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www.SBCounty.gov

SAN BERNARDINO COUNTY

Land Use Services Department

Plan Review Comments

Project Description:	**WQMP - Shandin Hills Behavioral Health Center**	**Application #:**	**WQMP-2023-00072**
Site Address/Tract No:	**4164 4th Ave, San Bernardino, CA 92407**	**APN:**	**0265141120000, 0265141240000, 0265141150000**
Application Date:	**3/2/2023**	**Expiration Date:**	
Owner Information	**Mr. Abe Tess**	**Owner Contact Information:**	**Atress@newgenhcg.com 323-823-3306**
Engineer Information:	**Dan Villines**	**Engineer Contact Information:**	**dvillines@bkf.com 949-322-8195**
Plans Reviewer:	**Sarah Seitz (NV5)** **Email:**	**sarah.seitz@NV5.com**	

☐ **1st Review:**		☐ **2nd Review:**		☐ **3rd Review:**	
☒ **4th Review**	**6/11/2024**				

No further comments.

I hereby declare that I have exercised responsible charge of the review of this project as defined in Section 6703 of the Business and Professions Code. The comments expressed herein are confined to a review only and do not relieve the Engineer of Work of their responsibilities for project design.

Tamara O'Neal — 6/11/2024
Name — Date:

REGISTERED PROFESSIONAL ENGINEER
TAMARA C. O'NEAL
No. 69107
CIVIL
STATE OF CALIFORNIA

Preliminary Water Quality Management Plan

For:

SHANDIN HILLS BEHAVIORAL HEALTH CENTER

APN 0265141120000, 0265141240000, 0265141150000

WQMP-2023-00072, PPCA-2020-00045, PREA-2021-00314, DRNSTY-2023-0043

Prepared for:

NewGen Health

4164 North 4th, LLC

9526 W. Pico Blvd

Los Angeles, CA 90035

Prepared by:

BKF Engineers

4675 MacArthur Court, Suite 400

Newport Beach, CA 92660

(949) 526-8461

Submittal Date: 3/24/2023

Revision Date: 5/28/2024

Approval Date:

Reviewed by
Padma Asam / NV5
06/11/2024
Contact: padma.asam@nv5.com

No further comments
NV5
06/11/2024

Project Owner's Certification

This Water Quality Management Plan (WQMP) has been prepared for NewGen Health by BKF Engineers. The WQMP is intended to comply with the requirements of San Bernardino County and the NPDES Areawide Stormwater Program requiring the preparation of a WQMP. The undersigned, while it owns the subject property, is responsible for the implementation of the provisions of this plan and will ensure that this plan is amended as appropriate to reflect up-to-date conditions on the site consistent with San Bernardino County's Municipal Storm Water Management Program and the intent of the NPDES Permit for San Bernardino County and the incorporated cities of San Bernardino County within the Santa Ana Region. Once the undersigned transfers its interest in the property, its successors in interest and the city/county shall be notified of the transfer. The new owner will be informed of its responsibility under this WQMP. A copy of the approved WQMP shall be available on the subject site in perpetuity.

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

.

Project Data			
Permit/Application Number(s):	WQMP-2023-00072	Grading Permit Number(s):	
Tract/Parcel Map Number(s):		Building Permit Number(s):	
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			**0265141120000, 0265141240000, 0265141150000**

Owner's Signature			
Owner Name: Mr. Abe Tess			
Title	CEO		
Company	NewGen Health, LLC		
Address	9526 W. Pico Blvd, Los Angeles, CA 90035		
Email	atress@newgenhcg.com		
Telephone #	323-823-3306		
Signature	A Tess	Date	5/28/2024

Preparer's Certification

Project Data			
Permit/Application Number(s):	WQMP-2023-00072	Grading Permit Number(s):	
Tract/Parcel Map Number(s):		Building Permit Number(s):	
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			**0265141120000, 0265141240000, 0265141150000**

"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: Dan Villines	
Title	Senior Project Manager
Company	BKF Engineers
Address	4675 MacArthur Court, Suite 400 Newport Beach, CA 92660
Email	dvillines@bkf.com
Telephone #	(949) 322-8195
Signature	
Date	12/11/23

PE Stamp Below



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Section 1 Discretionary Permit(s)

Form 1-1 Project Information					
Project Name	Shandin Mental Healthcare Rehab Center				
Project Owner Contact Name:	Mr. Abe Tess				
Mailing Address:	9526 W. Pico Blvd Los Angeles, CA 90035	E-mail Address:	atress@newgenhcg.com	Telephone:	323-823-3306
Permit/Application Number(s):	WQMP-2023-00072		Tract/Parcel Map Number(s):		
Additional Information/ Comments:					
Description of Project:	The project is the development of a 198 bed Mental Healthcare Rehabilitation Center on a mostly flat site. The existing 5.95 acre site includes the Shandin Hills Behavioral Health Center, which is composed of three large buildings, two small buildings, grassy areas, basketball courts and parking. These improvements compose approximately 2.63 acres of the site. The remaining 3.32 acres is undeveloped poor condition grassland. The project site is surrounded by existing residential development and fronts to 4th Avenue. In the existing condition the building footprint and asphalt/concrete paving is approximately 80,763 sqft of the site, while landscaping and undeveloped grassland is approximately 178,419 sqft. The proposed Medical Healthcare Rehabilitation Center is a single story building of approximately 72,000 sf. An access road will border the northern, western, and southern boundaries of the property with a main parking lot of 71 stalls located in the north east corner. The proposed development will eliminate a portion of the existing Shandin Behavioral Health Center and the entire undeveloped portion of the property. In the proposed condition the building footprint and asphalt/concrete paving is approximately 205,073 sqft of the site, while landscaping is approximately 54,109 sqft. In the proposed condition, a high point along the western boundary of the site will send flows north or south along the westerly property line. Flows that drain north will be collected in a storm drain and conveyed east and then south where they will enter the underground infiltration basin. Flows that drain south will be collected in a storm drain and conveyed east and then north where they will enter the underground infiltration basin. Water quality flows will infiltrate into the ground at the bottom of the basin.				
Provide summary of Conceptual WQMP conditions (if previously submitted and approved). Attach complete copy.	There is no previous conceptual WQMP for this project				

Section 2 Project Description

2.1 Project Information

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

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

Form 2.1-1 Description of Proposed Project

1 Development Category (Select all that apply):

☒ Significant re-development involving the addition or replacement of 5,000 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):	259,182	**3** Number of Dwelling Units:	N/A	**4** SIC Code:	RESIDENTIAL CARE 8361

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:

NewGen Healthcare Group will be responsible for long-term maintenance of WQMP stormwater facilities.

Abe Tess
NewGen Healthcare Group
9526 W Pico Blvd
Los Angeles, CA 90035

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 ☐	Source: Bacterial indicators are routinely detected in pavement runoff. Includes petroleum hydrocarbons.
Nutrients - Phosphorous	E ☒	N ☐	Source: Landscaping on-site
Nutrients - Nitrogen	E ☒	N ☐	Source: Landscaping on-site
Noxious Aquatic Plants	E ☒	N ☐	Source: Landscaping on-site
Sediment	E ☒	N ☐	Source: Landscaping on-site
Metals	E ☒	N ☐	Source: Wear associated with driving/ brake pads.
Oil and Grease	E ☒	N ☐	Source: vehicles
Trash/Debris	E ☒	N ☐	Source: paper, plastic, leaves, cut grass, and food waste
Pesticides / Herbicides	E ☒	N ☐	Source: Landscaping activities
Organic Compounds	E ☒	N ☐	Source: Landscaping on-site. Includes solvents and petroleum hydrocarbons
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 contaminants) [25%]
☐ Redevelopment projects in established historic district, historic preservation area, or similar significant core city center areas [10%]	☐ Transit-oriented developments (mixed use residential or commercial area designed to maximize access to public transportation) [20%]	☐ In-fill projects (conversion of empty lots & other underused spaces < 5 acres, substantially surrounded by urban land uses, into more beneficially used spaces, such as residential or commercial areas) [10%]	☐ Live-Work developments (variety of developments designed to support residential and vocational needs) [20%]
2 Total Credit % 0 *(Total all credit percentages up to a maximum allowable credit of 50 percent)*			
Description of Water Quality Credit Eligibility (if applicable)	N/A		

Section 3 Site and Watershed Description

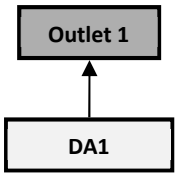
Describe the project site conditions that will facilitate the selection of BMP through an analysis of the physical conditions and limitations of the site and its receiving waters. Identify distinct drainage areas (DA) that collect flow from a portion of the site and describe how runoff from each DA (and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

Form 3-1 Site Location and Hydrologic Features

Site coordinates *take GPS measurement at approximate center of site*	Latitude 34d 10'13.86"N	Longitude 117d 18'39.18"W	Thomas Bros Map page

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*



Example only – modify for project specific WQMP using additional form

Conveyance	Briefly describe on-site drainage features to convey runoff that is not retained within a DMA
DA1 DMA C flows to DA1 DMA A	*Ex. Bioretention overflow to vegetated bioswale with 4' bottom width, 5:1 side slopes and bed slope of 0.01. Conveys runoff for 1000' through DMA 1 to existing catch basin on SE corner of property*
DA1 DMA A to Outlet 1	
DA1 DMA B to Outlet 1	
DA2 to Outlet 2	

Form 3-2 Existing Hydrologic Characteristics for Drainage Area 1				
For Drainage Area 1's sub-watershed DMA, provide the following characteristics	DMA A	DMA B	DMA C	DMA D
1 DMA drainage area (ft^2)	259,182			
2 Existing site impervious area (ft^2)	80,763			
3 Antecedent moisture condition *For desert 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)	901.33			
6 Longest flowpath slope (ft/ft)	0.0118			
7 Current land cover type(s) *Select from Fig C-3 of Hydrology Manual*	Grass			
8 Pre-developed pervious area condition: *Based on the extent of wet season vegetated cover good >75%; Fair 50-75%; Poor <50% Attach photos of site to support rating*	Poor			

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*	Devil Creek Channel, Little Mountain Dam, Little Mountain Channel, Mt View Storm Drain, 30th street storm drain, Twin Creek Channel, Santa Ana River R5 -R3, Prado Dam, Santa Ana River R2-R1, Pacific Ocean
Applicable TMDLs *Refer to Local Implementation Plan*	Santa Ana R3-Pathogens
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*	Santa Ana River R3 Bacterial Indicator, copper and lead Santa Ana River R4: Bacterial indicator Prado Dam - pH
Environmentally Sensitive Areas (ESA) *Refer to Watershed Mapping Tool – http://permitrack.sbcounty.gov/wap/*	N/A
Unlined Downstream Water Bodies *Refer to Watershed Mapping Tool – http://permitrack.sbcounty.gov/wap/*	Devil Creek Channel, Twin Creek Channel, Santa Ana River
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, Exempt See Appendix F
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	☒	☐	Information materials will be provided to the property owners on general housekeeping practices that contribute to the protection of stormwater quality.
N2	Activity Restrictions	☒	☐	Pesticide application will be performed by a licensed applicator.
N3	Landscape Management BMPs	☒	☐	Onsite landscaping will be maintained by the owner. Irrigation must be consistent with San Bernardino's Water Conservation Ordinance. Fertilizer and pesticide usage will be consistent with County Management Guidelines for Use of Fertilizers and Pesticides.
N4	BMP Maintenance	☒	☐	BMP Maintenance will be provided by Property Owner. BMP Maintenance Responsibilities are outlined in each BMP narrative in Section 5 of this WQMP.
N5	Title 22 CCR Compliance (How development will comply)	☒	☐	Medical waste will be treated onsite or transferred to a medical waste treatment facility in accordance with Title 22.
N6	Local Water Quality Ordinances	☒	☐	Owner will be in compliance with Local Water Quality Ordinances through the implementation of this WQMP.
N7	Spill Contingency Plan	☐	☒	Absorbent materials shall be kept on site for accidental spills, spills will be disposed of in a proper facility.
N8	Underground Storage Tank Compliance	☐	☒	There are no underground storage tanks on-site
N9	Hazardous Materials Disclosure Compliance	☒	☐	Owner will comply with the Hazardous Materials Disclosure

Form 4.1-1 Non-Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, if not applicable, state reason
		Included	Not Applicable	
N10	Uniform Fire Code Implementation	☐	☒	This is a mental healthcare facility; no applicable hazardous materials will come in to contact with stormwater discharges.
N11	Litter/Debris Control Program	☒	☐	Owner will implement a trash management program that will be enforced by the manager of the facility. Maintenance staff will provide daily litter and debris patrol and emptying of trash receptacles.
N12	Employee Training	☒	☐	Employee training will be provided. Owner will utilize County storm water best management practices brochures for employee training. Employee training will include good housekeeping practices and pollution prevention.
N13	Housekeeping of Loading Docks	☐	☒	The project does not include loading docks.
N14	Catch Basin Inspection Program	☒	☐	Monthly inspection by property owner's designee. Catch basins will be vacuumed when sediment/trash becomes 2 inches deep and disposed of properly.
N15	Vacuum Sweeping of Private Streets and Parking Lots	☒	☐	Landscaper maintenance contractors will be required to sweep up all cuttings and fertilizer materials off paved areas weekly and dispose of properly. Parking lots and access roads will be swept monthly utilizing a vacuum assisted sweeper by sweeping contractor.
N16	Other Non-structural Measures for Public Agency Projects	☐	☒	Not a public agency project.
N17	Comply with all other applicable NPDES permits	☒	☐	The owner shall comply with the statewide General Construction Permit during the entire period of construction by filing an NOI and SWPPP with the State Water Board and complying with all BMP Implementation and reporting requirements.

Form 4.1-2 Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, If not applicable, state reason
		Included	Not Applicable	
S1	Provide storm drain system stencilling and signage (CASQA New Development BMP Handbook SD-13)	☒	☐	Catch basins will be stenciled with prohibitive language that state "NO DUMPING-DRAINS TO OCEAN"
S2	Design and construct outdoor material storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-34)	☐	☒	No outdoor material storage on-site.
S3	Design and construct trash and waste storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-32)	☒	☐	Trash and waste storage areas will be paved with an impervious surface, designed to divert drainage around the area, and will have a roof and walls to prevent off-site transport of trash.
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)	☒	☐	Irrigation systems will include shut-off valves triggered by a pressure drop to limit water loss in the event of broken sprinkler heads or lines. Timers will be used to avoid over watering and adjusted seasonally by the landscape contractor. Plants will be grouped by water requirements and native and drought tolerant species will be used where appropriate.
S5	Finish grade of landscaped areas at a minimum of 1-2 inches below top of curb, sidewalk, or pavement	☒	☐	Landscaped areas will be depressed to promote infiltration.
S6	Protect slopes and channels and provide energy dissipation (CASQA New Development BMP Handbook SD-10)	☐	☒	No on-site channels and slopes.
S7	Covered dock areas (CASQA New Development BMP Handbook SD-31)	☐	☒	There are no docks on-site.
S8	Covered maintenance bays with spill containment plans (CASQA New Development BMP Handbook SD-31)	☐	☒	There will be no maintenance on-site.
S9	Vehicle wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☐	☒	There will be no vehicle washing on-site.
S10	Covered outdoor processing areas (CASQA New Development BMP Handbook SD-36)	☐	☒	There will be no outdoor processing.

Form 4.1-2 Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, If not applicable, state reason
		Included	Not Applicable	
S11	Equipment wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☐	☒	There will be no equipment washing on-site.
S12	Fueling areas (CASQA New Development BMP Handbook SD-30)	☐	☒	There will be no fueling on-site.
S13	Hillside landscaping (CASQA New Development BMP Handbook SD-10)	☐	☒	There are no hillsides on-site.
S14	Wash water control for food preparation areas	☒	☐	All food preparation will occur inside the structure and shall have contained areas with sanitary sewer connections for disposal of wash waters containing kitchen and food waste.
S15	Community car wash racks (CASQA New Development BMP Handbook SD-33)	☐	☒	There are no car washes on-site.

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: Landscaping is used wherever possible to minimize impervious areas. The project includes underground infiltration facility to collect and infiltrate run off from impervious areas. The ratio of impervious to pervious is 3.79.
Maximize natural infiltration capacity: Yes ☒ No ☐ Explanation: The underground infiltration facility will be positioned to maximize amount of stormwater collected for treatment.
Preserve existing drainage patterns and time of concentration: Yes ☒ No ☐ Explanation: project will maintain existing drainage patterns and the underground infiltration basin will maintain the time of concentration.
Disconnect impervious areas: Yes ☒ No ☐ Explanation: The underground infiltration basin will act to disconnect impervious areas.
Protect existing vegetation and sensitive areas: Yes ☐ No ☒ Explanation: There are no sensitive areas to protect. Existing vegetation is grass of poor quality. Landscaping will be planted throughout the site.
Re-vegetate disturbed areas: Yes ☐ No ☒ Explanation: Disturbed areas that are not paved or covered by buildings, sidewalks and other impervious surfaced will be landscaped.
Minimize unnecessary compaction in stormwater retention/infiltration basin/trench areas: Yes ☒ No ☐ Explanation: Heavy construction vehicles will be prohibited from unnecessary compaction near the infiltration facility. Compaction for the underground infiltration basin shall be per the manufacturer's recommendation.
Utilize vegetated drainage swales in place of underground piping or imperviously lined swales: Yes ☐ No ☒ Explanation: Underground piping required to convey flows from all areas of the site to the infiltration facility. Vegetated swales are not feasible to use as site drainage tends to generate sheet flow rather than areas of concentrated flows, therefore it would be difficult to channelize the runoff above ground.
Stake off areas that will be used for landscaping to minimize compaction during construction : Yes ☒ No ☐ Explanation: Landscaped areas will be staked to minimize unnecessary compaction wherever possible.

4.2 Project Performance Criteria

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

Methods applied in the following forms include:

- For LID BMP Design Capture Volume (DCV), the San Bernardino County Stormwater Program requires use of the P_6 method (MS4 Permit Section XI.D.6a.ii) – Form 4.2-1
- For HCOC pre- and post-development hydrologic calculation, the San Bernardino County Stormwater Program requires the use of the Rational Method (San Bernardino County Hydrology Manual Section D). Forms 4.2-2 through Form 4.2-5 calculate hydrologic variables including runoff volume, time of concentration, and peak runoff from the project site pre- and post-development using the Hydrology Manual Rational Method approach. For projects greater than 640 acres (1.0 mi^2), the Rational Method and these forms should not be used. For such projects, the Unit Hydrograph Method (San Bernardino County Hydrology Manual Section E) shall be applied for hydrologic calculations for HCOC performance criteria.

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

Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume (DA 1)

1 Project area DA 1 (ft^2): 259,182	**2** Imperviousness after applying preventative site design practices (Imp%): 79	**3** Runoff Coefficient (Rc): _0.59 *$R_c = 0.858(Imp\%)^3-0.78(Imp\%)^2+0.774(Imp\%)+0.04$*
4 Determine 1-hour rainfall depth for a 2-year return period $P_{2yr-1hr}$ (in): 0.697 *http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html*		
5 Compute P_6, Mean 6-hr Precipitation (inches): 1.03 *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): 25,765 *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	DMA A	DMA B	DMA C	DMA D	DMA E	DMA F	DMA G	DMA H
1a Land Cover type								
2a Hydrologic Soil Group (HSG)								
3a DMA Area, ft^2 *sum of areas of DMA should equal area of DA*								
4a Curve Number (CN) *use Items 1 and 2 to select the appropriate CN from Appendix C-2 of the TGD for WQMP*								
Weighted Curve Number Determination for: Post-developed DA	DMA A	DMA B	DMA C	DMA D	DMA E	DMA F	DMA G	DMA H
1b Land Cover type								
2b Hydrologic Soil Group (HSG)								
3b DMA Area, ft^2 *sum of areas of DMA should equal area of DA*								
4b Curve Number (CN) *use Items 5 and 6 to select the appropriate CN from Appendix C-2 of the TGD for WQMP*								

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

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

12 Pre-developed Volume (ft^3):
*V_{pre} =(1 / 12) * (Item sum of Item 3) * [(Item 11 – Item 9)^2 / ((Item 11 – Item 9 + Item 7) 21608.17*7.95/3.93*

13 Post-developed Volume (ft^3):
*V_{pre} =(1 / 12) * (Item sum of Item 3) * [(Item 11 – Item 10)^2 / ((Item 11 – Item 10 + Item 8) 21608.17*8.12/3.79*

14 Volume Reduction needed to meet HCOC Requirement, (ft^3):
*V_{HCOC} = (Item 13 * 0.95) – Item 12*

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

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

Variables	Pre-developed DA1 *Use additional forms if there are more than 4 DMA*				Post-developed DA1 *Use additional forms if there are more than 4 DMA*			
	DMA A	DMA B	DMA C	DMA D	DMA A	DMA B	DMA C	DMA D
1 Length of flowpath (ft) *Use Form 3-2 Item 5 for pre-developed condition*								
2 Change in elevation (ft)								
3 Slope (ft/ft), S_o = *Item 2 / Item 1*								
4 Land cover								
5 Initial DMA Time of Concentration (min) *Appendix C-1 of the TGD for WQMP*								
6 Length of conveyance from DMA outlet to project site outlet (ft) *May be zero if DMA outlet is at project site outlet*								
7 Cross-sectional area of channel (ft^2)								
8 Wetted perimeter of channel (ft)								
9 Manning's roughness of channel (n)								
10 Channel flow velocity (ft/sec) V_{fps} = *(1.49 / Item 9) * (Item 7/Item 8)^0.67 * (Item 3)^0.5*								
11 Travel time to outlet (min) T_t = *Item 6 / (Item 10 * 60)*								
12 Total time of concentration (min) T_c = *Item 5 + Item 11*								
13 Pre-developed time of concentration (min): *Minimum of Item 12 pre-developed DMA*								
14 Post-developed time of concentration (min): *Minimum of Item 12 post-developed DMA*								
15 Additional time of concentration needed to meet HCOC requirement (min): $T_{C\text{-}HCOC}$ = *(Item 13 * 0.95) – 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 DA to Project Outlet (*Use additional forms if more than 3 DMA)*			Post-developed DA to Project Outlet (*Use additional forms if more than 3 DMA)*		
		DMA A	DMA B	DMA C	DMA A	DMA B	DMA C
1 Rainfall Intensity for storm duration equal to time of concentration *I_{peak} = 10^(LOG Form 4.2-1 Item 4 - 0.6 LOG Form 4.2-4 Item 5 /60)*							
2 Drainage Area of each DMA (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)*	DMA A	*n/a*			*n/a*		
	DMA B		*n/a*			*n/a*	
	DMA C			*n/a*			*n/a*

8 Pre-developed Q_p at T_c for DMA A: *Q_p = Item 6_{DMAA} + [Item 6_{DMAB} * (Item 1_{DMAA} - Item 5_{DMAB})/(Item 1_{DMAB} - Item 5_{DMAB})* Item $7_{DMAA/2}$] + [Item 6_{DMAC} * (Item 1_{DMAA} - Item 5_{DMAC})/(Item 1_{DMAC} - Item 5_{DMAC})* Item $7_{DMAA/3}$]*	**9** Pre-developed Q_p at T_c for DMA B: *Q_p = Item 6_{DMAB} + [Item 6_{DMAA} * (Item 1_{DMAB} - Item 5_{DMAA})/(Item 1_{DMAA} - Item 5_{DMAA})* Item $7_{DMAB/1}$] + [Item 6_{DMAC} * (Item 1_{DMAB} - Item 5_{DMAC})/(Item 1_{DMAC} - Item 5_{DMAC})* Item $7_{DMAB/3}$]*	**10** Pre-developed Q_p at T_c for DMA C: *Q_p = Item 6_{DMAC} + [Item 6_{DMAA} * (Item 1_{DMAC} - Item 5_{DMAA})/(Item 1_{DMAA} - Item 5_{DMAA})* Item $7_{DMAC/1}$] + [Item 6_{DMAB} * (Item 1_{DMAC} - Item 5_{DMAB})/(Item 1_{DMAB} - Item 5_{DMAB})* Item $7_{DMAC/2}$]*
10 Peak runoff from pre-developed condition confluence analysis (cfs): *Maximum of Item 8, 9, and 10 (including additional forms as needed)*		
11 Post-developed Q_p at T_c for DMA A: *Same as Item 8 for post-developed values*	**12** Post-developed Q_p at T_c for DMA B: *Same as Item 9 for post-developed values*	**13** Post-developed Q_p at T_c for DMA C: *Same as Item 10 for post-developed values*
14 Peak runoff from post-developed condition confluence analysis (cfs): *Maximum of Item 11, 12, and 13 (including additional forms as needed)*		
15 Peak runoff reduction needed to meet HCOC Requirement (cfs): $Q_{p\text{-}HCOC}$ = *(Item 14 * 0.95) – Item 10*		

4.3 Project Conformance Analysis

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

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

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

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

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

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

If the combination of LID HSC, retention and infiltration, and harvest and use BMPs are unable to mitigate the entire DCV, then biotreatment BMPs may be implemented by the project proponent. If biotreatment BMPs are used, then they must be sized to provide sufficient capacity for effective treatment of the remainder of the volume-based performance criteria that cannot be achieved with LID BMPs (TGD for WQMP Section 5.4.4.2). **Under no circumstances shall any portion of the DCV be released from the site without effective mitigation and/or treatment**.

Form 4.3-1 Infiltration BMP Feasibility (DA 1)

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

[1] Would infiltration BMP pose significant risk for groundwater related concerns? Yes ☐ No ☒
Refer to Section 5.3.2.1 of the TGD for WQMP

If Yes, Provide basis: (attach)

[2] Would installation of infiltration BMP significantly increase the risk of geotechnical hazards? Yes ☐ No ☒
(Yes, if the answer to any of the following questions is yes, as established by a geotechnical expert):

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

If Yes, Provide basis: (attach)

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

If Yes, Provide basis: (attach)

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

If Yes, Provide basis: (attach)

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

If Yes, Provide basis: (attach)

[6] Would on-site infiltration or reduction of runoff over pre-developed conditions be partially or fully inconsistent with watershed management strategies as defined in the WAP, or impair beneficial uses? Yes ☐ No ☒
See Section 3.5 of the TGD for WQMP and WAP

If Yes, Provide basis: (attach)

[7] Any answer from Item 1 through Item 3 is "Yes": Yes ☐ No ☒
If yes, infiltration of any volume is not feasible onsite. Proceed to Form 4.3-4, Harvest and Use BMP. If no, then proceed to Item 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": Yes ☒ 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 (ft^2)			
3 Ratio of pervious area receiving runoff to impervious area			
4 Retention volume achieved from impervious area dispersion (ft^3) *V = Item2 * Item 3 * (0.5/12), assuming retention of 0.5 inches of runoff*			
5 Sum of retention volume achieved from impervious area dispersion (ft^3):		$V_{retention}$ *=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 (ft^2)			
8 Ponding depth (ft)			
9 Surface area of amended soil/gravel (ft^2)			
10 Average depth of amended soil/gravel (ft)			
11 Average porosity of amended soil/gravel			
12 Retention volume achieved from on-lot infiltration (ft^3) $V_{retention}$ *= (Item 7 *Item 8) + (Item 9 * Item 10 * Item 11)*			
13 Runoff volume retention from on-lot infiltration (ft^3):		$V_{retention}$ *=Sum of Item 12 for all BMPs*	

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

14 Implementation of evapotranspiration BMP (green, brown, or blue roofs): Yes ☐ No ☒ *If yes, complete Items 15-20. If no, proceed to Item 21*	DA 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): *$V_{retention}$ =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): *$V_{retention}$ = 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).

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

1 Remaining LID DCV not met by site design HSC BMP (ft^3): 25,765 *V_{unmet} = Form 4.2-1 Item 7 - Form 4.3-2 Item 30*

BMP Type *Use columns to the right to compute runoff volume retention from proposed infiltration BMP (select BMP from Table 5-4 in TGD for WQMP) - Use additional forms for more BMPs*	DA 1 DMA A BMP Type UNDERGROUND INFILTRATION FACILITY	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
2 Infiltration rate of underlying soils (in/hr) *See Section 5.4.2 and Appendix D of the TGD for WQMP for minimum requirements for assessment methods*	2.2		
3 Infiltration safety factor *See TGD Section 5.4.2 and Appendix D*	4.4		
4 Design percolation rate (in/hr) *P_{design} = Item 2 / Item 3*	0.5		
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*	2		
7 Ponding Depth (ft) *d_{BMP} = Minimum of (1/12*Item 4*Item 5) or Item 6*	2		
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*	25,344		
9 Amended soil depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 in the TGD for WQMP for reference to BMP design details*	N/A		
10 Amended soil porosity	N/A		
11 Gravel depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 of the TGD for WQMP for BMP design details*	N/A		
12 Gravel porosity	N/A		
13 Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*	3		
14 Above Ground Retention Volume (ft^3) *$V_{retention}$ = Item 8 * [Item7 + (Item 9 * Item 10) + (Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]*	N/A		
15 Underground Retention Volume (ft^3) *Volume determined using manufacturer's specifications and calculations*	41,580		

16 Total Retention Volume from LID Infiltration BMPs: 41580 *(Sum of Items 14 and 15 for all infiltration BMP included in plan)*

17 Fraction of DCV achieved with infiltration BMP: 161% *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 Harvest and Use BMPs (DA 1)

1 Remaining LID DCV not met by site design HSC or infiltration BMP (ft^3): *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 Selection and Evaluation of Biotreatment BMP (DA 1)

1 Remaining LID DCV not met by site design HSC, infiltration, or harvest and use BMP for potential biotreatment (ft^3): *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 Volume Based Biotreatment (DA 1) – Bioretention and Planter Boxes with Underdrains

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

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

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

Form 4.3-8 Flow Based Biotreatment (DA 1)

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

4.3.5 Conformance Summary

Complete Form 4.3-9 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): 25765 *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): 41580 *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): *(Form 4.2-2 Item 4 * 0.95) – Form 4.2-2 Item 1*	**2** On-site retention with site design hydrologic source control, infiltration, and harvest and use LID BMP (ft^3): *Sum of Form 4.3-9 Items 2, 3, and 4 Evaluate option to increase implementation of on-site retention in Forms 4.3-2, 4.3-3, and 4.3-4 in excess of LID DCV toward achieving HCOC volume reduction*
3 Remaining volume for HCOC volume capture (ft^3): *Item 1 – Item 2*	**4** Volume capture provided by incorporating additional on-site or off-site retention BMPs (ft^3): *Existing downstream BMP may be used to demonstrate additional volume capture (if so, attach to this WQMP a hydrologic analysis showing how the additional volume would be retained during a 2-yr storm event for the regional watershed)*

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

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

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

- Demonstrate increase in time of concentration achieved by proposed LID site design, LID BMP, and additional on-site or off-site retention BMP ☐
  BMP upstream of a waterbody segment with a potential HCOC may be used to demonstrate increased time of concentration through hydrograph attenuation (if so, show that the hydraulic residence time provided in BMP for a 2-year storm event is equal or greater than the addition time of concentration requirement in Form 4.2-4 Item 15)
- Increase time of concentration by preserving pre-developed flow path and/or increase travel time by reducing slope and increasing cross-sectional area and roughness for proposed on-site conveyance facilities ☐
- Incorporate appropriate in-stream controls for downstream waterbody segment to prevent impacts due to hydromodification, in a plan approved and signed by a licensed engineer in the State of California ☐

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

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

- Demonstrate reduction in peak runoff achieved by proposed LID site design, LID BMPs, and additional on-site or off-site retention BMPs ☐
  BMPs upstream of a waterbody segment with a potential HCOC may be used to demonstrate additional peak runoff reduction through hydrograph attenuation (if so, attach to this WQMP, a hydrograph analysis showing how the peak runoff would be reduced during a 2-yr storm event)
- Incorporate appropriate in-stream controls for downstream waterbody segment to prevent impacts due to hydromodification, in a plan approved and signed by a licensed engineer in the State of California ☐

4.4 Alternative Compliance Plan (if applicable)

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

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

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

Section 5 Inspection and Maintenance Responsibility for Post Construction BMP

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

Form 5-1 BMP Inspection and Maintenance

BMP	Reponsible Party(s)	Inspection/ Maintenance Activities Required	Minimum Frequency of Activities
Underground Infiltration Facility	Owner	Facilty shall be inspected for debris and sediment accumulation and maintained by a qualified technician. They will properly dispose of all wastes and inspect for standing water.	Annually
N1-Education of Property Owners, Tenants and Occupants on Stormwater BMPs	Owner	Property owner will familiarize him/herself with the educational materials in Attachment "C" and the contents of the WQMP.	Annually.
N2-Activity Restrictions	Owner	Owner will be aware of any use or activity restrictions. Inspections shall occur daily for activity restrictions, corrections made as needed.	Daily
N3-Landscape Management BMPs	Owner	Landscaping shall be inspected and maintained for overgrowth, watering needs, and plant needs.	Weekly as a part of landscape maintenance
N7- Spill Contingency Plan	Owner	Owner will keep absorbent materials on site for accidental spills, spills will be disposed of in a proper facility. Inspect products for expirations, replace as needed and after use.	Annually and after use
N11-LitterControl Program	Control Program Owner	Contract with their landscape maintenance firm to provide this service during regularly schedule maintenance.	Weekly
N12- Employee Training	Owner	Employees shall be trained to clean up spills and participate in ongoing maintenance. Owner will utilize County storm water best management practices brochures for employee training. Employee training will include good housekeeping practices and pollution prevention.	Annually for all employees and within 2 months for new hires.

Form 5-1 BMP Inspection and Maintenance

BMP	Reponsible Party(s)	Inspection/ Maintenance Activities Required	Minimum Frequency of Activities
N14- Catch Basin Inspection Program	Owner	Monthly inspection by property owner's designee. Catch basins will be vacuumed when sediment or trash becomes 2-inches deep and disposed of properly.	Monthly inspection and maintain as necessary.
N15: Vacuum Sweeping of Private Streets and Parking Lots	Owner	All landscape maintenance contractors will be required to sweep up all landscape cuttings, mowings and fertilizer materials off paved areas weekly and dispose of properly. Parking areas and drive ways will be swept using a vacuum assisted sweeper monthly by sweeping contractor.	Monthly
S1: Provide storm drain system stenciling20 and signage (CASQA New Development BMP Handbook SD-13)	Owner	Inspect inlet signage for faded or lost signs/ repair or replaces as needed.	Annually
S3: Design and construct trash and waste storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-32)	Owner	Trash and waste storage areas will be paved with an impervious surface, designed to divert drainage around the area and walled to prevent off-site transport of trash. Trash enclosure will be inspected and repaired or replaced as needed.	Ongoing Weekly
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)	Owner	Irrigation systems will include shut-off valves triggered by a pressure drop to limit water loss in the event of broken sprinkler heads or lines. Timers will be used to avoid over watering and adjusted seasonally by the landscape contractor. Plants will be grouped by water requirements and native and drought tolerant species will be used where appropriate. Irrigation systems will be inspected and replaced or repaired as needed.	Adjust watering cycles and duration seasonally / quarterly. Weekly as a part of landscape maintenance.
S5: Finish grade of landscaped areas at a minimum of 1-2 inches below top of curb, sidewalk, or pavement	Owner	Landscaped areas will be inspected for minimum depression and correct as needed.	Weekly as a part of landscape maintenance

Section 6 WQMP Attachments

6.1. Site Plan and Drainage Plan

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

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

6.2 Electronic Data Submittal

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

6.3 Post Construction

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

6.4 Other Supporting Documentation

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



SHANDIN MENTAL HEALTH REHABILITAION CENTER

PWQMP LOCATION MAP

MARCH 2023

BKF
4675 MACARTHUR COURT
SUITE 400
NEWPORT BEACH, CA 92660
(949) 526-8460
www.bkf.com

LEGEND

- SITE BOUNDARY
- IMPERVIOUS
- PERVIOUS–LANDSCAPING
- PROPOSED STORM DRAIN (SD)
- DRAIN CONNECTION LOCATION
- TYPE "A" CATCH BASIN WITH TRASH AND DEBRIS GUARD*
- DROP INLET*
- LANDSCAPE DRAIN*
- STORM DRAIN CLEANOUT*
- SURFACE FLOW DIRECTION
- PIPE FLOW DIRECTION
- UIF BMP BOTTOM EL=1384.77 — UNDERGROUND INFILTRATION FACILITY*
- PROPOSED BUILDING
- PROPOSED PAVING
- (S1) STORM DRAIN STENCILING
- (S3) TRASH AND WASTE STORAGE AREA*
- (S4) EFFICIENT IRRIGATION
- (S5) DEPRESSED LANDSCAPE AREAS
- (C0) CURB OPENING*

SUMMARY TABLE

DRAINAGE AREA	PERVIOUS AREA SQFT	IMPERVIOUS AREA SQFT	TOTAL AREA SQFT	PERVIOUS %	IMPERVIOUS %
1	54,109	205,073	259,182	21	79

STORM DRAIN STENCILING

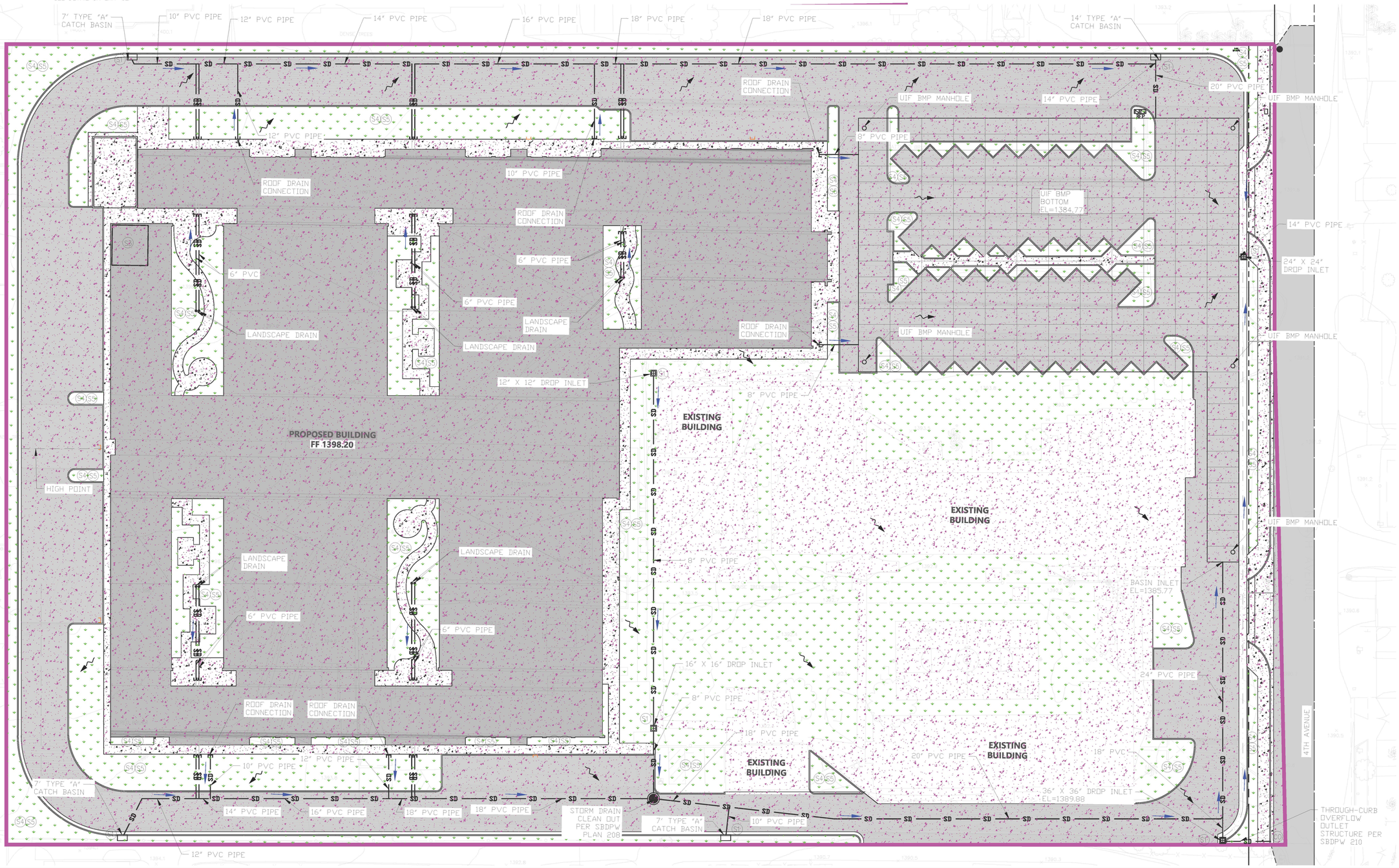
NO DUMPING–DRAINS TO OCEAN

NORTH

GRAPHIC SCALE

(IN FEET)
1 inch = 20 ft.

*SEE DETAIL ON EXH–02



AGENCY STAMP

NewGen Health

dsk architects

926 Natoma Street, Suite 200, San Francisco, CA 94103
t: 415.839.6418 / f: 415.839.7584

1539 Sawtelle Blvd, Suite 14, Los Angeles, CA 90025
t: 310.254.2263 / f: 415.839.7584

6700 Koll Center Parkway, Suite 110, Pleasanton, CA 94566
t: 925.484.5245 / f: 925.484.5206

663 Hill Street, San Luis Obispo, CA 93405
t: 805.541.4864 / c: 805.459.0806

:DRAFT, NOT FOR CONSTRUCTION:

CONSULTANT

BKF

REGISTERED PROFESSIONAL ENGINEER — BRUCE W. KING — No. C 42393 — CIVIL — STATE OF CALIFORNIA

PROJECT NAME

SHANDIN HILLS MENTAL HEALTH REHABILITATION CENTER (MHRC)

FACILITY INFO
SHANDIN HILLS BEHAVIORAL HEALTH CENTER
4164 N 4TH AVE, SAN BERNARDINO, CA 92407

KEY PLAN

PROJECT NORTH

PROJECT ISSUE DATE: 2022/08/19

DATE	NO.	REVISIONS
08/21/2023		CUP SUBMITTAL

DRAFTER: XX
REVIEWER: RD
PM: KJ
DSK JOB NO: 21025

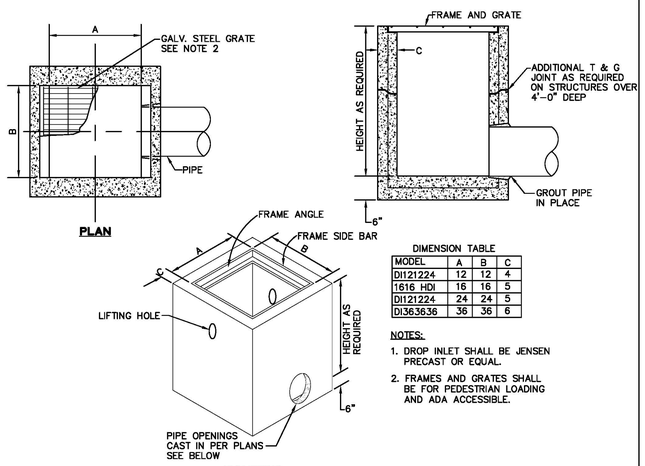
SHEET TITLE

PWQMP EXHIBIT

SHEET NUMBER

EXH-01

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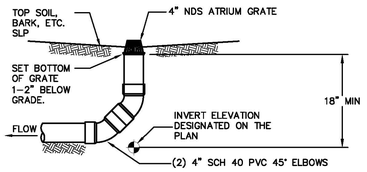
DIMENSION TABLE

MODEL	A	B	C
DI121224	12	12	4
1616 HDI	16	16	5
DI121224	24	24	5
DI363636	36	36	6

NOTES:

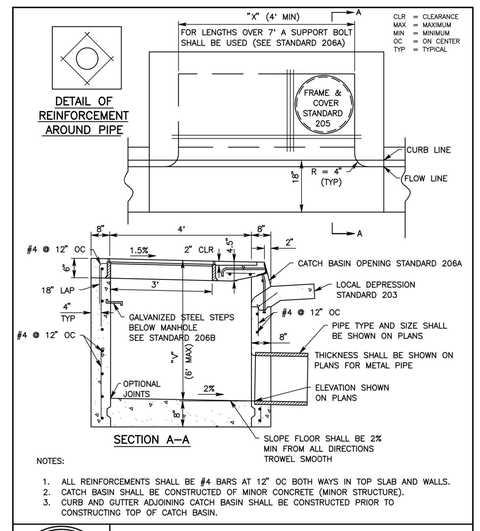
1. DROP INLET SHALL BE JENSEN PRECAST OR EQUAL.
2. FRAMES AND GRATES SHALL BE FOR PEDESTRIAN LOADING AND ADA ACCESSIBLE.

DROP INLET
NTS



NOTE:
GLUED FITTINGS MAY BE SUBSTITUTED FOR GASKETED FITTINGS AT THE OPTION OF THE INSTALLATION CONTRACTOR.

LANDSCAPE DRAIN
NTS



NOTES:

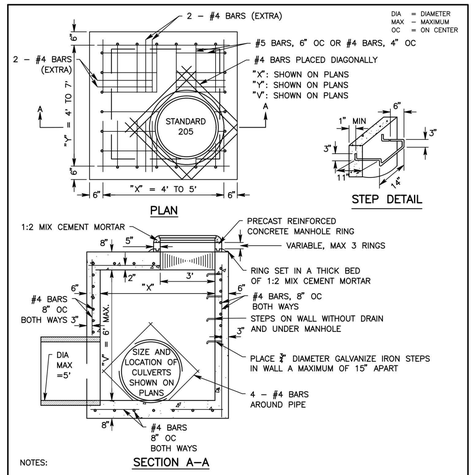
1. ALL REINFORCEMENTS SHALL BE #4 BARS AT 12" OC BOTH WAYS IN TOP SLAB AND WALLS.
2. CATCH BASIN SHALL BE CONSTRUCTED OF MINOR CONCRETE (MINOR STRUCTURE).
3. CURB AND GUTTER ADJOINING CATCH BASIN SHALL BE CONSTRUCTED PRIOR TO CONSTRUCTING TOP OF CATCH BASIN.

SAN BERNARDINO COUNTY DEPARTMENT OF PUBLIC WORKS

TYPE "A" CATCH BASIN

BRENDON P. BIGGS, PE DIRECTOR OF PUBLIC WORKS/ROAD COMMISSIONER

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NOTES:

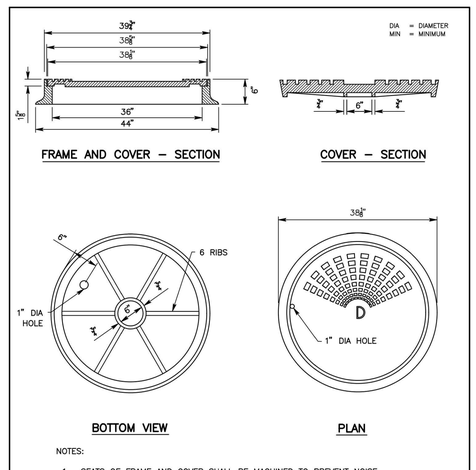
1. STORM DRAIN CLEANOUT SHALL BE CONSTRUCTED OF MINOR CONCRETE (MINOR STRUCTURE).
2. CLEARANCE FROM INSIDE DIAMETER OF PIPE TO CLEANOUT WALL SHALL BE 4" MINIMUM.
3. APPROVED PRECAST CONCRETE MANHOLE SHAFT RINGS WILL BE ACCEPTED IN LIEU OF CAST–IN–PLACE SHAFT.

SAN BERNARDINO COUNTY DEPARTMENT OF PUBLIC WORKS

STORM DRAIN CLEANOUT

BRENDON P. BIGGS, PE DIRECTOR OF PUBLIC WORKS/ROAD COMMISSIONER

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NOTES:

1. SEATS OF FRAME AND COVER SHALL BE MACHINED TO PREVENT NOISE.
2. TOTAL WEIGHT OF FRAME AND COVERS – 580 LBS MINIMUM.
3. MATERIAL SHALL BE CAST IRON (BITUMINOUS COATED).
4. SURFACE OF LETTERS SHALL BE FLUSH WITH FINISHED SURFACE OF COVER.

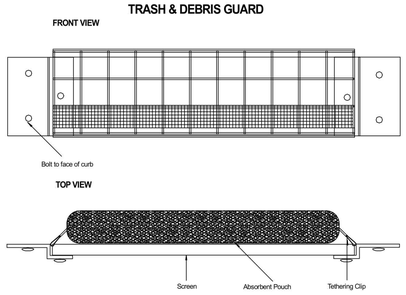
SAN BERNARDINO COUNTY DEPARTMENT OF PUBLIC WORKS

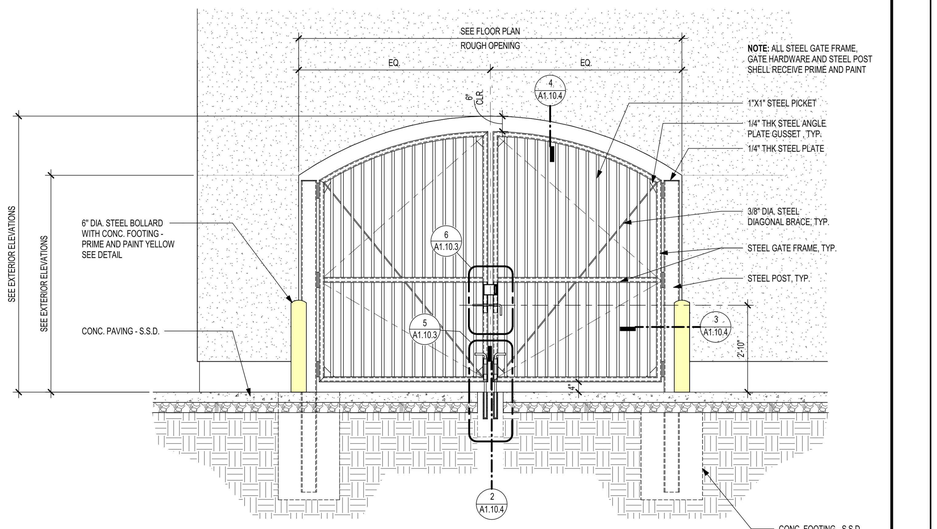
36" MANHOLE FRAME AND COVER

BRENDON P. BIGGS, PE DIRECTOR OF PUBLIC WORKS/ROAD COMMISSIONER

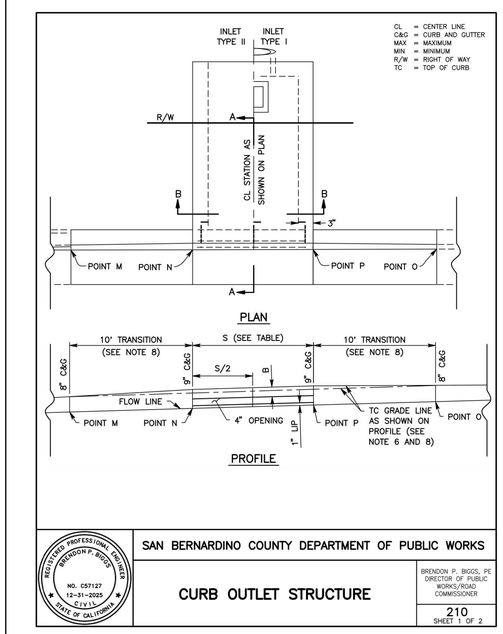
205

FLO-GARD™
TRASH & DEBRIS GUARD





1 TRASH BIN ROOM GATE ELEVATION
1/2" = 1'-0"

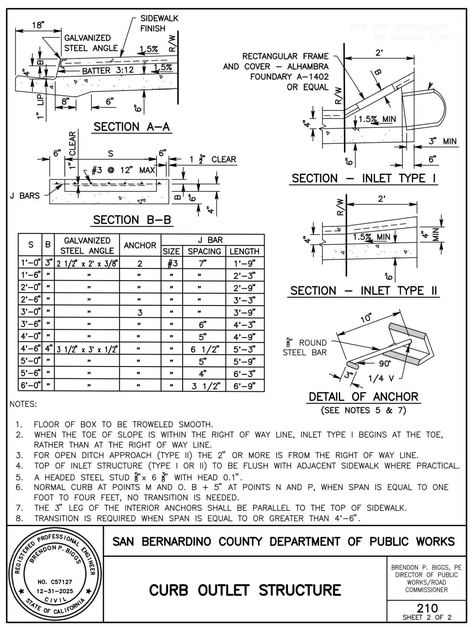


SAN BERNARDINO COUNTY DEPARTMENT OF PUBLIC WORKS

CURB OUTLET STRUCTURE

BRENDON P. BIGGS, PE DIRECTOR OF PUBLIC WORKS/ROAD COMMISSIONER

210
SHEET 1 OF 2



S	B	GALVANIZED STEEL ANGLE	ANCHOR	J BAR SIZE	J BAR SPACING	J BAR LENGTH
1'–0"	3"	2 1/2" x 2" x 3/8"	2	#3	7"	1'–9"
1'–6"	"	"	"	"	"	2'–3"
2'–0"	"	"	"	"	"	2'–9"
2'–6"	"	"	"	"	"	3'–3"
3'–0"	"	"	3	"	"	3'–9"
3'–6"	"	"	"	"	6"	4'–3"
4'–0"	"	"	"	"	5"	4'–9"
4'–6"	4"	3 1/2" x 3" x 1/2"	"	"	6 1/2"	5'–3"
5'–0"	"	"	"	"	5"	5'–9"
5'–6"	"	"	"	"	4"	6'–3"
6'–0"	"	"	"	"	3 1/2"	6'–9"

NOTES:

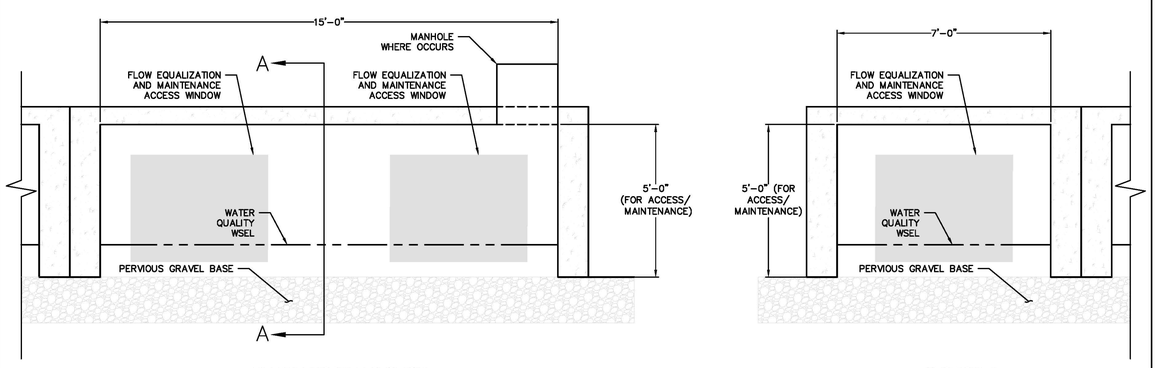
1. FLOOR OF BOX TO BE TROWELED SMOOTH.
2. WHEN THE TOE OF SLOPE IS WITHIN THE RIGHT OF WAY LINE, INLET TYPE I BEGINS AT THE TOE, RATHER THAN AT THE RIGHT OF WAY LINE.
3. FOR OPEN DITCH APPROACH (TYPE II) THE 2" OR MORE IS FROM THE RIGHT OF WAY LINE.
4. TOP OF INLET STRUCTURE (TYPE I OR II) TO BE FLUSH WITH ADJACENT SIDEWALK WHERE PRACTICAL.
5. A HEADED STEEL STUD ⅜" x 6 ⅜" WITH HEAD 0.1".
6. NORMAL CURB AT POINTS M AND O. B + 5" AT POINTS N AND P, WHEN SPAN IS EQUAL TO ONE FOOT TO FOUR FEET, NO TRANSITION IS NEEDED.
7. THE 3" LEG OF THE INTERIOR ANCHORS SHALL BE PARALLEL TO THE TOP OF SIDEWALK.
8. TRANSITION IS REQUIRED WHEN SPAN IS EQUAL TO OR GREATER THAN 4'–6".

SAN BERNARDINO COUNTY DEPARTMENT OF PUBLIC WORKS

CURB OUTLET STRUCTURE

BRENDON P. BIGGS, PE DIRECTOR OF PUBLIC WORKS/ROAD COMMISSIONER

210
SHEET 2 OF 2



UIF BMP MODULE SECTION
NTS

SECTION A
NTS

AGENCY STAMP

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:DRAFT, NOT FOR CONSTRUCTION:

CONSULTANT
BKF

BRUCE W. KIRBY No. C 42393 CIVIL STATE OF CALIFORNIA

PROJECT NAME
SHANDIN HILLS MENTAL HEALTH REHABILITATION CENTER (MHRC)

FACILITY INFO
SHANDIN HILLS BEHAVIORAL HEALTH CENTER
4164 N 4TH AVE, SAN BERNARDINO, CA 92407

KEY PLAN

PROJECT NORTH

PROJECT ISSUE DATE: 2022/08/19

DATE	NO.	REVISIONS
08/21/2023		CUP SUBMITTAL

DRAFTER: XX
REVIEWER: RD
PM: KJ
DSK JOB NO: 21025

SHEET TITLE
PWQMP EXHIBIT DETAILS

SHEET NUMBER
EXH-02

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APPENDIX A: HYDROLOGY

SHANDIN MHRC

4164 4th Ave
SAN BERNARDINO, CALIFORNIA
APN 0265141120000
APN 0265141240000
APN 0265141150000
Permit: DRNSTY-2023-00043

PRELIMINARY HYDROLOGY AND HYDRAULICS REPORT

April 2024

Prepared for:
NewGen Health, LLC
9526 W. Pico Blvd
Los Angeles CA 90035

Prepared by:
Daniel Villines
BKF Engineers
4675 MacArthur Court, Ste. 400
Newport Beach, CA 92660





TABLE OF CONTENTS

1. Introduction 1
2. Hydrology and Basin Routing Analysis 1
3. Preliminary Onsite Storm Drain Sizing 4
4. Conclusion 8
5. Exhibits 9
6. Technical Appendices 10

1. Introduction

DSK Architects has requested that BKF Engineers prepare a Preliminary Hydrology and Hydraulics Study for the development of the Shandin Medical Healthcare Rehabilitation Center (Project) located in San Bernardino, California.

The Project site is located at 4164 North 4th Avenue, between 45th Street and 48th Street. The existing site is approximately 5.9 acres, 2.62 acres of which is composed of the existing behavioral health complex and 3.28 is undeveloped open space. In the existing condition, storm water generally sheet flows across the lot towards North 4th Avenue. Flows collect in the gutter along North 4th Avenue and continue south to Devil Creek Channel.

The proposed Project will develop the open space portion of the site, expanding the health complex. The Project will include an approximately 76,000 square foot single story building with additional parking and small landscaped areas. In the proposed condition, storm water will be collected in inlet structures and conveyed in underground pipes to the proposed infiltration basin at the northeast corner of the project. The infiltration basin is sized to infiltrate the entire storm volume up to the 100-year storm event. Flows exceeding this volume will by-pass the infiltration basin and be released to the gutter in an under sidewalk drain at the southeast corner of the project and flow south along North 4th Avenue to Devil Creek Channel.

San Bernardino County has enacted a policy that the 100-year post-development peak flow rate should be less than or equal to 90% of the 100-year pre-development peak flow rate using the 25-year rainfall. The purpose of this preliminary report is to calculate the existing 100-year peak storm runoff flowrate, calculate the proposed 100-year peak storm runoff flowrate, and determine the preliminary infiltration facility size required to satisfy the San Bernardino storm water policy. The preliminary report will also include calculations used to determine the preliminary sizing of proposed onsite drainage systems used to convey stormwater to the infiltration facility.

2. Hydrology and Basin Routing Analysis

A hydrologic analysis of the existing and proposed site was performed in accordance with the San Bernardino County Hydrology Manual dated August of 1982 and Hydrology Addendum dated April of 2010 (Hydrology Manual) for the 2, 10, 25, and 100-year storm events.

A Small Area Unit Hydrograph study was performed to compute the hydrographs and peak flowrate for the existing and proposed conditions. The analysis was performed using Advanced Engineering Software (AES) Small Area Unit Hydrograph Module. AES generates a hydrograph and peak flowrates based on the drainage area, soil-loss rate, low loss fraction, time of concentration, and point rainfall values for various storm durations. These parameters were determined using the methodology described below:

- The drainage boundary for the site was delineated based on the aerial image of the region and the topographic map. It was determined that there are no off-site storm flows that enter the site, therefore the drainage area was comprised only of the Project site.

- The soil-loss rate was calculated using the equation below:

  Fm=apFp

  Where:

  Fm = soil-loss rate in inches/hour
  Ap = pervious area fraction- converted from impervious percentage as shown on Figure C-4 of the Hydrology Manual
  Fp = infiltration rate for the pervious area in inches/hour – from Figure C-6 using Curve Numbers* from Figure C-3 and soil type from the Web Soil Survey Website identified in the Hydrology Manual

- The low-loss fraction was calculated using the equation below:

  $Y_{Bar} = (1-Y)$

  Where:

  Y_{Bar} = low-loss fraction
  Y = Average 24-hour storm yield fraction for Project site = $(Y_1A_1+Y_2A_2\ldots)/(A_1+A_2\ldots)$

  Where:

  A1, A2 = Area of Project site with a particular Curve Number (CN)
  Y_1, Y_2 = 24-hour storm yield fraction for A1, A2
  $= (P_{24}-Ia)^2/((P_{24}-Ia+S)\,P_{24})$
  P_{24} = 24 hour rainfall from NOAA Atlas 14
  Ia = Initial Abstraction = 0.2*S
  S = soil capacity = (1000/CN)-10
  CN = Curve Number* from Figure C-3

  *Note Per Hydrology Manual, Impervious Areas are assigned a CN of 98

- Time of Concentration was calculated using Figure D-1 from the Hydrology Manual

  Where:

  L= Longest flowpath for the drainage area in feet
  H= Difference in elevation between the upstream and downstream ends of the longest flowpath
  PI = percentage of Impervious Cover from Figure C-4 of the Hydrology Map

- Point Rainfall was taken from NOAA Atlas 14 for the Project site.

The drainage areas, longest flowpaths, and upstream and downstream elevations can be found on the Existing Condition Small Area Unit Hydrograph Hydrology Map EXH-01 and Proposed Condition Small Area Unit Hydrograph Hydrology Map EXH-02. Calculations and supporting documentation can be found in Appendix A. Results of the AES Small Area Unit Hydrograph are summarized in Table 2-1, below.

Table 2-1
Results of 100-Year Small Area Unit Hydrograph Analysis

Project Condition	Peak 2-Year Flowrate (CFS)	2-Year Volume (ACFT)	Peak 10-Year Flowrate (CFS)	10-Year Volume (ACFT)	Peak 25-Year Flowrate (CFS)	25-Year Volume (ACFT)	Peak 100-Year Flowrate (CFS)	100-Year Volume (ACFT)
Existing	6.97	1.17	11.83	1.95	15.11	2.42	20.89	3.16
Proposed	8.85	1.47	14.55	2.26	18.39	2.74	25.06	3.47

The hydrograph for the proposed 100-year storm event was then routed through the basin using the AES software routing subroutine. The basin routing subroutine uses a stage-storage-outflow table. The elevations and storage inputs were based on rectangular storage units with a total base area of 25,344 sqft, maximum water quality ponding depth of 2 feet, and a total depth of 5 feet. The outflow was based on an infiltration rate from the Geotechnical Report prepared by LandMark Consultants Inc, see Appendix C. A safety factor of 2 was applied to the 2.18 in/hr infiltration rate, therefore a value of 1.09 in/hr was used over the 25,344 sqft basin bottom. Table 2-2 below summarizes to the results of the basin routing calculations. Table 2-3 below summarizes the water quality requirements for the infiltration basin.

Table 2-2: Results of Routing Analysis

Maximum Basin Inflow (CFS)	Basin Infiltration Rate (CFS)	Basin Storage Depth (FT)	Maximum Basin Depth (FT)	Basin Outflow (cfs)
25.06	0.64	5	4.89	0

Table 2-3: Water Quality Design Capture Volume

Water Quality Design Capture Volume (FT^3)	Maximum Allowable Water Quality Ponding Depth (FT)	Required Infiltrating Surface Area (sqft)	Infiltration Basin Area (SQFT)
25,765	2	12,882.5	25,344

Basin Routing calculations are included in Appendix A.

3. Preliminary Onsite Storm Drain Sizing

A Rational Method study was performed to compute 100-yr 1-hr peak flowrates for areas tributary to each proposed storm drain inlet. The results of the study produce 100-year peak flow rates that were then used in hydraulic analyses to determine preliminary pipe sizes for storm events of up to 100-years in magnitude.

In San Bernardino County, the Rational Method peak discharge is derived from the following equation:

$Q = 0.90 \cdot [I - ApFp] \cdot A$

Where…

Q = Peak Flow Rate
I = Intensity (In/Hr) from Figure D-3, 100-yr 1hr rainfall from NOAA Atlas 14, slope of 0.60 and Tc
Tc=Time of Concentration using Figure D-1 from the Hydrology Manual
Ap = pervious area fraction- converted from impervious percentage as shown on Figure C-4 of the Hydrology Manual = 0.1
Fp = infiltration rate for the pervious area in inches/hour – from Figure C-6 using Curve Numbers* from Figure C-3 and soil type from the Web Soil Survey Website identified in the Hydrology Manual = .02
A = Watershed Area (Acres)

The Rational Method analysis was performed for the 100-year storm event. The drainage areas, longest flowpaths, and upstream and downstream elevations can be found on the Proposed Rational Method Hydrology Map EXH-03. The supporting information and data for the analysis are included in Appendix B and the results are summarized in Table 3-1.

Table 3-1:Rational Method Analysis Data and Results

Inlet	Tributary Area (Ac)	Time of Concentration (Min)	Rainfall Intensity (In/Hr)	Pervious Fraction Ap	Pervious Area Loss Rate Fp (In/Hr)	100-Yr Peak Flow (cfs)
1A	0.481	7.8	6.70	0.1	0.02	2.90
2A	0.058	5.4	8.40	0.1	0.02	0.44
3A	0.275	7.2	7.00	0.1	0.02	1.73
4A	0.455	8	6.60	0.1	0.02	2.70
5A	0.059	5.4	8.40	0.1	0.02	0.45
6A	0.078	4.1	10.00	0.1	0.02	0.70
7A	0.028	2.7	15.50	0.1	0.02	0.39
8A	0.188	4	10.00	0.1	0.02	1.69
9A	1.625	9	6.15	0.1	0.02	8.99
10B	0.280	8	6.60	0.1	0.02	1.66
11B	0.061	5.3	8.50	0.1	0.02	0.47
12B	0.421	7.2	7.00	0.1	0.02	2.65
13B	0.059	5.4	8.40	0.1	0.02	0.45
14B	0.313	7.2	7.00	0.1	0.02	1.97
15B	0.023	5.4	8.40	0.1	0.02	0.18
16B	0.676	9.2	6.05	0.1	0.02	3.68
20C	0.617	6.9	7.20	0.1	0.02	4.00
30D	0.118	5.5	8.30	0.1	0.02	0.88
40E	0.096	5.6	8.20	0.1	0.02	0.71

Hydraulic Analyses were performed to determine preliminary pipe sizes with capacity for storm events of up to 100-years in magnitude using FlowMaster computer software developed by Bentley. FlowMaster can be used to calculate the full flow capacity of a pipe based on pipe diameter, slope, and Manning's Roughness Coefficient. For preliminary sizing purposes, a minimum pipe slope of 0.005 was used, along with a Manning's Roughness Coefficient of 0.010 for PVC pipe. Using the results of the FlowMaster calculations, a table was created with the full flow capacity for typical PVC pipe increments. The table was then used to determine the pipe size required for each pipe segment. The calculations are included in Appendix B.

Table 3-2 and Table 3-3 summarize the results of the hydraulic analysis. Storm Drain line designations can be found on the Proposed Rational Method Hydrology Map EXH-03.

Table 3-2: Full Flow Capacity for Standard PVC Pipe Sizes

Pipe Diameter (in)	Slope %	Manning's Roughness Coefficient	Full Flow Capacity (cfs)
6	0.5	0.010	0.52
8	0.5	0.010	1.11
10	0.5	0.010	2.01
12	0.5	0.010	3.27
14	0.5	0.010	4.94
16	0.5	0.010	7.05
18	0.5	0.010	9.66
20	0.5	0.010	12.79
24	0.5	0.010	20.79

Table 3-3: Preliminary Onsite Storm Drain Sizes

Storm Drain Line	Tributary Inlets	100-Yr Peak Flow (cfs)	Pipe Dia. (in)
IA	1A	2.90	12
2A	2A	0.44	6
2	1A, 2A	3.34	14
3A	3A	1.73	10
3	1A-3A	5.07	16
4A	4A	2.70	12
4	1A- 4A	7.77	18
5A	5A	0.45	6
5	1A-5A	8.22	18
6A	6A	0.70	8
7A	6A, 7A	1.09	8
6	1A-7A	9.31	18
8A	8A	1.69	10
7	1A-8A	11.00	20
9A	9A	8.99	18
8	1A-9A	19.99	24
10B	10B	1.66	10
11B	11B	0.47	6
10	10B, 11B	2.13	12
12B	12B	2.65	12
11	10B-12B	4.78	14
13B	13B	0.45	6
12	10B-13B	5.23	16
14B	14B	1.97	10
13	10B-14B	7.20	18
15B	15B	0.18	6
14	10B-15B	7.38	18
16B	16B	3.68	14
15	10B-16B	11.06	20
20C	20C	4.00	14
30D	30D	0.88	8
40E	40E	0.71	8

4. Conclusion

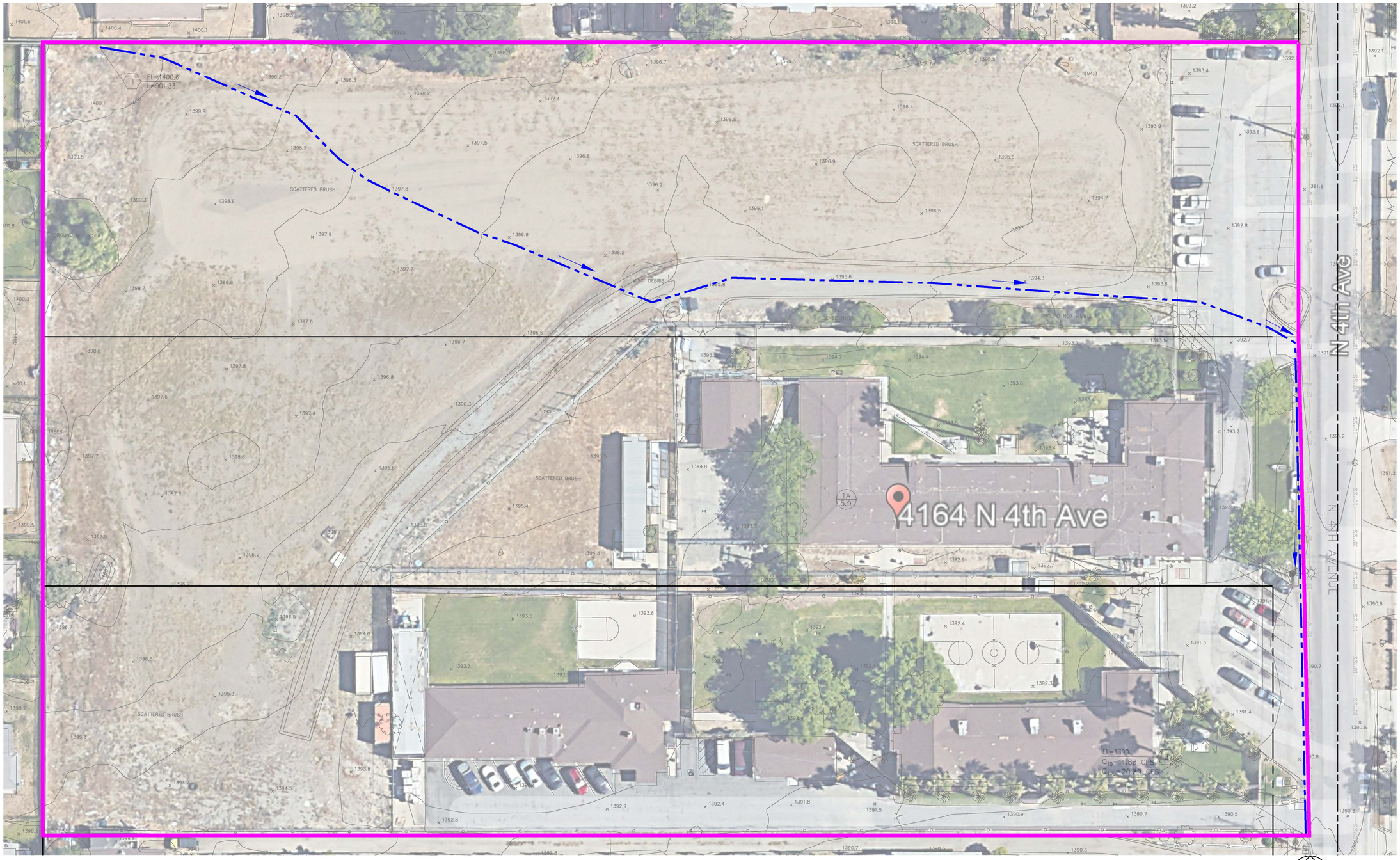
In order to meet the San Bernardino storm drain system policy, the Shandin MHRC must include an infiltration retention facility that is approximately 5 feet deep and has a bottom area of 25,344 sqft. Preliminary sizes have been determined for onsite storm drain pipes that can convey 100-year peak storm flows to the basin for infiltration.

5. Exhibits

Exhibit 1	Existing Condition Small Area Unit Hydrograph Hydrology Map
Exhibit 2	Proposed Condition Small Area Unit Hydrograph Hydrology Map
Exhibit 3	Proposed Condition Rational Method Hydrology Map

LEGEND

1A / 5.9	AREA DESIGNATION AREA (AC)		DRAINAGE AREA BOUNDARY
1	NODE DESIGNATION		FLOWPATH
EL	ELEVATION (FT)		FLOW DIRECTION
L	LENGTH OF FLOWPATH (FT)		
Q_{10}	10-YR STORM EVENT PEAK FLOW (CFS)		
Q_{100}	100-YR STORM EVENT PEAK FLOW (CFS)		



NORTH

GRAPHIC SCALE

(IN FEET)
1 inch = 20 ft.

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AGENCY STAMP

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CONSULTANT

BKF

REGISTERED PROFESSIONAL ENGINEER
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CIVIL
STATE OF CALIFORNIA

PROJECT NAME

SHANDIN HILLS MENTAL HEALTH REHABILITATION CENTER (MHRC)

FACILITY INFO
SHANDIN HILLS BEHAVIORAL HEALTH CENTER
4164 N 4TH AVE, SAN BERNARDINO, CA 92407

KEY PLAN

PROJECT NORTH

PROJECT ISSUE DATE: 2022/08/19

DATE	NO.	REVISIONS
08/21/2023		CUP SUBMITTAL

DRAFTER: XX
REVIEWER: RD
PM: KJ
DSK JOB NO: 21025

SHEET TITLE

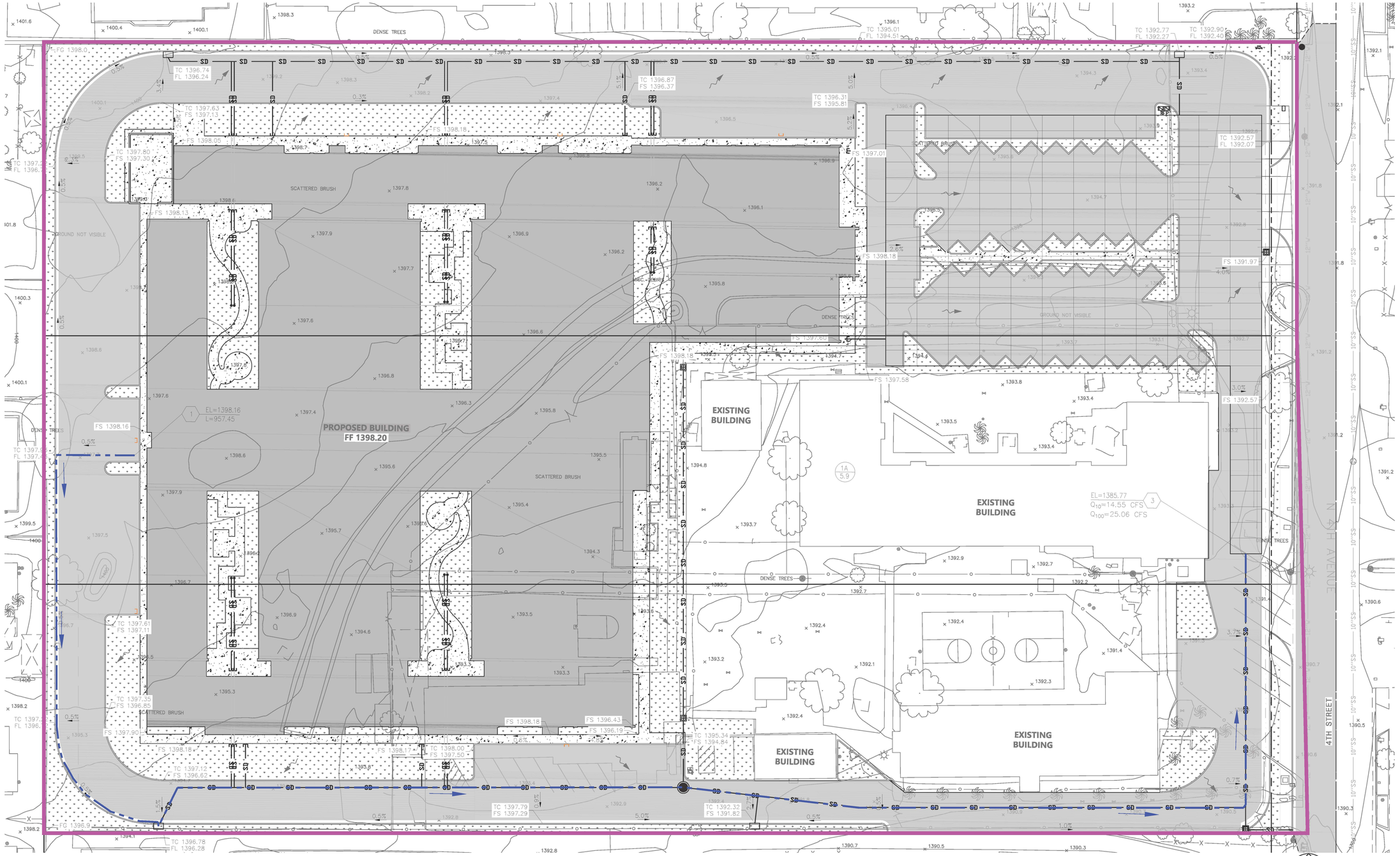
EXISTING CONDITION SMALL AREA UNIT HYDROGRAPH HYDROLOGY MAP

SHEET NUMBER

EXH-01

LEGEND

1A 5.9	AREA DESIGNATION AREA (AC)		DRAINAGE AREA BOUNDARY
1	NODE DESIGNATION		FLOWPATH
EL	ELEVATION (FT)		FLOW DIRECTION
L	LENGTH OF FLOWPATH (FT)	SD SD	PROPOSED STORM DRAIN
Q_{10}	10-YR STORM EVENT PEAK FLOW (CFS)		PROPOSED UNDERGROUND WATER QUALITY AND INFILTRATION BASIN
Q_{100}	100-YR STORM EVENT PEAK FLOW (CFS)		



NORTH

GRAPHIC SCALE

(IN FEET)
1 inch = 20 ft.

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PROJECT NAME

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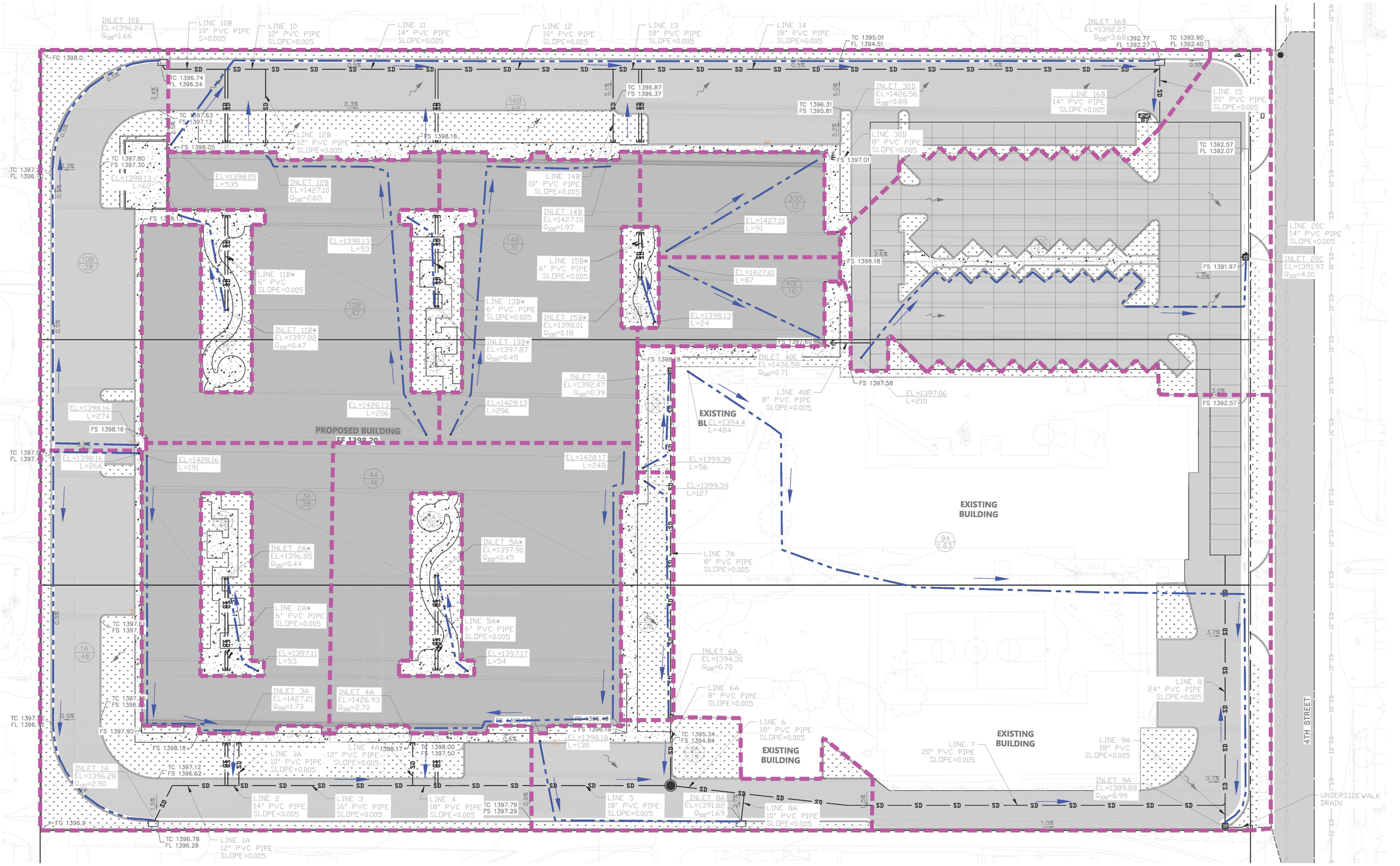
DRAFTER: XX REVIEWER: RD
PM: KJ DSK JOB NO: 21025

SHEET TITLE

PROPOSED SMALL AREA UNIT HYDROGRAPH HYDROLOGY MAP

SHEET NUMBER

EXH-02



LEGEND

1A 5.9	AREA DESIGNATION AREA (AC)
EL	ELEVATION (FT)
L	LENGTH OF FLOWPATH (FT)
Q_{100}	100-YR STORM EVENT PEAK FLOW (CFS)
	DRAINAGE AREA BOUNDARY
	FLOWPATH
	FLOW DIRECTION
SD SD	PROPOSED STORM DRAIN
	PROPOSED UNDERGROUND WATER QUALITY AND INFILTRATION BASIN

*NOTE: INLET AND STORM DRAIN DESIGNATIONS 2A, 5A, 11B, 13B, AND 15B INCLUDE BOTH THE MAINLINE AND THE EMERGENCY OVERFLOW FOR THE INTERIOR LANDSCAPED AREAS.

GRAPHIC SCALE
(IN FEET)
1 inch = 20 ft.

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08/21/2023		CUP SUBMITTAL

DRAFTER: XX
REVIEWER: RD
PM: KJ
DSK JOB NO: 21025

SHEET TITLE
PROPOSED RATIONAL METHOD HYDROLOGY MAP

SHEET NUMBER
EXH-03

6. Technical Appendices

APPENDIX A	Small Area Unit Hydrograph and Basin Routing Calculations
APPENDIX B	Preliminary Onsite Storm Drain Sizing Calculations
APPENDIX C	Geotechnical Report

APPENDIX A: Small Area Unit Hydrograph and Basin Routing Calculations

ACTUAL IMPERVIOUS COVER

Land Use (1)	Range-Percent	Recommended Value For Average Conditions-Percent (2)
Natural or Agriculture	0 - 0	0
Public Park	10 - 25	15
School	30 - 50	40
Single Family Residential: (3)		
2.5 acre lots	5 - 15	10
1 acre lots	10 - 25	20
2 dwellings/acre	20 - 40	30
3-4 dwellings/acre	30 - 50	40
5-7 dwellings/acre	35 - 55	50
8-10 dwellings/acre	50 - 70	60
More than 10 dwellings/acre	65 - 90	80
Multiple Family Residential:		
Condominiums	45 - 70	65
Apartments	65 - 90	80
Mobile Home Park	60 - 85	75
Commercial, Downtown Business or Industrial	80 - 100	90

Notes:

1. Land use should be based on ultimate development of the watershed. Long range master plans for the County and incorporated cities should be reviewed to insure reasonable land use assumptions.

2. Recommended values are based on average conditions which may not apply to a particular study area. The percentage impervious may vary greatly even on comparable sized lots due to differences in dwelling size, improvements, etc. Landscape practices should also be considered as it is common in some areas to use ornamental gravels underlain by impervious plastic materials in place of lawns and shrubs. A field investigation of a study area shall always be made, and a review of aerial photos, where available, may assist in estimating the percentage of impervious cover in developed areas.

3. For typical equestrian subdivisions increase impervious area 5 percent over the values recommended in the table above.

SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

ACTUAL IMPERVIOUS COVER FOR DEVELOPED AREAS

Figure C-4

Curve (1) Numbers of Hydrologic Soil-Cover Complexes For Pervious Areas-AMC II

Cover Type (3)	Quality of Cover (2)	Soil Group A	B	C	D
NATURAL COVERS -					
Barren (Rockland, eroded and graded land)		78	86	91	93
Chaparral, Broadleaf (Manzonita, ceanothus and scrub oak)	Poor	53	70	80	85
	Fair	40	63	75	81
	Good	31	57	71	78
Chaparral, Narrowleaf (Chamise and redshank)	Poor	71	82	88	91
	Fair	55	72	81	86
Grass, Annual or Perennial	Poor	67	78	86	89
	Fair	50	69	79	84
	Good	38	61	74	80
Meadows or Cienegas (Areas with seasonally high water table, principal vegetation is sod forming grass)	Poor	63	77	85	88
	Fair	51	70	80	84
	Good	30	58	71	78
Open Brush (Soft wood shrubs - buckwheat, sage, etc.)	Poor	62	76	84	88
	Fair	46	66	77	83
	Good	41	63	75	81
Woodland (Coniferous or broadleaf trees predominate. Canopy density is at least 50 percent.)	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	25	55	70	77
Woodland, Grass (Coniferous or broadleaf trees with canopy density from 20 to 50 percent)	Poor	57	73	82	86
	Fair	44	65	77	82
	Good	33	58	72	79
URBAN COVERS -					
Residential or Commercial Landscaping (Lawn, shrubs, etc.)	Good	32	56	69	75
Turf (Irrigated and mowed grass)	Poor	58	74	83	87
	Fair	44	65	77	82
	Good	33	58	72	79
AGRICULTURAL COVERS -					
Fallow (Land plowed but not tilled or seeded)		77	86	91	94

SAN BERNARDINO COUNTY

HYDROLOGY MANUAL

CURVE NUMBERS FOR PERVIOUS AREAS

Figure C-3 (1 of 2)



Map Scale: 1:1,120 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 15 30 60 90

Feet
0 50 100 200 300

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 14, Sep 6, 2022

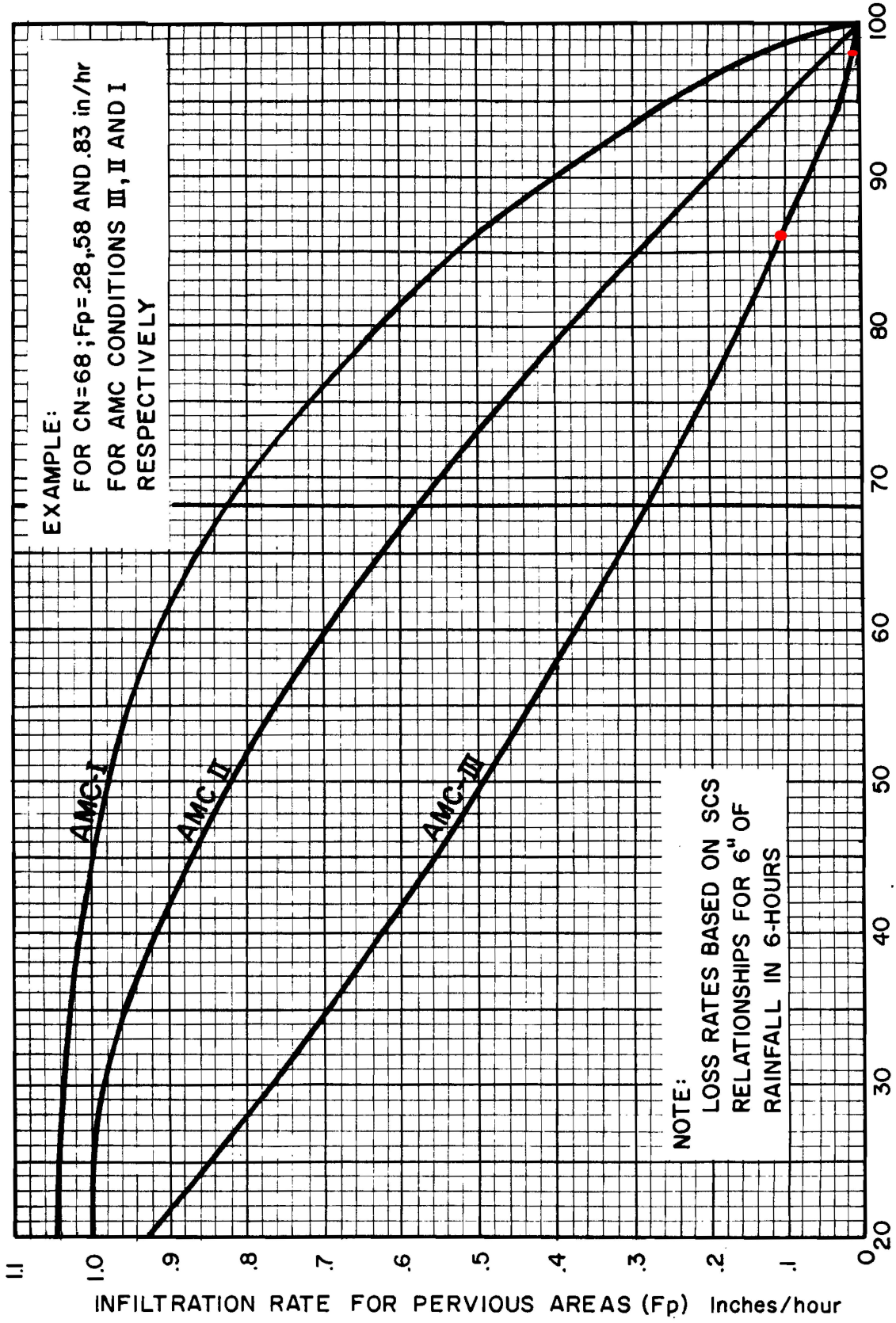
Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 17, 2022—Jun 12, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background 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
TuB	Tujunga loamy sand, 0 to 5 percent slopes	0.3	4.5%
TvC	Tujunga gravelly loamy sand, 0 to 9 percent slopes	6.0	95.5%
Totals for Area of Interest		**6.3**	**100.0%**



SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

INFILTRATION RATE FOR PERVIOUS AREAS VERSUS SCS CURVE NUMBERS

Figure C-6

NOAA Atlas 14, Volume 6, Version 2
Location name: San Bernardino, California, USA*
Latitude: 34.1706°, Longitude: -117.3104°
Elevation: 1393.32 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	0.136 (0.113-0.165)	0.180 (0.149-0.219)	0.242 (0.200-0.295)	0.296 (0.243-0.364)	0.374 (0.297-0.476)	0.438 (0.340-0.570)	0.507 (0.384-0.677)	0.583 (0.429-0.800)	0.694 (0.489-0.993)	0.786 (0.536-1.17)
10-min	0.194 (0.161-0.236)	0.258 (0.214-0.314)	0.347 (0.287-0.423)	0.424 (0.348-0.521)	0.536 (0.425-0.682)	0.628 (0.488-0.817)	0.727 (0.551-0.970)	0.836 (0.615-1.15)	0.994 (0.702-1.42)	1.13 (0.768-1.67)
15-min	0.235 (0.195-0.285)	0.312 (0.259-0.379)	0.419 (0.347-0.512)	0.513 (0.421-0.631)	0.648 (0.514-0.825)	0.759 (0.590-0.988)	0.879 (0.666-1.17)	1.01 (0.744-1.39)	1.20 (0.848-1.72)	1.36 (0.928-2.02)
30-min	0.349 (0.290-0.424)	0.464 (0.385-0.564)	0.624 (0.516-0.761)	0.762 (0.626-0.938)	0.963 (0.764-1.23)	1.13 (0.877-1.47)	1.31 (0.990-1.74)	1.50 (1.11-2.06)	1.79 (1.26-2.56)	2.03 (1.38-3.01)
60-min	0.525 (0.436-0.638)	0.697 (0.579-0.848)	0.937 (0.776-1.14)	1.15 (0.940-1.41)	1.45 (1.15-1.84)	1.70 (1.32-2.21)	1.97 (1.49-2.62)	2.26 (1.66-3.10)	2.69 (1.90-3.85)	3.05 (2.08-4.52)
2-hr	0.769 (0.639-0.935)	0.987 (0.819-1.20)	1.29 (1.06-1.57)	1.54 (1.26-1.89)	1.90 (1.51-2.42)	2.19 (1.70-2.85)	2.50 (1.89-3.33)	2.83 (2.08-3.88)	3.30 (2.33-4.73)	3.69 (2.51-5.47)
3-hr	0.944 (0.784-1.15)	1.20 (0.993-1.46)	1.54 (1.27-1.88)	1.83 (1.50-2.25)	2.23 (1.77-2.84)	2.55 (1.98-3.32)	2.89 (2.19-3.86)	3.25 (2.40-4.47)	3.76 (2.66-5.39)	4.18 (2.85-6.19)
6-hr	1.35 (1.13-1.64)	1.70 (1.41-2.07)	2.16 (1.79-2.63)	2.54 (2.09-3.13)	3.07 (2.44-3.91)	3.48 (2.70-4.53)	3.91 (2.96-5.22)	4.36 (3.21-5.98)	4.98 (3.51-7.13)	5.47 (3.73-8.12)
12-hr	1.78 (1.48-2.16)	2.25 (1.87-2.74)	2.87 (2.38-3.50)	3.37 (2.77-4.15)	4.06 (3.22-5.17)	4.59 (3.57-5.97)	5.13 (3.89-6.84)	5.69 (4.19-7.80)	6.44 (4.55-9.23)	7.03 (4.79-10.4)
24-hr	2.36 (2.09-2.71)	3.04 (2.69-3.51)	3.93 (3.47-4.55)	4.65 (4.07-5.42)	5.62 (4.76-6.77)	6.36 (5.28-7.83)	7.11 (5.76-8.96)	7.88 (6.21-10.2)	8.91 (6.74-12.0)	9.71 (7.10-13.5)
2-day	2.86 (2.53-3.29)	3.77 (3.34-4.35)	4.96 (4.38-5.74)	5.93 (5.19-6.91)	7.24 (6.13-8.72)	8.24 (6.84-10.1)	9.25 (7.50-11.7)	10.3 (8.11-13.3)	11.7 (8.85-15.8)	12.8 (9.36-17.9)
3-day	3.06 (2.71-3.53)	4.10 (3.63-4.73)	5.47 (4.83-6.33)	6.59 (5.76-7.68)	8.10 (6.87-9.76)	9.27 (7.70-11.4)	10.5 (8.48-13.2)	11.7 (9.22-15.1)	13.4 (10.1-18.0)	14.7 (10.7-20.5)
4-day	3.24 (2.87-3.73)	4.39 (3.88-5.06)	5.90 (5.21-6.83)	7.14 (6.25-8.32)	8.84 (7.48-10.6)	10.1 (8.42-12.5)	11.5 (9.31-14.5)	12.9 (10.2-16.7)	14.8 (11.2-19.9)	16.3 (11.9-22.7)
7-day	3.63 (3.22-4.18)	4.97 (4.40-5.74)	6.76 (5.97-7.82)	8.24 (7.22-9.61)	10.3 (8.72-12.4)	11.9 (9.88-14.6)	13.6 (11.0-17.1)	15.3 (12.1-19.8)	17.7 (13.4-23.9)	19.6 (14.3-27.4)
10-day	4.00 (3.54-4.61)	5.51 (4.87-6.35)	7.54 (6.65-8.72)	9.23 (8.08-10.8)	11.6 (9.82-14.0)	13.5 (11.2-16.6)	15.4 (12.5-19.4)	17.5 (13.8-22.6)	20.3 (15.4-27.4)	22.6 (16.5-31.5)
20-day	5.00 (4.43-5.76)	6.98 (6.17-8.05)	9.66 (8.52-11.2)	11.9 (10.4-13.9)	15.1 (12.8-18.2)	17.6 (14.6-21.7)	20.3 (16.4-25.6)	23.1 (18.2-29.9)	27.1 (20.5-36.5)	30.3 (22.2-42.3)
30-day	5.89 (5.22-6.78)	8.24 (7.29-9.51)	11.4 (10.1-13.2)	14.1 (12.4-16.5)	18.0 (15.2-21.6)	21.0 (17.4-25.8)	24.2 (19.6-30.5)	27.6 (21.8-35.8)	32.5 (24.6-43.8)	36.4 (26.6-50.7)
45-day	7.14 (6.33-8.23)	9.94 (8.79-11.5)	13.8 (12.1-15.9)	17.0 (14.9-19.8)	21.5 (18.2-25.9)	25.2 (20.9-31.0)	29.0 (23.5-36.5)	33.1 (26.1-42.9)	38.9 (29.4-52.4)	43.6 (31.9-60.8)
60-day	8.35 (7.40-9.62)	11.5 (10.2-13.3)	15.8 (13.9-18.3)	19.4 (17.0-22.7)	24.6 (20.8-29.6)	28.7 (23.8-35.3)	33.0 (26.7-41.6)	37.6 (29.6-48.7)	44.1 (33.4-59.5)	49.4 (36.1-68.9)

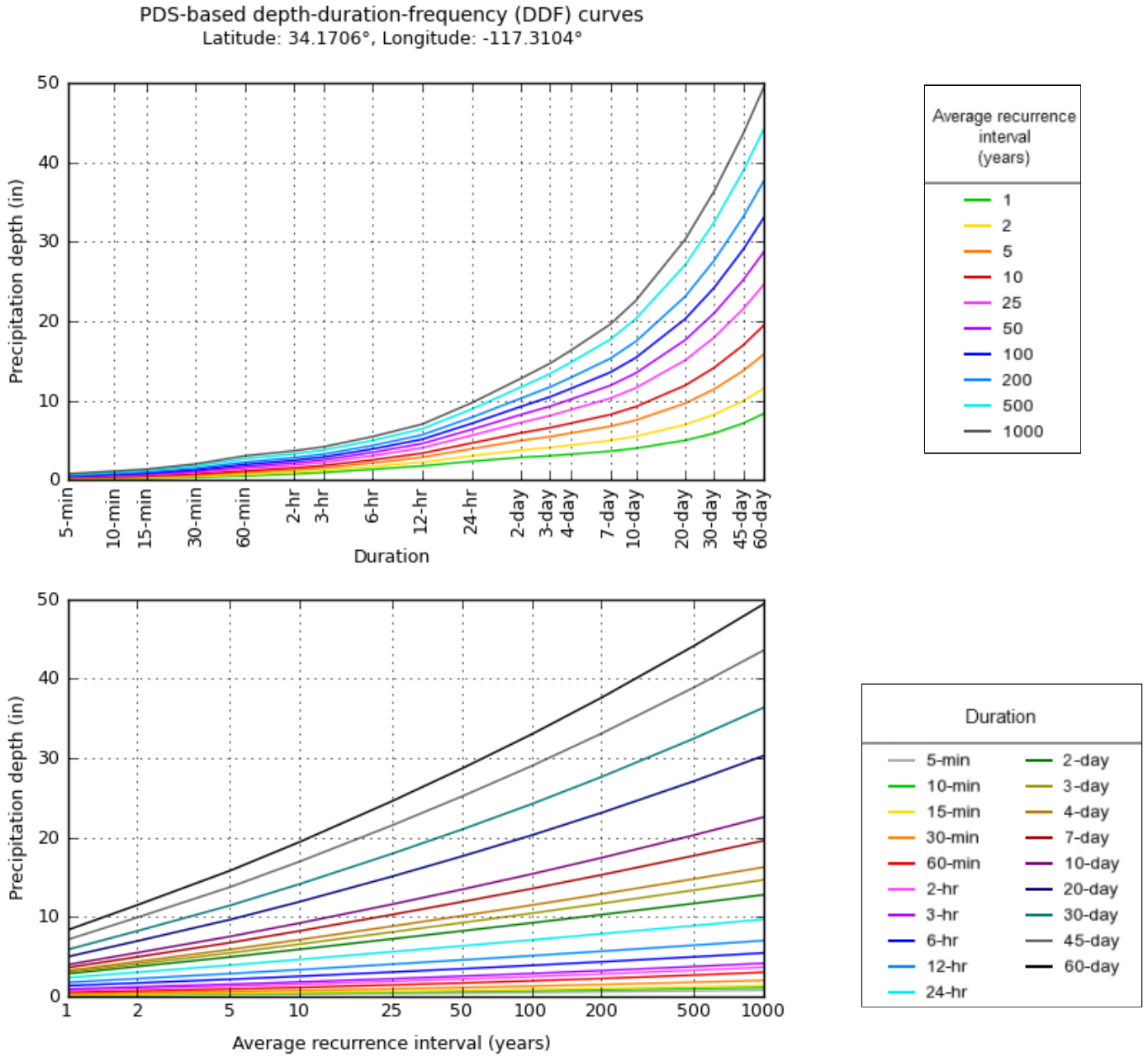
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

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

Please refer to NOAA Atlas 14 document for more information.

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PF graphical



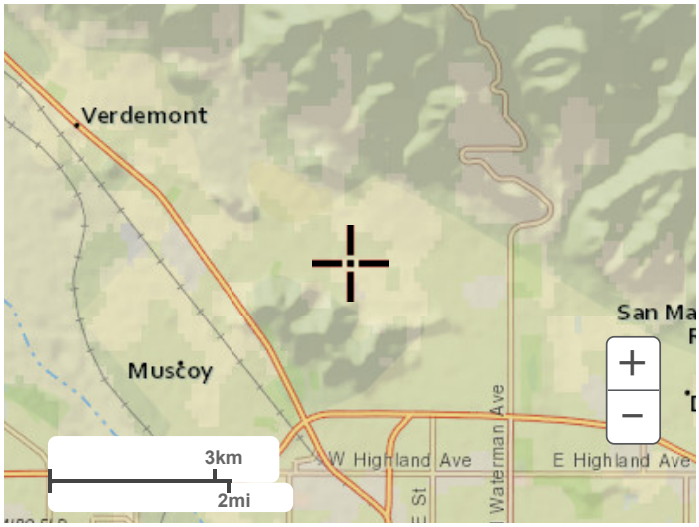
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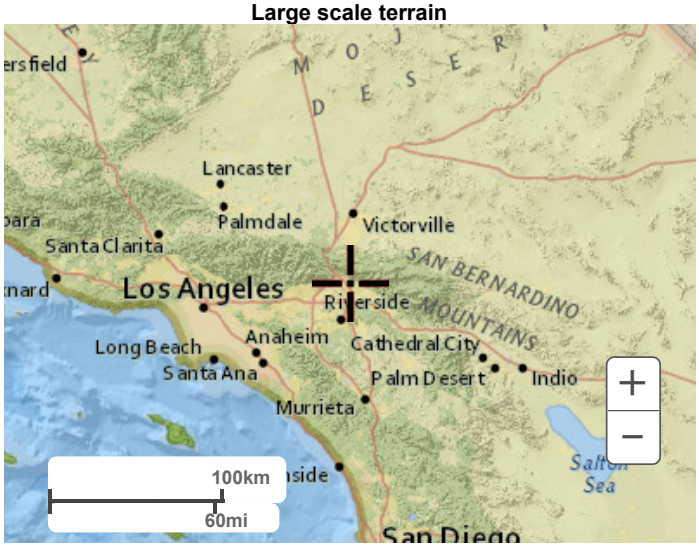
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Maps & aerials

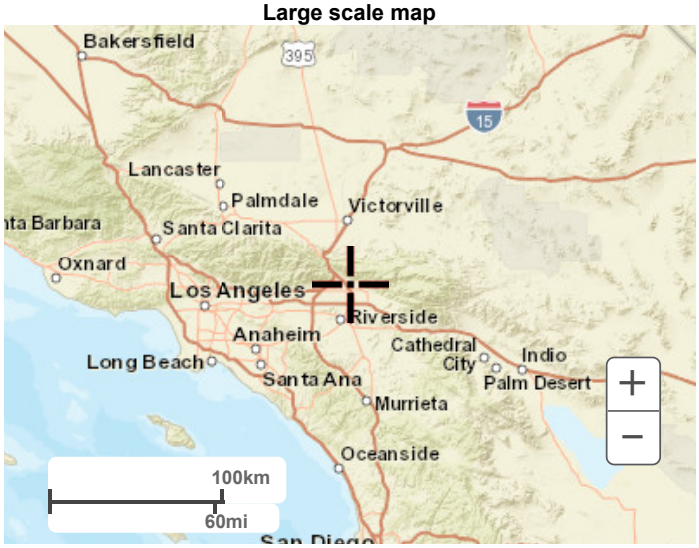
Small scale terrain



Large scale terrain



Large scale map



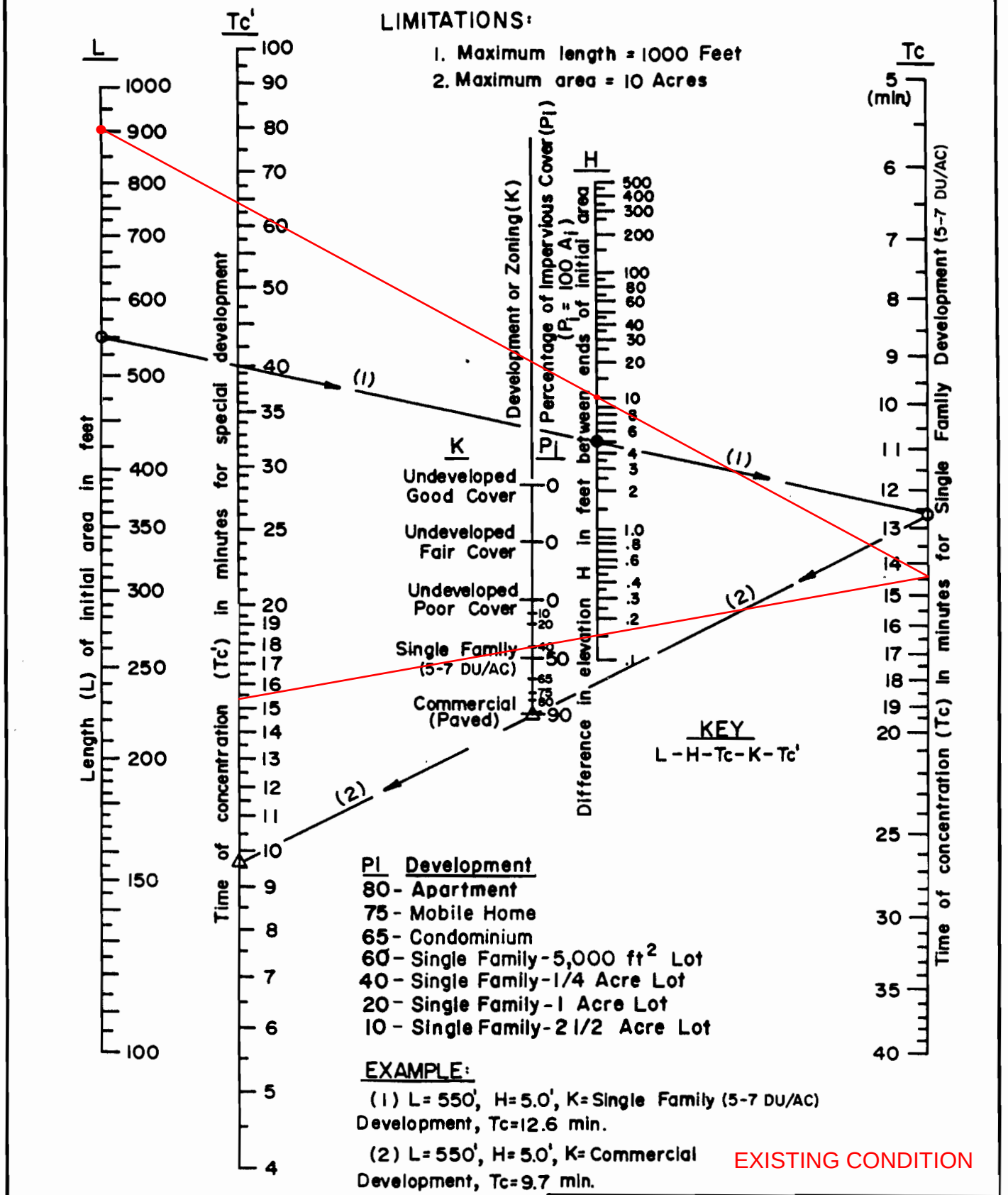
Large scale aerial



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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

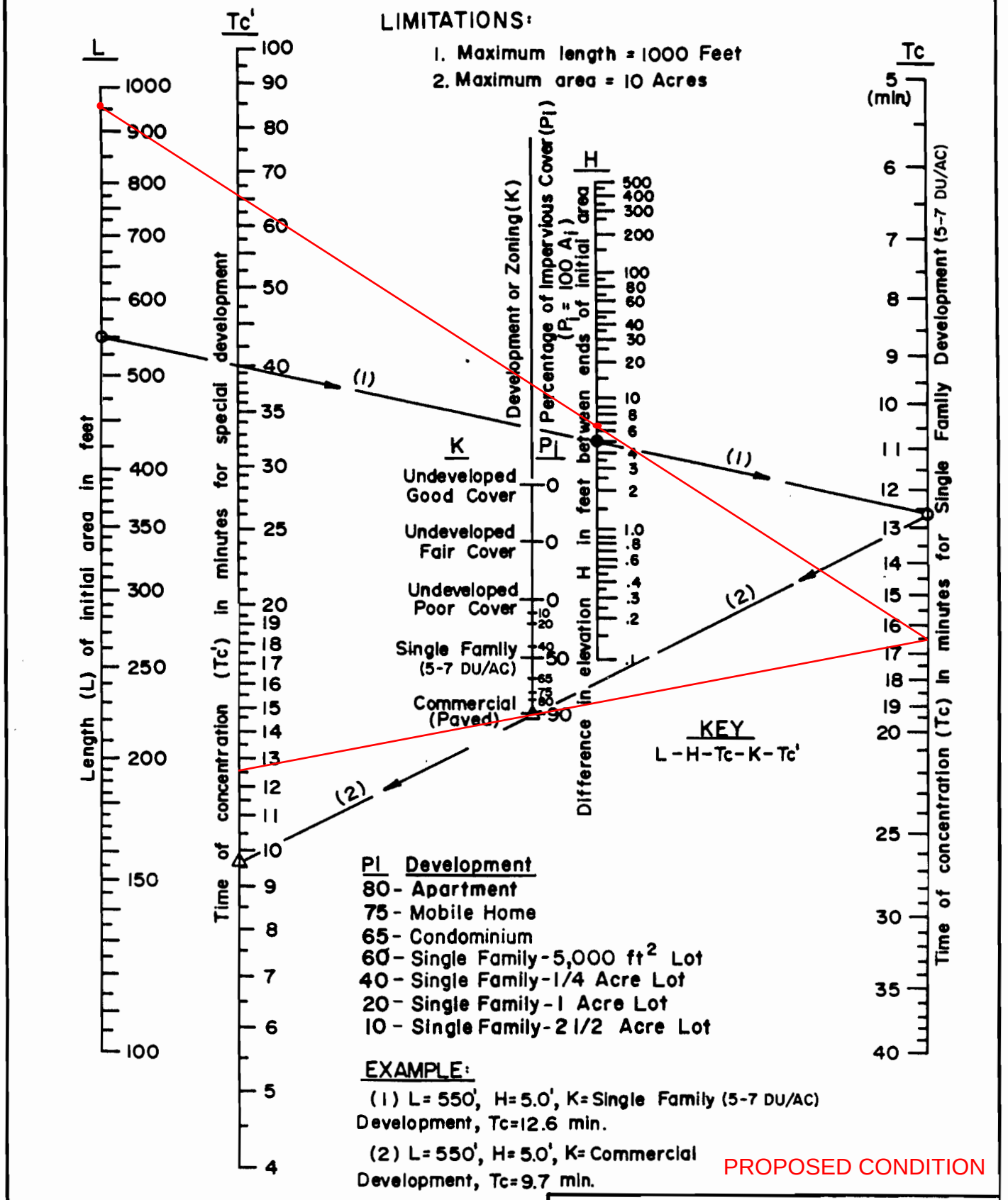
Disclaimer



SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

Figure D-1



SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

Figure D-1

SAUH CALCULATIONS: EXISTING 2YR

```
**************************************************************************
                     SMALL AREA UNIT HYDROGRAPH MODEL
==========================================================================
         (C) Copyright 1989-2016 Advanced Engineering Software (aes)
             Ver. 23.0  Release Date: 07/01/2016  License ID 1676

                          Analysis prepared by:




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

 Problem Descriptions:
  SHANDIN MHRC
  SMALL AREA UNIT HYDROGRAPH
  2 YR EXISTING
--------------------------------------------------------------------------


    RATIONAL METHOD CALIBRATION COEFFICIENT = 1.00
    TOTAL CATCHMENT AREA(ACRES) =    5.95
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.100
    LOW LOSS FRACTION = 0.239
    TIME OF CONCENTRATION(MIN.) = 15.40
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    USER SPECIFIED RAINFALL VALUES ARE USED
    RETURN FREQUENCY(YEARS) =   2
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.18
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.46
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  0.70
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  1.20
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  1.70
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  3.04

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

    TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     1.17
    TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     0.33

**************************************************************************
  TIME     VOLUME       Q    0.        2.5       5.0       7.5      10.0
 (HOURS)    (AF)      (CFS)
--------------------------------------------------------------------------
  0.09      0.0000      0.00  Q         .         .         .         .
  0.34      0.0026      0.24  Q         .         .         .         .
  0.60      0.0077      0.24  Q         .         .         .         .
  0.86      0.0129      0.25  Q         .         .         .         .
  1.11      0.0182      0.25  Q         .         .         .         .
  1.37      0.0235      0.25  .Q        .         .         .         .
  1.63      0.0288      0.25  .Q        .         .         .         .
  1.88      0.0342      0.26  .Q        .         .         .         .
  2.14      0.0397      0.26  .Q        .         .         .         .
  2.40      0.0452      0.26  .Q        .         .         .         .
  2.65      0.0508      0.26  .Q        .         .         .         .
  2.91      0.0565      0.27  .Q        .         .         .         .
  3.17      0.0622      0.27  .Q        .         .         .         .
```

3.42	0.0679	0.27	.Q	.	.	.	.
3.68	0.0738	0.28	.Q	.	.	.	.
3.94	0.0797	0.28	.Q	.	.	.	.
4.19	0.0857	0.28	.Q	.	.	.	.
4.45	0.0917	0.29	.Q	.	.	.	.
4.71	0.0979	0.29	.Q	.	.	.	.
4.96	0.1041	0.30	.Q	.	.	.	.
5.22	0.1104	0.30	.Q	.	.	.	.
5.48	0.1168	0.30	.Q	.	.	.	.
5.73	0.1233	0.31	.Q	.	.	.	.
5.99	0.1298	0.31	.Q	.	.	.	.
6.25	0.1365	0.32	.Q	.	.	.	.
6.50	0.1433	0.32	.Q	.	.	.	.
6.76	0.1501	0.33	.Q	.	.	.	.
7.02	0.1571	0.33	.Q	.	.	.	.
7.27	0.1642	0.34	.Q	.	.	.	.
7.53	0.1714	0.34	.Q	.	.	.	.
7.79	0.1788	0.35	.Q	.	.	.	.
8.04	0.1862	0.36	.Q	.	.	.	.
8.30	0.1938	0.36	.Q	.	.	.	.
8.56	0.2016	0.37	.Q	.	.	.	.
8.81	0.2095	0.38	.Q	.	.	.	.
9.07	0.2176	0.39	.Q	.	.	.	.
9.33	0.2258	0.39	.Q	.	.	.	.
9.58	0.2342	0.40	.Q	.	.	.	.
9.84	0.2428	0.41	.Q	.	.	.	.
10.10	0.2516	0.42	.Q	.	.	.	.
10.35	0.2606	0.43	.Q	.	.	.	.
10.61	0.2699	0.44	.Q	.	.	.	.
10.87	0.2794	0.45	.Q	.	.	.	.
11.12	0.2892	0.47	.Q	.	.	.	.
11.38	0.2993	0.48	.Q	.	.	.	.
11.64	0.3097	0.50	. Q	.	.	.	.
11.89	0.3204	0.51	. Q	.	.	.	.
12.15	0.3319	0.58	. Q	.	.	.	.
12.41	0.3450	0.66	. Q	.	.	.	.
12.66	0.3593	0.69	. Q	.	.	.	.
12.92	0.3741	0.71	. Q	.	.	.	.
13.18	0.3894	0.74	. Q	.	.	.	.
13.43	0.4055	0.77	. Q	.	.	.	.
13.69	0.4223	0.82	. Q	.	.	.	.
13.95	0.4399	0.85	. Q	.	.	.	.
14.20	0.4586	0.91	. Q	.	.	.	.
14.46	0.4782	0.95	. Q	.	.	.	.
14.72	0.4994	1.05	. Q	.	.	.	.
14.97	0.5225	1.12	. Q	.	.	.	.
15.23	0.5483	1.31	. Q	.	.	.	.
15.49	0.5776	1.45	. Q	.	.	.	.
15.74	0.6179	2.34	. Q.	.	.	.	.
16.00	0.6720	2.77	. .Q	.	.	.	.
16.26	0.7753	6.97	. .	.	.	Q	.
16.51	0.8695	1.91	. Q	.	.	.	.
16.77	0.9026	1.21	. Q	.	.	.	.
17.03	0.9259	0.99	. Q	.	.	.	.
17.28	0.9458	0.88	. Q	.	.	.	.
17.54	0.9635	0.79	. Q	.	.	.	.
17.80	0.9796	0.72	. Q	.	.	.	.
18.05	0.9944	0.67	. Q	.	.	.	.
18.31	1.0071	0.52	. Q	.	.	.	.
18.57	1.0178	0.49	.Q	.	.	.	.
18.82	1.0279	0.46	.Q	.	.	.	.

19.08	1.0374	0.44	.Q	.	.	.	.
19.34	1.0465	0.42	.Q	.	.	.	.
19.59	1.0551	0.40	.Q	.	.	.	.
19.85	1.0633	0.38	.Q	.	.	.	.
20.11	1.0712	0.37	.Q	.	.	.	.
20.36	1.0788	0.35	.Q	.	.	.	.
20.62	1.0862	0.34	.Q	.	.	.	.
20.88	1.0933	0.33	.Q	.	.	.	.
21.13	1.1001	0.32	.Q	.	.	.	.
21.39	1.1068	0.31	.Q	.	.	.	.
21.65	1.1133	0.30	.Q	.	.	.	.
21.90	1.1196	0.29	.Q	.	.	.	.
22.16	1.1257	0.29	.Q	.	.	.	.
22.42	1.1317	0.28	.Q	.	.	.	.
22.67	1.1375	0.27	.Q	.	.	.	.
22.93	1.1433	0.27	.Q	.	.	.	.
23.19	1.1488	0.26	.Q	.	.	.	.
23.44	1.1543	0.26	.Q	.	.	.	.
23.70	1.1597	0.25	Q	.	.	.	.
23.96	1.1649	0.25	Q	.	.	.	.
24.21	1.1701	0.24	Q	.	.	.	.
24.47	1.1726	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 Peak Flow Rate	Duration (minutes)
0%	1447.6
10%	308.0
20%	77.0
30%	46.2
40%	15.4
50%	15.4
60%	15.4
70%	15.4
80%	15.4
90%	15.4

SAUH CALCULATIONS: PROPOSED 2YR

```
**************************************************************************
                      SMALL AREA UNIT HYDROGRAPH MODEL
==========================================================================
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             Ver. 23.0  Release Date: 07/01/2016  License ID 1676

                           Analysis prepared by:




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

 Problem Descriptions:
  SHANDIN MHRC
  SMALL AREA UNIT HYDROGRAPH
  2 YR PROPOSED
--------------------------------------------------------------------------


    RATIONAL METHOD CALIBRATION COEFFICIENT = 1.00
    TOTAL CATCHMENT AREA(ACRES) =    5.95
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.002
    LOW LOSS FRACTION = 0.076
    TIME OF CONCENTRATION(MIN.) = 11.00
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    USER SPECIFIED RAINFALL VALUES ARE USED
    RETURN FREQUENCY(YEARS) =   2
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.18
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.46
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  0.70
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  1.20
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  1.70
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  3.04

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

    TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     1.47
    TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     0.04

**************************************************************************
  TIME     VOLUME       Q    0.        2.5       5.0       7.5      10.0
 (HOURS)    (AF)      (CFS)
--------------------------------------------------------------------------
  0.05      0.0000      0.00  Q         .         .         .         .
  0.23      0.0023      0.30  .Q        .         .         .         .
  0.42      0.0069      0.31  .Q        .         .         .         .
  0.60      0.0116      0.31  .Q        .         .         .         .
  0.78      0.0163      0.31  .Q        .         .         .         .
  0.97      0.0211      0.31  .Q        .         .         .         .
  1.15      0.0258      0.32  .Q        .         .         .         .
  1.33      0.0306      0.32  .Q        .         .         .         .
  1.52      0.0355      0.32  .Q        .         .         .         .
  1.70      0.0404      0.32  .Q        .         .         .         .
  1.88      0.0453      0.33  .Q        .         .         .         .
  2.07      0.0502      0.33  .Q        .         .         .         .
  2.25      0.0552      0.33  .Q        .         .         .         .
```

2.43	0.0603	0.33	.Q	.	.	.	.
2.62	0.0653	0.34	.Q	.	.	.	.
2.80	0.0705	0.34	.Q	.	.	.	.
2.98	0.0756	0.34	.Q	.	.	.	.
3.17	0.0808	0.34	.Q	.	.	.	.
3.35	0.0861	0.35	.Q	.	.	.	.
3.53	0.0914	0.35	.Q	.	.	.	.
3.72	0.0967	0.35	.Q	.	.	.	.
3.90	0.1021	0.36	.Q	.	.	.	.
4.08	0.1075	0.36	.Q	.	.	.	.
4.27	0.1130	0.36	.Q	.	.	.	.
4.45	0.1185	0.37	.Q	.	.	.	.
4.63	0.1241	0.37	.Q	.	.	.	.
4.82	0.1298	0.37	.Q	.	.	.	.
5.00	0.1355	0.38	.Q	.	.	.	.
5.18	0.1412	0.38	.Q	.	.	.	.
5.37	0.1470	0.38	.Q	.	.	.	.
5.55	0.1529	0.39	.Q	.	.	.	.
5.73	0.1588	0.39	.Q	.	.	.	.
5.92	0.1648	0.40	.Q	.	.	.	.
6.10	0.1709	0.40	.Q	.	.	.	.
6.28	0.1770	0.41	.Q	.	.	.	.
6.47	0.1832	0.41	.Q	.	.	.	.
6.65	0.1895	0.42	.Q	.	.	.	.
6.83	0.1958	0.42	.Q	.	.	.	.
7.02	0.2022	0.43	.Q	.	.	.	.
7.20	0.2087	0.43	.Q	.	.	.	.
7.38	0.2153	0.44	.Q	.	.	.	.
7.57	0.2219	0.44	.Q	.	.	.	.
7.75	0.2286	0.45	.Q	.	.	.	.
7.93	0.2355	0.45	.Q	.	.	.	.
8.12	0.2424	0.46	.Q	.	.	.	.
8.30	0.2494	0.46	.Q	.	.	.	.
8.48	0.2565	0.47	.Q	.	.	.	.
8.67	0.2637	0.48	.Q	.	.	.	.
8.85	0.2710	0.49	.Q	.	.	.	.
9.03	0.2785	0.49	.Q	.	.	.	.
9.22	0.2860	0.50	. Q	.	.	.	.
9.40	0.2937	0.51	. Q	.	.	.	.
9.58	0.3014	0.52	. Q	.	.	.	.
9.77	0.3094	0.53	. Q	.	.	.	.
9.95	0.3174	0.54	. Q	.	.	.	.
10.13	0.3256	0.54	. Q	.	.	.	.
10.32	0.3339	0.56	. Q	.	.	.	.
10.50	0.3424	0.56	. Q	.	.	.	.
10.68	0.3511	0.58	. Q	.	.	.	.
10.87	0.3599	0.59	. Q	.	.	.	.
11.05	0.3690	0.60	. Q	.	.	.	.
11.23	0.3782	0.61	. Q	.	.	.	.
11.42	0.3876	0.63	. Q	.	.	.	.
11.60	0.3972	0.64	. Q	.	.	.	.
11.78	0.4071	0.66	. Q	.	.	.	.
11.97	0.4172	0.67	. Q	.	.	.	.
12.15	0.4284	0.80	. Q	.	.	.	.
12.33	0.4409	0.85	. Q	.	.	.	.
12.52	0.4540	0.88	. Q	.	.	.	.
12.70	0.4675	0.90	. Q	.	.	.	.
12.88	0.4813	0.93	. Q	.	.	.	.
13.07	0.4955	0.95	. Q	.	.	.	.
13.25	0.5102	0.99	. Q	.	.	.	.
13.43	0.5253	1.01	. Q	.	.	.	.

```
 13.62      0.5410      1.06  .   Q     .         .         .         .
 13.80      0.5572      1.08  .   Q     .         .         .         .
 13.98      0.5741      1.14  .   Q     .         .         .         .
 14.17      0.5916      1.17  .   Q     .         .         .         .
 14.35      0.6099      1.24  .   Q     .         .         .         .
 14.53      0.6290      1.29  .    Q    .         .         .         .
 14.72      0.6493      1.40  .    Q    .         .         .         .
 14.90      0.6710      1.46  .    Q    .         .         .         .
 15.08      0.6944      1.63  .     Q   .         .         .         .
 15.27      0.7198      1.74  .     Q   .         .         .         .
 15.45      0.7497      2.21  .       Q .         .         .         .
 15.63      0.7863      2.63  .         Q         .         .         .
 15.82      0.8299      3.13  .          . Q      .         .         .
 16.00      0.8833      3.91  .          .    Q    .         .         .
 16.18      0.9799      8.85  .          .         .         .    Q    .
 16.37      1.0691      2.92  .         .Q         .         .         .
 16.55      1.1053      1.87  .       Q  .         .         .         .
 16.73      1.1311      1.54  .     Q    .         .         .         .
 16.92      1.1529      1.34  .    Q     .         .         .         .
 17.10      1.1721      1.20  .   Q      .         .         .         .
 17.28      1.1896      1.11  .   Q      .         .         .         .
 17.47      1.2059      1.03  .   Q      .         .         .         .
 17.65      1.2210      0.97  .  Q       .         .         .         .
 17.83      1.2352      0.91  .  Q       .         .         .         .
 18.02      1.2487      0.87  .  Q       .         .         .         .
 18.20      1.2605      0.69  . Q        .         .         .         .
 18.38      1.2706      0.65  . Q        .         .         .         .
 18.57      1.2802      0.62  . Q        .         .         .         .
 18.75      1.2895      0.60  . Q        .         .         .         .
 18.93      1.2983      0.57  . Q        .         .         .         .
 19.12      1.3068      0.55  . Q        .         .         .         .
 19.30      1.3150      0.53  . Q        .         .         .         .
 19.48      1.3229      0.51  . Q        .         .         .         .
 19.67      1.3306      0.50  .Q         .         .         .         .
 19.85      1.3380      0.48  .Q         .         .         .         .
 20.03      1.3452      0.47  .Q         .         .         .         .
 20.22      1.3522      0.46  .Q         .         .         .         .
 20.40      1.3590      0.44  .Q         .         .         .         .
 20.58      1.3657      0.43  .Q         .         .         .         .
 20.77      1.3722      0.42  .Q         .         .         .         .
 20.95      1.3785      0.41  .Q         .         .         .         .
 21.13      1.3847      0.40  .Q         .         .         .         .
 21.32      1.3908      0.40  .Q         .         .         .         .
 21.50      1.3967      0.39  .Q         .         .         .         .
 21.68      1.4025      0.38  .Q         .         .         .         .
 21.87      1.4082      0.37  .Q         .         .         .         .
 22.05      1.4138      0.37  .Q         .         .         .         .
 22.23      1.4193      0.36  .Q         .         .         .         .
 22.42      1.4247      0.35  .Q         .         .         .         .
 22.60      1.4300      0.35  .Q         .         .         .         .
 22.78      1.4352      0.34  .Q         .         .         .         .
 22.97      1.4403      0.33  .Q         .         .         .         .
 23.15      1.4453      0.33  .Q         .         .         .         .
 23.33      1.4503      0.32  .Q         .         .         .         .
 23.52      1.4552      0.32  .Q         .         .         .         .
 23.70      1.4600      0.31  .Q         .         .         .         .
 23.88      1.4647      0.31  .Q         .         .         .         .
 24.07      1.4694      0.31  .Q         .         .         .         .
 24.25      1.4717      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 Peak Flow Rate	Duration (minutes)
0%	1441.0
10%	319.0
20%	77.0
30%	44.0
40%	22.0
50%	11.0
60%	11.0
70%	11.0
80%	11.0
90%	11.0

SAUH CALCULATIONS: EXISTING 10YR

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******************************************************************************
                      SMALL AREA UNIT HYDROGRAPH MODEL
==============================================================================
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             Ver. 23.0  Release Date: 07/01/2016  License ID 1676

                           Analysis prepared by:




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

 Problem Descriptions:
  SHANDIN MHRC
  SMALL AREA UNIT HYDROGRAPH
  10 YR EXISTING
------------------------------------------------------------------------------


    RATIONAL METHOD CALIBRATION COEFFICIENT = 1.00
    TOTAL CATCHMENT AREA(ACRES) =    5.95
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.100
    LOW LOSS FRACTION = 0.172
    TIME OF CONCENTRATION(MIN.) = 15.40
    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) =  0.30
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.76
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  1.15
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  1.83
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  2.54
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  4.65

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

    TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     1.95
    TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     0.36

******************************************************************************
  TIME     VOLUME       Q    0.        5.0      10.0      15.0      20.0
 (HOURS)    (AF)      (CFS)
------------------------------------------------------------------------------
  0.09      0.0000      0.00  Q         .         .         .         .
  0.34      0.0044      0.42  Q         .         .         .         .
  0.60      0.0134      0.42  Q         .         .         .         .
  0.86      0.0224      0.43  Q         .         .         .         .
  1.11      0.0314      0.43  Q         .         .         .         .
  1.37      0.0406      0.44  Q         .         .         .         .
  1.63      0.0499      0.44  Q         .         .         .         .
  1.88      0.0592      0.44  Q         .         .         .         .
  2.14      0.0687      0.45  Q         .         .         .         .
  2.40      0.0782      0.45  Q         .         .         .         .
  2.65      0.0878      0.46  Q         .         .         .         .
  2.91      0.0976      0.46  Q         .         .         .         .
  3.17      0.1075      0.47  Q         .         .         .         .
```

3.42	0.1174	0.47	Q	.	.	.	.
3.68	0.1275	0.48	Q	.	.	.	.
3.94	0.1377	0.48	Q	.	.	.	.
4.19	0.1480	0.49	Q	.	.	.	.
4.45	0.1584	0.50	Q	.	.	.	.
4.71	0.1690	0.50	.Q	.	.	.	.
4.96	0.1797	0.51	.Q	.	.	.	.
5.22	0.1906	0.51	.Q	.	.	.	.
5.48	0.2016	0.52	.Q	.	.	.	.
5.73	0.2127	0.53	.Q	.	.	.	.
5.99	0.2240	0.54	.Q	.	.	.	.
6.25	0.2354	0.54	.Q	.	.	.	.
6.50	0.2470	0.55	.Q	.	.	.	.
6.76	0.2588	0.56	.Q	.	.	.	.
7.02	0.2708	0.57	.Q	.	.	.	.
7.27	0.2830	0.58	.Q	.	.	.	.
7.53	0.2953	0.59	.Q	.	.	.	.
7.79	0.3079	0.60	.Q	.	.	.	.
8.04	0.3207	0.61	.Q	.	.	.	.
8.30	0.3337	0.62	.Q	.	.	.	.
8.56	0.3470	0.63	.Q	.	.	.	.
8.81	0.3605	0.64	.Q	.	.	.	.
9.07	0.3743	0.66	.Q	.	.	.	.
9.33	0.3883	0.67	.Q	.	.	.	.
9.58	0.4027	0.69	.Q	.	.	.	.
9.84	0.4174	0.70	.Q	.	.	.	.
10.10	0.4324	0.72	.Q	.	.	.	.
10.35	0.4478	0.73	.Q	.	.	.	.
10.61	0.4635	0.76	.Q	.	.	.	.
10.87	0.4797	0.77	.Q	.	.	.	.
11.12	0.4963	0.80	.Q	.	.	.	.
11.38	0.5134	0.81	.Q	.	.	.	.
11.64	0.5310	0.85	.Q	.	.	.	.
11.89	0.5492	0.87	.Q	.	.	.	.
12.15	0.5683	0.94	.Q	.	.	.	.
12.41	0.5889	1.01	. Q	.	.	.	.
12.66	0.6108	1.06	. Q	.	.	.	.
12.92	0.6335	1.09	. Q	.	.	.	.
13.18	0.6572	1.15	. Q	.	.	.	.
13.43	0.6820	1.19	. Q	.	.	.	.
13.69	0.7080	1.27	. Q	.	.	.	.
13.95	0.7355	1.32	. Q	.	.	.	.
14.20	0.7635	1.33	. Q	.	.	.	.
14.46	0.7920	1.35	. Q	.	.	.	.
14.72	0.8225	1.53	. Q	.	.	.	.
14.97	0.8562	1.64	. Q	.	.	.	.
15.23	0.8944	1.97	. Q	.	.	.	.
15.49	0.9387	2.21	. Q	.	.	.	.
15.74	1.0076	4.29	. Q	.	.	.	.
16.00	1.1053	4.92	. Q.	.	.	.	.
16.26	1.2830	11.83	. .	.	Q	.	.
16.51	1.4460	3.54	. Q	.	.	.	.
16.77	1.5024	1.78	. Q	.	.	.	.
17.03	1.5365	1.43	. Q	.	.	.	.
17.28	1.5663	1.37	. Q	.	.	.	.
17.54	1.5938	1.23	. Q	.	.	.	.
17.80	1.6187	1.12	. Q	.	.	.	.
18.05	1.6414	1.03	. Q	.	.	.	.
18.31	1.6618	0.89	.Q	.	.	.	.
18.57	1.6800	0.83	.Q	.	.	.	.
18.82	1.6971	0.78	.Q	.	.	.	.

19.08	1.7133	0.74	.Q	.	.	.	.
19.34	1.7286	0.71	.Q	.	.	.	.
19.59	1.7433	0.68	.Q	.	.	.	.
19.85	1.7574	0.65	.Q	.	.	.	.
20.11	1.7709	0.62	.Q	.	.	.	.
20.36	1.7839	0.60	.Q	.	.	.	.
20.62	1.7965	0.58	.Q	.	.	.	.
20.88	1.8087	0.56	.Q	.	.	.	.
21.13	1.8205	0.55	.Q	.	.	.	.
21.39	1.8319	0.53	.Q	.	.	.	.
21.65	1.8431	0.52	.Q	.	.	.	.
21.90	1.8539	0.50	.Q	.	.	.	.
22.16	1.8645	0.49	Q	.	.	.	.
22.42	1.8748	0.48	Q	.	.	.	.
22.67	1.8849	0.47	Q	.	.	.	.
22.93	1.8947	0.46	Q	.	.	.	.
23.19	1.9044	0.45	Q	.	.	.	.
23.44	1.9138	0.44	Q	.	.	.	.
23.70	1.9231	0.43	Q	.	.	.	.
23.96	1.9322	0.42	Q	.	.	.	.
24.21	1.9411	0.42	Q	.	.	.	.
24.47	1.9455	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 Peak Flow Rate	Duration (minutes)
0%	1447.6
10%	261.8
20%	61.6
30%	46.2
40%	30.8
50%	15.4
60%	15.4
70%	15.4
80%	15.4
90%	15.4

SAUH CALCULATIONS: PROPOSED 10YR

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**************************************************************************
                    SMALL AREA UNIT HYDROGRAPH MODEL
==========================================================================
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             Ver. 23.0  Release Date: 07/01/2016  License ID 1676

                          Analysis prepared by:




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

 Problem Descriptions:
  SHANDIN MHRC
  SMALL AREA UNIT HYDROGRAPH
  10 YR PROPSED
--------------------------------------------------------------------------


    RATIONAL METHOD CALIBRATION COEFFICIENT = 1.00
    TOTAL CATCHMENT AREA(ACRES) =    5.95
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.002
    LOW LOSS FRACTION = 0.051
    TIME OF CONCENTRATION(MIN.) = 11.00
    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) =  0.30
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.76
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  1.15
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  1.83
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  2.54
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  4.65

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

    TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     2.26
    TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     0.04

**************************************************************************
  TIME     VOLUME       Q    0.        5.0      10.0      15.0      20.0
 (HOURS)    (AF)      (CFS)
--------------------------------------------------------------------------
  0.05      0.0000      0.00  Q         .         .         .         .
  0.23      0.0037      0.49  Q         .         .         .         .
  0.42      0.0112      0.50  Q         .         .         .         .
  0.60      0.0187      0.50  Q         .         .         .         .
  0.78      0.0263      0.50  .Q        .         .         .         .
  0.97      0.0340      0.51  .Q        .         .         .         .
  1.15      0.0417      0.51  .Q        .         .         .         .
  1.33      0.0494      0.51  .Q        .         .         .         .
  1.52      0.0572      0.52  .Q        .         .         .         .
  1.70      0.0651      0.52  .Q        .         .         .         .
  1.88      0.0730      0.53  .Q        .         .         .         .
  2.07      0.0810      0.53  .Q        .         .         .         .
  2.25      0.0890      0.53  .Q        .         .         .         .
```

```
 2.43      0.0971      0.54  .Q        .         .         .         .
 2.62      0.1053      0.54  .Q        .         .         .         .
 2.80      0.1135      0.54  .Q        .         .         .         .
 2.98      0.1218      0.55  .Q        .         .         .         .
 3.17      0.1301      0.55  .Q        .         .         .         .
 3.35      0.1386      0.56  .Q        .         .         .         .
 3.53      0.1471      0.56  .Q        .         .         .         .
 3.72      0.1556      0.57  .Q        .         .         .         .
 3.90      0.1643      0.57  .Q        .         .         .         .
 4.08      0.1730      0.58  .Q        .         .         .         .
 4.27      0.1818      0.58  .Q        .         .         .         .
 4.45      0.1906      0.59  .Q        .         .         .         .
 4.63      0.1996      0.59  .Q        .         .         .         .
 4.82      0.2086      0.60  .Q        .         .         .         .
 5.00      0.2177      0.60  .Q        .         .         .         .
 5.18      0.2269      0.61  .Q        .         .         .         .
 5.37      0.2362      0.62  .Q        .         .         .         .
 5.55      0.2456      0.62  .Q        .         .         .         .
 5.73      0.2551      0.63  .Q        .         .         .         .
 5.92      0.2647      0.64  .Q        .         .         .         .
 6.10      0.2743      0.64  .Q        .         .         .         .
 6.28      0.2841      0.65  .Q        .         .         .         .
 6.47      0.2940      0.65  .Q        .         .         .         .
 6.65      0.3040      0.66  .Q        .         .         .         .
 6.83      0.3141      0.67  .Q        .         .         .         .
 7.02      0.3243      0.68  .Q        .         .         .         .
 7.20      0.3346      0.68  .Q        .         .         .         .
 7.38      0.3451      0.70  .Q        .         .         .         .
 7.57      0.3556      0.70  .Q        .         .         .         .
 7.75      0.3663      0.71  .Q        .         .         .         .
 7.93      0.3772      0.72  .Q        .         .         .         .
 8.12      0.3882      0.73  .Q        .         .         .         .
 8.30      0.3993      0.74  .Q        .         .         .         .
 8.48      0.4106      0.75  .Q        .         .         .         .
 8.67      0.4220      0.76  .Q        .         .         .         .
 8.85      0.4336      0.77  .Q        .         .         .         .
 9.03      0.4454      0.78  .Q        .         .         .         .
 9.22      0.4573      0.80  .Q        .         .         .         .
 9.40      0.4694      0.80  .Q        .         .         .         .
 9.58      0.4817      0.82  .Q        .         .         .         .
 9.77      0.4942      0.83  .Q        .         .         .         .
 9.95      0.5069      0.85  .Q        .         .         .         .
10.13      0.5199      0.86  .Q        .         .         .         .
10.32      0.5330      0.88  .Q        .         .         .         .
10.50      0.5464      0.89  .Q        .         .         .         .
10.68      0.5601      0.91  .Q        .         .         .         .
10.87      0.5740      0.92  .Q        .         .         .         .
11.05      0.5882      0.95  .Q        .         .         .         .
11.23      0.6027      0.96  .Q        .         .         .         .
11.42      0.6174      0.99  .Q        .         .         .         .
11.60      0.6326      1.01  . Q       .         .         .         .
11.78      0.6481      1.04  . Q       .         .         .         .
11.97      0.6639      1.05  . Q       .         .         .         .
12.15      0.6807      1.16  . Q       .         .         .         .
12.33      0.6986      1.20  . Q       .         .         .         .
12.52      0.7171      1.25  . Q       .         .         .         .
12.70      0.7362      1.27  . Q       .         .         .         .
12.88      0.7558      1.32  . Q       .         .         .         .
13.07      0.7760      1.35  . Q       .         .         .         .
13.25      0.7969      1.41  . Q       .         .         .         .
13.43      0.8184      1.44  . Q       .         .         .         .
```

13.62	0.8408	1.51	. Q . . . .
13.80	0.8640	1.55	. Q . . . .
13.98	0.8883	1.65	. Q . . . .
14.17	0.9131	1.63	. Q . . . .
14.35	0.9378	1.63	. Q . . . .
14.53	0.9631	1.70	. Q . . . .
14.72	0.9902	1.87	. Q . . . .
14.90	1.0193	1.97	. Q . . . .
15.08	1.0511	2.23	. Q . . . .
15.27	1.0861	2.40	. Q . . . .
15.45	1.1301	3.40	. Q . . . .
15.63	1.1891	4.39	. Q . . . .
15.82	1.2614	5.16	. Q . . .
16.00	1.3492	6.42	. . Q . .
16.18	1.5081	14.55	. . . Q. .
16.37	1.6551	4.86	. Q. . . .
16.55	1.7117	2.61	. Q . . . .
16.73	1.7473	2.09	. Q . . . .
16.92	1.7766	1.78	. Q . . . .
17.10	1.8020	1.57	. Q . . . .
17.28	1.8260	1.60	. Q . . . .
17.47	1.8493	1.47	. Q . . . .
17.65	1.8709	1.38	. Q . . . .
17.83	1.8911	1.29	. Q . . . .
18.02	1.9102	1.22	. Q . . . .
18.20	1.9276	1.07	. Q . . . .
18.38	1.9435	1.02	. Q . . . .
18.57	1.9586	0.98	.Q . . . .
18.75	1.9731	0.94	.Q . . . .
18.93	1.9870	0.90	.Q . . . .
19.12	2.0004	0.87	.Q . . . .
19.30	2.0133	0.84	.Q . . . .
19.48	2.0258	0.81	.Q . . . .
19.67	2.0380	0.79	.Q . . . .
19.85	2.0497	0.77	.Q . . . .
20.03	2.0612	0.74	.Q . . . .
20.22	2.0723	0.72	.Q . . . .
20.40	2.0831	0.71	.Q . . . .
20.58	2.0937	0.69	.Q . . . .
20.77	2.1041	0.67	.Q . . . .
20.95	2.1142	0.66	.Q . . . .
21.13	2.1240	0.64	.Q . . . .
21.32	2.1337	0.63	.Q . . . .
21.50	2.1432	0.62	.Q . . . .
21.68	2.1525	0.61	.Q . . . .
21.87	2.1616	0.60	.Q . . . .
22.05	2.1705	0.59	.Q . . . .
22.23	2.1793	0.58	.Q . . . .
22.42	2.1880	0.57	.Q . . . .
22.60	2.1965	0.56	.Q . . . .
22.78	2.2048	0.55	.Q . . . .
22.97	2.2130	0.54	.Q . . . .
23.15	2.2211	0.53	.Q . . . .
23.33	2.2291	0.52	.Q . . . .
23.52	2.2370	0.52	.Q . . . .
23.70	2.2447	0.51	.Q . . . .
23.88	2.2524	0.50	.Q . . . .
24.07	2.2599	0.49	Q . . . .
24.25	2.2636	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 Peak Flow Rate	Duration (minutes)
0%	1441.0
10%	242.0
20%	66.0
30%	55.0
40%	22.0
50%	11.0
60%	11.0
70%	11.0
80%	11.0
90%	11.0

SAUH CALCULATIONS: EXISTING 25YR

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**************************************************************************
                     SMALL AREA UNIT HYDROGRAPH MODEL
==========================================================================
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                           Analysis prepared by:




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

 Problem Descriptions:
  SHANDIN MHRC
  SMALL AREA UNIT HYDROGRAPH
  25 YR EXISTING
--------------------------------------------------------------------------


    RATIONAL METHOD CALIBRATION COEFFICIENT = 1.00
    TOTAL CATCHMENT AREA(ACRES) =    5.95
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.100
    LOW LOSS FRACTION = 0.148
    TIME OF CONCENTRATION(MIN.) = 15.40
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    USER SPECIFIED RAINFALL VALUES ARE USED
    RETURN FREQUENCY(YEARS) =  25
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.37
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.96
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  1.45
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  2.23
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  3.07
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  5.62

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

    TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     2.42
    TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     0.37

**************************************************************************
  TIME     VOLUME       Q    0.        5.0      10.0      15.0      20.0
 (HOURS)    (AF)      (CFS)
--------------------------------------------------------------------------
  0.09      0.0000      0.00  Q         .         .         .         .
  0.34      0.0055      0.52  .Q        .         .         .         .
  0.60      0.0166      0.52  .Q        .         .         .         .
  0.86      0.0278      0.53  .Q        .         .         .         .
  1.11      0.0391      0.53  .Q        .         .         .         .
  1.37      0.0505      0.54  .Q        .         .         .         .
  1.63      0.0620      0.54  .Q        .         .         .         .
  1.88      0.0736      0.55  .Q        .         .         .         .
  2.14      0.0854      0.56  .Q        .         .         .         .
  2.40      0.0973      0.56  .Q        .         .         .         .
  2.65      0.1092      0.57  .Q        .         .         .         .
  2.91      0.1214      0.58  .Q        .         .         .         .
  3.17      0.1336      0.58  .Q        .         .         .         .
```

3.42	0.1460	0.59	.Q . . . .
3.68	0.1585	0.59	.Q . . . .
3.94	0.1712	0.60	.Q . . . .
4.19	0.1841	0.61	.Q . . . .
4.45	0.1970	0.62	.Q . . . .
4.71	0.2102	0.62	.Q . . . .
4.96	0.2235	0.63	.Q . . . .
5.22	0.2370	0.64	.Q . . . .
5.48	0.2506	0.65	.Q . . . .
5.73	0.2645	0.66	.Q . . . .
5.99	0.2785	0.67	.Q . . . .
6.25	0.2928	0.67	.Q . . . .
6.50	0.3072	0.69	.Q . . . .
6.76	0.3219	0.69	.Q . . . .
7.02	0.3368	0.71	.Q . . . .
7.27	0.3519	0.72	.Q . . . .
7.53	0.3673	0.73	.Q . . . .
7.79	0.3829	0.74	.Q . . . .
8.04	0.3988	0.76	.Q . . . .
8.30	0.4150	0.77	.Q . . . .
8.56	0.4315	0.79	.Q . . . .
8.81	0.4483	0.80	.Q . . . .
9.07	0.4654	0.82	.Q . . . .
9.33	0.4829	0.83	.Q . . . .
9.58	0.5008	0.85	.Q . . . .
9.84	0.5190	0.87	.Q . . . .
10.10	0.5377	0.89	.Q . . . .
10.35	0.5568	0.91	.Q . . . .
10.61	0.5764	0.94	.Q . . . .
10.87	0.5965	0.96	.Q . . . .
11.12	0.6172	0.99	.Q . . . .
11.38	0.6384	1.01	. Q . . . .
11.64	0.6604	1.05	. Q . . . .
11.89	0.6830	1.08	. Q . . . .
12.15	0.7066	1.15	. Q . . . .
12.41	0.7318	1.22	. Q . . . .
12.66	0.7584	1.28	. Q . . . .
12.92	0.7860	1.32	. Q . . . .
13.18	0.8148	1.40	. Q . . . .
13.43	0.8449	1.44	. Q . . . .
13.69	0.8767	1.55	. Q . . . .
13.95	0.9101	1.61	. Q . . . .
14.20	0.9439	1.57	. Q . . . .
14.46	0.9773	1.58	. Q . . . .
14.72	1.0130	1.79	. Q . . . .
14.97	1.0525	1.94	. Q . . . .
15.23	1.0979	2.34	. Q . . . .
15.49	1.1507	2.64	. Q . . . .
15.74	1.2375	5.54	. .Q . . .
16.00	1.3639	6.38	. . Q . . .
16.26	1.5917	15.11	. . . Q .
16.51	1.8003	4.56	. Q. . . .
16.77	1.8711	2.11	. Q . . . .
17.03	1.9112	1.68	. Q . . . .
17.28	1.9468	1.68	. Q . . . .
17.54	1.9804	1.49	. Q . . . .
17.80	2.0106	1.36	. Q . . . .
18.05	2.0383	1.25	. Q . . . .
18.31	2.0633	1.10	. Q . . . .
18.57	2.0859	1.03	. Q . . . .
18.82	2.1072	0.97	.Q . . . .

19.08	2.1273	0.92	.Q	.	.	.	.
19.34	2.1464	0.88	.Q	.	.	.	.
19.59	2.1647	0.84	.Q	.	.	.	.
19.85	2.1822	0.81	.Q	.	.	.	.
20.11	2.1990	0.78	.Q	.	.	.	.
20.36	2.2152	0.75	.Q	.	.	.	.
20.62	2.2308	0.72	.Q	.	.	.	.
20.88	2.2460	0.70	.Q	.	.	.	.
21.13	2.2606	0.68	.Q	.	.	.	.
21.39	2.2749	0.66	.Q	.	.	.	.
21.65	2.2887	0.64	.Q	.	.	.	.
21.90	2.3022	0.63	.Q	.	.	.	.
22.16	2.3153	0.61	.Q	.	.	.	.
22.42	2.3282	0.60	.Q	.	.	.	.
22.67	2.3407	0.58	.Q	.	.	.	.
22.93	2.3530	0.57	.Q	.	.	.	.
23.19	2.3650	0.56	.Q	.	.	.	.
23.44	2.3767	0.55	.Q	.	.	.	.
23.70	2.3882	0.54	.Q	.	.	.	.
23.96	2.3995	0.53	.Q	.	.	.	.
24.21	2.4106	0.52	.Q	.	.	.	.
24.47	2.4161	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 Peak Flow Rate	Duration (minutes)
0%	1447.6
10%	231.0
20%	61.6
30%	61.6
40%	30.8
50%	15.4
60%	15.4
70%	15.4
80%	15.4
90%	15.4

SAUH CALCULATIONS: PROPOSED 25YR

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**************************************************************************
                     SMALL AREA UNIT HYDROGRAPH MODEL
==========================================================================
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                           Analysis prepared by:




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

 Problem Descriptions:
  SHANDIN MHRC
  SMALL AREA UNIT HYDROGRAPH
  25 YR PROPOSED
--------------------------------------------------------------------------


    RATIONAL METHOD CALIBRATION COEFFICIENT = 1.00
    TOTAL CATCHMENT AREA(ACRES) =    5.95
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.002
    LOW LOSS FRACTION = 0.042
    TIME OF CONCENTRATION(MIN.) = 11.00
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    USER SPECIFIED RAINFALL VALUES ARE USED
    RETURN FREQUENCY(YEARS) =  25
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.37
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.96
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  1.45
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  2.23
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  3.07
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  5.62

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

    TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     2.74
    TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     0.05

**************************************************************************
  TIME     VOLUME       Q    0.        5.0      10.0      15.0      20.0
 (HOURS)    (AF)      (CFS)
--------------------------------------------------------------------------
  0.05      0.0000      0.00  Q         .         .         .         .
  0.23      0.0045      0.60  .Q        .         .         .         .
  0.42      0.0136      0.60  .Q        .         .         .         .
  0.60      0.0228      0.60  .Q        .         .         .         .
  0.78      0.0320      0.61  .Q        .         .         .         .
  0.97      0.0412      0.61  .Q        .         .         .         .
  1.15      0.0506      0.62  .Q        .         .         .         .
  1.33      0.0600      0.62  .Q        .         .         .         .
  1.52      0.0694      0.63  .Q        .         .         .         .
  1.70      0.0790      0.63  .Q        .         .         .         .
  1.88      0.0886      0.64  .Q        .         .         .         .
  2.07      0.0983      0.64  .Q        .         .         .         .
  2.25      0.1080      0.65  .Q        .         .         .         .
```

2.43	0.1178	0.65	.Q	.	.	.	.
2.62	0.1277	0.66	.Q	.	.	.	.
2.80	0.1377	0.66	.Q	.	.	.	.
2.98	0.1478	0.67	.Q	.	.	.	.
3.17	0.1579	0.67	.Q	.	.	.	.
3.35	0.1681	0.68	.Q	.	.	.	.
3.53	0.1784	0.68	.Q	.	.	.	.
3.72	0.1888	0.69	.Q	.	.	.	.
3.90	0.1993	0.69	.Q	.	.	.	.
4.08	0.2099	0.70	.Q	.	.	.	.
4.27	0.2205	0.71	.Q	.	.	.	.
4.45	0.2313	0.71	.Q	.	.	.	.
4.63	0.2421	0.72	.Q	.	.	.	.
4.82	0.2531	0.73	.Q	.	.	.	.
5.00	0.2641	0.73	.Q	.	.	.	.
5.18	0.2753	0.74	.Q	.	.	.	.
5.37	0.2866	0.75	.Q	.	.	.	.
5.55	0.2979	0.76	.Q	.	.	.	.
5.73	0.3094	0.76	.Q	.	.	.	.
5.92	0.3210	0.77	.Q	.	.	.	.
6.10	0.3327	0.78	.Q	.	.	.	.
6.28	0.3446	0.79	.Q	.	.	.	.
6.47	0.3566	0.79	.Q	.	.	.	.
6.65	0.3687	0.80	.Q	.	.	.	.
6.83	0.3809	0.81	.Q	.	.	.	.
7.02	0.3933	0.82	.Q	.	.	.	.
7.20	0.4058	0.83	.Q	.	.	.	.
7.38	0.4185	0.84	.Q	.	.	.	.
7.57	0.4313	0.85	.Q	.	.	.	.
7.75	0.4443	0.86	.Q	.	.	.	.
7.93	0.4574	0.87	.Q	.	.	.	.
8.12	0.4707	0.89	.Q	.	.	.	.
8.30	0.4842	0.89	.Q	.	.	.	.
8.48	0.4979	0.91	.Q	.	.	.	.
8.67	0.5117	0.92	.Q	.	.	.	.
8.85	0.5258	0.94	.Q	.	.	.	.
9.03	0.5400	0.95	.Q	.	.	.	.
9.22	0.5545	0.96	.Q	.	.	.	.
9.40	0.5692	0.97	.Q	.	.	.	.
9.58	0.5841	0.99	.Q	.	.	.	.
9.77	0.5993	1.01	. Q	.	.	.	.
9.95	0.6147	1.03	. Q	.	.	.	.
10.13	0.6303	1.04	. Q	.	.	.	.
10.32	0.6463	1.06	. Q	.	.	.	.
10.50	0.6625	1.08	. Q	.	.	.	.
10.68	0.6790	1.10	. Q	.	.	.	.
10.87	0.6959	1.12	. Q	.	.	.	.
11.05	0.7131	1.15	. Q	.	.	.	.
11.23	0.7306	1.17	. Q	.	.	.	.
11.42	0.7485	1.20	. Q	.	.	.	.
11.60	0.7668	1.22	. Q	.	.	.	.
11.78	0.7856	1.26	. Q	.	.	.	.
11.97	0.8048	1.28	. Q	.	.	.	.
12.15	0.8249	1.38	. Q	.	.	.	.
12.33	0.8461	1.42	. Q	.	.	.	.
12.52	0.8680	1.47	. Q	.	.	.	.
12.70	0.8905	1.50	. Q	.	.	.	.
12.88	0.9137	1.56	. Q	.	.	.	.
13.07	0.9376	1.59	. Q	.	.	.	.
13.25	0.9623	1.67	. Q	.	.	.	.
13.43	0.9879	1.71	. Q	.	.	.	.

13.62	1.0144	1.79	. Q . . . .
13.80	1.0420	1.84	. Q . . . .
13.98	1.0708	1.96	. Q . . . .
14.17	1.1000	1.91	. Q . . . .
14.35	1.1285	1.85	. Q . . . .
14.53	1.1572	1.94	. Q . . . .
14.72	1.1881	2.14	. Q . . . .
14.90	1.2214	2.26	. Q . . . .
15.08	1.2580	2.57	. Q . . . .
15.27	1.2985	2.78	. Q . . . .
15.45	1.3508	4.14	. Q . . . .
15.63	1.4239	5.51	. .Q . . . .
15.82	1.5149	6.52	. . Q . . . .
16.00	1.6258	8.12	. . Q . . . .
16.18	1.8267	18.39	. . . . Q .
16.37	2.0123	6.11	. . Q . . . .
16.55	2.0815	3.03	. Q . . . .
16.73	2.1226	2.40	. Q . . . .
16.92	2.1562	2.03	. Q . . . .
17.10	2.1851	1.78	. Q . . . .
17.28	2.2129	1.90	. Q . . . .
17.47	2.2406	1.75	. Q . . . .
17.65	2.2661	1.63	. Q . . . .
17.83	2.2901	1.53	. Q . . . .
18.02	2.3126	1.45	. Q . . . .
18.20	2.3334	1.30	. Q . . . .
18.38	2.3526	1.24	. Q . . . .
18.57	2.3710	1.18	. Q . . . .
18.75	2.3885	1.13	. Q . . . .
18.93	2.4054	1.09	. Q . . . .
19.12	2.4216	1.05	. Q . . . .
19.30	2.4373	1.02	. Q . . . .
19.48	2.4524	0.98	.Q . . . .
19.67	2.4671	0.95	.Q . . . .
19.85	2.4814	0.93	.Q . . . .
20.03	2.4952	0.90	.Q . . . .
20.22	2.5087	0.88	.Q . . . .
20.40	2.5219	0.86	.Q . . . .
20.58	2.5347	0.84	.Q . . . .
20.77	2.5472	0.82	.Q . . . .
20.95	2.5594	0.80	.Q . . . .
21.13	2.5714	0.78	.Q . . . .
21.32	2.5832	0.77	.Q . . . .
21.50	2.5946	0.75	.Q . . . .
21.68	2.6059	0.74	.Q . . . .
21.87	2.6170	0.72	.Q . . . .
22.05	2.6278	0.71	.Q . . . .
22.23	2.6385	0.70	.Q . . . .
22.42	2.6490	0.69	.Q . . . .
22.60	2.6593	0.67	.Q . . . .
22.78	2.6694	0.66	.Q . . . .
22.97	2.6794	0.65	.Q . . . .
23.15	2.6892	0.64	.Q . . . .
23.33	2.6989	0.63	.Q . . . .
23.52	2.7084	0.62	.Q . . . .
23.70	2.7178	0.62	.Q . . . .
23.88	2.7271	0.61	.Q . . . .
24.07	2.7362	0.60	.Q . . . .
24.25	2.7408	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 Peak Flow Rate	Duration (minutes)
0%	1441.0
10%	209.0
20%	66.0
30%	44.0
40%	22.0
50%	11.0
60%	11.0
70%	11.0
80%	11.0
90%	11.0

SAUH CALCULATIONS: EXISTING 100YR

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**************************************************************************
          NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
                    AND LOW LOSS FRACTION ESTIMATIONS
==========================================================================
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             Ver. 23.0  Release Date: 07/01/2016  License ID 1676

                             Analysis prepared by:




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 Problem Descriptions:
  SHANDIN MHRC
  SMALL AREA UNIT HYDROGRAPH
  100 YR EXISTING
--------------------------------------------------------------------------


    RATIONAL METHOD CALIBRATION COEFFICIENT = 1.00
    TOTAL CATCHMENT AREA(ACRES) =    5.90
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.045
    LOW LOSS FRACTION = 0.120
    TIME OF CONCENTRATION(MIN.) = 15.40
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    USER SPECIFIED RAINFALL VALUES ARE USED
    RETURN FREQUENCY(YEARS) = 100
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.51
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  1.31
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  1.97
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  2.89
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  3.91
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  7.11

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

    TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     3.16
    TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     0.33

**************************************************************************
  TIME     VOLUME       Q    0.        7.5      15.0      22.5      30.0
 (HOURS)    (AF)      (CFS)
--------------------------------------------------------------------------
  0.09      0.0000      0.00  Q         .         .         .         .
  0.34      0.0071      0.67  Q         .         .         .         .
  0.60      0.0213      0.67  Q         .         .         .         .
  0.86      0.0356      0.68  Q         .         .         .         .
  1.11      0.0501      0.68  Q         .         .         .         .
  1.37      0.0647      0.69  Q         .         .         .         .
  1.63      0.0795      0.70  Q         .         .         .         .
  1.88      0.0944      0.71  Q         .         .         .         .
  2.14      0.1094      0.71  Q         .         .         .         .
  2.40      0.1247      0.72  Q         .         .         .         .
  2.65      0.1400      0.73  Q         .         .         .         .
  2.91      0.1556      0.74  Q         .         .         .         .
  3.17      0.1713      0.74  Q         .         .         .         .
  3.42      0.1872      0.75  .Q        .         .         .         .
  3.68      0.2033      0.76  .Q        .         .         .         .
  3.94      0.2195      0.77  .Q        .         .         .         .
  4.19      0.2360      0.78  .Q        .         .         .         .
  4.45      0.2527      0.79  .Q        .         .         .         .
  4.71      0.2695      0.80  .Q        .         .         .         .
  4.96      0.2866      0.81  .Q        .         .         .         .
```

5.22	0.3039	0.82	.Q . . . .
5.48	0.3215	0.83	.Q . . . .
5.73	0.3392	0.84	.Q . . . .
5.99	0.3573	0.86	.Q . . . .
6.25	0.3756	0.87	.Q . . . .
6.50	0.3941	0.88	.Q . . . .
6.76	0.4130	0.89	.Q . . . .
7.02	0.4321	0.91	.Q . . . .
7.27	0.4515	0.92	.Q . . . .
7.53	0.4713	0.94	.Q . . . .
7.79	0.4914	0.95	.Q . . . .
8.04	0.5118	0.98	.Q . . . .
8.30	0.5326	0.99	.Q . . . .
8.56	0.5538	1.01	.Q . . . .
8.81	0.5754	1.03	.Q . . . .
9.07	0.5975	1.05	.Q . . . .
9.33	0.6200	1.07	.Q . . . .
9.58	0.6430	1.10	.Q . . . .
9.84	0.6664	1.12	.Q . . . .
10.10	0.6905	1.15	.Q . . . .
10.35	0.7151	1.17	.Q . . . .
10.61	0.7403	1.21	.Q . . . .
10.87	0.7662	1.23	.Q . . . .
11.12	0.7929	1.28	.Q . . . .
11.38	0.8203	1.30	.Q . . . .
11.64	0.8485	1.36	.Q . . . .
11.89	0.8776	1.39	.Q . . . .
12.15	0.9079	1.46	.Q . . . .
12.41	0.9394	1.51	. Q . . . .
12.66	0.9722	1.59	. Q . . . .
12.92	1.0064	1.63	. Q . . . .
13.18	1.0422	1.74	. Q . . . .
13.43	1.0796	1.80	. Q . . . .
13.69	1.1192	1.93	. Q . . . .
13.95	1.1611	2.02	. Q . . . .
14.20	1.2027	1.90	. Q . . . .
14.46	1.2427	1.87	. Q . . . .
14.72	1.2856	2.18	. Q . . . .
14.97	1.3339	2.38	. Q . . . .
15.23	1.3908	2.98	. Q . . . .
15.49	1.4588	3.43	. Q . . . .
15.74	1.5799	7.98	. Q . . .
16.00	1.7617	9.17	. . Q . . .
16.26	2.0804	20.89	. . . Q . .
16.51	2.3720	6.61	. Q . . . .
16.77	2.4702	2.64	. Q . . . .
17.03	2.5195	2.00	. Q . . . .
17.28	2.5632	2.12	. Q . . . .
17.54	2.6055	1.86	. Q . . . .
17.80	2.6431	1.68	. Q . . . .
18.05	2.6773	1.55	. Q . . . .
18.31	2.7088	1.42	.Q . . . .
18.57	2.7380	1.33	.Q . . . .
18.82	2.7654	1.25	.Q . . . .
19.08	2.7913	1.19	.Q . . . .
19.34	2.8160	1.13	.Q . . . .
19.59	2.8395	1.08	.Q . . . .
19.85	2.8620	1.04	.Q . . . .
20.11	2.8836	1.00	.Q . . . .
20.36	2.9044	0.96	.Q . . . .
20.62	2.9245	0.93	.Q . . . .
20.88	2.9439	0.90	.Q . . . .
21.13	2.9628	0.87	.Q . . . .
21.39	2.9811	0.85	.Q . . . .
21.65	2.9989	0.83	.Q . . . .
21.90	3.0162	0.81	.Q . . . .
22.16	3.0330	0.79	.Q . . . .
22.42	3.0495	0.77	.Q . . . .
22.67	3.0656	0.75	Q . . . .

22.93	3.0813	0.73	Q	.	.	.	.
23.19	3.0967	0.72	Q	.	.	.	.
23.44	3.1117	0.70	Q	.	.	.	.
23.70	3.1265	0.69	Q	.	.	.	.
23.96	3.1410	0.68	Q	.	.	.	.
24.21	3.1552	0.66	Q	.	.	.	.
24.47	3.1623	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 Peak Flow Rate	Duration (minutes)
0%	1447.6
10%	154.0
20%	61.6
30%	61.6
40%	30.8
50%	15.4
60%	15.4
70%	15.4
80%	15.4
90%	15.4

SAUH CALCULATIONS: PROPOSED 100YR

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**************************************************************************
                      SMALL AREA UNIT HYDROGRAPH MODEL
==========================================================================
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                           Analysis prepared by:




**************************************************************************
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 Problem Descriptions:
  SHANDIN MHRC
   SMALL AREA UNIT HYDROGRAPH
  PROPOSED
--------------------------------------------------------------------------


    RATIONAL METHOD CALIBRATION COEFFICIENT = 1.00
    TOTAL CATCHMENT AREA(ACRES) =    5.95
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.002
    LOW LOSS FRACTION = 0.030
    TIME OF CONCENTRATION(MIN.) = 11.00
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    USER SPECIFIED RAINFALL VALUES ARE USED
    RETURN FREQUENCY(YEARS) = 100
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.51
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  1.31
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  1.97
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  2.89
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  3.91
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  7.11

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

    TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     3.47
    TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     0.05

**************************************************************************
  TIME     VOLUME       Q    0.        7.5      15.0      22.5      30.0
 (HOURS)    (AF)      (CFS)
--------------------------------------------------------------------------
  0.05      0.0000      0.00  Q         .         .         .         .
  0.23      0.0057      0.75  Q         .         .         .         .
  0.42      0.0171      0.76  .Q        .         .         .         .
  0.60      0.0286      0.76  .Q        .         .         .         .
  0.78      0.0401      0.77  .Q        .         .         .         .
  0.97      0.0518      0.77  .Q        .         .         .         .
  1.15      0.0635      0.78  .Q        .         .         .         .
  1.33      0.0753      0.78  .Q        .         .         .         .
  1.52      0.0872      0.79  .Q        .         .         .         .
  1.70      0.0992      0.79  .Q        .         .         .         .
  1.88      0.1113      0.80  .Q        .         .         .         .
  2.07      0.1234      0.80  .Q        .         .         .         .
  2.25      0.1357      0.81  .Q        .         .         .         .
```

2.43	0.1480	0.82	.Q	.	.	.	.
2.62	0.1605	0.83	.Q	.	.	.	.
2.80	0.1730	0.83	.Q	.	.	.	.
2.98	0.1857	0.84	.Q	.	.	.	.
3.17	0.1984	0.84	.Q	.	.	.	.
3.35	0.2112	0.85	.Q	.	.	.	.
3.53	0.2242	0.86	.Q	.	.	.	.
3.72	0.2373	0.87	.Q	.	.	.	.
3.90	0.2504	0.87	.Q	.	.	.	.
4.08	0.2637	0.88	.Q	.	.	.	.
4.27	0.2771	0.89	.Q	.	.	.	.
4.45	0.2906	0.90	.Q	.	.	.	.
4.63	0.3043	0.90	.Q	.	.	.	.
4.82	0.3180	0.91	.Q	.	.	.	.
5.00	0.3319	0.92	.Q	.	.	.	.
5.18	0.3460	0.93	.Q	.	.	.	.
5.37	0.3601	0.94	.Q	.	.	.	.
5.55	0.3744	0.95	.Q	.	.	.	.
5.73	0.3889	0.96	.Q	.	.	.	.
5.92	0.4035	0.97	.Q	.	.	.	.
6.10	0.4182	0.98	.Q	.	.	.	.
6.28	0.4331	0.99	.Q	.	.	.	.
6.47	0.4482	1.00	.Q	.	.	.	.
6.65	0.4634	1.01	.Q	.	.	.	.
6.83	0.4788	1.02	.Q	.	.	.	.
7.02	0.4944	1.04	.Q	.	.	.	.
7.20	0.5102	1.04	.Q	.	.	.	.
7.38	0.5261	1.06	.Q	.	.	.	.
7.57	0.5422	1.07	.Q	.	.	.	.
7.75	0.5586	1.09	.Q	.	.	.	.
7.93	0.5751	1.10	.Q	.	.	.	.
8.12	0.5919	1.12	.Q	.	.	.	.
8.30	0.6088	1.13	.Q	.	.	.	.
8.48	0.6260	1.15	.Q	.	.	.	.
8.67	0.6435	1.16	.Q	.	.	.	.
8.85	0.6612	1.18	.Q	.	.	.	.
9.03	0.6791	1.19	.Q	.	.	.	.
9.22	0.6973	1.21	.Q	.	.	.	.
9.40	0.7158	1.23	.Q	.	.	.	.
9.58	0.7346	1.25	.Q	.	.	.	.
9.77	0.7537	1.27	.Q	.	.	.	.
9.95	0.7731	1.29	.Q	.	.	.	.
10.13	0.7928	1.31	.Q	.	.	.	.
10.32	0.8129	1.34	.Q	.	.	.	.
10.50	0.8334	1.36	.Q	.	.	.	.
10.68	0.8542	1.39	.Q	.	.	.	.
10.87	0.8754	1.41	.Q	.	.	.	.
11.05	0.8971	1.45	.Q	.	.	.	.
11.23	0.9192	1.47	.Q	.	.	.	.
11.42	0.9418	1.51	. Q	.	.	.	.
11.60	0.9649	1.54	. Q	.	.	.	.
11.78	0.9886	1.59	. Q	.	.	.	.
11.97	1.0128	1.61	. Q	.	.	.	.
12.15	1.0377	1.68	. Q	.	.	.	.
12.33	1.0635	1.72	. Q	.	.	.	.
12.52	1.0899	1.78	. Q	.	.	.	.
12.70	1.1172	1.82	. Q	.	.	.	.
12.88	1.1453	1.89	. Q	.	.	.	.
13.07	1.1743	1.93	. Q	.	.	.	.
13.25	1.2043	2.03	. Q	.	.	.	.
13.43	1.2354	2.08	. Q	.	.	.	.

13.62	1.2677	2.19	. Q . . . .
13.80	1.3014	2.25	. Q . . . .
13.98	1.3366	2.40	. Q . . . .
14.17	1.3721	2.29	. Q . . . .
14.35	1.4058	2.15	. Q . . . .
14.53	1.4392	2.25	. Q . . . .
14.72	1.4752	2.50	. Q . . . .
14.90	1.5143	2.66	. Q . . . .
15.08	1.5576	3.05	. Q . . . .
15.27	1.6058	3.31	. Q . . . .
15.45	1.6714	5.34	. Q . . . .
15.63	1.7684	7.46	. Q. . . .
15.82	1.8920	8.85	. .Q . . .
16.00	2.0426	11.03	. . Q . . .
16.18	2.3160	25.06	. . . . Q .
16.37	2.5686	8.29	. .Q . . .
16.55	2.6589	3.64	. Q . . . .
16.73	2.7080	2.84	. Q . . . .
16.92	2.7474	2.37	. Q . . . .
17.10	2.7810	2.06	. Q . . . .
17.28	2.8142	2.32	. Q . . . .
17.47	2.8479	2.13	. Q . . . .
17.65	2.8791	1.98	. Q . . . .
17.83	2.9081	1.85	. Q . . . .
18.02	2.9354	1.75	. Q . . . .
18.20	2.9610	1.64	. Q . . . .
18.38	2.9853	1.56	. Q . . . .
18.57	3.0084	1.49	.Q . . . .
18.75	3.0305	1.43	.Q . . . .
18.93	3.0517	1.37	.Q . . . .
19.12	3.0722	1.33	.Q . . . .
19.30	3.0919	1.28	.Q . . . .
19.48	3.1110	1.24	.Q . . . .
19.67	3.1295	1.20	.Q . . . .
19.85	3.1475	1.17	.Q . . . .
20.03	3.1649	1.14	.Q . . . .
20.22	3.1819	1.11	.Q . . . .
20.40	3.1985	1.08	.Q . . . .
20.58	3.2146	1.05	.Q . . . .
20.77	3.2303	1.03	.Q . . . .
20.95	3.2457	1.01	.Q . . . .
21.13	3.2608	0.98	.Q . . . .
21.32	3.2756	0.96	.Q . . . .
21.50	3.2900	0.94	.Q . . . .
21.68	3.3042	0.93	.Q . . . .
21.87	3.3181	0.91	.Q . . . .
22.05	3.3317	0.89	.Q . . . .
22.23	3.3451	0.88	.Q . . . .
22.42	3.3583	0.86	.Q . . . .
22.60	3.3712	0.85	.Q . . . .
22.78	3.3840	0.83	.Q . . . .
22.97	3.3965	0.82	.Q . . . .
23.15	3.4089	0.81	.Q . . . .
23.33	3.4210	0.80	.Q . . . .
23.52	3.4330	0.79	.Q . . . .
23.70	3.4448	0.77	.Q . . . .
23.88	3.4565	0.76	.Q . . . .
24.07	3.4680	0.75	.Q . . . .
24.25	3.4737	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 Peak Flow Rate	Duration (minutes)
0%	1441.0
10%	121.0
20%	66.0
30%	44.0
40%	22.0
50%	11.0
60%	11.0
70%	11.0
80%	11.0
90%	11.0

INFILTRATION BASIN ROUTING: 2YR

```
**************************************************************************
                     SMALL AREA UNIT HYDROGRAPH MODEL
==========================================================================
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                          Analysis prepared by:




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

 Problem Descriptions:
  SHANDIN MHRC
  INFILTRATION BASIN ROUTING
  2 YR
--------------------------------------------------------------------------


    RATIONAL METHOD CALIBRATION COEFFICIENT = 1.00
    TOTAL CATCHMENT AREA(ACRES) =    5.95
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.002
    LOW LOSS FRACTION = 0.076
    TIME OF CONCENTRATION(MIN.) = 11.00
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    USER SPECIFIED RAINFALL VALUES ARE USED
    RETURN FREQUENCY(YEARS) =   2
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.18
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.46
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  0.70
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  1.20
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  1.70
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  3.04

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

    TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     1.47
    TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     0.04

**************************************************************************
  TIME     VOLUME       Q    0.        2.5       5.0       7.5      10.0
 (HOURS)    (AF)      (CFS)
--------------------------------------------------------------------------
  0.05      0.0000      0.00  Q         .         .         .         .
  0.23      0.0023      0.30  .Q        .         .         .         .
  0.42      0.0069      0.31  .Q        .         .         .         .
  0.60      0.0116      0.31  .Q        .         .         .         .
  0.78      0.0163      0.31  .Q        .         .         .         .
  0.97      0.0211      0.31  .Q        .         .         .         .
  1.15      0.0258      0.32  .Q        .         .         .         .
  1.33      0.0306      0.32  .Q        .         .         .         .
  1.52      0.0355      0.32  .Q        .         .         .         .
  1.70      0.0404      0.32  .Q        .         .         .         .
  1.88      0.0453      0.33  .Q        .         .         .         .
  2.07      0.0502      0.33  .Q        .         .         .         .
  2.25      0.0552      0.33  .Q        .         .         .         .
```

2.43	0.0603	0.33	.Q	.	.	.	.
2.62	0.0653	0.34	.Q	.	.	.	.
2.80	0.0705	0.34	.Q	.	.	.	.
2.98	0.0756	0.34	.Q	.	.	.	.
3.17	0.0808	0.34	.Q	.	.	.	.
3.35	0.0861	0.35	.Q	.	.	.	.
3.53	0.0914	0.35	.Q	.	.	.	.
3.72	0.0967	0.35	.Q	.	.	.	.
3.90	0.1021	0.36	.Q	.	.	.	.
4.08	0.1075	0.36	.Q	.	.	.	.
4.27	0.1130	0.36	.Q	.	.	.	.
4.45	0.1185	0.37	.Q	.	.	.	.
4.63	0.1241	0.37	.Q	.	.	.	.
4.82	0.1298	0.37	.Q	.	.	.	.
5.00	0.1355	0.38	.Q	.	.	.	.
5.18	0.1412	0.38	.Q	.	.	.	.
5.37	0.1470	0.38	.Q	.	.	.	.
5.55	0.1529	0.39	.Q	.	.	.	.
5.73	0.1588	0.39	.Q	.	.	.	.
5.92	0.1648	0.40	.Q	.	.	.	.
6.10	0.1709	0.40	.Q	.	.	.	.
6.28	0.1770	0.41	.Q	.	.	.	.
6.47	0.1832	0.41	.Q	.	.	.	.
6.65	0.1895	0.42	.Q	.	.	.	.
6.83	0.1958	0.42	.Q	.	.	.	.
7.02	0.2022	0.43	.Q	.	.	.	.
7.20	0.2087	0.43	.Q	.	.	.	.
7.38	0.2153	0.44	.Q	.	.	.	.
7.57	0.2219	0.44	.Q	.	.	.	.
7.75	0.2286	0.45	.Q	.	.	.	.
7.93	0.2355	0.45	.Q	.	.	.	.
8.12	0.2424	0.46	.Q	.	.	.	.
8.30	0.2494	0.46	.Q	.	.	.	.
8.48	0.2565	0.47	.Q	.	.	.	.
8.67	0.2637	0.48	.Q	.	.	.	.
8.85	0.2710	0.49	.Q	.	.	.	.
9.03	0.2785	0.49	.Q	.	.	.	.
9.22	0.2860	0.50	. Q	.	.	.	.
9.40	0.2937	0.51	. Q	.	.	.	.
9.58	0.3014	0.52	. Q	.	.	.	.
9.77	0.3094	0.53	. Q	.	.	.	.
9.95	0.3174	0.54	. Q	.	.	.	.
10.13	0.3256	0.54	. Q	.	.	.	.
10.32	0.3339	0.56	. Q	.	.	.	.
10.50	0.3424	0.56	. Q	.	.	.	.
10.68	0.3511	0.58	. Q	.	.	.	.
10.87	0.3599	0.59	. Q	.	.	.	.
11.05	0.3690	0.60	. Q	.	.	.	.
11.23	0.3782	0.61	. Q	.	.	.	.
11.42	0.3876	0.63	. Q	.	.	.	.
11.60	0.3972	0.64	. Q	.	.	.	.
11.78	0.4071	0.66	. Q	.	.	.	.
11.97	0.4172	0.67	. Q	.	.	.	.
12.15	0.4284	0.80	. Q	.	.	.	.
12.33	0.4409	0.85	. Q	.	.	.	.
12.52	0.4540	0.88	. Q	.	.	.	.
12.70	0.4675	0.90	. Q	.	.	.	.
12.88	0.4813	0.93	. Q	.	.	.	.
13.07	0.4955	0.95	. Q	.	.	.	.
13.25	0.5102	0.99	. Q	.	.	.	.
13.43	0.5253	1.01	. Q	.	.	.	.

