CITY OF LA MESA
PRIORITY DEVELOPMENT PROJECT (PDP) WATER QUALITY TECHNICAL REPORT (WQTR) FOR WESTMONT LA MESA ASSISTED LIVING [INSERT PERMIT APPLICATION NUMBERS] [INSERT PROJECT ADDRESS] CITY OF LA MESA, COUNTY OF SAN DIEGO, CA ASSESSOR'S PARCEL NUMBER(S): 490-390-17-00 and 490-390-23-00
ENGINEER OF WORK: _____ Justin Becker, P.E.

PREPARED FOR:
WESTMONT DEVELOPMENT, LP
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PDP WQTR PREPARED BY:

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DATE OF WQTR:
APRIL 2016

PLANS PREPARED BY:

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ACRONYMS

APN	Assessor's Parcel Number
BMP	Best Management Practice
HMP	Hydromodification Management Plan
HSG	Hydrologic Soil Group
MS4	Municipal Separate Storm Sewer System
N/A	Not Applicable
NRCS	Natural Resources Conservation Service
PDP	Priority Development Project
PE	Professional Engineer
SC	Source Control
SD	Site Design
SDRWQCB	San Diego Regional Water Quality Control Board
SIC	Standard Industrial Classification
WQTR	Water Quality Technical Report

PDP WQTR PREPARER'S CERTIFICATION PAGE

Project Name: WESTMONT LA MESA ASSISTED LIVING

Permit Application Number: [Insert Permit Application Number]

PREPARER'S CERTIFICATION

I hereby declare that I am the Engineer in Responsible Charge of design of storm water best management practices (BMPs) for this project, and that I have exercised responsible charge over the design of the BMPs as defined in Section 6703 of the Business and Professions Code, and that the design is consistent with the PDP requirements of the City of La Mesa BMP Design Manual, which is a design manual for compliance with local City of La Mesa and regional MS4 Permit (California Regional Water Quality Control Board San Diego Region Order No. R9-2015-0100) requirements for storm water management.

I have read and understand that the City of La Mesa has adopted minimum requirements for managing urban runoff, including storm water, from land development activities, as described in the BMP Design Manual. I certify that this PDP WQTR has been completed to the best of my ability and accurately reflects the project being proposed and the applicable 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 WQTR by City staff 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.

_____

Engineer of Work's Signature, PE Number & Expiration Date

JUSTIN BECKER, P.E.

_____

Print Name

KIMLEY-HORN AND ASSOCIATES

_____

Company

04/08/2016

_____

Date

Engineer's Seal:

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PDP WQTR PROJECT OWNER'S CERTIFICATION PAGE

Project Name: WESTMONT LA MESA ASSISTED LIVING
Permit Application Number: [Insert Permit Application Number]

PROJECT OWNER'S CERTIFICATION

This PDP WQTR has been prepared for Westmont Development LP by Kimley-Horn and Associates. The PDP WQTR is intended to comply with the PDP requirements of the City of La Mesa BMP Design Manual, which is a design manual for compliance with local City of La Mesa and regional MS4 Permit (California Regional Water Quality Control Board San Diego Region Order No. R9-2015-0100) requirements for storm water management.

I have read and understand that the City of La Mesa has adopted minimum requirements for managing urban runoff, including storm water, from construction and land development activities.

I certify that the BMPs selected on this form will be implemented to minimize the potentially negative impacts of this project's construction and land development activities on water quality. I further agree to install, monitor, maintain, or revise the selected BMPs to ensure their effectiveness. I also understand that non-compliance with the City's WPO and Grading Ordinance may result in enforcement by the City, including fines, cease and desist orders, or other actions.

While I own the subject property, I am responsible for the implementation of the provisions of this plan. If I transfer my interest in the property, my successor-in-interest shall bear the aforementioned responsibility to implement the best management practices (BMPs) described within this plan. A signed copy of this document shall be available on the subject property into perpetuity.

_____
Project Owner's Signature

_____
Print Name

_____
Company

_____
Date

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SUBMITTAL RECORD

Use this Table to keep a record of submittals of this PDP WQTR. Each time the PDP WQTR is re-submitted, provide the date and status of the project. In column 4 summarize the changes that have been made or indicate if response to plancheck comments is included. When applicable, insert response to plancheck comments behind this page.

Submittal Number	Date	Project Status	Summary of Changes
1	04/12/2016	✓Preliminary Design / Planning/ CEQA ✓Final Design	Initial Submittal
2		✓Preliminary Design / Planning/ CEQA ✓Final Design	
3		✓Preliminary Design / Planning/ CEQA ✓Final Design	
4		✓Preliminary Design / Planning/ CEQA ✓Final Design	

PROJECT VICINITY MAP

Project Name: WESTMONT LA MESA ASSISTED LIVING
Permit Application Number: [Insert Permit Application Number]

Storm Water Intake Form

Applicability of Permanent, Post-Construction Storm Water BMP Requirements	
Project Identification	
Project Name: WESTMONT LA MESA ASSISTED LIVING	
Permit Application Number:	Date:
Project Address: Murray Drive, La Mesa, CA	
Assessor's Parcel Number(s): 490-390-17-00 and 490-390-23-00	
Project Owner Westmont Development LP 7660 Fay Avenue, Suite N La Jolla, CA 92037	
Plans Prepared By Justin Becker, P.E. Kimley-Horn and Associates 401 B Street, Suite 600, San Diego CA 92101 Main: (619) 234-9411 Direct: (619)744-0169	

Determination of Requirements		
Step	Answer	Progression
Step 1: Is the project a "development project"? See page 2 of this form for a list of permits and approvals that would be considered projects. See Section 1.3 of the BMP Design Manual for further guidance.	✓Yes	Go to Step 2.
	No	Stop. Permanent BMP requirements do not apply. No WQTR will be required. Provide discussion below.

Form I-1		
Step	Answer	Progression
Step 2: Is the project west or east of the Pacific / Salton Sea Divide? See below for discussion and an exhibit of the Pacific / Salton Sea Divide.	✓West	Go to Step 3.
	East	Standard Project requirements apply, including Standard Project WQTR. Go to Standard Project WQTR.

Form I-1		
Step	Answer	Progression
Step 3: Is the project a Standard Project, Priority Development Project (PDP), or exception to PDP definitions? To answer this item, complete the Project Type Determination Checklist on Pages 5 and 6 of this form, and see PDP exemption information below. For further guidance, see Section 1.4 of the BMP Design Manual *in its entirety*.	Standard Project	Standard Project requirements apply, including Standard Project WQTR. Go to Standard Project WQTR.
	✓PDP	Standard and PDP requirements apply, including PDP WQTR. Go to PDP WQTR.
	Exception to PDP definitions*	Standard Project requirements apply, and any additional requirements specific to the type of project. *Provide discussion and list any additional requirements below in this form.* Go to Standard Project WQTR.
*Exceptions to PDP definitions: The City staff have the discretion to exempt certain projects from being defined as PDPs, or to apply alternative PDP requirements as follows: (A) New or retrofit paved sidewalks, bicycle lanes, or trails that meet the following criteria: (i) Designed and constructed to direct storm water runoff to adjacent vegetated areas, or other non-erodible permeable areas; OR (ii) Designed and constructed to be hydraulically disconnected from paved streets or roads [i.e., runoff from the new improvement does not drain directly onto paved streets or roads]; OR (iii) Designed and constructed with permeable pavements or surfaces in accordance with US EPA Green Streets Guidance; (B) Retrofitting or redevelopment of existing paved alleys, streets or roads that are designed and constructed in accordance with the US EPA Green Streets Guidance.		
Discussion / justification, and additional requirements for exceptions to PDP definitions, if applicable: Not Applicable – Project in a Priority Development Project		

Storm Water Intake Form Certification	
Step 4: Sign and date the certification	
Applicant Certification: I have read and understand that the City of La Mesa has adopted minimum requirements for managing urban runoff, including storm water, from construction and land development activities. I certify that this intake form has been completed to the best of my ability and accurately reflects the project being proposed. I also understand that non-compliance with the City's WPO and Grading Ordinance may result in enforcement by the City, including fines, cease and desist orders, or other actions.	
Signature of Applicant:	Date:

Project Type Determination Checklist			
Project Type Determination: Standard Project or Priority Development Project (PDP)			
The project is (select one): ✓ New Development ☐ Redevelopment			
The total proposed newly created or replaced impervious area is: 101,843 ft^2 (2.338) acres			
Is the project in any of the following categories, (a) through (f)?			
Yes ✓	No ☐	(a)	New development projects that create 10,000 square feet or more of impervious surfaces (collectively over the entire project site). This includes commercial, industrial, residential, mixed-use, and public development projects on public or private land.
Yes ☐	No ✓	(b)	Redevelopment projects that create and/or replace 5,000 square feet or more of impervious surface (collectively over the entire project site 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 ✓	(c)	New and redevelopment projects that create and/or replace 5,000 square feet or more of impervious surface (collectively over the entire project site), and support one or more of the following uses: (i) Restaurants. This category is defined as a facility that sells prepared foods and drinks for consumption, including stationary lunch counters and refreshment stands selling prepared foods and drinks for immediate consumption (Standard Industrial Classification (SIC) code 5812). (ii) Hillside development projects. This category includes development on any natural slope that is twenty-five percent or greater. (iii) Parking lots. This category is defined as a land area or facility for the temporary parking or storage of motor vehicles used personally, for business, or for commerce. (iv) Streets, roads, highways, freeways, and driveways. This category is defined as any paved impervious surface used for the transportation of automobiles, trucks, motorcycles, and other vehicles.

Form I-2			
Yes ☐	No ✓	(d)	New or redevelopment projects that create and/or replace 2,500 square feet or more of impervious surface (collectively over the entire project site), and discharging 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). *Note: ESAs are areas that include but are not limited to all Clean Water Act Section 303(d) impaired water bodies; areas designated as Areas of Special Biological Significance by the State Water Board and San Diego Water Board; State Water Quality Protected Areas; water bodies designated with the RARE beneficial use by the State Water Board and San Diego Water Board; and any other equivalent environmentally sensitive areas which have been identified by the Copermittees. See BMP Design Manual Section 1.4.2 for additional guidance.*
Yes ☐	No ✓	(e)	New development projects, or redevelopment projects that create and/or replace 5,000 square feet or more of impervious surface, that support one or more of the following uses: (i) Automotive repair shops. This category is defined as a facility that is categorized in any one of the following SIC codes: 5013, 5014, 5541, 7532-7534, or 7536-7539. (ii) Retail gasoline outlets (RGOs). This category includes RGOs that meet the following criteria: (a) 5,000 square feet or more or (b) a projected Average Daily Traffic (ADT) of 100 or more vehicles per day.
Yes ☐	No ✓	(f)	New or redevelopment projects that result in the disturbance of one or more acres of land and are expected to generate pollutants post construction. *Note: See BMP Design Manual Section 1.4.2 for additional guidance.*

Does the project meet the definition of one or more of the Priority Development Project categories (a) through (f) listed above?

☐ No – the project is <u>not</u> a Priority Development Project (Standard Project).

✓ Yes – the project is a Priority Development Project (PDP).

The following is for redevelopment PDPs only:

The area of existing (pre-project) impervious area at the project site is: _____ ft^2 (A)

The total proposed newly created or replaced impervious area is _____ ft^2 (B)

Percent impervious surface created or replaced (B/A)*100: _____%

The percent impervious surface created or replaced is (select one based on the above calculation):

☐ less than or equal to fifty percent (50%) – only new impervious areas are considered PDP

OR

☐ greater than fifty percent (50%) – the entire project site is a PDP

Site Information Checklist For PDPs	
Project Summary Information	
Project Name	WESTMONT LA MESA ASSISTED LIVING
Project Address	Murray Drive, La Mesa, CA
Assessor's Parcel Number(s) (APN(s))	490-390-17-00 and 490-390-23-00
Permit Application Number	
Project Hydrologic Unit	Select One: Santa Margarita 902 San Luis Rey 903 Carlsbad 904 San Dieguito 905 Penasquitos 906 ✓ San Diego 907 Pueblo San Diego 908 Sweetwater 909 Otay 910 Tijuana 911
Project Watershed (Complete Hydrologic Unit, Area, and Subarea Name with Numeric Identifier)	Hydrologic Unit: San Diego Hydrologic Sub-Area Name: Mission San Diego Hydrologic Sub-Area #: 907.11 Watershed: Lower San Diego Subwatershed: Murray Reservoir Hydrologic Unit Code: 180703040704
Parcel Area (total area of Assessor's Parcel(s) associated with the project)	3.33 Acres (145,055 Square Feet)
Area to be Disturbed by the Project (Project Area)	3.15 Acres (137,200 Square Feet)
Project Proposed Impervious Area (subset of Project Area)	2.13 Acres (92,900 Square Feet)
Project Proposed Pervious Area (subset of Project Area)	1.02 Acres (44,300 Square Feet)
Note: Proposed Impervious Area + Proposed Pervious Area = Area to be Disturbed by the Project. This may be less than the Parcel Area.	

Description of Existing Site Condition

Current Status of the Site (select all that apply):

- Existing development
- ✓ Previously graded but not built out
- Demolition completed without new construction
- Agricultural or other non-impervious use
- ✓ Vacant, undeveloped/natural

Description / Additional Information:
The existing site is a previously graded and currently a vacant lot.

Existing Land Cover Includes (select all that apply):

- ✓ Vegetative Cover
- Non-Vegetated Pervious Areas
- Impervious Areas

Description / Additional Information:
The existing site is graded bare soil with minimal vegetation.

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 (GW):

- GW Depth < 5 feet
- 5 feet < GW Depth < 10 feet
- 10 feet < GW Depth < 20 feet
- ✓ GW Depth > 20 feet

According to the Geotechnical Investigation Report, dated December 29, 2015, prepared for Westmont of La Mesa by Geocon Incorporated, "groundwater was not encountered during field investigation and is not anticipated to significantly impact project development".

Existing Natural Hydrologic Features (select all that apply):

✓Watercourses
✓Seeps
✓Springs
✓Wetlands
✓None

Description / Additional Information:

The project site is within the Mission San Diego Hydrologic Sub Area 907.11 which is within the Lower San Diego watershed.

Description of Existing Site Drainage Patterns

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) Is runoff from offsite conveyed through the site? if yes, quantify 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 any existing storm drains, concrete channels, swales, detention facilities, storm water treatment facilities, natural or constructed channels; and
(4) Identify all discharge locations from the existing project site along with a summary of 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.

Describe existing site drainage patterns:

Current drainage patterns have the site separated by a ridge line that runs east to west across the middle of the site. On the north half of the site, water sheet flows north until it is collected into an existing 2' grated drop inlet. This inlet is connected to the existing storm drain system that runs across the northeast corner of the site. The southern portion of the site drains to one of two low points located east and west of the entry from Murray Drive. The low point on the east side of the entry collects runoff and discharges it through a 24" pipe to a sidewalk underdrain where it then travels in the northern gutter of Murray Drive. A curb inlet intercepts the gutter flows and then discharges to the 24" storm drain that runs across Murray Drive. The low point on the west side of the entry collects flows via a 24" grated inlet and discharges them to the curb inlet along the northern gutter of Murray Drive. The water then continues to the existing 24" storm drain in Murray Drive.

Description of Proposed Site Development
Project Description / Proposed Land Use and/or Activities: The proposed project is an assisted living facility for senior citizens.
List/describe proposed impervious features of the project (e.g., buildings, roadways, parking lots, courtyards, athletic courts, other impervious features): The proposed impervious areas consist of a 44,766 square-foot building, a courtyard area, sidewalks and parking areas.
List/describe proposed pervious features of the project (e.g., landscape areas): The proposed pervious areas consist of trees, shrubs, lawn and groundcover. Landscaped areas will be provided around the perimeter of the site where required and feasible.

