12	1.95	0.16	0.547
12.703	0.000	1.14	1.99	0.16	0.562
12.886	0.000	1.19	2.04	0.20	0.577
13.069	0.000	1.21	2.08	0.27	0.591
13.253	0.000	1.26	2.12	0.34	0.605
13.436	0.000	1.29	2.15	0.41	0.619
13.619	0.000	1.36	2.19	0.48	0.632
13.802	0.000	1.40	2.23	0.55	0.645
13.985	0.000	1.48	2.26	0.61	0.658
14.168	0.000	1.54	2.30	0.68	0.671
14.352	0.000	1.66	2.34	0.75	0.685
14.535	0.000	1.72	2.38	0.82	0.698
14.718	0.000	1.88	2.42	0.89	0.713
14.901	0.000	1.97	2.46	0.97	0.728
15.084	0.000	2.20	2.51	1.06	0.745
15.267	0.000	2.34	2.56	1.15	0.764
15.451	0.000	2.91	2.63	1.26	0.789
15.634	0.000	3.40	2.71	1.40	0.819

15.817	0.000	4.41	2.83	1.59	0.862
16.000	0.000	5.64	2.99	1.85	0.919
16.183	0.000	17.89	3.63	2.61	1.150
16.366	0.000	3.82	3.66	3.26	1.159
16.549	0.000	2.52	3.63	3.25	1.148
16.733	0.000	2.07	3.58	3.17	1.131
16.916	0.000	1.80	3.53	3.06	1.112
17.099	0.000	1.61	3.48	2.95	1.092
17.282	0.000	1.44	3.42	2.83	1.071
17.465	0.000	1.33	3.36	2.72	1.050
17.649	0.000	1.24	3.30	2.62	1.029
17.832	0.000	1.16	3.24	2.51	1.008
18.015	0.000	1.10	3.19	2.41	0.989
18.198	0.000	0.97	3.13	2.30	0.969
18.381	0.000	0.93	3.08	2.20	0.949
18.564	0.000	0.89	3.03	2.10	0.931
18.747	0.000	0.85	2.98	2.01	0.913
18.931	0.000	0.82	2.93	1.92	0.897
19.114	0.000	0.79	2.89	1.84	0.881
19.297	0.000	0.77	2.84	1.76	0.866
19.480	0.000	0.74	2.80	1.68	0.851
19.663	0.000	0.72	2.77	1.61	0.838
19.847	0.000	0.70	2.73	1.54	0.825
20.030	0.000	0.68	2.70	1.48	0.813
20.213	0.000	0.66	2.66	1.42	0.802
20.396	0.000	0.65	2.63	1.36	0.791
20.579	0.000	0.63	2.61	1.31	0.781
20.762	0.000	0.62	2.58	1.26	0.771
20.945	0.000	0.60	2.55	1.21	0.762
21.129	0.000	0.59	2.53	1.16	0.753
21.312	0.000	0.58	2.51	1.12	0.745
21.495	0.000	0.57	2.48	1.08	0.737
21.678	0.000	0.56	2.46	1.04	0.730
21.861	0.000	0.55	2.45	1.00	0.723
22.045	0.000	0.54	2.43	0.97	0.717
22.228	0.000	0.53	2.41	0.93	0.710
22.411	0.000	0.52	2.39	0.90	0.705

22.594	0.000	0.51	2.38	0.87	0.699
22.777	0.000	0.50	2.36	0.85	0.694
22.960	0.000	0.50	2.35	0.82	0.689
23.143	0.000	0.49	2.34	0.80	0.684
23.327	0.000	0.48	2.32	0.77	0.680
23.510	0.000	0.47	2.31	0.75	0.676
23.693	0.000	0.47	2.30	0.73	0.672
23.876	0.000	0.46	2.29	0.71	0.668
24.059	0.000	0.46	2.28	0.69	0.664
24.242	0.000	0.00	2.25	0.66	0.655
24.426	0.000	0.00	2.23	0.61	0.645
24.609	0.000	0.00	2.20	0.56	0.637
24.792	0.000	0.00	2.18	0.52	0.629
24.975	0.000	0.00	2.16	0.48	0.622
25.158	0.000	0.00	2.14	0.44	0.615
25.341	0.000	0.00	2.13	0.41	0.609
25.525	0.000	0.00	2.11	0.38	0.603
25.708	0.000	0.00	2.09	0.35	0.598
25.891	0.000	0.00	2.08	0.32	0.593
26.074	0.000	0.00	2.07	0.30	0.588
26.257	0.000	0.00	2.06	0.28	0.584
26.440	0.000	0.00	2.05	0.26	0.580
26.624	0.000	0.00	2.04	0.24	0.577
26.807	0.000	0.00	2.03	0.22	0.573
26.990	0.000	0.00	2.02	0.20	0.570
27.173	0.000	0.00	2.01	0.19	0.567
27.356	0.000	0.00	2.00	0.17	0.565
27.539	0.000	0.00	1.99	0.16	0.562
27.723	0.000	0.00	1.99	0.16	0.560
27.906	0.000	0.00	1.98	0.16	0.557
28.089	0.000	0.00	1.97	0.16	0.555
28.272	0.000	0.00	1.96	0.16	0.552
28.455	0.000	0.00	1.96	0.16	0.550
28.638	0.000	0.00	1.95	0.16	0.547
28.822	0.000	0.00	1.94	0.16	0.545
29.005	0.000	0.00	1.93	0.16	0.543
29.188	0.000	0.00	1.92	0.16	0.540

29.371	0.000	0.00	1.92	0.16	0.538
29.554	0.000	0.00	1.91	0.16	0.535
29.737	0.000	0.00	1.90	0.16	0.533
29.921	0.000	0.00	1.89	0.16	0.530
30.104	0.000	0.00	1.88	0.16	0.528
30.287	0.000	0.00	1.88	0.16	0.525
30.470	0.000	0.00	1.87	0.16	0.523
30.653	0.000	0.00	1.86	0.16	0.520
30.836	0.000	0.00	1.85	0.16	0.518
31.020	0.000	0.00	1.84	0.16	0.515
31.203	0.000	0.00	1.84	0.16	0.513
31.386	0.000	0.00	1.83	0.16	0.510
31.569	0.000	0.00	1.82	0.16	0.508
31.752	0.000	0.00	1.81	0.16	0.506
31.935	0.000	0.00	1.81	0.16	0.503
32.119	0.000	0.00	1.80	0.16	0.501
32.302	0.000	0.00	1.79	0.16	0.498
32.485	0.000	0.00	1.78	0.16	0.496
32.668	0.000	0.00	1.77	0.16	0.493
32.851	0.000	0.00	1.77	0.16	0.491
33.034	0.000	0.00	1.76	0.16	0.488
33.218	0.000	0.00	1.75	0.16	0.486
33.401	0.000	0.00	1.74	0.16	0.483
33.584	0.000	0.00	1.73	0.16	0.481
33.767	0.000	0.00	1.73	0.16	0.478
33.950	0.000	0.00	1.72	0.16	0.476
34.133	0.000	0.00	1.71	0.16	0.473
34.317	0.000	0.00	1.70	0.16	0.471
34.500	0.000	0.00	1.69	0.16	0.468
34.683	0.000	0.00	1.69	0.16	0.466
34.866	0.000	0.00	1.68	0.16	0.464
35.049	0.000	0.00	1.67	0.16	0.461
35.232	0.000	0.00	1.66	0.16	0.459
35.416	0.000	0.00	1.66	0.16	0.456
35.599	0.000	0.00	1.65	0.16	0.454
35.782	0.000	0.00	1.64	0.16	0.451
35.965	0.000	0.00	1.63	0.16	0.449

36.148	0.000	0.00	1.62	0.16	0.446
36.331	0.000	0.00	1.62	0.16	0.444
36.515	0.000	0.00	1.61	0.16	0.441
36.698	0.000	0.00	1.60	0.16	0.439
36.881	0.000	0.00	1.59	0.16	0.436
37.064	0.000	0.00	1.58	0.16	0.434
37.247	0.000	0.00	1.58	0.16	0.431
37.430	0.000	0.00	1.57	0.16	0.429
37.614	0.000	0.00	1.56	0.16	0.427
37.797	0.000	0.00	1.55	0.16	0.424
37.980	0.000	0.00	1.55	0.16	0.422
38.163	0.000	0.00	1.54	0.16	0.419
38.346	0.000	0.00	1.53	0.16	0.417
38.529	0.000	0.00	1.52	0.16	0.414
38.713	0.000	0.00	1.51	0.16	0.412
38.896	0.000	0.00	1.51	0.16	0.409
39.079	0.000	0.00	1.50	0.16	0.407
39.262	0.000	0.00	1.49	0.16	0.404
39.445	0.000	0.00	1.48	0.16	0.402
39.628	0.000	0.00	1.47	0.16	0.399
39.812	0.000	0.00	1.47	0.16	0.397
39.995	0.000	0.00	1.46	0.16	0.394
40.178	0.000	0.00	1.45	0.16	0.392
40.361	0.000	0.00	1.44	0.16	0.390
40.544	0.000	0.00	1.43	0.16	0.387
40.727	0.000	0.00	1.43	0.16	0.385
40.911	0.000	0.00	1.42	0.16	0.382
41.094	0.000	0.00	1.41	0.16	0.380
41.277	0.000	0.00	1.40	0.16	0.377
41.460	0.000	0.00	1.40	0.16	0.375
41.643	0.000	0.00	1.39	0.16	0.372
41.826	0.000	0.00	1.38	0.16	0.370
42.010	0.000	0.00	1.37	0.16	0.367
42.193	0.000	0.00	1.36	0.16	0.365
42.376	0.000	0.00	1.36	0.16	0.362
42.559	0.000	0.00	1.35	0.16	0.360
42.742	0.000	0.00	1.34	0.16	0.357

42.925	0.000	0.00	1.33	0.16	0.355
43.109	0.000	0.00	1.32	0.16	0.353
43.292	0.000	0.00	1.32	0.16	0.350
43.475	0.000	0.00	1.31	0.16	0.348
43.658	0.000	0.00	1.30	0.16	0.345
43.841	0.000	0.00	1.29	0.16	0.343
44.024	0.000	0.00	1.28	0.16	0.340
44.208	0.000	0.00	1.28	0.16	0.338
44.391	0.000	0.00	1.27	0.16	0.335
44.574	0.000	0.00	1.26	0.16	0.333
44.757	0.000	0.00	1.25	0.16	0.330
44.940	0.000	0.00	1.25	0.16	0.328
45.123	0.000	0.00	1.24	0.16	0.325
45.307	0.000	0.00	1.23	0.16	0.323
45.490	0.000	0.00	1.22	0.16	0.320
45.673	0.000	0.00	1.21	0.16	0.318
45.856	0.000	0.00	1.21	0.16	0.316
46.039	0.000	0.00	1.20	0.16	0.313
46.222	0.000	0.00	1.19	0.16	0.311
46.406	0.000	0.00	1.18	0.16	0.308
46.589	0.000	0.00	1.17	0.16	0.306
46.772	0.000	0.00	1.17	0.16	0.303
46.955	0.000	0.00	1.16	0.16	0.301
47.138	0.000	0.00	1.15	0.16	0.298
47.321	0.000	0.00	1.14	0.16	0.296
47.505	0.000	0.00	1.14	0.16	0.293
47.688	0.000	0.00	1.13	0.16	0.291
47.871	0.000	0.00	1.12	0.16	0.288
48.054	0.000	0.00	1.11	0.16	0.286
48.237	0.000	0.00	1.10	0.16	0.283
48.420	0.000	0.00	1.10	0.16	0.281
48.604	0.000	0.00	1.09	0.16	0.279
48.787	0.000	0.00	1.08	0.16	0.276
48.970	0.000	0.00	1.07	0.16	0.274
49.153	0.000	0.00	1.06	0.16	0.271
49.336	0.000	0.00	1.06	0.16	0.269
49.519	0.000	0.00	1.05	0.16	0.266

49.703	0.000	0.00	1.04	0.16	0.264
49.886	0.000	0.00	1.03	0.16	0.261
50.069	0.000	0.00	1.02	0.16	0.259
50.252	0.000	0.00	1.02	0.16	0.256
50.435	0.000	0.00	1.01	0.16	0.254
50.618	0.000	0.00	1.00	0.16	0.251
50.802	0.000	0.00	0.99	0.16	0.249
50.985	0.000	0.00	0.98	0.16	0.246
51.168	0.000	0.00	0.97	0.16	0.244
51.351	0.000	0.00	0.96	0.16	0.242
51.534	0.000	0.00	0.95	0.16	0.239
51.717	0.000	0.00	0.94	0.15	0.237
51.901	0.000	0.00	0.93	0.15	0.235
52.084	0.000	0.00	0.93	0.15	0.232
52.267	0.000	0.00	0.92	0.15	0.230
52.450	0.000	0.00	0.91	0.15	0.228
52.633	0.000	0.00	0.90	0.15	0.226
52.816	0.000	0.00	0.89	0.15	0.223
53.000	0.000	0.00	0.88	0.14	0.221
53.183	0.000	0.00	0.87	0.14	0.219
53.366	0.000	0.00	0.86	0.14	0.217
53.549	0.000	0.00	0.86	0.14	0.215
53.732	0.000	0.00	0.85	0.14	0.213
53.915	0.000	0.00	0.84	0.14	0.211
54.099	0.000	0.00	0.83	0.14	0.209
54.282	0.000	0.00	0.82	0.13	0.206
54.465	0.000	0.00	0.81	0.13	0.204
54.648	0.000	0.00	0.81	0.13	0.202
54.831	0.000	0.00	0.80	0.13	0.200
55.014	0.000	0.00	0.79	0.13	0.199
55.198	0.000	0.00	0.78	0.13	0.197
55.381	0.000	0.00	0.78	0.13	0.195
55.564	0.000	0.00	0.77	0.13	0.193
55.747	0.000	0.00	0.76	0.12	0.191
55.930	0.000	0.00	0.75	0.12	0.189
56.113	0.000	0.00	0.75	0.12	0.187
56.297	0.000	0.00	0.74	0.12	0.185