```
 13.62      0.5410      1.06  .   Q     .         .         .         .
 13.80      0.5572      1.08  .   Q     .         .         .         .
 13.98      0.5741      1.14  .   Q     .         .         .         .
 14.17      0.5916      1.17  .   Q     .         .         .         .
 14.35      0.6099      1.24  .   Q     .         .         .         .
 14.53      0.6290      1.29  .    Q    .         .         .         .
 14.72      0.6493      1.40  .    Q    .         .         .         .
 14.90      0.6710      1.46  .    Q    .         .         .         .
 15.08      0.6944      1.63  .     Q   .         .         .         .
 15.27      0.7198      1.74  .     Q   .         .         .         .
 15.45      0.7497      2.21  .       Q .         .         .         .
 15.63      0.7863      2.63  .         Q         .         .         .
 15.82      0.8299      3.13  .          . Q      .         .         .
 16.00      0.8833      3.91  .          .    Q    .         .         .
 16.18      0.9799      8.85  .          .         .         .    Q    .
 16.37      1.0691      2.92  .         .Q         .         .         .
 16.55      1.1053      1.87  .       Q  .         .         .         .
 16.73      1.1311      1.54  .     Q    .         .         .         .
 16.92      1.1529      1.34  .    Q     .         .         .         .
 17.10      1.1721      1.20  .   Q      .         .         .         .
 17.28      1.1896      1.11  .   Q      .         .         .         .
 17.47      1.2059      1.03  .   Q      .         .         .         .
 17.65      1.2210      0.97  .  Q       .         .         .         .
 17.83      1.2352      0.91  .  Q       .         .         .         .
 18.02      1.2487      0.87  .  Q       .         .         .         .
 18.20      1.2605      0.69  . Q        .         .         .         .
 18.38      1.2706      0.65  . Q        .         .         .         .
 18.57      1.2802      0.62  . Q        .         .         .         .
 18.75      1.2895      0.60  . Q        .         .         .         .
 18.93      1.2983      0.57  . Q        .         .         .         .
 19.12      1.3068      0.55  . Q        .         .         .         .
 19.30      1.3150      0.53  . Q        .         .         .         .
 19.48      1.3229      0.51  . Q        .         .         .         .
 19.67      1.3306      0.50  .Q         .         .         .         .
 19.85      1.3380      0.48  .Q         .         .         .         .
 20.03      1.3452      0.47  .Q         .         .         .         .
 20.22      1.3522      0.46  .Q         .         .         .         .
 20.40      1.3590      0.44  .Q         .         .         .         .
 20.58      1.3657      0.43  .Q         .         .         .         .
 20.77      1.3722      0.42  .Q         .         .         .         .
 20.95      1.3785      0.41  .Q         .         .         .         .
 21.13      1.3847      0.40  .Q         .         .         .         .
 21.32      1.3908      0.40  .Q         .         .         .         .
 21.50      1.3967      0.39  .Q         .         .         .         .
 21.68      1.4025      0.38  .Q         .         .         .         .
 21.87      1.4082      0.37  .Q         .         .         .         .
 22.05      1.4138      0.37  .Q         .         .         .         .
 22.23      1.4193      0.36  .Q         .         .         .         .
 22.42      1.4247      0.35  .Q         .         .         .         .
 22.60      1.4300      0.35  .Q         .         .         .         .
 22.78      1.4352      0.34  .Q         .         .         .         .
 22.97      1.4403      0.33  .Q         .         .         .         .
 23.15      1.4453      0.33  .Q         .         .         .         .
 23.33      1.4503      0.32  .Q         .         .         .         .
 23.52      1.4552      0.32  .Q         .         .         .         .
 23.70      1.4600      0.31  .Q         .         .         .         .
 23.88      1.4647      0.31  .Q         .         .         .         .
 24.07      1.4694      0.31  .Q         .         .         .         .
 24.25      1.4717      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)

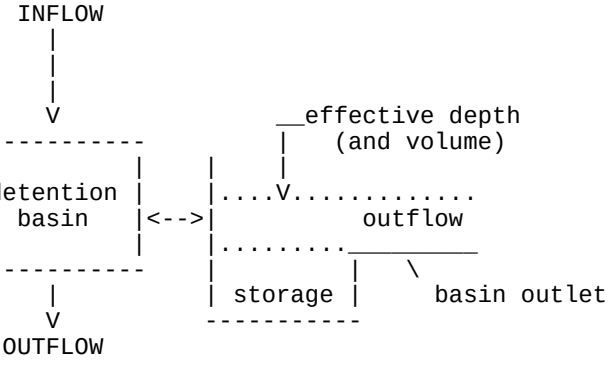
Percentile of Estimated Peak Flow Rate	Duration (minutes)
0%	1441.0
10%	319.0
20%	77.0
30%	44.0
40%	22.0
50%	11.0
60%	11.0
70%	11.0
80%	11.0
90%	11.0

Problem Descriptions:
SHANDIN MHRC
INFILTRATION BASIN ROUTING
2 YR

==========

FLOW-THROUGH DETENTION BASIN MODEL

SPECIFIED BASIN CONDITIONS ARE AS FOLLOWS:
CONSTANT HYDROGRAPH TIME UNIT(MINUTES) = 11.000
DEAD STORAGE(AF) = 0.00
SPECIFIED DEAD STORAGE(AF) FILLED = 0.00
ASSUMED INITIAL DEPTH(FEET) IN STORAGE BASIN = 0.00



DEPTH-VS.-STORAGE AND DEPTH-VS.-DISCHARGE INFORMATION:
TOTAL NUMBER OF BASIN DEPTH INFORMATION ENTRIES = 20

*BASIN-DEPTH (FEET)	STORAGE (ACRE-FEET)	OUTFLOW (CFS)	**	BASIN-DEPTH (FEET)	STORAGE (ACRE-FEET)	OUTFLOW (CFS)	*
0.000	0.000	0.000**		0.500	0.239	0.640*	
1.000	0.477	0.640**		1.500	0.716	0.640*	
2.000	0.955	0.640**		2.500	1.193	0.640*	
3.000	1.432	0.640**		3.500	1.670	0.640*	
4.000	1.909	0.640**		4.500	2.148	0.640*	
5.000	2.386	0.640**		5.500	2.625	0.640*	

```
     *      6.000      2.864      0.640**      6.500      1.994      0.340*
     *      7.000      2.148      0.340**      7.500      2.301      0.340*
     *      8.000      2.455      0.340**      8.500      2.608      0.340*
     *      9.000      2.761      0.340**      9.500      2.915      0.340*
-------------------------------------------------------------------------------
     BASIN STORAGE, OUTFLOW AND DEPTH ROUTING VALUES:
      INTERVAL   DEPTH   {S-O*DT/2}   {S+O*DT/2}
       NUMBER   (FEET)   (ACRE-FEET)  (ACRE-FEET)
           1     0.00       0.00000      0.00000
           2     0.50       0.23415      0.24385
           3     1.00       0.47215      0.48185
           4     1.50       0.71115      0.72085
           5     2.00       0.95015      0.95985
           6     2.50       1.18815      1.19785
           7     3.00       1.42715      1.43685
           8     3.50       1.66515      1.67485
           9     4.00       1.90415      1.91385
          10     4.50       2.14315      2.15285
          11     5.00       2.38115      2.39085
          12     5.50       2.62015      2.62985
          13     6.00       2.85915      2.86885
          14     6.50       1.99142      1.99658
          15     7.00       2.14542      2.15058
          16     7.50       2.29842      2.30358
          17     8.00       2.45242      2.45758
          18     8.50       2.60542      2.61058
          19     9.00       2.75842      2.76358
          20     9.50       2.91242      2.91758
     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  DEAD-STORAGE  INFLOW  EFFECTIVE  OUTFLOW  EFFECTIVE
       (HRS)   FILLED(AF)    (CFS)  DEPTH(FT)   (CFS)   VOLUME(AF)
-------------------------------------------------------------------------------
       0.050        0.000     0.00      0.00     0.00      0.000
       0.233        0.000     0.30      0.01     0.01      0.005
       0.417        0.000     0.31      0.02     0.02      0.009
       0.600        0.000     0.31      0.03     0.03      0.013
       0.783        0.000     0.31      0.04     0.04      0.017
       0.967        0.000     0.31      0.04     0.05      0.021
       1.150        0.000     0.32      0.05     0.06      0.025
       1.333        0.000     0.32      0.06     0.07      0.029
       1.517        0.000     0.32      0.07     0.08      0.032
       1.700        0.000     0.32      0.08     0.09      0.036
       1.883        0.000     0.33      0.08     0.10      0.039
       2.067        0.000     0.33      0.09     0.11      0.043
       2.250        0.000     0.33      0.10     0.12      0.046
       2.433        0.000     0.33      0.10     0.13      0.049
       2.617        0.000     0.34      0.11     0.14      0.052
       2.800        0.000     0.34      0.12     0.14      0.055
       2.983        0.000     0.34      0.12     0.15      0.058
       3.167        0.000     0.34      0.13     0.16      0.061
       3.350        0.000     0.35      0.13     0.17      0.063
       3.533        0.000     0.35      0.14     0.17      0.066
       3.717        0.000     0.35      0.14     0.18      0.069
       3.900        0.000     0.36      0.15     0.19      0.071
       4.083        0.000     0.36      0.15     0.19      0.074
```

4.267	0.000	0.36	0.16	0.20	0.076
4.450	0.000	0.37	0.16	0.21	0.079
4.633	0.000	0.37	0.17	0.21	0.081
4.817	0.000	0.37	0.17	0.22	0.083
5.000	0.000	0.38	0.18	0.23	0.086
5.183	0.000	0.38	0.18	0.23	0.088
5.367	0.000	0.38	0.19	0.24	0.090
5.550	0.000	0.39	0.19	0.24	0.092
5.733	0.000	0.39	0.20	0.25	0.095
5.917	0.000	0.40	0.20	0.26	0.097
6.100	0.000	0.40	0.21	0.26	0.099
6.283	0.000	0.41	0.21	0.27	0.101
6.467	0.000	0.41	0.22	0.27	0.103
6.650	0.000	0.42	0.22	0.28	0.105
6.833	0.000	0.42	0.22	0.28	0.107
7.017	0.000	0.43	0.23	0.29	0.109
7.200	0.000	0.43	0.23	0.30	0.111
7.383	0.000	0.44	0.24	0.30	0.113
7.567	0.000	0.44	0.24	0.31	0.115
7.750	0.000	0.45	0.25	0.31	0.117
7.933	0.000	0.45	0.25	0.32	0.120
8.117	0.000	0.46	0.25	0.32	0.122
8.300	0.000	0.46	0.26	0.33	0.124
8.483	0.000	0.47	0.26	0.33	0.126
8.667	0.000	0.48	0.27	0.34	0.128
8.850	0.000	0.49	0.27	0.35	0.130
9.033	0.000	0.49	0.28	0.35	0.132
9.217	0.000	0.50	0.28	0.36	0.134
9.400	0.000	0.51	0.29	0.36	0.137
9.583	0.000	0.52	0.29	0.37	0.139
9.767	0.000	0.53	0.30	0.37	0.141
9.950	0.000	0.54	0.30	0.38	0.144
10.133	0.000	0.54	0.31	0.39	0.146
10.317	0.000	0.56	0.31	0.39	0.148
10.500	0.000	0.56	0.32	0.40	0.151
10.683	0.000	0.58	0.32	0.41	0.153
10.867	0.000	0.59	0.33	0.41	0.156
11.050	0.000	0.60	0.33	0.42	0.159
11.233	0.000	0.61	0.34	0.43	0.162
11.417	0.000	0.63	0.34	0.44	0.165
11.600	0.000	0.64	0.35	0.44	0.168
11.783	0.000	0.66	0.36	0.45	0.171
11.967	0.000	0.67	0.36	0.46	0.174
12.150	0.000	0.80	0.37	0.47	0.179
12.333	0.000	0.85	0.39	0.49	0.184
12.517	0.000	0.88	0.40	0.50	0.190
12.700	0.000	0.90	0.41	0.52	0.196
12.883	0.000	0.93	0.42	0.53	0.202
13.067	0.000	0.95	0.44	0.55	0.208
13.250	0.000	0.99	0.45	0.57	0.214
13.433	0.000	1.01	0.46	0.58	0.221
13.617	0.000	1.06	0.48	0.60	0.228
13.800	0.000	1.08	0.49	0.62	0.235
13.983	0.000	1.14	0.51	0.63	0.242
14.167	0.000	1.17	0.52	0.64	0.251
14.350	0.000	1.24	0.54	0.64	0.260
14.533	0.000	1.29	0.56	0.64	0.269
14.717	0.000	1.40	0.59	0.64	0.281
14.900	0.000	1.46	0.61	0.64	0.293
15.083	0.000	1.63	0.65	0.64	0.308
15.267	0.000	1.74	0.68	0.64	0.325

15.450	0.000	2.21	0.73	0.64	0.349
15.633	0.000	2.63	0.79	0.64	0.379
15.817	0.000	3.13	0.87	0.64	0.416
16.000	0.000	3.91	0.98	0.64	0.466
16.183	0.000	8.85	1.24	0.64	0.590
16.367	0.000	2.92	1.31	0.64	0.625
16.550	0.000	1.87	1.35	0.64	0.643
16.733	0.000	1.54	1.38	0.64	0.657
16.917	0.000	1.34	1.40	0.64	0.668
17.100	0.000	1.20	1.42	0.64	0.676
17.283	0.000	1.11	1.43	0.64	0.683
17.467	0.000	1.03	1.44	0.64	0.689
17.650	0.000	0.97	1.45	0.64	0.694
17.833	0.000	0.91	1.46	0.64	0.698
18.017	0.000	0.87	1.47	0.64	0.702
18.200	0.000	0.69	1.47	0.64	0.702
18.383	0.000	0.65	1.47	0.64	0.703
18.567	0.000	0.62	1.47	0.64	0.702
18.750	0.000	0.60	1.47	0.64	0.702
18.933	0.000	0.57	1.47	0.64	0.701
19.117	0.000	0.55	1.46	0.64	0.699
19.300	0.000	0.53	1.46	0.64	0.698
19.483	0.000	0.51	1.46	0.64	0.696
19.667	0.000	0.50	1.45	0.64	0.693
19.850	0.000	0.48	1.45	0.64	0.691
20.033	0.000	0.47	1.44	0.64	0.689
20.217	0.000	0.46	1.44	0.64	0.686
20.400	0.000	0.44	1.43	0.64	0.683
20.583	0.000	0.43	1.42	0.64	0.680
20.767	0.000	0.42	1.42	0.64	0.676
20.950	0.000	0.41	1.41	0.64	0.673
21.133	0.000	0.40	1.40	0.64	0.669
21.317	0.000	0.40	1.39	0.64	0.666
21.500	0.000	0.39	1.39	0.64	0.662
21.683	0.000	0.38	1.38	0.64	0.658
21.867	0.000	0.37	1.37	0.64	0.654
22.050	0.000	0.37	1.36	0.64	0.650
22.233	0.000	0.36	1.35	0.64	0.645
22.417	0.000	0.35	1.34	0.64	0.641
22.600	0.000	0.35	1.33	0.64	0.637
22.783	0.000	0.34	1.32	0.64	0.632
22.967	0.000	0.33	1.31	0.64	0.627
23.150	0.000	0.33	1.30	0.64	0.623
23.333	0.000	0.32	1.29	0.64	0.618
23.517	0.000	0.32	1.28	0.64	0.613
23.700	0.000	0.31	1.27	0.64	0.608
23.883	0.000	0.31	1.26	0.64	0.603
24.067	0.000	0.31	1.25	0.64	0.598
24.250	0.000	0.00	1.23	0.64	0.588
24.433	0.000	0.00	1.21	0.64	0.579
24.617	0.000	0.00	1.19	0.64	0.569
24.800	0.000	0.00	1.17	0.64	0.559
24.983	0.000	0.00	1.15	0.64	0.550
25.167	0.000	0.00	1.13	0.64	0.540
25.350	0.000	0.00	1.11	0.64	0.530
25.533	0.000	0.00	1.09	0.64	0.521
25.717	0.000	0.00	1.07	0.64	0.511
25.900	0.000	0.00	1.05	0.64	0.501
26.083	0.000	0.00	1.03	0.64	0.491
26.267	0.000	0.00	1.01	0.64	0.482
26.450	0.000	0.00	0.99	0.64	0.472

26.633	0.000	0.00	0.97	0.64	0.462
26.817	0.000	0.00	0.95	0.64	0.453
27.000	0.000	0.00	0.93	0.64	0.443
27.183	0.000	0.00	0.91	0.64	0.433
27.367	0.000	0.00	0.89	0.64	0.424
27.550	0.000	0.00	0.87	0.64	0.414
27.733	0.000	0.00	0.85	0.64	0.404
27.917	0.000	0.00	0.83	0.64	0.394
28.100	0.000	0.00	0.81	0.64	0.385
28.283	0.000	0.00	0.79	0.64	0.375
28.467	0.000	0.00	0.77	0.64	0.365
28.650	0.000	0.00	0.75	0.64	0.356
28.833	0.000	0.00	0.72	0.64	0.346
29.017	0.000	0.00	0.70	0.64	0.336
29.200	0.000	0.00	0.68	0.64	0.327
29.383	0.000	0.00	0.66	0.64	0.317
29.567	0.000	0.00	0.64	0.64	0.307
29.750	0.000	0.00	0.62	0.64	0.298
29.933	0.000	0.00	0.60	0.64	0.288
30.117	0.000	0.00	0.58	0.64	0.278
30.300	0.000	0.00	0.56	0.64	0.268
30.483	0.000	0.00	0.54	0.64	0.259
30.667	0.000	0.00	0.52	0.64	0.249
30.850	0.000	0.00	0.50	0.64	0.239
31.033	0.000	0.00	0.48	0.63	0.230
31.217	0.000	0.00	0.46	0.60	0.221
31.400	0.000	0.00	0.44	0.58	0.212
31.583	0.000	0.00	0.43	0.56	0.203
31.767	0.000	0.00	0.41	0.53	0.195
31.950	0.000	0.00	0.39	0.51	0.188
32.133	0.000	0.00	0.38	0.49	0.180
32.317	0.000	0.00	0.36	0.47	0.173
32.500	0.000	0.00	0.35	0.45	0.166
32.683	0.000	0.00	0.33	0.44	0.160
32.867	0.000	0.00	0.32	0.42	0.153
33.050	0.000	0.00	0.31	0.40	0.147
33.233	0.000	0.00	0.30	0.39	0.141
33.417	0.000	0.00	0.28	0.37	0.136
33.600	0.000	0.00	0.27	0.36	0.130
33.783	0.000	0.00	0.26	0.34	0.125
33.967	0.000	0.00	0.25	0.33	0.120
34.150	0.000	0.00	0.24	0.32	0.115
34.333	0.000	0.00	0.23	0.30	0.111
34.517	0.000	0.00	0.22	0.29	0.106
34.700	0.000	0.00	0.21	0.28	0.102
34.883	0.000	0.00	0.21	0.27	0.098
35.067	0.000	0.00	0.20	0.26	0.094
35.250	0.000	0.00	0.19	0.25	0.090
35.433	0.000	0.00	0.18	0.24	0.087
35.617	0.000	0.00	0.17	0.23	0.083
35.800	0.000	0.00	0.17	0.22	0.080
35.983	0.000	0.00	0.16	0.21	0.077
36.167	0.000	0.00	0.15	0.20	0.074
36.350	0.000	0.00	0.15	0.19	0.071
36.533	0.000	0.00	0.14	0.19	0.068
36.717	0.000	0.00	0.14	0.18	0.065
36.900	0.000	0.00	0.13	0.17	0.063
37.083	0.000	0.00	0.13	0.16	0.060
37.267	0.000	0.00	0.12	0.16	0.058
37.450	0.000	0.00	0.12	0.15	0.056
37.633	0.000	0.00	0.11	0.15	0.053

37.817	0.000	0.00	0.11	0.14	0.051
38.000	0.000	0.00	0.10	0.13	0.049
38.183	0.000	0.00	0.10	0.13	0.047
38.367	0.000	0.00	0.09	0.12	0.045
38.550	0.000	0.00	0.09	0.12	0.044
38.733	0.000	0.00	0.09	0.11	0.042
38.917	0.000	0.00	0.08	0.11	0.040
39.100	0.000	0.00	0.08	0.11	0.039
39.283	0.000	0.00	0.08	0.10	0.037
39.467	0.000	0.00	0.07	0.10	0.036
39.650	0.000	0.00	0.07	0.09	0.034
39.833	0.000	0.00	0.07	0.09	0.033
40.017	0.000	0.00	0.07	0.09	0.031
40.200	0.000	0.00	0.06	0.08	0.030
40.383	0.000	0.00	0.06	0.08	0.029
40.567	0.000	0.00	0.06	0.08	0.028
40.750	0.000	0.00	0.06	0.07	0.027
40.933	0.000	0.00	0.05	0.07	0.026
41.117	0.000	0.00	0.05	0.07	0.025
41.300	0.000	0.00	0.05	0.06	0.024
41.483	0.000	0.00	0.05	0.06	0.023
41.667	0.000	0.00	0.05	0.06	0.022
41.850	0.000	0.00	0.04	0.06	0.021
42.033	0.000	0.00	0.04	0.06	0.020
42.217	0.000	0.00	0.04	0.05	0.019
42.400	0.000	0.00	0.04	0.05	0.019
42.583	0.000	0.00	0.04	0.05	0.018
42.767	0.000	0.00	0.04	0.05	0.017
42.950	0.000	0.00	0.03	0.04	0.016
43.133	0.000	0.00	0.03	0.04	0.016
43.317	0.000	0.00	0.03	0.04	0.015
43.500	0.000	0.00	0.03	0.04	0.015
43.683	0.000	0.00	0.03	0.04	0.014
43.867	0.000	0.00	0.03	0.04	0.013
44.050	0.000	0.00	0.03	0.04	0.013
44.233	0.000	0.00	0.03	0.03	0.012
44.417	0.000	0.00	0.02	0.03	0.012
44.600	0.000	0.00	0.02	0.03	0.011
44.783	0.000	0.00	0.02	0.03	0.011
44.967	0.000	0.00	0.02	0.03	0.011
45.150	0.000	0.00	0.02	0.03	0.010
45.333	0.000	0.00	0.02	0.03	0.010
45.517	0.000	0.00	0.02	0.03	0.009
45.700	0.000	0.00	0.02	0.02	0.009
45.883	0.000	0.00	0.02	0.02	0.009
46.067	0.000	0.00	0.02	0.02	0.008
46.250	0.000	0.00	0.02	0.02	0.008
46.433	0.000	0.00	0.02	0.02	0.008
46.617	0.000	0.00	0.02	0.02	0.007
46.800	0.000	0.00	0.01	0.02	0.007
46.983	0.000	0.00	0.01	0.02	0.007
47.167	0.000	0.00	0.01	0.02	0.006
47.350	0.000	0.00	0.01	0.02	0.006
47.533	0.000	0.00	0.01	0.02	0.006
47.717	0.000	0.00	0.01	0.02	0.006
47.900	0.000	0.00	0.01	0.02	0.005
48.083	0.000	0.00	0.01	0.01	0.005
48.267	0.000	0.00	0.01	0.01	0.005
48.450	0.000	0.00	0.01	0.01	0.005
48.633	0.000	0.00	0.01	0.01	0.005
48.817	0.000	0.00	0.01	0.01	0.004

49.000	0.000	0.00	0.01	0.01	0.004
49.183	0.000	0.00	0.01	0.01	0.004
49.367	0.000	0.00	0.01	0.01	0.004
49.550	0.000	0.00	0.01	0.01	0.004
49.733	0.000	0.00	0.01	0.01	0.004
49.917	0.000	0.00	0.01	0.01	0.004
50.100	0.000	0.00	0.01	0.01	0.003
50.283	0.000	0.00	0.01	0.01	0.003
50.467	0.000	0.00	0.01	0.01	0.003
50.650	0.000	0.00	0.01	0.01	0.003
50.833	0.000	0.00	0.01	0.01	0.003
51.017	0.000	0.00	0.01	0.01	0.003
51.200	0.000	0.00	0.01	0.01	0.003
51.383	0.000	0.00	0.01	0.01	0.003
51.567	0.000	0.00	0.01	0.01	0.002
51.750	0.000	0.00	0.00	0.01	0.002
51.933	0.000	0.00	0.00	0.01	0.002
52.117	0.000	0.00	0.00	0.01	0.002
52.300	0.000	0.00	0.00	0.01	0.002
52.483	0.000	0.00	0.00	0.01	0.002
52.667	0.000	0.00	0.00	0.01	0.002
52.850	0.000	0.00	0.00	0.01	0.002
53.033	0.000	0.00	0.00	0.00	0.002
53.217	0.000	0.00	0.00	0.00	0.002
53.400	0.000	0.00	0.00	0.00	0.002
53.583	0.000	0.00	0.00	0.00	0.002
53.767	0.000	0.00	0.00	0.00	0.002
53.950	0.000	0.00	0.00	0.00	0.001
54.133	0.000	0.00	0.00	0.00	0.001
54.317	0.000	0.00	0.00	0.00	0.001
54.500	0.000	0.00	0.00	0.00	0.001
54.683	0.000	0.00	0.00	0.00	0.001
54.867	0.000	0.00	0.00	0.00	0.001
55.050	0.000	0.00	0.00	0.00	0.001
55.233	0.000	0.00	0.00	0.00	0.001
55.417	0.000	0.00	0.00	0.00	0.001
55.600	0.000	0.00	0.00	0.00	0.001

INFILTRATION BASIN ROUTING: 10YR

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**************************************************************************
                     SMALL AREA UNIT HYDROGRAPH MODEL
==========================================================================
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                          Analysis prepared by:




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

 Problem Descriptions:
  SHANDIN MHRC
  INFILTRATION BASIN ROUTING
  10 YR
--------------------------------------------------------------------------


    RATIONAL METHOD CALIBRATION COEFFICIENT = 1.00
    TOTAL CATCHMENT AREA(ACRES) =    5.95
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.002
    LOW LOSS FRACTION = 0.051
    TIME OF CONCENTRATION(MIN.) = 11.00
    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) =  0.30
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.76
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  1.15
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  1.83
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  2.54
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  4.65

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

    TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     2.26
    TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     0.04

**************************************************************************
  TIME     VOLUME       Q    0.        5.0      10.0      15.0      20.0
 (HOURS)    (AF)      (CFS)
--------------------------------------------------------------------------
  0.05      0.0000      0.00  Q         .         .         .         .
  0.23      0.0037      0.49  Q         .         .         .         .
  0.42      0.0112      0.50  Q         .         .         .         .
  0.60      0.0187      0.50  Q         .         .         .         .
  0.78      0.0263      0.50  .Q        .         .         .         .
  0.97      0.0340      0.51  .Q        .         .         .         .
  1.15      0.0417      0.51  .Q        .         .         .         .
  1.33      0.0494      0.51  .Q        .         .         .         .
  1.52      0.0572      0.52  .Q        .         .         .         .
  1.70      0.0651      0.52  .Q        .         .         .         .
  1.88      0.0730      0.53  .Q        .         .         .         .
  2.07      0.0810      0.53  .Q        .         .         .         .
  2.25      0.0890      0.53  .Q        .         .         .         .
```

```
 2.43      0.0971      0.54  .Q        .         .         .         .
 2.62      0.1053      0.54  .Q        .         .         .         .
 2.80      0.1135      0.54  .Q        .         .         .         .
 2.98      0.1218      0.55  .Q        .         .         .         .
 3.17      0.1301      0.55  .Q        .         .         .         .
 3.35      0.1386      0.56  .Q        .         .         .         .
 3.53      0.1471      0.56  .Q        .         .         .         .
 3.72      0.1556      0.57  .Q        .         .         .         .
 3.90      0.1643      0.57  .Q        .         .         .         .
 4.08      0.1730      0.58  .Q        .         .         .         .
 4.27      0.1818      0.58  .Q        .         .         .         .
 4.45      0.1906      0.59  .Q        .         .         .         .
 4.63      0.1996      0.59  .Q        .         .         .         .
 4.82      0.2086      0.60  .Q        .         .         .         .
 5.00      0.2177      0.60  .Q        .         .         .         .
 5.18      0.2269      0.61  .Q        .         .         .         .
 5.37      0.2362      0.62  .Q        .         .         .         .
 5.55      0.2456      0.62  .Q        .         .         .         .
 5.73      0.2551      0.63  .Q        .         .         .         .
 5.92      0.2647      0.64  .Q        .         .         .         .
 6.10      0.2743      0.64  .Q        .         .         .         .
 6.28      0.2841      0.65  .Q        .         .         .         .
 6.47      0.2940      0.65  .Q        .         .         .         .
 6.65      0.3040      0.66  .Q        .         .         .         .
 6.83      0.3141      0.67  .Q        .         .         .         .
 7.02      0.3243      0.68  .Q        .         .         .         .
 7.20      0.3346      0.68  .Q        .         .         .         .
 7.38      0.3451      0.70  .Q        .         .         .         .
 7.57      0.3556      0.70  .Q        .         .         .         .
 7.75      0.3663      0.71  .Q        .         .         .         .
 7.93      0.3772      0.72  .Q        .         .         .         .
 8.12      0.3882      0.73  .Q        .         .         .         .
 8.30      0.3993      0.74  .Q        .         .         .         .
 8.48      0.4106      0.75  .Q        .         .         .         .
 8.67      0.4220      0.76  .Q        .         .         .         .
 8.85      0.4336      0.77  .Q        .         .         .         .
 9.03      0.4454      0.78  .Q        .         .         .         .
 9.22      0.4573      0.80  .Q        .         .         .         .
 9.40      0.4694      0.80  .Q        .         .         .         .
 9.58      0.4817      0.82  .Q        .         .         .         .
 9.77      0.4942      0.83  .Q        .         .         .         .
 9.95      0.5069      0.85  .Q        .         .         .         .
10.13      0.5199      0.86  .Q        .         .         .         .
10.32      0.5330      0.88  .Q        .         .         .         .
10.50      0.5464      0.89  .Q        .         .         .         .
10.68      0.5601      0.91  .Q        .         .         .         .
10.87      0.5740      0.92  .Q        .         .         .         .
11.05      0.5882      0.95  .Q        .         .         .         .
11.23      0.6027      0.96  .Q        .         .         .         .
11.42      0.6174      0.99  .Q        .         .         .         .
11.60      0.6326      1.01  . Q       .         .         .         .
11.78      0.6481      1.04  . Q       .         .         .         .
11.97      0.6639      1.05  . Q       .         .         .         .
12.15      0.6807      1.16  . Q       .         .         .         .
12.33      0.6986      1.20  . Q       .         .         .         .
12.52      0.7171      1.25  . Q       .         .         .         .
12.70      0.7362      1.27  . Q       .         .         .         .
12.88      0.7558      1.32  . Q       .         .         .         .
13.07      0.7760      1.35  . Q       .         .         .         .
13.25      0.7969      1.41  . Q       .         .         .         .
13.43      0.8184      1.44  . Q       .         .         .         .
```

13.62	0.8408	1.51	. Q . . . .
13.80	0.8640	1.55	. Q . . . .
13.98	0.8883	1.65	. Q . . . .
14.17	0.9131	1.63	. Q . . . .
14.35	0.9378	1.63	. Q . . . .
14.53	0.9631	1.70	. Q . . . .
14.72	0.9902	1.87	. Q . . . .
14.90	1.0193	1.97	. Q . . . .
15.08	1.0511	2.23	. Q . . . .
15.27	1.0861	2.40	. Q . . . .
15.45	1.1301	3.40	. Q . . . .
15.63	1.1891	4.39	. Q . . . .
15.82	1.2614	5.16	. Q . . .
16.00	1.3492	6.42	. . Q . .
16.18	1.5081	14.55	. . . Q. .
16.37	1.6551	4.86	. Q. . . .
16.55	1.7117	2.61	. Q . . . .
16.73	1.7473	2.09	. Q . . . .
16.92	1.7766	1.78	. Q . . . .
17.10	1.8020	1.57	. Q . . . .
17.28	1.8260	1.60	. Q . . . .
17.47	1.8493	1.47	. Q . . . .
17.65	1.8709	1.38	. Q . . . .
17.83	1.8911	1.29	. Q . . . .
18.02	1.9102	1.22	. Q . . . .
18.20	1.9276	1.07	. Q . . . .
18.38	1.9435	1.02	. Q . . . .
18.57	1.9586	0.98	.Q . . . .
18.75	1.9731	0.94	.Q . . . .
18.93	1.9870	0.90	.Q . . . .
19.12	2.0004	0.87	.Q . . . .
19.30	2.0133	0.84	.Q . . . .
19.48	2.0258	0.81	.Q . . . .
19.67	2.0380	0.79	.Q . . . .
19.85	2.0497	0.77	.Q . . . .
20.03	2.0612	0.74	.Q . . . .
20.22	2.0723	0.72	.Q . . . .
20.40	2.0831	0.71	.Q . . . .
20.58	2.0937	0.69	.Q . . . .
20.77	2.1041	0.67	.Q . . . .
20.95	2.1142	0.66	.Q . . . .
21.13	2.1240	0.64	.Q . . . .
21.32	2.1337	0.63	.Q . . . .
21.50	2.1432	0.62	.Q . . . .
21.68	2.1525	0.61	.Q . . . .
21.87	2.1616	0.60	.Q . . . .
22.05	2.1705	0.59	.Q . . . .
22.23	2.1793	0.58	.Q . . . .
22.42	2.1880	0.57	.Q . . . .
22.60	2.1965	0.56	.Q . . . .
22.78	2.2048	0.55	.Q . . . .
22.97	2.2130	0.54	.Q . . . .
23.15	2.2211	0.53	.Q . . . .
23.33	2.2291	0.52	.Q . . . .
23.52	2.2370	0.52	.Q . . . .
23.70	2.2447	0.51	.Q . . . .
23.88	2.2524	0.50	.Q . . . .
24.07	2.2599	0.49	Q . . . .
24.25	2.2636	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)

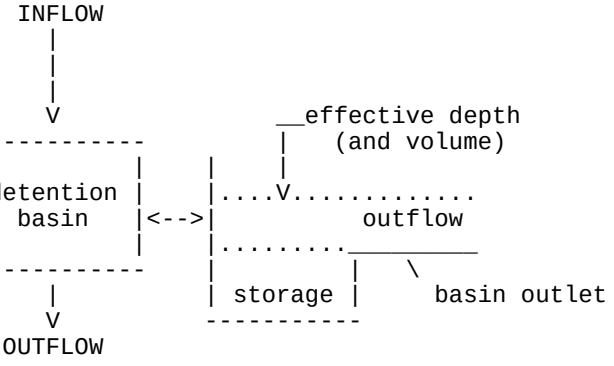
Percentile of Estimated Peak Flow Rate	Duration (minutes)
0%	1441.0
10%	242.0
20%	66.0
30%	55.0
40%	22.0
50%	11.0
60%	11.0
70%	11.0
80%	11.0
90%	11.0

Problem Descriptions:
SHANDIN MHRC
INFILTRATION BASIN ROUTING
10 YR

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FLOW-THROUGH DETENTION BASIN MODEL

SPECIFIED BASIN CONDITIONS ARE AS FOLLOWS:
CONSTANT HYDROGRAPH TIME UNIT(MINUTES) = 11.000
DEAD STORAGE(AF) = 0.00
SPECIFIED DEAD STORAGE(AF) FILLED = 0.00
ASSUMED INITIAL DEPTH(FEET) IN STORAGE BASIN = 0.00



DEPTH-VS.-STORAGE AND DEPTH-VS.-DISCHARGE INFORMATION:
TOTAL NUMBER OF BASIN DEPTH INFORMATION ENTRIES = 20

*BASIN-DEPTH (FEET)	STORAGE (ACRE-FEET)	OUTFLOW (CFS)	**	BASIN-DEPTH (FEET)	STORAGE (ACRE-FEET)	OUTFLOW (CFS)	*
0.000	0.000	0.000**		0.500	0.239	0.640*	
1.000	0.477	0.640**		1.500	0.716	0.640*	
2.000	0.955	0.640**		2.500	1.193	0.640*	
3.000	1.432	0.640**		3.500	1.670	0.640*	
4.000	1.909	0.640**		4.500	2.148	0.640*	
5.000	2.386	0.640**		5.500	2.625	0.640*	

```
     *      6.000      2.864      0.640**      6.500      1.994      0.340*
     *      7.000      2.148      0.340**      7.500      2.301      0.340*
     *      8.000      2.455      0.340**      8.500      2.608      0.340*
     *      9.000      2.761      0.340**      9.500      2.915      0.340*
-------------------------------------------------------------------------------
     BASIN STORAGE, OUTFLOW AND DEPTH ROUTING VALUES:
      INTERVAL   DEPTH   {S-O*DT/2}   {S+O*DT/2}
       NUMBER   (FEET)   (ACRE-FEET)  (ACRE-FEET)
           1     0.00       0.00000      0.00000
           2     0.50       0.23415      0.24385
           3     1.00       0.47215      0.48185
           4     1.50       0.71115      0.72085
           5     2.00       0.95015      0.95985
           6     2.50       1.18815      1.19785
           7     3.00       1.42715      1.43685
           8     3.50       1.66515      1.67485
           9     4.00       1.90415      1.91385
          10     4.50       2.14315      2.15285
          11     5.00       2.38115      2.39085
          12     5.50       2.62015      2.62985
          13     6.00       2.85915      2.86885
          14     6.50       1.99142      1.99658
          15     7.00       2.14542      2.15058
          16     7.50       2.29842      2.30358
          17     8.00       2.45242      2.45758
          18     8.50       2.60542      2.61058
          19     9.00       2.75842      2.76358
          20     9.50       2.91242      2.91758
     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  DEAD-STORAGE  INFLOW  EFFECTIVE  OUTFLOW  EFFECTIVE
       (HRS)   FILLED(AF)    (CFS)  DEPTH(FT)   (CFS)   VOLUME(AF)
-------------------------------------------------------------------------------
       0.050        0.000     0.00      0.00     0.00      0.000
       0.233        0.000     0.49      0.02     0.01      0.007
       0.417        0.000     0.50      0.03     0.03      0.014
       0.600        0.000     0.50      0.04     0.05      0.021
       0.783        0.000     0.50      0.06     0.07      0.028
       0.967        0.000     0.51      0.07     0.08      0.034
       1.150        0.000     0.51      0.08     0.10      0.040
       1.333        0.000     0.51      0.10     0.12      0.046
       1.517        0.000     0.52      0.11     0.13      0.052
       1.700        0.000     0.52      0.12     0.15      0.058
       1.883        0.000     0.53      0.13     0.16      0.063
       2.067        0.000     0.53      0.14     0.18      0.069
       2.250        0.000     0.53      0.15     0.19      0.074
       2.433        0.000     0.54      0.17     0.20      0.079
       2.617        0.000     0.54      0.18     0.22      0.084
       2.800        0.000     0.54      0.19     0.23      0.089
       2.983        0.000     0.55      0.20     0.24      0.093
       3.167        0.000     0.55      0.20     0.26      0.098
       3.350        0.000     0.56      0.21     0.27      0.102
       3.533        0.000     0.56      0.22     0.28      0.106
       3.717        0.000     0.57      0.23     0.29      0.111
       3.900        0.000     0.57      0.24     0.30      0.115
       4.083        0.000     0.58      0.25     0.31      0.119
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4.267	0.000	0.58	0.26	0.32	0.123
4.450	0.000	0.59	0.26	0.33	0.127
4.633	0.000	0.59	0.27	0.34	0.130
4.817	0.000	0.60	0.28	0.35	0.134
5.000	0.000	0.60	0.29	0.36	0.138
5.183	0.000	0.61	0.30	0.37	0.141
5.367	0.000	0.62	0.30	0.38	0.145
5.550	0.000	0.62	0.31	0.39	0.148
5.733	0.000	0.63	0.32	0.40	0.152
5.917	0.000	0.64	0.32	0.41	0.155
6.100	0.000	0.64	0.33	0.42	0.158
6.283	0.000	0.65	0.34	0.43	0.162
6.467	0.000	0.65	0.35	0.44	0.165
6.650	0.000	0.66	0.35	0.45	0.168
6.833	0.000	0.67	0.36	0.46	0.172
7.017	0.000	0.68	0.37	0.46	0.175
7.200	0.000	0.68	0.37	0.47	0.178
7.383	0.000	0.70	0.38	0.48	0.181
7.567	0.000	0.70	0.39	0.49	0.185
7.750	0.000	0.71	0.39	0.50	0.188
7.933	0.000	0.72	0.40	0.51	0.191
8.117	0.000	0.73	0.41	0.52	0.194
8.300	0.000	0.74	0.41	0.52	0.197
8.483	0.000	0.75	0.42	0.53	0.201
8.667	0.000	0.76	0.43	0.54	0.204
8.850	0.000	0.77	0.43	0.55	0.207
9.033	0.000	0.78	0.44	0.56	0.211
9.217	0.000	0.80	0.45	0.57	0.214
9.400	0.000	0.80	0.46	0.58	0.218
9.583	0.000	0.82	0.46	0.59	0.221
9.767	0.000	0.83	0.47	0.60	0.225
9.950	0.000	0.85	0.48	0.61	0.228
10.133	0.000	0.86	0.49	0.62	0.232
10.317	0.000	0.88	0.49	0.63	0.236
10.500	0.000	0.89	0.50	0.64	0.240
10.683	0.000	0.91	0.51	0.64	0.244
10.867	0.000	0.92	0.52	0.64	0.248
11.050	0.000	0.95	0.53	0.64	0.253
11.233	0.000	0.96	0.54	0.64	0.258
11.417	0.000	0.99	0.55	0.64	0.263
11.600	0.000	1.01	0.56	0.64	0.269
11.783	0.000	1.04	0.57	0.64	0.275
11.967	0.000	1.05	0.59	0.64	0.281
12.150	0.000	1.16	0.60	0.64	0.289
12.333	0.000	1.20	0.62	0.64	0.297
12.517	0.000	1.25	0.64	0.64	0.306
12.700	0.000	1.27	0.66	0.64	0.316
12.883	0.000	1.32	0.68	0.64	0.326
13.067	0.000	1.35	0.71	0.64	0.337
13.250	0.000	1.41	0.73	0.64	0.349
13.433	0.000	1.44	0.76	0.64	0.361
13.617	0.000	1.51	0.78	0.64	0.374
13.800	0.000	1.55	0.81	0.64	0.388
13.983	0.000	1.65	0.84	0.64	0.403
14.167	0.000	1.63	0.88	0.64	0.418
14.350	0.000	1.63	0.91	0.64	0.433
14.533	0.000	1.70	0.94	0.64	0.449
14.717	0.000	1.87	0.98	0.64	0.468
14.900	0.000	1.97	1.02	0.64	0.488
15.083	0.000	2.23	1.07	0.64	0.512
15.267	0.000	2.40	1.13	0.64	0.539

15.450	0.000	3.40	1.22	0.64	0.581
15.633	0.000	4.39	1.34	0.64	0.637
15.817	0.000	5.16	1.48	0.64	0.706
16.000	0.000	6.42	1.66	0.64	0.793
16.183	0.000	14.55	2.10	0.64	1.004
16.367	0.000	4.86	2.24	0.64	1.068
16.550	0.000	2.61	2.30	0.64	1.098
16.733	0.000	2.09	2.35	0.64	1.120
16.917	0.000	1.78	2.38	0.64	1.137
17.100	0.000	1.57	2.41	0.64	1.151
17.283	0.000	1.60	2.44	0.64	1.166
17.467	0.000	1.47	2.47	0.64	1.178
17.650	0.000	1.38	2.49	0.64	1.190
17.833	0.000	1.29	2.51	0.64	1.200
18.017	0.000	1.22	2.53	0.64	1.208
18.200	0.000	1.07	2.55	0.64	1.215
18.383	0.000	1.02	2.56	0.64	1.221
18.567	0.000	0.98	2.57	0.64	1.226
18.750	0.000	0.94	2.58	0.64	1.230
18.933	0.000	0.90	2.59	0.64	1.234
19.117	0.000	0.87	2.59	0.64	1.238
19.300	0.000	0.84	2.60	0.64	1.241
19.483	0.000	0.81	2.61	0.64	1.243
19.667	0.000	0.79	2.61	0.64	1.246
19.850	0.000	0.77	2.61	0.64	1.247
20.033	0.000	0.74	2.62	0.64	1.249
20.217	0.000	0.72	2.62	0.64	1.250
20.400	0.000	0.71	2.62	0.64	1.251
20.583	0.000	0.69	2.62	0.64	1.252
20.767	0.000	0.67	2.62	0.64	1.253
20.950	0.000	0.66	2.63	0.64	1.253
21.133	0.000	0.64	2.63	0.64	1.253
21.317	0.000	0.63	2.63	0.64	1.253
21.500	0.000	0.62	2.62	0.64	1.253
21.683	0.000	0.61	2.62	0.64	1.252
21.867	0.000	0.60	2.62	0.64	1.251
22.050	0.000	0.59	2.62	0.64	1.251
22.233	0.000	0.58	2.62	0.64	1.250
22.417	0.000	0.57	2.62	0.64	1.248
22.600	0.000	0.56	2.61	0.64	1.247
22.783	0.000	0.55	2.61	0.64	1.246
22.967	0.000	0.54	2.61	0.64	1.244
23.150	0.000	0.53	2.60	0.64	1.243
23.333	0.000	0.52	2.60	0.64	1.241
23.517	0.000	0.52	2.60	0.64	1.239
23.700	0.000	0.51	2.59	0.64	1.237
23.883	0.000	0.50	2.59	0.64	1.235
24.067	0.000	0.49	2.58	0.64	1.233
24.250	0.000	0.00	2.56	0.64	1.223
24.433	0.000	0.00	2.54	0.64	1.213
24.617	0.000	0.00	2.52	0.64	1.203
24.800	0.000	0.00	2.50	0.64	1.194
24.983	0.000	0.00	2.48	0.64	1.184
25.167	0.000	0.00	2.46	0.64	1.174
25.350	0.000	0.00	2.44	0.64	1.165
25.533	0.000	0.00	2.42	0.64	1.155
25.717	0.000	0.00	2.40	0.64	1.145
25.900	0.000	0.00	2.38	0.64	1.136
26.083	0.000	0.00	2.36	0.64	1.126
26.267	0.000	0.00	2.34	0.64	1.116
26.450	0.000	0.00	2.32	0.64	1.107

26.633	0.000	0.00	2.30	0.64	1.097
26.817	0.000	0.00	2.28	0.64	1.087
27.000	0.000	0.00	2.26	0.64	1.077
27.183	0.000	0.00	2.24	0.64	1.068
27.367	0.000	0.00	2.22	0.64	1.058
27.550	0.000	0.00	2.20	0.64	1.048
27.733	0.000	0.00	2.18	0.64	1.039
27.917	0.000	0.00	2.16	0.64	1.029
28.100	0.000	0.00	2.13	0.64	1.019
28.283	0.000	0.00	2.11	0.64	1.010
28.467	0.000	0.00	2.09	0.64	1.000
28.650	0.000	0.00	2.07	0.64	0.990
28.833	0.000	0.00	2.05	0.64	0.980
29.017	0.000	0.00	2.03	0.64	0.971
29.200	0.000	0.00	2.01	0.64	0.961
29.383	0.000	0.00	1.99	0.64	0.951
29.567	0.000	0.00	1.97	0.64	0.942
29.750	0.000	0.00	1.95	0.64	0.932
29.933	0.000	0.00	1.93	0.64	0.922
30.117	0.000	0.00	1.91	0.64	0.913
30.300	0.000	0.00	1.89	0.64	0.903
30.483	0.000	0.00	1.87	0.64	0.893
30.667	0.000	0.00	1.85	0.64	0.883
30.850	0.000	0.00	1.83	0.64	0.874
31.033	0.000	0.00	1.81	0.64	0.864
31.217	0.000	0.00	1.79	0.64	0.854
31.400	0.000	0.00	1.77	0.64	0.845
31.583	0.000	0.00	1.75	0.64	0.835
31.767	0.000	0.00	1.73	0.64	0.825
31.950	0.000	0.00	1.71	0.64	0.816
32.133	0.000	0.00	1.69	0.64	0.806
32.317	0.000	0.00	1.67	0.64	0.796
32.500	0.000	0.00	1.65	0.64	0.787
32.683	0.000	0.00	1.63	0.64	0.777
32.867	0.000	0.00	1.61	0.64	0.767
33.050	0.000	0.00	1.59	0.64	0.757
33.233	0.000	0.00	1.57	0.64	0.748
33.417	0.000	0.00	1.55	0.64	0.738
33.600	0.000	0.00	1.53	0.64	0.728
33.783	0.000	0.00	1.51	0.64	0.719
33.967	0.000	0.00	1.49	0.64	0.709
34.150	0.000	0.00	1.46	0.64	0.699
34.333	0.000	0.00	1.44	0.64	0.690
34.517	0.000	0.00	1.42	0.64	0.680
34.700	0.000	0.00	1.40	0.64	0.670
34.883	0.000	0.00	1.38	0.64	0.660
35.067	0.000	0.00	1.36	0.64	0.651
35.250	0.000	0.00	1.34	0.64	0.641
35.433	0.000	0.00	1.32	0.64	0.631
35.617	0.000	0.00	1.30	0.64	0.622
35.800	0.000	0.00	1.28	0.64	0.612
35.983	0.000	0.00	1.26	0.64	0.602
36.167	0.000	0.00	1.24	0.64	0.593
36.350	0.000	0.00	1.22	0.64	0.583
36.533	0.000	0.00	1.20	0.64	0.573
36.717	0.000	0.00	1.18	0.64	0.563
36.900	0.000	0.00	1.16	0.64	0.554
37.083	0.000	0.00	1.14	0.64	0.544
37.267	0.000	0.00	1.12	0.64	0.534
37.450	0.000	0.00	1.10	0.64	0.525
37.633	0.000	0.00	1.08	0.64	0.515

37.817	0.000	0.00	1.06	0.64	0.505
38.000	0.000	0.00	1.04	0.64	0.496
38.183	0.000	0.00	1.02	0.64	0.486
38.367	0.000	0.00	1.00	0.64	0.476
38.550	0.000	0.00	0.98	0.64	0.467
38.733	0.000	0.00	0.96	0.64	0.457
38.917	0.000	0.00	0.94	0.64	0.447
39.100	0.000	0.00	0.92	0.64	0.437
39.283	0.000	0.00	0.90	0.64	0.428
39.467	0.000	0.00	0.88	0.64	0.418
39.650	0.000	0.00	0.86	0.64	0.408
39.833	0.000	0.00	0.84	0.64	0.399
40.017	0.000	0.00	0.81	0.64	0.389
40.200	0.000	0.00	0.79	0.64	0.379
40.383	0.000	0.00	0.77	0.64	0.370
40.567	0.000	0.00	0.75	0.64	0.360
40.750	0.000	0.00	0.73	0.64	0.350
40.933	0.000	0.00	0.71	0.64	0.340
41.117	0.000	0.00	0.69	0.64	0.331
41.300	0.000	0.00	0.67	0.64	0.321
41.483	0.000	0.00	0.65	0.64	0.311
41.667	0.000	0.00	0.63	0.64	0.302
41.850	0.000	0.00	0.61	0.64	0.292
42.033	0.000	0.00	0.59	0.64	0.282
42.217	0.000	0.00	0.57	0.64	0.273
42.400	0.000	0.00	0.55	0.64	0.263
42.583	0.000	0.00	0.53	0.64	0.253
42.767	0.000	0.00	0.51	0.64	0.243
42.950	0.000	0.00	0.49	0.63	0.234
43.133	0.000	0.00	0.47	0.61	0.225
43.317	0.000	0.00	0.45	0.59	0.216
43.500	0.000	0.00	0.43	0.57	0.207
43.683	0.000	0.00	0.42	0.54	0.199
43.867	0.000	0.00	0.40	0.52	0.191
44.050	0.000	0.00	0.38	0.50	0.183
44.233	0.000	0.00	0.37	0.48	0.176
44.417	0.000	0.00	0.35	0.46	0.169
44.600	0.000	0.00	0.34	0.44	0.162
44.783	0.000	0.00	0.33	0.43	0.156
44.967	0.000	0.00	0.31	0.41	0.150
45.150	0.000	0.00	0.30	0.39	0.144
45.333	0.000	0.00	0.29	0.38	0.138
45.517	0.000	0.00	0.28	0.36	0.133
45.700	0.000	0.00	0.27	0.35	0.127
45.883	0.000	0.00	0.26	0.33	0.122
46.067	0.000	0.00	0.25	0.32	0.117
46.250	0.000	0.00	0.24	0.31	0.113
46.433	0.000	0.00	0.23	0.30	0.108
46.617	0.000	0.00	0.22	0.28	0.104
46.800	0.000	0.00	0.21	0.27	0.100
46.983	0.000	0.00	0.20	0.26	0.096
47.167	0.000	0.00	0.19	0.25	0.092
47.350	0.000	0.00	0.18	0.24	0.088
47.533	0.000	0.00	0.18	0.23	0.085
47.717	0.000	0.00	0.17	0.22	0.081
47.900	0.000	0.00	0.16	0.21	0.078
48.083	0.000	0.00	0.16	0.21	0.075
48.267	0.000	0.00	0.15	0.20	0.072
48.450	0.000	0.00	0.14	0.19	0.069
48.633	0.000	0.00	0.14	0.18	0.066
48.817	0.000	0.00	0.13	0.17	0.064

49.000	0.000	0.00	0.13	0.17	0.061
49.183	0.000	0.00	0.12	0.16	0.059
49.367	0.000	0.00	0.12	0.15	0.057
49.550	0.000	0.00	0.11	0.15	0.054
49.733	0.000	0.00	0.11	0.14	0.052
49.917	0.000	0.00	0.10	0.14	0.050
50.100	0.000	0.00	0.10	0.13	0.048
50.283	0.000	0.00	0.10	0.13	0.046
50.467	0.000	0.00	0.09	0.12	0.044
50.650	0.000	0.00	0.09	0.12	0.043
50.833	0.000	0.00	0.09	0.11	0.041
51.017	0.000	0.00	0.08	0.11	0.039
51.200	0.000	0.00	0.08	0.10	0.038
51.383	0.000	0.00	0.08	0.10	0.036
51.567	0.000	0.00	0.07	0.09	0.035
51.750	0.000	0.00	0.07	0.09	0.033
51.933	0.000	0.00	0.07	0.09	0.032
52.117	0.000	0.00	0.06	0.08	0.031
52.300	0.000	0.00	0.06	0.08	0.030
52.483	0.000	0.00	0.06	0.08	0.028
52.667	0.000	0.00	0.06	0.07	0.027
52.850	0.000	0.00	0.05	0.07	0.026
53.033	0.000	0.00	0.05	0.07	0.025
53.217	0.000	0.00	0.05	0.07	0.024
53.400	0.000	0.00	0.05	0.06	0.023
53.583	0.000	0.00	0.05	0.06	0.022
53.767	0.000	0.00	0.04	0.06	0.021
53.950	0.000	0.00	0.04	0.06	0.020
54.133	0.000	0.00	0.04	0.05	0.020
54.317	0.000	0.00	0.04	0.05	0.019
54.500	0.000	0.00	0.04	0.05	0.018
54.683	0.000	0.00	0.04	0.05	0.017
54.867	0.000	0.00	0.04	0.05	0.017
55.050	0.000	0.00	0.03	0.04	0.016
55.233	0.000	0.00	0.03	0.04	0.015
55.417	0.000	0.00	0.03	0.04	0.015
55.600	0.000	0.00	0.03	0.04	0.014
55.783	0.000	0.00	0.03	0.04	0.014
55.967	0.000	0.00	0.03	0.04	0.013
56.150	0.000	0.00	0.03	0.03	0.013
56.333	0.000	0.00	0.03	0.03	0.012
56.517	0.000	0.00	0.02	0.03	0.012
56.700	0.000	0.00	0.02	0.03	0.011
56.883	0.000	0.00	0.02	0.03	0.011
57.067	0.000	0.00	0.02	0.03	0.010
57.250	0.000	0.00	0.02	0.03	0.010
57.433	0.000	0.00	0.02	0.03	0.009
57.617	0.000	0.00	0.02	0.02	0.009
57.800	0.000	0.00	0.02	0.02	0.009
57.983	0.000	0.00	0.02	0.02	0.008
58.167	0.000	0.00	0.02	0.02	0.008
58.350	0.000	0.00	0.02	0.02	0.008
58.533	0.000	0.00	0.02	0.02	0.007
58.717	0.000	0.00	0.01	0.02	0.007
58.900	0.000	0.00	0.01	0.02	0.007
59.083	0.000	0.00	0.01	0.02	0.007
59.267	0.000	0.00	0.01	0.02	0.006
59.450	0.000	0.00	0.01	0.02	0.006
59.633	0.000	0.00	0.01	0.02	0.006
59.817	0.000	0.00	0.01	0.02	0.006
60.000	0.000	0.00	0.01	0.01	0.005

60.183	0.000	0.00	0.01	0.01	0.005
60.367	0.000	0.00	0.01	0.01	0.005
60.550	0.000	0.00	0.01	0.01	0.005
60.733	0.000	0.00	0.01	0.01	0.005
60.917	0.000	0.00	0.01	0.01	0.004
61.100	0.000	0.00	0.01	0.01	0.004
61.283	0.000	0.00	0.01	0.01	0.004
61.467	0.000	0.00	0.01	0.01	0.004
61.650	0.000	0.00	0.01	0.01	0.004
61.833	0.000	0.00	0.01	0.01	0.004
62.017	0.000	0.00	0.01	0.01	0.003
62.200	0.000	0.00	0.01	0.01	0.003
62.383	0.000	0.00	0.01	0.01	0.003
62.567	0.000	0.00	0.01	0.01	0.003
62.750	0.000	0.00	0.01	0.01	0.003
62.933	0.000	0.00	0.01	0.01	0.003
63.117	0.000	0.00	0.01	0.01	0.003
63.300	0.000	0.00	0.01	0.01	0.003
63.483	0.000	0.00	0.01	0.01	0.002
63.667	0.000	0.00	0.00	0.01	0.002
63.850	0.000	0.00	0.00	0.01	0.002
64.033	0.000	0.00	0.00	0.01	0.002
64.217	0.000	0.00	0.00	0.01	0.002
64.400	0.000	0.00	0.00	0.01	0.002
64.583	0.000	0.00	0.00	0.01	0.002
64.767	0.000	0.00	0.00	0.01	0.002
64.950	0.000	0.00	0.00	0.00	0.002
65.133	0.000	0.00	0.00	0.00	0.002
65.317	0.000	0.00	0.00	0.00	0.002
65.500	0.000	0.00	0.00	0.00	0.002
65.683	0.000	0.00	0.00	0.00	0.002
65.867	0.000	0.00	0.00	0.00	0.001
66.050	0.000	0.00	0.00	0.00	0.001
66.233	0.000	0.00	0.00	0.00	0.001
66.417	0.000	0.00	0.00	0.00	0.001
66.600	0.000	0.00	0.00	0.00	0.001
66.783	0.000	0.00	0.00	0.00	0.001
66.967	0.000	0.00	0.00	0.00	0.001
67.150	0.000	0.00	0.00	0.00	0.001
67.333	0.000	0.00	0.00	0.00	0.001
67.517	0.000	0.00	0.00	0.00	0.001

INFILTRATION BASIN ROUTING: 25YR

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**************************************************************************
                     SMALL AREA UNIT HYDROGRAPH MODEL
==========================================================================
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                          Analysis prepared by:




**************************************************************************
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 Problem Descriptions:
  SHANDIN MHRC
  INFILTRATION BASIN ROUTING
  25 YR
--------------------------------------------------------------------------


    RATIONAL METHOD CALIBRATION COEFFICIENT = 1.00
    TOTAL CATCHMENT AREA(ACRES) =    5.95
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.002
    LOW LOSS FRACTION = 0.042
    TIME OF CONCENTRATION(MIN.) = 11.00
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    USER SPECIFIED RAINFALL VALUES ARE USED
    RETURN FREQUENCY(YEARS) =  25
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.37
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.96
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  1.45
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  2.23
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  3.07
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  5.62

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

    TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     2.74
    TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     0.05

**************************************************************************
  TIME     VOLUME       Q    0.        5.0      10.0      15.0      20.0
 (HOURS)    (AF)      (CFS)
--------------------------------------------------------------------------
  0.05      0.0000      0.00  Q         .         .         .         .
  0.23      0.0045      0.60  .Q        .         .         .         .
  0.42      0.0136      0.60  .Q        .         .         .         .
  0.60      0.0228      0.60  .Q        .         .         .         .
  0.78      0.0320      0.61  .Q        .         .         .         .
  0.97      0.0412      0.61  .Q        .         .         .         .
  1.15      0.0506      0.62  .Q        .         .         .         .
  1.33      0.0600      0.62  .Q        .         .         .         .
  1.52      0.0694      0.63  .Q        .         .         .         .
  1.70      0.0790      0.63  .Q        .         .         .         .
  1.88      0.0886      0.64  .Q        .         .         .         .
  2.07      0.0983      0.64  .Q        .         .         .         .
  2.25      0.1080      0.65  .Q        .         .         .         .
```

2.43	0.1178	0.65	.Q	.	.	.	.
2.62	0.1277	0.66	.Q	.	.	.	.
2.80	0.1377	0.66	.Q	.	.	.	.
2.98	0.1478	0.67	.Q	.	.	.	.
3.17	0.1579	0.67	.Q	.	.	.	.
3.35	0.1681	0.68	.Q	.	.	.	.
3.53	0.1784	0.68	.Q	.	.	.	.
3.72	0.1888	0.69	.Q	.	.	.	.
3.90	0.1993	0.69	.Q	.	.	.	.
4.08	0.2099	0.70	.Q	.	.	.	.
4.27	0.2205	0.71	.Q	.	.	.	.
4.45	0.2313	0.71	.Q	.	.	.	.
4.63	0.2421	0.72	.Q	.	.	.	.
4.82	0.2531	0.73	.Q	.	.	.	.
5.00	0.2641	0.73	.Q	.	.	.	.
5.18	0.2753	0.74	.Q	.	.	.	.
5.37	0.2866	0.75	.Q	.	.	.	.
5.55	0.2979	0.76	.Q	.	.	.	.
5.73	0.3094	0.76	.Q	.	.	.	.
5.92	0.3210	0.77	.Q	.	.	.	.
6.10	0.3327	0.78	.Q	.	.	.	.
6.28	0.3446	0.79	.Q	.	.	.	.
6.47	0.3566	0.79	.Q	.	.	.	.
6.65	0.3687	0.80	.Q	.	.	.	.
6.83	0.3809	0.81	.Q	.	.	.	.
7.02	0.3933	0.82	.Q	.	.	.	.
7.20	0.4058	0.83	.Q	.	.	.	.
7.38	0.4185	0.84	.Q	.	.	.	.
7.57	0.4313	0.85	.Q	.	.	.	.
7.75	0.4443	0.86	.Q	.	.	.	.
7.93	0.4574	0.87	.Q	.	.	.	.
8.12	0.4707	0.89	.Q	.	.	.	.
8.30	0.4842	0.89	.Q	.	.	.	.
8.48	0.4979	0.91	.Q	.	.	.	.
8.67	0.5117	0.92	.Q	.	.	.	.
8.85	0.5258	0.94	.Q	.	.	.	.
9.03	0.5400	0.95	.Q	.	.	.	.
9.22	0.5545	0.96	.Q	.	.	.	.
9.40	0.5692	0.97	.Q	.	.	.	.
9.58	0.5841	0.99	.Q	.	.	.	.
9.77	0.5993	1.01	. Q	.	.	.	.
9.95	0.6147	1.03	. Q	.	.	.	.
10.13	0.6303	1.04	. Q	.	.	.	.
10.32	0.6463	1.06	. Q	.	.	.	.
10.50	0.6625	1.08	. Q	.	.	.	.
10.68	0.6790	1.10	. Q	.	.	.	.
10.87	0.6959	1.12	. Q	.	.	.	.
11.05	0.7131	1.15	. Q	.	.	.	.
11.23	0.7306	1.17	. Q	.	.	.	.
11.42	0.7485	1.20	. Q	.	.	.	.
11.60	0.7668	1.22	. Q	.	.	.	.
11.78	0.7856	1.26	. Q	.	.	.	.
11.97	0.8048	1.28	. Q	.	.	.	.
12.15	0.8249	1.38	. Q	.	.	.	.
12.33	0.8461	1.42	. Q	.	.	.	.
12.52	0.8680	1.47	. Q	.	.	.	.
12.70	0.8905	1.50	. Q	.	.	.	.
12.88	0.9137	1.56	. Q	.	.	.	.
13.07	0.9376	1.59	. Q	.	.	.	.
13.25	0.9623	1.67	. Q	.	.	.	.
13.43	0.9879	1.71	. Q	.	.	.	.

13.62	1.0144	1.79	. Q . . . .
13.80	1.0420	1.84	. Q . . . .
13.98	1.0708	1.96	. Q . . . .
14.17	1.1000	1.91	. Q . . . .
14.35	1.1285	1.85	. Q . . . .
14.53	1.1572	1.94	. Q . . . .
14.72	1.1881	2.14	. Q . . . .
14.90	1.2214	2.26	. Q . . . .
15.08	1.2580	2.57	. Q . . . .
15.27	1.2985	2.78	. Q . . . .
15.45	1.3508	4.14	. Q . . . .
15.63	1.4239	5.51	. .Q . . . .
15.82	1.5149	6.52	. . Q . . . .
16.00	1.6258	8.12	. . Q . . . .
16.18	1.8267	18.39	. . . . Q .
16.37	2.0123	6.11	. . Q . . . .
16.55	2.0815	3.03	. Q . . . .
16.73	2.1226	2.40	. Q . . . .
16.92	2.1562	2.03	. Q . . . .
17.10	2.1851	1.78	. Q . . . .
17.28	2.2129	1.90	. Q . . . .
17.47	2.2406	1.75	. Q . . . .
17.65	2.2661	1.63	. Q . . . .
17.83	2.2901	1.53	. Q . . . .
18.02	2.3126	1.45	. Q . . . .
18.20	2.3334	1.30	. Q . . . .
18.38	2.3526	1.24	. Q . . . .
18.57	2.3710	1.18	. Q . . . .
18.75	2.3885	1.13	. Q . . . .
18.93	2.4054	1.09	. Q . . . .
19.12	2.4216	1.05	. Q . . . .
19.30	2.4373	1.02	. Q . . . .
19.48	2.4524	0.98	.Q . . . .
19.67	2.4671	0.95	.Q . . . .
19.85	2.4814	0.93	.Q . . . .
20.03	2.4952	0.90	.Q . . . .
20.22	2.5087	0.88	.Q . . . .
20.40	2.5219	0.86	.Q . . . .
20.58	2.5347	0.84	.Q . . . .
20.77	2.5472	0.82	.Q . . . .
20.95	2.5594	0.80	.Q . . . .
21.13	2.5714	0.78	.Q . . . .
21.32	2.5832	0.77	.Q . . . .
21.50	2.5946	0.75	.Q . . . .
21.68	2.6059	0.74	.Q . . . .
21.87	2.6170	0.72	.Q . . . .
22.05	2.6278	0.71	.Q . . . .
22.23	2.6385	0.70	.Q . . . .
22.42	2.6490	0.69	.Q . . . .
22.60	2.6593	0.67	.Q . . . .
22.78	2.6694	0.66	.Q . . . .
22.97	2.6794	0.65	.Q . . . .
23.15	2.6892	0.64	.Q . . . .
23.33	2.6989	0.63	.Q . . . .
23.52	2.7084	0.62	.Q . . . .
23.70	2.7178	0.62	.Q . . . .
23.88	2.7271	0.61	.Q . . . .
24.07	2.7362	0.60	.Q . . . .
24.25	2.7408	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)

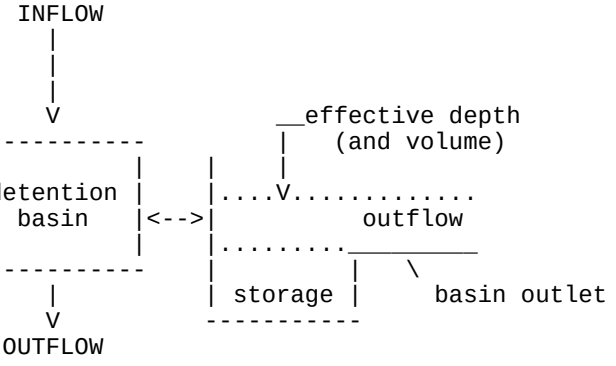
Percentile of Estimated Peak Flow Rate	Duration (minutes)
0%	1441.0
10%	209.0
20%	66.0
30%	44.0
40%	22.0
50%	11.0
60%	11.0
70%	11.0
80%	11.0
90%	11.0

Problem Descriptions:
SHANDIN MHRC
INFILTRATION BASIN ROUTING
25 YR

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FLOW-THROUGH DETENTION BASIN MODEL

SPECIFIED BASIN CONDITIONS ARE AS FOLLOWS:
CONSTANT HYDROGRAPH TIME UNIT(MINUTES) = 11.000
DEAD STORAGE(AF) = 0.00
SPECIFIED DEAD STORAGE(AF) FILLED = 0.00
ASSUMED INITIAL DEPTH(FEET) IN STORAGE BASIN = 0.00



DEPTH-VS.-STORAGE AND DEPTH-VS.-DISCHARGE INFORMATION:
TOTAL NUMBER OF BASIN DEPTH INFORMATION ENTRIES = 20

*BASIN-DEPTH (FEET)	STORAGE (ACRE-FEET)	OUTFLOW (CFS)	**	BASIN-DEPTH (FEET)	STORAGE (ACRE-FEET)	OUTFLOW (CFS)	*
0.000	0.000	0.000**		0.500	0.239	0.640*	
1.000	0.477	0.640**		1.500	0.716	0.640*	
2.000	0.955	0.640**		2.500	1.193	0.640*	
3.000	1.432	0.640**		3.500	1.670	0.640*	
4.000	1.909	0.640**		4.500	2.148	0.640*	
5.000	2.386	0.640**		5.500	2.625	0.640*	

```
*      6.000      2.864      0.640**      6.500      1.994      0.340*
*      7.000      2.148      0.340**      7.500      2.301      0.340*
*      8.000      2.455      0.340**      8.500      2.608      0.340*
*      9.000      2.761      0.340**      9.500      2.915      0.340*
-------------------------------------------------------------------------------
     BASIN STORAGE, OUTFLOW AND DEPTH ROUTING VALUES:
      INTERVAL   DEPTH   {S-O*DT/2}   {S+O*DT/2}
       NUMBER   (FEET)   (ACRE-FEET)  (ACRE-FEET)
           1     0.00       0.00000      0.00000
           2     0.50       0.23415      0.24385
           3     1.00       0.47215      0.48185
           4     1.50       0.71115      0.72085
           5     2.00       0.95015      0.95985
           6     2.50       1.18815      1.19785
           7     3.00       1.42715      1.43685
           8     3.50       1.66515      1.67485
           9     4.00       1.90415      1.91385
          10     4.50       2.14315      2.15285
          11     5.00       2.38115      2.39085
          12     5.50       2.62015      2.62985
          13     6.00       2.85915      2.86885
          14     6.50       1.99142      1.99658
          15     7.00       2.14542      2.15058
          16     7.50       2.29842      2.30358
          17     8.00       2.45242      2.45758
          18     8.50       2.60542      2.61058
          19     9.00       2.75842      2.76358
          20     9.50       2.91242      2.91758
     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  DEAD-STORAGE  INFLOW  EFFECTIVE  OUTFLOW  EFFECTIVE
       (HRS)   FILLED(AF)    (CFS)  DEPTH(FT)   (CFS)   VOLUME(AF)
-------------------------------------------------------------------------------
       0.050        0.000     0.00      0.00     0.00      0.000
       0.233        0.000     0.60      0.02     0.01      0.009
       0.417        0.000     0.60      0.04     0.04      0.017
       0.600        0.000     0.60      0.05     0.06      0.026
       0.783        0.000     0.61      0.07     0.08      0.034
       0.967        0.000     0.61      0.09     0.10      0.042
       1.150        0.000     0.62      0.10     0.12      0.049
       1.333        0.000     0.62      0.12     0.14      0.056
       1.517        0.000     0.63      0.13     0.16      0.063
       1.700        0.000     0.63      0.15     0.18      0.070
       1.883        0.000     0.64      0.16     0.20      0.077
       2.067        0.000     0.64      0.17     0.21      0.083
       2.250        0.000     0.65      0.19     0.23      0.090
       2.433        0.000     0.65      0.20     0.25      0.096
       2.617        0.000     0.66      0.21     0.26      0.102
       2.800        0.000     0.66      0.22     0.28      0.107
       2.983        0.000     0.67      0.24     0.30      0.113
       3.167        0.000     0.67      0.25     0.31      0.119
       3.350        0.000     0.68      0.26     0.32      0.124
       3.533        0.000     0.68      0.27     0.34      0.129
       3.717        0.000     0.69      0.28     0.35      0.134
       3.900        0.000     0.69      0.29     0.37      0.139
       4.083        0.000     0.70      0.30     0.38      0.144
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4.267	0.000	0.71	0.31	0.39	0.149
4.450	0.000	0.71	0.32	0.40	0.154
4.633	0.000	0.72	0.33	0.42	0.158
4.817	0.000	0.73	0.34	0.43	0.163
5.000	0.000	0.73	0.35	0.44	0.167
5.183	0.000	0.74	0.36	0.45	0.171
5.367	0.000	0.75	0.37	0.46	0.176
5.550	0.000	0.76	0.38	0.48	0.180
5.733	0.000	0.76	0.38	0.49	0.184
5.917	0.000	0.77	0.39	0.50	0.188
6.100	0.000	0.78	0.40	0.51	0.192
6.283	0.000	0.79	0.41	0.52	0.196
6.467	0.000	0.79	0.42	0.53	0.200
6.650	0.000	0.80	0.43	0.54	0.204
6.833	0.000	0.81	0.44	0.55	0.208
7.017	0.000	0.82	0.44	0.56	0.212
7.200	0.000	0.83	0.45	0.57	0.216
7.383	0.000	0.84	0.46	0.58	0.220
7.567	0.000	0.85	0.47	0.59	0.224
7.750	0.000	0.86	0.48	0.60	0.228
7.933	0.000	0.87	0.48	0.61	0.232
8.117	0.000	0.89	0.49	0.63	0.236
8.300	0.000	0.89	0.50	0.64	0.239
8.483	0.000	0.91	0.51	0.64	0.244
8.667	0.000	0.92	0.52	0.64	0.248
8.850	0.000	0.94	0.53	0.64	0.252
9.033	0.000	0.95	0.54	0.64	0.257
9.217	0.000	0.96	0.55	0.64	0.262
9.400	0.000	0.97	0.56	0.64	0.267
9.583	0.000	0.99	0.57	0.64	0.272
9.767	0.000	1.01	0.58	0.64	0.278
9.950	0.000	1.03	0.59	0.64	0.284
10.133	0.000	1.04	0.61	0.64	0.290
10.317	0.000	1.06	0.62	0.64	0.296
10.500	0.000	1.08	0.63	0.64	0.303
10.683	0.000	1.10	0.65	0.64	0.310
10.867	0.000	1.12	0.66	0.64	0.317
11.050	0.000	1.15	0.68	0.64	0.325
11.233	0.000	1.17	0.70	0.64	0.333
11.417	0.000	1.20	0.71	0.64	0.341
11.600	0.000	1.22	0.73	0.64	0.350
11.783	0.000	1.26	0.75	0.64	0.359
11.967	0.000	1.28	0.77	0.64	0.369
12.150	0.000	1.38	0.80	0.64	0.380
12.333	0.000	1.42	0.82	0.64	0.392
12.517	0.000	1.47	0.85	0.64	0.405
12.700	0.000	1.50	0.88	0.64	0.418
12.883	0.000	1.56	0.90	0.64	0.432
13.067	0.000	1.59	0.93	0.64	0.446
13.250	0.000	1.67	0.97	0.64	0.462
13.433	0.000	1.71	1.00	0.64	0.478
13.617	0.000	1.79	1.04	0.64	0.495
13.800	0.000	1.84	1.08	0.64	0.513
13.983	0.000	1.96	1.12	0.64	0.533
14.167	0.000	1.91	1.16	0.64	0.553
14.350	0.000	1.85	1.20	0.64	0.571
14.533	0.000	1.94	1.24	0.64	0.591
14.717	0.000	2.14	1.29	0.64	0.613
14.900	0.000	2.26	1.34	0.64	0.638
15.083	0.000	2.57	1.40	0.64	0.667
15.267	0.000	2.78	1.47	0.64	0.699

15.450	0.000	4.14	1.58	0.64	0.752
15.633	0.000	5.51	1.73	0.64	0.826
15.817	0.000	6.52	1.92	0.64	0.915
16.000	0.000	8.12	2.15	0.64	1.029
16.183	0.000	18.39	2.72	0.64	1.297
16.367	0.000	6.11	2.89	0.64	1.380
16.550	0.000	3.03	2.97	0.64	1.417
16.733	0.000	2.40	3.02	0.64	1.443
16.917	0.000	2.03	3.07	0.64	1.464
17.100	0.000	1.78	3.10	0.64	1.482
17.283	0.000	1.90	3.14	0.64	1.501
17.467	0.000	1.75	3.18	0.64	1.517
17.650	0.000	1.63	3.21	0.64	1.532
17.833	0.000	1.53	3.24	0.64	1.546
18.017	0.000	1.45	3.26	0.64	1.558
18.200	0.000	1.30	3.29	0.64	1.568
18.383	0.000	1.24	3.30	0.64	1.577
18.567	0.000	1.18	3.32	0.64	1.585
18.750	0.000	1.13	3.34	0.64	1.593
18.933	0.000	1.09	3.35	0.64	1.600
19.117	0.000	1.05	3.37	0.64	1.606
19.300	0.000	1.02	3.38	0.64	1.612
19.483	0.000	0.98	3.39	0.64	1.617
19.667	0.000	0.95	3.40	0.64	1.622
19.850	0.000	0.93	3.41	0.64	1.626
20.033	0.000	0.90	3.42	0.64	1.630
20.217	0.000	0.88	3.42	0.64	1.634
20.400	0.000	0.86	3.43	0.64	1.637
20.583	0.000	0.84	3.44	0.64	1.640
20.767	0.000	0.82	3.44	0.64	1.642
20.950	0.000	0.80	3.45	0.64	1.645
21.133	0.000	0.78	3.45	0.64	1.647
21.317	0.000	0.77	3.46	0.64	1.649
21.500	0.000	0.75	3.46	0.64	1.651
21.683	0.000	0.74	3.46	0.64	1.652
21.867	0.000	0.72	3.46	0.64	1.653
22.050	0.000	0.71	3.47	0.64	1.654
22.233	0.000	0.70	3.47	0.64	1.655
22.417	0.000	0.69	3.47	0.64	1.656
22.600	0.000	0.67	3.47	0.64	1.656
22.783	0.000	0.66	3.47	0.64	1.657
22.967	0.000	0.65	3.47	0.64	1.657
23.150	0.000	0.64	3.47	0.64	1.657
23.333	0.000	0.63	3.47	0.64	1.657
23.517	0.000	0.62	3.47	0.64	1.657
23.700	0.000	0.62	3.47	0.64	1.656
23.883	0.000	0.61	3.47	0.64	1.656
24.067	0.000	0.60	3.47	0.64	1.655
24.250	0.000	0.00	3.45	0.64	1.646
24.433	0.000	0.00	3.43	0.64	1.636
24.617	0.000	0.00	3.41	0.64	1.626
24.800	0.000	0.00	3.39	0.64	1.616
24.983	0.000	0.00	3.37	0.64	1.607
25.167	0.000	0.00	3.35	0.64	1.597
25.350	0.000	0.00	3.33	0.64	1.587
25.533	0.000	0.00	3.31	0.64	1.578
25.717	0.000	0.00	3.29	0.64	1.568
25.900	0.000	0.00	3.27	0.64	1.558
26.083	0.000	0.00	3.24	0.64	1.549
26.267	0.000	0.00	3.22	0.64	1.539
26.450	0.000	0.00	3.20	0.64	1.529

26.633	0.000	0.00	3.18	0.64	1.520
26.817	0.000	0.00	3.16	0.64	1.510
27.000	0.000	0.00	3.14	0.64	1.500
27.183	0.000	0.00	3.12	0.64	1.490
27.367	0.000	0.00	3.10	0.64	1.481
27.550	0.000	0.00	3.08	0.64	1.471
27.733	0.000	0.00	3.06	0.64	1.461
27.917	0.000	0.00	3.04	0.64	1.452
28.100	0.000	0.00	3.02	0.64	1.442
28.283	0.000	0.00	3.00	0.64	1.432
28.467	0.000	0.00	2.98	0.64	1.423
28.650	0.000	0.00	2.96	0.64	1.413
28.833	0.000	0.00	2.94	0.64	1.403
29.017	0.000	0.00	2.92	0.64	1.393
29.200	0.000	0.00	2.90	0.64	1.384
29.383	0.000	0.00	2.88	0.64	1.374
29.567	0.000	0.00	2.86	0.64	1.364
29.750	0.000	0.00	2.84	0.64	1.355
29.933	0.000	0.00	2.82	0.64	1.345
30.117	0.000	0.00	2.80	0.64	1.335
30.300	0.000	0.00	2.78	0.64	1.326
30.483	0.000	0.00	2.76	0.64	1.316
30.667	0.000	0.00	2.74	0.64	1.306
30.850	0.000	0.00	2.72	0.64	1.296
31.033	0.000	0.00	2.70	0.64	1.287
31.217	0.000	0.00	2.68	0.64	1.277
31.400	0.000	0.00	2.66	0.64	1.267
31.583	0.000	0.00	2.64	0.64	1.258
31.767	0.000	0.00	2.62	0.64	1.248
31.950	0.000	0.00	2.59	0.64	1.238
32.133	0.000	0.00	2.57	0.64	1.229
32.317	0.000	0.00	2.55	0.64	1.219
32.500	0.000	0.00	2.53	0.64	1.209
32.683	0.000	0.00	2.51	0.64	1.200
32.867	0.000	0.00	2.49	0.64	1.190
33.050	0.000	0.00	2.47	0.64	1.180
33.233	0.000	0.00	2.45	0.64	1.170
33.417	0.000	0.00	2.43	0.64	1.161
33.600	0.000	0.00	2.41	0.64	1.151
33.783	0.000	0.00	2.39	0.64	1.141
33.967	0.000	0.00	2.37	0.64	1.132
34.150	0.000	0.00	2.35	0.64	1.122
34.333	0.000	0.00	2.33	0.64	1.112
34.517	0.000	0.00	2.31	0.64	1.103
34.700	0.000	0.00	2.29	0.64	1.093
34.883	0.000	0.00	2.27	0.64	1.083
35.067	0.000	0.00	2.25	0.64	1.073
35.250	0.000	0.00	2.23	0.64	1.064
35.433	0.000	0.00	2.21	0.64	1.054
35.617	0.000	0.00	2.19	0.64	1.044
35.800	0.000	0.00	2.17	0.64	1.035
35.983	0.000	0.00	2.15	0.64	1.025
36.167	0.000	0.00	2.13	0.64	1.015
36.350	0.000	0.00	2.11	0.64	1.006
36.533	0.000	0.00	2.09	0.64	0.996
36.717	0.000	0.00	2.07	0.64	0.986
36.900	0.000	0.00	2.05	0.64	0.976
37.083	0.000	0.00	2.02	0.64	0.967
37.267	0.000	0.00	2.00	0.64	0.957
37.450	0.000	0.00	1.98	0.64	0.947
37.633	0.000	0.00	1.96	0.64	0.938