Does the project include grading and changes to site topography?

✓ Yes

No

Description / Additional Information:

The proposed grading does not significantly alter the existing site topography or overall drainage patterns. The site will have a ridgeline running east to west across the site. Runoff will now be diverted via overland flows and gutter flows to biofiltration basins before being discharged. The project will not discharge concentrated flows to Murray Road.

Description of Proposed Site Drainage Patterns

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 or 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.

Describe proposed site drainage patterns:

Storm water generated by the proposed development will surface flow to a storm drain conveyance network consisting of curb cuts, inlets and gutters. This network routes flows to five biofiltration basins where the water will be treated, detained, and then discharged into the existing storm drain network.

Identify whether any of the following features, activities, and/or pollutant source areas will be present (select all that apply):

- ✓ On-site 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:

Identification and Narrative of Receiving Water and Pollutants of Concern

Describe flow path of storm water from the project site discharge location(s), through urban storm conveyance systems as applicable, to receiving creeks, rivers, and lagoons as applicable, and ultimate discharge to the Pacific Ocean (or bay, lagoon, lake or reservoir, as applicable):

Storm water discharges the site in an existing storm drain conveyance network at two locations: one on the north side of the property and one on the south side of the property at Murray Drive. The north conveyance network consists of an existing 30 inch pipe flowing east to west. The south conveyance network consists of an existing 24 inch pipe flowing south to an existing point of connection in Murray Drive. Both conveyance systems drain toward the west and eventually discharge to the San Diego River which outlets at the Pacific Ocean.

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	Pollutant(s)/Stressor(s)	TMDLs / WQIP Highest Priority Pollutant
San Diego River	Enterococcus Fecal Coliform Low Dissolved Oxygen Manganese Nitrogen Phosphorus Total Dissolved Solids Toxicity	
Pacific Ocean	Enterococcus Total Coliform	

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 expected from the project site based on all proposed use(s) of the site (see BMP Design Manual Appendix B.6):

Pollutant	Not Applicable to the Project Site	Expected from the Project Site	Also a Receiving Water Pollutant of Concern
Sediment		X	
Nutrients		X	X
Heavy Metals		X	X
Organic Compounds		X	
Trash & Debris		X	

Oxygen Demanding Substances		X	
Oil & Grease		X	
Bacteria & Viruses		X	
Pesticides		X	

Hydromodification Management Requirements

Do hydromodification management requirements apply (see Section 1.6 of the BMP Design Manual)?

✓ 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):

Critical Coarse Sediment Yield Areas*

*This Section only required if hydromodification management requirements apply

Based on the maps provided within the WMAA, do potential critical coarse sediment yield areas exist within the project drainage boundaries?

☐ Yes

✓ No, No critical coarse sediment yield areas to be protected based on WMAA maps

If yes, have any of the optional analyses presented in Section 6.2 of the BMP Design Manual been performed?

☐ 6.2.1 Verification of Geomorphic Landscape Units (GLUs) Onsite

☐ 6.2.2 Downstream Systems Sensitivity to Coarse Sediment

☐ 6.2.3 Optional Additional Analysis of Potential Critical Coarse Sediment Yield Areas Onsite

✓ No optional analyses performed, the project will avoid critical coarse sediment yield areas identified based on WMAA maps

If optional analyses were performed, what is the final result?

☐ No critical coarse sediment yield areas to be protected based on verification of GLUs onsite

☐ Critical coarse sediment yield areas exist but additional analysis has determined that protection is not required. Documentation attached in Attachment 2.b of the WQTR.

☐ Critical coarse sediment yield areas exist and require protection. The project will implement management measures described in Sections 6.2.4 and 6.2.5 as applicable, and the areas are identified on the WQTR Exhibit.

Discussion / Additional Information:

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.

POC #1
POC #2

Has a geomorphic assessment been performed for the receiving channel(s)?

☐ No, the low flow threshold is 0.1Q2 (default low flow threshold)
☐ Yes, the result is the low flow threshold is 0.1Q2
☐ Yes, the result is the low flow threshold is 0.3Q2
✓ Yes, the result is the low flow threshold is 0.5Q2

If a geomorphic assessment has been performed, provide title, date, and preparer:

Westmost Assisted Living
April 4, 2016
Chang Consultants

Discussion / Additional Information: (optional)

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. The project consists of Type D soils, which has limited infiltration capabilities. Therefore, infiltration BMPs are not feasible. Biofiltration swales and detention basins will require underdrains as well as an impermeable liner.
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.

Source Control BMP Checklist for All Development Projects (Standard Projects and Priority Development Projects)	Form I-4

Source Control BMPs

All development projects must implement source control BMPs SC-1 through SC-6 where applicable and feasible. See Chapter 4 and Appendix E of the Model BMP Design Manual 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 Model 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?		
SC-1 Prevention of Illicit Discharges into the MS4	✓Yes	No	N/A
Discussion / justification if SC-1 not implemented:			
SC-2 Storm Drain Stenciling or Signage	✓Yes	No	N/A
Discussion / justification if SC-2 not implemented:			
SC-3 Protect Outdoor Materials Storage Areas from Rainfall, Run-On, Runoff, and Wind Dispersal	Yes	No	✓N/A
Discussion / justification if SC-3 not implemented: No outdoor material storage is anticipated.			
SC-4 Protect Materials Stored in Outdoor Work Areas from Rainfall, Run-On, Runoff, and Wind Dispersal	Yes	No	✓N/A
Discussion / justification if SC-4 not implemented: No outdoor material storage is anticipated.			

Form I-4 Page 2 of 2			
Source Control Requirement	Applied?		
SC-5 Protect Trash Storage Areas from Rainfall, Run-On, Runoff, and Wind Dispersal	✓Yes	No	N/A
Discussion / justification if SC-5 not implemented:			
SC-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 and Equipment Cleaning	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
Discussion / justification if SC-6 not implemented. Clearly identify which sources of runoff pollutants are discussed. Justification must be provided for all "No" answers shown above.			

Site Design BMP Checklist for All Development Projects (Standard Projects and Priority Development Projects)	Form I-5

Site Design BMPs

All development projects must implement site design BMPs SD-1 through SD-8 where applicable and feasible. See Chapter 4 and Appendix E of the Model BMP Design Manual 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 Model 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.

Site Design Requirement	Applied?		
SD-1 Maintain Natural Drainage Pathways and Hydrologic Features	✓Yes	No	N/A
Discussion / justification if SD-1 not implemented:			
SD-2 Conserve Natural Areas, Soils, and Vegetation	✓Yes	No	N/A
Discussion / justification if SD-2 not implemented:			
SD-3 Minimize Impervious Area	✓Yes	No	N/A
Discussion / justification if SD-3 not implemented:			
SD-4 Minimize Soil Compaction	Yes	No	✓N/A
Discussion / justification if SD-4 not implemented:			
SD-5 Impervious Area Dispersion	✓Yes	No	N/A
Discussion / justification if SD-5 not implemented:			

Form I-5 Page 2 of 2			
Site Design Requirement	Applied?		
SD-6 Runoff Collection	✓Yes	No	N/A
Discussion / justification if SD-6 not implemented:			
SD-7 Landscaping with Native or Drought Tolerant Species	✓Yes	No	N/A
Discussion / justification if SD-7 not implemented:			
SD-8 Harvesting and Using Precipitation	Yes	✓No	N/A
Discussion / justification if SD-8 not implemented: Harvest and use is not feasible. Refer to Form I-7 in Attachment 1.			

Summary of PDP Structural BMPs	Form I-6 (PDPs)

Project Identification
Project Name WESTMONT LA MESA ASSISTED LIVING
Permit Application Number

PDP Structural BMPs
All PDPs must implement structural BMPs for storm water pollutant control (see Chapter 5 of the BMP Design Manual). 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 local jurisdiction at the completion of construction. This may include requiring the project owner or project owner's representative and engineer of record to certify construction of the structural BMPs (see Section 1.12 of the BMP Design Manual). PDP structural BMPs must be maintained into perpetuity, and the local jurisdiction must confirm the maintenance (see Section 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. To treat storm water runoff and mitigate pollutants, biofiltration was selected as the BMP. Harvesting and reuse was deemed infeasible due to the limited demand for reuse. Infiltration is an unacceptable form of treatment due to the sites poor infiltration rates caused by Type D soil. Biofiltration will be used to in combination with flow control measures. Each basin was sized in accordance with the City of La Mesa sizing tables. The low flow threshold was determined to be 0.5 of the two year flow (Q2).

Form I-6 Page 3 of 12	
Structural BMP Summary Information (Copy this page as needed to provide information for each individual proposed structural BMP)	
Structural BMP ID No. A	
Construction Plan Sheet No. TBD	
Type of structural BMP: ✓Biofiltration (BF-1) ✓Biofiltration with Nutrient Sensitive Media Design (BF-2)	
Purpose: ✓Combined pollutant control and hydromodification control	
Who will certify construction of this BMP? Provide name and contact information for the party responsible to sign BMP verification forms (See Section 1.12 of the BMP Design Manual)	Justin Becker, P.E. 401 B Street, Suite 600, San Diego CA 92101 (619) 234-9411
Who will be the final owner of this BMP?	Westmont Development LP
Who will maintain this BMP into perpetuity?	Westmont Development LP
What is the funding mechanism for maintenance?	Westmont Development LP

Form I-6 Page 4 of 12	
Structural BMP Summary Information (Copy this page as needed to provide information for each individual proposed structural BMP)	
Structural BMP ID No. B	
Construction Plan Sheet No. TBD	
Type of structural BMP: ✓Biofiltration (BF-1) ✓Biofiltration with Nutrient Sensitive Media Design (BF-2)	
Purpose: ✓Combined pollutant control and hydromodification control	
Who will certify construction of this BMP? Provide name and contact information for the party responsible to sign BMP verification forms (See Section 1.12 of the BMP Design Manual)	Justin Becker, P.E. 401 B Street, Suite 600, San Diego CA 92101 (619) 234-9411
Who will be the final owner of this BMP?	Westmont Development LP
Who will maintain this BMP into perpetuity?	Westmont Development LP
What is the funding mechanism for maintenance?	Westmont Development LP

Form I-6 Page 5 of 12	
Structural BMP Summary Information (Copy this page as needed to provide information for each individual proposed structural BMP)	
Structural BMP ID No. C	
Construction Plan Sheet No. TBD	
Type of structural BMP: ✓Biofiltration (BF-1) ✓Biofiltration with Nutrient Sensitive Media Design (BF-2)	
Purpose: ✓Combined pollutant control and hydromodification control	
Who will certify construction of this BMP? Provide name and contact information for the party responsible to sign BMP verification forms (See Section 1.12 of the BMP Design Manual)	Justin Becker, P.E. 401 B Street, Suite 600, San Diego CA 92101 (619) 234-9411
Who will be the final owner of this BMP?	Westmont Development LP
Who will maintain this BMP into perpetuity?	Westmont Development LP
What is the funding mechanism for maintenance?	Westmont Development LP

Form I-6 Page 6 of 12	
Structural BMP Summary Information (Copy this page as needed to provide information for each individual proposed structural BMP)	
Structural BMP ID No. E	
Construction Plan Sheet No. TBD	
Type of structural BMP: ✓Biofiltration (BF-1) ✓Biofiltration with Nutrient Sensitive Media Design (BF-2)	
Purpose: ✓Combined pollutant control and hydromodification control	
Who will certify construction of this BMP? Provide name and contact information for the party responsible to sign BMP verification forms (See Section 1.12 of the BMP Design Manual)	Justin Becker, P.E. 401 B Street, Suite 600, San Diego CA 92101 (619) 234-9411
Who will be the final owner of this BMP?	Westmont Development LP
Who will maintain this BMP into perpetuity?	Westmont Development LP
What is the funding mechanism for maintenance?	Westmont Development LP

Form I-6 Page 7 of 12	
Structural BMP Summary Information (Copy this page as needed to provide information for each individual proposed structural BMP)	
Structural BMP ID No. H	
Construction Plan Sheet No. TBD	
Type of structural BMP: ✓Biofiltration (BF-1) ✓Biofiltration with Nutrient Sensitive Media Design (BF-2)	
Purpose: ✓Combined pollutant control and hydromodification control	
Who will certify construction of this BMP? Provide name and contact information for the party responsible to sign BMP verification forms (See Section 1.12 of the BMP Design Manual)	Justin Becker, P.E. 401 B Street, Suite 600, San Diego CA 92101 (619) 234-9411
Who will be the final owner of this BMP?	Westmont Development LP
Who will maintain this BMP into perpetuity?	Westmont Development LP
What is the funding mechanism for maintenance?	Westmont Development LP

Form I-6 Page 8 of 12
Structural BMP ID No. A
Construction Plan Sheet No. TBD
Discussion (as needed):

Form I-6 Page 9 of 12
Structural BMP ID No. B
Construction Plan Sheet No. TBD
Discussion (as needed):

Form I-6 Page 10 of 12
Structural BMP ID No. C
Construction Plan Sheet No. TBD
Discussion (as needed):

Form I-6 Page 11 of 12
Structural BMP ID No. E
Construction Plan Sheet No. TBD
Discussion (as needed):

Form I-6 Page 12 of 12
Structural BMP ID No. H
Construction Plan Sheet No. TBD
Discussion (as needed):

PDP Structural BMP Verification For DPW Permitted Land Development Projects	Form I-12 (PDPs)
Project Summary Information	
Project Name	Westmont La Mesa Assisted Living
Permit Application Number (e.g., L-grading)	TBD
Project Address	Murray Drive La Mesa, Ca
Assessor's Parcel Number(s) (APN(s))	490-390-17-00 and 490-390-23-00
Project Watershed (Complete Hydrologic Unit, Area, and Subarea Name with Numeric Identifier)	Hydrologic Unit: San Diego Hydrologic Sub-Area Name: Mission San Diego Hydrologic Sub-Area #: 907.11 Watershed: Lower San Diego Subwatershed: Murray Reservoir Hydrologic Unit Code: 180703040704
Maintenance Notification / Agreement No.	TBD
Responsible Party for Construction Phase	
Developer's Name	Westmont Development LP
Address	7660 Fay Avenue, Suite N La Jolla. CA 92037
Email Address	
Phone Number	
Engineer of Work	Justin Becker, P.E.
Engineer's Phone Number	(619) 234-9411
Responsible Party for Ongoing Maintenance	
Owner's Name(s)*	Westmont Development LP
Address	7660 Fay Avenue, Suite N La Jolla. CA 92037
Email Address	
Phone Number	
*Note: If a corporation or LLC, provide information for principal partner or Agent for Service of Process. If an HOA, provide information for the Board or property manager at time of project closeout.	

Form I-12 Page 2 of 4			
Structural BMPs (S-BMPs)* (List all from WQTR)			
S-BMP ID No.	Lot Number or Location	Description / Type	Construction Plan Sheet No.
A	SE Corner	Biofiltration with flow control	TBD
B	SW Corner	Biofiltration with flow control	TBD
C	NW Corner	Biofiltration with flow control	TBD
E	West PL	Biofiltration with flow control	TBD
H	SE Corner	Biofiltration with flow control	TBD
*All Priority Development Projects (PDPs) require a S-BMP			

Checklist for Applicant to submit to PDCI:

- ☐ Copy of the final accepted WQTR and any accepted addendum.
- ☐ Copy of the most current plan showing the Stormwater Structural BMP Table, plans/cross-section sheets of the Structural BMPs and the location of each verified as-built Structural BMP.
- ☐ Photograph of each Structural BMP.
- ☐ Photograph(s) of each Structural BMP during the construction process to illustrate proper construction.
- ☐ Copy of the approved Structural BMP maintenance agreement and associated security

By signing below, I certify that the Structural BMP(s) for this project have been constructed and all BMPs are in substantial conformance with the approved plans and applicable regulations. I understand the City reserves the right to inspect the above BMPs to verify compliance with the approved plans and Watershed Protection Ordinance (WPO). Should it be determined that the BMPs were not constructed to plan or code, corrective actions may be necessary before permits can be closed.

