Priority Development Project (PDP)
Storm Water Quality Management Plan (SWQMP)

AIRWAY LOGISTICS CENTER

PTS#665589

[Insert Drawing Number (if applicable) and Internal Order Number (if applicable)]

☐ **Check if electing for offsite alternative compliance**

Engineer of Work:

REGISTERED PROFESSIONAL ENGINEER
KAMAL S. SWEIS
No. 48592
Exp. 6-30-22
CIVIL
STATE OF CALIFORNIA

KAMAL SWEIS RCE#48592
Provide Wet Signature and Stamp Above Line

Prepared For:

BADIEE DEVELOPMENT, INC
1261 PROSPECT STREET STE.9
LA JOLLA, CA 92037
888-815-8886 CONTACT: SCOTT MERRY

Prepared By:

K&S ENGINEERING, INC.
Planning Engineering Surveying

K&S ENGINEERING
7801 MISSION CENTER COURT SUITE 100
SAN DIEGO, CA 92108
(619) 296-5565

Date:
10/06/2020

Approved by: City of San Diego Date

The City of SAN DIEGO

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    - Maintenance Agreement (Form DS-3247) (when applicable)
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- Attachment 6: Project's Geotechnical and Groundwater Investigation Report

Acronyms

APN	Assessor's Parcel Number
ASBS	Area of Special Biological Significance
BMP	Best Management Practice
CEQA	California Environmental Quality Act
CGP	Construction General Permit
DCV	Design Capture Volume
DMA	Drainage Management Areas
ESA	Environmentally Sensitive Area
GLU	Geomorphic Landscape Unit
GW	Ground Water
HMP	Hydromodification Management Plan
HSG	Hydrologic Soil Group
HU	Harvest and Use
INF	Infiltration
LID	Low Impact Development
LUP	Linear Underground/Overhead Projects
MS4	Municipal Separate Storm Sewer System
N/A	Not Applicable
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
PDP	Priority Development Project
PE	Professional Engineer
POC	Pollutant of Concern
SC	Source Control
SD	Site Design
SDRWQCB	San Diego Regional Water Quality Control Board
SIC	Standard Industrial Classification
SWPPP	Stormwater Pollutant Protection Plan
SWQMP	Storm Water Quality Management Plan
TMDL	Total Maximum Daily Load
WMAA	Watershed Management Area Analysis
WPCP	Water Pollution Control Program
WQIP	Water Quality Improvement Plan

Certification Page

Project Name: **Airway Logistic Center**
Permit Application: **PTS#665589**

I hereby declare that I am the Engineer in Responsible Charge of design of storm water BMPs for this project, and that I have exercised responsible charge over the design of the project as defined in Section 6703 of the Business and Professions Code, and that the design is consistent with the requirements of the Storm Water Standards, which is based on the requirements of SDRWQCB Order No. R9-2013-0001 as amended by R9-2015-0001 and R9-2015-0100 (MS4 Permit).

I have read and understand that the City Engineer has adopted minimum requirements for managing urban runoff, including storm water, from land development activities, as described in the Storm Water Standards. I certify that this PDP SWQMP has been completed to the best of my ability and accurately reflects the project being proposed and the applicable source control and site design BMPs proposed to minimize the potentially negative impacts of this project's land development activities on water quality. I understand and acknowledge that the plan check review of this PDP SWQMP by the City Engineer is confined to a review and does not relieve me, as the Engineer in Responsible Charge of design of storm water BMPs for this project, of my responsibilities for project design.

Kamal Sweis

Engineer of Work's Signature

48592 | 6/30/2022
PE# | Expiration Date

KAMAL S. SWEIS

Print Name

K&S ENGINEERING, INC

Company

10/06/2020

Date

Engineer's Stamp

Project Name: Airway Logistics Center

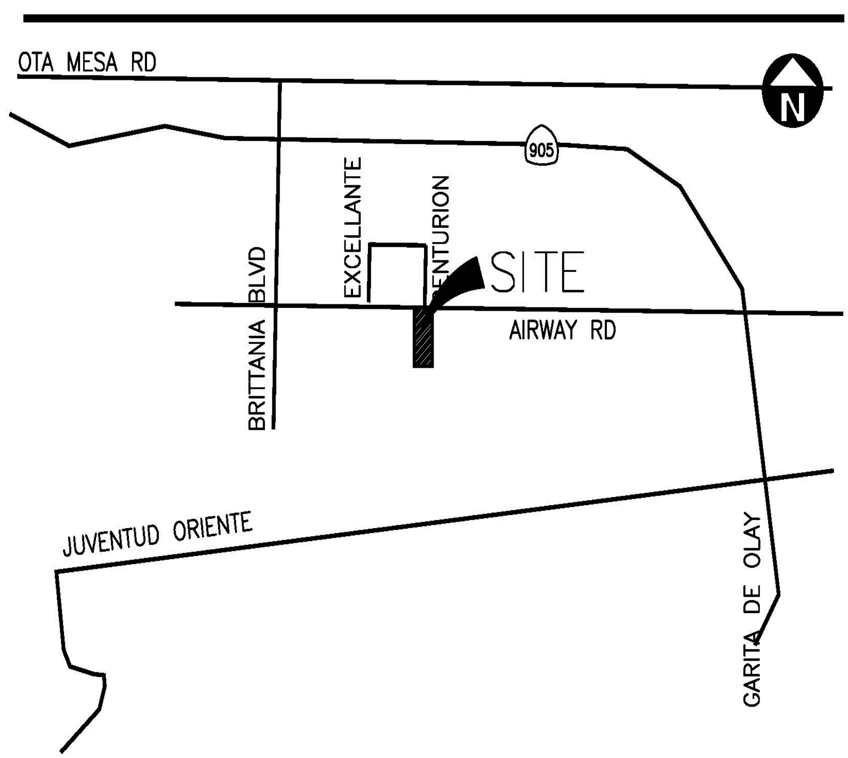
Submittal Record

Use this Table to keep a record of submittals of this PDP SWQMP. Each time the PDP SWQMP is re-submitted, provide the date and status of the project. In last column indicate changes that have been made or indicate if response to plancheck comments is included. When applicable, insert response to plancheck comments.

Submittal Number	Date	Project Status	Changes
1	5/18/2020	☑ Preliminary Design/Planning/CEQA ☐ Final Design	**Initial Submittal**
2	7/17/2020	☑ Preliminary Design/Planning/CEQA ☐ Final Design	Resubmittal
3	7/29/2020	☑ Preliminary Design/Planning/CEQA ☐ Final Design	Resubmittal
4	10/06/20	☑ Preliminary Design/Planning/CEQA ☐ Final Design	Resubmittal

Project Vicinity Map

Project Name: Airway Logistics Center
Permit Application PTS#665589



City of San Diego Form DS-560
Storm Water Requirements Applicability Checklist

Attach DS-560 form.

City of San Diego
Development Services
1222 First Ave., MS-302
San Diego, CA 92101
(619) 446-5000

Storm Water Requirements Applicability Checklist

FORM
DS-560
November 2018

Project Address: AIRWAY ROAD SAN DIEGO, CA 92154	Project Number: 665589

SECTION 1. Construction Storm Water BMP Requirements:

All construction sites are required to implement construction BMPs in accordance with the performance standards in the Storm Water Standards Manual. Some sites are additionally required to obtain coverage under the State Construction General Permit (CGP)[1], which is administered by the State Regional Water Quality Control Board.

For all projects complete PART A: If project is required to submit a SWPPP or WPCP, continue to PART B.

PART A: Determine Construction Phase Storm Water Requirements.

1. Is the project subject to California's statewide General NPDES permit for Storm Water Discharges Associated with Construction Activities, also known as the State Construction General Permit (CGP)? (Typically projects with land disturbance greater than or equal to 1 acre.)

   ☒ Yes; SWPPP required, skip questions 2-4 ☐ No; next question

2. Does the project propose construction or demolition activity, including but not limited to, clearing, grading, grubbing, excavation, or any other activity resulting in ground disturbance and/or contact with storm water?

   ☒ Yes; WPCP required, skip questions 3-4 ☐ No; next question

3. Does the project propose routine maintenance to maintain original line and grade, hydraulic capacity, or original purpose of the facility? (Projects such as pipeline/utility replacement)

   ☐ Yes; WPCP required, skip question 4 ☒ No; next question

4. Does the project only include the following Permit types listed below?

   - Electrical Permit, Fire Alarm Permit, Fire Sprinkler Permit, Plumbing Permit, Sign Permit, Mechanical Permit, Spa Permit.
   - Individual Right of Way Permits that exclusively include only ONE of the following activities: water service, sewer lateral, or utility service.
   - Right of Way Permits with a project footprint less than 150 linear feet that exclusively include only ONE of the following activities: curb ramp, sidewalk and driveway apron replacement, pot holing, curb and gutter replacement, and retaining wall encroachments.

   ☐ Yes; no document required

Check one of the boxes below, and continue to PART B:

☒ If you checked "Yes" for question 1,
a SWPPP is REQUIRED. Continue to PART B

☐ If you checked "No" for question 1, and checked "Yes" for question 2 or 3,
a WPCP is REQUIRED. If the project proposes less than 5,000 square feet of ground disturbance AND has less than a 5-foot elevation change over the entire project area, a Minor WPCP may be required instead. **Continue to PART B.**

☐ If you checked "No" for all questions 1-3, and checked "Yes" for question 4
PART B **does not apply and no document is required. Continue to Section 2.**

1. More information on the City's construction BMP requirements as well as CGP requirements can be found at: www.sandiego.gov/stormwater/regulations/index.shtml

PART B: Determine Construction Site Priority

This prioritization must be completed within this form, noted on the plans, and included in the SWPPP or WPCP. The city reserves the right to adjust the priority of projects both before and after construction. Construction projects are assigned an inspection frequency based on if the project has a "high threat to water quality." The City has aligned the local definition of "high threat to water quality" to the risk determination approach of the State Construction General Permit (CGP). The CGP determines risk level based on project specific sediment risk and receiving water risk. Additional inspection is required for projects within the Areas of Special Biological Significance (ASBS) watershed. **NOTE:** The construction priority does **NOT** change construction BMP requirements that apply to projects; rather, it determines the frequency of inspections that will be conducted by city staff.

Complete PART B and continued to Section 2

1. ☐ **ASBS**
   a. Projects located in the ASBS watershed.

2. ☐ **High Priority**
   a. Projects that qualify as Risk Level 2 or Risk Level 3 per the Construction General Permit (CGP) and not located in the ASBS watershed.
   b. Projects that qualify as LUP Type 2 or LUP Type 3 per the CGP and not located in the ASBS watershed.

3. ◉ **Medium Priority**
   a. Projects that are not located in an ASBS watershed or designated as a High priority site.
   b. Projects that qualify as Risk Level 1 or LUP Type 1 per the CGP and not located in an ASBS watershed.
   c. WPCP projects (>5,000sf of ground disturbance) located within the Los Penasquitos watershed management area.

4. ☐ **Low Priority**
   a. Projects not subject to a Medium or High site priority designation and are not located in an ASBS watershed.

SECTION 2. Permanent Storm Water BMP Requirements.

Additional information for determining the requirements is found in the Storm Water Standards Manual.

PART C: Determine if Not Subject to Permanent Storm Water Requirements.

Projects that are considered maintenance, or otherwise not categorized as "new development projects" or "redevelopment projects" according to the Storm Water Standards Manual are not subject to Permanent Storm Water BMPs.

If "yes" is checked for any number in Part C, proceed to Part F and check "Not Subject to Permanent Storm Water BMP Requirements".

If "no" is checked for all of the numbers in Part C continue to Part D.

1.	Does the project only include interior remodels and/or is the project entirely within an existing enclosed structure and does not have the potential to contact storm water?	☐ Yes ◉ No
2.	Does the project only include the construction of overhead or underground utilities without creating new impervious surfaces?	☐ Yes ◉ No
3.	Does the project fall under routine maintenance? Examples include, but are not limited to: roof or exterior structure surface replacement, resurfacing or reconfiguring surface parking lots or existing roadways without expanding the impervious footprint, and routine replacement of damaged pavement (grinding, overlay, and pothole repair).	☐ Yes ◉ No

PART D: PDP Exempt Requirements.

PDP Exempt projects are required to implement site design and source control BMPs.

If "yes" was checked for any questions in Part D, continue to Part F and check the box labeled "PDP Exempt."

If "no" was checked for all questions in Part D, continue to Part E.

1. **Does the project ONLY include new or retrofit sidewalks, bicycle lanes, or trails that:**
   - **Are designed and constructed to direct storm water runoff to adjacent vegetated areas, or other non-erodible permeable areas? Or;**
   - **Are designed and constructed to be hydraulically disconnected from paved streets and roads? Or;**
   - **Are designed and constructed with permeable pavements or surfaces in accordance with the Green Streets guidance in the City's Storm Water Standards manual?**

   ☐ Yes; PDP exempt requirements apply ☒ No; next question

2. Does the project ONLY include retrofitting or redeveloping existing paved alleys, streets or roads designed and constructed in accordance with the Green Streets guidance in the City's Storm Water Standards Manual?

   ☐ Yes; PDP exempt requirements apply ☒ No; project not exempt.

PART E: Determine if Project is a Priority Development Project (PDP).
Projects that match one of the definitions below are subject to additional requirements including preparation of a Storm Water Quality Management Plan (SWQMP).

If "yes" is checked for any number in PART E, continue to PART F and check the box labeled "Priority Development Project".

If "no" is checked for every number in PART E, continue to PART F and check the box labeled "Standard Development Project".

1.	**New Development that creates 10,000 square feet or more of impervious surfaces collectively over the project site.** This includes commercial, industrial, residential, mixed-use, and public development projects on public or private land.	☒ Yes ☐ No
2.	**Redevelopment project that creates and/or replaces 5,000 square feet or more of impervious surfaces on an existing site of 10,000 square feet or more of impervious surfaces.** This includes commercial, industrial, residential, mixed-use, and public development projects on public or private land.	☐ Yes ☒ No
3.	**New development or redevelopment of a restaurant.** Facilities that sell prepared foods and drinks for consumption, including stationary lunch counters and refreshment stands selling prepared foods and drinks for immediate consumption (SIC 5812), and where the land development creates and/or replace 5,000 square feet or more of impervious surface.	☐ Yes ☒ No
4.	**New development or redevelopment on a hillside.** The project creates and/or replaces 5,000 square feet or more of impervious surface (collectively over the project site) and where the development will grade on any natural slope that is twenty-five percent or greater.	☐ Yes ☒ No
5.	**New development or redevelopment of a parking lot that creates and/or replaces 5,000 square feet or more of impervious surface (collectively over the project site).**	☒ Yes ☐ No
6.	**New development or redevelopment of streets, roads, highways, freeways, and driveways.** The project creates and/or replaces 5,000 square feet or more of impervious surface (collectively over the project site).	☒ Yes ☐ No

7.	**New development or redevelopment discharging directly to an Environmentally Sensitive Area.** The project creates and/or replaces 2,500 square feet of impervious surface (collectively over project site), and discharges directly to an Environmentally Sensitive Area (ESA). "Discharging directly to" includes flow that is conveyed overland a distance of 200 feet or less from the project to the ESA, or conveyed in a pipe or open channel any distance as an isolated flow from the project to the ESA (i.e. not commingled with flows from adjacent lands).	☐ Yes ☒ No
8.	**New development or redevelopment projects of a retail gasoline outlet (RGO) that create and/or replaces 5,000 square feet of impervious surface.** The development project meets the following criteria: (a) 5,000 square feet or more or (b) has a projected Average Daily Traffic (ADT) of 100 or more vehicles per day.	☐ Yes ☒ No
9.	**New development or redevelopment projects of an automotive repair shops that creates and/or replaces 5,000 square feet or more of impervious surfaces.** Development projects categorized in any one of Standard Industrial Classification (SIC) codes 5013, 5014, 5541, 7532-7534, or 7536-7539.	☐ Yes ☒ No
10.	**Other Pollutant Generating Project.** The project is not covered in the categories above, results in the disturbance of one or more acres of land and is expected to generate pollutants post construction, such as fertilizers and pesticides. This does not include projects creating less than 5,000 sf of impervious surface and where added landscaping does not require regular use of pesticides and fertilizers, such as slope stabilization using native plants. Calculation of the square footage of impervious surface need not include linear pathways that are for infrequent vehicle use, such as emergency maintenance access or bicycle pedestrian use, if they are built with pervious surfaces of if they sheet flow to surrounding pervious surfaces.	☐ Yes ☒ No

PART F: Select the appropriate category based on the outcomes of PART C through PART E.

1.	The project is **NOT SUBJECT TO PERMANENT STORM WATER REQUIREMENTS**.	☐
2.	The project is a **STANDARD DEVELOPMENT PROJECT**. Site design and source control BMP requirements apply. See the Storm Water Standards Manual for guidance.	☐
3.	The project is **PDP EXEMPT**. Site design and source control BMP requirements apply. See the Storm Water Standards Manual for guidance.	☐
4.	The project is a **PRIORITY DEVELOPMENT PROJECT**. Site design, source control, and structural pollutant control BMP requirements apply. See the Storm Water Standards Manual for guidance on determining if project requires a hydromodification plan management	☒

SCOTT L. MERRY - V.P. CONSTRUCTION - BADIEE DEVELOPMENT

Name of Owner or Agent (Please Print) Title

[signature]

Signature

5/12/20

Date

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Applicability of Permanent, Post-Construction Storm Water BMP Requirements		Form I-1
Project Identification		
Project Name: Airway Logistics Center		
Permit Application Number: 665589		Date: 10/06/20
Determination of Requirements		
The purpose of this form is to identify permanent, post-construction requirements that apply to the project. This form serves as a short <u>summary</u> of applicable requirements, in some cases referencing separate forms that will serve as the backup for the determination of requirements. Answer each step below, starting with **Step 1** and progressing through each step until reaching "Stop". Refer to the manual sections and/or separate forms referenced in each step below.		
Step	**Answer**	**Progression**
Step 1: Is the project a "development project"? See Section 1.3 of the manual (Part 1 of Storm Water Standards) for guidance.	☑ Yes	Go to **Step 2**.
	☐ No	**Stop**. Permanent BMP requirements do not apply. No SWQMP will be required. Provide discussion below.
Discussion / justification if the project is <u>not</u> a "development project" (e.g., the project includes *only* interior remodels within an existing building):		
Step 2: Is the project a Standard Project, PDP, or PDP Exempt? To answer this item, see Section 1.4 of the manual in its entirety for guidance AND complete Form DS-560, Storm Water Requirements Applicability Checklist.	☐ Standard Project	**Stop.** Standard Project requirements apply
	☑ PDP	PDP requirements apply, including PDP SWQMP. Go to **Step 3**.
	☐ PDP Exempt	**Stop.** Standard Project requirements apply. Provide discussion and list any additional requirements below.
Discussion / justification, and additional requirements for exceptions to PDP definitions, if applicable:		

Project Name: Airway Logistics Center

Form I-1 Page 2 of 2		
Step	**Answer**	**Progression**
Step 3. Is the project subject to earlier PDP requirements due to a prior lawful approval? See Section 1.10 of the manual (Part 1 of Storm Water Standards) for guidance.	☐ Yes	Consult the City Engineer to determine requirements. Provide discussion and identify requirements below. Go to **Step 4**.
	☑ No	BMP Design Manual PDP requirements apply. Go to **Step 4**.
Discussion / justification of prior lawful approval, and identify requirements (<u>not required if prior lawful approval does not apply</u>):		
Step 4. Do hydromodification control requirements apply? See Section 1.6 of the manual (Part 1 of Storm Water Standards) for guidance.	☑ Yes	PDP structural BMPs required for pollutant control (Chapter 5) and hydromodification control (Chapter 6). Go to **Step 5**.
	☐ No	**Stop**. PDP structural BMPs required for pollutant control (Chapter 5) only. Provide brief discussion of exemption to hydromodification control below.
Discussion / justification if hydromodification control requirements do <u>not</u> apply:		
Step 5. Does protection of critical coarse sediment yield areas apply? See Section 6.2 of the manual (Part 1 of Storm Water Standards) for guidance.	☐ Yes	Management measures required for protection of critical coarse sediment yield areas (Chapter 6.2). **Stop**.
	☑ No	Management measures not required for protection of critical coarse sediment yield areas. Provide brief discussion below. **Stop**.
Discussion / justification if protection of critical coarse sediment yield areas does <u>not</u> apply:		

HMP Exemption Exhibit

Attach a HMP Exemption Exhibit that shows direct storm water runoff discharge from the project site to HMP exempt area. Include project area, applicable underground storm drain line and/or concrete lined channels, outfall information and exempt waterbody. Reference applicable drawing number(s).

Exhibit must be provided on 11"x17" or larger paper.

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Site Information Checklist For PDPs	Form I-3B
Project Summary Information	
Project Name	Airway Logistics Center
Project Address	AIRWAY ROAD SAN DIEGO, CA 92154
Assessor's Parcel Number(s) (APN(s))	646-110-28
Permit Application Number	665589
Project Watershed	Select One: ☐ San Dieguito River ☐ Penasquitos ☐ Mission Bay ☐ San Diego River ☐ San Diego Bay ☑ Tijuana River
Hydrologic subarea name with Numeric Identifier up to two decimal places (9XX.XX)	WATER TANKS Unit 911.12
Project Area (total area of Assessor's Parcel(s) associated with the project or total area of the right-of-way)	13.4 Acres (585673 Square Feet)
Area to be disturbed by the project (Project Footprint)	13.4 Acres (585673 Square Feet)
Project Proposed Impervious Area (subset of Project Footprint)	11.95 Acres (520700 Square Feet)
Project Proposed Pervious Area (subset of Project Footprint)	1.49 Acres (64973 Square Feet)
Note: Proposed Impervious Area + Proposed Pervious Area = Area to be Disturbed by the Project. This may be less than the Project Area.	
The proposed increase or decrease in impervious area in the proposed condition as compared to the pre-project condition	89 %

Project Name: Airway Logistics Center

Form I-3B Page 2 of 11
Description of Existing Site Condition and Drainage Patterns
Current Status of the Site (select all that apply): ☑Existing development ☐Previously graded but not built out ☐Agricultural or other non-impervious use ☐Vacant, undeveloped/natural Description / Additional Information:
Existing Land Cover Includes (select all that apply): ☐Vegetative Cover ☑Non-Vegetated Pervious Areas ☐Impervious Areas Description / Additional Information:
Underlying Soil belongs to Hydrologic Soil Group (select all that apply): ☐NRCS Type A ☐NRCS Type B ☐NRCS Type C ☑NRCS Type D
Approximate Depth to Groundwater: ☐Groundwater Depth < 5 feet ☐5 feet < Groundwater Depth < 10 feet ☐10 feet < Groundwater Depth < 20 feet ☑Groundwater Depth > 20 feet
Existing Natural Hydrologic Features (select all that apply): ☐Watercourses ☐Seeps ☐Springs ☐Wetlands ☑None Description / Additional Information:

Project Name: Airway Logistics Center

Form I-3B Page 3 of 11
Description of Existing Site Topography and Drainage
How is storm water runoff conveyed from the site? At a minimum, this description should answer: 1. Whether existing drainage conveyance is natural or urban; 2. If runoff from offsite is conveyed through the site? If yes, quantification of all offsite drainage areas, design flows, and locations where offsite flows enter the project site and summarize how such flows are conveyed through the site; 3. Provide details regarding existing project site drainage conveyance network, including storm drains, concrete channels, swales, detention facilities, storm water treatment facilities, and natural and constructed channels; 4. Identify all discharge locations from the existing project along with a summary of the conveyance system size and capacity for each of the discharge locations. Provide summary of the pre-project drainage areas and design flows to each of the existing runoff discharge locations.
Descriptions/Additional Information
1. The existing onsite drainage is natural and sheet flows from west to east. 2. Offsite drainage enters the site from the east from an existing truck parking at two concentrated points. At one location 23.88 cfs drain into the project site. At a second location 21.63 cfs are also accepted by the site. These flows are naturally conveyed across the site from west to east. 3. All offsite and onsite flows are naturally conveyed across the project site. No man made improvements exist on the site. 4.

Form I-3B Page 4 of 11
Description of Proposed Site Development and Drainage Patterns
Project Description / Proposed Land Use and/or Activities: The project proposes an industrial building with loading docks, parking, landscaping and two biofiltratrion BMP's for water quality, hydromodifocation and peak flow detention.
List/describe proposed impervious features of the project (e.g., buildings, roadways, parking lots, courtyards, athletic courts, other impervious features): Impervious features of the the project include one building, loading docks and vehicular parking.
List/describe proposed pervious features of the project (e.g., landscape areas): The pervious features include landscaped islands, slopes, buffer and biofiltration basins.
Does the project include grading and changes to site topography? ☑ Yes ☐ No Description / Additional Information: The project includes grading to accommodate a sloping building and dock high doors.

Form I-3B Page 5 of 11
Does the project include changes to site drainage (e.g., installation of new storm water conveyance systems)? ☑ Yes ☐ No If yes, provide details regarding the proposed project site drainage conveyance network, including storm drains, concrete channels, swales, detention facilities, storm water treatment facilities, natural and constructed channels, and the method for conveying offsite flows through or around the proposed project site. Identify all discharge locations from the proposed project site along with a summary of the conveyance system size and capacity for each of the discharge locations. Provide a summary of pre and post-project drainage areas and design flows to each of the runoff discharge locations. Reference the drainage study for detailed calculations. Description / Additional Information: The project proposes an underground system of storm drain pipes and inlets to convey the proposed project flows. Also offsite flows from the existing development on the east side of the site are intercepted by a proposed headwall and bypassed across the project site through an underground system of pipes. See Attachment 5 for detailed drainage calculations.

Project Name: Airway Logistics Center

Form I-3B Page 6 of 11
Identify whether any of the following features, activities, and/or pollutant source areas will be present (select all that apply): ☑Onsite storm drain inlets ☐Interior floor drains and elevator shaft sump pumps ☐Interior parking garages ☐Need for future indoor & structural pest control ☑Landscape/outdoor pesticide use ☐Pools, spas, ponds, decorative fountains, and other water features ☐Food service ☐Refuse areas ☐Industrial processes ☐Outdoor storage of equipment or materials ☐Vehicle and equipment cleaning ☐Vehicle/equipment repair and maintenance ☐Fuel dispensing areas ☑Loading docks ☐Fire sprinkler test water ☐Miscellaneous drain or wash water ☑Plazas, sidewalks, and parking lots Description/Additional Information:

Form I-3B Page 7 of 11
Identification and Narrative of Receiving Water
Narrative describing flow path from discharge location(s), through urban storm conveyance system, to receiving creeks, rivers, and lagoons and ultimate discharge location to Pacific Ocean (or bay, lagoon, lake or reservoir, as applicable) The runoff from the proposed site drains into an property then the flow surface flows to the Otay Mesa Creek to the US Mexico Border and into Mexico to the Tijuana River and into the Pacific Ocean.
Provide a summary of all beneficial uses of receiving waters downstream of the project discharge locations GROUND WATER POTENTIAL BENEFICIAL USE:MUN, AGR, IND INLAND SURFACE WATERS: SPRING CANYON EXISTING BENIFICIAL USES: AGR, REC2, WARM,WILD SPRING CANYON POTENTIAL BENIFICIAL USES: IND, REC1, WARM,WILD COASTAL WATERS EXISTING BENEFICIAL USES: IND,NAV,REC1,REC2,COMM,BIOL,WILD,RARE,MAR,AQUA,MIGR,SPAWN,SHELL
Identify all ASBS (areas of special biological significance) receiving waters downstream of the project discharge locations There are no areas of ASBS downstream project.
Provide distance from project outfall location to impaired or sensitive receiving waters The site doesn't drain to it, project doesn't discharge to the ESA
Summarize information regarding the proximity of the permanent, post-construction storm water BMPs to the City's Multi-Habitat Planning Area and environmentally sensitive lands The site is not in the proximity to the City's Multi-Habitat Planning Area.

Form I-3B Page 8 of 11		
Identification of Receiving Water Pollutants of Concern		
List any 303(d) impaired water bodies within the path of storm water from the project site to the Pacific Ocean (or bay, lagoon, lake or reservoir, as applicable), identify the pollutant(s)/stressor(s) causing impairment, and identify any TMDLs and/or Highest Priority Pollutants from the WQIP for the impaired water bodies:		
303(d) Impaired Water Body (Refer to Appendix K)	Pollutant(s)/Stressor(s) (Refer to Appendix K)	TMDLs/WQIP Highest Priority Pollutant (Refer to Table 1-4 in Chapter 1)
Tijuana River	utrophic	
	Indicator Bacteria	
	Low Dissolved Oxygen	
	Pesticides	
	Phosphorous	
	Sedimentation/Siltation	
	Selenium	
	Solids Surfactants (MBAS)	
	Synthetic Organics	
	Total Nitrogen as N Toxicity	

Identification of Project Site Pollutants*

*Identification of project site pollutants is only required if flow-thru treatment BMPs are implemented onsite in lieu of retention or biofiltration BMPs (note the project must also participate in an alternative compliance program unless prior lawful approval to meet earlier PDP requirements is demonstrated)

Identify pollutants anticipated from the project site based on all proposed use(s) of the site (see Appendix B.6):

Pollutant	Not Applicable to the Project Site	Anticipated from the Project Site	Also a Receiving Water Pollutant of Concern
Sediment	☑	☑	☑
Nutrients	☐	☐	☐
Heavy Metals	☐	☑	☑
Organic Compounds	☐	☑	☑
Trash & Debris	☐	☑	☑
Oxygen Demanding Substances	☐	☑	☑
Oil & Grease	☐	☑	☐
Bacteria & Viruses	☑	☐	☐
Pesticides	☑	☐	☐

Form I-3B Page 9 of 11
Hydromodification Management Requirements
Do hydromodification management requirements apply (see Section 1.6)? ☑ Yes, hydromodification management flow control structural BMPs required. ☐ No, the project will discharge runoff directly to existing underground storm drains discharging directly to water storage reservoirs, lakes, enclosed embayments, or the Pacific Ocean. ☐ No, the project will discharge runoff directly to conveyance channels whose bed and bank are concrete-lined all the way from the point of discharge to water storage reservoirs, lakes, enclosed embayments, or the Pacific Ocean. ☐ No, the project will discharge runoff directly to an area identified as appropriate for an exemption by the WMAA for the watershed in which the project resides. Description / Additional Information (to be provided if a 'No' answer has been selected above): Note: If "No" answer has been selected the SWQMP must include an exhibit that shows the storm water conveyance system from the project site to an exempt water body. The exhibit should include details about the conveyance system and the outfall to the exempt water body.
Critical Coarse Sediment Yield Areas* ***This Section only required if hydromodification management requirements apply**
Based on Section 6.2 and Appendix H does CCSYA exist on the project footprint or in the upstream area draining through the project footprint? ☐ Yes ☑ No Discussion / Additional Information: No upstream CCSYA drain into site, There is no CCYSA onsite. See Attachment 2b

Form I-3B Page 10 of 11
Flow Control for Post-Project Runoff*   ***This Section only required if hydromodification management requirements apply**
List and describe point(s) of compliance (POCs) for flow control for hydromodification management (see Section 6.3.1). For each POC, provide a POC identification name or number correlating to the project's HMP Exhibit and a receiving channel identification name or number correlating to the project's HMP Exhibit.   Project will have one point of compliance (POC-1) located on the east side of the site.
Has a geomorphic assessment been performed for the receiving channel(s)?   ☑No, the low flow threshold is $0.1Q_2$ (default low flow threshold)   ☐Yes, the result is the low flow threshold is $0.1Q_2$ ☐Yes, the result is the low flow threshold is $0.3Q_2$ ☐Yes, the result is the low flow threshold is $0.5Q_2$ If a geomorphic assessment has been performed, provide title, date, and preparer:
Discussion / Additional Information: (optional)   N/A

Form I-3B Page 11 of 11
Other Site Requirements and Constraints
When applicable, list other site requirements or constraints that will influence storm water management design, such as zoning requirements including setbacks and open space, or local codes governing minimum street width, sidewalk construction, allowable pavement types, and drainage requirements. N/A
Optional Additional Information or Continuation of Previous Sections As Needed
This space provided for additional information or continuation of information from previous sections as needed. N/A

Source Control BMP Checklist for PDPs	Form I-4B		
Source Control BMPs			
All development projects must implement source control BMPs where applicable and feasible. See Chapter 4 and Appendix E of the BMP Design Manual (Part 1 of the Storm Water Standards) for information to implement source control BMPs shown in this checklist. Answer each category below pursuant to the following. • "Yes" means the project will implement the source control BMP as described in Chapter 4 and/or Appendix E of the BMP Design Manual. Discussion / justification is not required. • "No" means the BMP is applicable to the project but it is not feasible to implement. Discussion / justification must be provided. • "N/A" means the BMP is not applicable at the project site because the project does not include the feature that is addressed by the BMP (e.g., the project has no outdoor materials storage areas). Discussion / justification may be provided.			
Source Control Requirement	**Applied?**		
4.2.1 Prevention of Illicit Discharges into the MS4	☑ Yes	☐ No	☐ N/A
Discussion / justification if 4.2.1 not implemented:			
4.2.2 Storm Drain Stenciling or Signage	☑ Yes	☐ No	☐ N/A
Discussion / justification if 4.2.2 not implemented:			
4.2.3 Protect Outdoor Materials Storage Areas from Rainfall, Run-On, Runoff, and Wind Dispersal	☐ Yes	☐ No	☑ N/A
Discussion / justification if 4.2.3 not implemented:			
4.2.4 Protect Materials Stored in Outdoor Work Areas from Rainfall, Run-On, Runoff, and Wind Dispersal	☐ Yes	☐ No	☑ N/A
Discussion / justification if 4.2.4 not implemented:			
4.2.5 Protect Trash Storage Areas from Rainfall, Run-On, Runoff, and Wind Dispersal	☐ Yes	☐ No	☑ N/A
Discussion / justification if 4.2.5 not implemented:			

Form I-4B Page 2 of 2			
Source Control Requirement	**Applied?**		
4.2.6 Additional BMPs Based on Potential Sources of Runoff Pollutants (must answer for each source listed below)			
On-site storm drain inlets	☑ Yes	☐ No	☐ N/A
Interior floor drains and elevator shaft sump pumps	☐ Yes	☐ No	☑ N/A
Interior parking garages	☐ Yes	☐ No	☑ N/A
Need for future indoor & structural pest control	☐ Yes	☐ No	☑ N/A
Landscape/Outdoor Pesticide Use	☐ Yes	☐ No	☑ N/A
Pools, spas, ponds, decorative fountains, and other water features	☐ Yes	☐ No	☑ N/A
Food service	☐ Yes	☐ No	☑ N/A
Refuse areas	☐ Yes	☐ No	☑ N/A
Industrial processes	☐ Yes	☐ No	☑ N/A
Outdoor storage of equipment or materials	☐ Yes	☐ No	☑ N/A
Vehicle/Equipment Repair and Maintenance	☐ Yes	☐ No	☑ N/A
Fuel Dispensing Areas	☐ Yes	☐ No	☑ N/A
Loading Docks	☐ Yes	☐ No	☑ N/A
Fire Sprinkler Test Water	☐ Yes	☐ No	☑ N/A
Miscellaneous Drain or Wash Water	☐ Yes	☐ No	☑ N/A
Plazas, sidewalks, and parking lots	☑ Yes	☐ No	☐ N/A
SC-6A: Large Trash Generating Facilities	☐ Yes	☐ No	☑ N/A
SC-6B: Animal Facilities	☐ Yes	☐ No	☑ N/A
SC-6C: Plant Nurseries and Garden Centers	☐ Yes	☐ No	☑ N/A
SC-6D: Automotive Facilities	☐ Yes	☐ No	☑ N/A
Discussion / justification if 4.2.6 not implemented. Clearly identify which sources of runoff pollutants are discussed. Justification must be provided for all "No" answers shown above.			

Project Name: Airway Logistics Center

Site Design BMP Checklist for PDPs			Form I-5B
Site Design BMPs			
All development projects must implement site design BMPs where applicable and feasible. See Chapter 4 and Appendix E of the BMP Design Manual (Part 1 of Storm Water Standards) for information to implement site design BMPs shown in this checklist. Answer each category below pursuant to the following. • "Yes" means the project will implement the site design BMP as described in Chapter 4 and/or Appendix E of the BMP Design Manual. Discussion / justification is not required. • "No" means the BMP is applicable to the project but it is not feasible to implement. Discussion / justification must be provided. • "N/A" means the BMP is not applicable at the project site because the project does not include the feature that is addressed by the BMP (e.g., the project site has no existing natural areas to conserve). Discussion / justification may be provided. A site map with implemented site design BMPs must be included at the end of this checklist.			
Site Design Requirement	**Applied?**		
4.3.1 Maintain Natural Drainage Pathways and Hydrologic Features	☐ Yes	☑ No	☐ N/A
Discussion / justification if 4.3.1 not implemented:			
1-1 Are existing natural drainage pathways and hydrologic features mapped on the site map?	☐ Yes	☑ No	☐ N/A
1-2 Are trees implemented? If yes, are they shown on the site map?	☐ Yes	☑ No	☐ N/A
1-3 Implemented trees meet the design criteria in 4.3.1 Fact Sheet (e.g. soil volume, maximum credit, etc.)?	☐ Yes	☑ No	☐ N/A
1-4 Is tree credit volume calculated using Appendix B.2.2.1 and SD-1 Fact Sheet in Appendix E?	☐ Yes	☑ No	☐ N/A
4.3.2 Have natural areas, soils and vegetation been conserved?	☐ Yes	☑ No	☐ N/A
Discussion / justification if 4.3.2 not implemented:			

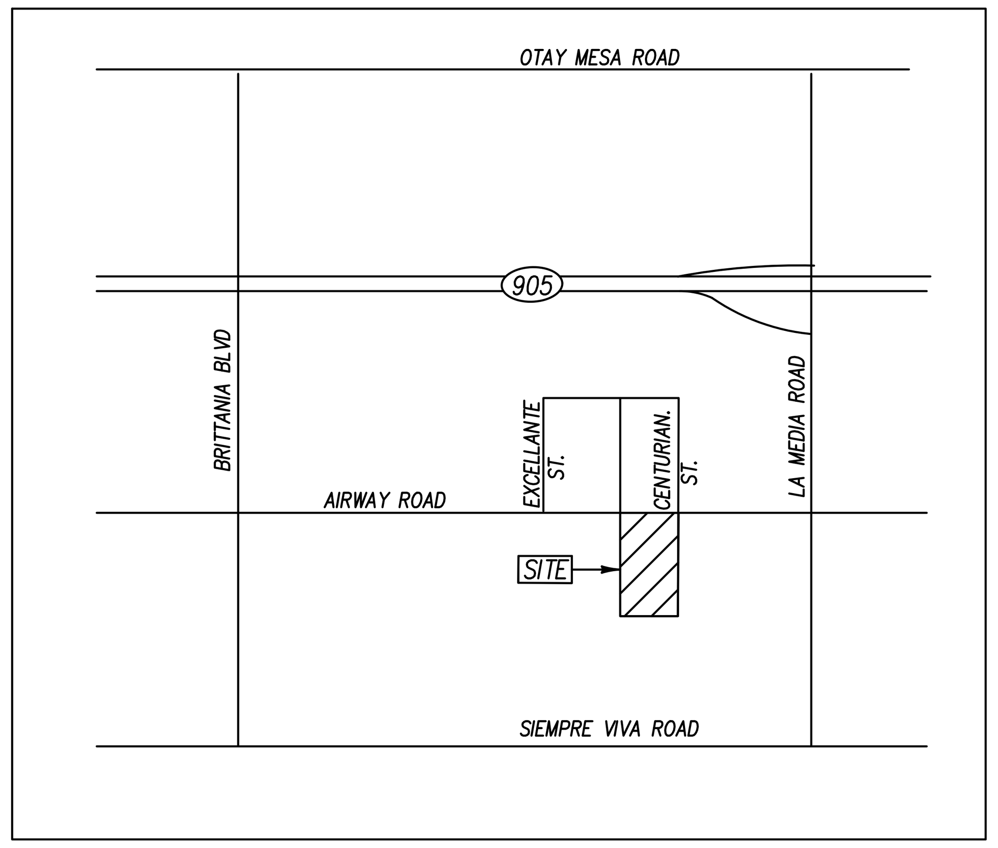
Form I-5B Page 2 of 4			
Site Design Requirement	**Applied?**		
4.3.3 Minimize Impervious Area	☑ Yes	☐ No	☐ N/A
Discussion / justification if 4.3.3 not implemented: Two biofiltration BMPs is being proposed			
4.3.4 Minimize Soil Compaction	☑ Yes	☐ No	☐ N/A
Discussion / justification if 4.3.4 not implemented: Two biofiltration BMPs are being proposed where soil compaction is minimized.			
4.3.5 Impervious Area Dispersion	☐ Yes	☐ No	☑ N/A
Discussion / justification if 4.3.5 not implemented:			
5-1 Is the pervious area receiving runon from impervious area identified on the site map?	☐ Yes	☐ No	☑ N/A
5-2 Does the pervious area satisfy the design criteria in 4.3.5 Fact Sheet in Appendix E (e.g. maximum slope, minimum length, etc.)	☐ Yes	☐ No	☑ N/A
5-3 Is impervious area dispersion credit volume calculated using Appendix B.2.1.1 and 4.3.5 Fact Sheet in Appendix E?	☐ Yes	☐ No	☑ N/A

Project Name: Airway Logistics Center

Form I-5B Page 3 of 4			
Site Design Requirement	**Applied?**		
4.3.6 Runoff Collection	☐ Yes	☑ No	☐ N/A
Discussion / justification if 4.3.6 not implemented: Runoff collection is infeasible, green roof requires structural capacity that will make this project very costly and therefore unfeasible. Permeable pavement is unfeasible due to soil conditions (soil type D)			
6a-1 Are green roofs implemented in accordance with design criteria in 4.3.6A Fact Sheet? If yes, are they shown on the site map?	☐ Yes	☑ No	☐ N/A
6a-2 Is the green roof credit volume calculated using Appendix B.2.1.2 and 4.3.6A Fact Sheet in Appendix E?	☐ Yes	☑ No	☐ N/A
6b-1 Are permeable pavements implemented in accordance with design criteria in 4.3.6B Fact Sheet? If yes, are they shown on the site map?	☐ Yes	☑ No	☐ N/A
6b-2 Is the permeable pavement credit volume calculated using Appendix B.2.1.3 and 4.3.6B Fact Sheet in Appendix E?	☐ Yes	☑ No	☐ N/A
4.3.7 Landscaping with Native or Drought Tolerant Species	☑ Yes	☐ No	☐ N/A
Discussion / justification if 4.3.7 not implemented: No permeable pavement is being proposed for this project.			
4.3.8 Harvest and Use Precipitation	☐ Yes	☑ No	☐ N/A
Discussion / justification if 4.3.8 not implemented: Harvesting and reuse not feasible for project (See attachment 1c)			
8-1 Are rain barrels implemented in accordance with design criteria in 4.3.8 Fact Sheet? If yes, are they shown on the site map?	☐ Yes	☑ No	☐ N/A
8-2 Is the rain barrel credit volume calculated using Appendix B.2.2.2 and 4.3.8 Fact Sheet in Appendix E?	☐ Yes	☐ No	☑ N/A

Project Name: Airway Logistics Center

Form I-5B Page 4 of 4
Insert Site Map with all site design BMPs identified:
See attached Site Design Exhibit

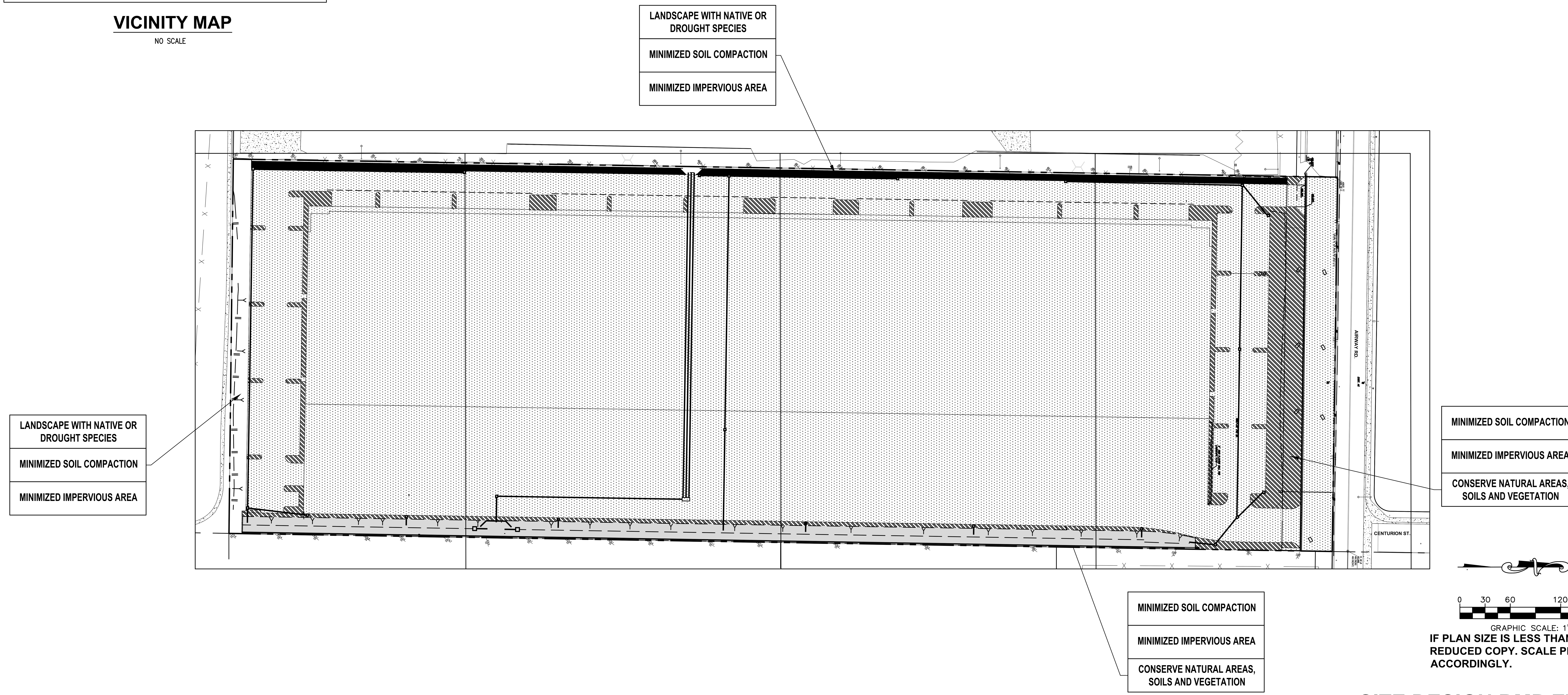


VICINITY MAP

NO SCALE

LEGEND

ITEM	SYMBOL
DMA LIMIT	- - - - -
IMPERVIOUS AREA	(dotted box)
PERVIOUS AREA	(hatched box)



0 30 60 120 180

GRAPHIC SCALE: 1" = 60'

IF PLAN SIZE IS LESS THAN 24"x36", THIS IS A REDUCED COPY. SCALE PLAN ACCORDINGLY.

SITE DESIGN BMP EXHIBIT FORM I-5B

K&S ENGINEERING, INC.
Planning . Engineering . Surveying
7801 Mission Center Court, Suite 100 San Diego, CA 92108
(619) 296-5565 Fax: (619) 296-5564

REGISTERED PROFESSIONAL ENGINEER KAMAL S. SWEIS NO.48592 EXP 6-30-22 CIVIL STATE OF CALIFORNIA

SITE DESIGN EXHIBIT FOR:

AIRWAY LOGISTICS CENTER

SHEET 1 OF 1

Project Name: Airway Logistics Center

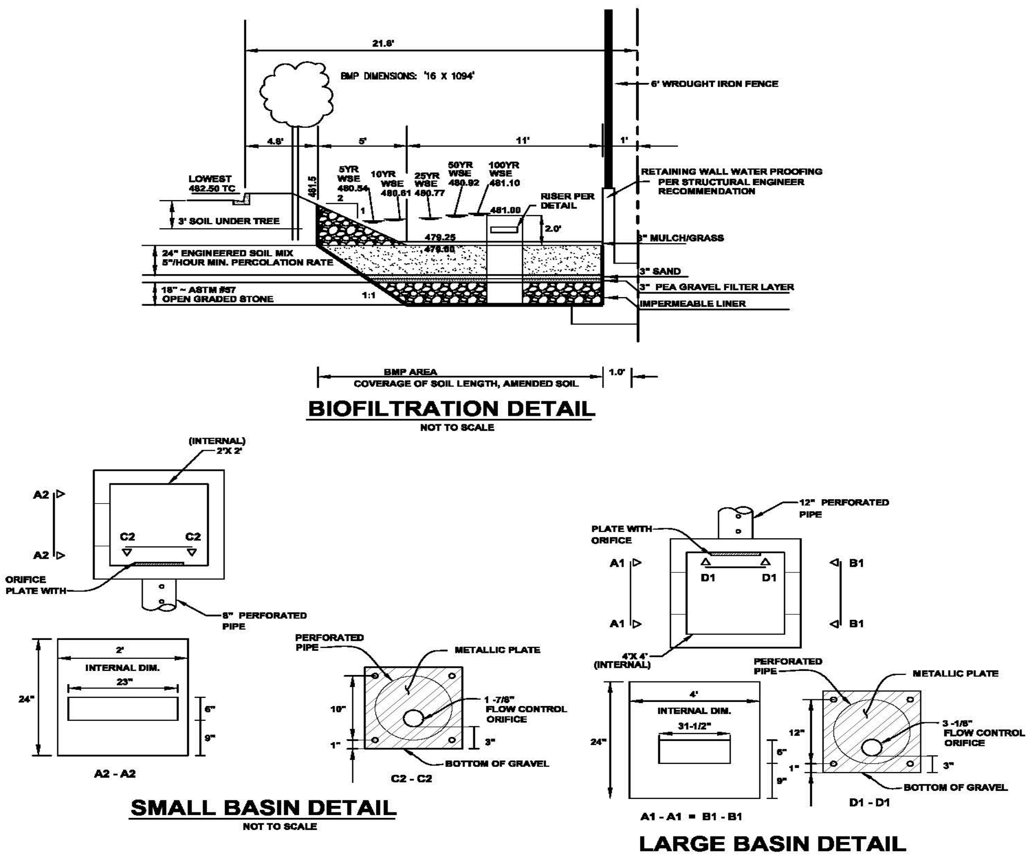
Summary of PDP Structural BMPs	Form I-6
PDP Structural BMPs	
All PDPs must implement structural BMPs for storm water pollutant control (see Chapter 5 of the BMP Design Manual, Part 1 of Storm Water Standards). Selection of PDP structural BMPs for storm water pollutant control must be based on the selection process described in Chapter 5. PDPs subject to hydromodification management requirements must also implement structural BMPs for flow control for hydromodification management (see Chapter 6 of the BMP Design Manual). Both storm water pollutant control and flow control for hydromodification management can be achieved within the same structural BMP(s). PDP structural BMPs must be verified by the City at the completion of construction. This includes requiring the project owner or project owner's representative to certify construction of the structural BMPs (complete Form DS-563). PDP structural BMPs must be maintained into perpetuity (see Chapter 7 of the BMP Design Manual). Use this form to provide narrative description of the general strategy for structural BMP implementation at the project site in the box below. Then complete the PDP structural BMP summary information sheet (page 3 of this form) for each structural BMP within the project (copy the BMP summary information page as many times as needed to provide summary information for each individual structural BMP).	
Describe the general strategy for structural BMP implementation at the site. This information must describe how the steps for selecting and designing storm water pollutant control BMPs presented in Section 5.1 of the BMP Design Manual were followed, and the results (type of BMPs selected). For projects requiring hydromodification flow control BMPs, indicate whether pollutant control and flow control BMPs are integrated or separate. Per Storm Water Infiltration Feasibility Condition letter from Geocon Infiltration Feasibility condition foe Baidee Development dated May 18 2020 Project No. G2467-42-01 infiltration is infeasible for this project. As a result of the the No Infiltration Condition presented in the above Storm Water Infiltration Feasibility Condition letter one BF-1 biofiltration basin is being proposed for this project for HMP and pollutant control for DMA 1. Harvest & Use is infeasible as shown on Form I-7 attached (Continue on page 2 as necessary.)	

Form I-6 Page 2 of
(Continued from page 1)

Project Name: Airway Logistics Center

Form I-6 Page of (Copy as many as needed)	
Structural BMP Summary Information	
Structural BMP ID No. BMP 1	
Construction Plan Sheet No. C-2	
Type of Structural BMP: ☐ Retention by harvest and use (e.g. HU-1, cistern) ☐ Retention by infiltration basin (INF-1) ☐ Retention by bioretention (INF-2) ☐ Retention by permeable pavement (INF-3) ☐ Partial retention by biofiltration with partial retention (PR-1) ☑ Biofiltration (BF-1) ☐ Flow-thru treatment control with prior lawful approval to meet earlier PDP requirements (provide BMP type/description in discussion section below) ☐ Flow-thru treatment control included as pre-treatment/forebay for an onsite retention or biofiltration BMP (provide BMP type/description and indicate which onsite retention or biofiltration BMP it serves in discussion section below) ☐ Flow-thru treatment control with alternative compliance (provide BMP type/description in discussion section below) ☐ Detention pond or vault for hydromodification management ☐ Other (describe in discussion section below)	
Purpose: ☐ Pollutant control only ☐ Hydromodification control only ☑ Combined pollutant control and hydromodification control ☐ Pre-treatment/forebay for another structural BMP ☐ Other (describe in discussion section below)	
Who will certify construction of this BMP? Provide name and contact information for the party responsible to sign BMP verification form DS-563	K&S ENGINEERING 7801 MISSION CENTER COURT, SUITE 100 SAN DIEGO, CA 92108
Who will be the final owner of this BMP?	BADIEE DEVELOPMENT 261 PROSPECT STREET STE.9 LA JOLLA, CA 92037
Who will maintain this BMP into perpetuity?	BADIEE DEVELOPMENT 261 PROSPECT STREET STE.9 LA JOLLA, CA 92037
What is the funding mechanism for maintenance?	Private Income

Form I-6 Page of (Copy as many as needed)
Structural BMP ID No. BMP 1
Construction Plan Sheet No. C-2
Discussion (as needed; must include worksheets showing BMP sizing calculations in the SWQMPs):



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Attachment 1
Backup For PDP Pollutant Control BMPs

This is the cover sheet for Attachment 1.

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Project Name: Airway Logistics Center

Indicate which Items are Included:

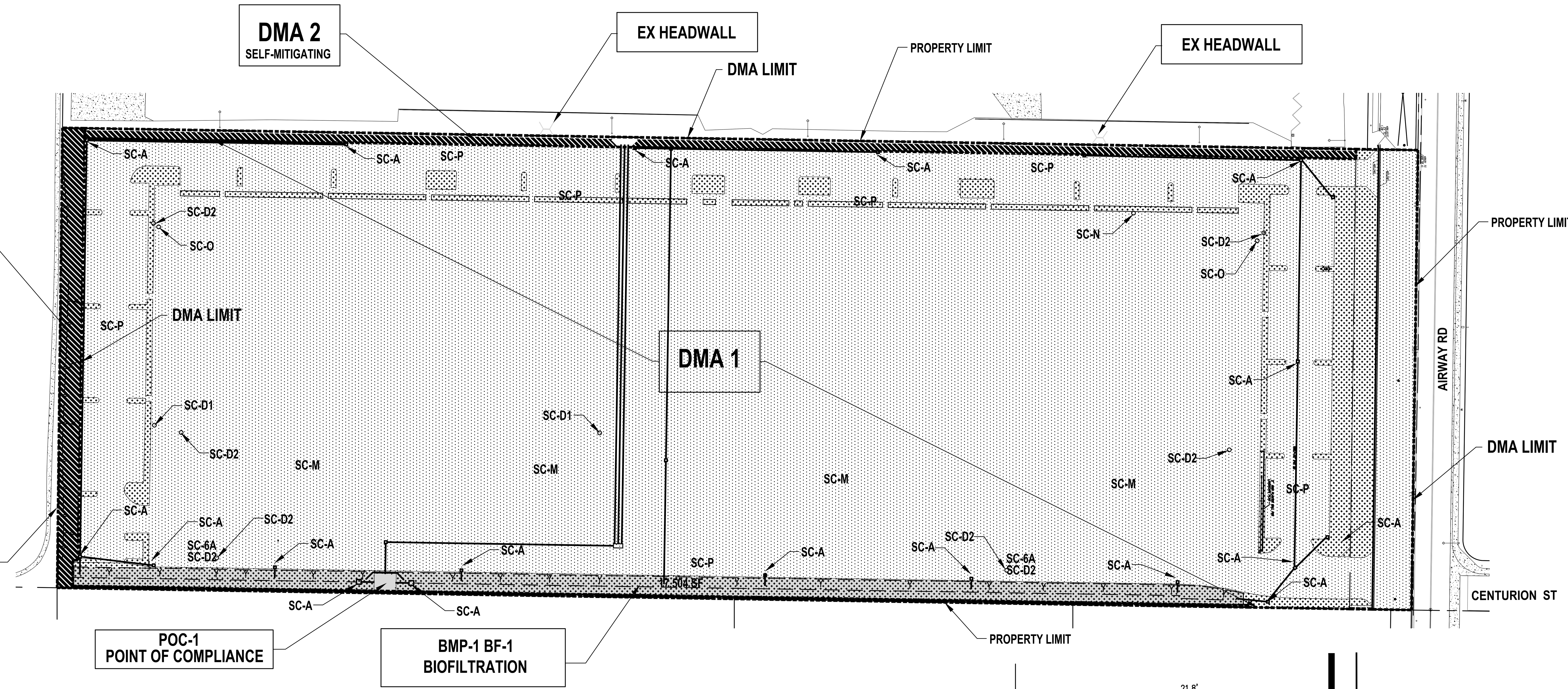
Attachment Sequence	Contents	Checklist
Attachment 1a	DMA Exhibit (Required) See DMA Exhibit Checklist.	☑ Included
Attachment 1b	Tabular Summary of DMAs Showing DMA ID matching DMA Exhibit, DMA Area, and DMA Type (Required)* *Provide table in this Attachment OR on DMA Exhibit in Attachment 1a	☑ Included on DMA Exhibit in Attachment 1a ☐ Included as Attachment 1b, separate from DMA Exhibit
Attachment 1c	Form I-7, Harvest and Use Feasibility Screening Checklist (Required unless the entire project will use infiltration BMPs) Refer to Appendix B.3-1 of the BMP Design Manual to complete Form I-7.	☑ Included ☐ Not included because the entire project will use infiltration BMPs
Attachment 1d	Infiltration Feasibility Information. Contents of Attachment 1d depend on the infiltration condition: • No Infiltration Condition: ○ Infiltration Feasibility Condition Letter (*Note: must be stamped and signed by licensed geotechnical engineer*) ○ Form I-8A (optional) ○ Form I-8B (optional) • Partial Infiltration Condition: ○ Infiltration Feasibility Condition Letter (*Note: must be stamped and signed by licensed geotechnical engineer*) ○ Form I-8A ○ Form I-8B • Full Infiltration Condition: ○ Form I-8A ○ Form I-8B ○ Worksheet C.4-3 ○ Form I-9 Refer to Appendices C and D of the BMP Design Manual for guidance.	☑ Included ☐ Not included because the entire project will use harvest and use BMPs
Attachment 1e	Pollutant Control BMP Design Worksheets / Calculations (Required) Refer to Appendices B and E of the BMP Design Manual for structural pollutant control BMP design guidelines and site design credit calculations	☑ Included

Project Name: Airway Logistics Center

Use this checklist to ensure the required information has been included on the DMA Exhibit:

The DMA Exhibit must identify:

- ☑ Underlying hydrologic soil group
- ☑ Approximate depth to groundwater
- ☑ Existing natural hydrologic features (watercourses, seeps, springs, wetlands)
- ☑ Critical coarse sediment yield areas to be protected
- ☑ Existing topography and impervious areas
- ☑ Existing and proposed site drainage network and connections to drainage offsite
- ☑ Proposed grading
- ☑ Proposed impervious features
- ☑ Proposed design features and surface treatments used to minimize imperviousness
- ☑ Drainage management area (DMA) boundaries, DMA ID numbers, and DMA areas (square footage or acreage), and DMA type (i.e., drains to BMP, self-retaining, or self-mitigating)
- ☑ Potential pollutant source areas and corresponding required source controls (see Chapter 4, Appendix E.1, and Form I-3B)
- ☑ Structural BMPs (identify location, type of BMP, size/detail, and include cross-section)



LEGEND

ITEM	SYMBOL
DMA LIMIT	
PERVIOUS AREA	
IMPERVIOUS AREA	
ONSITE STORM DRAIN INLETS, STENCILING/SIGNAGE "NO DUMPING! GOES TO OCEAN"	SC-A
FUTURE INDOOR & STRUCTURAL PEST CONTROL	SC-D1
LANDSCAPE/OUTDOOR PESTICIDE USE	SC-D2
REFUSE AREAS	SC-G
LOADING DOCKS	SC-M
FIRE SPRINKLER TEST WATER	SC-N
MISCELLANEOUS DRAIN OR WASH WATER	SC-O
PLAZAS, SIDEWALKS AND PARKING LOTS	SC-P
LARGE TRASH GENERATING FACILITIES	SC-6A

GROUNDWATER

GROUND WATER WAS NOT ENCOUNTERED PER GEOTECHNICAL REPORT PREPARED BY GEOCON INCORPORATED DATED MAY 18, 2020

HYDROLOGIC SOIL GROUP

THE 87% OF THE SITE IS CLASSIFIED AS HrC HUERHUERO LOAM SOIL TYP D AND THE REMAINING 13% AS SuB STOCKPEN GRAVELLY CLAY LOAM SOIL TYPE D PER NRCS WEB SOILS

CCSYA NOTE:

PROJECT IS NOT WITHIN OR DOESN'T RECEIVE OR DRAINS FROM CRITICAL COARSE SEDIMENT YIELD AREAS. SEE ATTACHMENT 2b

BMP CATEGORY/TYPE

BIOFILTRATION BF-1

TOTAL SITE AREA

585,607 SQ. FT.

TOTAL DISTURBED AREA

583,097 SQ. FT.

PROJECT AREA IMPERVIOUS/PERVIOUS TABLE

	IMPERVIOUS AREA (SQ.FT.)	PERVIOUS AREA (SQ.FT.)	TOTAL (SQ.FT.)
EXISTING	0	585,607	585,607
PROPOSED	513,735	71,872	585,607

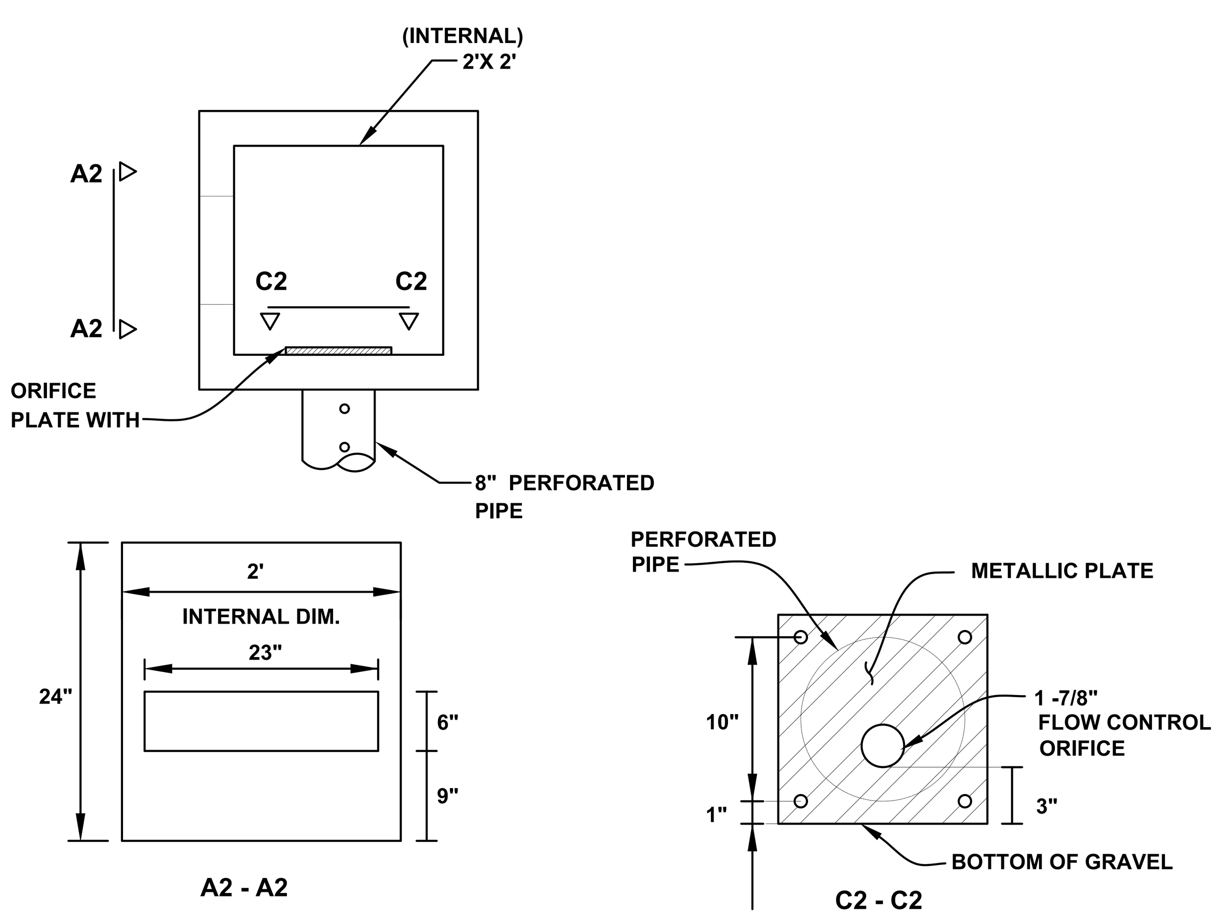
BIORETENTION SOIL MEDIA NOTE:

COMPOST SHALL BE CERTIFIED BY THE U.S. COMPOSTING COUNCIL'S SEAL OF TESTING ASSURANCE PROGRAM OR AN APPROVED EQUIVALENT PROGRAM. COMPOST SHALL COMPLY WITH THE FOLLOWING REQUIREMENTS:

1. ORGANIC MATERIAL CONTENT SHALL BE 35% TO 75% BY DRY WEIGHT.
2. CARBON TO NITROGEN (C:N) RATIO SHALL BE BETWEEN 15:1 AND 40:1, PREFERABLY ABOVE 20:1 TO REDUCE THE POTENTIAL FOR NITROGEN LEACHING/WASHOUT.
3. PHYSICAL CONTAMINANTS (MANMADE INERT MATERIALS) SHALL NOT EXCEED 1% BY DRY WEIGHT.
4. PH SHALL BE BETWEEN 6.0 AND 7.5.
5. SOLUBLE SALT CONCENTRATION SHALL BE LESS THAN 10 DS/M (METHOD TMECC 4.10–A, USDA AND U.S. COMPOSTING COUNCIL).
6. MATURITY (SEED EMERGENCE AND SEEDLING VIGOR) SHALL BE GREATER THAN 80% RELATIVE TO POSITIVE CONTROL (METHOD TMECC 5.05–A, USDA AND U.S. COMPOSTING COUNCIL)
7. STABILITY (CARBON DIOXIDE EVOLUTION RATE) SHALL BE LESS THAN 2.5 MG CO2–C PER G COMPOST ORGANIC MATTER (OM) PER DAY OR LESS THAN 5 MG CO2–C PER G COMPOST CARBON PER DAY, WHICHEVER UNIT IS REPORTED. (METHOD TMECC 5.08–B, USDA AND U.S. COMPOSTING COUNCIL). ALTERNATIVELY A SOLVITA RATING OF 6 OR HIGHER IS ACCEPTABLE.
8. MOISTURE SHALL BE 25%–55% WET WEIGHT BASIS.
9. SELECT PATHOGENS SHALL PASS US EPA CLASS A STANDARD, 40 CFR SECTION 503.32(A).
10. TRACE METALS SHALL PASS US EPA CLASS A STANDARD, 40 CFR SECTION 503.13, TABLES 1 AND 3.
11. SHALL BE WITHIN GRADATION LIMITS IN TABLE F.3–2 (ASTM D 422 SIEVE ANALYSIS OR APPROVED EQUIVALENT).

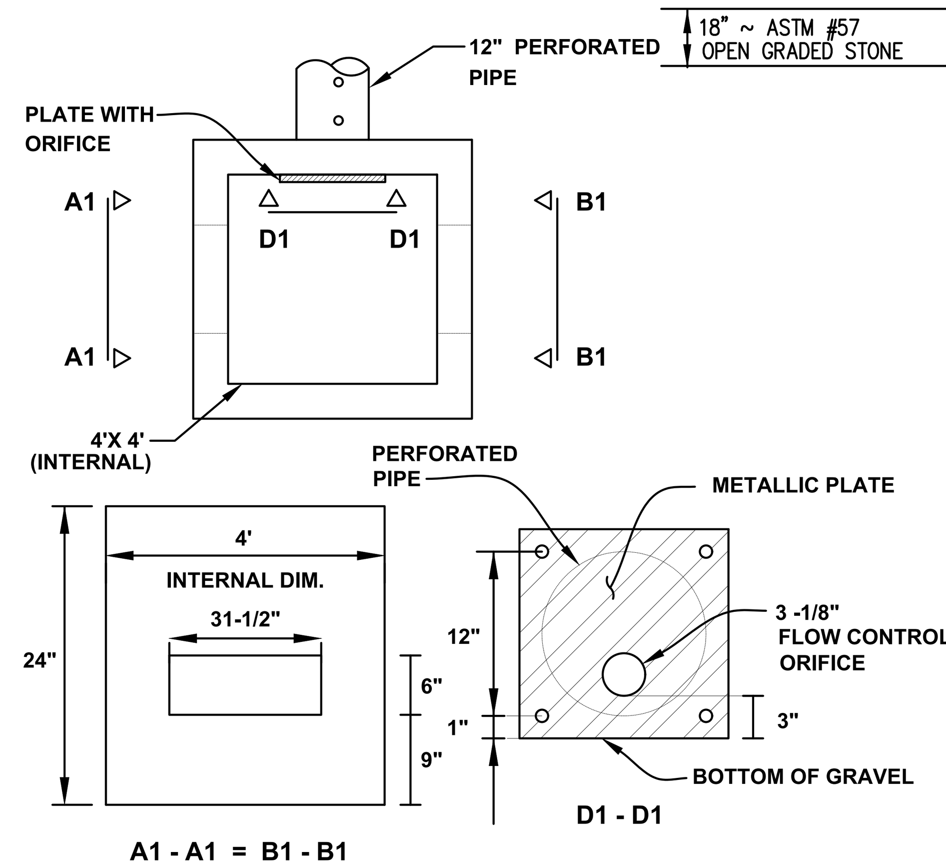
Table F.3-2: Compost Gradation Limits

Sieve Size	Percent Passing (by weight)
16 mm (5/8")	99 to 100
6.3 mm (1/4")	40 to 95
2 mm	40 to 90



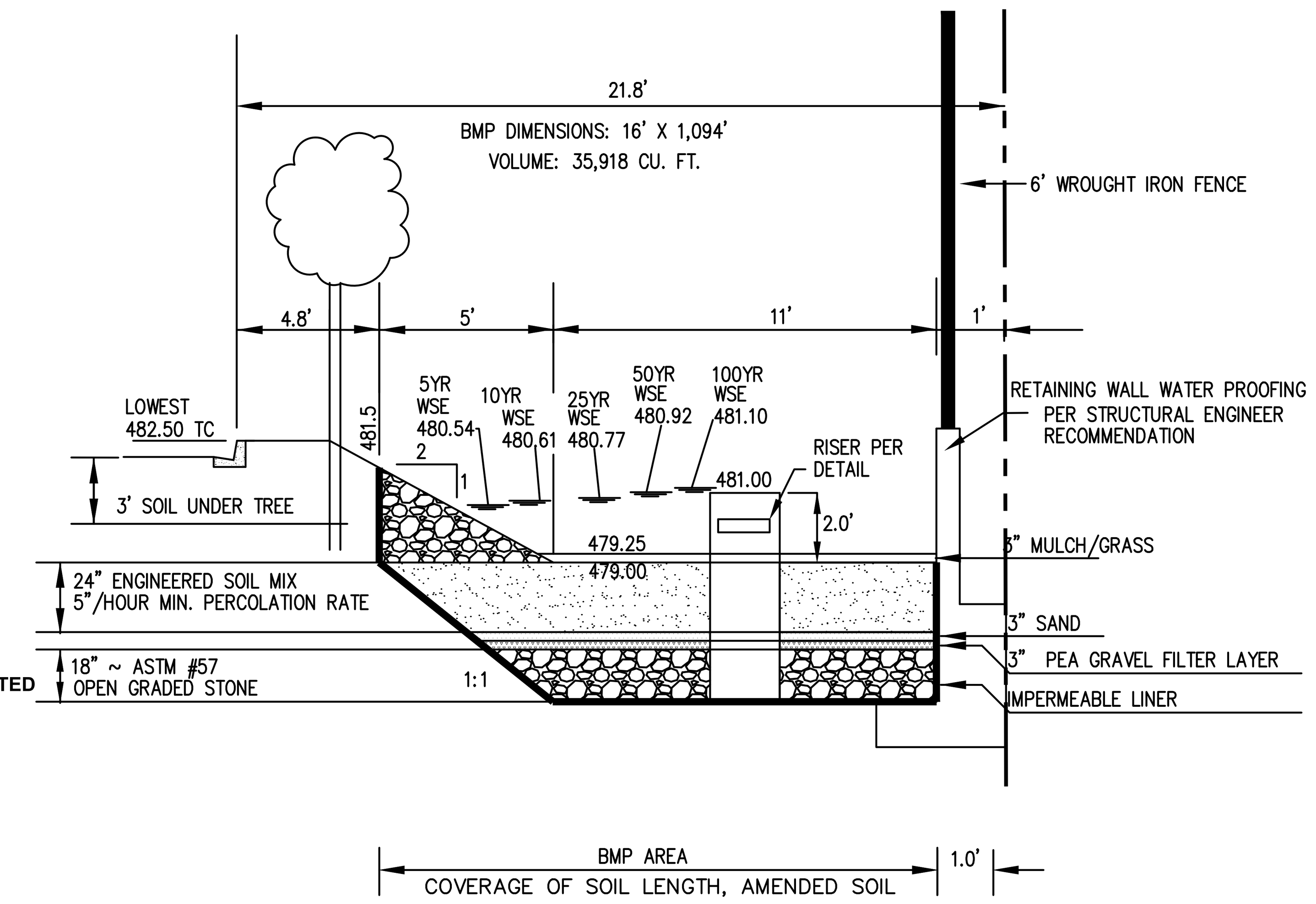
SMALL BASIN DETAIL

NOT TO SCALE



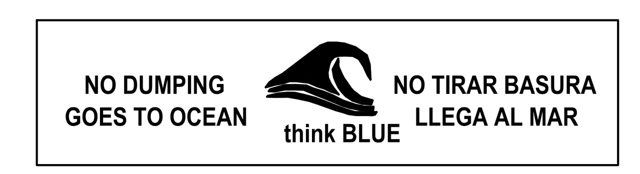
LARGE BASIN DETAIL

NOT TO SCALE



BIOFILTRATION DETAIL

NOT TO SCALE



NOTES:

1. THESE ARE SAMPLE TILES AND SIGNS.
2. CITY ENGINEER TO DESIGNATE OR APPROVE SIGNS, TILES OR STENCILS.
3. PROVIDE LABELING WITH PROHIBITIVE LANGUAGE ("NO DUMPING GOES TO OCEAN – NO TIRAR BASURA LLEGA AL MAR")
4. SIGN SHOULD BE PLACED ON THE CATCH BASIN GRATE.
5. SIGN SHALL HAVE A WHITE BACKGROUND WITH BLUE LETTERING.

STORM DRAIN SIGNAGE

NOT TO SCALE

0 30 60 120 180

GRAPHIC SCALE: 1" = 60'

IF PLAN SIZE IS LESS THAN 24"x36", THIS IS A REDUCED COPY. SCALE PLAN ACCORDINGLY.

K & S ENGINEERING, INC.
Planning . Engineering . Surveying
7801 Mission Center Court, Suite 100 San Diego, CA 92108
(619) 296-5565 Fax: (619) 296-5564

DRAINAGE MANAGEMENT AREA (DMA)
ATTACHMENT 1a

DMA SHEET FOR:

AIRWAY LOGISTICS CENTER

SHEET 1 OF 1

Attachment 1c

Harvest and Use Feasibility Checklist		Worksheet B.3-1 : Form I-7
1. Is there a demand for harvested water (check all that apply) at the project site that is reliably present during the wet season? ☒ Toilet and urinal flushing ☒ Landscape irrigation ☐ Other:___________		
2. If there is a demand; estimate the anticipated average wet season demand over a period of 36 hours. Guidance for planning level demand calculations for toilet/urinal flushing and landscape irrigation is provided in Section B.3.2. [Provide a summary of calculations here] Irrigation demand = 390 gal/acre x 1.49 acres = 581 gal = 78 CF T&U demand = 5.5 gal/employee/day x 1.5 days x 50 employees x 1/7.48 gal / cf = 55 cf Total demand = 87 + 55 = 142 cf		
3. Calculate the DCV using worksheet B-2.1. DCV = 20,292 (cubic feet) [Provide a summary of calculations here] SEE WORKSHEET B.5-1		
3a. Is the 36-hour demand greater than or equal to the DCV? ☐ Yes ⇩ / ☒ No ⇨	3b. Is the 36-hour demand greater than 0.25DCV but less than the full DCV? ☐ Yes ⇩ / ☒ No ⇨	3c. Is the 36-hour demand less than 0.25DCV? ☒ Yes ⇩
Harvest and use appears to be feasible. Conduct more detailed evaluation and sizing calculations to confirm that DCV can be used at an adequate rate to meet drawdown criteria.	Harvest and use may be feasible. Conduct more detailed evaluation and sizing calculations to determine feasibility. Harvest and use may only be able to be used for a portion of the site, or (optionally) the storage may need to be upsized to meet long term capture targets while draining in longer than 36 hours.	Harvest and use is considered to be infeasible.
Is harvest and use feasible based on further evaluation? ☐ Yes, refer to Appendix E to select and size harvest and use BMPs. ☒ No, select alternate BMPs.		

Attachment 1d

APPENDIX C

STORM WATER MANAGEMENT

We understand storm water management devices are being proposed in accordance with the current Storm Water Standards (SWS). If not properly constructed, there is a potential for distress to improvements and properties located hydrologically down gradient or adjacent to these devices. Factors such as the amount of water to be detained, its residence time, and soil permeability have an important effect on seepage transmission and the potential adverse impacts that may occur if the storm water management features are not properly designed and constructed. We have not performed a hydrogeological study at the site. If infiltration of storm water runoff occurs, downstream properties and improvements may be subjected to seeps, springs, slope instability, raised groundwater, movement of foundations and slabs, or other undesirable impacts as a result of water infiltration.

Hydrologic Soil Group

The United States Department of Agriculture (USDA), Natural Resources Conservation Services, possesses general information regarding the existing soil conditions for areas within the United States. The USDA website also provides the Hydrologic Soil Group. Table C-1 presents the descriptions of the hydrologic soil groups. In addition, the USDA website also provides an estimated saturated hydraulic conductivity for the existing soil.

TABLE C-1
HYDROLOGIC SOIL GROUP DEFINITIONS

Soil Group	Soil Group Definition
A	Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.
B	Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.
C	Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.
D	Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

The property is underlain by undocumented fill, surficial deposits such as topsoil, and Terrace Deposits. Table C-2 presents the information from the USDA website for the subject property.

TABLE C-2
USDA WEB SOIL SURVEY – HYDROLOGIC SOIL GROUP

Map Unit Name	Map Unit Symbol	Approximate Percentage of Property	Hydrologic Soil Group
Huerhuero loam, 2 to 9 percent slopes	HrC	93	D
Stockpen gravelly clay loam, 2 to 5 percent slopes	SuB	7	D

Infiltration Testing

We performed three infiltration tests at the locations shown on Figure 2. The tests were performed in 6-inch-diameter, drilled borings or in a hand-auger boring. Table C-3 presents the results of the testing. The calculation sheets are also attached.

We used the guidelines presented in the Riverside County Low Impact Development BMP Design Handbook. Based on this widely accepted guideline, the saturated hydraulic conductivity (Ksat) is equivalent to the infiltration rate. Therefore, the Ksat value determined from our testing is assumed to be the unfactored infiltration rate.

TABLE C-3
UNFACTORED, FIELD-SATURATED, INFILTRATION TEST RESULTS

Test No.	Depth (inches)	Geologic Unit	Field Infiltration Rate, I (in/hr)	Factored* Field Infiltration Rate, I (in/hr)
A-1	39	Qtc	0.003	0.001
A-1a	46	Qtc	0.005	0.003
A-2	33	Qtc	0.121	0.060
A-2a	25	Topsoil/Qtc	0.054	0.027
A-3	24	Topsoil/Qtc	0.004	0.002
A-3a	36	Qtc	0.023	0.012

* Factor of Safety of 2.0 for feasibility determination.

STORM WATER MANAGEMENT CONCLUSIONS

Soil Types

Undocumented Fill (Qudf) – We encountered undocumented fill dumped at existing grade some portions of the site. The undocumented fill within structural improvement areas will be fully or partially removed and replaced with compacted fill. Water that is allowed to migrate into the undocumented fill will cause settlement. Therefore, full and partial infiltration should be considered infeasible within undocumented fill.

Topsoil (Unmapped) – We encountered topsoil varying between 1 to 2 feet thick across the site. Topsoil within structural improvement areas will be removed and replaced with compacted fill. Water that is allowed to migrate into the topsoils may cause settlement. Therefore, full and partial infiltration should be considered infeasible within topsoil.

Terrace Deposits (Qtc/Qtg) – We encountered approximately 6 to 8 feet of stiff clay and sandy clay overlying dense to very dense clayey sand and sandy gravel. Infiltration into terrace deposits is not feasible due to low infiltration characteristic and high expansion potential.

Groundwater Elevation

Groundwater was not encountered in our test pits to a depth of 13 feet below the existing ground surface. Infiltration should not impact groundwater.

Existing Utilities

No known utilities cross the site. Infiltration due to utility concerns would be feasible.

Soil or Groundwater Contamination

We are unaware of contaminated soil or groundwater on the property. Therefore, full and partial infiltration associated with this risk is considered feasible.

Slopes

There are no existing slopes that would be impacted by infiltration.

Infiltration Rates

Our test results indicated very slow infiltration rates. The rates were 0.003 and 0.121 in/hr. The average rate is 0.035 in/hr with a factored rate for feasibility determination of 0.018 in/hr. The infiltration rates are not high enough to support full or partial infiltration.

Storm Water Management Devices

Liners and subdrains should be incorporated into the design and construction of the planned storm water devices. The liners should be impermeable (e.g. High-density polyethylene, HDPE, with a thickness of about 30 mil or equivalent Polyvinyl Chloride**,** PVC) to prevent water migration. The subdrains should be perforated within the liner area, installed at the base and above the liner, be at least 3 inches in diameter and consist of Schedule 40 PVC pipe. The subdrains outside of the liner should consist of solid pipe. The penetration of the liners at the subdrains should be properly waterproofed. The subdrains should be connected to a proper outlet. The devices should also be installed in accordance with the manufacturer's recommendations. Liners should be installed on the side walls of the proposed basins in accordance with a partial infiltration design.

Storm Water Standard Worksheets

The SWS requests the geotechnical engineer complete the *Categorization of Infiltration Feasibility Condition* (Worksheet C.4-1) worksheet information to help evaluate the potential for infiltration on the property. The attached Worksheet C.4-1 presents the completed information for the submittal process.

The regional storm water standards also have a worksheet (Worksheet Form D.5-1) that helps the project civil engineer estimate the factor of safety based on several factors. Table C-4 describes the suitability assessment input parameters related to the geotechnical engineering aspects for the factor of safety determination.

TABLE C-4
SUITABILITY ASSESSMENT RELATED CONSIDERATIONS FOR INFILTRATION FACILITY SAFETY FACTORS

Consideration	High Concern – 3 Points	Medium Concern – 2 Points	Low Concern – 1 Point
Assessment Methods	Use of soil survey maps or simple texture analysis to estimate short-term infiltration rates. Use of well permeameter or borehole methods without accompanying continuous boring log. Relatively sparse testing with direct infiltration methods	Use of well permeameter or borehole methods with accompanying continuous boring log. Direct measurement of infiltration area with localized infiltration measurement methods (e.g., Infiltrometer). Moderate spatial resolution	Direct measurement with localized (i.e. small-scale) infiltration testing methods at relatively high resolution or use of extensive test pit infiltration measurement methods.
Predominant Soil Texture	Silty and clayey soils with significant fines	Loamy soils	Granular to slightly loamy soils
Site Soil Variability	Highly variable soils indicated from site assessment or unknown variability	Soil boring/test pits indicate moderately homogenous soils	Soil boring/test pits indicate relatively homogenous soils
Depth to Groundwater/ Impervious Layer	<5 feet below facility bottom	5-15 feet below facility bottom	>15 feet below facility bottom

Table C-5 presents the estimated factor values for the evaluation of the factor of safety. This table only presents the suitability assessment safety factor (Part A) of the worksheet. The project civil engineer should evaluate the safety factor for design (Part B) and use the combined safety factor for the design infiltration rate.

TABLE C-5
FACTOR OF SAFETY WORKSHEET D.5-1 DESIGN VALUES[1]

Suitability Assessment Factor Category	Assigned Weight (w)	Factor Value (v)	Product (p = w x v)
Assessment Methods	0.25	2	0.50
Predominant Soil Texture	0.25	3	0.75
Site Soil Variability	0.25	2	0.50
Depth to Groundwater/Impervious Layer	0.25	1	0.25
Suitability Assessment Safety Factor, $S_A = \Sigma p$			2.0

[1] The project civil engineer should complete Worksheet D.5-1 using the data on this table. Additional information is required to evaluate the design factor of safety.

CONCLUSIONS

Our results indicate the site has relatively slow infiltration characteristics. Because of the site conditions, it is our opinion that there is a potential for lateral water migration. Undocumented and exists on the property and has a high potential for adverse settlement when wetted. It is our opinion that full or partial infiltration is infeasible on this site. Our evaluation included the soil and geologic conditions, estimated settlement and volume change of the underlying soil, slope stability, utility considerations, groundwater mounding, retaining walls, foundations and existing groundwater elevations.

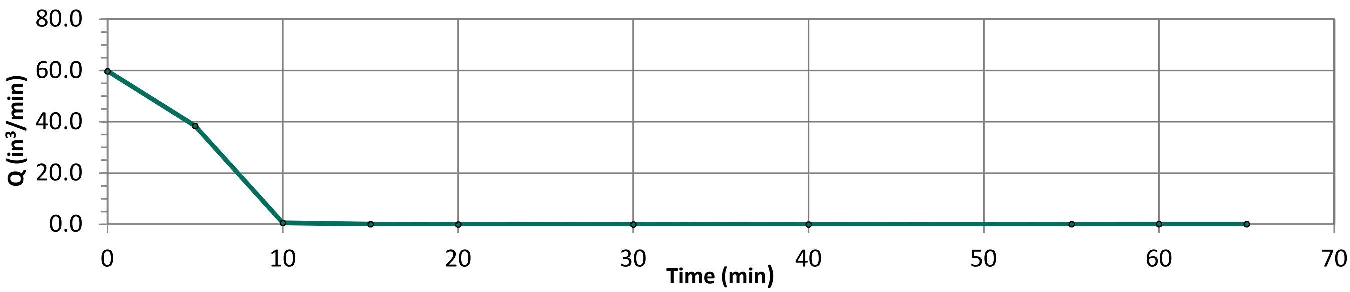
TEST NO.: **A-1**

GEOLOGIC UNIT: **Qvop**

EXCAVATION ELEVATION (MSL, FT): **478**

TEST INFORMATION	
BOREHOLE DIAMETER (IN):	6
BOREHOLE DEPTH (FT):	3.3
TEST/BOTTOM ELEVATION (MSL, FT):	475
MEASURED HEAD HEIGHT (IN):	5.3
CALCULATED HEAD HEIGHT (IN):	5.5
FACTOR OF SAFETY:	2.0

TEST RESULTS	
STEADY FLOW RATE (IN^3/MIN):	**0.028**
FIELD-SATURATED INFILTRATION RATE (IN/HR):	**0.003**
FACTORED INFILTRATION RATE (IN/HR):	**0.001**



TEST DATA

Reading	Time Elapsed (min)	Water Weight Consumed (lbs)	Water Volume Consumed (in^3)	Q (in^3/min)
1	0.00	0.000	0.00	0.00
2	5.00	10.800	299.08	59.815
3	5.00	6.940	192.18	38.437
4	5.00	0.105	2.91	0.582
5	5.00	0.005	0.14	0.028
6	10.00	0.005	0.14	0.014
7	10.00	0.005	0.14	0.014
8	15.00	0.005	0.14	0.009
9	5.00	0.005	0.14	0.028
10	5.00	0.005	0.14	0.028
11	5.00	0.005	0.14	0.028

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AARDVARK PERMEAMETER TEST RESULTS

OTAY MESA AIRWAY ROAD

PROJECT NO.: **G2467-42-01**

Attachment 1d

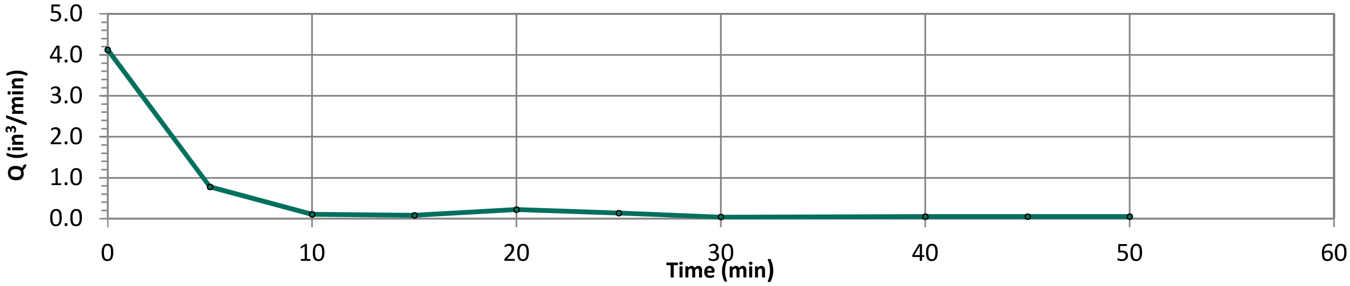
TEST NO.: **A-1a**

GEOLOGIC UNIT: **Qvop**

EXCAVATION ELEVATION (MSL, FT): **478**

TEST INFORMATION	
BOREHOLE DIAMETER (IN):	4
BOREHOLE DEPTH (FT):	3.8
TEST/BOTTOM ELEVATION (MSL, FT):	474
MEASURED HEAD HEIGHT (IN):	3.0
CALCULATED HEAD HEIGHT (IN):	4.1
FACTOR OF SAFETY:	2.0

TEST RESULTS	
STEADY FLOW RATE (IN^3/MIN):	**0.028**
FIELD-SATURATED INFILTRATION RATE (IN/HR):	**0.005**
FACTORED INFILTRATION RATE (IN/HR):	**0.003**



TEST DATA

Reading	Time Elapsed (min)	Water Weight Consumed (lbs)	Water Volume Consumed (in^3)	Q (in^3/min)
1	0.00	0.000	0.00	0.00
2	5.00	0.745	20.63	4.126
3	5.00	0.140	3.88	0.775
4	5.00	0.020	0.55	0.111
5	5.00	0.015	0.42	0.083
6	5.00	0.040	1.11	0.222
7	5.00	0.025	0.69	0.138
8	10.00	0.015	0.42	0.042
9	5.00	0.010	0.28	0.055
10	5.00	0.010	0.28	0.055
11	5.00	0.010	0.28	0.055
12	5.00	0.010	0.28	0.055
13	5.00	0.005	0.14	0.028
14	5.00	0.005	0.14	0.028
15	5.00	0.005	0.14	0.028

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PROJECT NO.: G2467-42-01

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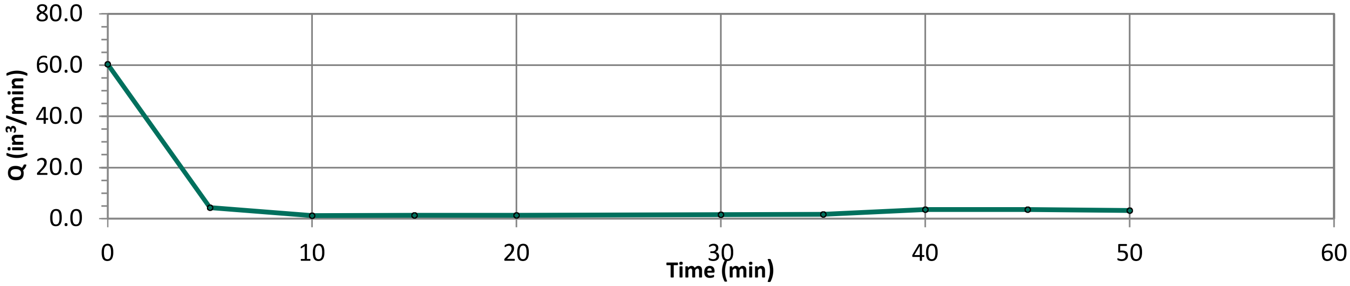
TEST NO.: **A-2**

GEOLOGIC UNIT: **Qvop**

EXCAVATION ELEVATION (MSL, FT): **483**

TEST INFORMATION	
BOREHOLE DIAMETER (IN):	6
BOREHOLE DEPTH (FT):	2.8
TEST/BOTTOM ELEVATION (MSL, FT):	480
MEASURED HEAD HEIGHT (IN):	4.3
CALCULATED HEAD HEIGHT (IN):	4.9
FACTOR OF SAFETY:	2.0

TEST RESULTS	
STEADY FLOW RATE (IN^3/MIN):	**1.052**
FIELD-SATURATED INFILTRATION RATE (IN/HR):	**0.121**
FACTORED INFILTRATION RATE (IN/HR):	**0.060**



TEST DATA

Reading	Time Elapsed (min)	Water Weight Consumed (lbs)	Water Volume Consumed (in^3)	Q (in^3/min)
1	0.00	0.000	0.00	0.00
2	5.00	10.895	301.71	60.342
3	5.00	0.790	21.88	4.375
4	5.00	0.215	5.95	1.191
5	5.00	0.235	6.51	1.302
6	10.00	0.500	13.85	1.385
7	5.00	0.285	7.89	1.578
8	5.00	0.300	8.31	1.662
9	5.00	0.655	18.14	3.628
10	5.00	0.645	17.86	3.572
11	5.00	0.580	16.06	3.212
12	5.00	0.325	9.00	1.800
13	5.00	0.275	7.62	1.523
14	5.00	0.205	5.68	1.135
15	5.00	0.215	5.95	1.191
16	5.00	0.135	3.74	0.748
17	5.00	0.215	5.95	1.191
18	5.00	0.195	5.40	1.080

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PROJECT NO.: G2467-42-01

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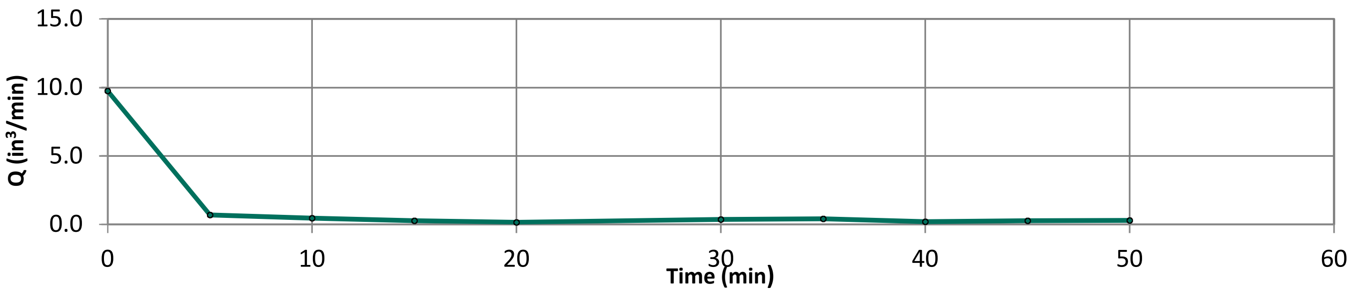
TEST NO.: **A-2a** GEOLOGIC UNIT: **Qvop**
EXCAVATION ELEVATION (MSL, FT): **483**

TEST INFORMATION	
BOREHOLE DIAMETER (IN):	4
BOREHOLE DEPTH (FT):	2.1
TEST/BOTTOM ELEVATION (MSL, FT):	481
MEASURED HEAD HEIGHT (IN):	3.0
CALCULATED HEAD HEIGHT (IN):	3.7
FACTOR OF SAFETY:	2.0

TEST RESULTS	
STEADY FLOW RATE (IN^3/MIN):	**0.286**
FIELD-SATURATED INFILTRATION RATE (IN/HR):	**0.054**
FACTORED INFILTRATION RATE (IN/HR):	**0.027**



TEST DATA				
Reading	Time Elapsed (min)	Water Weight Consumed (lbs)	Water Volume Consumed (in^3)	Q (in^3/min)
1	0.00	0.000	0.00	0.00
2	5.00	1.760	48.74	9.748
3	5.00	0.125	3.46	0.692
4	5.00	0.085	2.35	0.471
5	5.00	0.050	1.38	0.277
6	10.00	0.060	1.66	0.166
7	5.00	0.065	1.80	0.360
8	5.00	0.075	2.08	0.415
9	5.00	0.035	0.97	0.194
10	5.00	0.050	1.38	0.277
11	5.00	0.055	1.52	0.305
12	5.00	0.045	1.25	0.249
13	5.00	0.050	1.38	0.277
14	5.00	0.055	1.52	0.305
15	5.00	0.050	1.38	0.277

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PROJECT NO.: **G2467-42-01**

Attachment 1d

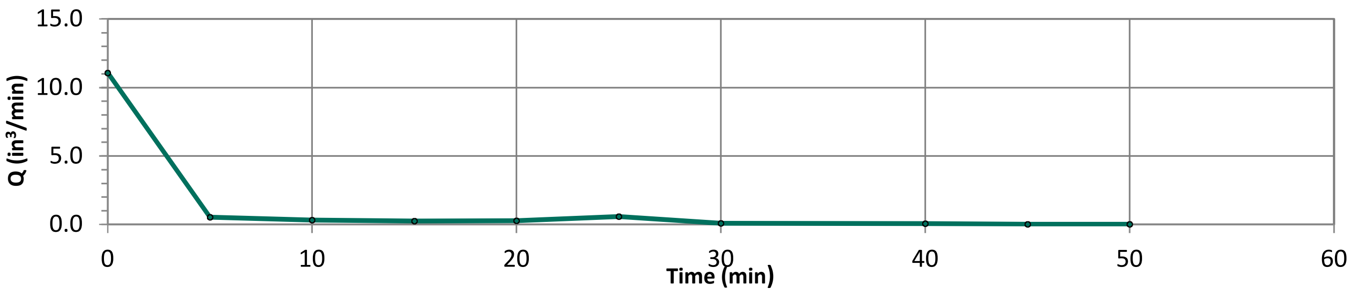
TEST NO.: **A-3**

GEOLOGIC UNIT: **Qvop**

EXCAVATION ELEVATION (MSL, FT): **485**

TEST INFORMATION	
BOREHOLE DIAMETER (IN):	5
BOREHOLE DEPTH (FT):	2.0
TEST/BOTTOM ELEVATION (MSL, FT):	483
MEASURED HEAD HEIGHT (IN):	3.3
CALCULATED HEAD HEIGHT (IN):	3.8
FACTOR OF SAFETY:	2.0

TEST RESULTS	
STEADY FLOW RATE (IN^3/MIN):	**0.028**
FIELD-SATURATED INFILTRATION RATE (IN/HR):	**0.004**
FACTORED INFILTRATION RATE (IN/HR):	**0.002**



TEST DATA				
Reading	Time Elapsed (min)	Water Weight Consumed (lbs)	Water Volume Consumed (in^3)	Q (in^3/min)
1	0.00	0.000	0.00	0.00
2	5.00	2.000	55.38	11.077
3	5.00	0.094	2.60	0.521
4	5.00	0.056	1.55	0.310
5	5.00	0.045	1.25	0.249
6	5.00	0.050	1.38	0.277
7	5.00	0.105	2.91	0.582
8	10.00	0.030	0.83	0.083
9	5.00	0.010	0.28	0.055
10	5.00	0.005	0.14	0.028
11	5.00	0.005	0.14	0.028
12	5.00	0.005	0.14	0.028

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PROJECT NO.: G2467-42-01

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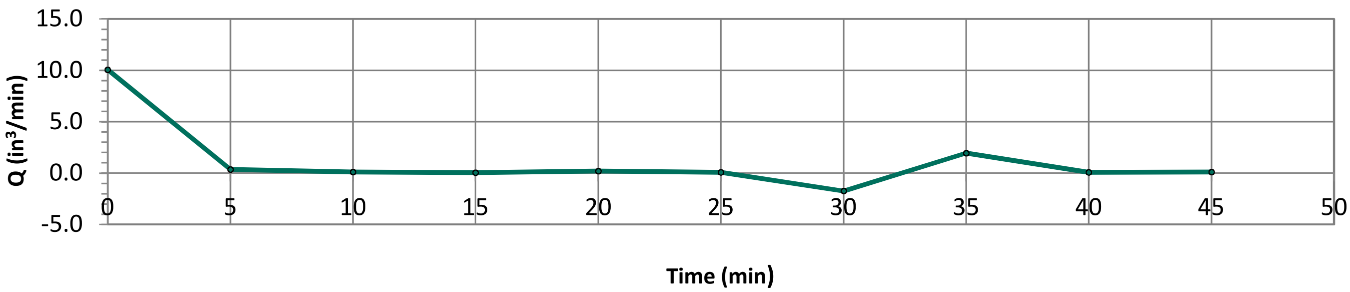
TEST NO.: **A-3a**

GEOLOGIC UNIT: **Qvop**

EXCAVATION ELEVATION (MSL, FT): **485**

TEST INFORMATION	
BOREHOLE DIAMETER (IN):	4
BOREHOLE DEPTH (FT):	3.0
TEST/BOTTOM ELEVATION (MSL, FT):	482
MEASURED HEAD HEIGHT (IN):	3.3
CALCULATED HEAD HEIGHT (IN):	4.0
FACTOR OF SAFETY:	2.0

TEST RESULTS	
STEADY FLOW RATE (IN^3/MIN):	**0.129**
FIELD-SATURATED INFILTRATION RATE (IN/HR):	**0.023**
FACTORED INFILTRATION RATE (IN/HR):	**0.012**



TEST DATA

Reading	Time Elapsed (min)	Water Weight Consumed (lbs)	Water Volume Consumed (in^3)	Q (in^3/min)
1	0.00	0.000	0.00	0.00
2	5.00	1.820	50.40	10.080
3	5.00	0.065	1.80	0.360
4	5.00	0.020	0.55	0.111
5	5.00	0.010	0.28	0.055
6	5.00	0.035	0.97	0.194
7	5.00	0.015	0.42	0.083
8	5.00	-0.315	-8.72	-1.745
9	5.00	0.355	9.83	1.966
10	5.00	0.015	0.42	0.083
11	5.00	0.020	0.55	0.111
12	5.00	0.020	0.55	0.111
13	5.00	0.025	0.69	0.138
14	5.00	0.025	0.69	0.138
15	5.00	0.020	0.55	0.111

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AARDVARK PERMEAMETER TEST RESULTS

OTAY MESA AIRWAY ROAD

PROJECT NO.: **G2467-42-01**

Attachment 1d

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4-1: Form I-8A[10]
Part 1 - Full Infiltration Feasibility Screening Criteria		
DMA(s) Being Analyzed:		Project Phase:
Entire Site		Preliminary
Criteria 1: Infiltration Rate Screening		
1A	Is the mapped hydrologic soil group according to the NRCS Web Soil Survey or UC Davis Soil Web Mapper Type A or B and corroborated by available site soil data[11]? ☐ Yes; the DMA may feasibly support full infiltration. Answer "Yes" to Criteria 1 Result or continue to Step 1B if the applicant elects to perform infiltration testing. ☐ No; the mapped soil types are A or B but is not corroborated by available site soil data (continue to Step 1B). ☑ No; the mapped soil types are C, D, or "urban/unclassified" and is corroborated by available site soil data. Answer "No" to Criteria 1 Result. ☐ No; the mapped soil types are C, D, or "urban/unclassified" but is not corroborated by available site soil data (continue to Step 1B).	
1B	Is the reliable infiltration rate calculated using planning phase methods from Table D.3-1? ☐ Yes; Continue to Step 1C. ☐ No; Skip to Step 1D.	
1C	Is the reliable infiltration rate calculated using planning phase methods from Table D.3-1 greater than 0.5 inches per hour? ☐ Yes; the DMA may feasibly support full infiltration. Answer "Yes" to Criteria 1 Result. ☐ No; full infiltration is not required. Answer "No" to Criteria 1 Result.	
1D	**Infiltration Testing Method.** Is the selected infiltration testing method suitable during the design phase (see Appendix D.3)? Note: Alternative testing standards may be allowed with appropriate rationales and documentation. ☐ Yes; continue to Step 1E. ☐ No; select an appropriate infiltration testing method.	