37.817	0.000	0.00	1.94	0.64	0.928
38.000	0.000	0.00	1.92	0.64	0.918
38.183	0.000	0.00	1.90	0.64	0.909
38.367	0.000	0.00	1.88	0.64	0.899
38.550	0.000	0.00	1.86	0.64	0.889
38.733	0.000	0.00	1.84	0.64	0.880
38.917	0.000	0.00	1.82	0.64	0.870
39.100	0.000	0.00	1.80	0.64	0.860
39.283	0.000	0.00	1.78	0.64	0.850
39.467	0.000	0.00	1.76	0.64	0.841
39.650	0.000	0.00	1.74	0.64	0.831
39.833	0.000	0.00	1.72	0.64	0.821
40.017	0.000	0.00	1.70	0.64	0.812
40.200	0.000	0.00	1.68	0.64	0.802
40.383	0.000	0.00	1.66	0.64	0.792
40.567	0.000	0.00	1.64	0.64	0.783
40.750	0.000	0.00	1.62	0.64	0.773
40.933	0.000	0.00	1.60	0.64	0.763
41.117	0.000	0.00	1.58	0.64	0.753
41.300	0.000	0.00	1.56	0.64	0.744
41.483	0.000	0.00	1.54	0.64	0.734
41.667	0.000	0.00	1.52	0.64	0.724
41.850	0.000	0.00	1.50	0.64	0.715
42.033	0.000	0.00	1.48	0.64	0.705
42.217	0.000	0.00	1.46	0.64	0.695
42.400	0.000	0.00	1.44	0.64	0.686
42.583	0.000	0.00	1.42	0.64	0.676
42.767	0.000	0.00	1.40	0.64	0.666
42.950	0.000	0.00	1.38	0.64	0.656
43.133	0.000	0.00	1.36	0.64	0.647
43.317	0.000	0.00	1.33	0.64	0.637
43.500	0.000	0.00	1.31	0.64	0.627
43.683	0.000	0.00	1.29	0.64	0.618
43.867	0.000	0.00	1.27	0.64	0.608
44.050	0.000	0.00	1.25	0.64	0.598
44.233	0.000	0.00	1.23	0.64	0.589
44.417	0.000	0.00	1.21	0.64	0.579
44.600	0.000	0.00	1.19	0.64	0.569
44.783	0.000	0.00	1.17	0.64	0.560
44.967	0.000	0.00	1.15	0.64	0.550
45.150	0.000	0.00	1.13	0.64	0.540
45.333	0.000	0.00	1.11	0.64	0.530
45.517	0.000	0.00	1.09	0.64	0.521
45.700	0.000	0.00	1.07	0.64	0.511
45.883	0.000	0.00	1.05	0.64	0.501
46.067	0.000	0.00	1.03	0.64	0.492
46.250	0.000	0.00	1.01	0.64	0.482
46.433	0.000	0.00	0.99	0.64	0.472
46.617	0.000	0.00	0.97	0.64	0.463
46.800	0.000	0.00	0.95	0.64	0.453
46.983	0.000	0.00	0.93	0.64	0.443
47.167	0.000	0.00	0.91	0.64	0.433
47.350	0.000	0.00	0.89	0.64	0.424
47.533	0.000	0.00	0.87	0.64	0.414
47.717	0.000	0.00	0.85	0.64	0.404
47.900	0.000	0.00	0.83	0.64	0.395
48.083	0.000	0.00	0.81	0.64	0.385
48.267	0.000	0.00	0.79	0.64	0.375
48.450	0.000	0.00	0.77	0.64	0.366
48.633	0.000	0.00	0.75	0.64	0.356
48.817	0.000	0.00	0.73	0.64	0.346

49.000	0.000	0.00	0.70	0.64	0.336
49.183	0.000	0.00	0.68	0.64	0.327
49.367	0.000	0.00	0.66	0.64	0.317
49.550	0.000	0.00	0.64	0.64	0.307
49.733	0.000	0.00	0.62	0.64	0.298
49.917	0.000	0.00	0.60	0.64	0.288
50.100	0.000	0.00	0.58	0.64	0.278
50.283	0.000	0.00	0.56	0.64	0.269
50.467	0.000	0.00	0.54	0.64	0.259
50.650	0.000	0.00	0.52	0.64	0.249
50.833	0.000	0.00	0.50	0.64	0.240
51.017	0.000	0.00	0.48	0.63	0.230
51.200	0.000	0.00	0.46	0.60	0.221
51.383	0.000	0.00	0.44	0.58	0.212
51.567	0.000	0.00	0.43	0.56	0.204
51.750	0.000	0.00	0.41	0.53	0.196
51.933	0.000	0.00	0.39	0.51	0.188
52.117	0.000	0.00	0.38	0.49	0.180
52.300	0.000	0.00	0.36	0.47	0.173
52.483	0.000	0.00	0.35	0.45	0.166
52.667	0.000	0.00	0.33	0.44	0.160
52.850	0.000	0.00	0.32	0.42	0.153
53.033	0.000	0.00	0.31	0.40	0.147
53.217	0.000	0.00	0.30	0.39	0.141
53.400	0.000	0.00	0.28	0.37	0.136
53.583	0.000	0.00	0.27	0.36	0.130
53.767	0.000	0.00	0.26	0.34	0.125
53.950	0.000	0.00	0.25	0.33	0.120
54.133	0.000	0.00	0.24	0.32	0.115
54.317	0.000	0.00	0.23	0.30	0.111
54.500	0.000	0.00	0.22	0.29	0.106
54.683	0.000	0.00	0.21	0.28	0.102
54.867	0.000	0.00	0.21	0.27	0.098
55.050	0.000	0.00	0.20	0.26	0.094
55.233	0.000	0.00	0.19	0.25	0.090
55.417	0.000	0.00	0.18	0.24	0.087
55.600	0.000	0.00	0.17	0.23	0.083
55.783	0.000	0.00	0.17	0.22	0.080
55.967	0.000	0.00	0.16	0.21	0.077
56.150	0.000	0.00	0.15	0.20	0.074
56.333	0.000	0.00	0.15	0.19	0.071
56.517	0.000	0.00	0.14	0.19	0.068
56.700	0.000	0.00	0.14	0.18	0.065
56.883	0.000	0.00	0.13	0.17	0.063
57.067	0.000	0.00	0.13	0.16	0.060
57.250	0.000	0.00	0.12	0.16	0.058
57.433	0.000	0.00	0.12	0.15	0.056
57.617	0.000	0.00	0.11	0.15	0.053
57.800	0.000	0.00	0.11	0.14	0.051
57.983	0.000	0.00	0.10	0.13	0.049
58.167	0.000	0.00	0.10	0.13	0.047
58.350	0.000	0.00	0.09	0.12	0.045
58.533	0.000	0.00	0.09	0.12	0.044
58.717	0.000	0.00	0.09	0.11	0.042
58.900	0.000	0.00	0.08	0.11	0.040
59.083	0.000	0.00	0.08	0.11	0.039
59.267	0.000	0.00	0.08	0.10	0.037
59.450	0.000	0.00	0.07	0.10	0.036
59.633	0.000	0.00	0.07	0.09	0.034
59.817	0.000	0.00	0.07	0.09	0.033
60.000	0.000	0.00	0.07	0.09	0.031

60.183	0.000	0.00	0.06	0.08	0.030
60.367	0.000	0.00	0.06	0.08	0.029
60.550	0.000	0.00	0.06	0.08	0.028
60.733	0.000	0.00	0.06	0.07	0.027
60.917	0.000	0.00	0.05	0.07	0.026
61.100	0.000	0.00	0.05	0.07	0.025
61.283	0.000	0.00	0.05	0.06	0.024
61.467	0.000	0.00	0.05	0.06	0.023
61.650	0.000	0.00	0.05	0.06	0.022
61.833	0.000	0.00	0.04	0.06	0.021
62.017	0.000	0.00	0.04	0.06	0.020
62.200	0.000	0.00	0.04	0.05	0.019
62.383	0.000	0.00	0.04	0.05	0.019
62.567	0.000	0.00	0.04	0.05	0.018
62.750	0.000	0.00	0.04	0.05	0.017
62.933	0.000	0.00	0.03	0.04	0.016
63.117	0.000	0.00	0.03	0.04	0.016
63.300	0.000	0.00	0.03	0.04	0.015
63.483	0.000	0.00	0.03	0.04	0.015
63.667	0.000	0.00	0.03	0.04	0.014
63.850	0.000	0.00	0.03	0.04	0.013
64.033	0.000	0.00	0.03	0.04	0.013
64.217	0.000	0.00	0.03	0.03	0.012
64.400	0.000	0.00	0.02	0.03	0.012
64.583	0.000	0.00	0.02	0.03	0.011
64.767	0.000	0.00	0.02	0.03	0.011
64.950	0.000	0.00	0.02	0.03	0.011
65.133	0.000	0.00	0.02	0.03	0.010
65.317	0.000	0.00	0.02	0.03	0.010
65.500	0.000	0.00	0.02	0.03	0.009
65.683	0.000	0.00	0.02	0.02	0.009
65.867	0.000	0.00	0.02	0.02	0.009
66.050	0.000	0.00	0.02	0.02	0.008
66.233	0.000	0.00	0.02	0.02	0.008
66.417	0.000	0.00	0.02	0.02	0.008
66.600	0.000	0.00	0.02	0.02	0.007
66.783	0.000	0.00	0.01	0.02	0.007
66.967	0.000	0.00	0.01	0.02	0.007
67.150	0.000	0.00	0.01	0.02	0.006
67.333	0.000	0.00	0.01	0.02	0.006
67.517	0.000	0.00	0.01	0.02	0.006
67.700	0.000	0.00	0.01	0.02	0.006
67.883	0.000	0.00	0.01	0.02	0.006
68.067	0.000	0.00	0.01	0.01	0.005
68.250	0.000	0.00	0.01	0.01	0.005
68.433	0.000	0.00	0.01	0.01	0.005
68.617	0.000	0.00	0.01	0.01	0.005
68.800	0.000	0.00	0.01	0.01	0.004
68.983	0.000	0.00	0.01	0.01	0.004
69.167	0.000	0.00	0.01	0.01	0.004
69.350	0.000	0.00	0.01	0.01	0.004
69.534	0.000	0.00	0.01	0.01	0.004
69.717	0.000	0.00	0.01	0.01	0.004
69.900	0.000	0.00	0.01	0.01	0.004
70.084	0.000	0.00	0.01	0.01	0.003
70.267	0.000	0.00	0.01	0.01	0.003
70.450	0.000	0.00	0.01	0.01	0.003
70.634	0.000	0.00	0.01	0.01	0.003
70.817	0.000	0.00	0.01	0.01	0.003
71.000	0.000	0.00	0.01	0.01	0.003
71.184	0.000	0.00	0.01	0.01	0.003

71.367	0.000	0.00	0.01	0.01	0.003
71.550	0.000	0.00	0.01	0.01	0.002
71.734	0.000	0.00	0.00	0.01	0.002
71.917	0.000	0.00	0.00	0.01	0.002
72.100	0.000	0.00	0.00	0.01	0.002
72.284	0.000	0.00	0.00	0.01	0.002
72.467	0.000	0.00	0.00	0.01	0.002
72.650	0.000	0.00	0.00	0.01	0.002
72.834	0.000	0.00	0.00	0.01	0.002
73.017	0.000	0.00	0.00	0.00	0.002
73.200	0.000	0.00	0.00	0.00	0.002
73.384	0.000	0.00	0.00	0.00	0.002
73.567	0.000	0.00	0.00	0.00	0.002
73.750	0.000	0.00	0.00	0.00	0.002
73.934	0.000	0.00	0.00	0.00	0.001
74.117	0.000	0.00	0.00	0.00	0.001
74.300	0.000	0.00	0.00	0.00	0.001
74.484	0.000	0.00	0.00	0.00	0.001
74.667	0.000	0.00	0.00	0.00	0.001
74.850	0.000	0.00	0.00	0.00	0.001
75.034	0.000	0.00	0.00	0.00	0.001
75.217	0.000	0.00	0.00	0.00	0.001
75.400	0.000	0.00	0.00	0.00	0.001
75.584	0.000	0.00	0.00	0.00	0.001

INFILTRATION BASIN ROUTING: 100YR

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**************************************************************************
                     SMALL AREA UNIT HYDROGRAPH MODEL
==========================================================================
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                          Analysis prepared by:




**************************************************************************
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 Problem Descriptions:
  SHANDIN MHRC
  ROUTING ANALYSIS
  25344 SQFT BASE FOR INF, INF=1.09, 20790 SQFT FOR VOLUME
--------------------------------------------------------------------------


    RATIONAL METHOD CALIBRATION COEFFICIENT = 1.00
    TOTAL CATCHMENT AREA(ACRES) =    5.95
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.002
    LOW LOSS FRACTION = 0.030
    TIME OF CONCENTRATION(MIN.) = 11.00
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    USER SPECIFIED RAINFALL VALUES ARE USED
    RETURN FREQUENCY(YEARS) = 100
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.51
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  1.31
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  1.97
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  2.89
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  3.91
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  7.11

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

    TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     3.47
    TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     0.05

**************************************************************************
  TIME     VOLUME       Q    0.        7.5      15.0      22.5      30.0
 (HOURS)    (AF)      (CFS)
--------------------------------------------------------------------------
  0.05      0.0000      0.00  Q         .         .         .         .
  0.23      0.0057      0.75  Q         .         .         .         .
  0.42      0.0171      0.76  .Q        .         .         .         .
  0.60      0.0286      0.76  .Q        .         .         .         .
  0.78      0.0401      0.77  .Q        .         .         .         .
  0.97      0.0518      0.77  .Q        .         .         .         .
  1.15      0.0635      0.78  .Q        .         .         .         .
  1.33      0.0753      0.78  .Q        .         .         .         .
  1.52      0.0872      0.79  .Q        .         .         .         .
  1.70      0.0992      0.79  .Q        .         .         .         .
  1.88      0.1113      0.80  .Q        .         .         .         .
  2.07      0.1234      0.80  .Q        .         .         .         .
  2.25      0.1357      0.81  .Q        .         .         .         .
```

2.43	0.1480	0.82	.Q	.	.	.	.
2.62	0.1605	0.83	.Q	.	.	.	.
2.80	0.1730	0.83	.Q	.	.	.	.
2.98	0.1857	0.84	.Q	.	.	.	.
3.17	0.1984	0.84	.Q	.	.	.	.
3.35	0.2112	0.85	.Q	.	.	.	.
3.53	0.2242	0.86	.Q	.	.	.	.
3.72	0.2373	0.87	.Q	.	.	.	.
3.90	0.2504	0.87	.Q	.	.	.	.
4.08	0.2637	0.88	.Q	.	.	.	.
4.27	0.2771	0.89	.Q	.	.	.	.
4.45	0.2906	0.90	.Q	.	.	.	.
4.63	0.3043	0.90	.Q	.	.	.	.
4.82	0.3180	0.91	.Q	.	.	.	.
5.00	0.3319	0.92	.Q	.	.	.	.
5.18	0.3460	0.93	.Q	.	.	.	.
5.37	0.3601	0.94	.Q	.	.	.	.
5.55	0.3744	0.95	.Q	.	.	.	.
5.73	0.3889	0.96	.Q	.	.	.	.
5.92	0.4035	0.97	.Q	.	.	.	.
6.10	0.4182	0.98	.Q	.	.	.	.
6.28	0.4331	0.99	.Q	.	.	.	.
6.47	0.4482	1.00	.Q	.	.	.	.
6.65	0.4634	1.01	.Q	.	.	.	.
6.83	0.4788	1.02	.Q	.	.	.	.
7.02	0.4944	1.04	.Q	.	.	.	.
7.20	0.5102	1.04	.Q	.	.	.	.
7.38	0.5261	1.06	.Q	.	.	.	.
7.57	0.5422	1.07	.Q	.	.	.	.
7.75	0.5586	1.09	.Q	.	.	.	.
7.93	0.5751	1.10	.Q	.	.	.	.
8.12	0.5919	1.12	.Q	.	.	.	.
8.30	0.6088	1.13	.Q	.	.	.	.
8.48	0.6260	1.15	.Q	.	.	.	.
8.67	0.6435	1.16	.Q	.	.	.	.
8.85	0.6612	1.18	.Q	.	.	.	.
9.03	0.6791	1.19	.Q	.	.	.	.
9.22	0.6973	1.21	.Q	.	.	.	.
9.40	0.7158	1.23	.Q	.	.	.	.
9.58	0.7346	1.25	.Q	.	.	.	.
9.77	0.7537	1.27	.Q	.	.	.	.
9.95	0.7731	1.29	.Q	.	.	.	.
10.13	0.7928	1.31	.Q	.	.	.	.
10.32	0.8129	1.34	.Q	.	.	.	.
10.50	0.8334	1.36	.Q	.	.	.	.
10.68	0.8542	1.39	.Q	.	.	.	.
10.87	0.8754	1.41	.Q	.	.	.	.
11.05	0.8971	1.45	.Q	.	.	.	.
11.23	0.9192	1.47	.Q	.	.	.	.
11.42	0.9418	1.51	. Q	.	.	.	.
11.60	0.9649	1.54	. Q	.	.	.	.
11.78	0.9886	1.59	. Q	.	.	.	.
11.97	1.0128	1.61	. Q	.	.	.	.
12.15	1.0377	1.68	. Q	.	.	.	.
12.33	1.0635	1.72	. Q	.	.	.	.
12.52	1.0899	1.78	. Q	.	.	.	.
12.70	1.1172	1.82	. Q	.	.	.	.
12.88	1.1453	1.89	. Q	.	.	.	.
13.07	1.1743	1.93	. Q	.	.	.	.
13.25	1.2043	2.03	. Q	.	.	.	.
13.43	1.2354	2.08	. Q	.	.	.	.

13.62	1.2677	2.19	. Q . . . .
13.80	1.3014	2.25	. Q . . . .
13.98	1.3366	2.40	. Q . . . .
14.17	1.3721	2.29	. Q . . . .
14.35	1.4058	2.15	. Q . . . .
14.53	1.4392	2.25	. Q . . . .
14.72	1.4752	2.50	. Q . . . .
14.90	1.5143	2.66	. Q . . . .
15.08	1.5576	3.05	. Q . . . .
15.27	1.6058	3.31	. Q . . . .
15.45	1.6714	5.34	. Q . . . .
15.63	1.7684	7.46	. Q. . . .
15.82	1.8920	8.85	. .Q . . .
16.00	2.0426	11.03	. . Q . . .
16.18	2.3160	25.06	. . . . Q .
16.37	2.5686	8.29	. .Q . . .
16.55	2.6589	3.64	. Q . . . .
16.73	2.7080	2.84	. Q . . . .
16.92	2.7474	2.37	. Q . . . .
17.10	2.7810	2.06	. Q . . . .
17.28	2.8142	2.32	. Q . . . .
17.47	2.8479	2.13	. Q . . . .
17.65	2.8791	1.98	. Q . . . .
17.83	2.9081	1.85	. Q . . . .
18.02	2.9354	1.75	. Q . . . .
18.20	2.9610	1.64	. Q . . . .
18.38	2.9853	1.56	. Q . . . .
18.57	3.0084	1.49	.Q . . . .
18.75	3.0305	1.43	.Q . . . .
18.93	3.0517	1.37	.Q . . . .
19.12	3.0722	1.33	.Q . . . .
19.30	3.0919	1.28	.Q . . . .
19.48	3.1110	1.24	.Q . . . .
19.67	3.1295	1.20	.Q . . . .
19.85	3.1475	1.17	.Q . . . .
20.03	3.1649	1.14	.Q . . . .
20.22	3.1819	1.11	.Q . . . .
20.40	3.1985	1.08	.Q . . . .
20.58	3.2146	1.05	.Q . . . .
20.77	3.2303	1.03	.Q . . . .
20.95	3.2457	1.01	.Q . . . .
21.13	3.2608	0.98	.Q . . . .
21.32	3.2756	0.96	.Q . . . .
21.50	3.2900	0.94	.Q . . . .
21.68	3.3042	0.93	.Q . . . .
21.87	3.3181	0.91	.Q . . . .
22.05	3.3317	0.89	.Q . . . .
22.23	3.3451	0.88	.Q . . . .
22.42	3.3583	0.86	.Q . . . .
22.60	3.3712	0.85	.Q . . . .
22.78	3.3840	0.83	.Q . . . .
22.97	3.3965	0.82	.Q . . . .
23.15	3.4089	0.81	.Q . . . .
23.33	3.4210	0.80	.Q . . . .
23.52	3.4330	0.79	.Q . . . .
23.70	3.4448	0.77	.Q . . . .
23.88	3.4565	0.76	.Q . . . .
24.07	3.4680	0.75	.Q . . . .
24.25	3.4737	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)

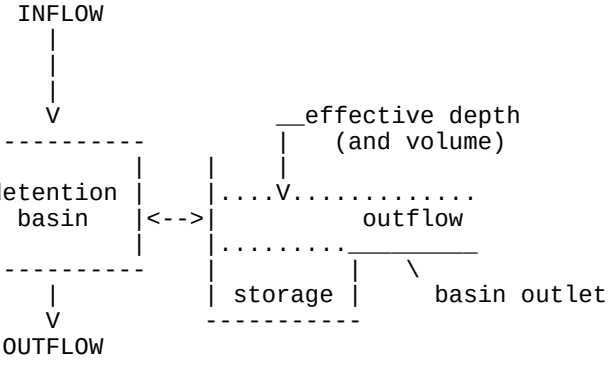
Percentile of Estimated Peak Flow Rate	Duration (minutes)
0%	1441.0
10%	121.0
20%	66.0
30%	44.0
40%	22.0
50%	11.0
60%	11.0
70%	11.0
80%	11.0
90%	11.0

Problem Descriptions:
SHANDIN MHRC
ROUTING ANALYSIS
25344 SQFT BASE FOR INF, INF=1.09, 20790 SQFT FOR VOLUME

==========

FLOW-THROUGH DETENTION BASIN MODEL

SPECIFIED BASIN CONDITIONS ARE AS FOLLOWS:
CONSTANT HYDROGRAPH TIME UNIT(MINUTES) = 11.000
DEAD STORAGE(AF) = 0.00
SPECIFIED DEAD STORAGE(AF) FILLED = 0.00
ASSUMED INITIAL DEPTH(FEET) IN STORAGE BASIN = 0.00



DEPTH-VS.-STORAGE AND DEPTH-VS.-DISCHARGE INFORMATION:
TOTAL NUMBER OF BASIN DEPTH INFORMATION ENTRIES = 20

*BASIN-DEPTH (FEET)	STORAGE (ACRE-FEET)	OUTFLOW (CFS)	**	BASIN-DEPTH (FEET)	STORAGE (ACRE-FEET)	OUTFLOW (CFS)	*
0.000	0.000	0.000**		0.500	0.239	0.640*	
1.000	0.477	0.640**		1.500	0.716	0.640*	
2.000	0.955	0.640**		2.500	1.193	0.640*	
3.000	1.432	0.640**		3.500	1.670	0.640*	
4.000	1.909	0.640**		4.500	2.148	0.640*	
5.000	2.396	0.640**		5.500	2.625	0.640*	