Please sign your name and seal.

Professional Engineer's Printed Name:

_____

Professional Engineer's Signed Name:

_____

Date: _____

[SEAL]

OFFICIAL USE ONLY:

For PDCI:

PDCI Inspector: _____

Date Project has/expects to close: _____

Date verification received from EOW: _____

By signing below, PDCI Inspector concurs that every noted Structural BMP has been installed per plan.

PDCI Inspector's Signature: _____ Date: _____

FOR WPP:

Date Received from PDCI: _____

WPP Submittal Reviewer:_____

WPP Reviewer concurs that the information provided for the following Structural BMPs is acceptable to enter into the Structural BMP Maintenance verification inventory:

List acceptable Structural BMPs:

WPP Reviewer's Signature: _____ Date: _____

ATTACHMENT 1
BACKUP FOR PDP POLLUTANT CONTROL BMPS

This is the cover sheet for Attachment 1.

Indicate which Items are Included behind this cover sheet:

Attachment Sequence	Contents	Checklist
Attachment 1a	DMA Exhibit (Required) See DMA Exhibit Checklist on the back of this Attachment cover sheet.	✓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
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
Attachment 1d	Form I-8, Categorization of Infiltration Feasibility Condition (Required unless the project will use harvest and use BMPs) Refer to Appendices C and D of the BMP Design Manual to complete Form I-8.	✓Included
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	✓Included

LEGEND

- DMA ID
- DMA ACREAGE
- PROPOSED BIOFILTRATION AREA
- DMA BOUNDARY
- OVERLAND FLOW DIRECTION
- PROPOSED STORM DRAIN
- HYDROMODIFICATION POINT OF COMPLIANCE

SUMMARY TABLE

DMA	Min Treatment Footprint	Min HMP Footprint	Min HMP Surface Volume	Min HMP Subsurface Volume	Proposed Footprint Area	Proposed Surface Storage	Proposed Subsurface Storage
A	436	1125	937	675	1125	938	1013
B	438	1131	942	678	1131	943	1018
C	872	2253	1876	1352	2253	1878	2028
E	679	1749	1456	1049	1749	1458	1574
H	217	557	463	334	1244	829	1120

NORTH

GRAPHIC SCALE IN FEET
0 15 30 60

No.	REVISIONS	DATE	BY

Kimley»Horn
401 B STREET, SUITE 600, SAN DIEGO, CA 92101
PHONE: 619-234-9411
WWW.KIMLEY-HORN.COM

KHA PROJECT 195023000
DATE APRIL 2016
SCALE AS SHOWN
DESIGNED BY JSB
DRAWN BY BMA
CHECKED BY JSB

WESTMONT ASSISTED LIVING

PROPOSED WQTR DMA AND HMP EXHIBIT

MURRAY DRIVE
LA MESA, CA

SHEET NUMBER
1 OF 1

Plotted By:Nord, Bryan Sheet Set:Kha Layout:Layout1 April 21, 2016 02:31:56pm K:\SND_LDEV\195023000 - Westmont La Mesa Assisted Living\Storm Water\Exhibits\Proposed SWMP Exhibit.dwg
This document, together with the concepts and designs presented herein, as an instrument of service, is intended only for the specific purpose and client for which it was prepared. Reuse of and improper reliance on this document without written authorization and adaptation by Kimley-Horn and Associates, Inc. shall be without liability to Kimley-Horn and Associates, Inc.

Harvest and Use Feasibility Checklist	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.

Modified ETWU = $ETo_{Wet} \times [[\Sigma(PF \times HA)/IE] + SLA] \times 0.015$

2.7*[[44,300*(0.2)/(0.9)]+0.0]*0.015= 399 (cubic feet)

3. Calculate the DCV using worksheet B-2.1.

DCV = 3433 (cubic feet)

3a. Is the 36 hour demand greater than or equal to the DCV?	3b. Is the 36 hour demand greater than 0.25DCV but less than the full DCV?	3c. Is the 36 hour demand less than 0.25DCV?
☐ Yes / ☒ No ⇨ ⇩	☐ Yes / ☒ No ⇨ ⇩	☒ 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.

Categorization of Infiltration Feasibility Condition			Form I-8
Part 1 - Full Infiltration Feasibility Screening Criteria Would infiltration of the full design volume be feasible from a physical perspective without any undesirable consequences that cannot be reasonably mitigated?			
Criteria	Screening Question	Yes	No
1	Is the estimated reliable infiltration rate below proposed facility locations greater than 0.5 inches per hour? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2 and Appendix D.	☐	☒
Provide basis: See Geotechnical report Westmont of La Mesa dated 12-29-2015. Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
2	Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of geotechnical hazards (slope stability, groundwater mounding, utilities, or other factors) that cannot be mitigated to an acceptable level? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2.	☐	☒
Provide basis: See Geotechnical report Westmont of La Mesa dated 12-29-2015. Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			

Form I-8 Page 2 of 4			
Criteria	Screening Question	Yes	No
3	Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of groundwater contamination (shallow water table, storm water pollutants or other factors) that cannot be mitigated to an acceptable level? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.	☐	☒
Provide basis: See Geotechnical report Westmont of La Mesa dated 12-29-2015. Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
4	Can infiltration greater than 0.5 inches per hour be allowed without causing potential water balance issues such as change of seasonality of ephemeral streams or increased discharge of contaminated groundwater to surface waters? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.	☐	☒
Provide basis: See Geotechnical report Westmont of La Mesa dated 12-29-2015. Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
Part 1 Result *	If all answers to rows 1 - 4 are "Yes" a full infiltration design is potentially feasible. The feasibility screening category is Full Infiltration If any answer from row 1-4 is "No", infiltration may be possible to some extent but would not generally be feasible or desirable to achieve a "full infiltration" design. Proceed to Part 2		☐Full Infiltration ☒No

*To be completed using gathered site information and best professional judgment considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by Agency/Jurisdictions to substantiate findings

Part 2 – Partial Infiltration vs. No Infiltration Feasibility Screening Criteria

Would infiltration of water in any appreciable amount be physically feasible without any negative consequences that cannot be reasonably mitigated?

Criteria	Screening Question	Yes	No
5	Do soil and geologic conditions allow for infiltration in any appreciable rate or volume? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2 and Appendix D.	☐	☒

Provide basis: See Geotechnical report Westmont of La Mesa dated 12-29-2015.

Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.

6	Can Infiltration in any appreciable quantity be allowed without increasing risk of geotechnical hazards (slope stability, groundwater mounding, utilities, or other factors) that cannot be mitigated to an acceptable level? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2.	☐	☒

Provide basis: See Geotechnical report Westmont of La Mesa dated 12-29-2015.

Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.

Form I-8 Page 4 of 4			
Criteria	Screening Question	Yes	No
7	Can Infiltration in any appreciable quantity be allowed without posing significant risk for groundwater related concerns (shallow water table, storm water pollutants or other factors)? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.	☐	☒
Provide basis: See Geotechnical report Westmont of La Mesa dated 12-29-2015. Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.			
8	Can infiltration be allowed without violating downstream water rights? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.	☐	☒
Provide basis: See Geotechnical report Westmont of La Mesa dated 12-29-2015. Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.			
Part 2 Result*	If all answers from row 1-4 are yes then partial infiltration design is potentially feasible. The feasibility screening category is Partial Infiltration. If any answer from row 5-8 is no, then infiltration of any volume is considered to be infeasible within the drainage area. The feasibility screening category is No Infiltration.	☐Partial Infiltration ☒No Infiltration	

*To be completed using gathered site information and best professional judgment considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by Agency/Jurisdictions to substantiate findings

Project:	Westmont La Mesa
Date:	April 18, 2016
BMP:	A

Design Capture Volume				Worksheet B-2.1
1	85th percentile 24-hr storm depth from Figure B.1-1	d=	0.54	inches
2	Area tributary to BMP	A=	0.49	acres
3	Area weighted runoff factor (estimate using Appenfix B.1.1 and B.2.1)	C=	0.68	unitless
4	Street trees volume reduction	TCV=	0	cubic-feet
5	Rain barrels volume reduction	RCV=	0	cubic-feet
6	Calculate DCV (3630xCxDxA) - TCV - RCV	DCV=	653	cubic-feet

Name of Area Draining to BMP:	DMA-A
Name of BMP Area:	IMP-A

Simple Sizing Method for Biofiltration BMPs			Worksheet B.5-1
1	Remaining DCV after implementing retention BMPs	653	cubic-feet
Patrial Retention			
2	Infiltration rate from Worksheet D.5-1 if partial infiltration is feasible	0.0	in/hr
3	Allowable drawdown time for aggregate storage below the underdrain	0	hours
4	Depth of runoff that can be infiltrated [Line 2 x Line 3]	0	inches
5	Aggregate pore space	0.40	in/in
6	Required depth of gravel below the underdrain [Line 4/Line 5]	0	inches
7	Assumed surface area of the biofiltraiton BMP	1,125	sq-ft
8	Media retained pore space	0.0	in/in
9	Volume retained by BMP [[Line 4 + (Line 12x Line 8)]/12] x Line 7	0	cubic-feet
10	DCV that requires biofiltration [Line 1 - Line 9]	653	cubic-feet
BMP Parameters			
11	Surface Ponding [6 inch minimum, 12 inch maximum]	10	inches
12	Media Thickness [18 inch minimum]	18	inches
13	Aggregate Storage above underdrain invert (12 inches typical) - use 0 inches for sizing if the aggregate is not over the entire bottom surface area	18	inches
14	Media available pore space	0.2	in/in
15	Media filtration rate to be used for sizing	5	in/hr
Baseline Calculations			
16	Allowable Routing Time for sizing	6	hours
17	Depth filtered during storm [Line 15 x Line 16]	30	inches
18	Depth of Detention Storage [Line 11+ (Line 12 x Line 14) + (Line 13 x Line 5)]	20.8	inches
19	Total Depth Treated [Line 17 + Line 18]	50.8	inches
Option 1 - Biofilter 1.5 times the DCV			
20	Required biofiltered volume [1.5 x Line 10]	980	cubic-feet
21	Required Footprint [Line 20/Line 19] x 12	232	sq-ft
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
22	Required Storage (surface + pore) Volume [0.75 x Line 10]	490	cubic-feet
23	Required Footprint [Line 22/Line 18] x 12	283	sq-ft
Option 3 - Minimum BMP Footprint			
24	Area draining to the BMP	21,200	sq-ft
25	Adjusted Runoff Factor for drainage area (Refer to Appendix B.1 and B.2)	0.68	
26	Minimum BMP Footprint [Line 24 x Line 25 x 0.03]	436	sq-ft
Required Footprint of the BMP			
27	Footprint of the BMP = Maximum(Minimum(Line 21, Line 23), Line 26)	436	sq-ft
Proposed Footprint of the BMP			
28	Proposed Footprint of the BMP	1,125	sq-ft
	Meeting Criteria?	Yes	

Project:	Westmont La Mesa
Date:	April 18, 2016
BMP:	B

Design Capture Volume				Worksheet B-2.1
1	85th percentile 24-hr storm depth from Figure B.1-1	d=	0.54	inches
2	Area tributary to BMP	A=	0.51	acres
3	Area weighted runoff factor (estimate using Appenfix B.1.1 and B.2.1)	C=	0.66	unitless
4	Street trees volume reduction	TCV=	0	cubic-feet
5	Rain barrels volume reduction	RCV=	0	cubic-feet
6	Calculate DCV (3630xCxDxA) - TCV - RCV	DCV=	657	cubic-feet

Name of Area Draining to BMP:	DMA-B
Name of BMP Area:	IMP-B

Simple Sizing Method for Biofiltration BMPs		Worksheet B.5-1	
1	Remaining DCV after implementing retention BMPs	657	cubic-feet
Patrial Retention			
2	Infiltration rate from Worksheet D.5-1 if partial infiltration is feasible	0.0	in/hr
3	Allowable drawdown time for aggregate storage below the underdrain	0	hours
4	Depth of runoff that can be infiltrated [Line 2 x Line 3]	0	inches
5	Aggregate pore space	0.40	in/in
6	Required depth of gravel below the underdrain [Line 4/Line 5]	0	inches
7	Assumed surface area of the biofiltraiton BMP	1,131	sq-ft
8	Media retained pore space	0.0	in/in
9	Volume retained by BMP [[Line 4 + (Line 12x Line 8)]/12] x Line 7	0	cubic-feet
10	DCV that requires biofiltration [Line 1 - Line 9]	657	cubic-feet
BMP Parameters			
11	Surface Ponding [6 inch minimum, 12 inch maximum]	10	inches
12	Media Thickness [18 inch minimum]	18	inches
13	Aggregate Storage above underdrain invert (12 inches typical) - use 0 inches for sizing if the aggregate is not over the entire bottom surface area	18	inches
14	Media available pore space	0.2	in/in
15	Media filtration rate to be used for sizing	5	in/hr
Baseline Calculations			
16	Allowable Routing Time for sizing	6	hours
17	Depth filtered during storm [Line 15 x Line 16]	30	inches
18	Depth of Detention Storage [Line 11+ (Line 12 x Line 14) + (Line 13 x Line 5)]	20.8	inches
19	Total Depth Treated [Line 17 + Line 18]	50.8	inches
Option 1 - Biofilter 1.5 times the DCV			
20	Required biofiltered volume [1.5 x Line 10]	986	cubic-feet
21	Required Footprint [Line 20/Line 19] x 12	233	sq-ft
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
22	Required Storage (surface + pore) Volume [0.75 x Line 10]	493	cubic-feet
23	Required Footprint [Line 22/Line 18] x 12	284	sq-ft
Option 3 - Minimum BMP Footprint			
24	Area draining to the BMP	22,000	sq-ft
25	Adjusted Runoff Factor for drainage area (Refer to Appendix B.1 and B.2)	0.66	
26	Minimum BMP Footprint [Line 24 x Line 25 x 0.03]	438	sq-ft
Required Footprint of the BMP			
27	Footprint of the BMP = Maximum(Minimum(Line 21, Line 23), Line 26)	438	sq-ft
Proposed Footprint of the BMP			
28	Proposed Footprint of the BMP	1,131	sq-ft
	Meeting Criteria?	Yes	

Project:	Westmont La Mesa
Date:	April 18, 2016
BMP:	C

Design Capture Volume				Worksheet B-2.1
1	85th percentile 24-hr storm depth from Figure B.1-1	d=	0.54	inches
2	Area tributary to BMP	A=	0.94	acres
3	Area weighted runoff factor (estimate using Appenfix B.1.1 and B.2.1)	C=	0.71	unitless
4	Street trees volume reduction	TCV=	0	cubic-feet
5	Rain barrels volume reduction	RCV=	0	cubic-feet
6	Calculate DCV (3630xCxDxA) - TCV - RCV	DCV=	1,308	cubic-feet