Note that it is not required to investigate each and every criterion in the worksheet, a single "no" answer in Part 1, Part 2, Part 3, or Part 4 determines a full, partial, or no infiltration condition.

[10] This form must be completed each time there is a change to the site layout that would affect the infiltration feasibility condition. Previously completed forms shall be retained to document the evolution of the site storm water design.

[11] Available data includes site-specific sampling or observation of soil types or texture classes, such as obtained from borings or test pits necessary to support other design elements.

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions	Worksheet C.4-1: Form I-8A[10]
1E	**Number of Percolation/Infiltration Tests.** Does the infiltration testing method performed satisfy the minimum number of tests specified in Table D.3-2? ☐ Yes; continue to Step 1F. ☐ No; conduct appropriate number of tests.
IF	**Factor of Safety.** Is the suitable Factor of Safety selected for full infiltration design? See guidance in D.5; Tables D.5-1 and D.5-2; and Worksheet D.5-1 (Form I-9). ☐ Yes; continue to Step 1G. ☐ No; select appropriate factor of safety.
1G	**Full Infiltration Feasibility.** Is the average measured infiltration rate divided by the Factor of Safety greater than 0.5 inches per hour? ☐ Yes; answer "Yes" to Criteria 1 Result. ☐ No; answer "No" to Criteria 1 Result.
Criteria 1 Result	Is the estimated reliable infiltration rate greater than 0.5 inches per hour within the DMA where runoff can reasonably be routed to a BMP? ☐ Yes; the DMA may feasibly support full infiltration. Continue to Criteria 2. ☑ No; full infiltration is not required. Skip to Part 1 Result.
Summarize infiltration testing methods, testing locations, replicates, and results and summarize estimates of reliable infiltration rates according to procedures outlined in D.5. Documentation should be included in project geotechnical report.	

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4-1: Form I-8A[10]	
Criteria 2: Geologic/Geotechnical Screening			
2A	If all questions in Step 2A are answered "Yes," continue to Step 2B. For any "No" answer in Step 2A answer "No" to Criteria 2, and submit an "Infiltration Feasibility Condition Letter" that meets the requirements in Appendix C.1.1. The geologic/geotechnical analyses listed in Appendix C.2.1 do not apply to the DMA because one of the following setbacks cannot be avoided and therefore result in the DMA being in a no infiltration condition. The setbacks must be the closest horizontal radial distance from the surface edge (at the overflow elevation) of the BMP.		
2A-1	Can the proposed full infiltration BMP(s) avoid areas with existing fill materials greater than 5 feet thick below the infiltrating surface?	☐Yes	☐No
2A-2	Can the proposed full infiltration BMP(s) avoid placement within 10 feet of existing underground utilities, structures, or retaining walls?	☐Yes	☐No
2A-3	Can the proposed full infiltration BMP(s) avoid placement within 50 feet of a natural slope (>25%) or within a distance of 1.5H from fill slopes where H is the height of the fill slope?	☐Yes	☐No
2B	When full infiltration is determined to be feasible, a geotechnical investigation report must be prepared that considers the relevant factors identified in Appendix C.2.1. If all questions in Step 2B are answered "Yes," then answer "Yes" to Criteria 2 Result. If there are "No" answers continue to Step 2C.		
2B-1	**Hydroconsolidation.** Analyze hydroconsolidation potential per approved ASTM standard due to a proposed full infiltration BMP. Can full infiltration BMPs be proposed within the DMA without increasing hydroconsolidation risks?	☐Yes	☐No
2B-2	**Expansive Soils.** Identify expansive soils (soils with an expansion index greater than 20) and the extent of such soils due to proposed full infiltration BMPs. Can full infiltration BMPs be proposed within the DMA without increasing expansive soil risks?	☐Yes	☐No

Attachment 1d

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4-1: Form I-8A[10]	
2B-3	**Liquefaction**. If applicable, identify mapped liquefaction areas. Evaluate liquefaction hazards in accordance with Section 6.4.2 of the City of San Diego's Guidelines for Geotechnical Reports (2011 or most recent edition). Liquefaction hazard assessment shall take into account any increase in groundwater elevation or groundwater mounding that could occur as a result of proposed infiltration or percolation facilities. Can full infiltration BMPs be proposed within the DMA without increasing liquefaction risks?	☐Yes	☐No
2B-4	**Slope Stability**. If applicable, perform a slope stability analysis in accordance with the ASCE and Southern California Earthquake Center (2002) Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Landslide Hazards in California to determine minimum slope setbacks for full infiltration BMPs. See the City of San Diego's Guidelines for Geotechnical Reports (2011) to determine which type of slope stability analysis is required. Can full infiltration BMPs be proposed within the DMA without increasing slope stability risks?	☐Yes	☐No
2B-5	**Other Geotechnical Hazards.** Identify site-specific geotechnical hazards not already mentioned (refer to Appendix C.2.1). Can full infiltration BMPs be proposed within the DMA without increasing risk of geologic or geotechnical hazards not already mentioned?	☐Yes	☐No
2B-6	**Setbacks.** Establish setbacks from underground utilities, structures, and/or retaining walls. Reference applicable ASTM or other recognized standard in the geotechnical report. Can full infiltration BMPs be proposed within the DMA using established setbacks from underground utilities, structures, and/or retaining walls?	☐ Yes	☐ No

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4-1: Form I-8A[10]	
2C	**Mitigation Measures.** Propose mitigation measures for each geologic/geotechnical hazard identified in Step 2B. Provide a discussion of geologic/geotechnical hazards that would prevent full infiltration BMPs that cannot be reasonably mitigated in the geotechnical report. See Appendix C.2.1.8 for a list of typically reasonable and typically unreasonable mitigation measures. Can mitigation measures be proposed to allow for full infiltration BMPs? If the question in Step 2 is answered "Yes," then answer "Yes" to Criteria 2 Result. If the question in Step 2C is answered "No," then answer "No" to Criteria 2 Result.	☐Yes	☐No
Criteria 2 Result	Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of geologic or geotechnical hazards that cannot be reasonably mitigated to an acceptable level?	☐Yes	☐No
Summarize findings and basis; provide references to related reports or exhibits.			

Part 1 Result – Full Infiltration Geotechnical Screening [12]	Result
If answers to both Criteria 1 and Criteria 2 are "Yes", a full infiltration design is potentially feasible based on Geotechnical conditions only. If either answer to Criteria 1 or Criteria 2 is "No", a full infiltration design is not required.	☐Full infiltration Condition ☑Complete Part 2

[12] To be completed using gathered site information and best professional judgement considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by City Engineer to substantiate findings.

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4-1: Form I-8A[10]
Part 2 – Partial vs. No Infiltration Feasibility Screening Criteria		
DMA(s) Being Analyzed:		Project Phase:
Entire Site		Preliminary
Criteria 3 : Infiltration Rate Screening		
3A	**NRCS Type C, D, or "urban/unclassified":** Is the mapped hydrologic soil group according to the NRCS Web Soil Survey or UC Davis Soil Web Mapper is Type C, D, or "urban/unclassified" and corroborated by available site soil data? ☐ Yes; the site is mapped as C soils and a reliable infiltration rate of 0.15 in/hr. is used to size partial infiltration BMPS. Answer "Yes" to Criteria 3 Result. ☐ Yes; the site is mapped as D soils or "urban/unclassified" and a reliable infiltration rate of 0.05 in/hr. is used to size partial infiltration BMPS. Answer "Yes" to Criteria 3 Result. ☑ No; infiltration testing is conducted (refer to Table D.3-1), continue to Step 3B.	
3B	**Infiltration Testing Result:** Is the reliable infiltration rate (i.e. average measured infiltration rate/2) greater than 0.05 in/hr. and less than or equal to 0.5 in/hr? ☐ Yes; the site may support partial infiltration. Answer "Yes" to Criteria 3 Result. ☑ No; the reliable infiltration rate (i.e. average measured rate/2) is less than 0.05 in/hr., partial infiltration is not required. Answer "No" to Criteria 3 Result.	
Criteria 3 Result	Is the estimated reliable infiltration rate (i.e., average measured infiltration rate/2) greater than or equal to 0.05 inches/hour and less than or equal to 0.5 inches/hour at any location within each DMA where runoff can reasonably be routed to a BMP? ☐ Yes; Continue to Criteria 4. ☑ No: Skip to Part 2 Result.	
Summarize infiltration testing and/or mapping results (i.e. soil maps and series description used for infiltration rate).		

Six infiltration tests were performed on the property. The factored test results were as follows:

A-1: 0.001 in/hr
A-1a: 0.003 in/hr
A-2: 0.060 in/hr
A-2a: 0.027 in/hr
A-3: 0.002 in/hr
A-3a: 0.012 in/hr

The average rate of the six tests is 0.02 in/hr. Five of the six tests had infiltration rates below 0.05 in/hr.

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4-1: Form I-8A[10]	
Criteria 4: Geologic/Geotechnical Screening			
4A	If all questions in Step 4A are answered "Yes," continue to Step 2B. For any "No" answer in Step 4A answer "No" to Criteria 4 Result, and submit an "Infiltration Feasibility Condition Letter" that meets the requirements in Appendix C.1.1. The geologic/geotechnical analyses listed in Appendix C.2.1 do not apply to the DMA because one of the following setbacks cannot be avoided and therefore result in the DMA being in a no infiltration condition. The setbacks must be the closest horizontal radial distance from the surface edge (at the overflow elevation) of the BMP.		
4A-1	Can the proposed partial infiltration BMP(s) avoid areas with existing fill materials greater than 5 feet thick?	☐Yes	☐No
4A-2	Can the proposed partial infiltration BMP(s) avoid placement within 10 feet of existing underground utilities, structures, or retaining walls?	☐Yes	☐No
4A-3	Can the proposed partial infiltration BMP(s) avoid placement within 50 feet of a natural slope (>25%) or within a distance of 1.5H from fill slopes where H is the height of the fill slope?	☐Yes	☐No
4B	When full infiltration is determined to be feasible, a geotechnical investigation report must be prepared that considers the relevant factors identified in Appendix C.2.1 If all questions in Step 4B are answered "Yes," then answer "Yes" to Criteria 4 Result. If there are any "No" answers continue to Step 4C.		
4B-1	**Hydroconsolidation.** Analyze hydroconsolidation potential per approved ASTM standard due to a proposed full infiltration BMP. Can partial infiltration BMPs be proposed within the DMA without increasing hydroconsolidation risks?	☐Yes	☐No
4B-2	**Expansive Soils.** Identify expansive soils (soils with an expansion index greater than 20) and the extent of such soils due to proposed full infiltration BMPs. Can partial infiltration BMPs be proposed within the DMA without increasing expansive soil risks?	☐Yes	☐No

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4-1: Form I-8A[10]	
4B-3	**Liquefaction**. If applicable, identify mapped liquefaction areas. Evaluate liquefaction hazards in accordance with Section 6.4.2 of the City of San Diego's Guidelines for Geotechnical Reports (2011). Liquefaction hazard assessment shall take into account any increase in groundwater elevation or groundwater mounding that could occur as a result of proposed infiltration or percolation facilities. Can partial infiltration BMPs be proposed within the DMA without increasing liquefaction risks?	☐Yes	☐No
4B-4	**Slope Stability**. If applicable, perform a slope stability analysis in accordance with the ASCE and Southern California Earthquake Center (2002) Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Landslide Hazards in California to determine minimum slope setbacks for full infiltration BMPs. See the City of San Diego's Guidelines for Geotechnical Reports (2011) to determine which type of slope stability analysis is required. Can partial infiltration BMPs be proposed within the DMA without increasing slope stability risks?	☐Yes	☐No
4B-5	**Other Geotechnical Hazards.** Identify site-specific geotechnical hazards not already mentioned (refer to Appendix C.2.1). Can partial infiltration BMPs be proposed within the DMA without increasing risk of geologic or geotechnical hazards not already mentioned?	☐Yes	☐No
4B-6	**Setbacks.** Establish setbacks from underground utilities, structures, and/or retaining walls. Reference applicable ASTM or other recognized standard in the geotechnical report. Can partial infiltration BMPs be proposed within the DMA using recommended setbacks from underground utilities, structures, and/or retaining walls?	☐Yes	☐No
4C	**Mitigation Measures.** Propose mitigation measures for each geologic/geotechnical hazard identified in Step 4B. Provide a discussion on geologic/geotechnical hazards that would prevent partial infiltration BMPs that cannot be reasonably mitigated in the geotechnical report. See Appendix C.2.1.8 for a list of typically reasonable and typically unreasonable mitigation measures. Can mitigation measures be proposed to allow for partial infiltration BMPs? If the question in Step 4C is answered "Yes," then answer "Yes" to Criteria 4 Result. If the question in Step 4C is answered "No," then answer "No" to Criteria 4 Result.	☐Yes	☐No

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4-1: Form I-8A[10]	
Criteria 4 Result	Can infiltration of greater than or equal to 0.05 inches/hour and less than or equal to 0.5 inches/hour be allowed without increasing the risk of geologic or geotechnical hazards that cannot be reasonably mitigated to an acceptable level?	☐ Yes	☐ No
Summarize findings and basis; provide references to related reports or exhibits.			

Part 2 – Partial Infiltration Geotechnical Screening Result[13]	Result
If answers to both Criteria 3 and Criteria 4 are "Yes", a partial infiltration design is potentially feasible based on geotechnical conditions only. If answers to either Criteria 3 or Criteria 4 is "No", then infiltration of any volume is considered to be infeasible within the site.	☐ Partial Infiltration Condition ☑ No Infiltration Condition

[13] To be completed using gathered site information and best professional judgement considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by City Engineer to substantiate findings.

The City of SAN DIEGO	Project Name	Airway Logistics Center	
	BMP ID	BMP 1	
Sizing Method for Pollutant Removal Criteria		**Worksheet B.5-1**	
1	Area draining to the BMP	563,666	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.9	
3	85th percentile 24-hour rainfall depth	0.48	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	20292	cu. ft.
BMP Parameters			
5	Surface ponding [6 inch minimum, 12 inch maximum]	6	inches
6	Media thickness [18 inches minimum], also add mulch layer and washed ASTM 33 fine aggregate sand thickness to this line for sizing calculations	27	inches
7	Aggregate storage (also add ASTM No 8 stone) above underdrain invert (12 inches typical) – use 0 inches if the aggregate is not over the entire bottom surface area	24	inches
8	Aggregate storage below underdrain invert (3 inches minimum) – use 0 inches if the aggregate is not over the entire bottom surface area	3	inches
9	Freely drained pore storage of the media	0.2	in/in
10	Porosity of aggregate storage	0.4	in/in
11	Media filtration rate to be used for sizing (maximum filtration rate of 5 in/hr. with no outlet control; if the filtration rate is controlled by the outlet use the outlet controlled rate (includes infiltration into the soil and flow rate through the outlet structure) which will be less than 5 in/hr.)	0.404	in/hr.
Baseline Calculations			
12	Allowable routing time for sizing	6	hours
13	Depth filtered during storm [Line 11 x Line 12]	2.424	inches
14	Depth of Detention Storage [Line 5 + (Line 6 x Line 9) + (Line 7 x Line 10) + (Line 8 x Line 10)]	22.2	inches
15	Total Depth Treated [Line 13 + Line 14]	24.624	inches
Option 1 – Biofilter 1.5 times the DCV			
16	Required biofiltered volume [1.5 x Line 4]	30438	cu. ft.
17	Required Footprint [Line 16/ Line 15] x 12	14833	sq. ft.
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
18	Required Storage (surface + pores) Volume [0.75 x Line 4]	15219	cu. ft.
19	Required Footprint [Line 18/ Line 14] x 12	8226	sq. ft.
Footprint of the BMP			
20	BMP Footprint Sizing Factor (Default 0.03 or an alternative minimum footprint sizing factor from Line 11 in Worksheet B.5-4)	0.03	
21	Minimum BMP Footprint [Line 1 x Line 2 x Line 20]	15219	sq. ft.
22	Footprint of the BMP = Maximum(Minimum(Line 17, Line 19), Line 21)	15219	sq. ft.
23	Provided BMP Footprint	17504	sq. ft.
24	Is Line 23 ≥ Line 22?	**Yes, Performance Standard is Met**	

Attachment 1e

The City of SAN DIEGO	Project Name	Airway Logistics Center	
	BMP ID	BMP 1	
Sizing Method for Volume Retention Criteria		**Worksheet B.5-2**	
1	Area draining to the BMP	563,666	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)	0.9	
3	85th percentile 24-hour rainfall depth	0.48	inches
4	Design capture volume [Line 1 x Line 2 x (Line 3/12)]	20292	cu. ft.
Volume Retention Requirement			
5	Measured infiltration rate in the DMA Note: When mapped hydrologic soil groups are used enter 0.10 for NRCS Type D soils and for NRCS Type C soils enter 0.30 When in no infiltration condition and the actual measured infiltration rate is unknown enter 0.0 if there are geotechnical and/or groundwater hazards identified in Appendix C or enter 0.05	0	in/hr.
6	Factor of safety	2	
7	Reliable infiltration rate, for biofiltration BMP sizing [Line 5 / Line 6]	0	in/hr.
8	Average annual volume reduction target (Figure B.5-2) When Line 7 > 0.01 in/hr. = Minimum (40, 166.9 x Line 7 +6.62) When Line 7 ≤ 0.01 in/hr. = 3.5%	3.5	%
9	Fraction of DCV to be retained (Figure B.5-3) When Line 8 > 8% = $0.0000013 \times \text{Line } 8^3 - 0.000057 \times \text{Line } 8^2 + 0.0086 \times \text{Line } 8 - 0.014$ When Line 8 ≤ 8% = 0.023	0.023	
10	Target volume retention [Line 9 x Line 4]	467	cu. ft.

Attachment 1e

The City of SAN DIEGO	Project Name	Airway Logistics Center				
	BMP ID	BMP 1				
Volume Retention for No Infiltration Condition				**Worksheet B.5-6**		
1	Area draining to the biofiltration BMP				563,666	sq. ft.
2	Adjusted runoff factor for drainage area (Refer to Appendix B.1 and B.2)				0.9	
3	Effective impervious area draining to the BMP [Line 1 x Line 2]				507299	sq. ft.
4	Required area for Evapotranspiration [Line 3 x 0.03]				15219	sq. ft.
5	Biofiltration BMP Footprint				17504	sq. ft.

Landscape Area (must be identified on DS-3247)

	Identification	1	2	3	4	5
6	Landscape area that meet the requirements in SD-B and SD-F Fact Sheet (sq. ft.)					
7	Impervious area draining to the landscape area (sq. ft.)					
8	Impervious to Pervious Area ratio [Line 7/Line 6]	0.00	0.00	0.00	0.00	0.00
9	Effective Credit Area If (Line 8 >1.5, Line 6, Line 7/1.5]	0	0	0	0	0
10	Sum of Landscape area [sum of Line 9 Id's 1 to 5]				0	sq. ft.
11	Provided footprint for evapotranspiration [Line 5 + Line 10]				17504	sq. ft.

Volume Retention Performance Standard

12	Is Line 11 ≥ Line 4?	Volume Retention Performance Standard is Met	
13	Fraction of the performance standard met through the BMP footprint and/or landscaping [Line 11/Line 4]	1.15	
14	Target Volume Retention [Line 10 from Worksheet B.5.2]	15	cu. ft.
15	Volume retention required from other site design BMPs [(1-Line 13) x Line 14]	-2.25	cu. ft.

Site Design BMP

	Identification	Site Design Type	Credit	
16	1			cu. ft.
	2			cu. ft.
	3			cu. ft.
	4			cu. ft.
	5			cu. ft.
	Sum of volume retention benefits from other site design BMPs (e.g. trees; rain barrels etc.). [sum of Line 16 Credits for Id's 1 to 5] Provide documentation of how the site design credit is calculated in the PDP SWQMP.		0	cu. ft.
17	Is Line 16 ≥ Line 15?	Volume Retention Performance Standard is Met		

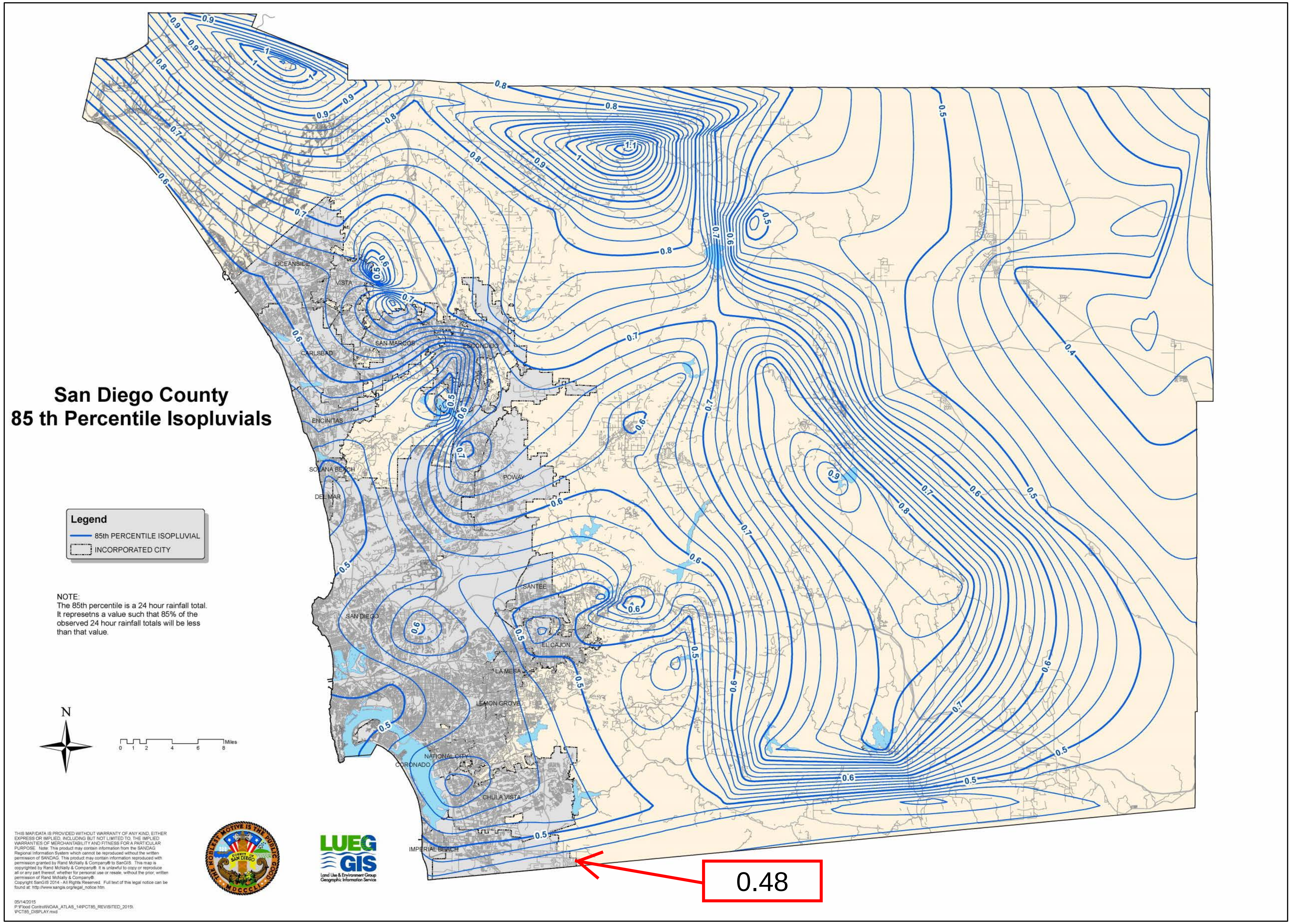

Figure B.1-1: 85th Percentile 24-hour Isopluvial Map

Project Name: Airway Logistics Center

Tabular Summary of DMAs							Worksheet B-1		
DMA Unique Identifier	Area (acres)	Impervious Area (acres)	% Imp	HSG	Area Weighted Runoff Coefficient	DCV (cubic feet)	Treated By (BMP ID)	Pollutant Control Type	Drains to (POC ID)
DMA-1	12.9	11.7	0.90	D	0.88	20,292	BMP-1	Biofiltration	POC-1
Summary of DMA Information (Must match project description and SWQMP Narrative)									
No. of DMAs	Total DMA Area (acres)	Total Impervious Area (acres)	% Imp		Area Weighted Runoff Coefficient	Total DCV (cubic feet)	Total Area Treated (acres)		No. of POCs
1	12.9	11.7	0.90		0.88	20,292	12.9		1

Where: DMA = Drainage Management Area; Imp = Imperviousness; HSG = Hydrologic Soil Group; DCV= Design Capture Volume; BMP = Best Management Practice; POC = Point of Compliance; ID = identifier; No. = Number

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Attachment 2
Backup for PDP Hydromodification Control Measures

This is the cover sheet for Attachment 2.

☐ Mark this box if this attachment is empty because the project is exempt from PDP hydromodification management requirements.

Project Name: Airway Logistics Center

Indicate which Items are Included:

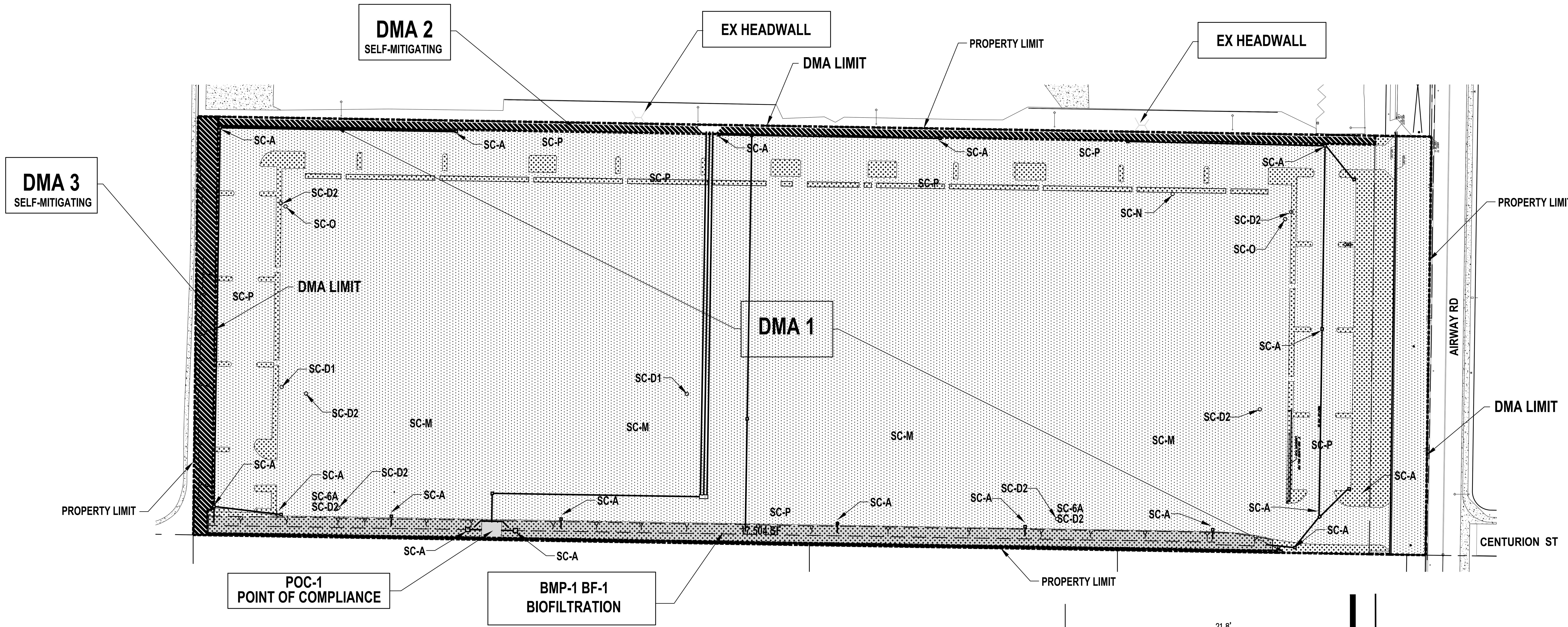
Attachment Sequence	Contents	Checklist
Attachment 2a	Hydromodification Management Exhibit (Required)	☑ Included See Hydromodification Management Exhibit Checklist.
Attachment 2b	Management of Critical Coarse Sediment Yield Areas (WMAA Exhibit is required, additional analyses are optional) See Section 6.2 of the BMP Design Manual.	☑ Exhibit showing project drainage boundaries marked on WMAA Critical Coarse Sediment Yield Area Map (Required) Optional analyses for Critical Coarse Sediment Yield Area Determination ☐ 6.2.1 Verification of Geomorphic Landscape Units Onsite ☐ 6.2.2 Downstream Systems Sensitivity to Coarse Sediment ☐ 6.2.3 Optional Additional Analysis of Potential Critical Coarse Sediment Yield Areas Onsite
Attachment 2c	Geomorphic Assessment of Receiving Channels (Optional) See Section 6.3.4 of the BMP Design Manual.	☑ Not Performed ☐ Included ☐ Submitted as separate stand-alone document
Attachment 2d	Flow Control Facility Design and Structural BMP Drawdown Calculations (Required) Overflow Design Summary for each structural BMP See Chapter 6 and Appendix G of the BMP Design Manual	☑ Included ☐ Submitted as separate stand-alone document

Project Name: Airway Logistics Center

Use this checklist to ensure the required information has been included on the Hydromodification Management Exhibit:

The Hydromodification Management Exhibit must identify:

- [x] Underlying hydrologic soil group
- [x] Approximate depth to groundwater
- [ ] Existing natural hydrologic features (watercourses, seeps, springs, wetlands)
- [ ] Critical coarse sediment yield areas to be protected OR provide a separate map showing that the project site is outside of any critical coarse sediment yield areas
- [x] Existing topography
- [x] Existing and proposed site drainage network and connections to drainage offsite
- [x] Proposed grading
- [x] Proposed impervious features
- [x] Proposed design features and surface treatments used to minimize imperviousness
- [x] Point(s) of Compliance (POC) for Hydromodification Management
  Existing and proposed drainage boundary and drainage area to each POC (when necessary, create separate exhibits for pre-development and post-project conditions)
- [x] Structural BMPs for hydromodification management (identify location, type of BMP, and size/detail).



LEGEND

ITEM	SYMBOL
DMA LIMIT	
PERVIOUS AREA	
IMPERVIOUS AREA	
ONSITE STORM DRAIN INLETS, STENCILING/SIGNAGE "NO DUMPING! GOES TO OCEAN"	SC-A
FUTURE INDOOR & STRUCTURAL PEST CONTROL	SC-D1
LANDSCAPE/OUTDOOR PESTICIDE USE	SC-D2
REFUSE AREAS	SC-G
LOADING DOCKS	SC-M
FIRE SPRINKLER TEST WATER	SC-N
MISCELLANEOUS DRAIN OR WASH WATER	SC-O
PLAZAS, SIDEWALKS AND PARKING LOTS	SC-P
LARGE TRASH GENERATING FACILITIES	SC-6A

GROUNDWATER

GROUND WATER WAS NOT ENCOUNTERED PER GEOTECHNICAL REPORT PREPARED BY GEOCON INCORPORATED DATED MAY 18, 2020

HYDROLOGIC SOIL GROUP

THE 87% OF THE SITE IS CLASSIFIED AS HrC HUERHUERO LOAM SOIL TYP D AND THE REMAINING 13% AS SuB STOCKPEN GRAVELLY CLAY LOAM SOIL TYPE D PER NRCS WEB SOILS

CCSYA NOTE:

PROJECT IS NOT WITHIN OR DOESN'T RECEIVE OR DRAINS FROM CRITICAL COARSE SEDIMENT YIELD AREAS. SEE ATTACHMENT 2b

BMP CATEGORY/TYPE

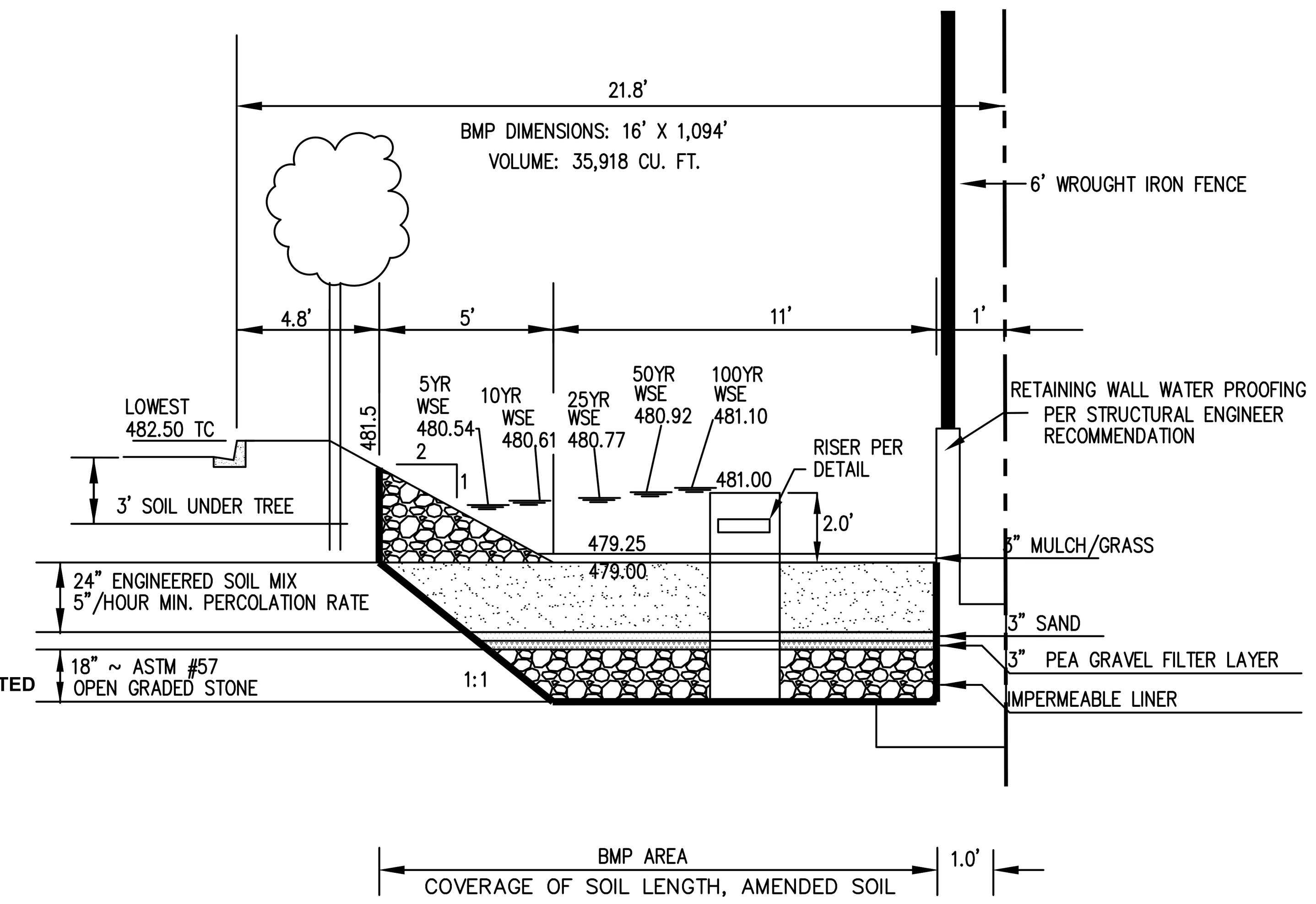
BIOFILTRATION BF-1

TOTAL SITE AREA

585,607 SQ. FT.

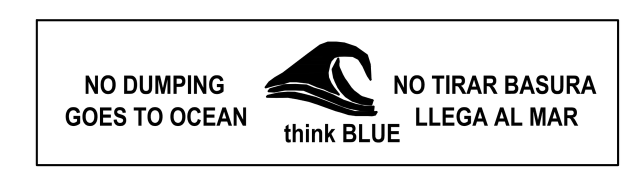
TOTAL DISTURBED AREA

583,097 SQ. FT.



BIOFILTRATION DETAIL

NOT TO SCALE



NOTES:

1. THESE ARE SAMPLE TILES AND SIGNS.
2. CITY ENGINEER TO DESIGNATE OR APPROVE SIGNS, TILES OR STENCILS.
3. PROVIDE LABELING WITH PROHIBITIVE LANGUAGE ("NO DUMPING GOES TO OCEAN – NO TIRAR BASURA LLEGA AL MAR")
4. SIGN SHOULD BE PLACED ON THE CATCH BASIN GRATE.
5. SIGN SHALL HAVE A WHITE BACKGROUND WITH BLUE LETTERING.

STORM DRAIN SIGNAGE

NOT TO SCALE

0 30 60 120 180

GRAPHIC SCALE: 1" = 60'

IF PLAN SIZE IS LESS THAN 24"x36", THIS IS A REDUCED COPY. SCALE PLAN ACCORDINGLY.

BIORETENTION SOIL MEDIA NOTE:

COMPOST SHALL BE CERTIFIED BY THE U.S. COMPOSTING COUNCIL'S SEAL OF TESTING ASSURANCE PROGRAM OR AN APPROVED EQUIVALENT PROGRAM. COMPOST SHALL COMPLY WITH THE FOLLOWING REQUIREMENTS:

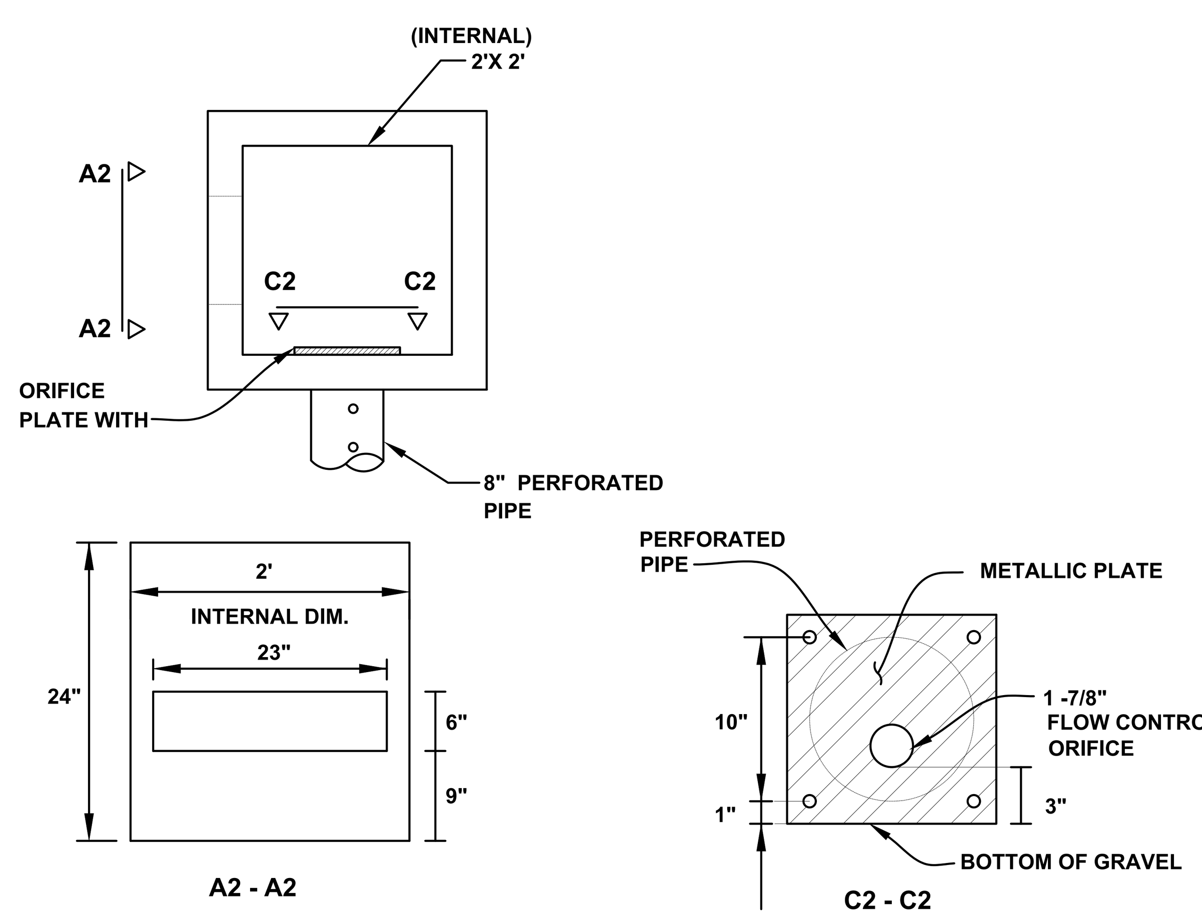
1. ORGANIC MATERIAL CONTENT SHALL BE 35% TO 75% BY DRY WEIGHT.
2. CARBON TO NITROGEN (C:N) RATIO SHALL BE BETWEEN 15:1 AND 40:1, PREFERABLY ABOVE 20:1 TO REDUCE THE POTENTIAL FOR NITROGEN LEACHING/WASHOUT.
3. PHYSICAL CONTAMINANTS (MANMADE INERT MATERIALS) SHALL NOT EXCEED 1% BY DRY WEIGHT.
4. PH SHALL BE BETWEEN 6.0 AND 7.5.
5. SOLUBLE SALT CONCENTRATION SHALL BE LESS THAN 10 DS/M (METHOD TMECC 4.10–A, USDA AND U.S. COMPOSTING COUNCIL).
6. MATURITY (SEED EMERGENCE AND SEEDLING VIGOR) SHALL BE GREATER THAN 80% RELATIVE TO POSITIVE CONTROL (METHOD TMECC 5.05–A, USDA AND U.S. COMPOSTING COUNCIL)
7. STABILITY (CARBON DIOXIDE EVOLUTION RATE) SHALL BE LESS THAN 2.5 MG CO_2–C PER G COMPOST ORGANIC MATTER (OM) PER DAY OR LESS THAN 5 MG CO_2–C PER G COMPOST CARBON PER DAY, WHICHEVER UNIT IS REPORTED. (METHOD TMECC 5.08–B, USDA AND U.S. COMPOSTING COUNCIL). ALTERNATIVELY A SOLVITA RATING OF 6 OR HIGHER IS ACCEPTABLE.
8. MOISTURE SHALL BE 25%–55% WET WEIGHT BASIS.
9. SELECT PATHOGENS SHALL PASS US EPA CLASS A STANDARD, 40 CFR SECTION 503.32(A).
10. TRACE METALS SHALL PASS US EPA CLASS A STANDARD, 40 CFR SECTION 503.13, TABLES 1 AND 3.
11. SHALL BE WITHIN GRADATION LIMITS IN TABLE F.3–2 (ASTM D 422 SIEVE ANALYSIS OR APPROVED EQUIVALENT).

Table F.3-2: Compost Gradation Limits

Sieve Size	Percent Passing (by weight)
16 mm (5/8")	99 to 100
6.3 mm (1/4")	40 to 95
2 mm	40 to 90

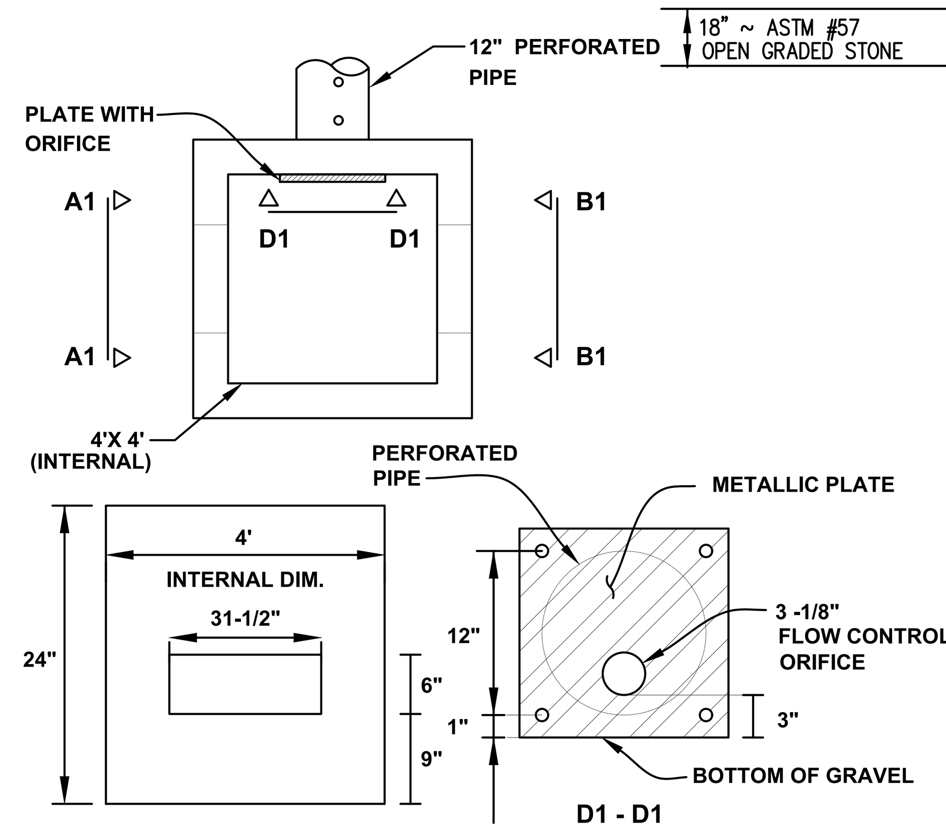
PROJECT AREA IMPERVIOUS/PERVIOUS TABLE

	IMPERVIOUS AREA (SQ.FT.)	PERVIOUS AREA (SQ.FT.)	TOTAL (SQ.FT.)
EXISTING	0	585,607	585,607
PROPOSED	513,735	71,872	585,607



SMALL BASIN DETAIL

NOT TO SCALE



LARGE BASIN DETAIL

NOT TO SCALE

DRAINAGE MANAGEMENT AREAS

DMA	SURFACE (SQ. FT.) HARDSCAPE/ROOF	SURFACE (SQ. FT.) LANDSCAPE	TOTAL (SQ. FT.)	TYPE OF STRUCTURAL BMP
DMA 1	510,846	51,486	562,332	BMP# 1 BF–1 BIOFILTRATION & HYDROMODIFICATION CONTROL
DMA 2	2,889	9,001	11,890	SELF–MITIGATING
DMA 3	–	11,385	11,385	SELF–MITIGATING
		TOTAL	585,607	

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CIVIL
STATE OF CALIFORNIA

HYDROMODIFICATION MANAGEMENT (HM) ATTACHMENT 2a

HMP SHEET FOR:

AIRWAY LOGISTICS CENTER

SHEET 1 OF 1

CCSYA Exhibit

Source: http://www.projectcleanwater.org
Regional San Diego County Watersheds-Potential Critical Coarse Sediment Yield Areas

Attachment 2b

TECHNICAL MEMORANDUM:

SWMM Modeling for Hydromodification Compliance of:

Baidee Project, San Diego, CA

Prepared For:

K&S Engineering.

May 18, 2020. Revised: August 11, 2020.

Prepared by:

Luis Parra, PhD, CPSWQ, ToR, D.WRE.
R.C.E. 66377

Dr. Luis Parra, PhD, PE, CFM

Telephone: (951) 774-6474

TECHNICAL MEMORANDUM

TO: K&S Engineering

FROM: Luis Parra, PhD, PE, CPSWQ, ToR, D.WRE, CFM.

DATE: May 18, 2020. Revised: August 11, 2020

RE: Summary of SWMM Modeling for Hydromodification Compliance for Baidee Project, San Diego, CA.

INTRODUCTION

This memorandum summarizes the approach used to model the proposed commercial site in the City of San Diego using the Environmental Protection Agency (EPA) Storm Water Management Model 5.0 (SWMM). SWMM models were prepared for the pre and post-developed conditions at the site in order to determine if the proposed LID HMP bio-filtration facility has sufficient volume to meet Order R9-2013-001 requirements of the California Regional Water Quality Control Board San Diego Region (SDRWQCB), as explained in the Final Hydromodification Management Plan (HMP), dated March 2011, prepared for the County of San Diego by Brown and Caldwell.

SWMM MODEL DEVELOPMENT

The Baidee Project site consists of an industrial/commercial development with associated hardscape and landscape of an existing site that is currently graded but undeveloped. One (1) SWMM model was prepared for this study: a compound pre-developed and post-developed file. The project site drains to one (1) Point of Compliance (POC) located in the east boundary, about 25% north of the SE corner.

The SWMM model was used because it is a non-proprietary model approved by the HMP document. For SWMM conditions, flow duration curves were prepared to determine if the proposed HMP BMP is sufficient to meet the current HMP requirements.

The inputs required to develop SWMM models include rainfall, watershed characteristics, and BMP configurations. The Kearny Mesa Gage from the Project Clean Water website was used for this study since it is the most representative of the project site precipitation due to elevation and proximity to the project site.

Per the California Irrigation Management Information System “Reference Evaporation Zones” (CIMIS ETo Zone Map), the project site is located within the Zone 6 Evapotranspiration Area. Thus evapotranspiration vales for the site were modeled using Zone 6 average monthly values from Table G.1-1 from the 2016 BMP Design Manual. Per the NRCS web soil survey, the project site is situated upon Class D soils. Soils have been assumed to be compacted in the existing condition to represent the existing mass-graded condition of the site, and also fully compacted in the post developed conditions. Other SWMM inputs for the subareas are discussed in the appendices to this document, where the selection of parameters is explained in detail.

HMP MODELING

PRE DEVELOPED CONDITIONS

In current existing conditions, runoff from the currently mass graded site discharges via overland flow to the existing discharge point described in the previous section. Table 1 below illustrates the pre-developed area to be redeveloped and impervious percentage accordingly.

TABLE 1 – SUMMARY OF PRE-DEVELOPED CONDITIONS

POC	DMA	Tributary Area, A (Ac)	Impervious Percentage, Ip(1)
POC-A	DMA-1-D-Pre	12.91	0%
TOTAL	**--**	**12.91**	--

Notes: (1) – Per the 2013 RWQCB permit, existing condition impervious surfaces are not to be accounted for in existing conditions analysis.

DEVELOPED CONDITIONS

The Baidee Project proposes a large building on the existing site inclusive of hardscape and landscape. Runoff from the project area is drained to one (1) bio-filtration basin without partial retention, located in soil Type D, divided in 2 portions, communicated at surface level via horizontal pipes to guarantee that both portion drain simultaneously. Once flows are routed via the proposed BMP, flows are then discharged to the POC via 2 outlet structures with corresponding discharge pipes. It should be pointed out that both structures will be modeled as a single BMP because the elevation of both portions are identical, the invert of all structures (orifices, weirs and slots) are identical, and the surface of both BMPs are connected hydraulically via horizontal pipes.

TABLE 2 – SUMMARY OF POST-DEVELOPED CONDITIONS

POC	DMA	Tributary Area, A (Ac)	Impervious Percentage, Ip
POC-1	DMA-1-D	12.52	92.8%
	BR-1	0.39	0.00%
TOTAL	**--**	**12.91**	N/A

One (1) LID biofiltration basin (no partial retention due to lack of infiltration of underlying soils) is located within the project site and is responsible for handling hydromodification requirements for the project site. In developed conditions, the basin will have a surface depth of 2.0 feet and a riser spillway structure divided in 2 parts: north portion and south portion (see dimensions in Table 3). Flows will then discharge from the basin via a low flow orifice outlet within the gravel layer. The riser structure will act as a spillway such that peak flows can be safely discharged to the receiving POC.

Beneath the basins' invert lies the proposed LID biofiltration portion of the drainage facility. This portion of the basin is comprised of a 3-inch layer of mulch, an 24-inch layer of amended soil (a highly sandy, organic rich composite with an infiltration capacity of at least 5 inches/hr), a 6-inch layer of filter media (3" sand and 3" pea gravel, included in the model as part of the gravel layer) and a 18-inch layer of gravel for additional detention and to accommodate the horizontal French drain system (the French Drain will be set at an elevation of 3-inches above the base of the gravel layer). These systems are to be located beneath the biofiltration layers to intercept treated storm water and convey these flows to a small diameter lower outlet orifice. Once flows have been routed by the outlet structures, flows are then drained to the receiving storm drain system.

It should be pointed out that there will be 2 orifices: one for the north portion (3-$^{1}/_{8}$") and another for the south portion (1-$^{7}/_{8}$"). However, from the SWMM point of view, the C coefficient of both orifices will be combined in a weighted average value as the system is modeled as a single BMP (both coefficients are practically identical, 0.2595 for the north portion and 0.2558 for the south portion; the orifices were chosen so that the discharge of the orifices were proportional to the surface area of the BMP; the overall C coefficient was chosen as 0.2585)

The biofiltration basin was modeled using the biofiltration LID module within SWMM. The biofiltration module can model the underground gravel storage layer, underdrain with an orifice plate, amended soil layer, and a surface storage pond up to the elevation of the invert of the spillway. It should be noted that detailed outlet structure location and elevations will be shown on the construction plans based on the recommendations of this study.

Water Quality BMP Sizing

It is assumed all storm water quality requirements for the project will be met by the bio-filtration LID BMPs detailed in the SWQMP and other BMPs included within the site design. However, detailed water quality requirements are not discussed within this technical memo. For further information in regards to storm water quality requirements for the project (including sizing and drawdown) please refer to the site specific Storm Water Quality Management Plan (SWQMP).

BMP MODELING FOR HMP PURPOSES

Modeling of dual purpose Water Quality/HMP BMPs

One (1) HMP BMP bio-filtration basin is proposed for water quality treatment and hydromodification conformance for the project site. Tables 3 & 4 illustrate the dimensions required for HMP compliance according to the SWMM model that was undertaken for the project.

TABLE 3 – SUMMARY OF DEVELOPED DUAL PURPOSE BMP

BMP	Tributary Area (Ac)	DIMENSIONS					
		BMP Area(1) (ft^2)	Gravel Depth(2) (in)	Lower Orif. D (in)(3)	Depth Riser Invert (ft)(4)	Weir Perimeter Length(5) (ft)	Total Surface Depth(6) (ft)
BR-1 (north)	12.91	12528	24	3.675 (C = 0.2595)	2.00	16	3.0 (3.5 to top of curb)
BR-1 (south)		4576	24	1.875 (C = 0.2558)	2.00	8	3.0 (3.5 to top of curb)
BR-1 (Model)		**17104**	**24**	**(C = 0.2585)**	**2.00**	**24**	**3.0 (3.5 to top of curb)**

Notes: (1): Area of amended soil equal to area of gravel
(2): Includes filter gravel layer, French Drain is set at an elevation of 12-inches above the base of the facility.
(3): Diameter of orifice in gravel layer with invert at bottom of layer; tied with hydromod min threshold ($0.1 \cdot Q_2$).
(4): Depth of ponding beneath riser structure's surface spillway.
(5): Overflow length, the internal perimeter of the riser is 16' North & 8' South (4'x4' & 2'x2' internal dimensions).
(6): Total surface depth of BMP from top crest elevation to surface invert.

TABLE 4 – SUMMARY OF RISER STRUCTURE

BASIN	Lower Slot			Overflow riser (emergency flows)	
	Width (in)	Height (in)	Elev (ft)	Width (ft)	Elev (ft)
1 (north)	63	6	0.75	16	2.0
1 (south)	23	6	0.75	8	2.0
1 (total)	**86**	**6**	**0.75**	**24**	**2.0**

For the point of view of the SWMM model, a simplification was made: the slot is so large that it does not attenuate flow in the continuous simulation model, and routing was not done above the invert of the riser; in other words, once the first 9" of the surface are full, it was conservatively assumed for continuous simulation purposes that flow in = flow out. This assumption is satisfied by the fact that when the 10-year hourly continuous simulation peak flow occurs, the slot is still working as an orifice. However, for synthetic storm peak flow mitigations (6 hr – 50 yr storm events and the like) the slots reduces the short duration peaks and the elevation – discharge - volume routing was prepared to show extreme event – short duration peak mitigation.

FLOW DURATION CURVE COMPARISON

The Flow Duration Curve (FDC) for the site was compared at the POC by exporting the hourly runoff time series results from SWMM to a spreadsheet.

Q_2 and Q_{10} were determined with a partial duration statistical analysis of the runoff time series in an Excel spreadsheet using the Cunnane plotting position method (which is the preferred plotting methodology in the HMP Permit). As the SWMM Model includes a statistical analysis based on the Weibull Plotting Position Method, the Weibull Method was also used within the spreadsheet to ensure that the results were similar to those obtained by the SWMM Model.

The range between 10% of Q_2 and Q_{10} was divided into 100 equal time intervals; the number of hours that each flow rate was exceeded was counted from the hourly series. Additionally, the intermediate peaks with a return period "i" were obtained (Q_i with i=3 to 9). For the purpose of the plot, the values were presented as percentage of time exceeded for each flow rate. FDC comparison at the POC is illustrated in Figure 1 in both normal and logarithmic scale. Attachment 5 provides a detailed drainage exhibit for the post-developed condition.

As can be seen in Figure 1, the FDC for the proposed condition with the HMP BMPs is within 110% of the curve for the existing condition in both peak flows and durations. The additional runoff volume generated from developing the site will be released to the existing point of discharge at a flow rate below the 10% Q_2 lower threshold for POC-1. Additionally, the project will also not increase peak flow rates between the Q_2 and the Q_{10}, as shown in the peak flow tables in Attachment 1.

Discussion of the Manning's coefficient (Pervious Areas) for Pre and Post-Development Conditions

Typically the Manning's coefficient is selected as n = 0.10 for pervious areas and n = 0.012 for impervious areas. Due to the complexity of the model carried out in pre and post-development conditions, a more accurate value of the Manning's coefficient for pervious areas has been chosen. Taking into consideration the "Handouts on Supplemental Guidance – Handout #2: Manning's "n" Values for Overland Flow Using EPA SWMM V.5" by the County of San Diego (Reference [6]) a more accurate value of n = 0.05 has been selected (see Table 1 of Reference [6] included in Attachment 7). An average n value between pasture and shrubs and bushes (which is also the value of dense grass) has been selected per the reference cited, for light rain (<0.8 in/hr) as more than 99% of the rainfall has been measured with this intensity.

Drawdown Calculations

According to SWQMP requirements the surface of the biofiltration basin must be emptied in less than 24 hours. Per the calculations done following the elevation-discharge-volume table and shown in Table 5, the surface of the biofiltration basin located below the invert of the slot empties in 3.74 hours, thus complying with SWQMP requirements.

TABLE 5 – DRAWDOWN CALCULATIONS

h (ft)	Q (cfs)	V (cu-ft)	Δt (hr)
0	0.598	20832	-
0.25	0.621	22506	0.76
0.5	0.644	26097	1.58
0.75	0.665	29802	1.57
		TOTAL	**3.91**

$\Delta t = 2(V_{i+1}-V_i)/[3600\cdot(Q_i+Q_{i+1})]$

SUMMARY

This study has demonstrated that the proposed HMP BMP provided for the Baidee Project site is sufficient to meet the current HMP criteria for the Point of Compliance (POC), if the cross-section area and volume recommended within this technical memorandum, and the respective orifice and outlet structure are incorporated as specified within the proposed project site.

KEY ASSUMPTIONS

1. Type D Soils is representative of the existing condition site.

ATTACHMENTS

1. Q_2 to Q_{10} Comparison Tables
2. FDC Plots (log and natural “x” scale) and Flow Duration Table.
3. List of the “n” largest Peaks: Pre-Development and Post-Development Conditions
4. Elevations vs. Discharge Table (not needed in SWMM for this project)
5. Pre & Post Development Maps
6. SWMM Input Data in Input Format (Existing and Proposed Models)
7. SWMM Screens and Explanation of Significant Variables
8. Soil Type Maps
9. Summary files from the SWMM Model

REFERENCES

[1] – *“Review and Analysis of San Diego County Hydromodification Management Plan (HMP): Assumptions, Criteria, Methods, & Modeling Tools – Prepared for the Cities of San Marcos, Oceanside & Vista”,* May 2012, TRW Engineering.

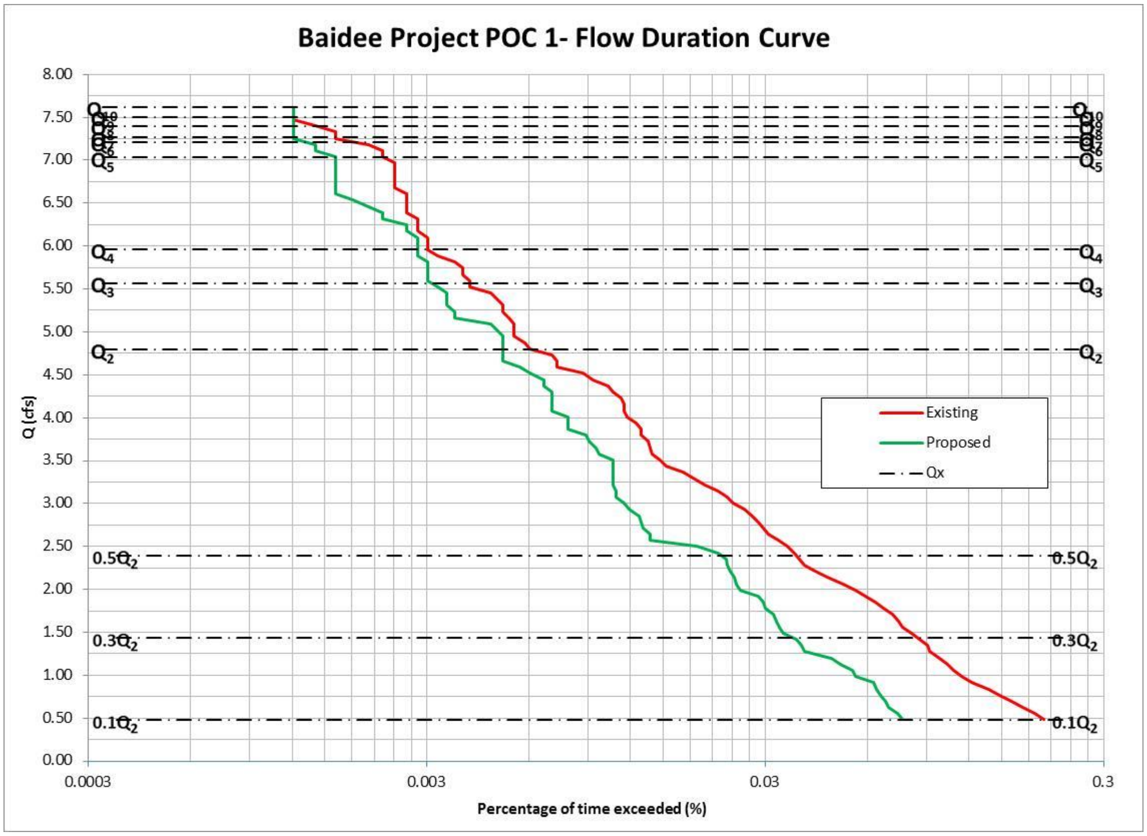
[2] – *“Final Hydromodification Management Plan (HMP) prepared for the County of San Diego”,* March 2011, Brown and Caldwell.

[3] - Order R9-20013-001, California Regional Water Quality Control Board San Diego Region (SDRWQCB).

[4] – “*Handbook of Hydrology*”, David R. Maidment, Editor in Chief. 1992, McGraw Hill.

[5] – “*City of La Mesa BMP Design Manual*”, February 2016.

[6] – “*Improving Accuracy in Continuous Hydrologic Modeling: Guidance for Selecting Pervious Overland Flow Manning’s n Values in the San Diego Region*”, 2016, TRW Engineering.



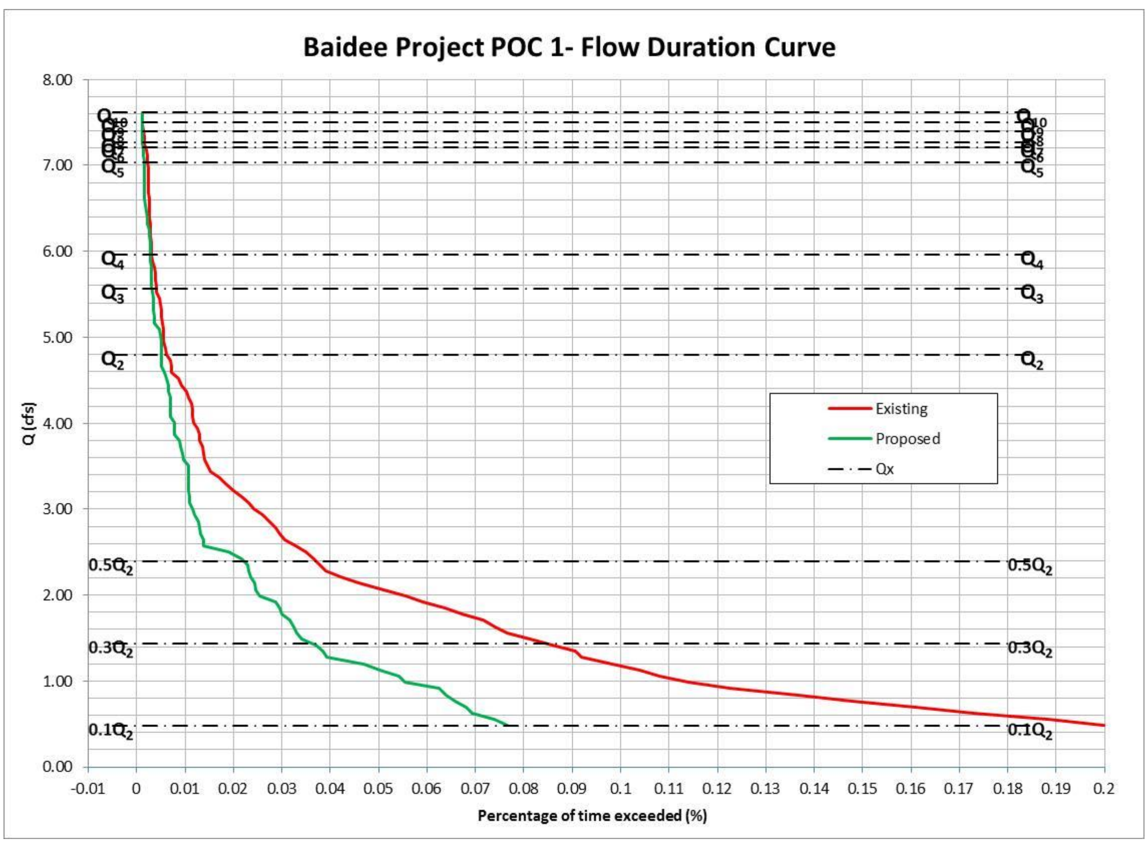


Figure 1a and 1b. Flow Duration Curve Comparison (logarithmic and normal "x" scale)

ATTACHMENT 1.

Q_2 to Q_{10} Comparison Table – POC 1

Return Period	Existing Condition (cfs)	Mitigated Condition (cfs)	Reduction, Exist - Mitigated (cfs)
2-year	4.792	4.330	0.462
3-year	5.571	5.107	0.464
4-year	5.962	5.934	0.028
5-year	7.031	6.328	0.703
6-year	7.212	6.473	0.739
7-year	7.270	6.776	0.494
8-year	7.394	7.140	0.254
9-year	7.506	7.317	0.189
10-year	7.615	7.676	-0.061

ATTACHMENT 2

FLOW DURATION CURVE ANALYSIS

1) Flow duration curve shall not exceed the existing conditions by more than 10%, neither in peak flow nor duration.

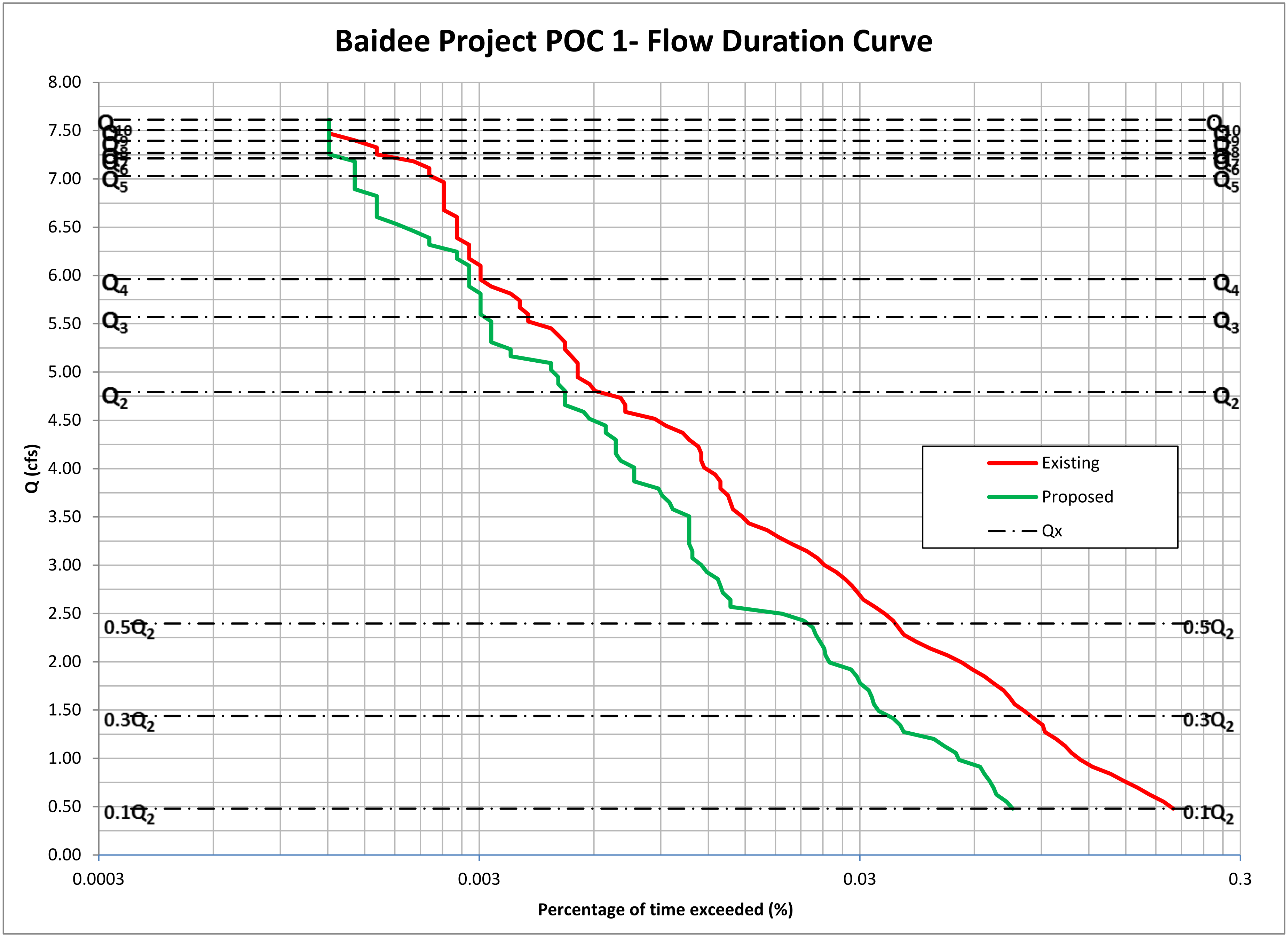
The figures on the following pages illustrate that the flow duration curve in post-development conditions after the proposed BMP is below the existing flow duration curve. The flow duration curve table following the curve shows that if the interval $0.10Q_2 - Q_{10}$ is divided in 100 sub-intervals, then a) the post development divided by pre-development durations are never larger than 110% (the permit allows up to 110%); and b) there are no more than 10 intervals in the range 101%-110% which would imply an excess over 10% of the length of the curve (the permit allows less than 10% of excesses measured as 101-110%).

Consequently, the design passes the hydromodification test.

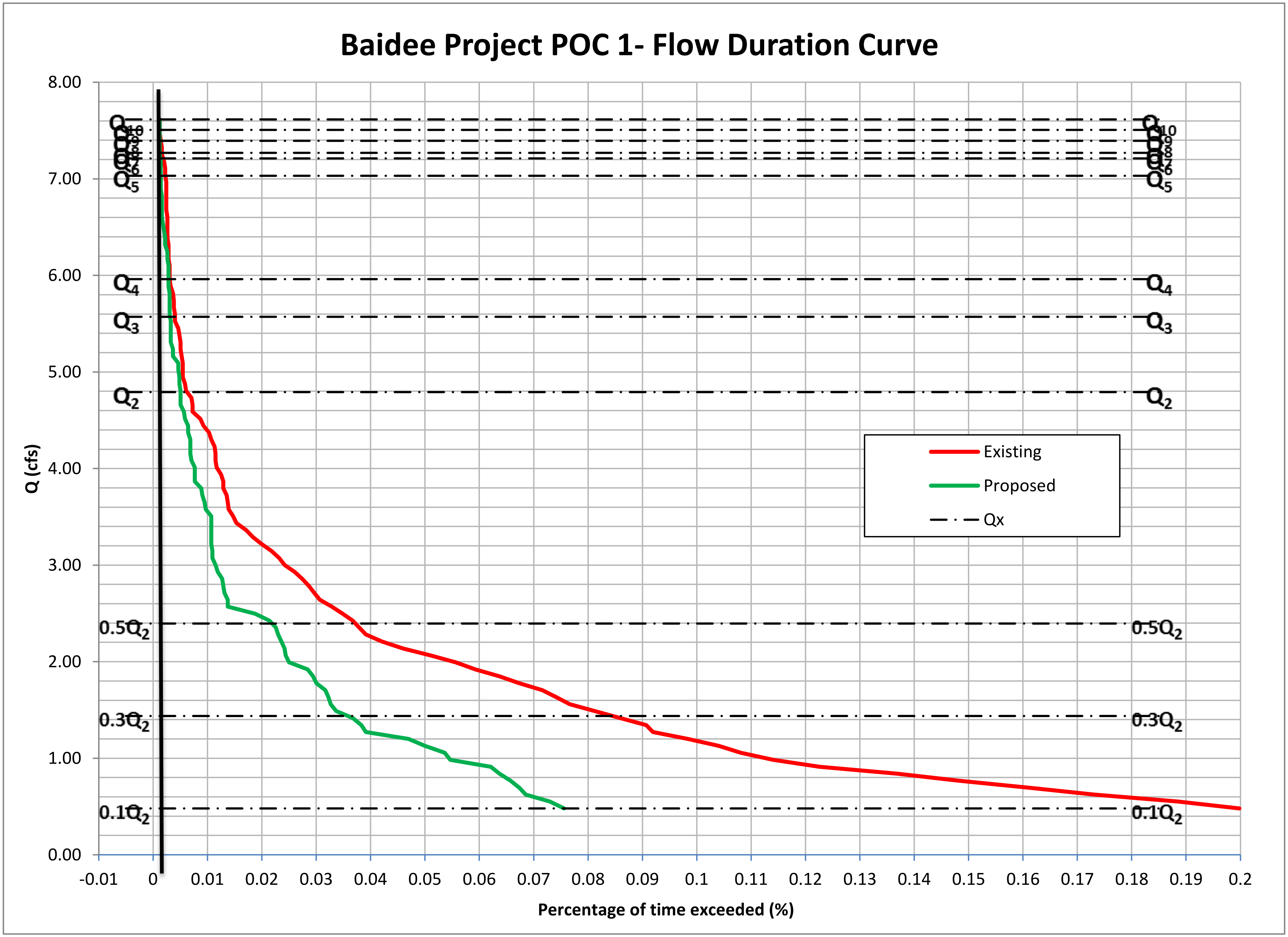
It is important to note that the flow duration curve can be expressed in the "x" axis as percentage of time, hours per year, total number of hours, or any other similar time variable. As those variables only differ by a multiplying constant, their plot in logarithmic scale is going to look exactly the same, and compliance can be observed regardless of the variable selected. However, in order to satisfy the City of San Diego HMP example, % of time exceeded is the variable of choice in the flow duration curve. The selection of a logarithmic scale in lieu of the normal scale is preferred, as differences between the pre-development and post-development curves can be seen more clearly in the entire range of analysis. Both graphics are presented just to prove the difference.

In terms of the "y" axis, the peak flow value is the variable of choice. As an additional analysis performed, not only the range of analysis is clearly depicted (10% of Q_2 to Q_{10}) but also all intermediate flows are shown (Q_2, Q_3, Q_4, Q_5, Q_6, Q_7, Q_8 and Q_9) in order to demonstrate compliance at any range $Q_x - Q_{x+1}$. It must be pointed out that one of the limitations of both the SWMM and SDHM models is that the intermediate analysis is not performed (to obtain Q_i from i = 2 to 10). The analysis was performed using the Cunnane Plotting position Method (the preferred method in the HMP permit) from the "n" largest independent peak flows obtained from the continuous time series.

The largest "n" peak flows are attached in this appendix, as well as the values of Q_i with a return period "i", from i=2 to 10. The Q_i values are also added into the flow-duration plot.



Baidee Project POC 1- Flow Duration Curve
Q (cfs)
8.00
7.50
7.00
6.50
6.00
5.50
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0.0003
0.003
0.03
0.3
Percentage of time exceeded (%)
Q10
Q9
Q8
Q7
Q6
Q5
Q4
Q3
Q2
0.5Q2
0.3Q2
0.1Q2
Existing
Proposed
Qx



Baidee Project POC 1- Flow Duration Curve
Q (cfs)
Percentage of time exceeded (%)
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
-0.01
0
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
0.1
0.11
0.12
0.13
0.14
0.15
0.16
0.17
0.18
0.19
0.2
Existing
Proposed
Qx
Q4
Q3
Q2
0.5Q2
0.3Q2
0.1Q2

Flow Duration Curve Data for Baidee Project, City of San Diego CA

Q2 =	4.79	cfs	Fraction	10 %
Q10 =	7.61	cfs		
Step =	0.0721	cfs		
Count =	496008	hours		
	56.58	years		

	Existing Condition			Detention Optimized			Pass or
Interval	Q (cfs)	Hours > Q	% time	Hours>Q	% time	Post/Pre	Fail?
1	0.479	991	2.00E-01	380	7.66E-02	38%	Pass
2	0.551	935	1.89E-01	367	7.40E-02	39%	Pass
3	0.623	859	1.73E-01	344	6.94E-02	40%	Pass
4	0.695	799	1.61E-01	338	6.81E-02	42%	Pass
5	0.767	734	1.48E-01	326	6.57E-02	44%	Pass
6	0.840	679	1.37E-01	317	6.39E-02	47%	Pass
7	0.912	608	1.23E-01	310	6.25E-02	51%	Pass
8	0.984	566	1.14E-01	275	5.54E-02	49%	Pass
9	1.056	536	1.08E-01	269	5.42E-02	50%	Pass
10	1.128	516	1.04E-01	249	5.02E-02	48%	Pass
11	1.200	488	9.84E-02	233	4.70E-02	48%	Pass
12	1.272	456	9.19E-02	195	3.93E-02	43%	Pass
13	1.344	450	9.07E-02	191	3.85E-02	42%	Pass
14	1.416	426	8.59E-02	184	3.71E-02	43%	Pass
15	1.488	403	8.12E-02	169	3.41E-02	42%	Pass
16	1.560	380	7.66E-02	164	3.31E-02	43%	Pass
17	1.632	368	7.42E-02	161	3.25E-02	44%	Pass
18	1.704	355	7.16E-02	157	3.17E-02	44%	Pass
19	1.777	334	6.73E-02	149	3.00E-02	45%	Pass
20	1.849	316	6.37E-02	147	2.96E-02	47%	Pass
21	1.921	294	5.93E-02	142	2.86E-02	48%	Pass
22	1.993	276	5.56E-02	126	2.54E-02	46%	Pass
23	2.065	253	5.10E-02	122	2.46E-02	48%	Pass
24	2.137	228	4.60E-02	121	2.44E-02	53%	Pass
25	2.209	209	4.21E-02	117	2.36E-02	56%	Pass
26	2.281	194	3.91E-02	115	2.32E-02	59%	Pass
27	2.353	188	3.79E-02	114	2.30E-02	61%	Pass
28	2.425	182	3.67E-02	108	2.18E-02	59%	Pass
29	2.497	173	3.49E-02	94	1.90E-02	54%	Pass
30	2.569	163	3.29E-02	68	1.37E-02	42%	Pass
31	2.642	152	3.06E-02	68	1.37E-02	45%	Pass
32	2.714	147	2.96E-02	65	1.31E-02	44%	Pass
33	2.786	142	2.86E-02	64	1.29E-02	45%	Pass
34	2.858	136	2.74E-02	63	1.27E-02	46%	Pass
35	2.930	129	2.60E-02	59	1.19E-02	46%	Pass
36	3.002	120	2.42E-02	57	1.15E-02	48%	Pass

Interval	Existing Condition			Detention Optimized			Pass or Fail?
	Q (cfs)	Hours > Q	% time	Hours>Q	% time	Post/Pre	
37	3.074	115	2.32E-02	54	1.09E-02	47%	Pass
38	3.146	108	2.18E-02	54	1.09E-02	50%	Pass
39	3.218	99	2.00E-02	53	1.07E-02	54%	Pass
40	3.290	91	1.83E-02	53	1.07E-02	58%	Pass
41	3.362	85	1.71E-02	53	1.07E-02	62%	Pass
42	3.434	76	1.53E-02	53	1.07E-02	70%	Pass
43	3.506	73	1.47E-02	53	1.07E-02	73%	Pass
44	3.579	69	1.39E-02	48	9.68E-03	70%	Pass
45	3.651	68	1.37E-02	47	9.48E-03	69%	Pass
46	3.723	67	1.35E-02	45	9.07E-03	67%	Pass
47	3.795	64	1.29E-02	44	8.87E-03	69%	Pass
48	3.867	64	1.29E-02	39	7.86E-03	61%	Pass
49	3.939	62	1.25E-02	39	7.86E-03	63%	Pass
50	4.011	58	1.17E-02	39	7.86E-03	67%	Pass
51	4.083	57	1.15E-02	35	7.06E-03	61%	Pass
52	4.155	57	1.15E-02	35	7.06E-03	61%	Pass
53	4.227	56	1.13E-02	35	7.06E-03	63%	Pass
54	4.299	53	1.07E-02	35	7.06E-03	66%	Pass
55	4.371	51	1.03E-02	33	6.65E-03	65%	Pass
56	4.443	46	9.27E-03	33	6.65E-03	72%	Pass
57	4.516	43	8.67E-03	30	6.05E-03	70%	Pass
58	4.588	36	7.26E-03	28	5.65E-03	78%	Pass
59	4.660	36	7.26E-03	25	5.04E-03	69%	Pass
60	4.732	35	7.06E-03	25	5.04E-03	71%	Pass
61	4.804	30	6.05E-03	25	5.04E-03	83%	Pass
62	4.876	29	5.85E-03	25	5.04E-03	86%	Pass
63	4.948	27	5.44E-03	25	5.04E-03	93%	Pass
64	5.020	27	5.44E-03	24	4.84E-03	89%	Pass
65	5.092	27	5.44E-03	23	4.64E-03	85%	Pass
66	5.164	26	5.24E-03	18	3.63E-03	69%	Pass
67	5.236	25	5.04E-03	18	3.63E-03	72%	Pass
68	5.308	25	5.04E-03	17	3.43E-03	68%	Pass
69	5.380	24	4.84E-03	17	3.43E-03	71%	Pass
70	5.453	23	4.64E-03	17	3.43E-03	74%	Pass
71	5.525	20	4.03E-03	16	3.23E-03	80%	Pass
72	5.597	20	4.03E-03	15	3.02E-03	75%	Pass
73	5.669	19	3.83E-03	15	3.02E-03	79%	Pass
74	5.741	19	3.83E-03	15	3.02E-03	79%	Pass
75	5.813	18	3.63E-03	15	3.02E-03	83%	Pass
76	5.885	16	3.23E-03	14	2.82E-03	88%	Pass
77	5.957	15	3.02E-03	14	2.82E-03	93%	Pass
78	6.029	15	3.02E-03	14	2.82E-03	93%	Pass
79	6.101	15	3.02E-03	14	2.82E-03	93%	Pass
80	6.173	14	2.82E-03	13	2.62E-03	93%	Pass
81	6.245	14	2.82E-03	13	2.62E-03	93%	Pass

Interval	Existing Condition			Detention Optimized			Pass or Fail?
	Q (cfs)	Hours > Q	% time	Hours>Q	% time	Post/Pre	
82	6.318	14	2.82E-03	11	2.22E-03	79%	Pass
83	6.390	13	2.62E-03	11	2.22E-03	85%	Pass
84	6.462	13	2.62E-03	10	2.02E-03	77%	Pass
85	6.534	13	2.62E-03	9	1.81E-03	69%	Pass
86	6.606	13	2.62E-03	8	1.61E-03	62%	Pass
87	6.678	12	2.42E-03	8	1.61E-03	67%	Pass
88	6.750	12	2.42E-03	8	1.61E-03	67%	Pass
89	6.822	12	2.42E-03	8	1.61E-03	67%	Pass
90	6.894	12	2.42E-03	8	1.61E-03	67%	Pass
91	6.966	12	2.42E-03	8	1.61E-03	67%	Pass
92	7.038	11	2.22E-03	8	1.61E-03	73%	Pass
93	7.110	11	2.22E-03	7	1.41E-03	64%	Pass
94	7.182	10	2.02E-03	7	1.41E-03	70%	Pass
95	7.255	8	1.61E-03	6	1.21E-03	75%	Pass
96	7.327	8	1.61E-03	6	1.21E-03	75%	Pass
97	7.399	7	1.41E-03	6	1.21E-03	86%	Pass
98	7.471	6	1.21E-03	6	1.21E-03	100%	Pass
99	7.543	6	1.21E-03	6	1.21E-03	100%	Pass
100	7.615	6	1.21E-03	6	1.21E-03	100%	Pass

Peak Flows calculated with Cunnane Plotting Position

Return Period (years)	Pre-dev. Q (cfs)	Post-Dev. Q (cfs)	Reduction (cfs)
10	7.615	7.676	-0.061
9	7.506	7.317	0.189
8	7.394	7.140	0.254
7	7.270	6.776	0.494
6	7.212	6.473	0.739
5	7.031	6.328	0.703
4	5.962	5.934	0.028
3	5.571	5.107	0.464
2	4.792	4.330	0.462

ATTACHMENT 3

List of the “n” Largest Peaks: Pre & Post-Developed Conditions

Basic Probabilistic Equation:

R = 1/P R: Return period (years).

P: Probability of a flow to be equaled or exceeded any given year (dimensionless).

Cunnane Equation:

$$P = \frac{i-0.4}{n+0.2}$$

Weibull Equation:

$$P = \frac{i}{n+1}$$

i: Position of the peak whose probability is desired (sorted from large to small).

n: Number of years analyzed.

Explanation of Variables for the Tables in this Attachment

Peak: Refers to the peak flow at the date given, taken from the continuous simulation hourly results of the n year analyzed.

Posit: If all peaks are sorted from large to small, the position of the peak in a sorting analysis is included under the variable Posit.

Date: Date of the occurrence of the peak at the outlet from the continuous simulation

Note: All peaks are not annual maxima; instead they are defined as event maxima, with a threshold to separate peaks of at least 12 hours. In other words, any peak P in a time series is defined as a value where dP/dt = 0, and the peak is the largest value in 25 hours (12 hours before, the hour of occurrence and 12 hours after the occurrence, so it is in essence a daily peak).

List of Peak events and Determination of Q2 and Q10 (Pre-Development)
Baidee Project - POC 1

T (Year)	Cunnane (cfs)	Weibull (cfs)
10	**7.61**	**7.78**
9	**7.51**	**7.56**
8	**7.39**	**7.43**
7	**7.27**	**7.30**
6	**7.21**	**7.22**
5	**7.03**	**7.07**
4	**5.96**	**6.01**
3	**5.57**	**5.59**
2	**4.79**	**4.79**

Note:
Cunnane is the preferred method by the HMP permit.

Peaks (cfs)	Date	Posit	Period of Return (Years) Weibull	Cunnane
3.6644	1/18/1973	57	1.02	1.01
3.7299	11/11/1972	56	1.04	1.03
3.7504	12/18/1967	55	1.05	1.05
3.9674	12/7/1992	54	1.07	1.07
3.9985	3/22/1954	53	1.09	1.09
4.0045	2/15/1992	52	1.12	1.11
4.0487	2/22/1969	51	1.14	1.13
4.1552	11/21/1978	50	1.16	1.15
4.2405	12/2/1952	49	1.18	1.18
4.2736	1/7/1993	48	1.21	1.20
4.2833	1/14/1969	47	1.23	1.23
4.3483	1/18/1952	46	1.26	1.25
4.3653	1/11/2001	45	1.29	1.28
4.3743	3/27/1992	44	1.32	1.31
4.3884	2/20/1993	43	1.35	1.34
4.3912	11/28/1970	42	1.38	1.38
4.4358	12/20/1997	41	1.41	1.41
4.4386	1/31/1979	40	1.45	1.44
4.4764	3/5/1970	39	1.49	1.48
4.4916	1/4/2005	38	1.53	1.52
4.5115	3/1/1983	37	1.57	1.56
4.516	10/19/2004	36	1.61	1.61
4.55	12/30/1951	35	1.66	1.65
4.5761	1/4/1995	34	1.71	1.70
4.5855	2/8/1976	33	1.76	1.75
4.7103	10/27/2004	32	1.81	1.81
4.7456	3/24/1983	31	1.87	1.87
4.7723	2/16/1959	30	1.93	1.93
4.7916	11/15/1965	29	2.00	2.00
4.8142	3/2/1983	28	2.07	2.07
4.9315	2/16/1998	27	2.15	2.15
4.9447	2/15/1986	26	2.23	2.23
5.123	10/20/2004	25	2.32	2.33
5.3722	11/21/1967	24	2.42	2.42
5.4355	11/25/1985	23	2.52	2.53
5.4758	3/1/1970	22	2.64	2.65
5.489	2/6/1992	21	2.76	2.78
5.5102	11/22/1996	20	2.90	2.92
5.6261	2/6/1976	19	3.05	3.08
5.7899	2/23/1998	18	3.22	3.25
5.844	2/23/2005	17	3.41	3.45
5.8453	1/18/1955	16	3.63	3.67
5.8892	3/1/1978	15	3.87	3.92
6.1436	11/12/1976	14	4.14	4.21
6.6306	1/3/2005	13	4.46	4.54
7.0068	3/4/1978	12	4.83	4.93
7.1728	1/29/1983	11	5.27	5.40
7.2109	12/21/1970	10	5.80	5.96
7.2246	2/22/2004	9	6.44	6.65
7.3394	10/14/2006	8	7.25	7.53
7.4701	3/27/1971	7	8.29	8.67
7.6382	2/2/1988	6	9.67	10.21
8.479	2/2/1998	5	11.60	12.43
8.6217	10/19/1972	4	14.50	15.89
8.8757	2/7/1998	3	19.33	22.00
8.9447	10/30/1998	2	29.00	35.75
9.3854	2/13/1998	1	58.00	95.33

List of Peak events and Determination of Q2 and Q10 (Post-Development)
Baidee Project - POC 1

T (Year)	Cunnane (cfs)	Weibull (cfs)
10	**7.68**	**7.78**
9	**7.32**	**7.48**
8	**7.14**	**7.17**
7	**6.78**	**6.93**
6	**6.47**	**6.50**
5	**6.33**	**6.35**
4	**5.93**	**5.99**
3	**5.11**	**5.11**
2	**4.33**	**4.33**

Note:
Cunnane is the preferred method by the HMP permit.

Peaks (cfs)	Date	Posit	Period of Return (Years) Weibull	Period of Return (Years) Cunnane
2.4367	1/6/1959	57	1.02	1.01
2.4804	12/4/1972	56	1.04	1.03
2.4855	3/5/1995	55	1.05	1.05
2.5024	3/18/1982	54	1.07	1.07
2.5103	10/20/2004	53	1.09	1.09
2.5301	1/5/1974	52	1.12	1.11
2.5366	1/15/1978	51	1.14	1.13
2.5473	1/16/1993	50	1.16	1.15
2.7084	3/1/1970	49	1.18	1.18
2.7668	2/28/1970	48	1.21	1.20
2.7859	1/18/1955	47	1.23	1.23
2.8938	1/17/1978	46	1.26	1.25
2.9138	1/7/1957	45	1.29	1.28
3.0245	10/19/2004	44	1.32	1.31
3.0309	2/19/2007	43	1.35	1.34
3.0603	1/8/1993	42	1.38	1.38
3.1874	11/23/1965	41	1.41	1.41
3.5767	2/23/2004	40	1.45	1.44
3.5807	12/28/1984	39	1.49	1.48
3.6609	11/15/1965	38	1.53	1.52
3.6986	1/22/1967	37	1.57	1.56
3.7634	3/1/1983	36	1.61	1.61
3.8119	2/8/1976	35	1.66	1.65
3.8257	1/13/1997	34	1.71	1.70
3.8335	1/29/1980	33	1.76	1.75
4.0422	2/14/1995	32	1.81	1.81
4.0642	3/1/1991	31	1.87	1.87
4.0664	2/16/1959	30	1.93	1.93
4.3299	3/22/1954	29	2.00	2.00
4.346	12/21/1970	28	2.07	2.07
4.4942	3/8/1968	27	2.15	2.15
4.5003	10/27/2004	26	2.23	2.23
4.5228	2/23/1998	25	2.32	2.33
4.5569	12/7/1992	24	2.42	2.42
4.6016	1/7/1993	23	2.52	2.53
4.6225	1/18/1952	22	2.64	2.65
5.0681	10/19/1972	21	2.76	2.78
5.1053	1/14/1969	20	2.90	2.92
5.1078	3/2/1983	19	3.05	3.08
5.1265	1/4/1995	18	3.22	3.25
5.1303	12/30/1951	17	3.41	3.45
5.5789	2/15/1986	16	3.63	3.67
5.8498	1/3/2005	15	3.87	3.92
6.1456	11/25/1985	14	4.14	4.21
6.297	11/12/1976	13	4.46	4.54
6.315	3/1/1978	12	4.83	4.93
6.404	2/6/1976	11	5.27	5.40
6.467	11/22/1996	10	5.80	5.96
6.5619	2/6/1992	9	6.44	6.65
7.0994	3/27/1971	8	7.25	7.53
7.1974	2/22/2004	7	8.29	8.67
7.753	2/2/1988	6	9.67	10.21
7.929	10/14/2006	5	11.60	12.43
8.8911	2/2/1998	4	14.50	15.89
9.1652	2/7/1998	3	19.33	22.00
9.2413	10/30/1998	2	29.00	35.75
9.8068	2/13/1998	1	58.00	95.33

ATTACHMENT 4

AREA VS ELEVATION

The storage provided by the LID BMP is entered into the LID Module within SWMM – please refer to Attachment 7 for further information. For verification, a stage storage relationship for the facilities is provided on the following pages.

DISCHARGE VS ELEVATION

The orifices have been selected to maximize their size while still restricting flows to conform with the required 10% of the Q2 event flow as mandated in the Final Hydromodification Management Plan by Brown & Caldwell, dated March 2011. While REC acknowledges that these orifices are small, to increase the size of these outlets would impact the basin's ability to restrict flows beneath the HMP thresholds, thus preventing the BMP from conformance with HMP requirements.

In order to further reduce the risk of blockage of the orifices, regular maintenance of the riser and orifices must be performed to ensure potential blockages are minimized. A detail of the orifice and riser structure is provided in Attachment 5 of this memorandum.

The LID low flow orifice discharge relationship is addressed within the LID Module within SWMM – please refer to Attachment 7 for further information.

DRAWDOWN CALCULATIONS

Surface drawdown calculations are provided on the following pages for reference and proof of draining within 24 hours. It is assumed the basin is full to the crest and discharges occur thru all available outlets as well as by infiltration.

DISCHARGE EQUATIONS

1) Weir:
   $Q_W = C_W \cdot L \cdot H^{3/2}$ (1)

2) Slot:

   As an orifice: $Q_s = B_s \cdot h_s \cdot c_g \cdot \sqrt{2g\left(H - \frac{h_s}{2}\right)}$ (2.a)

   As a weir: $Q_s = C_W \cdot B_s \cdot H^{3/2}$ (2.b)

   For H > h_s slot works as weir until orifice equation provides a smaller discharge. The elevation such that equation (2.a) = equation (2.b) is the elevation at which the behavior changes from weir to orifice.

3) Vertical Orifices

   As an orifice: $Q_o = 0.25 \cdot \pi D^2 \cdot c_g \cdot \sqrt{2g\left(H - \frac{D}{2}\right)}$ (3.a)

   As a weir: Critical depth and geometric family of circular sector must be solved to determined Q as a function of H:

$$\frac{Q_O^2}{g} = \frac{A_{cr}^3}{T_{cr}}; \quad H = y_{cr} + \frac{A_{cr}}{2 \cdot T_{cr}}; \; T_{cr} = 2\sqrt{y_{cr}(D - y_{cr})}\,; \quad A_{cr} = \frac{D^2}{8}[\alpha_{cr} - sin(\alpha_{cr})]\,;$$

$$y_{cr} = \frac{D}{2}[1 - sin(0.5 \cdot \alpha_{cr})]$$ (3.b.1, 3.b.2, 3.b.3, 3.b.4 and 3.b.5)

   There is a value of H (approximately H = 110% D) from which orifices no longer work as weirs as critical depth is not possible at the entrance of the orifice. This value of H is obtained equaling the discharge using critical equations and equations (3.b).

A mathematical model is prepared with the previous equations depending on the type o discharge.

The following are the variables used above:

Q_W, Q_s, Q_O = Discharge of weir, slot or orifice (cfs)

C_W, c_g : Coefficients of discharge of weir (typically 3.1) and orifice (0.61 to 0.62)

L, B_s, D, h_s : Length of weir, width of slot, diameter of orifice and height of slot, respectively; (ft)

H: Level of water in the pond over the invert of slot, weir or orifice (ft)

A_{cr}, T_{cr}, y_{cr}, α_{cr}: Critical variables for circular sector: area (sq-ft), top width (ft), critical depth (ft), and angle to the center, respectively.