56.480	0.000	0.00	0.73	0.12	0.184
56.663	0.000	0.00	0.72	0.12	0.182
56.846	0.000	0.00	0.72	0.12	0.180
57.029	0.000	0.00	0.71	0.12	0.178
57.212	0.000	0.00	0.70	0.12	0.176
57.396	0.000	0.00	0.70	0.11	0.175
57.579	0.000	0.00	0.69	0.11	0.173
57.762	0.000	0.00	0.68	0.11	0.171
57.945	0.000	0.00	0.68	0.11	0.170
58.128	0.000	0.00	0.67	0.11	0.168
58.311	0.000	0.00	0.66	0.11	0.166
58.495	0.000	0.00	0.66	0.11	0.165
58.678	0.000	0.00	0.65	0.11	0.163
58.861	0.000	0.00	0.64	0.11	0.162
59.044	0.000	0.00	0.64	0.10	0.160
59.227	0.000	0.00	0.63	0.10	0.158
59.410	0.000	0.00	0.62	0.10	0.157
59.594	0.000	0.00	0.62	0.10	0.155
59.777	0.000	0.00	0.61	0.10	0.154
59.960	0.000	0.00	0.61	0.10	0.152
60.143	0.000	0.00	0.60	0.10	0.151
60.326	0.000	0.00	0.59	0.10	0.149
60.509	0.000	0.00	0.59	0.10	0.148
60.693	0.000	0.00	0.58	0.10	0.146
60.876	0.000	0.00	0.58	0.09	0.145
61.059	0.000	0.00	0.57	0.09	0.144
61.242	0.000	0.00	0.57	0.09	0.142
61.425	0.000	0.00	0.56	0.09	0.141
61.608	0.000	0.00	0.56	0.09	0.139
61.792	0.000	0.00	0.55	0.09	0.138
61.975	0.000	0.00	0.54	0.09	0.137
62.158	0.000	0.00	0.54	0.09	0.135
62.341	0.000	0.00	0.53	0.09	0.134
62.524	0.000	0.00	0.53	0.09	0.133
62.707	0.000	0.00	0.52	0.09	0.131
62.891	0.000	0.00	0.52	0.08	0.130
63.074	0.000	0.00	0.51	0.08	0.129

63.257	0.000	0.00	0.51	0.08	0.128
63.440	0.000	0.00	0.50	0.08	0.126
63.623	0.000	0.00	0.50	0.08	0.125
63.806	0.000	0.00	0.49	0.08	0.124
63.990	0.000	0.00	0.49	0.08	0.123
64.173	0.000	0.00	0.48	0.08	0.121
64.356	0.000	0.00	0.48	0.08	0.120
64.539	0.000	0.00	0.47	0.08	0.119
64.722	0.000	0.00	0.47	0.08	0.118
64.905	0.000	0.00	0.47	0.08	0.117
65.089	0.000	0.00	0.46	0.08	0.116
65.272	0.000	0.00	0.46	0.07	0.114
65.455	0.000	0.00	0.45	0.07	0.113
65.638	0.000	0.00	0.45	0.07	0.112
65.821	0.000	0.00	0.44	0.07	0.111
66.004	0.000	0.00	0.44	0.07	0.110
66.188	0.000	0.00	0.43	0.07	0.109
66.371	0.000	0.00	0.43	0.07	0.108
66.554	0.000	0.00	0.43	0.07	0.107
66.737	0.000	0.00	0.42	0.07	0.106
66.920	0.000	0.00	0.42	0.07	0.105
67.103	0.000	0.00	0.41	0.07	0.104
67.287	0.000	0.00	0.41	0.07	0.103
67.470	0.000	0.00	0.41	0.07	0.102
67.653	0.000	0.00	0.40	0.07	0.101
67.836	0.000	0.00	0.40	0.07	0.100
68.019	0.000	0.00	0.39	0.06	0.099
68.202	0.000	0.00	0.39	0.06	0.098
68.386	0.000	0.00	0.39	0.06	0.097
68.569	0.000	0.00	0.38	0.06	0.096
68.752	0.000	0.00	0.38	0.06	0.095
68.935	0.000	0.00	0.37	0.06	0.094
69.118	0.000	0.00	0.37	0.06	0.093
69.301	0.000	0.00	0.37	0.06	0.092
69.485	0.000	0.00	0.36	0.06	0.091
69.668	0.000	0.00	0.36	0.06	0.090
69.851	0.000	0.00	0.36	0.06	0.090

70.034	0.000	0.00	0.35	0.06	0.089
70.217	0.000	0.00	0.35	0.06	0.088
70.400	0.000	0.00	0.35	0.06	0.087
70.584	0.000	0.00	0.34	0.06	0.086
70.767	0.000	0.00	0.34	0.06	0.085
70.950	0.000	0.00	0.34	0.06	0.084
71.133	0.000	0.00	0.33	0.05	0.084
71.316	0.000	0.00	0.33	0.05	0.083
71.499	0.000	0.00	0.33	0.05	0.082
71.683	0.000	0.00	0.32	0.05	0.081
71.866	0.000	0.00	0.32	0.05	0.080
72.049	0.000	0.00	0.32	0.05	0.080
72.232	0.000	0.00	0.31	0.05	0.079
72.415	0.000	0.00	0.31	0.05	0.078
72.598	0.000	0.00	0.31	0.05	0.077
72.782	0.000	0.00	0.30	0.05	0.077
72.965	0.000	0.00	0.30	0.05	0.076
73.148	0.000	0.00	0.30	0.05	0.075
73.331	0.000	0.00	0.30	0.05	0.074
73.514	0.000	0.00	0.29	0.05	0.074
73.697	0.000	0.00	0.29	0.05	0.073
73.881	0.000	0.00	0.29	0.05	0.072
74.064	0.000	0.00	0.28	0.05	0.071
74.247	0.000	0.00	0.28	0.05	0.071
74.430	0.000	0.00	0.28	0.05	0.070
74.613	0.000	0.00	0.28	0.05	0.069
74.796	0.000	0.00	0.27	0.04	0.069
74.980	0.000	0.00	0.27	0.04	0.068
75.163	0.000	0.00	0.27	0.04	0.067
75.346	0.000	0.00	0.27	0.04	0.067
75.529	0.000	0.00	0.26	0.04	0.066
75.712	0.000	0.00	0.26	0.04	0.065
75.895	0.000	0.00	0.26	0.04	0.065
76.079	0.000	0.00	0.26	0.04	0.064
76.262	0.000	0.00	0.25	0.04	0.063
76.445	0.000	0.00	0.25	0.04	0.063
76.628	0.000	0.00	0.25	0.04	0.062

76.811	0.000	0.00	0.25	0.04	0.062
76.994	0.000	0.00	0.24	0.04	0.061
77.178	0.000	0.00	0.24	0.04	0.060
77.361	0.000	0.00	0.24	0.04	0.060
77.544	0.000	0.00	0.24	0.04	0.059
77.727	0.000	0.00	0.23	0.04	0.059
77.910	0.000	0.00	0.23	0.04	0.058
78.093	0.000	0.00	0.23	0.04	0.058
78.277	0.000	0.00	0.23	0.04	0.057
78.460	0.000	0.00	0.22	0.04	0.056
78.643	0.000	0.00	0.22	0.04	0.056
78.826	0.000	0.00	0.22	0.04	0.055
79.009	0.000	0.00	0.22	0.04	0.055
79.192	0.000	0.00	0.22	0.04	0.054
79.376	0.000	0.00	0.21	0.04	0.054
79.559	0.000	0.00	0.21	0.03	0.053
79.742	0.000	0.00	0.21	0.03	0.053
79.925	0.000	0.00	0.21	0.03	0.052
80.108	0.000	0.00	0.21	0.03	0.052
80.291	0.000	0.00	0.20	0.03	0.051
80.475	0.000	0.00	0.20	0.03	0.051
80.658	0.000	0.00	0.20	0.03	0.050
80.841	0.000	0.00	0.20	0.03	0.050
81.024	0.000	0.00	0.20	0.03	0.049
81.207	0.000	0.00	0.19	0.03	0.049
81.390	0.000	0.00	0.19	0.03	0.048
81.574	0.000	0.00	0.19	0.03	0.048
81.757	0.000	0.00	0.19	0.03	0.047
81.940	0.000	0.00	0.19	0.03	0.047
82.123	0.000	0.00	0.18	0.03	0.046
82.306	0.000	0.00	0.18	0.03	0.046
82.489	0.000	0.00	0.18	0.03	0.045
82.673	0.000	0.00	0.18	0.03	0.045
82.856	0.000	0.00	0.18	0.03	0.045
83.039	0.000	0.00	0.18	0.03	0.044
83.222	0.000	0.00	0.17	0.03	0.044
83.405	0.000	0.00	0.17	0.03	0.043

83.588	0.000	0.00	0.17	0.03	0.043
83.772	0.000	0.00	0.17	0.03	0.042
83.955	0.000	0.00	0.17	0.03	0.042
84.138	0.000	0.00	0.17	0.03	0.042
84.321	0.000	0.00	0.16	0.03	0.041
84.504	0.000	0.00	0.16	0.03	0.041
84.687	0.000	0.00	0.16	0.03	0.040
84.871	0.000	0.00	0.16	0.03	0.040
85.054	0.000	0.00	0.16	0.03	0.040
85.237	0.000	0.00	0.16	0.03	0.039
85.420	0.000	0.00	0.15	0.03	0.039
85.603	0.000	0.00	0.15	0.03	0.038
85.786	0.000	0.00	0.15	0.02	0.038
85.970	0.000	0.00	0.15	0.02	0.038
86.153	0.000	0.00	0.15	0.02	0.037
86.336	0.000	0.00	0.15	0.02	0.037
86.519	0.000	0.00	0.15	0.02	0.037
86.702	0.000	0.00	0.14	0.02	0.036
86.885	0.000	0.00	0.14	0.02	0.036
87.069	0.000	0.00	0.14	0.02	0.036
87.252	0.000	0.00	0.14	0.02	0.035
87.435	0.000	0.00	0.14	0.02	0.035
87.618	0.000	0.00	0.14	0.02	0.035
87.801	0.000	0.00	0.14	0.02	0.034
87.984	0.000	0.00	0.13	0.02	0.034
88.168	0.000	0.00	0.13	0.02	0.034
88.351	0.000	0.00	0.13	0.02	0.033
88.534	0.000	0.00	0.13	0.02	0.033
88.717	0.000	0.00	0.13	0.02	0.033
88.900	0.000	0.00	0.13	0.02	0.032
89.083	0.000	0.00	0.13	0.02	0.032
89.267	0.000	0.00	0.13	0.02	0.032
89.450	0.000	0.00	0.12	0.02	0.031
89.633	0.000	0.00	0.12	0.02	0.031
89.816	0.000	0.00	0.12	0.02	0.031
89.999	0.000	0.00	0.12	0.02	0.030
90.182	0.000	0.00	0.12	0.02	0.030

90.366	0.000	0.00	0.12	0.02	0.030
90.549	0.000	0.00	0.12	0.02	0.029
90.732	0.000	0.00	0.12	0.02	0.029
90.915	0.000	0.00	0.12	0.02	0.029
91.098	0.000	0.00	0.11	0.02	0.029
91.281	0.000	0.00	0.11	0.02	0.028
91.465	0.000	0.00	0.11	0.02	0.028
91.648	0.000	0.00	0.11	0.02	0.028
91.831	0.000	0.00	0.11	0.02	0.028
92.014	0.000	0.00	0.11	0.02	0.027
92.197	0.000	0.00	0.11	0.02	0.027
92.380	0.000	0.00	0.11	0.02	0.027
92.564	0.000	0.00	0.11	0.02	0.026
92.747	0.000	0.00	0.10	0.02	0.026
92.930	0.000	0.00	0.10	0.02	0.026
93.113	0.000	0.00	0.10	0.02	0.026
93.296	0.000	0.00	0.10	0.02	0.025
93.479	0.000	0.00	0.10	0.02	0.025
93.663	0.000	0.00	0.10	0.02	0.025
93.846	0.000	0.00	0.10	0.02	0.025
94.029	0.000	0.00	0.10	0.02	0.024
94.212	0.000	0.00	0.10	0.02	0.024
94.395	0.000	0.00	0.10	0.02	0.024
94.578	0.000	0.00	0.09	0.02	0.024
94.762	0.000	0.00	0.09	0.02	0.024
94.945	0.000	0.00	0.09	0.02	0.023
95.128	0.000	0.00	0.09	0.02	0.023
95.311	0.000	0.00	0.09	0.01	0.023
95.494	0.000	0.00	0.09	0.01	0.023
95.677	0.000	0.00	0.09	0.01	0.022
95.861	0.000	0.00	0.09	0.01	0.022
96.044	0.000	0.00	0.09	0.01	0.022
96.227	0.000	0.00	0.09	0.01	0.022
96.410	0.000	0.00	0.09	0.01	0.022
96.593	0.000	0.00	0.08	0.01	0.021
96.776	0.000	0.00	0.08	0.01	0.021
96.960	0.000	0.00	0.08	0.01	0.021

97.143	0.000	0.00	0.08	0.01	0.021
97.326	0.000	0.00	0.08	0.01	0.020
97.509	0.000	0.00	0.08	0.01	0.020
97.692	0.000	0.00	0.08	0.01	0.020
97.875	0.000	0.00	0.08	0.01	0.020
98.059	0.000	0.00	0.08	0.01	0.020
98.242	0.000	0.00	0.08	0.01	0.020
98.425	0.000	0.00	0.08	0.01	0.019
98.608	0.000	0.00	0.08	0.01	0.019
98.791	0.000	0.00	0.08	0.01	0.019
98.974	0.000	0.00	0.07	0.01	0.019
99.158	0.000	0.00	0.07	0.01	0.019
99.341	0.000	0.00	0.07	0.01	0.018
99.524	0.000	0.00	0.07	0.01	0.018
99.707	0.000	0.00	0.07	0.01	0.018
99.890	0.000	0.00	0.07	0.01	0.018
100.073	0.000	0.00	0.07	0.01	0.018
100.257	0.000	0.00	0.07	0.01	0.018
100.440	0.000	0.00	0.07	0.01	0.017
100.623	0.000	0.00	0.07	0.01	0.017
100.806	0.000	0.00	0.07	0.01	0.017
100.989	0.000	0.00	0.07	0.01	0.017
101.172	0.000	0.00	0.07	0.01	0.017
101.356	0.000	0.00	0.07	0.01	0.017
101.539	0.000	0.00	0.07	0.01	0.016
101.722	0.000	0.00	0.06	0.01	0.016
101.905	0.000	0.00	0.06	0.01	0.016
102.088	0.000	0.00	0.06	0.01	0.016
102.271	0.000	0.00	0.06	0.01	0.016
102.455	0.000	0.00	0.06	0.01	0.016
102.638	0.000	0.00	0.06	0.01	0.015
102.821	0.000	0.00	0.06	0.01	0.015
103.004	0.000	0.00	0.06	0.01	0.015
103.187	0.000	0.00	0.06	0.01	0.015
103.370	0.000	0.00	0.06	0.01	0.015
103.554	0.000	0.00	0.06	0.01	0.015
103.737	0.000	0.00	0.06	0.01	0.015