Name of Area Draining to BMP:	DMA-C
Name of BMP Area:	IMP-C

Simple Sizing Method for Biofiltration BMPs		Worksheet B.5-1	
1	Remaining DCV after implementing retention BMPs	1,308	cubic-feet
Patrial Retention			
2	Infiltration rate from Worksheet D.5-1 if partial infiltration is feasible	0.0	in/hr
3	Allowable drawdown time for aggregate storage below the underdrain	0	hours
4	Depth of runoff that can be infiltrated [Line 2 x Line 3]	0	inches
5	Aggregate pore space	0.40	in/in
6	Required depth of gravel below the underdrain [Line 4/Line 5]	0	inches
7	Assumed surface area of the biofiltraiton BMP	2,253	sq-ft
8	Media retained pore space	0.0	in/in
9	Volume retained by BMP [[Line 4 + (Line 12x Line 8)]/12] x Line 7	0	cubic-feet
10	DCV that requires biofiltration [Line 1 - Line 9]	1,308	cubic-feet
BMP Parameters			
11	Surface Ponding [6 inch minimum, 12 inch maximum]	10	inches
12	Media Thickness [18 inch minimum]	18	inches
13	Aggregate Storage above underdrain invert (12 inches typical) - use 0 inches for sizing if the aggregate is not over the entire bottom surface area	18	inches
14	Media available pore space	0.2	in/in
15	Media filtration rate to be used for sizing	5	in/hr
Baseline Calculations			
16	Allowable Routing Time for sizing	6	hours
17	Depth filtered during storm [Line 15 x Line 16]	30	inches
18	Depth of Detention Storage [Line 11+ (Line 12 x Line 14) + (Line 13 x Line 5)]	20.8	inches
19	Total Depth Treated [Line 17 + Line 18]	50.8	inches
Option 1 - Biofilter 1.5 times the DCV			
20	Required biofiltered volume [1.5 x Line 10]	1,962	cubic-feet
21	Required Footprint [Line 20/Line 19] x 12	463	sq-ft
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
22	Required Storage (surface + pore) Volume [0.75 x Line 10]	981	cubic-feet
23	Required Footprint [Line 22/Line 18] x 12	566	sq-ft
Option 3 - Minimum BMP Footprint			
24	Area draining to the BMP	41,000	sq-ft
25	Adjusted Runoff Factor for drainage area (Refer to Appendix B.1 and B.2)	0.71	
26	Minimum BMP Footprint [Line 24 x Line 25 x 0.03]	872	sq-ft
Required Footprint of the BMP			
27	Footprint of the BMP = Maximum(Minimum(Line 21, Line 23), Line 26)	872	sq-ft
Proposed Footprint of the BMP			
28	Proposed Footprint of the BMP	2,253	sq-ft
	Meeting Criteria?	Yes	

Project:	Westmont La Mesa
Date:	April 18, 2016
BMP:	E

Design Capture Volume				Worksheet B-2.1
1	85th percentile 24-hr storm depth from Figure B.1-1	d=	0.54	inches
2	Area tributary to BMP	A=	0.88	acres
3	Area weighted runoff factor (estimate using Appenfix B.1.1 and B.2.1)	C=	0.59	unitless
4	Street trees volume reduction	TCV=	0	cubic-feet
5	Rain barrels volume reduction	RCV=	0	cubic-feet
6	Calculate DCV (3630xCxDxA) - TCV - RCV	DCV=	1,018	cubic-feet

Name of Area Draining to BMP:	DMA-E
Name of BMP Area:	IMP-E

Simple Sizing Method for Biofiltration BMPs		Worksheet B.5-1	
1	Remaining DCV after implementing retention BMPs	1,018	cubic-feet
Patrial Retention			
2	Infiltration rate from Worksheet D.5-1 if partial infiltration is feasible	0.0	in/hr
3	Allowable drawdown time for aggregate storage below the underdrain	0	hours
4	Depth of runoff that can be infiltrated [Line 2 x Line 3]	0	inches
5	Aggregate pore space	0.40	in/in
6	Required depth of gravel below the underdrain [Line 4/Line 5]	0	inches
7	Assumed surface area of the biofiltraiton BMP	1,749	sq-ft
8	Media retained pore space	0.0	in/in
9	Volume retained by BMP [[Line 4 + (Line 12x Line 8)]/12] x Line 7	0	cubic-feet
10	DCV that requires biofiltration [Line 1 - Line 9]	1,018	cubic-feet
BMP Parameters			
11	Surface Ponding [6 inch minimum, 12 inch maximum]	10	inches
12	Media Thickness [18 inch minimum]	18	inches
13	Aggregate Storage above underdrain invert (12 inches typical) - use 0 inches for sizing if the aggregate is not over the entire bottom surface area	18	inches
14	Media available pore space	0.2	in/in
15	Media filtration rate to be used for sizing	5	in/hr
Baseline Calculations			
16	Allowable Routing Time for sizing	6	hours
17	Depth filtered during storm [Line 15 x Line 16]	30	inches
18	Depth of Detention Storage [Line 11+ (Line 12 x Line 14) + (Line 13 x Line 5)]	20.8	inches
19	Total Depth Treated [Line 17 + Line 18]	50.8	inches
Option 1 - Biofilter 1.5 times the DCV			
20	Required biofiltered volume [1.5 x Line 10]	1,528	cubic-feet
21	Required Footprint [Line 20/Line 19] x 12	361	sq-ft
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
22	Required Storage (surface + pore) Volume [0.75 x Line 10]	764	cubic-feet
23	Required Footprint [Line 22/Line 18] x 12	441	sq-ft
Option 3 - Minimum BMP Footprint			
24	Area draining to the BMP	38,300	sq-ft
25	Adjusted Runoff Factor for drainage area (Refer to Appendix B.1 and B.2)	0.59	
26	Minimum BMP Footprint [Line 24 x Line 25 x 0.03]	679	sq-ft
Required Footprint of the BMP			
27	Footprint of the BMP = Maximum(Minimum(Line 21, Line 23), Line 26)	679	sq-ft
Proposed Footprint of the BMP			
28	Proposed Footprint of the BMP	1,749	sq-ft
	Meeting Criteria?	Yes	

Project:	Westmont La Mesa
Date:	April 18, 2016
BMP:	H

Design Capture Volume				Worksheet B-2.1
1	85th percentile 24-hr storm depth from Figure B.1-1	d=	0.54	inches
2	Area tributary to BMP	A=	0.34	acres
3	Area weighted runoff factor (estimate using Appenfix B.1.1 and B.2.1)	C=	0.49	unitless
4	Street trees volume reduction	TCV=	0	cubic-feet
5	Rain barrels volume reduction	RCV=	0	cubic-feet
6	Calculate DCV (3630xCxDxA) - TCV - RCV	DCV=	325	cubic-feet

Name of Area Draining to BMP:	DMA-H
Name of BMP Area:	IMP-H

Simple Sizing Method for Biofiltration BMPs		Worksheet B.5-1	
1	Remaining DCV after implementing retention BMPs	325	cubic-feet
Patrial Retention			
2	Infiltration rate from Worksheet D.5-1 if partial infiltration is feasible	0.0	in/hr
3	Allowable drawdown time for aggregate storage below the underdrain	0	hours
4	Depth of runoff that can be infiltrated [Line 2 x Line 3]	0	inches
5	Aggregate pore space	0.40	in/in
6	Required depth of gravel below the underdrain [Line 4/Line 5]	0	inches
7	Assumed surface area of the biofiltraiton BMP	1,244	sq-ft
8	Media retained pore space	0.0	in/in
9	Volume retained by BMP [[Line 4 + (Line 12x Line 8)]/12] x Line 7	0	cubic-feet
10	DCV that requires biofiltration [Line 1 - Line 9]	325	cubic-feet
BMP Parameters			
11	Surface Ponding [6 inch minimum, 12 inch maximum]	8	inches
12	Media Thickness [18 inch minimum]	18	inches
13	Aggregate Storage above underdrain invert (12 inches typical) - use 0 inches for sizing if the aggregate is not over the entire bottom surface area	18	inches
14	Media available pore space	0.2	in/in
15	Media filtration rate to be used for sizing	5	in/hr
Baseline Calculations			
16	Allowable Routing Time for sizing	6	hours
17	Depth filtered during storm [Line 15 x Line 16]	30	inches
18	Depth of Detention Storage [Line 11+ (Line 12 x Line 14) + (Line 13 x Line 5)]	18.8	inches
19	Total Depth Treated [Line 17 + Line 18]	48.8	inches
Option 1 - Biofilter 1.5 times the DCV			
20	Required biofiltered volume [1.5 x Line 10]	488	cubic-feet
21	Required Footprint [Line 20/Line 19] x 12	120	sq-ft
Option 2 - Store 0.75 of remaining DCV in pores and ponding			
22	Required Storage (surface + pore) Volume [0.75 x Line 10]	244	cubic-feet
23	Required Footprint [Line 22/Line 18] x 12	156	sq-ft
Option 3 - Minimum BMP Footprint			
24	Area draining to the BMP	14,700	sq-ft
25	Adjusted Runoff Factor for drainage area (Refer to Appendix B.1 and B.2)	0.49	
26	Minimum BMP Footprint [Line 24 x Line 25 x 0.03]	217	sq-ft
Required Footprint of the BMP			
27	Footprint of the BMP = Maximum(Minimum(Line 21, Line 23), Line 26)	217	sq-ft
Proposed Footprint of the BMP			
28	Proposed Footprint of the BMP	1,244	sq-ft
	Meeting Criteria?	Yes	

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.

Indicate which Items are Included behind this cover sheet:

Attachment Sequence	Contents	Checklist
Attachment 2a	Hydromodification Management Exhibit (Required)	✓Included (See DMA Exhibit)
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.	✓Included
Attachment 2d	Flow Control Facility Design, including Structural BMP Drawdown Calculations and Overflow Design Summary (Required) See Chapter 6 and Appendix G of the BMP Design Manual	✓Included
Attachment 2e	Vector Control Plan (Required when structural BMPs will not drain in 96 hours)	✓Not required because BMPs will drain in less than 96 hours

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wayne@changconsultants.com

April 4, 2016

Justin Becker, P.E.
Kimley-Horn
401 B Street, Suite 600
San Diego CA 92101

Subject: Westmont Assisted Living

Dear Justin:

I have performed an initial site visit and channel screening assessment for the Westmont Assisted Living project. The channel screening assessment is prepared where the receiving watercourse is initially a natural system with potential for erosion. The project runoff is conveyed in hardened, non-erodible drainage facilities westerly to the Alvarado Creek channel. The drainage facilities outlet into the channel just west of Fletcher Parkway. The channel has a natural bed and banks at the outlet, so the assessment begins at this location. According to the assessment criteria, the assessment must extend a short distance below the Alvarado Road crossing of Alvarado Creek. This study reach contains large cobbles, grade control features, and does not exhibit signs of significant erosion. Based on my initial work, I will prepare a channel screening assessment report for submittal to the city of La Mesa. The report will define the specific study reach, and then provide the necessary data in support of a low susceptibility to erosion (i.e., $0.5Q_2$) for the project.

Sincerely,

Wayne W. Chang, M.S., P.E.

Worksheet G.2-1: Sizing Factor Worksheet

Site Information			
Project Name:	Westmont La Mesa	Hydrologic Unit:	San Diego
Project Applicant:	Westmont Development	Rain Gauge:	Oceanside
Jurisdiction:	City of La Mesa	Total Project Area:	3.15 AC
APN Number:	490-390-17,20	Low Flow Threshold:	0.5Q2
BMP Name:	A	BMP Type:	Biofiltration W/Liner

Areas Draining to BMP						Sizing Factors			Minimum BMP Size		
DMA Name	Area (SF)	Soil Type	Pre-Project Slope	Post Project Surface type	Runoff Factor (From G2-1	Surface Area	Surface Volume	Subsurface Volume	Surface Area (SF)	Surface Volume (CF)	Subsurface Volume
A-1	15500	D	Flat	Impervious	1.0	0.070	0.0583	0.0420	1085	904	651
A-2	5700	D	Flat	Pervious	0.1	0.070	0.0583	0.0420	40	33	24
DMA Area	21200							Minimum BMP Size*	1125	937	675
								Proposed BMP Size	1,125	938	1012.5

*Minimum BMP Size = Total Rows Above

*Proposed BMP Size ≥ Minimum BMP size

Worksheet G.2-1: Sizing Factor Worksheet

Site Information			
Project Name:	Westmont La Mesa	Hydrologic Unit:	San Diego
Project Applicant:	Westmont Development	Rain Gauge:	Oceanside
Jurisdiction:	City of La Mesa	Total Project Area:	3.15 AC
APN Number:	490-390-17,20	Low Flow Threshold:	0.5Q2
BMP Name:	B	BMP Type:	Biofiltration W/Liner

Areas Draining to BMP						Sizing Factors			Minimum BMP Size		
DMA Name	Area (SF)	Soil Type	Pre-Project Slope	Post Project Surface type	Runoff Factor (From G2-1)	Surface Area	Surface Volume	Subsurface Volume	Surface Area (SF)	Surface Volume (CF)	Subsurface Volume
B-1	15500	D	Flat	Impervious	1.0	0.070	0.0583	0.0420	1085	904	651
B-2	6500	D	Flat	Pervious	0.1	0.070	0.0583	0.0420	46	38	27
DMA Area	22000							Minimum BMP Size*	1131	942	678
								Proposed BMP Size	1,131	943	1017.9

*Minimum BMP Size = Total Rows Above

*Proposed BMP Size ≥ Minimum BMP size

Worksheet G.2-1: Sizing Factor Worksheet

Site Information			
Project Name:	Westmont La Mesa	Hydrologic Unit:	San Diego
Project Applicant:	Westmont Development	Rain Gauge:	Oceanside
Jurisdiction:	City of La Mesa	Total Project Area:	3.15 AC
APN Number:	490-390-17,20	Low Flow Threshold:	0.5Q2
BMP Name:	C	BMP Type:	Biofiltration W/Liner

Areas Draining to BMP						Sizing Factors			Minimum BMP Size		
DMA Name	Area (SF)	Soil Type	Pre-Project Slope	Post Project Surface type	Runoff Factor (From G2-1	Surface Area	Surface Volume	Subsurface Volume	Surface Area (SF)	Surface Volume (CF)	Subsurface Volume
C-1	31200	D	Flat	Impervious	1.0	0.070	0.0583	0.0420	2184	1819	1310
C-2	9800	D	Flat	Pervious	0.1	0.070	0.0583	0.0420	69	57	41
Total DMA Area	41000							Minimum BMP Size*	2253	1876	1352
								Proposed BMP Size	2,253	1877.5	2027.7

*Minimum BMP Size = Total Rows Above

*Proposed BMP Size ≥ Minimum BMP size

Worksheet G.2-1: Sizing Factor Worksheet

Site Information			
Project Name:	Westmont La Mesa	Hydrologic Unit:	San Diego
Project Applicant:	Westmont Development	Rain Gauge:	Oceanside
Jurisdiction:	City of La Mesa	Total Project Area:	3.15 AC
APN Number:	490-390-17,20	Low Flow Threshold:	0.5Q2
BMP Name:	E	BMP Type:	Biofiltration W/Liner

Areas Draining to BMP						Sizing Factors			Minimum BMP Size		
DMA Name	Area (SF)	Soil Type	Pre-Project Slope	Post Project Surface type	Runoff Factor (From G2-1	Surface Area	Surface Volume	Subsurface Volume	Surface Area (SF)	Surface Volume (CF)	Subsurface Volume
E-1	23500	D	Flat	Impervious	1.0	0.070	0.0583	0.0420	1645	1370	987
E-2	14800	D	Flat	Pervious	0.1	0.070	0.0583	0.0420	104	86	62
Total DMA Area	38300							Minimum BMP Size*	1749	1456	1049
								Proposed BMP Size	1,749	1457.5	1574.1

*Minimum BMP Size = Total Rows Above

*Proposed BMP Size ≥ Minimum BMP size

Worksheet G.2-1: Sizing Factor Worksheet

Site Information			
Project Name:	Westmont La Mesa	Hydrologic Unit:	San Diego
Project Applicant:	Westmont Development	Rain Gauge:	Oceanside
Jurisdiction:	City of La Mesa	Total Project Area:	3.15 AC
APN Number:	490-390-17,20	Low Flow Threshold:	0.5Q2
BMP Name:	H	BMP Type:	Biofiltration W/Liner

Areas Draining to BMP						Sizing Factors			Minimum BMP Size		
DMA Name	Area (SF)	Soil Type	Pre-Project Slope	Post Project Surface type	Runoff Factor (From G2-1	Surface Area	Surface Volume	Subsurface Volume	Surface Area (SF)	Surface Volume (CF)	Subsurface Volume
H-1	7200	D	Flat	Impervious	1.0	0.070	0.0583	0.0420	504	420	302
H-2	7500	D	Flat	Pervious	0.1	0.070	0.0583	0.0420	53	44	32
DMA Area	14700							Minimum BMP Size*	557	463	334
								Proposed BMP Size	1,244	829	1119.6

*Minimum BMP Size = Total Rows Above

*Proposed BMP Size ≥ Minimum BMP size

ATTACHMENT 3
Structural BMP Maintenance Information

This is the cover sheet for Attachment 3.