Elevation vs Discharge vs Volume for Overall BMP

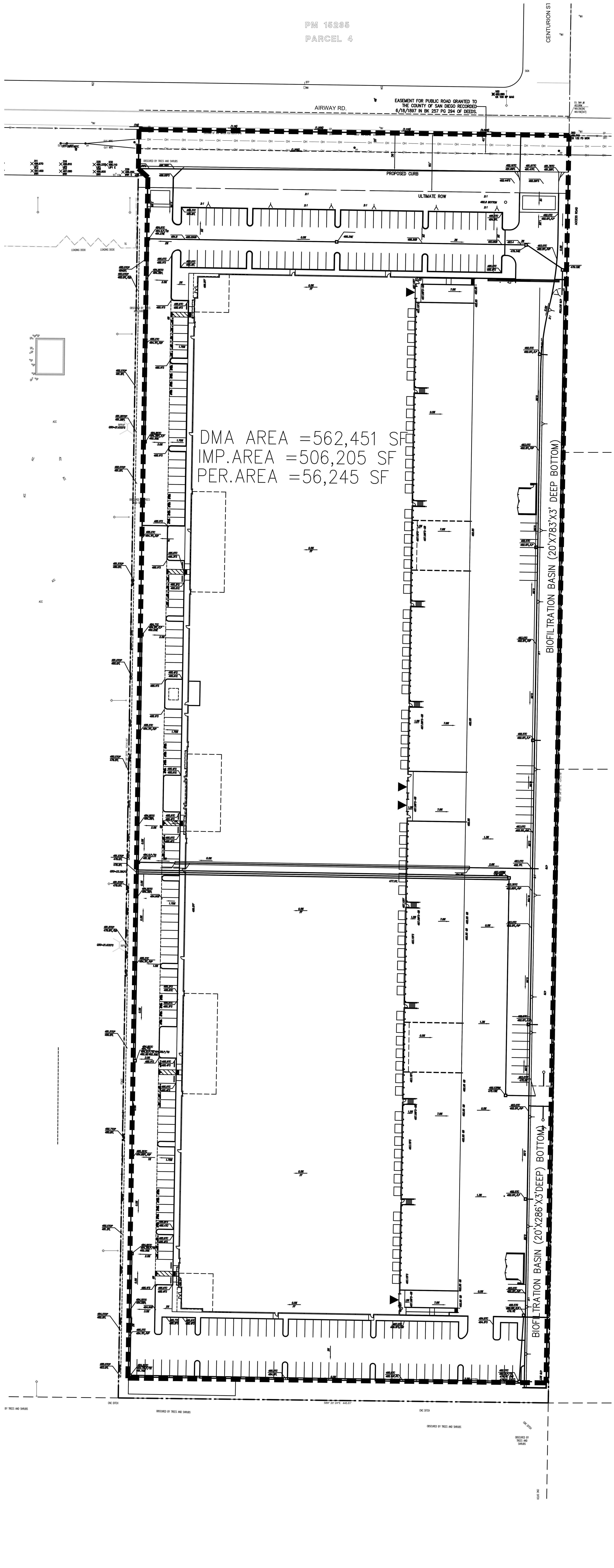
(measured from invert of low-flow orifice)

h (ft)	$Q_{orif+soil}$ (cfs)	Q_{Slot} (cfs)	Q_{emer} (cfs)	Q_{TOT} (cfs)	Vol (ft^3)
0.00	0.000	0	0	**0.00**	**0**
0.25	0.112	0	0	**0.11**	**1430**
0.50	0.212	0	0	**0.21**	**2886**
0.75	0.279	0	0	**0.28**	**4370**
1.00	0.332	0	0	**0.33**	**5880**
1.25	0.378	0	0	**0.38**	**7416**
1.50	0.418	0	0	**0.42**	**8980**
1.75	0.456	0	0	**0.46**	**10570**
2.00	0.479	0	0	**0.48**	**11782**
2.25	0.500	0	0	**0.50**	**13015**
2.50	0.519	0	0	**0.52**	**14268**
2.75	0.537	0	0	**0.54**	**15541**
3.00	0.554	0	0	**0.55**	**16833**
3.25	0.569	0	0	**0.57**	**18146**
3.50	0.584	0	0	**0.58**	**19479**
3.75	0.598	0	0	**0.60**	**20832**
4.00	0.621	0	0	**0.62**	**22506**
4.25	0.644	0	0	**0.64**	**26097**
4.50	0.665	0	0	**0.67**	**29802**
4.58	0.672	0.534	0	**1.21**	**31062**
4.67	0.679	1.512	0	**2.19**	**32335**
4.75	0.686	2.777	0	**3.46**	**33620**
4.83	0.693	4.276	0	**4.97**	**34918**
4.92	0.700	5.975	0	**6.68**	**36229**
5.00	0.707	7.855	0	**8.56**	**37552**
5.08	0.714	9.898	0	**10.61**	**38888**
5.17	0.720	11.323	0	**12.04**	**40236**
5.25	0.727	12.404	0	**13.13**	**41597**
5.33	0.734	13.397	0	**14.13**	**42971**
5.42	0.740	14.322	0	**15.06**	**44358**
5.50	0.747	15.191	0	**15.94**	**45757**
5.58	0.753	16.013	0	**16.77**	**47168**
5.67	0.760	16.794	0	**17.55**	**48592**
5.75	0.766	17.541	0	**18.31**	**50029**
5.83	0.772	18.257	1.790	**20.82**	**51479**
5.92	0.778	18.947	5.062	**24.79**	**52941**
6.00	0.785	19.612	9.300	**29.70**	**54415**
6.08	0.791	20.255	14.318	**35.36**	**55903**
6.17	0.797	20.878	20.010	**41.69**	**57403**
6.25	0.803	21.484	26.304	**48.59**	**58915**
6.33	0.809	22.072	33.147	**56.03**	**60440**
6.42	0.815	22.646	40.498	**63.96**	**61978**
6.50	0.821	23.205	48.324	**72.35**	**63529**
6.58	0.827	23.751	56.598	**81.18**	**65092**
6.67	0.833	24.285	65.297	**90.41**	**66667**
6.75	0.839	24.807	74.400	**100.05**	**68256**

ATTACHMENT 5

Pre & Post-Developed Maps, Project Plan and Detention

Section Sketches


PM 15235
PARCEL 4
CENTURION ST
AIRWAY RD.
EASEMENT FOR PUBLIC ROAD GRANTED TO THE COUNTY OF SAN DIEGO RECORDED 6/18/1897 IN BK 257 PG 294 OF DEEDS.
PROPOSED CURB
ULTIMATE ROW
DMA AREA =562,451 SF
IMP.AREA =506,205 SF
PER.AREA =56,245 SF
BIOFILTRATION BASIN (20'X783'X3' DEEP BOTTOM)
BIOFILTRATION BASIN (20'X286'X3'DEEP) BOTTOM

ATTACHMENT 6

SWMM Input Data in Input Format (Existing & Proposed Models)

PRE-DEV AND POST-DEV

```
[TITLE]

[OPTIONS]
FLOW_UNITS           CFS
INFILTRATION         GREEN_AMPT
FLOW_ROUTING         KINWAVE
START_DATE           08/29/1951
START_TIME           00:00:00
REPORT_START_DATE    08/29/1951
REPORT_START_TIME    00:00:00
END_DATE             03/29/2008
END_TIME             00:00:00
SWEEP_START          01/01
SWEEP_END            12/31
DRY_DAYS             0
REPORT_STEP          01:00:00
WET_STEP             00:15:00
DRY_STEP             04:00:00
ROUTING_STEP         0:01:00
ALLOW_PONDING        NO
INERTIAL_DAMPING     PARTIAL
VARIABLE_STEP        0.75
LENGTHENING_STEP     0
MIN_SURFAREA         0
NORMAL_FLOW_LIMITED  BOTH
SKIP_STEADY_STATE    NO
FORCE_MAIN_EQUATION  H-W
LINK_OFFSETS         DEPTH
MIN_SLOPE            0

[EVAPORATION]
;;Type       Parameters
;;---------- ----------
MONTHLY      0.07   0.1    0.13   0.17   0.19   0.22   0.24   0.22   0.19   0.13   0.09   0.06
DRY_ONLY     NO

[RAINGAGES]
;;               Rain      Time   Snow   Data
;;Name           Type      Intrvl Catch  Source
;;-------------- --------- ------ ------ ----------
LowerOtay        INTENSITY 1:00   1.0    TIMESERIES LowerOtay

[SUBCATCHMENTS]
;;                                                Total    Pcnt.             Pcnt.    Curb     Snow
;;Name           Raingage         Outlet           Area     Imperv   Width    Slope    Length   Pack
;;-------------- ---------------- ---------------- -------- -------- -------- -------- -------- --------
DMA-1-D          LowerOtay        br-1             12.5194  92.8     3600     1        0
BR-1             LowerOtay        POC-1            0.3927   0        16       0        0
DMA-1-D-Pre      LowerOtay        POC-1-Pre        12.9121  0        3600     1        0

[SUBAREAS]
;;Subcatchment   N-Imperv   N-Perv     S-Imperv   S-Perv     PctZero    RouteTo    PctRouted
;;-------------- ---------- ---------- ---------- ---------- ---------- ---------- ----------
DMA-1-D          0.012      0.05       0.05       0.1        25         OUTLET
BR-1             0.012      0.05       0.05       0.1        25         OUTLET
DMA-1-D-Pre      0.012      0.05       0.05       0.1        25         OUTLET

[INFILTRATION]
;;Subcatchment   Suction    HydCon     IMDmax
;;-------------- ---------- ---------- ----------
DMA-1-D          9          0.01875    0.33
BR-1             9          0.01875    0.33
DMA-1-D-Pre      9          0.01875    0.33

[LID_CONTROLS]
;;               Type/Layer Parameters
;;-------------- ---------- ----------
BR-1             BC
BR-1             SURFACE    6.29       0.0        0.0        0.0        5
BR-1             SOIL       24         0.4        0.2        0.1        5          5          1.5
BR-1             STORAGE    24         0.54       0          0
```

```
BR-1             DRAIN      0.2585     0.5        3          6

[LID_USAGE]
;;Subcatchment   LID Process      Number  Area       Width      InitSatur  FromImprv  ToPerv     Report File
;;-------------- ---------------- ------- ---------- ---------- ---------- ---------- ---------- -----------
BR-1             BR-1             1       17104      0          0          100        0

[OUTFALLS]
;;               Invert     Outfall    Stage/Table      Tide
;;Name           Elev.      Type       Time Series      Gate
;;-------------- ---------- ---------- ---------------- ----
POC-1            0          FREE                        NO
POC-1-Pre        0          FREE                        NO

[TIMESERIES]
;;Name           Date       Time       Value
;;-------------- ---------- ---------- ----------
LowerOtay        FILE "Lower Otay.txt"

[REPORT]
INPUT      NO
CONTROLS   NO
SUBCATCHMENTS ALL
NODES ALL
LINKS ALL

[TAGS]

[MAP]
DIMENSIONS 0.000 0.000 10000.000 10000.000
Units      None

[COORDINATES]
;;Node           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
POC-1            -250.000           5000.000
POC-1-Pre        -2500.000          5000.000

[VERTICES]
;;Link           X-Coord            Y-Coord
;;-------------- ------------------ ------------------

[Polygons]
;;Subcatchment   X-Coord            Y-Coord
;;-------------- ------------------ ------------------
DMA-1-D          -250.000           8200.000
BR-1             -250.000           7000.000
DMA-1-D-Pre      -2500.000          8200.000

[SYMBOLS]
;;Gage           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
LowerOtay        1609.467           6757.396
```

ATTACHMENT 7

EPA SWMM FIGURES AND EXPLANATIONS

Per the attached, the reader can see the screens associated with the EPA-SWMM Model in both pre-development and post-development conditions. Each portion, i.e., sub-catchments, outfalls, storage units, weir as a discharge, and outfalls (point of compliance), are also shown.

Variables for modeling are associated with typical recommended values by the EPA-SWMM model, typical values found in technical literature (such as Maidment's Handbook of Hydrology). Recommended values for the SWMM model have been attained from the interim Orange County criteria established for their SWMM calibration. Currently, no recommended values have been established by the San Diego County HMP Permit for the SWMM Model.

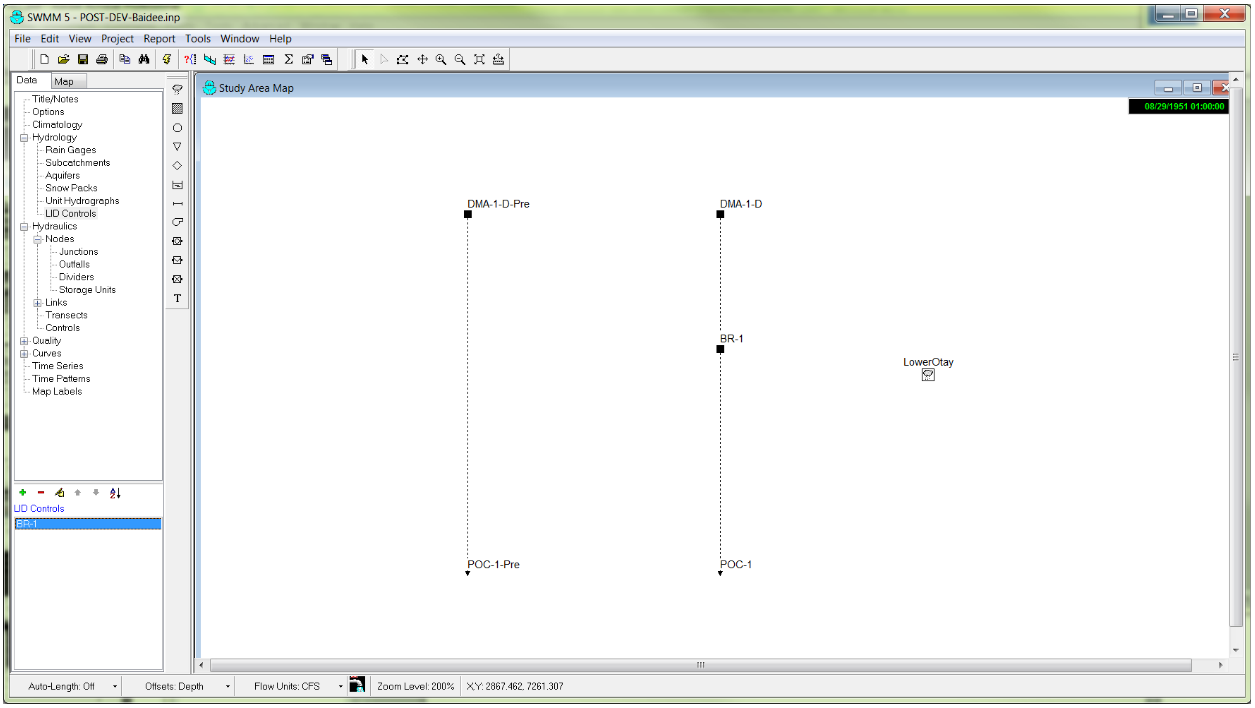
Soil characteristics of the existing soils were determined from the NRCS Web Soil Survey (located in Attachment 8 of this report).

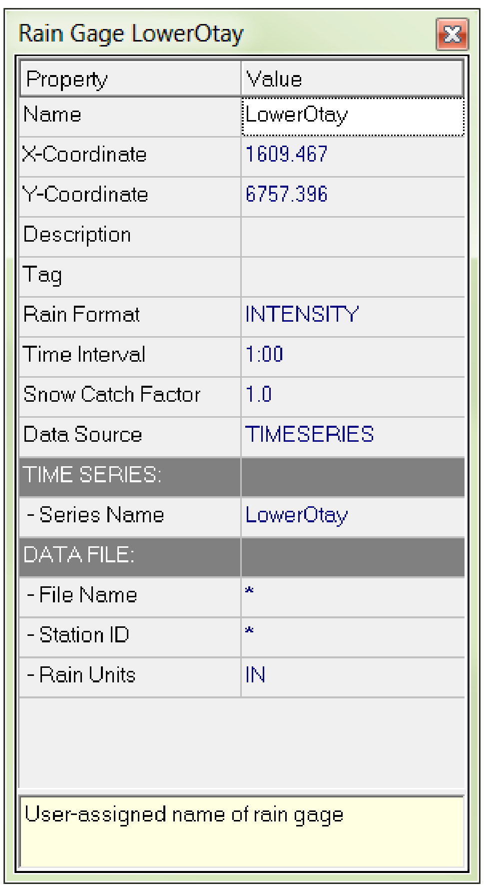
Some values incorporated within the SWMM model have been determined from the professional experience of REC using conservative assumptions that have a tendency to increase the size of the needed BMP and also generate a long-term runoff as a percentage of rainfall similar to those measured in gage stations in Southern California by the USGS.

A Technical document prepared by Tory R Walker Engineering for the Cities of San Marcos, Oceanside and Vista (Reference [1]) can also be consulted for additional information regarding typical values for SWMM parameters.

Manning's roughness coefficients have been based upon the findings of the "*Improving Accuracy in Continuous Hydrologic Modeling: Guidance for Selecting Pervious Overland Flow Manning's n Values in the San Diego Region*" date 2016 by TRW Engineering (Reference [6]).

PRE& POST DEVELOPED CONDITION

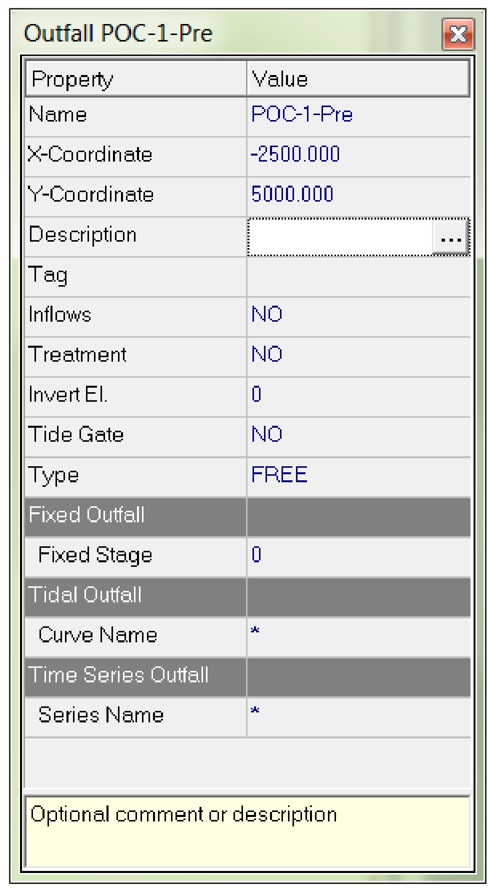




Rain Gage LowerOtay

Property	Value
Name	LowerOtay
X-Coordinate	1609.467
Y-Coordinate	6757.396
Description	
Tag	
Rain Format	INTENSITY
Time Interval	1:00
Snow Catch Factor	1.0
Data Source	TIMESERIES
TIME SERIES:	
- Series Name	LowerOtay
DATA FILE:	
- File Name	*
- Station ID	*
- Rain Units	IN

User-assigned name of rain gage



Outfall POC-1-Pre

Property	Value
Name	POC-1-Pre
X-Coordinate	-2500.000
Y-Coordinate	5000.000
Description	...
Tag	
Inflows	NO
Treatment	NO
Invert El.	0
Tide Gate	NO
Type	FREE
Fixed Outfall	
Fixed Stage	0
Tidal Outfall	
Curve Name	*
Time Series Outfall	
Series Name	*

Optional comment or description

Subcatchment DMA-1-D-Pre

Property	Value
Name	DMA-1-D-Pre
X-Coordinate	-2500.000
Y-Coordinate	8200.000
Description	...
Tag	
Rain Gage	LowerOtay
Outlet	POC-1-Pre
Area	12.9121
Width	3600
% Slope	1
% Imperv	0
N-Imperv	0.012
N-Perv	0.05
Dstore-Imperv	0.05
Dstore-Perv	0.1
%Zero-Imperv	25
Subarea Routing	OUTLET
Percent Routed	100
Infiltration	GREEN_AMPT
Groundwater	NO
Snow Pack	
LID Controls	0
Land Uses	0
Initial Buildup	NONE
Curb Length	0

Optional comment or description

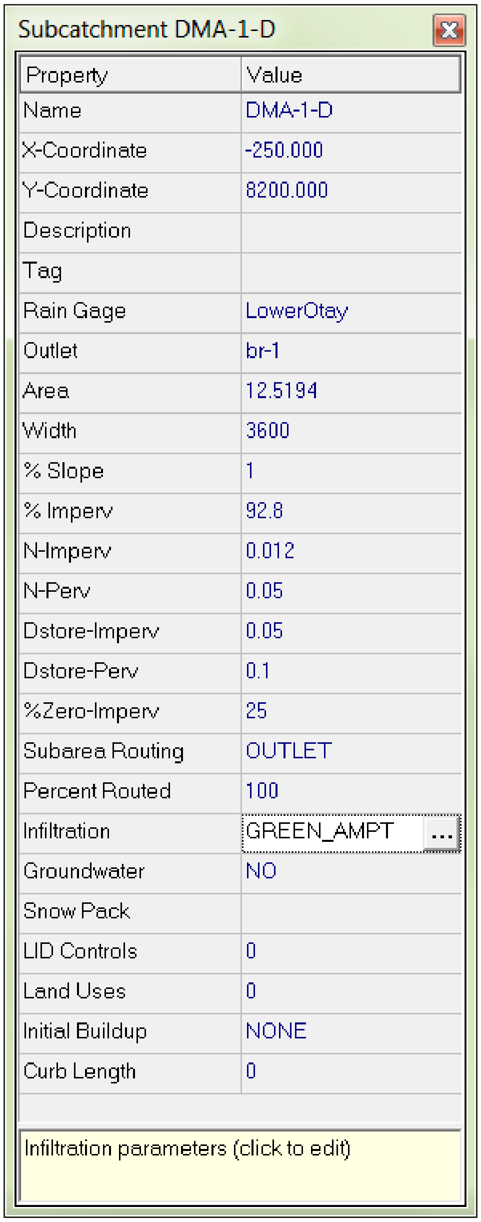
Infiltration Editor

Infiltration Method: GREEN_AMPT

Property	Value
Suction Head	9
Conductivity	0.01875
Initial Deficit	0.33

Soil capillary suction head (inches or mm)

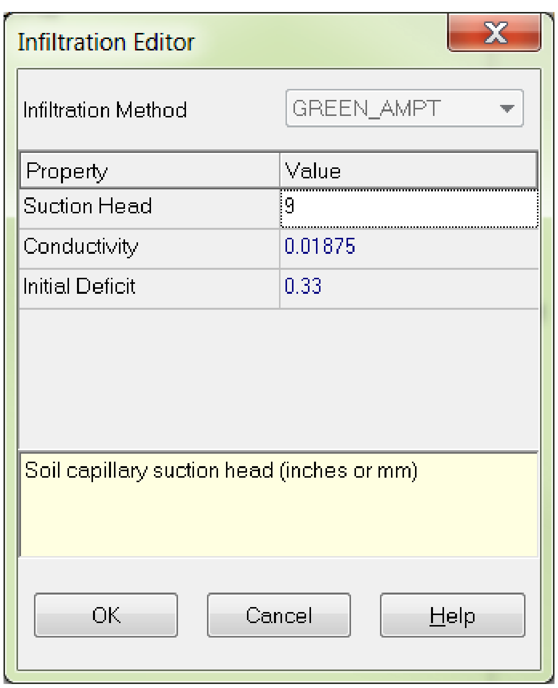
OK Cancel Help



Subcatchment DMA-1-D

Property	Value
Name	DMA-1-D
X-Coordinate	-250.000
Y-Coordinate	8200.000
Description	
Tag	
Rain Gage	LowerOtay
Outlet	br-1
Area	12.5194
Width	3600
% Slope	1
% Imperv	92.8
N-Imperv	0.012
N-Perv	0.05
Dstore-Imperv	0.05
Dstore-Perv	0.1
%Zero-Imperv	25
Subarea Routing	OUTLET
Percent Routed	100
Infiltration	GREEN_AMPT ...
Groundwater	NO
Snow Pack	
LID Controls	0
Land Uses	0
Initial Buildup	NONE
Curb Length	0

Infiltration parameters (click to edit)



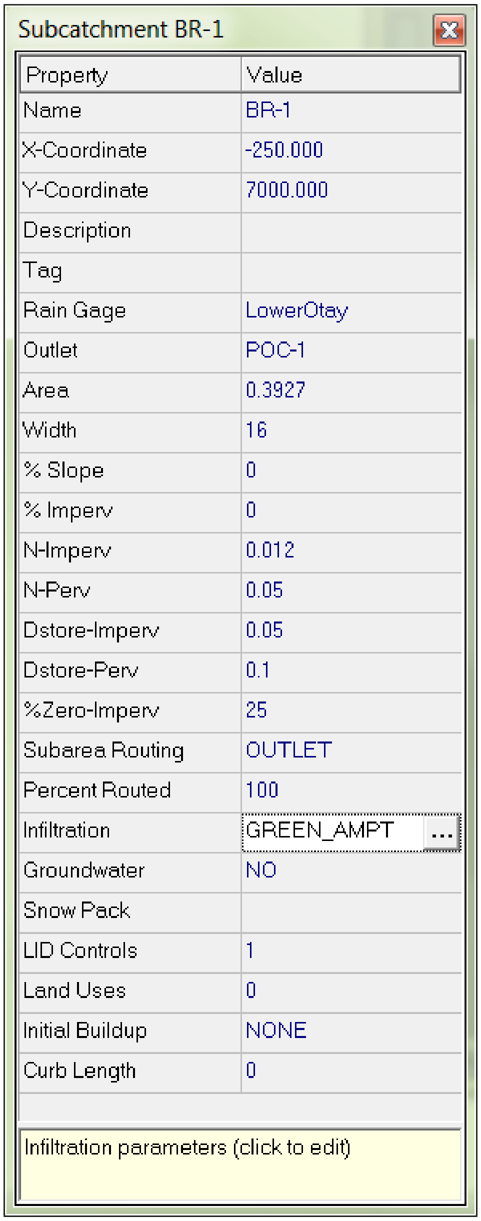
Infiltration Editor

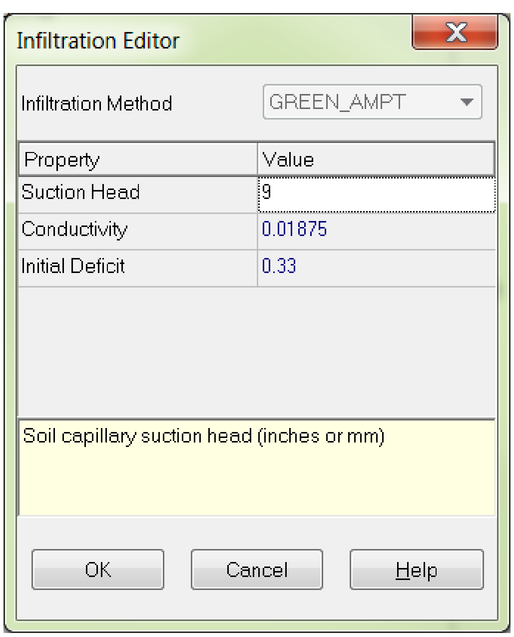
Infiltration Method: GREEN_AMPT

Property	Value
Suction Head	9
Conductivity	0.01875
Initial Deficit	0.33

Soil capillary suction head (inches or mm)

OK Cancel Help


Subcatchment BR-1
Property
Value
Name
BR-1
X-Coordinate
-250.000
Y-Coordinate
7000.000
Description
Tag
Rain Gage
LowerOtay
Outlet
POC-1
Area
0.3927
Width
16
% Slope
0
% Imperv
0
N-Imperv
0.012
N-Perv
0.05
Dstore-Imperv
0.05
Dstore-Perv
0.1
%Zero-Imperv
25
Subarea Routing
OUTLET
Percent Routed
100
Infiltration
GREEN_AMPT
Groundwater
NO
Snow Pack
LID Controls
1
Land Uses
0
Initial Buildup
NONE
Curb Length
0
Infiltration parameters (click to edit)


Infiltration Editor
Infiltration Method
GREEN_AMPT
Property
Value
Suction Head
9
Conductivity
0.01875
Initial Deficit
0.33
Soil capillary suction head (inches or mm)
OK
Cancel
Help

EXPLANATION OF SELECTED VARIABLES

Sub Catchment Areas:

Please refer to the attached diagrams that indicate the DMA and detention BMPs (BMP) sub areas modeled within the project site at both the pre and post developed conditions draining to the POC.

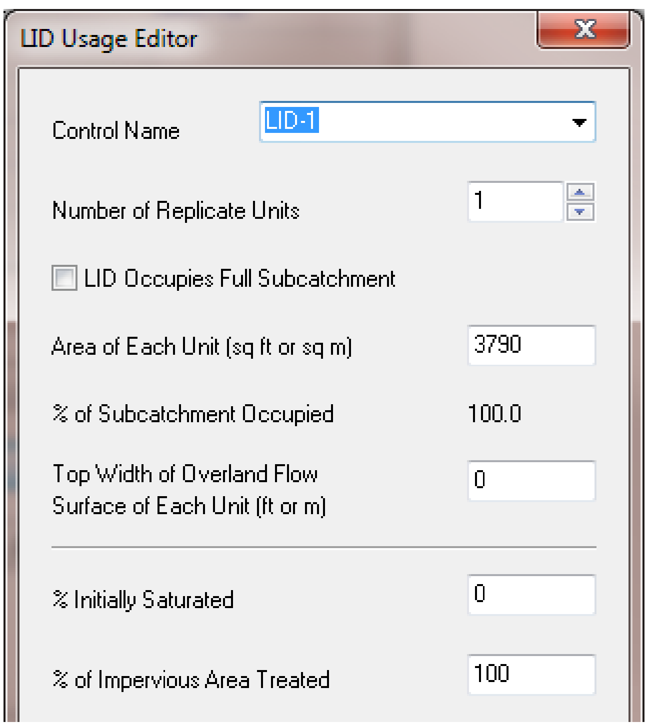
Parameters for the pre- and post-developed models include soil type C as determined from the NRCS websoil survey review (attached at the end of this appendix). Suction head, conductivity and initial deficit corresponds to average values expected for these soils types, according to sources consulted, professional experience, and approximate values obtained by the interim Orange County modeling approach.

REC selected infiltration values, such that the percentage of total precipitation that becomes runoff, is realistic for the soil types and slightly smaller than measured values for Southern California watersheds.

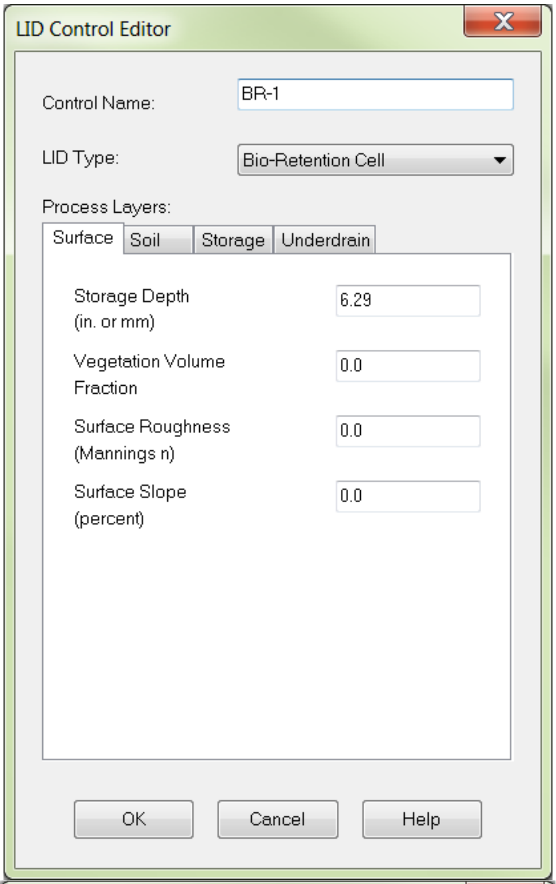
Selection of a Kinematic Approach: As the continuous model is based on hourly rainfall, and the time of concentration for the pre-development and post-development conditions is significantly smaller than 60 minutes, precise routing of the flows through the impervious surfaces, the underdrain pipe system, and the discharge pipe was considered unnecessary. The truncation error of the precipitation into hourly steps is much more significant than the precise routing in a system where the time of concentration is much smaller than 1 hour.

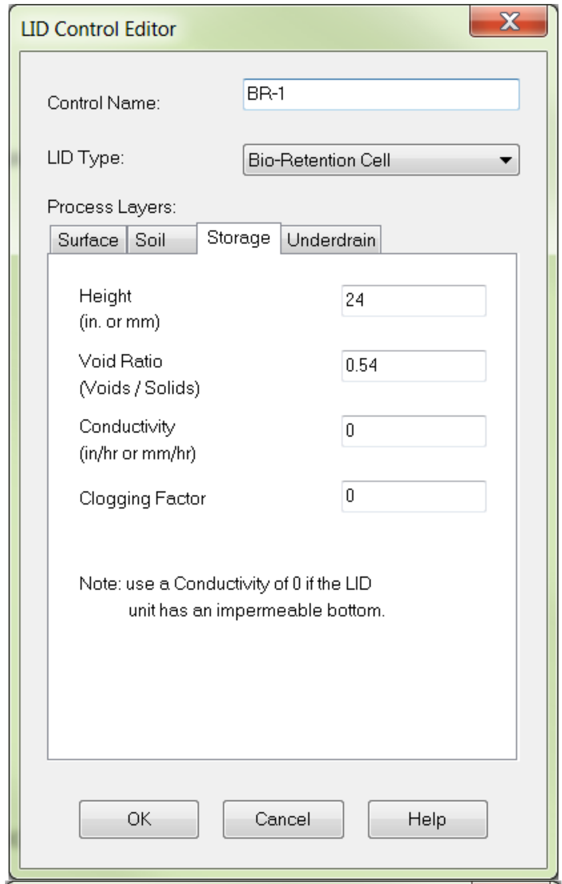
Sub-catchment BMP:

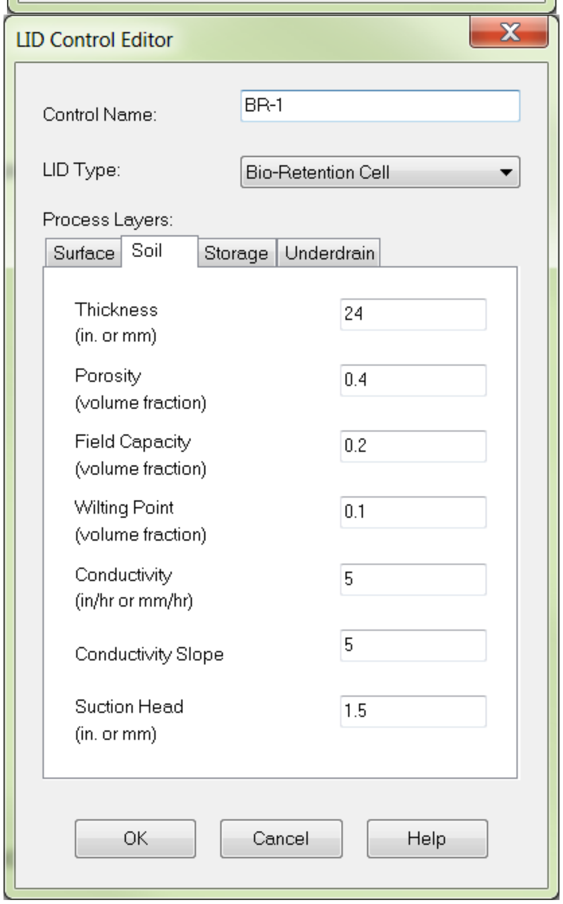
The area of biofiltration must be equal to the area of the development tributary to the biofiltration facility (area that drains into the biofiltration, equal external area plus bio-retention itself). Five (5) decimal places were given regarding the areas of the biofiltration to insure that the area used by the program for the LID subroutine corresponds exactly with this tributary.

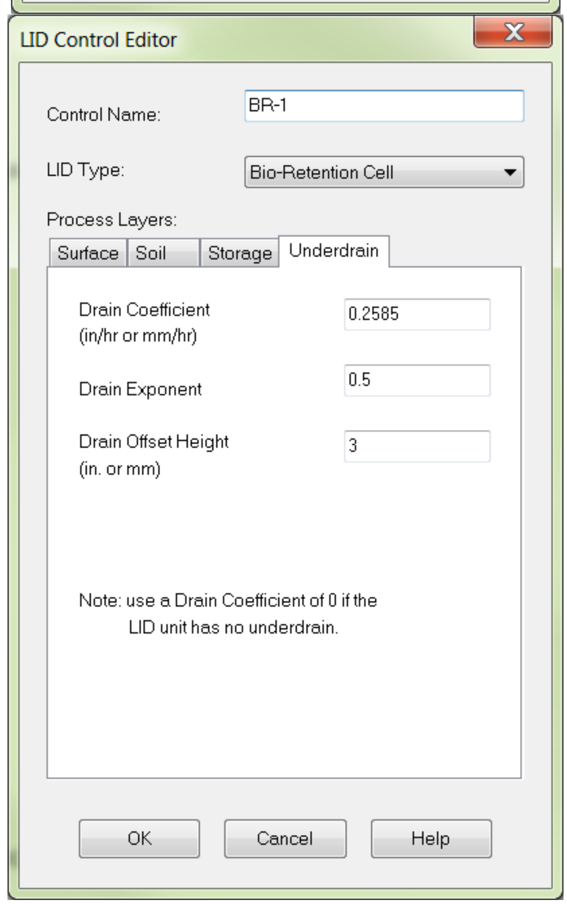


Detention Basin 1









LID Control Editor: Explanation of Significant Variables

Storage Depth:

The storage depth variable within the SWMM model is representative of the storage volume provided beneath the surface riser outlet and the surface of the bio filtration facility.

In those cases where the surface storage has a variable area that is also different to the area of the gravel and amended soil, the SWMM model needs to be calibrated as the LID module will use the storage depth multiplied by the BMP area as the amount of volume stored at the surface.

Let A_{BMP} be the area of the BMP (area of amended soil and area of gravel). The proper value of the storage depth S_D to be included in the LID module can be calculated by using geometric properties of the surface volume. Let A_0 be the surface area at the bottom of the surface pond, and let A_i be the surface area at the elevation of the invert of the first row of orifices (or at the invert of the riser if not surface orifices are included). Finally, let h_i be the difference in elevation between A_0 and A_i. By volumetric definition:

$$A_{BMP} \cdot S_D = \frac{(A_0+A_i)}{2} h_i \qquad (1)$$

Equation (1) allows the determination of S_D to be included as Storage Depth in the LID module. The 3-inches of gravel volume (3-inches x volume of voids (0.4) = 1.2-inches) is then subtracted to this volume.

Porosity: A porosity value of 0.4 has been selected for the model. The amended soil is to be highly sandy in content in order to have a saturated hydraulic conductivity of approximately 5 in/hr.

REC considers such a value to be slightly high; however, in order to comply with the HMP Permit, the value recommended by the Copermittees for the porosity of amended soil is 0.4, per Appendix A of the Final Hydromodification Management Plan by Brown & Caldwell, dated March 2011. Such porosity is equal to the porosity of the gravel per the same document.

Void Ratio: The ratio of the void volume divided by the soil volume is directly related to porosity as n/(1-n). As the underdrain layer is composed of gravel, a porosity value of 0.4 has been selected (also per Appendix A of the Final HMP document), which results in a void ratio of 0.4/(1-0.4) = 0.67 for the gravel detention layer.

Conductivity: Per the site specific geotechnical investigation for the project site, the design infiltration rate determined by SWQMP Form D-5.1 is 0.110 in/hr.

Clogging factor: A clogging factor was not used (0 indicates that there is no clogging assumed within the model). The reason for this is related to the fairness of a comparison with the SDHM model and the HMP sizing tables: a clogging factor was not considered, and instead, a conservative value of infiltration was recommended.

Drain (Flow) coefficient: The flow coefficient C in the SWMM Model is the coefficient needed to transform the orifice equation into a general power law equation of the form:

$$q = C(H - H_D)^n \tag{2}$$

where q is the peak flow in in/hr, n is the exponent (typically 0.5 for orifice equation), H_D is the elevation of the centroid of the orifice in inches (assumed equal to the invert of the orifice for small orifices and in our design equal to 0) and H is the depth of the water in inches.

The general orifice equation can be expressed as:

$$Q = \frac{\pi}{4} c_g \frac{D^2}{144} \sqrt{2g \frac{(H - H_D)}{12}} \tag{3}$$

where Q is the peak flow in cfs, D is the diameter in inches, c_g is the typical discharge coefficient for orifices (0.61-0.63 for thin walls and around 0.75-0.8 for thick walls), g is the acceleration of gravity in ft/s^2, and H and H_D are defined above and are also used in inches in Equation (3).

It is clear that:

$$q \left(\frac{in}{hr}\right) X \frac{A_{BMP}}{12\ X\ 3600} = Q\ (cfs) \tag{4}$$

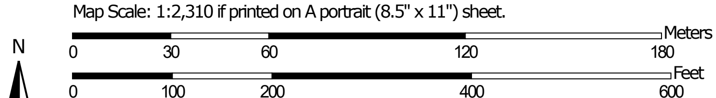
Cut-Off Flow: Q (cfs) and q (in/hr) are also the cutoff flow. For numerical reasons to insure the LID is full, the model uses cut-off = 1.01 Q.

ATTACHMENT 8

Soils Maps

Hydrologic Soil Group—San Diego County Area, California
(Baidee Project)

Map Scale: 1:2,310 if printed on A portrait (8.5" x 11") sheet.



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 Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

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 Diego County Area, California
Survey Area Data: Version 14, Sep 16, 2019

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

Date(s) aerial images were photographed: Feb 26, 2020—Mar 30, 2020

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.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
HrC	Huerhuero loam, 2 to 9 percent slopes	D	12.8	90.4%
SuB	Stockpen gravelly clay loam, 2 to 5 percent slopes	D	1.4	9.6%
Totals for Area of Interest			**14.2**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

ATTACHMENT 9

Summary Files from the SWMM Model

PRE-DEV AND POST-DEV

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.022)
--------------------------------------------------------------


*********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*********************************************************

****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ YES
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... NO
  Water Quality .......... NO
Infiltration Method ...... GREEN_AMPT
Starting Date ............ AUG-29-1951 00:00:00
Ending Date .............. MAR-29-2008 00:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 01:00:00
Wet Time Step ............ 00:15:00
Dry Time Step ............ 04:00:00


**************************        Volume         Depth
Runoff Quantity Continuity     acre-feet        inches
**************************     ---------       -------
Total Precipitation ......      1273.241       591.650
Evaporation Loss .........       180.228        83.748
Infiltration Loss ........       529.834       246.203
Surface Runoff ...........       580.313       269.660
Final Surface Storage ....         0.000         0.000
Continuity Error (%) .....        -1.346


**************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......       580.286       189.095
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........       580.286       189.095
Internal Outflow .........         0.000         0.000
Storage Losses ...........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.000         0.000
Continuity Error (%) .....         0.000


***************************
Subcatchment Runoff Summary
***************************

---------------------------------------------------------------------------------------------------------
                           Total      Total      Total      Total      Total        Total     Peak  Runoff
                          Precip      Runon       Evap      Infil     Runoff       Runoff   Runoff   Coeff
Subcatchment                  in         in         in         in         in     10^6 gal      CFS
---------------------------------------------------------------------------------------------------------
DMA-1-D                   591.65       0.00     106.94      32.66     461.35       156.83    10.41   0.780
BR-1                      591.65   14707.89    1300.00       0.00   14115.00       150.51     9.81   0.923
DMA-1-D-Pre               591.65       0.00      24.27     460.74     110.04        38.58     9.39   0.186
```

PRE-DEV AND POST-DEV