```
*      6.000      2.864      0.640**      6.500      1.994      0.340*
*      7.000      2.148      0.340**      7.500      2.301      0.340*
*      8.000      2.455      0.340**      8.500      2.608      0.340*
*      9.000      2.761      0.340**      9.500      2.915      0.340*
```

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	0.50	0.23415	0.24385
3	1.00	0.47215	0.48185
4	1.50	0.71115	0.72085
5	2.00	0.95015	0.95985
6	2.50	1.18815	1.19785
7	3.00	1.42715	1.43685
8	3.50	1.66515	1.67485
9	4.00	1.90415	1.91385
10	4.50	2.14315	2.15285
11	5.00	2.39115	2.40085
12	5.50	2.62015	2.62985
13	6.00	2.85915	2.86885
14	6.50	1.99142	1.99658
15	7.00	2.14542	2.15058
16	7.50	2.29842	2.30358
17	8.00	2.45242	2.45758
18	8.50	2.60542	2.61058
19	9.00	2.75842	2.76358
20	9.50	2.91242	2.91758

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)
0.050	0.000	0.00	0.00	0.00	0.000
0.233	0.000	0.75	0.02	0.01	0.011
0.417	0.000	0.76	0.05	0.04	0.022
0.600	0.000	0.76	0.07	0.07	0.032
0.783	0.000	0.77	0.09	0.10	0.042
0.967	0.000	0.77	0.11	0.13	0.052
1.150	0.000	0.78	0.13	0.15	0.062
1.333	0.000	0.78	0.15	0.18	0.071
1.517	0.000	0.79	0.17	0.20	0.080
1.700	0.000	0.79	0.18	0.22	0.088
1.883	0.000	0.80	0.20	0.25	0.097
2.067	0.000	0.80	0.22	0.27	0.105
2.250	0.000	0.81	0.24	0.29	0.113
2.433	0.000	0.82	0.25	0.31	0.120
2.617	0.000	0.83	0.27	0.33	0.128
2.800	0.000	0.83	0.28	0.35	0.135
2.983	0.000	0.84	0.30	0.37	0.142
3.167	0.000	0.84	0.31	0.39	0.149
3.350	0.000	0.85	0.33	0.41	0.156
3.533	0.000	0.86	0.34	0.43	0.162
3.717	0.000	0.87	0.35	0.44	0.169
3.900	0.000	0.87	0.37	0.46	0.175
4.083	0.000	0.88	0.38	0.48	0.181

4.267	0.000	0.89	0.39	0.49	0.187
4.450	0.000	0.90	0.40	0.51	0.193
4.633	0.000	0.90	0.42	0.52	0.199
4.817	0.000	0.91	0.43	0.54	0.204
5.000	0.000	0.92	0.44	0.55	0.210
5.183	0.000	0.93	0.45	0.57	0.215
5.367	0.000	0.94	0.46	0.58	0.221
5.550	0.000	0.95	0.47	0.60	0.226
5.733	0.000	0.96	0.48	0.61	0.231
5.917	0.000	0.97	0.49	0.63	0.237
6.100	0.000	0.98	0.51	0.64	0.242
6.283	0.000	0.99	0.52	0.64	0.247
6.467	0.000	1.00	0.53	0.64	0.252
6.650	0.000	1.01	0.54	0.64	0.258
6.833	0.000	1.02	0.55	0.64	0.264
7.017	0.000	1.04	0.56	0.64	0.270
7.200	0.000	1.04	0.58	0.64	0.276
7.383	0.000	1.06	0.59	0.64	0.282
7.567	0.000	1.07	0.60	0.64	0.289
7.750	0.000	1.09	0.62	0.64	0.296
7.933	0.000	1.10	0.63	0.64	0.302
8.117	0.000	1.12	0.65	0.64	0.310
8.300	0.000	1.13	0.66	0.64	0.317
8.483	0.000	1.15	0.68	0.64	0.325
8.667	0.000	1.16	0.70	0.64	0.333
8.850	0.000	1.18	0.71	0.64	0.341
9.033	0.000	1.19	0.73	0.64	0.349
9.217	0.000	1.21	0.75	0.64	0.358
9.400	0.000	1.23	0.77	0.64	0.367
9.583	0.000	1.25	0.79	0.64	0.376
9.767	0.000	1.27	0.81	0.64	0.385
9.950	0.000	1.29	0.83	0.64	0.395
10.133	0.000	1.31	0.85	0.64	0.405
10.317	0.000	1.34	0.87	0.64	0.416
10.500	0.000	1.36	0.89	0.64	0.427
10.683	0.000	1.39	0.92	0.64	0.438
10.867	0.000	1.41	0.94	0.64	0.450
11.050	0.000	1.45	0.97	0.64	0.462
11.233	0.000	1.47	1.00	0.64	0.475
11.417	0.000	1.51	1.02	0.64	0.488
11.600	0.000	1.54	1.05	0.64	0.502
11.783	0.000	1.59	1.08	0.64	0.516
11.967	0.000	1.61	1.11	0.64	0.531
12.150	0.000	1.68	1.15	0.64	0.546
12.333	0.000	1.72	1.18	0.64	0.563
12.517	0.000	1.78	1.22	0.64	0.580
12.700	0.000	1.82	1.25	0.64	0.598
12.883	0.000	1.89	1.29	0.64	0.617
13.067	0.000	1.93	1.33	0.64	0.636
13.250	0.000	2.03	1.38	0.64	0.657
13.433	0.000	2.08	1.42	0.64	0.679
13.617	0.000	2.19	1.47	0.64	0.703
13.800	0.000	2.25	1.52	0.64	0.727
13.983	0.000	2.40	1.58	0.64	0.754
14.167	0.000	2.29	1.63	0.64	0.779
14.350	0.000	2.15	1.68	0.64	0.802
14.533	0.000	2.25	1.73	0.64	0.826
14.717	0.000	2.50	1.79	0.64	0.854
14.900	0.000	2.66	1.85	0.64	0.885
15.083	0.000	3.05	1.93	0.64	0.922
15.267	0.000	3.31	2.01	0.64	0.962

15.450	0.000	5.34	2.16	0.64	1.033
15.633	0.000	7.46	2.38	0.64	1.137
15.817	0.000	8.85	2.64	0.64	1.261
16.000	0.000	11.03	2.97	0.64	1.419
16.183	0.000	25.06	3.75	0.64	1.788
16.367	0.000	8.29	3.99	0.64	1.904
16.550	0.000	3.64	4.09	0.64	1.950
16.733	0.000	2.84	4.15	0.64	1.983
16.917	0.000	2.37	4.21	0.64	2.009
17.100	0.000	2.06	4.25	0.64	2.031
17.283	0.000	2.32	4.31	0.64	2.056
17.467	0.000	2.13	4.36	0.64	2.079
17.650	0.000	1.98	4.40	0.64	2.099
17.833	0.000	1.85	4.44	0.64	2.118
18.017	0.000	1.75	4.47	0.64	2.134
18.200	0.000	1.64	4.50	0.64	2.149
18.383	0.000	1.56	4.53	0.64	2.163
18.567	0.000	1.49	4.56	0.64	2.176
18.750	0.000	1.43	4.58	0.64	2.188
18.933	0.000	1.37	4.60	0.64	2.199
19.117	0.000	1.33	4.62	0.64	2.210
19.300	0.000	1.28	4.64	0.64	2.219
19.483	0.000	1.24	4.66	0.64	2.229
19.667	0.000	1.20	4.68	0.64	2.237
19.850	0.000	1.17	4.70	0.64	2.245
20.033	0.000	1.14	4.71	0.64	2.253
20.217	0.000	1.11	4.73	0.64	2.260
20.400	0.000	1.08	4.74	0.64	2.266
20.583	0.000	1.05	4.75	0.64	2.273
20.767	0.000	1.03	4.76	0.64	2.278
20.950	0.000	1.01	4.77	0.64	2.284
21.133	0.000	0.98	4.78	0.64	2.289
21.317	0.000	0.96	4.79	0.64	2.294
21.500	0.000	0.94	4.80	0.64	2.299
21.683	0.000	0.93	4.81	0.64	2.303
21.867	0.000	0.91	4.82	0.64	2.307
22.050	0.000	0.89	4.83	0.64	2.311
22.233	0.000	0.88	4.84	0.64	2.314
22.417	0.000	0.86	4.84	0.64	2.318
22.600	0.000	0.85	4.85	0.64	2.321
22.783	0.000	0.83	4.85	0.64	2.324
22.967	0.000	0.82	4.86	0.64	2.327
23.150	0.000	0.81	4.87	0.64	2.329
23.333	0.000	0.80	4.87	0.64	2.332
23.517	0.000	0.79	4.87	0.64	2.334
23.700	0.000	0.77	4.88	0.64	2.336
23.883	0.000	0.76	4.88	0.64	2.338
24.067	0.000	0.75	4.89	0.64	2.339
24.250	0.000	0.00	4.87	0.64	2.330
24.433	0.000	0.00	4.85	0.64	2.320
24.617	0.000	0.00	4.83	0.64	2.310
24.800	0.000	0.00	4.81	0.64	2.301
24.983	0.000	0.00	4.79	0.64	2.291
25.167	0.000	0.00	4.77	0.64	2.281
25.350	0.000	0.00	4.75	0.64	2.272
25.533	0.000	0.00	4.73	0.64	2.262
25.717	0.000	0.00	4.71	0.64	2.252
25.900	0.000	0.00	4.69	0.64	2.242
26.083	0.000	0.00	4.67	0.64	2.233
26.267	0.000	0.00	4.65	0.64	2.223
26.450	0.000	0.00	4.63	0.64	2.213

26.633	0.000	0.00	4.61	0.64	2.204
26.817	0.000	0.00	4.59	0.64	2.194
27.000	0.000	0.00	4.57	0.64	2.184
27.183	0.000	0.00	4.55	0.64	2.175
27.367	0.000	0.00	4.53	0.64	2.165
27.550	0.000	0.00	4.51	0.64	2.155
27.733	0.000	0.00	4.49	0.64	2.145
27.917	0.000	0.00	4.47	0.64	2.136
28.100	0.000	0.00	4.45	0.64	2.126
28.283	0.000	0.00	4.43	0.64	2.116
28.467	0.000	0.00	4.41	0.64	2.107
28.650	0.000	0.00	4.39	0.64	2.097
28.833	0.000	0.00	4.37	0.64	2.087
29.017	0.000	0.00	4.35	0.64	2.078
29.200	0.000	0.00	4.33	0.64	2.068
29.383	0.000	0.00	4.31	0.64	2.058
29.567	0.000	0.00	4.29	0.64	2.048
29.750	0.000	0.00	4.27	0.64	2.039
29.933	0.000	0.00	4.25	0.64	2.029
30.117	0.000	0.00	4.23	0.64	2.019
30.300	0.000	0.00	4.21	0.64	2.010
30.483	0.000	0.00	4.19	0.64	2.000
30.667	0.000	0.00	4.17	0.64	1.990
30.850	0.000	0.00	4.15	0.64	1.981
31.033	0.000	0.00	4.13	0.64	1.971
31.217	0.000	0.00	4.11	0.64	1.961
31.400	0.000	0.00	4.09	0.64	1.952
31.583	0.000	0.00	4.07	0.64	1.942
31.767	0.000	0.00	4.05	0.64	1.932
31.950	0.000	0.00	4.03	0.64	1.922
32.133	0.000	0.00	4.01	0.64	1.913
32.317	0.000	0.00	3.99	0.64	1.903
32.500	0.000	0.00	3.97	0.64	1.893
32.683	0.000	0.00	3.95	0.64	1.884
32.867	0.000	0.00	3.93	0.64	1.874
33.050	0.000	0.00	3.91	0.64	1.864
33.233	0.000	0.00	3.89	0.64	1.855
33.417	0.000	0.00	3.87	0.64	1.845
33.600	0.000	0.00	3.85	0.64	1.835
33.783	0.000	0.00	3.83	0.64	1.825
33.967	0.000	0.00	3.80	0.64	1.816
34.150	0.000	0.00	3.78	0.64	1.806
34.333	0.000	0.00	3.76	0.64	1.796
34.517	0.000	0.00	3.74	0.64	1.787
34.700	0.000	0.00	3.72	0.64	1.777
34.883	0.000	0.00	3.70	0.64	1.767
35.067	0.000	0.00	3.68	0.64	1.758
35.250	0.000	0.00	3.66	0.64	1.748
35.433	0.000	0.00	3.64	0.64	1.738
35.617	0.000	0.00	3.62	0.64	1.728
35.800	0.000	0.00	3.60	0.64	1.719
35.983	0.000	0.00	3.58	0.64	1.709
36.167	0.000	0.00	3.56	0.64	1.699
36.350	0.000	0.00	3.54	0.64	1.690
36.533	0.000	0.00	3.52	0.64	1.680
36.717	0.000	0.00	3.50	0.64	1.670
36.900	0.000	0.00	3.48	0.64	1.661
37.083	0.000	0.00	3.46	0.64	1.651
37.267	0.000	0.00	3.44	0.64	1.641
37.450	0.000	0.00	3.42	0.64	1.632
37.633	0.000	0.00	3.40	0.64	1.622

37.817	0.000	0.00	3.38	0.64	1.612
38.000	0.000	0.00	3.36	0.64	1.602
38.183	0.000	0.00	3.34	0.64	1.593
38.367	0.000	0.00	3.32	0.64	1.583
38.550	0.000	0.00	3.30	0.64	1.573
38.733	0.000	0.00	3.28	0.64	1.564
38.917	0.000	0.00	3.26	0.64	1.554
39.100	0.000	0.00	3.24	0.64	1.544
39.283	0.000	0.00	3.22	0.64	1.535
39.467	0.000	0.00	3.20	0.64	1.525
39.650	0.000	0.00	3.17	0.64	1.515
39.833	0.000	0.00	3.15	0.64	1.505
40.017	0.000	0.00	3.13	0.64	1.496
40.200	0.000	0.00	3.11	0.64	1.486
40.383	0.000	0.00	3.09	0.64	1.476
40.567	0.000	0.00	3.07	0.64	1.467
40.750	0.000	0.00	3.05	0.64	1.457
40.933	0.000	0.00	3.03	0.64	1.447
41.117	0.000	0.00	3.01	0.64	1.438
41.300	0.000	0.00	2.99	0.64	1.428
41.483	0.000	0.00	2.97	0.64	1.418
41.667	0.000	0.00	2.95	0.64	1.408
41.850	0.000	0.00	2.93	0.64	1.399
42.033	0.000	0.00	2.91	0.64	1.389
42.217	0.000	0.00	2.89	0.64	1.379
42.400	0.000	0.00	2.87	0.64	1.370
42.583	0.000	0.00	2.85	0.64	1.360
42.767	0.000	0.00	2.83	0.64	1.350
42.950	0.000	0.00	2.81	0.64	1.341
43.133	0.000	0.00	2.79	0.64	1.331
43.317	0.000	0.00	2.77	0.64	1.321
43.500	0.000	0.00	2.75	0.64	1.312
43.683	0.000	0.00	2.73	0.64	1.302
43.867	0.000	0.00	2.71	0.64	1.292
44.050	0.000	0.00	2.69	0.64	1.282
44.233	0.000	0.00	2.67	0.64	1.273
44.417	0.000	0.00	2.65	0.64	1.263
44.600	0.000	0.00	2.63	0.64	1.253
44.783	0.000	0.00	2.61	0.64	1.244
44.967	0.000	0.00	2.59	0.64	1.234
45.150	0.000	0.00	2.57	0.64	1.224
45.333	0.000	0.00	2.55	0.64	1.215
45.517	0.000	0.00	2.52	0.64	1.205
45.700	0.000	0.00	2.50	0.64	1.195
45.883	0.000	0.00	2.48	0.64	1.185
46.067	0.000	0.00	2.46	0.64	1.176
46.250	0.000	0.00	2.44	0.64	1.166
46.433	0.000	0.00	2.42	0.64	1.156
46.617	0.000	0.00	2.40	0.64	1.147
46.800	0.000	0.00	2.38	0.64	1.137
46.983	0.000	0.00	2.36	0.64	1.127
47.167	0.000	0.00	2.34	0.64	1.118
47.350	0.000	0.00	2.32	0.64	1.108
47.533	0.000	0.00	2.30	0.64	1.098
47.717	0.000	0.00	2.28	0.64	1.088
47.900	0.000	0.00	2.26	0.64	1.079
48.083	0.000	0.00	2.24	0.64	1.069
48.267	0.000	0.00	2.22	0.64	1.059
48.450	0.000	0.00	2.20	0.64	1.050
48.633	0.000	0.00	2.18	0.64	1.040
48.817	0.000	0.00	2.16	0.64	1.030

49.000	0.000	0.00	2.14	0.64	1.021
49.183	0.000	0.00	2.12	0.64	1.011
49.367	0.000	0.00	2.10	0.64	1.001
49.550	0.000	0.00	2.08	0.64	0.992
49.733	0.000	0.00	2.06	0.64	0.982
49.917	0.000	0.00	2.04	0.64	0.972
50.100	0.000	0.00	2.02	0.64	0.962
50.283	0.000	0.00	2.00	0.64	0.953
50.467	0.000	0.00	1.97	0.64	0.943
50.650	0.000	0.00	1.95	0.64	0.933
50.833	0.000	0.00	1.93	0.64	0.924
51.017	0.000	0.00	1.91	0.64	0.914
51.200	0.000	0.00	1.89	0.64	0.904
51.383	0.000	0.00	1.87	0.64	0.895
51.567	0.000	0.00	1.85	0.64	0.885
51.750	0.000	0.00	1.83	0.64	0.875
51.933	0.000	0.00	1.81	0.64	0.865
52.117	0.000	0.00	1.79	0.64	0.856
52.300	0.000	0.00	1.77	0.64	0.846
52.483	0.000	0.00	1.75	0.64	0.836
52.667	0.000	0.00	1.73	0.64	0.827
52.850	0.000	0.00	1.71	0.64	0.817
53.033	0.000	0.00	1.69	0.64	0.807
53.217	0.000	0.00	1.67	0.64	0.798
53.400	0.000	0.00	1.65	0.64	0.788
53.583	0.000	0.00	1.63	0.64	0.778
53.767	0.000	0.00	1.61	0.64	0.768
53.950	0.000	0.00	1.59	0.64	0.759
54.133	0.000	0.00	1.57	0.64	0.749
54.317	0.000	0.00	1.55	0.64	0.739
54.500	0.000	0.00	1.53	0.64	0.730
54.683	0.000	0.00	1.51	0.64	0.720
54.867	0.000	0.00	1.49	0.64	0.710
55.050	0.000	0.00	1.47	0.64	0.701
55.233	0.000	0.00	1.45	0.64	0.691
55.417	0.000	0.00	1.43	0.64	0.681
55.600	0.000	0.00	1.41	0.64	0.672
55.783	0.000	0.00	1.39	0.64	0.662
55.967	0.000	0.00	1.37	0.64	0.652
56.150	0.000	0.00	1.35	0.64	0.642
56.333	0.000	0.00	1.33	0.64	0.633
56.517	0.000	0.00	1.31	0.64	0.623
56.700	0.000	0.00	1.29	0.64	0.613
56.883	0.000	0.00	1.26	0.64	0.604
57.067	0.000	0.00	1.24	0.64	0.594
57.250	0.000	0.00	1.22	0.64	0.584
57.433	0.000	0.00	1.20	0.64	0.575
57.617	0.000	0.00	1.18	0.64	0.565
57.800	0.000	0.00	1.16	0.64	0.555
57.983	0.000	0.00	1.14	0.64	0.545
58.167	0.000	0.00	1.12	0.64	0.536
58.350	0.000	0.00	1.10	0.64	0.526
58.533	0.000	0.00	1.08	0.64	0.516
58.717	0.000	0.00	1.06	0.64	0.507
58.900	0.000	0.00	1.04	0.64	0.497
59.083	0.000	0.00	1.02	0.64	0.487
59.267	0.000	0.00	1.00	0.64	0.478
59.450	0.000	0.00	0.98	0.64	0.468
59.633	0.000	0.00	0.96	0.64	0.458
59.817	0.000	0.00	0.94	0.64	0.448
60.000	0.000	0.00	0.92	0.64	0.439

60.183	0.000	0.00	0.90	0.64	0.429
60.367	0.000	0.00	0.88	0.64	0.419
60.550	0.000	0.00	0.86	0.64	0.410
60.733	0.000	0.00	0.84	0.64	0.400
60.917	0.000	0.00	0.82	0.64	0.390
61.100	0.000	0.00	0.80	0.64	0.381
61.283	0.000	0.00	0.78	0.64	0.371
61.467	0.000	0.00	0.76	0.64	0.361
61.650	0.000	0.00	0.74	0.64	0.352
61.833	0.000	0.00	0.72	0.64	0.342
62.017	0.000	0.00	0.70	0.64	0.332
62.200	0.000	0.00	0.68	0.64	0.322
62.383	0.000	0.00	0.65	0.64	0.313
62.567	0.000	0.00	0.63	0.64	0.303
62.750	0.000	0.00	0.61	0.64	0.293
62.933	0.000	0.00	0.59	0.64	0.284
63.117	0.000	0.00	0.57	0.64	0.274
63.300	0.000	0.00	0.55	0.64	0.264
63.483	0.000	0.00	0.53	0.64	0.255
63.667	0.000	0.00	0.51	0.64	0.245
63.850	0.000	0.00	0.49	0.63	0.235
64.033	0.000	0.00	0.47	0.62	0.226
64.217	0.000	0.00	0.45	0.59	0.217
64.400	0.000	0.00	0.44	0.57	0.208
64.583	0.000	0.00	0.42	0.55	0.200
64.767	0.000	0.00	0.40	0.52	0.192
64.950	0.000	0.00	0.39	0.50	0.184
65.133	0.000	0.00	0.37	0.48	0.177
65.317	0.000	0.00	0.36	0.46	0.170
65.500	0.000	0.00	0.34	0.45	0.163
65.683	0.000	0.00	0.33	0.43	0.157
65.867	0.000	0.00	0.31	0.41	0.151
66.050	0.000	0.00	0.30	0.40	0.145
66.233	0.000	0.00	0.29	0.38	0.139
66.417	0.000	0.00	0.28	0.36	0.133
66.600	0.000	0.00	0.27	0.35	0.128
66.783	0.000	0.00	0.26	0.34	0.123
66.967	0.000	0.00	0.25	0.32	0.118
67.150	0.000	0.00	0.24	0.31	0.113
67.333	0.000	0.00	0.23	0.30	0.109
67.517	0.000	0.00	0.22	0.29	0.104
67.700	0.000	0.00	0.21	0.27	0.100
67.883	0.000	0.00	0.20	0.26	0.096
68.067	0.000	0.00	0.19	0.25	0.093
68.250	0.000	0.00	0.19	0.24	0.089
68.433	0.000	0.00	0.18	0.23	0.085
68.617	0.000	0.00	0.17	0.22	0.082
68.800	0.000	0.00	0.16	0.21	0.079
68.983	0.000	0.00	0.16	0.21	0.076
69.167	0.000	0.00	0.15	0.20	0.073
69.350	0.000	0.00	0.15	0.19	0.070
69.534	0.000	0.00	0.14	0.18	0.067
69.717	0.000	0.00	0.13	0.18	0.064
69.900	0.000	0.00	0.13	0.17	0.062
70.084	0.000	0.00	0.12	0.16	0.059
70.267	0.000	0.00	0.12	0.16	0.057
70.450	0.000	0.00	0.11	0.15	0.055
70.634	0.000	0.00	0.11	0.14	0.052
70.817	0.000	0.00	0.11	0.14	0.050
71.000	0.000	0.00	0.10	0.13	0.048
71.184	0.000	0.00	0.10	0.13	0.046

71.367	0.000	0.00	0.09	0.12	0.045
71.550	0.000	0.00	0.09	0.12	0.043
71.734	0.000	0.00	0.09	0.11	0.041
71.917	0.000	0.00	0.08	0.11	0.039
72.100	0.000	0.00	0.08	0.10	0.038
72.284	0.000	0.00	0.08	0.10	0.036
72.467	0.000	0.00	0.07	0.10	0.035
72.650	0.000	0.00	0.07	0.09	0.034
72.834	0.000	0.00	0.07	0.09	0.032
73.017	0.000	0.00	0.06	0.08	0.031
73.200	0.000	0.00	0.06	0.08	0.030
73.384	0.000	0.00	0.06	0.08	0.029
73.567	0.000	0.00	0.06	0.07	0.027
73.750	0.000	0.00	0.06	0.07	0.026
73.934	0.000	0.00	0.05	0.07	0.025
74.117	0.000	0.00	0.05	0.07	0.024
74.300	0.000	0.00	0.05	0.06	0.023
74.484	0.000	0.00	0.05	0.06	0.022
74.667	0.000	0.00	0.04	0.06	0.021
74.850	0.000	0.00	0.04	0.06	0.021
75.034	0.000	0.00	0.04	0.05	0.020
75.217	0.000	0.00	0.04	0.05	0.019
75.400	0.000	0.00	0.04	0.05	0.018
75.584	0.000	0.00	0.04	0.05	0.018
75.767	0.000	0.00	0.04	0.05	0.017
75.950	0.000	0.00	0.03	0.04	0.016
76.134	0.000	0.00	0.03	0.04	0.016
76.317	0.000	0.00	0.03	0.04	0.015
76.500	0.000	0.00	0.03	0.04	0.014
76.684	0.000	0.00	0.03	0.04	0.014
76.867	0.000	0.00	0.03	0.04	0.013
77.050	0.000	0.00	0.03	0.03	0.013
77.234	0.000	0.00	0.03	0.03	0.012
77.417	0.000	0.00	0.02	0.03	0.012
77.600	0.000	0.00	0.02	0.03	0.011
77.784	0.000	0.00	0.02	0.03	0.011
77.967	0.000	0.00	0.02	0.03	0.010
78.150	0.000	0.00	0.02	0.03	0.010
78.334	0.000	0.00	0.02	0.03	0.010
78.517	0.000	0.00	0.02	0.03	0.009
78.700	0.000	0.00	0.02	0.02	0.009
78.884	0.000	0.00	0.02	0.02	0.008
79.067	0.000	0.00	0.02	0.02	0.008
79.250	0.000	0.00	0.02	0.02	0.008
79.434	0.000	0.00	0.02	0.02	0.007
79.617	0.000	0.00	0.02	0.02	0.007
79.800	0.000	0.00	0.01	0.02	0.007
79.984	0.000	0.00	0.01	0.02	0.007
80.167	0.000	0.00	0.01	0.02	0.006
80.350	0.000	0.00	0.01	0.02	0.006
80.534	0.000	0.00	0.01	0.02	0.006
80.717	0.000	0.00	0.01	0.02	0.006
80.900	0.000	0.00	0.01	0.01	0.005
81.084	0.000	0.00	0.01	0.01	0.005
81.267	0.000	0.00	0.01	0.01	0.005
81.450	0.000	0.00	0.01	0.01	0.005
81.634	0.000	0.00	0.01	0.01	0.005
81.817	0.000	0.00	0.01	0.01	0.004
82.000	0.000	0.00	0.01	0.01	0.004
82.184	0.000	0.00	0.01	0.01	0.004
82.367	0.000	0.00	0.01	0.01	0.004

82.550	0.000	0.00	0.01	0.01	0.004
82.734	0.000	0.00	0.01	0.01	0.004
82.917	0.000	0.00	0.01	0.01	0.003
83.100	0.000	0.00	0.01	0.01	0.003
83.284	0.000	0.00	0.01	0.01	0.003
83.467	0.000	0.00	0.01	0.01	0.003
83.650	0.000	0.00	0.01	0.01	0.003
83.834	0.000	0.00	0.01	0.01	0.003
84.017	0.000	0.00	0.01	0.01	0.003
84.200	0.000	0.00	0.01	0.01	0.003
84.384	0.000	0.00	0.01	0.01	0.002
84.567	0.000	0.00	0.01	0.01	0.002
84.750	0.000	0.00	0.00	0.01	0.002
84.934	0.000	0.00	0.00	0.01	0.002
85.117	0.000	0.00	0.00	0.01	0.002
85.300	0.000	0.00	0.00	0.01	0.002
85.484	0.000	0.00	0.00	0.01	0.002
85.667	0.000	0.00	0.00	0.01	0.002
85.850	0.000	0.00	0.00	0.00	0.002
86.034	0.000	0.00	0.00	0.00	0.002
86.217	0.000	0.00	0.00	0.00	0.002
86.400	0.000	0.00	0.00	0.00	0.002
86.584	0.000	0.00	0.00	0.00	0.002
86.767	0.000	0.00	0.00	0.00	0.001
86.950	0.000	0.00	0.00	0.00	0.001
87.134	0.000	0.00	0.00	0.00	0.001
87.317	0.000	0.00	0.00	0.00	0.001
87.500	0.000	0.00	0.00	0.00	0.001
87.684	0.000	0.00	0.00	0.00	0.001
87.867	0.000	0.00	0.00	0.00	0.001
88.050	0.000	0.00	0.00	0.00	0.001
88.234	0.000	0.00	0.00	0.00	0.001
88.417	0.000	0.00	0.00	0.00	0.001
88.600	0.000	0.00	0.00	0.00	0.001

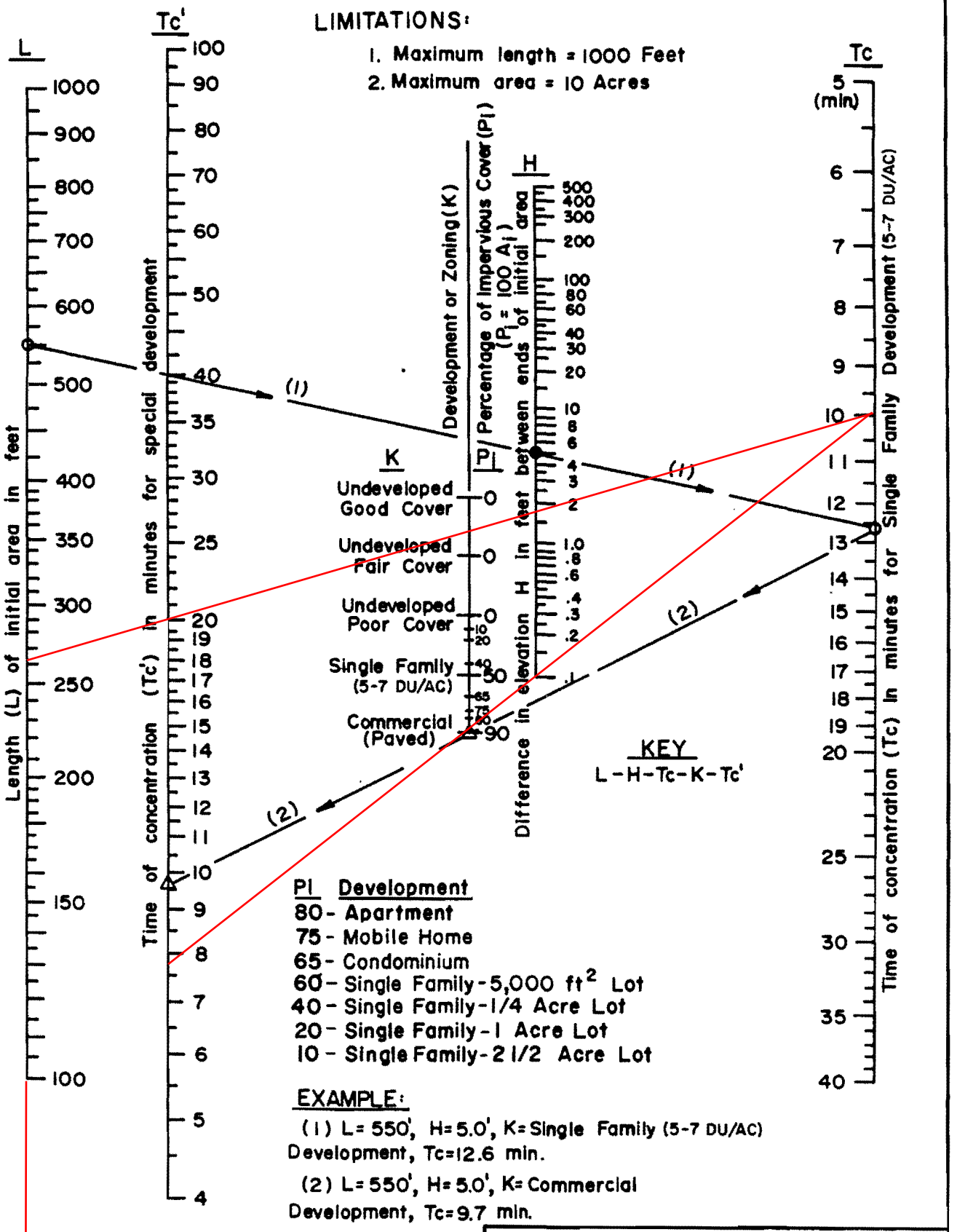
APPENDIX B: Preliminary Onsite Storm Drain Sizing Calculations

RATIONAL METHOD CALCULATIONS

Rational Method Analysis Data and Results

Inlet	Tributary Area (Ac)	Time of Concentration (Min)	Rainfall Intensity (In/Hr)	Pervious Fraction Ap	Pervious Area Loss Rate Fp (In/Hr)	100-Yr Peak Flow (cfs)
1A	0.481	7.8	6.70	0.1	0.02	2.90
2A	0.058	5.4	8.40	0.1	0.02	0.44
3A	0.275	7.2	7.00	0.1	0.02	1.73
4A	0.455	8	6.60	0.1	0.02	2.70
5A	0.059	5.4	8.40	0.1	0.02	0.45
6A	0.078	4.1	10.00	0.1	0.02	0.70
7A	0.028	2.7	15.50	0.1	0.02	0.39
8A	0.188	4	10.00	0.1	0.02	1.69
9A	1.625	9	6.15	0.1	0.02	8.99
10B	0.280	8	6.60	0.1	0.02	1.66
11B	0.061	5.3	8.50	0.1	0.02	0.47
12B	0.421	7.2	7.00	0.1	0.02	2.65
13B	0.059	5.4	8.40	0.1	0.02	0.45
14B	0.313	7.2	7.00	0.1	0.02	1.97
15B	0.023	5.4	8.40	0.1	0.02	0.18
16B	0.676	9.2	6.05	0.1	0.02	3.68
20C	0.617	6.9	7.20	0.1	0.02	4.00
30D	0.118	5.5	8.30	0.1	0.02	0.88
40E	0.096	5.6	8.20	0.1	0.02	0.71

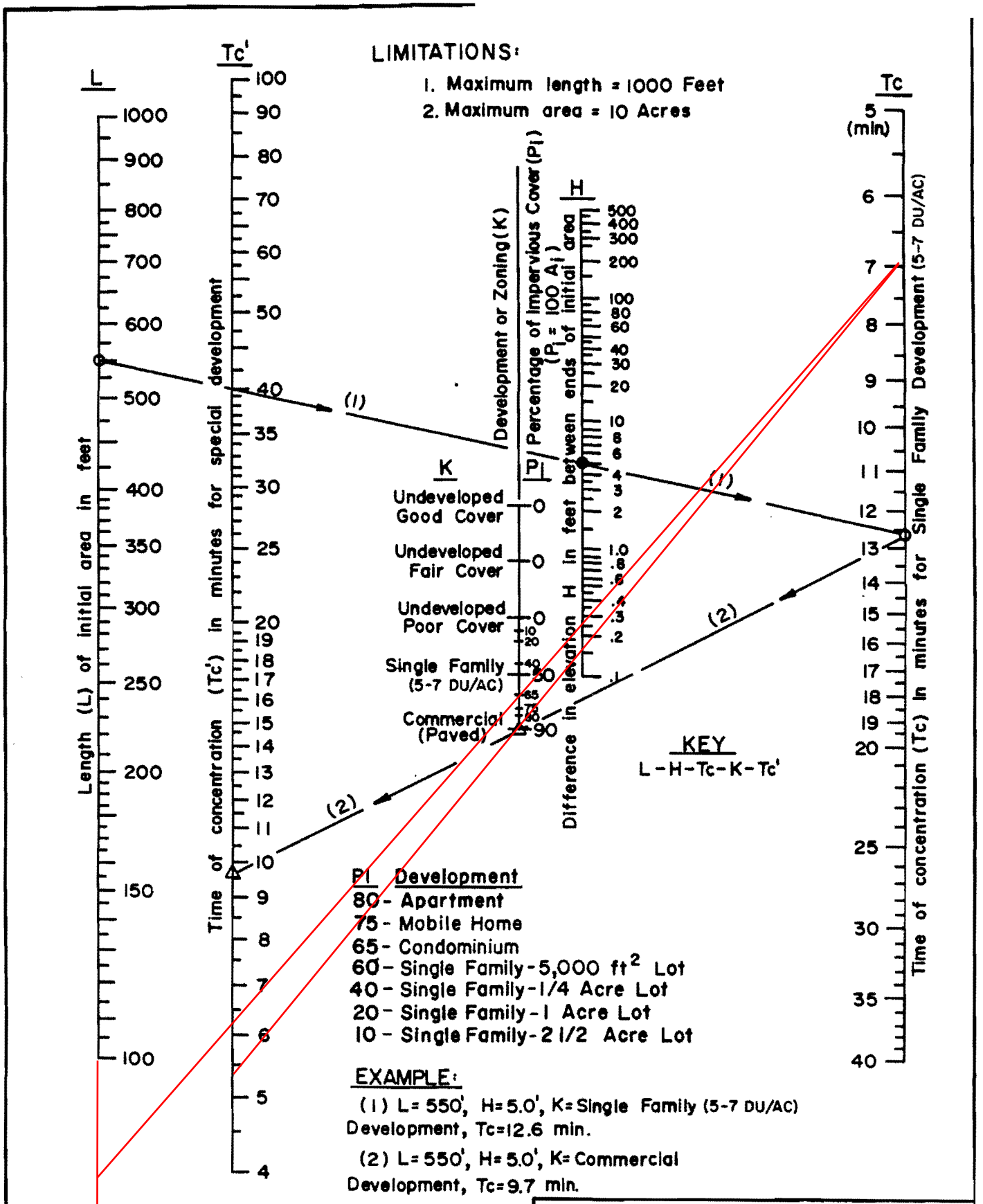
Inlet	Area sqft	Area Ac	L	El1	El2	Delta	TC
1A	20933	0.481	266	1398.16	1396.28	1.88	7.8
2A	2538	0.058	53	1397.11	1396.845	0.265	5.4
3A	11998	0.275	191	1428.16	1427.205	0.955	7.2
4A	19813	0.455	248	1428.17	1426.93	1.24	8
5A	2590	0.059	54	1398.17	1397.9	0.27	5.4
6A	3408	0.078	127	1399.39	1394.3	5.09	4.1
7A	1222	0.028	56	1399.39	1392.47	6.92	2.7
8A	8175	0.188	138	1398.18	1391.82	6.36	4
9A	70782	1.625	484	1394.4	1389.88	4.52	9
10B	12176	0.280	274	1398.16	1396.24	1.92	8
11B	2670	0.061	62	1398.13	1397.82	0.31	5.3
12B	18329	0.421	206	1428.13	1427.1	1.03	7.2
13B	2587	0.059	53	1398.13	1397.865	0.265	5.4
14B	13650	0.313	206	1428.13	1427.1	1.03	7.2
15B	1010	0.023	24	1398.13	1398.01	0.12	5.4
16B	29438	0.676	535	1398.05	1392.27	5.78	9.2
20C	26875	0.617	310	1397.06	1391.97	5.09	6.9
30D	5141	0.118	91	1427.01	1426.555	0.455	5.5
40E	4171	0.096	87	1427.01	1426.575	0.435	5.6



SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

Figure D-1



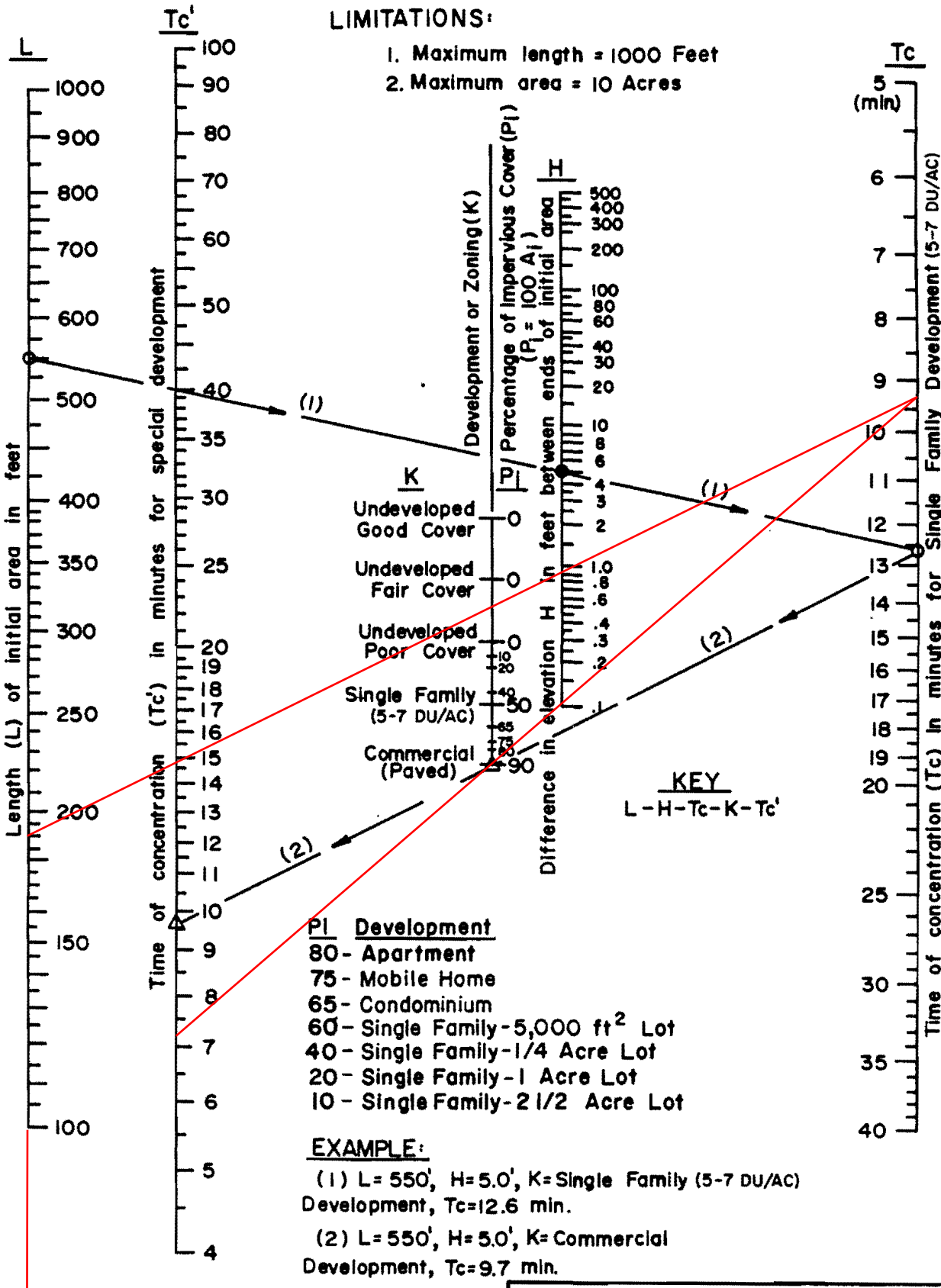
SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

Figure D-1

10

2A



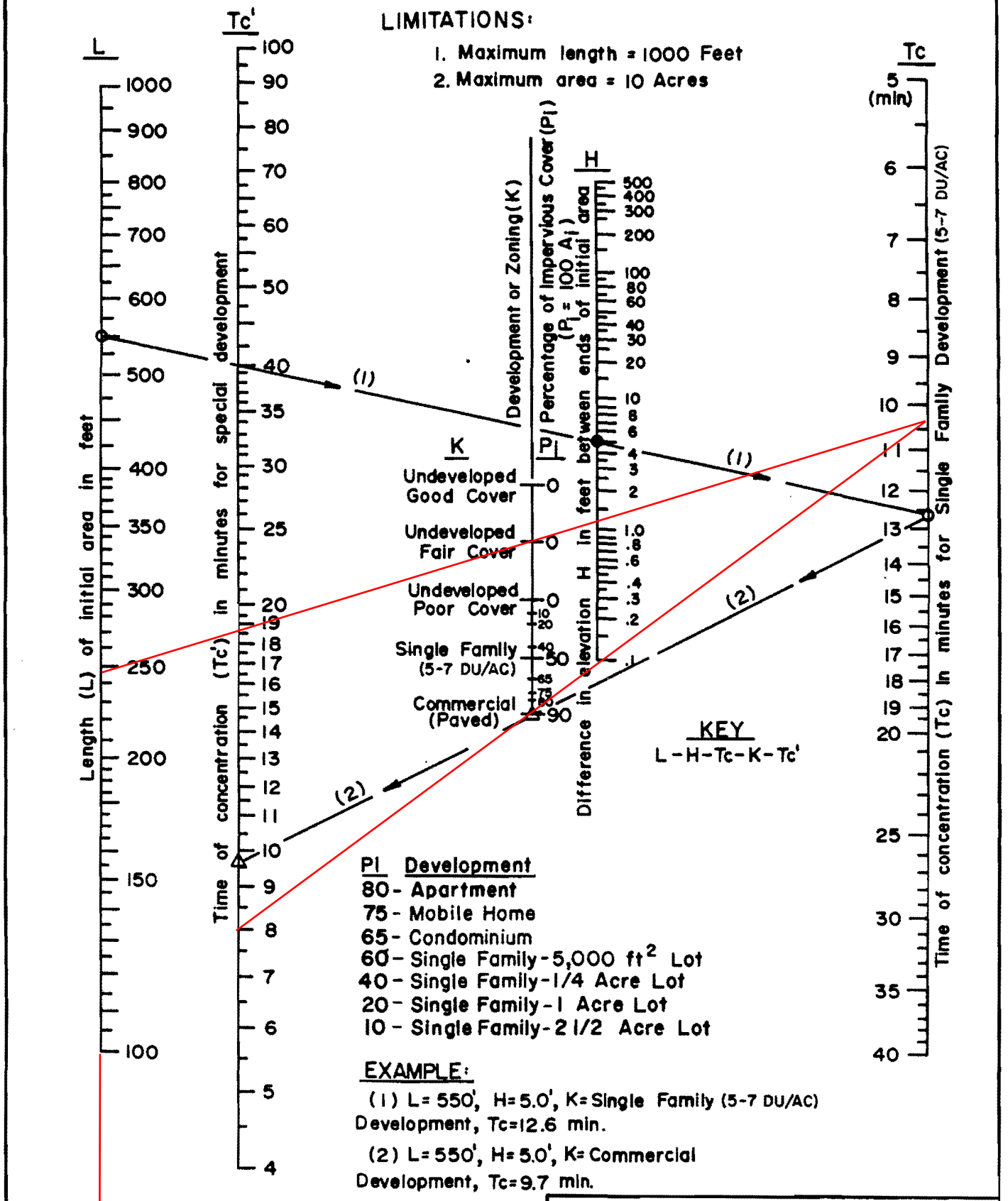
SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

Figure D-1

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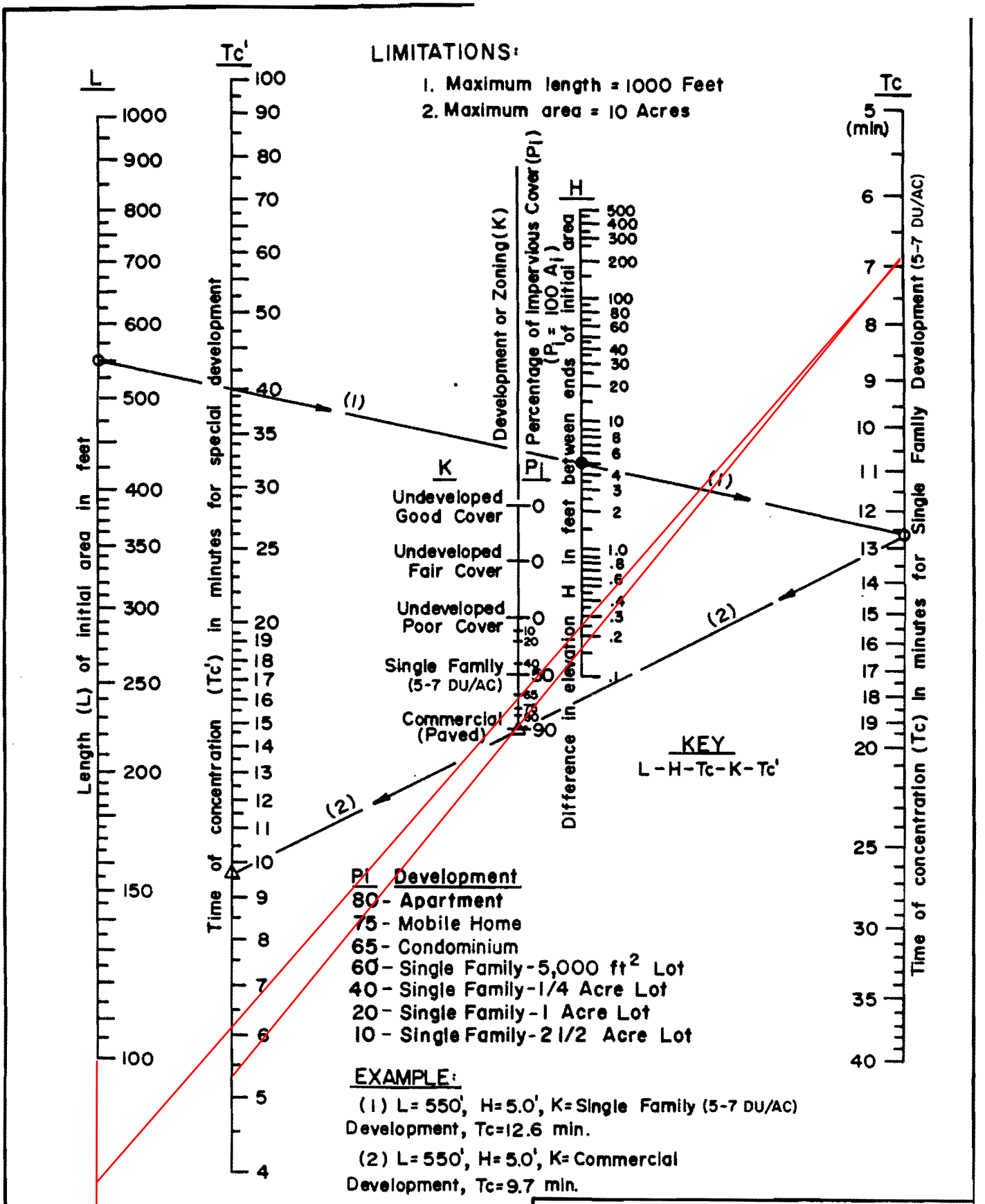
3A



SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

Figure D-1



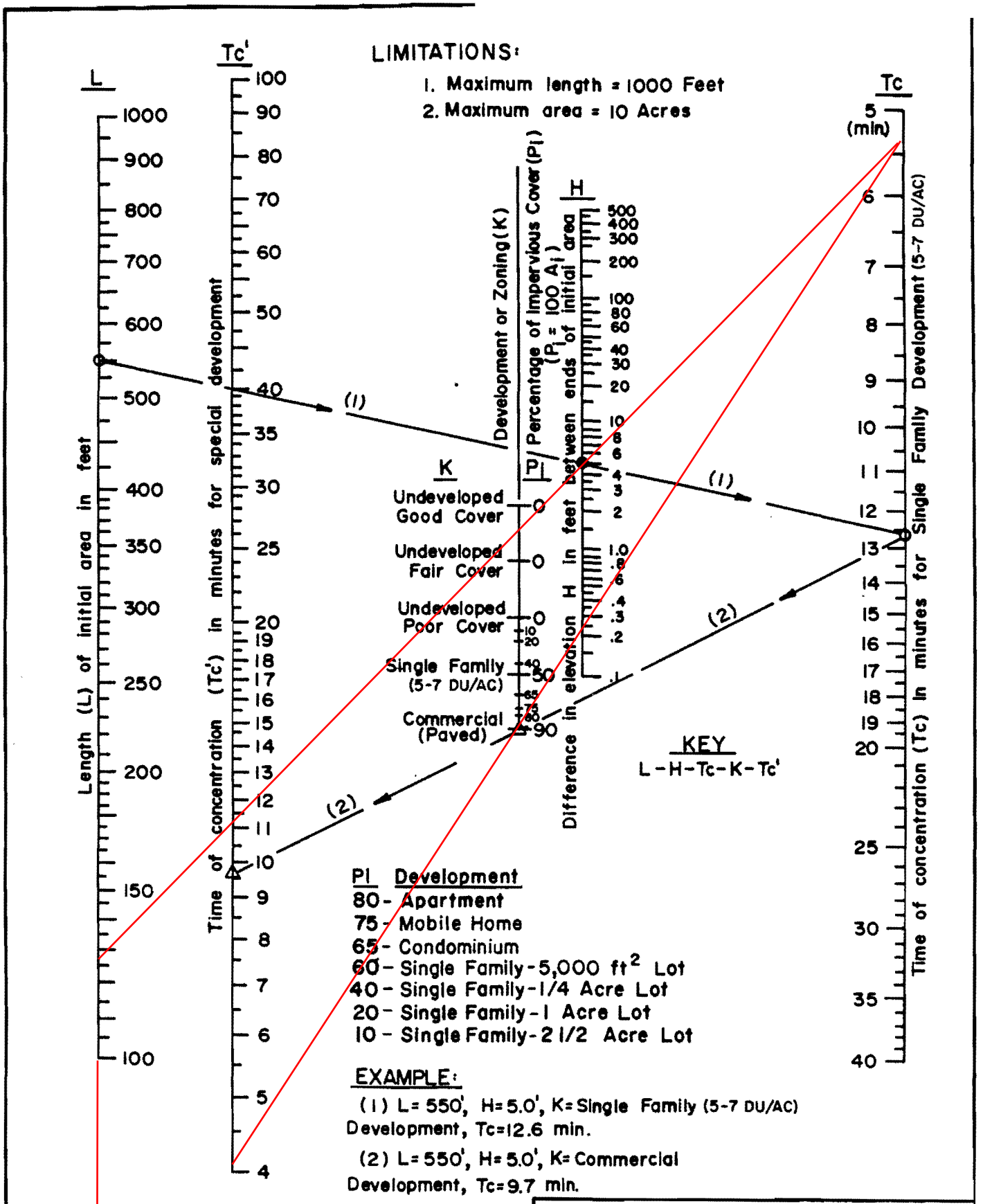
SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

Figure D-1

10

5A



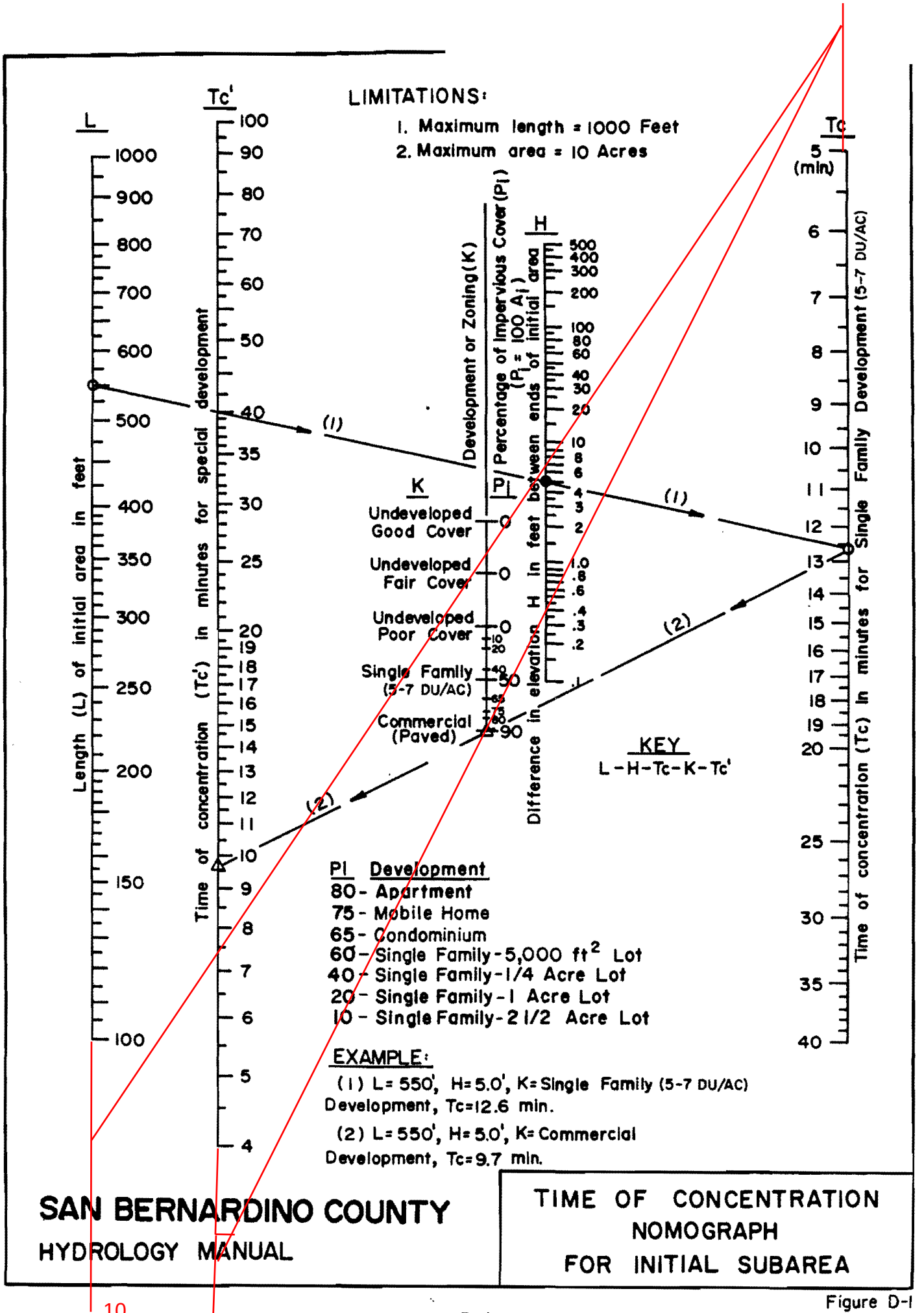
SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

Figure D-1

10

6A



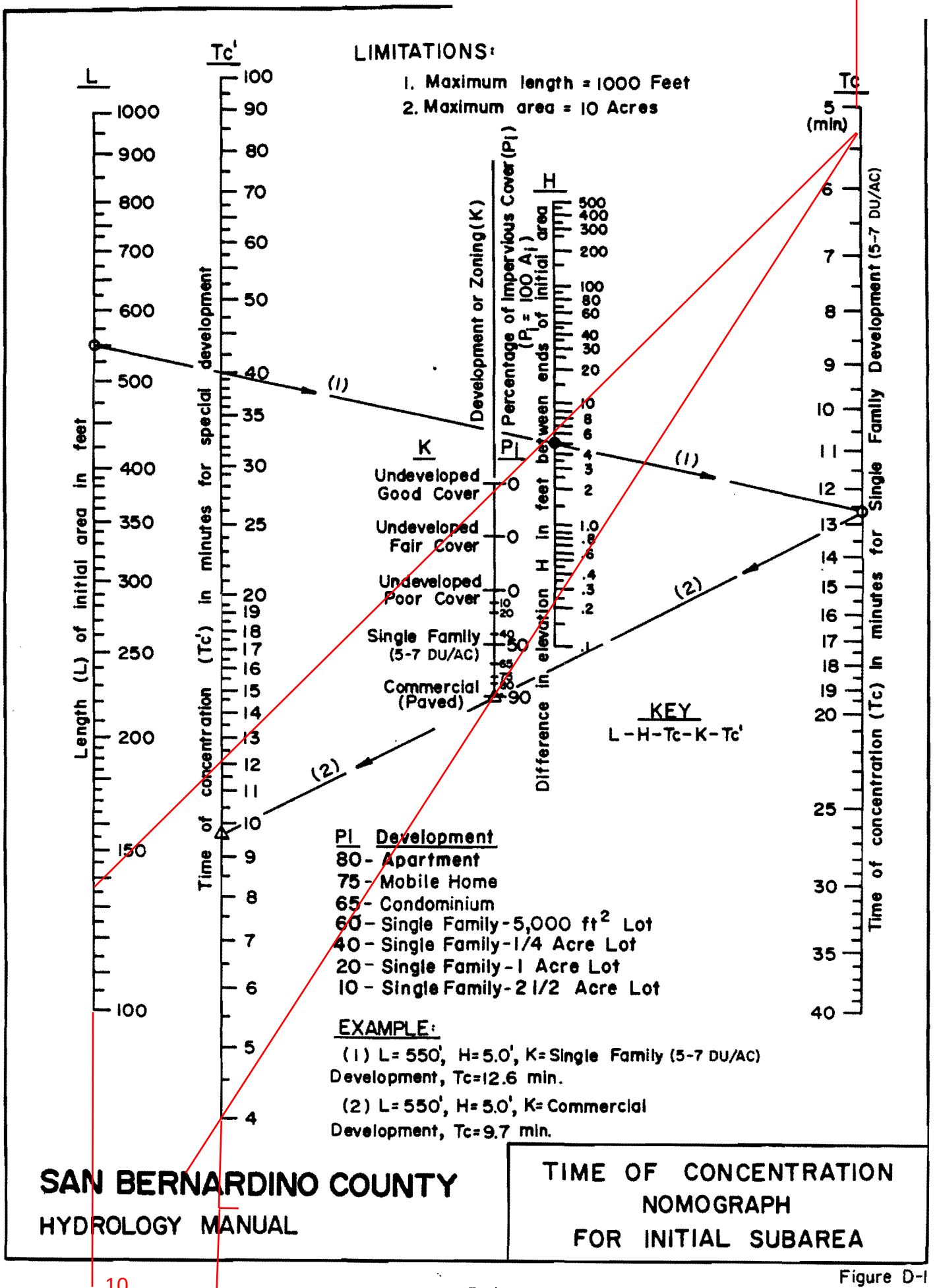
SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

Figure D-1

10

7A



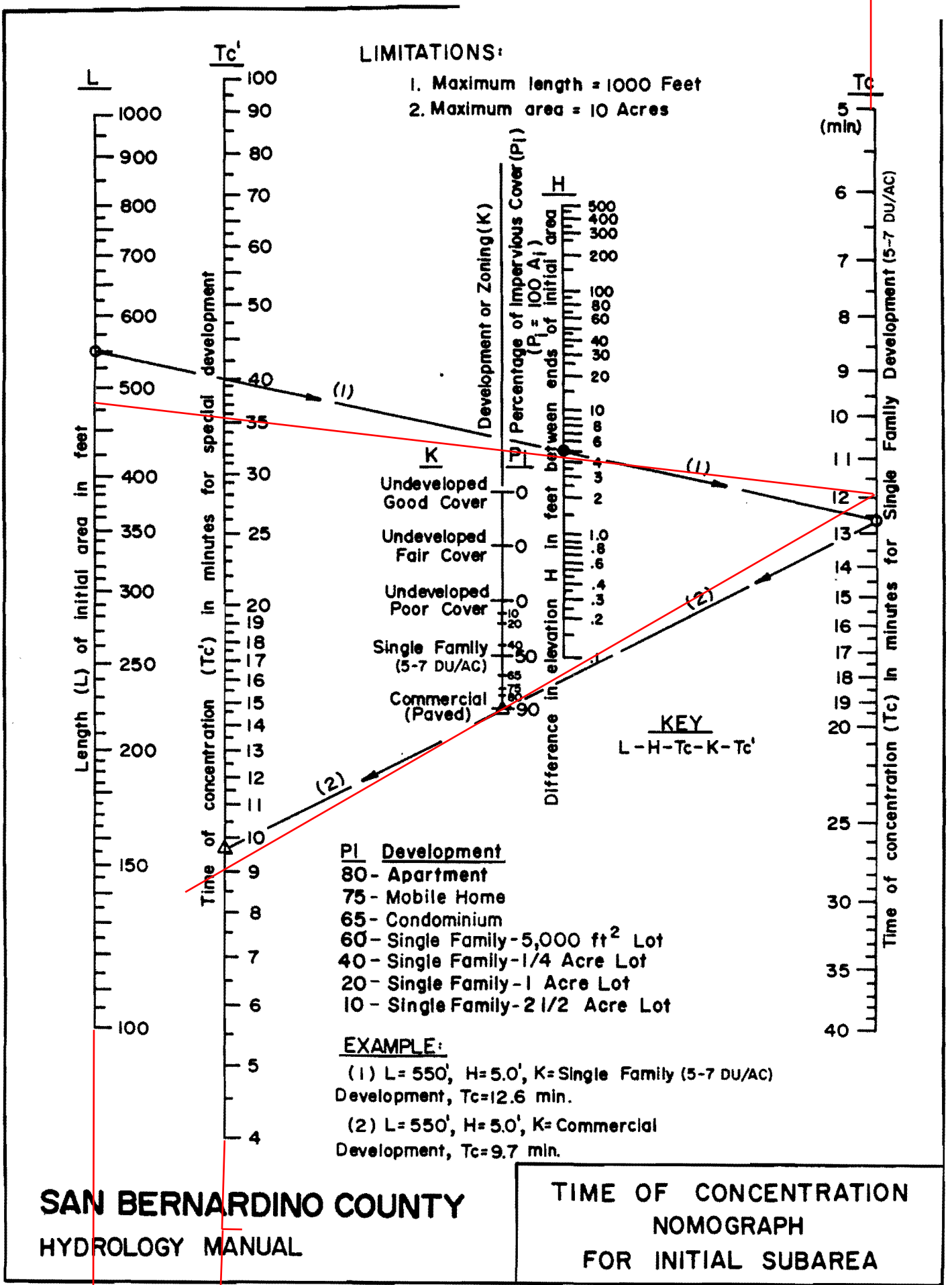
SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

Figure D-1

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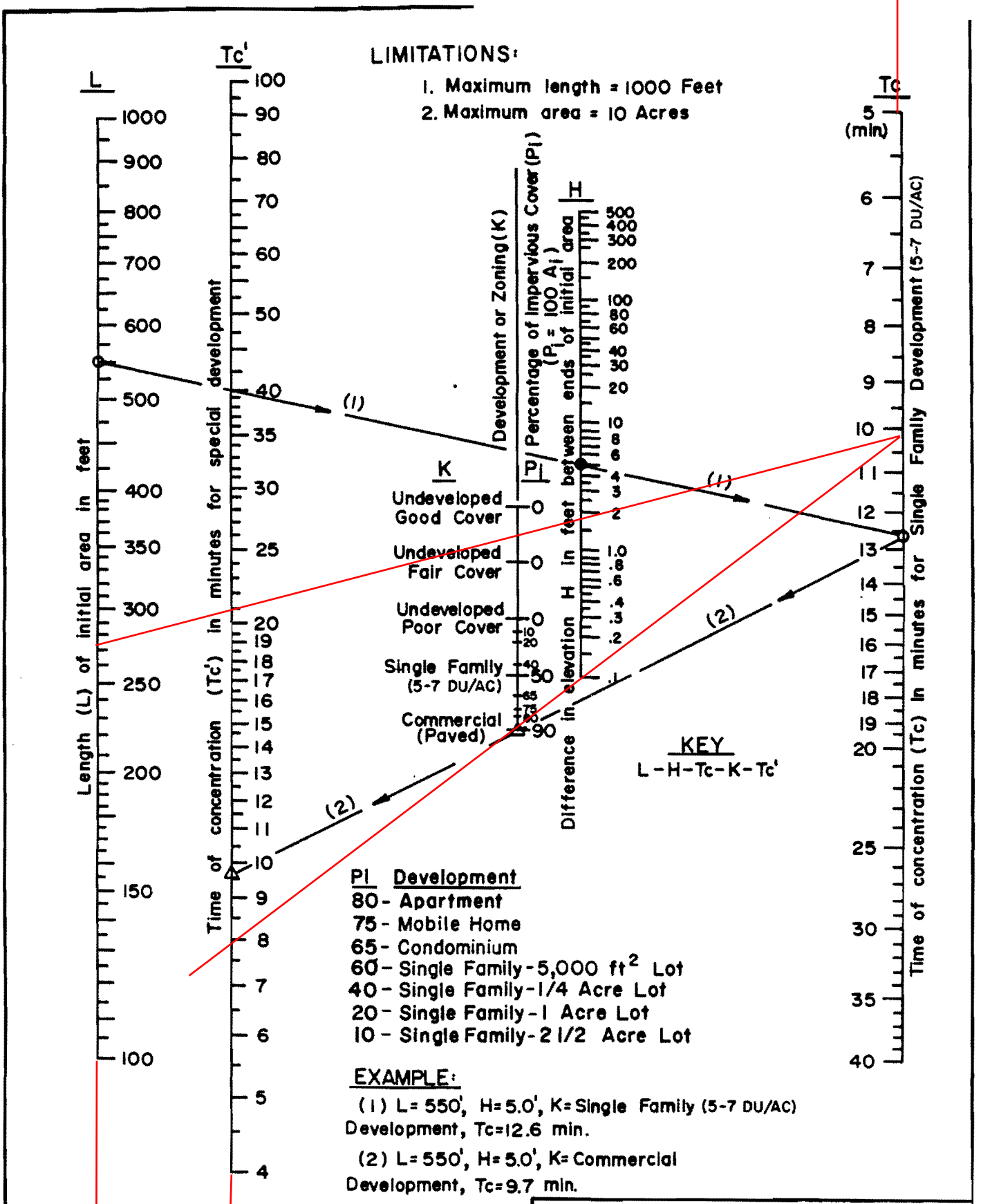
8A



SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

Figure D-1



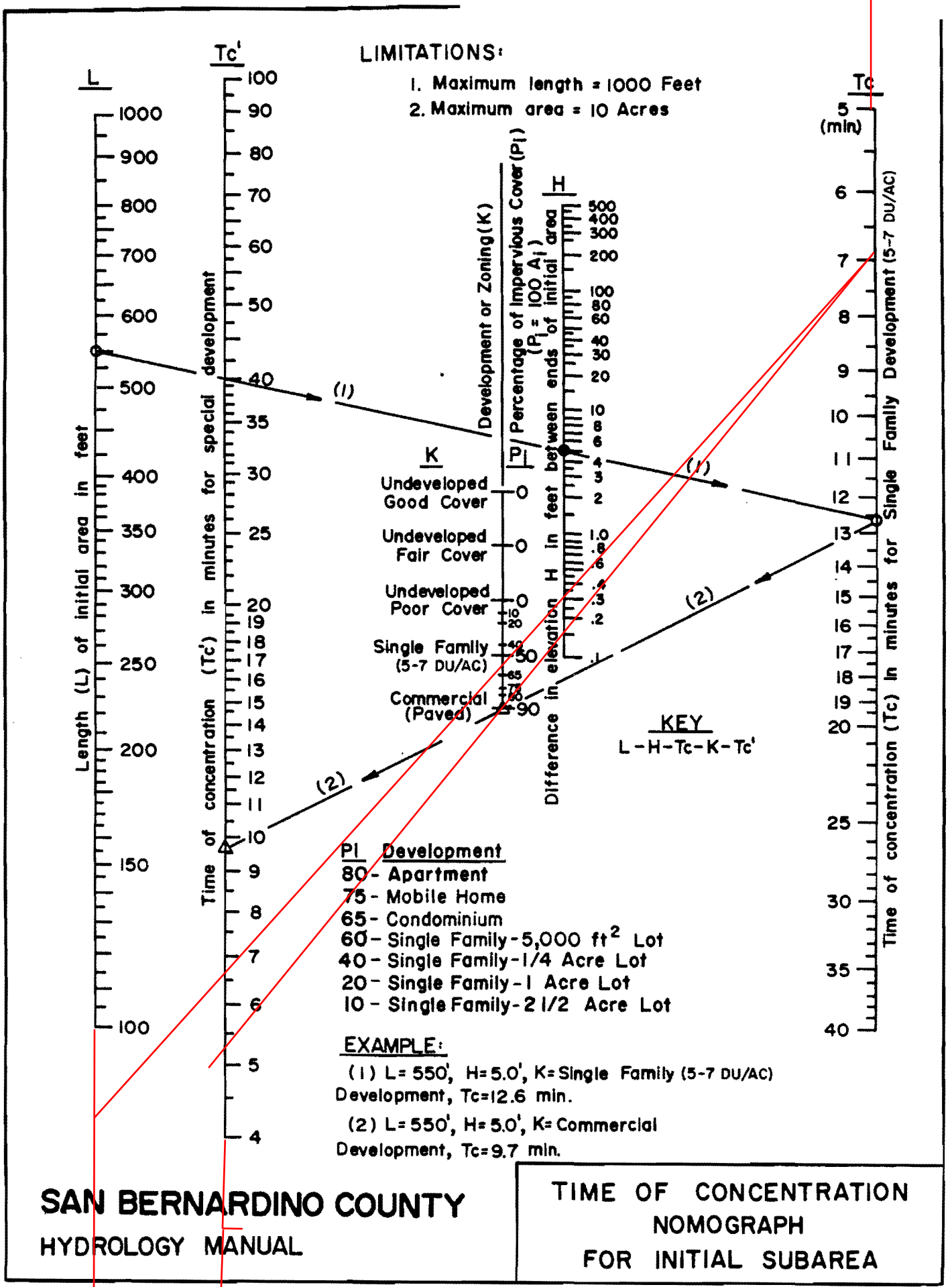
SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

Figure D-1

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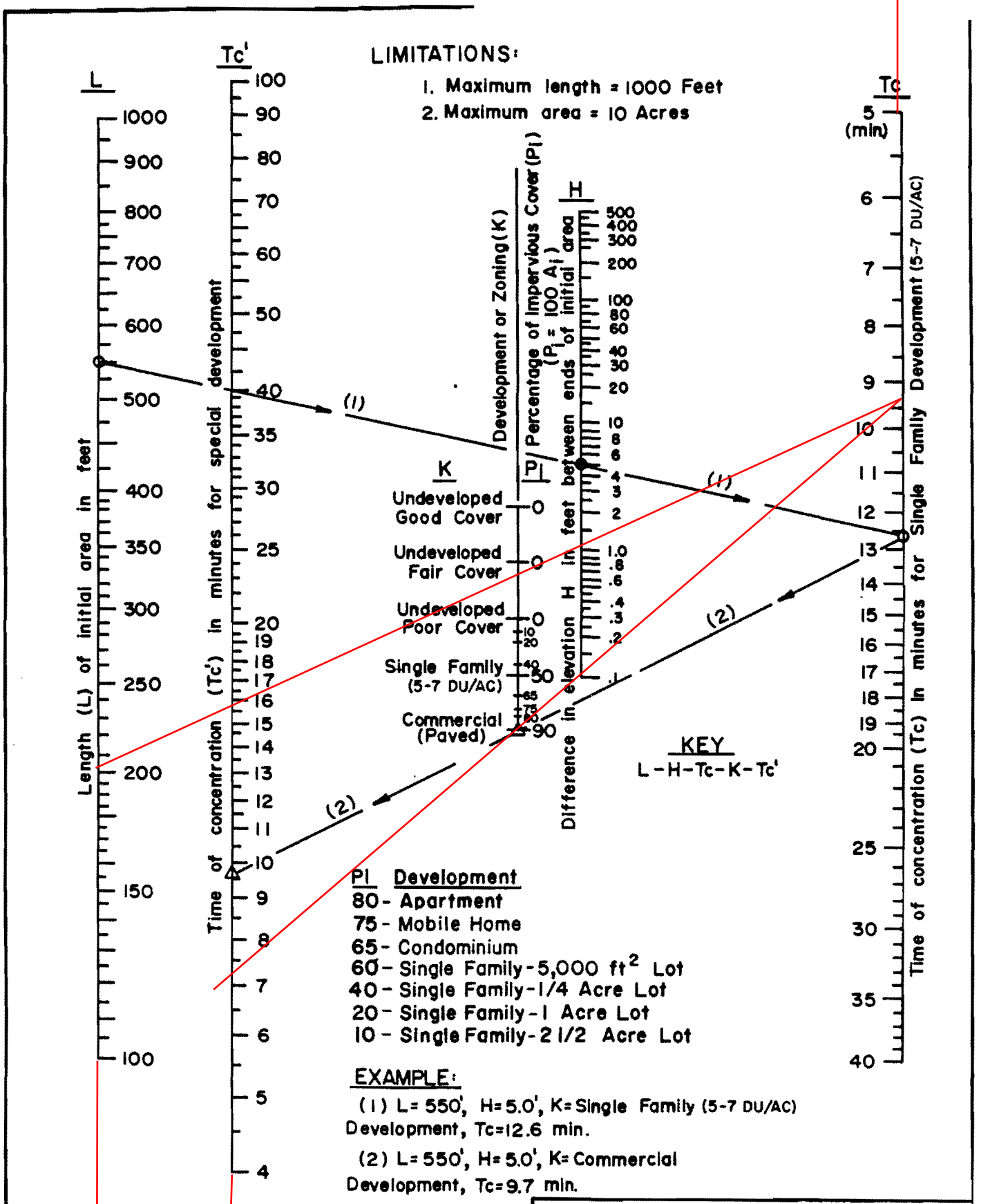
10B



SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

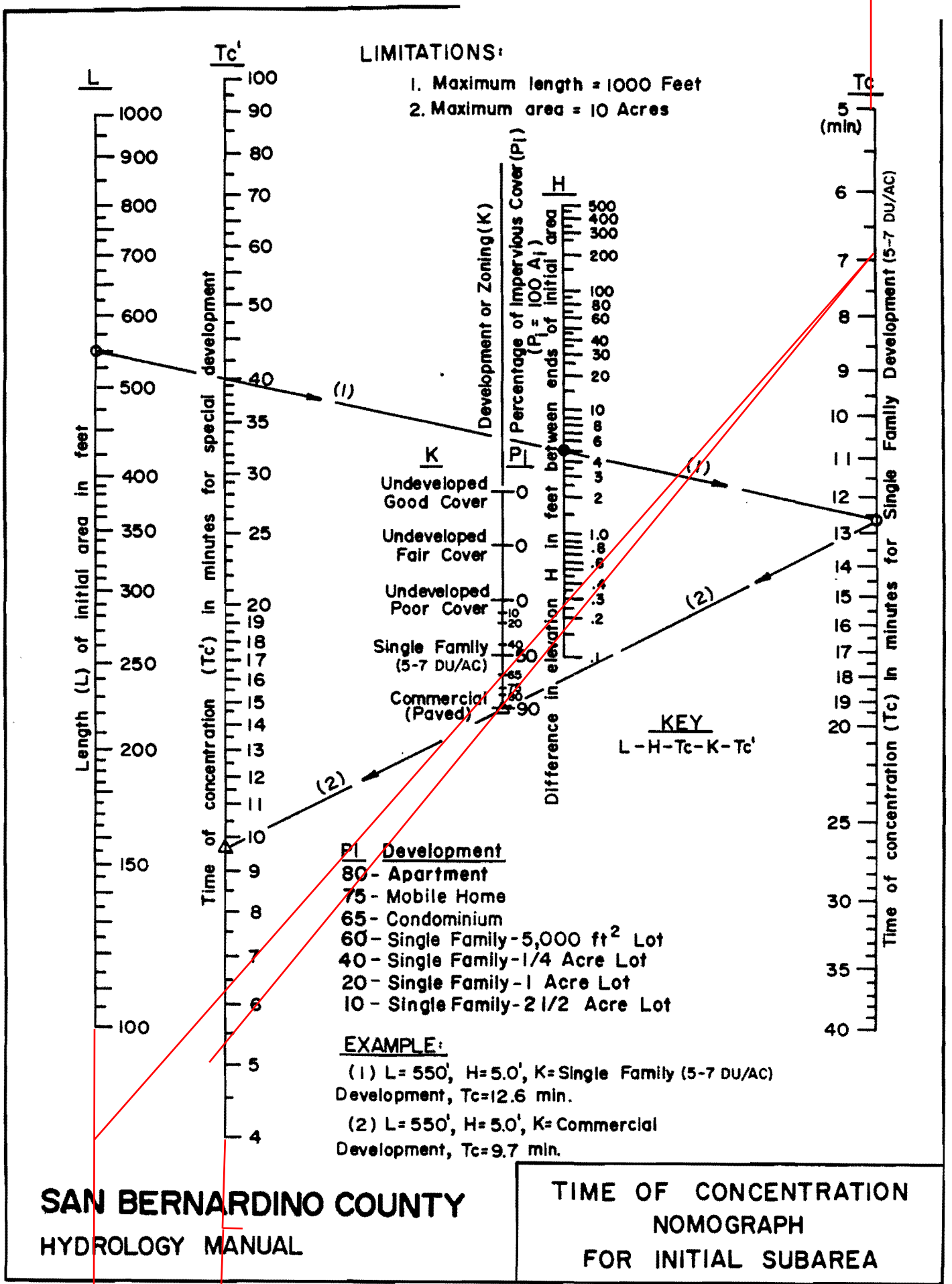
Figure D-1



SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

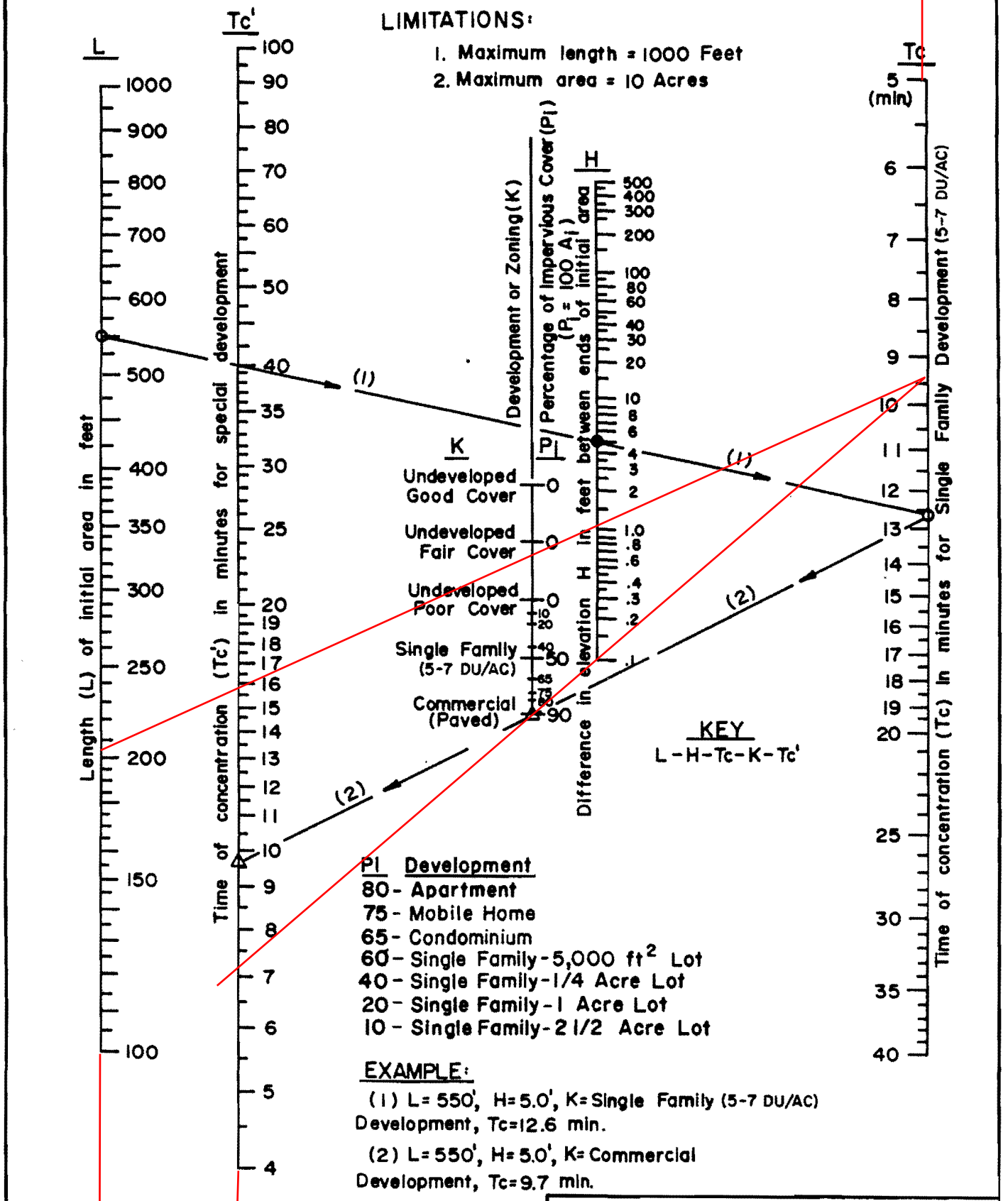
Figure D-1



SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

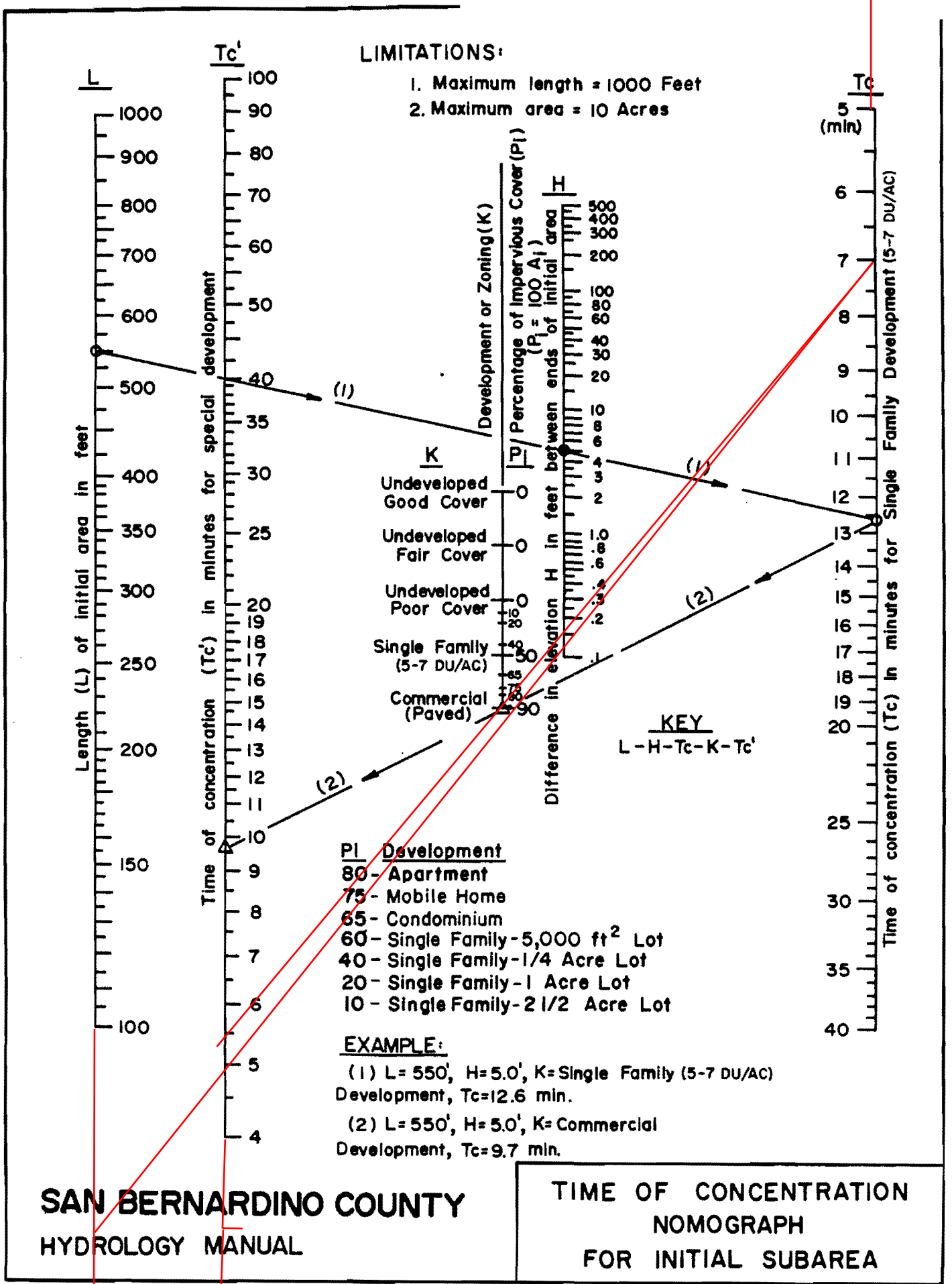
Figure D-1



SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

Figure D-1



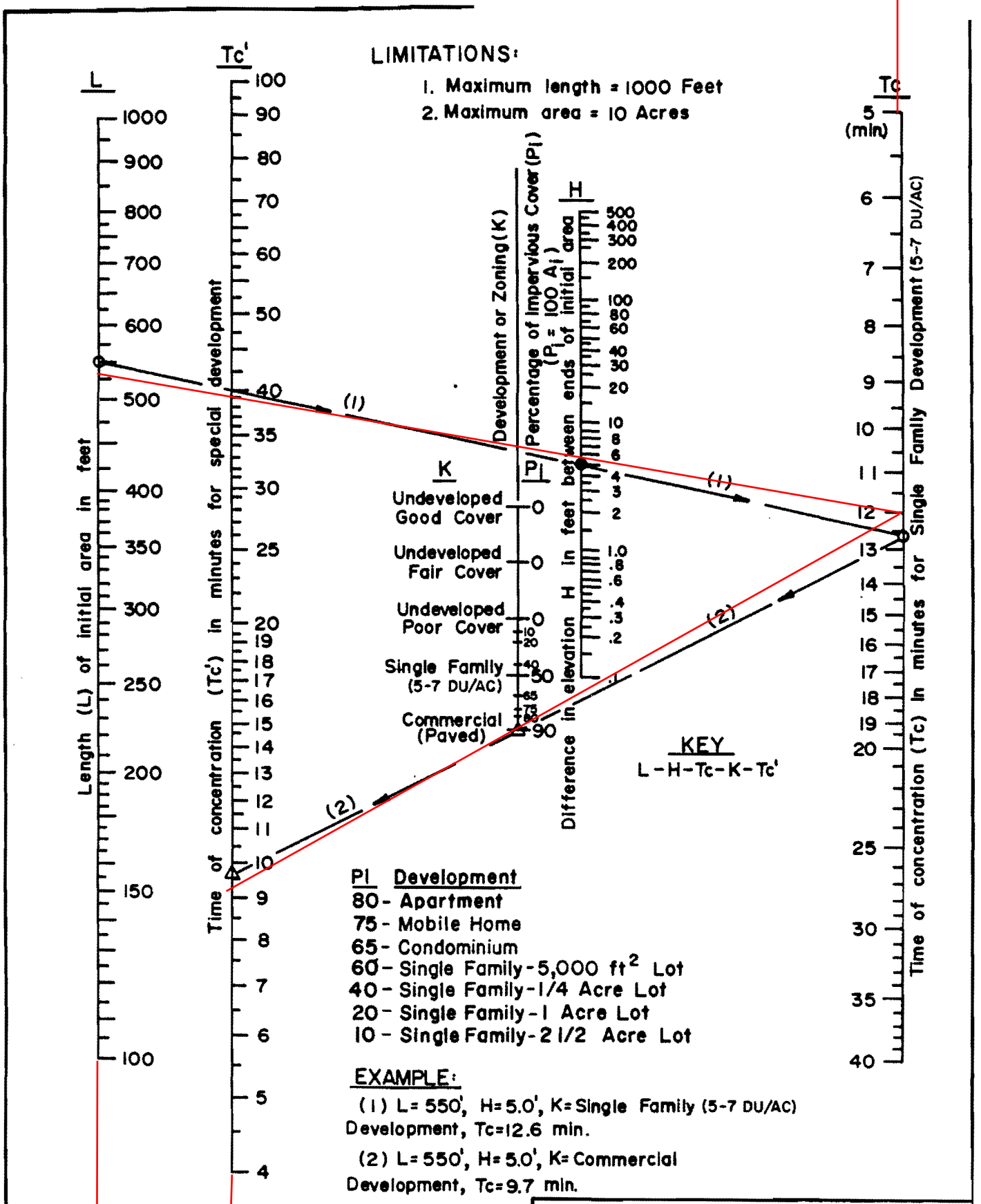
SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

Figure D-1

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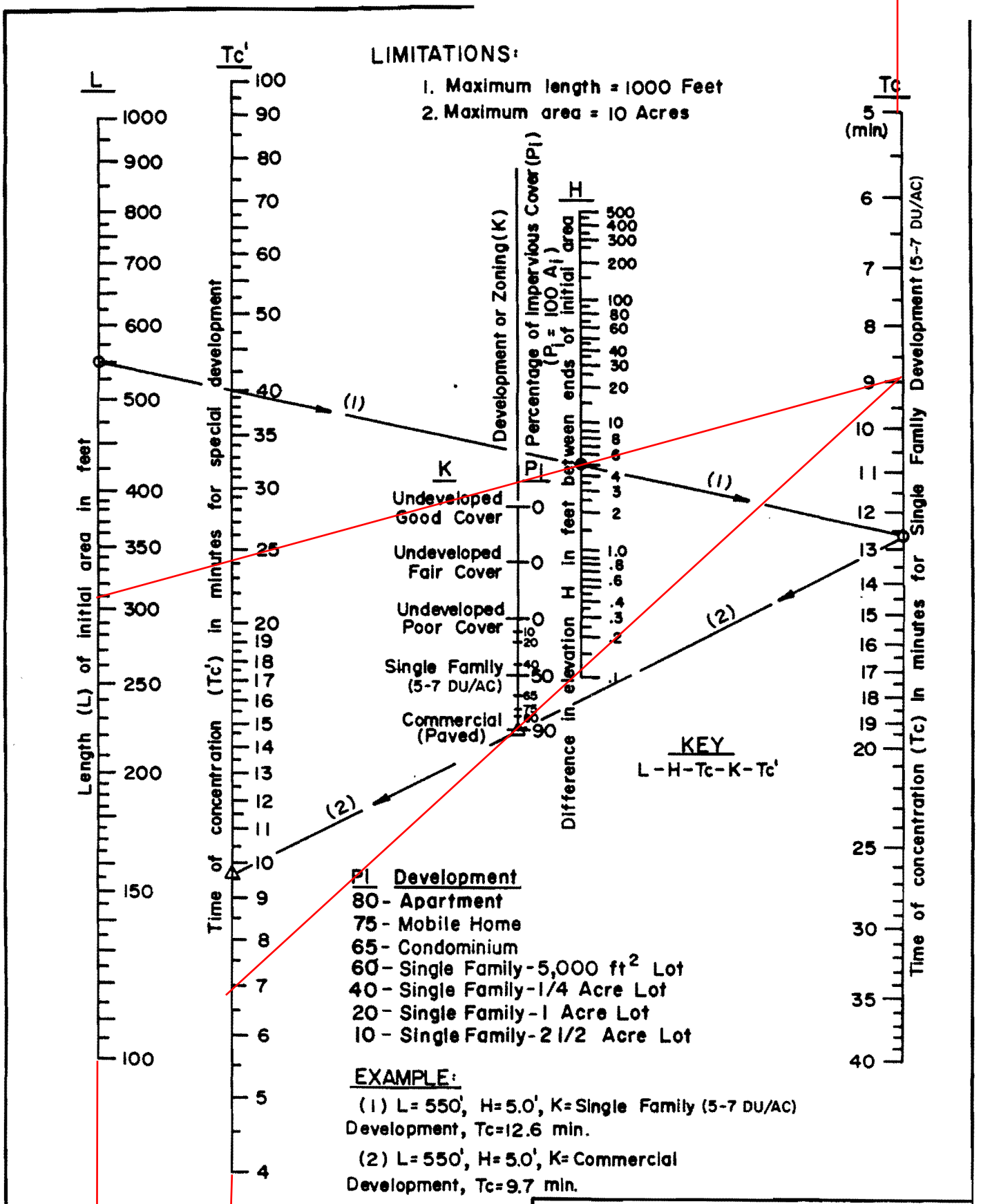
15B



SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

Figure D-1



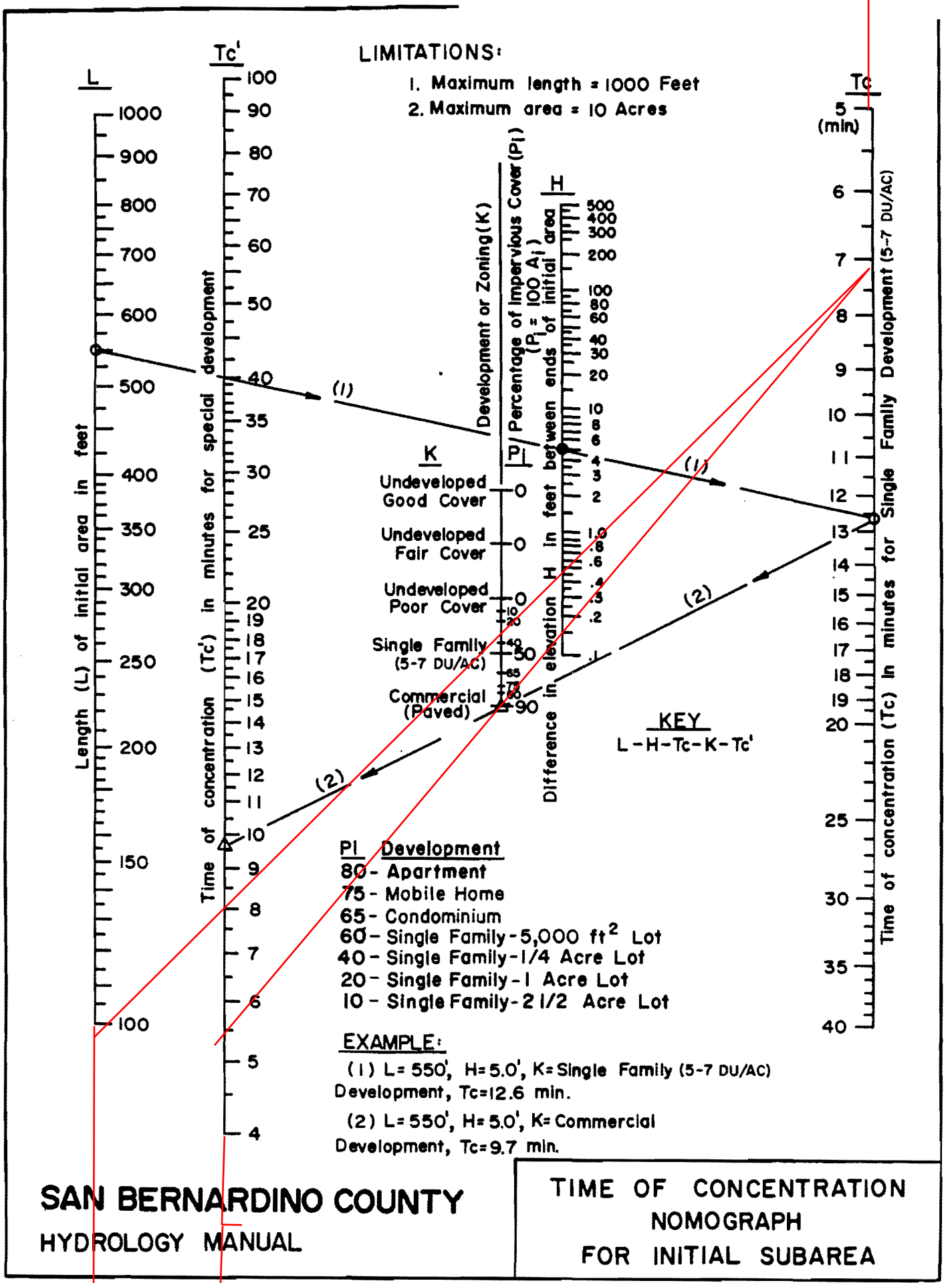
SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

Figure D-1

10

20C



SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

Figure D-1

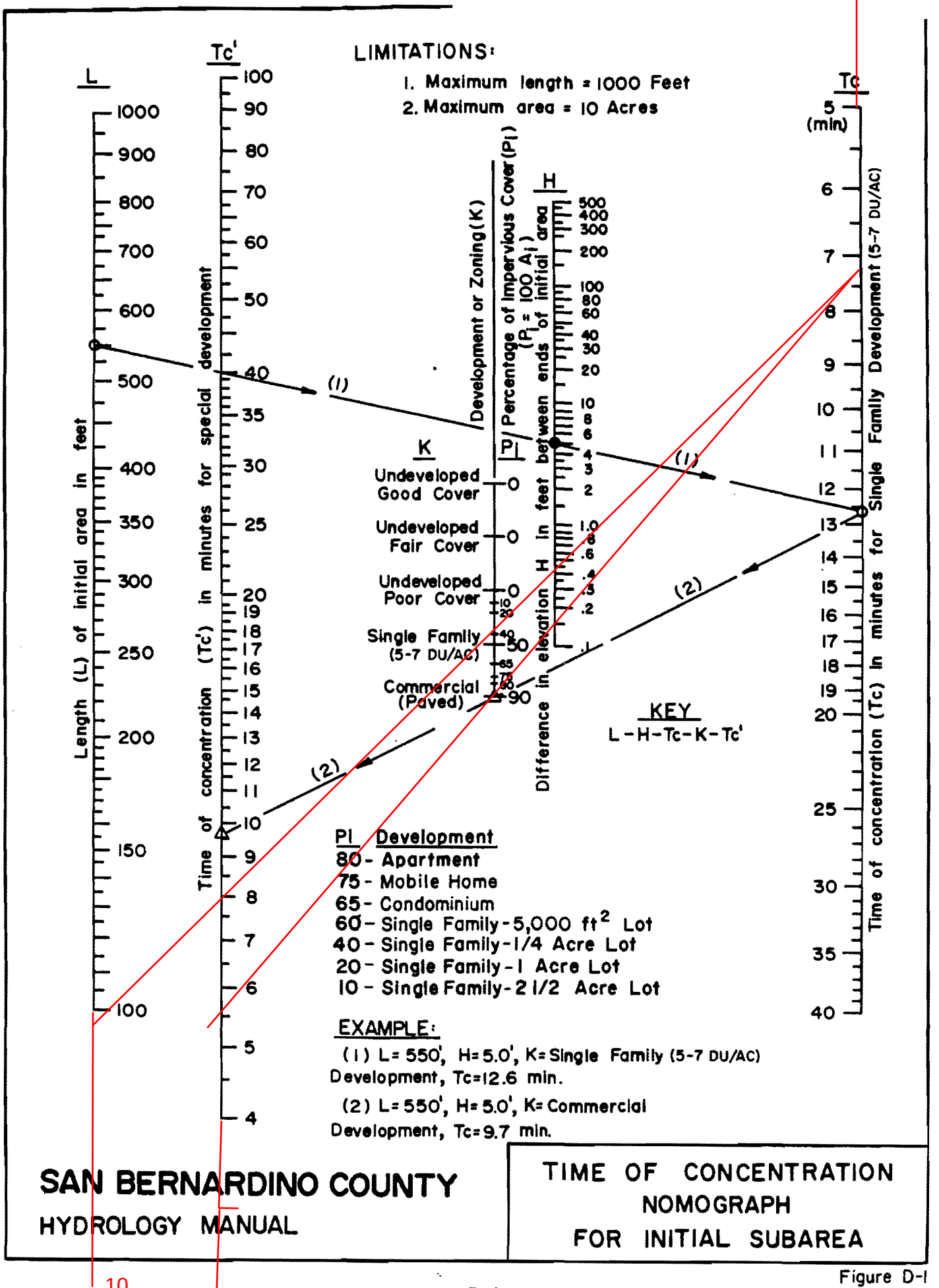
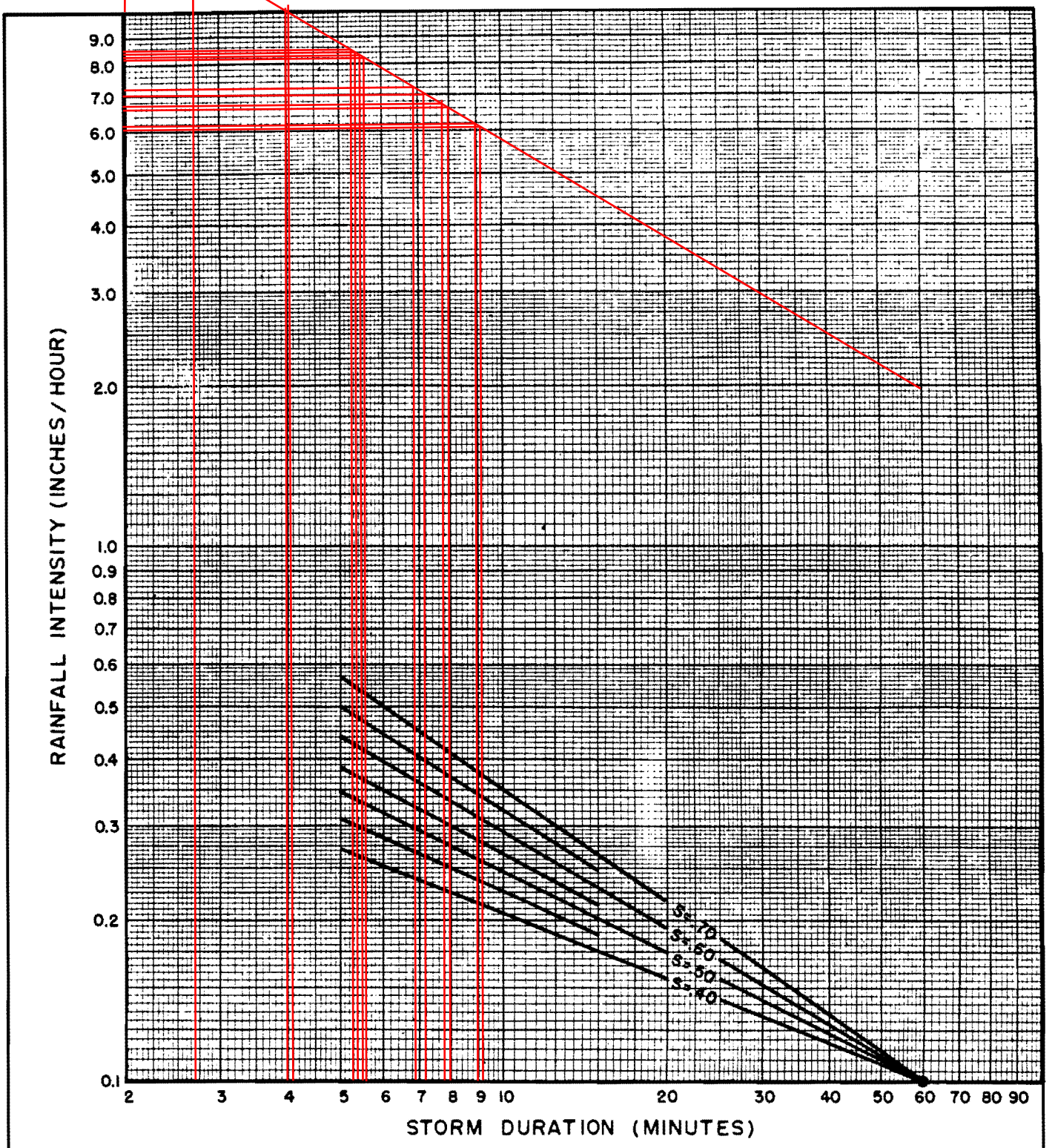

LIMITATIONS:
1. Maximum length = 1000 Feet
2. Maximum area = 10 Acres
L
Length (L) of initial area in feet
Tc'
Time of concentration (Tc') in minutes for special development
Development or Zoning (K)
Pl Percentage of Impervious Cover (Pl)
(Pl = 100 Ai)
Ai of initial area
H
Difference in elevation H in feet between ends
K
Undeveloped Good Cover
Undeveloped Fair Cover
Undeveloped Poor Cover
Single Family (5-7 DU/AC)
Commercial (Paved)
Tc
Time of concentration (Tc) in minutes for Single Family Development (5-7 DU/AC)
(1)
(2)
KEY
L-H-Tc-K-Tc'
Pl Development
80 - Apartment
75 - Mobile Home
65 - Condominium
60 - Single Family - 5,000 ft2 Lot
40 - Single Family - 1/4 Acre Lot
20 - Single Family - 1 Acre Lot
10 - Single Family - 2 1/2 Acre Lot
EXAMPLE:
(1) L= 550', H= 5.0', K= Single Family (5-7 DU/AC) Development, Tc=12.6 min.
(2) L= 550', H= 5.0', K= Commercial Development, Tc=9.7 min.
SAN BERNARDINO COUNTY
HYDROLOGY MANUAL
TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

Figure D-1



DESIGN STORM FREQUENCY = 100 YEARS

ONE HOUR POINT RAINFALL = 1.97 INCHES

LOG-LOG SLOPE = 0.6

PROJECT LOCATION = 4164 North 4th Ave, San Bernardino

SAN BERNARDINO COUNTY

HYDROLOGY MANUAL

INTENSITY - DURATION CURVES CALCULATION SHEET

FIGURE D-3

PIPE SIZING CALCULATIONS

Normal Depth Summary Table

Pipe Diameter (in)	Slope %	Manning's Roughness Coefficient	Full Flow Capacity (cfs)
6	0.5	0.010	0.52
8	0.5	0.010	1.11
10	0.5	0.010	2.01
12	0.5	0.010	3.27
14	0.5	0.010	4.94
16	0.5	0.010	7.05
18	0.5	0.010	9.66
20	0.5	0.010	12.79
24	0.5	0.010	20.79

Worksheet for Circular Pipe - 6

Project Description	
Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data	
Roughness Coefficient	0.010
Channel Slope	0.005 ft/ft
Normal Depth	6.0 in
Diameter	6.0 in
Discharge	0.52 cfs

Results	
Discharge	0.52 cfs
Normal Depth	6.0 in
Flow Area	0.2 ft²
Wetted Perimeter	1.6 ft
Hydraulic Radius	1.5 in
Top Width	0.00 ft
Critical Depth	4.4 in
Percent Full	100.0 %
Critical Slope	0.006 ft/ft
Velocity	2.63 ft/s
Velocity Head	0.11 ft
Specific Energy	0.61 ft
Froude Number	(N/A)
Maximum Discharge	0.55 cfs
Discharge Full	0.52 cfs
Slope Full	0.005 ft/ft
Flow Type	Undefined

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	0.0 %
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	6.0 in
Critical Depth	4.4 in
Channel Slope	0.005 ft/ft
Critical Slope	0.006 ft/ft

Worksheet for Circular Pipe - 8

Project Description	
Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data	
Roughness Coefficient	0.010
Channel Slope	0.005 ft/ft
Normal Depth	8.0 in
Diameter	8.0 in
Discharge	1.11 cfs

Results	
Discharge	1.11 cfs
Normal Depth	8.0 in
Flow Area	0.3 ft²
Wetted Perimeter	2.1 ft
Hydraulic Radius	2.0 in
Top Width	0.00 ft
Critical Depth	6.0 in
Percent Full	100.0 %
Critical Slope	0.006 ft/ft
Velocity	3.18 ft/s
Velocity Head	0.16 ft
Specific Energy	0.82 ft
Froude Number	(N/A)
Maximum Discharge	1.19 cfs
Discharge Full	1.11 cfs
Slope Full	0.005 ft/ft
Flow Type	Undefined

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	0.0 %
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	8.0 in
Critical Depth	6.0 in
Channel Slope	0.005 ft/ft
Critical Slope	0.006 ft/ft

Worksheet for Circular Pipe - 10

Project Description	
Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data	
Roughness Coefficient	0.010
Channel Slope	0.005 ft/ft
Normal Depth	10.0 in
Diameter	10.0 in
Discharge	2.01 cfs

Results	
Discharge	2.01 cfs
Normal Depth	10.0 in
Flow Area	0.5 ft²
Wetted Perimeter	2.6 ft
Hydraulic Radius	2.5 in
Top Width	0.00 ft
Critical Depth	7.6 in
Percent Full	100.0 %
Critical Slope	0.006 ft/ft
Velocity	3.69 ft/s
Velocity Head	0.21 ft
Specific Energy	1.05 ft
Froude Number	(N/A)
Maximum Discharge	2.17 cfs
Discharge Full	2.01 cfs
Slope Full	0.005 ft/ft
Flow Type	Undefined

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	0.0 %
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	10.0 in
Critical Depth	7.6 in
Channel Slope	0.005 ft/ft
Critical Slope	0.006 ft/ft

Worksheet for Circular Pipe - 12

Project Description	
Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data	
Roughness Coefficient	0.010
Channel Slope	0.005 ft/ft
Normal Depth	12.0 in
Diameter	12.0 in
Discharge	3.27 cfs

Results	
Discharge	3.27 cfs
Normal Depth	12.0 in
Flow Area	0.8 ft²
Wetted Perimeter	3.1 ft
Hydraulic Radius	3.0 in
Top Width	0.00 ft
Critical Depth	9.3 in
Percent Full	100.0 %
Critical Slope	0.006 ft/ft
Velocity	4.17 ft/s
Velocity Head	0.27 ft
Specific Energy	1.27 ft
Froude Number	(N/A)
Maximum Discharge	3.52 cfs
Discharge Full	3.27 cfs
Slope Full	0.005 ft/ft
Flow Type	Undefined

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	0.0 %
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	12.0 in
Critical Depth	9.3 in
Channel Slope	0.005 ft/ft
Critical Slope	0.006 ft/ft

Worksheet for Circular Pipe - 14

Project Description	
Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data	
Roughness Coefficient	0.010
Channel Slope	0.005 ft/ft
Normal Depth	14.0 in
Diameter	14.0 in
Discharge	4.94 cfs

Results	
Discharge	4.94 cfs
Normal Depth	14.0 in
Flow Area	1.1 ft²
Wetted Perimeter	3.7 ft
Hydraulic Radius	3.5 in
Top Width	0.00 ft
Critical Depth	11.0 in
Percent Full	100.0 %
Critical Slope	0.005 ft/ft
Velocity	4.62 ft/s
Velocity Head	0.33 ft
Specific Energy	1.50 ft
Froude Number	(N/A)
Maximum Discharge	5.31 cfs
Discharge Full	4.94 cfs
Slope Full	0.005 ft/ft
Flow Type	Undefined

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	0.0 %
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	14.0 in
Critical Depth	11.0 in
Channel Slope	0.005 ft/ft
Critical Slope	0.005 ft/ft

Worksheet for Circular Pipe - 16

Project Description	
Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data	
Roughness Coefficient	0.010
Channel Slope	0.005 ft/ft
Normal Depth	16.0 in
Diameter	16.0 in
Discharge	7.05 cfs

Results	
Discharge	7.05 cfs
Normal Depth	16.0 in
Flow Area	1.4 ft²
Wetted Perimeter	4.2 ft
Hydraulic Radius	4.0 in
Top Width	0.00 ft
Critical Depth	12.7 in
Percent Full	100.0 %
Critical Slope	0.005 ft/ft
Velocity	5.05 ft/s
Velocity Head	0.40 ft
Specific Energy	1.73 ft
Froude Number	(N/A)
Maximum Discharge	7.59 cfs
Discharge Full	7.05 cfs
Slope Full	0.005 ft/ft
Flow Type	Undefined

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	0.0 %
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	16.0 in
Critical Depth	12.7 in
Channel Slope	0.005 ft/ft
Critical Slope	0.005 ft/ft

Worksheet for Circular Pipe - 18

Project Description	
Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data	
Roughness Coefficient	0.010
Channel Slope	0.005 ft/ft
Normal Depth	18.0 in
Diameter	18.0 in
Discharge	9.66 cfs

Results	
Discharge	9.66 cfs
Normal Depth	18.0 in
Flow Area	1.8 ft²
Wetted Perimeter	4.7 ft
Hydraulic Radius	4.5 in
Top Width	0.00 ft
Critical Depth	14.4 in
Percent Full	100.0 %
Critical Slope	0.005 ft/ft
Velocity	5.46 ft/s
Velocity Head	0.46 ft
Specific Energy	1.96 ft
Froude Number	(N/A)
Maximum Discharge	10.39 cfs
Discharge Full	9.66 cfs
Slope Full	0.005 ft/ft
Flow Type	Undefined

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	0.0 %
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	18.0 in
Critical Depth	14.4 in
Channel Slope	0.005 ft/ft
Critical Slope	0.005 ft/ft

Worksheet for Circular Pipe - 20

Project Description	
Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data	
Roughness Coefficient	0.010
Channel Slope	0.005 ft/ft
Normal Depth	20.0 in
Diameter	20.0 in
Discharge	12.79 cfs

Results	
Discharge	12.79 cfs
Normal Depth	20.0 in
Flow Area	2.2 ft²
Wetted Perimeter	5.2 ft
Hydraulic Radius	5.0 in
Top Width	0.00 ft
Critical Depth	16.1 in
Percent Full	100.0 %
Critical Slope	0.005 ft/ft
Velocity	5.86 ft/s
Velocity Head	0.53 ft
Specific Energy	2.20 ft
Froude Number	(N/A)
Maximum Discharge	13.76 cfs
Discharge Full	12.79 cfs
Slope Full	0.005 ft/ft
Flow Type	Undefined

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	0.0 %
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	20.0 in
Critical Depth	16.1 in
Channel Slope	0.005 ft/ft
Critical Slope	0.005 ft/ft

Worksheet for Circular Pipe - 24

Project Description	
Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data	
Roughness Coefficient	0.010
Channel Slope	0.005 ft/ft
Normal Depth	24.0 in
Diameter	24.0 in
Discharge	20.79 cfs

Results	
Discharge	20.79 cfs
Normal Depth	24.0 in
Flow Area	3.1 ft²
Wetted Perimeter	6.3 ft
Hydraulic Radius	6.0 in
Top Width	0.00 ft
Critical Depth	19.6 in
Percent Full	100.0 %
Critical Slope	0.005 ft/ft
Velocity	6.62 ft/s
Velocity Head	0.68 ft
Specific Energy	2.68 ft
Froude Number	(N/A)
Maximum Discharge	22.37 cfs
Discharge Full	20.79 cfs
Slope Full	0.005 ft/ft
Flow Type	Undefined

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	0.0 %
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	24.0 in
Critical Depth	19.6 in
Channel Slope	0.005 ft/ft
Critical Slope	0.005 ft/ft

Storm Drain Sizing Summary Table

Storm Drain Line	Tributary Inlets	100-Yr Peak Flow (cfs)	Pipe Dia. (in)
IA	1A	2.90	12
2A	2A	0.44	6
2	1A, 2A	3.34	14
3A	3A	1.73	10
3	1A-3A	5.07	16
4A	4A	2.70	12
4	1A- 4A	7.77	18
5A	5A	0.45	6
5	1A-5A	8.22	18
6A	6A	0.70	8
7A	6A, 7A	1.09	8
6	1A-7A	9.31	18
8A	8A	1.69	10
7	1A-8A	11.00	20
9A	9A	8.99	18
8	1A-9A	19.99	24
10B	10B	1.66	10
11B	11B	0.47	6
10	10B, 11B	2.13	12
12B	12B	2.65	12
11	10B-12B	4.78	14
13B	13B	0.45	6
12	10B-13B	5.23	16
14B	14B	1.97	10
13	10B-14B	7.20	18
15B	15B	0.18	6
14	10B-15B	7.38	18
16B	16B	3.68	14
15	10B-16B	11.06	20
20C	20C	4.00	14
30D	30D	0.88	8
40E	40E	0.71	8

APPENDIX C: Geotechnical Report

Geotechnical Report

Shandin Hills MHRC
4164 N. 4th Avenue
San Bernardino, California

Prepared for:

New Gen HC
9526 W. Pico Blvd.
Los Angeles, CA 90035



LANDMARK
Geo-Engineers and Geologists

Prepared by:

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July 2023

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July 28, 2023

Mr. Abe Tress
New Gen HC
9526 W. Pico Blvd.
Los Angeles, CA 90035

Geotechnical Report
Shandin Hills MHRC
4164 N. 4th Avenue
San Bernardino, California
LCI Report No.: LP23116

Dear Mr. Tress:

As per your request, ***LandMark Consultants, Inc.*** is providing the following geotechnical report for the proposed private mental health center project located at 4164 N. 4th Avenue in the city of San Bernardino, California. The proposed development will consist of a new 72,000 sq-ft building on approximately 5.93 acres west of the existing mental health rehabilitation complex. This new structure is planned to be single tory, wood/metal-framed, with shallow reinforced concrete foundations and slab-on-grade.

Purpose of Work

The purpose of this study was to investigate the upper 41.5 feet of subsurface soil at selected locations within the site for evaluation of physical/engineering properties. From the analysis of the field and laboratory data, professional opinions were developed and are provided in this report regarding geotechnical conditions at this site and the effect on design and construction.

Authorization

Mr. John Tanori provided authorization by written agreement to proceed with our work on May 24, 2023. We conducted our work in general accordance with our written proposal dated May 18, 2023.

Field Exploration

Subsurface exploration was performed on June 22, 2023, using 2R Drilling of Ontario, California to advance five (5) borings to depths of 21.5 to 41.5 feet below existing ground surface. The borings were advanced with a truck-mounted, CME 75 drill rig using 8-inch diameter, hollow-stem, continuous-flight augers. The approximate boring locations were established in the field and plotted on the site map by sighting to discernible site features. The boring locations are shown on the Site and Exploration Plan (Plate A-2).

A geo-technician observed the drilling operations and maintained logs of the soil encountered with sampling depths. Soils were classified during drilling according to the Unified Soil Classification System using the visual-manual procedure in accordance with ASTM D2488. Relatively undisturbed and bulk samples of the subsurface materials were obtained at selected intervals. The relatively undisturbed soil samples were retrieved using a 2-inch outside diameter (OD) split-spoon sampler or a 3-inch OD Modified California Split-Barrel (ring) sampler lined with 6-inch stainless-steel sleeves.

In addition, Standard Penetration Tests (SPT) were performed in accordance with ASTM D1586 and ASTM D6066. The samples were obtained by driving the samplers ahead of the auger tip at selected depths using a 140-pound CME automatic hammer with a 30-inch drop. The number of blows required to drive the samplers the last 12 inches of an 18-inch drive depth into the soil is recorded on the boring logs as “blows per foot”. Blow counts (N values) reported on the boring logs represent the field blow counts. No corrections have been applied to the blow counts shown on the boring logs for effects of overburden pressure, automatic hammer drive energy, drill rod lengths, liners, and sampler diameter.

After logging and sampling the soil, the exploratory borings were backfilled with the excavated material. The backfill was loosely placed and was not compacted to the requirements specified for engineered fill.

The subsurface logs are presented on Plates B-1 through B-5 in Appendix B. A key to the log symbols is presented on Plate B-6. The stratification lines shown on the subsurface logs represent the approximate boundaries between the various strata. However, the transition from one stratum to another may be gradual over some range of depth.

Laboratory Testing

Laboratory tests were conducted on selected bulk soil samples to aid in classification and evaluation of selected properties of the site soils. The tests were conducted in general conformance to the procedures of the American Society for Testing and Materials (ASTM) or other standardized methods as referenced below. The laboratory testing program consisted of the following tests:

- Particle Size Analyses (ASTM D6913/D7928)
- Unit Dry Densities (ASTM D2937)
- Moisture Contents (ASTM D2216)
- Moisture-Density Relationship (ASTM D1557)
- Chemical Analyses (soluble sulfates & chlorides, pH, and resistivity) (Caltrans Methods)

The laboratory test results are presented on the subsurface logs (Appendix B) and in Appendix C. Engineering parameters of soil strength, compressibility, and relative density utilized for developing design criteria provided within this report were extrapolated from data obtained from the field and laboratory testing program.

Site Conditions

The project site is roughly rectangular shaped in plan view, elongated in the east-west direction, and is relatively flat-lying. The project site is currently occupied by the existing mental rehabilitation building in the southeast corner of the site. Adjacent properties are flat-lying and are approximately at the same elevation as this site. Single family residences are located surrounding the site. The project site is bounded on the east by N. 4th Avenue.

The project site lies at an elevation of approximately 1400 feet above mean sea level (AMSL) in the Inland Empire region of Southern California. Annual rainfall in this arid region is less than 4 inches per year with four months of average summertime temperatures above 100 ^{o}F. Winter temperatures are mild, seldom reaching freezing.

Geologic Setting

The project site is located within the eastern portion of the San Bernardino Basin or San Bernardino Valley Block. The valley is situated between the Transverse Range (San Bernardino Mountains) and the San Andreas Fault zone to the northeast, the Peninsular Range (San Jacinto Mountains) and the San Jacinto Fault zone to the southwest and the Perris Block further to the south-southwest.

The San Bernardino Mountains are the loftiest range within the Transverse Range province, with the highest peak, Mount San Gorgonio at 11,502 feet (3,508 m). The San Bernardino Mountains are about 65 miles (105 km) long, with a maximum width of 40 miles (65 km). They are bounded on the west and southwest by the Cajon Pass and the San Andreas Fault, on the north by the Mojave Desert, on the east by Twentynine Palms Valley, and on the southeast by Morongo and Coachella Valleys.

The San Andreas Fault Zone is located along the southern flanks of the San Bernardino Mountains, which have been uplifted along its trace (Norris & Webb, 1990). The flanks of the range are cut by deep, narrow canyons and are drained by several permanent streams. The Santa Ana River, located to the north of the site, has the largest drainage basin in southern California. It drains both the San Bernardino and eastern San Gabriel Mountains, and the northern Peninsular Ranges (Norris & Webb, 1990).

Subsurface Soils

Subsurface soils encountered during the field exploration conducted on June 22, 2023, consist of silty sand (SM), sand (SP-SM) and sand (SP). The near surface soils are non-expansive in nature. The subsurface logs (Plates B-1 through B-5) depict the stratigraphic relationships of the various soil types.

Groundwater

Groundwater was not encountered in the boring during the time of exploration. Based on available information from the Western Municipal Water District Cooperative Well Measuring Program, the nearest groundwater well with data (Well No. 01N04W21B002S) is located less than 1-mile southwest of the project site. The most recent measurement was recorded approximately 140-feet bgs.

There is uncertainty in the accuracy of short-term water level measurements. Groundwater levels may fluctuate with precipitation, irrigation of adjacent properties, drainage, and site grading. The groundwater level noted should not be interpreted to represent an accurate or permanent condition. Based on the regional topography, groundwater flow is assumed to be generally towards the south within the site area. Flow directions may vary locally in the vicinity of the site.

Faulting

The project site is located within the seismically active San Bernardino Valley of southern California and is considered likely to be subjected strong ground motion from earthquakes in the region. We have performed a computer-aided search of known faults or seismic zones that lie within a 36-mile radius of the project site (Table 1).

A fault map illustrating known active faults relative to the site is presented on Figure 1, *Regional Fault Map*. Figure 2 shows the project site in relation to local faults. The criterion for fault classification adopted by the California Geological Survey defines Earthquake Fault Zones along Holocene-active or pre-Holocene faults (CGS, 2023b). Earthquake Fault Zones are regulatory zones that address the hazard of surface fault rupture. A Holocene-active fault is one that has ruptured during Holocene time (within the last 11,700 years). A pre-Holocene fault is a fault that has not ruptured in the last 11,700 years. Pre-Holocene faults may still be capable of surface rupture in the future, but are not regulated by the Alquist-Priolo Act (AP).

Review of the current Alquist-Priolo Earthquake Fault Zone maps (CGS, 2023a) indicates that the nearest mapped Earthquake Fault Zone is the San Andreas – San Bernardino (south) fault located approximately 1.7 miles north of the project site.

General Ground Motion Analysis

The project site is considered likely to be subjected to moderate to strong ground motion from earthquakes in the region. Ground motions are dependent primarily on the earthquake magnitude and distance to the seismogenic (rupture) zone. Acceleration magnitudes also are dependent upon attenuation by rock and soil deposits, direction of rupture and type of fault; therefore, ground motions may vary considerably in the same general area.

2022 CBC General Ground Motion Parameters: The California Building Code (CBC) requires that a site-specific ground motion hazard analysis be performed in accordance with ASCE 7-16 Section 11.4.8 (ASCE, 2016) for structures on Site Class D with S_1 greater than or equal to 0.2 and Site Class E sites with S_s greater than or equal to 1.0 (CBC, 2019). **This project site has been classified as Site Class C which would require a site-specific ground motion hazard analysis**.

The 2022 CBC general ground motion parameters are based on the Risk-Targeted Maximum Considered Earthquake (MCE_R). The Structural Engineers Association of California (SEAOC) and Office of Statewide Health Planning and Development (OSHPD) Seismic Design Maps Web Application (SEAOC, 2020) was used to obtain the site coefficients and adjusted maximum considered earthquake spectral response acceleration parameters. Design spectral response acceleration parameters are defined as the earthquake ground motions that are two-thirds (2/3) of the corresponding MCE_R ground motions. The Maximum Considered Earthquake Geometric Mean (MCE_G) peak ground acceleration adjusted for soil site class effects (PGA_M) value to be used for liquefaction and seismic settlement analysis in accordance with 2022 CBC Section 1803.5.12.2 is estimated at 1.2g for the project site. ***Design earthquake ground motion parameters are provided in Table 2.***

Seismic and Other Hazards

► **Groundshaking.** The primary seismic hazard at the project site is the potential for strong groundshaking during earthquakes along the Cucamonga, San Jacinto, San Andreas and other nearby faults. A further discussion of groundshaking mentioned above.

► **Surface Rupture.** The project site does not lie within a State of California, Alquist-Priolo Earthquake Fault Zone or County of San Bernardino Fault Zone. Surface fault rupture is considered to be unlikely at the project site because of the well-delineated fault lines through the San Bernardino Valley as shown on USGS and CDMG maps.

However, because of the high tectonic activity and deep alluvium of the region, we cannot preclude the potential for surface rupture on undiscovered or new faults that may underlie the site.

► **Liquefaction.** Liquefaction is unlikely to be a potential hazard at the site, due to groundwater deeper than 50 feet (the maximum depth that liquefaction is known to occur).

<u>Other Potential Geologic Hazards.</u>

► **Landsliding.** The hazard of landsliding is unlikely due to the regional planar topography. No ancient landslides are shown on geologic maps of the region and no indications of landslides were observed during our site investigation.

► **Volcanic hazards.** The site is not located in proximity to any known volcanically active area and the risk of volcanic hazards is considered very low.

► **Tsunamis, sieches, and flooding.** The site does not lie near any large bodies of water, so the threat of tsunami, sieches, or other seismically-induced flooding is unlikely.

► **Expansive soil.** The near surface soils at the project site consist of sands which are non-expansive.

Hydroconsolidation

In arid climatic regions, granular soils have a potential to collapse upon wetting. This collapse (hydro-consolidation) phenomena is the result of the lubrication of soluble cements (carbonates) in the soil matrix causing the soil to densify from its loose configuration during deposition. Based on our experience in the vicinity of the project site, there is a slight risk of collapse upon inundation from at the site. Therefore, development of building foundation is not required to include provisions for mitigating the hydro-consolidation caused by soil saturation from landscape irrigation or broken utility lines.

Soil Infiltration Rate

A total of two (2) infiltration tests were conducted on July 10, 2023, at these proposed locations for the on-site storm-water retention basin as shown on the Site and Exploration Plan (Plate A-2). The infiltration tests were performed to the guideline from Design Handbook for Low Impact Development Best Management Practices, prepared by State Water Conservation District, Appendix A, Section 2.3, dated September 2011.

The tests were performed using 6-inch perforated pipe inside an 8-inch diameter flight auger borehole made to depths of approximately 5.0 feet below the existing ground surface, corresponding to the anticipated bottom depth of the stormwater retention basin. The pipes were filled with water and successive readings of drops in water levels were made every 10 minutes for a total elapsed time of 60 minutes, until a stabilization drop was recorded.

The test results indicate that the stabilized soil infiltration rate for the soil ranges from 2.2 to 2.5 inches per hour. A maximum soil infiltration rate of 2.2 inches per hour may be used for the on-site storm-water retention basin design. An oil/water separator should be installed at inlets to the stormwater retention basin to prevent sealing of the basin bottom with silt and oil residues. The field and conversion calculation worksheets are included in Appendix D.

We recommend additional testing should be performed after the completion of rough grading operations, to verify the soil infiltration rate.

Site Preparation

Pre-grade Meeting: Prior to site preparation, a meeting should be held at the site with as a minimum, the owner's representative, grading contractor and geotechnical engineer in attendance.

Clearing and Grubbing: Any surface improvements, debris or vegetation including grass, trees, and weeds on the site at the time of construction should be removed from the construction area. Root balls should be completely excavated. Organic stripping should be hauled from the site and not used as fill. *Any trash, construction debris, concrete slabs, old pavement, landfill, and buried obstructions such as old foundations, un-controlled fills and utility lines exposed during rough grading should be traced to the limits of the foreign material by the grading contractor and removed under our supervision.* Any excavations resulting from site clearing should be dish-shaped to the lowest depth of disturbance and backfilled under the observation of the geotechnical engineer's representative.

Building Pad Preparation: The existing surface soil within the proposed building pad areas should be removed to 48 inches below the original grade or 24 inches below the lowest foundation grade (whichever deeper), extending five feet beyond all exterior wall/column lines (including adjacent concrete areas). Exposed sub-grade should be scarified to a depth of 6 to 8 inches, uniformly moisture conditioned to at least 2% over optimum moisture content, and re-compacted to a minimum of 90% of the maximum density determined in accordance with ASTM D1557 methods.

Auxiliary Structures Foundation Preparation: Auxiliary structures such as free standing or retaining walls should have footings extended to a minimum of 18 inches below grade. The existing soil beneath the structure foundation prepared in the manner described for the house pad except the preparation needs only to extend 18 inches below and beyond the footing.

Sidewalk and Concrete Hardscape Areas: In areas other than the building pad which are to receive concrete slabs, the ground surface should be over-excavated to a depth of 8 to 12 inches, uniformly moisture conditioned to at least 2% over optimum moisture, and re-compacted to at least 90% of ASTM D1557 maximum density.

Street Subgrade Preparation: The native soils in street areas should be removed and recompacted to 12 inches below the design subgrade elevation. Engineered fill in street areas should be uniformly moisture conditioned to at least 2% over optimum moisture, placed in layers not more than 6 to 8 inches in thickness and mechanically compacted to a minimum of 90% of the ASTM D1557 maximum dry density.

The on-site soils are suitable for use as compacted fill and utility trench backfill. Imported fill soil (if required) should be like onsite soil or non-expansive, granular soil meeting the USCS classifications of SM, SP-SM, or SW-SM with a maximum rock size of 6 inches and no less than 5% passing the No. 200 sieve. ***The geotechnical engineer should approve imported fill soil sources before hauling material to the site***. Native and imported materials should be placed in lifts no greater than 8 inches in loose thickness, uniformly moisture conditioned to at least 2% over optimum moisture, and re-compacted to at least 90% of ASTM D1557 maximum density.

Moisture Control and Drainage: The moisture condition of the house pad should be maintained during trenching and utility installation until concrete is placed or should be rewetted before initiating delayed construction. Adequate site drainage is essential to the future performance of the project. Infiltration of excess irrigation water and stormwaters can adversely affect the performance of the subsurface soil at the site. Positive drainage should be maintained away from all structures (5% for 10 feet minimum across unpaved areas) to prevent ponding and subsequent saturation of the native soil. Gutters and downspouts may be considered as a means to convey water away from foundations. If landscape irrigation is allowed next to the building, drip irrigation systems or lined planter boxes should be used. The subgrade soil should be maintained in a moist, but not saturated state, and not allowed to dry out. Drainage should be maintained without ponding.

Utility Trench Backfill

On-site soil free of debris, vegetation, and other deleterious matter may be suitable for use as utility trench backfill. Backfill within roadways should be placed in layers not more than 6 to 8 inches in thickness, uniformly moisture conditioned to at least 2% over optimum moisture and mechanically compacted to a minimum of 90% of the ASTM D1557 maximum dry density except for the top 12 inches of the trench which shall be compacted to at least 95%. Native backfill should only be placed and compacted after encapsulating buried pipes with suitable bedding and pipe envelope material. Pipe envelope/bedding should be clean sand (Sand Equivalent SE>30). Precautions should be taken in the compaction of the backfill to avoid damage to the pipes and structures.

Soil Bearing Values and Lateral Loads

Shallow column footings and continuous wall footings are suitable to support the structures provided they are founded on a layer of properly prepared and compacted soil as described above. The foundations may be designed using an allowable soil bearing pressure of 1,800 psf. The allowable soil pressure may be increased by 20% for each foot of embedment depth more than 18 inches and by one-third for short term loads induced by winds or seismic events. The maximum allowable soil pressure at increased embedment depths shall not exceed 2,800 psf.

All exterior and interior foundations should be embedded a minimum of 18 inches below the building support pad or lowest adjacent final grade, whichever is deeper. Continuous wall footings should have a minimum width of 12 inches. Isolated column footings should have a minimum width of 24 inches. ***Recommended concrete reinforcement and sizing for all footings should be provided by the structural engineer.***

Resistance to horizontal loads will be developed by passive earth pressure on the sides of footings and frictional resistance developed along the bases of footings and concrete slabs. Passive resistance to lateral earth pressure may be calculated using an equivalent fluid pressure of 300 pcf to resist lateral loadings. The top one foot of embedment should not be considered in computing passive resistance unless the adjacent area is confined by a slab or pavement. An allowable friction coefficient of 0.35 may also be used at the base of the footings to resist lateral loading.

Foundation movement under the estimated static (non-seismic) loadings and static site conditions are estimated to not exceed ¾ inch with differential movement of about two-thirds of total movement for the loading assumptions stated above when the subgrade preparation guidelines given above are followed.

Slabs-on-Grade

Concrete slabs and flatwork should be a minimum of 5 inches thick. The concrete floor slabs may either be monolithically placed with the foundation or dowelled after footing placement. The concrete slabs may be placed on granular subgrade that has been compacted at least 90% relative compaction (ASTM D1557). ***Slab thickness and steel reinforcement should be determined by the design engineer.***

American Concrete Institute (ACI) guidelines (ACI 302.1R-15 Chapter 5, Section 5.2.3) provide recommendations regarding the use of moisture barriers beneath concrete slabs. The concrete floor slabs should be underlain by a 10-mil polyethylene vapor retarder that works as a capillary break to reduce moisture migration into the slab section.

All laps and seams should be overlapped 6-inches or as recommended by the manufacturer. The vapor retarder should be protected from puncture. The joints and penetrations should be sealed with the manufacturer's recommended adhesive, pressure-sensitive tape, or both. The vapor retarder should extend a minimum of 12 inches into the footing excavations. The vapor retarder may lie directly on the granular fill with 2 inches of clean sand cover. Placing sand over the vapor retarder may increase moisture transmission through the slab, because it provides a reservoir for bleed water from the concrete to collect. The sand placed over the vapor retarder may also move and mound prior to concrete placement, resulting in an irregular slab thickness.

For areas with moisture sensitive flooring materials, ACI recommends that concrete slabs be placed without a sand cover directly over the vapor retarder, provided that the concrete mix uses a low-water cement ratio and concrete curing methods are employed to compensate for release of bleed water through the top of the slab. The vapor retarder should have a minimum thickness of 15-mil (Stego-Wrap or equivalent).

All independent concrete flatwork should be underlain by 12 inches of moisture conditioned and compacted soils. All flatworks should be jointed in square patterns and at irregularities in shape at a maximum spacing of 10 feet or the least width of the sidewalk.

Concrete Mixes and Corrosivity

Selected chemical analyses for corrosivity were conducted on bulk samples of the near surface soil from the project site (Plate C-2). The native soils have low levels of sulfate and low to moderate levels of chloride ion concentrations. Resistivity determinations on the soil indicate a moderate potential for metal loss because of electrochemical corrosion processes. A minimum of 2,500 psi concrete of Type II Portland Cement with a maximum water/cement ratio of 0.60 (by weight) should be used for concrete placed in contact with native soil on this project (sitework including sidewalks, driveways, patios, and foundations).

Landmark does not practice corrosion engineering. We recommend that a qualified corrosion engineer evaluate the corrosion potential on metal construction materials and concrete at the site.

Excavations

All site excavations should conform to CalOSHA requirements for Type C soil. The contractor is solely responsible for the safety of workers entering trenches. Temporary excavations with depths of 4 feet or less may be cut nearly vertical for short duration. Temporary slopes should be no steeper than 1.5:1 (horizontal:vertical). Sandy soil slopes should be kept moist, but not saturated, to reduce the potential of raveling or sloughing. Excavations deeper than 4 feet will require shoring or slope inclinations in conformance to CAL/OSHA regulations for Type C soil. Surcharge loads of stockpiled soil or construction materials should be set back from the top of the slope a minimum distance equal to the height of the slope. All permanent slopes should not be steeper than 3:1 to reduce wind and rain erosion. Protected slopes with ground cover may be as steep as 2:1. However, maintenance with motorized equipment may not be possible at this inclination.

Lateral Earth Pressures

Earth retaining structures, such as retaining walls, should be designed to resist the soil pressure imposed by the retained soil mass. Walls with granular drained backfill may be designed for an assumed static earth pressure equivalent to that exerted by a fluid weighing 30 pcf for unrestrained (active) conditions (able to rotate 0.1% of wall height), and 50 pcf for restrained (at-rest) conditions. These values should be verified at the actual wall locations during construction. When applicable seismic earth pressure on walls may be assumed to exert a uniform pressure distribution of 7.5H psf against the back of the wall, where H is the height of the backfill. The total seismic load is assumed to act as a point load at 0.6H above the base of the wall.

Surcharge loads should be considered if loads are applied within a zone between the face of the wall and a plane projected behind the wall 45 degrees upward from the base of the wall. The increase in lateral earth pressure acting uniformly against the back of the wall should be taken as 50% of the surcharge load within this zone. Areas of the retaining wall subjected to traffic loads should be designed for a uniform surcharge load equivalent to two feet of native soil.

Walls should be provided with back drains to reduce the potential for the buildup of hydrostatic pressure. The drainage system should consist of a composite HDPE drainage panel or a 2-foot-wide zone of free draining crushed rock placed adjacent to the wall and extending 2/3 the height of the wall. The gravel should be completely enclosed in an approved filter fabric to separate the gravel and backfill soil. A perforated pipe should be placed perforations down at the base of the permeable material at least six inches below finished floor elevations.