103.920	0.000	0.00	0.06	0.01	0.014
104.103	0.000	0.00	0.06	0.01	0.014
104.286	0.000	0.00	0.06	0.01	0.014
104.469	0.000	0.00	0.06	0.01	0.014
104.653	0.000	0.00	0.06	0.01	0.014
104.836	0.000	0.00	0.05	0.01	0.014
105.019	0.000	0.00	0.05	0.01	0.014
105.202	0.000	0.00	0.05	0.01	0.013
105.385	0.000	0.00	0.05	0.01	0.013
105.568	0.000	0.00	0.05	0.01	0.013
105.752	0.000	0.00	0.05	0.01	0.013
105.935	0.000	0.00	0.05	0.01	0.013
106.118	0.000	0.00	0.05	0.01	0.013
106.301	0.000	0.00	0.05	0.01	0.013
106.484	0.000	0.00	0.05	0.01	0.013
106.667	0.000	0.00	0.05	0.01	0.012
106.851	0.000	0.00	0.05	0.01	0.012
107.034	0.000	0.00	0.05	0.01	0.012
107.217	0.000	0.00	0.05	0.01	0.012
107.400	0.000	0.00	0.05	0.01	0.012
107.583	0.000	0.00	0.05	0.01	0.012
107.766	0.000	0.00	0.05	0.01	0.012
107.950	0.000	0.00	0.05	0.01	0.012
108.133	0.000	0.00	0.05	0.01	0.011
108.316	0.000	0.00	0.05	0.01	0.011
108.499	0.000	0.00	0.04	0.01	0.011
108.682	0.000	0.00	0.04	0.01	0.011
108.865	0.000	0.00	0.04	0.01	0.011
109.049	0.000	0.00	0.04	0.01	0.011
109.232	0.000	0.00	0.04	0.01	0.011
109.415	0.000	0.00	0.04	0.01	0.011
109.598	0.000	0.00	0.04	0.01	0.011
109.781	0.000	0.00	0.04	0.01	0.011
109.964	0.000	0.00	0.04	0.01	0.010
110.148	0.000	0.00	0.04	0.01	0.010
110.331	0.000	0.00	0.04	0.01	0.010
110.514	0.000	0.00	0.04	0.01	0.010

110.697	0.000	0.00	0.04	0.01	0.010
110.880	0.000	0.00	0.04	0.01	0.010
111.063	0.000	0.00	0.04	0.01	0.010
111.247	0.000	0.00	0.04	0.01	0.010
111.430	0.000	0.00	0.04	0.01	0.010
111.613	0.000	0.00	0.04	0.01	0.010
111.796	0.000	0.00	0.04	0.01	0.009
111.979	0.000	0.00	0.04	0.01	0.009
112.162	0.000	0.00	0.04	0.01	0.009
112.346	0.000	0.00	0.04	0.01	0.009
112.529	0.000	0.00	0.04	0.01	0.009
112.712	0.000	0.00	0.04	0.01	0.009
112.895	0.000	0.00	0.04	0.01	0.009
113.078	0.000	0.00	0.04	0.01	0.009
113.261	0.000	0.00	0.03	0.01	0.009
113.445	0.000	0.00	0.03	0.01	0.009
113.628	0.000	0.00	0.03	0.01	0.009
113.811	0.000	0.00	0.03	0.01	0.008
113.994	0.000	0.00	0.03	0.01	0.008
114.177	0.000	0.00	0.03	0.01	0.008
114.360	0.000	0.00	0.03	0.01	0.008
114.544	0.000	0.00	0.03	0.01	0.008
114.727	0.000	0.00	0.03	0.01	0.008
114.910	0.000	0.00	0.03	0.01	0.008
115.093	0.000	0.00	0.03	0.01	0.008
115.276	0.000	0.00	0.03	0.01	0.008
115.459	0.000	0.00	0.03	0.01	0.008
115.643	0.000	0.00	0.03	0.01	0.008
115.826	0.000	0.00	0.03	0.00	0.008
116.009	0.000	0.00	0.03	0.00	0.008
116.192	0.000	0.00	0.03	0.00	0.007
116.375	0.000	0.00	0.03	0.00	0.007
116.558	0.000	0.00	0.03	0.00	0.007
116.742	0.000	0.00	0.03	0.00	0.007
116.925	0.000	0.00	0.03	0.00	0.007
117.108	0.000	0.00	0.03	0.00	0.007
117.291	0.000	0.00	0.03	0.00	0.007

117.474	0.000	0.00	0.03	0.00	0.007
117.657	0.000	0.00	0.03	0.00	0.007
117.841	0.000	0.00	0.03	0.00	0.007
118.024	0.000	0.00	0.03	0.00	0.007
118.207	0.000	0.00	0.03	0.00	0.007
118.390	0.000	0.00	0.03	0.00	0.007
118.573	0.000	0.00	0.03	0.00	0.007
118.756	0.000	0.00	0.03	0.00	0.006
118.940	0.000	0.00	0.03	0.00	0.006
119.123	0.000	0.00	0.03	0.00	0.006
119.306	0.000	0.00	0.03	0.00	0.006
119.489	0.000	0.00	0.02	0.00	0.006
119.672	0.000	0.00	0.02	0.00	0.006
119.855	0.000	0.00	0.02	0.00	0.006
120.039	0.000	0.00	0.02	0.00	0.006
120.222	0.000	0.00	0.02	0.00	0.006
120.405	0.000	0.00	0.02	0.00	0.006
120.588	0.000	0.00	0.02	0.00	0.006
120.771	0.000	0.00	0.02	0.00	0.006
120.954	0.000	0.00	0.02	0.00	0.006
121.138	0.000	0.00	0.02	0.00	0.006
121.321	0.000	0.00	0.02	0.00	0.006
121.504	0.000	0.00	0.02	0.00	0.006
121.687	0.000	0.00	0.02	0.00	0.006
121.870	0.000	0.00	0.02	0.00	0.005
122.053	0.000	0.00	0.02	0.00	0.005
122.237	0.000	0.00	0.02	0.00	0.005
122.420	0.000	0.00	0.02	0.00	0.005
122.603	0.000	0.00	0.02	0.00	0.005
122.786	0.000	0.00	0.02	0.00	0.005
122.969	0.000	0.00	0.02	0.00	0.005
123.152	0.000	0.00	0.02	0.00	0.005
123.336	0.000	0.00	0.02	0.00	0.005
123.519	0.000	0.00	0.02	0.00	0.005
123.702	0.000	0.00	0.02	0.00	0.005
123.885	0.000	0.00	0.02	0.00	0.005
124.068	0.000	0.00	0.02	0.00	0.005

124.251	0.000	0.00	0.02	0.00	0.005
124.435	0.000	0.00	0.02	0.00	0.005
124.618	0.000	0.00	0.02	0.00	0.005
124.801	0.000	0.00	0.02	0.00	0.005
124.984	0.000	0.00	0.02	0.00	0.005
125.167	0.000	0.00	0.02	0.00	0.005
125.350	0.000	0.00	0.02	0.00	0.005
125.534	0.000	0.00	0.02	0.00	0.005
125.717	0.000	0.00	0.02	0.00	0.004
125.900	0.000	0.00	0.02	0.00	0.004
126.083	0.000	0.00	0.02	0.00	0.004
126.266	0.000	0.00	0.02	0.00	0.004
126.449	0.000	0.00	0.02	0.00	0.004
126.633	0.000	0.00	0.02	0.00	0.004
126.816	0.000	0.00	0.02	0.00	0.004
126.999	0.000	0.00	0.02	0.00	0.004
127.182	0.000	0.00	0.02	0.00	0.004
127.365	0.000	0.00	0.02	0.00	0.004
127.548	0.000	0.00	0.02	0.00	0.004
127.732	0.000	0.00	0.02	0.00	0.004
127.915	0.000	0.00	0.02	0.00	0.004
128.098	0.000	0.00	0.02	0.00	0.004
128.281	0.000	0.00	0.02	0.00	0.004
128.464	0.000	0.00	0.02	0.00	0.004
128.647	0.000	0.00	0.02	0.00	0.004
128.831	0.000	0.00	0.02	0.00	0.004
129.014	0.000	0.00	0.01	0.00	0.004
129.197	0.000	0.00	0.01	0.00	0.004
129.380	0.000	0.00	0.01	0.00	0.004
129.563	0.000	0.00	0.01	0.00	0.004
129.746	0.000	0.00	0.01	0.00	0.004
129.930	0.000	0.00	0.01	0.00	0.004
130.113	0.000	0.00	0.01	0.00	0.004
130.296	0.000	0.00	0.01	0.00	0.003
130.479	0.000	0.00	0.01	0.00	0.003
130.662	0.000	0.00	0.01	0.00	0.003
130.845	0.000	0.00	0.01	0.00	0.003

131.029	0.000	0.00	0.01	0.00	0.003
131.212	0.000	0.00	0.01	0.00	0.003
131.395	0.000	0.00	0.01	0.00	0.003
131.578	0.000	0.00	0.01	0.00	0.003
131.761	0.000	0.00	0.01	0.00	0.003
131.944	0.000	0.00	0.01	0.00	0.003
132.128	0.000	0.00	0.01	0.00	0.003
132.311	0.000	0.00	0.01	0.00	0.003
132.494	0.000	0.00	0.01	0.00	0.003
132.677	0.000	0.00	0.01	0.00	0.003
132.860	0.000	0.00	0.01	0.00	0.003
133.043	0.000	0.00	0.01	0.00	0.003
133.227	0.000	0.00	0.01	0.00	0.003
133.410	0.000	0.00	0.01	0.00	0.003
133.593	0.000	0.00	0.01	0.00	0.003
133.776	0.000	0.00	0.01	0.00	0.003
133.959	0.000	0.00	0.01	0.00	0.003
134.142	0.000	0.00	0.01	0.00	0.003
134.326	0.000	0.00	0.01	0.00	0.003
134.509	0.000	0.00	0.01	0.00	0.003
134.692	0.000	0.00	0.01	0.00	0.003
134.875	0.000	0.00	0.01	0.00	0.003
135.058	0.000	0.00	0.01	0.00	0.003
135.241	0.000	0.00	0.01	0.00	0.003
135.425	0.000	0.00	0.01	0.00	0.003
135.608	0.000	0.00	0.01	0.00	0.003
135.791	0.000	0.00	0.01	0.00	0.003
135.974	0.000	0.00	0.01	0.00	0.003
136.157	0.000	0.00	0.01	0.00	0.003
136.340	0.000	0.00	0.01	0.00	0.003
136.524	0.000	0.00	0.01	0.00	0.003
136.707	0.000	0.00	0.01	0.00	0.002
136.890	0.000	0.00	0.01	0.00	0.002
137.073	0.000	0.00	0.01	0.00	0.002
137.256	0.000	0.00	0.01	0.00	0.002
137.439	0.000	0.00	0.01	0.00	0.002
137.623	0.000	0.00	0.01	0.00	0.002

137.806	0.000	0.00	0.01	0.00	0.002
137.989	0.000	0.00	0.01	0.00	0.002
138.172	0.000	0.00	0.01	0.00	0.002
138.355	0.000	0.00	0.01	0.00	0.002
138.538	0.000	0.00	0.01	0.00	0.002
138.722	0.000	0.00	0.01	0.00	0.002
138.905	0.000	0.00	0.01	0.00	0.002
139.088	0.000	0.00	0.01	0.00	0.002
139.271	0.000	0.00	0.01	0.00	0.002
139.454	0.000	0.00	0.01	0.00	0.002
139.637	0.000	0.00	0.01	0.00	0.002
139.821	0.000	0.00	0.01	0.00	0.002
140.004	0.000	0.00	0.01	0.00	0.002
140.187	0.000	0.00	0.01	0.00	0.002
140.370	0.000	0.00	0.01	0.00	0.002
140.553	0.000	0.00	0.01	0.00	0.002
140.736	0.000	0.00	0.01	0.00	0.002
140.920	0.000	0.00	0.01	0.00	0.002
141.103	0.000	0.00	0.01	0.00	0.002
141.286	0.000	0.00	0.01	0.00	0.002
141.469	0.000	0.00	0.01	0.00	0.002
141.652	0.000	0.00	0.01	0.00	0.002
141.835	0.000	0.00	0.01	0.00	0.002
142.019	0.000	0.00	0.01	0.00	0.002
142.202	0.000	0.00	0.01	0.00	0.002
142.385	0.000	0.00	0.01	0.00	0.002
142.568	0.000	0.00	0.01	0.00	0.002
142.751	0.000	0.00	0.01	0.00	0.002
142.934	0.000	0.00	0.01	0.00	0.002
143.118	0.000	0.00	0.01	0.00	0.002
143.301	0.000	0.00	0.01	0.00	0.002
143.484	0.000	0.00	0.01	0.00	0.002
143.667	0.000	0.00	0.01	0.00	0.002
143.850	0.000	0.00	0.01	0.00	0.002
144.033	0.000	0.00	0.01	0.00	0.002
144.217	0.000	0.00	0.01	0.00	0.002
144.400	0.000	0.00	0.01	0.00	0.002

144.583	0.000	0.00	0.01	0.00	0.002
144.766	0.000	0.00	0.01	0.00	0.002
144.949	0.000	0.00	0.01	0.00	0.002
145.132	0.000	0.00	0.01	0.00	0.002
145.316	0.000	0.00	0.01	0.00	0.002
145.499	0.000	0.00	0.01	0.00	0.002
145.682	0.000	0.00	0.01	0.00	0.002
145.865	0.000	0.00	0.01	0.00	0.002
146.048	0.000	0.00	0.01	0.00	0.001
146.231	0.000	0.00	0.01	0.00	0.001
146.415	0.000	0.00	0.01	0.00	0.001
146.598	0.000	0.00	0.01	0.00	0.001
146.781	0.000	0.00	0.01	0.00	0.001
146.964	0.000	0.00	0.01	0.00	0.001
147.147	0.000	0.00	0.01	0.00	0.001
147.330	0.000	0.00	0.01	0.00	0.001
147.514	0.000	0.00	0.01	0.00	0.001
147.697	0.000	0.00	0.01	0.00	0.001
147.880	0.000	0.00	0.01	0.00	0.001
148.063	0.000	0.00	0.01	0.00	0.001
148.246	0.000	0.00	0.01	0.00	0.001
148.429	0.000	0.00	0.01	0.00	0.001
148.613	0.000	0.00	0.01	0.00	0.001
148.796	0.000	0.00	0.01	0.00	0.001
148.979	0.000	0.00	0.01	0.00	0.001
149.162	0.000	0.00	0.01	0.00	0.001
149.345	0.000	0.00	0.01	0.00	0.001
149.528	0.000	0.00	0.00	0.00	0.001
149.712	0.000	0.00	0.00	0.00	0.001
149.895	0.000	0.00	0.00	0.00	0.001
150.078	0.000	0.00	0.00	0.00	0.001
150.261	0.000	0.00	0.00	0.00	0.001
150.444	0.000	0.00	0.00	0.00	0.001
150.627	0.000	0.00	0.00	0.00	0.001
150.811	0.000	0.00	0.00	0.00	0.001
150.994	0.000	0.00	0.00	0.00	0.001
151.177	0.000	0.00	0.00	0.00	0.001

151.360	0.000	0.00	0.00	0.00	0.001
151.543	0.000	0.00	0.00	0.00	0.001
151.726	0.000	0.00	0.00	0.00	0.001
151.910	0.000	0.00	0.00	0.00	0.001
152.093	0.000	0.00	0.00	0.00	0.001
152.276	0.000	0.00	0.00	0.00	0.001
152.459	0.000	0.00	0.00	0.00	0.001
152.642	0.000	0.00	0.00	0.00	0.001
152.825	0.000	0.00	0.00	0.00	0.001
153.009	0.000	0.00	0.00	0.00	0.001
153.192	0.000	0.00	0.00	0.00	0.001
153.375	0.000	0.00	0.00	0.00	0.001
153.558	0.000	0.00	0.00	0.00	0.001