```
***********************
LID Performance Summary
***********************
```

Subcatchment	LID Control	Total Inflow in	Evap Loss in	Infil Loss in	Surface Outflow in	Drain Outflow in	Init. Storage in	Final Storage in	Pcnt. Error
BR-1	BR-1	15299.54	1300.20	0.00	1492.52	12624.66	0.00	0.00	-0.77

Analysis begun on: Tue Aug 11 08:11:51 2020
Analysis ended on: Tue Aug 11 08:12:07 2020
Total elapsed time: 00:00:16: 00:00:17

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Attachment 3
Structural BMP Maintenance Information

This is the cover sheet for Attachment 3.

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Project Name: Airway Logistics Center

Indicate which Items are Included:

Attachment Sequence	Contents	Checklist
Attachment 3	Maintenance Agreement (Form DS-3247) (when applicable)	☐ Included ☑ Not applicable

Use this checklist to ensure the required information has been included in the Structural BMP Maintenance Information Attachment:

Attachment 3: For private entity operation and maintenance, Attachment 3 must include a Storm Water Management and Discharge Control Maintenance Agreement (Form DS-3247). The following information must be included in the exhibits attached to the maintenance agreement:

- ☐ Vicinity map
- ☐ Site design BMPs for which DCV reduction is claimed for meeting the pollutant control obligations.
- ☐ BMP and HMP location and dimensions
- ☐ BMP and HMP specifications/cross section/model
- ☐ Maintenance recommendations and frequency
- ☐ LID features such as (permeable paver and LS location, dim, SF).

Attachment 4
Copy of Plan Sheets Showing Permanent Storm Water BMPs

This is the cover sheet for Attachment 4.

PROJECT NOTES

1. THE PROPOSED PROJECT WILL COMPLY WITH ALL THE REQUIREMENTS OF THE CURRENT CITY OF SAN DIEGO STORM WATER STANDARDS MANUAL BEFORE A GRADING OR BUILDING PERMIT IS ISSUED. IT IS THE RESPONSIBILITY OF THE OWNER, DESIGNER, APPLICANT TO ENSURE THAT THE CURRENT STORM WATER PERMANENT BMP DESIGN STANDARDS ARE INCORPORATED INTO THE PROJECT.
2. PRIOR TO THE ISSUANCE OF ANY CONSTRUCTION PERMIT, THE OWNER/ PERMITEE SHALL ENTER INTO A MAINTENANCE AGREEMENT FOR THE ONGOING BMP MAINTENANCE, SATISFACTORY TO THE CITY ENGINEER.
3. PRIOR TO THE ISSUANCE OF ANY CONSTRUCTION PERMITS, THE OWNER/ PERMITEE SHALL INCORPORATE ANY CONSTRUCTION BEST MANAGEMENT PRACTICES NECESSARY TO COMPLY WITH CHAPTER 14, ARTICLE 2, DIVISION 1 (GRADING REGULATION) OF THE CITY OF SAN DIEGO MUNICIPAL CODE, INTO THE CONSTRUCTION PLANS OR SPECIFICATIONS.
4. ALL DRAINAGE FACILITIES CONSTRUCTED BY THIS PROJECT IS PRIVATE.
5. THE EXISTING AND PROPOSED 10"SEWER MAIN IN AIRWAY ROAD ARE PUBLIC.
6. ALL PROPOSED 10" SEWER MAIN & MH'S ARE PUBLIC TO THE ULTIMATE R/W. 8" SEWER MAIN & 6" LATERALS ARE PRIVATE.
7. ALL PROPOSED CURB & GUTTER, SIDEWALK, & AC WITHIN AIRWAY ROAD TO THE ULTIMATE R/W ARE PUBLIC PER CURRENT CITY OF SAN DIEGO DESIGN STANDARDS.
8. EXIST. WATER IN AIRWAY ROAD PUBLIC (OTAY WATER DIST.) ALL ONSITE WATER WILL BE PRIVATE.
9. EXISTING POWER LINES WILL BE CONVERTED TO UNDERGROUNDED. WILL BE PRIVATE.
10. A FLOOD STORAGE EASEMENT WILL BE GRANTED TO THE CITY OF SAN DIEGO FOR THE PURPOSE OF DETENTION AND PLAT AND LEGAL DESCRIPTION WILL BE SUBMITTED DURING MINISTERIAL REVIEW.
11. ALL STORM DRAINS WILL BE PRIVATE.

SEWER FLOW GENERATION

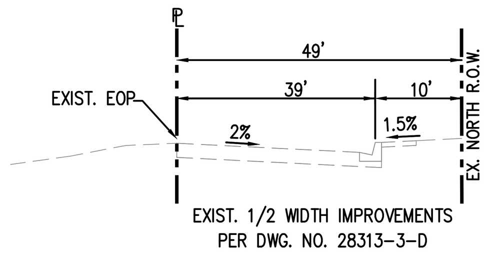
1. DATA (PER PLUMBER):
   8 TENNANTS
   20 OCCUPANTS/ TENNANTS
   TOILETS = 1.28 GAL/FLUSH @ 5 TIMES/DAY
   LAVATORY = 0.5 GAL/FLUSH @ 5 TOMES/DAY

   TOILETS 20X1.28X5
   LAVATORY 20X 0.5X5

   TENNANT USE PER DAY = 178 DAL/DAY/TENNANT
   APPROX. TOTAL USE PER DAY 1500 GAL/DAY

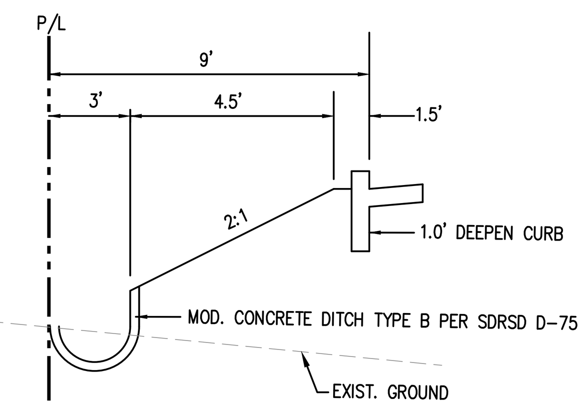
SEWER STUDY SUMMARY

LINE	FROM MH	TO MH	POPULATION	FLOW	LINE DIA.	DESIGN SLOPE	dn (ft)	dn/d	VELOCITY (fps)	REMARKS
A	1	2	160	.0023	10"	1.0%	.25	.30	.65	PUBLIC
B	2	3	160	.0023	10"	1.0%	.25	B	.65	PUBLIC
C	2	4	160	.0023	6"	1.0%	.28	C	.7	PUBLIC
D			160	.0023	6"	1.0% MIM.	.28	D	.7	PRIVATE



EXIST. SECTION ~ AIRWAY ROAD

NOT TO SCALE



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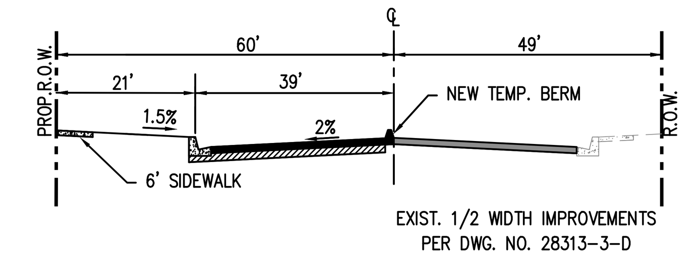


PROPOSED SECTION ~ AIRWAY ROAD

NOT TO SCALE

STA. 62+18.20 TO STA. 66+63.97

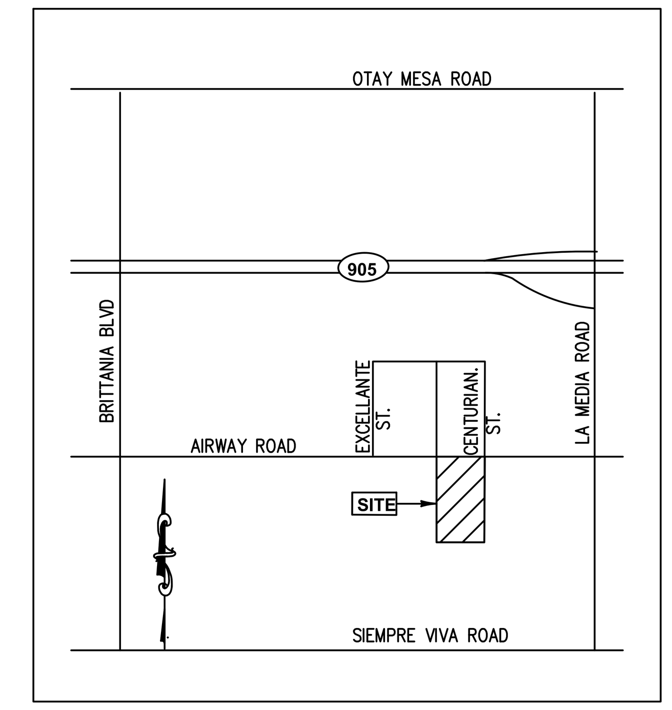
1.–EXIST AC BERM TO BE REPLACED WITH NEW BERM EXCEPT @ NEW DRIVEWAYS. WHERE THEY ARE TO BE REMOVED TO PROVIDE ACCESS.
2.–EXISTING BERM TO REMAIN CONTINUITY WITH ADJACENT PROPERTY OWNERS.

LEGAL DESCRIPTION

THE EAST HALF OF THE NORTHWEST QUARTER OF THE SOUTHEAST QUARTER OF SECTION 34, TOWNSHIP 18 SOUTH, RANGE 1 WEST, SAN BERNADINO BASE AND MERIDIAN, IN THE CITY OF SAN DIEGO, COUNTY OF SAN DIEGO, STATE OF CAFIFORNIA, ACCORDING TO THE OFFICIAL PLAT THEREOF. EXCEPT THEREFROM THE 2/3 WEST OF THE WEST HALF OF SAID EAST HALF.

ASSESSOR PARCEL

646-110-28-00



VICINITY MAP

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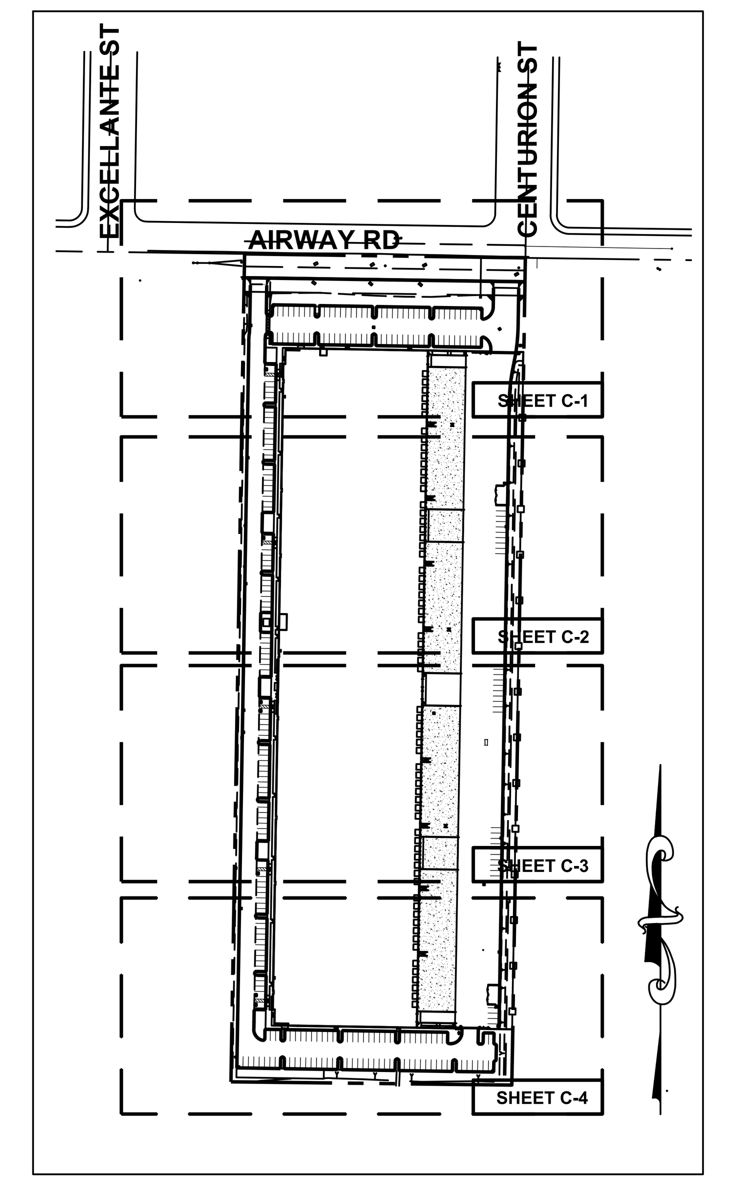
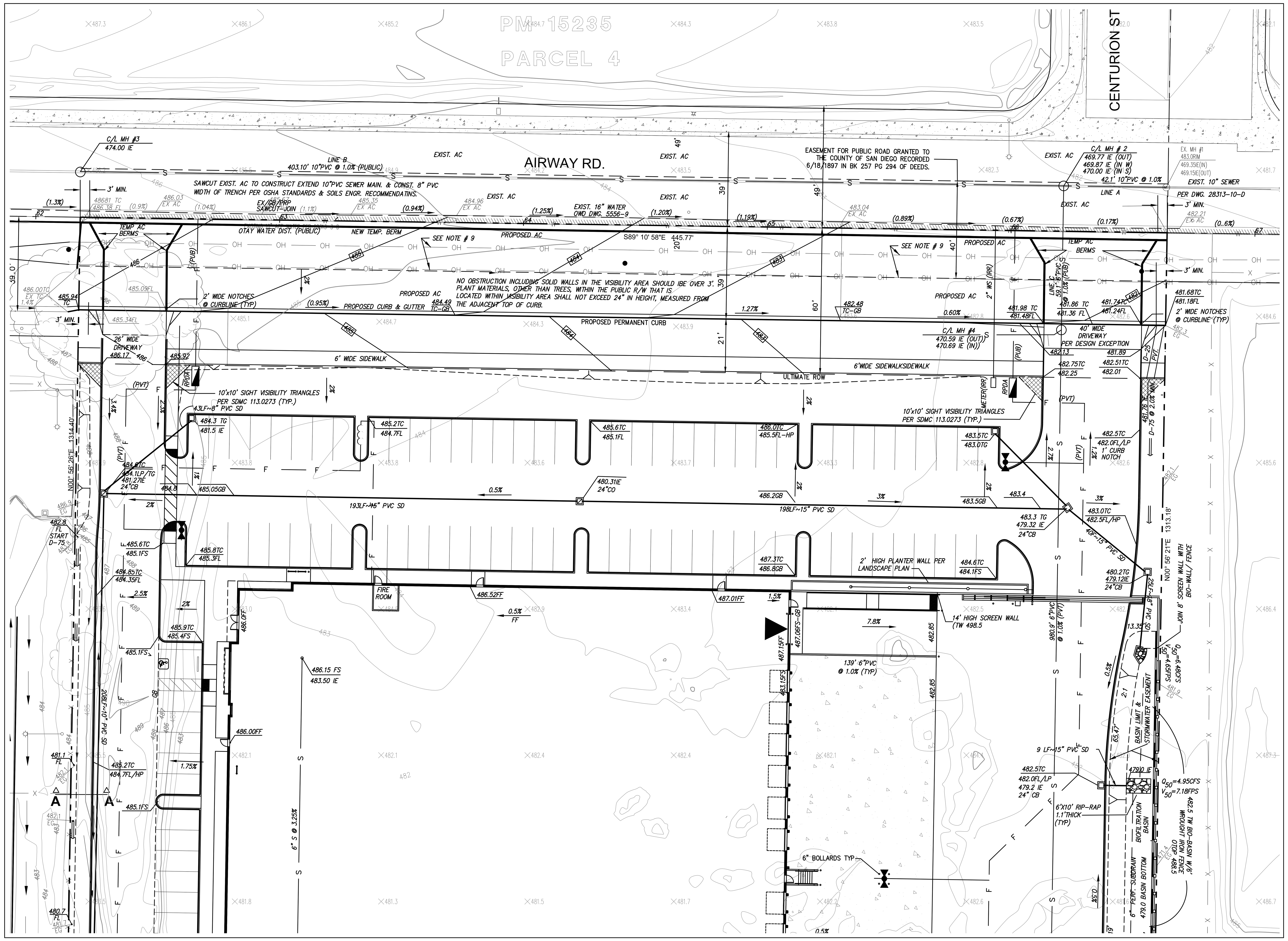


KEY MAP

SCALE: 1" = 200'



SEE SHEET C-2

GRADING QUANTITIES

DISTURBED AREA:	13.45 ACRES
CUT QUANTITIES:	2,060 C.Y.
FILL QUANTITIES:	80,600 C.Y.
IMPORT QUANTITIES:	78,540 C.Y.

MAXIMUM CUT 10' (MASS GRADE TO FINISH GRADE)
MAXIMUM FILL 3' (MASS GRADE TO FINISH GRADE)

EARTHWORK QUANTIES SHOWN ARE FOR ESTIMATING PURPOSES ONLY. ACTUAL QUANTITIES MAY VARY DUE TO SHRINKAGE, LOSSES DUE TO CLEARING OPERATIONS, COMPACTION, SETTLEMENT, ETC. CONTRACTOR SHOULD VERIFY QUANTITES PRIOR TO BIDDING.

0 10 20 40 60
GRAPHIC SCALE: 1" = 20'

K&S ENGINEERING, INC.
Planning . Engineering . Surveying
7801 Mission Center Court, Suite 100 San Diego, CA 92108
(619) 296-5565 Fax: (619) 296-5564

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Owner:

BADIEE DEVELOPMENT
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LA JOLLA, CA 92037
TEL : 888-815-8886

Project:

AIRWAY LOGISTICS CENTER

SAN DIEGO, CA

Consultants:

Civil:	K&S ENGINEERING, INC
Structural:	-
Mechanical:	-
Plumbing:	-
Electrical:	-
Landscape:	HUNTER LANDSCAPE
Fire Protection:	-
Soils Engineer:	-

Title: CONCEPTUAL GRADING PLAN

Project Number:	20054
Drawn by:	RI
Date:	04/29/2020

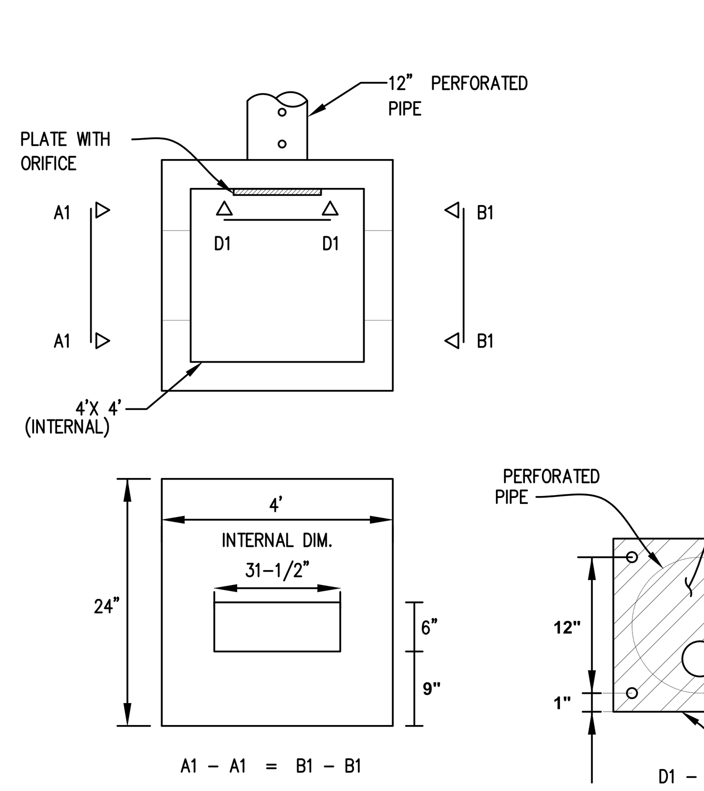
Revision:

Sheet:

C-1

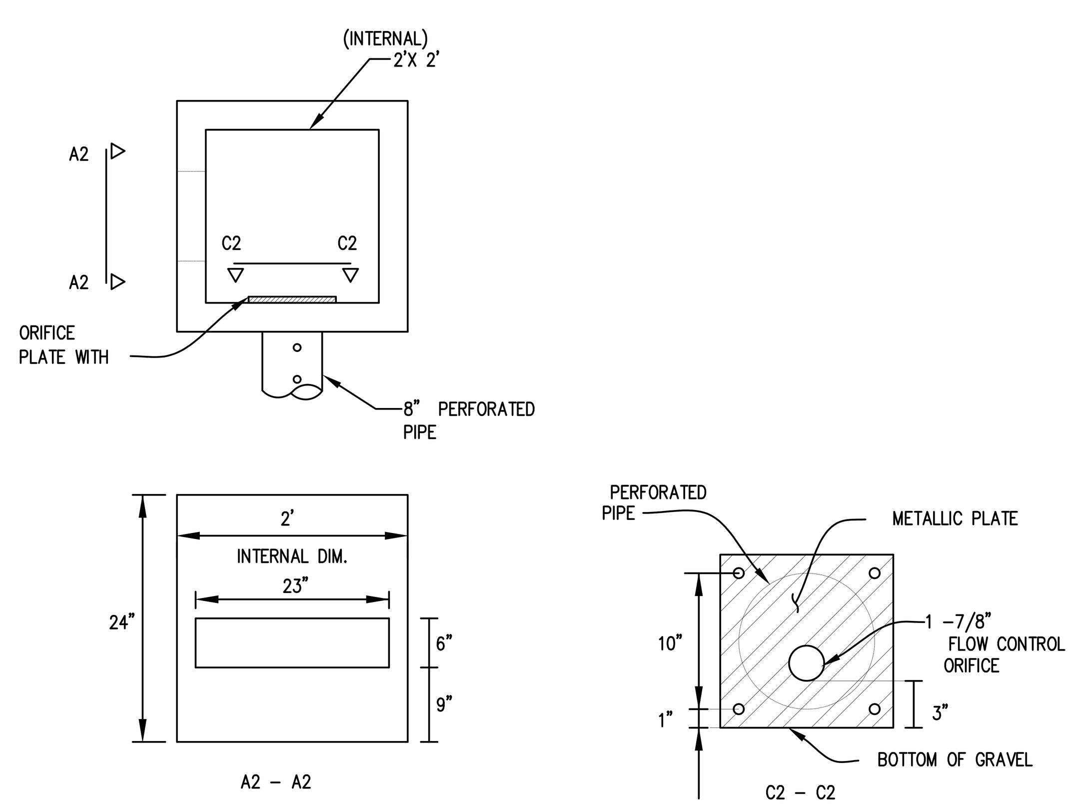
SEE SHEET C-1

SEE SHEET C-3



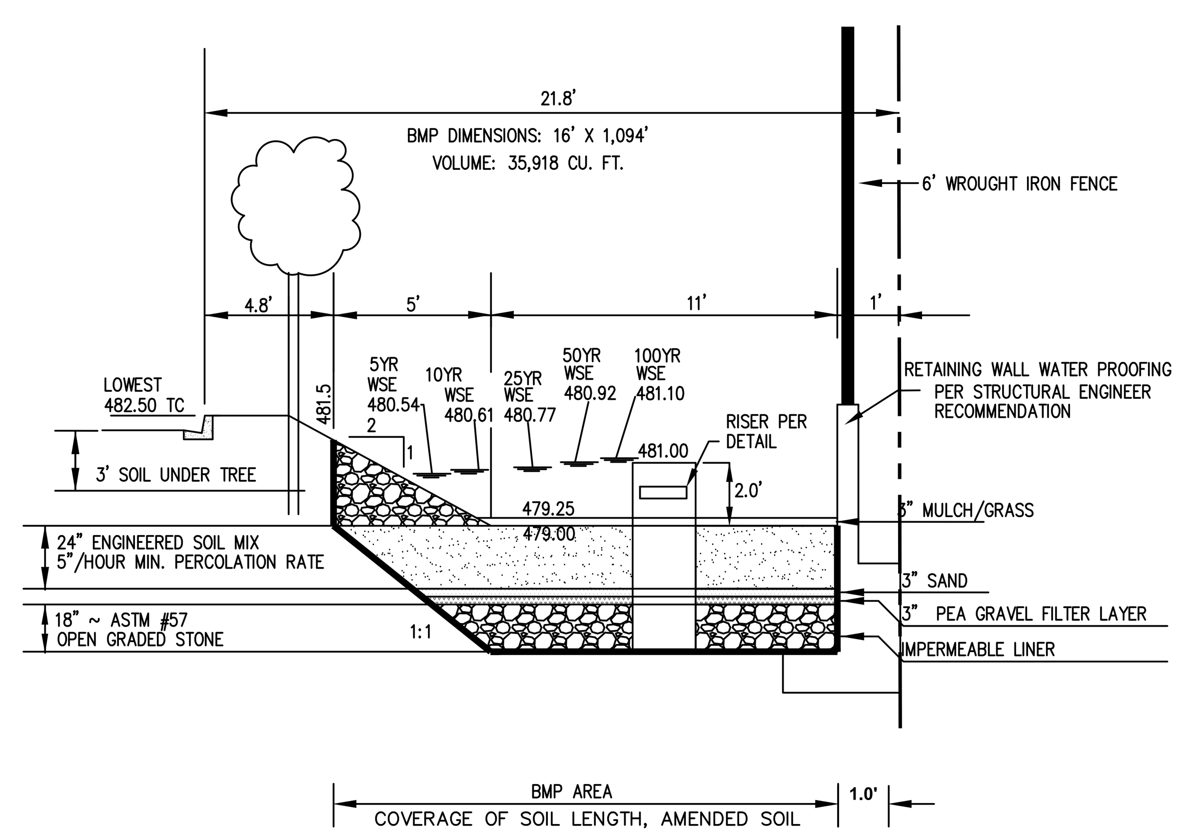
LARGE BASIN DETAIL

NOT TO SCALE



SMALL BASIN DETAIL

NOT TO SCALE



BIOFILTRATION DETAIL

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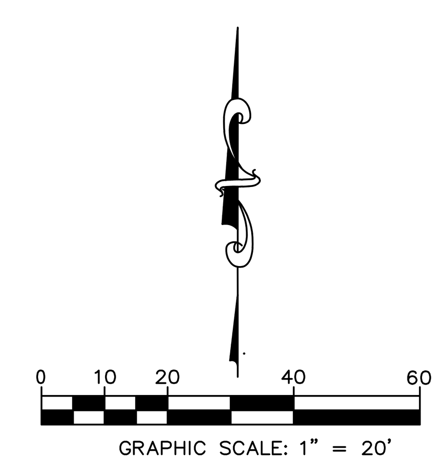

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REGISTERED PROFESSIONAL ENGINEER
KAMAL S. SWEIS
NO.46592
EXP 6-30-22
CIVIL
STATE OF CALIFORNIA

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Project:

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Civil:	K&S ENGINEERING, INC
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Plumbing:	-
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Fire Protection:	-
Soils Engineer:	-

Title: CONCEPTUAL GRADING PLAN

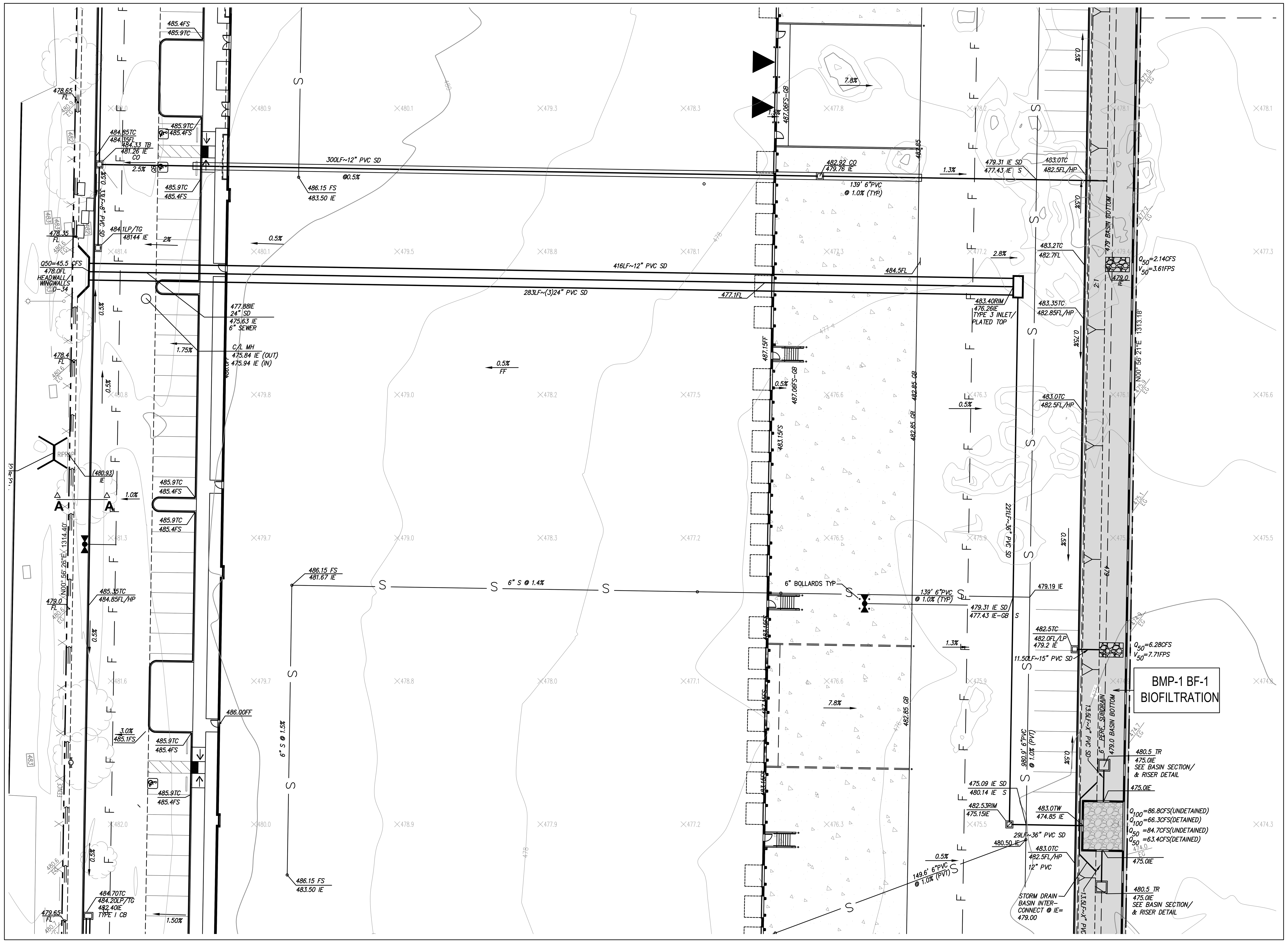
Project Number:	20054
Drawn by:	RI
Date:	04/29/2020

Revision:

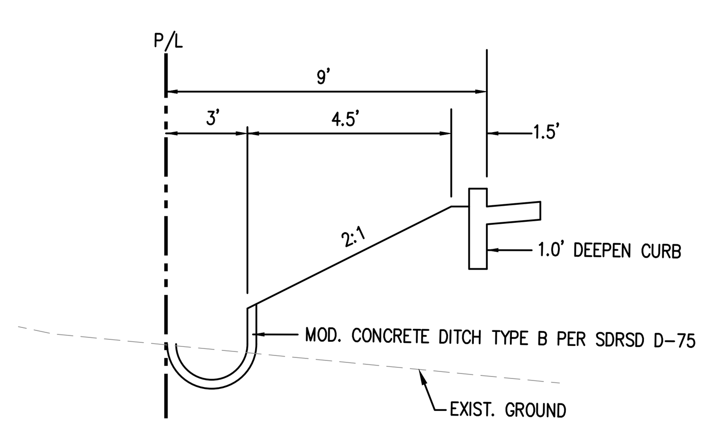
Sheet:

C-2

SEE SHEET C-2



SEE SHEET C-4



SECTION A-A

NOT TO SCALE

GRAPHIC SCALE: 1" = 20'

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TEL : 888-815-8886

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AIRWAY LOGISTICS CENTER

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Structural:	-
Mechanical:	-
Plumbing:	-
Electrical:	-
Landscape:	HUNTER LANDSCAPE
Fire Protection:	-
Soils Engineer:	-

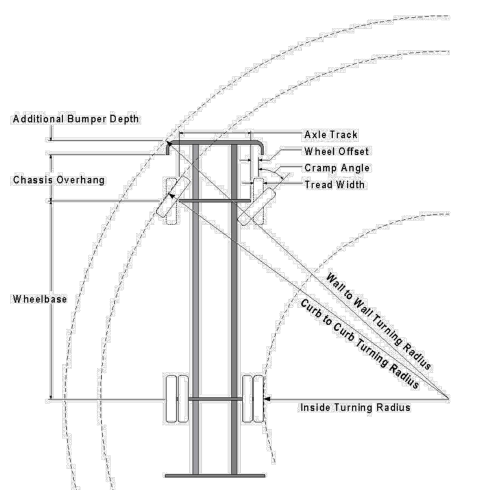
Title: CONCEPTUAL GRADING PLAN

Project Number:	20054
Drawn by:	RI
Date:	04/29/2020

Revision:

Sheet:

C-3



Pierce — **Turning Performance Analysis** — 02/13/2018

Bid Number: 284
Department: San Diego
Chassis: Arrow XT Chassis, Aerials/Tankers, Tandem Axle
Body: Aerial, HD Ladder 105', Alum Body

Parameters:

Inside Cramp Angle:	45°
Axle Track:	82.92 in.
Wheel Offset:	4.68 in.
Tread Width:	17.7 in.
Chassis Overhang:	68.99 in.
Additional Bumper Depth:	22 in.
Front Overhang:	92.5 in.
Wheelbase:	233.5 in.

Calculated Turning Radii:

Inside Turn:	18 ft. 4 in.
Curb to curb:	33 ft. 11 in.
Wall to wall:	38 ft. 8 in.

Comments:
29676

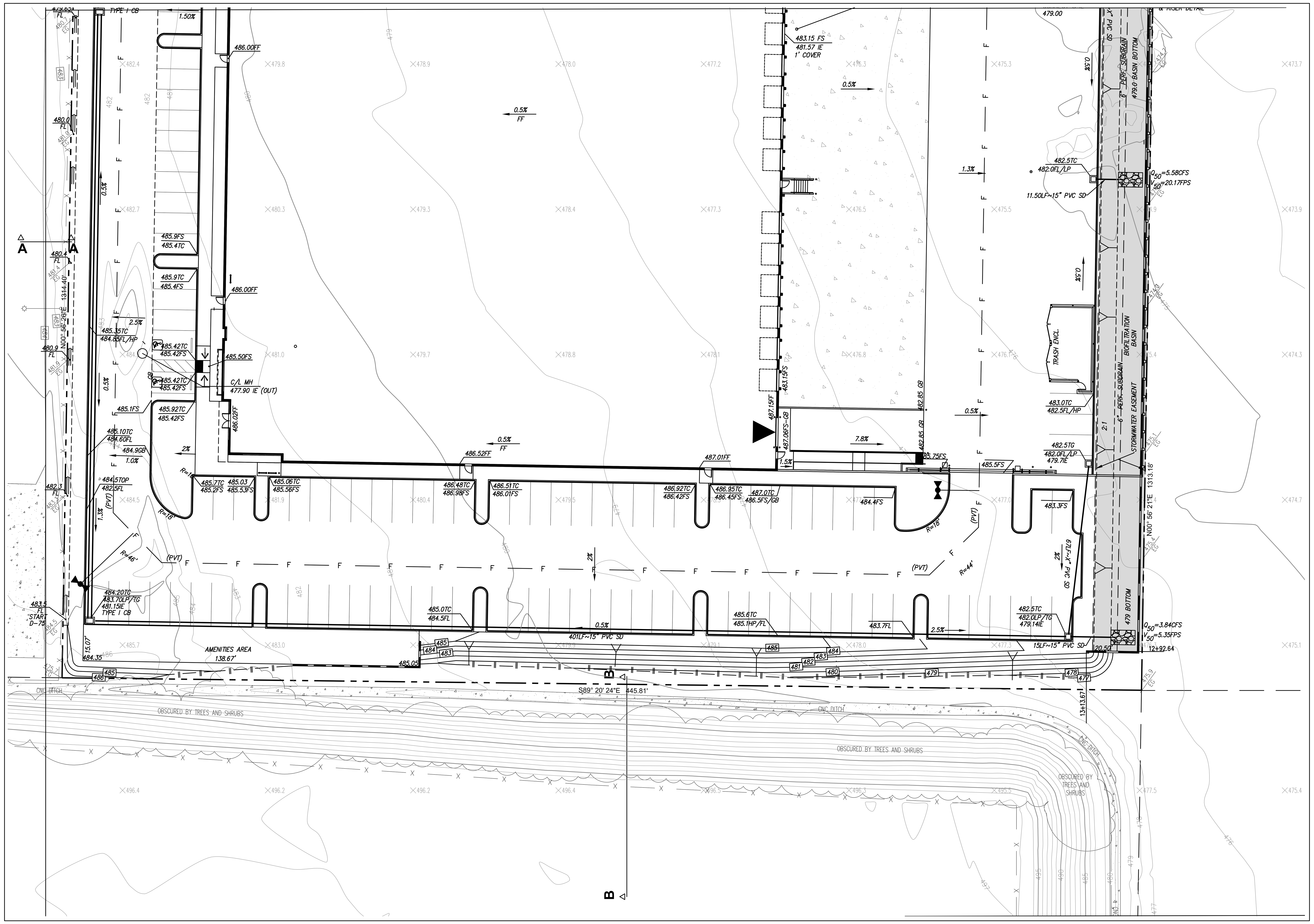
Category	Option	Description
Axle, Front, Custom	0018453	Axle, Front, Oshkosh TAK-4, Non Drive, 22,800 lb, Qtm/AXT/DCF
Wheels, Front	0019611	Wheels, Front, Alcoa, 22.50" x 12.25", Aluminum, Hub Pilot
Tires, Front	0521238	Tires, Front, Michelin, XFE (wb), 425/65R22.50, 20 ply
Bumpers	0677289	Bumper, 24" Extended, Under Slung, Recessed Crosslays, AXT, San Diego Only
Aerial Devices	0673136	Aerial, 105' Heavy Duty Ladder, (750 dry/500 water)

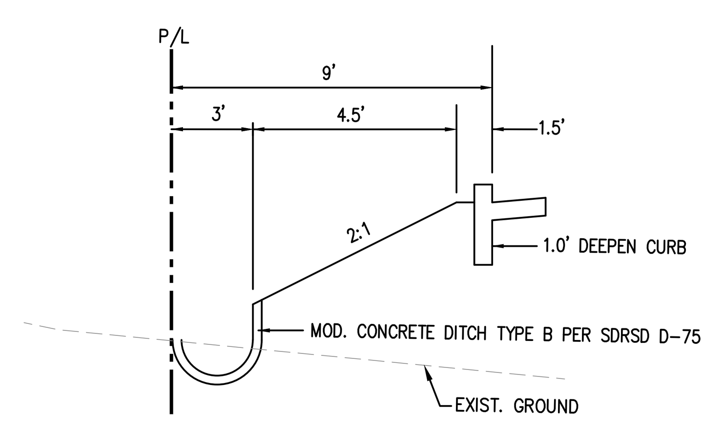
Notes:

Actual Inside cramp angle may be less due to highly specialized options.

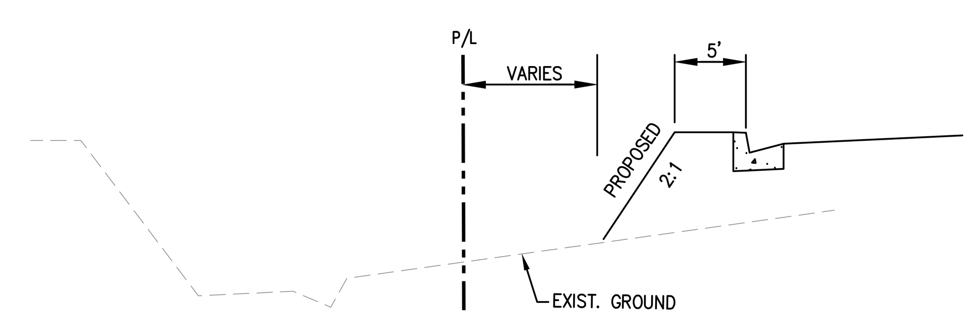
Curb to Curb turning radius calculated for 9.00 inch curb.

SEE SHEET C-3





SECTION A-A
NOT TO SCALE



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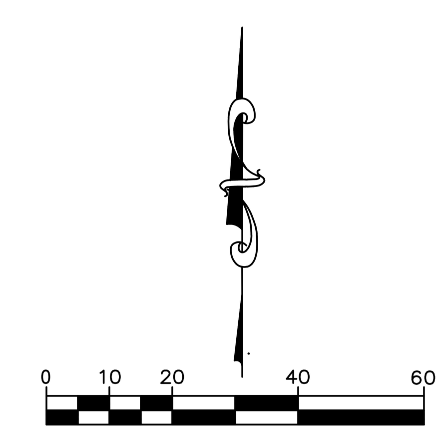

GRAPHIC SCALE: 1" = 20'

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REGISTERED PROFESSIONAL ENGINEER — KAMAL S. SWEIS — NO.48592 — EXP 6-30-22 — CIVIL — STATE OF CALIFORNIA

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Owner:

BADIEE DEVELOPMENT
1261 PROSPECT ST. STE. 9
LA JOLLA, CA 92037
TEL : 888-815-8886

Project:

AIRWAY LOGISTICS CENTER

SAN DIEGO, CA

Consultants:

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Structural:	-
Mechanical:	-
Plumbing:	-
Electrical:	-
Landscape:	HUNTER LANDSCAPE
Fire Protection:	-
Soils Engineer:	-

Title: CONCEPTUAL GRADING PLAN

Project Number:	20054
Drawn by:	RI
Date:	04/29/2020
Revision:	

Sheet:

C-4

Project Name: Airway Logistics Center

Use this checklist to ensure the required information has been included on the plans:

The plans must identify:

- [x] Structural BMP(s) with ID numbers matching Form I-6 Summary of PDP Structural BMPs
- [x] The grading and drainage design shown on the plans must be consistent with the delineation of DMAs shown on the DMA exhibit
- [x] Details and specifications for construction of structural BMP(s)
- [x] Signage indicating the location and boundary of structural BMP(s) as required by the City Engineer
- [x] How to access the structural BMP(s) to inspect and perform maintenance
- [x] Features that are provided to facilitate inspection (e.g., observation ports, cleanouts, silt posts, or other features that allow the inspector to view necessary components of the structural BMP and compare to maintenance thresholds)
- [ ] Manufacturer and part number for proprietary parts of structural BMP(s) when applicable
- [ ] Maintenance thresholds specific to the structural BMP(s), with a location-specific frame of reference (e.g., level of accumulated materials that triggers removal of the materials, to be identified based on viewing marks on silt posts or measured with a survey rod with respect to a fixed benchmark within the BMP)
- [ ] Recommended equipment to perform maintenance
- [ ] When applicable, necessary special training or certification requirements for inspection and maintenance personnel such as confined space entry or hazardous waste management
- [ ] Include landscaping plan sheets showing vegetation requirements for vegetated structural BMP(s)
- [ ] All BMPs must be fully dimensioned on the plans
- [ ] When proprietary BMPs are used, site specific cross section with outflow, inflow and model number shall be provided. Broucher photocopies are not allowed.

Attachment 5
Drainage Report

Attach project's drainage report. Refer to Drainage Design Manual to determine the reporting requirements.

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K&S ENGINEERING, INC.
Planning Engineering Surveying

Preliminary Drainage Study

For

Airway Logistics Center

PTS#665589

Prepared for:

Badiee Development Inc.
1261 Prospect Street Suite 9
La Jolla, CA 92037
Contact: Scott Merry (888) 815-8886

Prepared by:

K&S ENGINEERING, INC.
7801 Mission Center Court, Suite 100
San Diego, CA 92108
619.296.5565

August 12, 2020

K&S JN 19-045

REGISTERED PROFESSIONAL ENGINEER
KAMAL S. SWEIS
No. 48592
Exp. 6-30-22
CIVIL
STATE OF CALIFORNIA

Kamal S. Sweis RCE 48592

8/12/20
Date

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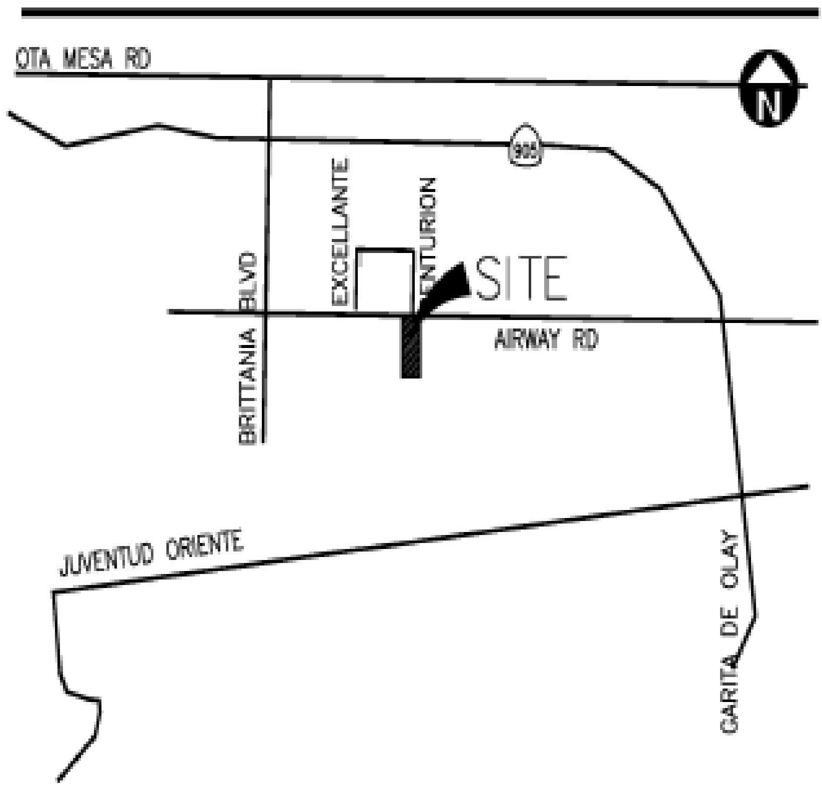

2 INTRODUCTION

THE PROJECT SITE IS LOCATED SOUTH OF THE INTERSECTION OF CENTURION STREET AND AIRWAY ROAD IN OTAY MESA.

THE PROJECT CONSISTS OF GRADING AND DRAINAGE IMPROVEMENTS FOR ONE INDUSTRIAL BUILDING WITH LOADING DOCKS, PARKING, LANDSCAPING, STORM DRAINS AND ONE BIOFILTRATION BMP FOR POLLUTANT CONTROL, HYDROMODIFICATION AND PEAK FLOW DETENTION PURPOSES.

THE SUBJECT REPORT REFLECTS THE PROPOSED PRECISE GRADING AND DRAINAGE AS SHOWN ON PRELIMINARY GRADING PLAN DRAWING PTS# 665589

3 PURPOSE OF THIS STUDY

THE PURPOSE OF THIS STUDY IS TO DETERMINE THE PROPOSED PEAK FLOWS PRODUCED BY THE PROPOSED DEVELOPMENT PROJECT FOR THE 5, 10, 25 AND 50 YEAR STORM EVENTS AS SHOWN ON THE GRADING PLAN FOR THE BADIEE DEVELOPMENT AS WELL AS TO DETERMINE THE PROPOSED PIPE AND INLET SIZES.

MOREOVER, THE PROPOSED PROJECT IS NOT IN THE CLOSE VICINITY OF NAVIGABLE WATERS OR WETLAND. THE PROPOSED CONSTRUCTION AND ANY ASSOCIATED RUNOFF WILL NOT RESULT INTO NAVIGABLE WATERS AND THEREFORE EXEMPT FROM THE REGIONAL WATER QUALITY CONTROL BOARD UNDER FEDERAL CLEAN WATER ACT (CWA) SECTION 401 OR 404.

4 PROJECT INFORMATION

4.1 EXISTING CONDITION

THE EXISTING SITE CONSISTS OF ONE NATURAL LOT. PERCENT IMPERVIOUS FOR THE EXISTING LOT IS 0.45. THE EXISTING SITE CURRENTLY DRAINS TO ONE LOCATION. Q(50) AT NODE 50 IS 21.5 CFS.

4.2 PROPOSED CONDITION

THE PROPOSED LAND USE WILL BE INDUSTRIAL. A RUNOFF COEFFICIENT OF 0.88 WAS USED TO DETERMINE THE PROPOSED RUNOFF FLOWS. THE PROPOSED UNDETAINED Q(50) AT NODE 30 IS 39.2 CFS.

4.3 OFFSITE HYDROLOGY

OFFSITE DRAINAGE ENTERS THE SITE FROM THE EAST FROM AN EXISTING TRUCK PARKING AT TWO CONCENTRATED POINTS. AT ONE LOCATION 23.88 CFS DRAIN INTO THE PROJECT SITE. AT A SECOND LOCATION 21.63 CFS ARE ALSO ACCEPTED BY THE SITE. THESE FLOWS ARE NATURALLY CONVEYED ACROSS THE SITE FROM WEST TO EAST.

USER DEFINED FLOW VALUES WERE USED IN THE HYDROLOGY SOFTWARE.

4.4 DETENTION BASIN METHODOLOGY

SEE SECTION 8 FOR DETENTION BASIN CALCULATIONS. ONE DETENTION BASIN WAS DESIGNED FOR THIS PROJECT USING THE JANUARY 2017 CITY OF SAN DIEGO DRAINAGE DESIGN MANUAL.

THE PURPOSE OF THIS BASIN IS TO TEMPORARILY STORE THE INCREASED RUNOFF AND RELEASE IT AT A RATE EQUAL OR LESS THAN THE EXISTING. HYDROGRAPHS WERE DETERMINED USING THE RATIONAL METHOD DESIGN STORM HYDROGRAPH METHOD. THE DETENTION BASIN SIZE WAS DETERMINED USING THE SINGLE

HYDROGRAPH PROCEDURE AND BY ROUTING THE 5, 10, 25 AND 50-YEAR STORM EVENTS HYDROGRAPHS. THE OUTLET STRUCTURE HAS BEEN SIZED TO DRAIN THE BASIN WITHIN 96 HOURS. ALSO, THIS DETENTION BASIN IS BEING USED IN CONJUNCTION WITH WATER QUALITY TREATMENT AND HYDROMODIFICATION FLOW CONTROL. THE PEAK FLOW ANALYSIS ASSUMMES THAT THE BOTTOM OF THE DETENTION BASIN IS THE WATER QUALITY WATER SURFACE ELEVATON. THE TOP OF THE EMBANKMENT HAS A 1 FOOT FREEBOARD ABOVE THE MAXIMUM WATER SURFACE ELEVATION.

4.5 SUMMARY

IN SHORT, IN ORDER TO MITIGATE THE INCREASED RUNOFF FROM THE EXISTING TO THE PROPOSED CONDITION, A DETENTION BASIN IS PROPOSED IN COMPLIANCE WITH THE OTAY MESA COMUNITY PLAN. PROPOSED FLOWS AFTER ROUTING ARE SMALLER THAN THE EXISTING ONES. ALSO, ULTIMATE RATIONAL METHOD FLOWS WERE USED TO SIZE THE PERMANENT DRAINAGE STRUCTURES PROPOSED BY THIS DEVELOPMENT; THEREFORE, THE PROJECT WOULD NOT CREATE OR CONTRIBUTE RUNOFF WATER WICH WOUL EXCEED THE CAPACIOTY OF ANY EXISTING OR PLANNED STORM WATER DRAINAGE SYSTEM, AND WILL NOT EXPOSED PEOPLE OR STRUCTURE TO A SIGNIFICANT RISK OF LOSS, INJURY OR DEATH INVOLVING FLOODING AS A RESULT OF THE FAILURE OF A LEVEE OR DAM.

THE PROJECT WILL MAINTAIN THE EXISTING DRAINAGE PATERN OF THE SITE AND WILL NOT RESULT IN ANY EROSION OR SILTATION. ALSO, THE PROJECT WILL NOT RESULT IN IN FLOODING ONSITE OR OFFSITE DUE TO THE INSTALLATION OF PEAK FLOW DETENTION BASINS. NO ADVERSE IMPACT WILL OCCUR TO THE DOWNSTREAM PROPERTIES AS RESULT OF THE PROPOSED DEVELOPMENT SINCE THE PROPOSED ARE BEING MITIGATED ON-SITE.

THE FOLLOWING TABLE SUMMARIZES THE EXISTING AND PROPOSED PEAK FLOW RATES FOR THE 5, 10, 50 & 100-YEAR STORM EVENTS AT THE ULTIMATE POINT OF DISCHARGE.PEAK RATIONAL METHOD FLOWS WERE USED TO SIZE ALL DRAINAGE STRUCTURES SUCH AS BROW DITCH, CURB INLETS AND STORM DRAIN PIPES AND DETENTION BASIN STRUCTURES.

PEAK FLOW SUMMARY TABLE

STORM EVENT	EXISTING CONDITION (cfs)	PROPOSED CONDITION BEFORE DETENTION (cfs)	PROPOSED CONDITION AFTER DETENTION (cfs)	RUNOFF RELEASED (ft3)	BASIN VOLUME REQUIRED (ft3)	DETENTION TIME (min)
5-Yr	**15.3**	**27.5**	**14.1**	**57,825**	**11,991**	**1,980**
10-Yr	**17.6**	**31.8**	**14.9**	**60,716**	**13,182**	**1,980**
25-Yr	**19.1**	**34.7**	**16.5**	**73,107**	**15,870**	**1,992**
50-Yr	**21.5**	**39.2**	**17.9**	**83,020**	**18,518**	**1,992**
100-Yr	**22.5**	**41.2**	**20.7**	**92,933**	**21,890**	**1,992**

5. DESIGN CRITERIA AND METHODOLOGY

THIS REPORT WAS PREPARED USING THE CITY OF SAN DIEGO TRANSPORTATION AND STORMWATER DESIGN MANUAL, JANUARY 2017 EDITION.

THE PROPOSED STORM FLOW WERE DETERMINED USING THE RATIONAL METHOD HYDROLOGY PROGRAM CIVILCADD/CIVILDESIGN WHICH IS BASED ON THE CITY OF SAN DIEGO DRAINAGE DESIGN MANUAL DATED 1984. SEE SECTION 4 FOR HYDROLOGY DESIGN MODELS. THE PIPES WERE SIZED USING THE 50 YEAR STORM EVENT. ALSO, INLETS WERE SIZED USING ATTACHED PLATE 2.6-0658

6. HYDROLOGY DESIGN MODELS

A. *DESIGN METHODS*

THE RATIONAL METHOD IS USED IN THIS HYDROLOGY STUDY; THE RATIONAL FORMULA IS AS FOLLOWS:

Q = CIA, WHERE : Q= PEAK DISCHARGE IN CUBIC FEET/SECOND *

C = RUNOFF COEFFICIENT (DIMENSIONLESS)

I = RAINFALL INTENSITY IN INCHES/HOUR

A = TRIBUTARY DRAINAGE AREA IN ACRES

*1 ACRE INCHES/HOUR = 1.008 CUBIC FEET/SEC

THE OVERLAND METHOD IS ALSO USED IN THIS HYDROLOGY STUDY;

THE URBAN AREAS OVERLAND FORMULA IS AS FOLLOWS:

$T=[1.8(1.1-C)(L)^{(.5)})]/[S(100)]^{.333}$

L = LENGTH OF WATERSHED

C = COEFFICIENT OF RUNOFF

T = TIME IN MINUTES

S = DIFFERENCE IN ELEVATION DIVIDED BY DE LENGTH OF WATERSHED

B. *DESIGN CRITERIA*

- FREQUENCY 50 YEAR STORM.
- RAIN FALL INTENSITY PER CITY OF SAN DIEGO DRAINAGE DESIGN MANUAL, JANUARY 2017.

C. *REFERENCES*

- CITY OF SAN DIEGO DRAINAGE DESIGN MANUAL, JANUARY 2017.
- COUNTY OF SAN DIEGO HYDROLOGY MANUAL, JUNE 2003
- HAND BOOK OF HYDRAULICS BY BRATER & KING, SIXTH EDITION.

ENGINEERING
& DEVELOPMENT
department

NOTICE

CITY OF SAN DIEGO • 1222 FIRST AVENUE, SAN DIEGO, CALIFORNIA 92101

DATE: August 7, 1987

TO: All Private Engineers

FROM: Subdivision Engineer

SUBJECT: DRAINAGE REQUIREMENTS FOR DEVELOPMENTS IN OTAY MESA

In order to minimize the effects of increased storm water runoff in Mexico, due to development of property in Otay Mesa, all property in Otay Mesa that is within the water shed that drains into Mexico, shall be developed with the following requirements:

1. Each property owner shall provide storm water detention facilities so that there will be no increase in the rate of runoff due to development of the property.

2. The detention facilities shall be designed so that the rate of runoff from the property will not be greater after development than it was before development for a 5 year, 10 year, 25 year and 50 year storm.

3. All drainage facilities crossing four-lane major or higher classification streets shall be designed for a Q_{100} (existing). Other facilities, except the major channel referred to in paragraph 5, may be designed for Q_{50} (existing).

4. The Drainage Design Manual shall be used as guidelines for design of drainage facilities and computing design discharges.

5. The City Engineer's Office, Flood Control Section, is preparing a preliminary plan for the main north-south channel from Otay Mesa Road near La Media to the Mexican Border. The preliminary design will include the design "Q" (Q_{100} existing), the invert grade, and the water surface elevation at the major road crossings.

C. R. LOCHHEAD
Subdivision Engineer

7 HYDROLOGY CALCULATIONS

7.1 RATIONAL METHOD CALCULATIONS

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 6.5

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/17/20

********* Hydrology Study Control Information **********

Program License Serial Number 6303

Rational hydrology study storm event year is 5.0
English (in-lb) input data Units used
English (in) rainfall data used

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity) = 1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++
Process from Point/Station 1.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
____
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Rainfall intensity (I) = 3.149(In/Hr) for a 5.0 year storm
User specified values are as follows:
TC = 5.00 min. Rain intensity = 3.15(In/Hr)
Total area = 7.570(Ac.) Total runoff = 23.880(CFS)

++
Process from Point/Station 1.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****
____
Along Main Stream number: 1 in normal stream number 1
Stream flow area = 7.570(Ac.)
Runoff from this stream = 23.880(CFS)
Time of concentration = 5.00 min.
Rainfall intensity = 3.149(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	23.880	5.00	3.149

Qmax(1) =
1.000 * 1.000 * 23.880) + = 23.880

Total of 1 streams to confluence:
Flow rates before confluence point:
23.880
Maximum flow rates at confluence using above data:
23.880
Area of streams before confluence:
7.570
Results of confluence:
Total flow rate = 23.880(CFS)
Time of concentration = 5.000 min.
Effective stream area after confluence = 7.570(Ac.)

++
Process from Point/Station 3.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Rainfall intensity (I) = 3.149(In/Hr) for a 5.0 year storm
User specified values are as follows:
TC = 5.00 min. Rain intensity = 3.15(In/Hr)
Total area = 16.520(Ac.) Total runoff = 21.630(CFS)

++
Process from Point/Station 3.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 16.520(Ac.)
Runoff from this stream = 21.630(CFS)
Time of concentration = 5.00 min.
Rainfall intensity = 3.149(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	23.880	5.00	3.149
2	21.630	5.00	3.149

Qmax(1) =
1.000 * 1.000 * 23.880) +
1.000 * 1.000 * 21.630) + = 45.510
Qmax(2) =
1.000 * 1.000 * 23.880) +
1.000 * 1.000 * 21.630) + = 45.510

Total of 2 streams to confluence:
Flow rates before confluence point:
23.880 21.630
Maximum flow rates at confluence using above data:
45.510 45.510

Area of streams before confluence:
7.570 16.520
Results of confluence:
Total flow rate = 45.510(CFS)
Time of concentration = 5.000 min.
Effective stream area after confluence = 24.090(Ac.)

++
Process from Point/Station 3.000 to Point/Station 50.000
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 481.200(Ft.)
Downstream point elevation = 474.600(Ft.)
Channel length thru subarea = 475.000(Ft.)
Channel base width = 0.000(Ft.)
Slope or 'Z' of left channel bank = 80.000
Slope or 'Z' of right channel bank = 80.000
Estimated mean flow rate at midpoint of channel = 58.205(CFS)
Manning's 'N' = 0.023
Maximum depth of channel = 0.500(Ft.)
Flow(q) thru subarea = 58.205(CFS)
Depth of flow = 0.493(Ft.), Average velocity = 2.994(Ft/s)
Channel flow top width = 78.876(Ft.)
Flow Velocity = 2.99(Ft/s)
Travel time = 2.64 min.
Time of concentration = 7.64 min.
Critical depth = 0.504(Ft.)
Adding area flow to channel
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[RURAL(greater than 0.5 Ac, 0.2 ha) area type]
Rainfall intensity = 2.532(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.450
Subarea runoff = 15.312(CFS) for 13.440(Ac.)
Total runoff = 60.822(CFS) Total area = 37.53(Ac.)
End of computations, total study area = 37.530 (Ac.)

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 6.5

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/17/20

********* Hydrology Study Control Information **********

Program License Serial Number 6303

Rational hydrology study storm event year is 10.0
English (in-lb) input data Units used
English (in) rainfall data used

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity) = 1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++
Process from Point/Station 1.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
____
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Rainfall intensity (I) = 3.592(In/Hr) for a 10.0 year storm
User specified values are as follows:
TC = 5.00 min. Rain intensity = 3.59(In/Hr)
Total area = 7.570(Ac.) Total runoff = 23.880(CFS)

++
Process from Point/Station 1.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****
____
Along Main Stream number: 1 in normal stream number 1
Stream flow area = 7.570(Ac.)
Runoff from this stream = 23.880(CFS)
Time of concentration = 5.00 min.
Rainfall intensity = 3.592(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	23.880	5.00	3.592

Qmax(1) =
1.000 * 1.000 * 23.880) + = 23.880

Total of 1 streams to confluence:
Flow rates before confluence point:
23.880
Maximum flow rates at confluence using above data:
23.880
Area of streams before confluence:
7.570
Results of confluence:
Total flow rate = 23.880(CFS)
Time of concentration = 5.000 min.
Effective stream area after confluence = 7.570(Ac.)

++
Process from Point/Station 3.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Rainfall intensity (I) = 3.592(In/Hr) for a 10.0 year storm
User specified values are as follows:
TC = 5.00 min. Rain intensity = 3.59(In/Hr)
Total area = 16.520(Ac.) Total runoff = 21.630(CFS)

++
Process from Point/Station 3.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 16.520(Ac.)
Runoff from this stream = 21.630(CFS)
Time of concentration = 5.00 min.
Rainfall intensity = 3.592(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	23.880	5.00	3.592
2	21.630	5.00	3.592

Qmax(1) =
1.000 * 1.000 * 23.880) +
1.000 * 1.000 * 21.630) + = 45.510
Qmax(2) =
1.000 * 1.000 * 23.880) +
1.000 * 1.000 * 21.630) + = 45.510

Total of 2 streams to confluence:
Flow rates before confluence point:
23.880 21.630
Maximum flow rates at confluence using above data:
45.510 45.510

Area of streams before confluence:
7.570 16.520
Results of confluence:
Total flow rate = 45.510(CFS)
Time of concentration = 5.000 min.
Effective stream area after confluence = 24.090(Ac.)

++
Process from Point/Station 3.000 to Point/Station 50.000
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 481.200(Ft.)
Downstream point elevation = 474.600(Ft.)
Channel length thru subarea = 475.000(Ft.)
Channel base width = 0.000(Ft.)
Slope or 'Z' of left channel bank = 80.000
Slope or 'Z' of right channel bank = 80.000
Estimated mean flow rate at midpoint of channel = 58.205(CFS)
Manning's 'N' = 0.023
Maximum depth of channel = 0.500(Ft.)
Flow(q) thru subarea = 58.205(CFS)
Depth of flow = 0.493(Ft.), Average velocity = 2.994(Ft/s)
Channel flow top width = 78.876(Ft.)
Flow Velocity = 2.99(Ft/s)
Travel time = 2.64 min.
Time of concentration = 7.64 min.
Critical depth = 0.504(Ft.)
Adding area flow to channel
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[RURAL(greater than 0.5 Ac, 0.2 ha) area type]
Rainfall intensity = 2.913(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.450
Subarea runoff = 17.620(CFS) for 13.440(Ac.)
Total runoff = 63.130(CFS) Total area = 37.53(Ac.)
End of computations, total study area = 37.530 (Ac.)

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 6.5

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/17/20

********* Hydrology Study Control Information **********

Program License Serial Number 6303

Rational hydrology study storm event year is 25.0
English (in-lb) input data Units used
English (in) rainfall data used

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity) = 1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++
Process from Point/Station 1.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
____
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Rainfall intensity (I) = 3.845(In/Hr) for a 25.0 year storm
User specified values are as follows:
TC = 5.00 min. Rain intensity = 3.85(In/Hr)
Total area = 7.570(Ac.) Total runoff = 23.880(CFS)

++
Process from Point/Station 1.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****
____
Along Main Stream number: 1 in normal stream number 1
Stream flow area = 7.570(Ac.)
Runoff from this stream = 23.880(CFS)
Time of concentration = 5.00 min.
Rainfall intensity = 3.845(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	23.880	5.00	3.845

Qmax(1) =
1.000 * 1.000 * 23.880) + = 23.880

Total of 1 streams to confluence:
Flow rates before confluence point:
23.880
Maximum flow rates at confluence using above data:
23.880
Area of streams before confluence:
7.570
Results of confluence:
Total flow rate = 23.880(CFS)
Time of concentration = 5.000 min.
Effective stream area after confluence = 7.570(Ac.)

++
Process from Point/Station 3.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
____
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Rainfall intensity (I) = 3.845(In/Hr) for a 25.0 year storm
User specified values are as follows:
TC = 5.00 min. Rain intensity = 3.85(In/Hr)
Total area = 16.520(Ac.) Total runoff = 21.630(CFS)

++
Process from Point/Station 3.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****
____
Along Main Stream number: 1 in normal stream number 2
Stream flow area = 16.520(Ac.)
Runoff from this stream = 21.630(CFS)
Time of concentration = 5.00 min.
Rainfall intensity = 3.845(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	23.880	5.00	3.845
2	21.630	5.00	3.845

Qmax(1) =
1.000 * 1.000 * 23.880) +
1.000 * 1.000 * 21.630) + = 45.510
Qmax(2) =
1.000 * 1.000 * 23.880) +
1.000 * 1.000 * 21.630) + = 45.510

Total of 2 streams to confluence:
Flow rates before confluence point:
23.880 21.630
Maximum flow rates at confluence using above data:
45.510 45.510

Area of streams before confluence:
7.570 16.520
Results of confluence:
Total flow rate = 45.510(CFS)
Time of concentration = 5.000 min.
Effective stream area after confluence = 24.090(Ac.)

++
Process from Point/Station 3.000 to Point/Station 50.000
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 481.200(Ft.)
Downstream point elevation = 474.600(Ft.)
Channel length thru subarea = 475.000(Ft.)
Channel base width = 0.000(Ft.)
Slope or 'Z' of left channel bank = 80.000
Slope or 'Z' of right channel bank = 80.000
Estimated mean flow rate at midpoint of channel = 58.205(CFS)
Manning's 'N' = 0.023
Maximum depth of channel = 0.500(Ft.)
Flow(q) thru subarea = 58.205(CFS)
Depth of flow = 0.493(Ft.), Average velocity = 2.994(Ft/s)
Channel flow top width = 78.876(Ft.)
Flow Velocity = 2.99(Ft/s)
Travel time = 2.64 min.
Time of concentration = 7.64 min.
Critical depth = 0.504(Ft.)
Adding area flow to channel
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[RURAL(greater than 0.5 Ac, 0.2 ha) area type]
Rainfall intensity = 3.163(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.450
Subarea runoff = 19.131(CFS) for 13.440(Ac.)
Total runoff = 64.641(CFS) Total area = 37.53(Ac.)
End of computations, total study area = 37.530 (Ac.)

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 6.5

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/17/20

********* Hydrology Study Control Information **********

Program License Serial Number 6303

Rational hydrology study storm event year is 50.0
English (in-lb) input data Units used
English (in) rainfall data used

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity) = 1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++
Process from Point/Station 1.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
____
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Rainfall intensity (I) = 4.265(In/Hr) for a 50.0 year storm
User specified values are as follows:
TC = 5.00 min. Rain intensity = 4.27(In/Hr)
Total area = 7.570(Ac.) Total runoff = 23.880(CFS)

++
Process from Point/Station 1.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****
____
Along Main Stream number: 1 in normal stream number 1
Stream flow area = 7.570(Ac.)
Runoff from this stream = 23.880(CFS)
Time of concentration = 5.00 min.
Rainfall intensity = 4.265(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	23.880	5.00	4.265

Qmax(1) =
1.000 * 1.000 * 23.880) + = 23.880

Total of 1 streams to confluence:
Flow rates before confluence point:
23.880
Maximum flow rates at confluence using above data:
23.880
Area of streams before confluence:
7.570
Results of confluence:
Total flow rate = 23.880(CFS)
Time of concentration = 5.000 min.
Effective stream area after confluence = 7.570(Ac.)

++
Process from Point/Station 3.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Rainfall intensity (I) = 4.265(In/Hr) for a 50.0 year storm
User specified values are as follows:
TC = 5.00 min. Rain intensity = 4.27(In/Hr)
Total area = 16.520(Ac.) Total runoff = 21.630(CFS)

++
Process from Point/Station 3.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 16.520(Ac.)
Runoff from this stream = 21.630(CFS)
Time of concentration = 5.00 min.
Rainfall intensity = 4.265(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	23.880	5.00	4.265
2	21.630	5.00	4.265

Qmax(1) =
1.000 * 1.000 * 23.880) +
1.000 * 1.000 * 21.630) + = 45.510
Qmax(2) =
1.000 * 1.000 * 23.880) +
1.000 * 1.000 * 21.630) + = 45.510

Total of 2 streams to confluence:
Flow rates before confluence point:
23.880 21.630
Maximum flow rates at confluence using above data:
45.510 45.510

Area of streams before confluence:
7.570 16.520
Results of confluence:
Total flow rate = 45.510(CFS)
Time of concentration = 5.000 min.
Effective stream area after confluence = 24.090(Ac.)

++
Process from Point/Station 3.000 to Point/Station 50.000
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 481.200(Ft.)
Downstream point elevation = 474.600(Ft.)
Channel length thru subarea = 475.000(Ft.)
Channel base width = 0.000(Ft.)
Slope or 'Z' of left channel bank = 80.000
Slope or 'Z' of right channel bank = 80.000
Estimated mean flow rate at midpoint of channel = 58.205(CFS)
Manning's 'N' = 0.023
Maximum depth of channel = 0.500(Ft.)
Flow(q) thru subarea = 58.205(CFS)
Depth of flow = 0.493(Ft.), Average velocity = 2.994(Ft/s)
Channel flow top width = 78.876(Ft.)
Flow Velocity = 2.99(Ft/s)
Travel time = 2.64 min.
Time of concentration = 7.64 min.
Critical depth = 0.504(Ft.)
Adding area flow to channel
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[RURAL(greater than 0.5 Ac, 0.2 ha) area type]
Rainfall intensity = 3.557(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.450
Subarea runoff = 21.511(CFS) for 13.440(Ac.)
Total runoff = 67.021(CFS) Total area = 37.53(Ac.)
End of computations, total study area = 37.530 (Ac.)

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 6.4

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 07/17/20

********* Hydrology Study Control Information **********

Program License Serial Number 4035

Rational hydrology study storm event year is 100.0
English (in-lb) input data Units used
English (in) rainfall data used

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity) = 1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++
Process from Point/Station 1.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
____
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Rainfall intensity (I) = 4.389(In/Hr) for a 100.0 year storm
User specified values are as follows:
TC = 5.00 min. Rain intensity = 4.39(In/Hr)
Total area = 7.570(Ac.) Total runoff = 23.880(CFS)

++
Process from Point/Station 1.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****
____
Along Main Stream number: 1 in normal stream number 1
Stream flow area = 7.570(Ac.)
Runoff from this stream = 23.880(CFS)
Time of concentration = 5.00 min.
Rainfall intensity = 4.389(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)

1 23.880 5.00 4.389
Qmax(1) =
1.000 * 1.000 * 23.880) + = 23.880

Total of 1 streams to confluence:
Flow rates before confluence point:
23.880
Maximum flow rates at confluence using above data:
23.880
Area of streams before confluence:
7.570
Results of confluence:
Total flow rate = 23.880(CFS)
Time of concentration = 5.000 min.
Effective stream area after confluence = 7.570(Ac.)

++
Process from Point/Station 3.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
____
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Rainfall intensity (I) = 4.389(In/Hr) for a 100.0 year storm
User specified values are as follows:
TC = 5.00 min. Rain intensity = 4.39(In/Hr)
Total area = 16.520(Ac.) Total runoff = 21.630(CFS)

++
Process from Point/Station 3.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****
____
Along Main Stream number: 1 in normal stream number 2
Stream flow area = 16.520(Ac.)
Runoff from this stream = 21.630(CFS)
Time of concentration = 5.00 min.
Rainfall intensity = 4.389(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	23.880	5.00	4.389
2	21.630	5.00	4.389

Qmax(1) =
1.000 * 1.000 * 23.880) +
1.000 * 1.000 * 21.630) + = 45.510
Qmax(2) =
1.000 * 1.000 * 23.880) +
1.000 * 1.000 * 21.630) + = 45.510

Total of 2 streams to confluence:
Flow rates before confluence point:
23.880 21.630
Maximum flow rates at confluence using above data:

45.510 45.510
Area of streams before confluence:
7.570 16.520
Results of confluence:
Total flow rate = 45.510(CFS)
Time of concentration = 5.000 min.
Effective stream area after confluence = 24.090(Ac.)

++
Process from Point/Station 3.000 to Point/Station 50.000
**** IMPROVED CHANNEL TRAVEL TIME ****
____
Upstream point elevation = 481.200(Ft.)
Downstream point elevation = 474.600(Ft.)
Channel length thru subarea = 475.000(Ft.)
Channel base width = 0.000(Ft.)
Slope or 'Z' of left channel bank = 80.000
Slope or 'Z' of right channel bank = 80.000
Estimated mean flow rate at midpoint of channel = 58.205(CFS)
Manning's 'N' = 0.023
Maximum depth of channel = 0.500(Ft.)
Flow(q) thru subarea = 58.205(CFS)
Depth of flow = 0.493(Ft.), Average velocity = 2.994(Ft/s)
Channel flow top width = 78.876(Ft.)
Flow Velocity = 2.99(Ft/s)
Travel time = 2.64 min.
Time of concentration = 7.64 min.
Critical depth = 0.504(Ft.)
Adding area flow to channel
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[RURAL(greater than 0.5 Ac, 0.2 ha) area type]
Rainfall intensity = 3.722(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.450
Subarea runoff = 22.509(CFS) for 13.440(Ac.)
Total runoff = 68.019(CFS) Total area = 37.53(Ac.)
End of computations, total study area = 37.530 (Ac.)

WEIGHTED RUNOFF COEFFICIENT PROPOSED CONDITION
$C_W = \dfrac{A_I C_I + A_P C_P}{A_T}$
$C_W = \dfrac{(513{,}735)\ (0.95)\ + (71{,}872)\ (0.45)}{585{,}607}$ $C_W = 0.88$

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 6.5

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/17/20

********* Hydrology Study Control Information **********

Program License Serial Number 6303

Rational hydrology study storm event year is 5.0
English (in-lb) input data Units used
English (in) rainfall data used

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity) = 1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

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Process from Point/Station 1.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
____
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Rainfall intensity (I) = 1.829(In/Hr) for a 5.0 year storm
User specified values are as follows:
TC = 14.78 min. Rain intensity = 1.83(In/Hr)
Total area = 7.570(Ac.) Total runoff = 23.880(CFS)

++
Process from Point/Station 1.000 to Point/Station 2.000
**** SUBAREA FLOW ADDITION ****
____
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Time of concentration = 14.78 min.
Rainfall intensity = 1.829(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff = 0.208(CFS) for 0.120(Ac.)
Total runoff = 24.088(CFS) Total area = 7.69(Ac.)

++
Process from Point/Station 1.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 7.690(Ac.)
Runoff from this stream = 24.088(CFS)
Time of concentration = 14.78 min.
Rainfall intensity = 1.829(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	24.088	14.78	1.829

Qmax(1) =
1.000 * 1.000 * 24.088) + = 24.088

Total of 1 streams to confluence:
Flow rates before confluence point:
24.088
Maximum flow rates at confluence using above data:
24.088
Area of streams before confluence:
7.690
Results of confluence:
Total flow rate = 24.088(CFS)
Time of concentration = 14.780 min.
Effective stream area after confluence = 7.690(Ac.)

++
Process from Point/Station 3.000 to Point/Station 4.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Rainfall intensity (I) = 1.829(In/Hr) for a 5.0 year storm
User specified values are as follows:
TC = 14.78 min. Rain intensity = 1.83(In/Hr)
Total area = 16.520(Ac.) Total runoff = 21.630(CFS)

++
Process from Point/Station 3.000 to Point/Station 4.000
**** SUBAREA FLOW ADDITION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Time of concentration = 14.78 min.
Rainfall intensity = 1.829(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff = 0.261(CFS) for 0.150(Ac.)

Total runoff = 21.891(CFS) Total area = 16.67(Ac.)

++
Process from Point/Station 4.000 to Point/Station 2.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
____
Upstream point/station elevation = 481.280(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 458.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 21.891(CFS)
Given pipe size = 24.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
2.912(Ft.) at the headworks or inlet of the pipe(s)
Pipe friction loss = 4.287(Ft.)
Minor friction loss = 0.905(Ft.) K-factor = 1.20
Pipe flow velocity = 6.97(Ft/s)
Travel time through pipe = 1.10 min.
Time of concentration (TC) = 15.88 min.

++
Process from Point/Station 4.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****
____
Along Main Stream number: 1 in normal stream number 2
Stream flow area = 16.670(Ac.)
Runoff from this stream = 21.891(CFS)
Time of concentration = 15.88 min.
Rainfall intensity = 1.765(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	24.088	14.78	1.829
2	21.891	15.88	1.765

Qmax(1) =
1.000 * 1.000 * 24.088) +
1.000 * 0.931 * 21.891) + = 44.469
Qmax(2) =
0.965 * 1.000 * 24.088) +
1.000 * 1.000 * 21.891) + = 45.135

Total of 2 streams to confluence:
Flow rates before confluence point:
24.088 21.891
Maximum flow rates at confluence using above data:
44.469 45.135
Area of streams before confluence:
7.690 16.670
Results of confluence:
Total flow rate = 45.135(CFS)
Time of concentration = 15.875 min.
Effective stream area after confluence = 24.360(Ac.)

++

Process from Point/Station 2.000 to Point/Station 5.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 478.200(Ft.)
Downstream point/station elevation = 476.260(Ft.)
Pipe length = 283.00(Ft.) Manning's N = 0.013
No. of pipes = 3 Required pipe flow = 45.135(CFS)
Given pipe size = 24.00(In.)
Calculated individual pipe flow = 15.045(CFS)
Normal flow depth in pipe = 16.29(In.)
Flow top width inside pipe = 22.41(In.)
Critical Depth = 16.78(In.)
Pipe flow velocity = 6.63(Ft/s)
Travel time through pipe = 0.71 min.
Time of concentration (TC) = 16.59 min.

++
Process from Point/Station 5.000 to Point/Station 6.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 476.260(Ft.)
Downstream point/station elevation = 475.150(Ft.)
Pipe length = 221.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 45.135(CFS)
Given pipe size = 36.00(In.)
Calculated individual pipe flow = 45.135(CFS)
Normal flow depth in pipe = 28.13(In.)
Flow top width inside pipe = 29.76(In.)
Critical Depth = 26.24(In.)
Pipe flow velocity = 7.61(Ft/s)
Travel time through pipe = 0.48 min.
Time of concentration (TC) = 17.07 min.

++
Process from Point/Station 6.000 to Point/Station 50.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 475.150(Ft.)
Downstream point/station elevation = 475.000(Ft.)
Pipe length = 29.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 45.135(CFS)
Given pipe size = 36.00(In.)
Calculated individual pipe flow = 45.135(CFS)
Normal flow depth in pipe = 27.75(In.)
Flow top width inside pipe = 30.26(In.)
Critical Depth = 26.24(In.)
Pipe flow velocity = 7.72(Ft/s)
Travel time through pipe = 0.06 min.
Time of concentration (TC) = 17.13 min.

++
Process from Point/Station 7.000 to Point/Station 8.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 98.000(Ft.)
Highest elevation = 484.700(Ft.)

Lowest elevation = 484.350(Ft.)
Elevation difference = 0.350(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 5.53 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(98.000^.5)/(0.357^(1/3)]= 5.53
Rainfall intensity (I) = 2.989(In/Hr) for a 5.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.605(CFS)
Total initial stream area = 0.230(Ac.)

++
Process from Point/Station 8.000 to Point/Station 9.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 482.350(Ft.)
Downstream point/station elevation = 481.270(Ft.)
Pipe length = 208.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 0.605(CFS)
Given pipe size = 10.00(In.)
Calculated individual pipe flow = 0.605(CFS)
Normal flow depth in pipe = 4.29(In.)
Flow top width inside pipe = 9.90(In.)
Critical Depth = 4.09(In.)
Pipe flow velocity = 2.70(Ft/s)
Travel time through pipe = 1.28 min.
Time of concentration (TC) = 6.81 min.

++
Process from Point/Station 8.000 to Point/Station 9.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 6.81 min.
Rainfall intensity = 2.684(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 2.031(CFS) for 0.860(Ac.)
Total runoff = 2.636(CFS) Total area = 1.09(Ac.)

++
Process from Point/Station 9.000 to Point/Station 10.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 481.270(Ft.)
Downstream point/station elevation = 480.310(Ft.)
Pipe length = 193.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 2.636(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 2.636(CFS)
Normal flow depth in pipe = 8.19(In.)
Flow top width inside pipe = 14.94(In.)
Critical Depth = 7.82(In.)
Pipe flow velocity = 3.85(Ft/s)
Travel time through pipe = 0.84 min.
Time of concentration (TC) = 7.64 min.

++
Process from Point/Station 10.000 to Point/Station 11.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 480.310(Ft.)
Downstream point/station elevation = 479.340(Ft.)
Pipe length = 194.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 2.636(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 2.636(CFS)
Normal flow depth in pipe = 8.18(In.)
Flow top width inside pipe = 14.94(In.)
Critical Depth = 7.82(In.)
Pipe flow velocity = 3.86(Ft/s)
Travel time through pipe = 0.84 min.
Time of concentration (TC) = 8.48 min.

++
Process from Point/Station 11.000 to Point/Station 12.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 479.340(Ft.)
Downstream point/station elevation = 479.120(Ft.)
Pipe length = 45.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 2.636(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 2.636(CFS)
Normal flow depth in pipe = 8.23(In.)
Flow top width inside pipe = 14.93(In.)
Critical Depth = 7.82(In.)
Pipe flow velocity = 3.82(Ft/s)
Travel time through pipe = 0.20 min.
Time of concentration (TC) = 8.68 min.

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.68 min.
Rainfall intensity = 2.376(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.276(CFS) for 0.610(Ac.)
Total runoff = 3.912(CFS) Total area = 1.70(Ac.)

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.68 min.
Rainfall intensity = 2.376(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.167(CFS) for 0.080(Ac.)
Total runoff = 4.079(CFS) Total area = 1.78(Ac.)

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.68 min.
Rainfall intensity = 2.376(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.042(CFS) for 0.020(Ac.)
Total runoff = 4.121(CFS) Total area = 1.80(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 479.120(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 25.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 4.121(CFS)
Given pipe size = 18.00(In.)
Calculated individual pipe flow = 4.121(CFS)
Normal flow depth in pipe = 9.69(In.)
Flow top width inside pipe = 17.95(In.)
Critical Depth = 9.32(In.)
Pipe flow velocity = 4.24(Ft/s)
Travel time through pipe = 0.10 min.
Time of concentration (TC) = 8.78 min.

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.78 min.
Rainfall intensity = 2.363(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 3.494(CFS) for 1.680(Ac.)
Total runoff = 7.615(CFS) Total area = 3.48(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.78 min.
Rainfall intensity = 2.363(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 3.931(CFS) for 1.890(Ac.)
Total runoff = 11.546(CFS) Total area = 5.37(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.78 min.

Rainfall intensity = 2.363(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 4.388(CFS) for 2.110(Ac.)
Total runoff = 15.934(CFS) Total area = 7.48(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.78 min.
Rainfall intensity = 2.363(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 3.431(CFS) for 1.650(Ac.)
Total runoff = 19.365(CFS) Total area = 9.13(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.78 min.
Rainfall intensity = 2.363(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 3.099(CFS) for 1.490(Ac.)
Total runoff = 22.464(CFS) Total area = 10.62(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.78 min.
Rainfall intensity = 2.363(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.373(CFS) for 0.660(Ac.)
Total runoff = 23.837(CFS) Total area = 11.28(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area = 11.280(Ac.)
Runoff from this stream = 23.837(CFS)
Time of concentration = 8.78 min.
Rainfall intensity = 2.363(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	23.837	8.78	2.363

Qmax(1) =

1.000 * 1.000 * 23.837) + = 23.837

Total of 1 main streams to confluence:
Flow rates before confluence point:
23.837
Maximum flow rates at confluence using above data:
23.837
Area of streams before confluence:
11.280

Results of confluence:
Total flow rate = 23.837(CFS)
Time of concentration = 8.777 min.
Effective stream area after confluence = 11.280(Ac.)

++
Process from Point/Station 7.000 to Point/Station 15.000
**** INITIAL AREA EVALUATION ****
____
User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 100.000(Ft.)
Highest elevation = 484.700(Ft.)
Lowest elevation = 484.200(Ft.)
Elevation difference = 0.500(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 4.99 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(100.000^.5)/(0.500^(1/3)]= 4.99
Setting time of concentration to 5 minutes
Rainfall intensity (I) = 3.149(In/Hr) for a 5.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.637(CFS)
Total initial stream area = 0.230(Ac.)

++
Process from Point/Station 15.000 to Point/Station 16.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
____
Upstream point/station elevation = 482.250(Ft.)
Downstream point/station elevation = 481.100(Ft.)
Pipe length = 233.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 0.637(CFS)
Given pipe size = 10.00(In.)
Calculated individual pipe flow = 0.637(CFS)
Normal flow depth in pipe = 4.49(In.)
Flow top width inside pipe = 9.95(In.)
Critical Depth = 4.21(In.)
Pipe flow velocity = 2.69(Ft/s)
Travel time through pipe = 1.44 min.
Time of concentration (TC) = 6.44 min.

++
Process from Point/Station 15.000 to Point/Station 16.000
**** SUBAREA FLOW ADDITION ****
____
User specified 'C' value of 0.880 given for subarea

Time of concentration = 6.44 min.
Rainfall intensity = 2.761(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.802(CFS) for 0.330(Ac.)
Total runoff = 1.439(CFS) Total area = 0.56(Ac.)

++
Process from Point/Station 16.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

____
Upstream point/station elevation = 481.100(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 416.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 1.439(CFS)
Given pipe size = 12.00(In.)
Calculated individual pipe flow = 1.439(CFS)
Normal flow depth in pipe = 6.48(In.)
Flow top width inside pipe = 11.96(In.)
Critical Depth = 6.10(In.)
Pipe flow velocity = 3.33(Ft/s)
Travel time through pipe = 2.08 min.
Time of concentration (TC) = 8.53 min.

++
Process from Point/Station 16.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****

____
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area = 0.560(Ac.)
Runoff from this stream = 1.439(CFS)
Time of concentration = 8.53 min.
Rainfall intensity = 2.397(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	23.837	8.78	2.363
2	1.439	8.53	2.397

Qmax(1) =
1.000 * 1.000 * 23.837) +
0.986 * 1.000 * 1.439) + = 25.255
Qmax(2) =
1.000 * 0.972 * 23.837) +
1.000 * 1.000 * 1.439) + = 24.600

Total of 2 main streams to confluence:
Flow rates before confluence point:
23.837 1.439
Maximum flow rates at confluence using above data:
25.255 24.600
Area of streams before confluence:
11.280 0.560

Results of confluence:

Total flow rate = 25.255(CFS)
Time of concentration = 8.777 min.
Effective stream area after confluence = 11.840(Ac.)

++
Process from Point/Station 18.000 to Point/Station 19.000
**** INITIAL AREA EVALUATION ****

____
User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 128.000(Ft.)
Highest elevation = 484.850(Ft.)
Lowest elevation = 484.200(Ft.)
Elevation difference = 0.650(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 5.62 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(128.000^.5)/(0.508^(1/3)]= 5.62
Rainfall intensity (I) = 2.964(In/Hr) for a 5.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.391(CFS)
Total initial stream area = 0.150(Ac.)

++
Process from Point/Station 19.000 to Point/Station 20.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

____
Upstream point/station elevation = 482.400(Ft.)
Downstream point/station elevation = 481.150(Ft.)
Pipe length = 250.00(Ft.) Manning's N = 0.013
No. of pipes = 2 Required pipe flow = 0.391(CFS)
Given pipe size = 6.00(In.)
Calculated individual pipe flow = 0.196(CFS)
Normal flow depth in pipe = 2.98(In.)
Flow top width inside pipe = 6.00(In.)
Critical Depth = 2.66(In.)
Pipe flow velocity = 2.02(Ft/s)
Travel time through pipe = 2.07 min.
Time of concentration (TC) = 7.68 min.

++
Process from Point/Station 19.000 to Point/Station 20.000
**** SUBAREA FLOW ADDITION ****

____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 7.68 min.
Rainfall intensity = 2.525(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.467(CFS) for 0.660(Ac.)
Total runoff = 1.858(CFS) Total area = 0.81(Ac.)

++
Process from Point/Station 20.000 to Point/Station 21.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

____
Upstream point/station elevation = 481.150(Ft.)
Downstream point/station elevation = 479.140(Ft.)

Pipe length = 401.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 1.858(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 1.858(CFS)
Normal flow depth in pipe = 6.66(In.)
Flow top width inside pipe = 14.90(In.)
Critical Depth = 6.50(In.)
Pipe flow velocity = 3.53(Ft/s)
Travel time through pipe = 1.89 min.
Time of concentration (TC) = 9.57 min.

++
Process from Point/Station 20.000 to Point/Station 21.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 9.57 min.
Rainfall intensity = 2.264(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.398(CFS) for 0.200(Ac.)
Total runoff = 2.256(CFS) Total area = 1.01(Ac.)

++
Process from Point/Station 20.000 to Point/Station 21.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 9.57 min.
Rainfall intensity = 2.264(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.159(CFS) for 0.080(Ac.)
Total runoff = 2.416(CFS) Total area = 1.09(Ac.)

++
Process from Point/Station 21.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 479.140(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 15.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 2.416(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 2.416(CFS)
Normal flow depth in pipe = 6.48(In.)
Flow top width inside pipe = 14.86(In.)
Critical Depth = 7.46(In.)
Pipe flow velocity = 4.76(Ft/s)
Travel time through pipe = 0.05 min.
Time of concentration (TC) = 9.63 min.

++
Process from Point/Station 21.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 3

Stream flow area = 1.090(Ac.)
Runoff from this stream = 2.416(CFS)
Time of concentration = 9.63 min.
Rainfall intensity = 2.258(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	23.837	8.78	2.363
2	1.439	8.53	2.397
3	2.416	9.63	2.258

Qmax(1) =
1.000 * 1.000 * 23.837) +
0.986 * 1.000 * 1.439) +
1.000 * 0.912 * 2.416) + = 27.458
Qmax(2) =
1.000 * 0.972 * 23.837) +
1.000 * 1.000 * 1.439) +
1.000 * 0.886 * 2.416) + = 26.740
Qmax(3) =
0.955 * 1.000 * 23.837) +
0.942 * 1.000 * 1.439) +
1.000 * 1.000 * 2.416) + = 26.544

Total of 3 main streams to confluence:
Flow rates before confluence point:
23.837 1.439 2.416
Maximum flow rates at confluence using above data:
27.458 26.740 26.544
Area of streams before confluence:
11.280 0.560 1.090

Results of confluence:
Total flow rate = 27.458(CFS)
Time of concentration = 8.777 min.
Effective stream area after confluence = 12.930(Ac.)

++
Process from Point/Station 40.000 to Point/Station 41.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 110.000(Ft.)
Highest elevation = 485.000(Ft.)
Lowest elevation = 476.800(Ft.)
Elevation difference = 8.200(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 2.13 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(110.000^.5)/(7.455^(1/3)]= 2.13
Setting time of concentration to 5 minutes
Rainfall intensity (I) = 3.149(In/Hr) for a 5.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.554(CFS)
Total initial stream area = 0.200(Ac.)
End of computations, total study area = 37.490 (Ac.)

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 6.5

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/17/20

********* Hydrology Study Control Information **********

Program License Serial Number 6303

Rational hydrology study storm event year is 10.0
English (in-lb) input data Units used
English (in) rainfall data used

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity) = 1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++
Process from Point/Station 1.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
____
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Rainfall intensity (I) = 2.135(In/Hr) for a 10.0 year storm
User specified values are as follows:
TC = 14.78 min. Rain intensity = 2.14(In/Hr)
Total area = 7.570(Ac.) Total runoff = 23.880(CFS)

++
Process from Point/Station 1.000 to Point/Station 2.000
**** SUBAREA FLOW ADDITION ****
____
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Time of concentration = 14.78 min.
Rainfall intensity = 2.135(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff = 0.243(CFS) for 0.120(Ac.)
Total runoff = 24.123(CFS) Total area = 7.69(Ac.)

++
Process from Point/Station 1.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 7.690(Ac.)
Runoff from this stream = 24.123(CFS)
Time of concentration = 14.78 min.
Rainfall intensity = 2.135(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	24.123	14.78	2.135

Qmax(1) =
1.000 * 1.000 * 24.123) + = 24.123

Total of 1 streams to confluence:
Flow rates before confluence point:
24.123
Maximum flow rates at confluence using above data:
24.123
Area of streams before confluence:
7.690
Results of confluence:
Total flow rate = 24.123(CFS)
Time of concentration = 14.780 min.
Effective stream area after confluence = 7.690(Ac.)

++
Process from Point/Station 3.000 to Point/Station 4.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Rainfall intensity (I) = 2.135(In/Hr) for a 10.0 year storm
User specified values are as follows:
TC = 14.78 min. Rain intensity = 2.14(In/Hr)
Total area = 16.520(Ac.) Total runoff = 21.630(CFS)

++
Process from Point/Station 3.000 to Point/Station 4.000
**** SUBAREA FLOW ADDITION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Time of concentration = 14.78 min.
Rainfall intensity = 2.135(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff = 0.304(CFS) for 0.150(Ac.)

Total runoff = 21.934(CFS) Total area = 16.67(Ac.)

++
Process from Point/Station 4.000 to Point/Station 2.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 481.280(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 458.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 21.934(CFS)
Given pipe size = 24.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
2.933(Ft.) at the headworks or inlet of the pipe(s)
Pipe friction loss = 4.304(Ft.)
Minor friction loss = 0.908(Ft.) K-factor = 1.20
Pipe flow velocity = 6.98(Ft/s)
Travel time through pipe = 1.09 min.
Time of concentration (TC) = 15.87 min.

++
Process from Point/Station 4.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 16.670(Ac.)
Runoff from this stream = 21.934(CFS)
Time of concentration = 15.87 min.
Rainfall intensity = 2.063(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	24.123	14.78	2.135
2	21.934	15.87	2.063

Qmax(1) =
1.000 * 1.000 * 24.123) +
1.000 * 0.931 * 21.934) + = 44.547
Qmax(2) =
0.966 * 1.000 * 24.123) +
1.000 * 1.000 * 21.934) + = 45.247

Total of 2 streams to confluence:
Flow rates before confluence point:
24.123 21.934
Maximum flow rates at confluence using above data:
44.547 45.247
Area of streams before confluence:
7.690 16.670
Results of confluence:
Total flow rate = 45.247(CFS)
Time of concentration = 15.873 min.
Effective stream area after confluence = 24.360(Ac.)

++

Process from Point/Station 2.000 to Point/Station 5.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 478.200(Ft.)
Downstream point/station elevation = 476.260(Ft.)
Pipe length = 283.00(Ft.) Manning's N = 0.013
No. of pipes = 3 Required pipe flow = 45.247(CFS)
Given pipe size = 24.00(In.)
Calculated individual pipe flow = 15.082(CFS)
Normal flow depth in pipe = 16.31(In.)
Flow top width inside pipe = 22.40(In.)
Critical Depth = 16.80(In.)
Pipe flow velocity = 6.63(Ft/s)
Travel time through pipe = 0.71 min.
Time of concentration (TC) = 16.58 min.

++
Process from Point/Station 5.000 to Point/Station 6.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 476.260(Ft.)
Downstream point/station elevation = 475.150(Ft.)
Pipe length = 221.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 45.247(CFS)
Given pipe size = 36.00(In.)
Calculated individual pipe flow = 45.247(CFS)
Normal flow depth in pipe = 28.22(In.)
Flow top width inside pipe = 29.64(In.)
Critical Depth = 26.30(In.)
Pipe flow velocity = 7.61(Ft/s)
Travel time through pipe = 0.48 min.
Time of concentration (TC) = 17.07 min.

++
Process from Point/Station 6.000 to Point/Station 50.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 475.150(Ft.)
Downstream point/station elevation = 475.000(Ft.)
Pipe length = 29.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 45.247(CFS)
Given pipe size = 36.00(In.)
Calculated individual pipe flow = 45.247(CFS)
Normal flow depth in pipe = 27.84(In.)
Flow top width inside pipe = 30.14(In.)
Critical Depth = 26.30(In.)
Pipe flow velocity = 7.72(Ft/s)
Travel time through pipe = 0.06 min.
Time of concentration (TC) = 17.13 min.

++
Process from Point/Station 7.000 to Point/Station 8.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 98.000(Ft.)
Highest elevation = 484.700(Ft.)

Lowest elevation = 484.350(Ft.)
Elevation difference = 0.350(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 5.53 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(98.000^.5)/(0.357^(1/3)]= 5.53
Rainfall intensity (I) = 3.416(In/Hr) for a 10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.691(CFS)
Total initial stream area = 0.230(Ac.)

++
Process from Point/Station 8.000 to Point/Station 9.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
____
Upstream point/station elevation = 482.350(Ft.)
Downstream point/station elevation = 481.270(Ft.)
Pipe length = 208.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 0.691(CFS)
Given pipe size = 10.00(In.)
Calculated individual pipe flow = 0.691(CFS)
Normal flow depth in pipe = 4.63(In.)
Flow top width inside pipe = 9.97(In.)
Critical Depth = 4.39(In.)
Pipe flow velocity = 2.80(Ft/s)
Travel time through pipe = 1.24 min.
Time of concentration (TC) = 6.76 min.

++
Process from Point/Station 8.000 to Point/Station 9.000
**** SUBAREA FLOW ADDITION ****
____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 6.76 min.
Rainfall intensity = 3.091(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 2.339(CFS) for 0.860(Ac.)
Total runoff = 3.030(CFS) Total area = 1.09(Ac.)

++
Process from Point/Station 9.000 to Point/Station 10.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
____
Upstream point/station elevation = 481.270(Ft.)
Downstream point/station elevation = 480.310(Ft.)
Pipe length = 193.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.030(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.030(CFS)
Normal flow depth in pipe = 8.94(In.)
Flow top width inside pipe = 14.72(In.)
Critical Depth = 8.40(In.)
Pipe flow velocity = 3.97(Ft/s)
Travel time through pipe = 0.81 min.
Time of concentration (TC) = 7.57 min.

++
Process from Point/Station 10.000 to Point/Station 11.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 480.310(Ft.)
Downstream point/station elevation = 479.340(Ft.)
Pipe length = 194.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.030(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.030(CFS)
Normal flow depth in pipe = 8.93(In.)
Flow top width inside pipe = 14.72(In.)
Critical Depth = 8.40(In.)
Pipe flow velocity = 3.98(Ft/s)
Travel time through pipe = 0.81 min.
Time of concentration (TC) = 8.39 min.

++
Process from Point/Station 11.000 to Point/Station 12.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 479.340(Ft.)
Downstream point/station elevation = 479.120(Ft.)
Pipe length = 45.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.030(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.030(CFS)
Normal flow depth in pipe = 8.99(In.)
Flow top width inside pipe = 14.70(In.)
Critical Depth = 8.40(In.)
Pipe flow velocity = 3.95(Ft/s)
Travel time through pipe = 0.19 min.
Time of concentration (TC) = 8.58 min.

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.58 min.
Rainfall intensity = 2.758(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.480(CFS) for 0.610(Ac.)
Total runoff = 4.511(CFS) Total area = 1.70(Ac.)

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.58 min.
Rainfall intensity = 2.758(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.194(CFS) for 0.080(Ac.)
Total runoff = 4.705(CFS) Total area = 1.78(Ac.)

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.58 min.
Rainfall intensity = 2.758(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.049(CFS) for 0.020(Ac.)
Total runoff = 4.753(CFS) Total area = 1.80(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 479.120(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 25.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 4.753(CFS)
Given pipe size = 18.00(In.)
Calculated individual pipe flow = 4.753(CFS)
Normal flow depth in pipe = 10.61(In.)
Flow top width inside pipe = 17.71(In.)
Critical Depth = 10.05(In.)
Pipe flow velocity = 4.39(Ft/s)
Travel time through pipe = 0.09 min.
Time of concentration (TC) = 8.67 min.

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.67 min.
Rainfall intensity = 2.743(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 4.056(CFS) for 1.680(Ac.)
Total runoff = 8.809(CFS) Total area = 3.48(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.67 min.
Rainfall intensity = 2.743(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 4.563(CFS) for 1.890(Ac.)
Total runoff = 13.372(CFS) Total area = 5.37(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.67 min.

Rainfall intensity = 2.743(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 5.094(CFS) for 2.110(Ac.)
Total runoff = 18.466(CFS) Total area = 7.48(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.67 min.
Rainfall intensity = 2.743(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 3.984(CFS) for 1.650(Ac.)
Total runoff = 22.450(CFS) Total area = 9.13(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.67 min.
Rainfall intensity = 2.743(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 3.597(CFS) for 1.490(Ac.)
Total runoff = 26.047(CFS) Total area = 10.62(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.67 min.
Rainfall intensity = 2.743(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.593(CFS) for 0.660(Ac.)
Total runoff = 27.641(CFS) Total area = 11.28(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area = 11.280(Ac.)
Runoff from this stream = 27.641(CFS)
Time of concentration = 8.67 min.
Rainfall intensity = 2.743(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	27.641	8.67	2.743

Qmax(1) =

1.000 * 1.000 * 27.641) + = 27.641

Total of 1 main streams to confluence:
Flow rates before confluence point:
27.641
Maximum flow rates at confluence using above data:
27.641
Area of streams before confluence:
11.280

Results of confluence:
Total flow rate = 27.641(CFS)
Time of concentration = 8.671 min.
Effective stream area after confluence = 11.280(Ac.)

++
Process from Point/Station 7.000 to Point/Station 15.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 100.000(Ft.)
Highest elevation = 484.700(Ft.)
Lowest elevation = 484.200(Ft.)
Elevation difference = 0.500(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 4.99 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(100.000^.5)/(0.500^(1/3)]= 4.99
Setting time of concentration to 5 minutes
Rainfall intensity (I) = 3.592(In/Hr) for a 10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.727(CFS)
Total initial stream area = 0.230(Ac.)

++
Process from Point/Station 15.000 to Point/Station 16.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 482.250(Ft.)
Downstream point/station elevation = 481.100(Ft.)
Pipe length = 233.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 0.727(CFS)
Given pipe size = 10.00(In.)
Calculated individual pipe flow = 0.727(CFS)
Normal flow depth in pipe = 4.84(In.)
Flow top width inside pipe = 9.99(In.)
Critical Depth = 4.51(In.)
Pipe flow velocity = 2.78(Ft/s)
Travel time through pipe = 1.40 min.
Time of concentration (TC) = 6.40 min.

++
Process from Point/Station 15.000 to Point/Station 16.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea

Time of concentration = 6.40 min.
Rainfall intensity = 3.177(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.922(CFS) for 0.330(Ac.)
Total runoff = 1.650(CFS) Total area = 0.56(Ac.)

++
Process from Point/Station 16.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 481.100(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 416.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 1.650(CFS)
Given pipe size = 12.00(In.)
Calculated individual pipe flow = 1.650(CFS)
Normal flow depth in pipe = 7.05(In.)
Flow top width inside pipe = 11.81(In.)
Critical Depth = 6.55(In.)
Pipe flow velocity = 3.43(Ft/s)
Travel time through pipe = 2.02 min.
Time of concentration (TC) = 8.42 min.

++
Process from Point/Station 16.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area = 0.560(Ac.)
Runoff from this stream = 1.650(CFS)
Time of concentration = 8.42 min.
Rainfall intensity = 2.783(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	27.641	8.67	2.743
2	1.650	8.42	2.783

Qmax(1) =
1.000 * 1.000 * 27.641) +
0.986 * 1.000 * 1.650) + = 29.267
Qmax(2) =
1.000 * 0.971 * 27.641) +
1.000 * 1.000 * 1.650) + = 28.475

Total of 2 main streams to confluence:
Flow rates before confluence point:
27.641 1.650
Maximum flow rates at confluence using above data:
29.267 28.475
Area of streams before confluence:
11.280 0.560

Results of confluence:

Total flow rate = 29.267(CFS)
Time of concentration = 8.671 min.
Effective stream area after confluence = 11.840(Ac.)

++
Process from Point/Station 18.000 to Point/Station 19.000
**** INITIAL AREA EVALUATION ****

____
User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 128.000(Ft.)
Highest elevation = 484.850(Ft.)
Lowest elevation = 484.200(Ft.)
Elevation difference = 0.650(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 5.62 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(128.000^.5)/(0.508^(1/3)]= 5.62
Rainfall intensity (I) = 3.388(In/Hr) for a 10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.447(CFS)
Total initial stream area = 0.150(Ac.)

++
Process from Point/Station 19.000 to Point/Station 20.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

____
Upstream point/station elevation = 482.400(Ft.)
Downstream point/station elevation = 481.150(Ft.)
Pipe length = 250.00(Ft.) Manning's N = 0.013
No. of pipes = 2 Required pipe flow = 0.447(CFS)
Given pipe size = 6.00(In.)
Calculated individual pipe flow = 0.224(CFS)
Normal flow depth in pipe = 3.22(In.)
Flow top width inside pipe = 5.98(In.)
Critical Depth = 2.85(In.)
Pipe flow velocity = 2.08(Ft/s)
Travel time through pipe = 2.00 min.
Time of concentration (TC) = 7.62 min.

++
Process from Point/Station 19.000 to Point/Station 20.000
**** SUBAREA FLOW ADDITION ****

____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 7.62 min.
Rainfall intensity = 2.918(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.695(CFS) for 0.660(Ac.)
Total runoff = 2.142(CFS) Total area = 0.81(Ac.)

++
Process from Point/Station 20.000 to Point/Station 21.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

____
Upstream point/station elevation = 481.150(Ft.)
Downstream point/station elevation = 479.140(Ft.)

Pipe length = 401.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 2.142(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 2.142(CFS)
Normal flow depth in pipe = 7.22(In.)
Flow top width inside pipe = 14.99(In.)
Critical Depth = 7.01(In.)
Pipe flow velocity = 3.67(Ft/s)
Travel time through pipe = 1.82 min.
Time of concentration (TC) = 9.44 min.

++
Process from Point/Station 20.000 to Point/Station 21.000
**** SUBAREA FLOW ADDITION ****
____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 9.44 min.
Rainfall intensity = 2.635(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.464(CFS) for 0.200(Ac.)
Total runoff = 2.606(CFS) Total area = 1.01(Ac.)

++
Process from Point/Station 20.000 to Point/Station 21.000
**** SUBAREA FLOW ADDITION ****
____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 9.44 min.
Rainfall intensity = 2.635(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.186(CFS) for 0.080(Ac.)
Total runoff = 2.791(CFS) Total area = 1.09(Ac.)

++
Process from Point/Station 21.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
____
Upstream point/station elevation = 479.140(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 15.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 2.791(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 2.791(CFS)
Normal flow depth in pipe = 7.03(In.)
Flow top width inside pipe = 14.97(In.)
Critical Depth = 8.05(In.)
Pipe flow velocity = 4.94(Ft/s)
Travel time through pipe = 0.05 min.
Time of concentration (TC) = 9.49 min.

++
Process from Point/Station 21.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****
____
The following data inside Main Stream is listed:
In Main Stream number: 3

Stream flow area = 1.090(Ac.)
Runoff from this stream = 2.791(CFS)
Time of concentration = 9.49 min.
Rainfall intensity = 2.629(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	27.641	8.67	2.743
2	1.650	8.42	2.783
3	2.791	9.49	2.629

Qmax(1) =
1.000 * 1.000 * 27.641) +
0.986 * 1.000 * 1.650) +
1.000 * 0.914 * 2.791) + = 31.817
Qmax(2) =
1.000 * 0.971 * 27.641) +
1.000 * 1.000 * 1.650) +
1.000 * 0.887 * 2.791) + = 30.950
Qmax(3) =
0.958 * 1.000 * 27.641) +
0.945 * 1.000 * 1.650) +
1.000 * 1.000 * 2.791) + = 30.836

Total of 3 main streams to confluence:
Flow rates before confluence point:
27.641 1.650 2.791
Maximum flow rates at confluence using above data:
31.817 30.950 30.836
Area of streams before confluence:
11.280 0.560 1.090

Results of confluence:
Total flow rate = 31.817(CFS)
Time of concentration = 8.671 min.
Effective stream area after confluence = 12.930(Ac.)

++
Process from Point/Station 40.000 to Point/Station 41.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 110.000(Ft.)
Highest elevation = 485.000(Ft.)
Lowest elevation = 476.800(Ft.)
Elevation difference = 8.200(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 2.13 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(110.000^.5)/(7.455^(1/3)]= 2.13
Setting time of concentration to 5 minutes
Rainfall intensity (I) = 3.592(In/Hr) for a 10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.632(CFS)
Total initial stream area = 0.200(Ac.)
End of computations, total study area = 37.490 (Ac.)

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25Yr

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 6.5

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/17/20

********* Hydrology Study Control Information **********

Program License Serial Number 6303

Rational hydrology study storm event year is 25.0
English (in-lb) input data Units used
English (in) rainfall data used

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity) = 1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++
Process from Point/Station 1.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
____
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Rainfall intensity (I) = 2.372(In/Hr) for a 25.0 year storm
User specified values are as follows:
TC = 14.78 min. Rain intensity = 2.37(In/Hr)
Total area = 7.570(Ac.) Total runoff = 23.880(CFS)

++
Process from Point/Station 1.000 to Point/Station 2.000
**** SUBAREA FLOW ADDITION ****
____
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Time of concentration = 14.78 min.
Rainfall intensity = 2.372(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff = 0.270(CFS) for 0.120(Ac.)
Total runoff = 24.150(CFS) Total area = 7.69(Ac.)

++
Process from Point/Station 1.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****

____

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 7.690(Ac.)
Runoff from this stream = 24.150(CFS)
Time of concentration = 14.78 min.
Rainfall intensity = 2.372(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	24.150	14.78	2.372

Qmax(1) =
1.000 * 1.000 * 24.150) + = 24.150

Total of 1 streams to confluence:
Flow rates before confluence point:
24.150
Maximum flow rates at confluence using above data:
24.150
Area of streams before confluence:
7.690
Results of confluence:
Total flow rate = 24.150(CFS)
Time of concentration = 14.780 min.
Effective stream area after confluence = 7.690(Ac.)

++
Process from Point/Station 3.000 to Point/Station 4.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

____

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Rainfall intensity (I) = 2.372(In/Hr) for a 25.0 year storm
User specified values are as follows:
TC = 14.78 min. Rain intensity = 2.37(In/Hr)
Total area = 16.520(Ac.) Total runoff = 21.630(CFS)

++
Process from Point/Station 3.000 to Point/Station 4.000
**** SUBAREA FLOW ADDITION ****

____

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Time of concentration = 14.78 min.
Rainfall intensity = 2.372(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff = 0.338(CFS) for 0.150(Ac.)

Total runoff = 21.968(CFS) Total area = 16.67(Ac.)

++
Process from Point/Station 4.000 to Point/Station 2.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
____
Upstream point/station elevation = 481.280(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 458.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 21.968(CFS)
Given pipe size = 24.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
2.949(Ft.) at the headworks or inlet of the pipe(s)
Pipe friction loss = 4.317(Ft.)
Minor friction loss = 0.911(Ft.) K-factor = 1.20
Pipe flow velocity = 6.99(Ft/s)
Travel time through pipe = 1.09 min.
Time of concentration (TC) = 15.87 min.

++
Process from Point/Station 4.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****
____
Along Main Stream number: 1 in normal stream number 2
Stream flow area = 16.670(Ac.)
Runoff from this stream = 21.968(CFS)
Time of concentration = 15.87 min.
Rainfall intensity = 2.297(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	24.150	14.78	2.372
2	21.968	15.87	2.297

Qmax(1) =
1.000 * 1.000 * 24.150) +
1.000 * 0.931 * 21.968) + = 44.608
Qmax(2) =
0.969 * 1.000 * 24.150) +
1.000 * 1.000 * 21.968) + = 45.359

Total of 2 streams to confluence:
Flow rates before confluence point:
24.150 21.968
Maximum flow rates at confluence using above data:
44.608 45.359
Area of streams before confluence:
7.690 16.670
Results of confluence:
Total flow rate = 45.359(CFS)
Time of concentration = 15.872 min.
Effective stream area after confluence = 24.360(Ac.)

++

Process from Point/Station 2.000 to Point/Station 5.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 478.200(Ft.)
Downstream point/station elevation = 476.260(Ft.)
Pipe length = 283.00(Ft.) Manning's N = 0.013
No. of pipes = 3 Required pipe flow = 45.359(CFS)
Given pipe size = 24.00(In.)
Calculated individual pipe flow = 15.120(CFS)
Normal flow depth in pipe = 16.34(In.)
Flow top width inside pipe = 22.38(In.)
Critical Depth = 16.82(In.)
Pipe flow velocity = 6.63(Ft/s)
Travel time through pipe = 0.71 min.
Time of concentration (TC) = 16.58 min.

++
Process from Point/Station 5.000 to Point/Station 6.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 476.260(Ft.)
Downstream point/station elevation = 475.150(Ft.)
Pipe length = 221.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 45.359(CFS)
Given pipe size = 36.00(In.)
Calculated individual pipe flow = 45.359(CFS)
Normal flow depth in pipe = 28.27(In.)
Flow top width inside pipe = 29.57(In.)
Critical Depth = 26.32(In.)
Pipe flow velocity = 7.61(Ft/s)
Travel time through pipe = 0.48 min.
Time of concentration (TC) = 17.07 min.

++
Process from Point/Station 6.000 to Point/Station 50.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 475.150(Ft.)
Downstream point/station elevation = 475.000(Ft.)
Pipe length = 29.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 45.359(CFS)
Given pipe size = 36.00(In.)
Calculated individual pipe flow = 45.359(CFS)
Normal flow depth in pipe = 27.89(In.)
Flow top width inside pipe = 30.08(In.)
Critical Depth = 26.32(In.)
Pipe flow velocity = 7.72(Ft/s)
Travel time through pipe = 0.06 min.
Time of concentration (TC) = 17.13 min.

++
Process from Point/Station 7.000 to Point/Station 8.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 98.000(Ft.)
Highest elevation = 484.700(Ft.)

Lowest elevation = 484.350(Ft.)
Elevation difference = 0.350(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 5.53 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(98.000^.5)/(0.357^(1/3)]= 5.53
Rainfall intensity (I) = 3.668(In/Hr) for a 25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.742(CFS)
Total initial stream area = 0.230(Ac.)

++
Process from Point/Station 8.000 to Point/Station 9.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 482.350(Ft.)
Downstream point/station elevation = 481.270(Ft.)
Pipe length = 208.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 0.742(CFS)
Given pipe size = 10.00(In.)
Calculated individual pipe flow = 0.742(CFS)
Normal flow depth in pipe = 4.82(In.)
Flow top width inside pipe = 9.99(In.)
Critical Depth = 4.55(In.)
Pipe flow velocity = 2.85(Ft/s)
Travel time through pipe = 1.22 min.
Time of concentration (TC) = 6.74 min.

++
Process from Point/Station 8.000 to Point/Station 9.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 6.74 min.
Rainfall intensity = 3.347(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 2.533(CFS) for 0.860(Ac.)
Total runoff = 3.275(CFS) Total area = 1.09(Ac.)

++
Process from Point/Station 9.000 to Point/Station 10.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 481.270(Ft.)
Downstream point/station elevation = 480.310(Ft.)
Pipe length = 193.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.275(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.275(CFS)
Normal flow depth in pipe = 9.41(In.)
Flow top width inside pipe = 14.51(In.)
Critical Depth = 8.75(In.)
Pipe flow velocity = 4.04(Ft/s)
Travel time through pipe = 0.80 min.
Time of concentration (TC) = 7.54 min.

++
Process from Point/Station 10.000 to Point/Station 11.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 480.310(Ft.)
Downstream point/station elevation = 479.340(Ft.)
Pipe length = 194.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.275(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.275(CFS)
Normal flow depth in pipe = 9.40(In.)
Flow top width inside pipe = 14.51(In.)
Critical Depth = 8.75(In.)
Pipe flow velocity = 4.05(Ft/s)
Travel time through pipe = 0.80 min.
Time of concentration (TC) = 8.34 min.

++
Process from Point/Station 11.000 to Point/Station 12.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 479.340(Ft.)
Downstream point/station elevation = 479.120(Ft.)
Pipe length = 45.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.275(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.275(CFS)
Normal flow depth in pipe = 9.47(In.)
Flow top width inside pipe = 14.47(In.)
Critical Depth = 8.75(In.)
Pipe flow velocity = 4.01(Ft/s)
Travel time through pipe = 0.19 min.
Time of concentration (TC) = 8.52 min.

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.52 min.
Rainfall intensity = 3.015(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.618(CFS) for 0.610(Ac.)
Total runoff = 4.893(CFS) Total area = 1.70(Ac.)

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.52 min.
Rainfall intensity = 3.015(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.212(CFS) for 0.080(Ac.)
Total runoff = 5.106(CFS) Total area = 1.78(Ac.)

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.52 min.
Rainfall intensity = 3.015(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.053(CFS) for 0.020(Ac.)
Total runoff = 5.159(CFS) Total area = 1.80(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 479.120(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 25.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 5.159(CFS)
Given pipe size = 18.00(In.)
Calculated individual pipe flow = 5.159(CFS)
Normal flow depth in pipe = 11.19(In.)
Flow top width inside pipe = 17.46(In.)
Critical Depth = 10.49(In.)
Pipe flow velocity = 4.47(Ft/s)
Travel time through pipe = 0.09 min.
Time of concentration (TC) = 8.62 min.

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.62 min.
Rainfall intensity = 3.000(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 4.436(CFS) for 1.680(Ac.)
Total runoff = 9.595(CFS) Total area = 3.48(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.62 min.
Rainfall intensity = 3.000(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 4.990(CFS) for 1.890(Ac.)
Total runoff = 14.585(CFS) Total area = 5.37(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.62 min.

Rainfall intensity = 3.000(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 5.571(CFS) for 2.110(Ac.)
Total runoff = 20.156(CFS) Total area = 7.48(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.62 min.
Rainfall intensity = 3.000(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 4.357(CFS) for 1.650(Ac.)
Total runoff = 24.513(CFS) Total area = 9.13(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.62 min.
Rainfall intensity = 3.000(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 3.934(CFS) for 1.490(Ac.)
Total runoff = 28.447(CFS) Total area = 10.62(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.62 min.
Rainfall intensity = 3.000(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.743(CFS) for 0.660(Ac.)
Total runoff = 30.190(CFS) Total area = 11.28(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area = 11.280(Ac.)
Runoff from this stream = 30.190(CFS)
Time of concentration = 8.62 min.
Rainfall intensity = 3.000(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	30.190	8.62	3.000

Qmax(1) =

1.000 * 1.000 * 30.190) + = 30.190

Total of 1 main streams to confluence:
Flow rates before confluence point:
30.190
Maximum flow rates at confluence using above data:
30.190
Area of streams before confluence:
11.280

Results of confluence:
Total flow rate = 30.190(CFS)
Time of concentration = 8.617 min.
Effective stream area after confluence = 11.280(Ac.)

++
Process from Point/Station 7.000 to Point/Station 15.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 100.000(Ft.)
Highest elevation = 484.700(Ft.)
Lowest elevation = 484.200(Ft.)
Elevation difference = 0.500(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 4.99 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(100.000^.5)/(0.500^(1/3)]= 4.99
Setting time of concentration to 5 minutes
Rainfall intensity (I) = 3.845(In/Hr) for a 25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.778(CFS)
Total initial stream area = 0.230(Ac.)

++
Process from Point/Station 15.000 to Point/Station 16.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 482.250(Ft.)
Downstream point/station elevation = 481.100(Ft.)
Pipe length = 233.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 0.778(CFS)
Given pipe size = 10.00(In.)
Calculated individual pipe flow = 0.778(CFS)
Normal flow depth in pipe = 5.03(In.)
Flow top width inside pipe = 10.00(In.)
Critical Depth = 4.68(In.)
Pipe flow velocity = 2.83(Ft/s)
Travel time through pipe = 1.37 min.
Time of concentration (TC) = 6.37 min.

++
Process from Point/Station 15.000 to Point/Station 16.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea

Time of concentration = 6.37 min.
Rainfall intensity = 3.433(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.997(CFS) for 0.330(Ac.)
Total runoff = 1.775(CFS) Total area = 0.56(Ac.)

++
Process from Point/Station 16.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

____
Upstream point/station elevation = 481.100(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 416.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 1.775(CFS)
Given pipe size = 12.00(In.)
Calculated individual pipe flow = 1.775(CFS)
Normal flow depth in pipe = 7.41(In.)
Flow top width inside pipe = 11.67(In.)
Critical Depth = 6.80(In.)
Pipe flow velocity = 3.49(Ft/s)
Travel time through pipe = 1.99 min.
Time of concentration (TC) = 8.36 min.

++
Process from Point/Station 16.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****

____
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area = 0.560(Ac.)
Runoff from this stream = 1.775(CFS)
Time of concentration = 8.36 min.
Rainfall intensity = 3.041(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	30.190	8.62	3.000
2	1.775	8.36	3.041

Qmax(1) =
1.000 * 1.000 * 30.190) +
0.987 * 1.000 * 1.775) + = 31.942
Qmax(2) =
1.000 * 0.970 * 30.190) +
1.000 * 1.000 * 1.775) + = 31.062

Total of 2 main streams to confluence:
Flow rates before confluence point:
30.190 1.775
Maximum flow rates at confluence using above data:
31.942 31.062
Area of streams before confluence:
11.280 0.560

Results of confluence:

Total flow rate = 31.942(CFS)
Time of concentration = 8.617 min.
Effective stream area after confluence = 11.840(Ac.)

++
Process from Point/Station 18.000 to Point/Station 19.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 128.000(Ft.)
Highest elevation = 484.850(Ft.)
Lowest elevation = 484.200(Ft.)
Elevation difference = 0.650(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 5.62 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(128.000^.5)/(0.508^(1/3)]= 5.62
Rainfall intensity (I) = 3.640(In/Hr) for a 25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.480(CFS)
Total initial stream area = 0.150(Ac.)

++
Process from Point/Station 19.000 to Point/Station 20.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 482.400(Ft.)
Downstream point/station elevation = 481.150(Ft.)
Pipe length = 250.00(Ft.) Manning's N = 0.013
No. of pipes = 2 Required pipe flow = 0.480(CFS)
Given pipe size = 6.00(In.)
Calculated individual pipe flow = 0.240(CFS)
Normal flow depth in pipe = 3.38(In.)
Flow top width inside pipe = 5.95(In.)
Critical Depth = 2.96(In.)
Pipe flow velocity = 2.12(Ft/s)
Travel time through pipe = 1.97 min.
Time of concentration (TC) = 7.58 min.

++
Process from Point/Station 19.000 to Point/Station 20.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 7.58 min.
Rainfall intensity = 3.175(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.844(CFS) for 0.660(Ac.)
Total runoff = 2.324(CFS) Total area = 0.81(Ac.)

++
Process from Point/Station 20.000 to Point/Station 21.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 481.150(Ft.)
Downstream point/station elevation = 479.140(Ft.)

Pipe length = 401.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 2.324(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 2.324(CFS)
Normal flow depth in pipe = 7.57(In.)
Flow top width inside pipe = 15.00(In.)
Critical Depth = 7.31(In.)
Pipe flow velocity = 3.74(Ft/s)
Travel time through pipe = 1.79 min.
Time of concentration (TC) = 9.37 min.

++
Process from Point/Station 20.000 to Point/Station 21.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 9.37 min.
Rainfall intensity = 2.893(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.509(CFS) for 0.200(Ac.)
Total runoff = 2.833(CFS) Total area = 1.01(Ac.)

++
Process from Point/Station 20.000 to Point/Station 21.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 9.37 min.
Rainfall intensity = 2.893(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.204(CFS) for 0.080(Ac.)
Total runoff = 3.037(CFS) Total area = 1.09(Ac.)

++
Process from Point/Station 21.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 479.140(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 15.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.037(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.037(CFS)
Normal flow depth in pipe = 7.38(In.)
Flow top width inside pipe = 15.00(In.)
Critical Depth = 8.41(In.)
Pipe flow velocity = 5.05(Ft/s)
Travel time through pipe = 0.05 min.
Time of concentration (TC) = 9.42 min.

++
Process from Point/Station 21.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 3

Stream flow area = 1.090(Ac.)
Runoff from this stream = 3.037(CFS)
Time of concentration = 9.42 min.
Rainfall intensity = 2.886(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	30.190	8.62	3.000
2	1.775	8.36	3.041
3	3.037	9.42	2.886

Qmax(1) =
1.000 * 1.000 * 30.190) +
0.987 * 1.000 * 1.775) +
1.000 * 0.915 * 3.037) + = 34.720
Qmax(2) =
1.000 * 0.970 * 30.190) +
1.000 * 1.000 * 1.775) +
1.000 * 0.888 * 3.037) + = 33.758
Qmax(3) =
0.962 * 1.000 * 30.190) +
0.949 * 1.000 * 1.775) +
1.000 * 1.000 * 3.037) + = 33.763

Total of 3 main streams to confluence:
Flow rates before confluence point:
30.190 1.775 3.037
Maximum flow rates at confluence using above data:
34.720 33.758 33.763
Area of streams before confluence:
11.280 0.560 1.090

Results of confluence:
Total flow rate = 34.720(CFS)
Time of concentration = 8.617 min.
Effective stream area after confluence = 12.930(Ac.)

++
Process from Point/Station 40.000 to Point/Station 41.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 110.000(Ft.)
Highest elevation = 485.000(Ft.)
Lowest elevation = 476.800(Ft.)
Elevation difference = 8.200(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 2.13 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(110.000^.5)/(7.455^(1/3)]= 2.13
Setting time of concentration to 5 minutes
Rainfall intensity (I) = 3.845(In/Hr) for a 25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.677(CFS)
Total initial stream area = 0.200(Ac.)
End of computations, total study area = 37.490 (Ac.)

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 6.5

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/17/20

********* Hydrology Study Control Information **********

Program License Serial Number 6303

Rational hydrology study storm event year is 50.0
English (in-lb) input data Units used
English (in) rainfall data used

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity) = 1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++
Process from Point/Station 1.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

____
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Rainfall intensity (I) = 2.724(In/Hr) for a 50.0 year storm
User specified values are as follows:
TC = 14.78 min. Rain intensity = 2.72(In/Hr)
Total area = 7.570(Ac.) Total runoff = 23.880(CFS)

++
Process from Point/Station 1.000 to Point/Station 2.000
**** SUBAREA FLOW ADDITION ****

____
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Time of concentration = 14.78 min.
Rainfall intensity = 2.724(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff = 0.310(CFS) for 0.120(Ac.)
Total runoff = 24.190(CFS) Total area = 7.69(Ac.)

++
Process from Point/Station 1.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****

____

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 7.690(Ac.)
Runoff from this stream = 24.190(CFS)
Time of concentration = 14.78 min.
Rainfall intensity = 2.724(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	24.190	14.78	2.724

Qmax(1) =
1.000 * 1.000 * 24.190) + = 24.190

Total of 1 streams to confluence:
Flow rates before confluence point:
24.190
Maximum flow rates at confluence using above data:
24.190
Area of streams before confluence:
7.690
Results of confluence:
Total flow rate = 24.190(CFS)
Time of concentration = 14.780 min.
Effective stream area after confluence = 7.690(Ac.)

++
Process from Point/Station 3.000 to Point/Station 4.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

____

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Rainfall intensity (I) = 2.724(In/Hr) for a 50.0 year storm
User specified values are as follows:
TC = 14.78 min. Rain intensity = 2.72(In/Hr)
Total area = 16.520(Ac.) Total runoff = 21.630(CFS)

++
Process from Point/Station 3.000 to Point/Station 4.000
**** SUBAREA FLOW ADDITION ****

____

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Time of concentration = 14.78 min.
Rainfall intensity = 2.724(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff = 0.388(CFS) for 0.150(Ac.)

Total runoff = 22.018(CFS) Total area = 16.67(Ac.)

++
Process from Point/Station 4.000 to Point/Station 2.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 481.280(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 458.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 22.018(CFS)
Given pipe size = 24.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
2.972(Ft.) at the headworks or inlet of the pipe(s)
Pipe friction loss = 4.337(Ft.)
Minor friction loss = 0.915(Ft.) K-factor = 1.20
Pipe flow velocity = 7.01(Ft/s)
Travel time through pipe = 1.09 min.
Time of concentration (TC) = 15.87 min.

++
Process from Point/Station 4.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 16.670(Ac.)
Runoff from this stream = 22.018(CFS)
Time of concentration = 15.87 min.
Rainfall intensity = 2.643(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	24.190	14.78	2.724
2	22.018	15.87	2.643

Qmax(1) =
1.000 * 1.000 * 24.190) +
1.000 * 0.931 * 22.018) + = 44.697
Qmax(2) =
0.971 * 1.000 * 24.190) +
1.000 * 1.000 * 22.018) + = 45.495

Total of 2 streams to confluence:
Flow rates before confluence point:
24.190 22.018
Maximum flow rates at confluence using above data:
44.697 45.495
Area of streams before confluence:
7.690 16.670
Results of confluence:
Total flow rate = 45.495(CFS)
Time of concentration = 15.869 min.
Effective stream area after confluence = 24.360(Ac.)

++

Process from Point/Station 2.000 to Point/Station 5.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 478.200(Ft.)
Downstream point/station elevation = 476.260(Ft.)
Pipe length = 283.00(Ft.) Manning's N = 0.013
No. of pipes = 3 Required pipe flow = 45.495(CFS)
Given pipe size = 24.00(In.)
Calculated individual pipe flow = 15.165(CFS)
Normal flow depth in pipe = 16.38(In.)
Flow top width inside pipe = 22.34(In.)
Critical Depth = 16.86(In.)
Pipe flow velocity = 6.64(Ft/s)
Travel time through pipe = 0.71 min.
Time of concentration (TC) = 16.58 min.

++
Process from Point/Station 5.000 to Point/Station 6.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 476.260(Ft.)
Downstream point/station elevation = 475.150(Ft.)
Pipe length = 221.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 45.495(CFS)
Given pipe size = 36.00(In.)
Calculated individual pipe flow = 45.495(CFS)
Normal flow depth in pipe = 28.36(In.)
Flow top width inside pipe = 29.44(In.)
Critical Depth = 26.35(In.)
Pipe flow velocity = 7.62(Ft/s)
Travel time through pipe = 0.48 min.
Time of concentration (TC) = 17.06 min.

++
Process from Point/Station 6.000 to Point/Station 50.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 475.150(Ft.)
Downstream point/station elevation = 475.000(Ft.)
Pipe length = 29.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 45.495(CFS)
Given pipe size = 36.00(In.)
Calculated individual pipe flow = 45.495(CFS)
Normal flow depth in pipe = 27.98(In.)
Flow top width inside pipe = 29.95(In.)
Critical Depth = 26.35(In.)
Pipe flow velocity = 7.72(Ft/s)
Travel time through pipe = 0.06 min.
Time of concentration (TC) = 17.13 min.

++
Process from Point/Station 7.000 to Point/Station 8.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 98.000(Ft.)
Highest elevation = 484.700(Ft.)

Lowest elevation = 484.350(Ft.)
Elevation difference = 0.350(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 5.53 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(98.000^.5)/(0.357^(1/3)]= 5.53
Rainfall intensity (I) = 4.081(In/Hr) for a 50.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.826(CFS)
Total initial stream area = 0.230(Ac.)

++
Process from Point/Station 8.000 to Point/Station 9.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 482.350(Ft.)
Downstream point/station elevation = 481.270(Ft.)
Pipe length = 208.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 0.826(CFS)
Given pipe size = 10.00(In.)
Calculated individual pipe flow = 0.826(CFS)
Normal flow depth in pipe = 5.13(In.)
Flow top width inside pipe = 10.00(In.)
Critical Depth = 4.82(In.)
Pipe flow velocity = 2.93(Ft/s)
Travel time through pipe = 1.18 min.
Time of concentration (TC) = 6.71 min.

++
Process from Point/Station 8.000 to Point/Station 9.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 6.71 min.
Rainfall intensity = 3.755(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 2.842(CFS) for 0.860(Ac.)
Total runoff = 3.668(CFS) Total area = 1.09(Ac.)

++
Process from Point/Station 9.000 to Point/Station 10.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 481.270(Ft.)
Downstream point/station elevation = 480.310(Ft.)
Pipe length = 193.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.668(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.668(CFS)
Normal flow depth in pipe = 10.20(In.)
Flow top width inside pipe = 14.00(In.)
Critical Depth = 9.28(In.)
Pipe flow velocity = 4.13(Ft/s)
Travel time through pipe = 0.78 min.
Time of concentration (TC) = 7.49 min.

++
Process from Point/Station 10.000 to Point/Station 11.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 480.310(Ft.)
Downstream point/station elevation = 479.340(Ft.)
Pipe length = 194.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.668(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.668(CFS)
Normal flow depth in pipe = 10.17(In.)
Flow top width inside pipe = 14.02(In.)
Critical Depth = 9.28(In.)
Pipe flow velocity = 4.14(Ft/s)
Travel time through pipe = 0.78 min.
Time of concentration (TC) = 8.27 min.

++
Process from Point/Station 11.000 to Point/Station 12.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 479.340(Ft.)
Downstream point/station elevation = 479.120(Ft.)
Pipe length = 45.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.668(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.668(CFS)
Normal flow depth in pipe = 10.27(In.)
Flow top width inside pipe = 13.94(In.)
Critical Depth = 9.28(In.)
Pipe flow velocity = 4.10(Ft/s)
Travel time through pipe = 0.18 min.
Time of concentration (TC) = 8.45 min.

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.45 min.
Rainfall intensity = 3.414(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.832(CFS) for 0.610(Ac.)
Total runoff = 5.500(CFS) Total area = 1.70(Ac.)

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.45 min.
Rainfall intensity = 3.414(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.240(CFS) for 0.080(Ac.)
Total runoff = 5.740(CFS) Total area = 1.78(Ac.)

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.45 min.
Rainfall intensity = 3.414(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.060(CFS) for 0.020(Ac.)
Total runoff = 5.800(CFS) Total area = 1.80(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 479.120(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 25.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 5.800(CFS)
Given pipe size = 18.00(In.)
Calculated individual pipe flow = 5.800(CFS)
Normal flow depth in pipe = 12.14(In.)
Flow top width inside pipe = 16.87(In.)
Critical Depth = 11.15(In.)
Pipe flow velocity = 4.57(Ft/s)
Travel time through pipe = 0.09 min.
Time of concentration (TC) = 8.54 min.

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.54 min.
Rainfall intensity = 3.399(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 5.025(CFS) for 1.680(Ac.)
Total runoff = 10.825(CFS) Total area = 3.48(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.54 min.
Rainfall intensity = 3.399(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 5.653(CFS) for 1.890(Ac.)
Total runoff = 16.478(CFS) Total area = 5.37(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.54 min.

Rainfall intensity = 3.399(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 6.311(CFS) for 2.110(Ac.)
Total runoff = 22.789(CFS) Total area = 7.48(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.54 min.
Rainfall intensity = 3.399(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 4.935(CFS) for 1.650(Ac.)
Total runoff = 27.724(CFS) Total area = 9.13(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.54 min.
Rainfall intensity = 3.399(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 4.457(CFS) for 1.490(Ac.)
Total runoff = 32.181(CFS) Total area = 10.62(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.54 min.
Rainfall intensity = 3.399(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.974(CFS) for 0.660(Ac.)
Total runoff = 34.155(CFS) Total area = 11.28(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area = 11.280(Ac.)
Runoff from this stream = 34.155(CFS)
Time of concentration = 8.54 min.
Rainfall intensity = 3.399(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	34.155	8.54	3.399

Qmax(1) =

1.000 * 1.000 * 34.155) + = 34.155

Total of 1 main streams to confluence:
Flow rates before confluence point:
34.155
Maximum flow rates at confluence using above data:
34.155
Area of streams before confluence:
11.280

Results of confluence:
Total flow rate = 34.155(CFS)
Time of concentration = 8.544 min.
Effective stream area after confluence = 11.280(Ac.)

++
Process from Point/Station 7.000 to Point/Station 15.000
**** INITIAL AREA EVALUATION ****
____
User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 100.000(Ft.)
Highest elevation = 484.700(Ft.)
Lowest elevation = 484.200(Ft.)
Elevation difference = 0.500(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 4.99 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(100.000^.5)/(0.500^(1/3)]= 4.99
Setting time of concentration to 5 minutes
Rainfall intensity (I) = 4.265(In/Hr) for a 50.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.863(CFS)
Total initial stream area = 0.230(Ac.)

++
Process from Point/Station 15.000 to Point/Station 16.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
____
Upstream point/station elevation = 482.250(Ft.)
Downstream point/station elevation = 481.100(Ft.)
Pipe length = 233.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 0.863(CFS)
Given pipe size = 10.00(In.)
Calculated individual pipe flow = 0.863(CFS)
Normal flow depth in pipe = 5.36(In.)
Flow top width inside pipe = 9.97(In.)
Critical Depth = 4.93(In.)
Pipe flow velocity = 2.90(Ft/s)
Travel time through pipe = 1.34 min.
Time of concentration (TC) = 6.34 min.

++
Process from Point/Station 15.000 to Point/Station 16.000
**** SUBAREA FLOW ADDITION ****
____
User specified 'C' value of 0.880 given for subarea

Time of concentration = 6.34 min.
Rainfall intensity = 3.847(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.117(CFS) for 0.330(Ac.)
Total runoff = 1.980(CFS) Total area = 0.56(Ac.)

++
Process from Point/Station 16.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
____
Upstream point/station elevation = 481.100(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 416.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 1.980(CFS)
Given pipe size = 12.00(In.)
Calculated individual pipe flow = 1.980(CFS)
Normal flow depth in pipe = 7.99(In.)
Flow top width inside pipe = 11.32(In.)
Critical Depth = 7.21(In.)
Pipe flow velocity = 3.57(Ft/s)
Travel time through pipe = 1.94 min.
Time of concentration (TC) = 8.28 min.

++
Process from Point/Station 16.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****
____
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area = 0.560(Ac.)
Runoff from this stream = 1.980(CFS)
Time of concentration = 8.28 min.
Rainfall intensity = 3.442(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	34.155	8.54	3.399
2	1.980	8.28	3.442

Qmax(1) =
1.000 * 1.000 * 34.155) +
0.987 * 1.000 * 1.980) + = 36.110
Qmax(2) =
1.000 * 0.969 * 34.155) +
1.000 * 1.000 * 1.980) + = 35.086

Total of 2 main streams to confluence:
Flow rates before confluence point:
34.155 1.980
Maximum flow rates at confluence using above data:
36.110 35.086
Area of streams before confluence:
11.280 0.560

Results of confluence:

Total flow rate = 36.110(CFS)
Time of concentration = 8.544 min.
Effective stream area after confluence = 11.840(Ac.)

++
Process from Point/Station 18.000 to Point/Station 19.000
**** INITIAL AREA EVALUATION ****

____
User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 128.000(Ft.)
Highest elevation = 484.850(Ft.)
Lowest elevation = 484.200(Ft.)
Elevation difference = 0.650(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 5.62 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(128.000^.5)/(0.508^(1/3)]= 5.62
Rainfall intensity (I) = 4.052(In/Hr) for a 50.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.535(CFS)
Total initial stream area = 0.150(Ac.)

++
Process from Point/Station 19.000 to Point/Station 20.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

____
Upstream point/station elevation = 482.400(Ft.)
Downstream point/station elevation = 481.150(Ft.)
Pipe length = 250.00(Ft.) Manning's N = 0.013
No. of pipes = 2 Required pipe flow = 0.535(CFS)
Given pipe size = 6.00(In.)
Calculated individual pipe flow = 0.267(CFS)
Normal flow depth in pipe = 3.61(In.)
Flow top width inside pipe = 5.87(In.)
Critical Depth = 3.13(In.)
Pipe flow velocity = 2.17(Ft/s)
Travel time through pipe = 1.92 min.
Time of concentration (TC) = 7.54 min.

++
Process from Point/Station 19.000 to Point/Station 20.000
**** SUBAREA FLOW ADDITION ****

____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 7.54 min.
Rainfall intensity = 3.578(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 2.078(CFS) for 0.660(Ac.)
Total runoff = 2.613(CFS) Total area = 0.81(Ac.)

++
Process from Point/Station 20.000 to Point/Station 21.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

____
Upstream point/station elevation = 481.150(Ft.)
Downstream point/station elevation = 479.140(Ft.)

Pipe length = 401.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 2.613(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 2.613(CFS)
Normal flow depth in pipe = 8.12(In.)
Flow top width inside pipe = 14.95(In.)
Critical Depth = 7.77(In.)
Pipe flow velocity = 3.85(Ft/s)
Travel time through pipe = 1.74 min.
Time of concentration (TC) = 9.27 min.

++
Process from Point/Station 20.000 to Point/Station 21.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 9.27 min.
Rainfall intensity = 3.288(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.579(CFS) for 0.200(Ac.)
Total runoff = 3.192(CFS) Total area = 1.01(Ac.)

++
Process from Point/Station 20.000 to Point/Station 21.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 9.27 min.
Rainfall intensity = 3.288(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.232(CFS) for 0.080(Ac.)
Total runoff = 3.423(CFS) Total area = 1.09(Ac.)

++
Process from Point/Station 21.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 479.140(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 15.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.423(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.423(CFS)
Normal flow depth in pipe = 7.92(In.)
Flow top width inside pipe = 14.98(In.)
Critical Depth = 8.95(In.)
Pipe flow velocity = 5.20(Ft/s)
Travel time through pipe = 0.05 min.
Time of concentration (TC) = 9.32 min.

++
Process from Point/Station 21.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 3

Stream flow area = 1.090(Ac.)
Runoff from this stream = 3.423(CFS)
Time of concentration = 9.32 min.
Rainfall intensity = 3.282(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	34.155	8.54	3.399
2	1.980	8.28	3.442
3	3.423	9.32	3.282

Qmax(1) =
1.000 * 1.000 * 34.155) +
0.987 * 1.000 * 1.980) +
1.000 * 0.917 * 3.423) + = 39.248
Qmax(2) =
1.000 * 0.969 * 34.155) +
1.000 * 1.000 * 1.980) +
1.000 * 0.889 * 3.423) + = 38.127
Qmax(3) =
0.966 * 1.000 * 34.155) +
0.953 * 1.000 * 1.980) +
1.000 * 1.000 * 3.423) + = 38.288

Total of 3 main streams to confluence:
Flow rates before confluence point:
34.155 1.980 3.423
Maximum flow rates at confluence using above data:
39.248 38.127 38.288
Area of streams before confluence:
11.280 0.560 1.090

Results of confluence:
Total flow rate = 39.248(CFS)
Time of concentration = 8.544 min.
Effective stream area after confluence = 12.930(Ac.)

++
Process from Point/Station 40.000 to Point/Station 41.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 110.000(Ft.)
Highest elevation = 485.000(Ft.)
Lowest elevation = 476.800(Ft.)
Elevation difference = 8.200(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 2.13 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(110.000^.5)/(7.455^(1/3)]= 2.13
Setting time of concentration to 5 minutes
Rainfall intensity (I) = 4.265(In/Hr) for a 50.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.751(CFS)
Total initial stream area = 0.200(Ac.)
End of computations, total study area = 37.490 (Ac.)

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 6.4

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 07/18/20

********* Hydrology Study Control Information **********

Program License Serial Number 4035

Rational hydrology study storm event year is 100.0
English (in-lb) input data Units used
English (in) rainfall data used

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity) = 1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++
Process from Point/Station 1.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
____
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Rainfall intensity (I) = 2.922(In/Hr) for a 100.0 year storm
User specified values are as follows:
TC = 14.78 min. Rain intensity = 2.92(In/Hr)
Total area = 7.570(Ac.) Total runoff = 23.880(CFS)

++
Process from Point/Station 1.000 to Point/Station 2.000
**** SUBAREA FLOW ADDITION ****
____
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Time of concentration = 14.78 min.
Rainfall intensity = 2.922(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff = 0.333(CFS) for 0.120(Ac.)
Total runoff = 24.213(CFS) Total area = 7.69(Ac.)

++
Process from Point/Station 1.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 7.690(Ac.)
Runoff from this stream = 24.213(CFS)
Time of concentration = 14.78 min.
Rainfall intensity = 2.922(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	24.213	14.78	2.922

Qmax(1) =
1.000 * 1.000 * 24.213) + = 24.213

Total of 1 streams to confluence:
Flow rates before confluence point:
24.213
Maximum flow rates at confluence using above data:
24.213
Area of streams before confluence:
7.690
Results of confluence:
Total flow rate = 24.213(CFS)
Time of concentration = 14.780 min.
Effective stream area after confluence = 7.690(Ac.)

++
Process from Point/Station 3.000 to Point/Station 4.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Rainfall intensity (I) = 2.922(In/Hr) for a 100.0 year storm
User specified values are as follows:
TC = 14.78 min. Rain intensity = 2.92(In/Hr)
Total area = 16.520(Ac.) Total runoff = 21.630(CFS)

++
Process from Point/Station 3.000 to Point/Station 4.000
**** SUBAREA FLOW ADDITION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Time of concentration = 14.78 min.
Rainfall intensity = 2.922(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff = 0.416(CFS) for 0.150(Ac.)

Total runoff = 22.046(CFS) Total area = 16.67(Ac.)

++
Process from Point/Station 4.000 to Point/Station 2.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
____
Upstream point/station elevation = 481.280(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 458.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 22.046(CFS)
Given pipe size = 24.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
2.986(Ft.) at the headworks or inlet of the pipe(s)
Pipe friction loss = 4.348(Ft.)
Minor friction loss = 0.918(Ft.) K-factor = 1.20
Pipe flow velocity = 7.02(Ft/s)
Travel time through pipe = 1.09 min.
Time of concentration (TC) = 15.87 min.

++
Process from Point/Station 4.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****
____
Along Main Stream number: 1 in normal stream number 2
Stream flow area = 16.670(Ac.)
Runoff from this stream = 22.046(CFS)
Time of concentration = 15.87 min.
Rainfall intensity = 2.842(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	24.213	14.78	2.922
2	22.046	15.87	2.842

Qmax(1) =
1.000 * 1.000 * 24.213) +
1.000 * 0.931 * 22.046) + = 44.748
Qmax(2) =
0.973 * 1.000 * 24.213) +
1.000 * 1.000 * 22.046) + = 45.599

Total of 2 streams to confluence:
Flow rates before confluence point:
24.213 22.046
Maximum flow rates at confluence using above data:
44.748 45.599
Area of streams before confluence:
7.690 16.670
Results of confluence:
Total flow rate = 45.599(CFS)
Time of concentration = 15.868 min.
Effective stream area after confluence = 24.360(Ac.)

++

Process from Point/Station 2.000 to Point/Station 5.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 478.200(Ft.)
Downstream point/station elevation = 476.260(Ft.)
Pipe length = 283.00(Ft.) Manning's N = 0.013
No. of pipes = 3 Required pipe flow = 45.599(CFS)
Given pipe size = 24.00(In.)
Calculated individual pipe flow = 15.200(CFS)
Normal flow depth in pipe = 16.41(In.)
Flow top width inside pipe = 22.32(In.)
Critical Depth = 16.86(In.)
Pipe flow velocity = 6.64(Ft/s)
Travel time through pipe = 0.71 min.
Time of concentration (TC) = 16.58 min.

++
Process from Point/Station 5.000 to Point/Station 6.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 476.260(Ft.)
Downstream point/station elevation = 475.150(Ft.)
Pipe length = 221.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 45.599(CFS)
Given pipe size = 36.00(In.)
Calculated individual pipe flow = 45.599(CFS)
Normal flow depth in pipe = 28.41(In.)
Flow top width inside pipe = 29.37(In.)
Critical Depth = 26.41(In.)
Pipe flow velocity = 7.62(Ft/s)
Travel time through pipe = 0.48 min.
Time of concentration (TC) = 17.06 min.

++
Process from Point/Station 6.000 to Point/Station 50.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 475.150(Ft.)
Downstream point/station elevation = 475.000(Ft.)
Pipe length = 29.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 45.599(CFS)
Given pipe size = 36.00(In.)
Calculated individual pipe flow = 45.599(CFS)
Normal flow depth in pipe = 28.03(In.)
Flow top width inside pipe = 29.89(In.)
Critical Depth = 26.41(In.)
Pipe flow velocity = 7.72(Ft/s)
Travel time through pipe = 0.06 min.
Time of concentration (TC) = 17.12 min.

++
Process from Point/Station 7.000 to Point/Station 8.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 98.000(Ft.)
Highest elevation = 484.700(Ft.)

Lowest elevation = 484.350(Ft.)
Elevation difference = 0.350(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 5.53 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(98.000^.5)/(0.357^(1/3)]= 5.53
Rainfall intensity (I) = 4.215(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.853(CFS)
Total initial stream area = 0.230(Ac.)

++
Process from Point/Station 8.000 to Point/Station 9.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
____
Upstream point/station elevation = 482.350(Ft.)
Downstream point/station elevation = 481.270(Ft.)
Pipe length = 208.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 0.853(CFS)
Given pipe size = 10.00(In.)
Calculated individual pipe flow = 0.853(CFS)
Normal flow depth in pipe = 5.24(In.)
Flow top width inside pipe = 9.99(In.)
Critical Depth = 4.90(In.)
Pipe flow velocity = 2.95(Ft/s)
Travel time through pipe = 1.17 min.
Time of concentration (TC) = 6.70 min.

++
Process from Point/Station 8.000 to Point/Station 9.000
**** SUBAREA FLOW ADDITION ****
____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 6.70 min.
Rainfall intensity = 3.911(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 2.960(CFS) for 0.860(Ac.)
Total runoff = 3.813(CFS) Total area = 1.09(Ac.)

++
Process from Point/Station 9.000 to Point/Station 10.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
____
Upstream point/station elevation = 481.270(Ft.)
Downstream point/station elevation = 480.310(Ft.)
Pipe length = 193.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.813(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.813(CFS)
Normal flow depth in pipe = 10.50(In.)
Flow top width inside pipe = 13.75(In.)
Critical Depth = 9.48(In.)
Pipe flow velocity = 4.16(Ft/s)
Travel time through pipe = 0.77 min.
Time of concentration (TC) = 7.47 min.

++
Process from Point/Station 10.000 to Point/Station 11.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 480.310(Ft.)
Downstream point/station elevation = 479.340(Ft.)
Pipe length = 194.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.813(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.813(CFS)
Normal flow depth in pipe = 10.48(In.)
Flow top width inside pipe = 13.77(In.)
Critical Depth = 9.48(In.)
Pipe flow velocity = 4.17(Ft/s)
Travel time through pipe = 0.78 min.
Time of concentration (TC) = 8.25 min.

++
Process from Point/Station 11.000 to Point/Station 12.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 479.340(Ft.)
Downstream point/station elevation = 479.120(Ft.)
Pipe length = 45.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.813(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.813(CFS)
Normal flow depth in pipe = 10.57(In.)
Flow top width inside pipe = 13.69(In.)
Critical Depth = 9.48(In.)
Pipe flow velocity = 4.13(Ft/s)
Travel time through pipe = 0.18 min.
Time of concentration (TC) = 8.43 min.

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.43 min.
Rainfall intensity = 3.590(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.927(CFS) for 0.610(Ac.)
Total runoff = 5.740(CFS) Total area = 1.70(Ac.)

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.43 min.
Rainfall intensity = 3.590(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.253(CFS) for 0.080(Ac.)
Total runoff = 5.993(CFS) Total area = 1.78(Ac.)

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.43 min.
Rainfall intensity = 3.590(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.063(CFS) for 0.020(Ac.)
Total runoff = 6.056(CFS) Total area = 1.80(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 479.120(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 25.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 6.056(CFS)
Given pipe size = 18.00(In.)
Calculated individual pipe flow = 6.056(CFS)
Normal flow depth in pipe = 12.54(In.)
Flow top width inside pipe = 16.55(In.)
Critical Depth = 11.40(In.)
Pipe flow velocity = 4.61(Ft/s)
Travel time through pipe = 0.09 min.
Time of concentration (TC) = 8.52 min.

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.52 min.
Rainfall intensity = 3.576(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 5.286(CFS) for 1.680(Ac.)
Total runoff = 11.342(CFS) Total area = 3.48(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.52 min.
Rainfall intensity = 3.576(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 5.947(CFS) for 1.890(Ac.)
Total runoff = 17.289(CFS) Total area = 5.37(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.52 min.

Rainfall intensity = 3.576(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 6.640(CFS) for 2.110(Ac.)
Total runoff = 23.929(CFS) Total area = 7.48(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.52 min.
Rainfall intensity = 3.576(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 5.192(CFS) for 1.650(Ac.)
Total runoff = 29.121(CFS) Total area = 9.13(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.52 min.
Rainfall intensity = 3.576(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 4.689(CFS) for 1.490(Ac.)
Total runoff = 33.810(CFS) Total area = 10.62(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.52 min.
Rainfall intensity = 3.576(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 2.077(CFS) for 0.660(Ac.)
Total runoff = 35.886(CFS) Total area = 11.28(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area = 11.280(Ac.)
Runoff from this stream = 35.886(CFS)
Time of concentration = 8.52 min.
Rainfall intensity = 3.576(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	35.886	8.52	3.576

Qmax(1) =

1.000 * 1.000 * 35.886) + = 35.886

Total of 1 main streams to confluence:
Flow rates before confluence point:
35.886
Maximum flow rates at confluence using above data:
35.886
Area of streams before confluence:
11.280

Results of confluence:
Total flow rate = 35.886(CFS)
Time of concentration = 8.522 min.
Effective stream area after confluence = 11.280(Ac.)

++
Process from Point/Station 7.000 to Point/Station 15.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 100.000(Ft.)
Highest elevation = 484.700(Ft.)
Lowest elevation = 484.200(Ft.)
Elevation difference = 0.500(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 4.99 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(100.000^.5)/(0.500^(1/3)]= 4.99
Setting time of concentration to 5 minutes
Rainfall intensity (I) = 4.389(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.888(CFS)
Total initial stream area = 0.230(Ac.)

++
Process from Point/Station 15.000 to Point/Station 16.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 482.250(Ft.)
Downstream point/station elevation = 481.100(Ft.)
Pipe length = 233.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 0.888(CFS)
Given pipe size = 10.00(In.)
Calculated individual pipe flow = 0.888(CFS)
Normal flow depth in pipe = 5.45(In.)
Flow top width inside pipe = 9.96(In.)
Critical Depth = 5.01(In.)
Pipe flow velocity = 2.92(Ft/s)
Travel time through pipe = 1.33 min.
Time of concentration (TC) = 6.33 min.

++
Process from Point/Station 15.000 to Point/Station 16.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea

Time of concentration = 6.33 min.
Rainfall intensity = 3.997(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.161(CFS) for 0.330(Ac.)
Total runoff = 2.049(CFS) Total area = 0.56(Ac.)

++
Process from Point/Station 16.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 481.100(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 416.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 2.049(CFS)
Given pipe size = 12.00(In.)
Calculated individual pipe flow = 2.049(CFS)
Normal flow depth in pipe = 8.19(In.)
Flow top width inside pipe = 11.17(In.)
Critical Depth = 7.33(In.)
Pipe flow velocity = 3.59(Ft/s)
Travel time through pipe = 1.93 min.
Time of concentration (TC) = 8.26 min.

++
Process from Point/Station 16.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area = 0.560(Ac.)
Runoff from this stream = 2.049(CFS)
Time of concentration = 8.26 min.
Rainfall intensity = 3.617(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	35.886	8.52	3.576
2	2.049	8.26	3.617

Qmax(1) =
1.000 * 1.000 * 35.886) +
0.989 * 1.000 * 2.049) + = 37.912
Qmax(2) =
1.000 * 0.969 * 35.886) +
1.000 * 1.000 * 2.049) + = 36.835

Total of 2 main streams to confluence:
Flow rates before confluence point:
35.886 2.049
Maximum flow rates at confluence using above data:
37.912 36.835
Area of streams before confluence:
11.280 0.560

Results of confluence:

Total flow rate = 37.912(CFS)
Time of concentration = 8.522 min.
Effective stream area after confluence = 11.840(Ac.)

++
Process from Point/Station 18.000 to Point/Station 19.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 128.000(Ft.)
Highest elevation = 484.850(Ft.)
Lowest elevation = 484.200(Ft.)
Elevation difference = 0.650(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 5.62 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(128.000^.5)/(0.508^(1/3)]= 5.62
Rainfall intensity (I) = 4.188(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.553(CFS)
Total initial stream area = 0.150(Ac.)

++
Process from Point/Station 19.000 to Point/Station 20.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 482.400(Ft.)
Downstream point/station elevation = 481.150(Ft.)
Pipe length = 250.00(Ft.) Manning's N = 0.013
No. of pipes = 2 Required pipe flow = 0.553(CFS)
Given pipe size = 6.00(In.)
Calculated individual pipe flow = 0.276(CFS)
Normal flow depth in pipe = 3.68(In.)
Flow top width inside pipe = 5.84(In.)
Critical Depth = 3.18(In.)
Pipe flow velocity = 2.18(Ft/s)
Travel time through pipe = 1.91 min.
Time of concentration (TC) = 7.52 min.

++
Process from Point/Station 19.000 to Point/Station 20.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 7.52 min.
Rainfall intensity = 3.744(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 2.174(CFS) for 0.660(Ac.)
Total runoff = 2.727(CFS) Total area = 0.81(Ac.)

++
Process from Point/Station 20.000 to Point/Station 21.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 481.150(Ft.)
Downstream point/station elevation = 479.140(Ft.)

Pipe length = 401.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 2.727(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 2.727(CFS)
Normal flow depth in pipe = 8.34(In.)
Flow top width inside pipe = 14.90(In.)
Critical Depth = 7.96(In.)
Pipe flow velocity = 3.89(Ft/s)
Travel time through pipe = 1.72 min.
Time of concentration (TC) = 9.24 min.

++
Process from Point/Station 20.000 to Point/Station 21.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 9.24 min.
Rainfall intensity = 3.472(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.611(CFS) for 0.200(Ac.)
Total runoff = 3.338(CFS) Total area = 1.01(Ac.)

++
Process from Point/Station 20.000 to Point/Station 21.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 9.24 min.
Rainfall intensity = 3.472(In/Hr) for a 100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.244(CFS) for 0.080(Ac.)
Total runoff = 3.583(CFS) Total area = 1.09(Ac.)

++
Process from Point/Station 21.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 479.140(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 15.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.583(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.583(CFS)
Normal flow depth in pipe = 8.14(In.)
Flow top width inside pipe = 14.94(In.)
Critical Depth = 9.18(In.)
Pipe flow velocity = 5.26(Ft/s)
Travel time through pipe = 0.05 min.
Time of concentration (TC) = 9.29 min.

++
Process from Point/Station 21.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 3

Stream flow area = 1.090(Ac.)
Runoff from this stream = 3.583(CFS)
Time of concentration = 9.29 min.
Rainfall intensity = 3.465(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	35.886	8.52	3.576
2	2.049	8.26	3.617
3	3.583	9.29	3.465

Qmax(1) =
1.000 * 1.000 * 35.886) +
0.989 * 1.000 * 2.049) +
1.000 * 0.917 * 3.583) + = 41.199
Qmax(2) =
1.000 * 0.969 * 35.886) +
1.000 * 1.000 * 2.049) +
1.000 * 0.889 * 3.583) + = 40.021
Qmax(3) =
0.969 * 1.000 * 35.886) +
0.958 * 1.000 * 2.049) +
1.000 * 1.000 * 3.583) + = 40.323

Total of 3 main streams to confluence:
Flow rates before confluence point:
35.886 2.049 3.583
Maximum flow rates at confluence using above data:
41.199 40.021 40.323
Area of streams before confluence:
11.280 0.560 1.090

Results of confluence:
Total flow rate = 41.199(CFS)
Time of concentration = 8.522 min.
Effective stream area after confluence = 12.930(Ac.)

++
Process from Point/Station 40.000 to Point/Station 41.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 110.000(Ft.)
Highest elevation = 485.000(Ft.)
Lowest elevation = 476.800(Ft.)
Elevation difference = 8.200(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 2.13 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(110.000^.5)/(7.455^(1/3)]= 2.13
Setting time of concentration to 5 minutes
Rainfall intensity (I) = 4.389(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.772(CFS)
Total initial stream area = 0.200(Ac.)
End of computations, total study area = 37.490 (Ac.)

RIPRAPs Manning Pipe,

Calculator Given Input Data:
Shape .... Circular
Solving for .... Depth of Flow
Diameter .... 15.0000 in
Flowrate .... 5.5800 cfs
Slope .... 0.2669 ft/ft
Manning's n 0.0130

Computed Results:
Depth .... 4.1492 in
Area 1.2272 ft2
Wetted Area 0.2765 ft2
Wetted Perimeter .... 16.6146 in
Perimeter .... 47.1239 in
Velocity .... 20.1781 fps
Hydraulic Radius .... 2.3968 in
Percent Full .... 27.6613 %
Full flow Flowrate .... 33.3728 cfs
Full flow velocity .... 27.1946 fps

Critical Information
Critical depth .... 11.8384 in
Critical slope .... 0.0072 ft/ft
Critical velocity .... 5.2369 fps
Critical area 1.0655 ft2
Critical perimeter .... 32.2388 in
Critical hydraulic radius .... 4.7593 in
Critical top width .... 15.0000 in
Specific energy .... 6.6732 ft
Minimum energy .... 1.4798 ft
Froude number 7.1537
Flow condition .... Supercritical

Manning Pipe Calculator

Given Input Data:

Shape .... Circular
Solving for .... Depth of Flow
Diameter .... 15.0000 in
Flowrate .... 6.2800 cfs
Slope .... 0.0181 ft/ft
Manning's n 0.0130

Computed Results:

Depth .... 9.4474 in
Area 1.2272 ft2
Wetted Area 0.8141 ft2
Wetted Perimeter .... 27.5018 in
Perimeter .... 47.1239 in
Velocity .... 7.7137 fps
Hydraulic Radius .... 4.2629 in
Percent Full .... 62.9824 %
Full flow Flowrate .... 8.6908 cfs
Full flow velocity .... 7.0819 fps

Critical Information

Critical depth .... 12.6769 in
Critical slope .... 0.0075 ft/ft
Critical velocity .... 5.4473 fps
Critical area 1.1529 ft2
Critical perimeter .... 33.9158 in
Critical hydraulic radius .... 4.8948 in
Critical top width .... 15.0000 in
Specific energy .... 1.7121 ft
Minimum energy .... 1.5846 ft
Froude number 1.6893
Flow condition .... Supercritical

Manning Pipe Calculator

Given Input Data:

Shape .... Circular
Solving for .... Depth of Flow
Diameter .... 15.0000 in
Flowrate .... 7.0500 cfs
Slope .... 0.2700 ft/ft
Manning's n 0.0130

Computed Results:

Depth .... 4.6662 in
Area 1.2272 ft2
Wetted Area 0.3256 ft2
Wetted Perimeter .... 17.7500 in
Perimeter .... 47.1239 in
Velocity .... 21.6533 fps
Hydraulic Radius .... 2.6414 in
Percent Full .... 31.1079 %
Full flow Flowrate .... 33.5661 cfs
Full flow velocity .... 27.3521 fps

Critical Information

Critical depth .... 13.5640 in
Critical slope .... 0.0078 ft/ft
Critical velocity .... 5.6615 fps
Critical area 1.2453 ft2
Critical perimeter .... 35.6900 in
Critical hydraulic radius .... 5.0243 in
Critical top width .... 15.0000 in
Specific energy .... 7.6752 ft
Minimum energy .... 1.6955 ft
Froude number 7.1973
Flow condition .... Supercritical

Manning Pipe Calculator

Given Input Data:
Shape .... Circular
Solving for .... Depth of Flow
Diameter .... 15.0000 in
Flowrate .... 5.4800 cfs
Slope .... 0.2700 ft/ft
Manning's n 0.0130

Computed Results:
Depth .... 4.0990 in
Area 1.2272 ft2
Wetted Area 0.2719 ft2
Wetted Perimeter .... 16.5022 in
Perimeter .... 47.1239 in
Velocity .... 20.1569 fps
Hydraulic Radius .... 2.3724 in
Percent Full .... 27.3266 %
Full flow Flowrate .... 33.5661 cfs
Full flow velocity .... 27.3521 fps

Critical Information
Critical depth .... 11.7158 in
Critical slope .... 0.0072 ft/ft
Critical velocity .... 5.2055 fps
Critical area 1.0527 ft2
Critical perimeter .... 31.9936 in
Critical hydraulic radius .... 4.7383 in
Critical top width .... 15.0000 in
Specific energy .... 6.6557 ft
Minimum energy .... 1.4645 ft
Froude number 7.1937
Flow condition .... Supercritical

Manning Pipe Calculator

Given Input Data:

Shape .... Circular
Solving for .... Depth of Flow
Diameter .... 15.0000 in
Flowrate .... 4.9500 cfs
Slope .... 0.0173 ft/ft
Manning's n 0.0130

Computed Results:

Depth .... 8.2229 in
Area 1.2272 ft2
Wetted Area 0.6888 ft2
Wetted Perimeter .... 25.0099 in
Perimeter .... 47.1239 in
Velocity .... 7.1867 fps
Hydraulic Radius .... 3.9658 in
Percent Full .... 54.8191 %
Full flow Flowrate .... 8.4965 cfs
Full flow velocity .... 6.9236 fps

Critical Information

Critical depth .... 11.0532 in
Critical slope .... 0.0069 ft/ft
Critical velocity .... 5.0319 fps
Critical area 0.9837 ft2
Critical perimeter .... 30.6684 in
Critical hydraulic radius .... 4.6189 in
Critical top width .... 15.0000 in
Specific energy .... 1.4879 ft
Minimum energy .... 1.3817 ft
Froude number 1.7071
Flow condition .... Supercritical

8. DETENTION BASIN CALCULATIONS

TECHNICAL MEMORANDUM:

Peak Flow Analysis of Extreme Events:
5 yr, 10 yr, 25 yr, 50 yr and 100 yr Storms.
Baidee Project, San Diego, CA

Prepared For:

K&S Engineering.

June 26, 2020. Revised: July 19, 2020; August 11, 2020.

Prepared by:

Luis Parra, PhD, CPSWQ, ToR, D.WRE.
R.C.E. 66377

Dr. Luis Parra, PhD, PE, CFM

Telephone: (951) 774-6474

TECHNICAL MEMORANDUM

TO: K&S Engineering

FROM: Luis Parra, PhD, PE, CPSWQ, ToR, D.WRE, CFM.

DATE: June 26, 2020. Revised: August 11, 2020.

RE: Peak Flow Analysis of Extreme Events: 5, 10, 25, 50 and 100 year Storms. Baidee Project, San Diego, CA.

1. INTRODUCTION

The purpose of this report is to establish a comparison between pre and post-development peak flows for the Baidee Project to prove that the proposed development does not increase the 5, 10, 25, 50 and 100 year peak flows after development because the peaks are mitigated below pre-development values via routing of the corresponding hydrographs in the designed BMP facility.

2. CHARACTERISTICS OF THE PROJECT AND ASSUMPTIONS FOR THE MODEL

The Baidee Project is a proposed industrial/commercial development with associated buildings, parking lots and landscape that drains to a single point of discharge along the east boundary.

Prior to draining out, runoff will be captured and routed into a BMP that is composed of 2 portions (see details of the BMP in the SWQMP), and from there runoff is routed and discharged.

The following is a list of the assumptions made to determine the pre and post-development peak flows, and the routing methodology:

- Pre and post-development peak flows will be determined with CIVILCADD/CIVIL DESIGN. Information tied to this program (soil type, elevations, C coefficients, precipitation intensity, etc) are either embedded in the program or added based upon characteristics gathered from other technical reports and for the grading plans. Pre and post-development results from CIVIL DESIGN are included in the appendices.
- From comparison purposes, the peak flow will be analyzed at the 13.44 acre area in pre-development conditions, corresponding to the 12.93 acre in post-development conditions (the 0.51 acre difference corresponds to a small area that cannot drain to the BMP). To establish a fair comparison, the peak flow of the 12.93 acre area will be assigned to the 0.51 acre area in a proportional matter, so that the peak flow of the 0.51 acre can be added into the analysis.
- In order to determine the peak flow after routing a hydrograph needs to be established. The Rick Engineering Rat-Hydro program will be used to define a 6 hr storm hydrograph such that

the peak flow is preserved, the C coefficient is used, the 6 hour rainfall is also used (from NOAA data), and the time of concentration is considered for time interval and hydrograph definition. RAT HYDRO information is included in the appendices (data entry, and results)

- The hydrograph will be then routed using Modified Puls. An elevation vs volume vs discharge tables will be used. That information is gathered from the hydromodification report so that the peak flow, volume and elevation equivalence is identical than the one used for hydromodification compliance. The Elevation vs Volume vs Discharge Table is included in the appendices.
- The initial elevation for routing purposes will be equivalent to invert elevation of the lowest surface outlet. The discharge at the first time interval will not be zero, but defined as a function of the discharge of the LID orifices. In other words, as soon as the routing process starts, the discharge via LID orifice will be included in the analysis so that the released peak flow is not underestimated. Routing result tables prepared with Excel are included in the appendices. The inflow hydrograph for those routing tables is the one defined with RAT Hydro
- Finally, the total peak flow after routing is the combination of the routed peak flow (i.e. the peak of 12.93 acres, routed) plus the proportional peak flow for the remaining 0.51 acres. This peak flow should be less than the pre-development peak flow obtained for the corresponding 13.44 acres analyzed.

3. RESULTS

Table 1 shows the peak flows obtained in pre-development conditions, as well as in post-development conditions before routing. In addition, routed peak flows are included, plus the assigned peak of the remaining 0.51 acre area, as well as the total post-development peak flow. Finally, a change in peak flow (ΔQ) is included, showing that pre – post is always a positive number, implying that pre-development peak flows are higher than post-development peak flows for all storms analyzed.

TABLE 1: PEAK FLOW RESULTS

	Pre peaks	Post-dev. Peak flows				Change
Return Period	$Q_{TOT,PRE}^{(1)}$	$Q_{unrouted}^{(2)}$	$Q_{routed}^{(2)}$	$Q_{remain}^{(3)}$	$Q_{TOT,POST}^{(4)}$	$\Delta Q^{(5)}$
5	15.31	27.46	13.57	1.08	13.75	1.56
10	17.62	31.82	14.41	1.26	14.60	3.02
25	19.13	34.72	16.13	1.37	16.35	2.78
50	21.51	39.25	17.59	1.55	17.85	3.66
100	22.51	41.20	21.65	1.63	21.96	0.55

(1) Pre-dev peak for an area of 13.44 acres

(2) Post-dev peaks for an area of 12.93 acres (before and after the routing calculation)

(3) Post-dev peak for the remaining 0.51 acre

(4) Post-dev. peak for the entire 13.44 acre area. It is not equal to Q_{routed} + Q_{remain} as the peaks are not simultaneous (largest total from adding both hydrographs used). $Q_{TOT,POST} = Q_{routed} + Q_{remain}$ one Δt later, proportional to RatHydro value after peak

(5) Change in peak flow: Pre-dev – Post-dev peak flow.

In addition to the results related to peak flow, results shown in Table 2 are included for the proposed detention basin, with every column defined as follows:

- Existing runoff: It refers to (a) total volume of runoff and (b) peak flow of the runoff of existing conditions for the storm analyzed (6-hr, N-yr Return Period, with N = 5, 10, 25, 50 & 100)
- Proposed runoff: It refers to (a) total volume of runoff and (b) peak flow of the runoff of developed conditions for the storm analyzed (6-hr, N-yr Return Period, with N = 5, 10, 25, 50 & 100)
- Runoff Detained: portion of proposed runoff volume that has been detained which is approximately 96.2% of the total runoff as 96.2% of the contributing area (12.93 acres out of 13.44 acres) contribute to the detention basin.
- Runoff Released: runoff released is equal to runoff detained because no infiltration is considered. Therefore, the inflow hydrograph simply transform and changes shape so that its peak flow is reduced, and its released time is increased, but the volume remains the same (volume only reduces when infiltration / evapotranspiration is considered). For purposes of extreme event routing using Modified Puls, evapotranspiration is not considered because the system is assumed saturated at t = 0 min.
- Basin Volume Required: we are interpreting this value as the maximum volume reached during the routing process at each storm less the initial volume at t=0 (because the basin is full to the invert of the lowest surface outlet). For example, a smaller volume is required for routing a 6 hour - 5 year storm, than for routing a 6 hour - 25 year storm event. The basin Volume Provided is larger than the largest basin volume required because there is always a free-board, even for the largest storm analyzed (6 hour – 100 year).
- Maximum BMP elevation: Maximum elevation the water reaches during the routing (ft)
- Detention Time (min): There are 2 detention times considered: (a) time that passes between the inlet and the outlet peak flow (or the lag between the occurrence of the peak flow in the inflow hydrograph and the peak flow in the outflow hydrograph); and (b) time the entire hydrograph is detained (time it takes for the basin to get empty, or time at which the basin reaches a discharge of 0.01 cfs).

TABLE 2: ROUTING: DETAILED RESULTS

Storm	Existing Runoff		Proposed Runoff		Runoff Retained = Released (ft^3)	Basin Vol Required (ft^3)(1)	Max(2). BMP Elev (ft)	Lag time (min)	Detention time (hours)
	Volume (ft^3)	Peak (cfs)	Volume (ft^3)	Peak (cfs)					
6hr, 5yr	30736	15.31	60106	15.19	57825	12,397	480.54	9	36.3
6hr, 10yr	32273	17.62	63111	16.15	60716	13,587	480.61	9	36.3
6hr, 25yr	38859	19.13	75991	17.87	73107	16,274	480.77	9	36.3
6hr, 50yr	44128	21.51	86295	19.46	83020	18,853	480.92	9	36.2
6hr,100yr	49397	22.51	96599	22.40	92933	21,982	481.10	9	36.2

(1): Volume required for routing (max volume in routing) above the volume of the BMP at the invert of lowest surface outlet (slot) = 29,802 ft^3. Volume provided above invert of slot = 38,454 cu-ft.
(2): Crest elevation of BMP = 482.50. Invert of slot: 479.75.

4. CONCLUSIONS

This report demonstrates that all peak flows analyzed (5 year, 10 year, 25 year, 50 year and 100 year peak flows) will be reduced below pre-development levels by the development due to the design of a BMP that provides water quality, hydromodification and flood control capabilities.

5. APPENDICES

- NOAA Precipitation Values
- CIVILCASS/CIVIL DESIGN Results (Pre & Post Development; 5, 10, 25, 50 & 100 yr Return Periods)
- RatHydro Hydrographs (Post-Development, 5, 10, 25, 50 and 100 Year Return Period)
- Elevation – Volume – Discharge Table
- Modified Puls Routing (Post-Development, 5, 10, 25, 50 and 100 Year Return Period)

NOAA PRECIPITATION DATA

NOAA Atlas 14, Volume 6, Version 2
Location name: San Diego, California, USA*
Latitude: 32.5574°, Longitude: -116.9646°
Elevation: 470.11 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	**0.104** (0.087-0.125)	**0.130** (0.108-0.157)	**0.166** (0.138-0.201)	**0.196** (0.162-0.240)	**0.240** (0.191-0.304)	**0.275** (0.215-0.356)	**0.312** (0.238-0.414)	**0.352** (0.261-0.481)	**0.409** (0.290-0.584)	**0.456** (0.312-0.673)
10-min	**0.149** (0.124-0.179)	**0.186** (0.155-0.225)	**0.237** (0.198-0.288)	**0.281** (0.232-0.344)	**0.344** (0.274-0.435)	**0.394** (0.308-0.510)	**0.448** (0.341-0.594)	**0.505** (0.374-0.690)	**0.587** (0.416-0.837)	**0.653** (0.447-0.965)
15-min	**0.180** (0.150-0.217)	**0.225** (0.188-0.272)	**0.287** (0.239-0.348)	**0.340** (0.281-0.416)	**0.416** (0.332-0.526)	**0.477** (0.372-0.617)	**0.541** (0.412-0.718)	**0.611** (0.452-0.834)	**0.710** (0.503-1.01)	**0.790** (0.540-1.17)
30-min	**0.252** (0.211-0.304)	**0.316** (0.264-0.382)	**0.403** (0.336-0.489)	**0.477** (0.394-0.584)	**0.584** (0.466-0.739)	**0.669** (0.523-0.866)	**0.760** (0.579-1.01)	**0.857** (0.634-1.17)	**0.996** (0.706-1.42)	**1.11** (0.758-1.64)
60-min	**0.349** (0.292-0.421)	**0.437** (0.365-0.528)	**0.557** (0.464-0.676)	**0.660** (0.545-0.808)	**0.807** (0.644-1.02)	**0.926** (0.723-1.20)	**1.05** (0.800-1.40)	**1.19** (0.877-1.62)	**1.38** (0.976-1.96)	**1.53** (1.05-2.27)
2-hr	**0.486** (0.406-0.587)	**0.609** (0.509-0.737)	**0.776** (0.646-0.941)	**0.914** (0.755-1.12)	**1.11** (0.884-1.40)	**1.26** (0.985-1.63)	**1.42** (1.08-1.88)	**1.59** (1.17-2.17)	**1.82** (1.29-2.60)	**2.01** (1.37-2.96)
3-hr	**0.596** (0.498-0.719)	**0.749** (0.625-0.905)	**0.952** (0.793-1.16)	**1.12** (0.926-1.37)	**1.36** (1.08-1.72)	**1.54** (1.20-1.99)	**1.73** (1.31-2.29)	**1.92** (1.42-2.63)	**2.19** (1.56-3.13)	**2.41** (1.65-3.56)
6-hr	**0.778** (0.651-0.940)	**0.981** (0.819-1.19)	**1.25** (1.04-1.51)	**1.47** (1.21-1.80)	**1.77** (1.41-2.24)	**2.01** (1.57-2.59)	**2.25** (1.71-2.98)	**2.50** (1.85-3.41)	**2.84** (2.01-4.04)	**3.11** (2.12-4.59)
12-hr	**0.998** (0.835-1.21)	**1.26** (1.05-1.52)	**1.60** (1.34-1.94)	**1.89** (1.56-2.31)	**2.28** (1.82-2.88)	**2.58** (2.02-3.34)	**2.89** (2.20-3.84)	**3.22** (2.38-4.39)	**3.66** (2.60-5.22)	**4.01** (2.75-5.93)
24-hr	**1.27** (1.11-1.48)	**1.61** (1.40-1.87)	**2.05** (1.79-2.40)	**2.42** (2.10-2.86)	**2.93** (2.46-3.56)	**3.33** (2.75-4.12)	**3.74** (3.02-4.73)	**4.17** (3.28-5.41)	**4.76** (3.61-6.40)	**5.22** (3.84-7.25)
2-day	**1.58** (1.38-1.84)	**2.03** (1.77-2.37)	**2.62** (2.28-3.07)	**3.11** (2.69-3.66)	**3.77** (3.17-4.58)	**4.29** (3.54-5.30)	**4.81** (3.88-6.09)	**5.36** (4.22-6.95)	**6.11** (4.63-8.23)	**6.70** (4.92-9.30)
3-day	**1.76** (1.54-2.06)	**2.29** (2.00-2.67)	**2.97** (2.59-3.48)	**3.53** (3.06-4.17)	**4.30** (3.61-5.22)	**4.89** (4.03-6.05)	**5.49** (4.43-6.94)	**6.11** (4.81-7.92)	**6.95** (5.27-9.36)	**7.61** (5.59-10.6)
4-day	**1.91** (1.67-2.23)	**2.49** (2.18-2.91)	**3.25** (2.84-3.81)	**3.87** (3.35-4.57)	**4.72** (3.96-5.73)	**5.37** (4.43-6.64)	**6.03** (4.86-7.62)	**6.71** (5.28-8.70)	**7.63** (5.78-10.3)	**8.35** (6.13-11.6)
7-day	**2.22** (1.94-2.59)	**2.89** (2.53-3.38)	**3.78** (3.30-4.43)	**4.51** (3.90-5.31)	**5.50** (4.62-6.68)	**6.26** (5.16-7.75)	**7.04** (5.68-8.90)	**7.84** (6.17-10.2)	**8.93** (6.77-12.0)	**9.78** (7.19-13.6)
10-day	**2.42** (2.12-2.83)	**3.16** (2.76-3.69)	**4.14** (3.61-4.84)	**4.93** (4.27-5.81)	**6.01** (5.05-7.30)	**6.84** (5.64-8.47)	**7.69** (6.21-9.73)	**8.57** (6.74-11.1)	**9.76** (7.40-13.1)	**10.7** (7.85-14.8)
20-day	**2.93** (2.57-3.42)	**3.86** (3.37-4.50)	**5.05** (4.41-5.92)	**6.02** (5.21-7.10)	**7.32** (6.15-8.89)	**8.31** (6.85-10.3)	**9.31** (7.51-11.8)	**10.3** (8.13-13.4)	**11.7** (8.87-15.7)	**12.8** (9.37-17.7)
30-day	**3.52** (3.08-4.11)	**4.65** (4.06-5.43)	**6.09** (5.31-7.13)	**7.24** (6.27-8.54)	**8.77** (7.37-10.7)	**9.92** (8.18-12.3)	**11.1** (8.94-14.0)	**12.2** (9.63-15.9)	**13.8** (10.4-18.6)	**15.0** (11.0-20.8)
45-day	**4.14** (3.62-4.83)	**5.47** (4.78-6.38)	**7.14** (6.23-8.36)	**8.46** (7.32-9.98)	**10.2** (8.56-12.4)	**11.5** (9.46-14.2)	**12.7** (10.3-16.1)	**14.0** (11.0-18.2)	**15.7** (11.9-21.1)	**16.9** (12.4-23.5)
60-day	**4.83** (4.23-5.63)	**6.36** (5.56-7.43)	**8.28** (7.21-9.69)	**9.77** (8.45-11.5)	**11.7** (9.83-14.2)	**13.1** (10.8-16.2)	**14.5** (11.7-18.3)	**15.9** (12.5-20.6)	**17.6** (13.4-23.7)	**18.9** (13.9-26.3)

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

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

Please refer to NOAA Atlas 14 document for more information.

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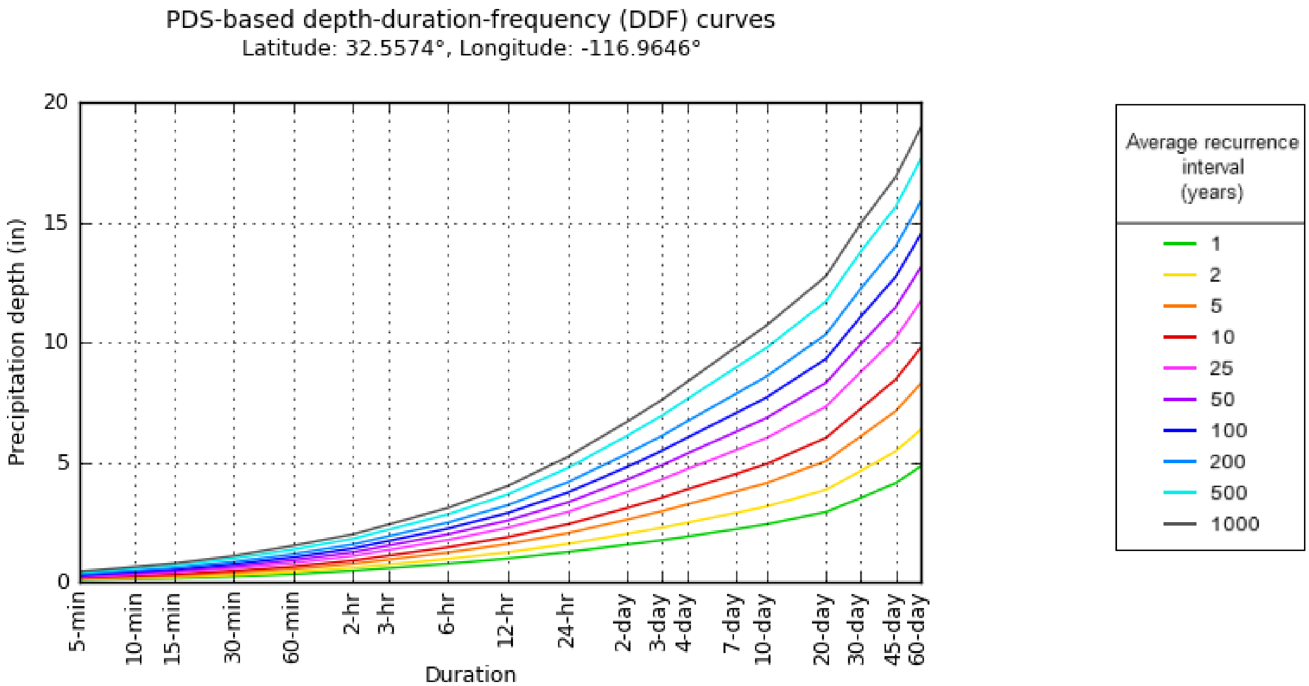
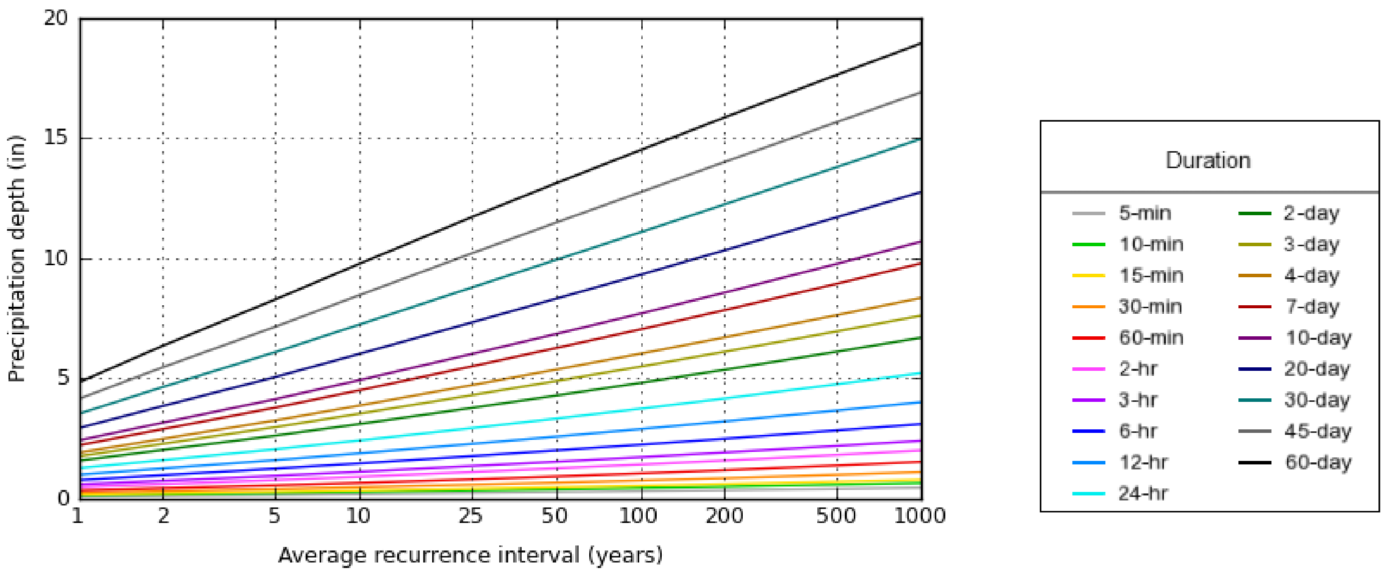
PF graphical





NOAA Atlas 14, Volume 6, Version 2

Created (GMT): Mon May 18 18:40:52 2020

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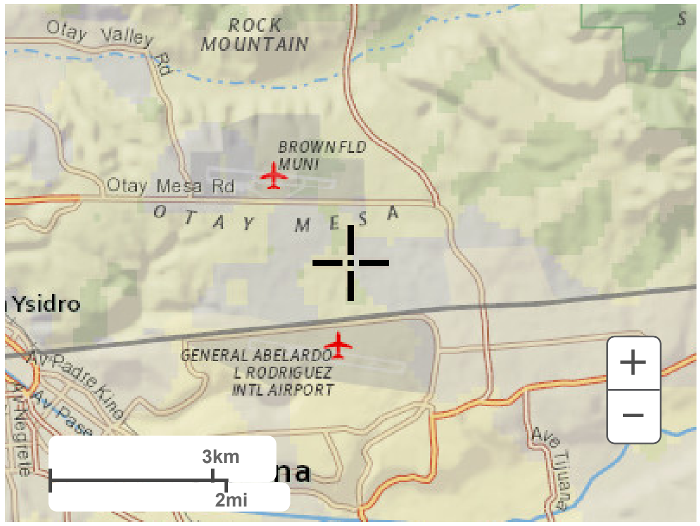
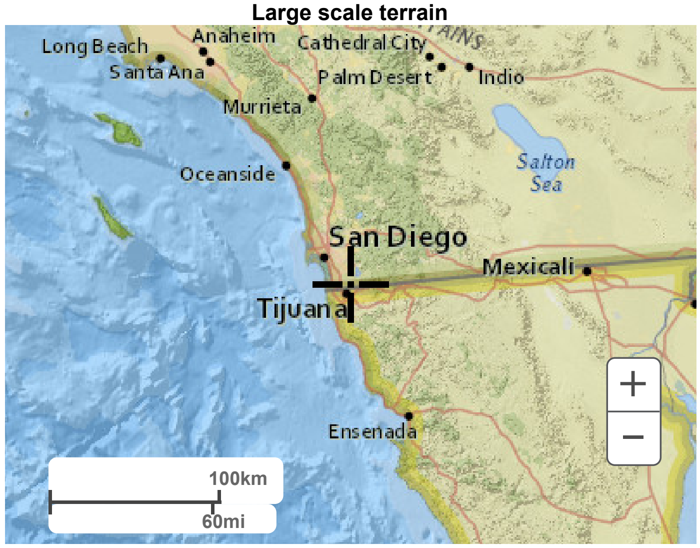
Maps & aerials

Small scale terrain

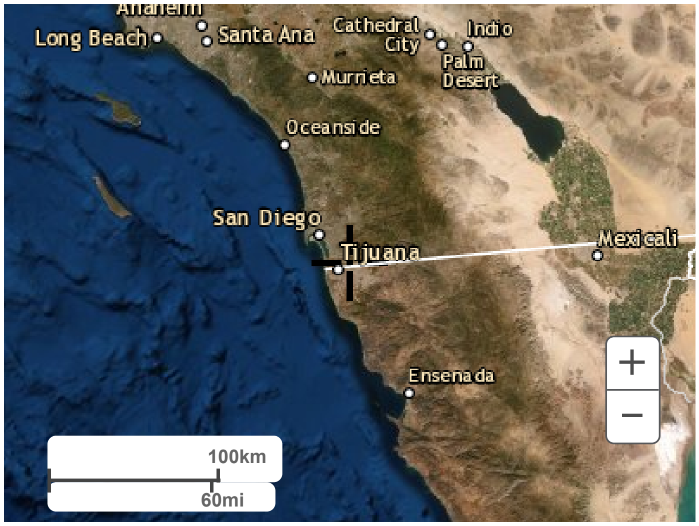


Large scale terrain



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

CIVILCADD / CIVIL DESIGN PEAK CALCULATIONS:

5 Year, Pre-Development Conditions

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 6.5

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/17/20

********* Hydrology Study Control Information **********

Program License Serial Number 6303

Rational hydrology study storm event year is 5.0
English (in-lb) input data Units used
English (in) rainfall data used

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity) = 1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++
Process from Point/Station 1.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

____
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Rainfall intensity (I) = 3.149(In/Hr) for a 5.0 year storm
User specified values are as follows:
TC = 5.00 min. Rain intensity = 3.15(In/Hr)
Total area = 7.570(Ac.) Total runoff = 23.880(CFS)

++
Process from Point/Station 1.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****

____
Along Main Stream number: 1 in normal stream number 1
Stream flow area = 7.570(Ac.)
Runoff from this stream = 23.880(CFS)
Time of concentration = 5.00 min.
Rainfall intensity = 3.149(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	23.880	5.00	3.149

Qmax(1) =
1.000 * 1.000 * 23.880) + = 23.880

Total of 1 streams to confluence:
Flow rates before confluence point:
23.880
Maximum flow rates at confluence using above data:
23.880
Area of streams before confluence:
7.570
Results of confluence:
Total flow rate = 23.880(CFS)
Time of concentration = 5.000 min.
Effective stream area after confluence = 7.570(Ac.)

++
Process from Point/Station 3.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

____
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Rainfall intensity (I) = 3.149(In/Hr) for a 5.0 year storm
User specified values are as follows:
TC = 5.00 min. Rain intensity = 3.15(In/Hr)
Total area = 16.520(Ac.) Total runoff = 21.630(CFS)

++
Process from Point/Station 3.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****

____
Along Main Stream number: 1 in normal stream number 2
Stream flow area = 16.520(Ac.)
Runoff from this stream = 21.630(CFS)
Time of concentration = 5.00 min.
Rainfall intensity = 3.149(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	23.880	5.00	3.149
2	21.630	5.00	3.149

Qmax(1) =
1.000 * 1.000 * 23.880) +
1.000 * 1.000 * 21.630) + = 45.510
Qmax(2) =
1.000 * 1.000 * 23.880) +
1.000 * 1.000 * 21.630) + = 45.510

Total of 2 streams to confluence:
Flow rates before confluence point:
23.880 21.630
Maximum flow rates at confluence using above data:
45.510 45.510

Area of streams before confluence:
7.570 16.520
Results of confluence:
Total flow rate = 45.510(CFS)
Time of concentration = 5.000 min.
Effective stream area after confluence = 24.090(Ac.)

++
Process from Point/Station 3.000 to Point/Station 50.000
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 481.200(Ft.)
Downstream point elevation = 474.600(Ft.)
Channel length thru subarea = 475.000(Ft.)
Channel base width = 0.000(Ft.)
Slope or 'Z' of left channel bank = 80.000
Slope or 'Z' of right channel bank = 80.000
Estimated mean flow rate at midpoint of channel = 58.205(CFS)
Manning's 'N' = 0.023
Maximum depth of channel = 0.500(Ft.)
Flow(q) thru subarea = 58.205(CFS)
Depth of flow = 0.493(Ft.), Average velocity = 2.994(Ft/s)
Channel flow top width = 78.876(Ft.)
Flow Velocity = 2.99(Ft/s)
Travel time = 2.64 min.
Time of concentration = 7.64 min.
Critical depth = 0.504(Ft.)
Adding area flow to channel
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[RURAL(greater than 0.5 Ac, 0.2 ha) area type]
Rainfall intensity = 2.532(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.450
Subarea runoff = 15.312(CFS) for 13.440(Ac.)
Total runoff = 60.822(CFS) Total area = 37.53(Ac.)
End of computations, total study area = 37.530 (Ac.)

CIVILCADD / CIVIL DESIGN PEAK CALCULATIONS:

10 Year, Pre-Development Conditions

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 6.5

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/17/20

********* Hydrology Study Control Information **********

Program License Serial Number 6303

Rational hydrology study storm event year is 10.0
English (in-lb) input data Units used
English (in) rainfall data used

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity) = 1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++
Process from Point/Station 1.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
____
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Rainfall intensity (I) = 3.592(In/Hr) for a 10.0 year storm
User specified values are as follows:
TC = 5.00 min. Rain intensity = 3.59(In/Hr)
Total area = 7.570(Ac.) Total runoff = 23.880(CFS)

++
Process from Point/Station 1.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****
____
Along Main Stream number: 1 in normal stream number 1
Stream flow area = 7.570(Ac.)
Runoff from this stream = 23.880(CFS)
Time of concentration = 5.00 min.
Rainfall intensity = 3.592(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	23.880	5.00	3.592

Qmax(1) =
1.000 * 1.000 * 23.880) + = 23.880

Total of 1 streams to confluence:
Flow rates before confluence point:
23.880
Maximum flow rates at confluence using above data:
23.880
Area of streams before confluence:
7.570
Results of confluence:
Total flow rate = 23.880(CFS)
Time of concentration = 5.000 min.
Effective stream area after confluence = 7.570(Ac.)

++
Process from Point/Station 3.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Rainfall intensity (I) = 3.592(In/Hr) for a 10.0 year storm
User specified values are as follows:
TC = 5.00 min. Rain intensity = 3.59(In/Hr)
Total area = 16.520(Ac.) Total runoff = 21.630(CFS)

++
Process from Point/Station 3.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 16.520(Ac.)
Runoff from this stream = 21.630(CFS)
Time of concentration = 5.00 min.
Rainfall intensity = 3.592(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	23.880	5.00	3.592
2	21.630	5.00	3.592

Qmax(1) =
1.000 * 1.000 * 23.880) +
1.000 * 1.000 * 21.630) + = 45.510
Qmax(2) =
1.000 * 1.000 * 23.880) +
1.000 * 1.000 * 21.630) + = 45.510

Total of 2 streams to confluence:
Flow rates before confluence point:
23.880 21.630
Maximum flow rates at confluence using above data:
45.510 45.510

Area of streams before confluence:
7.570 16.520
Results of confluence:
Total flow rate = 45.510(CFS)
Time of concentration = 5.000 min.
Effective stream area after confluence = 24.090(Ac.)

++
Process from Point/Station 3.000 to Point/Station 50.000
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 481.200(Ft.)
Downstream point elevation = 474.600(Ft.)
Channel length thru subarea = 475.000(Ft.)
Channel base width = 0.000(Ft.)
Slope or 'Z' of left channel bank = 80.000
Slope or 'Z' of right channel bank = 80.000
Estimated mean flow rate at midpoint of channel = 58.205(CFS)
Manning's 'N' = 0.023
Maximum depth of channel = 0.500(Ft.)
Flow(q) thru subarea = 58.205(CFS)
Depth of flow = 0.493(Ft.), Average velocity = 2.994(Ft/s)
Channel flow top width = 78.876(Ft.)
Flow Velocity = 2.99(Ft/s)
Travel time = 2.64 min.
Time of concentration = 7.64 min.
Critical depth = 0.504(Ft.)
Adding area flow to channel
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[RURAL(greater than 0.5 Ac, 0.2 ha) area type]
Rainfall intensity = 2.913(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.450
Subarea runoff = 17.620(CFS) for 13.440(Ac.)
Total runoff = 63.130(CFS) Total area = 37.53(Ac.)
End of computations, total study area = 37.530 (Ac.)

CIVILCADD / CIVIL DESIGN PEAK CALCULATIONS:

25 Year, Pre-Development Conditions

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 6.5

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/17/20

********* Hydrology Study Control Information **********

Program License Serial Number 6303

Rational hydrology study storm event year is 25.0
English (in-lb) input data Units used
English (in) rainfall data used

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity) = 1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++
Process from Point/Station 1.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
____
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Rainfall intensity (I) = 3.845(In/Hr) for a 25.0 year storm
User specified values are as follows:
TC = 5.00 min. Rain intensity = 3.85(In/Hr)
Total area = 7.570(Ac.) Total runoff = 23.880(CFS)

++
Process from Point/Station 1.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****
____
Along Main Stream number: 1 in normal stream number 1
Stream flow area = 7.570(Ac.)
Runoff from this stream = 23.880(CFS)
Time of concentration = 5.00 min.
Rainfall intensity = 3.845(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	23.880	5.00	3.845

Qmax(1) =
1.000 * 1.000 * 23.880) + = 23.880

Total of 1 streams to confluence:
Flow rates before confluence point:
23.880
Maximum flow rates at confluence using above data:
23.880
Area of streams before confluence:
7.570
Results of confluence:
Total flow rate = 23.880(CFS)
Time of concentration = 5.000 min.
Effective stream area after confluence = 7.570(Ac.)

++
Process from Point/Station 3.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
____
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Rainfall intensity (I) = 3.845(In/Hr) for a 25.0 year storm
User specified values are as follows:
TC = 5.00 min. Rain intensity = 3.85(In/Hr)
Total area = 16.520(Ac.) Total runoff = 21.630(CFS)

++
Process from Point/Station 3.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****
____
Along Main Stream number: 1 in normal stream number 2
Stream flow area = 16.520(Ac.)
Runoff from this stream = 21.630(CFS)
Time of concentration = 5.00 min.
Rainfall intensity = 3.845(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	23.880	5.00	3.845
2	21.630	5.00	3.845

Qmax(1) =
1.000 * 1.000 * 23.880) +
1.000 * 1.000 * 21.630) + = 45.510
Qmax(2) =
1.000 * 1.000 * 23.880) +
1.000 * 1.000 * 21.630) + = 45.510

Total of 2 streams to confluence:
Flow rates before confluence point:
23.880 21.630
Maximum flow rates at confluence using above data:
45.510 45.510

Area of streams before confluence:
7.570 16.520
Results of confluence:
Total flow rate = 45.510(CFS)
Time of concentration = 5.000 min.
Effective stream area after confluence = 24.090(Ac.)

++
Process from Point/Station 3.000 to Point/Station 50.000
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 481.200(Ft.)
Downstream point elevation = 474.600(Ft.)
Channel length thru subarea = 475.000(Ft.)
Channel base width = 0.000(Ft.)
Slope or 'Z' of left channel bank = 80.000
Slope or 'Z' of right channel bank = 80.000
Estimated mean flow rate at midpoint of channel = 58.205(CFS)
Manning's 'N' = 0.023
Maximum depth of channel = 0.500(Ft.)
Flow(q) thru subarea = 58.205(CFS)
Depth of flow = 0.493(Ft.), Average velocity = 2.994(Ft/s)
Channel flow top width = 78.876(Ft.)
Flow Velocity = 2.99(Ft/s)
Travel time = 2.64 min.
Time of concentration = 7.64 min.
Critical depth = 0.504(Ft.)
Adding area flow to channel
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[RURAL(greater than 0.5 Ac, 0.2 ha) area type]
Rainfall intensity = 3.163(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.450
Subarea runoff = 19.131(CFS) for 13.440(Ac.)
Total runoff = 64.641(CFS) Total area = 37.53(Ac.)
End of computations, total study area = 37.530 (Ac.)

CIVILCADD / CIVIL DESIGN PEAK CALCULATIONS:

50 Year, Pre-Development Conditions

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 6.5

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/17/20

********* Hydrology Study Control Information **********

Program License Serial Number 6303

Rational hydrology study storm event year is 50.0
English (in-lb) input data Units used
English (in) rainfall data used

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity) = 1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++
Process from Point/Station 1.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
____
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Rainfall intensity (I) = 4.265(In/Hr) for a 50.0 year storm
User specified values are as follows:
TC = 5.00 min. Rain intensity = 4.27(In/Hr)
Total area = 7.570(Ac.) Total runoff = 23.880(CFS)

++
Process from Point/Station 1.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****
____
Along Main Stream number: 1 in normal stream number 1
Stream flow area = 7.570(Ac.)
Runoff from this stream = 23.880(CFS)
Time of concentration = 5.00 min.
Rainfall intensity = 4.265(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	23.880	5.00	4.265

Qmax(1) =
1.000 * 1.000 * 23.880) + = 23.880

Total of 1 streams to confluence:
Flow rates before confluence point:
23.880
Maximum flow rates at confluence using above data:
23.880
Area of streams before confluence:
7.570
Results of confluence:
Total flow rate = 23.880(CFS)
Time of concentration = 5.000 min.
Effective stream area after confluence = 7.570(Ac.)

++
Process from Point/Station 3.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Rainfall intensity (I) = 4.265(In/Hr) for a 50.0 year storm
User specified values are as follows:
TC = 5.00 min. Rain intensity = 4.27(In/Hr)
Total area = 16.520(Ac.) Total runoff = 21.630(CFS)

++
Process from Point/Station 3.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 16.520(Ac.)
Runoff from this stream = 21.630(CFS)
Time of concentration = 5.00 min.
Rainfall intensity = 4.265(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	23.880	5.00	4.265
2	21.630	5.00	4.265

Qmax(1) =
1.000 * 1.000 * 23.880) +
1.000 * 1.000 * 21.630) + = 45.510
Qmax(2) =
1.000 * 1.000 * 23.880) +
1.000 * 1.000 * 21.630) + = 45.510

Total of 2 streams to confluence:
Flow rates before confluence point:
23.880 21.630
Maximum flow rates at confluence using above data:
45.510 45.510

Area of streams before confluence:
7.570 16.520
Results of confluence:
Total flow rate = 45.510(CFS)
Time of concentration = 5.000 min.
Effective stream area after confluence = 24.090(Ac.)

++
Process from Point/Station 3.000 to Point/Station 50.000
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 481.200(Ft.)
Downstream point elevation = 474.600(Ft.)
Channel length thru subarea = 475.000(Ft.)
Channel base width = 0.000(Ft.)
Slope or 'Z' of left channel bank = 80.000
Slope or 'Z' of right channel bank = 80.000
Estimated mean flow rate at midpoint of channel = 58.205(CFS)
Manning's 'N' = 0.023
Maximum depth of channel = 0.500(Ft.)
Flow(q) thru subarea = 58.205(CFS)
Depth of flow = 0.493(Ft.), Average velocity = 2.994(Ft/s)
Channel flow top width = 78.876(Ft.)
Flow Velocity = 2.99(Ft/s)
Travel time = 2.64 min.
Time of concentration = 7.64 min.
Critical depth = 0.504(Ft.)
Adding area flow to channel
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[RURAL(greater than 0.5 Ac, 0.2 ha) area type]
Rainfall intensity = 3.557(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.450
Subarea runoff = 21.511(CFS) for 13.440(Ac.)
Total runoff = 67.021(CFS) Total area = 37.53(Ac.)
End of computations, total study area = 37.530 (Ac.)

CIVILCADD / CIVIL DESIGN PEAK CALCULATIONS:

100 Year, Pre-Development Conditions

EXISTING 100 YEAR HYDROLOGY

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San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 6.4

Rational method hydrology  program based on
San Diego County Flood Control Division 1985 hydrology manual
      Rational Hydrology Study        Date: 07/18/20
------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

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


Program License Serial Number 4035

------------------------------------------------------------------------
Rational hydrology study storm event year is   100.0
English (in-lb) input data Units used
English (in) rainfall data used

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity)  =  1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       1.000 to Point/Station       2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
______________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type                     ]
Rainfall intensity (I) =      4.389(In/Hr) for a   100.0 year storm
User specified values are as follows:
TC =   5.00 min.  Rain intensity =      4.39(In/Hr)
Total area =        7.570(Ac.)  Total runoff =    23.880(CFS)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       1.000 to Point/Station       2.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      7.570(Ac.)
Runoff from this stream =     23.880(CFS)
Time of concentration =    5.00 min.
Rainfall intensity =     4.389(In/Hr)
Summary of stream data:

Stream   Flow rate      TC            Rainfall Intensity
 No.       (CFS)      (min)                 (In/Hr)


1       23.880      5.00            4.389
Qmax(1) =
         1.000 *    1.000 *    23.880) + =      23.880

Total of 1 streams to confluence:
Flow rates before confluence point:
      23.880
```

```
Maximum flow rates at confluence using above data:
       23.880
Area of streams before confluence:
        7.570
Results of confluence:
Total flow rate =     23.880(CFS)
Time of concentration =     5.000 min.
Effective stream area after confluence =      7.570(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       3.000 to Point/Station       2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
______________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type                        ]
Rainfall intensity (I) =      4.389(In/Hr) for a   100.0 year storm
User specified values are as follows:
TC =   5.00 min.  Rain intensity =       4.39(In/Hr)
Total area =       16.520(Ac.)  Total runoff =    21.630(CFS)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       3.000 to Point/Station       2.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =     16.520(Ac.)
Runoff from this stream =     21.630(CFS)
Time of concentration =    5.00 min.
Rainfall intensity =     4.389(In/Hr)
Summary of stream data:

Stream   Flow rate      TC            Rainfall Intensity
 No.       (CFS)       (min)                 (In/Hr)


1       23.880      5.00            4.389
2       21.630      5.00            4.389
Qmax(1) =
          1.000 *    1.000 *    23.880) +
          1.000 *    1.000 *    21.630) + =      45.510
Qmax(2) =
          1.000 *    1.000 *    23.880) +
          1.000 *    1.000 *    21.630) + =      45.510

Total of 2 streams to confluence:
Flow rates before confluence point:
      23.880      21.630
Maximum flow rates at confluence using above data:
       45.510       45.510
Area of streams before confluence:
        7.570       16.520
Results of confluence:
Total flow rate =     45.510(CFS)
Time of concentration =     5.000 min.
Effective stream area after confluence =     24.090(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       3.000 to Point/Station      50.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =   481.200(Ft.)
```

```
Downstream point elevation =   474.600(Ft.)
Channel length thru subarea  =   475.000(Ft.)
Channel base width  =    0.000(Ft.)
Slope or 'Z' of left channel bank =  80.000
Slope or 'Z' of right channel bank =  80.000
Estimated mean flow rate at midpoint of channel =     58.205(CFS)
Manning's 'N'    = 0.023
Maximum depth of channel  =    0.500(Ft.)
Flow(q) thru subarea =     58.205(CFS)
Depth of flow =   0.493(Ft.), Average velocity =   2.994(Ft/s)
Channel flow top width =   78.876(Ft.)
Flow Velocity =    2.99(Ft/s)
Travel time  =    2.64 min.
Time of concentration =    7.64 min.
Critical depth =      0.504(Ft.)
 Adding area flow to channel
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[RURAL(greater than 0.5 Ac, 0.2 ha) area type]
Rainfall intensity =      3.722(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.450
Subarea runoff =     22.509(CFS) for   13.440(Ac.)
Total runoff =     68.019(CFS)   Total area =       37.53(Ac.)
End of computations, total study area =          37.530 (Ac.)
```