The pipe should be sloped to drain to an appropriate outlet that is protected against erosion. Walls should be properly waterproofed. The project geotechnical engineer should approve any alternative drain system.

Pavements

Pavements should be designed according to the 2022 Caltrans Highway Design Manual or other acceptable methods. Traffic indices were not provided by the project engineer or owner; therefore, we have provided structural sections for several traffic indices for comparative evaluation. The public agency or design engineer should decide the appropriate traffic index for the site. Maintenance of proper drainage is necessary to prolong the service life of the pavements. Based on the current Caltrans method, an estimated R-value of 60 for the subgrade soil and assumed traffic indices, the following table provides our estimates for asphaltic concrete (AC pavement sections.

PAVEMENT STUCTURAL SECTIONS

R-Value of Subgrade Soil - 60 (estimated) Design Method - CALTRANS 2022

Traffic Index (assumed)	Flexible Pavements	
	Asphaltic Concrete Thickness (in.)	Aggregate Base Thickness (in.)
5.0	3.0	4.0
6.0	3.5	4.0
7.0	4.5	4.0
8.0	5.0	4.0

Notes:

1) Asphaltic concrete shall be Caltrans, Type A HMA (Hot Mix Asphalt), ¾ inch maximum (½ inch maximum for parking areas), with PG70-10 PG64-16 asphalt concrete, compacted to a minimum of 95% of the Hveem density (CAL 308) or a minimum of 92% of the Maximum Theoretical Density (ASTM D2041).
2) Aggregate base shall conform to Caltrans Class 2 (¾ in. maximum), compacted to a minimum of 95% of ASTM D1557 maximum dry density.
3) Place pavements on 12 inches of moisture conditioned (at least 2% of over optimum) native soil compacted to a minimum of 95% of the maximum dry density determined by ASTM D1557, or the governing agency requirements.

Final pavement sections may need to be determined by sampling and R-Value testing during grading operations when actual subgrade soils are exposed.

Observation and Density Testing

Site preparation and fill placement should be continuously observed and tested by a representative of a qualified geotechnical engineering firm. Near full-time observation services during the excavation and scarification process is necessary to detect undesirable materials or conditions and soft areas that may be encountered in the construction area. The geotechnical firm that provides observation and testing during construction shall assume the responsibility of "***geotechnical engineer of record***" and, as such, shall perform additional tests and investigation as necessary to satisfy themselves as to the site conditions and the recommendations for site development.

Additional Services

We recommend that ***Landmark Consultants, Inc.*** be retained to provide tests and observations services during construction. *The geotechnical engineering firm providing such tests and observations shall become the geotechnical engineer of record and assume responsibility for the project.*

Landmark Consultants, Inc. *recommendations for this site are, to a high degree, dependent upon appropriate quality control of subgrade preparation, fill placement, and foundation construction. Accordingly, the findings and professional opinions in this report are made contingent upon the opportunity for* ***Landmark Consultants, Inc.*** *to observe grading operations and foundation excavations for the proposed construction.*

If parties other than ***Landmark Consultants, Inc.*** *are engaged to provide observation and testing services during construction, such parties must be notified that they will be required to assume complete responsibility as the geotechnical engineer of record for the geotechnical phase of the project by concurring with the recommendations in this report and/or by providing alternative recommendations.*

Closure

Additional information concerning the scope and cost of these services can be obtained from our office. We did not encounter soil conditions that would preclude implementation of the proposed project provided the recommendations contained in this report are implemented in the design and construction of this project.

We appreciate the opportunity to provide our findings and professional opinions regarding geotechnical conditions at the site. Please provide our office with a set of the foundation plans and civil plans for review to insure that the geotechnical site constraints have been included in the design documents. If you have any questions or comments regarding our findings, please call our office at (760) 360-0665.

Respectfully Submitted,
LandMark Consultants, Inc.



Greg M. Chandra, PE, M.ASCE
Principal Engineer

Attachments:

Appendix A: Vicinity and Site Maps
Appendix B: Subsurface Soil Logs and Soil Key
Appendix C: Laboratory Test Results
Appendix D: Soil Infiltration Test Results

TABLES

Table 1
Summary of Characteristics of Closest Known Active Faults

Fault Name	Approximate Distance (miles)	Approximate Distance (km)	Maximum Moment Magnitude (Mw)	Fault Length (km)	Slip Rate (mm/yr)
San Andreas - San Bernardino (South)	1.7	2.7	7.4	103 ± 10	30 ± 7
San Jacinto - San Bernardino	3.9	6.2	6.7	36 ± 4	12 ± 6
Cucamonga	7.3	11.6	6.9	28 ± 3	5 ± 2
Cleghorn	7.3	11.7	6.5	25 ± 3	3 ± 2
North Frontal Fault Zone - Western	9.6	15.3	7.2	51 ± 5	1 ± 0.5
San Jacinto - San Jacinto Valley	11.2	17.9	6.9	43 ± 4	12 ± 6
San Andreas - Mojave	13.7	21.9	7.1	39 ± 4	3 ± 3
San Jose	22.1	35.3	6.4	20 ± 2	0.5 ± 0.5
Sierra Madre	24.9	39.9	7.2	57 ± 6	2 ± 1
Chino Avenue	25.8	41.3	6.7	28 ± 3	1 ± 1
Helendale - S. Lockhart	28.2	45.2	7.3	97 ± 10	0.6 ± 0.4
Elsinore - Glen Ivy	28.6	45.8	6.8	36 ± 4	5 ± 2
Whittier	28.6	45.8	6.8	38 ± 4	2.5 ± 1
Clamshell-Sawpit	31.1	49.7	6.5	16 ± 2	0.5 ± 0.5
North Frontal Fault Zone - Eastern	32.3	51.7	6.7	27 ± 3	0.5 ± 0.3
Pinto Mtn.	34.6	55.4	7.2	74 ± 7	2.5 ± 2
Elsinore - Temecula	34.8	55.7	6.8	43 ± 4	5 ± 2
Puente Hills Blind Thrust	36.0	57.7	7.1	44 ± 4	0.7 ± 0.4
San Jacinto - Anza	37.2	59.5	7.2	91 ± 9	12 ± 6
Lenwood - Lockhart - Old Woman Springs	37.4	59.9	7.5	145 ± 15	0.6 ± 0.4
Garnet Hill *	38.9	62.3			
Morongo *	40.8	65.2			

* Note: Faults not included in CGS database.

Table 2
2022 California Building Code (CBC) and ASCE 7-16 Seismic Parameters

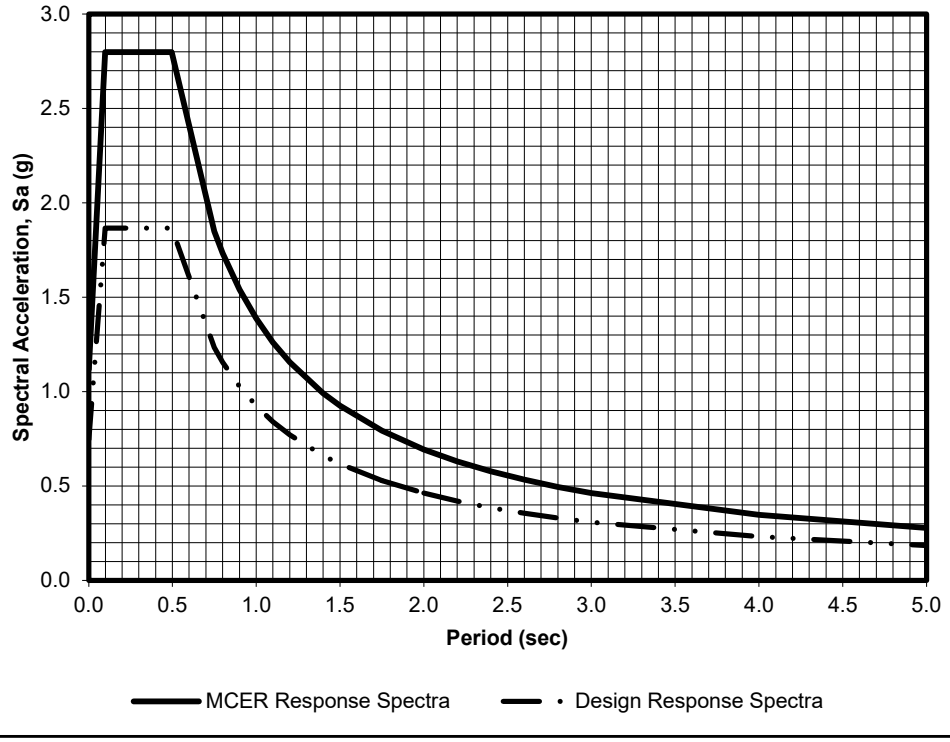
			ASCE 7-16 Reference
Soil Site Class:	**C**		Table 20.3-1
Latitude:	34.1706	N	
Longitude:	-117.3108	W	
Risk Category:	II		
Seismic Design Category:	E		

Maximum Considered Earthquake (MCE) Ground Motion

Mapped MCE_R Short Period Spectral Response	S_s	2.332 g	ASCE Figure 22-1	
Mapped MCE_R 1 second Spectral Response	S_1	0.991 g	ASCE Figure 22-2	
Short Period (0.2 s) Site Coefficient	F_a	1.20	ASCE Table 11.4-1	
Long Period (1.0 s) Site Coefficient	F_v	1.40	ASCE Table 11.4-2	
MCE_R Spectral Response Acceleration Parameter (0.2 s)	S_{MS}	2.798 g	= Fa * S_s	ASCE Equation 11.4-1
MCE_R Spectral Response Acceleration Parameter (1.0 s)	S_{M1}	1.387 g	= Fv * S_1	ASCE Equation 11.4-2

Design Earthquake Ground Motion

Design Spectral Response Acceleration Parameter (0.2 s)	S_{DS}	1.866 g	= 2/3*S_{MS}	ASCE Equation 11.4-3
Design Spectral Response Acceleration Parameter (1.0 s)	S_{D1}	0.925 g	= 2/3*S_{M1}	ASCE Equation 11.4-4
Risk Coefficient at Short Periods (less than 0.2 s)	C_{RS}	0.904		ASCE Figure 22-17
Risk Coefficient at Long Periods (greater than 1.0 s)	C_{R1}	0.883		ASCE Figure 22-18
	T_L	8.00 sec		ASCE Figure 22-12
	T_O	0.10 sec	=0.2*S_{D1}/S_{DS}	
	T_S	0.50 sec	=S_{D1}/S_{DS}	
Peak Ground Acceleration	PGA_M	1.20 g		ASCE Equation 11.8-1



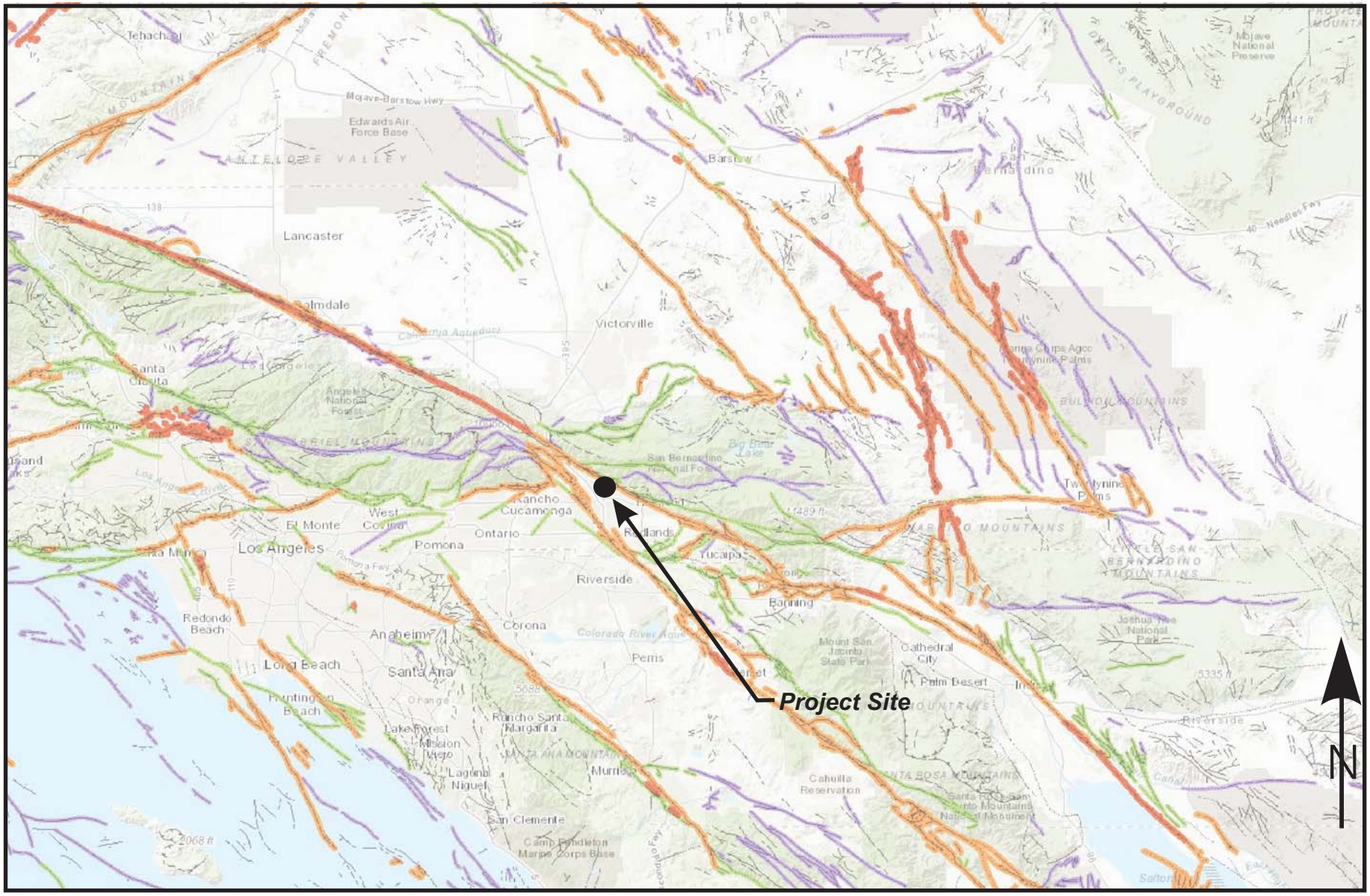
Period T (sec)	Sa (g)	MCE_R Sa (g)
0.00	0.75	1.12
0.10	1.87	2.80
0.50	1.87	2.80
0.75	1.23	1.85
0.80	1.16	1.73
0.90	1.03	1.54
1.00	0.92	1.39
1.10	0.84	1.26
1.20	0.77	1.16
1.20	0.77	1.16
1.40	0.66	0.99
1.50	0.62	0.92
1.75	0.53	0.79
2.00	0.46	0.69
2.20	0.42	0.63
2.40	0.39	0.58
2.60	0.36	0.53
2.80	0.33	0.50
3.00	0.31	0.46
4.00	0.23	0.35
5.00	0.18	0.28

Table 3
Soil Site Class Determination per ASCE 7-16, Section 20.4
Shandin Hills MHRC - San Bernardino, CA
LCI Project No. LP23116

Boring B-1

Sample Depth	SPT Blow Count	di/Ni	Sum di/Ni	Avg. Nch
0				
5	35	0.14	0.65	**62**
10	26	0.19		
15	100	0.05		
20	100	0.05		
25	83	0.06		
30	100	0.05		
35	100	0.05		
40	100	0.05		

FIGURES



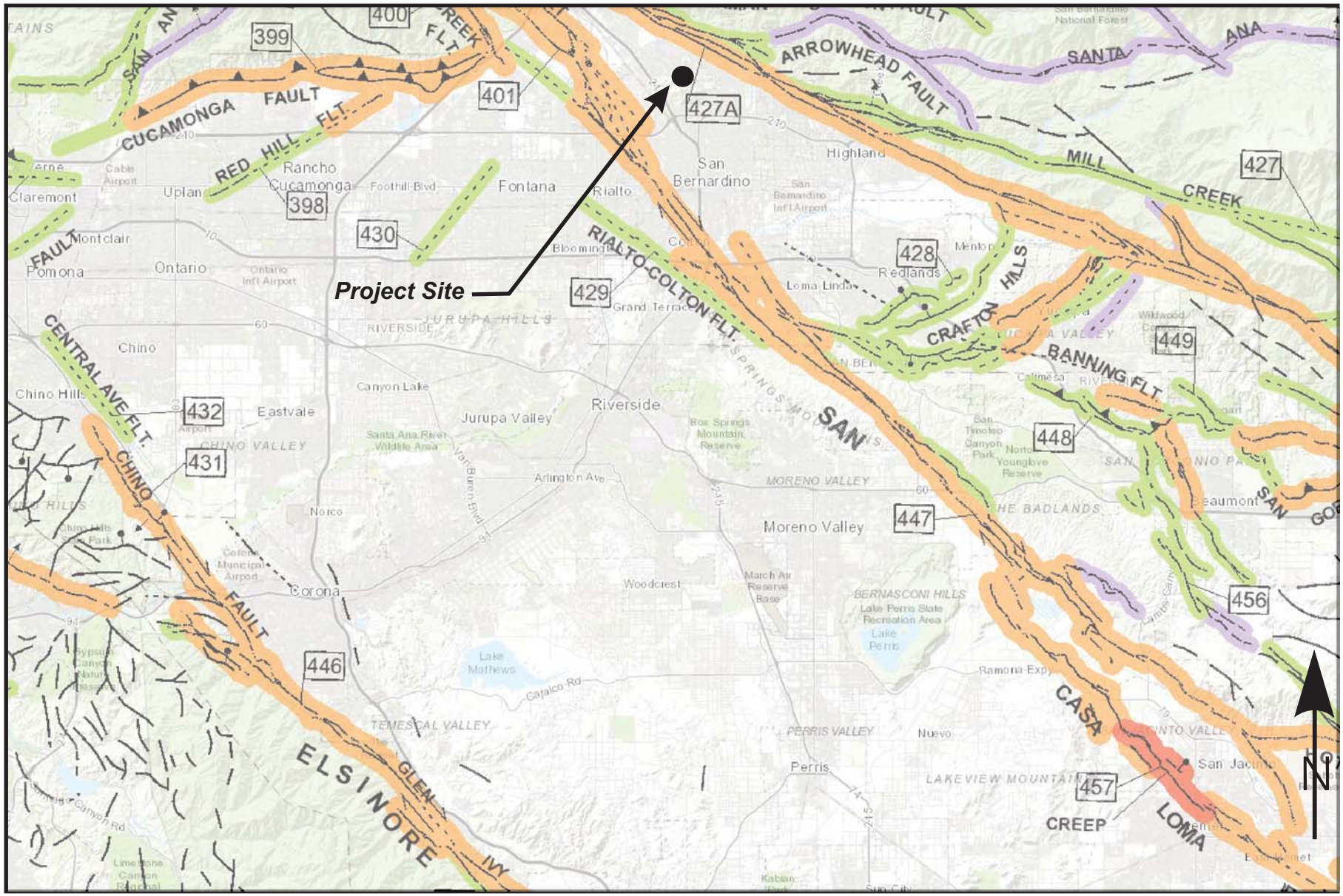
Source: California Geological Survey 2010 Fault Activity Map of California https://maps.conservation.ca.gov/cgs/fam/

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Project No.: LP23116

Regional Fault Map

Figure 1



Source: California Geological Survey 2010 Fault Activity Map of California
https://maps.conservation.ca.gov/cgs/fam/App/index.html

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Project No.: LP23116

Map of Local Faults

Figure 2

EXPLANATION

Fault traces on land are indicated by solid lines where well located, by dashed lines where approximately located or inferred, and by dotted lines where concealed by younger rocks or by lakes or bays. Fault traces are queried where continuation or existence is uncertain. Concealed faults in the Great Valley are based on maps of selected subsurface horizons, so locations shown are approximate and may indicate structural trend only. All offshore faults based on seismic reflection profile records are shown as solid lines where well defined, dashed where inferred, queried where uncertain.

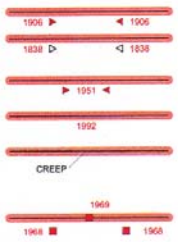
FAULT CLASSIFICATION COLOR CODE
(Indicating Recency of Movement)

Fault along which historic (last 200 years) displacement has occurred and is associated with one or more of the following:

(a) a recorded earthquake with surface rupture. (Also included are some well-defined surface breaks caused by ground shaking during earthquakes, e.g. extensive ground breakage, not on the White Wolf fault, caused by the Arvin-Tehachapi earthquake of 1952). The date of the associated earthquake is indicated. Where repeated surface ruptures on the same fault have occurred, only the date of the latest movement may be indicated, especially if earlier reports are not well documented as to location of ground breaks.

(b) fault creep slippage - slow ground displacement usually without accompanying earthquakes.

(c) displaced survey lines.



A triangle to the right or left of the date indicates termination point of observed surface displacement. Solid red triangle indicates known location of rupture termination point. Open black triangle indicates uncertain or estimated location of rupture termination point.

Date bracketed by triangles indicates local fault break.

No triangle by date indicates an intermediate point along fault break.

Fault that exhibits fault creep slippage. Hachures indicate linear extent of fault creep. Annotation (creep with leader) indicates representative locations where fault creep has been observed and recorded.

Square on fault indicates where fault creep slippage has occured that has been triggered by an earthquake on some other fault. Date of causative earthquake indicated. Squares to right and left of date indicate terminal points between which triggered creep slippage has occurred (creep either continuous or intermittent between these end points).

Holocene fault displacement (during past 11,700 years) without historic record. Geomorphic evidence for Holocene faulting includes sag ponds, scarps showing little erosion, or the following features in Holocene age deposits: offset stream courses, linear scarps, shutter ridges, and triangular faceted spurs. Recency of faulting offshore is based on the interpreted age of the youngest strata displaced by faulting.

Late Quaternary fault displacement (during past 700,000 years). Geomorphic evidence similar to that described for Holocene faults except features are less distinct. Faulting may be younger, but lack of younger overlying deposits precludes more accurate age classification.

Quaternary fault (age undifferentiated). Most faults of this category show evidence of displacement sometime during the past 1.6 million years; possible exceptions are faults which displace rocks of undifferentiated Plio-Pleistocene age. Unnumbered Quaternary faults were based on Fault Map of California, 1975. See Bulletin 201, Appendix D for source data.

Pre-Quaternary fault (older that 1.6 million years) or fault without recognized Quaternary displacement. Some faults are shown in this category because the source of mapping used was of reconnaissnce nature, or was not done with the object of dating fault displacements. Faults in this category are not necessarily inactive.

ADDITIONAL FAULT SYMBOLS

Bar and ball on downthrown side (relative or apparent).

Arrows along fault indicate relative or apparent direction of lateral movement.

Arrow on fault indicates direction of dip.

Low angle fault (barbs on upper plate). Fault surface generally dips less than 45° but locally may have been subsequently steepened. On offshore faults, barbs simply indicate a reverse fault regardless of steepness of dip.

OTHER SYMBOLS



Numbers refer to annotations listed in the appendices of the accompanying report. Annotations include fault name, age of fault displacement, and pertinent references including Earthquake Fault Zone maps where a fault has been zoned by the Alquist-Priolo Earthquake Fault Zoning Act. This Act requires the State Geologist to delineate zones to encompass faults with Holocene displacement.

Structural discontinuity (offshore) separating differing Neogene structural domains. May indicate discontinuities between basement rocks.

Brawley Seismic Zone, a linear zone of seismicity locally up to 10 km wide associated with the releasing step between the Imperial and San Andreas faults.

Geologic Time Scale			Years Before Present (Approx.)	Fault Symbol	Recency of Movement	DESCRIPTION	
						ON LAND	OFFSHORE
Quaternary	Late Quaternary	Historic	200			Displacement during historic time (e.g. San Andreas fault 1906). Includes areas of known fault creep.	
		Holocene	11,700			Displacement during Holocene time.	Fault offsets seafloor sediments or strata of Holocene age.
	Pleistocene					Faults showing evidence of displacement during late Quaternary time.	Fault cuts strata of Late Pleistocene age.
	Early Quaternary		700,000			Undivided Quaternary faults – most faults in this category show evidence of displacement during the last 1,600,000 years; possible exceptions are faults which displace rocks of undifferentiated Plio-Pleistocene age.	Fault cuts strata of Quaternary age.
Pre-Quaternary			1,600,000*			Faults without recognized Quaternary displacement or showing evidence of no displacement during Quaternary time. Not necessarily inactive.	Fault cuts strata of Pliocene or older age.
			4.5 billion (Age of Earth)				

* Quaternary now recognized as extending to 2.6 Ma (Walker and Geissman, 2009). Quaternary faults in this map were established using the previous 1.6 Ma criterion.

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Project No.: LP23116

Fault Map Legend

Figure 3

APPENDIX A

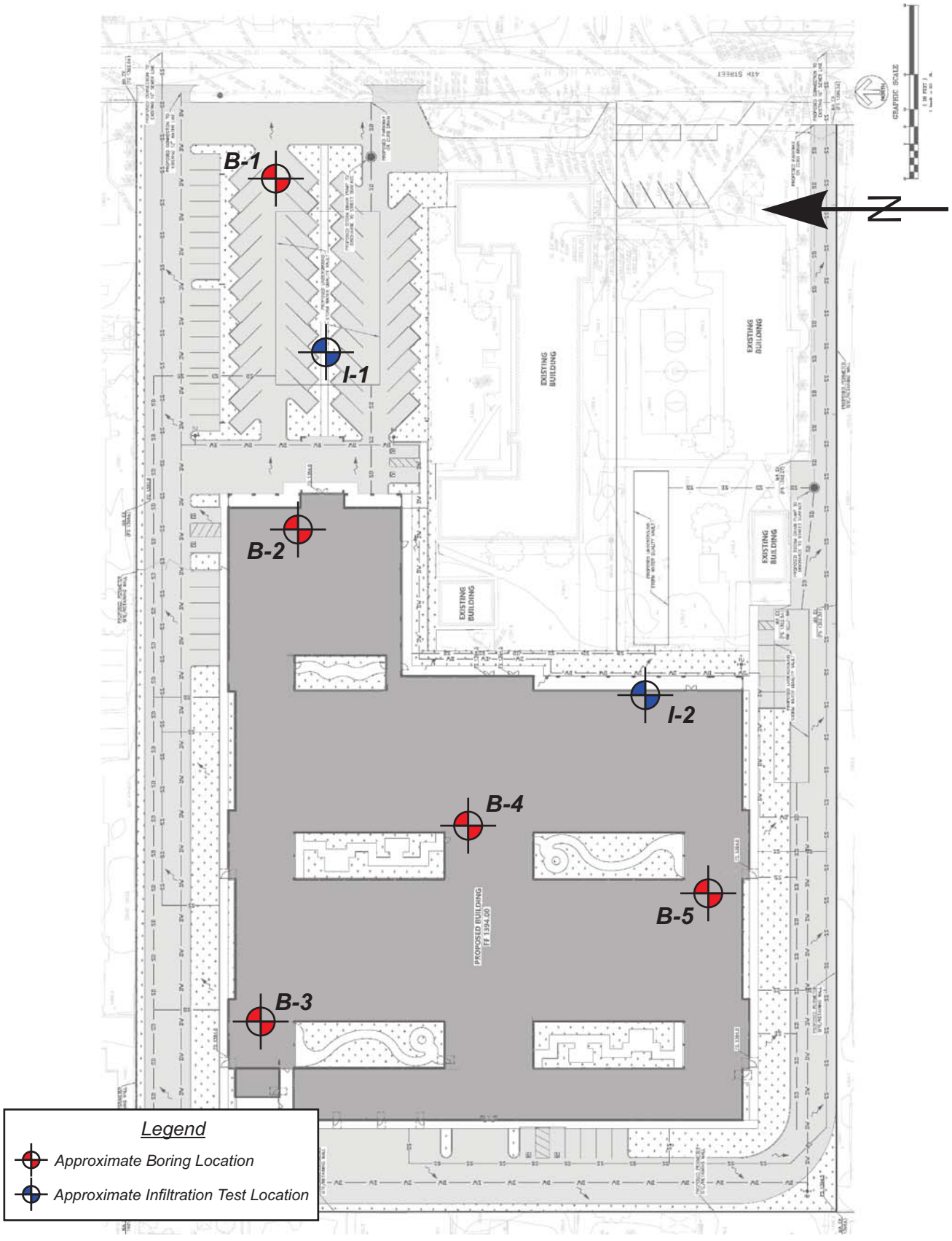


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Vicinity Map

Plate A-1



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Project No.: LP23116

Site and Exploration Map

Plate A-2



117° 18' 44" W

N

Map Scale: 1:2,540 if printed on A portrait (8.5" x 11") sheet.

Meters: 0, 35, 70, 140, 210

Feet: 0, 100, 200, 400, 600

Map projection: Web Mercator Corner coordinates: WGS84

117° 18' 29" W

N

USDA Natural Resources Conservation Service

Web Soil Survey
National Cooperative Soil Survey

7/24/2023
Page 1 of 3

LANDMARK
Geo-Engineers and Geologists

Project No.: LP23116

USDA Soil Conservation Soil Service Map

Plate A-3

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 14, Sep 6, 2022

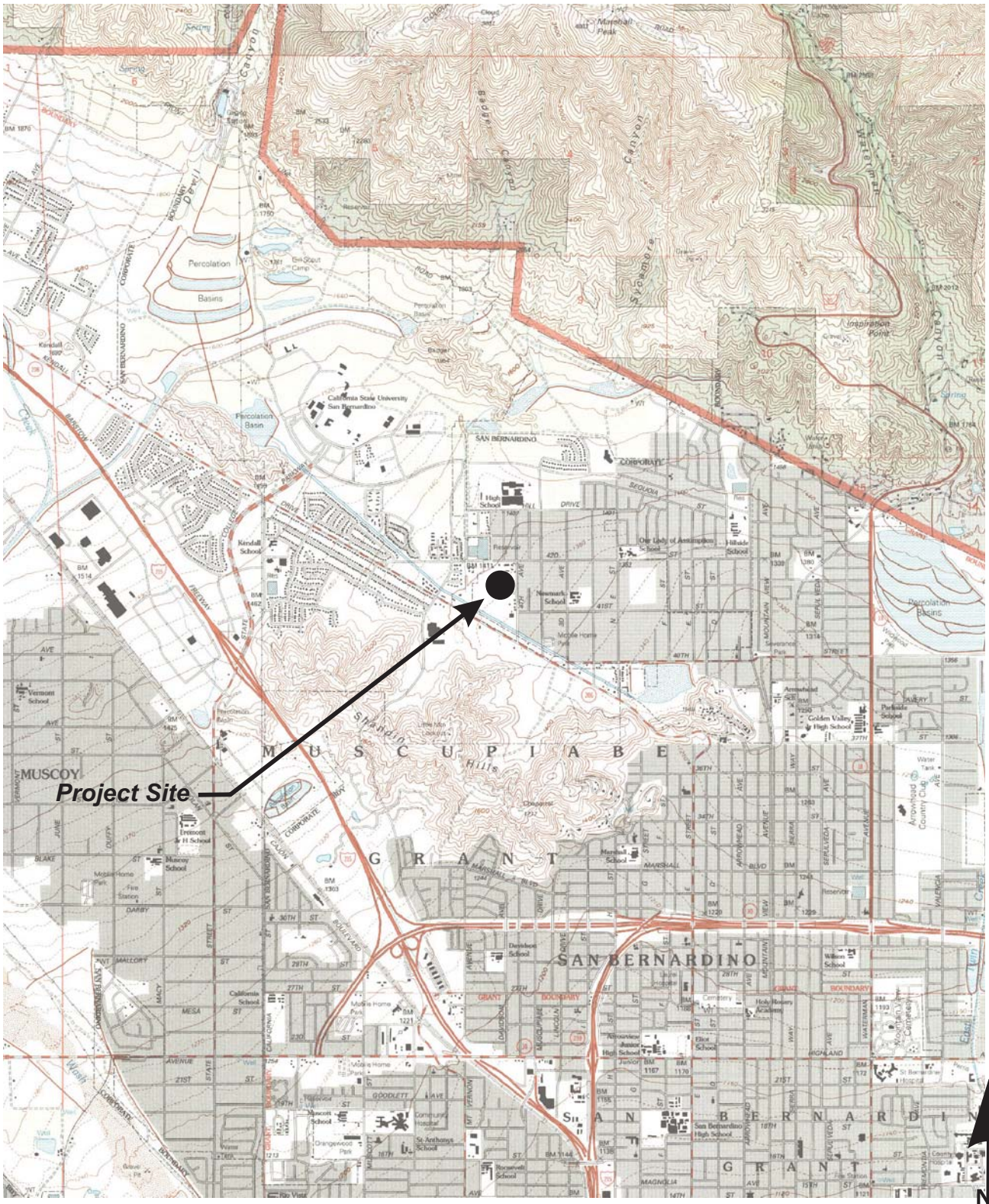
Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 17, 2022—Jun 12, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background 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
SpC	Soboba stony loamy sand, 2 to 9 percent slopes	0.1	0.3%
TuB	Tujunga loamy sand, 0 to 5 percent slopes	5.6	17.5%
TvC	Tujunga gravelly loamy sand, 0 to 9 percent slopes	26.4	82.2%
Totals for Area of Interest		**32.1**	**100.0%**



Reference: USGS Topographic Map
San Bernardino North, CA Quadrangle
Scale 1:25,000

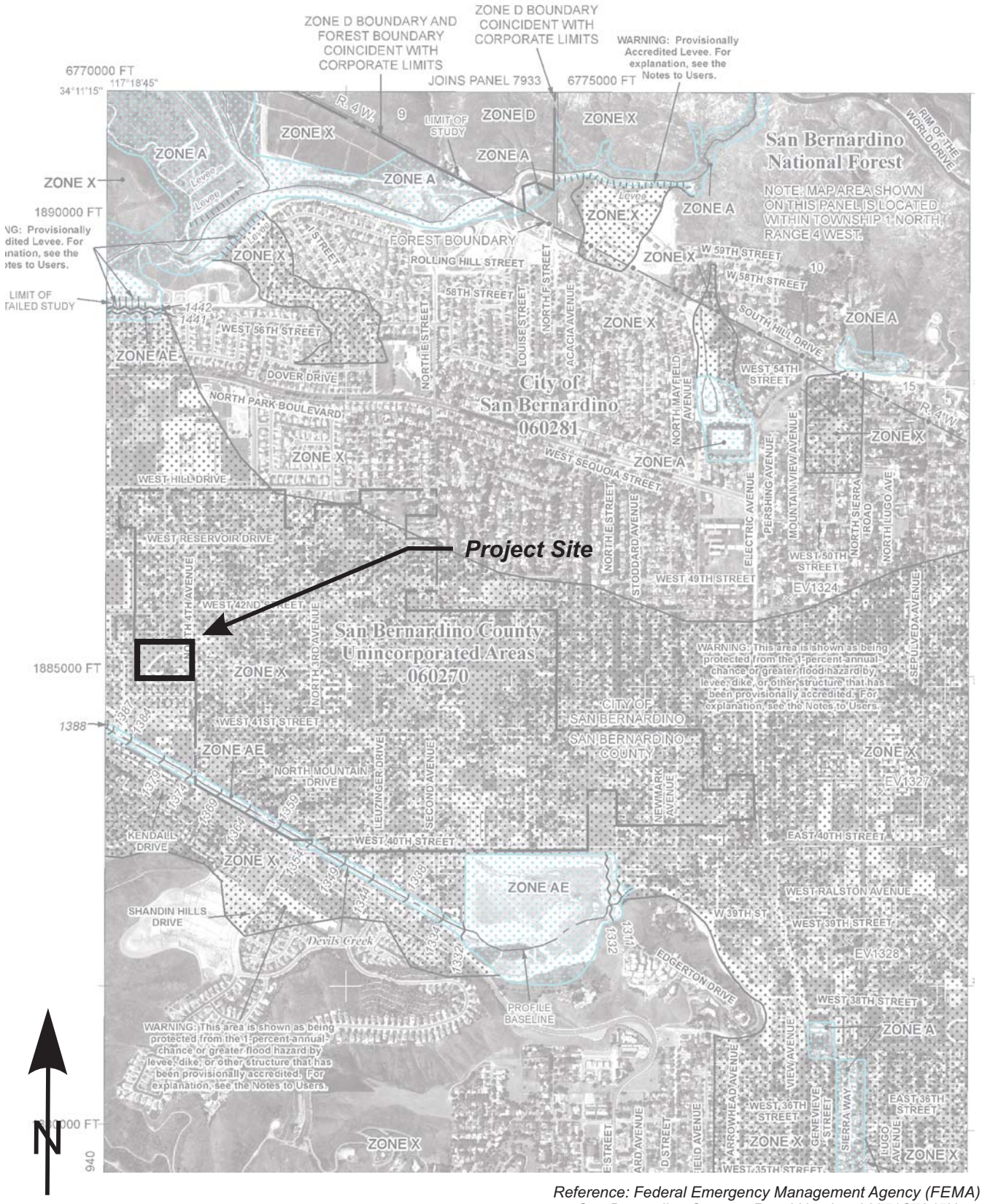
Site Coordinates
Lat: 34.1706N
Long: -117.3108W

LANDMARK
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Project No.: LP23116

Topographic Map

Plate A-4



Reference: Federal Emergency Management Agency (FEMA)
San Bernardino County - Panel Number 06071C7945H

LANDMARK Geo-Engineers and Geologists		Plate
Project No.: LP23116	**FEMA Flood Insurance Rate Map (FIRM)**	**A-5**

LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X — Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% annual chance floodplain boundary

0.2% annual chance floodplain boundary

Floodway boundary

Zone D boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.

513 — Base Flood Elevation line and value; elevation in feet*

(EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988

A — A — Cross section line

23 — 23 — Transect line

87°07'45", 32°22'30" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere

$^{24}76^{000m}$N — 1000-meter Universal Transverse Mercator grid values, zone 11N

600000 FT — 5000-foot grid ticks: California State Plane coordinate system, zone VI (FIPSZONE 0406), Lambert Conformal Conic projection

DX5510 × — Bench mark (see explanation in Notes to Users section of this FIRM panel)

● M1.5 — River Mile

APPENDIX B

LOG OF BORING No. B-1

SHEET 1 OF 1

DEPTH	FIELD: SAMPLE	FIELD: USCS CLASS.	FIELD: BLOW COUNT	FIELD: POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	LABORATORY: DRY DENSITY (pcf)	LABORATORY: MOISTURE CONTENT (% dry wt.)	LABORATORY: OTHER TESTS
					SILTY SAND (SP): Reddish gray, dry, medium dense, fine to coarse grained			Passing #200 = 15.4%
5			20		SAND (SP): Reddish brown, dry, medium dense, fine to coarse grained, some fine gravel	103.6	3.0	
10			15				3.3	Passing #200 = 4.9%
15			52		SAND (SP-SM): Brown, dry, medium dense to dense, fine to coarse grained, some fine gravel	122.9	2.6	
20			29				2.	Passing #200 = 5.4%
25								
30								
35								
40								
45								
50								
55								
60					Groundwater was encountered at time of drilling. This is not considered the stabilized groundwater depth as groundwater may rise to a level higher than that measured in borehole.			

DATE DRILLED: 6/22/23

LOGGED BY: L. Jackson

SURFACE ELEVATION: Approximately 1395 ft

TOTAL DEPTH: 21.5 feet

TYPE OF BIT: Hollow Stem Auger

HAMMER WT.: 140 lbs.

DEPTH TO WATER: NA

DIAMETER: 8 in.

DROP: 30 in.

PROJECT NO. LP23116

LANDMARK Geo-Engineers and Geologists

PLATE B-1

LOG OF BORING No. B-2

SHEET 1 OF 1

DEPTH	FIELD: SAMPLE	FIELD: USCS CLASS.	FIELD: BLOW COUNT	FIELD: POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	LABORATORY: DRY DENSITY (pcf)	LABORATORY: MOISTURE CONTENT (% dry wt.)	LABORATORY: OTHER TESTS
5			60		SAND (SP-SM): Reddish brown to brown, dry, dense to very dense, fine to coarse grained, some fine gravel	99.9	1.5	Passing #200 = 9.8%
10			34				1.7	Passing #200 = 8.7%
15			33		moist	109.3	8.8	
20			40				3.1	Passing #200 = 7.7%
25			50/5”			125.6	2.4	
30			50/6”				2.2	Passing #200 = 6.2%
35								
40								
45								
50								
55								
60					Groundwater was encountered at time of drilling. This is not considered the stabilized groundwater depth as groundwater may rise to a level higher than that measured in borehole.			

DATE DRILLED: 6/22/23

LOGGED BY: L. Jackson

SURFACE ELEVATION: Approximately 1396 ft

TOTAL DEPTH: 31.5 feet

TYPE OF BIT: Hollow Stem Auger

HAMMER WT.: 140 lbs.

DEPTH TO WATER: NA

DIAMETER: 8 in.

DROP: 30 in.

PROJECT NO. LP23116

LANDMARK
Geo-Engineers and Geologists

PLATE B-2

LOG OF BORING No. B-3

SHEET 1 OF 1

DEPTH	FIELD: SAMPLE	FIELD: USCS CLASS.	FIELD: BLOW COUNT	FIELD: POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	LABORATORY: DRY DENSITY (pcf)	LABORATORY: MOISTURE CONTENT (% dry wt.)	LABORATORY: OTHER TESTS
5			26		SAND (SP): Reddish brown, dry, medium dense, fine to coarse grained, some fine gravel	116.9	2.7	Passing #200 = 2.2%
10			16		No recovery			
15			68		SAND (SP-SM): Reddish gray to brown, dry, dense to very dense, fine to coarse grained, some fine gravel	132.5	1.6	Passing #200 = 5.4%
20			38				2.5	
25								
30								
35								
40								
45								
50								
55								
60								

Groundwater was encountered at time of drilling. This is not considered the stabilized groundwater depth as groundwater may rise to a level higher than that measured in borehole.

DATE DRILLED: 6/22/23

LOGGED BY: L. Jackson

SURFACE ELEVATION: Approximately 1400 ft

TOTAL DEPTH: 21.5 feet

TYPE OF BIT: Hollow Stem Auger

HAMMER WT.: 140 lbs.

DEPTH TO WATER: NA

DIAMETER: 8 in.

DROP: 30 in.

PROJECT NO. LP23116

LANDMARK Geo-Engineers and Geologists

PLATE B-3

LOG OF BORING No. B-4

SHEET 1 OF 1

DEPTH	FIELD: SAMPLE	FIELD: USCS CLASS.	FIELD: BLOW COUNT	FIELD: POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	LABORATORY: DRY DENSITY (pcf)	LABORATORY: MOISTURE CONTENT (% dry wt.)	LABORATORY: OTHER TESTS
5			35		SAND (SP-SM): Reddish brown to dark brown, dry, medium dense to very dense, fine to coarse grained, some fine gravel	125.4	2.1	
10			26				2.1	Passing #200 = 9.6%
15			50/6”			132.5	2.9	
20			50/4”				1.9	Passing #200 = 6.5%
25			83			114.0	2.4	
30			50/6”				2.7	Passing #200 = 7.5%
35			50/3”				2.6	
40			50/6”				2.9	Passing #200 = 6.1%
45								
50								
55								
60					Groundwater was encountered at time of drilling. This is not considered the stabilized groundwater depth as groundwater may rise to a level higher than that measured in borehole.			

DATE DRILLED: 6/22/23
LOGGED BY: L. Jackson
SURFACE ELEVATION: Approximately 1398 ft

TOTAL DEPTH: 41.5 feet
TYPE OF BIT: Hollow Stem Auger
HAMMER WT.: 140 lbs.

DEPTH TO WATER: NA
DIAMETER: 8 in.
DROP: 30 in.

PROJECT NO. LP23116

LANDMARK
Geo-Engineers and Geologists

PLATE B-4

LOG OF BORING No. B-5

SHEET 1 OF 1

DEPTH	FIELD: SAMPLE	FIELD: USCS CLASS.	FIELD: BLOW COUNT	FIELD: POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	LABORATORY: DRY DENSITY (pcf)	LABORATORY: MOISTURE CONTENT (% dry wt.)	LABORATORY: OTHER TESTS
5			32		SAND (SP): Reddish brown to gray brown, dry, medium dense to very dense, fine to coarse grained, some fine gravel	123.2	2.9	Passing #200 = 4.3%
10			18				3.3	
15			63			105.6	3.2	Passing #200 = 2.5%
20			75/9”				1.4	
25								
30								
35								
40								
45								
50								
55								
60								

Groundwater was encountered at time of drilling. This is not considered the stabilized groundwater depth as groundwater may rise to a level higher than that measured in borehole.

DATE DRILLED: 6/22/23

LOGGED BY: L. Jackson

SURFACE ELEVATION: Approximately 1394 ft

TOTAL DEPTH: 21.5 feet

TYPE OF BIT: Hollow Stem Auger

HAMMER WT.: 140 lbs.

DEPTH TO WATER: NA

DIAMETER: 8 in.

DROP: 30 in.

PROJECT NO. LP23116

LANDMARK Geo-Engineers and Geologists

PLATE B-5

DEFINITION OF TERMS

PRIMARY DIVISIONS			SYMBOLS	SECONDARY DIVISIONS
Coarse grained soils More than half of material is larger that No. 200 sieve	**Gravels** More than half of coarse fraction is larger than No. 4 sieve	Clean gravels (less than 5% fines)	**GW**	Well graded gravels, gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels, or gravel-sand mixtures, little or no fines
		Gravel with fines	**GM**	Silty gravels, gravel-sand-silt mixtures, non-plastic fines
			GC	Clayey gravels, gravel-sand-clay mixtures, plastic fines
	Sands More than half of coarse fraction is smaller than No. 4 sieve	Clean sands (less than 5% fines)	**SW**	Well graded sands, gravelly sands, little or no fines
			SP	Poorly graded sands or gravelly sands, little or no fines
		Sands with fines	**SM**	Silty sands, sand-silt mixtures, non-plastic fines
			SC	Clayey sands, sand-clay mixtures, plastic fines
Fine grained soils More than half of material is smaller than No. 200 sieve	**Silts and clays** Liquid limit is less than 50%		**ML**	Inorganic silts, clayey silts with slight plasticity
			CL	Inorganic clays of low to medium plasticity, gravely, sandy, or lean clays
			OL	Organic silts and organic clays of low plasticity
	Silts and clays Liquid limit is more than 50%		**MH**	Inorganic silts, micaceous or diatomaceous silty soils, elastic silts
			CH	Inorganic clays of high plasticity, fat clays
			OH	Organic clays of medium to high plasticity, organic silts
Highly organic soils			**PT**	Peat and other highly organic soils

GRAIN SIZES

Silts and Clays	Sand			Gravel		Cobbles	Boulders
	Fine	Medium	Coarse	Fine	Coarse		

200 40 10 4 3/4" 3" 12"

US Standard Series Sieve — Clear Square Openings

Sands, Gravels, etc.	Blows/ft. *
Very Loose	0-4
Loose	4-10
Medium Dense	10-30
Dense	30-50
Very Dense	Over 50

Clays & Plastic Silts	Strength **	Blows/ft. *
Very Soft	0-0.25	0-2
Soft	0.25-0.5	2-4
Firm	0.5-1.0	4-8
Stiff	1.0-2.0	8-16
Very Stiff	2.0-4.0	16-32
Hard	Over 4.0	Over 32

* Number of blows of 140 lb. hammer falling 30 inches to drive a 2 inch O.D. (1 3/8 in. I.D.) split spoon (ASTM D1586).

** Unconfined compressive strength in tons/s.f. as determined by laboratory testing or approximated by the Standard Penetration Test (ASTM D1586), Pocket Penetrometer, Torvane, or visual observation.

Type of Samples:

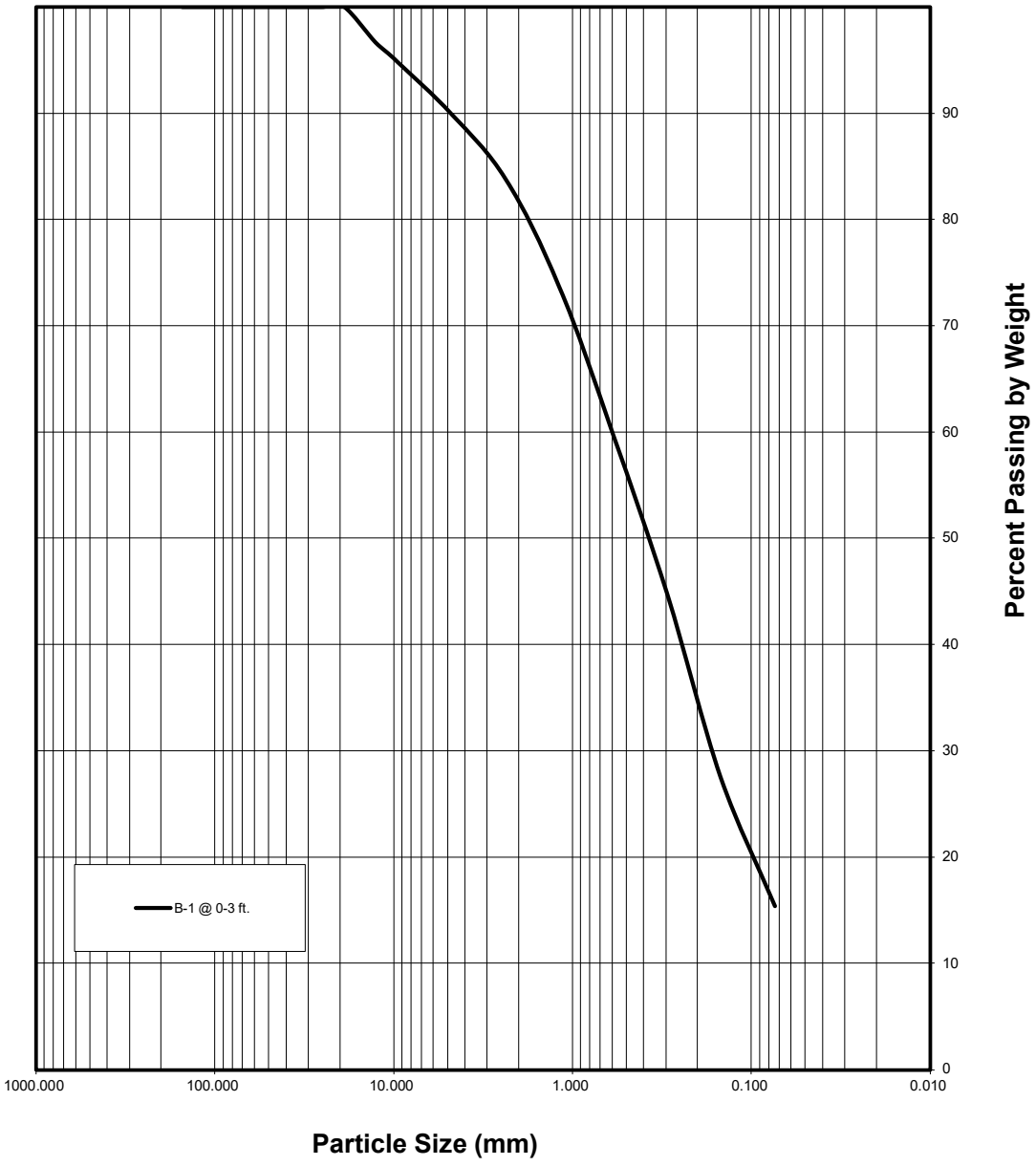
Ring Sample Standard Penetration Test Shelby Tube Bulk (Bag) Sample

Drilling Notes:

1. Sampling and Blow Counts
   - Ring Sampler - Number of blows per foot of a 140 lb. hammer falling 30 inches.
   - Standard Penetration Test - Number of blows per foot.
   - Shelby Tube - Three (3) inch nominal diameter tube hydraulically pushed.
2. P. P. = Pocket Penetrometer (tons/s.f.).
3. NR = No recovery.
4. GWT = Ground Water Table observed @ specified time.

APPENDIX C

SIEVE ANALYSIS						
Cobbles and Boulders	Gravel		Sand			Silt and Clay
	Coarse	Fine	Coarse	Medium	Fine	



LANDMARK
Geo-Engineers and Geologists

Project No.: LP23116

Grain Size Analysis

Plate C-1

LANDMARK CONSULTANTS, INC.

CLIENT: New Gen HC
PROJECT: Shandin Hills MHRC - San Bernardino, CA
JOB No.: LP23116
DATE: 06/23/23

CHEMICAL ANALYSIS

Boring:	B-1	**Caltrans**
Sample Depth, ft:	0-3	**Method**
pH:	7.8	**643**
Electrical Conductivity (mmhos):	--	**424**
Resistivity (ohm-cm):	9,300	**643**
Chloride (Cl), ppm:	80	**422**
Sulfate (SO4), ppm:	23	**417**

General Guidelines for Soil Corrosivity

Material Affected	Chemical Agent	Amount in Soil (ppm)	Degree of Corrosivity
Concrete	Soluble Sulfates	0 - 1,000	Low
		1,000 - 2,000	Moderate
		2,000 - 20,000	Severe
		> 20,000	Very Severe
Normal Grade Steel	Soluble Chlorides	0 - 200	Low
		200 - 700	Moderate
		700 - 1,500	Severe
		> 1,500	Very Severe
Normal Grade Steel	Resistivity	1 - 1,000	Very Severe
		1,000 - 2,000	Severe
		2,000 - 10,000	Moderate
		> 10,000	Low

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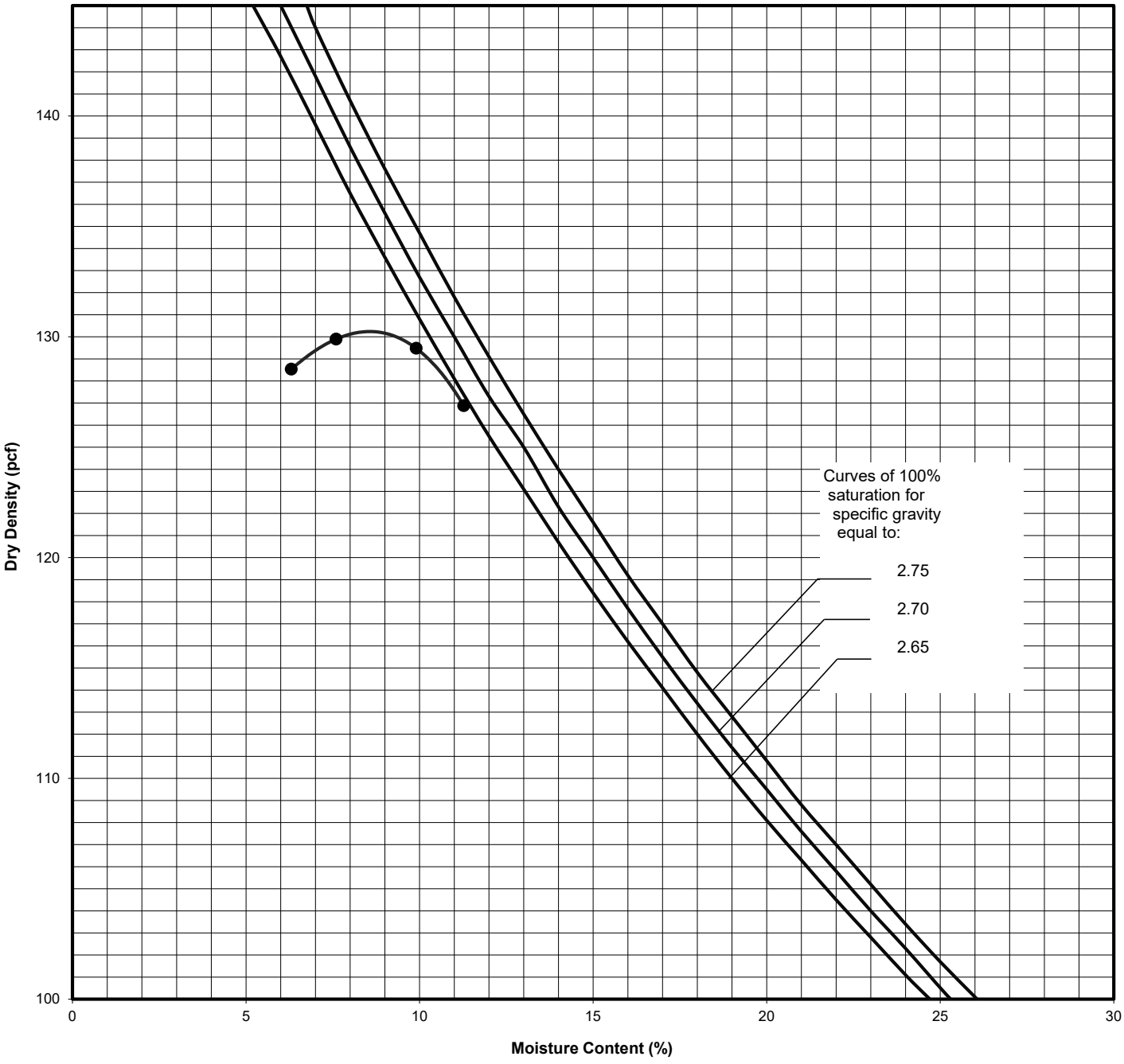
Project No.: LP23116

Selected Chemical Test Results

Plate C-2

Client: New GEN HC
Project: Shandin Hills MHRC - San Bernardino, CA
Project No.: LP23116
Date: 6/30/2023
Lab. No.: N/A

Soil Description: Olive-Brown Silty Sand w/ Gravel
Sample Location: B-1 @ 0-3 ft.
Test Method: ASTM D-1557 A
Maximum Dry Density (pcf): **130.2**
Optimum Moisture Content (%): **8.6**



LANDMARK
Geo-Engineers and Geologists

Project No.: LP23116

Moisture Density Relationship

Plate C-3

APPENDIX D

LANDMARK CONSULTANTS, INC

Project:	Shandin Hills MHRC	Project No:	LP23116	Date:	7/10/2023
Test Hole No:	I-1	Tested By:	Maddy E		
Depth of Test Hole, D_T:	60"	USCS Soil Classification:	SM		
Test Hole Dimensions (inches)			Length	Width	
Diameter (if round)=	6"	Sides (if rectangular)=			

Sandy Soil Criteria Test*

Trial No.	Start Time	Stop Time	Time Interval, (min.)	Initial Depth to Water (in.)	Final Depth to Water (in.)	Change in Water Level (in.)	Greater than or Equal to 6"? (y/n)
1	8:02	8:15	13.00	16.00	48.00	32.00	Yes
2	8:25	8:40	15.00	23.00	36.00	13.00	Yes

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

Trial No.	Start Time	Stop Time	Δt Time Interval (min.)	D_o Initial Depth to Water (in.)	D_f Final Depth to Water (in.)	ΔD Change in Water Level (in.)	Percolation Rate (min./in.)
1	8:41	8:51	10.00	27.00	34.00	7.00	1.43
2	8:51	9:01	10.00	25.00	32.00	7.00	1.43
3	9:01	9:11	10.00	24.00	32.00	8.00	1.25
4	9:11	9:21	10.00	23.00	31.00	8.00	1.25
5	9:21	9:31	10.00	23.00	31.00	8.00	1.25
6	9:31	9:41	10.00	21.00	29.00	8.00	1.25
7							
8							
9							
10							
11							
12							

COMMENTS:

PERCOLATION RATE CONVERSION

CLIENT: New Gen HC
PROJECT: Shandin Hills MHRC
PROJECT NO.: LP23116
DATE: 7/14/2023

TEST HOLE NO: I-1

Time interval, **Δt** = 10 inches
Initial Depth to Water, D_0 = 21 inches
Final Depth to Water, D_f = 29 inches
Total Depth of Test Hole, D_T = 60 inches
[2]Test Hole Radius, **r** = 4 inches

The conversion equation is used:

$$I_t = \frac{\Delta H\ 60\ r}{\Delta t(r+2H_{avg})}$$

"H_o" is the initial height of water at the selected time interval

$H_o = D_T - D_0$ = 60 - 21 = 39 inches

"H_f" is the final height of water at the selected time interval

$H_f = D_T - D_0$ = 60 - 21 = 31 inches

"ΔH" is the change in height over the time interval

$\Delta H = \Delta D = H_o - H_f$ = 39 - 31 = 8 inches

"H_{avg}" is the average head height over the time interval

$H_{avg} = (H_o - H_f)/2$ = (39 + 31)/2 = 35 inches

"I_t" is the tested infiltration rate

$$I_t = \frac{\Delta H\ 60\ r}{\Delta t\ (r+2H_{avg})} = \frac{(8\text{ in})(60\text{min/hr})(4\text{in})}{(10\text{ min})((4\text{ in}) + 2\ (35\text{ in}))} = 2.59\text{ in/hr}$$

LANDMARK Geo-Engineers and Geologists **Project No.: LP23116**	**Percolation Rate Conversion**	**Plate D-2**

LANDMARK CONSULTANTS, INC

Project:	Shandin Hills MHRC	Project No:	LP23116	Date:	7/10/2023
Test Hole No:	I-2	Tested By:	Maddy E		
Depth of Test Hole, D_T:	60"	USCS Soil Classification:	SM		
Test Hole Dimensions (inches)			Length	Width	
Diameter (if round)=	6"	Sides (if rectangular)=			

Sandy Soil Criteria Test*

Trial No.	Start Time	Stop Time	Time Interval, (min.)	Initial Depth to Water (in.)	Final Depth to Water (in.)	Change in Water Level (in.)	Greater than or Equal to 6"? (y/n)
1	8:15	8:30	15.00	0.00	23.00	23.00	Yes
2	8:32	8:47	15.00	9.00	22.00	13.00	Yes

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

Trial No.	Start Time	Stop Time	Δt Time Interval (min.)	D_o Initial Depth to Water (in.)	D_f Final Depth to Water (in.)	ΔD Change in Water Level (in.)	Percolation Rate (min./in.)
1	8:48	8:58	10.00	8.00	18.00	10.00	1.00
2	8:58	9:08	10.00	9.00	17.00	8.00	1.25
3	9:08	9:18	10.00	10.00	17.00	7.00	1.43
4	9:18	9:28	10.00	11.00	16.00	5.00	2.00
5	9:28	9:38	10.00	12.00	17.00	5.00	2.00
6	9:38	9:48	10.00	9.00	14.00	5.00	2.00
7							
8							
9							
10							
11							
12							

COMMENTS:

PERCOLATION RATE CONVERSION

CLIENT: New Gen HC
PROJECT: Shandin Hills MHRC
PROJECT NO.: LP23116
DATE: 7/14/2023

TEST HOLE NO: I-2

Time interval, **Δt** = 10 inches
Initial Depth to Water, D_0 = 9 inches
Final Depth to Water, D_f = 14 inches
Total Depth of Test Hole, D_T = 60 inches
²Test Hole Radius, **r** = 4 inches

The conversion equation is used:

$$I_t = \frac{\Delta H\ 60\ r}{\Delta t(r+2H_{avg}}$$

"H_o" is the initial height of water at the selected time interval

$H_o = D_T - D_0$ = 60 - 9 = 51 inches

"H_f" is the final height of water at the selected time interval

$H_f = D_T - D_0$ = 60 - 14 = 46 inches

"ΔH" is the change in height over the time interval

$\Delta H = \Delta D = H_o - H_f$ = 51 - 46 = 5 inches

"H_{avg}" is the average head height over the time interval

$H_{avg} = (H_o - H_f)/2$ = (51 + 46)/2 = 48.5 inches

"I_t" is the tested infiltration rate

$$I_t = \frac{\Delta H\ 60\ r}{\Delta t\ (r+2H_{avg})} = \frac{(5\text{ in})(60\text{min/hr})(4\text{in})}{(10\text{ min})((4\text{ in}) + 2\ (48.5\text{ in}))} = 2.18\text{ in/hr}$$

LANDMARK Geo-Engineers and Geologists Project No.: LP23116	Percolation Rate Conversion	Plate D-4

APPENDIX B: FACTOR OF SAFETY CALC AND INFILTRATION REPORT

Worksheet H: Factor of Safety and Design Infiltration Rate and Worksheet

Factor Category		Factor Description	Assigned Weight (w)	Factor Value (v)	Product (p) p = w x v
A	Suitability Assessment	Soil assessment methods	0.25	2	0.5
		Predominant soil texture	0.25	3	0.75
		Site soil variability	0.25	1	0.25
		Depth to groundwater / impervious layer	0.25	1	0.25
		Suitability Assessment Safety Factor, $S_A = \Sigma p$			1.75
B	Design	Tributary area size	0.25	2	0.5
		Level of pretreatment/ expected sediment loads	0.25	3	0.75
		Redundancy	0.25	3	0.75
		Compaction during construction	0.25	2	0.5
		Design Safety Factor, $S_B = \Sigma p$			2.5
Combined Safety Factor, $S_{TOT} = S_A \times S_B$					4.4
Measured Infiltration Rate, inch/hr, K_M (corrected for test-specific bias)					2.2
Design Infiltration Rate, in/hr, $K_{DESIGN} = K_M/S_{TOT}$					0.5

Supporting Data

Briefly describe infiltration test and provide reference to test forms:

Note: The minimum combined adjustment factor shall not be less than 2.0 and the maximum combined adjustment factor shall not exceed 9.0.

Geotechnical Report

Shandin Hills MHRC
4164 N. 4th Avenue
San Bernardino, California

Prepared for:

New Gen HC
9526 W. Pico Blvd.
Los Angeles, CA 90035



LANDMARK
Geo-Engineers and Geologists

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July 2023

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July 28, 2023

Mr. Abe Tress
New Gen HC
9526 W. Pico Blvd.
Los Angeles, CA 90035

Geotechnical Report
Shandin Hills MHRC
4164 N. 4th Avenue
San Bernardino, California
LCI Report No.: LP23116

Dear Mr. Tress:

As per your request, ***LandMark Consultants, Inc.*** is providing the following geotechnical report for the proposed private mental health center project located at 4164 N. 4th Avenue in the city of San Bernardino, California. The proposed development will consist of a new 72,000 sq-ft building on approximately 5.93 acres west of the existing mental health rehabilitation complex. This new structure is planned to be single tory, wood/metal-framed, with shallow reinforced concrete foundations and slab-on-grade.

Purpose of Work

The purpose of this study was to investigate the upper 41.5 feet of subsurface soil at selected locations within the site for evaluation of physical/engineering properties. From the analysis of the field and laboratory data, professional opinions were developed and are provided in this report regarding geotechnical conditions at this site and the effect on design and construction.

Authorization

Mr. John Tanori provided authorization by written agreement to proceed with our work on May 24, 2023. We conducted our work in general accordance with our written proposal dated May 18, 2023.

Field Exploration

Subsurface exploration was performed on June 22, 2023, using 2R Drilling of Ontario, California to advance five (5) borings to depths of 21.5 to 41.5 feet below existing ground surface. The borings were advanced with a truck-mounted, CME 75 drill rig using 8-inch diameter, hollow-stem, continuous-flight augers. The approximate boring locations were established in the field and plotted on the site map by sighting to discernible site features. The boring locations are shown on the Site and Exploration Plan (Plate A-2).

A geo-technician observed the drilling operations and maintained logs of the soil encountered with sampling depths. Soils were classified during drilling according to the Unified Soil Classification System using the visual-manual procedure in accordance with ASTM D2488. Relatively undisturbed and bulk samples of the subsurface materials were obtained at selected intervals. The relatively undisturbed soil samples were retrieved using a 2-inch outside diameter (OD) split-spoon sampler or a 3-inch OD Modified California Split-Barrel (ring) sampler lined with 6-inch stainless-steel sleeves.

In addition, Standard Penetration Tests (SPT) were performed in accordance with ASTM D1586 and ASTM D6066. The samples were obtained by driving the samplers ahead of the auger tip at selected depths using a 140-pound CME automatic hammer with a 30-inch drop. The number of blows required to drive the samplers the last 12 inches of an 18-inch drive depth into the soil is recorded on the boring logs as “blows per foot”. Blow counts (N values) reported on the boring logs represent the field blow counts. No corrections have been applied to the blow counts shown on the boring logs for effects of overburden pressure, automatic hammer drive energy, drill rod lengths, liners, and sampler diameter.

After logging and sampling the soil, the exploratory borings were backfilled with the excavated material. The backfill was loosely placed and was not compacted to the requirements specified for engineered fill.

The subsurface logs are presented on Plates B-1 through B-5 in Appendix B. A key to the log symbols is presented on Plate B-6. The stratification lines shown on the subsurface logs represent the approximate boundaries between the various strata. However, the transition from one stratum to another may be gradual over some range of depth.

Laboratory Testing

Laboratory tests were conducted on selected bulk soil samples to aid in classification and evaluation of selected properties of the site soils. The tests were conducted in general conformance to the procedures of the American Society for Testing and Materials (ASTM) or other standardized methods as referenced below. The laboratory testing program consisted of the following tests:

- Particle Size Analyses (ASTM D6913/D7928)
- Unit Dry Densities (ASTM D2937)
- Moisture Contents (ASTM D2216)
- Moisture-Density Relationship (ASTM D1557)
- Chemical Analyses (soluble sulfates & chlorides, pH, and resistivity) (Caltrans Methods)

The laboratory test results are presented on the subsurface logs (Appendix B) and in Appendix C. Engineering parameters of soil strength, compressibility, and relative density utilized for developing design criteria provided within this report were extrapolated from data obtained from the field and laboratory testing program.

Site Conditions

The project site is roughly rectangular shaped in plan view, elongated in the east-west direction, and is relatively flat-lying. The project site is currently occupied by the existing mental rehabilitation building in the southeast corner of the site. Adjacent properties are flat-lying and are approximately at the same elevation as this site. Single family residences are located surrounding the site. The project site is bounded on the east by N. 4th Avenue.

The project site lies at an elevation of approximately 1400 feet above mean sea level (AMSL) in the Inland Empire region of Southern California. Annual rainfall in this arid region is less than 4 inches per year with four months of average summertime temperatures above 100 ^{o}F. Winter temperatures are mild, seldom reaching freezing.

Geologic Setting

The project site is located within the eastern portion of the San Bernardino Basin or San Bernardino Valley Block. The valley is situated between the Transverse Range (San Bernardino Mountains) and the San Andreas Fault zone to the northeast, the Peninsular Range (San Jacinto Mountains) and the San Jacinto Fault zone to the southwest and the Perris Block further to the south-southwest.

The San Bernardino Mountains are the loftiest range within the Transverse Range province, with the highest peak, Mount San Gorgonio at 11,502 feet (3,508 m). The San Bernardino Mountains are about 65 miles (105 km) long, with a maximum width of 40 miles (65 km). They are bounded on the west and southwest by the Cajon Pass and the San Andreas Fault, on the north by the Mojave Desert, on the east by Twentynine Palms Valley, and on the southeast by Morongo and Coachella Valleys.

The San Andreas Fault Zone is located along the southern flanks of the San Bernardino Mountains, which have been uplifted along its trace (Norris & Webb, 1990). The flanks of the range are cut by deep, narrow canyons and are drained by several permanent streams. The Santa Ana River, located to the north of the site, has the largest drainage basin in southern California. It drains both the San Bernardino and eastern San Gabriel Mountains, and the northern Peninsular Ranges (Norris & Webb, 1990).

Subsurface Soils

Subsurface soils encountered during the field exploration conducted on June 22, 2023, consist of silty sand (SM), sand (SP-SM) and sand (SP). The near surface soils are non-expansive in nature. The subsurface logs (Plates B-1 through B-5) depict the stratigraphic relationships of the various soil types.

Groundwater

Groundwater was not encountered in the boring during the time of exploration. Based on available information from the Western Municipal Water District Cooperative Well Measuring Program, the nearest groundwater well with data (Well No. 01N04W21B002S) is located less than 1-mile southwest of the project site. The most recent measurement was recorded approximately 140-feet bgs.

There is uncertainty in the accuracy of short-term water level measurements. Groundwater levels may fluctuate with precipitation, irrigation of adjacent properties, drainage, and site grading. The groundwater level noted should not be interpreted to represent an accurate or permanent condition. Based on the regional topography, groundwater flow is assumed to be generally towards the south within the site area. Flow directions may vary locally in the vicinity of the site.

Faulting

The project site is located within the seismically active San Bernardino Valley of southern California and is considered likely to be subjected strong ground motion from earthquakes in the region. We have performed a computer-aided search of known faults or seismic zones that lie within a 36-mile radius of the project site (Table 1).

A fault map illustrating known active faults relative to the site is presented on Figure 1, *Regional Fault Map*. Figure 2 shows the project site in relation to local faults. The criterion for fault classification adopted by the California Geological Survey defines Earthquake Fault Zones along Holocene-active or pre-Holocene faults (CGS, 2023b). Earthquake Fault Zones are regulatory zones that address the hazard of surface fault rupture. A Holocene-active fault is one that has ruptured during Holocene time (within the last 11,700 years). A pre-Holocene fault is a fault that has not ruptured in the last 11,700 years. Pre-Holocene faults may still be capable of surface rupture in the future, but are not regulated by the Alquist-Priolo Act (AP).

Review of the current Alquist-Priolo Earthquake Fault Zone maps (CGS, 2023a) indicates that the nearest mapped Earthquake Fault Zone is the San Andreas – San Bernardino (south) fault located approximately 1.7 miles north of the project site.

General Ground Motion Analysis

The project site is considered likely to be subjected to moderate to strong ground motion from earthquakes in the region. Ground motions are dependent primarily on the earthquake magnitude and distance to the seismogenic (rupture) zone. Acceleration magnitudes also are dependent upon attenuation by rock and soil deposits, direction of rupture and type of fault; therefore, ground motions may vary considerably in the same general area.

2022 CBC General Ground Motion Parameters: The California Building Code (CBC) requires that a site-specific ground motion hazard analysis be performed in accordance with ASCE 7-16 Section 11.4.8 (ASCE, 2016) for structures on Site Class D with S_1 greater than or equal to 0.2 and Site Class E sites with S_s greater than or equal to 1.0 (CBC, 2019). **This project site has been classified as Site Class C which would require a site-specific ground motion hazard analysis**.

The 2022 CBC general ground motion parameters are based on the Risk-Targeted Maximum Considered Earthquake (MCE_R). The Structural Engineers Association of California (SEAOC) and Office of Statewide Health Planning and Development (OSHPD) Seismic Design Maps Web Application (SEAOC, 2020) was used to obtain the site coefficients and adjusted maximum considered earthquake spectral response acceleration parameters. Design spectral response acceleration parameters are defined as the earthquake ground motions that are two-thirds (2/3) of the corresponding MCE_R ground motions. The Maximum Considered Earthquake Geometric Mean (MCE_G) peak ground acceleration adjusted for soil site class effects (PGA_M) value to be used for liquefaction and seismic settlement analysis in accordance with 2022 CBC Section 1803.5.12.2 is estimated at 1.2g for the project site. ***Design earthquake ground motion parameters are provided in Table 2.***

Seismic and Other Hazards

► **Groundshaking.** The primary seismic hazard at the project site is the potential for strong groundshaking during earthquakes along the Cucamonga, San Jacinto, San Andreas and other nearby faults. A further discussion of groundshaking mentioned above.

► **Surface Rupture.** The project site does not lie within a State of California, Alquist-Priolo Earthquake Fault Zone or County of San Bernardino Fault Zone. Surface fault rupture is considered to be unlikely at the project site because of the well-delineated fault lines through the San Bernardino Valley as shown on USGS and CDMG maps.

However, because of the high tectonic activity and deep alluvium of the region, we cannot preclude the potential for surface rupture on undiscovered or new faults that may underlie the site.

► **Liquefaction.** Liquefaction is unlikely to be a potential hazard at the site, due to groundwater deeper than 50 feet (the maximum depth that liquefaction is known to occur).

<u>Other Potential Geologic Hazards.</u>

► **Landsliding.** The hazard of landsliding is unlikely due to the regional planar topography. No ancient landslides are shown on geologic maps of the region and no indications of landslides were observed during our site investigation.

► **Volcanic hazards.** The site is not located in proximity to any known volcanically active area and the risk of volcanic hazards is considered very low.

► **Tsunamis, sieches, and flooding.** The site does not lie near any large bodies of water, so the threat of tsunami, sieches, or other seismically-induced flooding is unlikely.

► **Expansive soil.** The near surface soils at the project site consist of sands which are non-expansive.

Hydroconsolidation

In arid climatic regions, granular soils have a potential to collapse upon wetting. This collapse (hydro-consolidation) phenomena is the result of the lubrication of soluble cements (carbonates) in the soil matrix causing the soil to densify from its loose configuration during deposition. Based on our experience in the vicinity of the project site, there is a slight risk of collapse upon inundation from at the site. Therefore, development of building foundation is not required to include provisions for mitigating the hydro-consolidation caused by soil saturation from landscape irrigation or broken utility lines.

Soil Infiltration Rate

A total of two (2) infiltration tests were conducted on July 10, 2023, at these proposed locations for the on-site storm-water retention basin as shown on the Site and Exploration Plan (Plate A-2). The infiltration tests were performed to the guideline from Design Handbook for Low Impact Development Best Management Practices, prepared by State Water Conservation District, Appendix A, Section 2.3, dated September 2011.

The tests were performed using 6-inch perforated pipe inside an 8-inch diameter flight auger borehole made to depths of approximately 5.0 feet below the existing ground surface, corresponding to the anticipated bottom depth of the stormwater retention basin. The pipes were filled with water and successive readings of drops in water levels were made every 10 minutes for a total elapsed time of 60 minutes, until a stabilization drop was recorded.

The test results indicate that the stabilized soil infiltration rate for the soil ranges from 2.2 to 2.5 inches per hour. A maximum soil infiltration rate of 2.2 inches per hour may be used for the on-site storm-water retention basin design. An oil/water separator should be installed at inlets to the stormwater retention basin to prevent sealing of the basin bottom with silt and oil residues. The field and conversion calculation worksheets are included in Appendix D.

We recommend additional testing should be performed after the completion of rough grading operations, to verify the soil infiltration rate.

Site Preparation

Pre-grade Meeting: Prior to site preparation, a meeting should be held at the site with as a minimum, the owner's representative, grading contractor and geotechnical engineer in attendance.

Clearing and Grubbing: Any surface improvements, debris or vegetation including grass, trees, and weeds on the site at the time of construction should be removed from the construction area. Root balls should be completely excavated. Organic stripping should be hauled from the site and not used as fill. *Any trash, construction debris, concrete slabs, old pavement, landfill, and buried obstructions such as old foundations, un-controlled fills and utility lines exposed during rough grading should be traced to the limits of the foreign material by the grading contractor and removed under our supervision.* Any excavations resulting from site clearing should be dish-shaped to the lowest depth of disturbance and backfilled under the observation of the geotechnical engineer's representative.

Building Pad Preparation: The existing surface soil within the proposed building pad areas should be removed to 48 inches below the original grade or 24 inches below the lowest foundation grade (whichever deeper), extending five feet beyond all exterior wall/column lines (including adjacent concrete areas). Exposed sub-grade should be scarified to a depth of 6 to 8 inches, uniformly moisture conditioned to at least 2% over optimum moisture content, and re-compacted to a minimum of 90% of the maximum density determined in accordance with ASTM D1557 methods.

Auxiliary Structures Foundation Preparation: Auxiliary structures such as free standing or retaining walls should have footings extended to a minimum of 18 inches below grade. The existing soil beneath the structure foundation prepared in the manner described for the house pad except the preparation needs only to extend 18 inches below and beyond the footing.

Sidewalk and Concrete Hardscape Areas: In areas other than the building pad which are to receive concrete slabs, the ground surface should be over-excavated to a depth of 8 to 12 inches, uniformly moisture conditioned to at least 2% over optimum moisture, and re-compacted to at least 90% of ASTM D1557 maximum density.

Street Subgrade Preparation: The native soils in street areas should be removed and recompacted to 12 inches below the design subgrade elevation. Engineered fill in street areas should be uniformly moisture conditioned to at least 2% over optimum moisture, placed in layers not more than 6 to 8 inches in thickness and mechanically compacted to a minimum of 90% of the ASTM D1557 maximum dry density.

The on-site soils are suitable for use as compacted fill and utility trench backfill. Imported fill soil (if required) should be like onsite soil or non-expansive, granular soil meeting the USCS classifications of SM, SP-SM, or SW-SM with a maximum rock size of 6 inches and no less than 5% passing the No. 200 sieve. ***The geotechnical engineer should approve imported fill soil sources before hauling material to the site***. Native and imported materials should be placed in lifts no greater than 8 inches in loose thickness, uniformly moisture conditioned to at least 2% over optimum moisture, and re-compacted to at least 90% of ASTM D1557 maximum density.

Moisture Control and Drainage: The moisture condition of the house pad should be maintained during trenching and utility installation until concrete is placed or should be rewetted before initiating delayed construction. Adequate site drainage is essential to the future performance of the project. Infiltration of excess irrigation water and stormwaters can adversely affect the performance of the subsurface soil at the site. Positive drainage should be maintained away from all structures (5% for 10 feet minimum across unpaved areas) to prevent ponding and subsequent saturation of the native soil. Gutters and downspouts may be considered as a means to convey water away from foundations. If landscape irrigation is allowed next to the building, drip irrigation systems or lined planter boxes should be used. The subgrade soil should be maintained in a moist, but not saturated state, and not allowed to dry out. Drainage should be maintained without ponding.

Utility Trench Backfill

On-site soil free of debris, vegetation, and other deleterious matter may be suitable for use as utility trench backfill. Backfill within roadways should be placed in layers not more than 6 to 8 inches in thickness, uniformly moisture conditioned to at least 2% over optimum moisture and mechanically compacted to a minimum of 90% of the ASTM D1557 maximum dry density except for the top 12 inches of the trench which shall be compacted to at least 95%. Native backfill should only be placed and compacted after encapsulating buried pipes with suitable bedding and pipe envelope material. Pipe envelope/bedding should be clean sand (Sand Equivalent SE>30). Precautions should be taken in the compaction of the backfill to avoid damage to the pipes and structures.

Soil Bearing Values and Lateral Loads

Shallow column footings and continuous wall footings are suitable to support the structures provided they are founded on a layer of properly prepared and compacted soil as described above. The foundations may be designed using an allowable soil bearing pressure of 1,800 psf. The allowable soil pressure may be increased by 20% for each foot of embedment depth more than 18 inches and by one-third for short term loads induced by winds or seismic events. The maximum allowable soil pressure at increased embedment depths shall not exceed 2,800 psf.

All exterior and interior foundations should be embedded a minimum of 18 inches below the building support pad or lowest adjacent final grade, whichever is deeper. Continuous wall footings should have a minimum width of 12 inches. Isolated column footings should have a minimum width of 24 inches. ***Recommended concrete reinforcement and sizing for all footings should be provided by the structural engineer.***

Resistance to horizontal loads will be developed by passive earth pressure on the sides of footings and frictional resistance developed along the bases of footings and concrete slabs. Passive resistance to lateral earth pressure may be calculated using an equivalent fluid pressure of 300 pcf to resist lateral loadings. The top one foot of embedment should not be considered in computing passive resistance unless the adjacent area is confined by a slab or pavement. An allowable friction coefficient of 0.35 may also be used at the base of the footings to resist lateral loading.

Foundation movement under the estimated static (non-seismic) loadings and static site conditions are estimated to not exceed ¾ inch with differential movement of about two-thirds of total movement for the loading assumptions stated above when the subgrade preparation guidelines given above are followed.

Slabs-on-Grade

Concrete slabs and flatwork should be a minimum of 5 inches thick. The concrete floor slabs may either be monolithically placed with the foundation or dowelled after footing placement. The concrete slabs may be placed on granular subgrade that has been compacted at least 90% relative compaction (ASTM D1557). ***Slab thickness and steel reinforcement should be determined by the design engineer.***

American Concrete Institute (ACI) guidelines (ACI 302.1R-15 Chapter 5, Section 5.2.3) provide recommendations regarding the use of moisture barriers beneath concrete slabs. The concrete floor slabs should be underlain by a 10-mil polyethylene vapor retarder that works as a capillary break to reduce moisture migration into the slab section.

All laps and seams should be overlapped 6-inches or as recommended by the manufacturer. The vapor retarder should be protected from puncture. The joints and penetrations should be sealed with the manufacturer's recommended adhesive, pressure-sensitive tape, or both. The vapor retarder should extend a minimum of 12 inches into the footing excavations. The vapor retarder may lie directly on the granular fill with 2 inches of clean sand cover. Placing sand over the vapor retarder may increase moisture transmission through the slab, because it provides a reservoir for bleed water from the concrete to collect. The sand placed over the vapor retarder may also move and mound prior to concrete placement, resulting in an irregular slab thickness.

For areas with moisture sensitive flooring materials, ACI recommends that concrete slabs be placed without a sand cover directly over the vapor retarder, provided that the concrete mix uses a low-water cement ratio and concrete curing methods are employed to compensate for release of bleed water through the top of the slab. The vapor retarder should have a minimum thickness of 15-mil (Stego-Wrap or equivalent).

All independent concrete flatwork should be underlain by 12 inches of moisture conditioned and compacted soils. All flatworks should be jointed in square patterns and at irregularities in shape at a maximum spacing of 10 feet or the least width of the sidewalk.

Concrete Mixes and Corrosivity

Selected chemical analyses for corrosivity were conducted on bulk samples of the near surface soil from the project site (Plate C-2). The native soils have low levels of sulfate and low to moderate levels of chloride ion concentrations. Resistivity determinations on the soil indicate a moderate potential for metal loss because of electrochemical corrosion processes. A minimum of 2,500 psi concrete of Type II Portland Cement with a maximum water/cement ratio of 0.60 (by weight) should be used for concrete placed in contact with native soil on this project (sitework including sidewalks, driveways, patios, and foundations).

Landmark does not practice corrosion engineering. We recommend that a qualified corrosion engineer evaluate the corrosion potential on metal construction materials and concrete at the site.

Excavations