Song Property Basin Stage Storage
Project: R314340.01 - MLC Song Property
Basin Description: WQ Basin

Contour Elevation	Contour Area (sq. ft)	Depth (ft)	Incremental Volume Avg. End (cu. ft)	Cumulative Volume Avg. End (cu. ft)	Incremental Volume Conic (cu. ft)	Cumulative Volume Conic (cu. ft)
1,259.60	11,446.09	N/A	N/A	0.00	N/A	0.00
1,259.80	11,752.95	0.20	2319.90	2319.90	2319.84	2319.84
1,260.00	12,064.87	0.20	2381.78	4701.69	2381.71	4701.55
1,260.20	12,374.08	0.20	2443.90	7145.58	2443.83	7145.38
1,260.40	12,686.23	0.20	2506.03	9651.61	2505.97	9651.35
1,260.60	13,002.26	0.20	2568.85	12220.46	2568.78	12220.13
1,260.80	13,322.88	0.20	2632.51	14852.98	2632.45	14852.58
1,261.00	13,648.70	0.20	2697.16	17550.13	2697.09	17549.67
1,261.20	13,969.56	0.20	2761.83	20311.96	2761.76	20311.44
1,261.40	14,293.18	0.20	2826.27	23138.23	2826.21	23137.65
1,261.60	14,620.52	0.20	2891.37	26029.60	2891.31	26028.96
1,261.80	14,952.29	0.20	2957.28	28986.89	2957.22	28986.18
1,262.00	15,289.10	0.20	3024.14	32011.02	3024.08	32010.25
1,262.20	15,530.04	0.20	3081.91	35092.94	3081.88	35092.14
1,262.40	15,772.35	0.20	3130.24	38223.18	3130.21	38222.34
1,262.60	16,016.26	0.20	3178.86	41402.04	3178.83	41401.17
1,262.80	16,262.25	0.20	3227.85	44629.89	3227.82	44628.99
1,263.00	16,510.87	0.20	3277.31	47907.20	3277.28	47906.27
1,263.20	16,761.05	0.20	3327.19	51234.39	3327.16	51233.43
1,263.40	17,011.75	0.20	3377.28	54611.67	3377.25	54610.68
1,263.60	17,262.98	0.20	3427.47	58039.15	3427.44	58038.12
1,263.80	17,514.72	0.20	3477.77	61516.91	3477.74	61515.86

Attachment C

Referenced Materials

NOAA Atlas 14, Volume 6, Version 2
Location name: Redlands, California, USA*
Latitude: 34.0824°, Longitude: -117.1997°
Elevation: 1271.65 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	**0.099** (0.082-0.120)	**0.128** (0.106-0.156)	**0.167** (0.139-0.204)	**0.200** (0.164-0.246)	**0.246** (0.195-0.313)	**0.282** (0.219-0.367)	**0.320** (0.242-0.426)	**0.360** (0.265-0.493)	**0.415** (0.293-0.594)	**0.460** (0.313-0.682)
10-min	**0.141** (0.118-0.172)	**0.183** (0.152-0.223)	**0.240** (0.199-0.292)	**0.287** (0.236-0.353)	**0.352** (0.280-0.448)	**0.404** (0.314-0.525)	**0.458** (0.347-0.611)	**0.515** (0.380-0.707)	**0.595** (0.420-0.852)	**0.659** (0.449-0.977)
15-min	**0.171** (0.142-0.208)	**0.222** (0.184-0.270)	**0.290** (0.240-0.353)	**0.347** (0.285-0.426)	**0.426** (0.338-0.542)	**0.489** (0.380-0.635)	**0.554** (0.420-0.739)	**0.623** (0.459-0.855)	**0.720** (0.508-1.03)	**0.797** (0.543-1.18)
30-min	**0.255** (0.212-0.309)	**0.330** (0.274-0.401)	**0.432** (0.358-0.526)	**0.516** (0.424-0.635)	**0.635** (0.504-0.807)	**0.728** (0.566-0.946)	**0.826** (0.626-1.10)	**0.928** (0.684-1.27)	**1.07** (0.757-1.53)	**1.19** (0.809-1.76)
60-min	**0.370** (0.308-0.449)	**0.480** (0.399-0.583)	**0.627** (0.520-0.765)	**0.750** (0.616-0.922)	**0.922** (0.732-1.17)	**1.06** (0.822-1.38)	**1.20** (0.909-1.60)	**1.35** (0.993-1.85)	**1.56** (1.10-2.23)	**1.72** (1.18-2.56)
2-hr	**0.528** (0.439-0.641)	**0.677** (0.563-0.823)	**0.877** (0.726-1.07)	**1.04** (0.856-1.28)	**1.27** (1.01-1.61)	**1.45** (1.13-1.88)	**1.63** (1.24-2.17)	**1.82** (1.34-2.50)	**2.09** (1.47-2.99)	**2.30** (1.56-3.40)
3-hr	**0.650** (0.541-0.789)	**0.831** (0.690-1.01)	**1.07** (0.887-1.31)	**1.27** (1.04-1.56)	**1.54** (1.22-1.96)	**1.75** (1.36-2.28)	**1.97** (1.49-2.63)	**2.20** (1.62-3.01)	**2.51** (1.77-3.59)	**2.75** (1.87-4.08)
6-hr	**0.910** (0.757-1.11)	**1.16** (0.965-1.41)	**1.49** (1.24-1.82)	**1.76** (1.45-2.17)	**2.13** (1.69-2.71)	**2.42** (1.88-3.14)	**2.71** (2.06-3.61)	**3.01** (2.22-4.13)	**3.43** (2.42-4.90)	**3.75** (2.55-5.55)
12-hr	**1.21** (1.01-1.47)	**1.56** (1.29-1.89)	**2.00** (1.66-2.44)	**2.37** (1.95-2.91)	**2.86** (2.27-3.64)	**3.24** (2.52-4.21)	**3.63** (2.75-4.83)	**4.02** (2.96-5.52)	**4.56** (3.22-6.52)	**4.97** (3.39-7.37)
24-hr	**1.63** (1.44-1.87)	**2.11** (1.86-2.43)	**2.73** (2.41-3.16)	**3.23** (2.83-3.77)	**3.92** (3.32-4.72)	**4.44** (3.68-5.46)	**4.97** (4.02-6.26)	**5.51** (4.34-7.13)	**6.24** (4.72-8.41)	**6.80** (4.98-9.49)
2-day	**2.01** (1.78-2.31)	**2.63** (2.33-3.04)	**3.46** (3.05-4.00)	**4.13** (3.62-4.82)	**5.05** (4.28-6.08)	**5.76** (4.78-7.08)	**6.48** (5.25-8.16)	**7.22** (5.69-9.35)	**8.23** (6.23-11.1)	**9.02** (6.60-12.6)
3-day	**2.17** (1.92-2.50)	**2.89** (2.55-3.33)	**3.84** (3.39-4.44)	**4.63** (4.05-5.39)	**5.71** (4.84-6.88)	**6.56** (5.44-8.06)	**7.43** (6.02-9.36)	**8.34** (6.57-10.8)	**9.58** (7.25-12.9)	**10.6** (7.73-14.7)
4-day	**2.34** (2.07-2.70)	**3.14** (2.77-3.62)	**4.20** (3.71-4.86)	**5.09** (4.45-5.94)	**6.32** (5.35-7.61)	**7.29** (6.05-8.96)	**8.29** (6.71-10.4)	**9.34** (7.36-12.1)	**10.8** (8.16-14.5)	**11.9** (8.74-16.7)
7-day	**2.70** (2.39-3.11)	**3.66** (3.23-4.22)	**4.93** (4.35-5.71)	**6.00** (5.25-7.00)	**7.49** (6.34-9.02)	**8.65** (7.18-10.6)	**9.87** (7.99-12.4)	**11.1** (8.78-14.4)	**12.9** (9.77-17.4)	**14.3** (10.5-20.0)
10-day	**2.92** (2.59-3.37)	**3.98** (3.52-4.59)	**5.40** (4.76-6.25)	**6.58** (5.76-7.68)	**8.24** (6.98-9.93)	**9.54** (7.92-11.7)	**10.9** (8.83-13.7)	**12.3** (9.71-16.0)	**14.3** (10.8-19.3)	**15.9** (11.6-22.1)
20-day	**3.61** (3.20-4.16)	**4.96** (4.38-5.72)	**6.78** (5.98-7.84)	**8.31** (7.27-9.69)	**10.5** (8.86-12.6)	**12.2** (10.1-14.9)	**13.9** (11.3-17.5)	**15.8** (12.5-20.5)	**18.4** (13.9-24.8)	**20.5** (15.0-28.6)
30-day	**4.25** (3.76-4.89)	**5.84** (5.17-6.74)	**8.01** (7.07-9.27)	**9.84** (8.61-11.5)	**12.4** (10.5-14.9)	**14.4** (12.0-17.8)	**16.6** (13.4-20.9)	**18.8** (14.8-24.4)	**22.0** (16.6-29.7)	**24.5** (17.9-34.2)
45-day	**5.09** (4.50-5.86)	**6.97** (6.17-8.05)	**9.54** (8.42-11.0)	**11.7** (10.2-13.7)	**14.8** (12.5-17.8)	**17.2** (14.3-21.2)	**19.8** (16.0-24.9)	**22.5** (17.7-29.1)	**26.3** (19.9-35.5)	**29.4** (21.5-40.9)
60-day	**5.96** (5.27-6.86)	**8.11** (7.18-9.36)	**11.1** (9.75-12.8)	**13.5** (11.9-15.8)	**17.1** (14.4-20.5)	**19.9** (16.5-24.4)	**22.8** (18.5-28.7)	**25.9** (20.4-33.6)	**30.3** (23.0-40.9)	**33.9** (24.8-47.2)

[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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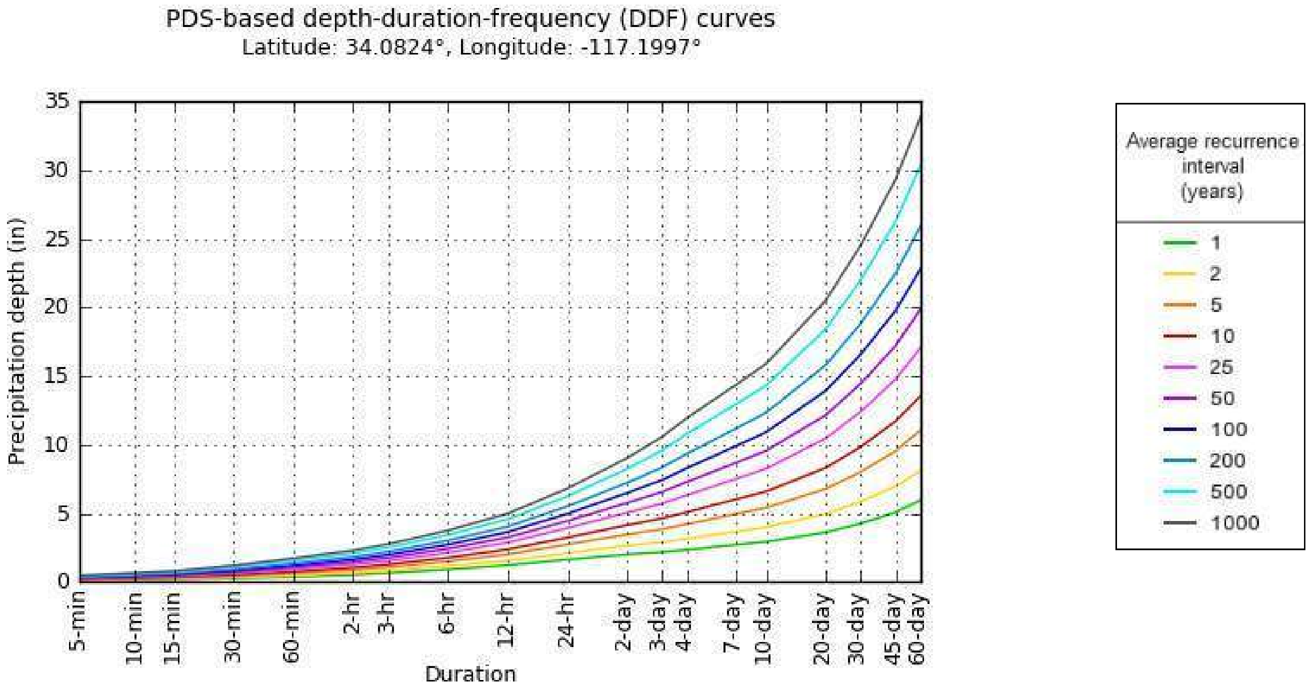
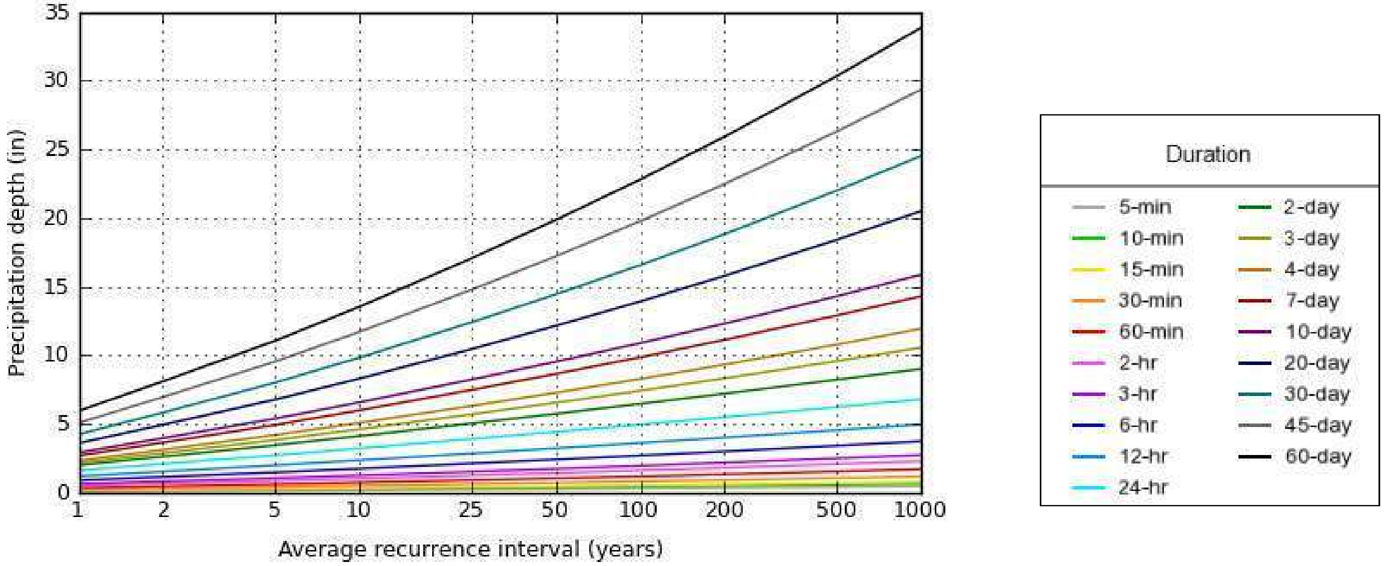
PF graphical