CIVILCADD / CIVIL DESIGN PEAK CALCULATIONS:

5 Year, Post-Development Conditions

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 6.5

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/17/20

********* Hydrology Study Control Information **********

Program License Serial Number 6303

Rational hydrology study storm event year is 5.0
English (in-lb) input data Units used
English (in) rainfall data used

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity) = 1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++
Process from Point/Station 1.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Rainfall intensity (I) = 1.829(In/Hr) for a 5.0 year storm
User specified values are as follows:
TC = 14.78 min. Rain intensity = 1.83(In/Hr)
Total area = 7.570(Ac.) Total runoff = 23.880(CFS)

++
Process from Point/Station 1.000 to Point/Station 2.000
**** SUBAREA FLOW ADDITION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Time of concentration = 14.78 min.
Rainfall intensity = 1.829(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff = 0.208(CFS) for 0.120(Ac.)
Total runoff = 24.088(CFS) Total area = 7.69(Ac.)

++
Process from Point/Station 1.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 7.690(Ac.)
Runoff from this stream = 24.088(CFS)
Time of concentration = 14.78 min.
Rainfall intensity = 1.829(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	24.088	14.78	1.829

Qmax(1) =
1.000 * 1.000 * 24.088) + = 24.088

Total of 1 streams to confluence:
Flow rates before confluence point:
24.088
Maximum flow rates at confluence using above data:
24.088
Area of streams before confluence:
7.690
Results of confluence:
Total flow rate = 24.088(CFS)
Time of concentration = 14.780 min.
Effective stream area after confluence = 7.690(Ac.)

++
Process from Point/Station 3.000 to Point/Station 4.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Rainfall intensity (I) = 1.829(In/Hr) for a 5.0 year storm
User specified values are as follows:
TC = 14.78 min. Rain intensity = 1.83(In/Hr)
Total area = 16.520(Ac.) Total runoff = 21.630(CFS)

++
Process from Point/Station 3.000 to Point/Station 4.000
**** SUBAREA FLOW ADDITION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Time of concentration = 14.78 min.
Rainfall intensity = 1.829(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff = 0.261(CFS) for 0.150(Ac.)

Total runoff = 21.891(CFS) Total area = 16.67(Ac.)

++
Process from Point/Station 4.000 to Point/Station 2.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 481.280(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 458.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 21.891(CFS)
Given pipe size = 24.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
2.912(Ft.) at the headworks or inlet of the pipe(s)
Pipe friction loss = 4.287(Ft.)
Minor friction loss = 0.905(Ft.) K-factor = 1.20
Pipe flow velocity = 6.97(Ft/s)
Travel time through pipe = 1.10 min.
Time of concentration (TC) = 15.88 min.

++
Process from Point/Station 4.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 16.670(Ac.)
Runoff from this stream = 21.891(CFS)
Time of concentration = 15.88 min.
Rainfall intensity = 1.765(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	24.088	14.78	1.829
2	21.891	15.88	1.765

Qmax(1) =
1.000 * 1.000 * 24.088) +
1.000 * 0.931 * 21.891) + = 44.469
Qmax(2) =
0.965 * 1.000 * 24.088) +
1.000 * 1.000 * 21.891) + = 45.135

Total of 2 streams to confluence:
Flow rates before confluence point:
24.088 21.891
Maximum flow rates at confluence using above data:
44.469 45.135
Area of streams before confluence:
7.690 16.670
Results of confluence:
Total flow rate = 45.135(CFS)
Time of concentration = 15.875 min.
Effective stream area after confluence = 24.360(Ac.)

++

Process from Point/Station 2.000 to Point/Station 5.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 478.200(Ft.)
Downstream point/station elevation = 476.260(Ft.)
Pipe length = 283.00(Ft.) Manning's N = 0.013
No. of pipes = 3 Required pipe flow = 45.135(CFS)
Given pipe size = 24.00(In.)
Calculated individual pipe flow = 15.045(CFS)
Normal flow depth in pipe = 16.29(In.)
Flow top width inside pipe = 22.41(In.)
Critical Depth = 16.78(In.)
Pipe flow velocity = 6.63(Ft/s)
Travel time through pipe = 0.71 min.
Time of concentration (TC) = 16.59 min.

++
Process from Point/Station 5.000 to Point/Station 6.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 476.260(Ft.)
Downstream point/station elevation = 475.150(Ft.)
Pipe length = 221.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 45.135(CFS)
Given pipe size = 36.00(In.)
Calculated individual pipe flow = 45.135(CFS)
Normal flow depth in pipe = 28.13(In.)
Flow top width inside pipe = 29.76(In.)
Critical Depth = 26.24(In.)
Pipe flow velocity = 7.61(Ft/s)
Travel time through pipe = 0.48 min.
Time of concentration (TC) = 17.07 min.

++
Process from Point/Station 6.000 to Point/Station 50.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 475.150(Ft.)
Downstream point/station elevation = 475.000(Ft.)
Pipe length = 29.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 45.135(CFS)
Given pipe size = 36.00(In.)
Calculated individual pipe flow = 45.135(CFS)
Normal flow depth in pipe = 27.75(In.)
Flow top width inside pipe = 30.26(In.)
Critical Depth = 26.24(In.)
Pipe flow velocity = 7.72(Ft/s)
Travel time through pipe = 0.06 min.
Time of concentration (TC) = 17.13 min.

++
Process from Point/Station 7.000 to Point/Station 8.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 98.000(Ft.)
Highest elevation = 484.700(Ft.)

Lowest elevation = 484.350(Ft.)
Elevation difference = 0.350(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 5.53 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(98.000^.5)/(0.357^(1/3)]= 5.53
Rainfall intensity (I) = 2.989(In/Hr) for a 5.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.605(CFS)
Total initial stream area = 0.230(Ac.)

++
Process from Point/Station 8.000 to Point/Station 9.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
____
Upstream point/station elevation = 482.350(Ft.)
Downstream point/station elevation = 481.270(Ft.)
Pipe length = 208.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 0.605(CFS)
Given pipe size = 10.00(In.)
Calculated individual pipe flow = 0.605(CFS)
Normal flow depth in pipe = 4.29(In.)
Flow top width inside pipe = 9.90(In.)
Critical Depth = 4.09(In.)
Pipe flow velocity = 2.70(Ft/s)
Travel time through pipe = 1.28 min.
Time of concentration (TC) = 6.81 min.

++
Process from Point/Station 8.000 to Point/Station 9.000
**** SUBAREA FLOW ADDITION ****
____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 6.81 min.
Rainfall intensity = 2.684(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 2.031(CFS) for 0.860(Ac.)
Total runoff = 2.636(CFS) Total area = 1.09(Ac.)

++
Process from Point/Station 9.000 to Point/Station 10.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
____
Upstream point/station elevation = 481.270(Ft.)
Downstream point/station elevation = 480.310(Ft.)
Pipe length = 193.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 2.636(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 2.636(CFS)
Normal flow depth in pipe = 8.19(In.)
Flow top width inside pipe = 14.94(In.)
Critical Depth = 7.82(In.)
Pipe flow velocity = 3.85(Ft/s)
Travel time through pipe = 0.84 min.
Time of concentration (TC) = 7.64 min.

++
Process from Point/Station 10.000 to Point/Station 11.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 480.310(Ft.)
Downstream point/station elevation = 479.340(Ft.)
Pipe length = 194.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 2.636(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 2.636(CFS)
Normal flow depth in pipe = 8.18(In.)
Flow top width inside pipe = 14.94(In.)
Critical Depth = 7.82(In.)
Pipe flow velocity = 3.86(Ft/s)
Travel time through pipe = 0.84 min.
Time of concentration (TC) = 8.48 min.

++
Process from Point/Station 11.000 to Point/Station 12.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 479.340(Ft.)
Downstream point/station elevation = 479.120(Ft.)
Pipe length = 45.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 2.636(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 2.636(CFS)
Normal flow depth in pipe = 8.23(In.)
Flow top width inside pipe = 14.93(In.)
Critical Depth = 7.82(In.)
Pipe flow velocity = 3.82(Ft/s)
Travel time through pipe = 0.20 min.
Time of concentration (TC) = 8.68 min.

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.68 min.
Rainfall intensity = 2.376(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.276(CFS) for 0.610(Ac.)
Total runoff = 3.912(CFS) Total area = 1.70(Ac.)

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.68 min.
Rainfall intensity = 2.376(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.167(CFS) for 0.080(Ac.)
Total runoff = 4.079(CFS) Total area = 1.78(Ac.)

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.68 min.
Rainfall intensity = 2.376(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.042(CFS) for 0.020(Ac.)
Total runoff = 4.121(CFS) Total area = 1.80(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 479.120(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 25.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 4.121(CFS)
Given pipe size = 18.00(In.)
Calculated individual pipe flow = 4.121(CFS)
Normal flow depth in pipe = 9.69(In.)
Flow top width inside pipe = 17.95(In.)
Critical Depth = 9.32(In.)
Pipe flow velocity = 4.24(Ft/s)
Travel time through pipe = 0.10 min.
Time of concentration (TC) = 8.78 min.

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.78 min.
Rainfall intensity = 2.363(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 3.494(CFS) for 1.680(Ac.)
Total runoff = 7.615(CFS) Total area = 3.48(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.78 min.
Rainfall intensity = 2.363(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 3.931(CFS) for 1.890(Ac.)
Total runoff = 11.546(CFS) Total area = 5.37(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.78 min.

Rainfall intensity = 2.363(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 4.388(CFS) for 2.110(Ac.)
Total runoff = 15.934(CFS) Total area = 7.48(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.78 min.
Rainfall intensity = 2.363(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 3.431(CFS) for 1.650(Ac.)
Total runoff = 19.365(CFS) Total area = 9.13(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.78 min.
Rainfall intensity = 2.363(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 3.099(CFS) for 1.490(Ac.)
Total runoff = 22.464(CFS) Total area = 10.62(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.78 min.
Rainfall intensity = 2.363(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.373(CFS) for 0.660(Ac.)
Total runoff = 23.837(CFS) Total area = 11.28(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area = 11.280(Ac.)
Runoff from this stream = 23.837(CFS)
Time of concentration = 8.78 min.
Rainfall intensity = 2.363(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	23.837	8.78	2.363

Qmax(1) =

1.000 * 1.000 * 23.837) + = 23.837

Total of 1 main streams to confluence:
Flow rates before confluence point:
23.837
Maximum flow rates at confluence using above data:
23.837
Area of streams before confluence:
11.280

Results of confluence:
Total flow rate = 23.837(CFS)
Time of concentration = 8.777 min.
Effective stream area after confluence = 11.280(Ac.)

++
Process from Point/Station 7.000 to Point/Station 15.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 100.000(Ft.)
Highest elevation = 484.700(Ft.)
Lowest elevation = 484.200(Ft.)
Elevation difference = 0.500(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 4.99 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(100.000^.5)/(0.500^(1/3)]= 4.99
Setting time of concentration to 5 minutes
Rainfall intensity (I) = 3.149(In/Hr) for a 5.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.637(CFS)
Total initial stream area = 0.230(Ac.)

++
Process from Point/Station 15.000 to Point/Station 16.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 482.250(Ft.)
Downstream point/station elevation = 481.100(Ft.)
Pipe length = 233.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 0.637(CFS)
Given pipe size = 10.00(In.)
Calculated individual pipe flow = 0.637(CFS)
Normal flow depth in pipe = 4.49(In.)
Flow top width inside pipe = 9.95(In.)
Critical Depth = 4.21(In.)
Pipe flow velocity = 2.69(Ft/s)
Travel time through pipe = 1.44 min.
Time of concentration (TC) = 6.44 min.

++
Process from Point/Station 15.000 to Point/Station 16.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea

Time of concentration = 6.44 min.
Rainfall intensity = 2.761(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.802(CFS) for 0.330(Ac.)
Total runoff = 1.439(CFS) Total area = 0.56(Ac.)

++
Process from Point/Station 16.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

____

Upstream point/station elevation = 481.100(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 416.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 1.439(CFS)
Given pipe size = 12.00(In.)
Calculated individual pipe flow = 1.439(CFS)
Normal flow depth in pipe = 6.48(In.)
Flow top width inside pipe = 11.96(In.)
Critical Depth = 6.10(In.)
Pipe flow velocity = 3.33(Ft/s)
Travel time through pipe = 2.08 min.
Time of concentration (TC) = 8.53 min.

++
Process from Point/Station 16.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****

____

The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area = 0.560(Ac.)
Runoff from this stream = 1.439(CFS)
Time of concentration = 8.53 min.
Rainfall intensity = 2.397(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	23.837	8.78	2.363
2	1.439	8.53	2.397

Qmax(1) =
1.000 * 1.000 * 23.837) +
0.986 * 1.000 * 1.439) + = 25.255
Qmax(2) =
1.000 * 0.972 * 23.837) +
1.000 * 1.000 * 1.439) + = 24.600

Total of 2 main streams to confluence:
Flow rates before confluence point:
23.837 1.439
Maximum flow rates at confluence using above data:
25.255 24.600
Area of streams before confluence:
11.280 0.560

Results of confluence:

Total flow rate = 25.255(CFS)
Time of concentration = 8.777 min.
Effective stream area after confluence = 11.840(Ac.)

++
Process from Point/Station 18.000 to Point/Station 19.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 128.000(Ft.)
Highest elevation = 484.850(Ft.)
Lowest elevation = 484.200(Ft.)
Elevation difference = 0.650(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 5.62 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(128.000^.5)/(0.508^(1/3)]= 5.62
Rainfall intensity (I) = 2.964(In/Hr) for a 5.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.391(CFS)
Total initial stream area = 0.150(Ac.)

++
Process from Point/Station 19.000 to Point/Station 20.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 482.400(Ft.)
Downstream point/station elevation = 481.150(Ft.)
Pipe length = 250.00(Ft.) Manning's N = 0.013
No. of pipes = 2 Required pipe flow = 0.391(CFS)
Given pipe size = 6.00(In.)
Calculated individual pipe flow = 0.196(CFS)
Normal flow depth in pipe = 2.98(In.)
Flow top width inside pipe = 6.00(In.)
Critical Depth = 2.66(In.)
Pipe flow velocity = 2.02(Ft/s)
Travel time through pipe = 2.07 min.
Time of concentration (TC) = 7.68 min.

++
Process from Point/Station 19.000 to Point/Station 20.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 7.68 min.
Rainfall intensity = 2.525(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.467(CFS) for 0.660(Ac.)
Total runoff = 1.858(CFS) Total area = 0.81(Ac.)

++
Process from Point/Station 20.000 to Point/Station 21.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 481.150(Ft.)
Downstream point/station elevation = 479.140(Ft.)

Pipe length = 401.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 1.858(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 1.858(CFS)
Normal flow depth in pipe = 6.66(In.)
Flow top width inside pipe = 14.90(In.)
Critical Depth = 6.50(In.)
Pipe flow velocity = 3.53(Ft/s)
Travel time through pipe = 1.89 min.
Time of concentration (TC) = 9.57 min.

++
Process from Point/Station 20.000 to Point/Station 21.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 9.57 min.
Rainfall intensity = 2.264(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.398(CFS) for 0.200(Ac.)
Total runoff = 2.256(CFS) Total area = 1.01(Ac.)

++
Process from Point/Station 20.000 to Point/Station 21.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 9.57 min.
Rainfall intensity = 2.264(In/Hr) for a 5.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.159(CFS) for 0.080(Ac.)
Total runoff = 2.416(CFS) Total area = 1.09(Ac.)

++
Process from Point/Station 21.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 479.140(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 15.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 2.416(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 2.416(CFS)
Normal flow depth in pipe = 6.48(In.)
Flow top width inside pipe = 14.86(In.)
Critical Depth = 7.46(In.)
Pipe flow velocity = 4.76(Ft/s)
Travel time through pipe = 0.05 min.
Time of concentration (TC) = 9.63 min.

++
Process from Point/Station 21.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 3

Stream flow area = 1.090(Ac.)
Runoff from this stream = 2.416(CFS)
Time of concentration = 9.63 min.
Rainfall intensity = 2.258(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	23.837	8.78	2.363
2	1.439	8.53	2.397
3	2.416	9.63	2.258

Qmax(1) =
1.000 * 1.000 * 23.837) +
0.986 * 1.000 * 1.439) +
1.000 * 0.912 * 2.416) + = 27.458
Qmax(2) =
1.000 * 0.972 * 23.837) +
1.000 * 1.000 * 1.439) +
1.000 * 0.886 * 2.416) + = 26.740
Qmax(3) =
0.955 * 1.000 * 23.837) +
0.942 * 1.000 * 1.439) +
1.000 * 1.000 * 2.416) + = 26.544

Total of 3 main streams to confluence:
Flow rates before confluence point:
23.837 1.439 2.416
Maximum flow rates at confluence using above data:
27.458 26.740 26.544
Area of streams before confluence:
11.280 0.560 1.090

Results of confluence:
Total flow rate = 27.458(CFS)
Time of concentration = 8.777 min.
Effective stream area after confluence = 12.930(Ac.)

++
Process from Point/Station 40.000 to Point/Station 41.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 110.000(Ft.)
Highest elevation = 485.000(Ft.)
Lowest elevation = 476.800(Ft.)
Elevation difference = 8.200(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 2.13 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(110.000^.5)/(7.455^(1/3)]= 2.13
Setting time of concentration to 5 minutes
Rainfall intensity (I) = 3.149(In/Hr) for a 5.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.554(CFS)
Total initial stream area = 0.200(Ac.)
End of computations, total study area = 37.490 (Ac.)

CIVILCADD / CIVIL DESIGN PEAK CALCULATIONS:

10 Year, Post-Development Conditions

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 6.5

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/17/20

********* Hydrology Study Control Information **********

Program License Serial Number 6303

Rational hydrology study storm event year is 10.0
English (in-lb) input data Units used
English (in) rainfall data used

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity) = 1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++
Process from Point/Station 1.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
____
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Rainfall intensity (I) = 2.135(In/Hr) for a 10.0 year storm
User specified values are as follows:
TC = 14.78 min. Rain intensity = 2.14(In/Hr)
Total area = 7.570(Ac.) Total runoff = 23.880(CFS)

++
Process from Point/Station 1.000 to Point/Station 2.000
**** SUBAREA FLOW ADDITION ****
____
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Time of concentration = 14.78 min.
Rainfall intensity = 2.135(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff = 0.243(CFS) for 0.120(Ac.)
Total runoff = 24.123(CFS) Total area = 7.69(Ac.)

++
Process from Point/Station 1.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 7.690(Ac.)
Runoff from this stream = 24.123(CFS)
Time of concentration = 14.78 min.
Rainfall intensity = 2.135(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	24.123	14.78	2.135

Qmax(1) =
1.000 * 1.000 * 24.123) + = 24.123

Total of 1 streams to confluence:
Flow rates before confluence point:
24.123
Maximum flow rates at confluence using above data:
24.123
Area of streams before confluence:
7.690
Results of confluence:
Total flow rate = 24.123(CFS)
Time of concentration = 14.780 min.
Effective stream area after confluence = 7.690(Ac.)

++
Process from Point/Station 3.000 to Point/Station 4.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Rainfall intensity (I) = 2.135(In/Hr) for a 10.0 year storm
User specified values are as follows:
TC = 14.78 min. Rain intensity = 2.14(In/Hr)
Total area = 16.520(Ac.) Total runoff = 21.630(CFS)

++
Process from Point/Station 3.000 to Point/Station 4.000
**** SUBAREA FLOW ADDITION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Time of concentration = 14.78 min.
Rainfall intensity = 2.135(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff = 0.304(CFS) for 0.150(Ac.)

Total runoff = 21.934(CFS) Total area = 16.67(Ac.)

++
Process from Point/Station 4.000 to Point/Station 2.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 481.280(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 458.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 21.934(CFS)
Given pipe size = 24.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
2.933(Ft.) at the headworks or inlet of the pipe(s)
Pipe friction loss = 4.304(Ft.)
Minor friction loss = 0.908(Ft.) K-factor = 1.20
Pipe flow velocity = 6.98(Ft/s)
Travel time through pipe = 1.09 min.
Time of concentration (TC) = 15.87 min.

++
Process from Point/Station 4.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 16.670(Ac.)
Runoff from this stream = 21.934(CFS)
Time of concentration = 15.87 min.
Rainfall intensity = 2.063(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	24.123	14.78	2.135
2	21.934	15.87	2.063

Qmax(1) =
1.000 * 1.000 * 24.123) +
1.000 * 0.931 * 21.934) + = 44.547
Qmax(2) =
0.966 * 1.000 * 24.123) +
1.000 * 1.000 * 21.934) + = 45.247

Total of 2 streams to confluence:
Flow rates before confluence point:
24.123 21.934
Maximum flow rates at confluence using above data:
44.547 45.247
Area of streams before confluence:
7.690 16.670
Results of confluence:
Total flow rate = 45.247(CFS)
Time of concentration = 15.873 min.
Effective stream area after confluence = 24.360(Ac.)

++

Process from Point/Station 2.000 to Point/Station 5.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 478.200(Ft.)
Downstream point/station elevation = 476.260(Ft.)
Pipe length = 283.00(Ft.) Manning's N = 0.013
No. of pipes = 3 Required pipe flow = 45.247(CFS)
Given pipe size = 24.00(In.)
Calculated individual pipe flow = 15.082(CFS)
Normal flow depth in pipe = 16.31(In.)
Flow top width inside pipe = 22.40(In.)
Critical Depth = 16.80(In.)
Pipe flow velocity = 6.63(Ft/s)
Travel time through pipe = 0.71 min.
Time of concentration (TC) = 16.58 min.

++
Process from Point/Station 5.000 to Point/Station 6.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 476.260(Ft.)
Downstream point/station elevation = 475.150(Ft.)
Pipe length = 221.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 45.247(CFS)
Given pipe size = 36.00(In.)
Calculated individual pipe flow = 45.247(CFS)
Normal flow depth in pipe = 28.22(In.)
Flow top width inside pipe = 29.64(In.)
Critical Depth = 26.30(In.)
Pipe flow velocity = 7.61(Ft/s)
Travel time through pipe = 0.48 min.
Time of concentration (TC) = 17.07 min.

++
Process from Point/Station 6.000 to Point/Station 50.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 475.150(Ft.)
Downstream point/station elevation = 475.000(Ft.)
Pipe length = 29.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 45.247(CFS)
Given pipe size = 36.00(In.)
Calculated individual pipe flow = 45.247(CFS)
Normal flow depth in pipe = 27.84(In.)
Flow top width inside pipe = 30.14(In.)
Critical Depth = 26.30(In.)
Pipe flow velocity = 7.72(Ft/s)
Travel time through pipe = 0.06 min.
Time of concentration (TC) = 17.13 min.

++
Process from Point/Station 7.000 to Point/Station 8.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 98.000(Ft.)
Highest elevation = 484.700(Ft.)

Lowest elevation = 484.350(Ft.)
Elevation difference = 0.350(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 5.53 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(98.000^.5)/(0.357^(1/3)]= 5.53
Rainfall intensity (I) = 3.416(In/Hr) for a 10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.691(CFS)
Total initial stream area = 0.230(Ac.)

++
Process from Point/Station 8.000 to Point/Station 9.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 482.350(Ft.)
Downstream point/station elevation = 481.270(Ft.)
Pipe length = 208.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 0.691(CFS)
Given pipe size = 10.00(In.)
Calculated individual pipe flow = 0.691(CFS)
Normal flow depth in pipe = 4.63(In.)
Flow top width inside pipe = 9.97(In.)
Critical Depth = 4.39(In.)
Pipe flow velocity = 2.80(Ft/s)
Travel time through pipe = 1.24 min.
Time of concentration (TC) = 6.76 min.

++
Process from Point/Station 8.000 to Point/Station 9.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 6.76 min.
Rainfall intensity = 3.091(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 2.339(CFS) for 0.860(Ac.)
Total runoff = 3.030(CFS) Total area = 1.09(Ac.)

++
Process from Point/Station 9.000 to Point/Station 10.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 481.270(Ft.)
Downstream point/station elevation = 480.310(Ft.)
Pipe length = 193.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.030(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.030(CFS)
Normal flow depth in pipe = 8.94(In.)
Flow top width inside pipe = 14.72(In.)
Critical Depth = 8.40(In.)
Pipe flow velocity = 3.97(Ft/s)
Travel time through pipe = 0.81 min.
Time of concentration (TC) = 7.57 min.

++
Process from Point/Station 10.000 to Point/Station 11.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 480.310(Ft.)
Downstream point/station elevation = 479.340(Ft.)
Pipe length = 194.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.030(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.030(CFS)
Normal flow depth in pipe = 8.93(In.)
Flow top width inside pipe = 14.72(In.)
Critical Depth = 8.40(In.)
Pipe flow velocity = 3.98(Ft/s)
Travel time through pipe = 0.81 min.
Time of concentration (TC) = 8.39 min.

++
Process from Point/Station 11.000 to Point/Station 12.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 479.340(Ft.)
Downstream point/station elevation = 479.120(Ft.)
Pipe length = 45.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.030(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.030(CFS)
Normal flow depth in pipe = 8.99(In.)
Flow top width inside pipe = 14.70(In.)
Critical Depth = 8.40(In.)
Pipe flow velocity = 3.95(Ft/s)
Travel time through pipe = 0.19 min.
Time of concentration (TC) = 8.58 min.

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.58 min.
Rainfall intensity = 2.758(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.480(CFS) for 0.610(Ac.)
Total runoff = 4.511(CFS) Total area = 1.70(Ac.)

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.58 min.
Rainfall intensity = 2.758(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.194(CFS) for 0.080(Ac.)
Total runoff = 4.705(CFS) Total area = 1.78(Ac.)

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.58 min.
Rainfall intensity = 2.758(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.049(CFS) for 0.020(Ac.)
Total runoff = 4.753(CFS) Total area = 1.80(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 479.120(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 25.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 4.753(CFS)
Given pipe size = 18.00(In.)
Calculated individual pipe flow = 4.753(CFS)
Normal flow depth in pipe = 10.61(In.)
Flow top width inside pipe = 17.71(In.)
Critical Depth = 10.05(In.)
Pipe flow velocity = 4.39(Ft/s)
Travel time through pipe = 0.09 min.
Time of concentration (TC) = 8.67 min.

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.67 min.
Rainfall intensity = 2.743(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 4.056(CFS) for 1.680(Ac.)
Total runoff = 8.809(CFS) Total area = 3.48(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.67 min.
Rainfall intensity = 2.743(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 4.563(CFS) for 1.890(Ac.)
Total runoff = 13.372(CFS) Total area = 5.37(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.67 min.

Rainfall intensity = 2.743(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 5.094(CFS) for 2.110(Ac.)
Total runoff = 18.466(CFS) Total area = 7.48(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.67 min.
Rainfall intensity = 2.743(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 3.984(CFS) for 1.650(Ac.)
Total runoff = 22.450(CFS) Total area = 9.13(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.67 min.
Rainfall intensity = 2.743(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 3.597(CFS) for 1.490(Ac.)
Total runoff = 26.047(CFS) Total area = 10.62(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.67 min.
Rainfall intensity = 2.743(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.593(CFS) for 0.660(Ac.)
Total runoff = 27.641(CFS) Total area = 11.28(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area = 11.280(Ac.)
Runoff from this stream = 27.641(CFS)
Time of concentration = 8.67 min.
Rainfall intensity = 2.743(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	27.641	8.67	2.743

Qmax(1) =

1.000 * 1.000 * 27.641) + = 27.641

Total of 1 main streams to confluence:
Flow rates before confluence point:
27.641
Maximum flow rates at confluence using above data:
27.641
Area of streams before confluence:
11.280

Results of confluence:
Total flow rate = 27.641(CFS)
Time of concentration = 8.671 min.
Effective stream area after confluence = 11.280(Ac.)

++
Process from Point/Station 7.000 to Point/Station 15.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 100.000(Ft.)
Highest elevation = 484.700(Ft.)
Lowest elevation = 484.200(Ft.)
Elevation difference = 0.500(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 4.99 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(100.000^.5)/(0.500^(1/3)]= 4.99
Setting time of concentration to 5 minutes
Rainfall intensity (I) = 3.592(In/Hr) for a 10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.727(CFS)
Total initial stream area = 0.230(Ac.)

++
Process from Point/Station 15.000 to Point/Station 16.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 482.250(Ft.)
Downstream point/station elevation = 481.100(Ft.)
Pipe length = 233.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 0.727(CFS)
Given pipe size = 10.00(In.)
Calculated individual pipe flow = 0.727(CFS)
Normal flow depth in pipe = 4.84(In.)
Flow top width inside pipe = 9.99(In.)
Critical Depth = 4.51(In.)
Pipe flow velocity = 2.78(Ft/s)
Travel time through pipe = 1.40 min.
Time of concentration (TC) = 6.40 min.

++
Process from Point/Station 15.000 to Point/Station 16.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea

Time of concentration = 6.40 min.
Rainfall intensity = 3.177(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.922(CFS) for 0.330(Ac.)
Total runoff = 1.650(CFS) Total area = 0.56(Ac.)

++
Process from Point/Station 16.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
____
Upstream point/station elevation = 481.100(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 416.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 1.650(CFS)
Given pipe size = 12.00(In.)
Calculated individual pipe flow = 1.650(CFS)
Normal flow depth in pipe = 7.05(In.)
Flow top width inside pipe = 11.81(In.)
Critical Depth = 6.55(In.)
Pipe flow velocity = 3.43(Ft/s)
Travel time through pipe = 2.02 min.
Time of concentration (TC) = 8.42 min.

++
Process from Point/Station 16.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****
____
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area = 0.560(Ac.)
Runoff from this stream = 1.650(CFS)
Time of concentration = 8.42 min.
Rainfall intensity = 2.783(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	27.641	8.67	2.743
2	1.650	8.42	2.783

Qmax(1) =
1.000 * 1.000 * 27.641) +
0.986 * 1.000 * 1.650) + = 29.267
Qmax(2) =
1.000 * 0.971 * 27.641) +
1.000 * 1.000 * 1.650) + = 28.475

Total of 2 main streams to confluence:
Flow rates before confluence point:
27.641 1.650
Maximum flow rates at confluence using above data:
29.267 28.475
Area of streams before confluence:
11.280 0.560

Results of confluence:

Total flow rate = 29.267(CFS)
Time of concentration = 8.671 min.
Effective stream area after confluence = 11.840(Ac.)

++
Process from Point/Station 18.000 to Point/Station 19.000
**** INITIAL AREA EVALUATION ****

____
User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 128.000(Ft.)
Highest elevation = 484.850(Ft.)
Lowest elevation = 484.200(Ft.)
Elevation difference = 0.650(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 5.62 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(128.000^.5)/(0.508^(1/3)]= 5.62
Rainfall intensity (I) = 3.388(In/Hr) for a 10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.447(CFS)
Total initial stream area = 0.150(Ac.)

++
Process from Point/Station 19.000 to Point/Station 20.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

____
Upstream point/station elevation = 482.400(Ft.)
Downstream point/station elevation = 481.150(Ft.)
Pipe length = 250.00(Ft.) Manning's N = 0.013
No. of pipes = 2 Required pipe flow = 0.447(CFS)
Given pipe size = 6.00(In.)
Calculated individual pipe flow = 0.224(CFS)
Normal flow depth in pipe = 3.22(In.)
Flow top width inside pipe = 5.98(In.)
Critical Depth = 2.85(In.)
Pipe flow velocity = 2.08(Ft/s)
Travel time through pipe = 2.00 min.
Time of concentration (TC) = 7.62 min.

++
Process from Point/Station 19.000 to Point/Station 20.000
**** SUBAREA FLOW ADDITION ****

____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 7.62 min.
Rainfall intensity = 2.918(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.695(CFS) for 0.660(Ac.)
Total runoff = 2.142(CFS) Total area = 0.81(Ac.)

++
Process from Point/Station 20.000 to Point/Station 21.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

____
Upstream point/station elevation = 481.150(Ft.)
Downstream point/station elevation = 479.140(Ft.)

Pipe length = 401.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 2.142(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 2.142(CFS)
Normal flow depth in pipe = 7.22(In.)
Flow top width inside pipe = 14.99(In.)
Critical Depth = 7.01(In.)
Pipe flow velocity = 3.67(Ft/s)
Travel time through pipe = 1.82 min.
Time of concentration (TC) = 9.44 min.

++
Process from Point/Station 20.000 to Point/Station 21.000
**** SUBAREA FLOW ADDITION ****
____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 9.44 min.
Rainfall intensity = 2.635(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.464(CFS) for 0.200(Ac.)
Total runoff = 2.606(CFS) Total area = 1.01(Ac.)

++
Process from Point/Station 20.000 to Point/Station 21.000
**** SUBAREA FLOW ADDITION ****
____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 9.44 min.
Rainfall intensity = 2.635(In/Hr) for a 10.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.186(CFS) for 0.080(Ac.)
Total runoff = 2.791(CFS) Total area = 1.09(Ac.)

++
Process from Point/Station 21.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
____
Upstream point/station elevation = 479.140(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 15.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 2.791(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 2.791(CFS)
Normal flow depth in pipe = 7.03(In.)
Flow top width inside pipe = 14.97(In.)
Critical Depth = 8.05(In.)
Pipe flow velocity = 4.94(Ft/s)
Travel time through pipe = 0.05 min.
Time of concentration (TC) = 9.49 min.

++
Process from Point/Station 21.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****
____
The following data inside Main Stream is listed:
In Main Stream number: 3

Stream flow area = 1.090(Ac.)
Runoff from this stream = 2.791(CFS)
Time of concentration = 9.49 min.
Rainfall intensity = 2.629(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	27.641	8.67	2.743
2	1.650	8.42	2.783
3	2.791	9.49	2.629

Qmax(1) =
1.000 * 1.000 * 27.641) +
0.986 * 1.000 * 1.650) +
1.000 * 0.914 * 2.791) + = 31.817
Qmax(2) =
1.000 * 0.971 * 27.641) +
1.000 * 1.000 * 1.650) +
1.000 * 0.887 * 2.791) + = 30.950
Qmax(3) =
0.958 * 1.000 * 27.641) +
0.945 * 1.000 * 1.650) +
1.000 * 1.000 * 2.791) + = 30.836

Total of 3 main streams to confluence:
Flow rates before confluence point:
27.641 1.650 2.791
Maximum flow rates at confluence using above data:
31.817 30.950 30.836
Area of streams before confluence:
11.280 0.560 1.090

Results of confluence:
Total flow rate = 31.817(CFS)
Time of concentration = 8.671 min.
Effective stream area after confluence = 12.930(Ac.)

++
Process from Point/Station 40.000 to Point/Station 41.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 110.000(Ft.)
Highest elevation = 485.000(Ft.)
Lowest elevation = 476.800(Ft.)
Elevation difference = 8.200(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 2.13 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(110.000^.5)/(7.455^(1/3)]= 2.13
Setting time of concentration to 5 minutes
Rainfall intensity (I) = 3.592(In/Hr) for a 10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.632(CFS)
Total initial stream area = 0.200(Ac.)
End of computations, total study area = 37.490 (Ac.)

CIVILCADD / CIVIL DESIGN PEAK CALCULATIONS:

25 Year, Post-Development Conditions

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 6.5

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/17/20

********* Hydrology Study Control Information **********

Program License Serial Number 6303

Rational hydrology study storm event year is 25.0
English (in-lb) input data Units used
English (in) rainfall data used

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity) = 1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++
Process from Point/Station 1.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
____
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Rainfall intensity (I) = 2.372(In/Hr) for a 25.0 year storm
User specified values are as follows:
TC = 14.78 min. Rain intensity = 2.37(In/Hr)
Total area = 7.570(Ac.) Total runoff = 23.880(CFS)

++
Process from Point/Station 1.000 to Point/Station 2.000
**** SUBAREA FLOW ADDITION ****
____
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Time of concentration = 14.78 min.
Rainfall intensity = 2.372(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff = 0.270(CFS) for 0.120(Ac.)
Total runoff = 24.150(CFS) Total area = 7.69(Ac.)

++
Process from Point/Station 1.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****

____

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 7.690(Ac.)
Runoff from this stream = 24.150(CFS)
Time of concentration = 14.78 min.
Rainfall intensity = 2.372(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	24.150	14.78	2.372

Qmax(1) =
1.000 * 1.000 * 24.150) + = 24.150

Total of 1 streams to confluence:
Flow rates before confluence point:
24.150
Maximum flow rates at confluence using above data:
24.150
Area of streams before confluence:
7.690
Results of confluence:
Total flow rate = 24.150(CFS)
Time of concentration = 14.780 min.
Effective stream area after confluence = 7.690(Ac.)

++
Process from Point/Station 3.000 to Point/Station 4.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

____

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Rainfall intensity (I) = 2.372(In/Hr) for a 25.0 year storm
User specified values are as follows:
TC = 14.78 min. Rain intensity = 2.37(In/Hr)
Total area = 16.520(Ac.) Total runoff = 21.630(CFS)

++
Process from Point/Station 3.000 to Point/Station 4.000
**** SUBAREA FLOW ADDITION ****

____

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Time of concentration = 14.78 min.
Rainfall intensity = 2.372(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff = 0.338(CFS) for 0.150(Ac.)

Total runoff = 21.968(CFS) Total area = 16.67(Ac.)

++
Process from Point/Station 4.000 to Point/Station 2.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 481.280(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 458.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 21.968(CFS)
Given pipe size = 24.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
2.949(Ft.) at the headworks or inlet of the pipe(s)
Pipe friction loss = 4.317(Ft.)
Minor friction loss = 0.911(Ft.) K-factor = 1.20
Pipe flow velocity = 6.99(Ft/s)
Travel time through pipe = 1.09 min.
Time of concentration (TC) = 15.87 min.

++
Process from Point/Station 4.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 16.670(Ac.)
Runoff from this stream = 21.968(CFS)
Time of concentration = 15.87 min.
Rainfall intensity = 2.297(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	24.150	14.78	2.372
2	21.968	15.87	2.297

Qmax(1) =
1.000 * 1.000 * 24.150) +
1.000 * 0.931 * 21.968) + = 44.608
Qmax(2) =
0.969 * 1.000 * 24.150) +
1.000 * 1.000 * 21.968) + = 45.359

Total of 2 streams to confluence:
Flow rates before confluence point:
24.150 21.968
Maximum flow rates at confluence using above data:
44.608 45.359
Area of streams before confluence:
7.690 16.670
Results of confluence:
Total flow rate = 45.359(CFS)
Time of concentration = 15.872 min.
Effective stream area after confluence = 24.360(Ac.)

++

Process from Point/Station 2.000 to Point/Station 5.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 478.200(Ft.)
Downstream point/station elevation = 476.260(Ft.)
Pipe length = 283.00(Ft.) Manning's N = 0.013
No. of pipes = 3 Required pipe flow = 45.359(CFS)
Given pipe size = 24.00(In.)
Calculated individual pipe flow = 15.120(CFS)
Normal flow depth in pipe = 16.34(In.)
Flow top width inside pipe = 22.38(In.)
Critical Depth = 16.82(In.)
Pipe flow velocity = 6.63(Ft/s)
Travel time through pipe = 0.71 min.
Time of concentration (TC) = 16.58 min.

++
Process from Point/Station 5.000 to Point/Station 6.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 476.260(Ft.)
Downstream point/station elevation = 475.150(Ft.)
Pipe length = 221.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 45.359(CFS)
Given pipe size = 36.00(In.)
Calculated individual pipe flow = 45.359(CFS)
Normal flow depth in pipe = 28.27(In.)
Flow top width inside pipe = 29.57(In.)
Critical Depth = 26.32(In.)
Pipe flow velocity = 7.61(Ft/s)
Travel time through pipe = 0.48 min.
Time of concentration (TC) = 17.07 min.

++
Process from Point/Station 6.000 to Point/Station 50.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 475.150(Ft.)
Downstream point/station elevation = 475.000(Ft.)
Pipe length = 29.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 45.359(CFS)
Given pipe size = 36.00(In.)
Calculated individual pipe flow = 45.359(CFS)
Normal flow depth in pipe = 27.89(In.)
Flow top width inside pipe = 30.08(In.)
Critical Depth = 26.32(In.)
Pipe flow velocity = 7.72(Ft/s)
Travel time through pipe = 0.06 min.
Time of concentration (TC) = 17.13 min.

++
Process from Point/Station 7.000 to Point/Station 8.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 98.000(Ft.)
Highest elevation = 484.700(Ft.)

Lowest elevation = 484.350(Ft.)
Elevation difference = 0.350(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 5.53 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(98.000^.5)/(0.357^(1/3)]= 5.53
Rainfall intensity (I) = 3.668(In/Hr) for a 25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.742(CFS)
Total initial stream area = 0.230(Ac.)

++
Process from Point/Station 8.000 to Point/Station 9.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 482.350(Ft.)
Downstream point/station elevation = 481.270(Ft.)
Pipe length = 208.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 0.742(CFS)
Given pipe size = 10.00(In.)
Calculated individual pipe flow = 0.742(CFS)
Normal flow depth in pipe = 4.82(In.)
Flow top width inside pipe = 9.99(In.)
Critical Depth = 4.55(In.)
Pipe flow velocity = 2.85(Ft/s)
Travel time through pipe = 1.22 min.
Time of concentration (TC) = 6.74 min.

++
Process from Point/Station 8.000 to Point/Station 9.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 6.74 min.
Rainfall intensity = 3.347(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 2.533(CFS) for 0.860(Ac.)
Total runoff = 3.275(CFS) Total area = 1.09(Ac.)

++
Process from Point/Station 9.000 to Point/Station 10.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 481.270(Ft.)
Downstream point/station elevation = 480.310(Ft.)
Pipe length = 193.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.275(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.275(CFS)
Normal flow depth in pipe = 9.41(In.)
Flow top width inside pipe = 14.51(In.)
Critical Depth = 8.75(In.)
Pipe flow velocity = 4.04(Ft/s)
Travel time through pipe = 0.80 min.
Time of concentration (TC) = 7.54 min.

++
Process from Point/Station 10.000 to Point/Station 11.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 480.310(Ft.)
Downstream point/station elevation = 479.340(Ft.)
Pipe length = 194.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.275(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.275(CFS)
Normal flow depth in pipe = 9.40(In.)
Flow top width inside pipe = 14.51(In.)
Critical Depth = 8.75(In.)
Pipe flow velocity = 4.05(Ft/s)
Travel time through pipe = 0.80 min.
Time of concentration (TC) = 8.34 min.

++
Process from Point/Station 11.000 to Point/Station 12.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 479.340(Ft.)
Downstream point/station elevation = 479.120(Ft.)
Pipe length = 45.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.275(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.275(CFS)
Normal flow depth in pipe = 9.47(In.)
Flow top width inside pipe = 14.47(In.)
Critical Depth = 8.75(In.)
Pipe flow velocity = 4.01(Ft/s)
Travel time through pipe = 0.19 min.
Time of concentration (TC) = 8.52 min.

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.52 min.
Rainfall intensity = 3.015(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.618(CFS) for 0.610(Ac.)
Total runoff = 4.893(CFS) Total area = 1.70(Ac.)

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.52 min.
Rainfall intensity = 3.015(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.212(CFS) for 0.080(Ac.)
Total runoff = 5.106(CFS) Total area = 1.78(Ac.)

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.52 min.
Rainfall intensity = 3.015(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.053(CFS) for 0.020(Ac.)
Total runoff = 5.159(CFS) Total area = 1.80(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 479.120(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 25.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 5.159(CFS)
Given pipe size = 18.00(In.)
Calculated individual pipe flow = 5.159(CFS)
Normal flow depth in pipe = 11.19(In.)
Flow top width inside pipe = 17.46(In.)
Critical Depth = 10.49(In.)
Pipe flow velocity = 4.47(Ft/s)
Travel time through pipe = 0.09 min.
Time of concentration (TC) = 8.62 min.

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.62 min.
Rainfall intensity = 3.000(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 4.436(CFS) for 1.680(Ac.)
Total runoff = 9.595(CFS) Total area = 3.48(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.62 min.
Rainfall intensity = 3.000(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 4.990(CFS) for 1.890(Ac.)
Total runoff = 14.585(CFS) Total area = 5.37(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.62 min.

Rainfall intensity = 3.000(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 5.571(CFS) for 2.110(Ac.)
Total runoff = 20.156(CFS) Total area = 7.48(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.62 min.
Rainfall intensity = 3.000(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 4.357(CFS) for 1.650(Ac.)
Total runoff = 24.513(CFS) Total area = 9.13(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.62 min.
Rainfall intensity = 3.000(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 3.934(CFS) for 1.490(Ac.)
Total runoff = 28.447(CFS) Total area = 10.62(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.62 min.
Rainfall intensity = 3.000(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.743(CFS) for 0.660(Ac.)
Total runoff = 30.190(CFS) Total area = 11.28(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area = 11.280(Ac.)
Runoff from this stream = 30.190(CFS)
Time of concentration = 8.62 min.
Rainfall intensity = 3.000(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	30.190	8.62	3.000

Qmax(1) =

1.000 * 1.000 * 30.190) + = 30.190

Total of 1 main streams to confluence:
Flow rates before confluence point:
30.190
Maximum flow rates at confluence using above data:
30.190
Area of streams before confluence:
11.280

Results of confluence:
Total flow rate = 30.190(CFS)
Time of concentration = 8.617 min.
Effective stream area after confluence = 11.280(Ac.)

++
Process from Point/Station 7.000 to Point/Station 15.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 100.000(Ft.)
Highest elevation = 484.700(Ft.)
Lowest elevation = 484.200(Ft.)
Elevation difference = 0.500(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 4.99 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(100.000^.5)/(0.500^(1/3)]= 4.99
Setting time of concentration to 5 minutes
Rainfall intensity (I) = 3.845(In/Hr) for a 25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.778(CFS)
Total initial stream area = 0.230(Ac.)

++
Process from Point/Station 15.000 to Point/Station 16.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 482.250(Ft.)
Downstream point/station elevation = 481.100(Ft.)
Pipe length = 233.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 0.778(CFS)
Given pipe size = 10.00(In.)
Calculated individual pipe flow = 0.778(CFS)
Normal flow depth in pipe = 5.03(In.)
Flow top width inside pipe = 10.00(In.)
Critical Depth = 4.68(In.)
Pipe flow velocity = 2.83(Ft/s)
Travel time through pipe = 1.37 min.
Time of concentration (TC) = 6.37 min.

++
Process from Point/Station 15.000 to Point/Station 16.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea

Time of concentration = 6.37 min.
Rainfall intensity = 3.433(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.997(CFS) for 0.330(Ac.)
Total runoff = 1.775(CFS) Total area = 0.56(Ac.)

++
Process from Point/Station 16.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 481.100(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 416.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 1.775(CFS)
Given pipe size = 12.00(In.)
Calculated individual pipe flow = 1.775(CFS)
Normal flow depth in pipe = 7.41(In.)
Flow top width inside pipe = 11.67(In.)
Critical Depth = 6.80(In.)
Pipe flow velocity = 3.49(Ft/s)
Travel time through pipe = 1.99 min.
Time of concentration (TC) = 8.36 min.

++
Process from Point/Station 16.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area = 0.560(Ac.)
Runoff from this stream = 1.775(CFS)
Time of concentration = 8.36 min.
Rainfall intensity = 3.041(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	30.190	8.62	3.000
2	1.775	8.36	3.041

Qmax(1) =
1.000 * 1.000 * 30.190) +
0.987 * 1.000 * 1.775) + = 31.942
Qmax(2) =
1.000 * 0.970 * 30.190) +
1.000 * 1.000 * 1.775) + = 31.062

Total of 2 main streams to confluence:
Flow rates before confluence point:
30.190 1.775
Maximum flow rates at confluence using above data:
31.942 31.062
Area of streams before confluence:
11.280 0.560

Results of confluence:

Total flow rate = 31.942(CFS)
Time of concentration = 8.617 min.
Effective stream area after confluence = 11.840(Ac.)

++
Process from Point/Station 18.000 to Point/Station 19.000
**** INITIAL AREA EVALUATION ****

____
User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 128.000(Ft.)
Highest elevation = 484.850(Ft.)
Lowest elevation = 484.200(Ft.)
Elevation difference = 0.650(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 5.62 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(128.000^.5)/(0.508^(1/3)]= 5.62
Rainfall intensity (I) = 3.640(In/Hr) for a 25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.480(CFS)
Total initial stream area = 0.150(Ac.)

++
Process from Point/Station 19.000 to Point/Station 20.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

____
Upstream point/station elevation = 482.400(Ft.)
Downstream point/station elevation = 481.150(Ft.)
Pipe length = 250.00(Ft.) Manning's N = 0.013
No. of pipes = 2 Required pipe flow = 0.480(CFS)
Given pipe size = 6.00(In.)
Calculated individual pipe flow = 0.240(CFS)
Normal flow depth in pipe = 3.38(In.)
Flow top width inside pipe = 5.95(In.)
Critical Depth = 2.96(In.)
Pipe flow velocity = 2.12(Ft/s)
Travel time through pipe = 1.97 min.
Time of concentration (TC) = 7.58 min.

++
Process from Point/Station 19.000 to Point/Station 20.000
**** SUBAREA FLOW ADDITION ****

____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 7.58 min.
Rainfall intensity = 3.175(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.844(CFS) for 0.660(Ac.)
Total runoff = 2.324(CFS) Total area = 0.81(Ac.)

++
Process from Point/Station 20.000 to Point/Station 21.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

____
Upstream point/station elevation = 481.150(Ft.)
Downstream point/station elevation = 479.140(Ft.)

Pipe length = 401.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 2.324(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 2.324(CFS)
Normal flow depth in pipe = 7.57(In.)
Flow top width inside pipe = 15.00(In.)
Critical Depth = 7.31(In.)
Pipe flow velocity = 3.74(Ft/s)
Travel time through pipe = 1.79 min.
Time of concentration (TC) = 9.37 min.

++
Process from Point/Station 20.000 to Point/Station 21.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 9.37 min.
Rainfall intensity = 2.893(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.509(CFS) for 0.200(Ac.)
Total runoff = 2.833(CFS) Total area = 1.01(Ac.)

++
Process from Point/Station 20.000 to Point/Station 21.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 9.37 min.
Rainfall intensity = 2.893(In/Hr) for a 25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.204(CFS) for 0.080(Ac.)
Total runoff = 3.037(CFS) Total area = 1.09(Ac.)

++
Process from Point/Station 21.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 479.140(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 15.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.037(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.037(CFS)
Normal flow depth in pipe = 7.38(In.)
Flow top width inside pipe = 15.00(In.)
Critical Depth = 8.41(In.)
Pipe flow velocity = 5.05(Ft/s)
Travel time through pipe = 0.05 min.
Time of concentration (TC) = 9.42 min.

++
Process from Point/Station 21.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 3

Stream flow area = 1.090(Ac.)
Runoff from this stream = 3.037(CFS)
Time of concentration = 9.42 min.
Rainfall intensity = 2.886(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	30.190	8.62	3.000
2	1.775	8.36	3.041
3	3.037	9.42	2.886

Qmax(1) =
1.000 * 1.000 * 30.190) +
0.987 * 1.000 * 1.775) +
1.000 * 0.915 * 3.037) + = 34.720
Qmax(2) =
1.000 * 0.970 * 30.190) +
1.000 * 1.000 * 1.775) +
1.000 * 0.888 * 3.037) + = 33.758
Qmax(3) =
0.962 * 1.000 * 30.190) +
0.949 * 1.000 * 1.775) +
1.000 * 1.000 * 3.037) + = 33.763

Total of 3 main streams to confluence:
Flow rates before confluence point:
30.190 1.775 3.037
Maximum flow rates at confluence using above data:
34.720 33.758 33.763
Area of streams before confluence:
11.280 0.560 1.090

Results of confluence:
Total flow rate = 34.720(CFS)
Time of concentration = 8.617 min.
Effective stream area after confluence = 12.930(Ac.)

++
Process from Point/Station 40.000 to Point/Station 41.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 110.000(Ft.)
Highest elevation = 485.000(Ft.)
Lowest elevation = 476.800(Ft.)
Elevation difference = 8.200(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 2.13 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(110.000^.5)/(7.455^(1/3)]= 2.13
Setting time of concentration to 5 minutes
Rainfall intensity (I) = 3.845(In/Hr) for a 25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.677(CFS)
Total initial stream area = 0.200(Ac.)
End of computations, total study area = 37.490 (Ac.)

CIVILCADD / CIVIL DESIGN PEAK CALCULATIONS:

50 Year, Post-Development Conditions

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 6.5

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/17/20

********* Hydrology Study Control Information **********

Program License Serial Number 6303

Rational hydrology study storm event year is 50.0
English (in-lb) input data Units used
English (in) rainfall data used

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity) = 1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++
Process from Point/Station 1.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
____
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Rainfall intensity (I) = 2.724(In/Hr) for a 50.0 year storm
User specified values are as follows:
TC = 14.78 min. Rain intensity = 2.72(In/Hr)
Total area = 7.570(Ac.) Total runoff = 23.880(CFS)

++
Process from Point/Station 1.000 to Point/Station 2.000
**** SUBAREA FLOW ADDITION ****
____
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Time of concentration = 14.78 min.
Rainfall intensity = 2.724(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff = 0.310(CFS) for 0.120(Ac.)
Total runoff = 24.190(CFS) Total area = 7.69(Ac.)

++
Process from Point/Station 1.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****

____

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 7.690(Ac.)
Runoff from this stream = 24.190(CFS)
Time of concentration = 14.78 min.
Rainfall intensity = 2.724(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	24.190	14.78	2.724

Qmax(1) =
1.000 * 1.000 * 24.190) + = 24.190

Total of 1 streams to confluence:
Flow rates before confluence point:
24.190
Maximum flow rates at confluence using above data:
24.190
Area of streams before confluence:
7.690
Results of confluence:
Total flow rate = 24.190(CFS)
Time of concentration = 14.780 min.
Effective stream area after confluence = 7.690(Ac.)

++
Process from Point/Station 3.000 to Point/Station 4.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

____

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Rainfall intensity (I) = 2.724(In/Hr) for a 50.0 year storm
User specified values are as follows:
TC = 14.78 min. Rain intensity = 2.72(In/Hr)
Total area = 16.520(Ac.) Total runoff = 21.630(CFS)

++
Process from Point/Station 3.000 to Point/Station 4.000
**** SUBAREA FLOW ADDITION ****

____

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type]
Time of concentration = 14.78 min.
Rainfall intensity = 2.724(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff = 0.388(CFS) for 0.150(Ac.)

Total runoff = 22.018(CFS) Total area = 16.67(Ac.)

++
Process from Point/Station 4.000 to Point/Station 2.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 481.280(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 458.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 22.018(CFS)
Given pipe size = 24.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
The approximate hydraulic grade line above the pipe invert is
2.972(Ft.) at the headworks or inlet of the pipe(s)
Pipe friction loss = 4.337(Ft.)
Minor friction loss = 0.915(Ft.) K-factor = 1.20
Pipe flow velocity = 7.01(Ft/s)
Travel time through pipe = 1.09 min.
Time of concentration (TC) = 15.87 min.

++
Process from Point/Station 4.000 to Point/Station 2.000
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 16.670(Ac.)
Runoff from this stream = 22.018(CFS)
Time of concentration = 15.87 min.
Rainfall intensity = 2.643(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	24.190	14.78	2.724
2	22.018	15.87	2.643

Qmax(1) =
1.000 * 1.000 * 24.190) +
1.000 * 0.931 * 22.018) + = 44.697
Qmax(2) =
0.971 * 1.000 * 24.190) +
1.000 * 1.000 * 22.018) + = 45.495

Total of 2 streams to confluence:
Flow rates before confluence point:
24.190 22.018
Maximum flow rates at confluence using above data:
44.697 45.495
Area of streams before confluence:
7.690 16.670
Results of confluence:
Total flow rate = 45.495(CFS)
Time of concentration = 15.869 min.
Effective stream area after confluence = 24.360(Ac.)