All site excavations should conform to CalOSHA requirements for Type C soil. The contractor is solely responsible for the safety of workers entering trenches. Temporary excavations with depths of 4 feet or less may be cut nearly vertical for short duration. Temporary slopes should be no steeper than 1.5:1 (horizontal:vertical). Sandy soil slopes should be kept moist, but not saturated, to reduce the potential of raveling or sloughing. Excavations deeper than 4 feet will require shoring or slope inclinations in conformance to CAL/OSHA regulations for Type C soil. Surcharge loads of stockpiled soil or construction materials should be set back from the top of the slope a minimum distance equal to the height of the slope. All permanent slopes should not be steeper than 3:1 to reduce wind and rain erosion. Protected slopes with ground cover may be as steep as 2:1. However, maintenance with motorized equipment may not be possible at this inclination.

Lateral Earth Pressures

Earth retaining structures, such as retaining walls, should be designed to resist the soil pressure imposed by the retained soil mass. Walls with granular drained backfill may be designed for an assumed static earth pressure equivalent to that exerted by a fluid weighing 30 pcf for unrestrained (active) conditions (able to rotate 0.1% of wall height), and 50 pcf for restrained (at-rest) conditions. These values should be verified at the actual wall locations during construction. When applicable seismic earth pressure on walls may be assumed to exert a uniform pressure distribution of 7.5H psf against the back of the wall, where H is the height of the backfill. The total seismic load is assumed to act as a point load at 0.6H above the base of the wall.

Surcharge loads should be considered if loads are applied within a zone between the face of the wall and a plane projected behind the wall 45 degrees upward from the base of the wall. The increase in lateral earth pressure acting uniformly against the back of the wall should be taken as 50% of the surcharge load within this zone. Areas of the retaining wall subjected to traffic loads should be designed for a uniform surcharge load equivalent to two feet of native soil.

Walls should be provided with back drains to reduce the potential for the buildup of hydrostatic pressure. The drainage system should consist of a composite HDPE drainage panel or a 2-foot-wide zone of free draining crushed rock placed adjacent to the wall and extending 2/3 the height of the wall. The gravel should be completely enclosed in an approved filter fabric to separate the gravel and backfill soil. A perforated pipe should be placed perforations down at the base of the permeable material at least six inches below finished floor elevations.

The pipe should be sloped to drain to an appropriate outlet that is protected against erosion. Walls should be properly waterproofed. The project geotechnical engineer should approve any alternative drain system.

Pavements

Pavements should be designed according to the 2022 Caltrans Highway Design Manual or other acceptable methods. Traffic indices were not provided by the project engineer or owner; therefore, we have provided structural sections for several traffic indices for comparative evaluation. The public agency or design engineer should decide the appropriate traffic index for the site. Maintenance of proper drainage is necessary to prolong the service life of the pavements. Based on the current Caltrans method, an estimated R-value of 60 for the subgrade soil and assumed traffic indices, the following table provides our estimates for asphaltic concrete (AC pavement sections.

PAVEMENT STUCTURAL SECTIONS

R-Value of Subgrade Soil - 60 (estimated) Design Method - CALTRANS 2022

Traffic Index (assumed)	Flexible Pavements	
	Asphaltic Concrete Thickness (in.)	Aggregate Base Thickness (in.)
5.0	3.0	4.0
6.0	3.5	4.0
7.0	4.5	4.0
8.0	5.0	4.0

Notes:

1) Asphaltic concrete shall be Caltrans, Type A HMA (Hot Mix Asphalt), ¾ inch maximum (½ inch maximum for parking areas), with PG70-10 PG64-16 asphalt concrete, compacted to a minimum of 95% of the Hveem density (CAL 308) or a minimum of 92% of the Maximum Theoretical Density (ASTM D2041).
2) Aggregate base shall conform to Caltrans Class 2 (¾ in. maximum), compacted to a minimum of 95% of ASTM D1557 maximum dry density.
3) Place pavements on 12 inches of moisture conditioned (at least 2% of over optimum) native soil compacted to a minimum of 95% of the maximum dry density determined by ASTM D1557, or the governing agency requirements.

Final pavement sections may need to be determined by sampling and R-Value testing during grading operations when actual subgrade soils are exposed.

Observation and Density Testing

Site preparation and fill placement should be continuously observed and tested by a representative of a qualified geotechnical engineering firm. Near full-time observation services during the excavation and scarification process is necessary to detect undesirable materials or conditions and soft areas that may be encountered in the construction area. The geotechnical firm that provides observation and testing during construction shall assume the responsibility of "***geotechnical engineer of record***" and, as such, shall perform additional tests and investigation as necessary to satisfy themselves as to the site conditions and the recommendations for site development.

Additional Services

We recommend that ***Landmark Consultants, Inc.*** be retained to provide tests and observations services during construction. *The geotechnical engineering firm providing such tests and observations shall become the geotechnical engineer of record and assume responsibility for the project.*

Landmark Consultants, Inc. *recommendations for this site are, to a high degree, dependent upon appropriate quality control of subgrade preparation, fill placement, and foundation construction. Accordingly, the findings and professional opinions in this report are made contingent upon the opportunity for* ***Landmark Consultants, Inc.*** *to observe grading operations and foundation excavations for the proposed construction.*

If parties other than ***Landmark Consultants, Inc.*** *are engaged to provide observation and testing services during construction, such parties must be notified that they will be required to assume complete responsibility as the geotechnical engineer of record for the geotechnical phase of the project by concurring with the recommendations in this report and/or by providing alternative recommendations.*

Closure

Additional information concerning the scope and cost of these services can be obtained from our office. We did not encounter soil conditions that would preclude implementation of the proposed project provided the recommendations contained in this report are implemented in the design and construction of this project.

We appreciate the opportunity to provide our findings and professional opinions regarding geotechnical conditions at the site. Please provide our office with a set of the foundation plans and civil plans for review to insure that the geotechnical site constraints have been included in the design documents. If you have any questions or comments regarding our findings, please call our office at (760) 360-0665.

Respectfully Submitted,
LandMark Consultants, Inc.



Greg M. Chandra, PE, M.ASCE
Principal Engineer

Attachments:

Appendix A: Vicinity and Site Maps
Appendix B: Subsurface Soil Logs and Soil Key
Appendix C: Laboratory Test Results
Appendix D: Soil Infiltration Test Results

TABLES

Table 1
Summary of Characteristics of Closest Known Active Faults

Fault Name	Approximate Distance (miles)	Approximate Distance (km)	Maximum Moment Magnitude (Mw)	Fault Length (km)	Slip Rate (mm/yr)
San Andreas - San Bernardino (South)	1.7	2.7	7.4	103 ± 10	30 ± 7
San Jacinto - San Bernardino	3.9	6.2	6.7	36 ± 4	12 ± 6
Cucamonga	7.3	11.6	6.9	28 ± 3	5 ± 2
Cleghorn	7.3	11.7	6.5	25 ± 3	3 ± 2
North Frontal Fault Zone - Western	9.6	15.3	7.2	51 ± 5	1 ± 0.5
San Jacinto - San Jacinto Valley	11.2	17.9	6.9	43 ± 4	12 ± 6
San Andreas - Mojave	13.7	21.9	7.1	39 ± 4	3 ± 3
San Jose	22.1	35.3	6.4	20 ± 2	0.5 ± 0.5
Sierra Madre	24.9	39.9	7.2	57 ± 6	2 ± 1
Chino Avenue	25.8	41.3	6.7	28 ± 3	1 ± 1
Helendale - S. Lockhart	28.2	45.2	7.3	97 ± 10	0.6 ± 0.4
Elsinore - Glen Ivy	28.6	45.8	6.8	36 ± 4	5 ± 2
Whittier	28.6	45.8	6.8	38 ± 4	2.5 ± 1
Clamshell-Sawpit	31.1	49.7	6.5	16 ± 2	0.5 ± 0.5
North Frontal Fault Zone - Eastern	32.3	51.7	6.7	27 ± 3	0.5 ± 0.3
Pinto Mtn.	34.6	55.4	7.2	74 ± 7	2.5 ± 2
Elsinore - Temecula	34.8	55.7	6.8	43 ± 4	5 ± 2
Puente Hills Blind Thrust	36.0	57.7	7.1	44 ± 4	0.7 ± 0.4
San Jacinto - Anza	37.2	59.5	7.2	91 ± 9	12 ± 6
Lenwood - Lockhart - Old Woman Springs	37.4	59.9	7.5	145 ± 15	0.6 ± 0.4
Garnet Hill *	38.9	62.3			
Morongo *	40.8	65.2			

* Note: Faults not included in CGS database.

Table 2
2022 California Building Code (CBC) and ASCE 7-16 Seismic Parameters

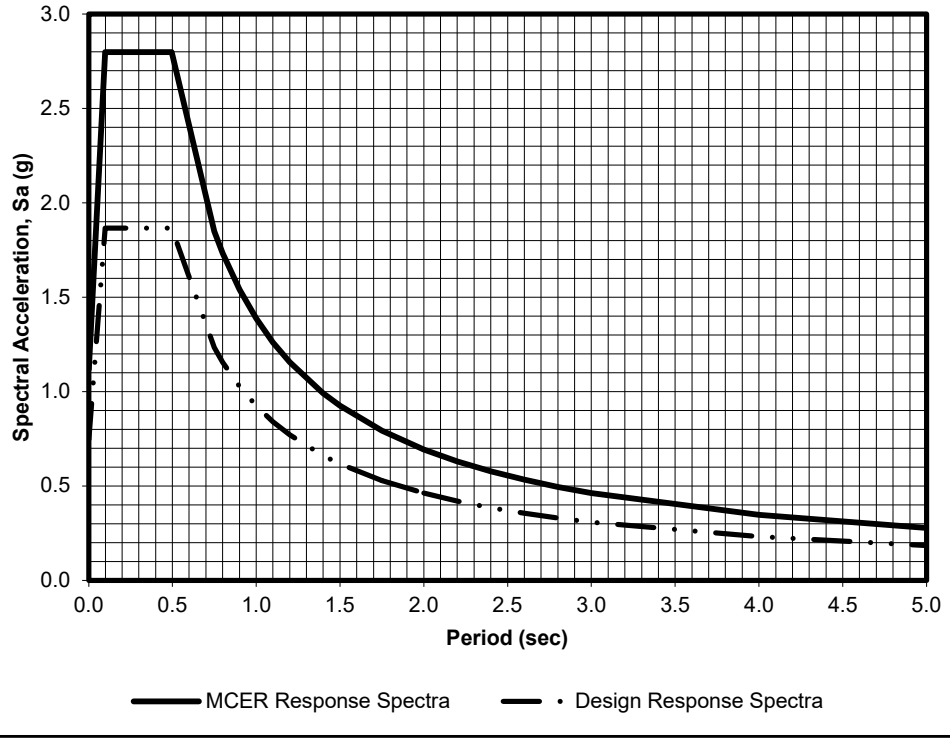
			ASCE 7-16 Reference
Soil Site Class:	**C**		Table 20.3-1
Latitude:	34.1706	N	
Longitude:	-117.3108	W	
Risk Category:	II		
Seismic Design Category:	E		

Maximum Considered Earthquake (MCE) Ground Motion

Mapped MCE_R Short Period Spectral Response	S_s	2.332 g	ASCE Figure 22-1	
Mapped MCE_R 1 second Spectral Response	S_1	0.991 g	ASCE Figure 22-2	
Short Period (0.2 s) Site Coefficient	F_a	1.20	ASCE Table 11.4-1	
Long Period (1.0 s) Site Coefficient	F_v	1.40	ASCE Table 11.4-2	
MCE_R Spectral Response Acceleration Parameter (0.2 s)	S_{MS}	2.798 g	= Fa * S_s	ASCE Equation 11.4-1
MCE_R Spectral Response Acceleration Parameter (1.0 s)	S_{M1}	1.387 g	= Fv * S_1	ASCE Equation 11.4-2

Design Earthquake Ground Motion

Design Spectral Response Acceleration Parameter (0.2 s)	S_{DS}	1.866 g	= 2/3*S_{MS}	ASCE Equation 11.4-3
Design Spectral Response Acceleration Parameter (1.0 s)	S_{D1}	0.925 g	= 2/3*S_{M1}	ASCE Equation 11.4-4
Risk Coefficient at Short Periods (less than 0.2 s)	C_{RS}	0.904		ASCE Figure 22-17
Risk Coefficient at Long Periods (greater than 1.0 s)	C_{R1}	0.883		ASCE Figure 22-18
	T_L	8.00 sec		ASCE Figure 22-12
	T_O	0.10 sec	=0.2*S_{D1}/S_{DS}	
	T_S	0.50 sec	=S_{D1}/S_{DS}	
Peak Ground Acceleration	PGA_M	1.20 g		ASCE Equation 11.8-1



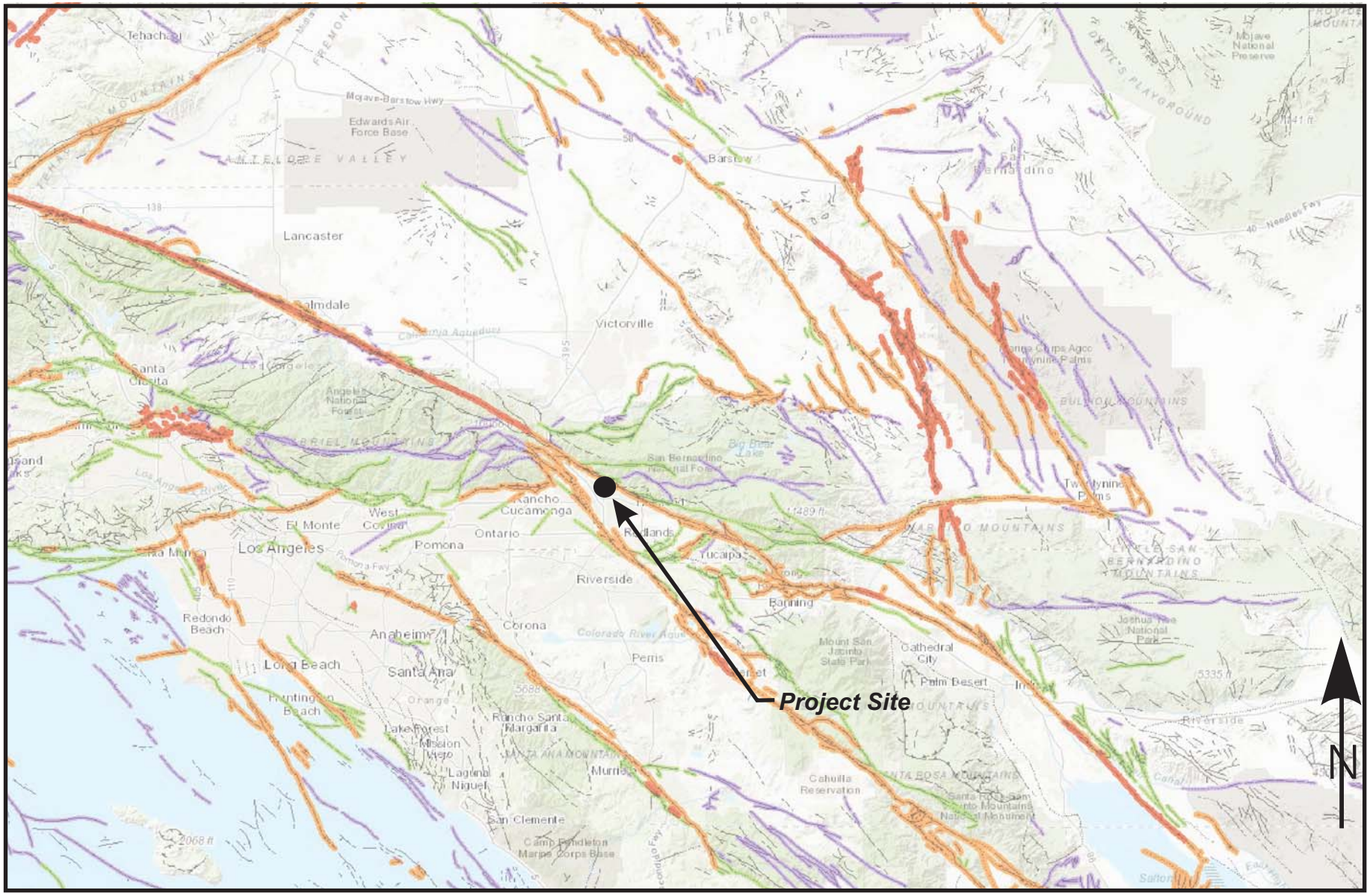
Period T (sec)	Sa (g)	MCE_R Sa (g)
0.00	0.75	1.12
0.10	1.87	2.80
0.50	1.87	2.80
0.75	1.23	1.85
0.80	1.16	1.73
0.90	1.03	1.54
1.00	0.92	1.39
1.10	0.84	1.26
1.20	0.77	1.16
1.20	0.77	1.16
1.40	0.66	0.99
1.50	0.62	0.92
1.75	0.53	0.79
2.00	0.46	0.69
2.20	0.42	0.63
2.40	0.39	0.58
2.60	0.36	0.53
2.80	0.33	0.50
3.00	0.31	0.46
4.00	0.23	0.35
5.00	0.18	0.28

Table 3
Soil Site Class Determination per ASCE 7-16, Section 20.4
Shandin Hills MHRC - San Bernardino, CA
LCI Project No. LP23116

Boring B-1

Sample Depth	SPT Blow Count	di/Ni	Sum di/Ni	Avg. Nch
0				
5	35	0.14	0.65	**62**
10	26	0.19		
15	100	0.05		
20	100	0.05		
25	83	0.06		
30	100	0.05		
35	100	0.05		
40	100	0.05		

FIGURES



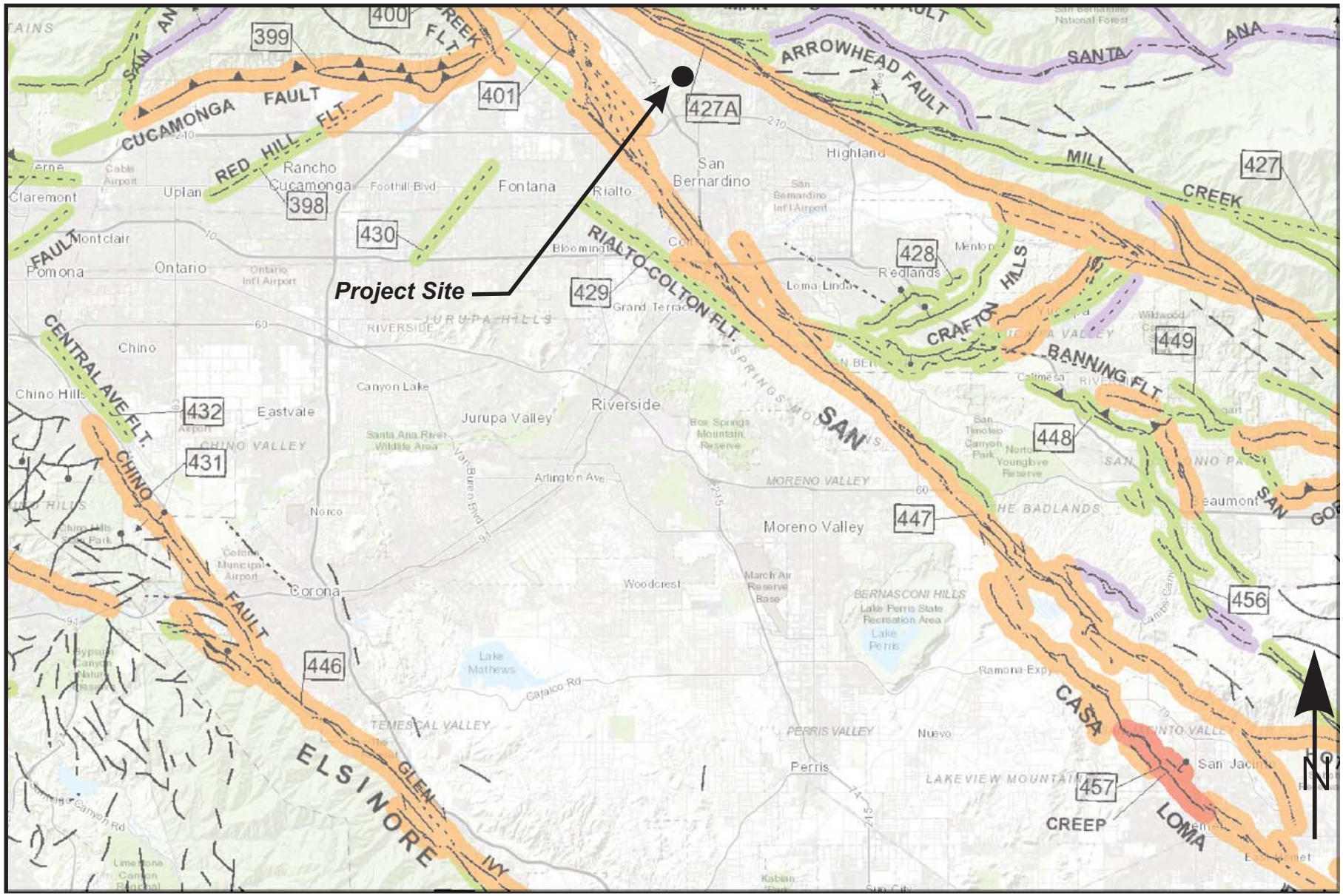
Source: California Geological Survey 2010 Fault Activity Map of California https://maps.conservation.ca.gov/cgs/fam/

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Regional Fault Map

Figure 1



Source: California Geological Survey 2010 Fault Activity Map of California
https://maps.conservation.ca.gov/cgs/fam/App/index.html

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Map of Local Faults

Figure 2

EXPLANATION

Fault traces on land are indicated by solid lines where well located, by dashed lines where approximately located or inferred, and by dotted lines where concealed by younger rocks or by lakes or bays. Fault traces are queried where continuation or existence is uncertain. Concealed faults in the Great Valley are based on maps of selected subsurface horizons, so locations shown are approximate and may indicate structural trend only. All offshore faults based on seismic reflection profile records are shown as solid lines where well defined, dashed where inferred, queried where uncertain.

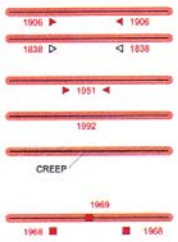
FAULT CLASSIFICATION COLOR CODE
(Indicating Recency of Movement)

Fault along which historic (last 200 years) displacement has occurred and is associated with one or more of the following:

(a) a recorded earthquake with surface rupture. (Also included are some well-defined surface breaks caused by ground shaking during earthquakes, e.g. extensive ground breakage, not on the White Wolf fault, caused by the Arvin-Tehachapi earthquake of 1952). The date of the associated earthquake is indicated. Where repeated surface ruptures on the same fault have occurred, only the date of the latest movement may be indicated, especially if earlier reports are not well documented as to location of ground breaks.

(b) fault creep slippage - slow ground displacement usually without accompanying earthquakes.

(c) displaced survey lines.



A triangle to the right or left of the date indicates termination point of observed surface displacement. Solid red triangle indicates known location of rupture termination point. Open black triangle indicates uncertain or estimated location of rupture termination point.

Date bracketed by triangles indicates local fault break.

No triangle by date indicates an intermediate point along fault break.

Fault that exhibits fault creep slippage. Hachures indicate linear extent of fault creep. Annotation (creep with leader) indicates representative locations where fault creep has been observed and recorded.

Square on fault indicates where fault creep slippage has occured that has been triggered by an earthquake on some other fault. Date of causative earthquake indicated. Squares to right and left of date indicate terminal points between which triggered creep slippage has occurred (creep either continuous or intermittent between these end points).

Holocene fault displacement (during past 11,700 years) without historic record. Geomorphic evidence for Holocene faulting includes sag ponds, scarps showing little erosion, or the following features in Holocene age deposits: offset stream courses, linear scarps, shutter ridges, and triangular faceted spurs. Recency of faulting offshore is based on the interpreted age of the youngest strata displaced by faulting.

Late Quaternary fault displacement (during past 700,000 years). Geomorphic evidence similar to that described for Holocene faults except features are less distinct. Faulting may be younger, but lack of younger overlying deposits precludes more accurate age classification.

Quaternary fault (age undifferentiated). Most faults of this category show evidence of displacement sometime during the past 1.6 million years; possible exceptions are faults which displace rocks of undifferentiated Plio-Pleistocene age. Unnumbered Quaternary faults were based on Fault Map of California, 1975. See Bulletin 201, Appendix D for source data.

Pre-Quaternary fault (older that 1.6 million years) or fault without recognized Quaternary displacement. Some faults are shown in this category because the source of mapping used was of reconnaissnce nature, or was not done with the object of dating fault displacements. Faults in this category are not necessarily inactive.

ADDITIONAL FAULT SYMBOLS

Bar and ball on downthrown side (relative or apparent).

Arrows along fault indicate relative or apparent direction of lateral movement.

Arrow on fault indicates direction of dip.

Low angle fault (barbs on upper plate). Fault surface generally dips less than 45° but locally may have been subsequently steepened. On offshore faults, barbs simply indicate a reverse fault regardless of steepness of dip.

OTHER SYMBOLS



Numbers refer to annotations listed in the appendices of the accompanying report. Annotations include fault name, age of fault displacement, and pertinent references including Earthquake Fault Zone maps where a fault has been zoned by the Alquist-Priolo Earthquake Fault Zoning Act. This Act requires the State Geologist to delineate zones to encompass faults with Holocene displacement.

Structural discontinuity (offshore) separating differing Neogene structural domains. May indicate discontinuities between basement rocks.

Brawley Seismic Zone, a linear zone of seismicity locally up to 10 km wide associated with the releasing step between the Imperial and San Andreas faults.

Geologic Time Scale			Years Before Present (Approx.)	Fault Symbol	Recency of Movement	DESCRIPTION	
						ON LAND	OFFSHORE
Quaternary	Late Quaternary	Historic	200			Displacement during historic time (e.g. San Andreas fault 1906). Includes areas of known fault creep.	
		Holocene	11,700			Displacement during Holocene time.	Fault offsets seafloor sediments or strata of Holocene age.
	Pleistocene					Faults showing evidence of displacement during late Quaternary time.	Fault cuts strata of Late Pleistocene age.
	Early Quaternary		700,000			Undivided Quaternary faults – most faults in this category show evidence of displacement during the last 1,600,000 years; possible exceptions are faults which displace rocks of undifferentiated Plio-Pleistocene age.	Fault cuts strata of Quaternary age.
Pre-Quaternary			1,600,000*			Faults without recognized Quaternary displacement or showing evidence of no displacement during Quaternary time. Not necessarily inactive.	Fault cuts strata of Pliocene or older age.
			4.5 billion (Age of Earth)				

* Quaternary now recognized as extending to 2.6 Ma (Walker and Geissman, 2009). Quaternary faults in this map were established using the previous 1.6 Ma criterion.

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Fault Map Legend

Figure 3

APPENDIX A

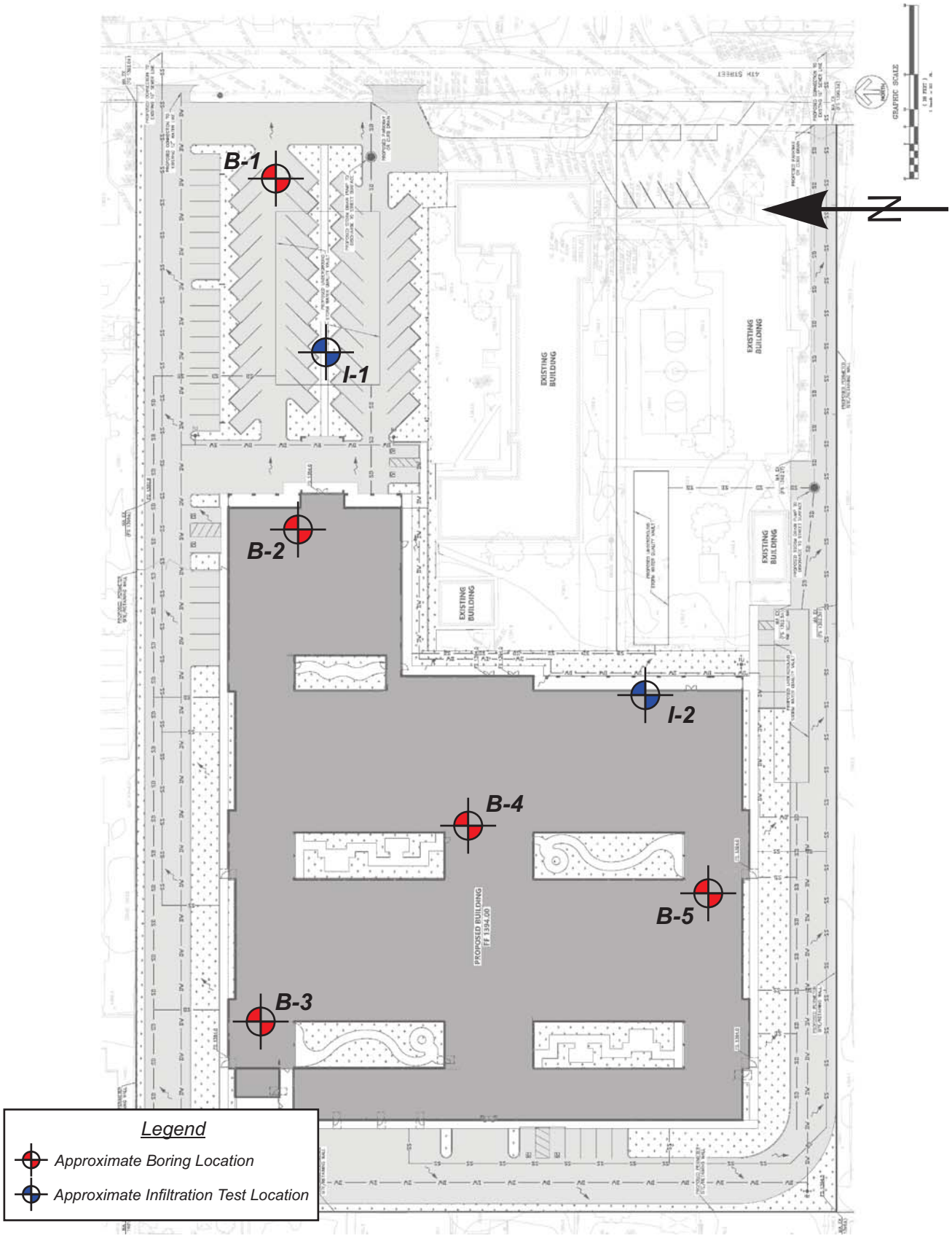


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Vicinity Map

Plate A-1



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Site and Exploration Map

Plate A-2



117° 18' 44" W

N

Map Scale: 1:2,540 if printed on A portrait (8.5" x 11") sheet.

Meters: 0, 35, 70, 140, 210

Feet: 0, 100, 200, 400, 600

Map projection: Web Mercator Corner coordinates: WGS84

117° 18' 29" W

N

USDA Natural Resources Conservation Service

Web Soil Survey
National Cooperative Soil Survey

7/24/2023
Page 1 of 3

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USDA Soil Conservation Soil Service Map

Plate A-3

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 14, Sep 6, 2022

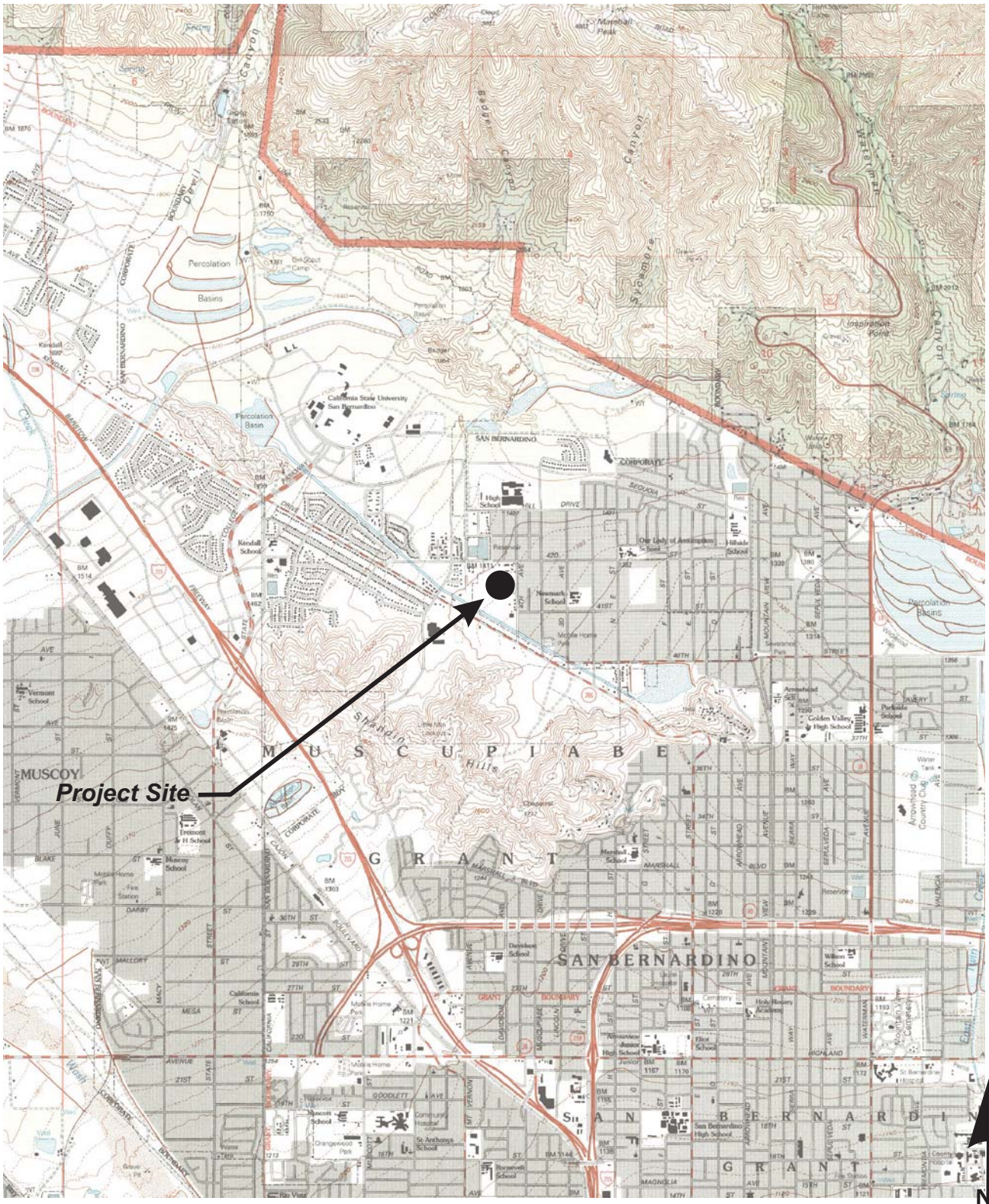
Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 17, 2022—Jun 12, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background 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
SpC	Soboba stony loamy sand, 2 to 9 percent slopes	0.1	0.3%
TuB	Tujunga loamy sand, 0 to 5 percent slopes	5.6	17.5%
TvC	Tujunga gravelly loamy sand, 0 to 9 percent slopes	26.4	82.2%
Totals for Area of Interest		**32.1**	**100.0%**



Reference: USGS Topographic Map
San Bernardino North, CA Quadrangle
Scale 1:25,000

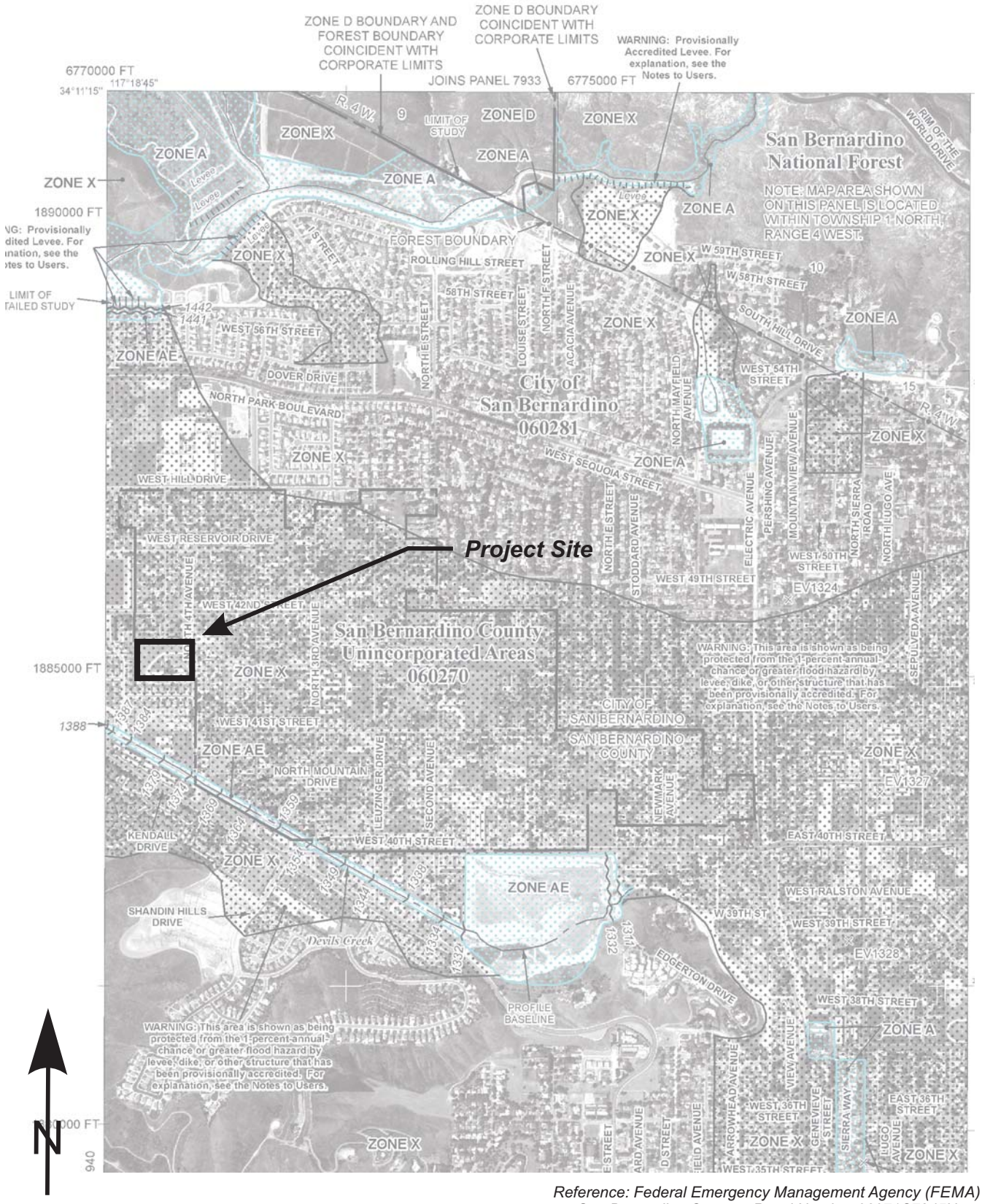
Site Coordinates
Lat: 34.1706N
Long: -117.3108W

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Topographic Map

Plate A-4



Reference: Federal Emergency Management Agency (FEMA)
San Bernardino County - Panel Number 06071C7945H

LANDMARK Geo-Engineers and Geologists		Plate
Project No.: LP23116	**FEMA Flood Insurance Rate Map (FIRM)**	**A-5**

LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X — Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% annual chance floodplain boundary

0.2% annual chance floodplain boundary

Floodway boundary

Zone D boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.

513 — Base Flood Elevation line and value; elevation in feet*

(EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988

A — A — Cross section line

23 — 23 — Transect line

87°07'45", 32°22'30" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere

$^{24}76^{000m}$N — 1000-meter Universal Transverse Mercator grid values, zone 11N

600000 FT — 5000-foot grid ticks: California State Plane coordinate system, zone VI (FIPSZONE 0406), Lambert Conformal Conic projection

DX5510 × — Bench mark (see explanation in Notes to Users section of this FIRM panel)

● M1.5 — River Mile

APPENDIX B

LOG OF BORING No. B-1

SHEET 1 OF 1

DEPTH	FIELD: SAMPLE	FIELD: USCS CLASS.	FIELD: BLOW COUNT	FIELD: POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	LABORATORY: DRY DENSITY (pcf)	LABORATORY: MOISTURE CONTENT (% dry wt.)	LABORATORY: OTHER TESTS
					SILTY SAND (SP): Reddish gray, dry, medium dense, fine to coarse grained			Passing #200 = 15.4%
5			20		SAND (SP): Reddish brown, dry, medium dense, fine to coarse grained, some fine gravel	103.6	3.0	
10			15				3.3	Passing #200 = 4.9%
15			52		SAND (SP-SM): Brown, dry, medium dense to dense, fine to coarse grained, some fine gravel	122.9	2.6	
20			29				2.	Passing #200 = 5.4%
25								
30								
35								
40								
45								
50								
55								
60					Groundwater was encountered at time of drilling. This is not considered the stabilized groundwater depth as groundwater may rise to a level higher than that measured in borehole.			

DATE DRILLED: 6/22/23

LOGGED BY: L. Jackson

SURFACE ELEVATION: Approximately 1395 ft

TOTAL DEPTH: 21.5 feet

TYPE OF BIT: Hollow Stem Auger

HAMMER WT.: 140 lbs.

DEPTH TO WATER: NA

DIAMETER: 8 in.

DROP: 30 in.

PROJECT NO. LP23116

LANDMARK Geo-Engineers and Geologists

PLATE B-1

LOG OF BORING No. B-2

SHEET 1 OF 1

DEPTH	FIELD: SAMPLE	FIELD: USCS CLASS.	FIELD: BLOW COUNT	FIELD: POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	LABORATORY: DRY DENSITY (pcf)	LABORATORY: MOISTURE CONTENT (% dry wt.)	LABORATORY: OTHER TESTS
5			60		SAND (SP-SM): Reddish brown to brown, dry, dense to very dense, fine to coarse grained, some fine gravel	99.9	1.5	Passing #200 = 9.8%
10			34				1.7	Passing #200 = 8.7%
15			33		moist	109.3	8.8	
20			40				3.1	Passing #200 = 7.7%
25			50/5”			125.6	2.4	
30			50/6”				2.2	Passing #200 = 6.2%
35								
40								
45								
50								
55								
60					Groundwater was encountered at time of drilling. This is not considered the stabilized groundwater depth as groundwater may rise to a level higher than that measured in borehole.			

DATE DRILLED: 6/22/23

LOGGED BY: L. Jackson

SURFACE ELEVATION: Approximately 1396 ft

TOTAL DEPTH: 31.5 feet

TYPE OF BIT: Hollow Stem Auger

HAMMER WT.: 140 lbs.

DEPTH TO WATER: NA

DIAMETER: 8 in.

DROP: 30 in.

PROJECT NO. LP23116

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PLATE B-2

LOG OF BORING No. B-3

SHEET 1 OF 1

DEPTH	FIELD: SAMPLE	FIELD: USCS CLASS.	FIELD: BLOW COUNT	FIELD: POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	LABORATORY: DRY DENSITY (pcf)	LABORATORY: MOISTURE CONTENT (% dry wt.)	LABORATORY: OTHER TESTS
5			26		SAND (SP): Reddish brown, dry, medium dense, fine to coarse grained, some fine gravel	116.9	2.7	Passing #200 = 2.2%
10			16		No recovery			
15			68		SAND (SP-SM): Reddish gray to brown, dry, dense to very dense, fine to coarse grained, some fine gravel	132.5	1.6	Passing #200 = 5.4%
20			38				2.5	
25								
30								
35								
40								
45								
50								
55								
60								

Groundwater was encountered at time of drilling. This is not considered the stabilized groundwater depth as groundwater may rise to a level higher than that measured in borehole.

DATE DRILLED: 6/22/23

LOGGED BY: L. Jackson

SURFACE ELEVATION: Approximately 1400 ft

TOTAL DEPTH: 21.5 feet

TYPE OF BIT: Hollow Stem Auger

HAMMER WT.: 140 lbs.

DEPTH TO WATER: NA

DIAMETER: 8 in.

DROP: 30 in.

PROJECT NO. LP23116

LANDMARK Geo-Engineers and Geologists

PLATE B-3

LOG OF BORING No. B-4

SHEET 1 OF 1

DEPTH	FIELD: SAMPLE	FIELD: USCS CLASS.	FIELD: BLOW COUNT	FIELD: POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	LABORATORY: DRY DENSITY (pcf)	LABORATORY: MOISTURE CONTENT (% dry wt.)	LABORATORY: OTHER TESTS
5			35		SAND (SP-SM): Reddish brown to dark brown, dry, medium dense to very dense, fine to coarse grained, some fine gravel	125.4	2.1	
10			26				2.1	Passing #200 = 9.6%
15			50/6”			132.5	2.9	
20			50/4”				1.9	Passing #200 = 6.5%
25			83			114.0	2.4	
30			50/6”				2.7	Passing #200 = 7.5%
35			50/3”				2.6	
40			50/6”				2.9	Passing #200 = 6.1%
45								
50								
55								
60					Groundwater was encountered at time of drilling. This is not considered the stabilized groundwater depth as groundwater may rise to a level higher than that measured in borehole.			

DATE DRILLED: 6/22/23
LOGGED BY: L. Jackson
SURFACE ELEVATION: Approximately 1398 ft

TOTAL DEPTH: 41.5 feet
TYPE OF BIT: Hollow Stem Auger
HAMMER WT.: 140 lbs.

DEPTH TO WATER: NA
DIAMETER: 8 in.
DROP: 30 in.

PROJECT NO. LP23116

LANDMARK
Geo-Engineers and Geologists

PLATE B-4

LOG OF BORING No. B-5

SHEET 1 OF 1

DEPTH	FIELD: SAMPLE	FIELD: USCS CLASS.	FIELD: BLOW COUNT	FIELD: POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	LABORATORY: DRY DENSITY (pcf)	LABORATORY: MOISTURE CONTENT (% dry wt.)	LABORATORY: OTHER TESTS
5			32		SAND (SP): Reddish brown to gray brown, dry, medium dense to very dense, fine to coarse grained, some fine gravel	123.2	2.9	Passing #200 = 4.3%
10			18				3.3	
15			63			105.6	3.2	Passing #200 = 2.5%
20			75/9”				1.4	
25								
30								
35								
40								
45								
50								
55								
60								

Groundwater was encountered at time of drilling. This is not considered the stabilized groundwater depth as groundwater may rise to a level higher than that measured in borehole.

DATE DRILLED: 6/22/23

LOGGED BY: L. Jackson

SURFACE ELEVATION: Approximately 1394 ft

TOTAL DEPTH: 21.5 feet

TYPE OF BIT: Hollow Stem Auger

HAMMER WT.: 140 lbs.

DEPTH TO WATER: NA

DIAMETER: 8 in.

DROP: 30 in.

PROJECT NO. LP23116

LANDMARK Geo-Engineers and Geologists

PLATE B-5

DEFINITION OF TERMS

PRIMARY DIVISIONS			SYMBOLS	SECONDARY DIVISIONS
Coarse grained soils More than half of material is larger that No. 200 sieve	**Gravels** More than half of coarse fraction is larger than No. 4 sieve	Clean gravels (less than 5% fines)	**GW**	Well graded gravels, gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels, or gravel-sand mixtures, little or no fines
		Gravel with fines	**GM**	Silty gravels, gravel-sand-silt mixtures, non-plastic fines
			GC	Clayey gravels, gravel-sand-clay mixtures, plastic fines
	Sands More than half of coarse fraction is smaller than No. 4 sieve	Clean sands (less than 5% fines)	**SW**	Well graded sands, gravelly sands, little or no fines
			SP	Poorly graded sands or gravelly sands, little or no fines
		Sands with fines	**SM**	Silty sands, sand-silt mixtures, non-plastic fines
			SC	Clayey sands, sand-clay mixtures, plastic fines
Fine grained soils More than half of material is smaller than No. 200 sieve	**Silts and clays** Liquid limit is less than 50%		**ML**	Inorganic silts, clayey silts with slight plasticity
			CL	Inorganic clays of low to medium plasticity, gravely, sandy, or lean clays
			OL	Organic silts and organic clays of low plasticity
	Silts and clays Liquid limit is more than 50%		**MH**	Inorganic silts, micaceous or diatomaceous silty soils, elastic silts
			CH	Inorganic clays of high plasticity, fat clays
			OH	Organic clays of medium to high plasticity, organic silts
Highly organic soils			**PT**	Peat and other highly organic soils

GRAIN SIZES

Silts and Clays	Sand			Gravel		Cobbles	Boulders
	Fine	Medium	Coarse	Fine	Coarse		

200 40 10 4 3/4" 3" 12"

US Standard Series Sieve — Clear Square Openings

Sands, Gravels, etc.	Blows/ft. *
Very Loose	0-4
Loose	4-10
Medium Dense	10-30
Dense	30-50
Very Dense	Over 50

Clays & Plastic Silts	Strength **	Blows/ft. *
Very Soft	0-0.25	0-2
Soft	0.25-0.5	2-4
Firm	0.5-1.0	4-8
Stiff	1.0-2.0	8-16
Very Stiff	2.0-4.0	16-32
Hard	Over 4.0	Over 32

* Number of blows of 140 lb. hammer falling 30 inches to drive a 2 inch O.D. (1 3/8 in. I.D.) split spoon (ASTM D1586).

** Unconfined compressive strength in tons/s.f. as determined by laboratory testing or approximated by the Standard Penetration Test (ASTM D1586), Pocket Penetrometer, Torvane, or visual observation.

Type of Samples:

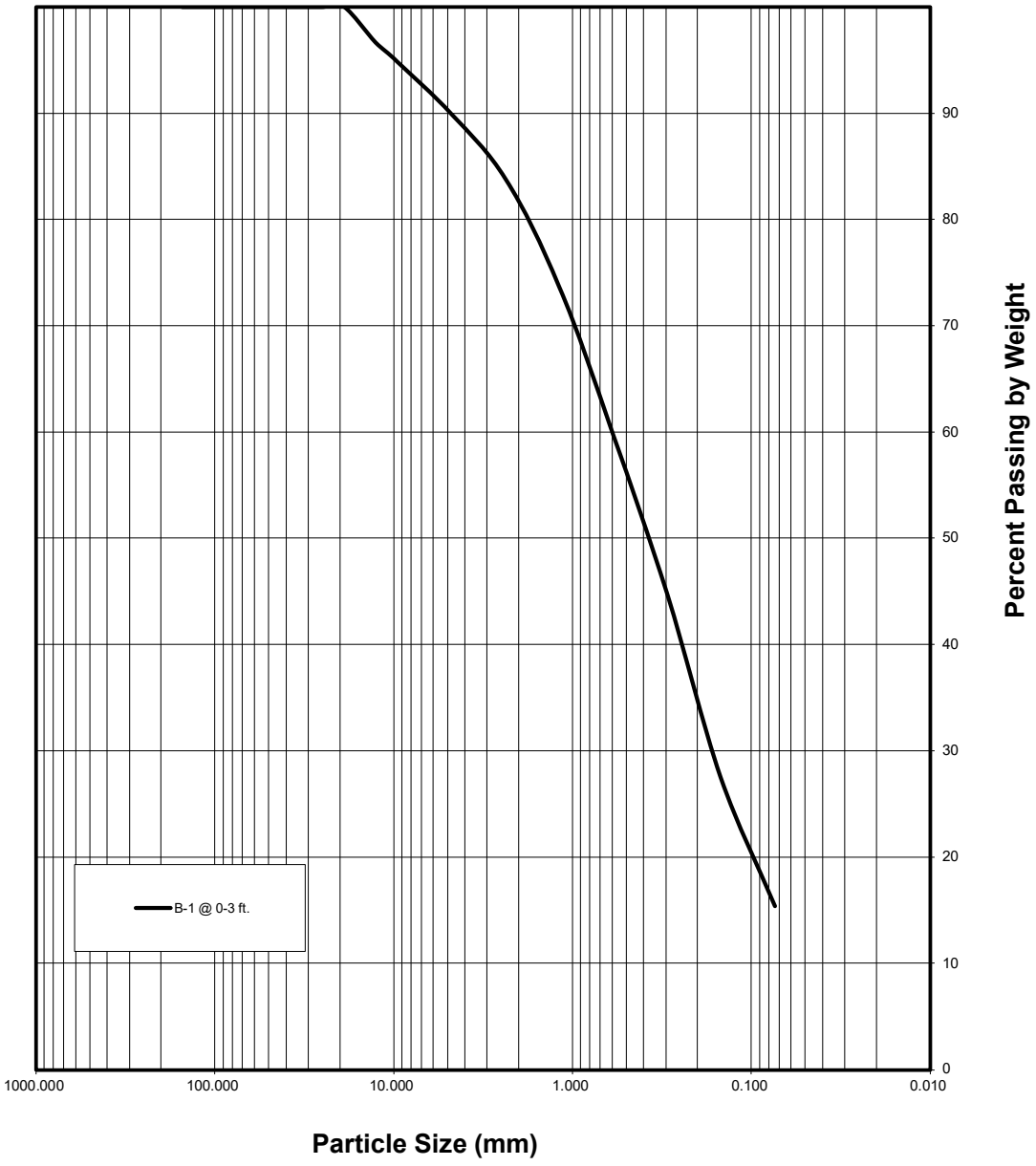
Ring Sample Standard Penetration Test Shelby Tube Bulk (Bag) Sample

Drilling Notes:

1. Sampling and Blow Counts
   - Ring Sampler - Number of blows per foot of a 140 lb. hammer falling 30 inches.
   - Standard Penetration Test - Number of blows per foot.
   - Shelby Tube - Three (3) inch nominal diameter tube hydraulically pushed.
2. P. P. = Pocket Penetrometer (tons/s.f.).
3. NR = No recovery.
4. GWT = Ground Water Table observed @ specified time.

APPENDIX C

SIEVE ANALYSIS						
Cobbles and Boulders	Gravel		Sand			Silt and Clay
	Coarse	Fine	Coarse	Medium	Fine	



LANDMARK
Geo-Engineers and Geologists

Project No.: LP23116

Grain Size Analysis

Plate C-1

LANDMARK CONSULTANTS, INC.

CLIENT: New Gen HC
PROJECT: Shandin Hills MHRC - San Bernardino, CA
JOB No.: LP23116
DATE: 06/23/23

CHEMICAL ANALYSIS

Boring:	B-1	**Caltrans**
Sample Depth, ft:	0-3	**Method**
pH:	7.8	**643**
Electrical Conductivity (mmhos):	--	**424**
Resistivity (ohm-cm):	9,300	**643**
Chloride (Cl), ppm:	80	**422**
Sulfate (SO4), ppm:	23	**417**

General Guidelines for Soil Corrosivity

Material Affected	Chemical Agent	Amount in Soil (ppm)	Degree of Corrosivity
Concrete	Soluble Sulfates	0 - 1,000	Low
		1,000 - 2,000	Moderate
		2,000 - 20,000	Severe
		> 20,000	Very Severe
Normal Grade Steel	Soluble Chlorides	0 - 200	Low
		200 - 700	Moderate
		700 - 1,500	Severe
		> 1,500	Very Severe
Normal Grade Steel	Resistivity	1 - 1,000	Very Severe
		1,000 - 2,000	Severe
		2,000 - 10,000	Moderate
		> 10,000	Low

LANDMARK
Geo-Engineers and Geologists

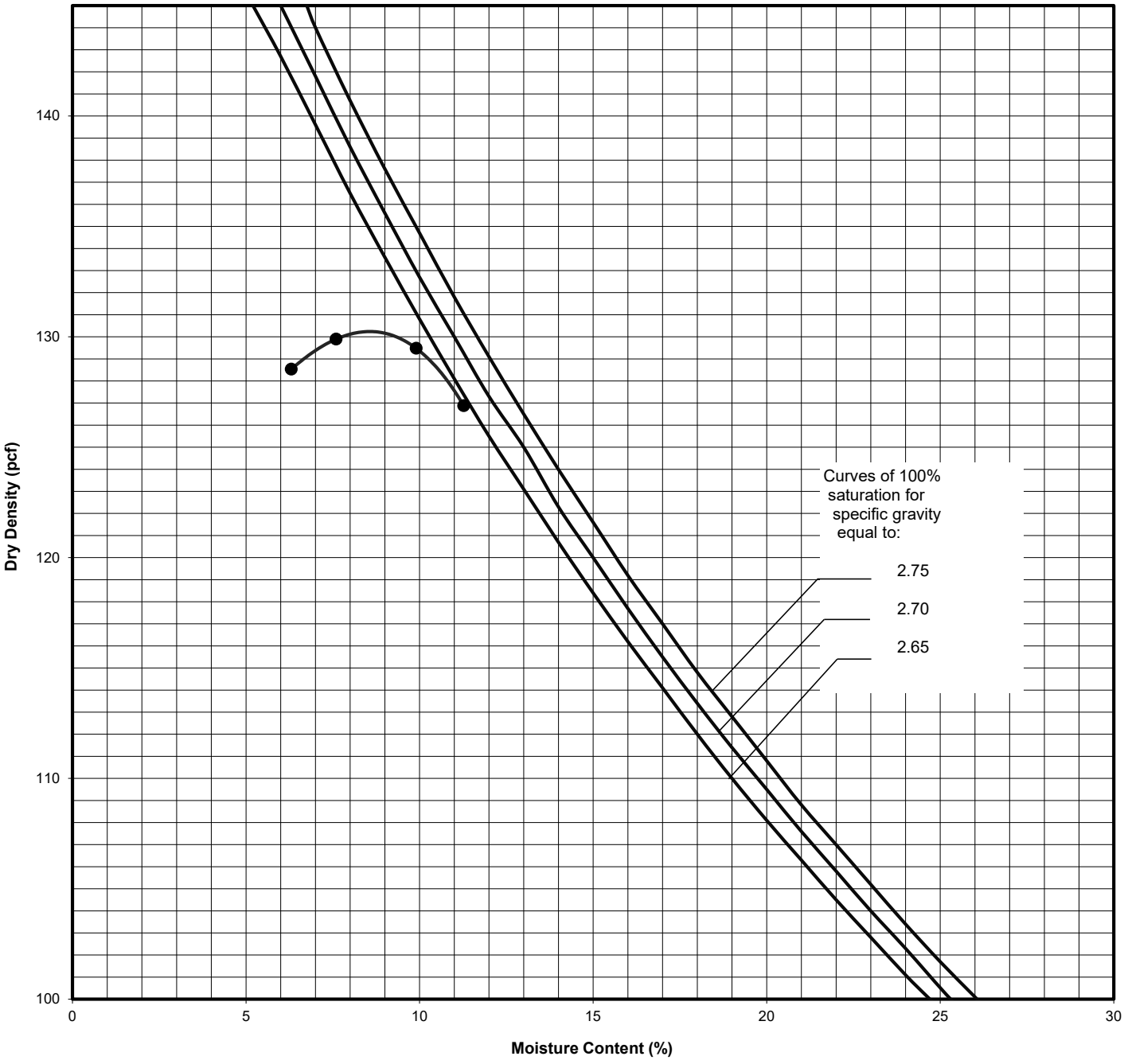
Project No.: LP23116

Selected Chemical Test Results

Plate C-2

Client: New GEN HC
Project: Shandin Hills MHRC - San Bernardino, CA
Project No.: LP23116
Date: 6/30/2023
Lab. No.: N/A

Soil Description: Olive-Brown Silty Sand w/ Gravel
Sample Location: B-1 @ 0-3 ft.
Test Method: ASTM D-1557 A
Maximum Dry Density (pcf): **130.2**
Optimum Moisture Content (%): **8.6**



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Geo-Engineers and Geologists

Project No.: LP23116

Moisture Density Relationship

Plate C-3

APPENDIX D

LANDMARK CONSULTANTS, INC

Project:	Shandin Hills MHRC	Project No:	LP23116	Date:	7/10/2023
Test Hole No:	I-1	Tested By:	Maddy E		
Depth of Test Hole, D_T:	60"	USCS Soil Classification:	SM		
Test Hole Dimensions (inches)			Length	Width	
Diameter (if round)=	6"	Sides (if rectangular)=			

Sandy Soil Criteria Test*

Trial No.	Start Time	Stop Time	Time Interval, (min.)	Initial Depth to Water (in.)	Final Depth to Water (in.)	Change in Water Level (in.)	Greater than or Equal to 6"? (y/n)
1	8:02	8:15	13.00	16.00	48.00	32.00	Yes
2	8:25	8:40	15.00	23.00	36.00	13.00	Yes

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

Trial No.	Start Time	Stop Time	Δt Time Interval (min.)	D_o Initial Depth to Water (in.)	D_f Final Depth to Water (in.)	ΔD Change in Water Level (in.)	Percolation Rate (min./in.)
1	8:41	8:51	10.00	27.00	34.00	7.00	1.43
2	8:51	9:01	10.00	25.00	32.00	7.00	1.43
3	9:01	9:11	10.00	24.00	32.00	8.00	1.25
4	9:11	9:21	10.00	23.00	31.00	8.00	1.25
5	9:21	9:31	10.00	23.00	31.00	8.00	1.25
6	9:31	9:41	10.00	21.00	29.00	8.00	1.25
7							
8							
9							
10							
11							
12							

COMMENTS:

PERCOLATION RATE CONVERSION

CLIENT: New Gen HC
PROJECT: Shandin Hills MHRC
PROJECT NO.: LP23116
DATE: 7/14/2023

TEST HOLE NO: I-1

Time interval, **Δt** = 10 inches
Initial Depth to Water, D_0 = 21 inches
Final Depth to Water, D_f = 29 inches
Total Depth of Test Hole, D_T = 60 inches
[2]Test Hole Radius, **r** = 4 inches

The conversion equation is used:

$$I_t = \frac{\Delta H\ 60\ r}{\Delta t(r+2H_{avg})}$$

"H_o" is the initial height of water at the selected time interval

$H_o = D_T - D_0$ = 60 - 21 = 39 inches

"H_f" is the final height of water at the selected time interval

$H_f = D_T - D_0$ = 60 - 21 = 31 inches

"ΔH" is the change in height over the time interval

$\Delta H = \Delta D = H_o - H_f$ = 39 - 31 = 8 inches

"H_{avg}" is the average head height over the time interval

$H_{avg} = (H_o - H_f)/2$ = (39 + 31)/2 = 35 inches

"I_t" is the tested infiltration rate

$$I_t = \frac{\Delta H\ 60\ r}{\Delta t\ (r+2H_{avg})} = \frac{(8\text{ in})(60\text{min/hr})(4\text{in})}{(10\text{ min})((4\text{ in}) + 2\ (35\text{ in}))} = 2.59\text{ in/hr}$$

LANDMARK Geo-Engineers and Geologists **Project No.: LP23116**	**Percolation Rate Conversion**	**Plate D-2**

LANDMARK CONSULTANTS, INC

Project:	Shandin Hills MHRC	Project No:	LP23116	Date:	7/10/2023
Test Hole No:	I-2	Tested By:	Maddy E		
Depth of Test Hole, D_T:	60"	USCS Soil Classification:	SM		
Test Hole Dimensions (inches)			Length	Width	
Diameter (if round)=	6"	Sides (if rectangular)=			

Sandy Soil Criteria Test*

Trial No.	Start Time	Stop Time	Time Interval, (min.)	Initial Depth to Water (in.)	Final Depth to Water (in.)	Change in Water Level (in.)	Greater than or Equal to 6"? (y/n)
1	8:15	8:30	15.00	0.00	23.00	23.00	Yes
2	8:32	8:47	15.00	9.00	22.00	13.00	Yes

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

Trial No.	Start Time	Stop Time	Δt Time Interval (min.)	D_o Initial Depth to Water (in.)	D_f Final Depth to Water (in.)	ΔD Change in Water Level (in.)	Percolation Rate (min./in.)
1	8:48	8:58	10.00	8.00	18.00	10.00	1.00
2	8:58	9:08	10.00	9.00	17.00	8.00	1.25
3	9:08	9:18	10.00	10.00	17.00	7.00	1.43
4	9:18	9:28	10.00	11.00	16.00	5.00	2.00
5	9:28	9:38	10.00	12.00	17.00	5.00	2.00
6	9:38	9:48	10.00	9.00	14.00	5.00	2.00
7							
8							
9							
10							
11							
12							

COMMENTS:

PERCOLATION RATE CONVERSION

CLIENT: New Gen HC
PROJECT: Shandin Hills MHRC
PROJECT NO.: LP23116
DATE: 7/14/2023

TEST HOLE NO: I-2

Time interval, **Δt** = 10 inches
Initial Depth to Water, D_0 = 9 inches
Final Depth to Water, D_f = 14 inches
Total Depth of Test Hole, D_T = 60 inches
²Test Hole Radius, **r** = 4 inches

The conversion equation is used:

$$I_t = \frac{\Delta H\ 60\ r}{\Delta t(r+2H_{avg}}$$

"H_o" is the initial height of water at the selected time interval

$H_o = D_T - D_0$ = 60 - 9 = 51 inches

"H_f" is the final height of water at the selected time interval

$H_f = D_T - D_0$ = 60 - 14 = 46 inches

"ΔH" is the change in height over the time interval

$\Delta H = \Delta D = H_o - H_f$ = 51 - 46 = 5 inches

"H_{avg}" is the average head height over the time interval

$H_{avg} = (H_o - H_f)/2$ = (51 + 46)/2 = 48.5 inches

"I_t" is the tested infiltration rate

$$I_t = \frac{\Delta H\ 60\ r}{\Delta t\ (r+2H_{avg})} = \frac{(5\text{ in})(60\text{min/hr})(4\text{in})}{(10\text{ min})((4\text{ in}) + 2\ (48.5\text{ in}))} = 2.18\text{ in/hr}$$

LANDMARK Geo-Engineers and Geologists Project No.: LP23116	Percolation Rate Conversion	Plate D-4

APPENDIX C: BMP INFORMATION

Oldcastle Infrastructure™
A CRH COMPANY

Welcome, **rhayes**

Project Information | System Parameters | Layout | Module Design | Request Files

System Type: Infiltration 2 FT - 6 FT

Is Watertight System Required? NO YES

Cast-in-Place Slab: NO YES

Utilize Link Slabs: NO YES

Storage Volume Required (CF): 41,580

System Internal Height (ft): 2

Nominal Module Capacity (CF): 210

Estimated Number of Modules: 198

Module Designation: SC1 2-0

Module Outside Dimensions: 16' Long x 8' Wide x 2.58' Tall

Module Inside Dimensions: 15' Long x 7' Wide x 2' Tall

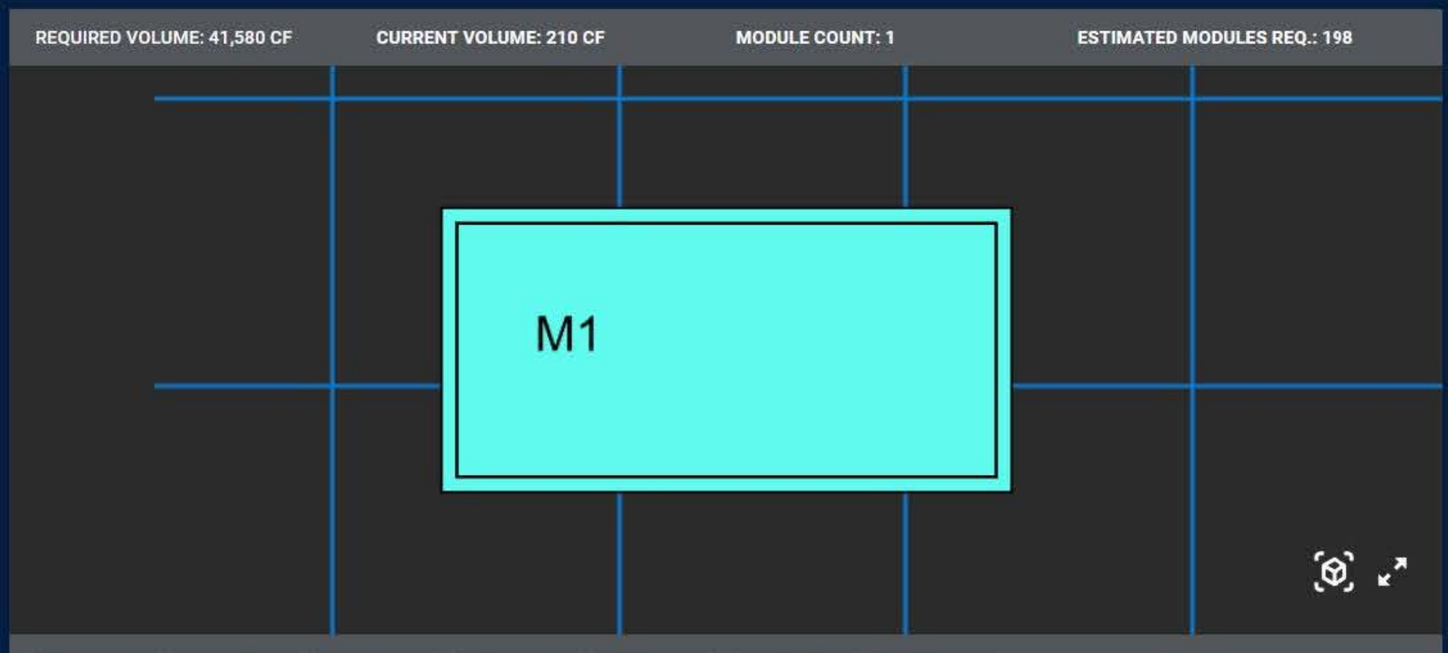
System Invert Elevation (ft): 1,384.77

Is Groundwater Elevation Greater than System Invert Elevation?

Top of Module Elevation (ft): 1,387.35

Back to Dashboard | Save | Previous | Next

REQUIRED VOLUME: 41,580 CF | CURRENT VOLUME: 210 CF | MODULE COUNT: 1 | ESTIMATED MODULES REQ.: 198



Select All | Add Module | Copy | Clear All | Array | Reset View | Plan View

Clear Selections | Delete Module | Rotate Module | Undo

Drag to move/rotate | Scroll to zoom in/out | Left click for single module selection, Hold CTRL + Left click for multiple module selection, Hold SHIFT + Left click for connected module loop selection



WEATHER the Storm



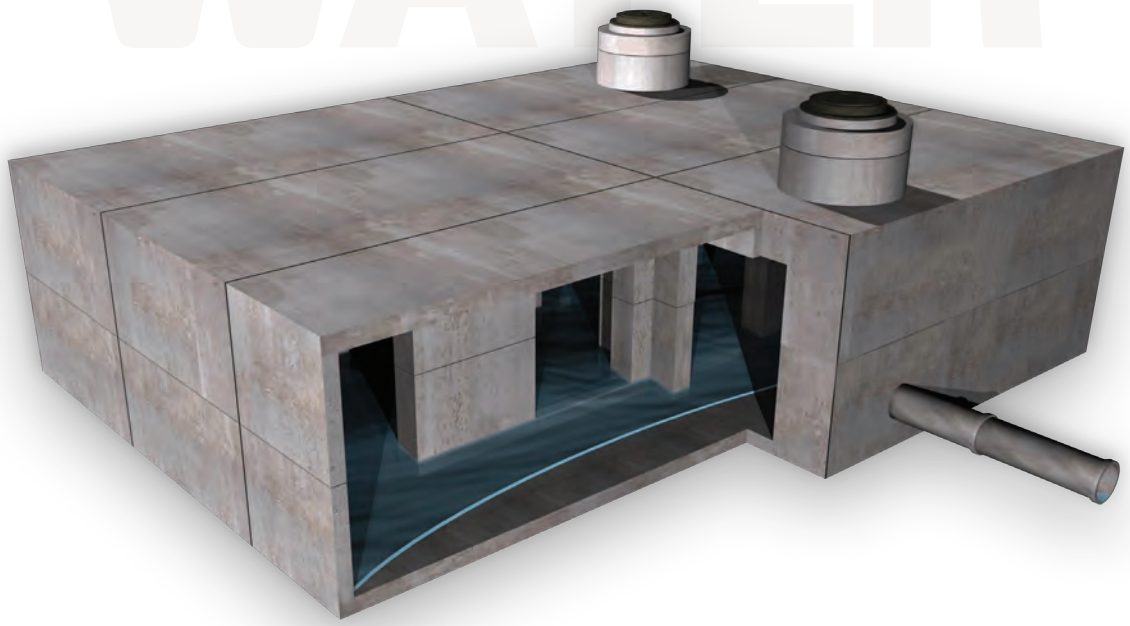
StormCapture® System

Oldcastle Infrastructure™
A CRH COMPANY

Oldcastle Infrastructure™
A CRH COMPANY

STORMCAPTURE®

Modular Stormwater Management System for Infiltration, Detention, Retention, Treatment and Harvesting



StormCapture® System

Backfill Requirements–Modules are typically backfilled with existing site materials.

Custom Sizes–Available in internal heights from 2’ to 14’ to best-fit site needs.

Design Assistance–Let our professionals customize for your specific needs.

Easy to Install–Fast installation with minimal handling.

Large Storage Capacity–Smaller system footprint for greater design flexibility.

Modular Design–Precast concrete modules measure 8’ wide by 16’ long OD, (7’ x 15’ ID), with customizable heights.

Traffic Loading–Only requires 6” of cover.

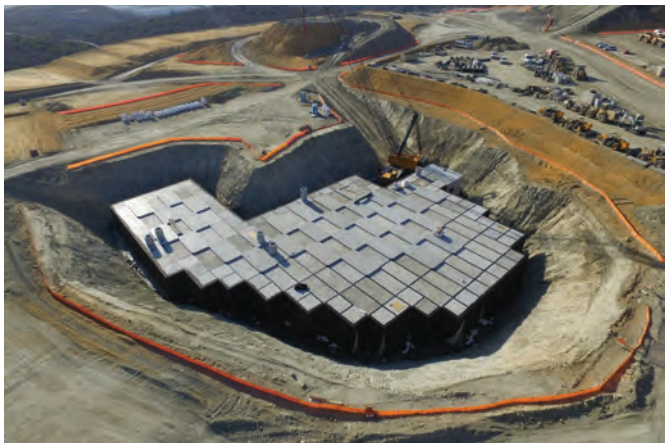
Treatment Train–Available with pre-treatment, post-treatment, or both.

StormCapture Advantages

Same-day staging and installation of StormCapture project.



StormCapture offers fast installation with minimal handling.



StormCapture modules are designed for HS20 traffic loading.



StormCapture detention system installed beneath office parking lot.



Fast Service – Get help from our national engineering team with layouts and specifications to meet your project's requirements.

Cost Savings – Highly competitive installation and maintenance costs.

Codes – Designed to the latest codes for HS-20-44 (full truckload plus impact).

Sustainability – The system is maintainable for long-term sustainability.

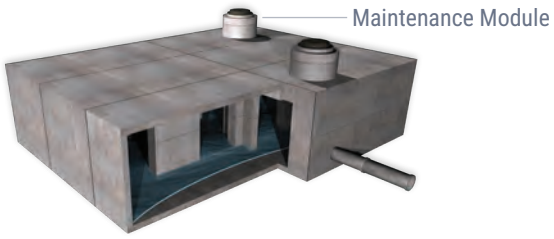
LID – Ideal for Low-Impact Development (LID).

LEED – Manufactured locally with recycled material for potential LEED credits. LEED 2009 for New Construction & Major Renovation, U.S. Green Building Council: Sustainable Sites (5.1, 5.2, 6.1, 6.2), Materials & Resources (4.1, 4.2, 5.1, 5.2), Water Efficiency (1.1, 1.2, 3.1, 3.2).

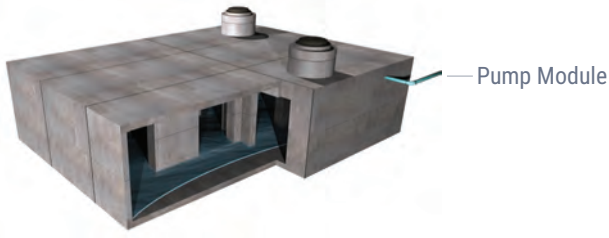
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Applications

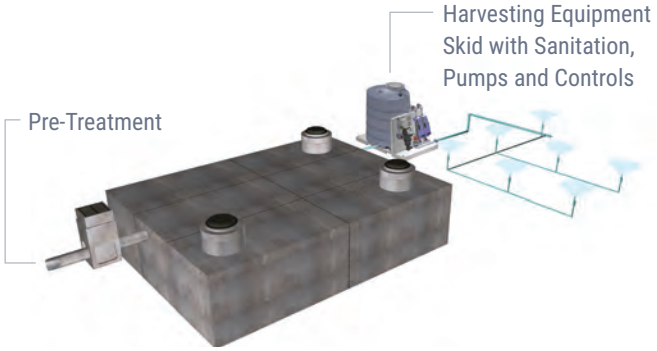
StormCapture offers numerous options for infiltration, detention, retention, treatment and harvesting to solve your stormwater management needs. Let us show you how we can design and customize a solution for you.



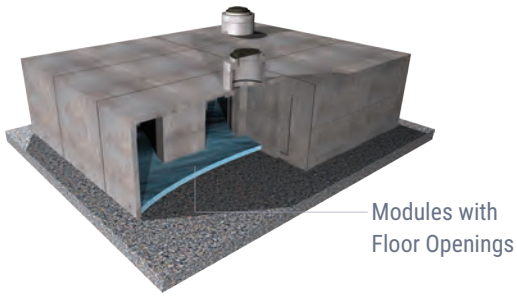
DETENTION



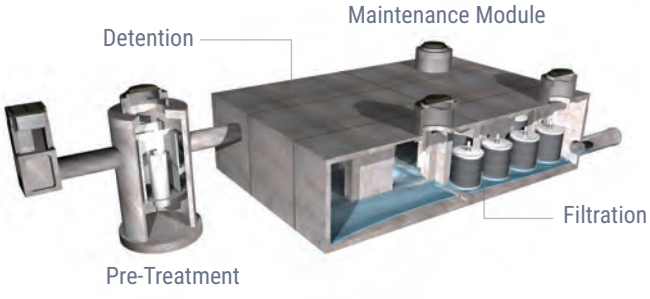
RETENTION



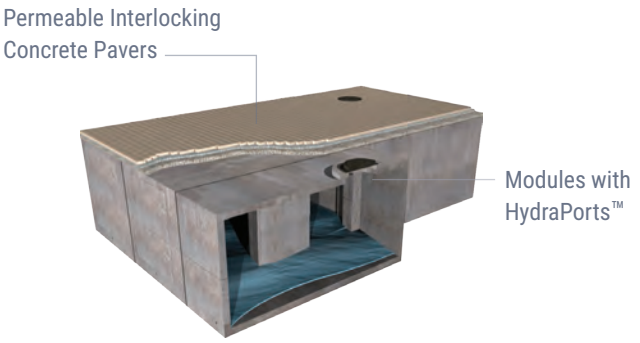
HARVESTING



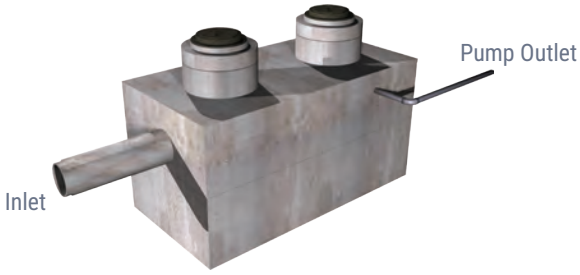
INFILTRATION



TREATMENT



PERMECAPTURE



CISTERNS

INSTALLED IN JUST ONE DAY

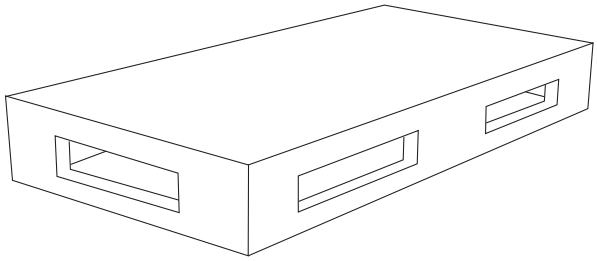




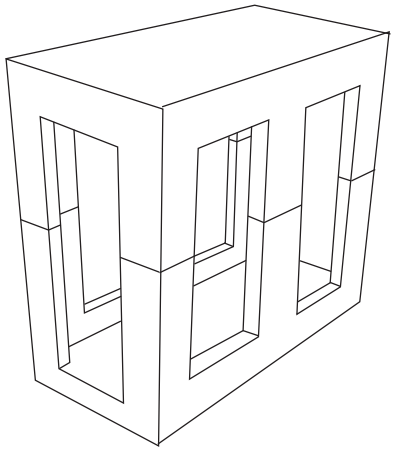




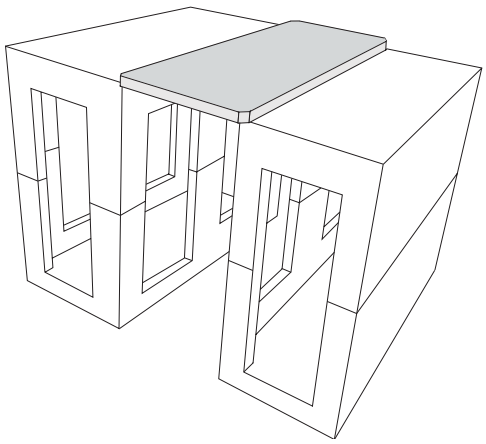
StormCapture Modules



SC1 - Single piece modules can be used for applications from 2' to 7' tall. Appropriate for cisterns, infiltration, detention and retention systems. SC1 modules are typically installed on minimally compacted gravel base, depending on specific project requirements.



SC2 - Two piece modules can be used for applications from 7' to 14' tall for maximum storage capacity in a condensed footprint. Appropriate for cisterns, infiltration, detention and retention systems. SC2 modules are typically installed on compacted native subgrade.



Link Slab - Unique design allows for significant reduction in the quantity of modules and associated costs, while providing maximum storage capacity.



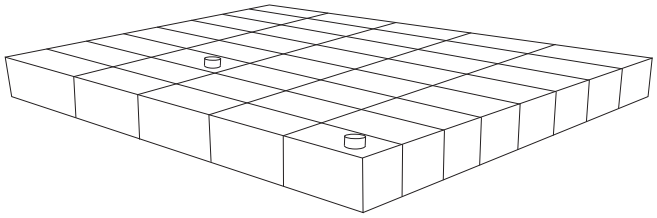
Module Sizes & Capacities

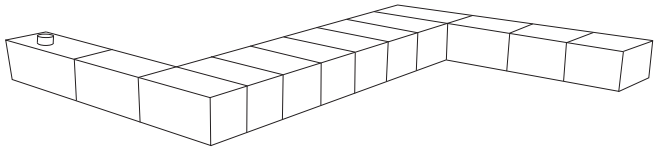
Modules are 8'x16' outside dimensions.
Capacity varies by configuration of openings.

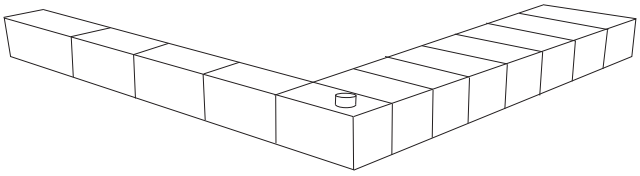
INSIDE DIMENSIONS (FT)	CAPACITY RANGE (FT^3)
7x15x2	210-212
7x15x3	315-325
7x15x4	420-442
7x15x5	525-559
7x15x6	630-678
7x15x7	735-793
7x15x8	840-910

INSIDE DIMENSIONS (FT)	CAPACITY RANGE (FT^3)
7x15x9	945-1,027
7x15x10	1,050-1,140
7x15x11	1,155 - 1,257
7x15x12	1,260 - 1,374
7x15x13	1,365 -1,491
7x15x14	1,470 - 1,608

Endless Configurations







Contact us today to start designing your system!

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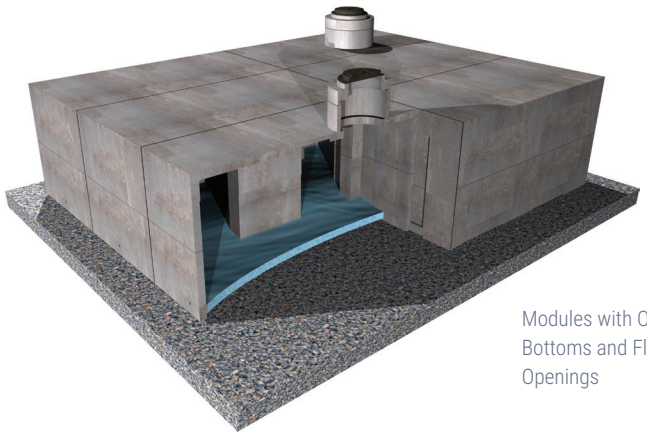
(800) 579-8819
oldcastleinfrastructure.com

Water

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STORMCAPTURE®
Infiltration



Modules with Open Bottoms and Floor Openings

Eliminate the issues created with discharging stormwater offsite by using a StormCapture exfiltration system to infiltrate stormwater into the soil for natural treatment and to replenish local aquifers.

Provides cost-effective solutions for site-specific applications where stormwater needs to be detained and allowed to discharge at a controlled rate. StormCapture allows maximization of developable land by allowing detention to be placed efficiently and easily under parking lots and roadways with very little cover, as well as in non-traffic areas. Low-Impact Development (LID) is a growing trend that involves managing stormwater at the source. Where soils are conducive to the natural infiltration process, StormCapture exfiltration systems are a great choice.

MAINTAINABLE
- Designed for maintenance, not replacement
- Optional direct module access
- Open interior

STRUCTURALLY SUPERIOR
- Vehicular traffic loading design with as little as 6" of Earth cover
- No concrete footing required
- HS-20-44 design for full truck load plus impact

EFFICIENT
- Large storage capacity
- Not reliant on stone backfill for storage
- Unique LinkSlab® design reduces concrete

ECONOMICAL
- Competitive installed and lifetime cost
- Typically backfilled with existing site materials
- Large capacity yields smaller footprint
- Rapid and simple installation

StormTrap®

MODULAR CONCRETE
STORMWATER MANAGEMENT

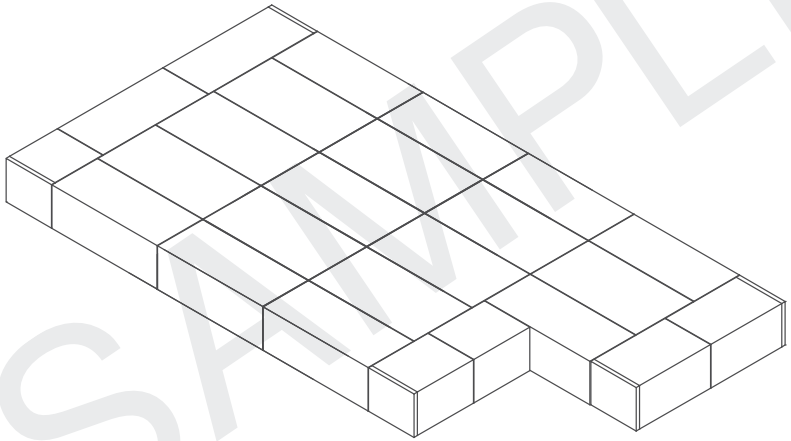
CONTACT STORMTRAP TO REQUEST A DESIGN AND BUDGET FOR YOUR SPECIFIC PROJECT NEEDS.

SHEET INDEX

PAGE	DESCRIPTION
0.0	COVER SHEET
1.0	SINGLETRAP DESIGN CRITERIA
2.0	SINGLETRAP SYSTEM LAYOUT
3.0	SINGLETRAP INSTALLATION SPECIFICATIONS
3.1	SINGLETRAP INSTALLATION SPECIFICATIONS
4.0	SINGLETRAP BACKFILL SPECIFICATIONS
5.0	RECOMMENDED PIPE/ACCESS OPENING SPECIFICATIONS
6.0	SPLASH PAD & GEOWEB DETAILS
6.1	SPLASH PAD LAYOUT SPECIFICATIONS
7.0	SINGLETRAP MODULE TYPES

STORMTRAP CONTACT INFORMATION

STORM TRAP SUPPLIER: STORMTRAP
CONTACT NAME: STORMTRAP
CELL PHONE: STORMTRAP
SALES EMAIL: STORMTRAP



SAMPLE

SINGLETRAP© - INFILTRATION
SAMPLE PROJECT

StormTrap®

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COVER SHEET

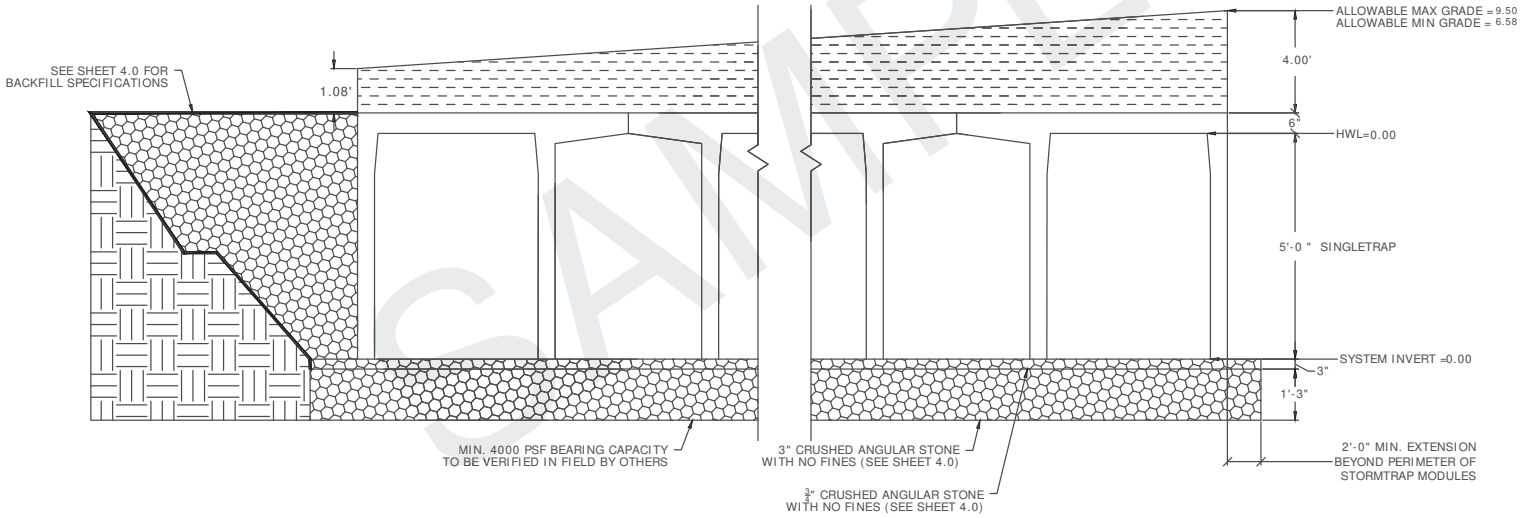
SHEET NUMBER:

0.0

STORMTRAP SYSTEM INFORMATION		
WATER STORAGE REQ'D:	10000	CUBIC FEET
WATER STORAGE PROV:	12559.8	CUBIC FEET
UNIT HEADROOM:	5' 0 "	SINGLETRAP
UNIT QUANTITY:	27	TOTAL PIECES

STORMTRAP STRUCTURAL DESIGN CRITERIA

1. STORMTRAP MODULES SHALL BE MANUFACTURED AND INSTALLED ACCORDING TO SHOP DRAWINGS APPROVED BY THE INSTALLING CONTRACTOR AND ENGINEER OF RECORD. THE SHOP DRAWINGS SHALL INDICATE SIZE AND LOCATION OF ROOF OPENINGS AND INLET/ OUTLET PIPE TYPES, SIZES, INVERT ELEVATIONS AND SIZE OF OPENINGS.
2. COVER RANGE: MIN. 1.08' MAX. 4.00' CONSULT STORMTRAP FOR ADDITIONAL COVER OPTIONS.
3. ALL DIMENSIONS AND SOIL CONDITIONS, INCLUDING BUT NOT LIMITED TO GROUNDWATER AND SOIL BEARING CAPACITY ARE REQUIRED TO BE VERIFIED IN THE FIELD BY OTHERS PRIOR TO STORMTRAP INSTALLATION.



5'-0 " SINGLETRAP

SAMPLE

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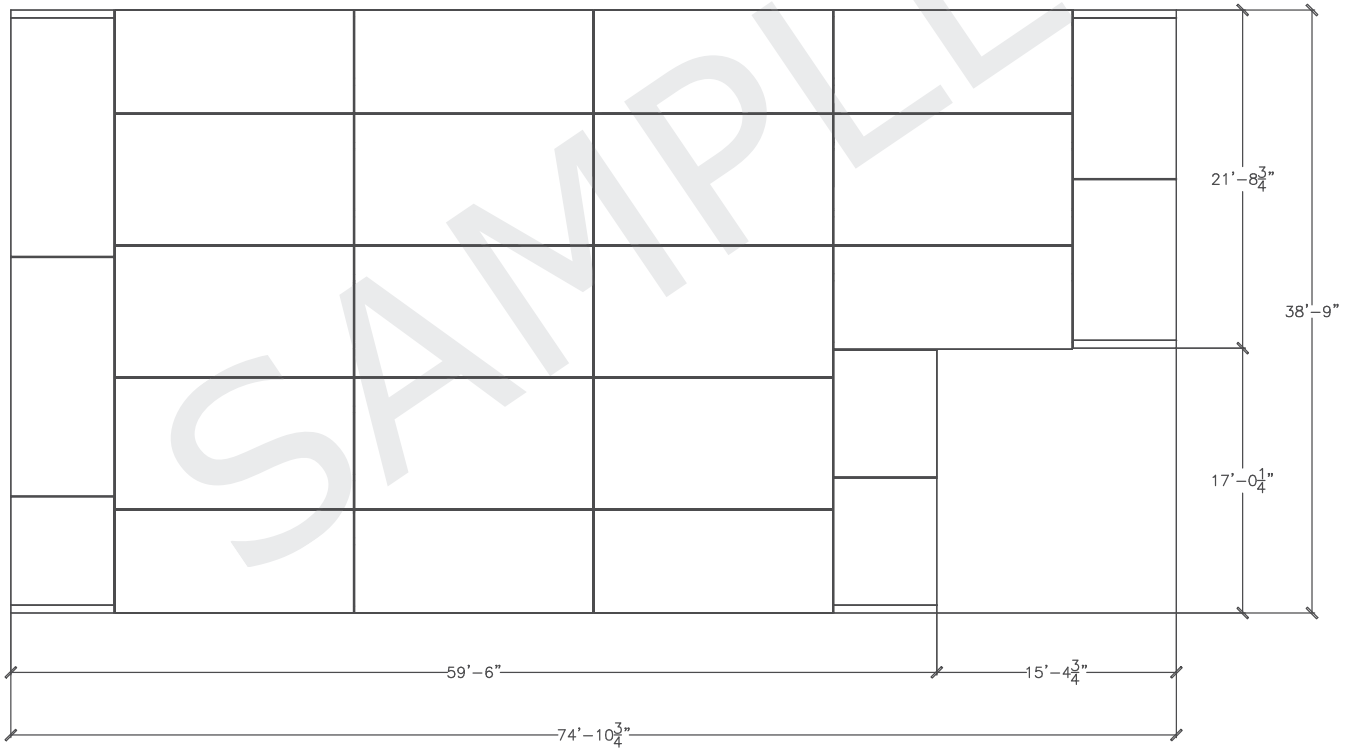
1.0

BILL OF MATERIALS

QTY.	UNIT TYPE	DESCRIPTION	WEIGHT
0	I	5' 0 " SINGLETRAP	
10	II	5' 0 " SINGLETRAP	
0	III	5' 0 " SINGLETRAP	
12	IV	5' 0 " SINGLETRAP	
0	VII	5' 0 " SINGLETRAP	
5	SPIV	5' 0 " SINGLETRAP	
5	PANEL	8" THICK PANELS	
5	JOINTWRAP	150' PER ROLL	
24	JOINTTAPE	14.5' PER ROLL	

DESIGN CRITERIA
ALLOWABLE MAX GRADE= 9.50
ALLOWABLE MIN GRADE = 6.58
INSIDE HEIGHT ELEVATION = 0.00
SYSTEM INVERT = 0.00
STORMTRAP VOLUME = 12559.8 C.F.

NOTES:
1. DIMENSIONING OF STORMTRAP SYSTEM SHOWN BELOW ALLOW FOR A 3/4" GAP BETWEEN EACH MODULE.
2. ALL DIMENSIONS TO BE VERIFIED IN THE FIELD BY OTHERS.
3. SEE SHEET 3.0 FOR INSTALLATION SPECIFICATIONS.
4. SP - INDICATES A MODULE WITH MODIFICATIONS.
5. P - INDICATES A MODULE WITH A PANEL ATTACHMENT.
6. CONTRACTORS RESPONSIBILITY TO ENSURE CONSISTENCY/ACCURACY TO FINAL ENGINEER OF RECORD PLAN SET.



SAMPLE

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SHEET TITLE:
SINGLETRAP
LAYOUT DETAILS

SHEET NUMBER:
2.0

STORMTRAP INSTALLATION SPECIFICATIONS

1. STORMTRAP SHALL BE INSTALLED IN ACCORDANCE WITH ASTM C891 STANDARD PRACTICE FOR INSTALLATION OF UNDERGROUND PRE-CAST CONCRETE UTILITY STRUCTURES. THE FOLLOWING ADDITIONS AND/OR EXCEPTIONS SHALL APPLY:

2. IT IS THE RESPONSIBILITY OF THE INSTALLING CONTRACTOR TO ENSURE THAT PROPER/ADEQUATE EQUIPMENT IS USED TO SET/INSTALL THE MODULES.

3. THE AGGREGATE FOUNDATION HAS BEEN DESIGNED BASED ON THE FOLLOWING ASSUMPTIONS. THESE ASSUMPTIONS WILL NEED TO BE VERIFIED BY A GEOTECHNICAL ENGINEER WHICH WILL NEED TO BE EMPLOYED BY THE OWNER.

   3.1. A QUALIFIED GEOTECHNICAL ENGINEER WILL BE EMPLOYED, BY OWNER, TO PROVIDE ASSISTANCE IN EVALUATING THE EXISTING SOIL CONDITIONS AT THE ELEVATION THE STONE FOUNDATION IS TO BE PLACED. IF A FOUNDATION IS TO BE USED FOR THIS CONDITION, THE BEARING PRESSURE OF THE SOILS AT THIS LEVEL WILL NEED TO MEET OR EXCEED ALLOWABLE CAPACITY. IF THIS IS NOT POSSIBLE, THE STONE FOUNDATION MAY NOT BE AN OPTION FOR THIS LOCATION.

   3.2. A QUALIFIED GEOTECHNICAL ENGINEER WILL BE EMPLOYED, BY OWNER, TO EVALUATE A SOURCE OF STONE AGGREGATES THAT WILL BE PLACED ON PROPERLY COMPACTED SOILS (SEE SHEET 1.0 FOR SOIL BEARING CAPACITY REQUIREMENTS). THE AGGREGATE BASE COURSE FOR WHICH THE STORMTRAP SYSTEM WILL BEAR DIRECTLY ON SHALL CONSIST OF A 3" THICK BED OF ¾" DIAMETER ANGULAR STONE, WELL COMPACTED AND SEATED, WITH NO FINES. AND A 15" THICK BED OF 3" DIAMETER STONE AGGREGATE (SEE SHEET 4.0 FOR FURTHER DESCRIPTION/EXPLANATION). PLEASE NOTE THAT THESE ARE ONLY MINIMUM RECOMMENDATIONS AND A QUALIFIED GEOTECHNICAL ENGINEER SHALL BE USED TO DETERMINE THE EXACT REQUIREMENTS FOR THE LOCATIONS THAT THE STORMTRAP SYSTEM IS TO BE LOCATED.

   3.3. THE CONTRACTOR SHALL REMOVE ANY AND ALL EXPANDABLE OR COLLAPSIBLE SOILS AT THE DIRECTION OF A QUALIFIED GEOTECHNICAL ENGINEER.

   3.4. THE AGGREGATE FOUNDATION SHALL BE INSTALLED SUCH THAT THE AGGREGATE EXTENDS A MINIMUM OF 2'-0" PAST THE OUTSIDE OF THE SYSTEM (SEE DETAIL 1).

   3.5. THE ¾" AGGREGATE SHALL BE COMPACTED USING A VIBRATING ROLLER WITH ITS' FULL DYNAMIC FORCE APPLIED TO ACHIEVE A FLAT SURFACE.

   3.6. DISK, DRY AND COMPACT THE TOP 8" OF THE SUBGRADE SOILS TO 95% OF THE STANDARD DRY DENSITY AND 110% OPTIMUM MOISTURE CONTENT.

   3.7. AGGREGATE SHALL BE GRADED WITHIN +/- ¼" OF THE GRADE SHOWN ON THE PLANS.

   3.8. MINIMUM SOIL BEARING CAPACITY LISTED ON SHEET 1.0 SHALL BE VERIFIED IN FIELD BY OTHERS.

4. THE STORMTRAP MODULES SHALL BE PLACED SUCH THAT THE MAXIMUM SPACE BETWEEN ADJACENT MODULES DOES NOT EXCEED ¾" (SEE DETAIL 2). IF THE SPACE EXCEEDS ¾", THE MODULES SHALL BE RESET WITH APPROPRIATE ADJUSTMENT MADE TO LINE AND GRADE TO BRING THE SPACE INTO SPECIFICATION.

5. STORMTRAP MODULES ARE NOT WATERTIGHT. IF A WATERTIGHT SOLUTION IS REQUIRED, CONTACT STORMTRAP FOR RECOMMENDATIONS. THE WATERTIGHT APPLICATION IS TO BE PROVIDED AND IMPLEMENTED BY THE CONTRACTOR. THE CONTRACTOR IS RESPONSIBLE TO ENSURE THAT THE SELECTED WATERTIGHT SOLUTION PERFORMS AS SPECIFIED BY THE MANUFACTURER. CONTACT STORMTRAP IF A WATERTIGHT APPLICATION IS REQUIRED.

6. ALL EXTERIOR JOINTS BETWEEN ADJACENT STORMTRAP MODULES SHALL BE SEALED WITH 8" WIDE PRE-FORMED, COLD-APPLIED, SELF-ADHERING ELASTOMERIC RESIN, BONDED TO A WOVEN , HIGHLY PUNCTURE RESISTANT POLYMER WRAP, CONFORMING TO ASTM C891 AND SHALL BE INTEGRATED WITH PRIMER SEALANT AS APPROVED BY STORMTRAP (SEE DETAILS 3 & 4). THE JOINT WRAP DOES NOT PROVIDE A WATERTIGHT SEAL. THE SOLE PURPOSE OF THE JOINT WRAP IS TO PROVIDE A SILT AND SOIL TIGHT SYSTEM. THE ADHESIVE EXTERIOR JOINT WRAP SHALL BE INSTALLED ACCORDING TO THE FOLLOWING INSTALLATION INSTRUCTIONS:

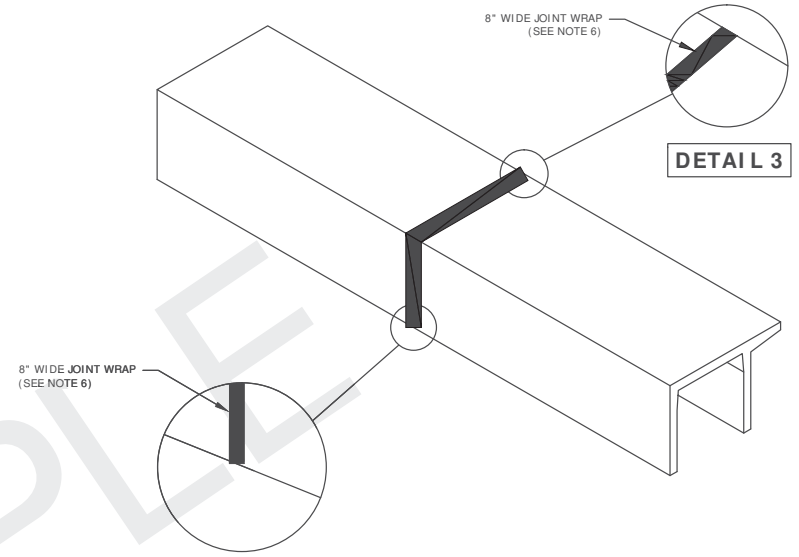
   6.1. USE A BRUSH OR WET CLOTH TO THOROUGHLY CLEAN THE OUTSIDE SURFACE AT THE POINT WHERE THE JOINT WRAP IS TO BE APPLIED.

   6.2. A RELEASE PAPER PROTECTS THE ADHESIVE SIDE OF THE JOINT WRAP. PLACE THE ADHESIVE TAPE (ADHESIVE SIDE DOWN) AROUND THE STRUCTURE, REMOVING THE RELEASE PAPER AS YOU GO. PRESS THE JOINT WRAP FIRMLY AGAINST THE STORMTRAP MODULE SURFACE WHEN APPLYING.

7. IF THE CONTRACTOR NEEDS TO CANCEL ANY SHIPMENTS, THEY MUST DO SO 48 HOURS PRIOR TO THEIR SCHEDULED ARRIVAL AT THE JOB SITE. IF CANCELED AFTER THAT TIME, PLEASE CONTACT THE PROJECT MANAGER.

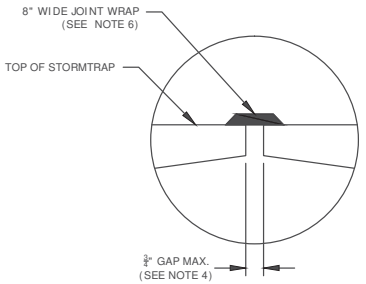
8. IF THE STORMTRAP MODULE(S) IS DAMAGED IN ANY WAY PRIOR, DURING, OR AFTER INSTALL, STORMTRAP, MUST BE CONTACTED IMMEDIATELY TO ASSESS THE DAMAGE AND TO DETERMINE WHETHER OR NOT THE MODULE(S) WILL NEED TO BE REPLACED. IF ANY MODULE ARRIVES AT THE JOBSITE DAMAGED DO NOT UNLOAD IT; CONTACT STORMTRAP, IMMEDIATELY. ANY DAMAGE NOT REPORTED BEFORE THE TRUCK IS UNLOADED WILL BE THE CONTRACTOR'S RESPONSIBILITY.

9. STORMTRAP MODULES CANNOT BE ALTERED IN ANY WAY AFTER MANUFACTURING WITHOUT WRITTEN CONSENT FROM STORMTRAP, .

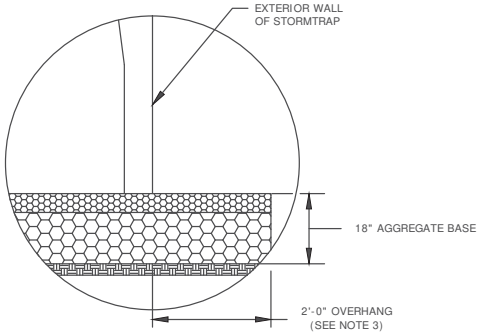


DETAIL 3

DETAIL 4



DETAIL 2



DETAIL 1

SAMPLE

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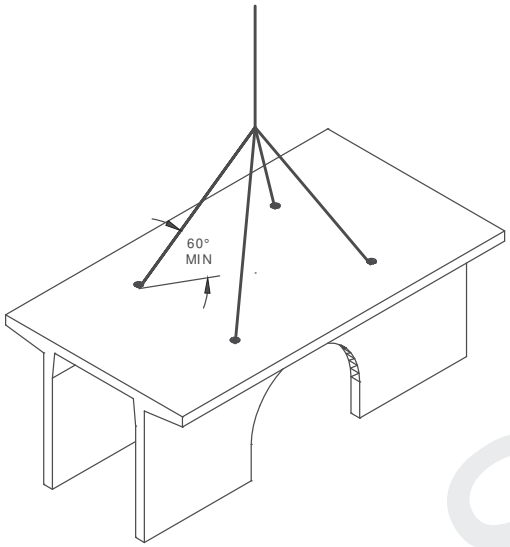
SINGLETRAP INSTALLATION SPECIFICATIONS

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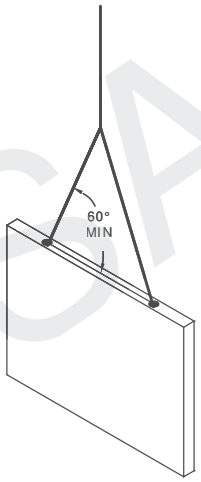
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END PANEL ERECTION/INSTALLATION NOTES

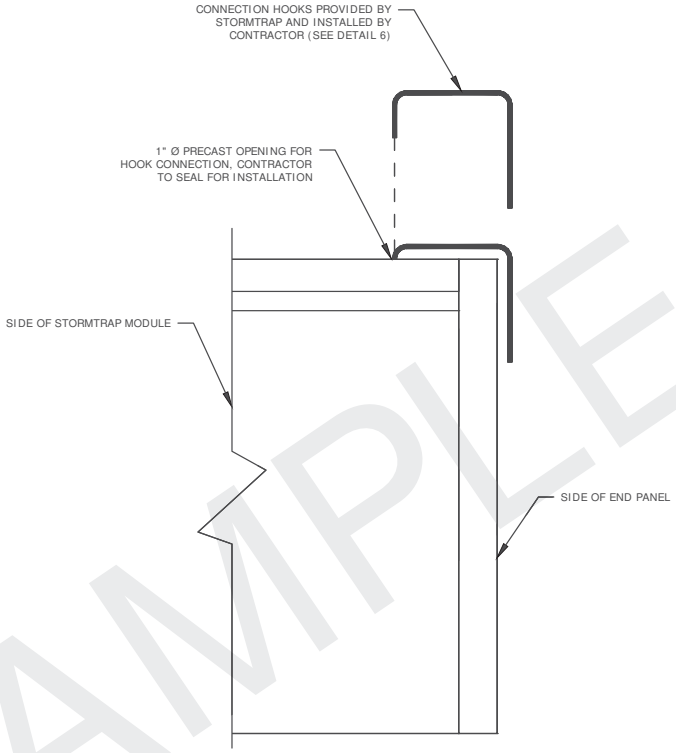
1. END PANELS WILL BE SUPPLIED TO CLOSE OFF OPEN ENDS OF ROWS.
2. PANELS SHALL BE INSTALLED IN A TILT UP FASHION DIRECTLY ADJACENT TO OPEN END OF MODULE (REFER TO SHEET 2.0 FOR END PANEL LOCATIONS).
3. CONNECTION HOOKS WILL BE SUPPLIED WITH END PANELS TO SECURELY CONNECT PANEL TO ADJACENT STORMTRAP MODULE (SEE PANEL CONNECTION ELEVATION VIEW).
4. ONCE CONNECTION HOOK IS ATTACHED, LIFTING CLUTCHES MAY BE REMOVED.
5. JOINT WRAP SHALL BE PLACED AROUND PERIMETER JOINT PANEL (SEE SHEET 3.0).



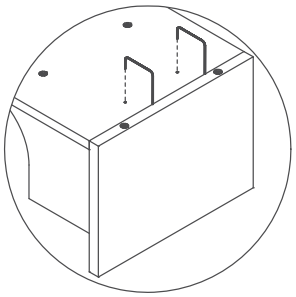
MODULE LIFTING DETAIL



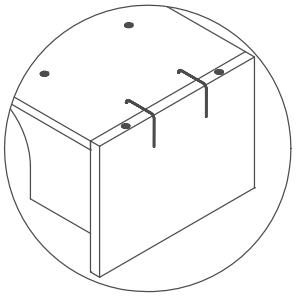
END PANEL LIFTING DETAIL



PANEL CONNECTION ELEVATION VIEW



STEP 1



STEP 2

DETAIL 6

SAMPLE

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3.1

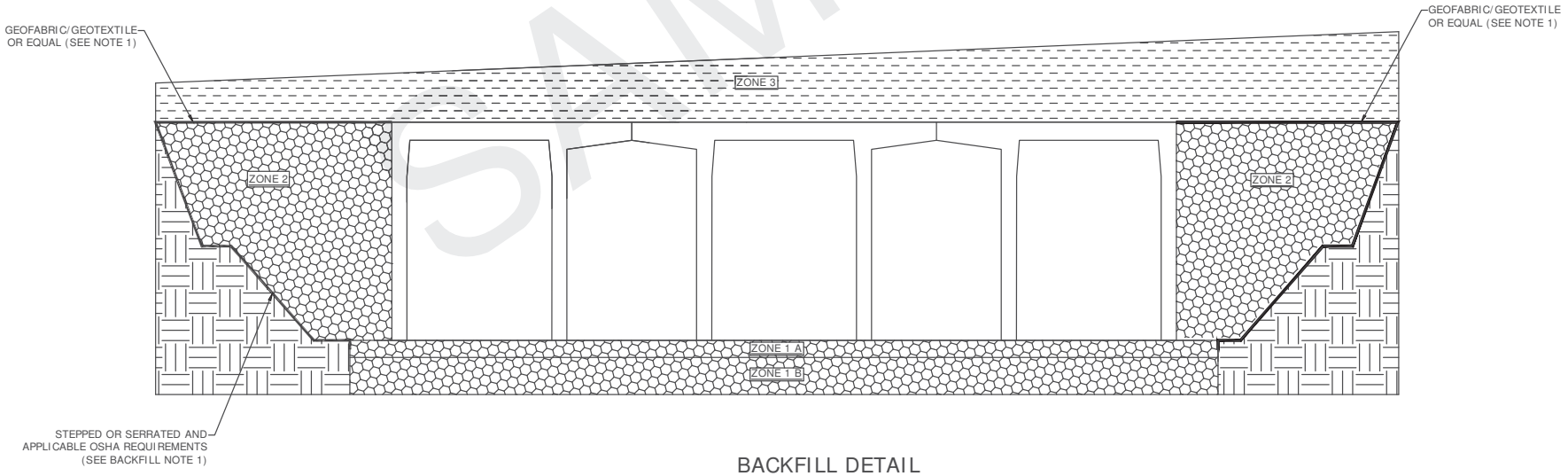
ZONE CHART		
ZONES	ZONE DESCRIPTIONS	REMARKS
ZONE 1 A	FOUNDATION AGGREGATE	
ZONE 1 B	FOUNDATION AGGREGATE	
ZONE 2	BACKFILL	
ZONE 3	FINAL COVER OVERTOP	

STORMTRAP ZONE INSTALLATION SPECIFICATIONS/PROCEDURES

1. THE FILL PLACED AROUND THE STORMTRAP MODULES MUST DEPOSITED ON BOTH SIDES AT THE SAME TIME AND TO APPROXIMATELY THE SAME ELEVATION. AT NO TIME SHALL THE FILL BEHIND ONE SIDE WALL BE MORE THAN 2'-0" HIGHER THAN THE FILL ON THE OPPOSITE SIDE. BACKFILL SHALL EITHER BE COMPACTED AND/OR VIBRATED TO ENSURE THAT BACKFILL AGGREGATE/STONE MATERIAL IS WELL SEATED AND PROPERLY INTER LOCKED. CARE SHALL BE TAKEN TO PREVENT ANY WEDGING ACTION AGAINST THE STRUCTURE, AND ALL SLOPES WITHIN THE AREA TO BE BACKFILLED MUST BE STEPPED OR SERRATED TO PREVENT WEDGING ACTION. CARE SHALL ALSO BE TAKEN AS NOT TO DISRUPT THE JOINT WRAP FROM THE JOINT DURING THE BACKFILL PROCESS. BACKFILL MATERIAL SHALL BE CLEAN, CRUSHED, ANGULAR No. 5 (AASHTO M43) AGGREGATE. IF NATIVE EARTH IS SUSCEPTIBLE TO MIGRATION, CONFIRM WITH GEOTECHNICAL ENGINEER AND PROVIDE PROTECTION AS REQUIRED.

2. DURING PLACEMENT OF MATERIAL OVERTOP THE SYSTEM, AT NO TIME SHALL MACHINERY BE USED OVERTOP THAT EXCEEDS THE DESIGN LIMITATIONS OF THE SYSTEM. WHEN PLACEMENT OF MATERIAL OVERTOP, MATERIAL SHALL BE PLACED SUCH THAT THE DIRECTION OF PLACEMENT IS PARALLEL WITH THE OVERALL LONGITUDINAL DIRECTION OF THE SYSTEM WHENEVER POSSIBLE.

3. THE FILL PLACED OVERTOP THE SYSTEM SHALL BE PLACED AT A MINIMUM OF 6" LIFTS. AT NO TIME SHALL MACHINERY OR VEHICLES GREATER THAN THE DESIGN HS-20 LOADING CRITERIA TRAVEL OVERTOP THE SYSTEM WITHOUT THE MINIMUM DESIGN COVERAGE. IF TRAVEL IS NECESSARY OVERTOP THE SYSTEM PRIOR TO ACHIEVING THE MINIMUM DESIGN COVER, IT MAY BE NECESSARY TO REDUCE THE ULTIMATE LOAD/BURDEN OF THE OPERATING MACHINERY SO AS TO NOT EXCEED THE DESIGN CAPACITY OF THE SYSTEM. IN SOME CASES, IN ORDER TO ACHIEVE REQUIRED COMPACTION, HAND COMPACTION MAY BE NECESSARY IN ORDER NOT TO EXCEED THE ALLOTTED DESIGN LOADING.



BACKFILL DETAIL

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SINGLETRAP BACKFILL SPECIFICATIONS

SHEET NUMBER:

4.0

RECOMMENDED ACCESS OPENING SPECIFICATION

1. A TYPICAL ACCESS OPENING FOR THE STORMTRAP SYSTEM ARE 2'-0" IN DIAMETER. ACCESS OPENINGS LARGER THAN 3'-0" IN DIAMETER NEED TO BE APPROVED BY STORMTRAP. ALL OPENINGS MUST RETAIN AT LEAST 1'-0" OF CLEARANCE FROM THE END OF THE STORMTRAP MODULE UNLESS NOTED OTHERWISE. ALL ACCESS OPENINGS TO BE LOCATED ON INSIDE LEG UNLESS OTHERWISE SPECIFIED.
2. PLASTIC COATED STEEL STEPS PRODUCED BY M.A. INDUSTRIES PART #PS3-PFC OR APPROVED EQUAL (SEE STEP DETAIL) ARE PROVIDED INSIDE ANY MODULE WHERE DEEMED NECESSARY. THE HIGHEST STEP IN THE MODULE IS TO BE PLACED A DISTANCE OF 1'-0" FROM THE INSIDE EDGE OF THE STORMTRAP MODULES. ALL ENSUING STEPS SHALL BE PLACED WITH A MAXIMUM DISTANCE OF 1'-4" BETWEEN THEM. STEPS MAY BE MOVED OR ALTERED TO AVOID OPENINGS OR OTHER IRREGULARITIES IN THE MODULE.
3. STORMTRAP LIFTING INSERTS MAY BE RELOCATED TO AVOID INTERFERENCE WITH ACCESS OPENINGS OR THE CENTER OF GRAVITY OF THE MODULE AS NEEDED.
4. STORMTRAP ACCESS OPENINGS MAY BE RELOCATED TO AVOID INTERFERENCE WITH INLET AND/OR OUTLET PIPE OPENINGS SO PLACEMENT OF STEPS IS ATTAINABLE.
5. ACCESS OPENINGS SHOULD BE LOCATED IN ORDER TO MEET THE APPROPRIATE MUNICIPAL REQUIREMENTS. STORMTRAP RECOMMENDS AT LEAST TWO ACCESS OPENINGS PER SYSTEM FOR ACCESS AND INSPECTION.
6. USE PRECAST ADJUSTING RINGS AS NEEDED TO MEET GRADE. STORMTRAP RECOMMENDS FOR COVER OVER 2' TO USE PRECAST BARREL OR CONE INSPECTIONS. (PROVIDED BY OTHERS)

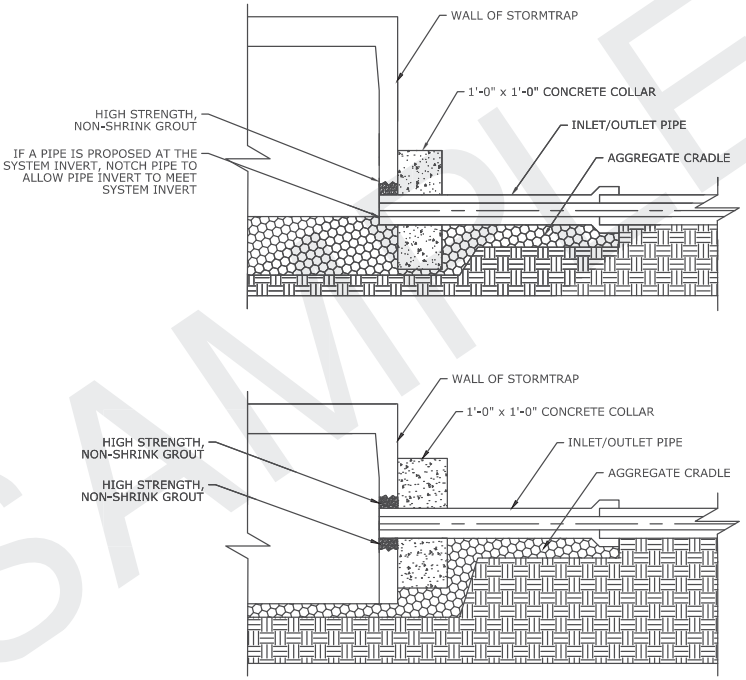
RECOMMENDED PIPE OPENING SPECIFICATION

1. MINIMUM EDGE DISTANCE FOR AN OPENING ON THE OUTSIDE WALL SHALL BE NO LESS THAN 1'-0".
2. MAXIMUM OPENING SIZE TO BE DETERMINED BY THE MODULE HEIGHT. PREFERRED OPENING SIZE IS Ø 36" OR LESS. ANY OPENING NEEDED THAT DOES NOT FIT THIS CRITERIA SHALL BE BROUGHT TO THE ATTENTION OF STORMTRAP FOR REVIEW.
3. CONNECTING PIPES SHALL BE INSTALLED WITH A 1'-0" CONCRETE COLLAR, AND AN AGGREGATE CRADLE FOR AT LEAST ONE PIPE LENGTH (SEE PIPE CONNECTION DETAIL). A STRUCTURAL GRADE CONCRETE OR HIGH STRENGTH, NON-SHRINK GROUT WITH A MINIMUM 28 DAY COMPRESSIVE STRENGTH OF 3000 PSI SHALL BE USED.
4. THE ANNULAR SPACE BETWEEN THE PIPE AND THE HOLE SHALL BE FILLED WITH HIGH STRENGTH NON-SHRINK GROUT.

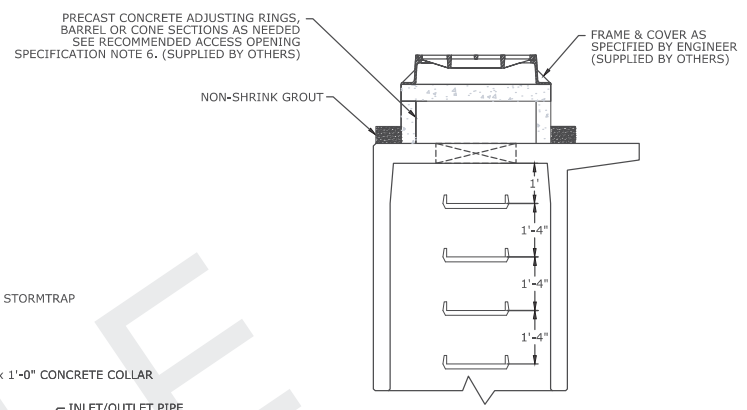
RECOMMENDED PIPE INSTALLATION INSTRUCTIONS

1. CLEAN AND LIGHTLY LUBRICATE ALL OF THE PIPE TO BE INSERTED INTO STORMTRAP.
2. IF PIPE IS CUT, CARE SHOULD BE TAKEN TO ALLOW NO SHARP EDGES. BEVEL AND LUBRICATE LEAD END OF PIPE.
3. ALIGN CENTER OF PIPE TO CORRECT ELEVATION AND INSERT INTO OPENING.

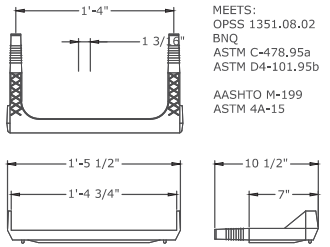
NOTE: ALL ANCILLARY PRODUCTS RECOMMENDED AND SHOWN ON THIS SHEET ARE RECOMMENDATIONS ONLY AND SUBJECT TO CHANGE PER THE INSTALLING CONTRACTOR.



PIPE CONNECTION DETAIL



RISER / STAIR DETAIL



MEETS:
OPSS 1351.08.02
BNQ
ASTM C-478.95a
ASTM D4-101.95b

AASHTO M-199
ASTM 4A-15

STEP DETAIL

SAMPLE

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NTS

SHEET TITLE:

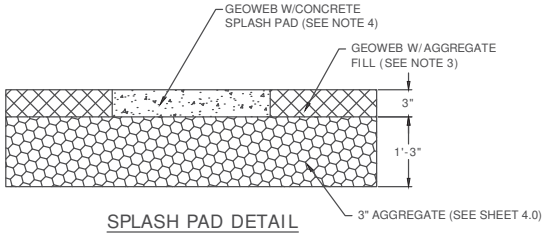
RECOMMENDED PIPE / ACCESS OPENING SPECIFICATIONS

SHEET NUMBER:

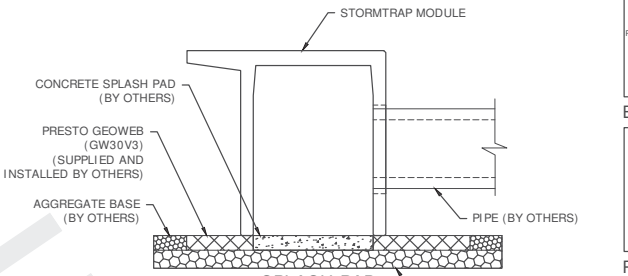
5.0

NOTES:

1. THE APPROVED GEOWEB SHALL BE PRESTO GEOWEB (GW30V3). THE GEOWEB NOMINAL DIMENSIONS SHALL BE 9-FT x 25-FT.
2. THE CONCRETE SPLASH PAD AND GEOWEB SHALL BE INSTALLED PRIOR TO INSTALLATION OF THE STORMTRAP MODULES.
3. THE GEOWEB INFILL MATERIAL SHALL BE #5 AGGREGATE.
4. THE CONCRETE SPLASH PAD SHALL BE INSTALLED WITHIN THE GEOWEB AND IS REQUIRED AT ALL PIPE ENTRY LOCATIONS.
5. THE GEOWEB EDGE SHALL BE INSTALLED 1-FT BEYOND THE OUTER PERIMETER OF THE STORMTRAP SYSTEM.
6. THE GEOWEB LONGITUDINAL DIMENSION (25-FT) SHALL BE INSTALLED PARALLEL TO THE STORMTRAP LEGS.
7. THE CONCRETE SPLASH PAD AND GEOWEB SHALL BE CENTERED AT THE PIPE PENETRATION.
8. REFER TO SPLASH PAD LAYOUT FOR CONCRETE SPLASH PAD DIMENSIONS.
9. IF ANY PRODUCT OTHER THAN PRESTO GEOWEB IS TO BE INSTALLED, THE PRODUCT MANUFACTURER IS REQUIRED TO SUBMIT A LETTER STATING THAT THE PRODUCT IS EQUAL OR BETTER THEN PRESTO GEOWEB, BOTH IN PERFORMANCE AND IN STRUCTURAL CAPACITY.

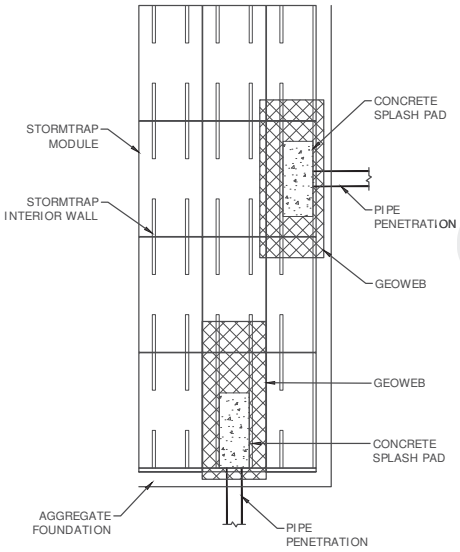


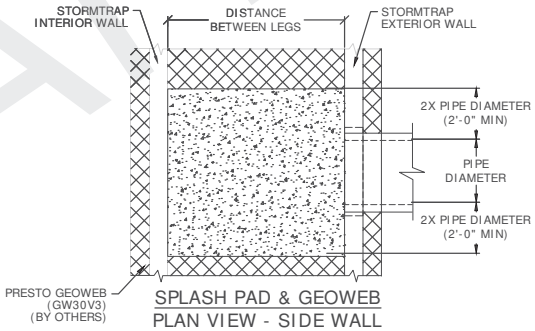
SPLASH PAD DETAIL



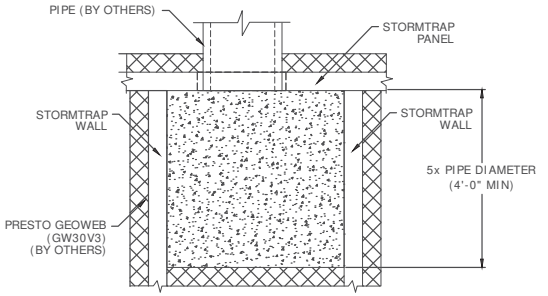
SPLASH PAD ELEVATION

SPLASH PAD CONFIGURATION





SPLASH PAD & GEOWEB
PLAN VIEW - SIDE WALL



SPLASH PAD & GEOWEB
PLAN VIEW - END PANEL

SAMPLE

StormTrap®

PATENTS LISTED AT: [HTTP://STORMTRAP.COM/PATENT]

1-877-867-6872

ENGINEER INFORMATION:

PROJECT INFORMATION:

SINGLETRAP

INFILTRATION

CURRENT ISSUE DATE:

ISSUED FOR:

SAMPLE PROJECT

REV.	DATE:	ISSUED FOR:	DWN BY:

SCALE:

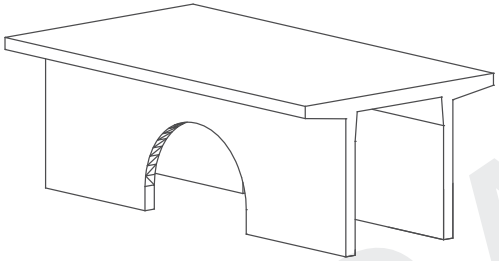
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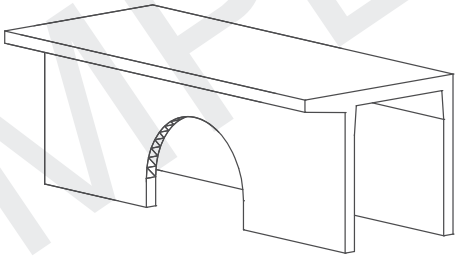
SPLASH PAD & GEOWEB DETAILS

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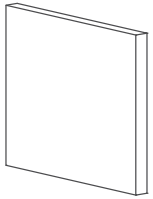
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TYPE I



TYPE II



TYPE IV
END PANEL

SAMPLE

NOTES:
1. OPENING LOCATIONS AND SHAPES MAY VARY.
2. SP - INDICATES A MODULE WITH MODIFICATIONS.
3. P - INDICATES A MODULE WITH A PANEL ATTACHMENT.
4. POCKET WINDOW OPENINGS ARE OPTIONAL.

StormTrap®

PATENTS LISTED AT: [HTTP://STORMTRAP.COM/PATENT]

1-877-867-6872

ENGINEER INFORMATION:

PROJECT INFORMATION:

SINGLETRAP

INFILTRATION

CURRENT ISSUE DATE:

ISSUED FOR:

SAMPLE PROJECT

REV.	DATE:	ISSUED FOR:	DWN BY:

SCALE:

NTS

SHEET TITLE:

SINGLETRAP
MODULE TYPES

SHEET NUMBER:

7.0

APPENDIX D: EDUCATIONAL MATERIALS

Regulatory information

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

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

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

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

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

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

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



Documents & reports:

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