NOAA Atlas 14, Volume 6, Version 2 Created (GMT): Tue Jan 25 00:49:31 2022

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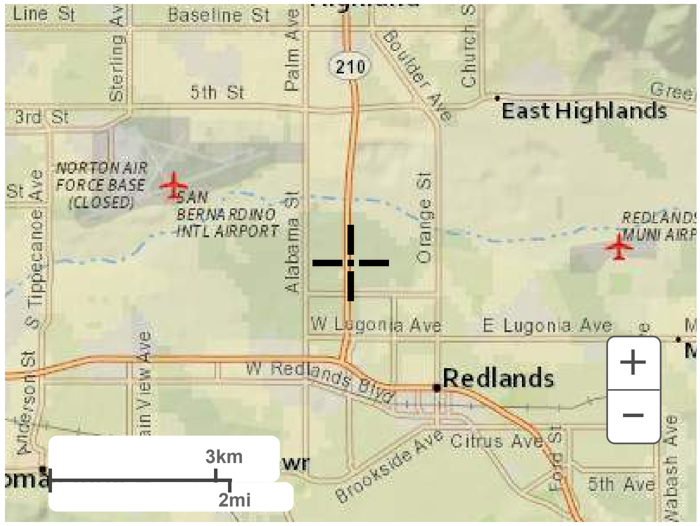
Maps & aerials

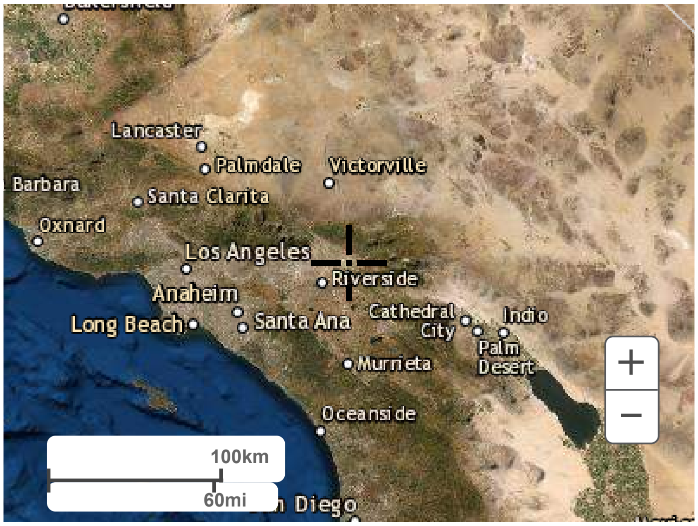
Small scale terrain



Large scale terrain

Large scale map

Large scale aerial



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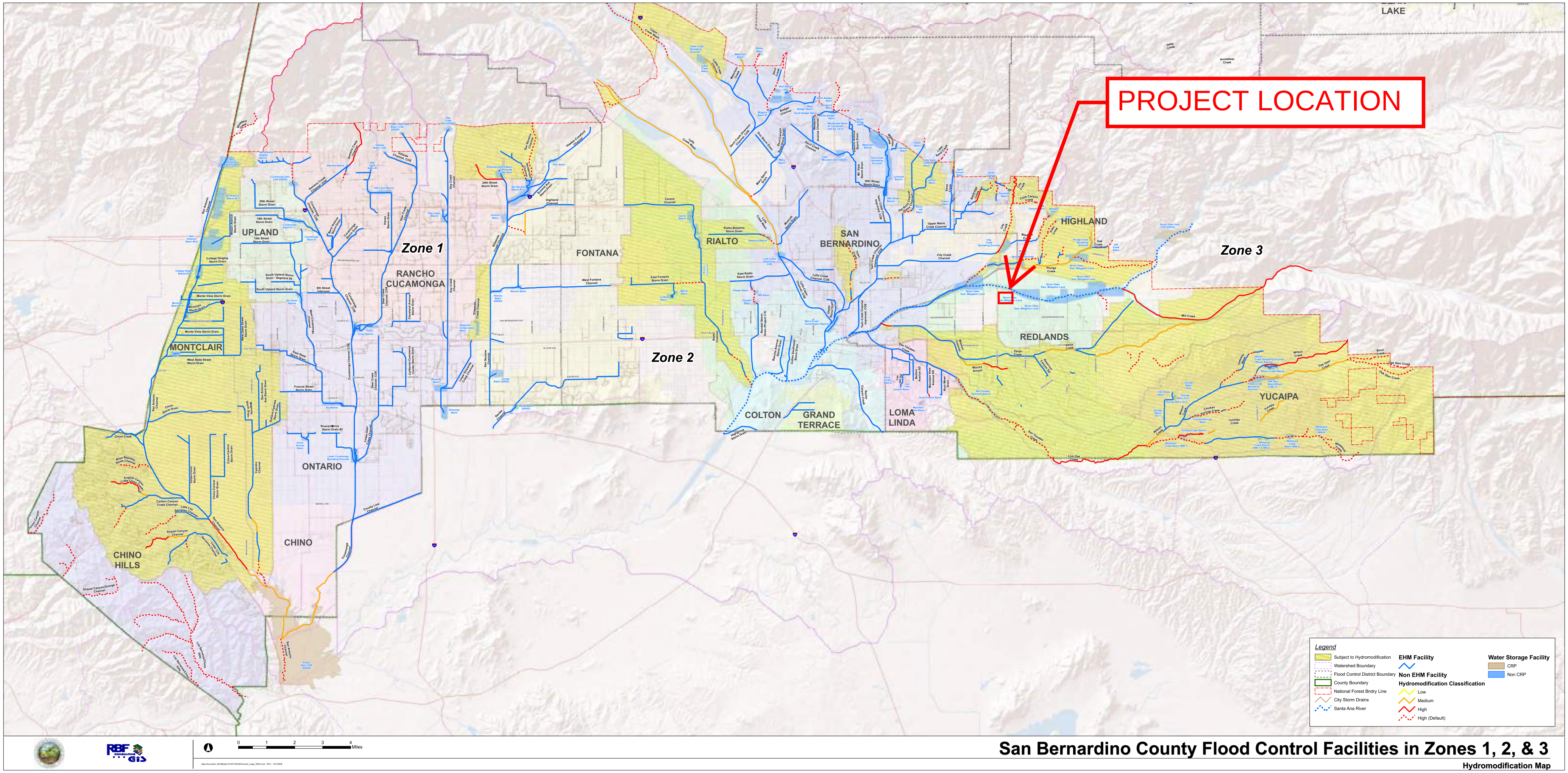
US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov


PROJECT LOCATION
Zone 1
Zone 2
Zone 3
UPLAND
MONTCLAIR
RANCHO CUCAMONGA
FONTANA
RIALTO
SAN BERNARDINO
HIGHLAND
REDLANDS
YUCAIPA
COLTON
GRAND TERRACE
LOMA LINDA
ONTARIO
CHINO
CHINO HILLS
LAKE
Legend
Subject to Hydromodification
Watershed Boundary
Flood Control District Boundary
County Boundary
National Forest Bndry Line
City Storm Drains
Santa Ana River
EHM Facility
Non EHM Facility
Hydromodification Classification
Low
Medium
High
High (Default)
Water Storage Facility
CRP
Non CRP
Miles
San Bernardino County Flood Control Facilities in Zones 1, 2, & 3
Hydromodification Map

Attachment D

Geotechnical Reports

September 10, 2021
J.N. 21-315

MERITAGE HOMES
5 Peters Canyon Road, Suite 310
Irvine, California 92606

Attention: Ms. Johanna Crooker

Subject: Due-Diligence/Feasibility Geotechnical Assessment, Approximately 10±-Acre Property at 1160 W. Pioneer Avenue, East of 210 Freeway and North of Domestic Avenue, City of Redlands, San Bernardino County, California

Dear Ms. Crooker:

In accordance with your request, **Petra Geosciences, Inc. (Petra)** has performed a geotechnical due-diligence evaluation of the subject site for development of residential lots and related utility and street improvements. This report presents our findings and professional opinions with respect to the geotechnical feasibility of the proposed development, geotechnical constraints that should be taken into consideration during development of the site and potential mitigation measures to bring the site to compliance from a geotechnical engineering viewpoint.

It must be emphasized that that this report is intended as a feasibility-level geotechnical assessment only and is based solely on a review of the referenced background geologic literature and our limited subsurface exploration and laboratory testing. As such, the contents of this report are not suitable for submittal to regulatory agencies, nor should the findings or conclusions provided herein be relied upon for earthwork, quantity calculation or procedure, or structural engineering design. This geotechnical evaluation does not address soil contamination or other environmental issues affecting the property which will be provided under separate cover.

SITE GENERAL OVERVIEW

The subject site is located at 1160 W. Pioneer Avenue in the city of Redlands, San Bernardino County, California. According to the California Department of Conservation, Geologic Energy Management Division (CalGEM) Online Mapping System (2021), the site is located within Township 01 South, Range 03 West, Section 16, San Bernardino Base and Meridian. A site location map is included as Figure 1.

The rectangular shaped site is comprised of approximately 10±-acres of vacant land with Assessor Parcel Number (APN) 0167-061-01. Access to the subject property is via W. Pioneer Avenue along the south or

W. Domestic Avenue which is an unimproved dirt road along the northern boundary of the site. A drainage bounds the western edge of the subject property, with the 210 Freeway easement beyond. Vacant land and an orchard bound the site along the east with Citrus Valley High School beyond.

The site slopes gently to the north with existing elevations on the order of approximately 1,276± feet above mean sea level (msl) along the south portion of the site, to 1,267± feet above msl along the north portion of the site. Light to moderate vegetation covers the site with several mature trees along the south and east boundaries of the site.

DUE DILIGENCE ASSESSMENT

Literature Review

Petra has reviewed available published and unpublished geologic/geotechnical maps and literature, as well as online aerial imagery in the general area of the project site, see references. No geotechnical reports are known to exist for this site.

Site Reconnaissance and Subsurface Investigation

A preliminary subsurface exploration program was conducted within the site by representatives of Petra on August 6, 2021. The field investigation included the excavation of 6 exploratory borings (B-1 through B-6) to approximate depths ranging from 10.5 to 56.5 feet below existing ground surface (bgs) utilizing a conventional rubber-tired drill rig. One Boring, Boring B-1, was converted to a percolation test well. Following drilling, logging and percolation testing, the borings were loosely backfilled with the soil cuttings and logs of the borings are shown in Appendix A. The approximate locations of the exploratory borings are shown on Figure 2. The purpose of our preliminary investigation was to evaluate the subsurface surface soil materials to determine the unsuitable soil removal depths (remedial grading).

Laboratory Testing

The preliminary laboratory program consisted of testing select undisturbed and/or bulk samples of onsite native soil materials for in-situ moisture and dry density, expansion index, maximum dry density and optimum moisture content, and general corrosion potential (sulfate, chloride, pH, resistivity). The laboratory data is tabulated in Appendix B and the results are included in the conclusions and recommendations section herein.

FINDINGS

Proposed Development

Although there are no preliminary grading plans, the current conceptual development is expected to consist of building pads for single-family residences with other site improvements consisting of new in-tract streets and underground utility lines (sewer, water, storm drain and dry utilities), an offsite sewer line, masonry block screen walls, concrete sidewalks and landscaping etc.

Site Reconnaissance

A representative of Petra conducted a site reconnaissance and performed photo documentation during the field investigation on August 6, 2021 to observe the current surface conditions at subject site. The property is situated in an area of residential, commercial and open space/undeveloped land use.

The site surrounding areas consist of W. Domestic Avenue, with agricultural fields and the Santa Ana River beyond to the north; a drainage channel and the 210 Foothill Freeway, with commercial development beyond to the west; Pioneer Avenue, with vacant land beyond to the south and; Citrus Valley High School, with Texas Street, vacant land and residential development beyond to the east.

Based on information obtained during a parallel study, the site appears to have been used for cultivated orchards since at least 1930 until sometime between/during 1994 and 2002. Sometime between/during 1994 and 2002 the orchards have been removed from the site and the site has remained vacant land to present.

Dumped household trash was observed in several areas of the site and included plastic bags, plastic bottles, cans, pans, wood, cardboard and other miscellaneous household trash along with windblown trash. One water well was observed near the southwest portion of the subject property; however, it is unclear if this well is within the subject property. The well pumps water to a concrete underground irrigation distribution box which then distributes the water to underground concrete irrigation lines. A second concrete irrigation structure was observed within the southeast portion of the site. There was no evidence of sumps, pits, pools, or lagoons identified during our site reconnaissance. Three wooden power poles with overhead lines were located along the southwest portion of the subject property. Three pole-mounted transformers are located on the last pole adjacent to the water well.

Preliminary Geotechnical Field and Laboratory Results

As noted, our preliminary field investigation included the excavation of six exploratory test borings (B-1 through B-6) to depths between approximately 10.5 to 51.5 feet bgs. Boring B-6 was converted to a field percolation well to evaluate the infiltration rate of the alluvial deposits underlying the site. The following presents the results of subsurface and laboratory investigations.

Hollow Stem Auger Borings

Based on our six borings, the site is generally underlain by native younger alluvial soil deposits that were observed to the maximum depth explored of 56.5 feet bgs. These alluvial soils generally consisted of thinly to thickly interbedded sequences of dry to slightly moist sand and silty sand with low to medium density in the upper 20 to 25 feet and increasing in density with greater depth. Thin interbeds of sandy silt were occasionally encountered, as well as thin gravel layers. Logs of the borings are included as Appendix A.

The result of our analysis indicates that the site is not susceptible to seismically induced liquefaction settlements; however, is considered susceptible to seismically induced dry sand/dynamic settlements. Based on our analysis, total dry sand settlement can range from 4 to 6 inches at the location studied with a potential for differential settlement of 2 inches.

In the literature, prediction of the seismic settlement for unsaturated sandy soils, referred to as "dry sand" settlement, is based on observation of performance of 5 sites that were comprised of clean sands (i.e., sands with 5 percent fines or less). However, the shallow site soils, above the assumed historic high ground water level, are comprised of sands with substantial amounts of fines. This influences (reduces) the settlement potential under a seismic event. To overcome this, the measured parameters of soils with fines are first converted to clean sand values and then will be used in the predictive routines. This is an indirect approach and, therefore, lacks the performance-based verification requirements. For this reason, some review agencies do not require "dry sand" settlement calculations as a part of their approval process.

For the subject site, the total seismic settlement is considered to be within the tolerable range and mitigation of the adverse impact of 1 to 2 inches of differential settlement on proposed structures may include post tensioned slabs along with the structural engineer's design calculations.