++

Process from Point/Station 2.000 to Point/Station 5.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 478.200(Ft.)
Downstream point/station elevation = 476.260(Ft.)
Pipe length = 283.00(Ft.) Manning's N = 0.013
No. of pipes = 3 Required pipe flow = 45.495(CFS)
Given pipe size = 24.00(In.)
Calculated individual pipe flow = 15.165(CFS)
Normal flow depth in pipe = 16.38(In.)
Flow top width inside pipe = 22.34(In.)
Critical Depth = 16.86(In.)
Pipe flow velocity = 6.64(Ft/s)
Travel time through pipe = 0.71 min.
Time of concentration (TC) = 16.58 min.

++
Process from Point/Station 5.000 to Point/Station 6.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 476.260(Ft.)
Downstream point/station elevation = 475.150(Ft.)
Pipe length = 221.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 45.495(CFS)
Given pipe size = 36.00(In.)
Calculated individual pipe flow = 45.495(CFS)
Normal flow depth in pipe = 28.36(In.)
Flow top width inside pipe = 29.44(In.)
Critical Depth = 26.35(In.)
Pipe flow velocity = 7.62(Ft/s)
Travel time through pipe = 0.48 min.
Time of concentration (TC) = 17.06 min.

++
Process from Point/Station 6.000 to Point/Station 50.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 475.150(Ft.)
Downstream point/station elevation = 475.000(Ft.)
Pipe length = 29.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 45.495(CFS)
Given pipe size = 36.00(In.)
Calculated individual pipe flow = 45.495(CFS)
Normal flow depth in pipe = 27.98(In.)
Flow top width inside pipe = 29.95(In.)
Critical Depth = 26.35(In.)
Pipe flow velocity = 7.72(Ft/s)
Travel time through pipe = 0.06 min.
Time of concentration (TC) = 17.13 min.

++
Process from Point/Station 7.000 to Point/Station 8.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 98.000(Ft.)
Highest elevation = 484.700(Ft.)

Lowest elevation = 484.350(Ft.)
Elevation difference = 0.350(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 5.53 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(98.000^.5)/(0.357^(1/3)]= 5.53
Rainfall intensity (I) = 4.081(In/Hr) for a 50.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.826(CFS)
Total initial stream area = 0.230(Ac.)

++
Process from Point/Station 8.000 to Point/Station 9.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 482.350(Ft.)
Downstream point/station elevation = 481.270(Ft.)
Pipe length = 208.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 0.826(CFS)
Given pipe size = 10.00(In.)
Calculated individual pipe flow = 0.826(CFS)
Normal flow depth in pipe = 5.13(In.)
Flow top width inside pipe = 10.00(In.)
Critical Depth = 4.82(In.)
Pipe flow velocity = 2.93(Ft/s)
Travel time through pipe = 1.18 min.
Time of concentration (TC) = 6.71 min.

++
Process from Point/Station 8.000 to Point/Station 9.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 6.71 min.
Rainfall intensity = 3.755(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 2.842(CFS) for 0.860(Ac.)
Total runoff = 3.668(CFS) Total area = 1.09(Ac.)

++
Process from Point/Station 9.000 to Point/Station 10.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 481.270(Ft.)
Downstream point/station elevation = 480.310(Ft.)
Pipe length = 193.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.668(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.668(CFS)
Normal flow depth in pipe = 10.20(In.)
Flow top width inside pipe = 14.00(In.)
Critical Depth = 9.28(In.)
Pipe flow velocity = 4.13(Ft/s)
Travel time through pipe = 0.78 min.
Time of concentration (TC) = 7.49 min.

++
Process from Point/Station 10.000 to Point/Station 11.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 480.310(Ft.)
Downstream point/station elevation = 479.340(Ft.)
Pipe length = 194.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.668(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.668(CFS)
Normal flow depth in pipe = 10.17(In.)
Flow top width inside pipe = 14.02(In.)
Critical Depth = 9.28(In.)
Pipe flow velocity = 4.14(Ft/s)
Travel time through pipe = 0.78 min.
Time of concentration (TC) = 8.27 min.

++
Process from Point/Station 11.000 to Point/Station 12.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 479.340(Ft.)
Downstream point/station elevation = 479.120(Ft.)
Pipe length = 45.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.668(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.668(CFS)
Normal flow depth in pipe = 10.27(In.)
Flow top width inside pipe = 13.94(In.)
Critical Depth = 9.28(In.)
Pipe flow velocity = 4.10(Ft/s)
Travel time through pipe = 0.18 min.
Time of concentration (TC) = 8.45 min.

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.45 min.
Rainfall intensity = 3.414(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.832(CFS) for 0.610(Ac.)
Total runoff = 5.500(CFS) Total area = 1.70(Ac.)

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.45 min.
Rainfall intensity = 3.414(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.240(CFS) for 0.080(Ac.)
Total runoff = 5.740(CFS) Total area = 1.78(Ac.)

++
Process from Point/Station 11.000 to Point/Station 12.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.45 min.
Rainfall intensity = 3.414(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.060(CFS) for 0.020(Ac.)
Total runoff = 5.800(CFS) Total area = 1.80(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 479.120(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 25.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 5.800(CFS)
Given pipe size = 18.00(In.)
Calculated individual pipe flow = 5.800(CFS)
Normal flow depth in pipe = 12.14(In.)
Flow top width inside pipe = 16.87(In.)
Critical Depth = 11.15(In.)
Pipe flow velocity = 4.57(Ft/s)
Travel time through pipe = 0.09 min.
Time of concentration (TC) = 8.54 min.

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.54 min.
Rainfall intensity = 3.399(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 5.025(CFS) for 1.680(Ac.)
Total runoff = 10.825(CFS) Total area = 3.48(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.54 min.
Rainfall intensity = 3.399(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 5.653(CFS) for 1.890(Ac.)
Total runoff = 16.478(CFS) Total area = 5.37(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.54 min.

Rainfall intensity = 3.399(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 6.311(CFS) for 2.110(Ac.)
Total runoff = 22.789(CFS) Total area = 7.48(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.54 min.
Rainfall intensity = 3.399(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 4.935(CFS) for 1.650(Ac.)
Total runoff = 27.724(CFS) Total area = 9.13(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.54 min.
Rainfall intensity = 3.399(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 4.457(CFS) for 1.490(Ac.)
Total runoff = 32.181(CFS) Total area = 10.62(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea
Time of concentration = 8.54 min.
Rainfall intensity = 3.399(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.974(CFS) for 0.660(Ac.)
Total runoff = 34.155(CFS) Total area = 11.28(Ac.)

++
Process from Point/Station 12.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****

The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area = 11.280(Ac.)
Runoff from this stream = 34.155(CFS)
Time of concentration = 8.54 min.
Rainfall intensity = 3.399(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	34.155	8.54	3.399

Qmax(1) =

1.000 * 1.000 * 34.155) + = 34.155

Total of 1 main streams to confluence:
Flow rates before confluence point:
34.155
Maximum flow rates at confluence using above data:
34.155
Area of streams before confluence:
11.280

Results of confluence:
Total flow rate = 34.155(CFS)
Time of concentration = 8.544 min.
Effective stream area after confluence = 11.280(Ac.)

++
Process from Point/Station 7.000 to Point/Station 15.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 100.000(Ft.)
Highest elevation = 484.700(Ft.)
Lowest elevation = 484.200(Ft.)
Elevation difference = 0.500(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 4.99 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(100.000^.5)/(0.500^(1/3)]= 4.99
Setting time of concentration to 5 minutes
Rainfall intensity (I) = 4.265(In/Hr) for a 50.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.863(CFS)
Total initial stream area = 0.230(Ac.)

++
Process from Point/Station 15.000 to Point/Station 16.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 482.250(Ft.)
Downstream point/station elevation = 481.100(Ft.)
Pipe length = 233.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 0.863(CFS)
Given pipe size = 10.00(In.)
Calculated individual pipe flow = 0.863(CFS)
Normal flow depth in pipe = 5.36(In.)
Flow top width inside pipe = 9.97(In.)
Critical Depth = 4.93(In.)
Pipe flow velocity = 2.90(Ft/s)
Travel time through pipe = 1.34 min.
Time of concentration (TC) = 6.34 min.

++
Process from Point/Station 15.000 to Point/Station 16.000
**** SUBAREA FLOW ADDITION ****

User specified 'C' value of 0.880 given for subarea

Time of concentration = 6.34 min.
Rainfall intensity = 3.847(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 1.117(CFS) for 0.330(Ac.)
Total runoff = 1.980(CFS) Total area = 0.56(Ac.)

++
Process from Point/Station 16.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
____
Upstream point/station elevation = 481.100(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 416.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 1.980(CFS)
Given pipe size = 12.00(In.)
Calculated individual pipe flow = 1.980(CFS)
Normal flow depth in pipe = 7.99(In.)
Flow top width inside pipe = 11.32(In.)
Critical Depth = 7.21(In.)
Pipe flow velocity = 3.57(Ft/s)
Travel time through pipe = 1.94 min.
Time of concentration (TC) = 8.28 min.

++
Process from Point/Station 16.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****
____
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area = 0.560(Ac.)
Runoff from this stream = 1.980(CFS)
Time of concentration = 8.28 min.
Rainfall intensity = 3.442(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	34.155	8.54	3.399
2	1.980	8.28	3.442

Qmax(1) =
1.000 * 1.000 * 34.155) +
0.987 * 1.000 * 1.980) + = 36.110
Qmax(2) =
1.000 * 0.969 * 34.155) +
1.000 * 1.000 * 1.980) + = 35.086

Total of 2 main streams to confluence:
Flow rates before confluence point:
34.155 1.980
Maximum flow rates at confluence using above data:
36.110 35.086
Area of streams before confluence:
11.280 0.560

Results of confluence:

Total flow rate = 36.110(CFS)
Time of concentration = 8.544 min.
Effective stream area after confluence = 11.840(Ac.)

++
Process from Point/Station 18.000 to Point/Station 19.000
**** INITIAL AREA EVALUATION ****

____

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 128.000(Ft.)
Highest elevation = 484.850(Ft.)
Lowest elevation = 484.200(Ft.)
Elevation difference = 0.650(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 5.62 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(128.000^.5)/(0.508^(1/3)]= 5.62
Rainfall intensity (I) = 4.052(In/Hr) for a 50.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.535(CFS)
Total initial stream area = 0.150(Ac.)

++
Process from Point/Station 19.000 to Point/Station 20.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

____

Upstream point/station elevation = 482.400(Ft.)
Downstream point/station elevation = 481.150(Ft.)
Pipe length = 250.00(Ft.) Manning's N = 0.013
No. of pipes = 2 Required pipe flow = 0.535(CFS)
Given pipe size = 6.00(In.)
Calculated individual pipe flow = 0.267(CFS)
Normal flow depth in pipe = 3.61(In.)
Flow top width inside pipe = 5.87(In.)
Critical Depth = 3.13(In.)
Pipe flow velocity = 2.17(Ft/s)
Travel time through pipe = 1.92 min.
Time of concentration (TC) = 7.54 min.

++
Process from Point/Station 19.000 to Point/Station 20.000
**** SUBAREA FLOW ADDITION ****

____

User specified 'C' value of 0.880 given for subarea
Time of concentration = 7.54 min.
Rainfall intensity = 3.578(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 2.078(CFS) for 0.660(Ac.)
Total runoff = 2.613(CFS) Total area = 0.81(Ac.)

++
Process from Point/Station 20.000 to Point/Station 21.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

____

Upstream point/station elevation = 481.150(Ft.)
Downstream point/station elevation = 479.140(Ft.)

Pipe length = 401.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 2.613(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 2.613(CFS)
Normal flow depth in pipe = 8.12(In.)
Flow top width inside pipe = 14.95(In.)
Critical Depth = 7.77(In.)
Pipe flow velocity = 3.85(Ft/s)
Travel time through pipe = 1.74 min.
Time of concentration (TC) = 9.27 min.

++
Process from Point/Station 20.000 to Point/Station 21.000
**** SUBAREA FLOW ADDITION ****

____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 9.27 min.
Rainfall intensity = 3.288(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.579(CFS) for 0.200(Ac.)
Total runoff = 3.192(CFS) Total area = 1.01(Ac.)

++
Process from Point/Station 20.000 to Point/Station 21.000
**** SUBAREA FLOW ADDITION ****

____
User specified 'C' value of 0.880 given for subarea
Time of concentration = 9.27 min.
Rainfall intensity = 3.288(In/Hr) for a 50.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff = 0.232(CFS) for 0.080(Ac.)
Total runoff = 3.423(CFS) Total area = 1.09(Ac.)

++
Process from Point/Station 21.000 to Point/Station 30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

____
Upstream point/station elevation = 479.140(Ft.)
Downstream point/station elevation = 479.000(Ft.)
Pipe length = 15.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 3.423(CFS)
Given pipe size = 15.00(In.)
Calculated individual pipe flow = 3.423(CFS)
Normal flow depth in pipe = 7.92(In.)
Flow top width inside pipe = 14.98(In.)
Critical Depth = 8.95(In.)
Pipe flow velocity = 5.20(Ft/s)
Travel time through pipe = 0.05 min.
Time of concentration (TC) = 9.32 min.

++
Process from Point/Station 21.000 to Point/Station 30.000
**** CONFLUENCE OF MAIN STREAMS ****

____
The following data inside Main Stream is listed:
In Main Stream number: 3

Stream flow area = 1.090(Ac.)
Runoff from this stream = 3.423(CFS)
Time of concentration = 9.32 min.
Rainfall intensity = 3.282(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	34.155	8.54	3.399
2	1.980	8.28	3.442
3	3.423	9.32	3.282

Qmax(1) =
1.000 * 1.000 * 34.155) +
0.987 * 1.000 * 1.980) +
1.000 * 0.917 * 3.423) + = 39.248
Qmax(2) =
1.000 * 0.969 * 34.155) +
1.000 * 1.000 * 1.980) +
1.000 * 0.889 * 3.423) + = 38.127
Qmax(3) =
0.966 * 1.000 * 34.155) +
0.953 * 1.000 * 1.980) +
1.000 * 1.000 * 3.423) + = 38.288

Total of 3 main streams to confluence:
Flow rates before confluence point:
34.155 1.980 3.423
Maximum flow rates at confluence using above data:
39.248 38.127 38.288
Area of streams before confluence:
11.280 0.560 1.090

Results of confluence:
Total flow rate = 39.248(CFS)
Time of concentration = 8.544 min.
Effective stream area after confluence = 12.930(Ac.)

++
Process from Point/Station 40.000 to Point/Station 41.000
**** INITIAL AREA EVALUATION ****

User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance = 110.000(Ft.)
Highest elevation = 485.000(Ft.)
Lowest elevation = 476.800(Ft.)
Elevation difference = 8.200(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 2.13 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(110.000^.5)/(7.455^(1/3)]= 2.13
Setting time of concentration to 5 minutes
Rainfall intensity (I) = 4.265(In/Hr) for a 50.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff = 0.751(CFS)
Total initial stream area = 0.200(Ac.)
End of computations, total study area = 37.490 (Ac.)

CIVILCADD / CIVIL DESIGN PEAK CALCULATIONS:

100 Year, Post-Development Conditions

100 YEAR HYDROLOGY

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San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2005 Version 6.4

Rational method hydrology  program based on
San Diego County Flood Control Division 1985 hydrology manual
      Rational Hydrology Study        Date: 07/18/20
------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

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


Program License Serial Number 4035

------------------------------------------------------------------------
Rational hydrology study storm event year is   100.0
English (in-lb) input data Units used
English (in) rainfall data used

Standard intensity of Appendix I-B used for year and
Elevation 0 - 1500 feet
Factor (to multiply * intensity)  =  1.000
Only used if inside City of San Diego
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       1.000 to Point/Station       2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
______________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type                        ]
Rainfall intensity (I) =      2.922(In/Hr) for a   100.0 year storm
User specified values are as follows:
TC =  14.78 min.  Rain intensity =       2.92(In/Hr)
Total area =        7.570(Ac.)  Total runoff =    23.880(CFS)


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Process from Point/Station       1.000 to Point/Station       2.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type                        ]
Time of concentration =    14.78 min.
Rainfall intensity =      2.922(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      0.333(CFS) for    0.120(Ac.)
Total runoff =     24.213(CFS)   Total area =        7.69(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       1.000 to Point/Station       2.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      7.690(Ac.)
```

```
Runoff from this stream =     24.213(CFS)
Time of concentration =   14.78 min.
Rainfall intensity =     2.922(In/Hr)
Summary of stream data:

Stream   Flow rate      TC            Rainfall Intensity
 No.       (CFS)       (min)                 (In/Hr)


1       24.213     14.78            2.922
Qmax(1) =
          1.000 *    1.000 *    24.213) + =      24.213

Total of 1 streams to confluence:
Flow rates before confluence point:
      24.213
Maximum flow rates at confluence using above data:
       24.213
Area of streams before confluence:
        7.690
Results of confluence:
Total flow rate =     24.213(CFS)
Time of concentration =    14.780 min.
Effective stream area after confluence =      7.690(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       3.000 to Point/Station       4.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
______________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type                     ]
Rainfall intensity (I) =      2.922(In/Hr) for a   100.0 year storm
User specified values are as follows:
TC =  14.78 min.  Rain intensity =       2.92(In/Hr)
Total area =       16.520(Ac.)  Total runoff =    21.630(CFS)


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Process from Point/Station       3.000 to Point/Station       4.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type                     ]
Time of concentration =    14.78 min.
Rainfall intensity =      2.922(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      0.416(CFS) for    0.150(Ac.)
Total runoff =     22.046(CFS)   Total area =       16.67(Ac.)


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Process from Point/Station       4.000 to Point/Station       2.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   481.280(Ft.)
Downstream point/station elevation =   479.000(Ft.)
Pipe length  =   458.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    22.046(CFS)
Given pipe size =     24.00(In.)
NOTE: Normal flow is pressure flow in user selected pipe size.
```

```
The approximate hydraulic grade line above the pipe invert is
     2.986(Ft.)  at the headworks or inlet of the pipe(s)
 Pipe friction loss =      4.348(Ft.)
 Minor friction loss =      0.918(Ft.)  K-factor =   1.20
Pipe flow velocity =      7.02(Ft/s)
Travel time through pipe =    1.09 min.
Time of concentration (TC) =    15.87 min.


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Process from Point/Station       4.000 to Point/Station       2.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =     16.670(Ac.)
Runoff from this stream =     22.046(CFS)
Time of concentration =   15.87 min.
Rainfall intensity =     2.842(In/Hr)
Summary of stream data:

Stream   Flow rate      TC           Rainfall Intensity
 No.       (CFS)       (min)                 (In/Hr)


1       24.213     14.78            2.922
2       22.046     15.87            2.842
Qmax(1) =
          1.000 *    1.000 *    24.213) +
          1.000 *    0.931 *    22.046) + =      44.748
Qmax(2) =
          0.973 *    1.000 *    24.213) +
          1.000 *    1.000 *    22.046) + =      45.599

Total of 2 streams to confluence:
Flow rates before confluence point:
      24.213      22.046
Maximum flow rates at confluence using above data:
       44.748       45.599
Area of streams before confluence:
        7.690       16.670
Results of confluence:
Total flow rate =     45.599(CFS)
Time of concentration =    15.868 min.
Effective stream area after confluence =     24.360(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       2.000 to Point/Station       5.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   478.200(Ft.)
Downstream point/station elevation =   476.260(Ft.)
Pipe length  =   283.00(Ft.)   Manning's N = 0.013
No. of pipes = 3  Required pipe flow  =    45.599(CFS)
Given pipe size =     24.00(In.)
Calculated individual pipe flow  =    15.200(CFS)
Normal flow depth in pipe =   16.41(In.)
Flow top width inside pipe =   22.32(In.)
Critical Depth =   16.86(In.)
Pipe flow velocity =      6.64(Ft/s)
Travel time through pipe =    0.71 min.
Time of concentration (TC) =    16.58 min.


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Process from Point/Station       5.000 to Point/Station       6.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
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______________________________________________________________________
Upstream point/station elevation =   476.260(Ft.)
Downstream point/station elevation =   475.150(Ft.)
Pipe length  =   221.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    45.599(CFS)
Given pipe size =     36.00(In.)
Calculated individual pipe flow  =    45.599(CFS)
Normal flow depth in pipe =   28.41(In.)
Flow top width inside pipe =   29.37(In.)
Critical Depth =   26.41(In.)
Pipe flow velocity =      7.62(Ft/s)
Travel time through pipe =    0.48 min.
Time of concentration (TC) =    17.06 min.


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Process from Point/Station        6.000 to Point/Station       50.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   475.150(Ft.)
Downstream point/station elevation =   475.000(Ft.)
Pipe length  =    29.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    45.599(CFS)
Given pipe size =     36.00(In.)
Calculated individual pipe flow  =    45.599(CFS)
Normal flow depth in pipe =   28.03(In.)
Flow top width inside pipe =   29.89(In.)
Critical Depth =   26.41(In.)
Pipe flow velocity =      7.72(Ft/s)
Travel time through pipe =    0.06 min.
Time of concentration (TC) =    17.12 min.


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Process from Point/Station        7.000 to Point/Station        8.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance  =   98.000(Ft.)
Highest elevation =  484.700(Ft.)
Lowest elevation =  484.350(Ft.)
Elevation difference =    0.350(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     5.53 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*(  98.000^.5)/( 0.357^(1/3)]=   5.53
Rainfall intensity (I) =      4.215(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff =      0.853(CFS)
Total initial stream area =        0.230(Ac.)


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Process from Point/Station        8.000 to Point/Station        9.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   482.350(Ft.)
Downstream point/station elevation =   481.270(Ft.)
Pipe length  =   208.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     0.853(CFS)
Given pipe size =     10.00(In.)
Calculated individual pipe flow  =     0.853(CFS)
Normal flow depth in pipe =    5.24(In.)
Flow top width inside pipe =    9.99(In.)
Critical Depth =    4.90(In.)
Pipe flow velocity =      2.95(Ft/s)
Travel time through pipe =    1.17 min.
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Time of concentration (TC) =     6.70 min.


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Process from Point/Station       8.000 to Point/Station       9.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
User specified 'C' value of 0.880 given for subarea
Time of concentration =     6.70 min.
Rainfall intensity =      3.911(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff =      2.960(CFS) for    0.860(Ac.)
Total runoff =      3.813(CFS)   Total area =       1.09(Ac.)


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Process from Point/Station       9.000 to Point/Station      10.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   481.270(Ft.)
Downstream point/station elevation =   480.310(Ft.)
Pipe length  =   193.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     3.813(CFS)
Given pipe size =     15.00(In.)
Calculated individual pipe flow  =     3.813(CFS)
Normal flow depth in pipe =   10.50(In.)
Flow top width inside pipe =   13.75(In.)
Critical Depth =    9.48(In.)
Pipe flow velocity =      4.16(Ft/s)
Travel time through pipe =    0.77 min.
Time of concentration (TC) =     7.47 min.


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Process from Point/Station      10.000 to Point/Station      11.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   480.310(Ft.)
Downstream point/station elevation =   479.340(Ft.)
Pipe length  =   194.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     3.813(CFS)
Given pipe size =     15.00(In.)
Calculated individual pipe flow  =     3.813(CFS)
Normal flow depth in pipe =   10.48(In.)
Flow top width inside pipe =   13.77(In.)
Critical Depth =    9.48(In.)
Pipe flow velocity =      4.17(Ft/s)
Travel time through pipe =    0.78 min.
Time of concentration (TC) =     8.25 min.


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Process from Point/Station      11.000 to Point/Station      12.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   479.340(Ft.)
Downstream point/station elevation =   479.120(Ft.)
Pipe length  =    45.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     3.813(CFS)
Given pipe size =     15.00(In.)
Calculated individual pipe flow  =     3.813(CFS)
Normal flow depth in pipe =   10.57(In.)
Flow top width inside pipe =   13.69(In.)
Critical Depth =    9.48(In.)
Pipe flow velocity =      4.13(Ft/s)
Travel time through pipe =    0.18 min.
Time of concentration (TC) =     8.43 min.
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Process from Point/Station       11.000 to Point/Station      12.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
User specified 'C' value of 0.880 given for subarea
Time of concentration =     8.43 min.
Rainfall intensity =      3.590(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff =      1.927(CFS) for    0.610(Ac.)
Total runoff =      5.740(CFS)   Total area =       1.70(Ac.)


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Process from Point/Station       11.000 to Point/Station      12.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
User specified 'C' value of 0.880 given for subarea
Time of concentration =     8.43 min.
Rainfall intensity =      3.590(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff =      0.253(CFS) for    0.080(Ac.)
Total runoff =      5.993(CFS)   Total area =       1.78(Ac.)


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Process from Point/Station       11.000 to Point/Station      12.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
User specified 'C' value of 0.880 given for subarea
Time of concentration =     8.43 min.
Rainfall intensity =      3.590(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff =      0.063(CFS) for    0.020(Ac.)
Total runoff =      6.056(CFS)   Total area =       1.80(Ac.)


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Process from Point/Station       12.000 to Point/Station      30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   479.120(Ft.)
Downstream point/station elevation =   479.000(Ft.)
Pipe length  =    25.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     6.056(CFS)
Given pipe size =     18.00(In.)
Calculated individual pipe flow  =     6.056(CFS)
Normal flow depth in pipe =   12.54(In.)
Flow top width inside pipe =   16.55(In.)
Critical Depth =   11.40(In.)
Pipe flow velocity =      4.61(Ft/s)
Travel time through pipe =    0.09 min.
Time of concentration (TC) =     8.52 min.


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Process from Point/Station       12.000 to Point/Station      30.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
User specified 'C' value of 0.880 given for subarea
Time of concentration =     8.52 min.
Rainfall intensity =      3.576(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff =      5.286(CFS) for    1.680(Ac.)
Total runoff =     11.342(CFS)   Total area =       3.48(Ac.)
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Process from Point/Station       12.000 to Point/Station      30.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
User specified 'C' value of 0.880 given for subarea
Time of concentration =     8.52 min.
Rainfall intensity =      3.576(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff =      5.947(CFS) for    1.890(Ac.)
Total runoff =     17.289(CFS)   Total area =       5.37(Ac.)


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Process from Point/Station       12.000 to Point/Station      30.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
User specified 'C' value of 0.880 given for subarea
Time of concentration =     8.52 min.
Rainfall intensity =      3.576(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff =      6.640(CFS) for    2.110(Ac.)
Total runoff =     23.929(CFS)   Total area =       7.48(Ac.)


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Process from Point/Station       12.000 to Point/Station      30.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
User specified 'C' value of 0.880 given for subarea
Time of concentration =     8.52 min.
Rainfall intensity =      3.576(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff =      5.192(CFS) for    1.650(Ac.)
Total runoff =     29.121(CFS)   Total area =       9.13(Ac.)


+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       12.000 to Point/Station      30.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
User specified 'C' value of 0.880 given for subarea
Time of concentration =     8.52 min.
Rainfall intensity =      3.576(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff =      4.689(CFS) for    1.490(Ac.)
Total runoff =     33.810(CFS)   Total area =      10.62(Ac.)


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Process from Point/Station       12.000 to Point/Station      30.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
User specified 'C' value of 0.880 given for subarea
Time of concentration =     8.52 min.
Rainfall intensity =      3.576(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff =      2.077(CFS) for    0.660(Ac.)
Total runoff =     35.886(CFS)   Total area =      11.28(Ac.)


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Process from Point/Station       12.000 to Point/Station      30.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
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```
Stream flow area =     11.280(Ac.)
Runoff from this stream =     35.886(CFS)
Time of concentration =    8.52 min.
Rainfall intensity =     3.576(In/Hr)
Summary of stream data:

Stream   Flow rate      TC            Rainfall Intensity
 No.       (CFS)       (min)                 (In/Hr)


1       35.886      8.52            3.576
Qmax(1) =
          1.000 *    1.000 *    35.886) + =      35.886

Total of 1 main streams to confluence:
Flow rates before confluence point:
      35.886
Maximum flow rates at confluence using above data:
       35.886
Area of streams before confluence:
       11.280


Results of confluence:
Total flow rate =     35.886(CFS)
Time of concentration =     8.522 min.
Effective stream area after confluence  =     11.280(Ac.)


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Process from Point/Station        7.000 to Point/Station       15.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance  =  100.000(Ft.)
Highest elevation =  484.700(Ft.)
Lowest elevation =  484.200(Ft.)
Elevation difference =    0.500(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     4.99 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*( 100.000^.5)/(   0.500^(1/3)]=   4.99
Setting time of concentration to 5 minutes
Rainfall intensity (I) =      4.389(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff =      0.888(CFS)
Total initial stream area =        0.230(Ac.)


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Process from Point/Station       15.000 to Point/Station       16.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   482.250(Ft.)
Downstream point/station elevation =   481.100(Ft.)
Pipe length  =   233.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     0.888(CFS)
Given pipe size =     10.00(In.)
Calculated individual pipe flow  =     0.888(CFS)
Normal flow depth in pipe =    5.45(In.)
Flow top width inside pipe =    9.96(In.)
Critical Depth =    5.01(In.)
Pipe flow velocity =      2.92(Ft/s)
Travel time through pipe =    1.33 min.
Time of concentration (TC) =     6.33 min.
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Process from Point/Station       15.000 to Point/Station       16.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
User specified 'C' value of 0.880 given for subarea
Time of concentration =     6.33 min.
Rainfall intensity =      3.997(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff =      1.161(CFS) for    0.330(Ac.)
Total runoff =      2.049(CFS)   Total area =       0.56(Ac.)


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Process from Point/Station       16.000 to Point/Station       30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   481.100(Ft.)
Downstream point/station elevation =   479.000(Ft.)
Pipe length  =   416.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     2.049(CFS)
Given pipe size =     12.00(In.)
Calculated individual pipe flow  =     2.049(CFS)
Normal flow depth in pipe =    8.19(In.)
Flow top width inside pipe =   11.17(In.)
Critical Depth =    7.33(In.)
Pipe flow velocity =      3.59(Ft/s)
Travel time through pipe =    1.93 min.
Time of concentration (TC) =     8.26 min.


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Process from Point/Station       16.000 to Point/Station       30.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =      0.560(Ac.)
Runoff from this stream =      2.049(CFS)
Time of concentration =    8.26 min.
Rainfall intensity =     3.617(In/Hr)
Summary of stream data:

Stream   Flow rate      TC            Rainfall Intensity
 No.       (CFS)       (min)                 (In/Hr)


1       35.886      8.52            3.576
2        2.049      8.26            3.617
Qmax(1) =
         1.000 *    1.000 *    35.886) +
         0.989 *    1.000 *     2.049) + =      37.912
Qmax(2) =
         1.000 *    0.969 *    35.886) +
         1.000 *    1.000 *     2.049) + =      36.835

Total of 2 main streams to confluence:
Flow rates before confluence point:
      35.886       2.049
Maximum flow rates at confluence using above data:
       37.912       36.835
Area of streams before confluence:
       11.280        0.560


Results of confluence:
Total flow rate =     37.912(CFS)
Time of concentration =     8.522 min.
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Effective stream area after confluence  =     11.840(Ac.)


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Process from Point/Station       18.000 to Point/Station      19.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance  =  128.000(Ft.)
Highest elevation =  484.850(Ft.)
Lowest elevation =  484.200(Ft.)
Elevation difference =    0.650(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     5.62 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*( 128.000^.5)/( 0.508^(1/3)]=   5.62
Rainfall intensity (I) =      4.188(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff =      0.553(CFS)
Total initial stream area =        0.150(Ac.)


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Process from Point/Station       19.000 to Point/Station      20.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   482.400(Ft.)
Downstream point/station elevation =   481.150(Ft.)
Pipe length  =   250.00(Ft.)   Manning's N = 0.013
No. of pipes = 2  Required pipe flow  =     0.553(CFS)
Given pipe size =      6.00(In.)
Calculated individual pipe flow  =     0.276(CFS)
Normal flow depth in pipe =    3.68(In.)
Flow top width inside pipe =    5.84(In.)
Critical Depth =    3.18(In.)
Pipe flow velocity =      2.18(Ft/s)
Travel time through pipe =    1.91 min.
Time of concentration (TC) =     7.52 min.


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Process from Point/Station       19.000 to Point/Station      20.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
User specified 'C' value of 0.880 given for subarea
Time of concentration =     7.52 min.
Rainfall intensity =      3.744(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff =      2.174(CFS) for    0.660(Ac.)
Total runoff =      2.727(CFS)   Total area =        0.81(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       20.000 to Point/Station      21.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   481.150(Ft.)
Downstream point/station elevation =   479.140(Ft.)
Pipe length  =   401.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     2.727(CFS)
Given pipe size =     15.00(In.)
Calculated individual pipe flow  =     2.727(CFS)
Normal flow depth in pipe =    8.34(In.)
Flow top width inside pipe =   14.90(In.)
Critical Depth =    7.96(In.)
Pipe flow velocity =      3.89(Ft/s)
Travel time through pipe =    1.72 min.
```

```
Time of concentration (TC) =     9.24 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      20.000 to Point/Station      21.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
User specified 'C' value of 0.880 given for subarea
Time of concentration =     9.24 min.
Rainfall intensity =      3.472(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff =      0.611(CFS) for    0.200(Ac.)
Total runoff =      3.338(CFS)   Total area =        1.01(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      20.000 to Point/Station      21.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
User specified 'C' value of 0.880 given for subarea
Time of concentration =     9.24 min.
Rainfall intensity =      3.472(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.880
Subarea runoff =      0.244(CFS) for    0.080(Ac.)
Total runoff =      3.583(CFS)   Total area =        1.09(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      21.000 to Point/Station      30.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****
______________________________________________________________________
Upstream point/station elevation =   479.140(Ft.)
Downstream point/station elevation =   479.000(Ft.)
Pipe length  =    15.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     3.583(CFS)
Given pipe size =     15.00(In.)
Calculated individual pipe flow  =     3.583(CFS)
Normal flow depth in pipe =    8.14(In.)
Flow top width inside pipe =   14.94(In.)
Critical Depth =    9.18(In.)
Pipe flow velocity =      5.26(Ft/s)
Travel time through pipe =    0.05 min.
Time of concentration (TC) =     9.29 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      21.000 to Point/Station      30.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 3
Stream flow area =      1.090(Ac.)
Runoff from this stream =      3.583(CFS)
Time of concentration =    9.29 min.
Rainfall intensity =     3.465(In/Hr)
Summary of stream data:

Stream   Flow rate      TC            Rainfall Intensity
 No.       (CFS)       (min)                 (In/Hr)


1       35.886      8.52           3.576
2        2.049      8.26           3.617
3        3.583      9.29           3.465
Qmax(1) =
          1.000 *    1.000 *    35.886) +
          0.989 *    1.000 *     2.049) +
```

```
         1.000 *    0.917 *     3.583) + =      41.199
Qmax(2) =
         1.000 *    0.969 *    35.886) +
         1.000 *    1.000 *     2.049) +
         1.000 *    0.889 *     3.583) + =      40.021
Qmax(3) =
         0.969 *    1.000 *    35.886) +
         0.958 *    1.000 *     2.049) +
         1.000 *    1.000 *     3.583) + =      40.323

Total of 3 main streams to confluence:
Flow rates before confluence point:
      35.886       2.049       3.583
Maximum flow rates at confluence using above data:
       41.199       40.021       40.323
Area of streams before confluence:
       11.280        0.560        1.090