- **Basin Plans:** The document for each region of the State Water Quality Board's jurisdiction, including Santa Ana, is the Water Quality Control Plan, commonly referred to as the Basin Plan. It is the foundation for the regulatory programs of each regional board. The Basin Plan documents the beneficial uses of the region's ground and surface waters, existing water quality conditions, problems, and goals, and actions by the regional board and others that are necessary to achieve and maintain water quality standards.

▶Water Control Plan for the Santa Ana River Basin

- **Municipal National Pollutant Discharge Elimination System (NPDES) Permits:** The permits of each region outline additional steps for a storm water management program and specify requirements to help protect the beneficial uses of the receiving waters. They require permittees to develop and implement Best Management Practices (BMPs) to control/reduce the discharge of pollutants to waters of the United States to the maximum extent practicable (MEP).

  ▶Santa Ana Regional Water Quality Control Board Municipal NPDES Permit Order No. R8-2002-0012

- **Report of Waste Discharge:** The Report of Waste Discharge (ROWD) describes the San Bernardino Stormwater Program, implemented by the County and cities to comply with their jointly held stormwater permit. It is the principle policy and guidance document for the NPDES Stormwater Program.

  ▶Report of Waste Discharge 2000

- **San Bernardino County Storm Water Program Annual Status Report:** The Annual Status Report is a requirement of the NPDES permit for submittal to the Regional Boards and United States Environmental Protection Agency. The report presents an analysis and assessment of permit compliance activities.

▶Annual report - will be posted soon

For more information about how you can prevent stormwater pollution:

www.sbcountystormwater.org

STORMWATER Pollution Prevention

Important Phone Numbers

San Bernardino County Flood Control
(909) 387-8112

County of San Bernardino
(909) 387-8109

City of Big Bear Lake
(909) 866-5831

City of Chino (909) 591-9850

City of Chino Hills (909) 364-2722

City of Colton (909) 370-6128

City of Fontana (909) 350-6772

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

City of Highland (909) 864-8732 x 230

City of Loma Linda (909) 799-4405

City of Montclair (909) 625-9470

City of Ontario (909) 395-2025

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

City of Redlands (909) 798-7655

City of Rialto (909) 421-4921

City of San Bernardino (909) 384-5154

City of Upland (909) 931-4370

City of Yucaipa (909) 797-2489 x 243

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

STORMWATER Pollution Prevention

INDUSTRIAL AND COMMERCIAL FACILITIES



Pollution Prevention

STORMWATER

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



Prohibited Discharges

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

Outdoor Storage

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

Outdoor Processes

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

Spills and Clean Ups

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

Industrial and Commercial Facilities

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

Training

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

Permitting

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

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

1 (800) CLEANUP

or visit our websites at:

www.sbcounty.gov/stormwater

www.1800cleanup.org

San Bernardino County STORMWATER PROGRAM

Prevención de Contaminación
AL SISTEMA DE DRENAJE

Números de Teléfono Importantes

San Bernardino County Flood Control
(909) 387-8112

County of San Bernardino
(909) 387-8109

City of Big Bear Lake
(909) 866-5831

City of Chino (909) 591-9850

City of Chino Hills (909) 364-2722

City of Colton (909) 370-6128

City of Fontana (909) 350-6772

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

City of Highland (909) 864-8732 x 230

City of Loma Linda (909) 799-4405

City of Montclair (909) 625-9470

City of Ontario (909) 395-2025

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

City of Redlands (909) 798-7655

City of Rialto (909) 421-4921

City of San Bernardino (909) 384-5154

City of Upland (909) 931-4370

City of Yucaipa (909) 797-2489 x 243

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

Prevención de Contaminación
AL SISTEMA DE DRENAJE

INSTALACIONES INDUSTRIALES Y COMERCIALES



Prevención de Contaminación
AL SISTEMA DE DRENAJE

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



Desagües Prohibidos

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

Almacenamiento al Aire Libre

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

Procesos al Aire Libre

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

Derrames y Limpieza

- Limpie los derrames inmediatamente, utilice métodos de limpieza en seco como son el uso de materiales absorbentes y elimine estos materiales de la manera adecuada.
- Siempre tenga a la mano un estuche para derrames cerca de las puertas de los muelles de carga de sustancias químicas, en las áreas de mantenimiento de vehículos y en las áreas de combustible.
- Siga su Plan de Emergencia Comercial, como lo registró con el Departamento de Bomberos del

Instalaciones Industriales y Comerciales

Condado marcando al (909) 386-8401.

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

Capacitación

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

Autoridad Competente

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

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

1 (800) CLEANUP

o visite nuestro sitio:

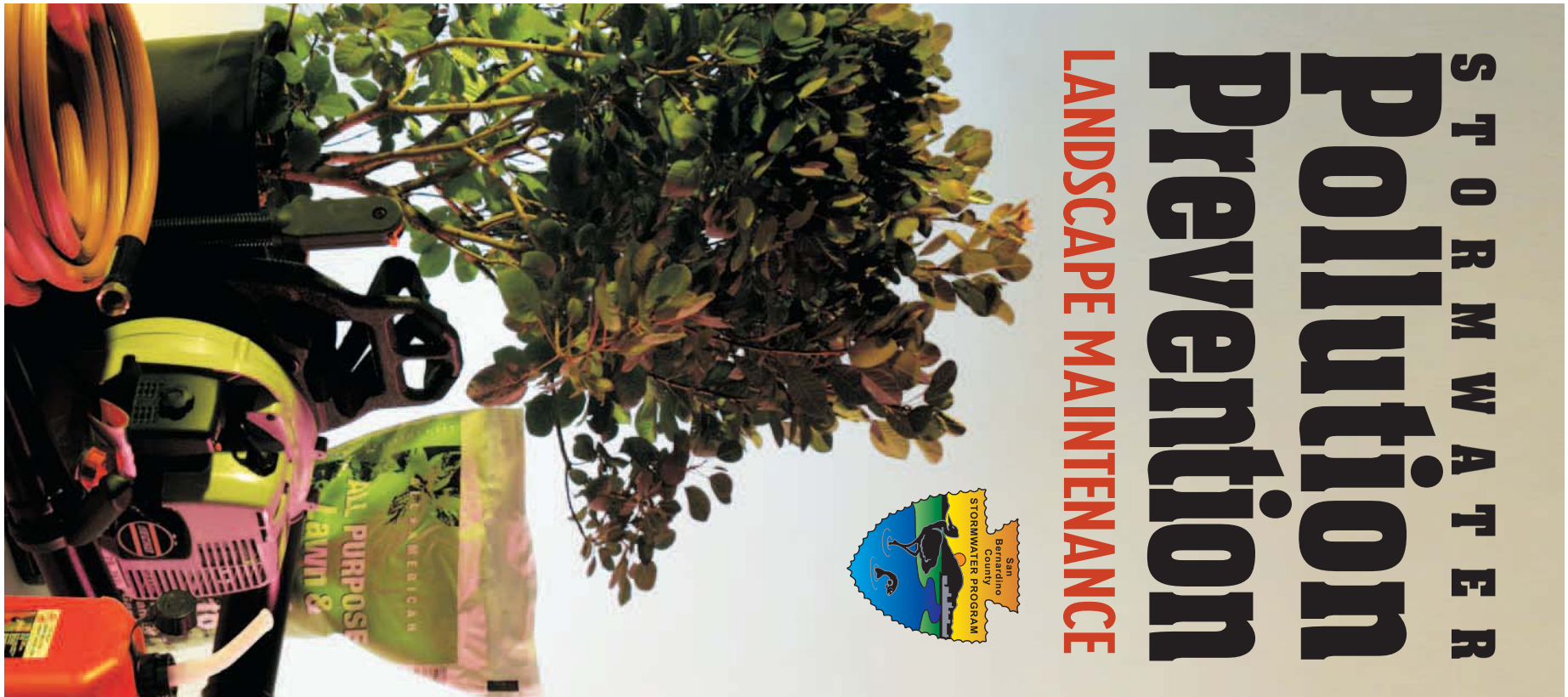
www.sbcounty.gov/stormwater

www.1800cleanup.org

San Bernardino County STORMWATER PROGRAM

San Bernardino County Stormwater Program
825 East Third Street · Room 127
San Bernardino, CA 94215-0835

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STANDARD
U.S. POSTAGE
PAID
SACRAMENTO, CA
PERMIT# 000



STORMWATER Pollution Prevention

Stormwater Management Practices for Commercial Landscape Maintenance

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

Recycle Yard Waste

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

Use Fertilizers, Herbicides and Pesticides Safely

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



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

Recycle Hazardous Waste

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

Use Water Wisely

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

Prevent Erosion

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

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

Store Materials Safely

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

To report illegal dumping call

(877) WASTE18

or visit our website:

sbcountystormwater.org

San Bernardino County STORMWATER PROGRAM

SAN BERNARDINO COUNTY
STORMWATER POLLUTION PREVENTION

Commercial landscape maintenance:

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

- **Recycle Yard Waste:** Recycle leaves, grass clippings and other yard waste. Do not blow, sweep, rake or hose yard waste into the street. Let your customers know about grass cycling --the natural recycling of grass by leaving clippings on the lawn when mowing instead of using a grass catcher. Grass clippings will quickly decompose, returning valuable nutrients to the soil. You can get more information at www.ciwmb.ca.gov/Organics.
- **Use Fertilizers, Herbicides & Pesticides Safely:** Fertilizers, herbicides and pesticides are often carried into the storm drain system by sprinkler runoff. Use natural, non-toxic alternatives to traditional garden chemicals. If you must use chemical fertilizers, herbicides, or pesticides spot apply rather than blanketing entire areas, avoid applying near curbs and driveways and never apply before a rain.
- **Recycle Hazardous Waste:** Pesticides, fertilizers, herbicides and motor oil contaminate landfills and should be disposed of through a Hazardous Waste Facility. For information on proper disposal, call (909) 386-8401.
- **Use Water Wisely:** Conserve water and prevent runoff by controlling the amount of water and direction of sprinklers. Sprinklers should be on long enough to allow water to soak into the ground but not so long as to cause runoff. Periodically inspect, fix leaks and realign sprinkler heads.



- **Planting:** Plant native vegetation to reduce the need of water, fertilizers, herbicides and pesticides.
- **Prevent Erosion:** Erosion washes sediments, debris and toxic runoff into the storm drain system, polluting waterways. Prevent erosion and sediment runoff by using ground cover, berms and vegetation down-slope to capture runoff. Avoid excavation or grading during wet weather.



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

For more information about how you can prevent stormwater pollution:

www.sbcountystormwater.org

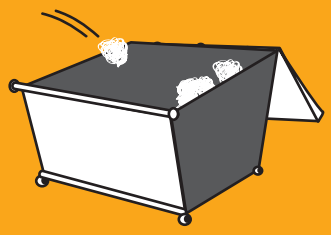
COMMERCIAL TRASH ENCLOSURES

FOLLOW THESE **REQUIREMENTS** TO **KEEP OUR WATERWAYS CLEAN**

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

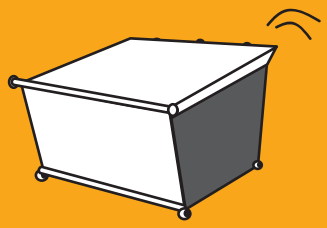
PROTECT WATER QUALITY BY FOLLOWING THESE SIMPLE STEPS

PUT TRASH INSIDE



Place trash inside the bin (preferably in sealed bags)

CLOSE THE LID



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

KEEP TOXICS OUT



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

SOME ADDITIONAL GUIDELINES, INCLUDE

✓ SWEEP FREQUENTLY

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

✓ FIX LEAKS

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

✓ CONSTRUCT ROOF

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

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

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

San Bernardino County STORMWATER PROGRAM

To report illegal dumping **(877-WASTE18)** or
to find a household hazardous waste facility (800-OILY CAT): **sbcountystormwater.org**
To dispose of hazardous waste call the San Bernardino County Fire Dept. - CUPA Program **(909) 386-8401**

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

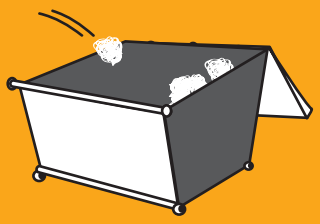
CONTENEDORES COMERCIALES PARA LA BASURA

SIGA ESTOS **PASOS** PARA MANTENER LIMPIAS NUESTRAS VÍAS FLUVIALES

Los contenedores de basura, tales como aquellos que se encuentran en las unidades comerciales y departamentos, generalmente contienen materiales que están destinados a los rellenos sanitarios o en algún establecimiento de reciclaje.
Estos materiales NO deben ser vertidos en nuestros lagos y ríos locales.

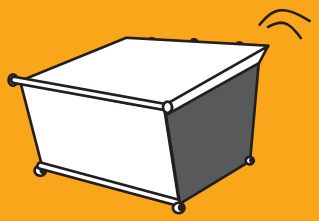
SIGA ESTOS PASOS PARA PROTEGER LA CALIDAD DEL AGUA

COLOQUE LA BASURA ADENTRO



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

CIERRE LA TAPA



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

MANTENGA LOS PRODUCTOS TÓXICOS AFUERA



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

ALGUNAS GUÍAS ADICIONALES, LAS CUALES INCLUYEN

✓ BARRER CON FRECUENCIA

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

✓ REPARE LAS GOTERAS

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

✓ CONSTRUYA UN TECHO

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

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

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

San Bernardino County STORMWATER PROGRAM

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

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

SAN BERNARDINO COUNTY
STORMWATER POLLUTION PREVENTION

Construction & development:

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



- **Store Materials Safely:** Keep construction materials and debris away from the street, gutter and storm drains. Cover exposed stockpiles of soil, sand or gravel and excavated material with plastic sheeting, protected from rain, wind and runoff.
- **Preventing Erosion:** Avoid excavation or grading during wet weather. Plant temporary vegetation or add hydro mulch on slopes where construction is not immediately planned, and permanent vegetation once excavation and grading are complete. Construct diversion dikes to channel runoff to a detention basin and around the construction site. Use gravel approaches where truck traffic is frequent to reduce soil compaction and limit the tracking of sediment into the streets. For more information on erosion control, call (909) 799-7407.



- **Cleaning & Preventing Spills:** Use a drip pan and funnel when draining or pouring fluids. Sweep up dry spills, instead of hosing. Be ready for spills by preparing and using spill containment and cleanup kits that include safety equipment and dry cleanup materials such as kitty litter or sawdust. To report serious spills, call 911.
- **Maintaining Vehicles & Equipment:** Maintain and refuel vehicles and equipment at a single location on-site, away from the street, gutter and storm drains. Perform major equipment repairs and washings off-site. Inspect vehicles and equipment frequently for leaks, and prevent leaks from stored vehicles by draining gas, hydraulic oil, transmission, and brake and radiator fluids.
- **Ordering Materials & Recycling Waste:** Reduce waste by ordering only the amounts of materials needed for the job. Use recycled or recyclable materials whenever possible. You can recycle broken asphalt, concrete, wood, and cleared vegetation. Dispose of hazardous materials through a hazardous waste hauler or other means in accordance with the construction permit. Non-recyclable materials should be taken to a landfill or disposed of as hazardous waste. For recycling and disposal information, call (909) 386-8401.
- **Concrete and mortar application:** Never dispose of cement washout into driveways, streets, gutters or drainage ditches. Wash concrete mixers and equipment only in specified washout areas, where the water flows into lined containment ponds. Cement wash water can be recycled by pumping it back into cement mixers for reuse.

For more information about how you can prevent stormwater pollution:

www.sbcountystormwater.org

STORMWATER Pollution Prevention

CONSTRUCTION

Cement wash, sediment, vehicle fluids, dust and hazardous debris from construction sites often make their way into the San Bernardino County storm drain system and do not get treated before reaching the Santa Ana River. This pollutes our drinking water and contaminates waterways, making them unsafe for people and wildlife. Follow these best management practices to prevent pollution and protect public health.



Store Materials Safely
Keep construction materials and debris away from the street, gutter and storm drains. Cover exposed stockpiles of soil, sand or gravel and excavated material with plastic sheeting, protected from rain, wind and runoff.



Ordering Materials & Recycling Waste
Reduce waste by ordering only the amounts of materials needed for the job. Use recycled or recyclable materials whenever possible. You can recycle broken asphalt, concrete, wood, and cleared vegetation. Non-recyclable materials should be taken to a landfill or disposed of as hazardous waste. For recycling and disposal information, call (909) 386-8401.



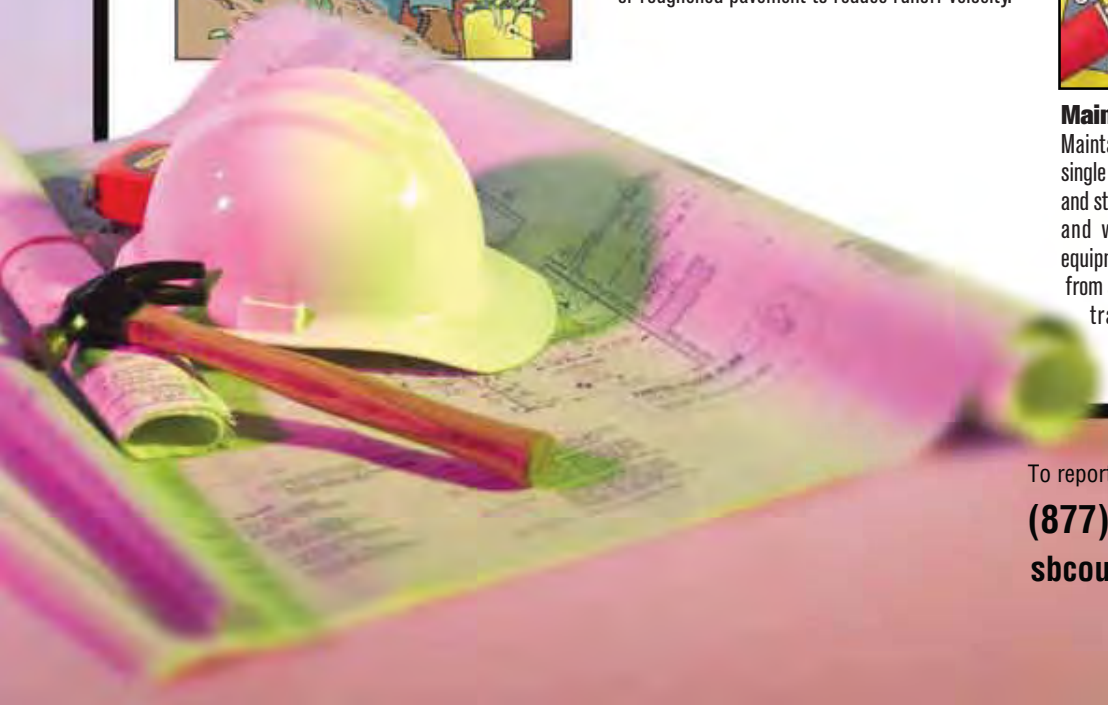
Cleaning & Preventing Spills
Use a drip pan and funnel when draining or pouring fluids. Sweep up dry spills, instead of hosing. Be ready for spills by preparing and using spill containment and cleanup kits that include safety equipment and dry cleanup materials such as kitty litter or sawdust. To report serious spills, call 911.



Preventing Erosion
Avoid excavation or grading during wet weather. Plant temporary vegetation or add hydromulch on slopes where construction is not immediately planned, and permanent vegetation once excavation and grading are complete. Construct diversion dikes to channel runoff to a detention basin and around the construction site. Channels can be lined with grass or roughened pavement to reduce runoff velocity.



Maintaining Vehicles & Equipment
Maintain and refuel vehicles and equipment at a single location on-site, away from the street, gutter and storm drains. Perform major equipment repairs and washings off-site. Inspect vehicles and equipment frequently for leaks, and prevent leaks from stored vehicles by draining gas, hydraulic oil, transmission, brake and radiator fluids.



To report illegal dumping call
(877) WASTE18
sbcountystormwater.org

San Bernardino County STORMWATER PROGRAM

Prevención de Contaminación del Desagüe

CONSTRUCCIÓN

Cemento, sedimentos, liquidos de auto, polvos y residuos peligrosos acaban por llegar a los drenajes del Condado de San Bernardino y terminando en el Rio de Santa Ana. Esto contamina el agua que tomamos, haciendola peligorsa para la gente y la vida salvaje. Sigue estas practicas para prevenir la contaminación y protejer la salud publica.



Almacenando Materiales Cuidadosamente

Manten materiales de construcción y residuos lejos de las calles, coladeras y desagües. Manten tapados los bultos de arena, grava y herramientas para excavar cuviertos con algun plastico para protejerlos de la lluvia, el aire y el desagüe.



Ordenando Materiales & Reciclando Desechos

Reduce la cantidad al ordenar el material, solo ordena lo necesario. Usa materiales que se puedan reciclar cuando sea posible. Se puede reciclar el aspfalto, concreto, madera y la vegetacion. Materiales no reciclados se deven llevar a lugares de desechos peligrosos. Para mas información llama al (909) 386-8401.



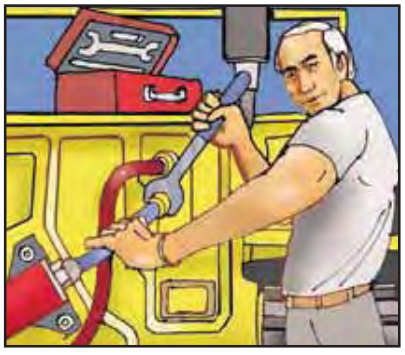
Limpiando & Previniendo Derrames

Usa siempre un enbudo al vaciar liquidos. Barre los derrames en ves de lavarlos con la manguera. Mantente siempre preparado para cualquier derrame, usa siempre las herramientas de seguridad al igual que materiales como, tierra para desechos de gato o aserrin. Para reportar derrames llama al 911.



Previniendo Erosiones

Evita las excavaciones durante lluvia. Planta vegetacion temporal en colinas donde aun no hay planes de construccion y planta vegetacion permanente al terminar las excavaciones. Construye algunos canales para el desagüe. Estos pueden ser creados con pasto y cemento para reducir la velocidad del desagüe.



Mantenimiento de Vehiculos & Herramientas

Has el mantenimiento y carga de vehiculos en el mismo lugar, lejos de la calle, las alcantarillas y los drenajes. Inspecciona los vehiculos y el equipo de cualquier goteadura y preveen goteaduras de autos que no se usan vasiandoles la gasolina, aceite de transmision, frenos y liquidos del radiador.



Para reportar actividades ilegales llamar al:

(877) WASTE18

sbcountystormwater.org

San Bernardino County STORMWATER PROGRAM

STORMWATER Pollution Prevention

EXCAVATION AND GRADING

Sediment, cement wash, asphalt and vehicle fluids from soil excavation and grading often make their way into the San Bernardino County storm drain system and do not get treated before reaching the Santa Ana River. This pollutes our drinking water and contaminates waterways, making them unsafe for people and wildlife. Follow these best management practices to prevent pollution and protect public health.



Recycling Waste

Recycle broken asphalt, concrete, wood, and cleared vegetation whenever possible. Non-recyclable materials should be taken to a landfill or disposed of as hazardous waste. For recycling and disposal information, call (909) 386-8401.



Maintaining Vehicles & Equipment

Maintain and refuel vehicles and equipment at a single location on-site, away from the street, gutters and storm drains. Perform major equipment repairs and washings off-site. Inspect vehicles and equipment frequently for leaks. Use gravel approaches where truck traffic is heavy to reduce soil compaction and limit the tracking of sediment into the street.



Cleaning & Preventing Spills

Use a drip pan and funnel when draining or pouring fluids. Sweep up dry spills, instead of hosing. Be ready for spills by preparing and using spill containment and cleanup kits that include safety equipment and dry cleanup materials such as kitty litter or sawdust. Prevent leaks from stored vehicles by draining gas, hydraulic oil, transmission, brake and radiator fluids. To report serious spills, call 911.



Storing Materials

Keep construction materials and debris away from the street, gutter and storm drains. Cover exposed stockpiles of soil, sand or gravel and excavated material with plastic sheeting, protected from rain, wind and runoff.



Preventing Erosion

Avoid excavation or grading during wet weather. Plant temporary vegetation on slopes where construction is not immediately planned, and permanent vegetation once excavation and grading are complete. Construct diversion dikes to channel runoff. Channels can be lined with grass or roughened pavement to reduce runoff velocity.

To report illegal dumping call

(877) WASTE18

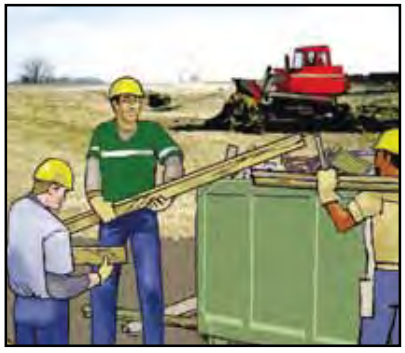
sbcountystormwater.org

San Bernardino County STORMWATER PROGRAM

Prevención de Contaminación del Desagüe

EXCAVACIONES

Sedimento, cemento, asfalto y liquidos de auto, tierra y residuos peligrosos de lugares de construcción acaban por llegar a los drenajes del Condado de San Bernardino y terminando en el Rio de Santa Ana. Esto contamina el agua que tomamos, haciendola peligorsa para la gente y la vida salvaje. Sigue estas practicas para prevenir la contaminación y protejer la salud publica.



Reciclando Desechos
Recicla el aspfalto, concreto, madera y la vegetacion cuando sea posible. Materiales no reciclados se deverian llevar a lugares de desechos peligrosos. Para màs informacion llama al (909) 386-8401.



Manteniendo Vehiculos & Herramientas
Has el mantenimiento y carga de vehiculos en el mismo lugar, lejos de la calle, las alcantarillas y los drenajes. Inspecciona los vehiculos y el equipo de cualquier goteadura. Usa grava donde mayormente se consentra el trafico de camiones para y reducir el sedimento en las calles.



Limpiando & Previniendo Derrames
Usa siempre un enbudo al vaciar liquidos. Barre los derrames en ves de lavarlos con la manguera. Mantente siempre preparado para cualquier derrame, usa siempre las herramientas de seguridad al igual que materiales como, tierra para desechos de gato o aserrin. Preveen goteaduras de autos que no se usan vasiandoles la gasolina, aceite de transmision, frenos y liquidos del radiador. Para reportar derrames llama al 911.



Almacenando Materiales
Manten materiales de construccion y residuos lejos de las calles, coladeras y desagües. Manten tapados los bultos de arena, grava y erramientas para excavar cuviertos con algun plastico para protejerlos de la lluvia, el aire y el desagüe.



Previniendo Erosiones
Evita las excavaciones durante lluvia. Planta vegetacion temporal en colinas donde aun no hay planes de construcción y planta vegetacion permanente al terminar las excavaciones. Construye algunos canales para el desagüe. Estos pueden ser creados con pasto y cemento para reducir la velocidad del desagüe.

Para reportar actividades ilegales llamar al:

(877) WASTE18
sbcountystormwater.org

San Bernardino County
STORMWATER PROGRAM

STORMWATER Pollution Prevention

FRESH CONCRETE & MORTAR APPLICATION

Cement wash, sediment, vehicle fluids, dust and hazardous debris from construction sites often make their way into the San Bernardino County storm drain system and do not get treated before reaching the Santa Ana River. This pollutes our drinking water and contaminates waterways, making them unsafe for people and wildlife. Follow these best management practices to prevent pollution and protect public health.



Storing Materials

Keep construction materials and debris away from the street, gutter and storm drains. Secure open bags of cement and cover exposed stockpiles of soil, sand or gravel and excavated material with plastic sheeting, protected from rain, wind and runoff.



Ordering Materials & Recycling Waste

Reduce waste by ordering only the amounts of materials needed for the job. Use recycled or recyclable materials whenever possible. When breaking up paving, recycle the pieces at a crushing company. You can also recycle broken asphalt, concrete, wood, and cleared vegetation. Non-recyclable materials should be taken to a landfill or disposed of as hazardous waste. Call (909) 386-8401 for recycling and disposal information.



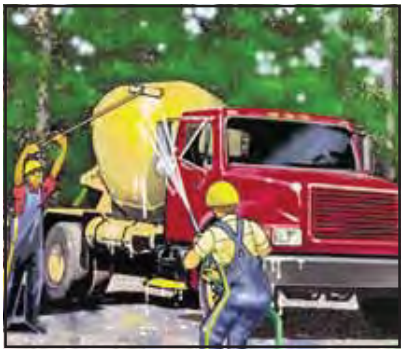
During Construction

Schedule excavation and grading during dry weather. Prevent mortar and cement from entering the street and storm drains by placing erosion controls. Setup small mixers on tarps or drop cloths, for easy cleanup of debris. Never bury waste material. Recycle or dispose of it as hazardous waste.



Cleaning Up

Wash concrete dust onto designated dirt areas, not down driveways or into the street or storm drains. Wash out concrete mixers and equipment in specified washout areas, where water can flow into a containment pond. Cement washwater can be recycled by pumping it back into cement mixers for reuse. Never dispose of cement washout into driveways, streets, gutters, storm drains or drainage ditches.



To report illegal dumping call

(877) WASTE18

sbcountystormwater.org

San Bernardino County STORMWATER PROGRAM

Prevención de Contaminación del Desagüe

APLICANDO CONCRETO FRESCO

Cemento, grava, asfalto y liquidos de auto, tierra y residuos peligrosos de lugares de concreto fresco por llegar a los drenajes del Condado de San Bernardino y terminando en el Rio de Santa Ana. Esto contamina el agua que tomamos, haciendola peligorsa para la gente y la vida salvaje. Sigue estas practicas para prevenir la contaminación y protejer la salud publica.



Almacenando Materiales
Manten materiales de construcción y residuos lejos de las calles, coladeras y desagües. Manten tapados los bultos de arena, grava y herramientas para excavar cuviertos con algun plastico para protejerlos de la lluvia, el aire y el desagüe.



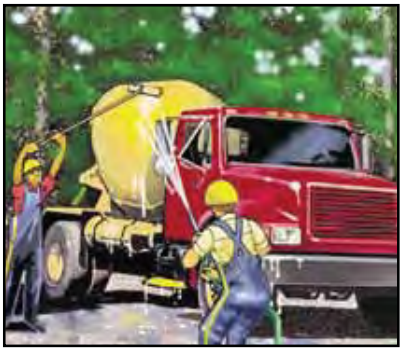
Ordenando Materiales & Reciclando
Reduce la cantidad al ordenar el material, solo ordena lo necesario. Usa materiales recicables cuando sea posible. Cuando estes rompiendo el pavimento, recicla los pedasos en la compañia demolidora. Se puede reciclar el aspfalto, concreto, madera y la vegetacion. Materiales no reciclados se deverian llevar a lugares de desechos peligrosos. llama al (909) 386-8401 para más información.



Durante Construcción
Planea las excavaciones durante clima seco. No dejes que el cemento o la cal lleguen hasta las calles o drenajes, evita esto con plantas temporales para detener el desagüe. Cubre las maquinas de mesclar con alguna garra para que se facilite la limpieza de residuos. Nunca entierres los desechos. Recicla todos los desechos peligrosos.



Limpiando
Lava la cal en un area designada, no la eches hacia la cochera o en la calle. Lava las mescladoras y las herramientas en un lugar especifico, donde el agua llegue a un contenedor. El agua de cemento se puede reciclar volviendola a usar en las mescladoras. Nunca dejes el agua de cemento que corra hacia las calles, alcantarillas o drenajes.



Para reportar actividades ilegales llamar al:

(877) WASTE18
sbcountystormwater.org

San Bernardino County STORMWATER PROGRAM

STORMWATER Pollution Prevention

ROADWORK AND PAVING

Asphalt, saw-cut slurry and excavated materials from road paving, surfacing and pavement removal often make their way into the San Bernardino County storm drain system and do not get treated before reaching the Santa Ana River. This pollutes our drinking water and contaminates waterways, making them unsafe for people and wildlife. Follow these best management practices to prevent pollution and protect public health.



Preventing Erosion
Schedule excavation and grading work during dry weather. Develop and implement erosion and sediment control plans for excavated embankments. Cover exposed stockpiles of soil, sand or gravel and excavated material with plastic sheeting, protected from rain, wind and runoff.



During Construction
Cover catch basins and maintenance holes when applying seal coat, slurry seal or fog seal. Use check dams, ditches or berms around excavations, and avoid over applying water for dust control. Never wash excess materials from exposed aggregate or concrete into the street, gutter or a storm drain.



Maintaining Vehicles & Equipment
Maintain and refuel vehicles and equipment at a single location on-site, away from the street, gutter and storm drains. Perform major equipment repairs and washings off-site. Inspect vehicles and equipment frequently for leaks, and prevent leaks from stored vehicles by draining gas, hydraulic oil, transmission, brake and radiator fluids.

Asphalt & Concrete Removal
Barricade storm drain openings during saw-cutting, and recycle broken up pavement at a crushing company. For recycling information, call (909) 386-8401.



Cleaning & Preventing Spills
Be ready for spills by preparing and using spill containment and cleanup kits that include safety equipment and dry cleanup materials such as kitty litter or sawdust. Sweep up dry spills, instead of hosing. Prevent spills from paver machines by using drip pans, or by placing absorbent materials like cloths or rags under the machines when not in use. To report serious spills, call 911.



To report illegal dumping call

(877) WASTE18

sbcountystormwater.org

San Bernardino County STORMWATER PROGRAM

Prevención de Contaminación del Desagüe

TRABAJO DE CARRETERAS & PAVIMENTO

Asfalto, mezcla y materiales de excavaciones del pavimento acaban por llegar a los drenajes del Condado de San Bernardino y terminando en el Rio de Santa Ana. Esto contamina el agua que tomamos, haciendola peligorsa para la gente y la vida salvaje. Sigue estas practicas para prevenir la contaminación y protejer la salud publica.



Previniendo Erosiones
Planea las excavaciones trabajo de jardineria durante el clima seco. Desarrolla e implementa planes de embancamientos de control de sedimento y excavaciones. Cubre montones de tierra, grava y otros materiales con un plastico para protejerlos de la llvia, aire y desagüe.



Durante Construcción
Cubre los lavados y da mantenimiento a los hoyos al aplicar selladura o mezcla. Revisa las areas de excavaciones, y evita pasarte de agua para preveenir polvadura. Nunca laves los materiales llenos de concreto en la calle, drenajes o en el desagüe.



Mantenimiento de Vehiculos & Herramientas
Has el mantenimiento y carga de vehiculos en el mismo lugar, lejos de la calle, las alcantarillas y los drenajes. Inspecciona los vehiculos y el equipo de cualquier goteadura y evita goteaduras de autos que no se usan vasiandoles la gasolina, aceite de transmision, frenos y liquidos del radiador.

Removiendo Asfalto & Concreto
Bloquea alrededor de los drenajes cuando estes usando las maquinas de sierra, tambien recicla todo el pavimento roto en la compañia demolidora. Para más información llama al (909) 386-8401.



Limpiando & Previniendo Derrames
Mantente siempre preparado para cualquier derrame, usa siempre las herramientas de seguridad al igual que materiales como, tierra para desechos de gato o aserrin Barre los derrames en ves de lavarlos con la manguera. Previene los derrames de las maquinas usando enbudos o colocanto garras para absorver cualquier liquido. Para reportar derrames llama al 911.



Para reportar actividades ilegales llamar al:

(877) WASTE18
sbcountystormwater.org

San Bernardino County
STORMWATER PROGRAM

After the Storm

What is stormwater runoff?



Stormwater runoff occurs when precipitation from rain or snowmelt flows over the ground. Impervious surfaces like driveways, sidewalks, and streets prevent stormwater from naturally soaking into the ground.

Why is stormwater runoff a problem?



Stormwater can pick up debris, chemicals, dirt, and other pollutants and flow into a storm sewer system or directly to a lake, stream, river, wetland, or coastal water. Anything that enters a storm sewer system is discharged untreated into the waterbodies we use for swimming, fishing, and providing drinking water.

The effects of pollution





Polluted stormwater runoff can have many adverse effects on plants, fish, animals, and people.

- Sediment can cloud the water and make it difficult or impossible for aquatic plants to grow. Sediment also can destroy aquatic habitats.
- Excess nutrients can cause algae blooms. When algae die, they sink to the bottom and decompose in a process that removes oxygen from the water. Fish and other aquatic organisms can't exist in water with low dissolved oxygen levels.
- Bacteria and other pathogens can wash into swimming areas and create health hazards, often making beach closures necessary.
- Debris—plastic bags, six-pack rings, bottles, and cigarette butts—washed into waterbodies can choke, suffocate, or disable aquatic life like ducks, fish, turtles, and birds.
- Household hazardous wastes like insecticides, pesticides, paint, solvents, used motor oil, and other auto fluids can poison aquatic life. Land animals and people can become sick or die from eating diseased fish and shellfish or ingesting polluted water.
- Polluted stormwater often affects drinking water sources. This, in turn, can affect human health and increase drinking water treatment costs.



EPA 833-B-03-002
January 2003

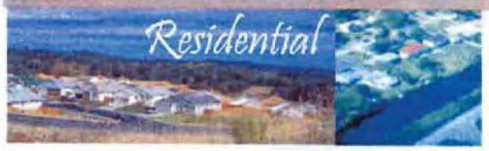
For more information contact:

or visit
www.epa.gov/npdes/stormwater
www.epa.gov/nps

Stormwater Pollution Solutions



Residential



Recycle or properly dispose of household products that contain chemicals, such as insecticides, pesticides, paint, solvents, and used motor oil and other auto fluids. Don't pour them onto the ground or into storm drains.

Auto care



Washing your car and degreasing auto parts at home can send detergents and other contaminants through the storm sewer system. Dumping automotive fluids into storm drains has the same result as dumping the materials directly into a waterbody.

- Use a commercial car wash that treats or recycles its wastewater, or wash your car on your yard so the water infiltrates into the ground.
- Repair leaks and dispose of used auto fluids and batteries at designated drop-off or recycling locations.

Lawn care



Excess fertilizers and pesticides applied to lawns and gardens wash off and pollute streams. In addition, yard clippings and leaves can wash into storm drains and contribute nutrients and organic matter to streams.

- Don't overwater your lawn. Consider using a soaker hose instead of a sprinkler.
- Use pesticides and fertilizers sparingly. When use is necessary, use these chemicals in the recommended amounts. Use organic mulch or safer pest control methods whenever possible.
- Compost or mulch yard waste. Don't leave it in the street or sweep it into storm drains or streams.
- Cover piles of dirt or mulch being used in landscaping projects.

Septic systems



Leaking and poorly maintained septic systems release nutrients and pathogens (bacteria and viruses) that can be picked up by stormwater and discharged into nearby waterbodies. Pathogens can cause public health problems and environmental concerns.

- Inspect your system every 3 years and pump your tank as necessary (every 3 to 5 years).
- Don't dispose of household hazardous waste in sinks or toilets.

Pet waste



Pet waste can be a major source of bacteria and excess nutrients in local waters.

- When walking your pet, remember to pick up the waste and dispose of it properly. Flushing pet waste is the best disposal method. Leaving pet waste on the ground increases public health risks by allowing harmful bacteria and nutrients to wash into the storm drain and eventually into local waterbodies.

Education is essential to changing people's behavior. Signs and markers near storm drains warn residents that pollutants entering the drains will be carried untreated into a local waterbody.

Residential landscaping

Permeable Pavement—Traditional concrete and asphalt don't allow water to soak into the ground. Instead these surfaces rely on storm drains to divert unwanted water. Permeable pavement systems allow rain and snowmelt to soak through, decreasing stormwater runoff.

Rain Barrels—You can collect rainwater from rooftops in mosquito-proof containers. The water can be used later on lawn or garden areas.

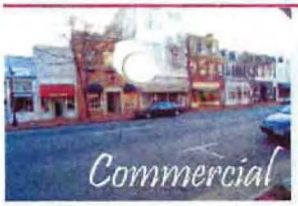


Rain Gardens and Grassy Swales—Specially designed areas planted with native plants can provide natural places for rainwater to collect and soak into the ground. Rain from rooftop areas or paved areas can be diverted into these areas rather than into storm drains.



Vegetated Filter Strips—Filter strips are areas of native grass or plants created along roadways or streams. They trap the pollutants stormwater picks up as it flows across driveways and streets.

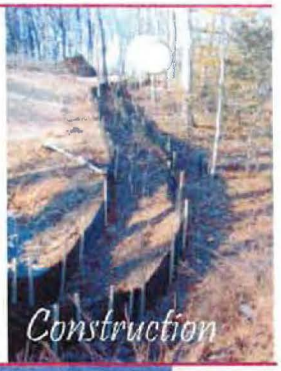
Commercial



Dirt, oil, and debris that collect in parking lots and paved areas can be washed into the storm sewer system and eventually enter local waterbodies.

- Sweep up litter and debris from sidewalks, driveways and parking lots, especially around storm drains.
- Cover grease storage and dumpsters and keep them clean to avoid leaks.
- Report any chemical spill to the local hazardous waste cleanup team. They'll know the best way to keep spills from harming the environment.

Construction



Erosion controls that aren't maintained can cause excessive amounts of sediment and debris to be washed into the stormwater system. Construction vehicles can leak fuel, oil, and other harmful fluids that can be picked up by stormwater and deposited into local waterbodies.

- Divert stormwater away from disturbed or exposed areas of the construction site.
- Install silt fences, vehicle mud removal areas, vegetative cover, and other sediment and erosion controls and properly maintain them, especially after rainstorms.
- Prevent soil erosion by minimizing disturbed areas during construction projects, and seed and mulch bare areas as soon as possible.

Agriculture

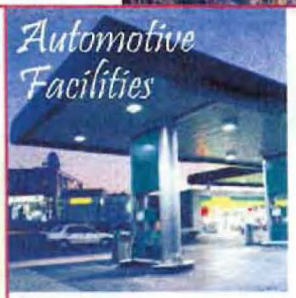


Lack of vegetation on streambanks can lead to erosion. Overgrazed pastures can also contribute excessive amounts of sediment to local waterbodies. Excess fertilizers and pesticides can poison aquatic animals and lead to destructive algae blooms. Livestock in streams can contaminate waterways with bacteria, making them unsafe for human contact.



- Keep livestock away from streambanks and provide them a water source away from waterbodies.
- Store and apply manure away from waterbodies and in accordance with a nutrient management plan.
- Vegetate riparian areas along waterways.
- Rotate animal grazing to prevent soil erosion in fields.
- Apply fertilizers and pesticides according to label instructions to save money and minimize pollution.

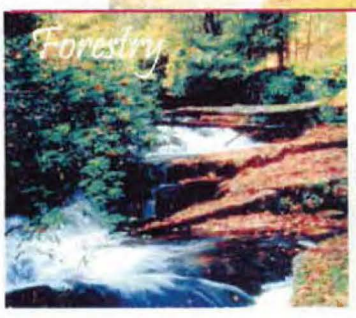
Automotive Facilities



Uncovered fueling stations allow spills to be washed into storm drains. Cars waiting to be repaired can leak fuel, oil, and other harmful fluids that can be picked up by stormwater.

- Clean up spills immediately and properly dispose of cleanup materials.
- Provide cover over fueling stations and design or retrofit facilities for spill containment.
- Properly maintain fleet vehicles to prevent oil, gas, and other discharges from being washed into local waterbodies.
- Install and maintain oil/water separators.

Forestry



Improperly managed logging operations can result in erosion and sedimentation.

- Conduct preharvest planning to prevent erosion and lower costs.
- Use logging methods and equipment that minimize soil disturbance.
- Plan and design skid trails, yard areas, and truck access roads to minimize stream crossings and avoid disturbing the forest floor.
- Construct stream crossings so that they minimize erosion and physical changes to streams.
- Expedite revegetation of cleared areas.

Help Protect Our Waterways!

Use these guidelines for Outdoor Cleaning Activities and Wash Water Disposal

Did you know that disposing of pollutants into the street, gutter, storm drain or body of water is *PROHIBITED* by law and can result in stiff penalties?

Best Management Practices

Waste wash water from Mechanics, Plumbers, Window/Power Washers, Carpet Cleaners, Car Washing and Mobile Detailing activities may contain significant quantities of motor oil, grease, chemicals, dirt, detergents, brake pad dust, litter and other materials.

Best Management Practices, or BMPs as they are known, are guides to prevent pollutants from entering the storm drains. ***Each of us*** can do our part to keep stormwater clean by using the suggested BMPs below:

Simple solutions for both light and heavy duty jobs:

Do...consider dry cleaning methods first such as a mop, broom, rag or wire brush. Always keep a spill response kit on site.

Do...prepare the work area before power cleaning by using sand bags, rubber mats, vacuum booms, containment pads or temporary berms to keep wash water away from the gutters and storm drains.

Do...use vacuums or other machines to remove and collect loose debris or litter before applying water.

Do...obtain the property owner's permission to dispose of ***small amounts*** of power washing waste water on to landscaped, gravel or unpaved surfaces.

Do...check your local sanitary sewer agency's policies on wash water disposal regulations before disposing of wash water into the sewer. (See list on reverse side)

Do...be aware that if discharging to landscape areas, soapy wash water may damage landscaping. Residual wash water may remain on paved surfaces to evaporate. Sweep up solid residuals and dispose of properly. Vacuum booms are another option for capturing and collecting wash water.

Do...check to see if local ordinances prevent certain activities.

Do not let...wash or waste water from sidewalk, plaza or building cleaning go into a street or storm drain.



Report illegal storm drain disposal
Call Toll Free
1-800-506-2555

Using Cleaning Agents

Try using biodegradable/phosphate-free products. They are easier on the environment, but don't confuse them with being toxic free. Soapy water entering the storm drain system can impact the delicate aquatic environment.



When cleaning surfaces with a ***high-pressure washer*** or ***steam cleaner***, additional precautions should be taken to prevent the discharge of pollutants into the storm drain system. These two methods of surface cleaning can loosen additional material that can contaminate local waterways.

Think Water Conservation

Minimize water use by using high pressure, low volume nozzles. Be sure to check all hoses for leaks. Water is a precious resource, don't let it flow freely and be sure to shut it off in between uses.

Screening Wash Water

Conduct thorough dry cleanup before washing exterior surfaces, such as buildings and decks ***with loose paint***, sidewalks or plaza areas. Keep debris from entering the storm drain after cleaning by first passing the wash water through a "20 mesh" or finer screen to catch the solid materials, then dispose of the mesh in a refuse container. Do not let the remaining wash water enter a street, gutter or storm drain.

Drain Inlet Protection & Collection of Wash Water

- Prior to any washing, block all storm drains with an impervious barrier such as sandbags or berms, or seal the storm drain with plugs or other appropriate materials.
- Create a containment area with berms and traps or take advantage of a low spot to keep wash water contained.
- Wash vehicles and equipment on grassy or gravel areas so that the wash water can seep into the ground.
- Pump or vacuum up all wash water in the contained area.

Concrete/Coring/Saw Cutting and Drilling Projects

Protect any down-gradient inlets by using dry activity techniques whenever possible. If water is used, minimize the amount of water used during the coring/drilling or saw cutting process. Place a barrier of sandbags and/or absorbent berms to protect the storm drain inlet or watercourse. Use a shovel or wet vacuum to remove the residue from the pavement. Do not wash residue or particulate matter into a storm drain inlet or watercourse.

Helpful telephone numbers and links:

Riverside County Stormwater Protection Partners

Flood Control District	(951) 955-1200
County of Riverside	(951) 955-1000
City of Banning	(951) 922-3105
City of Beaumont	(951) 769-8520
City of Calimesa	(909) 795-9801
City of Canyon Lake	(951) 244-2955
Cathedral City	(760) 770-0327
City of Coachella	(760) 398-4978
City of Corona	(951) 736-2447
City of Desert Hot Springs	(760) 329-6411
City of Eastvale	(951) 361-0900
City of Hemet	(951) 765-2300
City of Indian Wells	(760) 346-2489
City of Indio	(760) 391-4000
City of Lake Elsinore	(951) 674-3124
City of La Quinta	(760) 777-7000
City of Menifee	(951) 672-6777
City of Moreno Valley	(951) 413-3000
City of Murrieta	(951) 304-2489
City of Norco	(951) 270-5607
City of Palm Desert	(760) 346-0611
City of Palm Springs	(760) 323-8299
City of Perris	(951) 943-6100
City of Rancho Mirage	(760) 324-4511
City of Riverside	(951) 361-0900
City of San Jacinto	(951) 654-7337
City of Temecula	(951) 694-6444
City of Wildomar	(951) 677-7751

REPORT ILLEGAL STORM DRAIN DISPOSAL
1-800-506-2555 or e-mail us at
fcnpdes@rcflood.org

- Riverside County Flood Control and Water Conservation District
  www.rcflood.org

Online resources include:

- California Storm Water Quality Association
  www.casqa.org
- State Water Resources Control Board
  www.waterboards.ca.gov
- Power Washers of North America
  www.thepwna.org

Stormwater Pollution

What you should know for...

Outdoor Cleaning Activities and Professional Mobile Service Providers



Storm drain pollution prevention information for:

- Car Washing / Mobile Detailers
- Window and Carpet Cleaners
- Power Washers
- Waterproofers / Street Sweepers
- Equipment cleaners or degreasers and all mobile service providers

Do you know where street flows actually go?

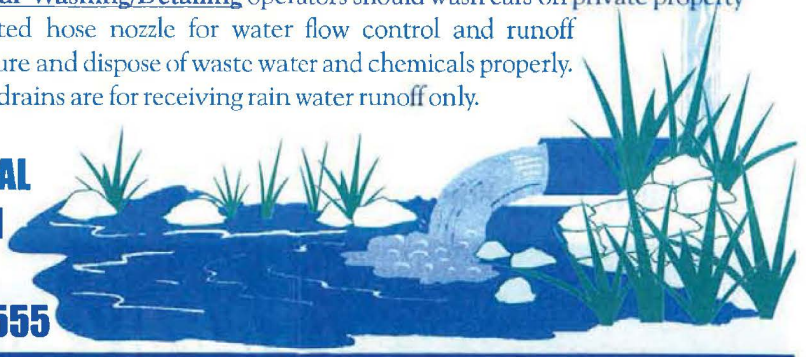
Storm drains are NOT connected to sanitary sewer systems and treatment plants!



The primary purpose of storm drains is to carry *rain* water away from developed areas to prevent flooding. Pollutants discharged to storm drains are transported directly into rivers, lakes and streams. Soaps, degreasers, automotive fluids, litter and a host of materials are washed off buildings, sidewalks, plazas and parking areas. Vehicles and equipment must be properly managed to prevent the pollution of local waterways.

Unintentional spills by mobile service operators can flow into storm drains and pollute our waterways. **Avoid mishaps.** *Always* have a **Spill Response Kit** on hand to clean up unintentional spills. Only emergency **Mechanical** repairs should be done in City streets, using drip pans for spills. **Plumbing** should be done on private property. Always store chemicals in a leak-proof container and keep covered when not in use. **Window/Power Washing** waste water shouldn't be released into the streets, but should be disposed of in a sanitary sewer, landscaped area or in the soil. Soiled **Carpet Cleaning** wash water should be filtered before being discharged into the sanitary sewer. Dispose of all filter debris properly. **Car Washing/Detailing** operators should wash cars on private property and use a regulated hose nozzle for water flow control and runoff prevention. Capture and dispose of waste water and chemicals properly. Remember, storm drains are for receiving rain water runoff only.

REPORT ILLEGAL STORM DRAIN DISPOSAL 1-800-506-2555



Stormwater Pollution from Construction Activities

The two most common sources of stormwater pollution problems associated with construction activities are ***erosion*** and ***sedimentation***. Failure to maintain adequate erosion and sediment controls at construction sites often results in sediment discharges into the storm drain system, creating multiple problems once it enters local waterways.

Construction vehicles and heavy equipment can also track significant amounts of mud and sediment onto adjacent streets. Additionally, wind may transport construction materials and wastes into streets storm drains, or directly into our local waterways.

Resources

State Water Resources Control Board
Division of Water Quality
1001 I Street
Sacramento CA 95814
(916) 341-5455
www.swrcb.ca.gov/stormwtr/

Colorado River Basin Regional Water
Quality Control Board - Region 7
73-720 Fred Waring Drive, Suite 100
Palm Desert, CA 92260
(760) 346-7491
www.swrcb.ca.gov/~rwqcb7/

Santa Ana Regional Water
Quality Control Board - Region 8
3737 Main Street, Suite 500
Riverside, CA 92501-3348
(909) 782-4130
www.swrcb.ca.gov/~rwqcb8/

San Diego Regional Water
Quality Control Board - Region 9
9771 Clairemont Mesa Blvd., Suite A
San Diego, CA 92124
(858) 467-2952
www.swrcb.ca.gov/~rwqcb9/

StormWater Pollution . . . What You Should Know

Riverside County has two drainage systems - sewers and storm drains. The storm drain system was designed to reduce flooding by carrying excess rainwater away from streets and developed areas. Since the storm drain system does not provide for water treatment, it also serves the *unintended* function of transporting pollutants directly to our local waterways.

Unlike sanitary sewers, storm drains are not connected to a wastewater treatment plant – they flow directly to our local streams, rivers and lakes.

Stormwater runoff is a part of the natural hydrologic process. However, land development and construction activities can significantly alter natural drainage processes and introduce pollutants into stormwater runoff. Polluted stormwater runoff from construction sites has been identified as a major source of water pollution in California. It jeopardizes the quality of our local waterways and can pose a serious threat to the health of our aquatic ecosystems.

The Cities and County of Riverside StormWater/CleanWater Protection Program

Because preventing pollution is much easier and less costly than cleaning up "after the fact," the Cities and County of Riverside StormWater/CleanWater Protection Program informs residents and businesses on pollution prevention activities. This pamphlet describes various Best Management Practices (BMPs) that construction site operators can use to prevent stormwater pollution.

In accordance with applicable federal and state law, the Cities and County of Riverside have adopted ordinances for stormwater management and discharge control that **prohibit** the discharge of pollutants into the storm drain system or local surface waters. This includes discharges from construction sites containing sediment, concrete, mortar, paint, solvents, lubricants, vehicle fluids, fuel, pesticides, and construction debris.

PLEASE NOTE: The Federal, State and local regulations strictly prohibit the discharge of sediment and pollutants into the streets, the storm drain system or waterways. As an owner, operator or supervisor of a construction site, you may be held financially responsible for any environmental damage caused by your subcontractors or employees.

To report a hazardous materials spill, call:

Riverside County Hazardous Materials
Emergency Response Team
(909) 358-5055 8:00 a.m. – 5:00 p.m.
(909) 358-5245 after 5:00 p.m.

In an emergency call: **911**

For recycling and hazardous waste disposal, call:

(909) 358-5055

To report an illegal dumping or a clogged storm drain, call:

1-800-506-2555

To order additional brochures or to obtain information on other pollution prevention activities, please call (909) 955-1200 or visit the StormWater/CleanWater Protection Program website at:
www.co.riverside.ca.us/depts/flood/waterquality/npdes.asp

StormWater Pollution

What you should know for...

GENERAL CONSTRUCTION & SITE SUPERVISION

Best Management Practices (BMPs) for:

- Developers
- General Contractors
- Home Builders
- Construction Inspectors
- Anyone in the construction business

The StormWater/CleanWater Protection Program gratefully acknowledges the Santa Ana Regional Nonpoint Pollution Control Program, Alameda Countywide CleanWater Program and the City of Los Angeles Stormwater Management Division for information provided in this brochure.

What Should You Do?

Advance Planning to Prevent Pollution

- ❑ Remove existing vegetation only as needed.
- ❑ Schedule excavation, grading, and paving operations for dry weather periods, if possible.
- ❑ Designate a specific area of the construction site, well away from storm drain inlets or watercourses, for material storage and equipment maintenance.
- ❑ Develop and implement an effective combination of erosion and sediment controls for the construction site.
- ❑ Practice source reduction by ordering only the amount of materials that are needed to finish the project.
- ❑ Educate your employees and subcontractors about stormwater management requirements and their pollution prevention responsibilities.
- ❑ Control the amount of surface runoff at the construction site by impeding internally generated flows and using berms or drainage ditches to direct incoming offsite flows to go around the site. ***Note:*** *Consult local drainage policies for more information.*

Best Management Practices

The following Best Management Practices (BMPs) can significantly reduce pollutant discharges from your construction site. Compliance with stormwater regulations can be as simple as minimizing stormwater contact with potential pollutants by providing covers and secondary containment for construction materials, designating areas away from storm drain systems for storing equipment and materials and implementing good housekeeping practices at the construction site.

- ❑ Protect all storm drain inlets and streams located near the construction site to prevent sediment-laden water from entering the storm drain system.
- ❑ Limit access to and from the site. Stabilize construction entrances/exits to minimize the track out of dirt and mud onto adjacent streets. Conduct frequent street sweeping.
- ❑ Protect stockpiles and construction materials from winds and rain by storing them under a roof, secured impermeable tarp or plastic sheeting.
- ❑ Avoid storing or stockpiling materials near storm drain inlets, gullies or streams.
- ❑ Phase grading operations to limit disturbed areas and duration of exposure.
- ❑ Perform major maintenance and repairs of vehicles and equipment offsite.
- ❑ Wash out concrete mixers only in designated washout areas at the construction site.
- ❑ Set-up and operate small concrete mixers on tarps or heavy plastic drop cloths.
- ❑ Keep construction sites clean by removing trash, debris, wastes, etc. on a regular basis.
- ❑ Clean-up spills immediately using dry clean-up methods (e.g., absorbent materials such as cat litter, sand or rags for liquid spills; sweeping for dry spills such as cement, mortar or fertilizer) and by removing the contaminated soil from spills on dirt areas. .
- ❑ Prevent erosion by implementing any or a combination of soil stabilization practices such as mulching, surface roughening, permanent or temporary seeding.
- ❑ Maintain all vehicles and equipment in good working condition. Inspect frequently for leaks, and repair promptly.
- ❑ Practice proper waste disposal. Many construction materials and wastes, including solvents, water-based paint, vehicle fluids, broken asphalt and concrete, wood, and cleared vegetation can be recycled. Materials that cannot be recycled must be taken to an appropriate landfill or disposed of as hazardous waste.
- ❑ Cover open dumpsters with secured tarps or plastic sheeting. Never clean out a dumpster by washing it down on the construction site.
- ❑ Arrange for an adequate debris disposal schedule to insure that dumpsters do not overflow.

General Construction Activities Stormwater Permit

(Construction Activities General Permit)

The State Water Resources Control Board (SWRCB) adopted a new Construction Activities General Permit (WQ Order No. 99-08DWQ) on August 19, 1999, superseding the now expired SWRCB statewide General Permit (WQ Order No. 92-08DWQ). This permit is administered and enforced by the SWRCB and the local Regional Water Quality Control Boards (RWQCB). The updated Construction Activities General Permit establishes a number of new stormwater management requirements for construction site operator.

NOTE: *Some construction activies stormwater permits are issued on a regional basis. Consult your local RWQCB to find out if your project requires coverage under any of these permits.*

Frequently Asked Questions:

Does my construction site require coverage under the Construction Activities General Permit?

Yes, if construction activity results in the disturbance of five or more acres of total land area or is part of a common plan of development that results in the disturbance of five or more acres.

How do I obtain coverage under the Construction Activities General Permit?

Obtain the permit package and submit the completed Notice of Intent (NOI) form to the SWRCB prior to grading or disturbing soil at the construction site. For ongoing construction activity involving a change of ownership, the new owner must submit a new NOI within 30 days of the date of change of ownership. The completed NOI along with the required fee should be mailed to the SWRCB.

What must I do to comply with the requirements of the Construction Activities General Permit?

- ● Implement BMPs for non-stormwater discharges year-round.
- ● Prepare and implement a Stormwater Pollution Prevention Plan (SWPPP) prior to commencing construction activities.
- ● Keep a copy of the SWPPP at the construction site for the entire duration of the project.
- ● Calculate the anticipated stormwater run-off.
- ● Implement an effective combination of erosion and sediment control on all soil disturbed areas.
- ● Conduct site inspections prior to anticipated storm events, every 24-hours during extended storm events, and after actual storm event.
- ● Perform repair and maintenance of BMPs as soon as possible after storm events depending upon worker safety.
- ● Update the SWPPP as needed, to manage pollutants or reflect changes in site conditions.
- ● Include description of post construction BMPs at the construction site, including parties responsible for long-term maintenance.

NOTE: *Please refer to the Construction Activities General Permit for detailed information. You may contact the SWRCB, your local RWQCB, or visit the SWRCB website at www.swrcb.ca.gov/stormwtr/ to obtain a State Construction Activities Stormwater General Permit packet.*

How long is this Construction Activities General Permit in effect?

The Permit coverage stays in effect untilyou submit a Notice of Termination (NOT) to the SWRCB. For the purpose of submitting a NOT, all soil disturbing activities have to be completed and one of the three following criteria has to be met:

1. Change of ownership;
2. A uniform vegetative cover with 70 percent coverage has been established; or,
3. Equivalent stabilization measures such as the use of reinforced channel liners, soil cement, fiber matrices, geotextiles, etc., have been employed.