Indicate which Items are Included behind this cover sheet:

Attachment Sequence	Contents	Checklist
Attachment 3a	Structural BMP Maintenance Thresholds and Actions (Required)	✓Included See Structural BMP Maintenance Information Checklist on the back of this Attachment cover sheet.
Attachment 3b	Draft Maintenance Agreement (when applicable)	✓City to provide.

Bioretention TC-32

Design Considerations

- Soil for Infiltration
- Tributary Area
- Slope
- Aesthetics
- Environmental Side-effects

Description

The bioretention best management practice (BMP) functions as a soil and plant-based filtration device that removes pollutants through a variety of physical, biological, and chemical treatment processes. These facilities normally consist of a grass buffer strip, sand bed, ponding area, organic layer or mulch layer, planting soil, and plants. The runoff's velocity is reduced by passing over or through buffer strip and subsequently distributed evenly along a ponding area. Exfiltration of the stored water in the bioretention area planting soil into the underlying soils occurs over a period of days.

Targeted Constituents

☑	Sediment	■
☑	Nutrients	▲
☑	Trash	■
☑	Metals	■
☑	Bacteria	■
☑	Oil and Grease	■
☑	Organics	■

Legend *(Removal Effectiveness)*

● Low ■ High

▲ Medium

California Experience

None documented. Bioretention has been used as a stormwater BMP since 1992. In addition to Prince George's County, MD and Alexandria, VA, bioretention has been used successfully at urban and suburban areas in Montgomery County, MD; Baltimore County, MD; Chesterfield County, VA; Prince William County, VA; Smith Mountain Lake State Park, VA; and Cary, NC.

Advantages

- Bioretention provides stormwater treatment that enhances the quality of downstream water bodies by temporarily storing runoff in the BMP and releasing it over a period of four days to the receiving water (EPA, 1999).
- The vegetation provides shade and wind breaks, absorbs noise, and improves an area's landscape.

Limitations

- The bioretention BMP is not recommended for areas with slopes greater than 20% or where mature tree removal would

be required since clogging may result, particularly if the BMP receives runoff with high sediment loads (EPA, 1999).

- Bioretention is not a suitable BMP at locations where the water table is within 6 feet of the ground surface and where the surrounding soil stratum is unstable.
- By design, bioretention BMPs have the potential to create very attractive habitats for mosquitoes and other vectors because of highly organic, often heavily vegetated areas mixed with shallow water.
- In cold climates the soil may freeze, preventing runoff from infiltrating into the planting soil.

Design and Sizing Guidelines

- The bioretention area should be sized to capture the design storm runoff.
- In areas where the native soil permeability is less than 0.5 in/hr an underdrain should be provided.
- Recommended minimum dimensions are 15 feet by 40 feet, although the preferred width is 25 feet. Excavated depth should be 4 feet.
- Area should drain completely within 72 hours.
- Approximately 1 tree or shrub per 50 ft^2 of bioretention area should be included.
- Cover area with about 3 inches of mulch.

Construction/Inspection Considerations

Bioretention area should not be established until contributing watershed is stabilized.

Performance

Bioretention removes stormwater pollutants through physical and biological processes, including adsorption, filtration, plant uptake, microbial activity, decomposition, sedimentation and volatilization (EPA, 1999). Adsorption is the process whereby particulate pollutants attach to soil (e.g., clay) or vegetation surfaces. Adequate contact time between the surface and pollutant must be provided for in the design of the system for this removal process to occur. Thus, the infiltration rate of the soils must not exceed those specified in the design criteria or pollutant removal may decrease. Pollutants removed by adsorption include metals, phosphorus, and hydrocarbons. Filtration occurs as runoff passes through the bioretention area media, such as the sand bed, ground cover, and planting soil.

Common particulates removed from stormwater include particulate organic matter, phosphorus, and suspended solids. Biological processes that occur in wetlands result in pollutant uptake by plants and microorganisms in the soil. Plant growth is sustained by the uptake of nutrients from the soils, with woody plants locking up these nutrients through the seasons. Microbial activity within the soil also contributes to the removal of nitrogen and organic matter. Nitrogen is removed by nitrifying and denitrifying bacteria, while aerobic bacteria are responsible for the decomposition of the organic matter. Microbial processes require oxygen and can result in depleted oxygen levels if the bioretention area is not adequately

aerated. Sedimentation occurs in the swale or ponding area as the velocity slows and solids fall out of suspension.

The removal effectiveness of bioretention has been studied during field and laboratory studies conducted by the University of Maryland (Davis et al, 1998). During these experiments, synthetic stormwater runoff was pumped through several laboratory and field bioretention areas to simulate typical storm events in Prince George's County, MD. Removal rates for heavy metals and nutrients are shown in Table 1.

Table 1 Laboratory and Estimated Bioretention Davis et al. (1998); PGDER (1993)

Pollutant	Removal Rate
Total Phosphorus	70-83%
Metals (Cu, Zn, Pb)	93-98%
TKN	68-80%
Total Suspended Solids	90%
Organics	90%
Bacteria	90%

Results for both the laboratory and field experiments were similar for each of the pollutants analyzed. Doubling or halving the influent pollutant levels had little effect on the effluent pollutants concentrations (Davis et al, 1998).

The microbial activity and plant uptake occurring in the bioretention area will likely result in higher removal rates than those determined for infiltration BMPs.

Siting Criteria

Bioretention BMPs are generally used to treat stormwater from impervious surfaces at commercial, residential, and industrial areas (EPA, 1999). Implementation of bioretention for stormwater management is ideal for median strips, parking lot islands, and swales. Moreover, the runoff in these areas can be designed to either divert directly into the bioretention area or convey into the bioretention area by a curb and gutter collection system.

The best location for bioretention areas is upland from inlets that receive sheet flow from graded areas and at areas that will be excavated (EPA, 1999). In order to maximize treatment effectiveness, the site must be graded in such a way that minimizes erosive conditions as sheet flow is conveyed to the treatment area. Locations where a bioretention area can be readily incorporated into the site plan without further environmental damage are preferred. Furthermore, to effectively minimize sediment loading in the treatment area, bioretention only should be used in stabilized drainage areas.

Additional Design Guidelines

The layout of the bioretention area is determined after site constraints such as location of utilities, underlying soils, existing vegetation, and drainage are considered (EPA, 1999). Sites with loamy sand soils are especially appropriate for bioretention because the excavated soil can be backfilled and used as the planting soil, thus eliminating the cost of importing planting soil.

The use of bioretention may not be feasible given an unstable surrounding soil stratum, soils with clay content greater than 25 percent, a site with slopes greater than 20 percent, and/or a site with mature trees that would be removed during construction of the BMP.

Bioretention can be designed to be off-line or on-line of the existing drainage system (EPA, 1999). The drainage area for a bioretention area should be between 0.1 and 0.4 hectares (0.25 and 1.0 acres). Larger drainage areas may require multiple bioretention areas. Furthermore, the maximum drainage area for a bioretention area is determined by the expected rainfall intensity and runoff rate. Stabilized areas may erode when velocities are greater than 5 feet per second (1.5 meter per second). The designer should determine the potential for erosive conditions at the site.

The size of the bioretention area, which is a function of the drainage area and the runoff generated from the area is sized to capture the water quality volume.

The recommended minimum dimensions of the bioretention area are 15 feet (4.6 meters) wide by 40 feet (12.2 meters) long, where the minimum width allows enough space for a dense, randomly-distributed area of trees and shrubs to become established. Thus replicating a natural forest and creating a microclimate, thereby enabling the bioretention area to tolerate the effects of heat stress, acid rain, runoff pollutants, and insect and disease infestations which landscaped areas in urban settings typically are unable to tolerate. The preferred width is 25 feet (7.6 meters), with a length of twice the width. Essentially, any facilities wider than 20 feet (6.1 meters) should be twice as long as they are wide, which promotes the distribution of flow and decreases the chances of concentrated flow.

In order to provide adequate storage and prevent water from standing for excessive periods of time the ponding depth of the bioretention area should not exceed 6 inches (15 centimeters). Water should not be left to stand for more than 72 hours. A restriction on the type of plants that can be used may be necessary due to some plants' water intolerance. Furthermore, if water is left standing for longer than 72 hours mosquitoes and other insects may start to breed.

The appropriate planting soil should be backfilled into the excavated bioretention area. Planting soils should be sandy loam, loamy sand, or loam texture with a clay content ranging from 10 to 25 percent.

Generally the soil should have infiltration rates greater than 0.5 inches (1.25 centimeters) per hour, which is typical of sandy loams, loamy sands, or loams. The pH of the soil should range between 5.5 and 6.5, where pollutants such as organic nitrogen and phosphorus can be adsorbed by the soil and microbial activity can flourish. Additional requirements for the planting soil include a 1.5 to 3 percent organic content and a maximum 500 ppm concentration of soluble salts.

Soil tests should be performed for every 500 cubic yards (382 cubic meters) of planting soil, with the exception of pH and organic content tests, which are required only once per bioretention area (EPA, 1999). Planting soil should be 4 inches (10.1 centimeters) deeper than the bottom of the largest root ball and 4 feet (1.2 meters) altogether. This depth will provide adequate soil for the plants' root systems to become established, prevent plant damage due to severe wind, and provide adequate moisture capacity. Most sites will require excavation in order to obtain the recommended depth.

Planting soil depths of greater than 4 feet (1.2 meters) may require additional construction practices such as shoring measures (EPA, 1999). Planting soil should be placed in 18 inches or greater lifts and lightly compacted until the desired depth is reached. Since high canopy trees may be destroyed during maintenance the bioretention area should be vegetated to resemble a terrestrial forest community ecosystem that is dominated by understory trees. Three species each of both trees and shrubs are recommended to be planted at a rate of 2500 trees and shrubs per hectare (1000 per acre). For instance, a 15 foot (4.6 meter) by 40 foot (12.2 meter) bioretention area (600 square feet or 55.75 square meters) would require 14 trees and shrubs. The shrub-to-tree ratio should be 2:1 to 3:1.

Trees and shrubs should be planted when conditions are favorable. Vegetation should be watered at the end of each day for fourteen days following its planting. Plant species tolerant of pollutant loads and varying wet and dry conditions should be used in the bioretention area.

The designer should assess aesthetics, site layout, and maintenance requirements when selecting plant species. Adjacent non-native invasive species should be identified and the designer should take measures, such as providing a soil breach to eliminate the threat of these species invading the bioretention area. Regional landscaping manuals should be consulted to ensure that the planting of the bioretention area meets the landscaping requirements established by the local authorities. The designers should evaluate the best placement of vegetation within the bioretention area. Plants should be placed at irregular intervals to replicate a natural forest. Trees should be placed on the perimeter of the area to provide shade and shelter from the wind. Trees and shrubs can be sheltered from damaging flows if they are placed away from the path of the incoming runoff. In cold climates, species that are more tolerant to cold winds, such as evergreens, should be placed in windier areas of the site.

Following placement of the trees and shrubs, the ground cover and/or mulch should be established. Ground cover such as grasses or legumes can be planted at the beginning of the growing season. Mulch should be placed immediately after trees and shrubs are planted. Two to 3 inches (5 to 7.6 cm) of commercially-available fine shredded hardwood mulch or shredded hardwood chips should be applied to the bioretention area to protect from erosion.

Maintenance

The primary maintenance requirement for bioretention areas is that of inspection and repair or replacement of the treatment area's components. Generally, this involves nothing more than the routine periodic maintenance that is required of any landscaped area. Plants that are appropriate for the site, climatic, and watering conditions should be selected for use in the bioretention cell. Appropriately selected plants will aide in reducing fertilizer, pesticide, water, and overall maintenance requirements. Bioretention system components should blend over time through plant and root growth, organic decomposition, and the development of a natural

soil horizon. These biologic and physical processes over time will lengthen the facility's life span and reduce the need for extensive maintenance.

Routine maintenance should include a biannual health evaluation of the trees and shrubs and subsequent removal of any dead or diseased vegetation (EPA, 1999). Diseased vegetation should be treated as needed using preventative and low-toxic measures to the extent possible. BMPs have the potential to create very attractive habitats for mosquitoes and other vectors because of highly organic, often heavily vegetated areas mixed with shallow water. Routine inspections for areas of standing water within the BMP and corrective measures to restore proper infiltration rates are necessary to prevent creating mosquito and other vector habitat. In addition, bioretention BMPs are susceptible to invasion by aggressive plant species such as cattails, which increase the chances of water standing and subsequent vector production if not routinely maintained.

In order to maintain the treatment area's appearance it may be necessary to prune and weed. Furthermore, mulch replacement is suggested when erosion is evident or when the site begins to look unattractive. Specifically, the entire area may require mulch replacement every two to three years, although spot mulching may be sufficient when there are random void areas. Mulch replacement should be done prior to the start of the wet season.

New Jersey's Department of Environmental Protection states in their bioretention systems standards that accumulated sediment and debris removal (especially at the inflow point) will normally be the primary maintenance function. Other potential tasks include replacement of dead vegetation, soil pH regulation, erosion repair at inflow points, mulch replenishment, unclogging the underdrain, and repairing overflow structures. There is also the possibility that the cation exchange capacity of the soils in the cell will be significantly reduced over time. Depending on pollutant loads, soils may need to be replaced within 5-10 years of construction (LID, 2000).

Cost

Construction Cost

Construction cost estimates for a bioretention area are slightly greater than those for the required landscaping for a new development (EPA, 1999). A general rule of thumb (Coffman, 1999) is that residential bioretention areas average about $3 to $4 per square foot, depending on soil conditions and the density and types of plants used. Commercial, industrial and institutional site costs can range between $10 to $40 per square foot, based on the need for control structures, curbing, storm drains and underdrains.

Retrofitting a site typically costs more, averaging $6,500 per bioretention area. The higher costs are attributed to the demolition of existing concrete, asphalt, and existing structures and the replacement of fill material with planting soil. The costs of retrofitting a commercial site in Maryland, Kettering Development, with 15 bioretention areas were estimated at $111,600.

In any bioretention area design, the cost of plants varies substantially and can account for a significant portion of the expenditures. While these cost estimates are slightly greater than those of typical landscaping treatment (due to the increased number of plantings, additional soil excavation, backfill material, use of underdrains etc.), those landscaping expenses that would be required regardless of the bioretention installation should be subtracted when determining the net cost.

Perhaps of most importance, however, the cost savings compared to the use of traditional structural stormwater conveyance systems makes bioretention areas quite attractive financially. For example, the use of bioretention can decrease the cost required for constructing stormwater conveyance systems at a site. A medical office building in Maryland was able to reduce the amount of storm drain pipe that was needed from 800 to 230 feet - a cost savings of $24,000 (PGDER, 1993). And a new residential development spent a total of approximately $100,000 using bioretention cells on each lot instead of nearly $400,000 for the traditional stormwater ponds that were originally planned (Rappahanock,). Also, in residential areas, stormwater management controls become a part of each property owner's landscape, reducing the public burden to maintain large centralized facilities.

Maintenance Cost

The operation and maintenance costs for a bioretention facility will be comparable to those of typical landscaping required for a site. Costs beyond the normal landscaping fees will include the cost for testing the soils and may include costs for a sand bed and planting soil.