Percolation Test Results

The falling-head percolation test was performed at Boring B-6 location to determining the shallow site infiltration rate, I_t [expressed in units of inches/hour, utilizing the Porchet Method (RCFCWCD, 2011)]. Following a presoaking period, field testing was conducted in a perforated-cased borehole (with ¾-inch gravel surrounding the pipe) at 10-minute intervals for a period of approximately 1 hour. Test data are attached in Appendix C. The infiltration rate, I_t, was calculated by determining the volumetric water flow rate through the wetted borehole surface area, expressed in terms of inches per hour. An un-factored infiltration rate of 2.8 inches per hour is obtained. A Reduction Factor of 1.25 should be considered for Site Suitability considerations to the value of Infiltration Rate provided herein.

Laboratory Tests

Limited laboratory testing was conducted on various representative fill samples collected from drill rig locations for engineering and classification properties. The in-situ moisture and dry density results are indicated on the boring logs in Appendix A. The native soils in the upper 5 feet across the site was found to generally consist of very dry to slightly moist sand to silty sand that have a very low expansion potential (EI of 0). Lab testing found site soils to have a negligible corrosion potential to concrete materials (soluble sulfate of 0.0009 percent), very low exposure to chlorides (108 mg/L), moderately alkaline (soil pH of 8.4) and are considered mildly corrosive to buried metallic elements and (minimum resistivity of 10,000 ohm-cm). Maximum dry density and optimum moisture content had a value of 125.0 pcf at 9.0 percent optimum moisture content. [Collapse testing of the native alluvium soils in an adjacent site to the north indicated a collapse potential generally on the order of 0.15 to 0.45 percent indicating a relatively low collapse potential.] The tabulated laboratory data is also included in Appendix B.

Compressible/Collapsible Soils

Based on our borings and laboratory testing, the existing soils, including all topsoil and the upper portions of low-density and dry alluvial soils, are considered unsuitable for support of proposed fills, structures, pavement or other improvements and should be removed to underlying competent alluvial soils and replaced as properly compacted fill. Based on our boring data, the upper 6 feet of site soils should be uniformly removed to competent alluvium and then the bottom excavation should be tested in the field. If the natural bottom excavation is found to have a minimum of 85 percent in-situ relative density, then the bottom surface may be properly processed to at least 12 inches in depth by moisture content to at least 2 percent above optimum moisture content and recompacted to at least 90 percent relative compaction. Then engineered fill placement may commence to design grades. Localized areas of deeper excavation/removal of unsuitable soils may be necessary and contingencies should be planned for.

Groundwater

Groundwater was not encountered in our borings to the maximum explored depth of approximately 56.5 feet below grade. In addition, California Department of Water Resources website indicated that recent groundwater levels since 1990 in the nearby area are greater than 130 feet bgs. Groundwater may have been as shallow as 55 feet back in the 1940's however it is highly unlikely groundwater levels would rise to those previous elevations in the future. Groundwater is not anticipated to impact the proposed development.

Faulting

Based on our review of published geologic maps, no faults are known to project through the property, and no portion of the site lies within an Earthquake Fault Hazard Zone as designated by the State of California pursuant to the Alquist-Priolo Earthquake Zoning Act. Therefore, it is our opinion that surface-rupturing will not affect the site.

Strong Ground Motions

The site is located in a seismically active area of Southern California and will likely be subjected to very strong seismically-related ground shaking during the anticipated life span of the project. Structures within the site should therefore be designed and constructed to resist the effects of strong ground motion in accordance with the 2019 California Building Code (CBC).

Liquefaction and Dynamic Settlement Potential

Based on review of the San Bernardino County geologic hazard maps the site is not specifically located within a mapped the liquefaction hazard zone, however the site is in close proximity to an area mapped as high liquefaction potential. Regional groundwater depths from nearby in the area indicate recent depths of over 130 feet bgs or more, however historic high groundwater in the 1940’s was as high as 55 feet± bgs. Our boings didn’t not encountered groundwater to a depth of 56.5 feet bgs, therefore liquefaction does not appear to be a hazard at this site.

Based on the youth and low density of the underlying alluvium we also performed a seismic or “dry sand” settlement analysis. Based on our preliminary analysis, the potential for seismic (dynamic) settlement at this site was determined to be between 4 to 6 inches. It is our professional opinion that the adverse impacts of this additional settlement on structural behavior could be mitigated by a placement of an engineered fill layer and a foundation design using a differential settlement of 2 inches in 40 feet.

CONCLUSIONS AND RECOMMENDATIONS

Based on our site reconnaissance, limited field investigation and laboratory testing, the development of the subject project site is considered feasible from a geotechnical engineering standpoint. It is recommended that the following geotechnical issues be considered by the Client during this due diligence period.

<u>Primary Geotechnical Issues</u>

Our professional opinion, from a geotechnical engineering viewpoint, regarding various aspects of site condition and/or proposed development is presented herein. The following presents the salient points of our due diligence assessment that we recommend be considered for future site development.

- <u>Design Level Geotechnical Report and Grading Plan Review Report</u>: The City of Redlands will require a formal geotechnical report during the review and approval process and may also require a geotechnical review of the final grading plans. Any formal geotechnical reports should include recommendations for site rough grading, post-grading improvements, and preliminary building foundation design based on the current 2019 California Building Code.

- <u>Demolition, Clearing and Grubbing</u>: All existing site improvements, underground utility lines and/or structures will need to be demolished are removed from the site. In addition, due the past site usage, the possibility does exist that other unknown underground structures may be found below current grades. It is recommended that all vegetation (including the root ball), debris and trash encountered on the site be removed and disposed in accordance with current local regulations.

  One water well was observed near the southwest portion of the subject property, however, it is unclear if this well is within the subject property. In the event the well is not intended for future use, it is recommended that the well be abandoned in accordance with the California Well Standards as published by the California Department of Water Resources (Bulletin 74-81 and 74-90), with oversight provided by the appropriate agencies.

  The well pumps water to a concrete underground irrigation distribution box which then distributes the water to underground concrete irrigation lines. If these are encountered during clearing and grubbing or future grading and development, they should be left in place until an experienced environmental professional (such as Petra) has had the opportunity to evaluate the conditions and provide recommendations if needed. In the event concrete irrigation lines are encountered, caution should be taken to not crush the lines until it can be ascertained that they do not contain asbestos.

  Three pole mounted transformers were adjacent the well. No staining was observed on or in the soils below the transformers. If the transformers are to be removed, it is recommended that the removal be completed by a licensed contractor or the utility company responsible for the transformer.

  It is unknown if there are any septic tanks or leach fields on the site. If any are encountered during site development, it is recommended that they be removed in accordance with current regulations.

- <u>Removal of Unsuitable Soil Materials:</u> Based on our boring data, the upper 6 feet of native site were generally loose and dry and generally unsuitable for support of proposed fills or structures and should be removed to competent alluvium exhibiting at least 85 percent in-situ relative density. Additionally, any cut lots should be further overexcavated at least 3 feet below finish pad grades if not already accomplished by the remedial removals. Remedial grading removals in street and non-structural areas may be reduced to 2 feet below design grades or at least 3 feet below existing site grades, whichever is deeper. The bottom of all remedial excavations should be properly processed in-place prior to fill placement.

- Suitability of Onsite Soils for Fill: All onsite soils consisting of "clean" native alluvium are considered suitable for use in engineering fill provided they are free of organics or other deleterious materials. The near-surface site soils (upper 5± feet) may be in a very dry condition and may to be pre-watered for an extended period to bring the site soils to near optimum conditions at the onset of grading.

- Shrinkage/Importing of Fill: Although grading plans and preliminary grading quantities are not currently available, all earthwork calculations should take into account soil shrinkage and site subsidence during remedial alluvial removals and replacement as compacted fill. Estimated shrinkage of native alluvium could be on the order of 15 to 17± percent when removed and compacted as engineered fill and site subsidence could be on the order of 0.1 to 0.2 feet. It should also be noted that the removal and exporting of the existing trees and their underground root ball system may affect the upper 1 to 1.5 feet across the site that should also be taken into account with preliminary earthwork calculations.

  In the event that import is needed to complete grading of the site, the potential source(s) should be evaluated prior to importing to the site such that non-expansive, low corrosive soils that are free of deleterious materials will be used.

- Deep Utility Trenching: Based on the observed soil types, sands and silty sands with generally low fines content, these soils types are prone to caving and any deep trenching for utility lines may need to be laid back at a slope excavation flatter than normal or shoring may need to be employed.

- Expansion and Corrosion Potential of Site Soils: Our laboratory testing indicated site soils to be very low in expansion potential and have a negligible exposure to sulfates. Additionally, site soils are considered moderately corrosive to buried metallic elements. As site grading remains to be completed, additional sampling and laboratory testing should be performed during grading operations for expansion and general corrosion potential for the purposes of providing final foundation and other design recommendations.

- Building Foundation Design: Based on the observed soils types and anticipated engineered grading, conventional foundations are expected to be feasible, however based on our dynamic settlement analysis that indicated 2 inches of potential settlement, we recommend a post-tensioned slab on-grade for the proposed dwellings. Final foundation design would be provided at the completion of site grading depending on the as-graded conditions and expansion potential of soils at or near finish grades. Very low expansion soils are anticipated across the site at this time.

- Pavement Design: Based on the observed soil types, sands and silty sands, a preliminary pavement design of 3 inches of asphalt over 6 inches of base for in-tract streets may be utilized for budgeting purposes only. A thicker pavement section may be needed for West Domestic Avenue depending on the traffic index. Final pavement design should be provided at the completion of site and street grading based on final sampling and testing of subgrade soils for R-value.

- Onsite Stormwater Infiltration: Based on the observed soil types, sands and silty sands with generally low fines content, we expect to have reasonable percolation or infiltration rates, as indicated by our pilot test, and onsite storm water infiltration systems may be effective for transmitting water into the subsurface. Once basin locations and depths are known, supplemental field infiltration testing should be performed and the required setback established.

REPORT LIMITATIONS

This report is based on the existing conditions of the subject property and the geotechnical observations made during our site reconnaissance and preliminary field investigation and limited laboratory testing. The soil conditions observed in our field investigation are believed to be representative of the general area conditions; however, soil conditions can vary in characteristics between excavations, both laterally and vertically and we recommend supplemental test pits for further evaluation during the design phase of the project. The conclusions and opinions contained in this report are based on the results of the described geotechnical evaluations and represent our professional judgment. This report has been prepared consistent with that level of care being provided by other professionals providing similar services at the same locale and in the same time period. The contents of this report are professional opinions and as such, are not to be considered a guaranty or warranty.

This report should be reviewed and updated after a period of one year or if the site ownership or project concept changes from that described herein. This report has not been prepared for use by parties or projects other than those named or described herein. This report may not contain sufficient information for other parties or other purposes.

This opportunity to be of service is sincerely appreciated. If you have any additional questions or concerns, please feel free contact this office.

Respectfully submitted,
PETRA GEOSCIENCES, INC.

9/10/2021

REGISTERED PROFESSIONAL ENGINEER
SIAMAK JAFROUDI
No. GE002024
GEOTECHNICAL
STATE OF CALIFORNIA

Siamak Jafroudi, PhD
Senior Principal Engineer
GE 2024

SJ/lv

Attachments: References
Figure 1 – Site Location Map
Figure 2 – Boring Location Map
Appendix A – Boring Logs
Appendix B – Laboratory Test Data
Appendix C – Percolation Test Data

Distribution: Addressee (electronic)

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N

Base Map Reference: Google Earth (2021) Map

PETRA GEOSCIENCES, INC.
40880 County Center Drive, Suite M
Temecula, California 92591
PHONE: (951) 600-9271
COSTA MESA TEMECULA VALENCIA PALM DESERT CORONA

SITE LOCATION MAP

1160 W. Pioneer Avenue Project
Redlands, California

PETRA GEOSCIENCES INC.

DATE: Sept, 2021
J.N.: 21-315

Figure 1

EXPLANAION

Approximate Location of Site Boundary

B-6 Approximate Location of Geotechnical Borings

P-1 Percolation Test Location

N

Reference: Goolge Earth Image, 2021

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BORING LOCATION MAP

1160 W. Pioneer Avenue Project
Redlsnds, California

PETRA GEOSCIENCES INC.

DATE: Sept, 2021

J.N.: 21-315

Figure 2

EXPLANAION

Approximate Location of Site Boundary

Approximate Location of Exploratory Boring TD = Total Depth

N

Reference: Goolge Earth Image, 2022

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BORING LOCATION MAP

1160 W. Pioneer Avenue Project
Redlsnds, California

PETRA GEOSCIENCES INC.

DATE: April 2022

J.N.: 22-199

Figure 2

APPENDIX A

BORING LOGS

Soil Classification

PETRA

4 Moisture Content

- Dry
- Slightly Moist
- Moist
- Very Moist
- Wet (Saturated)

Modifiers

Trace	< 1 %
Few	1 - 5%
Some	5 - 12 %
Numerous	12 - 20 %

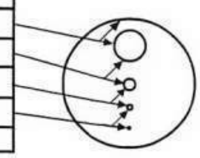
Soil Classification Should Include:

PREFERRED ORDER

1. Group Name
2. Group Symbol
3. Color
4. Moisture Content
5. Relative Density / Consistency
6. Grain Size Range
7. Structure
8. Odor
9. Additional comments indicating soil characteristics which might affect engineering properties

6 Grain Size

Description		Sieve Size	Grain Size	Approximate Size
Boulders		>12"	>12"	Larger than basketball-sized
Cobbles		3 - 12"	3 - 12"	Fist-sized to basketball-sized
Gravel	coarse	3/4 - 3"	3/4 - 3"	Thumb-sized to fist-sized
	fine	#4 - 3/4"	0.19 - 0.75"	Pea-sized to thumb-sized
Sand	coarse	#10 - #4	0.079 - 0.19"	Rock salt-sized to pea-sized
	medium	#40 - #10	0.017 - 0.079"	Sugar-sized to rock salt-sized
	fine	#200 - #40	0.0029 - 0.017"	Flour-sized to sugar-sized to
Fines		Passing #200	<0.0029"	Flour-sized and smaller



1 2 Unified Soil Classification System

Coarse-grained Soils > 1/2 of materials is larger than #200 sieve	The No. 200 U.S. Standard Sieve is about the smallest particle visible to the naked eye	GRAVELS more than half of coarse fraction is larger than #4 sieve	Clean Gravels (less than 5% fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines
				GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
			Gravels with fines	GM	Silty Gravels, poorly-graded gravel-sand-silt mixtures
				GC	Clayey Gravels, poorly-graded gravel-sand-clay mixtures
		SANDS more than half of coarse fraction is smaller than #4 sieve	Clean Sands (less than 5% fines)	SW	Well-graded sands, gravelly sands, little or no fines
				SP	Poorly-graded sands, gravelly sands, little or no fines
			Sands with fines	SM	Silty Sands, poorly-graded sand-gravel-silt mixtures
				SC	Clayey Sands, poorly-graded sand-gravel-clay mixtures
		SILTS & CLAYS Liquid Limit Less Than 50		ML	Inorganic silts & very fine sands, silty or clayey fine sands, clayey silts with slight plasticity
Fine-grained Soils > 1/2 of materials is smaller than #200 sieve				CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
				OL	Organic siltys & clays of low plasticity
		SILTS & CLAYS Liquid Limit GreaterThan 50		MH	Inorganic silts, micaceous or diatomaceous fine sand or silt
				CH	Inorganice clays of high plasticity, fat clays
				OH	Organic silts and clays of medium-to-high plasticity
Highly Organic Soils				PT	Peat, humus swamp soils with high organic content