Results of confluence:
Total flow rate =     41.199(CFS)
Time of concentration =     8.522 min.
Effective stream area after confluence  =     12.930(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       40.000 to Point/Station       41.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
User specified 'C' value of 0.880 given for subarea
Initial subarea flow distance  =  110.000(Ft.)
Highest elevation =  485.000(Ft.)
Lowest elevation =  476.800(Ft.)
Elevation difference =    8.200(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) =     2.13 min.
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8800)*( 110.000^.5)/(   7.455^(1/3)]=   2.13
Setting time of concentration to 5 minutes
Rainfall intensity (I) =      4.389(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.880
Subarea runoff =      0.772(CFS)
Total initial stream area =        0.200(Ac.)
End of computations, total study area =          37.490 (Ac.)
```

RAT HYDRO (Information and Results)


Rational Method Hydrograph
Rick Engineering Company
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Dennis Bowling (619) 291-0707, DBowling@RickEngineering.com
Generate Rational Method Hydrograph
Required Entry Fields
Rational Method Time of Concentration (In Minutes)
8.52
6 Hour Rainfall (In Inches)
2.25
Basin Area (In Acres)
13.93
Rational Method Runoff Coefficient
0.88
Peak Discharge (In CFS)
41.20
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Generate Rational Method Hydrograph

Required Entry Fields

Rational Method Time of Concentration (In Minutes)	8.55
6 Hour Rainfall (In Inches)	2.01
Basin Area (In Acres)	12.93
Rational Method Runoff Coefficient	0.88
Peak Discharge (In CFS)	39.24

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Generate Rational Method Hydrograph

Required Entry Fields

Rational Method Time of Concentration (In Minutes)	8.62
6 Hour Rainfall (In Inches)	1.77
Basin Area (In Acres)	12.93
Rational Method Runoff Coefficient	0.88
Peak Discharge (In CFS)	34.70

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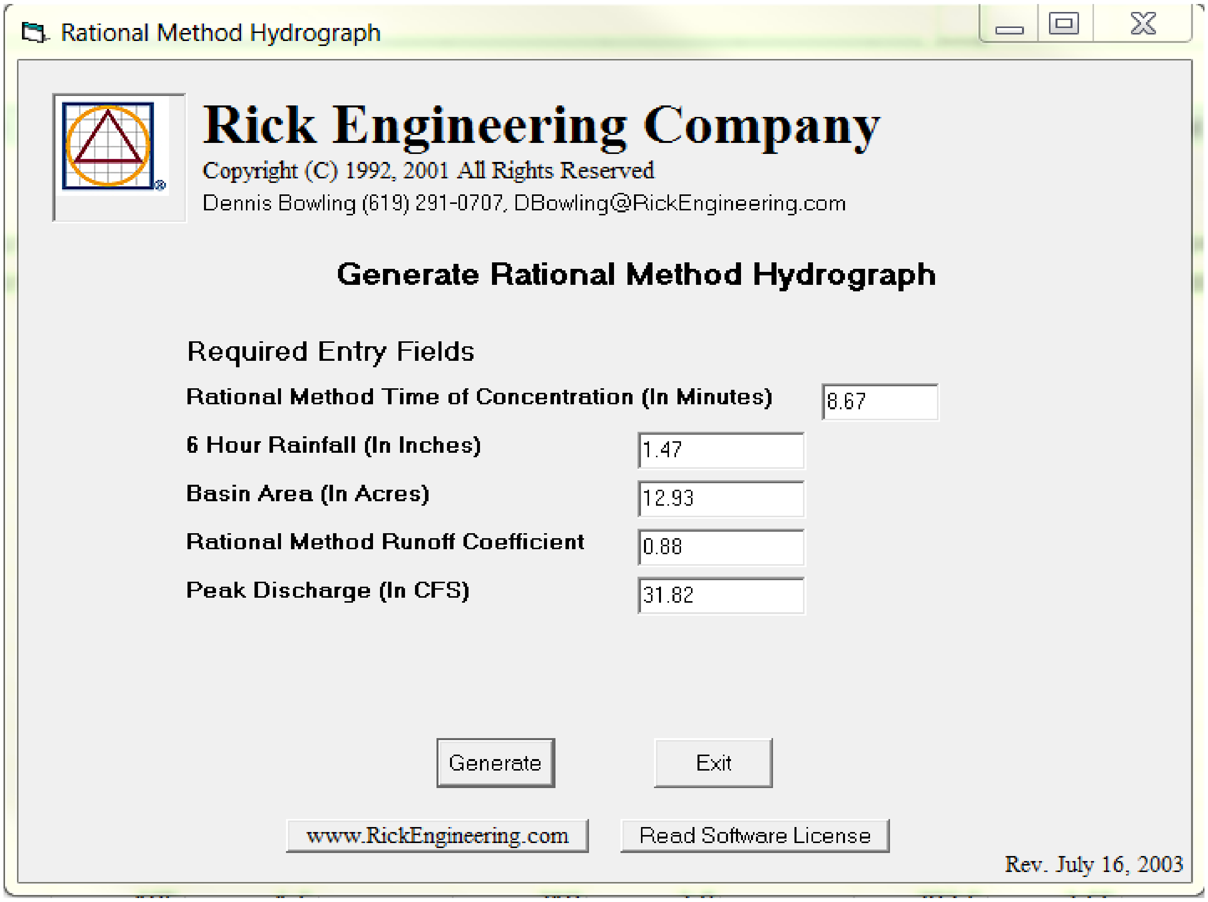
Rational Method Hydrograph
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Generate Rational Method Hydrograph
Required Entry Fields
Rational Method Time of Concentration (In Minutes) 8.67
6 Hour Rainfall (In Inches) 1.47
Basin Area (In Acres) 12.93
Rational Method Runoff Coefficient 0.88
Peak Discharge (In CFS) 31.82
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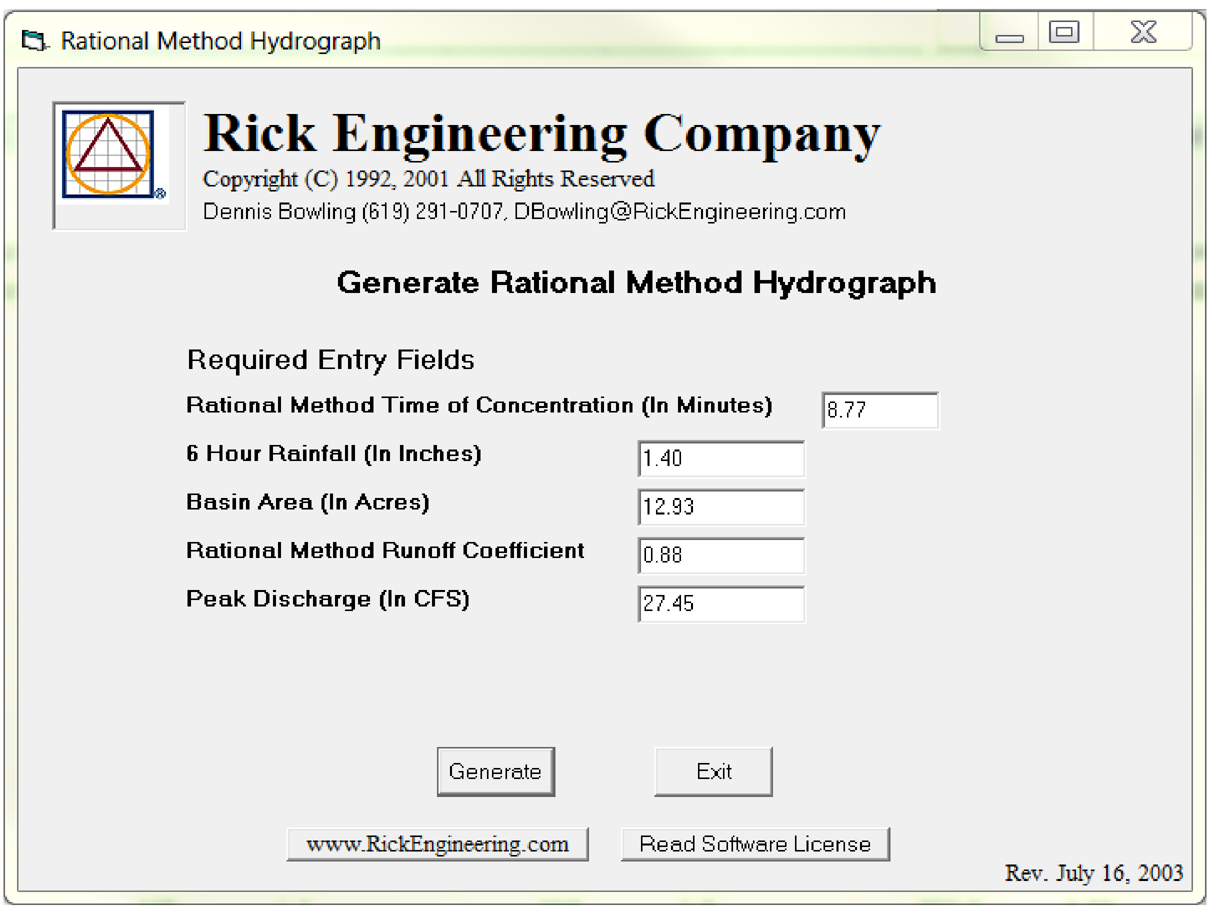
Rational Method Hydrograph
Rick Engineering Company
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Dennis Bowling (619) 291-0707, DBowling@RickEngineering.com
Generate Rational Method Hydrograph
Required Entry Fields
Rational Method Time of Concentration (In Minutes) 8.77
6 Hour Rainfall (In Inches) 1.40
Basin Area (In Acres) 12.93
Rational Method Runoff Coefficient 0.88
Peak Discharge (In CFS) 27.45
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Rev. July 16, 2003

RATIONAL METHOD HYDROGRAPH PROGRAM

RUN DATE 5/18/2020
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 9 MIN.
6 HOUR RAINFALL 1.4 INCHES
BASIN AREA 12.93 ACRES
RUNOFF COEFFICIENT 0.88
PEAK DISCHARGE 27.45 CFS

TIME (MIN) = 0	DISCHARGE (CFS) = 0
TIME (MIN) = 9	DISCHARGE (CFS) = 0
TIME (MIN) = 18	DISCHARGE (CFS) = 1
TIME (MIN) = 27	DISCHARGE (CFS) = 1
TIME (MIN) = 36	DISCHARGE (CFS) = 1
TIME (MIN) = 45	DISCHARGE (CFS) = 1
TIME (MIN) = 54	DISCHARGE (CFS) = 1.1
TIME (MIN) = 63	DISCHARGE (CFS) = 1.1
TIME (MIN) = 72	DISCHARGE (CFS) = 1.1
TIME (MIN) = 81	DISCHARGE (CFS) = 1.2
TIME (MIN) = 90	DISCHARGE (CFS) = 1.2
TIME (MIN) = 99	DISCHARGE (CFS) = 1.3
TIME (MIN) = 108	DISCHARGE (CFS) = 1.3
TIME (MIN) = 117	DISCHARGE (CFS) = 1.4
TIME (MIN) = 126	DISCHARGE (CFS) = 1.5
TIME (MIN) = 135	DISCHARGE (CFS) = 1.5
TIME (MIN) = 144	DISCHARGE (CFS) = 1.6
TIME (MIN) = 153	DISCHARGE (CFS) = 1.7
TIME (MIN) = 162	DISCHARGE (CFS) = 1.8
TIME (MIN) = 171	DISCHARGE (CFS) = 1.9
TIME (MIN) = 180	DISCHARGE (CFS) = 2.1
TIME (MIN) = 189	DISCHARGE (CFS) = 2.2
TIME (MIN) = 198	DISCHARGE (CFS) = 2.6
TIME (MIN) = 207	DISCHARGE (CFS) = 2.8
TIME (MIN) = 216	DISCHARGE (CFS) = 3.4
TIME (MIN) = 225	DISCHARGE (CFS) = 3.9
TIME (MIN) = 234	DISCHARGE (CFS) = 5.7
TIME (MIN) = 243	DISCHARGE (CFS) = 9.3
TIME (MIN) = 252	DISCHARGE (CFS) = 27.45
TIME (MIN) = 261	DISCHARGE (CFS) = 4.6
TIME (MIN) = 270	DISCHARGE (CFS) = 3.1
TIME (MIN) = 279	DISCHARGE (CFS) = 2.4
TIME (MIN) = 288	DISCHARGE (CFS) = 2
TIME (MIN) = 297	DISCHARGE (CFS) = 1.7
TIME (MIN) = 306	DISCHARGE (CFS) = 1.6
TIME (MIN) = 315	DISCHARGE (CFS) = 1.4
TIME (MIN) = 324	DISCHARGE (CFS) = 1.3
TIME (MIN) = 333	DISCHARGE (CFS) = 1.2
TIME (MIN) = 342	DISCHARGE (CFS) = 1.1
TIME (MIN) = 351	DISCHARGE (CFS) = 1.1
TIME (MIN) = 360	DISCHARGE (CFS) = 1
TIME (MIN) = 369	DISCHARGE (CFS) = 0

RATIONAL METHOD HYDROGRAPH PROGRAM

RUN DATE 5/18/2020
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 9 MIN.
6 HOUR RAINFALL 1.47 INCHES
BASIN AREA 12.93 ACRES
RUNOFF COEFFICIENT 0.88
PEAK DISCHARGE 31.82 CFS

TIME (MIN) = 0	DISCHARGE (CFS) = 0
TIME (MIN) = 9	DISCHARGE (CFS) = 0
TIME (MIN) = 18	DISCHARGE (CFS) = 1
TIME (MIN) = 27	DISCHARGE (CFS) = 1
TIME (MIN) = 36	DISCHARGE (CFS) = 1.1
TIME (MIN) = 45	DISCHARGE (CFS) = 1.1
TIME (MIN) = 54	DISCHARGE (CFS) = 1.1
TIME (MIN) = 63	DISCHARGE (CFS) = 1.2
TIME (MIN) = 72	DISCHARGE (CFS) = 1.2
TIME (MIN) = 81	DISCHARGE (CFS) = 1.2
TIME (MIN) = 90	DISCHARGE (CFS) = 1.3
TIME (MIN) = 99	DISCHARGE (CFS) = 1.3
TIME (MIN) = 108	DISCHARGE (CFS) = 1.4
TIME (MIN) = 117	DISCHARGE (CFS) = 1.4
TIME (MIN) = 126	DISCHARGE (CFS) = 1.5
TIME (MIN) = 135	DISCHARGE (CFS) = 1.6
TIME (MIN) = 144	DISCHARGE (CFS) = 1.7
TIME (MIN) = 153	DISCHARGE (CFS) = 1.8
TIME (MIN) = 162	DISCHARGE (CFS) = 1.9
TIME (MIN) = 171	DISCHARGE (CFS) = 2
TIME (MIN) = 180	DISCHARGE (CFS) = 2.2
TIME (MIN) = 189	DISCHARGE (CFS) = 2.4
TIME (MIN) = 198	DISCHARGE (CFS) = 2.7
TIME (MIN) = 207	DISCHARGE (CFS) = 2.9
TIME (MIN) = 216	DISCHARGE (CFS) = 3.6
TIME (MIN) = 225	DISCHARGE (CFS) = 4.1
TIME (MIN) = 234	DISCHARGE (CFS) = 6
TIME (MIN) = 243	DISCHARGE (CFS) = 6.8
TIME (MIN) = 252	DISCHARGE (CFS) = 31.82
TIME (MIN) = 261	DISCHARGE (CFS) = 4.8
TIME (MIN) = 270	DISCHARGE (CFS) = 3.2
TIME (MIN) = 279	DISCHARGE (CFS) = 2.5
TIME (MIN) = 288	DISCHARGE (CFS) = 2.1
TIME (MIN) = 297	DISCHARGE (CFS) = 1.8
TIME (MIN) = 306	DISCHARGE (CFS) = 1.6
TIME (MIN) = 315	DISCHARGE (CFS) = 1.5
TIME (MIN) = 324	DISCHARGE (CFS) = 1.4
TIME (MIN) = 333	DISCHARGE (CFS) = 1.3
TIME (MIN) = 342	DISCHARGE (CFS) = 1.2
TIME (MIN) = 351	DISCHARGE (CFS) = 1.1
TIME (MIN) = 360	DISCHARGE (CFS) = 1.1
TIME (MIN) = 369	DISCHARGE (CFS) = 0

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RUN DATE 5/18/2020
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 9 MIN.
6 HOUR RAINFALL 1.77 INCHES
BASIN AREA 12.93 ACRES
RUNOFF COEFFICIENT 0.88
PEAK DISCHARGE 34.7 CFS

TIME (MIN) = 0	DISCHARGE (CFS) = 0
TIME (MIN) = 9	DISCHARGE (CFS) = 0
TIME (MIN) = 18	DISCHARGE (CFS) = 1.2
TIME (MIN) = 27	DISCHARGE (CFS) = 1.2
TIME (MIN) = 36	DISCHARGE (CFS) = 1.3
TIME (MIN) = 45	DISCHARGE (CFS) = 1.3
TIME (MIN) = 54	DISCHARGE (CFS) = 1.4
TIME (MIN) = 63	DISCHARGE (CFS) = 1.4
TIME (MIN) = 72	DISCHARGE (CFS) = 1.5
TIME (MIN) = 81	DISCHARGE (CFS) = 1.5
TIME (MIN) = 90	DISCHARGE (CFS) = 1.6
TIME (MIN) = 99	DISCHARGE (CFS) = 1.6
TIME (MIN) = 108	DISCHARGE (CFS) = 1.7
TIME (MIN) = 117	DISCHARGE (CFS) = 1.7
TIME (MIN) = 126	DISCHARGE (CFS) = 1.8
TIME (MIN) = 135	DISCHARGE (CFS) = 1.9
TIME (MIN) = 144	DISCHARGE (CFS) = 2
TIME (MIN) = 153	DISCHARGE (CFS) = 2.1
TIME (MIN) = 162	DISCHARGE (CFS) = 2.3
TIME (MIN) = 171	DISCHARGE (CFS) = 2.4
TIME (MIN) = 180	DISCHARGE (CFS) = 2.7
TIME (MIN) = 189	DISCHARGE (CFS) = 2.8
TIME (MIN) = 198	DISCHARGE (CFS) = 3.2
TIME (MIN) = 207	DISCHARGE (CFS) = 3.5
TIME (MIN) = 216	DISCHARGE (CFS) = 4.3
TIME (MIN) = 225	DISCHARGE (CFS) = 4.9
TIME (MIN) = 234	DISCHARGE (CFS) = 7.2
TIME (MIN) = 243	DISCHARGE (CFS) = 11.8
TIME (MIN) = 252	DISCHARGE (CFS) = 34.7
TIME (MIN) = 261	DISCHARGE (CFS) = 5.8
TIME (MIN) = 270	DISCHARGE (CFS) = 3.9
TIME (MIN) = 279	DISCHARGE (CFS) = 3
TIME (MIN) = 288	DISCHARGE (CFS) = 2.5
TIME (MIN) = 297	DISCHARGE (CFS) = 2.2
TIME (MIN) = 306	DISCHARGE (CFS) = 2
TIME (MIN) = 315	DISCHARGE (CFS) = 1.8
TIME (MIN) = 324	DISCHARGE (CFS) = 1.6
TIME (MIN) = 333	DISCHARGE (CFS) = 1.5
TIME (MIN) = 342	DISCHARGE (CFS) = 1.4
TIME (MIN) = 351	DISCHARGE (CFS) = 1.3
TIME (MIN) = 360	DISCHARGE (CFS) = 1.3
TIME (MIN) = 369	DISCHARGE (CFS) = 0

RATIONAL METHOD HYDROGRAPH PROGRAM

RUN DATE 5/18/2020
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 9 MIN.
6 HOUR RAINFALL 2.01 INCHES
BASIN AREA 12.93 ACRES
RUNOFF COEFFICIENT 0.88
PEAK DISCHARGE 39.24 CFS

TIME (MIN) = 0	DISCHARGE (CFS) = 0
TIME (MIN) = 9	DISCHARGE (CFS) = 0
TIME (MIN) = 18	DISCHARGE (CFS) = 1.4
TIME (MIN) = 27	DISCHARGE (CFS) = 1.4
TIME (MIN) = 36	DISCHARGE (CFS) = 1.5
TIME (MIN) = 45	DISCHARGE (CFS) = 1.5
TIME (MIN) = 54	DISCHARGE (CFS) = 1.6
TIME (MIN) = 63	DISCHARGE (CFS) = 1.6
TIME (MIN) = 72	DISCHARGE (CFS) = 1.7
TIME (MIN) = 81	DISCHARGE (CFS) = 1.7
TIME (MIN) = 90	DISCHARGE (CFS) = 1.8
TIME (MIN) = 99	DISCHARGE (CFS) = 1.8
TIME (MIN) = 108	DISCHARGE (CFS) = 1.9
TIME (MIN) = 117	DISCHARGE (CFS) = 2
TIME (MIN) = 126	DISCHARGE (CFS) = 2.1
TIME (MIN) = 135	DISCHARGE (CFS) = 2.2
TIME (MIN) = 144	DISCHARGE (CFS) = 2.3
TIME (MIN) = 153	DISCHARGE (CFS) = 2.4
TIME (MIN) = 162	DISCHARGE (CFS) = 2.6
TIME (MIN) = 171	DISCHARGE (CFS) = 2.7
TIME (MIN) = 180	DISCHARGE (CFS) = 3
TIME (MIN) = 189	DISCHARGE (CFS) = 3.2
TIME (MIN) = 198	DISCHARGE (CFS) = 3.7
TIME (MIN) = 207	DISCHARGE (CFS) = 4
TIME (MIN) = 216	DISCHARGE (CFS) = 4.9
TIME (MIN) = 225	DISCHARGE (CFS) = 5.6
TIME (MIN) = 234	DISCHARGE (CFS) = 8.2
TIME (MIN) = 243	DISCHARGE (CFS) = 13.5
TIME (MIN) = 252	DISCHARGE (CFS) = 39.24
TIME (MIN) = 261	DISCHARGE (CFS) = 6.6
TIME (MIN) = 270	DISCHARGE (CFS) = 4.4
TIME (MIN) = 279	DISCHARGE (CFS) = 3.4
TIME (MIN) = 288	DISCHARGE (CFS) = 2.9
TIME (MIN) = 297	DISCHARGE (CFS) = 2.5
TIME (MIN) = 306	DISCHARGE (CFS) = 2.2
TIME (MIN) = 315	DISCHARGE (CFS) = 2
TIME (MIN) = 324	DISCHARGE (CFS) = 1.9
TIME (MIN) = 333	DISCHARGE (CFS) = 1.7
TIME (MIN) = 342	DISCHARGE (CFS) = 1.6
TIME (MIN) = 351	DISCHARGE (CFS) = 1.5
TIME (MIN) = 360	DISCHARGE (CFS) = 1.4
TIME (MIN) = 369	DISCHARGE (CFS) = 0

RATIONAL METHOD HYDROGRAPH PROGRAM

RUN DATE 7/19/2020
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 9 MIN.
6 HOUR RAINFALL 2.25 INCHES
BASIN AREA 13.93 ACRES
RUNOFF COEFFICIENT 0.88
PEAK DISCHARGE 41.2 CFS

TIME (MIN) = 0	DISCHARGE (CFS) = 0
TIME (MIN) = 9	DISCHARGE (CFS) = 0
TIME (MIN) = 18	DISCHARGE (CFS) = 1.7
TIME (MIN) = 27	DISCHARGE (CFS) = 1.7
TIME (MIN) = 36	DISCHARGE (CFS) = 1.8
TIME (MIN) = 45	DISCHARGE (CFS) = 1.8
TIME (MIN) = 54	DISCHARGE (CFS) = 1.9
TIME (MIN) = 63	DISCHARGE (CFS) = 1.9
TIME (MIN) = 72	DISCHARGE (CFS) = 2
TIME (MIN) = 81	DISCHARGE (CFS) = 2
TIME (MIN) = 90	DISCHARGE (CFS) = 2.1
TIME (MIN) = 99	DISCHARGE (CFS) = 2.2
TIME (MIN) = 108	DISCHARGE (CFS) = 2.3
TIME (MIN) = 117	DISCHARGE (CFS) = 2.4
TIME (MIN) = 126	DISCHARGE (CFS) = 2.5
TIME (MIN) = 135	DISCHARGE (CFS) = 2.6
TIME (MIN) = 144	DISCHARGE (CFS) = 2.8
TIME (MIN) = 153	DISCHARGE (CFS) = 2.9
TIME (MIN) = 162	DISCHARGE (CFS) = 3.1
TIME (MIN) = 171	DISCHARGE (CFS) = 3.3
TIME (MIN) = 180	DISCHARGE (CFS) = 3.7
TIME (MIN) = 189	DISCHARGE (CFS) = 3.9
TIME (MIN) = 198	DISCHARGE (CFS) = 4.4
TIME (MIN) = 207	DISCHARGE (CFS) = 4.8
TIME (MIN) = 216	DISCHARGE (CFS) = 5.9
TIME (MIN) = 225	DISCHARGE (CFS) = 6.7
TIME (MIN) = 234	DISCHARGE (CFS) = 9.8
TIME (MIN) = 243	DISCHARGE (CFS) = 22.4
TIME (MIN) = 252	DISCHARGE (CFS) = 41.2
TIME (MIN) = 261	DISCHARGE (CFS) = 7.9
TIME (MIN) = 270	DISCHARGE (CFS) = 5.3
TIME (MIN) = 279	DISCHARGE (CFS) = 4.1
TIME (MIN) = 288	DISCHARGE (CFS) = 3.5
TIME (MIN) = 297	DISCHARGE (CFS) = 3
TIME (MIN) = 306	DISCHARGE (CFS) = 2.7
TIME (MIN) = 315	DISCHARGE (CFS) = 2.4
TIME (MIN) = 324	DISCHARGE (CFS) = 2.2
TIME (MIN) = 333	DISCHARGE (CFS) = 2.1
TIME (MIN) = 342	DISCHARGE (CFS) = 1.9
TIME (MIN) = 351	DISCHARGE (CFS) = 1.8
TIME (MIN) = 360	DISCHARGE (CFS) = 1.7
TIME (MIN) = 369	DISCHARGE (CFS) = 0

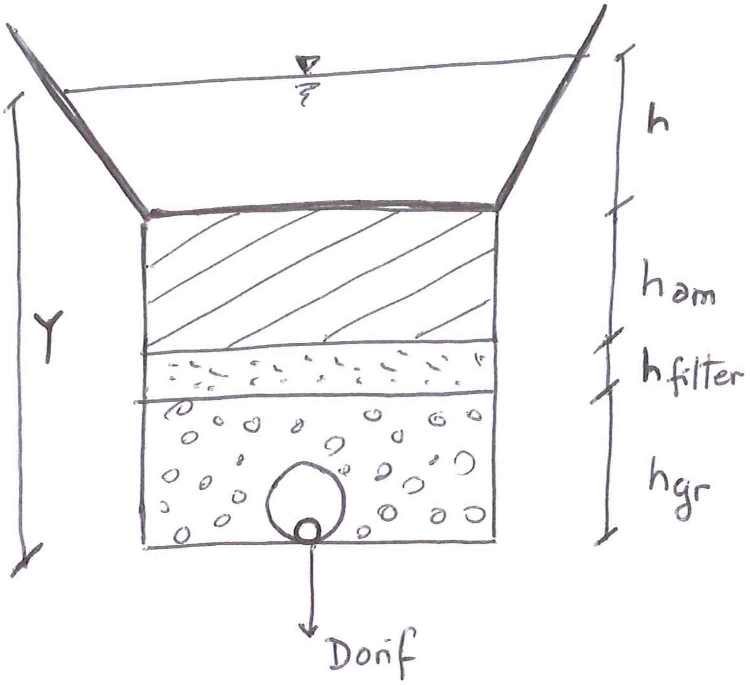
ELEVATION vs DISCHARGE vs VOLUME TABLE

Elevation vs Discharge vs Volume for Overall BMP

(measured from invert of low-flow orifice)

h (ft)	$Q_{orif+soil}$ (cfs)	Q_{Slot} (cfs)	Q_{emer} (cfs)	Q_{TOT} (cfs)	Vol (ft^3)
0.00	0.000	0	0	**0.00**	**0**
0.25	0.112	0	0	**0.11**	**1430**
0.50	0.212	0	0	**0.21**	**2886**
0.75	0.279	0	0	**0.28**	**4370**
1.00	0.332	0	0	**0.33**	**5880**
1.25	0.378	0	0	**0.38**	**7416**
1.50	0.418	0	0	**0.42**	**8980**
1.75	0.456	0	0	**0.46**	**10570**
2.00	0.479	0	0	**0.48**	**11782**
2.25	0.500	0	0	**0.50**	**13015**
2.50	0.519	0	0	**0.52**	**14268**
2.75	0.537	0	0	**0.54**	**15541**
3.00	0.554	0	0	**0.55**	**16833**
3.25	0.569	0	0	**0.57**	**18146**
3.50	0.584	0	0	**0.58**	**19479**
3.75	0.598	0	0	**0.60**	**20832**
4.00	0.621	0	0	**0.62**	**22506**
4.25	0.644	0	0	**0.64**	**26097**
4.50	0.665	0	0	**0.67**	**29802**
4.58	0.672	0.534	0	**1.21**	**31062**
4.67	0.679	1.512	0	**2.19**	**32335**
4.75	0.686	2.777	0	**3.46**	**33620**
4.83	0.693	4.276	0	**4.97**	**34918**
4.92	0.700	5.975	0	**6.68**	**36229**
5.00	0.707	7.855	0	**8.56**	**37552**
5.08	0.714	9.898	0	**10.61**	**38888**
5.17	0.720	11.323	0	**12.04**	**40236**
5.25	0.727	12.404	0	**13.13**	**41597**
5.33	0.734	13.397	0	**14.13**	**42971**
5.42	0.740	14.322	0	**15.06**	**44358**
5.50	0.747	15.191	0	**15.94**	**45757**
5.58	0.753	16.013	0	**16.77**	**47168**
5.67	0.760	16.794	0	**17.55**	**48592**
5.75	0.766	17.541	0	**18.31**	**50029**
5.83	0.772	18.257	1.790	**20.82**	**51479**
5.92	0.778	18.947	5.062	**24.79**	**52941**
6.00	0.785	19.612	9.300	**29.70**	**54415**
6.08	0.791	20.255	14.318	**35.36**	**55903**
6.17	0.797	20.878	20.010	**41.69**	**57403**
6.25	0.803	21.484	26.304	**48.59**	**58915**
6.33	0.809	22.072	33.147	**56.03**	**60440**
6.42	0.815	22.646	40.498	**63.96**	**61978**
6.50	0.821	23.205	48.324	**72.35**	**63529**
6.58	0.827	23.751	56.598	**81.18**	**65092**
6.67	0.833	24.285	65.297	**90.41**	**66667**
6.75	0.839	24.807	74.400	**100.05**	**68256**

Discharge thru orifice with energy losses in Amended Soil (getting $Q_{orif+soil} = Q$).



Assumptions:

- Friction loss thru Trench Drain is negligible
- Energy loss on filter layer & gravel layer is negligible compared to that of amended soil.

Δh : loss by flow thru amended soil.

f_i = Infiltration thru amended soil.

Solving problem:

Darcy's law flow = orifice equation flow (including losses)

$$(1)\quad Q = f_i \cdot \frac{\Delta h}{h_{am}} \cdot A_{BMP} = c_g \cdot \frac{\pi D_o^2}{4} \sqrt{2g\left(h_{gr} + h_{filter} + h_{am} + h - \Delta h - D_{orif}/2\right)}$$

Δh: becomes a quadratic eq. with a solution.

Once Δh is known, Q is obtained (Q = flow thru orifice).

Scenarios:

(a): $Y \leq h_{gr} + h_{filter}$: Use orifice equation.

(b): $h_{gr} + h_{filter} < Y \leq h_{am} + h_{filter} + h_{gr}$: Use (1) with $h = 0$ and $h_{am} + h_{gr} + h_{filter} = Y$

(c) $Y > h_{am} + h_{filter} + h_{gr}$: use (1) as given.

Discharge thru Slot. (Q_{slot})

$$Q_{slot} = 3.1 \left(h_{slot} \right)^{1.5} \cdot B$$

h_{slot}: Elevation over slot invert when $h_{slot} \leq 0.5$ ft

(Slot dimensions : $H = 0.5$ ft; $B = 7.17$ ft)
$B = 86''$

When $h_{slot} \geq H$ then :

$$Q_{slot} = \text{MIN} \left[3.1 \left(h_{slot} \right)^{1.5} \cdot B \, , \; 0.61 \cdot B \cdot H \cdot \sqrt{2g \left(h_{slot} - \frac{H}{2} \right)} \right]$$

Note: Per HMP Document, all slots are combined
($B = 63''$ North + $23''$ South = $86''$ = 7.17 ft ; $H = 0.5$ ft in all cases).

Discharge thru Weir. (Q_{emer}).

$$Q_{emerg} = 3.1 \cdot \left(h_{emer} \right)^{1.5} \cdot B_{emer}$$

h_{emer} = Elevation over risers invert (risers of North & South at same elevation)

B_{emer} = 16' (North) + 8' (South) = 24'.

Note : Per HMP Document, emergency overflows (N & S) are combined.

ROUTING RESULTS (100, 50, 25, 10 and 5 yr Storms)

MODIFIED PULS

RESULTS: Routing of 6 hr - 5 yr Total Hydrograph in BMP-1

Max outflow:	13.57 cfs		initial elev:	4.50 ft
Max elevation in pond:	5.29 ft	(Elevation)	Peak flow in:	27.450 cfs
Vol-out:	86821 cu-ft		Vol in:	57051 cu-ft
h_{max} over surface:	1.54 ft			

Pond Storm: 6 hr - 5 yr

time (hr)	Inflow, In (cfs)	In+In+1 (cfs)	fn (cfs)	Inf. Vol, F (ft3)	2S1/At-O1 (cfs)	2S2/At+O2 (cfs)	Outflow, On (cfs)	Volume, S (ft3)	Elevation, h (ft-osl)
0.15	0.00	1.00	0.00	0.0	110.38		0.000	29802	4.500
0.30	1.00	2.00	0.000	0.0	109.98	111.38	0.700	29883	4.505
0.45	1.00	2.00	0.000	0.0	110.45	111.98	0.762	30028	4.515
0.60	1.00	2.00	0.000	0.0	110.83	112.45	0.812	30143	4.523
0.75	1.00	2.10	0.000	0.0	111.13	112.83	0.851	30234	4.529
0.90	1.10	2.20	0.000	0.0	111.44	113.23	0.892	30330	4.535
1.05	1.10	2.20	0.000	0.0	111.77	113.64	0.936	30431	4.542
1.20	1.10	2.30	0.000	0.0	112.03	113.97	0.970	30510	4.547
1.35	1.20	2.40	0.000	0.0	112.32	114.33	1.007	30598	4.553
1.50	1.20	2.50	0.000	0.0	112.62	114.72	1.047	30691	4.559
1.65	1.30	2.60	0.000	0.0	112.94	115.12	1.089	30789	4.565
1.80	1.30	2.70	0.000	0.0	113.28	115.54	1.133	30891	4.572
1.95	1.40	2.90	0.000	0.0	113.62	115.98	1.178	30996	4.579
2.10	1.50	3.00	0.000	0.0	114.01	116.52	1.253	31122	4.587
2.25	1.50	3.10	0.000	0.0	114.34	117.01	1.339	31232	4.594
2.40	1.60	3.30	0.000	0.0	114.61	117.44	1.412	31327	4.601
2.55	1.70	3.50	0.000	0.0	114.93	117.91	1.494	31433	4.608
2.70	1.80	3.70	0.000	0.0	115.26	118.43	1.582	31548	4.615
2.85	1.90	4.00	0.000	0.0	115.61	118.96	1.675	31667	4.623
3.00	2.10	4.30	0.000	0.0	116.04	119.61	1.787	31812	4.632
3.15	2.20	4.80	0.000	0.0	116.51	120.34	1.913	31974	4.643
3.30	2.60	5.40	0.000	0.0	117.15	121.31	2.081	32192	4.657
3.45	2.80	6.20	0.000	0.0	117.91	122.55	2.318	32463	4.675
3.60	3.40	7.30	0.000	0.0	118.82	124.11	2.648	32796	4.697
3.75	3.90	9.60	0.000	0.0	119.98	126.12	3.070	33223	4.724
3.90	5.70	15.00	0.000	0.0	121.89	129.58	3.844	33948	4.771
4.05	9.30	36.75	0.000	0.0	125.60	136.89	5.644	35436	4.866
4.20	27.45	32.05	0.000	0.0	137.81	162.35	12.271	40522	5.184
4.35	4.60	7.70	0.000	0.0	142.72	169.86	13.568	42199	5.286
4.50	3.10	5.50	0.000	0.0	131.67	150.42	9.376	38083	5.033
4.65	2.40	4.40	0.000	0.0	125.74	137.17	5.717	35492	4.870
4.80	2.00	3.70	0.000	0.0	122.18	130.14	3.977	34063	4.778
4.95	1.70	3.30	0.000	0.0	119.84	125.88	3.021	33173	4.721
5.10	1.60	3.00	0.000	0.0	118.26	123.14	2.442	32589	4.683
5.25	1.40	2.70	0.000	0.0	117.11	121.26	2.071	32180	4.657
5.40	1.30	2.50	0.000	0.0	116.17	119.81	1.822	31858	4.635
5.55	1.20	2.30	0.000	0.0	115.42	118.67	1.624	31602	4.619
5.70	1.10	2.20	0.000	0.0	114.80	117.72	1.461	31390	4.605
5.85	1.10	2.10	0.000	0.0	114.33	117.00	1.336	31229	4.594
6.00	1.00	1.00	0.000	0.0	113.95	116.43	1.237	31101	4.586
6.15	0.00	0.00	0.000	0.0	112.81	114.95	1.072	30748	4.563
6.30	0.00	0.00	0.000	0.0	111.11	112.81	0.849	30229	4.528
6.45	0.00	0.00	0.000	0.0	109.77	111.11	0.672	29818	4.501
6.60	0.00	0.00	0.000	0.0	108.44	109.77	0.663	29458	4.477
6.75	0.00	0.00	0.000	0.0	107.12	108.44	0.661	29100	4.453
6.90	0.00	0.00	0.000	0.0	105.80	107.12	0.659	28744	4.429

time (hr)	Inflow, In (cfs)	In+In+1 (cfs)	fn (cfs)	Inf. Vol, F (ft3)	2S1/At-O1 (cfs)	2S2/At+O2 (cfs)	Outflow, On (cfs)	Volume, S (ft3)	Elevation, h (ft-osl)
7.05	0.00	0.00	0.000	0.0	104.49	105.80	0.657	28389	4.405
7.20	0.00	0.00	0.000	0.0	103.18	104.49	0.655	28034	4.381
7.35	0.00	0.00	0.000	0.0	101.87	103.18	0.653	27681	4.357
7.50	0.00	0.00	0.000	0.0	100.57	101.87	0.651	27329	4.333
7.65	0.00	0.00	0.000	0.0	99.27	100.57	0.649	26979	4.309
7.80	0.00	0.00	0.000	0.0	97.98	99.27	0.647	26629	4.286
7.95	0.00	0.00	0.000	0.0	96.69	97.98	0.645	26280	4.262
8.10	0.00	0.00	0.000	0.0	95.40	96.69	0.642	25933	4.239
8.25	0.00	0.00	0.000	0.0	94.12	95.40	0.640	25586	4.214
8.40	0.00	0.00	0.000	0.0	92.85	94.12	0.638	25241	4.190
8.55	0.00	0.00	0.000	0.0	91.58	92.85	0.636	24897	4.166
8.70	0.00	0.00	0.000	0.0	90.31	91.58	0.634	24554	4.143
8.85	0.00	0.00	0.000	0.0	89.04	90.31	0.632	24213	4.119
9.00	0.00	0.00	0.000	0.0	87.79	89.04	0.630	23872	4.095
9.15	0.00	0.00	0.000	0.0	86.53	87.79	0.627	23533	4.071
9.30	0.00	0.00	0.000	0.0	85.28	86.53	0.625	23194	4.048
9.45	0.00	0.00	0.000	0.0	84.03	85.28	0.623	22857	4.024
9.60	0.00	0.00	0.000	0.0	82.79	84.03	0.621	22521	4.001
9.75	0.00	0.00	0.000	0.0	81.56	82.79	0.617	22187	3.952
9.90	0.00	0.00	0.000	0.0	80.33	81.56	0.612	21855	3.903
10.05	0.00	0.00	0.000	0.0	79.12	80.33	0.607	21526	3.854
10.20	0.00	0.00	0.000	0.0	77.91	79.12	0.603	21199	3.805
10.35	0.00	0.00	0.000	0.0	76.72	77.91	0.598	20875	3.756
10.50	0.00	0.00	0.000	0.0	75.53	76.72	0.595	20553	3.698
10.65	0.00	0.00	0.000	0.0	74.34	75.53	0.592	20232	3.639
10.80	0.00	0.00	0.000	0.0	73.17	74.34	0.588	19914	3.580
10.95	0.00	0.00	0.000	0.0	72.00	73.17	0.585	19597	3.522
11.10	0.00	0.00	0.000	0.0	70.83	72.00	0.582	19282	3.463
11.25	0.00	0.00	0.000	0.0	69.68	70.83	0.578	18969	3.404
11.40	0.00	0.00	0.000	0.0	68.53	69.68	0.575	18657	3.346
11.55	0.00	0.00	0.000	0.0	67.38	68.53	0.571	18348	3.288
11.70	0.00	0.00	0.000	0.0	66.25	67.38	0.568	18040	3.230
11.85	0.00	0.00	0.000	0.0	65.12	66.25	0.564	17734	3.172
12.00	0.00	0.00	0.000	0.0	64.00	65.12	0.561	17431	3.114
12.15	0.00	0.00	0.000	0.0	62.88	64.00	0.557	17129	3.056
12.30	0.00	0.00	0.000	0.0	61.78	62.88	0.553	16829	2.999
12.45	0.00	0.00	0.000	0.0	60.68	61.78	0.550	16531	2.942
12.60	0.00	0.00	0.000	0.0	59.59	60.68	0.546	16236	2.884
12.75	0.00	0.00	0.000	0.0	58.50	59.59	0.542	15942	2.828
12.90	0.00	0.00	0.000	0.0	57.43	58.50	0.538	15650	2.771
13.05	0.00	0.00	0.000	0.0	56.36	57.43	0.534	15361	2.715
13.20	0.00	0.00	0.000	0.0	55.30	56.36	0.530	15073	2.658
13.35	0.00	0.00	0.000	0.0	54.24	55.30	0.526	14788	2.602
13.50	0.00	0.00	0.000	0.0	53.20	54.24	0.522	14505	2.547
13.65	0.00	0.00	0.000	0.0	52.16	53.20	0.518	14224	2.491
13.80	0.00	0.00	0.000	0.0	51.14	52.16	0.514	13945	2.436
13.95	0.00	0.00	0.000	0.0	50.12	51.14	0.510	13669	2.380
14.10	0.00	0.00	0.000	0.0	49.11	50.12	0.505	13395	2.326
14.25	0.00	0.00	0.000	0.0	48.10	49.11	0.501	13123	2.272
14.40	0.00	0.00	0.000	0.0	47.11	48.10	0.497	12854	2.217
14.55	0.00	0.00	0.000	0.0	46.12	47.11	0.492	12586	2.163
14.70	0.00	0.00	0.000	0.0	45.15	46.12	0.488	12322	2.109

MODIFIED PULS

RESULTS: Routing of 6 hr - 10 yr Total Hydrograph in BMP-1

Max outflow: 14.41 cfs — initial elev: 4.50 ft

Max elevation in pond: 5.36 ft (Elevation) — Peak flow in: 31.820 cfs

Vol-out: 89559 cu-ft — Vol in: 59789 cu-ft

h_{max} over surface: 1.61 ft

Pond Storm: 6 hr - 10 yr

time (hr)	Inflow, In (cfs)	In+In+1 (cfs)	fn (cfs)	Inf. Vol, F (ft3)	2S1/At-O1 (cfs)	2S2/At+O2 (cfs)	Outflow, On (cfs)	Volume, S (ft3)	Elevation, h (ft-osl)
0.15	0.00	1.00	0.00	0.0	110.38		0.000	29802	4.500
0.30	1.00	2.00	0.000	0.0	109.98	111.38	0.700	29883	4.505
0.45	1.00	2.10	0.000	0.0	110.45	111.98	0.762	30028	4.515
0.60	1.10	2.20	0.000	0.0	110.91	112.55	0.822	30167	4.524
0.75	1.10	2.20	0.000	0.0	111.35	113.11	0.880	30301	4.533
0.90	1.10	2.30	0.000	0.0	111.70	113.55	0.926	30408	4.540
1.05	1.20	2.40	0.000	0.0	112.05	114.00	0.972	30516	4.547
1.20	1.20	2.20	0.000	0.0	112.41	114.45	1.020	30627	4.555
1.35	1.00	2.30	0.000	0.0	112.54	114.61	1.036	30665	4.557
1.50	1.30	2.60	0.000	0.0	112.72	114.84	1.060	30720	4.561
1.65	1.30	2.70	0.000	0.0	113.10	115.32	1.110	30837	4.568
1.80	1.40	2.80	0.000	0.0	113.48	115.80	1.160	30953	4.576
1.95	1.40	2.90	0.000	0.0	113.86	116.28	1.212	31068	4.584
2.10	1.50	3.10	0.000	0.0	114.17	116.76	1.294	31175	4.591
2.25	1.60	3.30	0.000	0.0	114.50	117.27	1.382	31289	4.598
2.40	1.70	3.50	0.000	0.0	114.85	117.80	1.475	31409	4.606
2.55	1.80	3.70	0.000	0.0	115.21	118.35	1.570	31532	4.614
2.70	1.90	3.90	0.000	0.0	115.58	118.91	1.667	31657	4.622
2.85	2.00	4.20	0.000	0.0	115.95	119.48	1.765	31783	4.631
3.00	2.20	4.60	0.000	0.0	116.39	120.15	1.880	31933	4.640
3.15	2.40	5.10	0.000	0.0	116.94	120.99	2.025	32120	4.653
3.30	2.70	5.60	0.000	0.0	117.62	122.04	2.210	32354	4.668
3.45	2.90	6.50	0.000	0.0	118.30	123.22	2.459	32605	4.684
3.60	3.60	7.70	0.000	0.0	119.22	124.80	2.793	32942	4.706
3.75	4.10	10.10	0.000	0.0	120.44	126.92	3.239	33393	4.735
3.90	6.00	12.80	0.000	0.0	122.39	130.54	4.073	34146	4.784
4.05	6.80	38.62	0.000	0.0	124.79	135.19	5.202	35097	4.845
4.20	31.82	36.62	0.000	0.0	138.49	163.41	12.459	40756	5.198
4.35	4.80	8.00	0.000	0.0	146.29	175.11	14.412	43389	5.358
4.50	3.20	5.70	0.000	0.0	133.27	154.29	10.508	38820	5.079
4.65	2.50	4.60	0.000	0.0	126.60	138.97	6.185	35852	4.893
4.80	2.10	3.90	0.000	0.0	122.74	131.20	4.231	34282	4.792
4.95	1.80	3.40	0.000	0.0	120.28	126.64	3.180	33334	4.731
5.10	1.60	3.10	0.000	0.0	118.57	123.68	2.556	32703	4.691
5.25	1.50	2.90	0.000	0.0	117.38	121.67	2.142	32272	4.663
5.40	1.40	2.70	0.000	0.0	116.48	120.28	1.903	31962	4.642
5.55	1.30	2.50	0.000	0.0	115.75	119.18	1.712	31715	4.626
5.70	1.20	2.30	0.000	0.0	115.15	118.25	1.552	31509	4.613
5.85	1.10	2.20	0.000	0.0	114.62	117.45	1.413	31329	4.601
6.00	1.10	1.10	0.000	0.0	114.21	116.82	1.305	31189	4.592
6.15	0.00	0.00	0.000	0.0	113.09	115.31	1.109	30834	4.568
6.30	0.00	0.00	0.000	0.0	111.34	113.09	0.878	30298	4.533
6.45	0.00	0.00	0.000	0.0	109.94	111.34	0.696	29873	4.505
6.60	0.00	0.00	0.000	0.0	108.62	109.94	0.663	29506	4.480
6.75	0.00	0.00	0.000	0.0	107.29	108.62	0.661	29148	4.456
6.90	0.00	0.00	0.000	0.0	105.98	107.29	0.659	28791	4.432

time (hr)	Inflow, In (cfs)	In+In+1 (cfs)	fn (cfs)	Inf. Vol, F (ft3)	2S1/At-O1 (cfs)	2S2/At+O2 (cfs)	Outflow, On (cfs)	Volume, S (ft3)	Elevation, h (ft-osl)
7.05	0.00	0.00	0.000	0.0	104.66	105.98	0.657	28436	4.408
7.20	0.00	0.00	0.000	0.0	103.35	104.66	0.655	28082	4.384
7.35	0.00	0.00	0.000	0.0	102.04	103.35	0.653	27728	4.360
7.50	0.00	0.00	0.000	0.0	100.74	102.04	0.651	27376	4.336
7.65	0.00	0.00	0.000	0.0	99.45	100.74	0.649	27025	4.313
7.80	0.00	0.00	0.000	0.0	98.15	99.45	0.647	26676	4.289
7.95	0.00	0.00	0.000	0.0	96.86	98.15	0.645	26327	4.266
8.10	0.00	0.00	0.000	0.0	95.58	96.86	0.643	25979	4.242
8.25	0.00	0.00	0.000	0.0	94.29	95.58	0.641	25633	4.218
8.40	0.00	0.00	0.000	0.0	93.02	94.29	0.638	25287	4.194
8.55	0.00	0.00	0.000	0.0	91.75	93.02	0.636	24943	4.170
8.70	0.00	0.00	0.000	0.0	90.48	91.75	0.634	24600	4.146
8.85	0.00	0.00	0.000	0.0	89.21	90.48	0.632	24258	4.122
9.00	0.00	0.00	0.000	0.0	87.95	89.21	0.630	23918	4.098
9.15	0.00	0.00	0.000	0.0	86.70	87.95	0.628	23578	4.075
9.30	0.00	0.00	0.000	0.0	85.45	86.70	0.626	23240	4.051
9.45	0.00	0.00	0.000	0.0	84.20	85.45	0.623	22902	4.028
9.60	0.00	0.00	0.000	0.0	82.96	84.20	0.621	22566	4.004
9.75	0.00	0.00	0.000	0.0	81.72	82.96	0.617	22232	3.959
9.90	0.00	0.00	0.000	0.0	80.50	81.72	0.613	21900	3.909
10.05	0.00	0.00	0.000	0.0	79.28	80.50	0.608	21570	3.860
10.20	0.00	0.00	0.000	0.0	78.07	79.28	0.604	21243	3.811
10.35	0.00	0.00	0.000	0.0	76.88	78.07	0.599	20918	3.763
10.50	0.00	0.00	0.000	0.0	75.69	76.88	0.595	20596	3.706
10.65	0.00	0.00	0.000	0.0	74.50	75.69	0.592	20275	3.647
10.80	0.00	0.00	0.000	0.0	73.32	74.50	0.589	19956	3.588
10.95	0.00	0.00	0.000	0.0	72.15	73.32	0.586	19639	3.530
11.10	0.00	0.00	0.000	0.0	70.99	72.15	0.582	19324	3.471
11.25	0.00	0.00	0.000	0.0	69.83	70.99	0.579	19010	3.412
11.40	0.00	0.00	0.000	0.0	68.68	69.83	0.575	18699	3.354
11.55	0.00	0.00	0.000	0.0	67.54	68.68	0.572	18389	3.296
11.70	0.00	0.00	0.000	0.0	66.40	67.54	0.568	18081	3.238
11.85	0.00	0.00	0.000	0.0	65.27	66.40	0.565	17775	3.179
12.00	0.00	0.00	0.000	0.0	64.15	65.27	0.561	17471	3.121
12.15	0.00	0.00	0.000	0.0	63.03	64.15	0.558	17169	3.064
12.30	0.00	0.00	0.000	0.0	61.92	63.03	0.554	16869	3.007
12.45	0.00	0.00	0.000	0.0	60.82	61.92	0.550	16571	2.949
12.60	0.00	0.00	0.000	0.0	59.73	60.82	0.546	16275	2.892
12.75	0.00	0.00	0.000	0.0	58.65	59.73	0.542	15981	2.835
12.90	0.00	0.00	0.000	0.0	57.57	58.65	0.539	15689	2.779
13.05	0.00	0.00	0.000	0.0	56.50	57.57	0.535	15399	2.722
13.20	0.00	0.00	0.000	0.0	55.44	56.50	0.531	15112	2.666
13.35	0.00	0.00	0.000	0.0	54.38	55.44	0.527	14826	2.610
13.50	0.00	0.00	0.000	0.0	53.34	54.38	0.523	14543	2.554
13.65	0.00	0.00	0.000	0.0	52.30	53.34	0.519	14261	2.499
13.80	0.00	0.00	0.000	0.0	51.27	52.30	0.515	13982	2.443
13.95	0.00	0.00	0.000	0.0	50.25	51.27	0.510	13706	2.388
14.10	0.00	0.00	0.000	0.0	49.24	50.25	0.506	13431	2.333
14.25	0.00	0.00	0.000	0.0	48.24	49.24	0.502	13159	2.279
14.40	0.00	0.00	0.000	0.0	47.24	48.24	0.497	12889	2.225
14.55	0.00	0.00	0.000	0.0	46.26	47.24	0.493	12622	2.170
14.70	0.00	0.00	0.000	0.0	45.28	46.26	0.488	12357	2.117

MODIFIED PULS

RESULTS: Routing of 6 hr - 25 yr Total Hydrograph in BMP-1

Max outflow:	16.13 cfs		initial elev:	4.50 ft
Max elevation in pond:	5.52 ft	(Elevation)	Peak flow in:	34.700 cfs
Vol-out:	101751 cu-ft		Vol in:	71982 cu-ft
h_{max} over surface:	1.77 ft			

Pond Storm: 6 hr - 25 yr

time (hr)	Inflow, In (cfs)	In+In+1 (cfs)	fn (cfs)	Inf. Vol, F (ft3)	2S1/At-O1 (cfs)	2S2/At+O2 (cfs)	Outflow, On (cfs)	Volume, S (ft3)	Elevation, h (ft-osl)
0.15	0.00	1.20	0.00	0.0	110.38		0.000	29802	4.500
0.30	1.20	2.40	0.000	0.0	110.14	111.58	0.721	29931	4.509
0.45	1.20	2.50	0.000	0.0	110.89	112.54	0.820	30163	4.524
0.60	1.30	2.60	0.000	0.0	111.57	113.39	0.910	30371	4.538
0.75	1.30	2.70	0.000	0.0	112.19	114.17	0.991	30560	4.550
0.90	1.40	2.80	0.000	0.0	112.76	114.89	1.066	30733	4.562
1.05	1.40	2.90	0.000	0.0	113.29	115.56	1.135	30895	4.572
1.20	1.50	3.00	0.000	0.0	113.79	116.19	1.201	31048	4.582
1.35	1.50	3.10	0.000	0.0	114.19	116.79	1.300	31182	4.591
1.50	1.60	3.20	0.000	0.0	114.52	117.29	1.386	31294	4.599
1.65	1.60	3.30	0.000	0.0	114.80	117.72	1.460	31390	4.605
1.80	1.70	3.40	0.000	0.0	115.05	118.10	1.526	31474	4.610
1.95	1.70	3.50	0.000	0.0	115.27	118.45	1.586	31552	4.615
2.10	1.80	3.70	0.000	0.0	115.49	118.77	1.643	31625	4.620
2.25	1.90	3.90	0.000	0.0	115.76	119.19	1.714	31718	4.626
2.40	2.00	4.10	0.000	0.0	116.07	119.66	1.796	31823	4.633
2.55	2.10	4.40	0.000	0.0	116.40	120.17	1.884	31937	4.641
2.70	2.30	4.70	0.000	0.0	116.82	120.80	1.993	32078	4.650
2.85	2.40	5.10	0.000	0.0	117.28	121.52	2.116	32238	4.660
3.00	2.70	5.50	0.000	0.0	117.82	122.38	2.283	32427	4.673
3.15	2.80	6.00	0.000	0.0	118.36	123.32	2.480	32626	4.686
3.30	3.20	6.70	0.000	0.0	118.96	124.36	2.699	32848	4.700
3.45	3.50	7.80	0.000	0.0	119.71	125.66	2.974	33125	4.718
3.60	4.30	9.20	0.000	0.0	120.78	127.51	3.364	33520	4.744
3.75	4.90	12.10	0.000	0.0	122.10	129.98	3.941	34032	4.776
3.90	7.20	19.00	0.000	0.0	124.31	134.20	4.947	34899	4.832
4.05	11.80	46.50	0.000	0.0	128.59	143.31	7.357	36707	4.947
4.20	34.70	40.50	0.000	0.0	146.28	175.09	14.409	43385	5.358
4.35	5.80	9.70	0.000	0.0	154.53	186.78	16.125	46076	5.519
4.50	3.90	6.90	0.000	0.0	139.02	164.23	12.604	40938	5.210
4.65	3.00	5.50	0.000	0.0	129.75	145.92	8.082	37216	4.979
4.80	2.50	4.70	0.000	0.0	124.82	135.25	5.218	35110	4.846
4.95	2.20	4.20	0.000	0.0	121.86	129.52	3.830	33936	4.770
5.10	2.00	3.80	0.000	0.0	119.94	126.06	3.058	33210	4.723
5.25	1.80	3.40	0.000	0.0	118.60	123.74	2.569	32717	4.691
5.40	1.60	3.10	0.000	0.0	117.60	122.00	2.203	32346	4.667
5.55	1.50	2.90	0.000	0.0	116.75	120.70	1.975	32055	4.648
5.70	1.40	2.70	0.000	0.0	116.06	119.65	1.794	31821	4.633
5.85	1.30	2.60	0.000	0.0	115.48	118.76	1.640	31623	4.620
6.00	1.30	1.30	0.000	0.0	115.03	118.08	1.523	31471	4.610
6.15	0.00	0.00	0.000	0.0	113.89	116.33	1.221	31081	4.585
6.30	0.00	0.00	0.000	0.0	111.97	113.89	0.962	30491	4.546
6.45	0.00	0.00	0.000	0.0	110.45	111.97	0.762	30026	4.515
6.60	0.00	0.00	0.000	0.0	109.12	110.45	0.664	29641	4.489
6.75	0.00	0.00	0.000	0.0	107.79	109.12	0.662	29283	4.465
6.90	0.00	0.00	0.000	0.0	106.47	107.79	0.660	28926	4.441

time (hr)	Inflow, In (cfs)	In+In+1 (cfs)	fn (cfs)	Inf. Vol, F (ft3)	2S1/At-O1 (cfs)	2S2/At+O2 (cfs)	Outflow, On (cfs)	Volume, S (ft3)	Elevation, h (ft-osl)
7.05	0.00	0.00	0.000	0.0	105.16	106.47	0.658	28570	4.417
7.20	0.00	0.00	0.000	0.0	103.85	105.16	0.656	28215	4.393
7.35	0.00	0.00	0.000	0.0	102.54	103.85	0.654	27862	4.369
7.50	0.00	0.00	0.000	0.0	101.23	102.54	0.652	27509	4.345
7.65	0.00	0.00	0.000	0.0	99.93	101.23	0.650	27158	4.322
7.80	0.00	0.00	0.000	0.0	98.64	99.93	0.648	26807	4.298
7.95	0.00	0.00	0.000	0.0	97.35	98.64	0.646	26458	4.274
8.10	0.00	0.00	0.000	0.0	96.06	97.35	0.644	26110	4.251
8.25	0.00	0.00	0.000	0.0	94.78	96.06	0.641	25763	4.227
8.40	0.00	0.00	0.000	0.0	93.50	94.78	0.639	25417	4.203
8.55	0.00	0.00	0.000	0.0	92.23	93.50	0.637	25073	4.179
8.70	0.00	0.00	0.000	0.0	90.96	92.23	0.635	24729	4.155
8.85	0.00	0.00	0.000	0.0	89.69	90.96	0.633	24387	4.131
9.00	0.00	0.00	0.000	0.0	88.43	89.69	0.631	24046	4.107
9.15	0.00	0.00	0.000	0.0	87.17	88.43	0.629	23706	4.084
9.30	0.00	0.00	0.000	0.0	85.92	87.17	0.626	23367	4.060
9.45	0.00	0.00	0.000	0.0	84.67	85.92	0.624	23030	4.036
9.60	0.00	0.00	0.000	0.0	83.43	84.67	0.622	22693	4.013
9.75	0.00	0.00	0.000	0.0	82.19	83.43	0.619	22358	3.978
9.90	0.00	0.00	0.000	0.0	80.96	82.19	0.614	22025	3.928
10.05	0.00	0.00	0.000	0.0	79.74	80.96	0.610	21694	3.879
10.20	0.00	0.00	0.000	0.0	78.53	79.74	0.605	21366	3.830
10.35	0.00	0.00	0.000	0.0	77.33	78.53	0.601	21041	3.781
10.50	0.00	0.00	0.000	0.0	76.13	77.33	0.597	20717	3.729
10.65	0.00	0.00	0.000	0.0	74.95	76.13	0.593	20396	3.669
10.80	0.00	0.00	0.000	0.0	73.77	74.95	0.590	20076	3.610
10.95	0.00	0.00	0.000	0.0	72.59	73.77	0.587	19759	3.552
11.10	0.00	0.00	0.000	0.0	71.43	72.59	0.583	19443	3.493
11.25	0.00	0.00	0.000	0.0	70.27	71.43	0.580	19129	3.434
11.40	0.00	0.00	0.000	0.0	69.11	70.27	0.577	18816	3.376
11.55	0.00	0.00	0.000	0.0	67.97	69.11	0.573	18506	3.317
11.70	0.00	0.00	0.000	0.0	66.83	67.97	0.570	18197	3.260
11.85	0.00	0.00	0.000	0.0	65.70	66.83	0.566	17891	3.201
12.00	0.00	0.00	0.000	0.0	64.57	65.70	0.562	17586	3.143
12.15	0.00	0.00	0.000	0.0	63.45	64.57	0.559	17283	3.086
12.30	0.00	0.00	0.000	0.0	62.34	63.45	0.555	16982	3.028
12.45	0.00	0.00	0.000	0.0	61.24	62.34	0.552	16683	2.971
12.60	0.00	0.00	0.000	0.0	60.14	61.24	0.548	16387	2.914
12.75	0.00	0.00	0.000	0.0	59.06	60.14	0.544	16092	2.857
12.90	0.00	0.00	0.000	0.0	57.98	59.06	0.540	15799	2.800
13.05	0.00	0.00	0.000	0.0	56.90	57.98	0.536	15508	2.744
13.20	0.00	0.00	0.000	0.0	55.84	56.90	0.532	15220	2.687
13.35	0.00	0.00	0.000	0.0	54.78	55.84	0.528	14934	2.631
13.50	0.00	0.00	0.000	0.0	53.73	54.78	0.524	14649	2.575
13.65	0.00	0.00	0.000	0.0	52.69	53.73	0.520	14367	2.520
13.80	0.00	0.00	0.000	0.0	51.66	52.69	0.516	14088	2.464
13.95	0.00	0.00	0.000	0.0	50.64	51.66	0.512	13810	2.409
14.10	0.00	0.00	0.000	0.0	49.62	50.64	0.508	13535	2.354
14.25	0.00	0.00	0.000	0.0	48.61	49.62	0.503	13262	2.299
14.40	0.00	0.00	0.000	0.0	47.62	48.61	0.499	12991	2.245
14.55	0.00	0.00	0.000	0.0	46.63	47.62	0.495	12723	2.191
14.70	0.00	0.00	0.000	0.0	45.65	46.63	0.490	12457	2.137

MODIFIED PULS

RESULTS: Routing of 6 hr - 50 yr Total Hydrograph in BMP-1

Max outflow:	17.59	cfs		initial elev:	4.50 ft
Max elevation in pond:	5.67	ft	(Elevation)	Peak flow in:	39.240 cfs
Vol-out:	111655	cu-ft		Vol in:	81886 cu-ft
h_{max} over surface:	1.92	ft			

Pond Storm: 6 hr - 50 yr

time (hr)	Inflow, In (cfs)	In+In+1 (cfs)	fn (cfs)	Inf. Vol, F (ft3)	2S1/At-O1 (cfs)	2S2/At+O2 (cfs)	Outflow, On (cfs)	Volume, S (ft3)	Elevation, h (ft-osl)
0.15	0.00	1.40	0.00	0.0	110.38		0.00	29802	4.500
0.30	1.40	2.80	0.000	0.0	110.29	111.78	0.74	29979	4.512
0.45	1.40	2.90	0.000	0.0	111.34	113.09	0.88	30298	4.533
0.60	1.50	3.00	0.000	0.0	112.24	114.24	1.00	30575	4.551
0.75	1.50	3.10	0.000	0.0	113.04	115.24	1.10	30818	4.567
0.90	1.60	3.20	0.000	0.0	113.75	116.14	1.20	31035	4.582
1.05	1.60	3.30	0.000	0.0	114.29	116.95	1.33	31218	4.594
1.20	1.70	3.40	0.000	0.0	114.72	117.59	1.44	31362	4.603
1.35	1.70	3.50	0.000	0.0	115.06	118.12	1.53	31479	4.611
1.50	1.80	3.60	0.000	0.0	115.35	118.56	1.61	31577	4.617
1.65	1.80	3.70	0.000	0.0	115.60	118.95	1.67	31664	4.623
1.80	1.90	3.90	0.000	0.0	115.83	119.30	1.73	31743	4.628
1.95	2.00	4.10	0.000	0.0	116.12	119.73	1.81	31840	4.634
2.10	2.10	4.30	0.000	0.0	116.43	120.22	1.89	31948	4.641
2.25	2.20	4.50	0.000	0.0	116.77	120.73	1.98	32063	4.649
2.40	2.30	4.70	0.000	0.0	117.12	121.27	2.07	32183	4.657
2.55	2.40	5.00	0.000	0.0	117.48	121.82	2.17	32307	4.665
2.70	2.60	5.30	0.000	0.0	117.88	122.48	2.30	32449	4.674
2.85	2.70	5.70	0.000	0.0	118.28	123.18	2.45	32596	4.684
3.00	3.00	6.20	0.000	0.0	118.74	123.98	2.62	32767	4.695
3.15	3.20	6.90	0.000	0.0	119.30	124.94	2.82	32972	4.708
3.30	3.70	7.70	0.000	0.0	120.02	126.20	3.09	33239	4.725
3.45	4.00	8.90	0.000	0.0	120.91	127.72	3.41	33565	4.746
3.60	4.90	10.50	0.000	0.0	122.01	129.81	3.90	33995	4.774
3.75	5.60	13.80	0.000	0.0	123.42	132.51	4.54	34551	4.810
3.90	8.20	21.70	0.000	0.0	125.76	137.22	5.73	35503	4.871
4.05	13.50	52.74	0.000	0.0	130.44	147.46	8.51	37517	4.998
4.20	39.24	45.84	0.000	0.0	151.95	183.18	15.62	45242	5.469
4.35	6.60	11.00	0.000	0.0	162.61	197.79	17.59	48654	5.670
4.50	4.40	7.80	0.000	0.0	145.25	173.61	14.18	43047	5.338
4.65	3.40	6.30	0.000	0.0	132.76	153.05	10.15	38584	5.064
4.80	2.90	5.40	0.000	0.0	126.64	139.06	6.21	35870	4.894
4.95	2.50	4.70	0.000	0.0	123.18	132.04	4.43	34455	4.804
5.10	2.20	4.20	0.000	0.0	121.00	127.88	3.44	33598	4.749
5.25	2.00	3.90	0.000	0.0	119.44	125.20	2.88	33026	4.712
5.40	1.90	3.60	0.000	0.0	118.37	123.34	2.49	32632	4.686
5.55	1.70	3.30	0.000	0.0	117.58	121.97	2.20	32340	4.667
5.70	1.60	3.10	0.000	0.0	116.87	120.88	2.01	32096	4.651
5.85	1.50	2.90	0.000	0.0	116.27	119.97	1.85	31892	4.638
6.00	1.40	1.40	0.000	0.0	115.75	119.17	1.71	31714	4.626
6.15	0.00	0.00	0.000	0.0	114.42	117.15	1.36	31262	4.596
6.30	0.00	0.00	0.000	0.0	112.39	114.42	1.02	30620	4.554
6.45	0.00	0.00	0.000	0.0	110.78	112.39	0.81	30128	4.522
6.60	0.00	0.00	0.000	0.0	109.45	110.78	0.66	29731	4.495
6.75	0.00	0.00	0.000	0.0	108.12	109.45	0.66	29373	4.471
6.90	0.00	0.00	0.000	0.0	106.80	108.12	0.66	29015	4.447

time (hr)	Inflow, In (cfs)	In+In+1 (cfs)	fn (cfs)	Inf. Vol, F (ft3)	2S1/At-O1 (cfs)	2S2/At+O2 (cfs)	Outflow, On (cfs)	Volume, S (ft3)	Elevation, h (ft-osl)
7.05	0.00	0.00	0.000	0.0	105.49	106.80	0.66	28659	4.423
7.20	0.00	0.00	0.000	0.0	104.17	105.49	0.66	28304	4.399
7.35	0.00	0.00	0.000	0.0	102.87	104.17	0.65	27950	4.375
7.50	0.00	0.00	0.000	0.0	101.56	102.87	0.65	27597	4.351
7.65	0.00	0.00	0.000	0.0	100.26	101.56	0.65	27246	4.328
7.80	0.00	0.00	0.000	0.0	98.96	100.26	0.65	26895	4.304
7.95	0.00	0.00	0.000	0.0	97.67	98.96	0.65	26546	4.280
8.10	0.00	0.00	0.000	0.0	96.38	97.67	0.64	26197	4.257
8.25	0.00	0.00	0.000	0.0	95.10	96.38	0.64	25850	4.233
8.40	0.00	0.00	0.000	0.0	93.82	95.10	0.64	25504	4.209
8.55	0.00	0.00	0.000	0.0	92.54	93.82	0.64	25159	4.185
8.70	0.00	0.00	0.000	0.0	91.27	92.54	0.64	24815	4.161
8.85	0.00	0.00	0.000	0.0	90.01	91.27	0.63	24473	4.137
9.00	0.00	0.00	0.000	0.0	88.74	90.01	0.63	24131	4.113
9.15	0.00	0.00	0.000	0.0	87.49	88.74	0.63	23791	4.089
9.30	0.00	0.00	0.000	0.0	86.23	87.49	0.63	23452	4.066
9.45	0.00	0.00	0.000	0.0	84.98	86.23	0.62	23114	4.042
9.60	0.00	0.00	0.000	0.0	83.74	84.98	0.62	22777	4.019
9.75	0.00	0.00	0.000	0.0	82.50	83.74	0.62	22442	3.990
9.90	0.00	0.00	0.000	0.0	81.27	82.50	0.62	22108	3.941
10.05	0.00	0.00	0.000	0.0	80.04	81.27	0.61	21777	3.891
10.20	0.00	0.00	0.000	0.0	78.83	80.04	0.61	21448	3.842
10.35	0.00	0.00	0.000	0.0	77.63	78.83	0.60	21122	3.793
10.50	0.00	0.00	0.000	0.0	76.43	77.63	0.60	20798	3.744
10.65	0.00	0.00	0.000	0.0	75.24	76.43	0.59	20476	3.684
10.80	0.00	0.00	0.000	0.0	74.06	75.24	0.59	20156	3.625
10.95	0.00	0.00	0.000	0.0	72.89	74.06	0.59	19838	3.566
11.10	0.00	0.00	0.000	0.0	71.72	72.89	0.58	19522	3.508
11.25	0.00	0.00	0.000	0.0	70.56	71.72	0.58	19207	3.449
11.40	0.00	0.00	0.000	0.0	69.40	70.56	0.58	18894	3.390
11.55	0.00	0.00	0.000	0.0	68.25	69.40	0.57	18584	3.332
11.70	0.00	0.00	0.000	0.0	67.11	68.25	0.57	18274	3.274
11.85	0.00	0.00	0.000	0.0	65.98	67.11	0.57	17967	3.216
12.00	0.00	0.00	0.000	0.0	64.85	65.98	0.56	17662	3.158
12.15	0.00	0.00	0.000	0.0	63.73	64.85	0.56	17359	3.100
12.30	0.00	0.00	0.000	0.0	62.62	63.73	0.56	17058	3.043
12.45	0.00	0.00	0.000	0.0	61.51	62.62	0.55	16758	2.985
12.60	0.00	0.00	0.000	0.0	60.42	61.51	0.55	16461	2.928
12.75	0.00	0.00	0.000	0.0	59.33	60.42	0.54	16166	2.871
12.90	0.00	0.00	0.000	0.0	58.25	59.33	0.54	15872	2.814
13.05	0.00	0.00	0.000	0.0	57.17	58.25	0.54	15581	2.758
13.20	0.00	0.00	0.000	0.0	56.10	57.17	0.53	15292	2.701
13.35	0.00	0.00	0.000	0.0	55.05	56.10	0.53	15005	2.645
13.50	0.00	0.00	0.000	0.0	54.00	55.05	0.53	14721	2.589
13.65	0.00	0.00	0.000	0.0	52.95	54.00	0.52	14438	2.533
13.80	0.00	0.00	0.000	0.0	51.92	52.95	0.52	14158	2.478
13.95	0.00	0.00	0.000	0.0	50.89	51.92	0.51	13879	2.422
14.10	0.00	0.00	0.000	0.0	49.88	50.89	0.51	13604	2.367
14.25	0.00	0.00	0.000	0.0	48.87	49.88	0.50	13330	2.313
14.40	0.00	0.00	0.000	0.0	47.87	48.87	0.50	13059	2.259
14.55	0.00	0.00	0.000	0.0	46.87	47.87	0.50	12790	2.204
14.70	0.00	0.00	0.000	0.0	45.89	46.87	0.491	12523	2.150

MODIFIED PULS

RESULTS: Routing of 6 hr - 100 yr Total Hydrograph in BMP-1

Max outflow: 21.65 cfs — initial elev: 4.50 ft

Max elevation in pond: 5.85 ft (Elevation) — Peak flow in: 41.200 cfs

Vol-out: 128265 cu-ft — Vol in: 98496 cu-ft

h_{max} over surface: 2.10 ft

Pond Storm: 6 hr - 100 yr

time (hr)	Inflow, In (cfs)	In+In+1 (cfs)	fn (cfs)	Inf. Vol, F (ft3)	2S1/At-O1 (cfs)	2S2/At+O2 (cfs)	Outflow, On (cfs)	Volume, S (ft3)	Elevation, h (ft-osl)
0.15	0.00	1.70	0.00	0.0	110.38		0.00	29802	4.500
0.30	1.70	3.40	0.000	0.0	110.53	112.08	0.77	30052	4.517
0.45	1.70	3.50	0.000	0.0	112.00	113.93	0.97	30501	4.546
0.60	1.80	3.60	0.000	0.0	113.24	115.50	1.13	30880	4.571
0.75	1.80	3.70	0.000	0.0	114.22	116.84	1.31	31194	4.592
0.90	1.90	3.80	0.000	0.0	114.93	117.92	1.50	31436	4.608
1.05	1.90	3.90	0.000	0.0	115.46	118.73	1.64	31616	4.620
1.20	2.00	4.00	0.000	0.0	115.87	119.36	1.74	31757	4.629
1.35	2.00	4.10	0.000	0.0	116.21	119.87	1.83	31871	4.636
1.50	2.10	4.30	0.000	0.0	116.49	120.31	1.91	31968	4.643
1.65	2.20	4.50	0.000	0.0	116.81	120.79	1.99	32076	4.650
1.80	2.30	4.70	0.000	0.0	117.15	121.31	2.08	32192	4.657
1.95	2.40	4.90	0.000	0.0	117.50	121.85	2.17	32312	4.665
2.10	2.50	5.10	0.000	0.0	117.83	122.40	2.29	32431	4.673
2.25	2.60	5.40	0.000	0.0	118.13	122.93	2.40	32543	4.680
2.40	2.80	5.70	0.000	0.0	118.48	123.53	2.53	32672	4.689
2.55	2.90	6.00	0.000	0.0	118.86	124.18	2.66	32811	4.698
2.70	3.10	6.40	0.000	0.0	119.25	124.86	2.80	32955	4.707
2.85	3.30	7.00	0.000	0.0	119.71	125.65	2.97	33123	4.718
3.00	3.70	7.60	0.000	0.0	120.32	126.71	3.19	33348	4.732
3.15	3.90	8.30	0.000	0.0	121.02	127.92	3.45	33606	4.749
3.30	4.40	9.20	0.000	0.0	121.75	129.32	3.78	33895	4.768
3.45	4.80	10.70	0.000	0.0	122.61	130.95	4.17	34231	4.789
3.60	5.90	12.60	0.000	0.0	123.84	133.31	4.73	34715	4.820
3.75	6.70	16.50	0.000	0.0	125.39	136.44	5.53	35347	4.861
3.90	9.80	32.20	0.000	0.0	127.96	141.89	6.96	36430	4.929
4.05	22.40	63.60	0.000	0.0	136.48	160.16	11.84	40047	5.155
4.20	41.20	49.10	0.000	0.0	164.34	200.08	17.87	49196	5.702
4.35	7.90	13.20	0.000	0.0	170.14	213.44	21.65	51784	5.851
4.50	5.30	9.40	0.000	0.0	152.06	183.34	15.64	45280	5.472
4.65	4.10	7.60	0.000	0.0	137.24	161.46	12.11	40325	5.172
4.80	3.50	6.50	0.000	0.0	129.27	144.84	7.78	37005	4.966
4.95	3.00	5.70	0.000	0.0	125.07	135.77	5.35	35213	4.852
5.10	2.70	5.10	0.000	0.0	122.51	130.77	4.13	34193	4.787
5.25	2.40	4.60	0.000	0.0	120.84	127.61	3.39	33541	4.745
5.40	2.20	4.30	0.000	0.0	119.59	125.44	2.93	33079	4.715
5.55	2.10	4.00	0.000	0.0	118.69	123.89	2.60	32747	4.693
5.70	1.90	3.70	0.000	0.0	117.99	122.69	2.35	32492	4.677
5.85	1.80	3.50	0.000	0.0	117.40	121.69	2.15	32278	4.663
6.00	1.70	1.70	0.000	0.0	116.88	120.90	2.01	32100	4.651
6.15	0.00	0.00	0.000	0.0	115.36	118.58	1.61	31582	4.617
6.30	0.00	0.00	0.000	0.0	113.13	115.36	1.11	30847	4.569
6.45	0.00	0.00	0.000	0.0	111.37	113.13	0.88	30308	4.533
6.60	0.00	0.00	0.000	0.0	109.97	111.37	0.70	29881	4.505
6.75	0.00	0.00	0.000	0.0	108.64	109.97	0.66	29513	4.480
6.90	0.00	0.00	0.000	0.0	107.32	108.64	0.66	29155	4.456

time (hr)	Inflow, In (cfs)	In+In+1 (cfs)	fn (cfs)	Inf. Vol, F (ft3)	2S1/At-O1 (cfs)	2S2/At+O2 (cfs)	Outflow, On (cfs)	Volume, S (ft3)	Elevation, h (ft-osl)
7.05	0.00	0.00	0.000	0.0	106.00	107.32	0.66	28798	4.432
7.20	0.00	0.00	0.000	0.0	104.69	106.00	0.66	28443	4.408
7.35	0.00	0.00	0.000	0.0	103.38	104.69	0.66	28089	4.384
7.50	0.00	0.00	0.000	0.0	102.07	103.38	0.65	27735	4.361
7.65	0.00	0.00	0.000	0.0	100.77	102.07	0.65	27383	4.337
7.80	0.00	0.00	0.000	0.0	99.47	100.77	0.65	27032	4.313
7.95	0.00	0.00	0.000	0.0	98.18	99.47	0.65	26682	4.289
8.10	0.00	0.00	0.000	0.0	96.89	98.18	0.64	26334	4.266
8.25	0.00	0.00	0.000	0.0	95.60	96.89	0.64	25986	4.242
8.40	0.00	0.00	0.000	0.0	94.32	95.60	0.64	25639	4.218
8.55	0.00	0.00	0.000	0.0	93.04	94.32	0.64	25294	4.194
8.70	0.00	0.00	0.000	0.0	91.77	93.04	0.64	24950	4.170
8.85	0.00	0.00	0.000	0.0	90.50	91.77	0.63	24607	4.146
9.00	0.00	0.00	0.000	0.0	89.24	90.50	0.63	24265	4.122
9.15	0.00	0.00	0.000	0.0	87.98	89.24	0.63	23924	4.099
9.30	0.00	0.00	0.000	0.0	86.72	87.98	0.63	23585	4.075
9.45	0.00	0.00	0.000	0.0	85.47	86.72	0.63	23246	4.052
9.60	0.00	0.00	0.000	0.0	84.22	85.47	0.62	22909	4.028
9.75	0.00	0.00	0.000	0.0	82.98	84.22	0.62	22573	4.005
9.90	0.00	0.00	0.000	0.0	81.75	82.98	0.62	22238	3.960
10.05	0.00	0.00	0.000	0.0	80.52	81.75	0.61	21906	3.910
10.20	0.00	0.00	0.000	0.0	79.30	80.52	0.61	21577	3.861
10.35	0.00	0.00	0.000	0.0	78.10	79.30	0.60	21249	3.812
10.50	0.00	0.00	0.000	0.0	76.90	78.10	0.60	20925	3.764
10.65	0.00	0.00	0.000	0.0	75.71	76.90	0.60	20602	3.707
10.80	0.00	0.00	0.000	0.0	74.52	75.71	0.59	20281	3.648
10.95	0.00	0.00	0.000	0.0	73.35	74.52	0.59	19962	3.589
11.10	0.00	0.00	0.000	0.0	72.17	73.35	0.59	19645	3.531
11.25	0.00	0.00	0.000	0.0	71.01	72.17	0.58	19330	3.472
11.40	0.00	0.00	0.000	0.0	69.85	71.01	0.58	19016	3.413
11.55	0.00	0.00	0.000	0.0	68.70	69.85	0.58	18705	3.355
11.70	0.00	0.00	0.000	0.0	67.56	68.70	0.57	18395	3.297
11.85	0.00	0.00	0.000	0.0	66.42	67.56	0.57	18087	3.239
12.00	0.00	0.00	0.000	0.0	65.29	66.42	0.56	17781	3.180
12.15	0.00	0.00	0.000	0.0	64.17	65.29	0.56	17477	3.123
12.30	0.00	0.00	0.000	0.0	63.05	64.17	0.56	17175	3.065
12.45	0.00	0.00	0.000	0.0	61.95	63.05	0.55	16875	3.008
12.60	0.00	0.00	0.000	0.0	60.85	61.95	0.55	16577	2.950
12.75	0.00	0.00	0.000	0.0	59.75	60.85	0.55	16281	2.893
12.90	0.00	0.00	0.000	0.0	58.67	59.75	0.54	15987	2.836
13.05	0.00	0.00	0.000	0.0	57.59	58.67	0.54	15695	2.780
13.20	0.00	0.00	0.000	0.0	56.52	57.59	0.53	15405	2.723
13.35	0.00	0.00	0.000	0.0	55.46	56.52	0.53	15117	2.667
13.50	0.00	0.00	0.000	0.0	54.40	55.46	0.53	14832	2.611
13.65	0.00	0.00	0.000	0.0	53.36	54.40	0.52	14548	2.555
13.80	0.00	0.00	0.000	0.0	52.32	53.36	0.52	14267	2.500
13.95	0.00	0.00	0.000	0.0	51.29	52.32	0.51	13988	2.444
14.10	0.00	0.00	0.000	0.0	50.27	51.29	0.51	13711	2.389
14.25	0.00	0.00	0.000	0.0	49.26	50.27	0.51	13437	2.334
14.40	0.00	0.00	0.000	0.0	48.26	49.26	0.50	13165	2.280
14.55	0.00	0.00	0.000	0.0	47.26	48.26	0.50	12895	2.226
14.70	0.00	0.00	0.000	0.0	46.27	47.26	0.493	12627	2.171

APPENDIX A – TABLES AND CHARTS

Ernest F. Brater and Horace Williams King

HANDBOOK OF HYDRAULICS

For the Solution of Hydraulic Engineering Problems

Table 7-14. Values of K' for Circular Channels in the Formula

$$Q = \frac{K'}{n} d^{8/3} s^{1/2}$$

D = depth of water d = diameter of channel

$\frac{D}{d}$	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
.0		.00007	.00031	.00074	.00138	.00222	.00328	.00455	.00604	.00775
.1	.00967	.0118	.0142	.0167	.0195	.0225	.0257	.0291	.0327	.0366
.2	.0406	.0448	.0492	.0537	.0585	.0634	.0686	.0738	.0793	.0849
.3	.0907	.0966	.1027	.1089	.1153	.1218	.1284	.1352	.1420	.1490
.4	.1561	.1633	.1705	.1779	.1854	.1929	.2005	.2082	.2160	.2238
.5	.232	.239	.247	.255	.263	.271	.279	.287	.295	.303
.6	.311	.319	.327	.335	.343	.350	.358	.366	.373	.380
.7	.388	.395	.402	.409	.416	.422	.429	.435	.441	.447
.8	.453	.458	.463	.468	.473	.477	.481	.485	.488	.491
.9	.494	.496	.497	.498	.498	.498	.496	.494	.489	.483
1.0	.463									

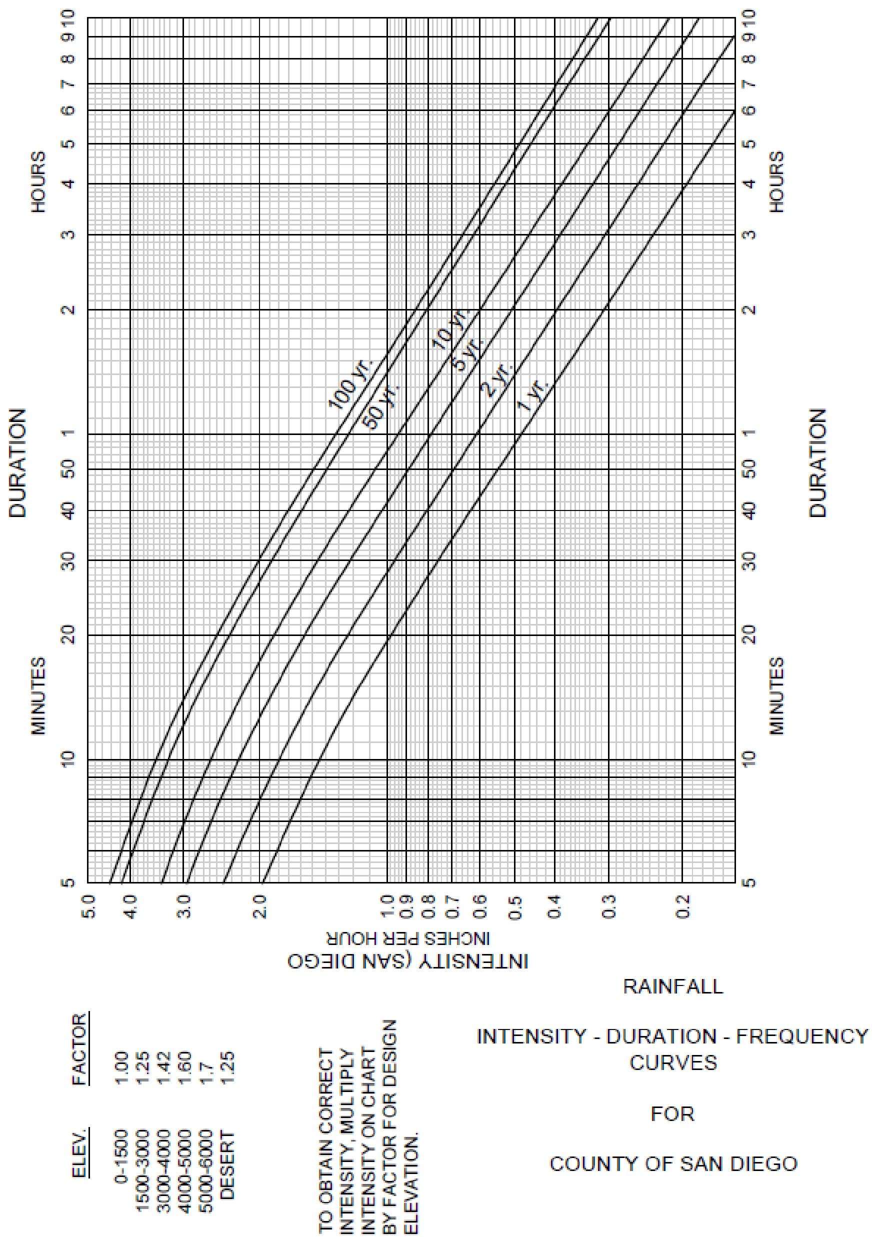


Figure A-1. Intensity-Duration-Frequency Design Chart

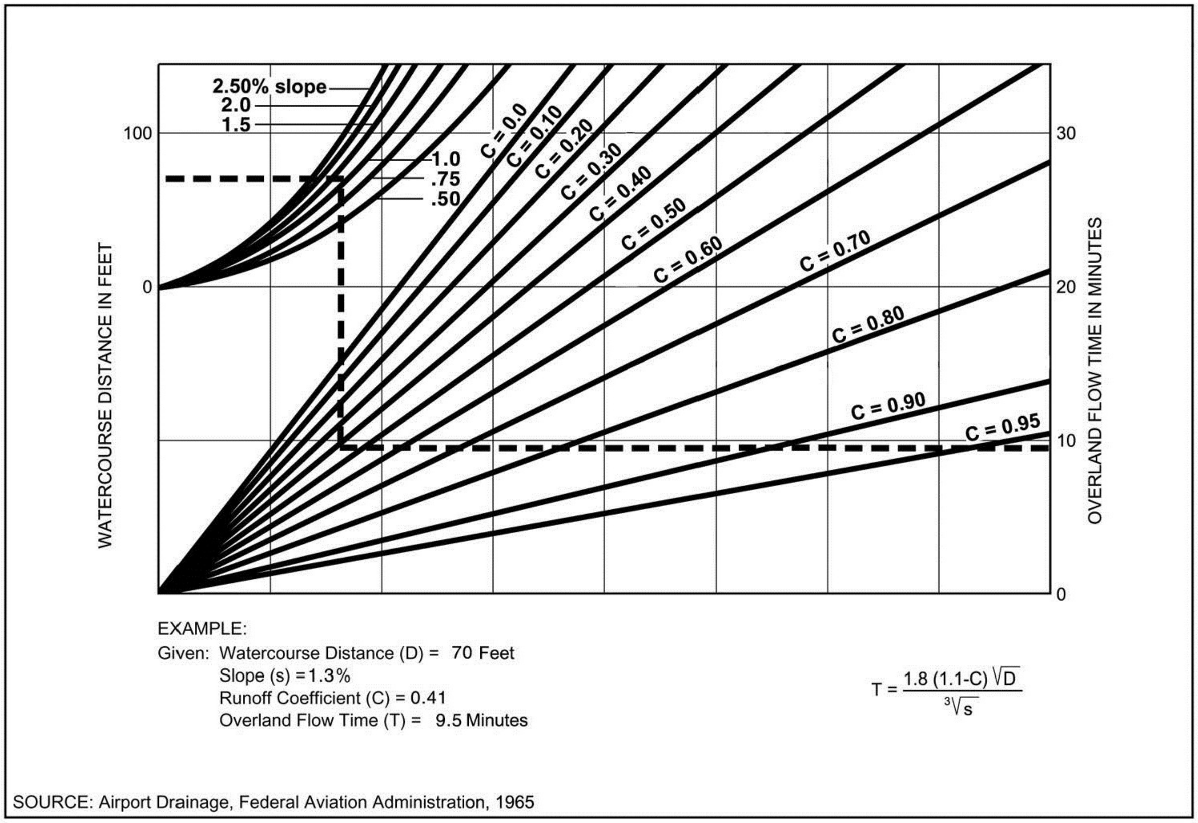


Figure A-4. Rational Formula – Overland Time of Flow Nomograph

<u>**Note**</u>: Use formula for watercourse distances in excess of 100 feet.

Table A-1. Runoff Coefficients for Rational Method

Land Use	Runoff Coefficient (C)
	Soil Type [1]
Residential:	
Single Family	0.55
Multi-Units	0.70
Mobile Homes	0.65
Rural (lots greater than ½ acre)	0.45
Commercial [2]	
80% Impervious	0.85
Industrial [2]	
90% Impervious	0.95

Note:
[1] Type D soil to be used for all areas.
[2] Where actual conditions deviate significantly from the tabulated imperviousness values of 80% or 90%, the values given for coefficient C, may be revised by multiplying 80% or 90% by the ratio of actual imperviousness to the tabulated imperviousness. However, in case shall the final coefficient be less than 0.50. For example: Consider commercial property on D soil.

Actual imperviousness = 50%
Tabulated imperviousness = 80%
Revised C = (50/80) x 0.85 = 0.53

The values in Table A–1 are typical for urban areas. However, if the basin contains rural or agricultural land use, parks, golf courses, or other types of nonurban land use that are expected to be permanent, the appropriate value should be selected based upon the soil and cover and approved by the City.

A.1.3. Rainfall Intensity

The rainfall intensity (I) is the rainfall in inches per hour (in/hr.) for a duration equal to the T_C for a selected storm frequency. Once a particular storm frequency has been selected for design and a T_C calculated for the drainage area, the rainfall intensity can be determined from the Intensity-Duration-Frequency Design Chart (Figure A-1).

Appendix C

Manning Roughness Coefficients

The Manning roughness coefficient (n) is used to represent flow resistance in open-channel hydraulic computations. This Appendix offers a compilation of Manning roughness coefficients that may be used in the hydraulic design and evaluation of drainage facilities.

These values serve only as a basic guide. The procedure for selecting appropriate values for Manning roughness coefficient, especially in natural channel systems, is subjective and requires judgment and skill that is primarily developed through experience. For work where very accurate determination of water surface profile is necessary, the design engineer should consult the governing Agency to obtain data regarding roughness coefficient values applicable to specific streams. The design engineer may also examine Flood Insurance Study data, or one of several references for more specific information on determining roughness coefficient.

Table C-1. Average Manning Roughness Coefficients for Pavement and Gutters (1)

Material	Manning Roughness Coefficient (n)
Concrete Gutter (2)	0.015
Concrete Pavement	
Float Finish	0.014
Broom Finish	0.016
Concrete Gutter with Asphalt Pavement	
Smooth Finish	0.013
Rough Texture	0.015
Asphalt Pavement	
Smooth Finish	0.013
Rough Texture	0.016

Based on FHWA HEC-22.

(1) Based on materials and workmanship required by standard specifications.

(2) Increase roughness coefficient in gutters with mild slopes where sediment might accumulate by 0.020.

Table C-2. Average Manning Roughness Coefficients for Closed Conduits [1]

Conduit	Manning Roughness Coefficient (n)
Reinforced Concrete Pipe (RCP)	0.013
Corrugated Metal Pipe and Pipe Arch	
2-3/8 x ½ inch Corrugations	
Unlined	0.024
Half Lined	
Full Flow	0.018
d/D>=0.60	0.016
d/D<0.60	0.013
Fully Lined	0.013
3x1 inch Corrugations	0.027
6x2 inch Corrugations	0.032
Spiral Rib Pipe	0.013
Helically Wound Pipe	
18-inch	0.015
24-inch	0.017
30-inch	0.019
36-inch	0.021
42-inch	0.022
48-inch	0.023
Plastic Pipe (HPDE and PVC)	
Smooth	0.013
Corrugated	0.024
Vitrified Clay Pipe	0.014
Cast-Iron Pipe (Uncoated)	0.013
Steel Pipe	0.011
Brick	0.017
Cast-In-Place Concrete Pipe	
Rough Wood Forms	0.017
Smooth Wood or Steel Forms	0.014

[1] Based on materials and workmanship required by standard specifications.

Table C-3. Average Manning Roughness Coefficients for Small Open Channels Conveying Less than 50 cfs(1)

Lining Type	Design Flow Depth		
	0 – 0.5 ft	0.5 – 2.0 ft	> 2.0 ft
Concrete (Poured)	0.015	0.013	0.013
Air Blown Concrete	0.023	0.019	0.016
Grouted Riprap	0.040	0.030	0.028
Stone Masonry	0.042	0.032	0.030
Soil Cement	0.025	0.022	0.020
Bare Soil	0.023	0.020	0.020
Rock Cut	0.045	0.035	0.025
Rock Riprap	Based on Rock Size (See Chapter 7, Section 7.6.17)		

(1) Based on materials and workmanship required by standard specifications.

Table C-4. Average Manning Roughness Coefficients for Larger Open Channels

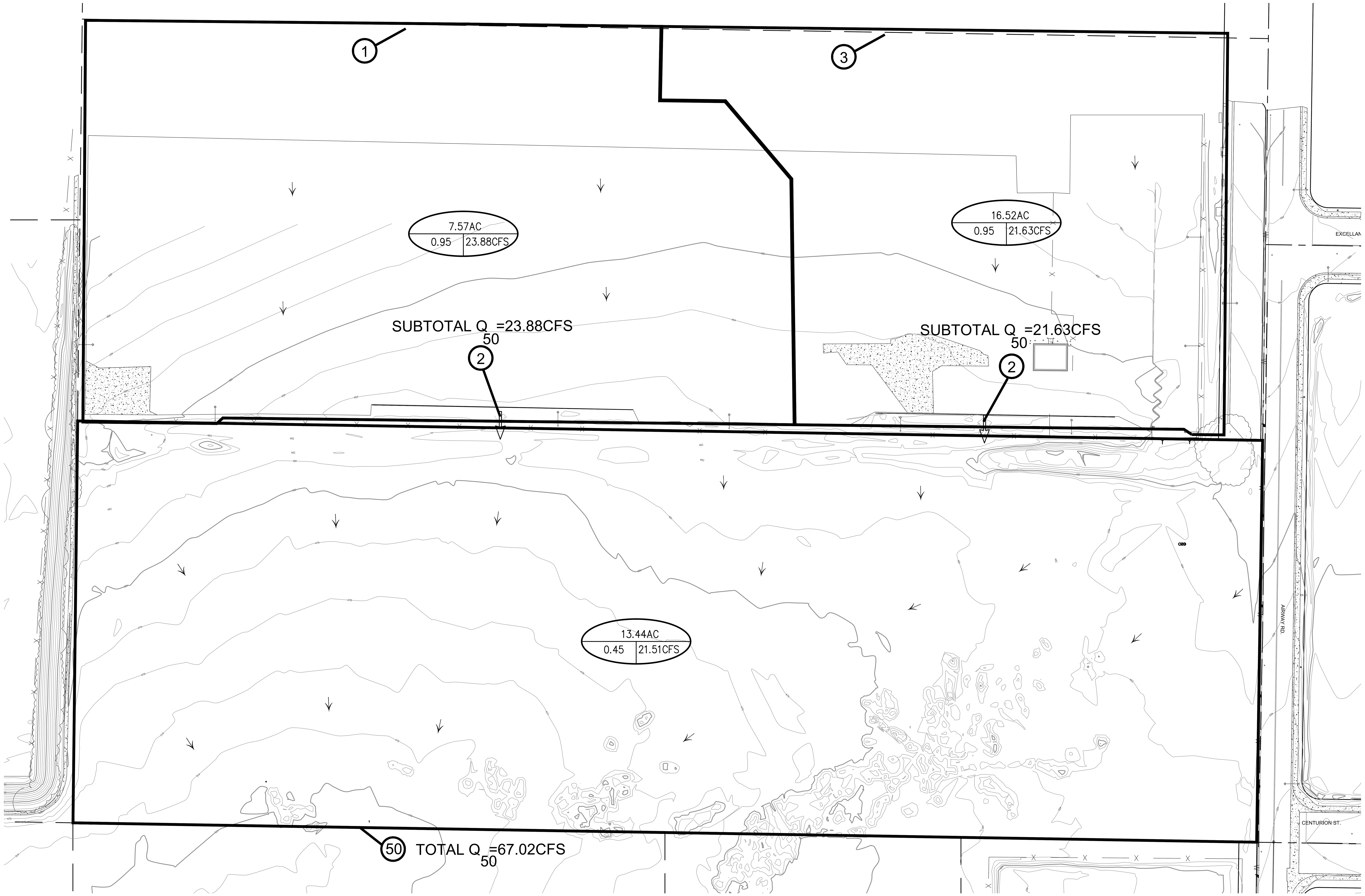
Channel	Manning Roughness Coefficient(n)
Unlined Channels Clay Loam Sand	 0.023 0.020
Lined Channels Grass Lined (well maintained) Grass Lined (not maintained)	 0.035 0.045
Wetland-Bottom Channels (New Channel)	0.023
Wetland-Bottom Channels (Mature Channel)	See Table A-5
Riprap-Lined Channels	See Chapter 7, Section 7.6.17
Concrete (Poured)	0.014
Air Blown Mortar (Gunite or Shotcrete)(1)	0.016
Asphaltic Concrete or Bituminous Plant Mix	0.018

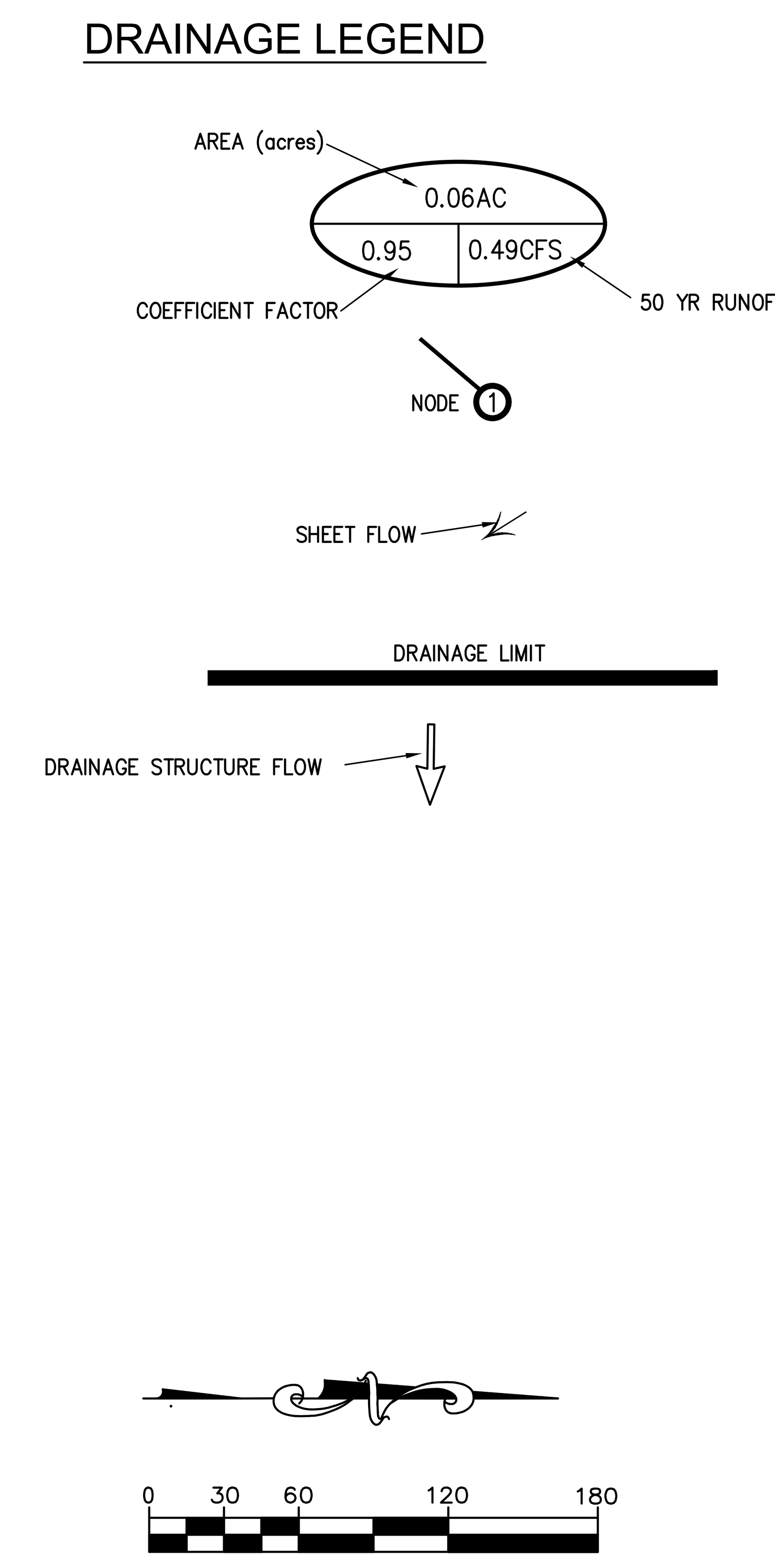
(1) For air blown concrete, use n=0.012 (if troweled) and n=0.025 if purposely roughened.
Note: For channels with revetments or multiple lining types, use composite Manning roughness coefficient based on component lining materials.

Table C-5. Average Manning Roughness Coefficients for Natural Channels

Channel	Manning Roughness Coefficient (n)
Minor Streams (Surface Width at Flood Stage < 100 ft)	
Fairly Regular Section	
(A) Some Grass and Weeds, Little or No Brush	0.030
(B) Dense Growth of Weeds, Depth of Flow Materially Greater than Weed Height	0.040
(C) Some Weeds, Light Brush on Banks	0.040
(D) Some Weeds, Heavy Brush on Banks	0.060
(E) For Trees within Channel with Branches Submerged at High Stage, Increase all above values by:	0.015
Irregular Section, with Pools, Slight Channel Meander Channels (A) through (E) above, Increase all Values by:	0.015
Mountain Streams; No Vegetation in Channel, Banks Usually Steep, Trees and Brush along Banks Submerged at High Stage	
(A) Bottom, Gravel, Cobbles and Few Boulders	0.050
(B) Bottom, Cobbles with Large Boulders	0.060
Flood Plains (Adjacent to Natural Streams)	
Pasture, No Brush	
(A) Short Grass	0.030
(B) High Grass	0.040
Cultivated Areas	
(A) No Crop	0.040
(B) Mature Row Crops	0.040
(C) Mature Field Crops	0.050
Heavy Weeds, Scattered Brush	0.050
Light Brush and Trees	0.060
Medium-to-Dense Brush	0.090
Dense Willows	0.170
Cleared Land with Tree Stumps, 100-150 per Acre	0.060
Heavy Stand of Timber, Little Undergrowth	
(A) Flood Depth below Branches	0.110
(B) Flood Depth Reaches Branches	0.140

APPENDIX B – DRAINAGE EXHIBIT





IF PLAN SIZE IS LESS THAN 24"x36", THIS IS A REDUCED COPY. SCALE PLAN ACCORDINGLY.

(REV 5/13/2019)

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Planning . Engineering . Surveying
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(619) 296-5565 Fax: (619) 296-5564

REGISTERED PROFESSIONAL ENGINEER
KAMAL S. SWEIS
NO.48592
EXP 6-30-22
CIVIL
STATE OF CALIFORNIA

CITY OF SAN DIEGO	DRAWING NO.
EXISTING HYDROLOGY PLAN FOR:	H1
AIRWAY LOGISTICS CENTER	SHEET 1 OF 2

(REV 5/13/2019)

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REGISTERED PROFESSIONAL ENGINEER
KAMAL S. SWEIS
NO.48592
EXP 6-30-22
CIVIL
STATE OF CALIFORNIA

CITY OF SAN DIEGO	DRAWING NO.
PROPOSED HYDROLOGY PLAN FOR:	H2
AIRWAY LOGISTICS CENTER	SHEET 2 OF 2

Attachment 6
Geotechnical and Groundwater Investigation Report

Attach project's geotechnical and groundwater investigation report. Refer to Appendix C.4 to determine the reporting requirements.

GEOCON
INCORPORATED

GEOTECHNICAL
ENVIRONMENTAL
MATERIALS

GEOTECHNICAL INVESTIGATION

AIRWAY ROAD
INDUSTRIAL BUILDING
SAN DIEGO, CALIFORNIA

PREPARED FOR

BADIEE DEVELOPMENT
LA JOLLA, CALIFORNIA

MAY 18, 2020
PROJECT NO. G2467-42-01

Project No. G2467-42-01
May 18, 2020

Badiee Development
Post Office Box 3111
La Jolla, California 92038

Attention: Mr. Scott Merry

Subject: GEOTECHNICAL INVESTIGATION
AIRWAY ROAD INDUSTRIAL BUILDING
AIRWAY ROAD
SAN DIEGO, CALIFORNIA

Dear Mr. Merry:

In accordance with your request, we have prepared this geotechnical investigation report for a proposed industrial building at the subject site. The site is underlain by Pleistocene Terrace Deposits mantled by topsoil. Some undocumented fill stockpiles are present on the property.

This report is based on our observations made during our field investigation performed on November 15, 2019, and laboratory testing. Based on the results of this study, we opine that the subject site is suitable for construction of the proposed industrial building. The accompanying report presents the results of our study and conclusions and recommendations regarding geotechnical aspects of site development.

Should you have questions regarding this investigation, or if we may be of further service, please contact the undersigned at your convenience.

Very truly yours,

GEOCON INCORPORATED

Rodney C. Mikesell
GE 2533

Rupert S. Adams
CEG 2561

RCM:RSA:arm

(e-mail) Addressee

TABLE OF CONTENTS

TABLE OF CONTENTS (Concluded)

GEOTECHNICAL INVESTIGATION

1. PURPOSE AND SCOPE

This report presents the results of our geotechnical investigation for a proposed industrial building located south of the intersection of Airway Road and Centurion Street, in San Diego, California (see Vicinity Map, Figure 1). The purpose of our investigation was to evaluate subsurface soil and geologic conditions at the site, and provide conclusions and recommendations pertaining to the geotechnical aspects of developing the property as proposed.

The scope of our investigation included a site reconnaissance, excavation and logging of 17 test pits, performing 3 infiltration tests in areas of proposed storm water basins or other storm water management devices, and reviewing published and unpublished geologic literature and reports (see List of References). Appendix A presents a discussion of our field investigation. We performed laboratory tests on soil samples obtained from the exploratory test pits to evaluate pertinent physical properties for engineering analyses. The results of laboratory testing are presented in Appendix B.

Site geologic conditions are depicted on Figure 2 (Geologic Map). A CAD file of the preliminary grading plan prepared by K&S Engineering was utilized as a base map to plot geologic contacts and trench locations.

The conclusions and recommendations presented herein are based on our analysis of the data obtained during the investigation, and our experience with similar soil and geologic conditions on this and adjacent properties.

2. SITE AND PROJECT DESCRIPTION

The property consists of an undeveloped rectangular parcel located south of the intersection of Airway Road and Centurion Street, in the Otay Mesa district of San Diego, California (see Figure 1). The subject parcel consists of approximately 13 acres of undeveloped land and is approximately 440 feet wide and 1,250 feet long. Site topography is relatively flat with elevations ranging from approximately 477 feet to 489 feet above mean sea level (MSL).

The proposed improvements will consist of a single-story approximately 247,000 square-foot industrial warehouse building with associated improvements such as utilities, paving, storm water management devices, and landscape improvements. Retaining walls are expected for loading docks. Proposed cuts and fills are estimated to be less than seven feet. New slopes are not anticipated.

The locations and descriptions of the site and proposed development are based on our site reconnaissance and recent field investigations, and our understanding of site development as shown on the preliminary grading plan by K&S Engineering. If project details vary significantly from those described, Geocon Incorporated should be contacted to review the changes and provide additional analyses and/or revisions to this report, if warranted.

3. SOIL AND GEOLOGIC CONDITIONS

Based on the results of the field investigation, the site is underlain by Pleistocene Terrace Deposits mantled by topsoil, which are described below in order of increasing age. Portions of the site are covered in undocumented fill and end-dumped piles of trash and construction debris. Mapped geologic conditions are depicted on the *Geologic Map* (Figure 2), and on the *Geologic Cross Section* (Figure 3). Exploratory test pit logs are presented in Appendix A, Figures A-1 through A-17.

3.1 Undocumented Fill (Qudf)

The north and east portions of the site have numerous end-dumped soil and trash piles, consisting of construction and landscaping debris, plastic, metal, and other debris. We also observed several old wooden power poles and fiberglass boat hulls. These soils and debris are unsuitable for support of structural fill or other improvements in their present condition. Trash should be hauled offsite prior to grading. Miscellaneous soil piles can be incorporated during grading, provided they are free of trash and/or hazardous substances.

3.2 Topsoil (Unmapped)

Topsoil mantles the site and typically consists of loose, dry to damp, silty and clayey fine sand. Topsoil ranges from one to two feet thick across the site. Remedial grading in the form of removal and recompaction will be required in areas receiving improvements. In addition, topsoil will likely exhibit “medium” expansion characteristics.

3.3 Terrace Deposits (Qtc and Qtg)

Pleistocene-age Terrace Deposits underlie the surficial deposits across the site. This unit typically consists of two relatively distinct layers or “members”. An upper clay layer (Qtc) overlies a lower, coarse-grained, granular layer (Qtg). The upper layer consists of stiff to hard, damp to moist, brown, olive-brown to reddish-brown clay with varying amounts of sand. The clay layer ranges in thickness from approximately four to seven feet thick in the areas explored.

The lower sand-gravel member (Qtg) of consists of dense to very dense, dry to damp, silty and clayey sand with gravel and sandy gravel. Some cobble up to 12-inches in maximum dimension was observed. Thin, concretionary lenses were observed in some test pits.

Both the upper clay member and lower sand-gravel member of the Terrace Deposits possess adequate strength characteristics for support of structures and/or structural fills. However, based on our experience and laboratory testing, the clay member possesses a "medium to very high" expansion potential (EI greater than 51), and poor pavement support characteristics. Expansion indexes of over 200 have been recorded in the clay member on some nearby projects; the highest expansion index obtained from laboratory testing of soils from this site was 129.

4. GROUNDWATER

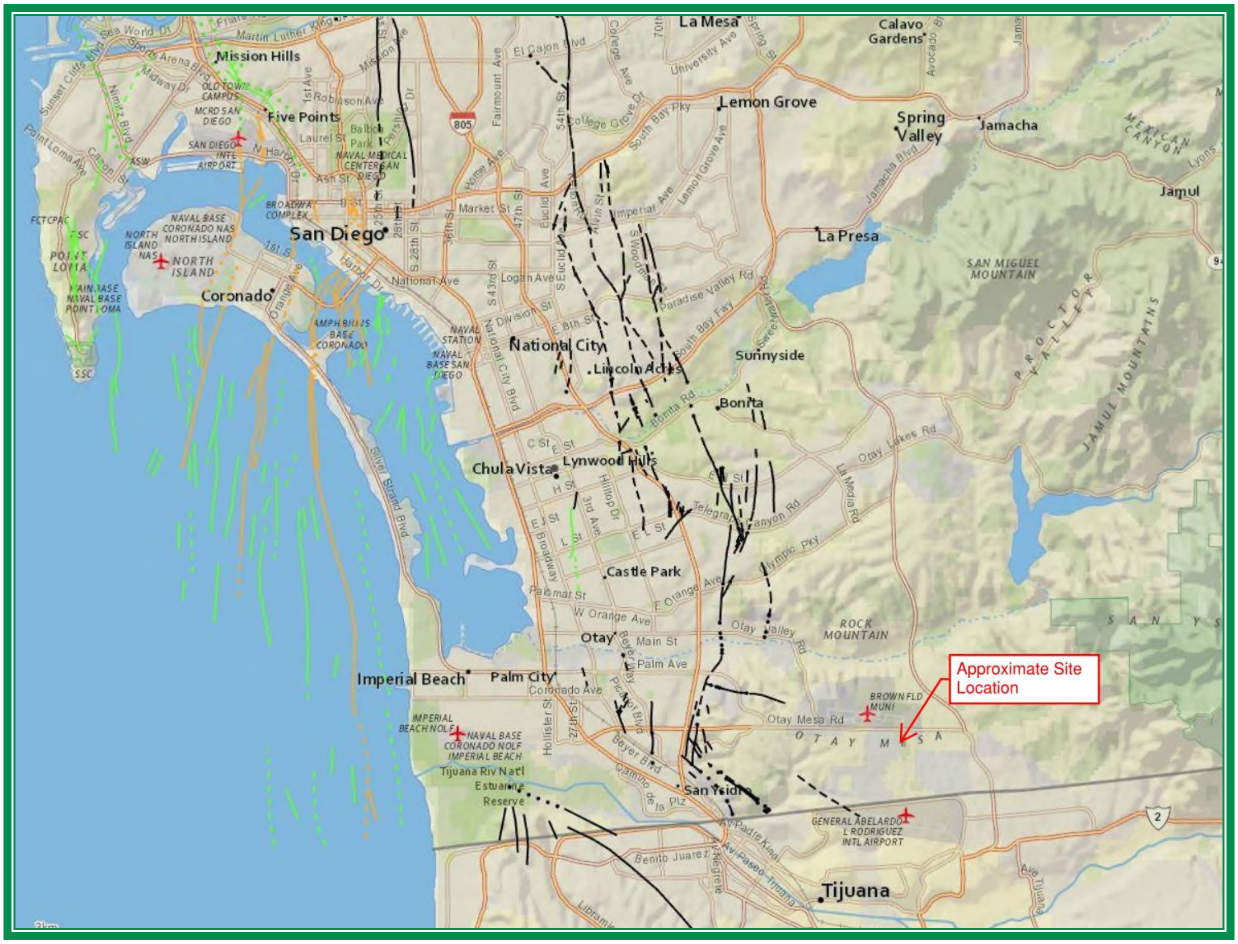
We did not encounter groundwater or seepage during our site investigation. However, it is not uncommon for shallow seepage conditions to develop where none previously existed when sites are irrigated or infiltration is implemented. Seepage is dependent on seasonal precipitation, irrigation, land use, among other factors, and varies as a result. Proper surface drainage will be important to future performance of the project.

5. GEOLOGIC HAZARDS

5.1 Faulting and Seismicity

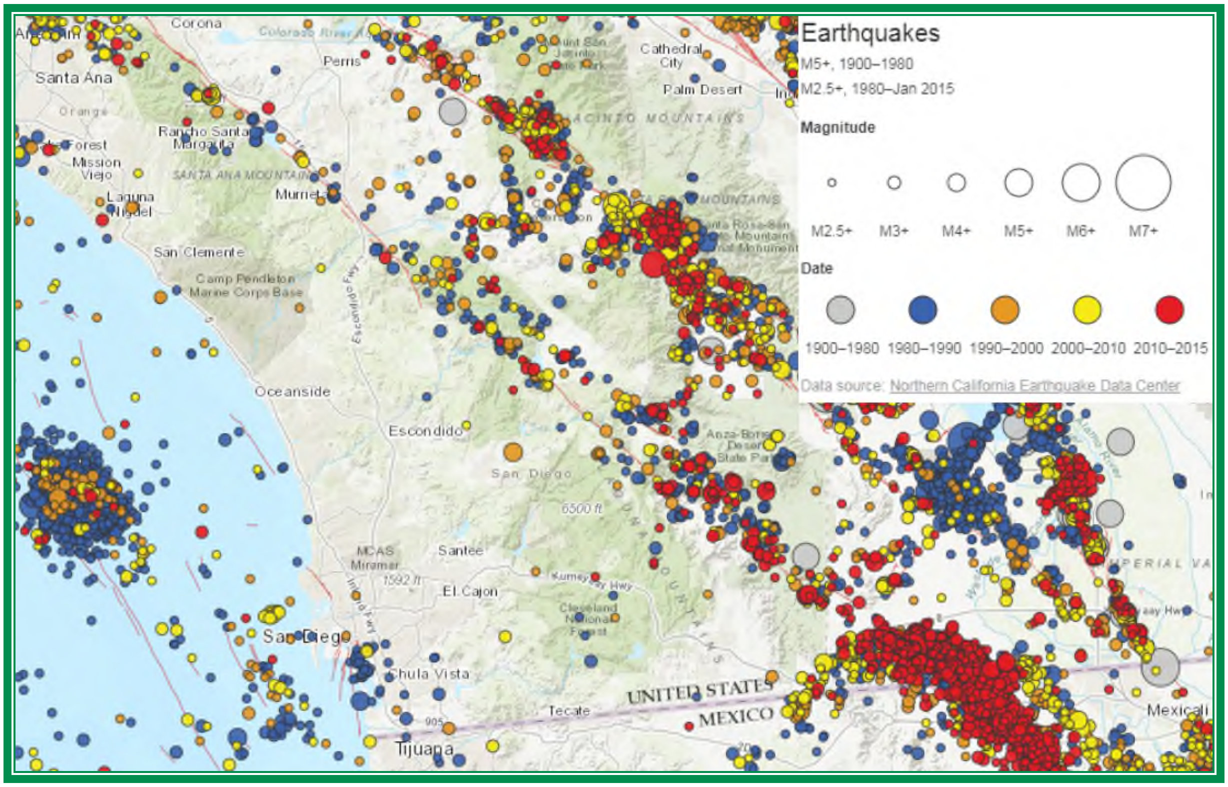
A review of the referenced geologic materials and our knowledge of the general area indicates that the site is not underlain by active, potentially active, or inactive faults. An active fault is defined by the California Geological Survey (CGS) as a fault showing evidence for activity within the last 11,000 years. The closest active fault is Newport Inglewood-Rose Canyon Fault zone, located approximately 11 miles west of the site. The site is not located within a State of California Earthquake Fault Zone.

The United States Geological Survey (USGS) has developed a program to evaluate the approximate location of faulting in the area of properties. The following figure shows the location of the existing faulting in the San Diego County and Southern California region. The faults are shown as solid, dashed and dotted traces representing well constrained, moderately constrained and inferred faults, respectively. The fault line colors represent faults with ages less than 150 years (red), 15,000 years (orange), 130,000 years (green), 750,000 years (blue) and 1.6 million years (black).



Faults in the San Diego Area

The San Diego County and Southern California region is seismically active. The following figure presents the occurrence of earthquakes with a magnitude greater than 2.5 from the period of 1900 through 2015 according to the Bay Area Earthquake Alliance website.



Earthquakes in Southern California

Considerations important in seismic design include the frequency and duration of motion and the soil conditions underlying the site. Seismic design of structures should be evaluated in accordance with the California Building Code (CBC) guidelines currently adopted by the local agency.

5.2 Ground Rupture

The risk associated with ground rupture hazard is very low due to the absence of active faults at the subject site.

5.3 Storm Surge, Tsunamis, and Seiches

The site is not located near the ocean, therefore the potential of storm surges affecting the site is considered low.

A tsunami is a series of long period waves generated in the ocean by a sudden displacement of large volumes of water. Causes of tsunamis include underwater earthquakes, volcanic eruptions, or offshore slope failures. The first-order driving force for locally generated tsunamis offshore southern California is expected to be tectonic deformation from large earthquakes (Legg, *et al.*, 2002). Historically, tsunami wave heights have ranged up to 3.7 feet in the San Diego area. According to the County of San Diego Hazard Mitigation Plan (2010), the largest tsunami effect recorded in San Diego since 1950 was May 22, 1960 which had maximum run-up amplitudes of 2.1 feet (0.7 meters). Wave heights and run-up elevations from tsunamis along the San Diego Coast have historically fallen within the normal range of the tides. The County of San Diego Hazard Mitigation Plan (2010) maps zones of possible tsunami inundation for coastal areas throughout the county. The site is not included within one of these high-risk hazard areas. Therefore, we consider the risk of a tsunami hazard at the site to be low.

A seiche is a run-up of water within a lake or embayment triggered by fault- or landslide-induced ground displacement. The site is not located near a lake or embayment, therefore we consider the potential for seiches to impact the site low.

5.4 Flooding

According to maps produced by the Federal Emergency Management Agency (FEMA), the site is zoned as “Zone X – Minimal Flood Hazard.” Based on our review of FEMA flood maps, the risk of site flooding is considered low.

5.5 Liquefaction and Seismically Induced Settlement

Soil liquefaction occurs within relatively loose, cohesionless sand located below the water table that is subjected to ground accelerations from earthquakes. Due to the dense nature of the soils underlying the site, proposed grading, and the lack of permanent, shallow groundwater, there is a very low risk of liquefaction occurring at the site.

5.6 Landslides

The site is relatively flat and lacks sloped topography necessary for landslides to form. Additionally, the published geologic maps do not show landslides on or adjacent to the site. Therefore, we consider the potential for a landsliding on or adjacent to the site is very low.

5.7 Geologic Hazard Category

Review of the 2008 City of San Diego Seismic Safety Study, Geologic Hazards and Faults, Sheet 3, indicates the site is mapped as Geologic Hazard Category 53. Category 53 is described as “Level or sloping terrain, unfavorable geologic structure, low to moderate risk.”

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 General

6.1.1 No soil or geologic conditions were observed that would preclude the development of the property as presently proposed provided that the recommendations of this report are followed.

6.1.2 The site is underlain by compressible surficial deposits consisting of topsoil, overlying Pleistocene-age Terrace Deposits. Topsoil ranges from one to two feet thick but may be thicker in unexplored areas of the site. Additionally, significant quantities of soil, trash, and construction debris have been dumped at the site.

6.1.3 Undocumented fill and topsoil are unsuitable in their present condition to receive additional fill soil or settlement-sensitive structures and will require removal and recompaction. The underlying terrace deposits are suitable for support of structural improvements, however, the upper clay portion of the terrace deposits is highly expansive. To reduce the potential for soil heave impacting foundations and site improvements, we recommend selective grading consisting of mining the sand-gravel member of the terrace deposits for use as a pad capping material, in combination with burial of the expansive clay member in mined areas.

6.1.4 We did not encounter groundwater during our subsurface exploration, and groundwater should not be a constraint to project development. However, seepage within surficial soils and formational materials may be encountered during the grading operations, especially during the rainy seasons.

6.1.5 Except for possible strong seismic shaking, no significant geologic hazards were observed or are known to exist on the site that would adversely affect the site. No special seismic design considerations, other than those recommended herein, are required.

6.1.6 Proper drainage should be maintained in order to preserve the engineering properties of the fill in both the building pads and slope areas. Recommendations for site drainage are provided herein.

6.1.7 Based on the results of our field infiltration testing and laboratory testing, we opine full or partial infiltration on the property is infeasible as discussed in Appendix C.

6.1.8 Provided the recommendations of this report are followed, it is our opinion that the proposed development will not destabilize or result in settlement of adjacent properties and City right-of-way.

6.1.9 Subsurface conditions observed may be extrapolated to reflect general soil/geologic conditions; however, some variations in subsurface conditions between trench locations should be anticipated.

6.2 Soil and Excavation Characteristics

6.2.1 In general, special shoring requirements may not be necessary if temporary excavations will be less than 4 feet in height. It is the responsibility of the contractor and their competent person to ensure all excavations, temporary slopes and trenches are properly constructed and maintained in accordance with applicable OSHA guidelines, in order to maintain safety and the stability of the excavations and adjacent improvements. These excavations should not be allowed to become saturated or to dry out. Surcharge loads should not be permitted to a distance equal to the height of the excavation from the top of the excavation. The top of the excavation should be a minimum of 15 feet from the edge of existing improvements. Excavations steeper than those recommended or closer than 15 feet from an existing surface improvement should be shored in accordance with applicable OSHA codes and regulations.

6.2.2 Excavation of existing undocumented fill and surficial deposits should be possible with moderate to heavy effort using conventional heavy-duty equipment. We expect excavation of the terrace deposits will require moderate to heavy effort. We expect that gravel, cobbles and cemented zones may be encountered within the terrace deposits requiring very heavy effort to excavate.

6.2.3 The soil encountered in the field investigation is considered to be “expansive” (expansion index [EI] of 20 or greater) as defined by 2019 California Building Code (CBC) Section 1803.5.3. Table 6.2 presents soil classifications based on the expansion index. We expect a majority of the soil encountered in the upper six to ten feet below existing site grades to possess a “medium” to “very high” expansion potential (EI of 51 or greater).

TABLE 6.2
EXPANSION CLASSIFICATION BASED ON EXPANSION INDEX

Expansion Index (EI)	ASTM D 4829 Expansion Classification	2019 CBC Expansion Classification
0 – 20	Very Low	Non-Expansive
21 – 50	Low	Expansive
51 – 90	Medium	
91 – 130	High	
Greater Than 130	Very High	

6.2.4 We performed laboratory tests on samples of the site materials to evaluate the percentage of water-soluble sulfate content. Appendix B presents results of the laboratory water-soluble sulfate content tests. The test results indicate the on-site materials at the locations tested possess "S0" sulfate exposure to concrete structures as defined by 2019 CBC Section 1904 and ACI 318-14 Chapter 19. The presence of water-soluble sulfates is not a visually discernible characteristic; therefore, other soil samples from the site could yield different concentrations. Additionally, over time landscaping activities (i.e., addition of fertilizers and other soil nutrients) may affect the concentration.

6.2.5 We tested samples for potential of hydrogen (pH) and resistivity and chloride to aid in evaluating the corrosion potential. Appendix B presents the laboratory test results. Based on the test results the soils appear to be corrosive.

6.2.6 Geocon Incorporated does not practice in the field of corrosion engineering. Therefore, further evaluation by a corrosion engineer may be performed if improvements susceptible to corrosion are planned.

6.3 Grading Recommendations

6.3.1 Grading should be performed in accordance with the recommendations provided in this report, the Recommended Grading Specifications contained in Appendix D and the City of San Diego's Grading Ordinance. Geocon Incorporated should observe the grading operations on a full-time basis and provide testing during the fill placement.

6.3.2 Prior to commencing grading, a preconstruction conference should be held at the site with the county inspector, developer, grading and underground contractors, civil engineer, and geotechnical engineer in attendance. Special soil handling and/or the grading plans can be discussed at that time.

6.3.3 Site preparation should begin with the removal of deleterious material, construction debris, and vegetation. The depth of vegetation removal should be such that material exposed in cut areas or soil to be used as fill is relatively free of organic matter. Material generated during stripping and/or site demolition should be exported from the site. Asphalt and concrete should not be mixed with the fill soil unless approved by the Geotechnical Engineer.

6.3.4 Abandoned foundations and buried utilities (if encountered) should be removed and the resultant depressions and/or trenches should be backfilled with properly compacted material as part of the remedial grading.

6.3.5 We recommend undocumented fill and topsoil be removed and replaced as compacted fill throughout the site. Trash and debris may be encountered in the undocumented fill. Trash and debris, if encountered, should be removed from the fill and exported.

6.3.6 Based on the existing site conditions, we expect grading will result in cuts and fills from existing grade of approximately 7 feet or less to construct the proposed sheet grades. Because of the limited depth of fills to reach pad grade, we expect grading will result in expansive clay soils near finish grade elevations. Therefore, we recommend select grading occur to provide a 5-foot-thick cap of *low*- to *medium*-expansive soil. To obtain select capping material, we recommend mining the underlying *low*- to *medium*-expansive, granular member of the Terrance Deposit (Qtg), which is suitable for site capping, in combination with burial of the expansive clay member in mined areas, as described below.

6.3.7 Within structural improvement areas (building pads, parking lots, etc.) we recommend grading to provide a select pad cap that extends at least 5-feet below pad grade and to a minimum of at least 3-feet below bottom of footing elevation, whichever is deeper. Pad-cap elevation should be adjusted for loading dock ramps and wall footings, which are typically lower than the building pad grade. Based on our experience with nearby sites, the sand-gravel can be mined to depths up to 30-feet below existing site grades. The approximate depth to the sand-gravel terrace deposits soil is shown on Figure 2 next to each trench location.

6.3.8 Mined areas should be selected so as to not create a fill differential greater than 15 feet within the building pad, if possible.

6.3.9 Within the building pad, the remedial excavation should extend to a horizontal distance beyond the building pad limits of 5 feet or to a distance equal to the depth of the excavation, whichever is greater. Excavations outside of the building pad should extend to at least 5 feet beyond the structural improvement limits.

6.3.10 The bottom of the excavations (including mining excavations) should be sloped one percent to the adjacent street or deepest fill. Prior to fill soil being placed, the existing ground surface should be scarified, moisture conditioned as necessary, and compacted to a depth of at least 12 inches. A representative of Geocon should be on-site during removals to evaluate the limits of the remedial grading.

6.3.11 The site should then be brought to final subgrade elevations with fill compacted in layers. In general, soil native to the site is suitable for use from a geotechnical engineering standpoint as fill if relatively free from vegetation, debris and other deleterious material. Layers of fill should be no thicker than will allow for adequate bonding and compaction. Fill, including backfill and scarified ground surfaces, should be compacted to a dry density of at least 90 percent of the laboratory maximum dry density near to slightly above optimum moisture content in accordance with ASTM Test Procedure D 1557. Fill materials placed below optimum moisture content may require additional moisture conditioning prior to placing additional fill.

6.3.12 Import fill (if necessary) should consist of the characteristics presented in Table 6.3. Geocon Incorporated should be notified of the import soil source and should perform laboratory testing of import soil prior to its arrival at the site to determine its suitability as fill material.

TABLE 6.3
SUMMARY OF IMPORT FILL RECOMMENDATIONS

Soil Characteristic	Values
Expansion Potential	"Very Low" to "Low" (Expansion Index of 50 or less)
Particle Size	Maximum Dimension Less Than 3 Inches
	Generally Free of Debris

6.4 Seismic Design Criteria

6.4.1 Table 6.4.1 summarizes site-specific design criteria obtained from the 2019 California Building Code (CBC; Based on the 2018 International Building Code [IBC] and ASCE 7-16), Chapter 16 Structural Design, Section 1613 Earthquake Loads. We used the computer program *U.S. Seismic Design Maps*, provided by the Structural Engineers Association of California (SEAOC) to calculate the seismic design parameters. The short spectral response uses a period of 0.2 second. We evaluated the Site Class based on the discussion in Section 1613.2.2 of the 2019 CBC and Table 20.3-1 of ASCE 7-16. The values presented herein are for the risk-targeted maximum considered earthquake (MCE_R). Sites designated as Site Class D, E and F may require additional analyses if requested by the project structural engineer and client.

TABLE 6.4.1
2019 CBC SEISMIC DESIGN PARAMETERS

Parameter	Value	2019 CBC Reference
Site Class	C	Section 1613.2.2
MCE_R Ground Motion Spectral Response Acceleration – Class B (short), S_S	0.717g	Figure 1613.2.1(1)
MCE_R Ground Motion Spectral Response Acceleration – Class B (1 sec), S_1	0.267g	Figure 1613.2.1(2)
Site Coefficient, F_A	1.213	Table 1613.2.3(1)
Site Coefficient, F_V	1.5*	Table 1613.2.3(2)
Site Class Modified MCE_R Spectral Response Acceleration (short), S_{MS}	0.87g	Section 1613.2.3 (Eqn 16-36)
Site Class Modified MCE_R Spectral Response Acceleration – (1 sec), S_{M1}	0.401g*	Section 1613.2.3 (Eqn 16-37)
5% Damped Design Spectral Response Acceleration (short), S_{DS}	0.58g	Section 1613.2.4 (Eqn 16-38)
5% Damped Design Spectral Response Acceleration (1 sec), S_{D1}	0.267g*	Section 1613.2.4 (Eqn 16-39)

***Note:** Using the code-based values presented in this table, in lieu of a performing a ground motion hazard analysis, requires the exceptions outlined in ASCE 7-16 Section 11.4.8 be followed by the project structural engineer. Per Section 11.4.8 of ASCE/SEI 7-16, a ground motion hazard analysis should be performed for projects for Site Class “E” sites with Ss greater than or equal to 1.0g and for Site Class “D” and “E” sites with S1 greater than 0.2g. Section 11.4.8 also provides exceptions which indicates that the ground motion hazard analysis may be waived provided the exceptions are followed.

6.4.2 Table 6.4.2 presents the mapped maximum considered geometric mean (MCE_G) seismic design parameters for projects located in Seismic Design Categories of D through F in accordance with ASCE 7-16.

TABLE 6.4.2
ASCE 7-16 PEAK GROUND ACCELERATION

Parameter	Value	ASCE 7-16 Reference
Mapped MCE_G Peak Ground Acceleration, PGA	0.312g	Figure 22-7
Site Coefficient, F_{PGA}	1.2	Table 11.8-1
Site Class Modified MCE_G Peak Ground Acceleration, PGA_M	0.374g	Section 11.8.3 (Eqn 11.8-1)

6.4.3 Conformance to the criteria in Tables 6.4.1 and 6.4.2 for seismic design does not constitute any kind of guarantee or assurance that significant structural damage or ground failure will not occur if a large earthquake occurs. The primary goal of seismic design is to protect life, not to avoid all damage, since such design may be economically prohibitive.

6.4.4 The project structural engineer and architect should evaluate the appropriate Risk Category and Seismic Design Category for the planned structures. The values presented herein assume a Risk Category of II and resulting in a Seismic Design Category D. Table 6.4.3 presents a summary of the risk categories.

TABLE 6.4.3
ASCE 7-16 RISK CATEGORIES

Risk Category	Building Use	Examples
I	Low risk to Human Life at Failure	Barn, Storage Shelter
II	Nominal Risk to Human Life at Failure (Buildings Not Designated as I, III or IV)	Residential, Commercial and Industrial Buildings
III	Substantial Risk to Human Life at Failure	Theaters, Lecture Halls, Dining Halls, Schools, Prisons, Small Healthcare Facilities, Infrastructure Plants, Storage for Explosives/Toxins
IV	Essential Facilities	Hazardous Material Facilities, Hospitals, Fire and Rescue, Emergency Shelters, Police Stations, Power Stations, Aviation Control Facilities, National Defense, Water Storage

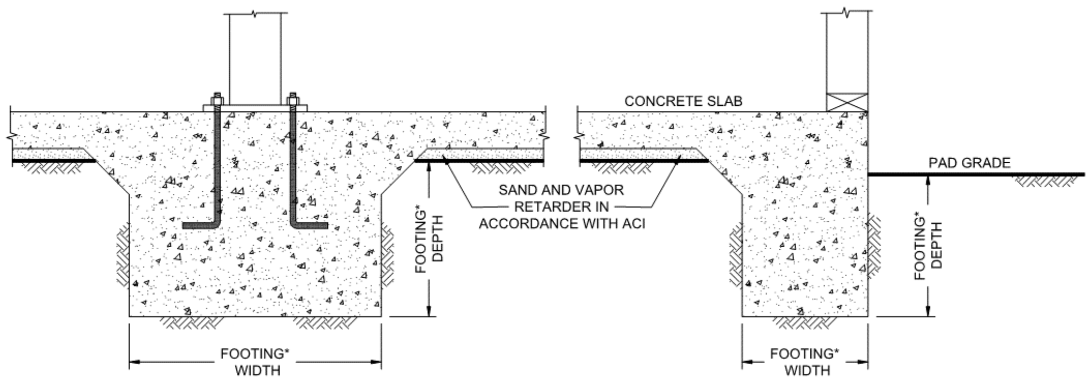
6.5 Shallow Foundations

6.5.1 The proposed structure can be supported on a shallow foundation system founded in compacted fill provided the grading recommendations provided in Section 6.4 are followed. Foundations for the structure should consist of continuous strip footings and/or isolated spread footings. Table 6.5 provides a summary of the foundation design recommendations.

TABLE 6.5
SUMMARY OF FOUNDATION RECOMMENDATIONS

Parameter	Value
Minimum Continuous Foundation Width	12 inches
Minimum Isolated Foundation Width	24 inches
Minimum Foundation Depth	24 Inches Below Lowest Adjacent Grade
Minimum Steel Reinforcement	4 No. 5 Bars, 2 at the Top and 2 at the Bottom
Allowable Bearing Capacity	2,000 psf
Bearing Capacity Increase	500 psf per Foot of Depth
	300 psf per Foot of Width
Maximum Allowable Bearing Capacity	3,500 psf
Estimated Total Settlement	1 Inch
Estimated Differential Settlement	½ Inch in 40 Feet
Footing Size Used for Settlement	9-Foot Square
Design Expansion Index	50 or less

6.5.2 The foundations should be embedded in accordance with the recommendations herein and the Wall/Column Footing Dimension Detail. The embedment depths should be measured from the lowest adjacent pad grade for both interior and exterior footings. Footings should be deepened such that the bottom outside edge of the footing is at least 7 feet horizontally from the face of the slope.



Wall/Column Footing Dimension Detail

6.5.3 The bearing capacity values presented herein are for dead plus live loads and may be increased by one-third when considering transient loads due to wind or seismic forces.

6.5.4 Where buildings or other improvements are planned near the top of a slope steeper than 3:1 (horizontal:vertical), special foundations and/or design considerations are recommended due to the tendency for lateral soil movement to occur.

- For fill slopes less than 20 feet high, building footings should be deepened such that the bottom outside edge of the footing is at least 7 feet horizontally from the face of the slope.
- When located next to a descending 3:1 (horizontal:vertical) fill slope or steeper, the foundations should be extended to a depth where the minimum horizontal distance is equal to H/3 (where H equals the vertical distance from the top of the fill slope to the base of the fill soil) with a minimum of 7 feet but need not exceed 40 feet. The horizontal distance is measured from the outer, deepest edge of the footing to the face of the slope. An acceptable alternative to deepening the footings would be the use of a post-tensioned slab and foundation system or increased footing and slab reinforcement. Specific design parameters or recommendations for either of these alternatives can be provided once the building location and fill slope geometry have been determined.
- Although other improvements, which are relatively rigid or brittle, such as concrete flatwork or masonry walls, may experience some distress if located near the top of a slope, it is generally not economical to mitigate this potential. It may be possible, however, to incorporate design measures that would permit some lateral soil movement without causing extensive distress. Geocon Incorporated should be consulted for specific recommendations.

6.5.5 We should observe the foundation excavations prior to the placement of reinforcing steel and concrete to check that the exposed soil conditions are similar to those expected and that they have been extended to the appropriate bearing strata. Foundation modifications may be required if unexpected soil conditions are encountered.

6.5.6 Geocon Incorporated should be consulted to provide additional design parameters as required by the structural engineer.

6.6 Conventional Retaining Wall Recommendations

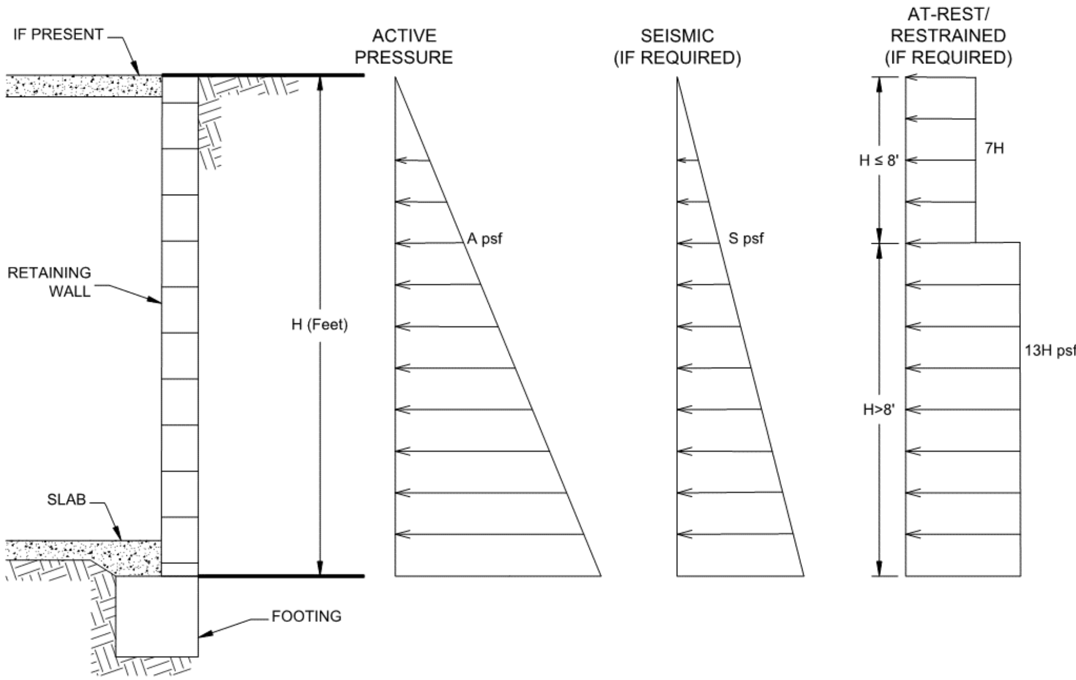
6.6.1 Retaining walls should be designed using the values presented in Table 6.6.1. Soil with an expansion index (EI) of greater than 50 should not be used as backfill material behind retaining walls.

TABLE 6.6.1
RETAINING WALL DESIGN RECOMMENDATIONS

Parameter	Value	
	EI≤50	EI≤90
Active Soil Pressure, A (Fluid Density, Level Backfill)	35 pcf	45 pcf
Active Soil Pressure, A (Fluid Density, 2:1 Sloping Backfill)	50 psf	60 pcf
Seismic Pressure, S	15H psf	
At-Rest/Restrained Walls Additional Uniform Pressure (0 to 8 Feet High)	7H psf	
At-Rest/Restrained Walls Additional Uniform Pressure (8+ Feet High)	13H psf	
Expected Expansion Index for the Subject Property	EI≤50	

H equals the height of the retaining portion of the wall

6.6.2 The project retaining walls should be designed as shown in the Retaining Wall Loading Diagram.



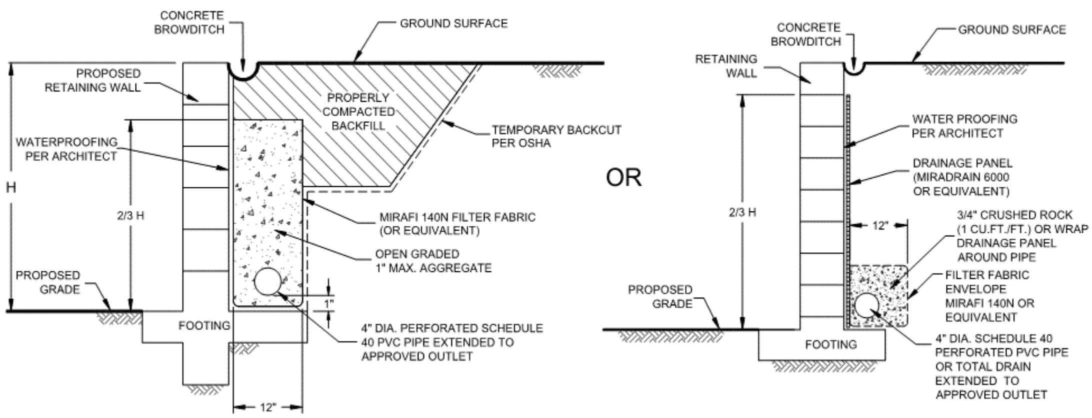
Retaining Wall Loading Diagram

6.6.3 Unrestrained walls are those that are allowed to rotate more than 0.001H (where H equals the height of the retaining portion of the wall) at the top of the wall. Where walls are restrained from movement at the top (at-rest condition), an additional uniform pressure of 7H psf should be added to the active soil pressure for walls 8 feet or less. For walls greater than 8 feet tall, an additional uniform pressure of 13H psf should be applied to the wall starting at 8 feet from the top of the wall to the base of the wall. For retaining walls subject to vehicular loads within a horizontal distance equal to two-thirds the wall height, a surcharge equivalent to 2 feet of fill soil should be added.

6.6.4 The structural engineer should determine the Seismic Design Category for the project in accordance with Section 1613.2.5 of the 2019 CBC or Section 11.6 of ASCE 7-16. For structures assigned to Seismic Design Category of D, E, or F, retaining walls that support more than 6 feet of backfill should be designed with seismic lateral pressure in accordance with Section 1803.5.12 of the 2019 CBC. The seismic load is dependent on the retained height where H is the height of the wall, in feet, and the calculated loads result in pounds per square foot (psf) exerted at the base of the wall and zero at the top of the wall. A seismic load of 18H psf should be used for design. We used the peak ground acceleration adjusted for Site Class effects, PGA_M, of 0.374g calculated from ASCE 7-16 Section 11.8.3 and applied a pseudo-static coefficient of 0.3.

6.6.5 Retaining walls should be designed to ensure stability against overturning sliding, and excessive foundation pressure. Where a keyway is extended below the wall base with the intent to engage passive pressure and enhance sliding stability, it is not necessary to consider active pressure on the keyway.

6.6.6 Drainage openings through the base of the wall (weep holes) should not be used where the seepage could be a nuisance or otherwise adversely affect the property adjacent to the base of the wall. The recommendations herein assume a properly compacted granular (EI of 50 or less) free-draining backfill material with no hydrostatic forces or imposed surcharge load. The retaining wall should be properly drained as shown in the Typical Retaining Wall Drainage Detail. If conditions different than those described are expected, or if specific drainage details are desired, Geocon Incorporated should be contacted for additional recommendations.



Typical Retaining Wall Drainage Detail

6.6.7 The retaining walls may be designed using either the active and restrained (at-rest) loading condition or the active and seismic loading condition as suggested by the structural engineer. Typically, it appears the design of the restrained condition for retaining wall loading may be adequate for the seismic design of the retaining walls. However, the active earth pressure combined with the seismic design load should be reviewed and also considered in the design of the retaining walls.

6.6.8 In general, wall foundations having should be designed in accordance with Table 6.6.2. The proximity of the foundation to the top of a slope steeper than 3:1 could impact the allowable soil bearing pressure. Therefore, retaining wall foundations should be deepened such that the bottom outside edge of the footing is at least 7 feet horizontally from the face of the slope.

TABLE 6.6.2
SUMMARY OF RETAINING WALL FOUNDATION RECOMMENDATIONS

Parameter	Value
Minimum Retaining Wall Foundation Width	12 inches
Minimum Retaining Wall Foundation Depth	12 Inches
Minimum Steel Reinforcement	Per Structural Engineer
Bearing Capacity	2,000 psf
Bearing Capacity Increase	500 psf per additional foot of footing depth
	300 psf per additional foot of footing width
Maximum Bearing Capacity	4,000 psf
Estimated Total Settlement	1 Inch
Estimated Differential Settlement	½ Inch in 40 Feet

6.6.9 The recommendations presented herein are generally applicable to the design of rigid concrete or masonry retaining walls. In the event that other types of walls (such as mechanically stabilized earth [MSE] walls, soil nail walls, or soldier pile walls) are planned, Geocon Incorporated should be consulted for additional recommendations.

6.6.10 Unrestrained walls will move laterally when backfilled and loading is applied. The amount of lateral deflection is dependent on the wall height, the type of soil used for backfill, and loads acting on the wall. The retaining walls and improvements above the retaining walls should be designed to incorporate an appropriate amount of lateral deflection as determined by the structural engineer.

6.6.11 Soil contemplated for use as retaining wall backfill, including import materials, should be identified in the field prior to backfill. At that time, Geocon Incorporated should obtain samples for laboratory testing to evaluate its suitability. Modified lateral earth pressures may be necessary if the backfill soil does not meet the required expansion index or shear strength. City or regional standard wall designs, if used, are based on a specific active lateral earth pressure and/or soil friction angle. In this regard, on-site soil to be used as backfill may or may not meet the values for standard wall designs. Geocon Incorporated should be consulted to assess the suitability of the on-site soil for use as wall backfill if standard wall designs will be used.

6.7 Lateral Loading

6.7.1 Table 6.7 should be used to help design the proposed structures and improvements to resist lateral loads for the design of footings or shear keys. The allowable passive pressure assumes a horizontal surface extending at least 5 feet, or three times the surface generating the passive pressure, whichever is greater. The upper 12 inches of material in areas not protected by floor slabs or pavement should not be included in design for passive resistance. Where walls are planned adjacent to and/or on descending slopes, a passive pressure of 150 pcf should be used in design.

TABLE 6.8
SUMMARY OF LATERAL LOAD DESIGN RECOMMENDATIONS

Parameter	Value
Passive Pressure Fluid Density	350 pcf
Passive Pressure Fluid Density Adjacent to and/or on Descending Slopes	150 pcf
Coefficient of Friction (Concrete and Soil)	0.35
Coefficient of Friction (Along Vapor Barrier)	0.2 to 0.25*

*Per manufacturer's recommendations.

6.7.2 The passive and frictional resistant loads can be combined for design purposes. The lateral passive pressures may be increased by one-third when considering transient loads due to wind or seismic forces.

6.8 Preliminary Pavement Recommendations

6.8.1 Preliminary pavement recommendations for the streets and parking areas are provided below. The final pavement sections should be based on the R-Value of the subgrade soil encountered at final subgrade elevation. For pavement design we used an R-Value of 16 based on laboratory testing of a sample of soil taken during our field investigation. Preliminary flexible pavement sections for varying traffic indices are presented in Table 6.8.1. The project civil engineer or traffic engineer should determine the appropriate Traffic Index (TI) or traffic loading expected on the project for the various pavement areas that will be constructed.

TABLE 6.8.1
PRELIMINARY ASPHALT CONCRETE PAVEMENT SECTIONS

Traffic Index	Asphalt Concrete (inches)	Class 2 Base (inches)
4.5	3	6
5	3	8
5.5	3	10
6	3.5	10.5
6.5	3.5	12
7	4	13
7.5	4.5	13.5
8	5	14.5

6.8.2 Prior to placing base materials, the upper 12 inches of the subgrade soil should be scarified, moisture conditioned as necessary, and recompacted to a dry density of at least 95 percent of the laboratory maximum dry density near to slightly above optimum moisture content as determined by ASTM D 1557. Similarly, the base material should be compacted to a dry density of at least 95 percent of the laboratory maximum dry density near to slightly above optimum moisture content. Asphalt concrete should be compacted to a density of at least 95 percent of the laboratory Hveem density in accordance with ASTM D 2726.

6.8.3 A rigid Portland cement concrete (PCC) pavement section should be placed in roadway aprons and cross gutters. We calculated the rigid pavement section in general conformance with the procedure recommended by the American Concrete Institute report ACI 330R-08 Guide for Design and Construction of Concrete Parking Lots using the parameters presented in Table 6.8.2.

TABLE 6.8.2
RIGID PAVEMENT DESIGN PARAMETERS

Design Parameter	Design Value
Modulus of subgrade reaction, k	100 pci
Modulus of rupture for concrete, M_R	500 psi
Concrete Compressive Strength	3,000 psi
Traffic Category, TC	A and C
Average daily truck traffic, ADTT	10 and 300