References and Sources of Additional Information

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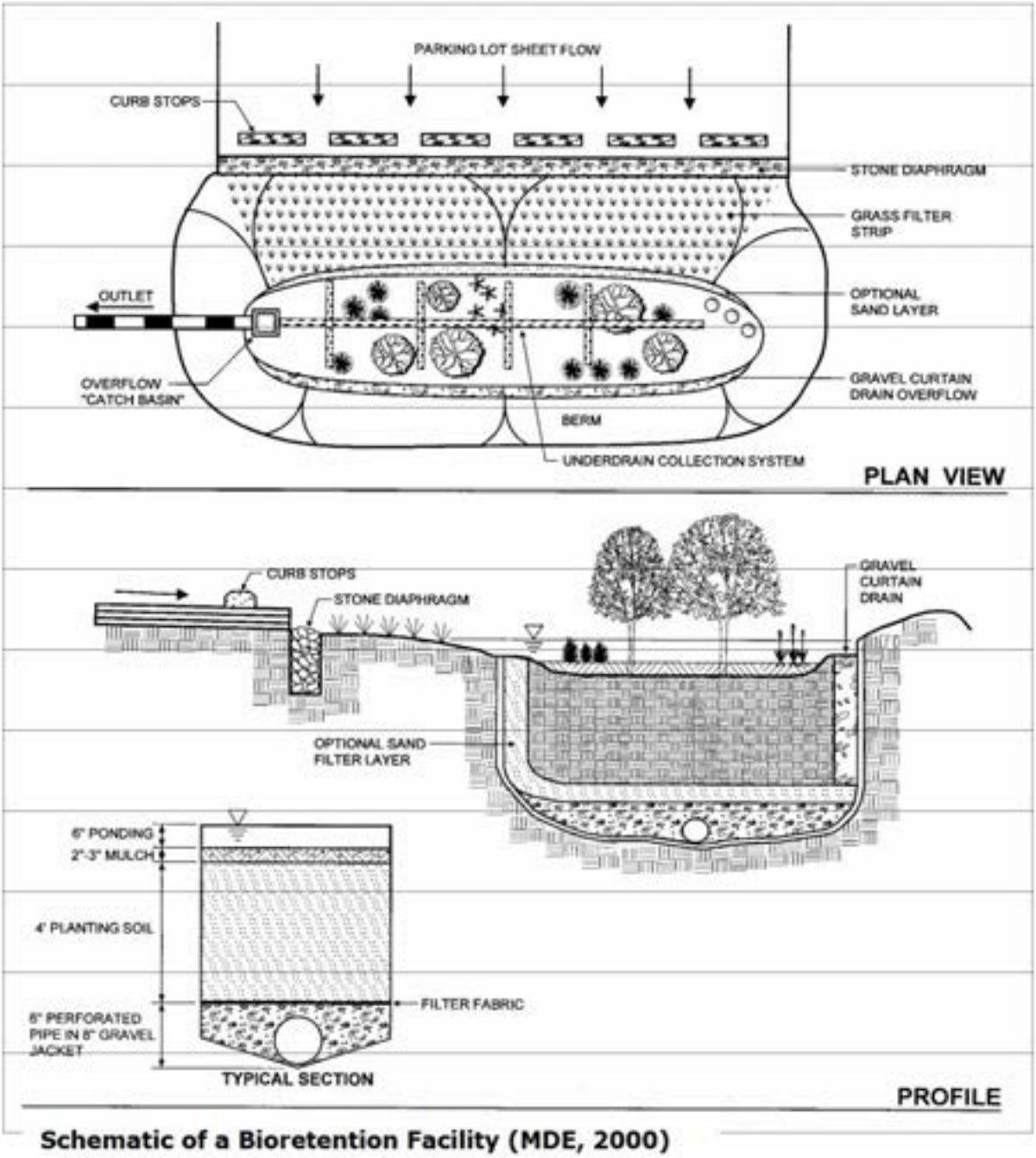
Hsieh, C.-h. and Davis, A.P. "Engineering Bioretention for Treatment of Urban Stormwater Runoff," *Watersheds 2002, Proceedings on CDROM Research Symposium*, Session 15, Ft. Lauderdale, FL, Feb. 2002.

Prince George's County Department of Environmental Resources (PGDER), 1993. Design Manual for Use of *Bioretention in Stormwater Management*. Division of Environmental Management, Watershed Protection Branch. Landover, MD.

U.S. EPA Office of Water, 1999. Stormwater Technology Fact Sheet: Bioretention. EPA 832-F-99-012.

Weinstein, N. Davis, A.P. and Veeramachaneni, R. "Low Impact Development (LID) Stormwater Management Approach for the Control of Diffuse Pollution from Urban Roadways," *5th International Conference Diffuse/Nonpoint Pollution and Watershed Management Proceedings*, C.S. Melching and Emre Alp, Eds. 2001 International Water Association



Schematic of a Bioretention Facility (MDE, 2000)

Media Filter

TC-40

Design Considerations

- Aesthetics
- Hydraulic Head

Description

Stormwater media filters are usually two-chambered including a pretreatment settling basin and a filter bed filled with sand or other absorptive filtering media. As stormwater flows into the first chamber, large particles settle out, and then finer particles and other pollutants are removed as stormwater flows through the filtering media in the second chamber. There are a number of design variations including the Austin sand filter, Delaware sand filter, and multi-chambered treatment train (MCTT).

California Experience

Caltrans constructed and monitored five Austin sand filters, two MCTTs, and one Delaware design in southern California. Pollutant removal was very similar for each of the designs; however operational and maintenance aspects were quite different. The Delaware filter and MCTT maintain permanent pools and consequently mosquito management was a critical issue, while the Austin style which is designed to empty completely between storms was less affected. Removal of the top few inches of sand was required at 3 of the Austin filters and the Delaware filter during the third year of operation; consequently, sizing of the filter bed is a critical design factor for establishing maintenance frequency.

Advantages

- Relatively high pollutant removal, especially for sediment and associated pollutants.
- Widespread application with sufficient capture volume can provide significant control of channel erosion and enlargement caused by changes to flow frequency relationships resulting from the increase of impervious cover in a watershed.

Limitations

Targeted Constituents

☑	Sediment	■
☑	Nutrients	●
☑	Trash	■
☑	Metals	■
☑	Bacteria	▲
☑	Oil and Grease	■
☑	Organics	■

Legend ***(Removal Effectiveness)***

● Low ■ High

▲ Medium

ATTACHMENT 4
Copy of Plan Sheets Showing Permanent Storm Water BMPs

This is the cover sheet for Attachment 4.

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

The plans must identify:

- ✓Structural BMP(s) with ID numbers matching Form I-6 Summary of PDP Structural BMPs
- ✓The grading and drainage design shown on the plans must be consistent with the delineation of DMAs shown on the DMA exhibit
- ✓Details and specifications for construction of structural BMP(s)
- ✓Signage indicating the location and boundary of structural BMP(s) as required by City staff
- ✓How to access the structural BMP(s) to inspect and perform maintenance
- ✓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. Photocopies of general brochures are not acceptable.

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ATTACHMENT 5
Copy of Project's Drainage Report

This is the cover sheet for Attachment 5.

Westmont La Mesa Assisted Living

Drainage Report

Prepared For:

WESTMONT DEVELOPMENT, LP

7660 Fay Avenue, Suite N

La Jolla, CA 92037

APRIL 2016

Prepared By:

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Appendices

Appendix A Drainage References

- Rainfall Isopluvial Maps

Appendix B RickRat Hydrograph Calculations

Appendix C Hydraflow Hydrograph Calculations

Appendix D Existing Drainage Exhibit

Appendix E Proposed Drainage Exhibit

Figure 1 Vicinity Map

1 INTRODUCTION

This Drainage Report has been prepared for Westmont Development LP to document the engineering analysis used in the drainage evaluation and design for the proposed Westmont Assisted Living Facility in La Mesa, CA. The project site is located at the northeast corner of State Route 125 and Murray Drive. More specifically, the site is bounded by Grossmont Healthcare District Medical Library to the north, Briercrest Park to the east, Murray Drive to the south and State Route 125 to the west. (See **Figure 1**)

The 3.33 acre project site consists of one three-story **558,157 SF** building that provides assisted living housing for senior citizens. Patios, courtyards, and landscaped areas are provided to increase site aesthetics and bioretention areas are provided for water quality and peak attenuation purposes.

2 PROCEDURE AND METHODOLOGIES

Hydrologic calculations were completed per the San Diego County Hydrology Manual, utilizing the Rational Method. More specifically:

- Rainfall data was generated from the rainfall isopluvial maps for given rainfall events based on the location of the project site (see **Appendix A**).
- Drainage Management Areas (DMAs) were delineated using 0.5-ft contour interval topographic mapping gathered during the Preliminary Site Development Plan phase of the project.
- A site-specific Runoff Coefficient was calculated using a weighted average based on the Preliminary Site Plan provided by Lenity Architects.

A unit hydrograph was created for each proposed DMA using the RickRat Hydrograph Program, approved for use by San Diego County. A 5 minute time of concentration and a site specific 6-hour rainfall depth equal to 2.6 inches was used in these calculations.

The unit hydrograph results were then inputs into the stage-storage analysis completed using the Hydraflow Hydrographs Program. The stage-storage results were used to analyze each proposed water quality basin and determine the necessary outlet control needed for peak attenuation purposes.

3 EXISTING DRAINAGE

3.1 EXISTING DRAINAGE CONDITIONS

The existing site is mass graded and predominantly flat, except along the south side where the site slopes down upwards of 10’ to meet grade along Murray Drive. Approximately one-third of the site drains towards the north and the other two-thirds drains towards the south. There are existing temporary inlets on-site that capture and convey site stormwater to existing underground storm drain systems, one located at the northeast corner of the site and a second system located within Murray Drive. The northeast storm system conveys runoff through an existing 30” RCP storm drain flowing west under the freeway. The south storm system conveys runoff through an existing 24” RCP storm drain that flows south across

Murray Drive and then west underneath the freeway. These flows confluence downstream within the City's existing storm drain infrastructure. There is no stormwater run-on to the site and approximately 0.62 cfs runs off the site and is captured within Murray Drive's stormwater conveyance system. Refer to the Existing Drainage Exhibit provided in **Appendix D**.

3.2 EXISTING HYDROLOGIC CALCULATIONS

Table 3-1 summarizes the existing peak flows generated by a 50 year and 100 year storm event using the Rational Method specified in the San Diego Hydrology Manual.

Table 3–1 Existing Peak Flow Calculations

DMA	DMA Description	Total Area (acre)	Runoff Coefficient	50 Year Rainfall Intensity (in/hr)	50 Year Flow Rate (cfs)	100 Year Rainfall Intensity (in/hr)	100 Year Flow Rate (cfs)
A	North	0.74	0.35	6.06	1.57	6.85	1.77
B	South	1.8	0.35	6.06	3.82	6.85	4.32
C	South	0.53	0.35	6.06	1.12	6.85	1.27
D	Run-off	0.26	0.35	6.06	0.55	6.85	0.62
	Total	3.33			7.06		7.98

4 PROPOSED DRAINAGE

4.1 PROPOSED DRAINAGE CONDITIONS

Storm water generated by the proposed development will surface flow to a storm drain conveyance network consisting of curb cuts, inlets and gutters. This network routes flows to biofiltration basins where the water will be treated, detained, and then discharged into the existing storm drain network.

The City Engineer has explained that the existing park detention facility and streambed located adjacent to the property was originally designed to accept portions of a proposed development's runoff. Under this direction and guidance, approximately one-quarter of the property is designed to discharge east into existing park detention facilities. Overflow inlets located within these bioretention areas will capture peak flows and route them to the existing storm drain systems. Refer to the Proposed Drainage Exhibit provided in **Appendix E**.

4.2 PROPOSED HYDROLOGIC CALCULATIONS

Table 4-1 summarizes the proposed peak flows generated by a 50 year and 100 year storm event using the Rational Method specified in the San Diego Hydrology Manual.

Table 4–1 Proposed Peak Flow Calculations

DMA	DMA Region	Total Area (acre)	Runoff Coefficient	50 Year Rainfall Intensity (in/hr)	50 Year Flow Rate (cfs)	100 Year Rainfall Intensity (in/hr)	100 Year Flow Rate (cfs)
A	South	0.49	0.75	6.06	2.23	6.85	2.52
B	South	0.51	0.75	6.06	2.32	6.85	2.62
H	South	0.34	0.75	6.06	1.55	6.85	1.75
Sub-Total:		1.34			6.09		6.88
C	North	0.94	0.75	6.06	4.27	6.85	4.83
E	East	0.88	0.75	6.06	4.00	6.85	4.52
Site Total:		3.16			14.36		16.23
F	Run-off	0.04	0.75	6.06	0.18	6.85	0.21
G	Run-off	0.06	0.75	6.06	0.27	6.85	0.31
D	Run-off	0.07	0.75	6.06	0.32	6.85	0.36
Run-off Total:		0.17			0.77		0.87

Table 4-2 summarizes the results from the bioretention stage storage analysis to ensure the 100 year proposed peak flows do not exceed the site's existing peak flows.

Table 4–2 Proposed Onsite Peak Discharge Summary

DMA Region	$Q_{100\text{-Existing}}$ (cfs)	$Q_{100\text{-Proposed}}$ (cfs)	$Q_{100\text{-Released}}$ (cfs)
South	5.59	6.88	4.86
North	1.77	4.83	1.48
East	N/A	4.52	3.41

Based on these results, the additional runoff due to increased impervious area is minimal and does not exceed the capacity of the existing downstream storm drain system, therefore, no adverse downstream impacts are anticipated. Refer to **Appendix B** and **Appendix C** for the detailed RickRat Hydrograph and Hydraflow Hydrograph analysis respectfully.

APPENDICES

APPENDIX A

DRAINAGE REFERENCES

- Rainfall Isopluvial Maps

Note that the Initial Time of Concentration should be reflective of the general land-use at the upstream end of a drainage basin. A single lot with an area of two or less acres does not have a significant effect where the drainage basin area is 20 to 600 acres.

Table 3-2 provides limits of the length (Maximum Length (L_M)) of sheet flow to be used in hydrology studies. Initial T_i values based on average C values for the Land Use Element are also included. These values can be used in planning and design applications as described below. Exceptions may be approved by the "Regulating Agency" when submitted with a detailed study.