5 Consistency - Fine Grained Soils

Apparent Density	SPT (# blows/foot)	Modified CA Sampler (# blows/foot)	Field Test
Very Soft	<2	<3	Easily penetrated by thumb; exudes between thumb and fingers when squeezed in hand
Soft	2-4	3-6	Easily penetrated one inch by thumb; molded by light finger pressure
Firm	5-8	7-12	Penetrated over 1/2 inch by thumb with moderate effort; molded by strong finger pressure
Stiff	9-15	13-25	Indented about 1/2 inch by thumb but penetrated only with great effort
Very Stiff	16-30	26-50	Readily indented by thumbnail
Hard	>30	>50	Indented with difficulty by thumbnail

5 Relative Density - Coarse Grained Soils

Apparent Density	SPT (# blows/foot)	Modified CA Sampler (# blows/foot)	Field Test
Very Loose	<4	<5	Easily penetrated with 1/2-inch reinforcing rod pushed by hand
Loose	4-10	5-12	Easily penetrated with 1/2-inch reinforcing rod pushed by hand
Medium Dense	11-30	13-35	Easily penetrated 1-foot with 1/2-inch reinforcing rod driven with a 5-lb hammer
Dense	31-50	36-60	Difficult to penetrated 1-foot with 1/2-inch reinforcing rod driven with a 5-lb hammer
Very Dense	>50	>60	Penetrated only a few inches with 1/2-inch reinforcing rod driven with a 5-lb hammer

EXPLORATION LOG

Project: **1160 W. Pioneer Ave**			Boring No.: **B-1**
Location: **Redlands, California**			Elevation: **1268ft (msl)**
Job No.: **21-315**	Client: **Meritage**		Date: **August 6, 2021**
Drill Method: **CME-75 Hollowstem**	Driving Weight: **140lbs**		Logged By: **BR**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		Young Axial Valley Deposits (Qya) Silty Sand (SM): Gray brown, dry, loose, fine to medium-grained sand, porous with scattered rootlets.							
		Gray brown, dry, medium dense, fine to medium-grained sand.		12 9 11			2.0	106.1	Max, Corrosion, Atterberg, Sieve, Expansion
5		Gray brown, dry, medium dense, fine to medium-grained sand.		5 7 8			1.1	105.8	
		Interbedded Silty Sand and Silt (SM-ML): Olive gray, damp, loose, interbedded silty fine to medium-grained sand and slightly clayey silt, with <5% sub-rounded fine-grained gravel.		3 5 7			6.5	94.9	
10		Silty Sand (SM): Olive brown, moist, medium dense, silty fine-grained sand.		8 12 12			6.4	91.9	
15		Poorly Graded Sand (SP): Olive brown, moist, medium dense, poorly graded fine-grained sand.		5 8 13			5.0	101.8	
20		Gray brown, moist, medium dense, poorly graded fine to medium-grained sand.		9 12 17			2.2		
25		Gray brown, moist, medium dense, poorly graded fine to medium-grained sand, with <5% sub-rounded fine grained gravel.		7 8 12					
30		Silty Sand (SM): Olive brown, moist, medium dense, fine-grained sand.		8 12 20			7.2	98.4	
35		Olive brown, moist, medium dense, fine-grained sand.		7					

PLATE

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E X P L O R A T I O N   L O G

Project: **1160 W. Pioneer Ave**			Boring No.: **B-1**
Location: **Redlands, California**			Elevation: **1268ft (msl)**
Job No.: **21-315**	Client: **Meritage**		Date: **August 6, 2021**
Drill Method: **CME-75 Hollowstem**	Driving Weight: **140lbs**		Logged By: **BR**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
				8 12					
40		Interbedded Silty Sand and Clean Sand (SP-SM): Olive brown, moist, dense, interbedded sandy silt and clean fine to medium-grained sand.		15 14 23			3.2	103.5	
45		Silty Sand (SM): Olive brown, moist, medium dense, fine grained-sand.		9 11 17					
50		Poorly Graded Sand (SP): Gray, damp, very dense, poorly graded fine to medium-grained sand.		29 32 50			2.0	105.8	
55		Silty Sand (SM): Olive gray, damp, very dense, fine to medium-grained sand.		30 30 37					
		Total depth 56.5-feet. No groundwater or seepage. Backfilled with cuttings.							
60									
65									
70									

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project:	**1160 W. Pioneer Ave**	Boring No.:	**B-2**
Location:	**Redlands, California**	Elevation:	**1264ft (msl)**
Job No.:	**21-315** Client: **Meritage**	Date:	**August 6, 2021**
Drill Method:	**CME-75 Hollowstem** Driving Weight: **140lbs**	Logged By:	**BR**

Depth (Feet)	Lithology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		Young Axial Valley Deposits (Qya) Silty Sand (SM): Olive gray, dry, loose, fine-grained sand.							
		Olive gray, dry, loose, fine-grained sand, porous, with rootlets.		4 5 6	■		0.8	98.9	
5		Light gray, dry, medium dense, fine to medium-grained sand.		4 7 7	■		1.3		
		Poorly Graded Sand (SP): Light gray, dry, medium dense, poorly graded fine to medium-grained sand.		4 8 10	■		0.7		
10		Silty Sand (SM): Light gray, dry, medium dense, fine-grained sand, with <5% sub-rounded fine-grained gravel.		5 6 9	■		4.2	95.5	
15		Olive gray, damp, medium dense, fine-grained sand.		7 8 12	■		2.3	100.2	
		Olive brown, damp, loose, fine-grained sand, micaceous.		3 3 5	◩				
20				6 7 9	■		1.9	103.0	
25		Olive gray to olive brown, moist, medium dense, fine-grained sand.		7 9 15	■		11.4	93.4	
		Total Depth 26.5 feet. No groundwater or seepage. Backfilled with cuttings.							
30									
35									

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **1160 W. Pioneer Ave**		Boring No.: **B-3**	
Location: **Redlands, California**		Elevation: **1264ft (msl)**	
Job No.: **21-315**	Client: **Meritage**	Date: **August 6, 2021**	
Drill Method: **CME-75 Hollowstem**	Driving Weight: **140lbs**	Logged By: **BR**	

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		Younger Axial Valley Deposits (Qya) Silty Sand (SM): Olive brown, dry, loose, fine to medium-grained sand.							
		Olive brown, dry, loose, fine to medium-grained sand.		5 5 6	■		1.4	105.9	
5		Gray to olive gray, dry, medium dense, fine to medium-grained sand.		4 5 8	■		2.1	107.0	
		Poorly Graded Sand (SP): Gray, dry, medium dense, poorly graded fine-grained sand.		4 6 10	■		6.3	89.9	
10		Gray, dry, medium dense, poorly graded fine to medium-grained sand, with >5% sub-rounded fine-grained gravel.		5 7 13	■		2.3		
15		Silty Sand (SM): Olive brown, dry, medium dense, fine-grained sand.		6 6 12	■		6.8	100.2	
20		Poorly Graded Sand (SP): Gray, dry, dense, poorly graded fine to medium-grained sand, with <5% sub-angular fine-grained gravel.		7 18 25	■		2.0	107.1	
		Gray, dry, medium dense, poorly graded fine to medium-grained sand, with <5% sub-sub rounded fine-grained gravel.		6 11 13	◪				
25		Gray, dry, dense, poorly graded fine to medium-grained sand, with >10% coarse sand grains.		13 22 22	■		1.3		
		Total Depth 26.5-feet. No groundwater or seepage. Backfilled with cuttings.							
30									
35									

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project:	**1160 W. Pioneer Ave**	Boring No.:	**B-4**
Location:	**Redlands, California**	Elevation:	**1260ft (msl)**
Job No.: **21-315**	Client: **Meritage**	Date:	**August 6, 2021**
Drill Method: **CME-75 Hollowstem**	Driving Weight: **140lbs**	Logged By:	**BR**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		Younger Axial Valley Deposits (Qya) Silty Sand (SM-ML): Light gray brown, dry, medium dense, fine-grained sand.		14 9 9	■		0.9	104.2	
		Light gray brown, dry, loose, fine to medium-grained sand.		4 6 6	■		1.4	97.4	
5									
		Silt (ML): Light gray, dry, medium dense, sandy silt.		5 9 9	■		0.9	105.3	
		Poorly Graded Sand (SP): Gray, loose, dry, poorly graded fine to medium-grained sand, with <5% coarse sand grains.		5 3 7	◪				
10									
		Total depth 10.5-feet. No groundwater or seepage. Converted to percolation test boring.							
15									
20									
25									
30									
35									

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project:	1160 W. Pioneer Ave	Boring No.:	B-5
Location:	Redlands, California	Elevation:	1262ft (msl)
Job No.: 21-315	Client: Meritage	Date:	August 6, 2021
Drill Method: CME-75 Hollowstem	Driving Weight: 140lbs	Logged By:	BR

Depth (Feet)	Lithology	Material Description	WATER	Blows per 6 in.	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
0		Younger Axial Valley Deposits (Qya) Silty Sand (SM): Light olive gray, dry, loose, fine-grained sand.		5 7 7	■		1.8	102.9	
		Light olive gray, dry, medium dense, fine-grained sand.		3 7 9	■		2.7	99.7	
5									
		Silt (ML): Gray brown, dry, firm, sandy silt.		3 5 7	■		2.8	96.8	
		Interbedded Silty Sand and Poorly Graded Sand (SP-SM): Gray brown, dry, medium dense, interbedded silty fine to medium-grained sand and poorly graded fine to medium-grained sand.		5 6 10	■		2.8	102.0	
10		Total depth 10.5-feet. No groundwater or seepage. Backfilled with cuttings.							
15									
20									
25									
30									
35									

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project:	**1160 W. Pioneer Ave**	Boring No.:	**B-6**
Location:	**Redlands, California**	Elevation:	**1270ft (msl)**
Job No.: **21-315**	Client: **Meritage**	Date:	**August 6, 2021**
Drill Method: **CME-75 Hollowstem**	Driving Weight: **140**	Logged By:	**BR**

Depth (Feet)	Lith-ology	Material Description	WATER	Blows per 6 in.	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
0		Young Axial Valley Deposits (Qya) Silty Sand (SM): Gray brown, dry, medium dense, fine-grained sand.		8 7 7	■		0.7		
		Gray brown, dry, medium dense, fine-grained sand, with <5% sub-rounded fine- grained gravel.		5 6 9	■		1.7	106.9	
5		Olive gray brown, dry, medium dense, fine-grained sand.		4 6 7	■		0.8		
10		Gray, dry, medium dense, fine to coarse-grained sand, with <10% sub-angular fine gravel.		7 9 11	■		1.3		
		Total depth 10.5-feet. No groundwater or caving. Backfilled with cuttings.							
15									
20									
25									
30									
35									

PLATE

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APPENDIX B

LABORATORY TEST DATA

Maximum Dry Density and Optimum Moisture Content Test Data

Boring/Depth (feet)	Soil Type	Optimum Moisture (%)	Maximum Dry Density (pcf)
B-1 @ 0-5	Silty Sand	9.0	125.0

Per ASTM Test Method ASTM D 1557

Expansion Index Test Data

Boring/Depth (feet)	Soil Type	Expansion Index	Expansion Potential
B-1 @ 0-5	Silty fine Sand	0	Very Low

Per ASTM Test Method ASTM D 4829

Corrosion Test Data

Boring/Depth (feet)	Sulfate (%)	Chloride (mg/L)	pH	Resistivity (ohm-cm)	Corrosivity Potential
B-1 @ 2	0.0009	108	8.4	10,000	Concrete: Negligible Steel: Moderate

Per California Test Method CTM 417, 422, 643

COMPACTION TEST REPORT

Project No.: 21-315 **Date:** 9/7/2021

Project: 1160 W. Pioneer Ave

Client: Meritage

Source of Sample: Phase 100 **Depth:** 0-5

Sample Number: B-1

Remarks: Expansion Index: 0 (Very Low)