6.8.4 Based on the criteria presented herein, the PCC pavement sections should have a minimum thickness as presented in Table 6.8.3.

TABLE 6.8.3
RIGID VEHICULAR PAVEMENT RECOMMENDATIONS

Location	Portland Cement Concrete (inches)
Automobile Parking Stalls (TC=A)	5.5
Driveways (TC=C)	7.5

6.8.5 The PCC vehicular pavement should be placed over subgrade soil that is compacted to a dry density of at least 95 percent of the laboratory maximum dry density near to slightly above optimum moisture content.

6.8.6 The rigid pavement should also be designed and constructed incorporating the parameters presented in Table 6.8.4.

TABLE 6.8.4
ADDITIONAL RIGID PAVEMENT RECOMMENDATIONS

Subject	Value
Thickened Edge	1.2 Times Slab Thickness
	Minimum Increase of 2 Inches
	4 Feet Wide
Crack Control Joint Spacing	30 Times Slab Thickness
	Max. Spacing of 12 feet for 5.5-Inch-Thick
	Max. Spacing of 15 Feet for Slabs 6 Inches and Thicker
Crack Control Joint Depth	Per ACI 330R-08
	1 Inch Using Early-Entry Saws on Slabs Less Than 9 Inches Thick
Crack Control Joint Width	¼-Inch for Sealed Joints
	⅜-Inch is Common for Sealed Joints
	1/10- to 1/8-Inch is Common for Unsealed Joints

6.8.7 Reinforcing steel will not be necessary within the concrete for geotechnical purposes with the possible exception of dowels at construction joints as discussed herein.

6.8.8 To control the location and spread of concrete shrinkage cracks, crack-control joints (weakened plane joints) should be included in the design of the concrete pavement slab. Crack-control joints should be sealed with an appropriate sealant to prevent the migration of water through the control joint to the subgrade materials. The depth of the crack-control joints should be determined by the referenced ACI report.

6.8.9 To provide load transfer between adjacent pavement slab sections, a butt-type construction joint should be constructed. The butt-type joint should be thickened by at least 20 percent at the edge and taper back at least 4 feet from the face of the slab. As an alternative to the butt-type construction joint, dowelling can be used between construction joints for pavements of 7 inches or thicker. As discussed in the referenced ACI guide, dowels should consist of smooth, 1-inch-diameter reinforcing steel 14 inches long embedded a minimum of 6 inches into the slab on either side of the construction joint. Dowels should be located at the midpoint of the slab, spaced at 12 inches on center and lubricated to allow joint movement while still transferring loads. In addition, tie bars should be installed as recommended in

Section 3.8.3 of the referenced ACI guide. The structural engineer should provide other alternative recommendations for load transfer.

6.8.10 Concrete curb/gutter should be placed on soil subgrade compacted to a dry density of at least 90 percent of the laboratory maximum dry density near to slightly above optimum moisture content. Cross-gutters that receives vehicular should be placed on subgrade soil compacted to a dry density of at least 95 percent of the laboratory maximum dry density near to slightly above optimum moisture content. Base materials should not be placed below the curb/gutter, or cross-gutters so water is not able to migrate from the adjacent parkways to the pavement sections. Where flatwork is located directly adjacent to the curb/gutter, the concrete flatwork should be structurally connected to the curbs to help reduce the potential for offsets between the curbs and the flatwork.

6.9 Exterior Concrete Flatwork

6.9.1 Exterior concrete flatwork not subject to vehicular traffic should be constructed in accordance with the recommendations presented in Table 6.9. The recommended steel reinforcement would help reduce the potential for cracking.

TABLE 6.9
MINIMUM CONCRETE FLATWORK RECOMMENDATIONS

Expansion Index, EI	Minimum Steel Reinforcement* Options	Minimum Thickness
EI ≤ 90	6x6-W2.9/W2.9 (6x6-6/6) welded wire mesh	4 Inches
	No. 3 Bars 18 inches on center, Both Directions	
EI ≤ 130	4x4-W4.0/W4.0 (4x4-4/4) welded wire mesh	
	No. 4 Bars 12 inches on center, Both Directions	

*In excess of 8 feet square.

6.9.2 Even with the incorporation of the recommendations of this report, the exterior concrete flatwork has a potential to experience some uplift due to expansive soil beneath grade. The steel reinforcement should overlap continuously in flatwork to reduce the potential for vertical offsets within flatwork. Additionally, flatwork should be structurally connected to the curbs, where possible, to reduce the potential for offsets between the curbs and the flatwork.

6.9.3 Concrete flatwork should be provided with crack control joints to reduce and/or control shrinkage cracking. Crack control spacing should be determined by the project structural engineer based upon the slab thickness and intended usage. Criteria of the American

Concrete Institute (ACI) should be taken into consideration when establishing crack control spacing. Subgrade soil for exterior slabs not subjected to vehicle loads should be compacted in accordance with criteria presented in the grading section prior to concrete placement. Subgrade soil should be properly compacted, and the moisture content of subgrade soil should be verified prior to placing concrete. Base materials will not be required below concrete improvements.

6.9.4 Where exterior flatwork abuts the structure at entrant or exit points, the exterior slab should be dowelled into the structure's foundation stemwall. This recommendation is intended to reduce the potential for differential elevations that could result from differential settlement or minor heave of the flatwork. Dowelling details should be designed by the project structural engineer.

6.9.5 The recommendations presented herein are intended to reduce the potential for cracking of exterior slabs as a result of differential movement. However, even with the incorporation of the recommendations presented herein, slabs-on-grade will still crack. The occurrence of concrete shrinkage cracks is independent of the soil supporting characteristics. Their occurrence may be reduced and/or controlled by limiting the slump of the concrete, the use of crack control joints and proper concrete placement and curing. Crack control joints should be spaced at intervals no greater than 12 feet. Literature provided by the Portland Concrete Association (PCA) and American Concrete Institute (ACI) present recommendations for proper concrete mix, construction, and curing practices, and should be incorporated into project construction.

6.10 Slope Maintenance

6.10.1 Slopes that are steeper than 3:1 (horizontal:vertical) may, under conditions which are both difficult to prevent and predict, be susceptible to near surface (surficial) slope instability. The instability is typically limited to the outer three feet of a portion of the slope and usually does not directly impact the improvements on the pad areas above or below the slope. The occurrence of surficial instability is more prevalent on fill slopes and is generally preceded by a period of heavy rainfall, excessive irrigation, or the migration of subsurface seepage. The disturbance and/or loosening of the surficial soils, as might result from root growth, soil expansion, or excavation for irrigation lines and slope planting, may also be a significant contributing factor to surficial instability. It is, therefore, recommended that, to the maximum extent practical: (a) disturbed/loosened surficial soils be either removed or properly recompacted, (b) irrigation systems be periodically inspected and maintained to eliminate leaks and excessive irrigation, and (c) surface drains on and adjacent to slopes be periodically maintained to preclude ponding or erosion. Although the incorporation of the above recommendations should reduce the potential for surficial slope instability, it will not eliminate the possibility, and, therefore, it may be necessary to rebuild or repair a portion of the project's slopes in the future.

6.11 Storm Water Management

6.11.1 If storm water management devices are not properly designed and constructed, there is a risk for distress to improvements and property located hydrologically down gradient or adjacent to these devices. Factors such as the amount of water being detained, its residence time, and soil permeability have an important effect on seepage transmission and the potential adverse impacts that may occur if the storm water management features are not properly designed and constructed. We have not performed a hydrogeological study at the site. If infiltration of storm water runoff into the subsurface occurs, downstream improvements may be subjected to seeps, springs, slope instability, raised groundwater, movement of foundations and slabs, or other undesirable impacts as a result of water infiltration.

6.11.2 We performed an infiltration study on the property. A summary of our study and storm water management recommendations are provided in Appendix C. Based on the results of our study, full and partial infiltration is considered infeasible due to slow infiltration characteristics of the on-site soil. Basins should utilize a liner to prevent infiltration from causing adverse settlement and heave, and migrating to utilities, and foundations.

6.12 Site Drainage and Moisture Protection

6.12.1 Adequate site drainage is critical to reduce the potential for differential soil movement, erosion and subsurface seepage. Under no circumstances should water be allowed to pond adjacent to footings. The site should be graded and maintained such that surface drainage is directed away from structures in accordance with 2019 CBC 1803.3 or other applicable standards. In addition, surface drainage should be directed away from the top of slopes into swales or other controlled drainage devices. Roof and pavement drainage should be directed into conduits that carry runoff away from the proposed structure.

6.12.2 In the case of basement walls or building walls retaining landscaping areas, a water-proofing system should be used on the wall and joints, and a Miradrain drainage panel (or similar) should be placed over the waterproofing. The project architect or civil engineer should provide detailed specifications on the plans for all waterproofing and drainage.

6.12.3 Underground utilities should be leak free. Utility and irrigation lines should be checked periodically for leaks, and detected leaks should be repaired promptly. Detrimental soil movement could occur if water is allowed to infiltrate the soil for prolonged periods of time.

6.12.4 Landscaping planters adjacent to paved areas are not recommended due to the potential for surface or irrigation water to infiltrate the pavement's subgrade and base course. We recommend that subdrains to collect excess irrigation water and transmit it to drainage structures, or impervious above-grade planter boxes be used. In addition, where landscaping is planned adjacent to the pavement, we recommend construction of a cutoff wall along the edge of the pavement that extends at least 6 inches below the bottom of the base material.

6.13 Grading and Foundation Plan Review

6.13.1 Geocon Incorporated should review the grading plans and foundation plans for the project prior to final design submittal to evaluate whether additional analyses and/or recommendations are required.

LIMITATIONS AND UNIFORMITY OF CONDITIONS

1. The firm that performed the geotechnical investigation for the project should be retained to provide testing and observation services during construction to provide continuity of geotechnical interpretation and to check that the recommendations presented for geotechnical aspects of site development are incorporated during site grading, construction of improvements, and excavation of foundations. If another geotechnical firm is selected to perform the testing and observation services during construction operations, that firm should prepare a letter indicating their intent to assume the responsibilities of project geotechnical engineer of record. A copy of the letter should be provided to the regulatory agency for their records. In addition, that firm should provide revised recommendations concerning the geotechnical aspects of the proposed development, or a written acknowledgement of their concurrence with the recommendations presented in our report. They should also perform additional analyses deemed necessary to assume the role of Geotechnical Engineer of Record.

2. The recommendations of this report pertain only to the site investigated and are based upon the assumption that the soil conditions do not deviate from those disclosed in the investigation. If any variations or undesirable conditions are encountered during construction, or if the proposed construction will differ from that anticipated herein, Geocon Incorporated should be notified so that supplemental recommendations can be given. The evaluation or identification of the potential presence of hazardous or corrosive materials was not part of the scope of services provided by Geocon Incorporated.

3. This report is issued with the understanding that it is the responsibility of the owner or his representative to ensure that the information and recommendations contained herein are brought to the attention of the architect and engineer for the project and incorporated into the plans, and the necessary steps are taken to see that the contractor and subcontractors carry out such recommendations in the field.

4. The findings of this report are valid as of the present date. However, changes in the conditions of a property can occur with the passage of time, whether they be due to natural processes or the works of man on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and should not be relied upon after a period of three years.

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NO SCALE

VICINITY MAP

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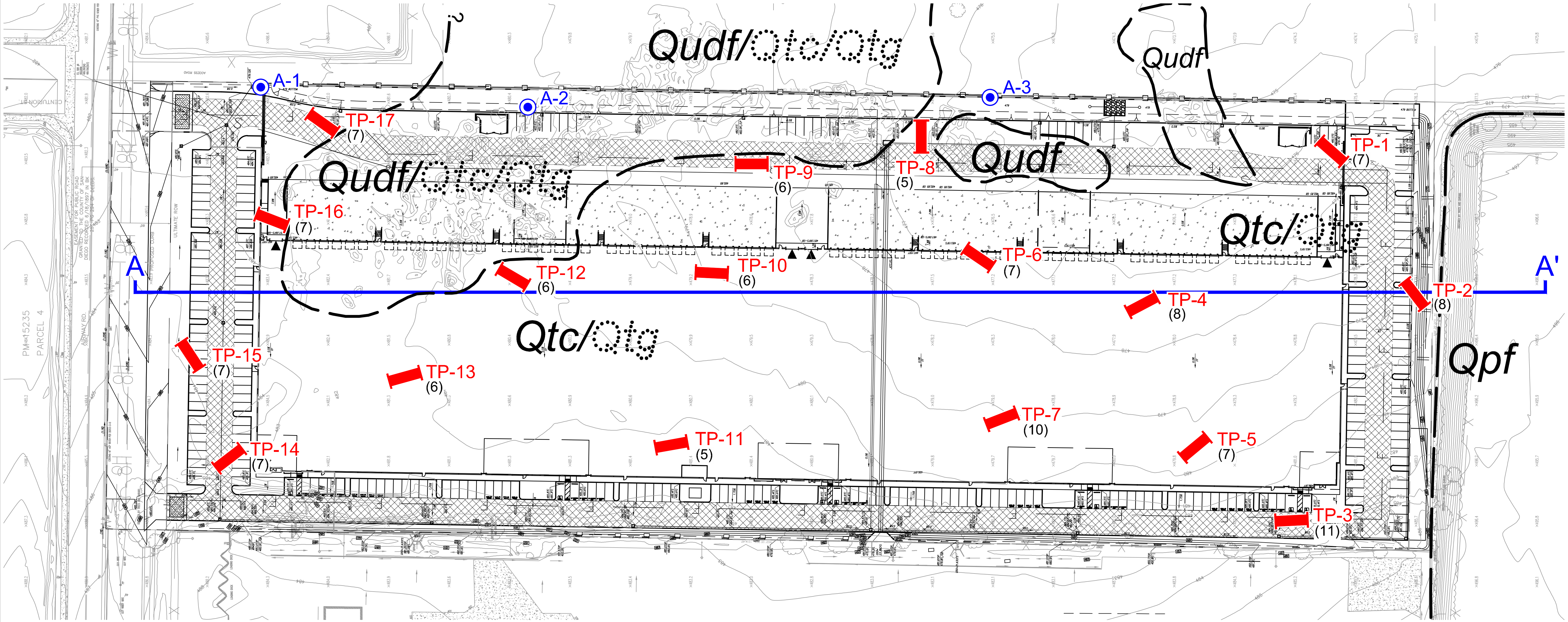
OTAY MESA
AIRWAY ROAD
SAN DIEGO, CALIFORNIA

RA / CW		DSK/GTYPD	DATE 05 - 18 - 2020	PROJECT NO. G2467 - 42 - 01	FIG. 1

OTAY MESA
AIRWAY ROAD
SAN DIEGO, CALIFORNIA



GEOCON LEGEND

Qudf ........UNDOCUMENTED FILL (Soil, Trash and Construction Debris)

Qpf ....PREVIOUSLY PLACED FILL

Qtc ....TERRACE DEPOSITS, CLAY MEMBER (Dotted Where Buried)

Qtg ....TERRACE DEPOSITS, SAND-GRAVEL MEMBER (Dotted Where Buried)

?........APPROX. LOCATION OF GEOLOGIC CONTACT (Queried Where Uncertain)

T-17 ....APPROX. LOCATION OF TRENCH

A-3 ....APPROX. LOCATION OF INFILTRATION TEST

(7) ....APPROX. DEPTH TO TOP OF TERRACE DEPOSIT (SANDS-GRAVEL MEMBER)

A A' ....APPROX. LOCATION OF GEOLOGIC CROSS SECTION

0' 50' 100' 150' 200'

SCALE 1"=100'(on 11x17)

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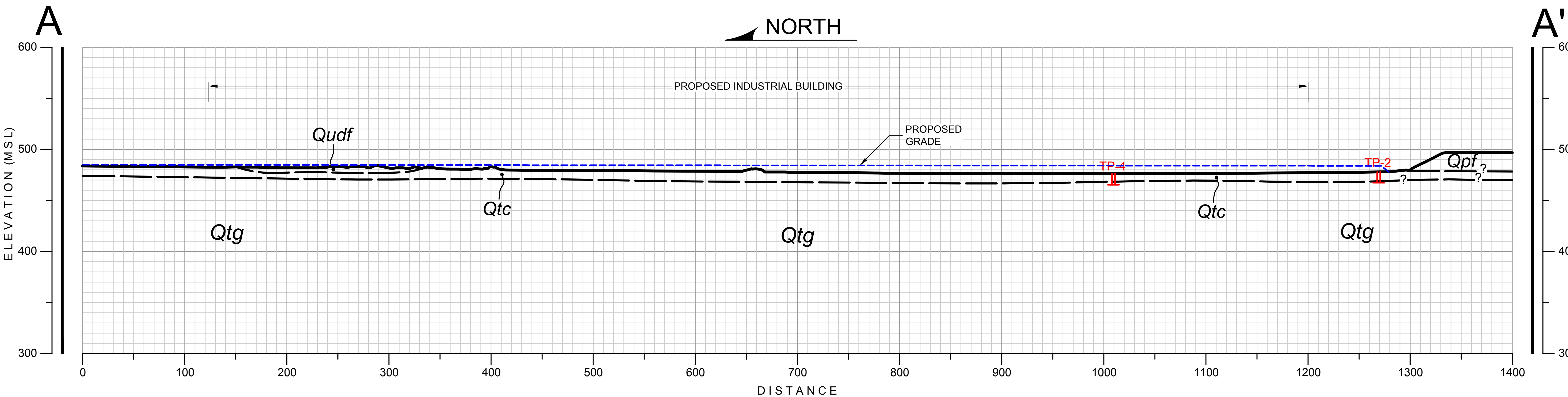
GEOLOGIC MAP

FIGURE 2

DATE 05 - 18 - 2020

Plotted:05/18/2020 8:24AM | By:ALVIN LADRILLONO | File Location:Y:\PROJECTS\G2467-42-01 (Otay Mesa Airway Road)\SHEETS\G2467-42-01 Geo Map.dwg

OTAY MESA
AIRWAY ROAD
SAN DIEGO, CALIFORNIA



GEOLOGIC CROSS-SECTION A-A'

SCALE: 1" = 100' (Vert. = Horiz.)

GEOCON LEGEND

Qudf ........UNDOCUMENTED FILL
(Soil, Trash and Construction Debris)

Qpf ....PREVIOUSLY PLACED FILL

Qtc ....TERRACE DEPOSITS, CLAY MEMBER

Qtg ....TERRACE DEPOSITS, SAND-GRAVEL MEMBER

~?~ ....APPROX. LOCATION OF GEOLOGIC CONTACT
(Queried Where Uncertain)

T-4 ....APPROX. LOCATION OF TRENCH

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FIGURE 3
DATE 05 - 18 - 2020

Plotted:05/18/2020 11:02AM | By:ALVIN LADRILLONO | File Location:Y:\PROJECTS\G2467-42-01 (Otay Mesa Airway Road)\SHEETS\G2467-42-01 XSection.dwg

APPENDIX A

APPENDIX A

FIELD INVESTIGATION

We performed our field investigation on November 15, 2019. Our investigation consisted of a site reconnaissance, and logging of 17 exploratory test pits. The exploratory test pits were excavated to depths between 8 and 13 feet. We also performed three infiltration borings on March 6, 2020, which were excavated with a CME 75 truck-mounted drill rig. The approximate locations of the exploratory test pits and infiltration tests are shown on Figure 2.

The soil conditions encountered in the trenches were visually examined, classified, and logged in general conformance with the American Society for Testing and Materials (ASTM) Practice for Description and Identification of Soils (Visual-Manual Procedure D 2488). Exploratory test pit logs are presented on Figures A-1 through A-17. The logs depict the various soil types encountered and indicate the depths at which samples were obtained.

PROJECT NO. G2467-42-01

TRENCH TP 1

ELEV. (MSL.) +/-478' DATE COMPLETED 11-15-2019

EQUIPMENT JOHN DEERE 310L BY: R. ADAMS

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SC	**TOPSOIL** Loose, damp, dark brown, Clayey, medium to coarse SAND; trace cobble fragments			
2								
4				CL	**TERRACE DEPOSITS-CLAY MEMBER (Qtc)** Firm to stiff, damp to moist, dark brown to reddish-brown, Sandy CLAY			
6	TP1-1			SC	Medium dense, dry to damp, orange-brown to reddish-brown, Clayey, medium coarse SAND; blocky texture, trace caliche -At 6 feet: becomes dense, some subrounded cobble up to 6-inch in width			
8				GM	**TERRACE DEPOSITS-SAND-GRAVEL MEMBER (Qtg)** Dense, damp, orange-brown to pale yellowish brown, fine to medium Sandy GRAVEL; gravel/cobble subrounded up to 10-inches in width. Difficult excavation			
10								
					PRACTICAL REFUSAL 11 FEET No groundwater Backfilled 11-15-2019			

Figure A-1,
Log of Trench TP 1, Page 1 of 1

G2467-42-01.GPJ

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... DISTURBED OR BAG SAMPLE
- ... STANDARD PENETRATION TEST
- ... CHUNK SAMPLE
- ... DRIVE SAMPLE (UNDISTURBED)
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2467-42-01

TRENCH TP 2

ELEV. (MSL.) **+/-481'** DATE COMPLETED **11-15-2019**

EQUIPMENT **JOHN DEERE 310L** BY: **R. ADAMS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SC	**TOPSOIL** Loose, dry, grayish-brown, Clayey, fine to medium SAND; trace silt			
2	TP2-1			CL/CH	**TERRACE DEPOSITS-CLAY MEMBER (Qtc)** Firm to stiff, damp, dark brown to dark reddish brown, fine to medium Sandy CLAY			
	TP2-2							
4								
6				SC	Medium dense to dense, dry to damp, reddish-brown, Clayey, medium to coarse SAND; blocky texture, manganese staining, trace caliche -At 7.5 feet: becomes very dense; difficult excavation			
8				GM	**TERRACE DEPOSITS-SAND-GRAVEL MEMBER (Qtg)** Very dense, dry to damp, reddish brown to yellowish brown, Silty GRAVEL; some fine to coarse sand, sub-rounded cobble up to 8-inch in width			

TRENCH DEPTH 9 FEET PRACTICAL REFUSAL
No groundwater
Backfilled 11-15-2019

Figure A-2,
Log of Trench TP 2, Page 1 of 1

G2467-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2467-42-01

TRENCH TP 3

ELEV. (MSL.) +/-485' DATE COMPLETED 11-15-2019

EQUIPMENT JOHN DEERE 310L BY: R. ADAMS

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	TP3-1			SM	**TOPSOIL** Loose, dry, grayish-brown, Silty, fine SAND; trace gravel up to 1-inch in width			
2				CH	**TERRACE DEPOSITS-CLAY MEMBER (Qtc)** Stiff to hard, dry to damp, dark brown, fine, Sandy CLAY; few rootlets -At 3 feet: becomes reddish-brown (mottled), blocky, some caliche			
4	TP3-2							
6								
				SC	Dense to very dense, reddish brown, Clayey SAND; some caliche -At 8 feet: becomes very coarse			
8	TP3-3							
10								
				GM	**TERRACE DEPOSITS-SAND-GRAVEL MEMBER (Qtg)** Very dense, damp, reddish-brown, Sandy GRAVEL; trace silt, gravel up to 2 inches, few cobble up to 8 inches in width			
12					TRENCH DEPTH 12 FEET No groundwater Backfilled 11-15-2019			

Figure A-3,
Log of Trench TP 3, Page 1 of 1

G2467-42-01.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

TRENCH TP 4

ELEV. (MSL.) +/-480' DATE COMPLETED 11-15-2019

EQUIPMENT JOHN DEERE 310L BY: R. ADAMS

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM/SC	**TOPSOIL** Loose, dry, grayish-brown, Silty, fine SAND; some clay			
	TP4-1			CH	**TERRACE DEPOSITS-CLAY MEMBER (Qtc)** Firm to stiff, moist, dark brown to reddish brown CLAY; some caliche			
2								
4					-At 4 feet: abundant caliche			
				CL	Stiff to very stiff, damp, orange brown, medium coarse Sandy CLAY; some caliche			
6								
8	TP4-2			GM	**TERRACE DEPOSITS-SAND-GRAVEL MEMBER (Qtg)** Dense, damp, fine to coarse Sandy GRAVEL; trace clay, gravel up to 4 inches, few cobble up to 9 inches in width			
10					TRENCH DEPTH 10 FEET No groundwater Backfilled 11-15-2019			

Figure A-4,
Log of Trench TP 4, Page 1 of 1

G2467-42-01.GPJ

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2467-42-01

TRENCH TP 5

ELEV. (MSL.) **+/-482'** DATE COMPLETED **11-15-2019**

EQUIPMENT **JOHN DEERE 310L** BY: **R. ADAMS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**TOPSOIL** Loose, dry, grayish-brown, Silty, fine to medium SAND			
				CH	**TERRACE DEPOSITS-CLAY MEMBER (Qtc)** Firm, damp, dark brown, CLAY; trace sand, trace caliche			
2								
					-At 3 feet: becomes reddish-brown			
4					-At 4 feet: becomes moist to wet			
				SM	Dense, moist, orange-brown, Silty, fine to medium SAND; some gravel up to 4 inches, few cobble up to 10 inches; trace silt			
6								
				GM	**TERRACE DEPOSITS-SAND-GRAVEL MEMBER (Qtg)** Dense, moist, orange-brown, medium coarse, Sandy GRAVEL			
8					TRENCH DEPTH 8 FEET No groundwater Backfilled 11-15-2019			

Figure A-5,
Log of Trench TP 5, Page 1 of 1

G2467-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2467-42-01

TRENCH TP 6

ELEV. (MSL.) +/-479' DATE COMPLETED 11-15-2019

EQUIPMENT JOHN DEERE 310L BY: R. ADAMS

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	Loose, dry, grayish-brown, Silty, fine to medium SAND; trace caliche			
2				CH	**TERRACE DEPOSITS-CLAY MEMBER (Qtc)** Firm to stiff, damp to moist, dark brown, medium coarse, Sandy CLAY; weak blocky texture -At 3 feet: becomes dark reddish-brown			
4	TP6-1			CL	Firm, damp to moist, reddish-brown to brown, medium to coarse Sandy CLAY			
6								
7				GM	**TERRACE DEPOSITS-SAND-GRAVEL MEMBER (Qtg)** Dense, damp to moist, medium coarse Sandy GRAVEL; some cobble up to 10 inch in width, some clay			
8								
10								

TRENCH DEPTH 10.5 FEET
No groundwater encountered
Backfilled 11-15-2019

Figure A-6,
Log of Trench TP 6, Page 1 of 1

G2467-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

TRENCH TP 7

ELEV. (MSL.) **+/-482'** DATE COMPLETED **11-15-2019**

EQUIPMENT **JOHN DEERE 310L** BY: **R. ADAMS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**TOPSOIL** Loose, dry, grayish-brown to reddish-brown, Silty, fine to medium SAND; few rootlets			
2				CH	**TERRACE DEPOSITS-CLAY MEMBER (Qtc)** Firm to stiff, damp, dark brown, CLAY; trace medium sand -At 3.5 feet: becomes reddish-brown, some caliche			
4								
6				SC	Dense, damp to moist, reddish-brown to pale yellowish-brown Clayey, fine to coarse SAND; some gravel up to 8 inch in width			
8								
10				GM	**TERRACE DEPOSITS-SAND-GRAVEL MEMBER (Qtg)** Very dense, damp, yellowish-brown, medium coarse Sandy GRAVEL; few cobble up to 8 inches -At 11 feet: becomes weakly moderately cemented-concretion lens			
12								
					TRENCH DEPTH 13 FEET No groundwater Backfilled 11-15-2019			

Figure A-7,
Log of Trench TP 7, Page 1 of 1

G2467-42-01.GPJ

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... DISTURBED OR BAG SAMPLE
- ... STANDARD PENETRATION TEST
- ... CHUNK SAMPLE
- ... DRIVE SAMPLE (UNDISTURBED)
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

TRENCH TP 8

ELEV. (MSL.) **+/-479'** DATE COMPLETED **11-15-2019**

EQUIPMENT **JOHN DEERE 310L** BY: **R. ADAMS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0 – 2				GM	**TOPSOIL** Loose, dry, grayish-brown, SIlty, fine to medium SAND; few rootlets			
2 – 5				CH	**TERRACE DEPOSITS-CLAY MEMBER (Qtc)** Stiff, damp, reddish-brown to brown CLAY; trace medium to coarse sand; trace subrounded cobble up to 6 inches in width			
5 – 6.5				SC	**TERRACE DEPOSITS-SAND-GRAVEL MEMBER (Qtg)** Dense, damp, orange-brown Clayey, medium to coarse SAND; little gravel up to 3 inches; few cobble up to 10 inches in width			

TRENCH DEPTH 6.5 FEET
No groundwater
Backfilled 11-15-2019

Figure A-8,
Log of Trench TP 8, Page 1 of 1

G2467-42-01.GPJ

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

TRENCH TP 9

ELEV. (MSL.) **+/-481'** DATE COMPLETED **11-15-2019**

EQUIPMENT **JOHN DEERE 310L** BY: **R. ADAMS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**TOPSOIL** Loose, dry, grayish brown to brown, Silty, fine to medium SAND; trace rootlets			
				CH	**TERRACE DEPOSITS-CLAY MEMBER (Qtc)** Stiff, damp to moist, brown to reddish-brown CLAY			
2	TP9-1							
4								
6				SP	**TERRACE DEPOSITS-SAND-GRAVEL MEMBER (Qtg)** Medium dense, damp, orange-brown to grayish brown, fine to medium SAND			
				SP	Medium dense to dense, damp to moist, whitish-gray to orange-brown, fine to coarse SAND; some gravel up to 4 inches, trace cobble up to 8 inches			
8								
				GM	Dense, damp, orange-brown, medium coarse, Sandy GRAVEL			
10								

TRENCH DEPTH 10 FEET, PRACTICAL REFUSAL
No groundwater
Backfilled 11-15-2019

Figure A-9,
Log of Trench TP 9, Page 1 of 1

G2467-42-01.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2467-42-01

TRENCH TP 10

ELEV. (MSL.) **+/-482'** DATE COMPLETED **11-15-2019**

EQUIPMENT **JOHN DEERE 310L** BY: **R. ADAMS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**TOPSOIL** Loose, dry, grayish-brown, Silty, fine to medium SAND			
				CH	**TERRACE DEPOSITS-CLAY MEMBER (Qtc)** Stiff, damp, dark brown to reddish-brown, CLAY; trace, medium coarse sand			
2								
4								
				SC	Dense, damp, reddish-brown, Clayey medium coarse SAND; some gravel up to 3 inch in width			
6				GM	**TERRACE DEPOSITS-SAND-GRAVEL MEMBER (Qtg)** Very dense, dry to damp, pale yellowish-brown, fine to coarse Sandy GRAVEL; trace cobble up to 8 inch in width			
8					TRENCH DEPTH 8 FEET No groundwater Backfilled 11-15-2019			

Figure A-10,
Log of Trench TP 10, Page 1 of 1

G2467-42-01.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2467-42-01

TRENCH TP 11

ELEV. (MSL.) **+/-484'** DATE COMPLETED **11-15-2019**

EQUIPMENT **JOHN DEERE 310L** BY: **R. ADAMS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**TOPSOIL** Loose, dry, gray to grayish-brown, Silty, fine SAND; trace clay			
				CH	**TERRACE DEPOSITS-CLAY MEMBER (Qtc)** Stiff to very stiff, damp, dark reddish-brown CLAY; trace coarse sand			
2								
4					-At 4 feet: becomes moist, trace cobble up to 8 inch in width; trace caliche stringers			
				GC	**TERRACE DEPOSITS-SAND-GRAVEL MEMBER (Qtg)** Very stiff to hard, damp, brown to orange brown, Clayey GRAVEL; some medium to coarse sand			
6								
				GM	Dense to very dense, damp, orange-brown, medium to coarse Sandy GRAVEL; trace clay, few cobble up to 12 inch in width			
8					PRACTICAL REFUSAL 8 FEET No groundwater Backfilled 11-15-2019			

Figure A-11,
Log of Trench TP 11, Page 1 of 1

G2467-42-01.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2467-42-01

TRENCH TP 12

ELEV. (MSL.) **+/-483'** DATE COMPLETED **11-15-2019**

EQUIPMENT **JOHN DEERE 310L** BY: **R. ADAMS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**TOPSOIL** Loose, dry, gray to grayish-brown, Silty, fine SAND; trace clay			
2				CH	**TERRACE DEPOSITS-CLAY MEMBER (Qtc)** Stiff, damp, dark reddish brown CLAY; trace sand, some caliche			
4	TP12-1			CL	Stiff to hard, dry to damp, brown to orange brown, medium coarse Sandy CLAY			
6				GM	**TERRACE DEPOSITS-SAND-GRAVEL MEMBER (Qtg)** Dense to very dense, damp, medium coarse, Sandy GRAVEL; trace clay, few subrounded cobble up to 10 inch in width			
8								
10					-At 10 feet: becomes medium dense, moist			

TRENCH DEPTH 11.5 FEET
No groundwater
Backfilled 11-15-2019

Figure A-12,
Log of Trench TP 12, Page 1 of 1

G2467-42-01.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2467-42-01

TRENCH TP 13

ELEV. (MSL.) **+/-484'** DATE COMPLETED **11-15-2019**

EQUIPMENT **JOHN DEERE 310L** BY: **R. ADAMS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**TOPSOIL** Loose, dry, gray to grayish-brown, Silty, fine SAND; trace clay			
				CH	**TERRACE DEPOSITS-CLAY MEMBER (Qtc)** Firm to stiff, damp, dark brown to dark reddish-brown, CLAY; trace medium coarse sand, few caliche stringers			
2								
				SC	Medium dense to dense, dry to damp, orange-brown, Clayey, medium to coarse SAND; blocky texture			
4								
6				SP	**TERRACE DEPOSITS-SAND-GRAVEL MEMBER (Qtg)** Medium dense to dense, damp, orange brown, medium to coarse SAND; trace clay			
8								
				GM	Dense, damp, orange-brown, medium to coarse, Sandy GRAVEL; trace subrounded cobble up to 8 inch in width			
10								
					TRENCH DEPTH 11.5 FEET No groundwater Backfilled 11-15-2019			

Figure A-13,
Log of Trench TP 13, Page 1 of 1

G2467-42-01.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

TRENCH TP 14

ELEV. (MSL.) **+/-485'** DATE COMPLETED **11-15-2019**

EQUIPMENT **JOHN DEERE 310L** BY: **R. ADAMS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**TOPSOIL** Loose, dry, gray to grayish-brown, Silty, fine SAND; trace clay			
				CH	**TERRACE DEPOSITS-CLAY MEMBER (Qtc)** Stiff to hard, damp, brown to reddish-brown, medium to coarse Sandy CLAY; caliche stringers, manganese staining on parting surfaces			
2								
4								
6				SC	Dense to very dense, damp, orange-brown Clayey, medium coarse SAND			
8				GM	**TERRACE DEPOSITS-SAND-GRAVEL MEMBER (Qtg)** Very dense, damp, orange-brown to reddish brown, medium coarse, Sandy GRAVEL			
				GC	Very dense, damp, orange-brown, Clayey GRAVEL; some medium to coarse sand			
10								

TRENCH DEPTH 11 FEET
No groundwater
Backfilled 11-15-2019

Figure A-14,
Log of Trench TP 14, Page 1 of 1

G2467-42-01.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

TRENCH TP 15

ELEV. (MSL.) **+/-486'** DATE COMPLETED **11-15-2019**

EQUIPMENT **JOHN DEERE 310L** BY: **R. ADAMS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**TOPSOIL** Loose, dry, gray to grayish-brown, Silty, fine SAND; trace clay			
2				CH	**TERRACE DEPOSITS-CLAY MEMBER (Qtc)** Stiff, damp, brown to reddish-brown CLAY; trace coarse sand, some caliche stringers			
4				CH	Stiff to very stiff, damp, reddish-brown to orange brown, medium to coarse Sandy CLAY; blocky texture, clay films on parting surfaces			
6								
8				SC	**TERRACE DEPOSITS-SAND-GRAVEL MEMBER (Qtg)** Dense, damp, orange-brown, Clayey, medium coarse SAND			
10				GM	Very dense, damp, orange-brown to reddish brown, medium coarse Sandy GRAVEL; trace cobble up to 12 inch in width			
					PRACTICAL REFUSAL 11 FEET No groundwater Backfilled 11-15-2019			

Figure A-15,
Log of Trench TP 15, Page 1 of 1

G2467-42-01.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... DISTURBED OR BAG SAMPLE
- ... STANDARD PENETRATION TEST
- ... CHUNK SAMPLE
- ... DRIVE SAMPLE (UNDISTURBED)
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G2467-42-01

TRENCH TP 16

ELEV. (MSL.) **+/-486'** DATE COMPLETED **11-15-2019**

EQUIPMENT **JOHN DEERE 310L** BY: **R. ADAMS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**TOPSOIL** Loose, dry to damp, grayish-brown, Silty, fine to medium SAND			
2	TP16-1			CH	**TERRACE DEPOSITS-CLAY MEMBER (Qtc)** Stiff, damp, brown to reddish-brown CLAY; manganese staining on parting surfaces, abundant caliche; trace subrounded gravel up to 4 inch in width			
4	TP16-2			CH	Stiff, damp, orange to reddish-brown, medium to coarse Sandy CLAY			
6								
8				GM	**TERRACE DEPOSITS-SAND-GRAVEL MEMBER (Qtg)** Dense to very dense, damp, orange-brown, medium coarse Sandy GRAVEL; trace clay, trace cobble			
					TRENCH DEPTH 9 FEET No groundwater Backfilled 11-15-2019			

Figure A-16,
Log of Trench TP 16, Page 1 of 1

G2467-42-01.GPJ

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

TRENCH TP 17

ELEV. (MSL.) **+/-484'** DATE COMPLETED **11-15-2019**

EQUIPMENT **JOHN DEERE 310L** BY: **R. ADAMS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**TOPSOIL** Loose, dry, grayish-brown, Silty fine SAND; trace clay			
				CH	**TERRACE DEPOSITS-CLAY MEMBER (Qtc)** Firm to stiff, damp, grayish-brown to brown CLAY; trace coarse sand, abundant caliche			
2								
4					-At 4 feet: trace gravel			
				CH	Stiff, damp to moist, orange-brown, medium coarse Sandy CLAY; trace caliche			
6								
				SW	**TERRACE DEPOSITS-SAND-GRAVEL MEMBER (Qtg)** Dense, damp, whitish orange, medium coarse SAND; trace clay, few gravel, trace cobble			
8								
				GP	Dense to very dense, damp, orange-brown, medium coarse, Sandy GRAVEL; few cobble up to 12 inch in width			
10					TRENCH DEPTH 10 FEET No groundwater Backfilled 11-15-2019			

G2467-42-01.GPJ

Figure A-17,
Log of Trench TP 17, Page 1 of 1

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

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APPENDIX B

APPENDIX B

LABORATORY TESTING

Laboratory tests were performed in accordance with generally accepted test methods of the American Society for Testing and Materials (ASTM) or other suggested procedures. Selected samples were tested for *in-situ* dry density and moisture content, maximum dry density and optimum moisture content, expansion potential, soluble sulfate content, chloride content, p.H. and resistivity, and resistance value (R-Value). The results of these tests are summarized on Tables B-I through B-VI.

TABLE B-I
SUMMARY OF LABORATORY MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT TEST RESULTS
ASTM D 1557-02

Sample No.	Description	Maximum Dry Density (pcf)	Optimum Moisture Content (% dry wt.)
T4-2	Reddish brown Silty Gravel (GM); some (f-c) sand, trace clay	133.7	7.9
T12-1	Brown Clayey Silt (ML); trace (f-c) sand	115.8	13.0

TABLE B-II
SUMMARY OF LABORATORY EXPANSION INDEX TEST RESULTS
ASTM D 4829-03

Sample No.	Moisture Content		Dry Density (pcf)	Expansion Index
	Before Test (%)	After Test (%)		
T3-1	8.7	16.2	116.2	22
T4-1	12.2	30.9	101.9	129
T4-2	8.2	16.1	116.6	16
T6-1	8.4	16.9	115.9	48
T12-1	12.9	27.6	101.2	76

TABLE B-III
SUMMARY OF LABORATORY WATER-SOLUBLE SULFATE TEST RESULTS CALIFORNIA TEST NO. 417

Sample No.	Water-Soluble Sulfate (%)	Sulfate Exposure
T4-2	0.039	S0
T12-1	0.069	S0

TABLE B-IV
SUMMARY OF LABORATORY WATER-SOLUBLE CHLORIDE ION CONTENT TEST RESULTS AASHTO TEST NO. T 291

Sample No.	Chloride Ion Content ppm (%)
T4-2	660 (0.066)

TABLE B-V
SUMMARY OF LABORATORY POTENTIAL OF HYDROGEN (PH) AND RESISTIVITY TEST RESULTS CALIFORNIA TEST METHOD 643

Sample No.	pH	Minimum Resistivity (ohm-centimeters)
T4-2	7.0	450

TABLE B-VI
SUMMARY OF LABORATORY RESISTANCE VALUE (R-VALUE) TEST RESULTS ASTM D 2844

Sample No.	Depth (Feet)	Description (Geologic Unit)	R-Value
T4-2	8-10	Reddish brown Silty Gravel (GM); some (f-c) sand, trace clay	16

APPENDIX C

APPENDIX C

STORM WATER MANAGEMENT

We understand storm water management devices are being proposed in accordance with the current Storm Water Standards (SWS). If not properly constructed, there is a potential for distress to improvements and properties located hydrologically down gradient or adjacent to these devices. Factors such as the amount of water to be detained, its residence time, and soil permeability have an important effect on seepage transmission and the potential adverse impacts that may occur if the storm water management features are not properly designed and constructed. We have not performed a hydrogeological study at the site. If infiltration of storm water runoff occurs, downstream properties and improvements may be subjected to seeps, springs, slope instability, raised groundwater, movement of foundations and slabs, or other undesirable impacts as a result of water infiltration.

Hydrologic Soil Group

The United States Department of Agriculture (USDA), Natural Resources Conservation Services, possesses general information regarding the existing soil conditions for areas within the United States. The USDA website also provides the Hydrologic Soil Group. Table C-1 presents the descriptions of the hydrologic soil groups. In addition, the USDA website also provides an estimated saturated hydraulic conductivity for the existing soil.

TABLE C-1
HYDROLOGIC SOIL GROUP DEFINITIONS

Soil Group	Soil Group Definition
A	Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.
B	Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.
C	Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.
D	Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

The property is underlain by undocumented fill, surficial deposits such as topsoil, and Terrace Deposits. Table C-2 presents the information from the USDA website for the subject property.

TABLE C-2
USDA WEB SOIL SURVEY – HYDROLOGIC SOIL GROUP

Map Unit Name	Map Unit Symbol	Approximate Percentage of Property	Hydrologic Soil Group
Huerhuero loam, 2 to 9 percent slopes	HrC	93	D
Stockpen gravelly clay loam, 2 to 5 percent slopes	SuB	7	D

Infiltration Testing

We performed three infiltration tests at the locations shown on Figure 2. The tests were performed in 6-inch-diameter, drilled borings or in a hand-auger boring. Table C-3 presents the results of the testing. The calculation sheets are also attached.

We used the guidelines presented in the Riverside County Low Impact Development BMP Design Handbook. Based on this widely accepted guideline, the saturated hydraulic conductivity (Ksat) is equivalent to the infiltration rate. Therefore, the Ksat value determined from our testing is assumed to be the unfactored infiltration rate.

TABLE C-3
UNFACTORED, FIELD-SATURATED, INFILTRATION TEST RESULTS

Test No.	Depth (inches)	Geologic Unit	Field Infiltration Rate, I (in/hr)	Factored* Field Infiltration Rate, I (in/hr)
A-1	39	Qtc	0.003	0.001
A-1a	46	Qtc	0.005	0.003
A-2	33	Qtc	0.121	0.060
A-2a	25	Topsoil/Qtc	0.054	0.027
A-3	24	Topsoil/Qtc	0.004	0.002
A-3a	36	Qtc	0.023	0.012

* Factor of Safety of 2.0 for feasibility determination.

STORM WATER MANAGEMENT CONCLUSIONS

Soil Types

Undocumented Fill (Qudf) – We encountered undocumented fill dumped at existing grade some portions of the site. The undocumented fill within structural improvement areas will be fully or partially removed and replaced with compacted fill. Water that is allowed to migrate into the undocumented fill will cause settlement. Therefore, full and partial infiltration should be considered infeasible within undocumented fill.

Topsoil (Unmapped) – We encountered topsoil varying between 1 to 2 feet thick across the site. Topsoil within structural improvement areas will be removed and replaced with compacted fill. Water that is allowed to migrate into the topsoils may cause settlement. Therefore, full and partial infiltration should be considered infeasible within topsoil.

Terrace Deposits (Qtc/Qtg) – We encountered approximately 6 to 8 feet of stiff clay and sandy clay overlying dense to very dense clayey sand and sandy gravel. Infiltration into terrace deposits is not feasible due to low infiltration characteristic and high expansion potential.

Groundwater Elevation

Groundwater was not encountered in our test pits to a depth of 13 feet below the existing ground surface. Infiltration should not impact groundwater.

Existing Utilities

No known utilities cross the site. Infiltration due to utility concerns would be feasible.

Soil or Groundwater Contamination

We are unaware of contaminated soil or groundwater on the property. Therefore, full and partial infiltration associated with this risk is considered feasible.

Slopes

There are no existing slopes that would be impacted by infiltration.

Infiltration Rates

Our test results indicated very slow infiltration rates. The rates were 0.003 and 0.121 in/hr. The average rate is 0.035 in/hr with a factored rate for feasibility determination of 0.018 in/hr. The infiltration rates are not high enough to support full or partial infiltration.

Storm Water Management Devices

Liners and subdrains should be incorporated into the design and construction of the planned storm water devices. The liners should be impermeable (e.g. High-density polyethylene, HDPE, with a thickness of about 30 mil or equivalent Polyvinyl Chloride**,** PVC) to prevent water migration. The subdrains should be perforated within the liner area, installed at the base and above the liner, be at least 3 inches in diameter and consist of Schedule 40 PVC pipe. The subdrains outside of the liner should consist of solid pipe. The penetration of the liners at the subdrains should be properly waterproofed. The subdrains should be connected to a proper outlet. The devices should also be installed in accordance with the manufacturer's recommendations. Liners should be installed on the side walls of the proposed basins in accordance with a partial infiltration design.

Storm Water Standard Worksheets

The SWS requests the geotechnical engineer complete the *Categorization of Infiltration Feasibility Condition* (Worksheet C.4-1) worksheet information to help evaluate the potential for infiltration on the property. The attached Worksheet C.4-1 presents the completed information for the submittal process.

The regional storm water standards also have a worksheet (Worksheet Form D.5-1) that helps the project civil engineer estimate the factor of safety based on several factors. Table C-4 describes the suitability assessment input parameters related to the geotechnical engineering aspects for the factor of safety determination.

TABLE C-4
SUITABILITY ASSESSMENT RELATED CONSIDERATIONS FOR INFILTRATION FACILITY SAFETY FACTORS

Consideration	High Concern – 3 Points	Medium Concern – 2 Points	Low Concern – 1 Point
Assessment Methods	Use of soil survey maps or simple texture analysis to estimate short-term infiltration rates. Use of well permeameter or borehole methods without accompanying continuous boring log. Relatively sparse testing with direct infiltration methods	Use of well permeameter or borehole methods with accompanying continuous boring log. Direct measurement of infiltration area with localized infiltration measurement methods (e.g., Infiltrometer). Moderate spatial resolution	Direct measurement with localized (i.e. small-scale) infiltration testing methods at relatively high resolution or use of extensive test pit infiltration measurement methods.
Predominant Soil Texture	Silty and clayey soils with significant fines	Loamy soils	Granular to slightly loamy soils
Site Soil Variability	Highly variable soils indicated from site assessment or unknown variability	Soil boring/test pits indicate moderately homogenous soils	Soil boring/test pits indicate relatively homogenous soils
Depth to Groundwater/ Impervious Layer	<5 feet below facility bottom	5-15 feet below facility bottom	>15 feet below facility bottom

Table C-5 presents the estimated factor values for the evaluation of the factor of safety. This table only presents the suitability assessment safety factor (Part A) of the worksheet. The project civil engineer should evaluate the safety factor for design (Part B) and use the combined safety factor for the design infiltration rate.

TABLE C-5
FACTOR OF SAFETY WORKSHEET D.5-1 DESIGN VALUES[1]

Suitability Assessment Factor Category	Assigned Weight (w)	Factor Value (v)	Product (p = w x v)
Assessment Methods	0.25	2	0.50
Predominant Soil Texture	0.25	3	0.75
Site Soil Variability	0.25	2	0.50
Depth to Groundwater/Impervious Layer	0.25	1	0.25
Suitability Assessment Safety Factor, $S_A = \Sigma p$			2.0

[1] The project civil engineer should complete Worksheet D.5-1 using the data on this table. Additional information is required to evaluate the design factor of safety.

CONCLUSIONS

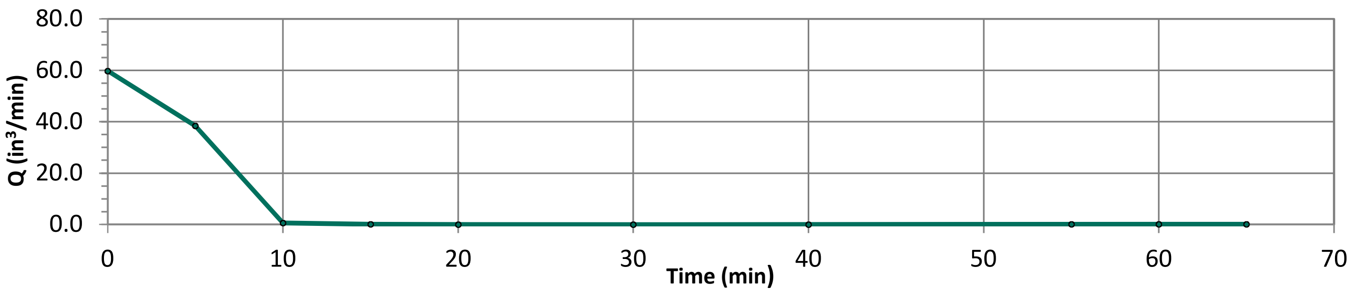
Our results indicate the site has relatively slow infiltration characteristics. Because of the site conditions, it is our opinion that there is a potential for lateral water migration. Undocumented and exists on the property and has a high potential for adverse settlement when wetted. It is our opinion that full or partial infiltration is infeasible on this site. Our evaluation included the soil and geologic conditions, estimated settlement and volume change of the underlying soil, slope stability, utility considerations, groundwater mounding, retaining walls, foundations and existing groundwater elevations.

TEST NO.: **A-1** GEOLOGIC UNIT: **Qvop**

EXCAVATION ELEVATION (MSL, FT): **478**

TEST INFORMATION	
BOREHOLE DIAMETER (IN):	6
BOREHOLE DEPTH (FT):	3.3
TEST/BOTTOM ELEVATION (MSL, FT):	475
MEASURED HEAD HEIGHT (IN):	5.3
CALCULATED HEAD HEIGHT (IN):	5.5
FACTOR OF SAFETY:	2.0

TEST RESULTS	
STEADY FLOW RATE (IN^3/MIN):	**0.028**
FIELD-SATURATED INFILTRATION RATE (IN/HR):	**0.003**
FACTORED INFILTRATION RATE (IN/HR):	**0.001**



TEST DATA

Reading	Time Elapsed (min)	Water Weight Consumed (lbs)	Water Volume Consumed (in^3)	Q (in^3/min)
1	0.00	0.000	0.00	0.00
2	5.00	10.800	299.08	59.815
3	5.00	6.940	192.18	38.437
4	5.00	0.105	2.91	0.582
5	5.00	0.005	0.14	0.028
6	10.00	0.005	0.14	0.014
7	10.00	0.005	0.14	0.014
8	15.00	0.005	0.14	0.009
9	5.00	0.005	0.14	0.028
10	5.00	0.005	0.14	0.028
11	5.00	0.005	0.14	0.028

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AARDVARK PERMEAMETER TEST RESULTS

OTAY MESA AIRWAY ROAD

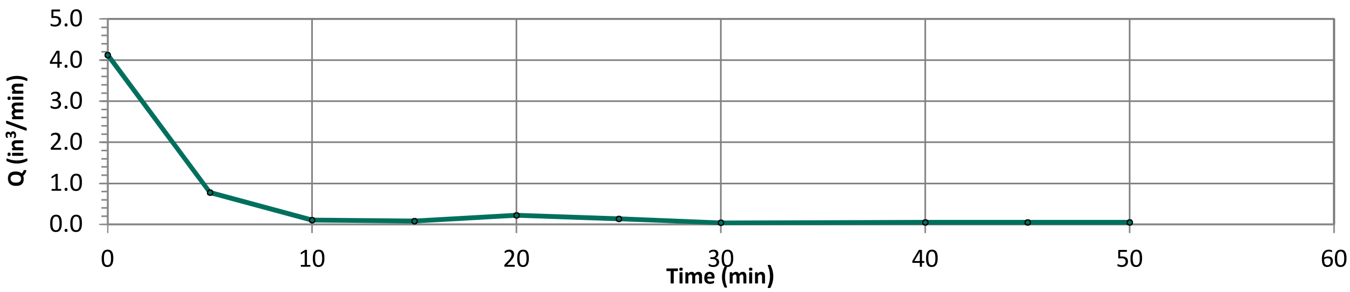
PROJECT NO.: G2467-42-01

TEST NO.: **A-1a** GEOLOGIC UNIT: **Qvop**

EXCAVATION ELEVATION (MSL, FT): **478**

TEST INFORMATION	
BOREHOLE DIAMETER (IN):	4
BOREHOLE DEPTH (FT):	3.8
TEST/BOTTOM ELEVATION (MSL, FT):	474
MEASURED HEAD HEIGHT (IN):	3.0
CALCULATED HEAD HEIGHT (IN):	4.1
FACTOR OF SAFETY:	2.0

TEST RESULTS	
STEADY FLOW RATE (IN^3/MIN):	**0.028**
FIELD-SATURATED INFILTRATION RATE (IN/HR):	**0.005**
FACTORED INFILTRATION RATE (IN/HR):	**0.003**



TEST DATA

Reading	Time Elapsed (min)	Water Weight Consumed (lbs)	Water Volume Consumed (in^3)	Q (in^3/min)
1	0.00	0.000	0.00	0.00
2	5.00	0.745	20.63	4.126
3	5.00	0.140	3.88	0.775
4	5.00	0.020	0.55	0.111
5	5.00	0.015	0.42	0.083
6	5.00	0.040	1.11	0.222
7	5.00	0.025	0.69	0.138
8	10.00	0.015	0.42	0.042
9	5.00	0.010	0.28	0.055
10	5.00	0.010	0.28	0.055
11	5.00	0.010	0.28	0.055
12	5.00	0.010	0.28	0.055
13	5.00	0.005	0.14	0.028
14	5.00	0.005	0.14	0.028
15	5.00	0.005	0.14	0.028

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AARDVARK PERMEAMETER TEST RESULTS

OTAY MESA AIRWAY ROAD

PROJECT NO.: G2467-42-01

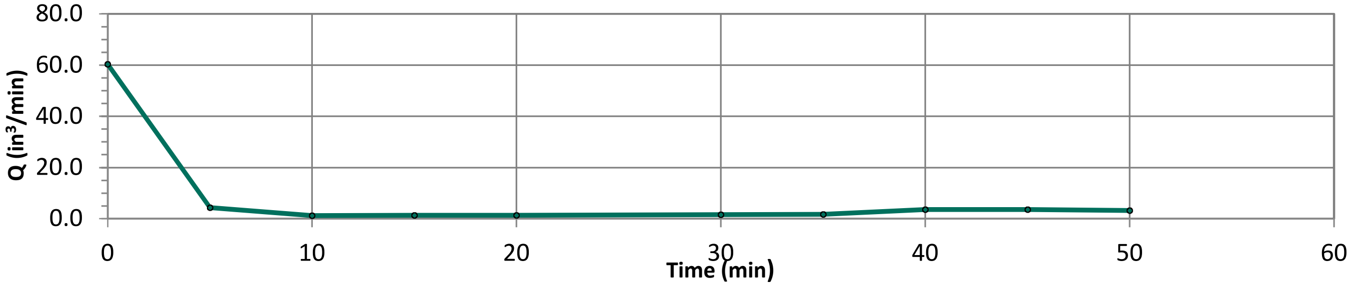
TEST NO.: **A-2**

GEOLOGIC UNIT: **Qvop**

EXCAVATION ELEVATION (MSL, FT): **483**

TEST INFORMATION	
BOREHOLE DIAMETER (IN):	6
BOREHOLE DEPTH (FT):	2.8
TEST/BOTTOM ELEVATION (MSL, FT):	480
MEASURED HEAD HEIGHT (IN):	4.3
CALCULATED HEAD HEIGHT (IN):	4.9
FACTOR OF SAFETY:	2.0

TEST RESULTS	
STEADY FLOW RATE (IN^3/MIN):	**1.052**
FIELD-SATURATED INFILTRATION RATE (IN/HR):	**0.121**
FACTORED INFILTRATION RATE (IN/HR):	**0.060**



TEST DATA

Reading	Time Elapsed (min)	Water Weight Consumed (lbs)	Water Volume Consumed (in^3)	Q (in^3/min)
1	0.00	0.000	0.00	0.00
2	5.00	10.895	301.71	60.342
3	5.00	0.790	21.88	4.375
4	5.00	0.215	5.95	1.191
5	5.00	0.235	6.51	1.302
6	10.00	0.500	13.85	1.385
7	5.00	0.285	7.89	1.578
8	5.00	0.300	8.31	1.662
9	5.00	0.655	18.14	3.628
10	5.00	0.645	17.86	3.572
11	5.00	0.580	16.06	3.212
12	5.00	0.325	9.00	1.800
13	5.00	0.275	7.62	1.523
14	5.00	0.205	5.68	1.135
15	5.00	0.215	5.95	1.191
16	5.00	0.135	3.74	0.748
17	5.00	0.215	5.95	1.191
18	5.00	0.195	5.40	1.080

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AARDVARK PERMEAMETER TEST RESULTS

OTAY MESA AIRWAY ROAD

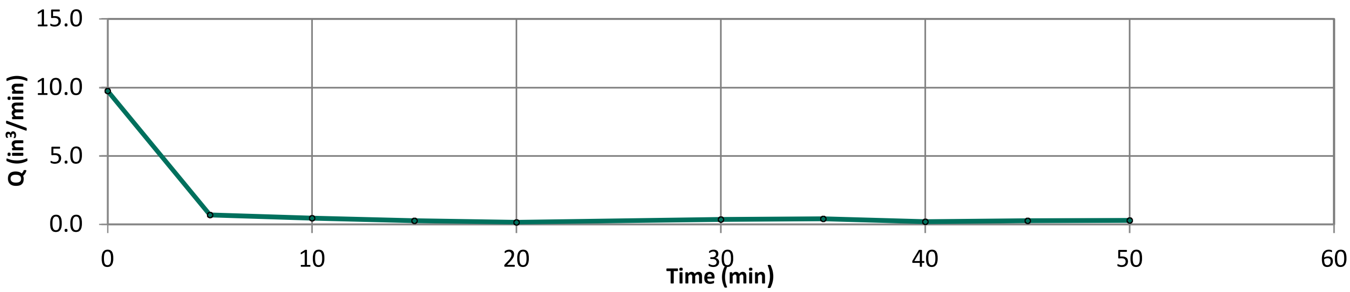
PROJECT NO.: G2467-42-01

TEST NO.: **A-2a** GEOLOGIC UNIT: **Qvop**

EXCAVATION ELEVATION (MSL, FT): **483**

TEST INFORMATION	
BOREHOLE DIAMETER (IN):	4
BOREHOLE DEPTH (FT):	2.1
TEST/BOTTOM ELEVATION (MSL, FT):	481
MEASURED HEAD HEIGHT (IN):	3.0
CALCULATED HEAD HEIGHT (IN):	3.7
FACTOR OF SAFETY:	2.0

TEST RESULTS	
STEADY FLOW RATE (IN^3/MIN):	**0.286**
FIELD-SATURATED INFILTRATION RATE (IN/HR):	**0.054**
FACTORED INFILTRATION RATE (IN/HR):	**0.027**



TEST DATA

Reading	Time Elapsed (min)	Water Weight Consumed (lbs)	Water Volume Consumed (in^3)	Q (in^3/min)
1	0.00	0.000	0.00	0.00
2	5.00	1.760	48.74	9.748
3	5.00	0.125	3.46	0.692
4	5.00	0.085	2.35	0.471
5	5.00	0.050	1.38	0.277
6	10.00	0.060	1.66	0.166
7	5.00	0.065	1.80	0.360
8	5.00	0.075	2.08	0.415
9	5.00	0.035	0.97	0.194
10	5.00	0.050	1.38	0.277
11	5.00	0.055	1.52	0.305
12	5.00	0.045	1.25	0.249
13	5.00	0.050	1.38	0.277
14	5.00	0.055	1.52	0.305
15	5.00	0.050	1.38	0.277

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AARDVARK PERMEAMETER TEST RESULTS

OTAY MESA AIRWAY ROAD

PROJECT NO.: G2467-42-01

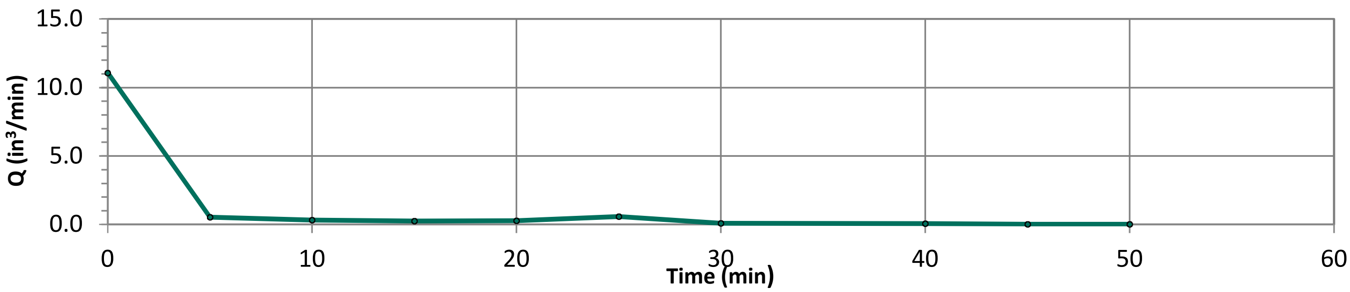
TEST NO.: **A-3**

GEOLOGIC UNIT: **Qvop**

EXCAVATION ELEVATION (MSL, FT): **485**

TEST INFORMATION	
BOREHOLE DIAMETER (IN):	5
BOREHOLE DEPTH (FT):	2.0
TEST/BOTTOM ELEVATION (MSL, FT):	483
MEASURED HEAD HEIGHT (IN):	3.3
CALCULATED HEAD HEIGHT (IN):	3.8
FACTOR OF SAFETY:	2.0

TEST RESULTS	
STEADY FLOW RATE (IN^3/MIN):	**0.028**
FIELD-SATURATED INFILTRATION RATE (IN/HR):	**0.004**
FACTORED INFILTRATION RATE (IN/HR):	**0.002**



TEST DATA				
Reading	Time Elapsed (min)	Water Weight Consumed (lbs)	Water Volume Consumed (in^3)	Q (in^3/min)
1	0.00	0.000	0.00	0.00
2	5.00	2.000	55.38	11.077
3	5.00	0.094	2.60	0.521
4	5.00	0.056	1.55	0.310
5	5.00	0.045	1.25	0.249
6	5.00	0.050	1.38	0.277
7	5.00	0.105	2.91	0.582
8	10.00	0.030	0.83	0.083
9	5.00	0.010	0.28	0.055
10	5.00	0.005	0.14	0.028
11	5.00	0.005	0.14	0.028
12	5.00	0.005	0.14	0.028

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AARDVARK PERMEAMETER TEST RESULTS

OTAY MESA AIRWAY ROAD

PROJECT NO.: **G2467-42-01**

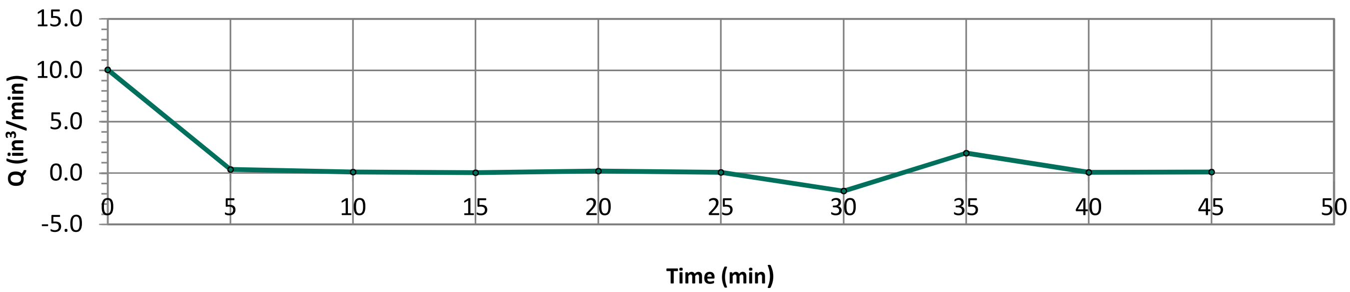
TEST NO.: **A-3a**

GEOLOGIC UNIT: **Qvop**

EXCAVATION ELEVATION (MSL, FT): **485**

TEST INFORMATION	
BOREHOLE DIAMETER (IN):	4
BOREHOLE DEPTH (FT):	3.0
TEST/BOTTOM ELEVATION (MSL, FT):	482
MEASURED HEAD HEIGHT (IN):	3.3
CALCULATED HEAD HEIGHT (IN):	4.0
FACTOR OF SAFETY:	2.0

TEST RESULTS	
STEADY FLOW RATE (IN^3/MIN):	**0.129**
FIELD-SATURATED INFILTRATION RATE (IN/HR):	**0.023**
FACTORED INFILTRATION RATE (IN/HR):	**0.012**



TEST DATA

Reading	Time Elapsed (min)	Water Weight Consumed (lbs)	Water Volume Consumed (in^3)	Q (in^3/min)
1	0.00	0.000	0.00	0.00
2	5.00	1.820	50.40	10.080
3	5.00	0.065	1.80	0.360
4	5.00	0.020	0.55	0.111
5	5.00	0.010	0.28	0.055
6	5.00	0.035	0.97	0.194
7	5.00	0.015	0.42	0.083
8	5.00	-0.315	-8.72	-1.745
9	5.00	0.355	9.83	1.966
10	5.00	0.015	0.42	0.083
11	5.00	0.020	0.55	0.111
12	5.00	0.020	0.55	0.111
13	5.00	0.025	0.69	0.138
14	5.00	0.025	0.69	0.138
15	5.00	0.020	0.55	0.111

GEOCON INCORPORATED

GEOTECHNICAL CONSULTANTS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121-2974
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AARDVARK PERMEAMETER TEST RESULTS

OTAY MESA AIRWAY ROAD

PROJECT NO.: G2467-42-01

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions	Worksheet C.4-1: Form I-8A[10]
Part 1 - Full Infiltration Feasibility Screening Criteria	
DMA(s) Being Analyzed:	**Project Phase:**
Entire Site	Preliminary
Criteria 1: Infiltration Rate Screening	
1A	Is the mapped hydrologic soil group according to the NRCS Web Soil Survey or UC Davis Soil Web Mapper Type A or B and corroborated by available site soil data[11]? ☐Yes; the DMA may feasibly support full infiltration. Answer "Yes" to Criteria 1 Result or continue to Step 1B if the applicant elects to perform infiltration testing. ☐No; the mapped soil types are A or B but is not corroborated by available site soil data (continue to Step 1B). ☑No; the mapped soil types are C, D, or "urban/unclassified" and is corroborated by available site soil data. Answer "No" to Criteria 1 Result. ☐No; the mapped soil types are C, D, or "urban/unclassified" but is not corroborated by available site soil data (continue to Step 1B).
1B	Is the reliable infiltration rate calculated using planning phase methods from Table D.3-1? ☐Yes; Continue to Step 1C. ☐No; Skip to Step 1D.
1C	Is the reliable infiltration rate calculated using planning phase methods from Table D.3-1 greater than 0.5 inches per hour? ☐Yes; the DMA may feasibly support full infiltration. Answer "Yes" to Criteria 1 Result. ☐No; full infiltration is not required. Answer "No" to Criteria 1 Result.
1D	**Infiltration Testing Method.** Is the selected infiltration testing method suitable during the design phase (see Appendix D.3)? Note: Alternative testing standards may be allowed with appropriate rationales and documentation. ☐Yes; continue to Step 1E. ☐No; select an appropriate infiltration testing method.

Note that it is not required to investigate each and every criterion in the worksheet, a single "no" answer in Part 1, Part 2, Part 3, or Part 4 determines a full, partial, or no infiltration condition.

[10] This form must be completed each time there is a change to the site layout that would affect the infiltration feasibility condition. Previously completed forms shall be retained to document the evolution of the site storm water design.

[11] Available data includes site-specific sampling or observation of soil types or texture classes, such as obtained from borings or test pits necessary to support other design elements.

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions	Worksheet C.4-1: Form I-8A[10]
1E	**Number of Percolation/Infiltration Tests.** Does the infiltration testing method performed satisfy the minimum number of tests specified in Table D.3-2? ☐Yes; continue to Step 1F. ☐No; conduct appropriate number of tests.
IF	**Factor of Safety.** Is the suitable Factor of Safety selected for full infiltration design? See guidance in D.5; Tables D.5-1 and D.5-2; and Worksheet D.5-1 (Form I-9). ☐Yes; continue to Step 1G. ☐No; select appropriate factor of safety.
1G	**Full Infiltration Feasibility.** Is the average measured infiltration rate divided by the Factor of Safety greater than 0.5 inches per hour? ☐Yes; answer "Yes" to Criteria 1 Result. ☐No; answer "No" to Criteria 1 Result.
Criteria 1 Result	Is the estimated reliable infiltration rate greater than 0.5 inches per hour within the DMA where runoff can reasonably be routed to a BMP? ☐Yes; the DMA may feasibly support full infiltration. Continue to Criteria 2. ☑No; full infiltration is not required. Skip to Part 1 Result.
Summarize infiltration testing methods, testing locations, replicates, and results and summarize estimates of reliable infiltration rates according to procedures outlined in D.5. Documentation should be included in project geotechnical report.	

<table>
<tr><th colspan="2">Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions</th><th colspan="2">Worksheet C.4-1: Form I-8A[10]</th></tr>
<tr><td colspan="4">Criteria 2: Geologic/Geotechnical Screening</td></tr>
<tr><td>2A</td><td colspan="3">If all questions in Step 2A are answered “Yes,” continue to Step 2B.

For any “No” answer in Step 2A answer “No” to Criteria 2, and submit an “Infiltration Feasibility Condition Letter” that meets the requirements in Appendix C.1.1. The geologic/geotechnical analyses listed in Appendix C.2.1 do not apply to the DMA because one of the following setbacks cannot be avoided and therefore result in the DMA being in a no infiltration condition. The setbacks must be the closest horizontal radial distance from the surface edge (at the overflow elevation) of the BMP.</td></tr>
<tr><td>2A-1</td><td>Can the proposed full infiltration BMP(s) avoid areas with existing fill materials greater than 5 feet thick below the infiltrating surface?</td><td>☐Yes</td><td>☐No</td></tr>
<tr><td>2A-2</td><td>Can the proposed full infiltration BMP(s) avoid placement within 10 feet of existing underground utilities, structures, or retaining walls?</td><td>☐Yes</td><td>☐No</td></tr>
<tr><td>2A-3</td><td>Can the proposed full infiltration BMP(s) avoid placement within 50 feet of a natural slope (>25%) or within a distance of 1.5H from fill slopes where H is the height of the fill slope?</td><td>☐Yes</td><td>☐No</td></tr>
<tr><td>2B</td><td colspan="3">When full infiltration is determined to be feasible, a geotechnical investigation report must be prepared that considers the relevant factors identified in Appendix C.2.1.

If all questions in Step 2B are answered “Yes,” then answer “Yes” to Criteria 2 Result.
If there are “No” answers continue to Step 2C.</td></tr>
<tr><td>2B-1</td><td>Hydroconsolidation. Analyze hydroconsolidation potential per approved ASTM standard due to a proposed full infiltration BMP.

Can full infiltration BMPs be proposed within the DMA without increasing hydroconsolidation risks?</td><td>☐Yes</td><td>☐No</td></tr>
<tr><td>2B-2</td><td>Expansive Soils. Identify expansive soils (soils with an expansion index greater than 20) and the extent of such soils due to proposed full infiltration BMPs.

Can full infiltration BMPs be proposed within the DMA without increasing expansive soil risks?</td><td>☐Yes</td><td>☐No</td></tr>
</table>

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4-1: Form I-8A[10]	
2B-3	**Liquefaction**. If applicable, identify mapped liquefaction areas. Evaluate liquefaction hazards in accordance with Section 6.4.2 of the City of San Diego's Guidelines for Geotechnical Reports (2011 or most recent edition). Liquefaction hazard assessment shall take into account any increase in groundwater elevation or groundwater mounding that could occur as a result of proposed infiltration or percolation facilities. Can full infiltration BMPs be proposed within the DMA without increasing liquefaction risks?	☐Yes	☐No
2B-4	**Slope Stability**. If applicable, perform a slope stability analysis in accordance with the ASCE and Southern California Earthquake Center (2002) Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Landslide Hazards in California to determine minimum slope setbacks for full infiltration BMPs. See the City of San Diego's Guidelines for Geotechnical Reports (2011) to determine which type of slope stability analysis is required. Can full infiltration BMPs be proposed within the DMA without increasing slope stability risks?	☐Yes	☐No
2B-5	**Other Geotechnical Hazards.** Identify site-specific geotechnical hazards not already mentioned (refer to Appendix C.2.1). Can full infiltration BMPs be proposed within the DMA without increasing risk of geologic or geotechnical hazards not already mentioned?	☐Yes	☐No
2B-6	**Setbacks.** Establish setbacks from underground utilities, structures, and/or retaining walls. Reference applicable ASTM or other recognized standard in the geotechnical report. Can full infiltration BMPs be proposed within the DMA using established setbacks from underground utilities, structures, and/or retaining walls?	☐ Yes	☐ No

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4-1: Form I-8A[10]	
2C	**Mitigation Measures.** Propose mitigation measures for each geologic/geotechnical hazard identified in Step 2B. Provide a discussion of geologic/geotechnical hazards that would prevent full infiltration BMPs that cannot be reasonably mitigated in the geotechnical report. See Appendix C.2.1.8 for a list of typically reasonable and typically unreasonable mitigation measures. Can mitigation measures be proposed to allow for full infiltration BMPs? If the question in Step 2 is answered "Yes," then answer "Yes" to Criteria 2 Result. If the question in Step 2C is answered "No," then answer "No" to Criteria 2 Result.	☐Yes	☐No
Criteria 2 Result	Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of geologic or geotechnical hazards that cannot be reasonably mitigated to an acceptable level?	☐Yes	☐No
Summarize findings and basis; provide references to related reports or exhibits.			

Part 1 Result – Full Infiltration Geotechnical Screening [12]	Result
If answers to both Criteria 1 and Criteria 2 are "Yes", a full infiltration design is potentially feasible based on Geotechnical conditions only. If either answer to Criteria 1 or Criteria 2 is "No", a full infiltration design is not required.	☐Full infiltration Condition ☑Complete Part 2

[12] To be completed using gathered site information and best professional judgement considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by City Engineer to substantiate findings.

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions	Worksheet C.4-1: Form I-8A[10]
Part 2 – Partial vs. No Infiltration Feasibility Screening Criteria	
DMA(s) Being Analyzed:	**Project Phase:**
Entire Site	Preliminary

Criteria 3 : Infiltration Rate Screening

3A	**NRCS Type C, D, or "urban/unclassified":** Is the mapped hydrologic soil group according to the NRCS Web Soil Survey or UC Davis Soil Web Mapper is Type C, D, or "urban/unclassified" and corroborated by available site soil data? ☐ Yes; the site is mapped as C soils and a reliable infiltration rate of 0.15 in/hr. is used to size partial infiltration BMPS. Answer "Yes" to Criteria 3 Result. ☐ Yes; the site is mapped as D soils or "urban/unclassified" and a reliable infiltration rate of 0.05 in/hr. is used to size partial infiltration BMPS. Answer "Yes" to Criteria 3 Result. ☑ No; infiltration testing is conducted (refer to Table D.3-1), continue to Step 3B.
3B	**Infiltration Testing Result:** Is the reliable infiltration rate (i.e. average measured infiltration rate/2) greater than 0.05 in/hr. and less than or equal to 0.5 in/hr? ☐ Yes; the site may support partial infiltration. Answer "Yes" to Criteria 3 Result. ☑ No; the reliable infiltration rate (i.e. average measured rate/2) is less than 0.05 in/hr., partial infiltration is not required. Answer "No" to Criteria 3 Result.
Criteria 3 Result	Is the estimated reliable infiltration rate (i.e., average measured infiltration rate/2) greater than or equal to 0.05 inches/hour and less than or equal to 0.5 inches/hour at any location within each DMA where runoff can reasonably be routed to a BMP? ☐ Yes; Continue to Criteria 4. ☑ No: Skip to Part 2 Result.

Summarize infiltration testing and/or mapping results (i.e. soil maps and series description used for infiltration rate).

Six infiltration tests were performed on the property. The factored test results were as follows:

A-1: 0.001 in/hr
A-1a: 0.003 in/hr
A-2: 0.060 in/hr
A-2a: 0.027 in/hr
A-3: 0.002 in/hr
A-3a: 0.012 in/hr

The average rate of the six tests is 0.02 in/hr. Five of the six tests had infiltration rates below 0.05 in/hr.

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions			Worksheet C.4-1: Form I-8A[10]	
Criteria 4: Geologic/Geotechnical Screening				
4A	If all questions in Step 4A are answered "Yes," continue to Step 2B. For any "No" answer in Step 4A answer "No" to Criteria 4 Result, and submit an "Infiltration Feasibility Condition Letter" that meets the requirements in Appendix C.1.1. The geologic/geotechnical analyses listed in Appendix C.2.1 do not apply to the DMA because one of the following setbacks cannot be avoided and therefore result in the DMA being in a no infiltration condition. The setbacks must be the closest horizontal radial distance from the surface edge (at the overflow elevation) of the BMP.			
4A-1	Can the proposed partial infiltration BMP(s) avoid areas with existing fill materials greater than 5 feet thick?	☐Yes	☐No	
4A-2	Can the proposed partial infiltration BMP(s) avoid placement within 10 feet of existing underground utilities, structures, or retaining walls?	☐Yes	☐No	
4A-3	Can the proposed partial infiltration BMP(s) avoid placement within 50 feet of a natural slope (>25%) or within a distance of 1.5H from fill slopes where H is the height of the fill slope?	☐Yes	☐No	
4B	When full infiltration is determined to be feasible, a geotechnical investigation report must be prepared that considers the relevant factors identified in Appendix C.2.1 If all questions in Step 4B are answered "Yes," then answer "Yes" to Criteria 4 Result. If there are any "No" answers continue to Step 4C.			
4B-1	**Hydroconsolidation.** Analyze hydroconsolidation potential per approved ASTM standard due to a proposed full infiltration BMP. Can partial infiltration BMPs be proposed within the DMA without increasing hydroconsolidation risks?	☐Yes	☐No	
4B-2	**Expansive Soils.** Identify expansive soils (soils with an expansion index greater than 20) and the extent of such soils due to proposed full infiltration BMPs. Can partial infiltration BMPs be proposed within the DMA without increasing expansive soil risks?	☐Yes	☐No	

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4-1: Form I-8A[10]	
4B-3	**Liquefaction**. If applicable, identify mapped liquefaction areas. Evaluate liquefaction hazards in accordance with Section 6.4.2 of the City of San Diego's Guidelines for Geotechnical Reports (2011). Liquefaction hazard assessment shall take into account any increase in groundwater elevation or groundwater mounding that could occur as a result of proposed infiltration or percolation facilities. Can partial infiltration BMPs be proposed within the DMA without increasing liquefaction risks?	☐Yes	☐No
4B-4	**Slope Stability**. If applicable, perform a slope stability analysis in accordance with the ASCE and Southern California Earthquake Center (2002) Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Landslide Hazards in California to determine minimum slope setbacks for full infiltration BMPs. See the City of San Diego's Guidelines for Geotechnical Reports (2011) to determine which type of slope stability analysis is required. Can partial infiltration BMPs be proposed within the DMA without increasing slope stability risks?	☐Yes	☐No
4B-5	**Other Geotechnical Hazards.** Identify site-specific geotechnical hazards not already mentioned (refer to Appendix C.2.1). Can partial infiltration BMPs be proposed within the DMA without increasing risk of geologic or geotechnical hazards not already mentioned?	☐Yes	☐No
4B-6	**Setbacks.** Establish setbacks from underground utilities, structures, and/or retaining walls. Reference applicable ASTM or other recognized standard in the geotechnical report. Can partial infiltration BMPs be proposed within the DMA using recommended setbacks from underground utilities, structures, and/or retaining walls?	☐Yes	☐No
4C	**Mitigation Measures.** Propose mitigation measures for each geologic/geotechnical hazard identified in Step 4B. Provide a discussion on geologic/geotechnical hazards that would prevent partial infiltration BMPs that cannot be reasonably mitigated in the geotechnical report. See Appendix C.2.1.8 for a list of typically reasonable and typically unreasonable mitigation measures. Can mitigation measures be proposed to allow for partial infiltration BMPs? If the question in Step 4C is answered "Yes," then answer "Yes" to Criteria 4 Result. If the question in Step 4C is answered "No," then answer "No" to Criteria 4 Result.	☐Yes	☐No

<table>
<tr><th colspan="2">Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions</th><th colspan="2">Worksheet C.4-1: Form I-8A[10]</th></tr>
<tr><td>Criteria 4 Result</td><td>Can infiltration of greater than or equal to 0.05 inches/hour and less than or equal to 0.5 inches/hour be allowed without increasing the risk of geologic or geotechnical hazards that cannot be reasonably mitigated to an acceptable level?</td><td>☐ Yes</td><td>☐ No</td></tr>
<tr><td colspan="4">Summarize findings and basis; provide references to related reports or exhibits.</td></tr>
</table>

Part 2 – Partial Infiltration Geotechnical Screening Result[13]	Result
If answers to both Criteria 3 and Criteria 4 are "Yes", a partial infiltration design is potentially feasible based on geotechnical conditions only. If answers to either Criteria 3 or Criteria 4 is "No", then infiltration of any volume is considered to be infeasible within the site.	☐ Partial Infiltration Condition ☑ No Infiltration Condition

[13] To be completed using gathered site information and best professional judgement considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by City Engineer to substantiate findings.

APPENDIX D

APPENDIX D

RECOMMENDED GRADING SPECIFICATIONS

FOR

AIRWAY ROAD
INDUSTRIAL BUILDING
SAN DIEGO, CALIFORNIA

PROJECT NO. G2467-42-01

RECOMMENDED GRADING SPECIFICATIONS

1. GENERAL

1.1 These Recommended Grading Specifications shall be used in conjunction with the Geotechnical Report for the project prepared by Geocon. The recommendations contained in the text of the Geotechnical Report are a part of the earthwork and grading specifications and shall supersede the provisions contained hereinafter in the case of conflict.

1.2 Prior to the commencement of grading, a geotechnical consultant (Consultant) shall be employed for the purpose of observing earthwork procedures and testing the fills for substantial conformance with the recommendations of the Geotechnical Report and these specifications. The Consultant should provide adequate testing and observation services so that they may assess whether, in their opinion, the work was performed in substantial conformance with these specifications. It shall be the responsibility of the Contractor to assist the Consultant and keep them apprised of work schedules and changes so that personnel may be scheduled accordingly.

1.3 It shall be the sole responsibility of the Contractor to provide adequate equipment and methods to accomplish the work in accordance with applicable grading codes or agency ordinances, these specifications and the approved grading plans. If, in the opinion of the Consultant, unsatisfactory conditions such as questionable soil materials, poor moisture condition, inadequate compaction, and/or adverse weather result in a quality of work not in conformance with these specifications, the Consultant will be empowered to reject the work and recommend to the Owner that grading be stopped until the unacceptable conditions are corrected.

2. DEFINITIONS

2.1 **Owner** shall refer to the owner of the property or the entity on whose behalf the grading work is being performed and who has contracted with the Contractor to have grading performed.

2.2 **Contractor** shall refer to the Contractor performing the site grading work.

2.3 **Civil Engineer** or **Engineer of Work** shall refer to the California licensed Civil Engineer or consulting firm responsible for preparation of the grading plans, surveying and verifying as-graded topography.

2.4 **Consultant** shall refer to the soil engineering and engineering geology consulting firm retained to provide geotechnical services for the project.

2.5 **Soil Engineer** shall refer to a California licensed Civil Engineer retained by the Owner, who is experienced in the practice of geotechnical engineering. The Soil Engineer shall be responsible for having qualified representatives on-site to observe and test the Contractor's work for conformance with these specifications.

2.6 **Engineering Geologist** shall refer to a California licensed Engineering Geologist retained by the Owner to provide geologic observations and recommendations during the site grading.

2.7 **Geotechnical Report** shall refer to a soil report (including all addenda) which may include a geologic reconnaissance or geologic investigation that was prepared specifically for the development of the project for which these Recommended Grading Specifications are intended to apply.

3. MATERIALS

3.1 Materials for compacted fill shall consist of any soil excavated from the cut areas or imported to the site that, in the opinion of the Consultant, is suitable for use in construction of fills. In general, fill materials can be classified as *soil* fills, *soil-rock* fills or *rock* fills, as defined below.

3.1.1 **Soil fills** are defined as fills containing no rocks or hard lumps greater than 12 inches in maximum dimension and containing at least 40 percent by weight of material smaller than ¾ inch in size.

3.1.2 **Soil-rock fills** are defined as fills containing no rocks or hard lumps larger than 4 feet in maximum dimension and containing a sufficient matrix of soil fill to allow for proper compaction of soil fill around the rock fragments or hard lumps as specified in Paragraph 6.2. **Oversize rock** is defined as material greater than 12 inches.

3.1.3 **Rock fills** are defined as fills containing no rocks or hard lumps larger than 3 feet in maximum dimension and containing little or no fines. Fines are defined as material smaller than ¾ inch in maximum dimension. The quantity of fines shall be less than approximately 20 percent of the rock fill quantity.

3.2 Material of a perishable, spongy, or otherwise unsuitable nature as determined by the Consultant shall not be used in fills.

3.3 Materials used for fill, either imported or on-site, shall not contain hazardous materials as defined by the California Code of Regulations, Title 22, Division 4, Chapter 30, Articles 9 and 10; 40CFR; and any other applicable local, state or federal laws. The Consultant shall not be responsible for the identification or analysis of the potential presence of hazardous materials. However, if observations, odors or soil discoloration cause Consultant to suspect the presence of hazardous materials, the Consultant may request from the Owner the termination of grading operations within the affected area. Prior to resuming grading operations, the Owner shall provide a written report to the Consultant indicating that the suspected materials are not hazardous as defined by applicable laws and regulations.

3.4 The outer 15 feet of *soil-rock* fill slopes, measured horizontally, should be composed of properly compacted *soil* fill materials approved by the Consultant. *Rock* fill may extend to the slope face, provided that the slope is not steeper than 2:1 (horizontal:vertical) and a soil layer no thicker than 12 inches is track-walked onto the face for landscaping purposes. This procedure may be utilized provided it is acceptable to the governing agency, Owner and Consultant.

3.5 Samples of soil materials to be used for fill should be tested in the laboratory by the Consultant to determine the maximum density, optimum moisture content, and, where appropriate, shear strength, expansion, and gradation characteristics of the soil.

3.6 During grading, soil or groundwater conditions other than those identified in the Geotechnical Report may be encountered by the Contractor. The Consultant shall be notified immediately to evaluate the significance of the unanticipated condition.

4. CLEARING AND PREPARING AREAS TO BE FILLED

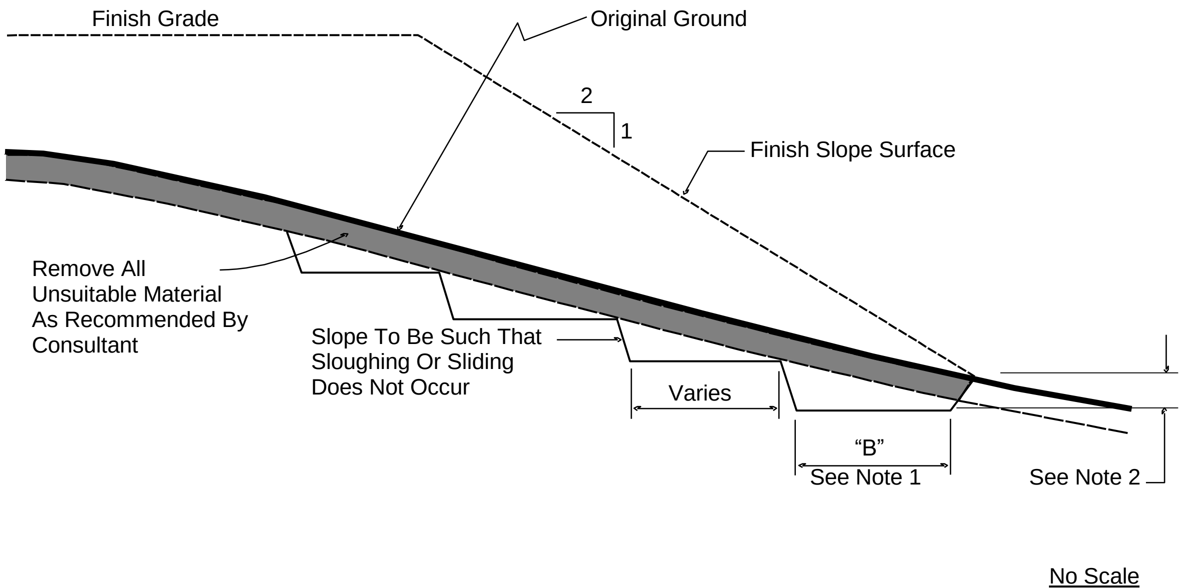
4.1 Areas to be excavated and filled shall be cleared and grubbed. Clearing shall consist of complete removal above the ground surface of trees, stumps, brush, vegetation, man-made structures, and similar debris. Grubbing shall consist of removal of stumps, roots, buried logs and other unsuitable material and shall be performed in areas to be graded. Roots and other projections exceeding 1½ inches in diameter shall be removed to a depth of 3 feet below the surface of the ground. Borrow areas shall be grubbed to the extent necessary to provide suitable fill materials.

4.2 Asphalt pavement material removed during clearing operations should be properly disposed at an approved off-site facility or in an acceptable area of the project evaluated by Geocon and the property owner. Concrete fragments that are free of reinforcing steel may be placed in fills, provided they are placed in accordance with Section 6.2 or 6.3 of this document.

4.3 After clearing and grubbing of organic matter and other unsuitable material, loose or porous soils shall be removed to the depth recommended in the Geotechnical Report. The depth of removal and compaction should be observed and approved by a representative of the Consultant. The exposed surface shall then be plowed or scarified to a minimum depth of 6 inches and until the surface is free from uneven features that would tend to prevent uniform compaction by the equipment to be used.

4.4 Where the slope ratio of the original ground is steeper than 5:1 (horizontal:vertical), or where recommended by the Consultant, the original ground should be benched in accordance with the following illustration.

TYPICAL BENCHING DETAIL



DETAIL NOTES: (1) Key width "B" should be a minimum of 10 feet, or sufficiently wide to permit complete coverage with the compaction equipment used. The base of the key should be graded horizontal, or inclined slightly into the natural slope.

(2) The outside of the key should be below the topsoil or unsuitable surficial material and at least 2 feet into dense formational material. Where hard rock is exposed in the bottom of the key, the depth and configuration of the key may be modified as approved by the Consultant.

4.5 After areas to receive fill have been cleared and scarified, the surface should be moisture conditioned to achieve the proper moisture content, and compacted as recommended in Section 6 of these specifications.

5. COMPACTION EQUIPMENT

5.1 Compaction of *soil* or *soil-rock* fill shall be accomplished by sheepsfoot or segmented-steel wheeled rollers, vibratory rollers, multiple-wheel pneumatic-tired rollers, or other types of acceptable compaction equipment. Equipment shall be of such a design that it will be capable of compacting the *soil* or *soil-rock* fill to the specified relative compaction at the specified moisture content.

5.2 Compaction of *rock* fills shall be performed in accordance with Section 6.3.

6. PLACING, SPREADING AND COMPACTION OF FILL MATERIAL

6.1 *Soil* fill, as defined in Paragraph 3.1.1, shall be placed by the Contractor in accordance with the following recommendations:

6.1.1 *Soil* fill shall be placed by the Contractor in layers that, when compacted, should generally not exceed 8 inches. Each layer shall be spread evenly and shall be thoroughly mixed during spreading to obtain uniformity of material and moisture in each layer. The entire fill shall be constructed as a unit in nearly level lifts. Rock materials greater than 12 inches in maximum dimension shall be placed in accordance with Section 6.2 or 6.3 of these specifications.

6.1.2 In general, the *soil* fill shall be compacted at a moisture content at or above the optimum moisture content as determined by ASTM D 1557.

6.1.3 When the moisture content of *soil* fill is below that specified by the Consultant, water shall be added by the Contractor until the moisture content is in the range specified.

6.1.4 When the moisture content of the *soil* fill is above the range specified by the Consultant or too wet to achieve proper compaction, the *soil* fill shall be aerated by the Contractor by blading/mixing, or other satisfactory methods until the moisture content is within the range specified.

6.1.5 After each layer has been placed, mixed, and spread evenly, it shall be thoroughly compacted by the Contractor to a relative compaction of at least 90 percent. Relative compaction is defined as the ratio (expressed in percent) of the in-place dry density of the compacted fill to the maximum laboratory dry density as determined in accordance with ASTM D 1557. Compaction shall be continuous over the entire area, and compaction equipment shall make sufficient passes so that the specified minimum relative compaction has been achieved throughout the entire fill.

6.1.6 Where practical, soils having an Expansion Index greater than 50 should be placed at least 3 feet below finish pad grade and should be compacted at a moisture content generally 2 to 4 percent greater than the optimum moisture content for the material.

6.1.7 Properly compacted *soil* fill shall extend to the design surface of fill slopes. To achieve proper compaction, it is recommended that fill slopes be over-built by at least 3 feet and then cut to the design grade. This procedure is considered preferable to track-walking of slopes, as described in the following paragraph.

6.1.8 As an alternative to over-building of slopes, slope faces may be back-rolled with a heavy-duty loaded sheepsfoot or vibratory roller at maximum 4-foot fill height intervals. Upon completion, slopes should then be track-walked with a D-8 dozer or similar equipment, such that a dozer track covers all slope surfaces at least twice.

6.2 *Soil-rock* fill, as defined in Paragraph 3.1.2, shall be placed by the Contractor in accordance with the following recommendations:

6.2.1 Rocks larger than 12 inches but less than 4 feet in maximum dimension may be incorporated into the compacted *soil* fill, but shall be limited to the area measured 15 feet minimum horizontally from the slope face and 5 feet below finish grade or 3 feet below the deepest utility, whichever is deeper.

6.2.2 Rocks or rock fragments up to 4 feet in maximum dimension may either be individually placed or placed in windrows. Under certain conditions, rocks or rock fragments up to 10 feet in maximum dimension may be placed using similar methods. The acceptability of placing rock materials greater than 4 feet in maximum dimension shall be evaluated during grading as specific cases arise and shall be approved by the Consultant prior to placement.

6.2.3 For individual placement, sufficient space shall be provided between rocks to allow for passage of compaction equipment.

6.2.4 For windrow placement, the rocks should be placed in trenches excavated in properly compacted *soil* fill. Trenches should be approximately 5 feet wide and 4 feet deep in maximum dimension. The voids around and beneath rocks should be filled with approved granular soil having a Sand Equivalent of 30 or greater and should be compacted by flooding. Windrows may also be placed utilizing an "open-face" method in lieu of the trench procedure, however, this method should first be approved by the Consultant.

6.2.5 Windrows should generally be parallel to each other and may be placed either parallel to or perpendicular to the face of the slope depending on the site geometry. The minimum horizontal spacing for windrows shall be 12 feet center-to-center with a 5-foot stagger or offset from lower courses to next overlying course. The minimum vertical spacing between windrow courses shall be 2 feet from the top of a lower windrow to the bottom of the next higher windrow.

6.2.6 Rock placement, fill placement and flooding of approved granular soil in the windrows should be continuously observed by the Consultant.

6.3 *Rock* fills, as defined in Section 3.1.3, shall be placed by the Contractor in accordance with the following recommendations:

6.3.1 The base of the *rock* fill shall be placed on a sloping surface (minimum slope of 2 percent). The surface shall slope toward suitable subdrainage outlet facilities. The *rock* fills shall be provided with subdrains during construction so that a hydrostatic pressure buildup does not develop. The subdrains shall be permanently connected to controlled drainage facilities to control post-construction infiltration of water.

6.3.2 *Rock* fills shall be placed in lifts not exceeding 3 feet. Placement shall be by rock trucks traversing previously placed lifts and dumping at the edge of the currently placed lift. Spreading of the *rock* fill shall be by dozer to facilitate *seating* of the rock. The *rock* fill shall be watered heavily during placement. Watering shall consist of water trucks traversing in front of the current rock lift face and spraying water continuously during rock placement. Compaction equipment with compactive energy comparable to or greater than that of a 20-ton steel vibratory roller or other compaction equipment providing suitable energy to achieve the required compaction or deflection as recommended in Paragraph 6.3.3 shall be utilized. The number of passes to be made should be determined as described in Paragraph 6.3.3. Once a *rock* fill lift has been covered with *soil* fill, no additional *rock* fill lifts will be permitted over the *soil* fill.

6.3.3 Plate bearing tests, in accordance with ASTM D 1196, may be performed in both the compacted *soil* fill and in the *rock* fill to aid in determining the required minimum number of passes of the compaction equipment. If performed, a minimum of three plate bearing tests should be performed in the properly compacted *soil* fill (minimum relative compaction of 90 percent). Plate bearing tests shall then be performed on areas of *rock* fill having two passes, four passes and six passes of the compaction equipment, respectively. The number of passes required for the *rock* fill shall be determined by comparing the results of the plate bearing tests for the *soil* fill and the *rock* fill and by evaluating the deflection variation with number of passes. The required number of passes of the compaction equipment will be performed as necessary until the plate bearing deflections are equal to or less than that determined for the properly compacted *soil* fill. In no case will the required number of passes be less than two.

6.3.4 A representative of the Consultant should be present during *rock* fill operations to observe that the minimum number of "passes" have been obtained, that water is being properly applied and that specified procedures are being followed. The actual number of plate bearing tests will be determined by the Consultant during grading.

6.3.5 Test pits shall be excavated by the Contractor so that the Consultant can state that, in their opinion, sufficient water is present and that voids between large rocks are properly filled with smaller rock material. In-place density testing will not be required in the *rock* fills.

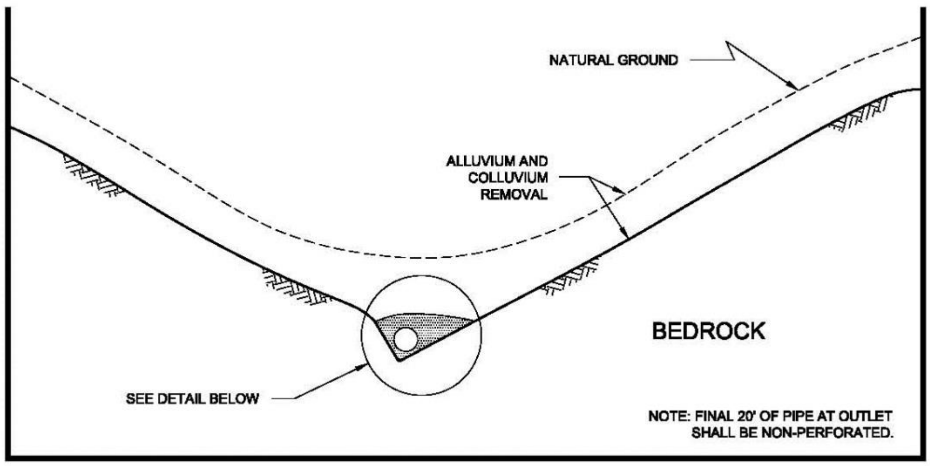
6.3.6 To reduce the potential for "piping" of fines into the *rock* fill from overlying *soil* fill material, a 2-foot layer of graded filter material shall be placed above the uppermost lift of *rock* fill. The need to place graded filter material below the *rock* should be determined by the Consultant prior to commencing grading. The gradation of the graded filter material will be determined at the time the *rock* fill is being excavated. Materials typical of the *rock* fill should be submitted to the Consultant in a timely manner, to allow design of the graded filter prior to the commencement of *rock* fill placement.

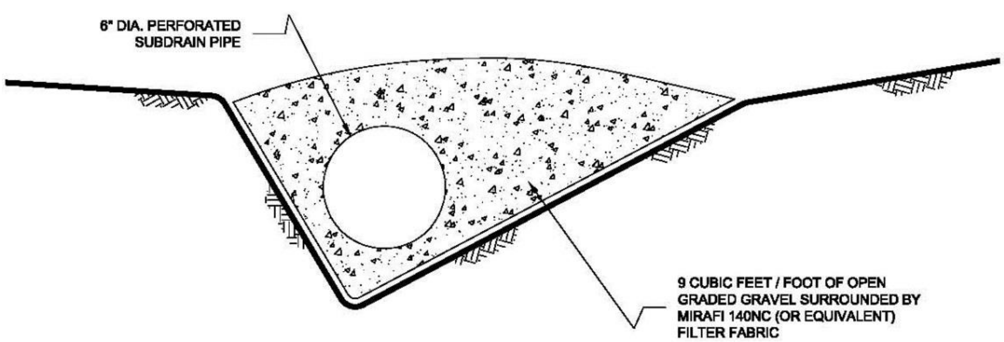
6.3.7 *Rock* fill placement should be continuously observed during placement by the Consultant.

7. SUBDRAINS

7.1 The geologic units on the site may have permeability characteristics and/or fracture systems that could be susceptible under certain conditions to seepage. The use of canyon subdrains may be necessary to mitigate the potential for adverse impacts associated with seepage conditions. Canyon subdrains with lengths in excess of 500 feet or extensions of existing offsite subdrains should use 8-inch-diameter pipes. Canyon subdrains less than 500 feet in length should use 6-inch-diameter pipes.

TYPICAL CANYON DRAIN DETAIL





NOTES:

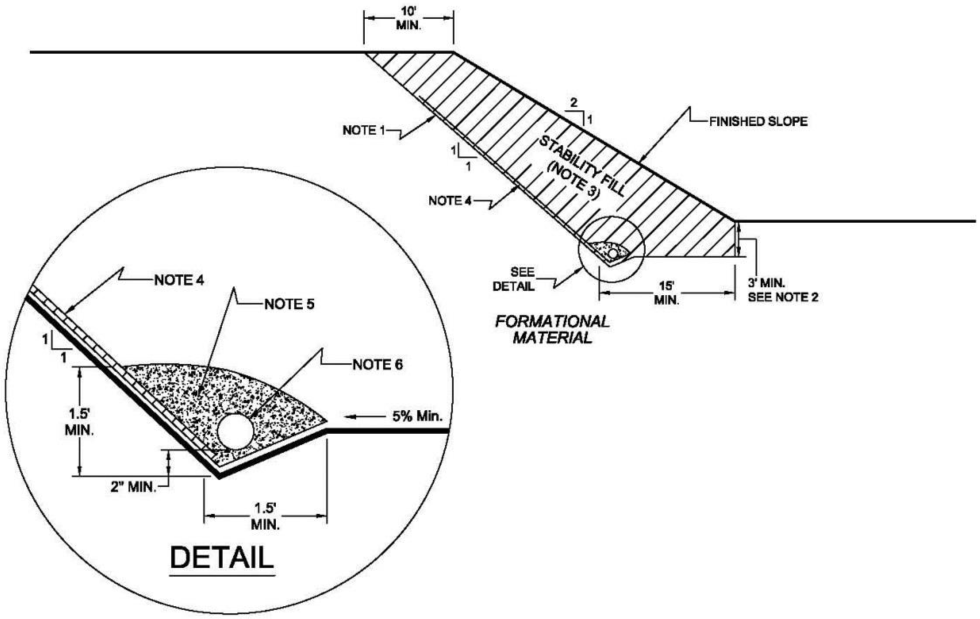
1......6-INCH DIAMETER, SCHEDULE 80 PVC PERFORATED PIPE FOR FILLS IN EXCESS OF 100-FEET IN DEPTH OR A PIPE LENGTH OF LONGER THAN 500 FEET.

2......6-INCH DIAMETER, SCHEDULE 40 PVC PERFORATED PIPE FOR FILLS LESS THAN 100-FEET IN DEPTH OR A PIPE LENGTH SHORTER THAN 500 FEET.

NO SCALE

7.2 Slope drains within stability fill keyways should use 4-inch-diameter (or lager) pipes.

TYPICAL STABILITY FILL DETAIL



NOTES:

1.....EXCAVATE BACKCUT AT 1:1 INCLINATION (UNLESS OTHERWISE NOTED).

2.....BASE OF STABILITY FILL TO BE 3 FEET INTO FORMATIONAL MATERIAL, SLOPING A MINIMUM 5% INTO SLOPE.

3.....STABILITY FILL TO BE COMPOSED OF PROPERLY COMPACTED GRANULAR SOIL.

4.....CHIMNEY DRAINS TO BE APPROVED PREFABRICATED CHIMNEY DRAIN PANELS (MIRADRAIN G200N OR EQUIVALENT) SPACED APPROXIMATELY 20 FEET CENTER TO CENTER AND 4 FEET WIDE. CLOSER SPACING MAY BE REQUIRED IF SEEPAGE IS ENCOUNTERED.

5.....FILTER MATERIAL TO BE 3/4-INCH, OPEN-GRADED CRUSHED ROCK ENCLOSED IN APPROVED FILTER FABRIC (MIRAFI 140NC).

6.....COLLECTOR PIPE TO BE 4-INCH MINIMUM DIAMETER, PERFORATED, THICK-WALLED PVC SCHEDULE 40 OR EQUIVALENT, AND SLOPED TO DRAIN AT 1 PERCENT MINIMUM TO APPROVED OUTLET.

NO SCALE

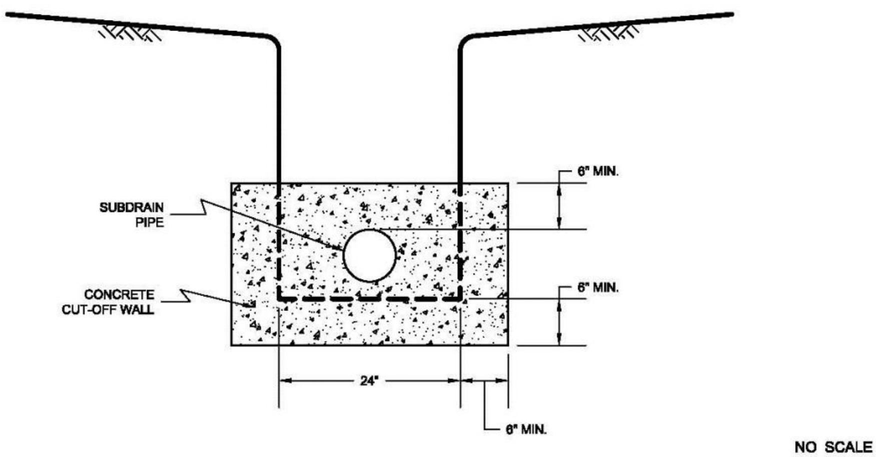
7.3 The actual subdrain locations will be evaluated in the field during the remedial grading operations. Additional drains may be necessary depending on the conditions observed and the requirements of the local regulatory agencies. Appropriate subdrain outlets should be evaluated prior to finalizing 40-scale grading plans.

7.4 *Rock* fill or *soil-rock* fill areas may require subdrains along their down-slope perimeters to mitigate the potential for buildup of water from construction or landscape irrigation. The subdrains should be at least 6-inch-diameter pipes encapsulated in gravel and filter fabric. *Rock* fill drains should be constructed using the same requirements as canyon subdrains.

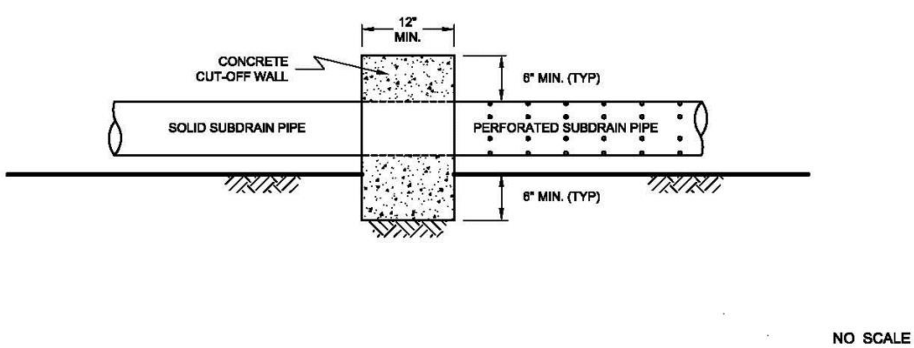
7.5 Prior to outletting, the final 20-foot segment of a subdrain that will not be extended during future development should consist of non-perforated drainpipe. At the non-perforated/ perforated interface, a seepage cutoff wall should be constructed on the downslope side of the pipe.

TYPICAL CUT OFF WALL DETAIL

FRONT VIEW

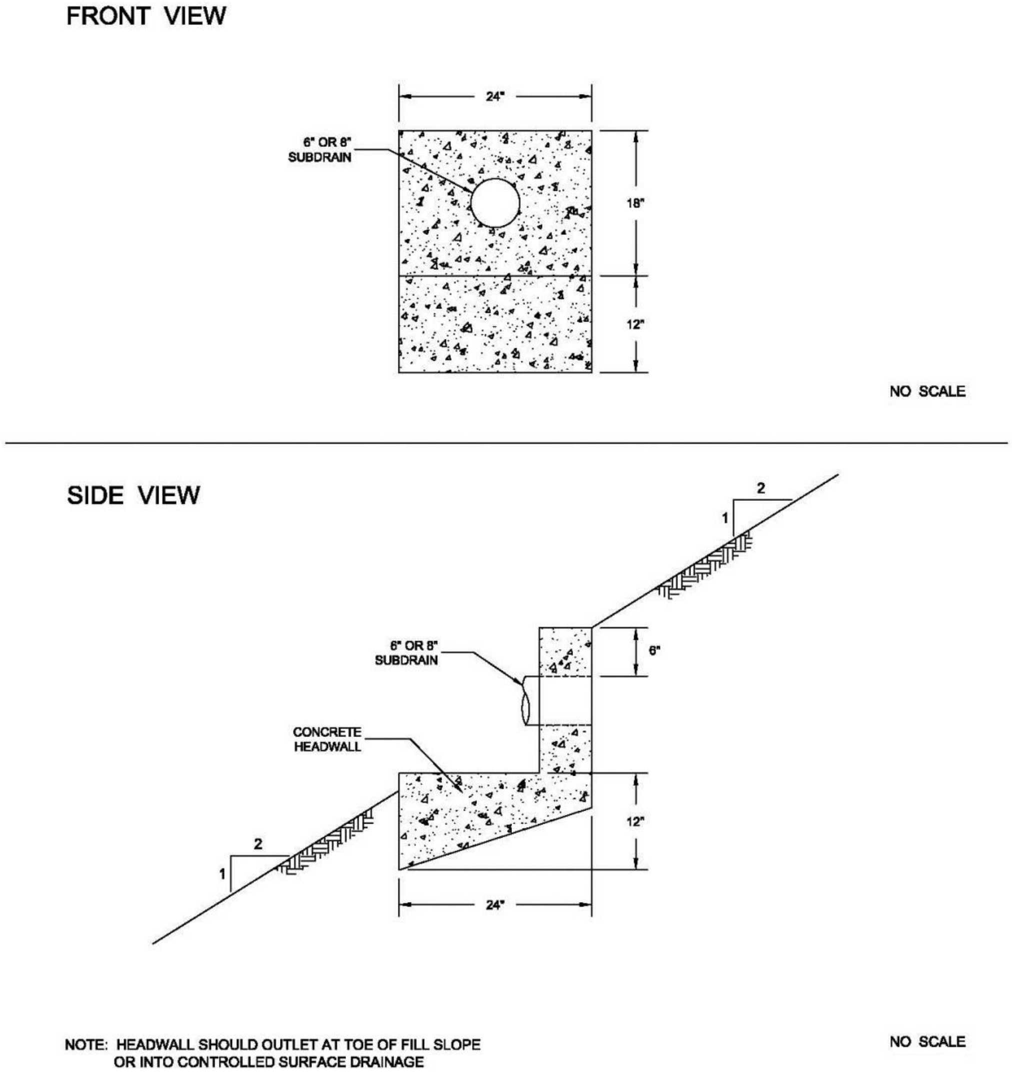


SIDE VIEW



7.6 Subdrains that discharge into a natural drainage course or open space area should be provided with a permanent headwall structure.

TYPICAL HEADWALL DETAIL



7.7 The final grading plans should show the location of the proposed subdrains. After completion of remedial excavations and subdrain installation, the project civil engineer should survey the drain locations and prepare an "as-built" map showing the drain locations. The final outlet and connection locations should be determined during grading operations. Subdrains that will be extended on adjacent projects after grading can be placed on formational material and a vertical riser should be placed at the end of the subdrain. The grading contractor should consider videoing the subdrains shortly after burial to check proper installation and functionality. The contractor is responsible for the performance of the drains.

8. OBSERVATION AND TESTING

8.1 The Consultant shall be the Owner's representative to observe and perform tests during clearing, grubbing, filling, and compaction operations. In general, no more than 2 feet in vertical elevation of *soil* or *soil-rock* fill should be placed without at least one field density test being performed within that interval. In addition, a minimum of one field density test should be performed for every 2,000 cubic yards of *soil* or *soil-rock* fill placed and compacted.

8.2 The Consultant should perform a sufficient distribution of field density tests of the compacted *soil* or *soil-rock* fill to provide a basis for expressing an opinion whether the fill material is compacted as specified. Density tests shall be performed in the compacted materials below any disturbed surface. When these tests indicate that the density of any layer of fill or portion thereof is below that specified, the particular layer or areas represented by the test shall be reworked until the specified density has been achieved.

8.3 During placement of *rock* fill, the Consultant should observe that the minimum number of passes have been obtained per the criteria discussed in Section 6.3.3. The Consultant should request the excavation of observation pits and may perform plate bearing tests on the placed *rock* fills. The observation pits will be excavated to provide a basis for expressing an opinion as to whether the *rock* fill is properly seated and sufficient moisture has been applied to the material. When observations indicate that a layer of *rock* fill or any portion thereof is below that specified, the affected layer or area shall be reworked until the *rock* fill has been adequately seated and sufficient moisture applied.

8.4 A settlement monitoring program designed by the Consultant may be conducted in areas of *rock* fill placement. The specific design of the monitoring program shall be as recommended in the Conclusions and Recommendations section of the project Geotechnical Report or in the final report of testing and observation services performed during grading.

8.5 We should observe the placement of subdrains, to check that the drainage devices have been placed and constructed in substantial conformance with project specifications.

8.6 Testing procedures shall conform to the following Standards as appropriate:

8.6.1 Soil and Soil-Rock Fills:

8.6.1.1 Field Density Test, ASTM D 1556, *Density of Soil In-Place By the Sand-Cone Method.*

8.6.1.2 Field Density Test, Nuclear Method, ASTM D 6938, *Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth).*

8.6.1.3 Laboratory Compaction Test, ASTM D 1557, *Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-Pound Hammer and 18-Inch Drop.*

8.6.1.4. Expansion Index Test, ASTM D 4829, *Expansion Index Test*.

9. PROTECTION OF WORK

9.1 During construction, the Contractor shall properly grade all excavated surfaces to provide positive drainage and prevent ponding of water. Drainage of surface water shall be controlled to avoid damage to adjoining properties or to finished work on the site. The Contractor shall take remedial measures to prevent erosion of freshly graded areas until such time as permanent drainage and erosion control features have been installed. Areas subjected to erosion or sedimentation shall be properly prepared in accordance with the Specifications prior to placing additional fill or structures.

9.2 After completion of grading as observed and tested by the Consultant, no further excavation or filling shall be conducted except in conjunction with the services of the Consultant.

10. CERTIFICATIONS AND FINAL REPORTS

10.1 Upon completion of the work, Contractor shall furnish Owner a certification by the Civil Engineer stating that the lots and/or building pads are graded to within 0.1 foot vertically of elevations shown on the grading plan and that all tops and toes of slopes are within 0.5 foot horizontally of the positions shown on the grading plans. After installation of a section of subdrain, the project Civil Engineer should survey its location and prepare an *as-built* plan of the subdrain location. The project Civil Engineer should verify the proper outlet for the subdrains and the Contractor should ensure that the drain system is free of obstructions.

10.2 The Owner is responsible for furnishing a final as-graded soil and geologic report satisfactory to the appropriate governing or accepting agencies. The as-graded report should be prepared and signed by a California licensed Civil Engineer experienced in geotechnical engineering and by a California Certified Engineering Geologist, indicating that the geotechnical aspects of the grading were performed in substantial conformance with the Specifications or approved changes to the Specifications.

LIST OF REFERENCES

1. FEMA (2012), *Flood Map Service Center*, FEMA website, https://msc.fema.gov/portal/home, flood map number 06073C2159G, effective May 16, 2012, accessed March 13, 2020;

2. Jennings, C. W., 1994, California Division of Mines and Geology, *Fault Activity Map of California and Adjacent Areas*, California Geologic Data Map Series Map No. 6.

3. Kennedy, M. P., and S. S. Tan, 2007, *Geologic Map of the Oceanside 30'x60' Quadrangle, California*, USGS Regional Map Series Map No. 1, Scale 1:100,000.

4. SEAOC (2019), *OSHPD Seismic Design Maps:* Structural Engineers Association of California website, http://seismicmaps.org/, accessed March 13, 2020;

5. USGS (2019), *Quaternary Fault and Fold Database of the United States*: U.S. Geological Survey website, https://www.usgs.gov/natural-hazards/earthquake-hazards/faults, accessed March 13, 2020;

6. Unpublished reports and maps on file with Geocon Incorporated.

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