Table 3-2

MAXIMUM OVERLAND FLOW LENGTH (L_M) & INITIAL TIME OF CONCENTRATION (T_i)

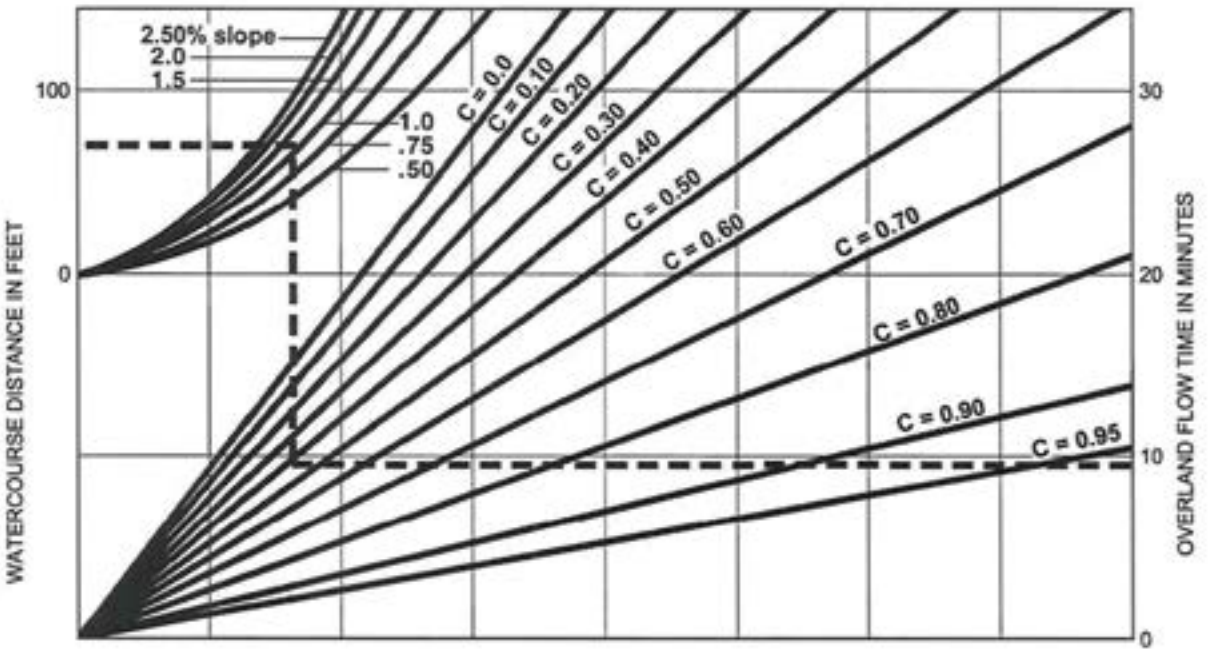
Element*	DU/	.5%		1%		2%		3%		5%		10%	
	Acre	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i
Natural		50	13.2	70	12.5	85	10.9	100	10.3	100	8.7	100	6.9
LDR	1	50	12.2	70	11.5	85	10.0	100	9.5	100	8.0	100	6.4
LDR	2	50	11.3	70	10.5	85	9.2	100	8.8	100	7.4	100	5.8
LDR	2.9	50	10.7	70	10.0	85	8.8	95	8.1	100	7.0	100	5.6
MDR	4.3	50	10.2	70	9.6	80	8.1	95	7.8	100	6.7	100	5.3
MDR	7.3	50	9.2	65	8.4	80	7.4	95	7.0	100	6.0	100	4.8
MDR	10.9	50	8.7	65	7.9	80	6.9	90	6.4	100	5.7	100	4.5
MDR	14.5	50	8.2	65	7.4	80	6.5	90	6.0	100	5.4	100	4.3
HDR	24	50	6.7	65	6.1	75	5.1	90	4.9	95	4.3	100	3.5
HDR	43	50	5.3	65	4.7	75	4.0	85	3.8	95	3.4	100	2.7
N. Com		50	5.3	60	4.5	75	4.0	85	3.8	95	3.4	100	2.7
G. Com		50	4.7	60	4.1	75	3.6	85	3.4	90	2.9	100	2.4
O.P./Com		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
Limited I.		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
General I.		50	3.7	60	3.2	70	2.7	80	2.6	90	2.3	100	1.9

*See Table 3-1 for more detailed description

Table 3-1
RUNOFF COEFFICIENTS FOR URBAN AREAS

Land Use		Runoff Coefficient "C"				
			Soil Type			
NRCS Elements	County Elements	% IMPER.	A	B	C	D
Undisturbed Natural Terrain (Natural)	Permanent Open Space	0*	0.20	0.25	0.30	0.35
Low Density Residential (LDR)	Residential, 1.0 DU/A or less	10	0.27	0.32	0.36	0.41
Low Density Residential (LDR)	Residential, 2.0 DU/A or less	20	0.34	0.38	0.42	0.46
Low Density Residential (LDR)	Residential, 2.9 DU/A or less	25	0.38	0.41	0.45	0.49
Medium Density Residential (MDR)	Residential, 4.3 DU/A or less	30	0.41	0.45	0.48	0.52
Medium Density Residential (MDR)	Residential, 7.3 DU/A or less	40	0.48	0.51	0.54	0.57
Medium Density Residential (MDR)	Residential, 10.9 DU/A or less	45	0.52	0.54	0.57	0.60
Medium Density Residential (MDR)	Residential, 14.5 DU/A or less	50	0.55	0.58	0.60	0.63
High Density Residential (HDR)	Residential, 24.0 DU/A or less	65	0.66	0.67	0.69	0.71
High Density Residential (HDR)	Residential, 43.0 DU/A or less	80	0.76	0.77	0.78	0.79
Commercial/Industrial (N. Com)	Neighborhood Commercial	80	0.76	0.77	0.78	0.79
Commercial/Industrial (G. Com)	General Commercial	85	0.80	0.80	0.81	0.82
Commercial/Industrial (O.P. Com)	Office Professional/Commercial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (Limited I.)	Limited Industrial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (General I.)	General Industrial	95	0.87	0.87	0.87	0.87

*The values associated with 0% impervious may be used for direct calculation of the runoff coefficient as described in Section 3.1.2 (representing the pervious runoff coefficient, Cp, for the soil type), or for areas that will remain undisturbed in perpetuity. Justification must be given that the area will remain natural forever (e.g., the area is located in Cleveland National Forest).
DU/A = dwelling units per acre
NRCS = National Resources Conservation Service



EXAMPLE:

Given: Watercourse Distance (D) = 70 Feet
Slope (s) = 1.3%
Runoff Coefficient (C) = 0.41
Overland Flow Time (T) = 9.5 Minutes

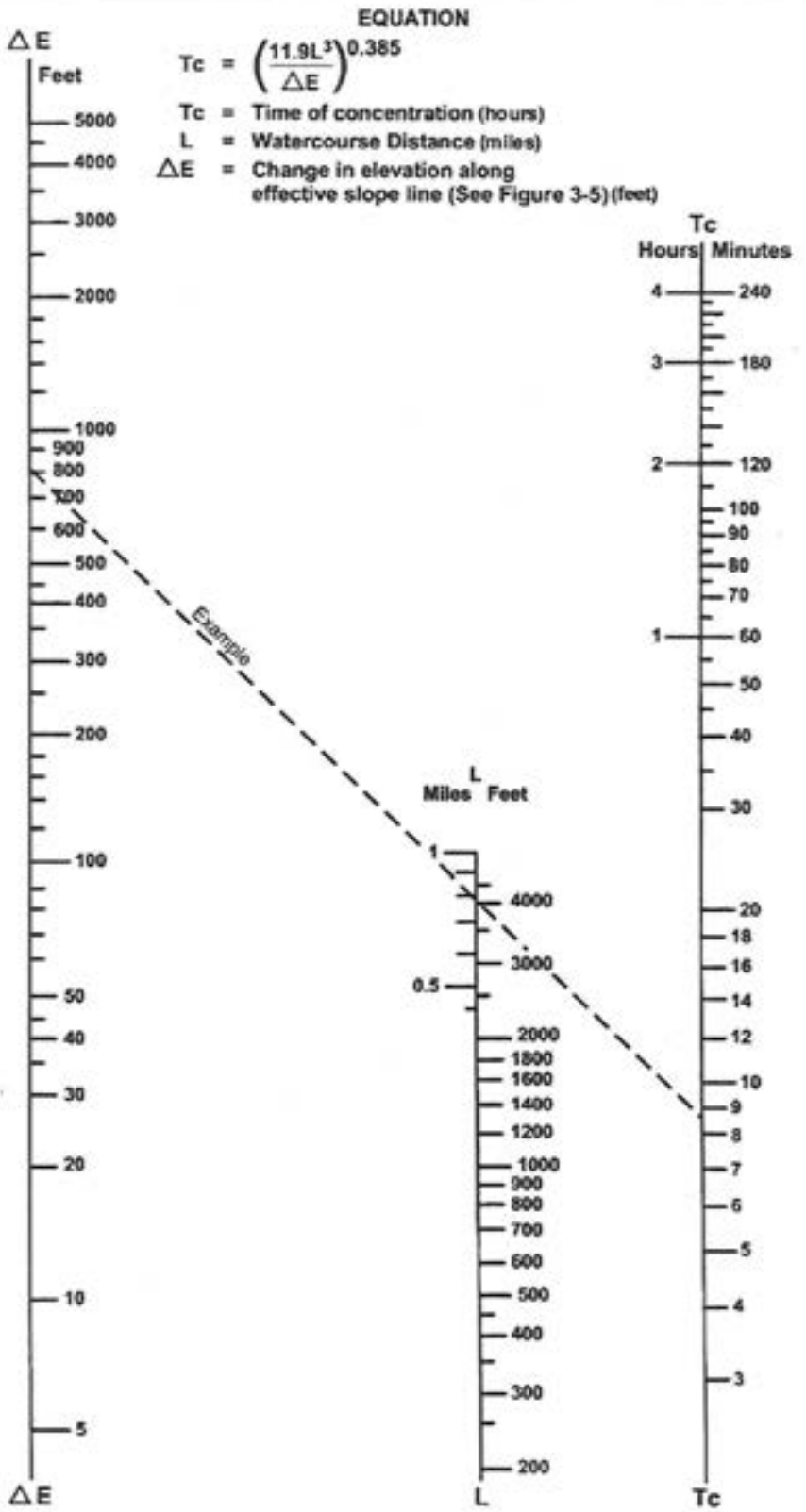
$$T = \frac{1.8\,(1.1-C)\sqrt{D}}{\sqrt[3]{s}}$$

OURCE: Airport Drainage, Federal Aviation Administration, 1965

FIGURE

Rational Formula - Overland Time of Flow Nomograph

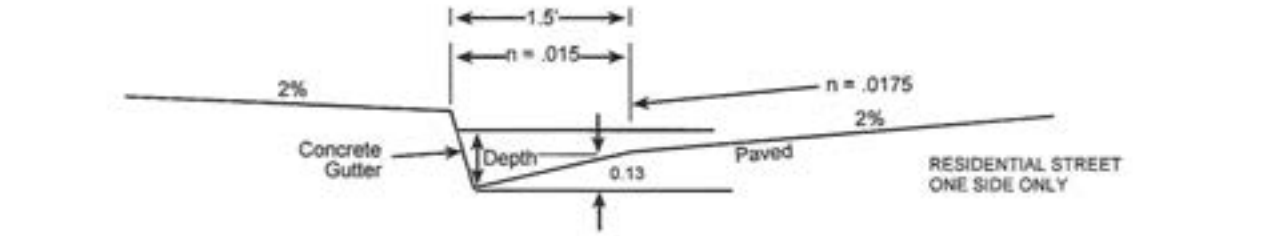
3-3

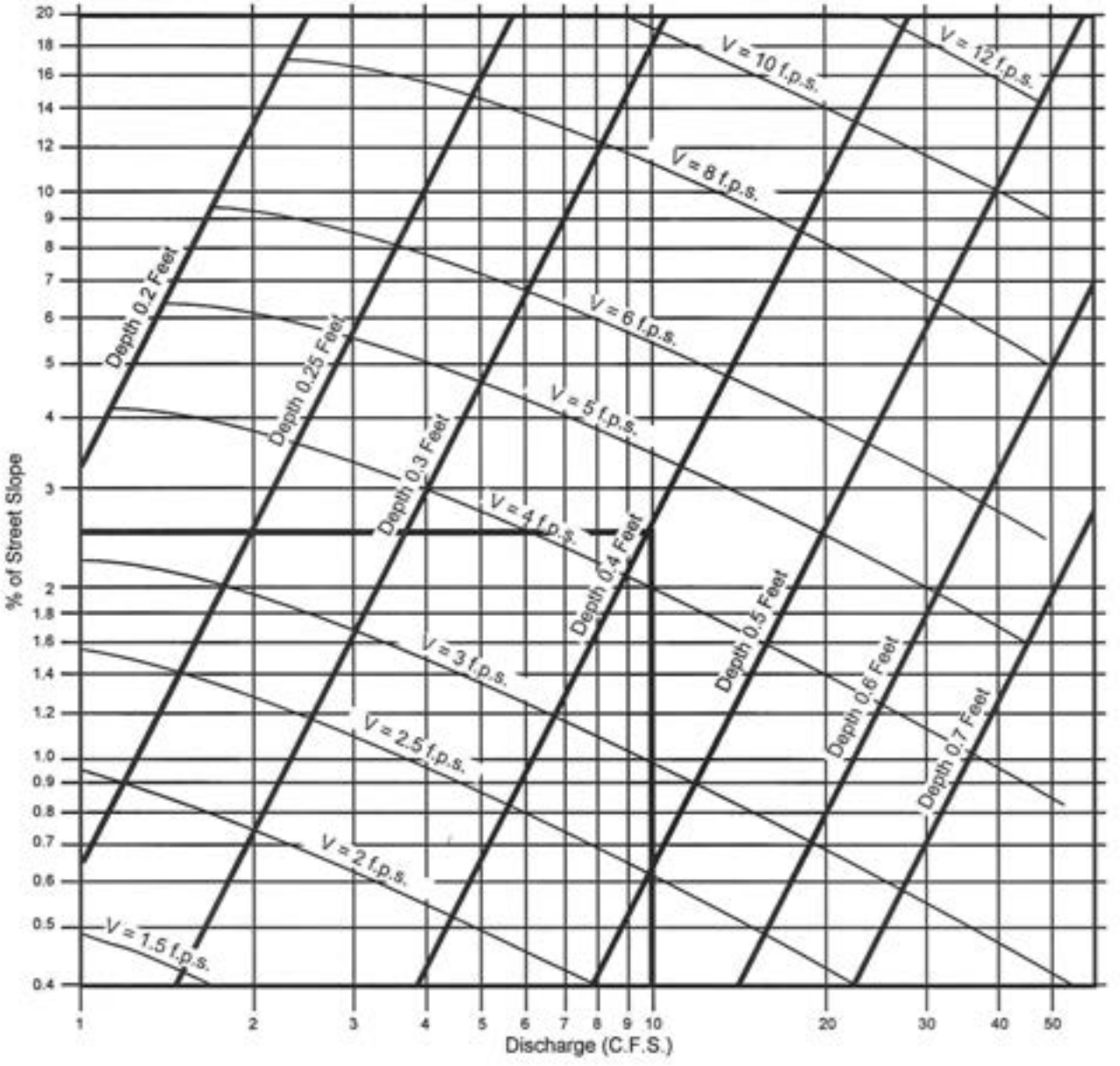


SOURCE: California Division of Highways (1941) and Kirpich (1940)

FIGURE 3-4

Nomograph for Determination of
Time of Concentration (Tc) or Travel Time (Tt) for Natural Watersheds