MATERIAL DESCRIPTION

Description: Brown Silty fine to medium Sand

Classifications - **USCS:** **AASHTO:**

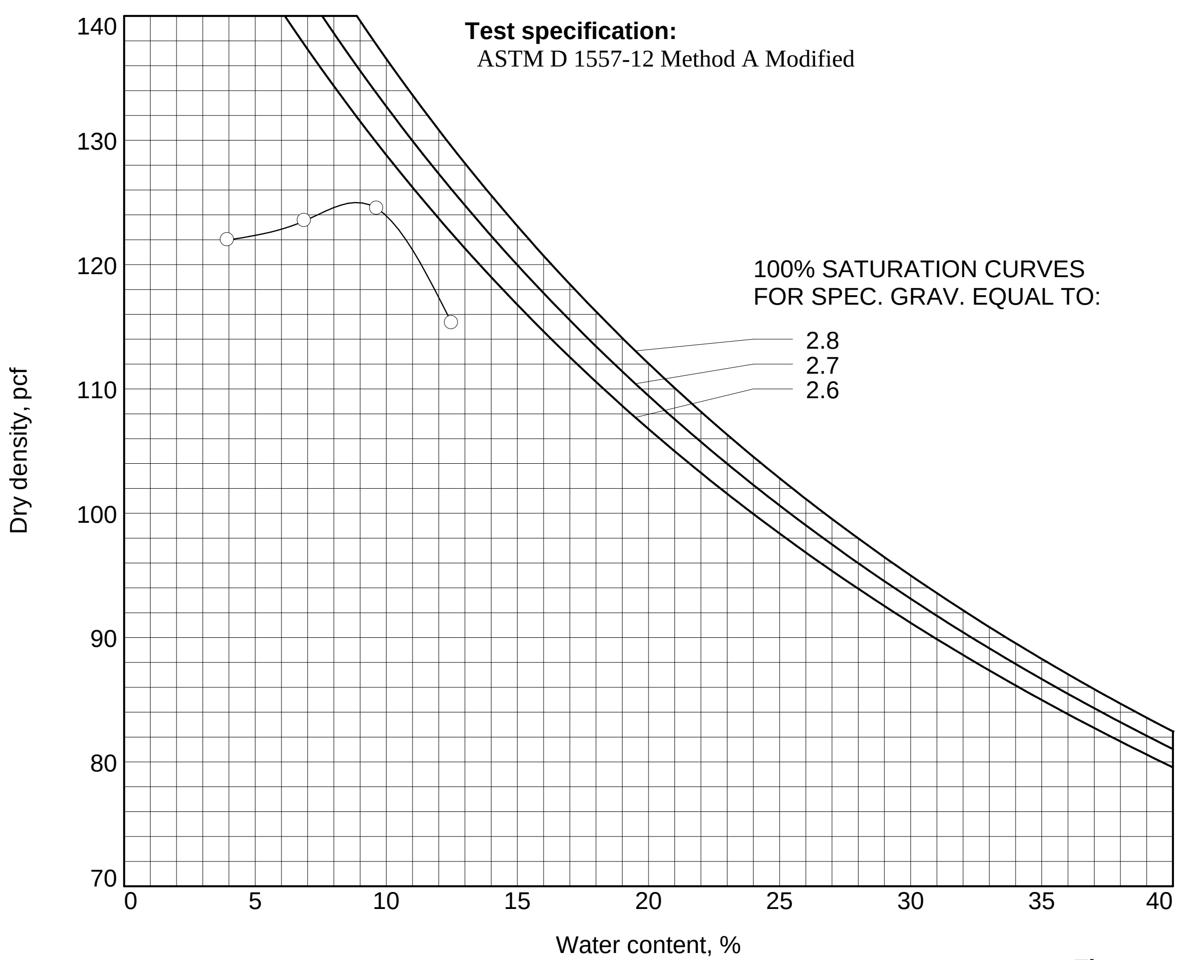
Nat. Moist. = **Sp.G. =**

Liquid Limit = **Plasticity Index =**

% < No.200 = 29.9 %

TEST RESULTS
Maximum dry density = 125.0 pcf
Optimum moisture = 9.0 %

Test specification:
ASTM D 1557-12 Method A Modified



Figure

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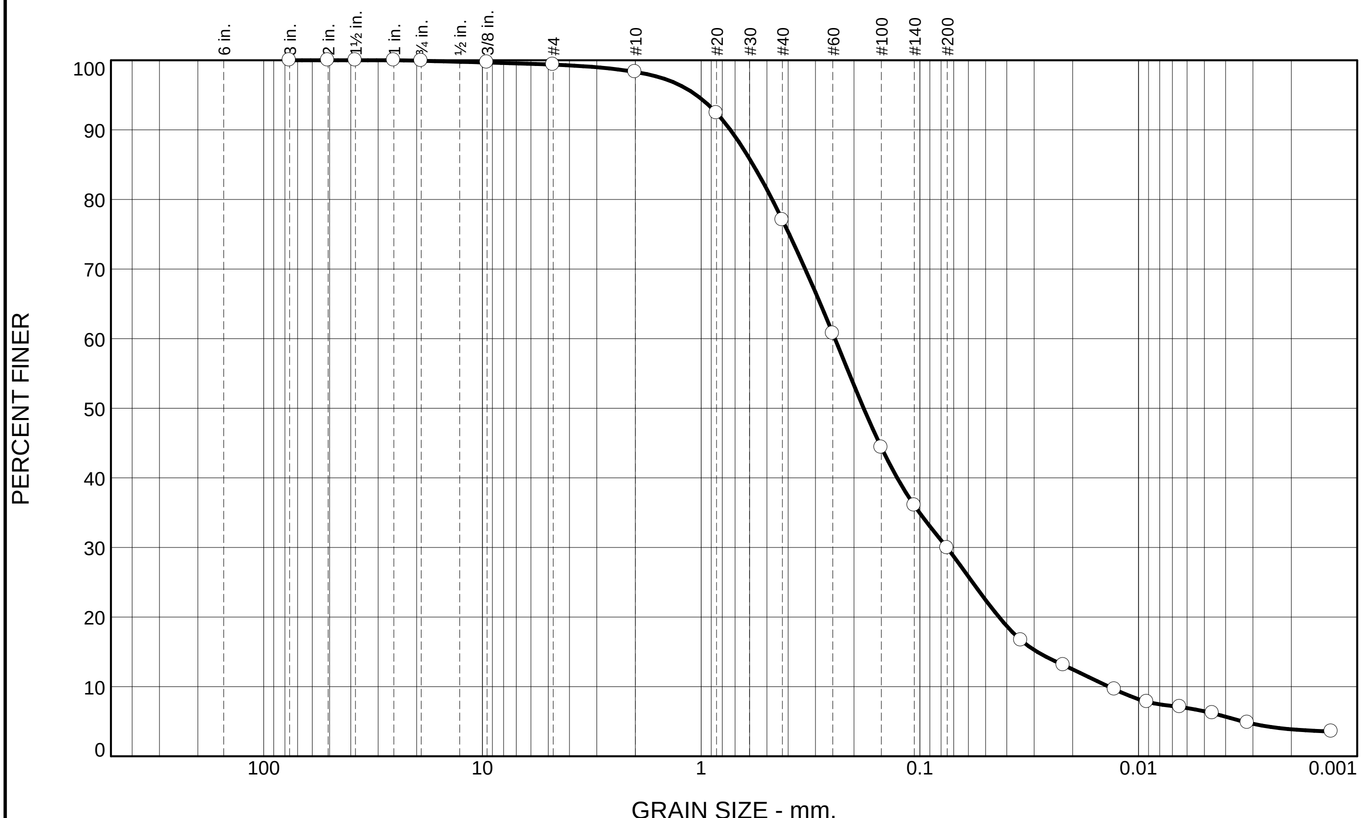
Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.1	0.5	1.1	21.2	47.2	23.4	6.5

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100.0		
2	100.0		
1.5	100.0		
1	100.0		
.75	99.9		
.375	99.7		
#4	99.4		
#10	98.3		
#20	92.4		
#40	77.1		
#60	60.8		
#100	44.4		
#140	36.0		
#200	29.9		

* (no specification provided)

Material Description

Brown Silty fine to medium Sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.7351 D_{85}= 0.5786 D_{60}= 0.2444
D_{50}= 0.1806 D_{30}= 0.0752 D_{15}= 0.0290
D_{10}= 0.0137 C_u= 17.90 C_c= 1.70

Classification

USCS= AASHTO=

Remarks

Source of Sample: Phase 100 **Depth:** 0-5
Sample Number: B-1

Date: 9/9/2021

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Client: Meritage
Project: 1160 W. Pioneer Ave

Project No: 21-315 **Figure**

APPENDIX C

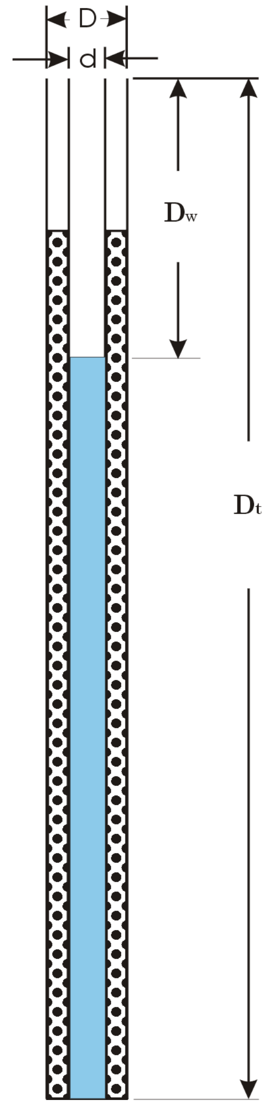
PERCOLATION TEST DATA

Test Number: P-1

Shallow Percolation Test Method

Total Depth of Boring, D_t (ft):	10
Diameter of Hole, D (in):	8
Diameter of Pipe, d (in):	3
Agg. Correction (% Voids):	40
Pre-soak depth (ft):	5

Time Interval (min)	Depth to Water Surface D_w (ft)		Change in Head (in)	Perc. Rate (min/in)	Perc. Rate (gal/day/ft^2)
	1st Reading	2nd Reading			
25	5.05	9.42	52.44	0.48	51.86
25	5.50	9.26	45.12	0.55	46.94
10	5.02	6.55	18.36	0.54	30.37
10	5.05	6.70	19.80	0.51	33.44
10	5.20	6.72	18.24	0.55	31.43
10	5.05	6.68	19.56	0.51	32.96
10	5.22	6.78	18.72	0.53	32.57
10	5.15	6.73	18.96	0.53	32.51



Percolation Rate: 0.53 Minutes/Inch

39.62 gal/day/ft²

Infiltration Rate: 2.79 Inches/Hour*
(Porchet Method)

where Infiltration Rate, $I_t = \Delta H\,(60r) / \Delta t\,(r + 2H_{avg})$

$r = D / 2$

$H_o = D_t - D_o$

$H_f = D_t - D_f$

$\Delta H = \Delta D = H_o - H_f$

$H_{avg} = (H_o + H_f) / 2$

*Raw Number, Does Not Include a Factor of Safety

Testing by Bryan Rall 8/9/21

Reference: RCFCWCD, Design Handbook for LIDBMP, dated September, 2011

PETRA GEOSCIENCES, INC.
40880 County Center Drive, Suite M
Temecula, CA 92591
PHONE: (951) 600-9271
COSTA MESA TEMECULA VALENCIA PALM DESERT CORONA SAN DIEGO

PERCOLATION TEST SUMMARY

1160 W. Pioneer Ave
Redlands, California

PETRA GEOSCIENCES

DATE: Sept. 2021

J.N.: 21-315

Figure 1

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for San Bernardino County Southwestern Part, California

January 11, 2022

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

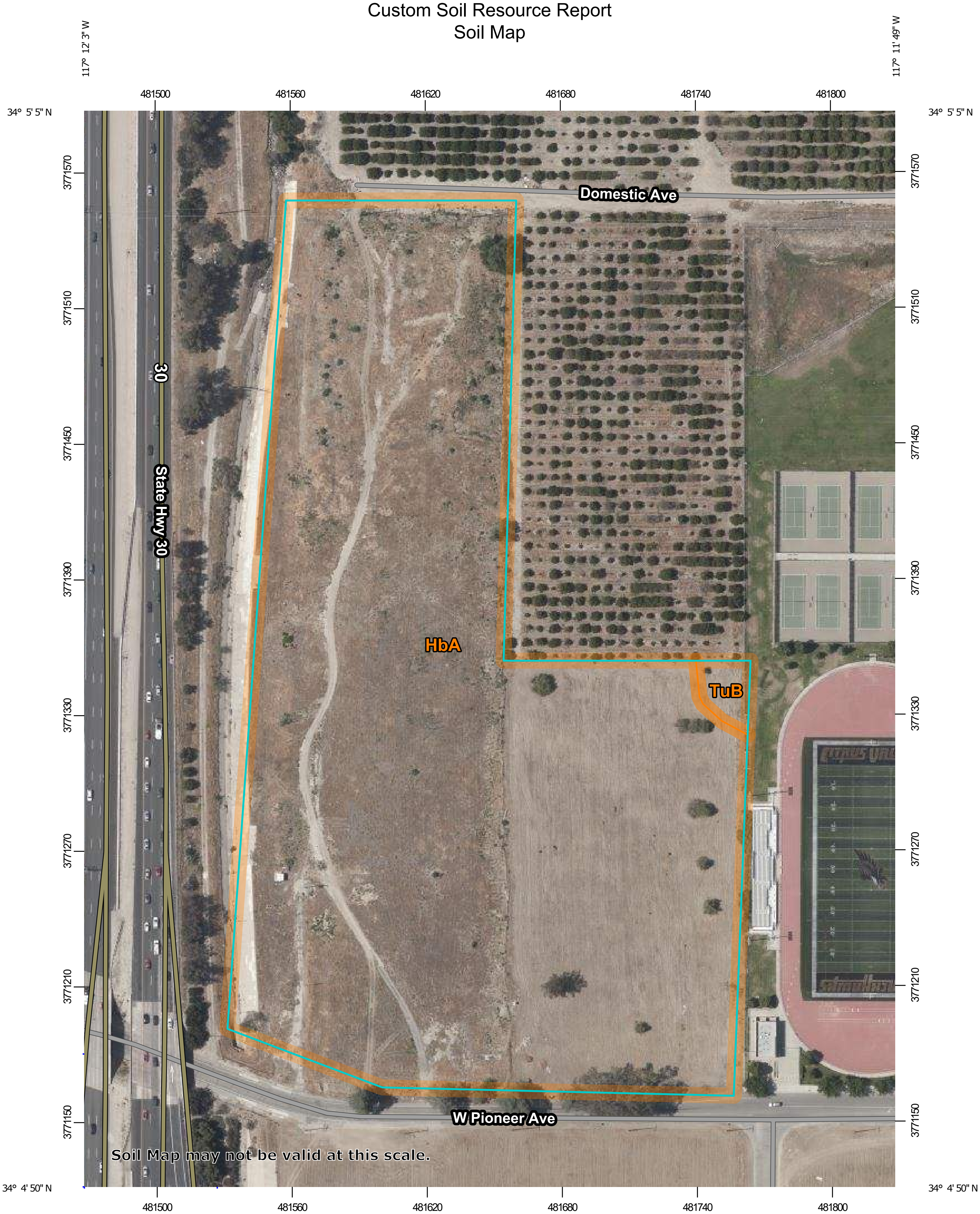
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



Map Scale: 1:2,320 if printed on A portrait (8.5" x 11") sheet.

Meters: 0, 30, 60, 120, 180

Feet: 0, 100, 200, 400, 600

N

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: San Bernardino County Southwestern Part, California
Survey Area Data: Version 13, Sep 13, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 1, 2018—Jun 30, 2018

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND	MAP INFORMATION
	imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
HbA	Hanford sandy loam, 0 to 2 percent slopes	15.6	99.1%
TuB	Tujunga loamy sand, 0 to 5 percent slopes	0.1	0.9%
Totals for Area of Interest		**15.7**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

San Bernardino County Southwestern Part, California

HbA—Hanford sandy loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2y8tv
Elevation: 790 to 1,610 feet
Mean annual precipitation: 10 to 19 inches
Mean annual air temperature: 65 to 65 degrees F
Frost-free period: 345 to 365 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Hanford and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hanford

Setting

Landform: Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile

A - 0 to 12 inches: sandy loam
C - 12 to 60 inches: fine sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: RareNone
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 7.8 inches)

Interpretive groups

Land capability classification (irrigated): 1
Land capability classification (nonirrigated): 3c
Hydrologic Soil Group: A
Ecological site: R019XG911CA - Loamy Fan
Hydric soil rating: No

Minor Components

Hanford, steeper slopes

Percent of map unit: 5 percent
Landform: Alluvial fans
Landform position (three-dimensional): Tread

Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Greenfield, sandy loam
Percent of map unit: 5 percent
Landform: Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Unnamed
Percent of map unit: 5 percent
Hydric soil rating: No

TuB—Tujunga loamy sand, 0 to 5 percent slopes

Map Unit Setting
National map unit symbol: 2sx6y
Elevation: 650 to 3,110 feet
Mean annual precipitation: 10 to 25 inches
Mean annual air temperature: 62 to 65 degrees F
Frost-free period: 325 to 365 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Tujunga, loamy sand, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tujunga, Loamy Sand

Setting
Landform: Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile
A - 0 to 6 inches: loamy sand
C1 - 6 to 18 inches: loamy sand
C2 - 18 to 60 inches: loamy sand

Properties and qualities
Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Very low

Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Ecological site: R019XG912CA - Sandy Fan
Hydric soil rating: No

Minor Components

Tujunga, gravelly loamy sand

Percent of map unit: 10 percent
Landform: Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Hanford, sandy loam

Percent of map unit: 5 percent
Landform: Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

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