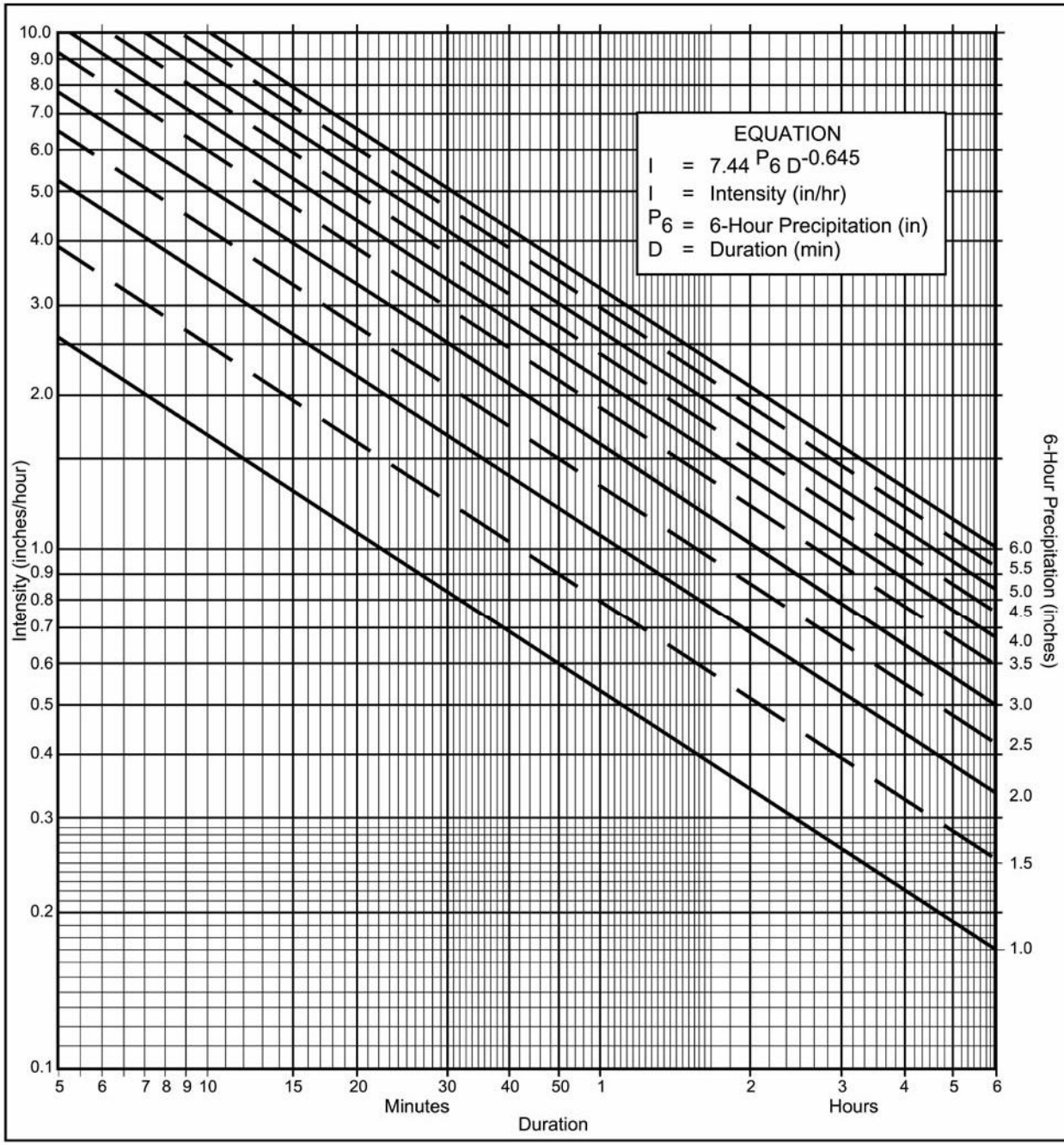
EXAMPLE:
Given: Q = 10 S = 2.5%
Chart gives: Depth = 0.4, Velocity = 4.4 f.p.s.

SOURCE: San Diego County Department of Special District Services Design Manual

FIGURE

Gutter and Roadway Discharge - Velocity Chart

3-6



Directions for Application:

(1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).

(2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicaple to Desert).

(3) Plot 6 hr precipitation on the right side of the chart.

(4) Draw a line through the point parallel to the plotted lines.

(5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

(a) Selected frequency 50 year

(b) P_6 = 2.3 in., P_{24} = 4.7, $\frac{P_6}{P_{24}}$ = 49 %(2)

(c) Adjusted P_6(2) = 2.4 in.

(d) t_x = _____ min.

(e) I = _____ in./hr.

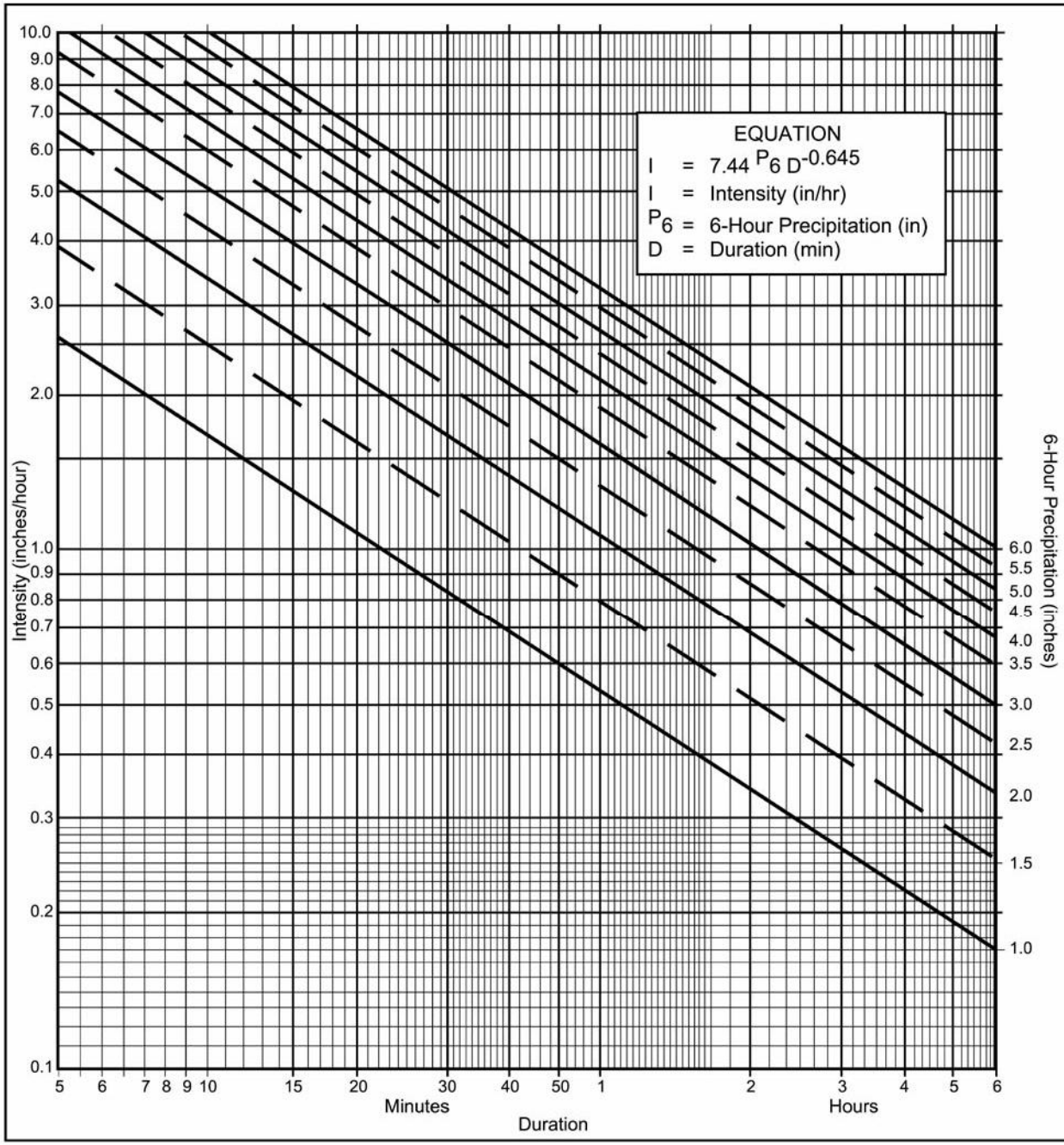
Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P6	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
Duration	I	I	I	I	I	I	I	I	I	I	I
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

Intensity-Duration Design Chart - Template

FIGURE

3-1



Directions for Application:

(1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).

(2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicaple to Desert).

(3) Plot 6 hr precipitation on the right side of the chart.

(4) Draw a line through the point parallel to the plotted lines.

(5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

(a) Selected frequency 100 year

(b) P_6 = 2.6 in., P_{24} = 5.0 , $\frac{P_6}{P_{24}}$ = 52 %(2)

(c) Adjusted P_6(2) = 2.6 in.

(d) t_x = _____ min.

(e) I = _____ in./hr.

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P6	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
Duration	I	I	I	I	I	I	I	I	I	I	I
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

Intensity-Duration Design Chart - Template

FIGURE

3-1

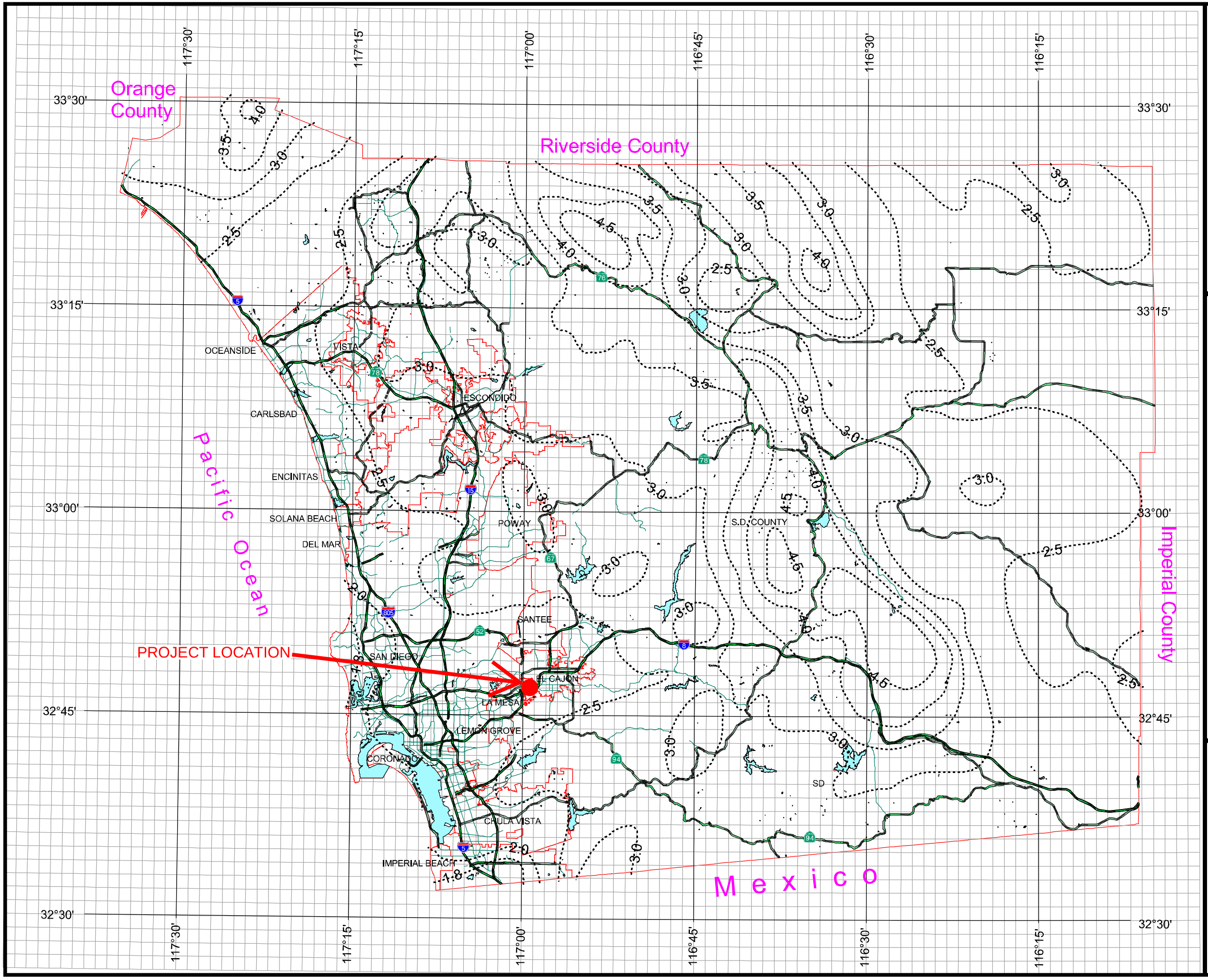
County of San Diego Hydrology Manual

Rainfall Isopluvials

50 Year Rainfall Event - 6 Hours

Isopluvial (inches)

P6 = 2.3 INCHES



DPW GIS
Department of Public Works
Geographic Information Services

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3 0 3 Miles

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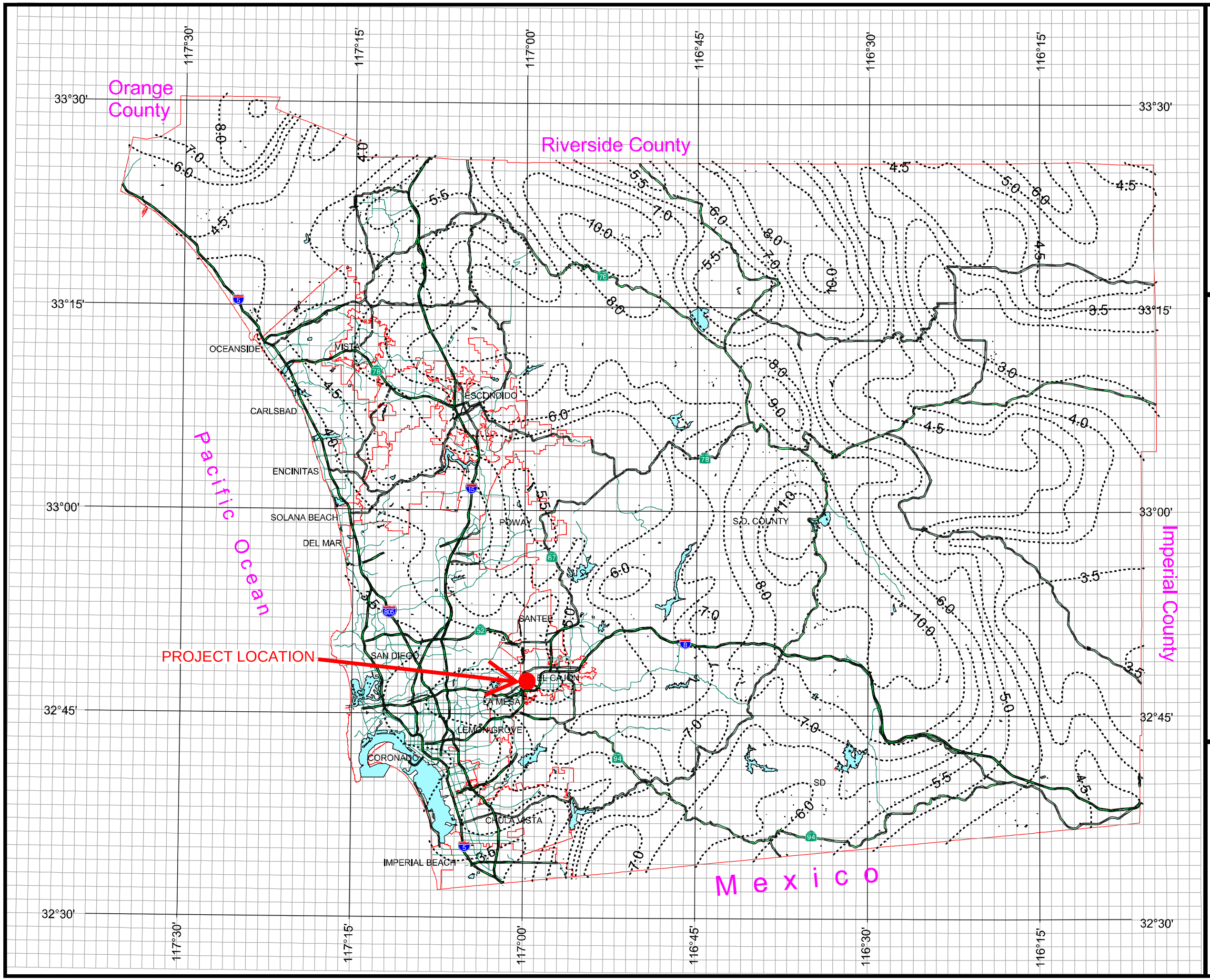
County of San Diego Hydrology Manual

Rainfall Isopluvials



50 Year Rainfall Event - 24 Hours

Isopluvial (inches)

P24 = 4.7 INCHES

DPW GIS
Department of Public Works
Geographic Information Services

SanGIS
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3 0 3 Miles

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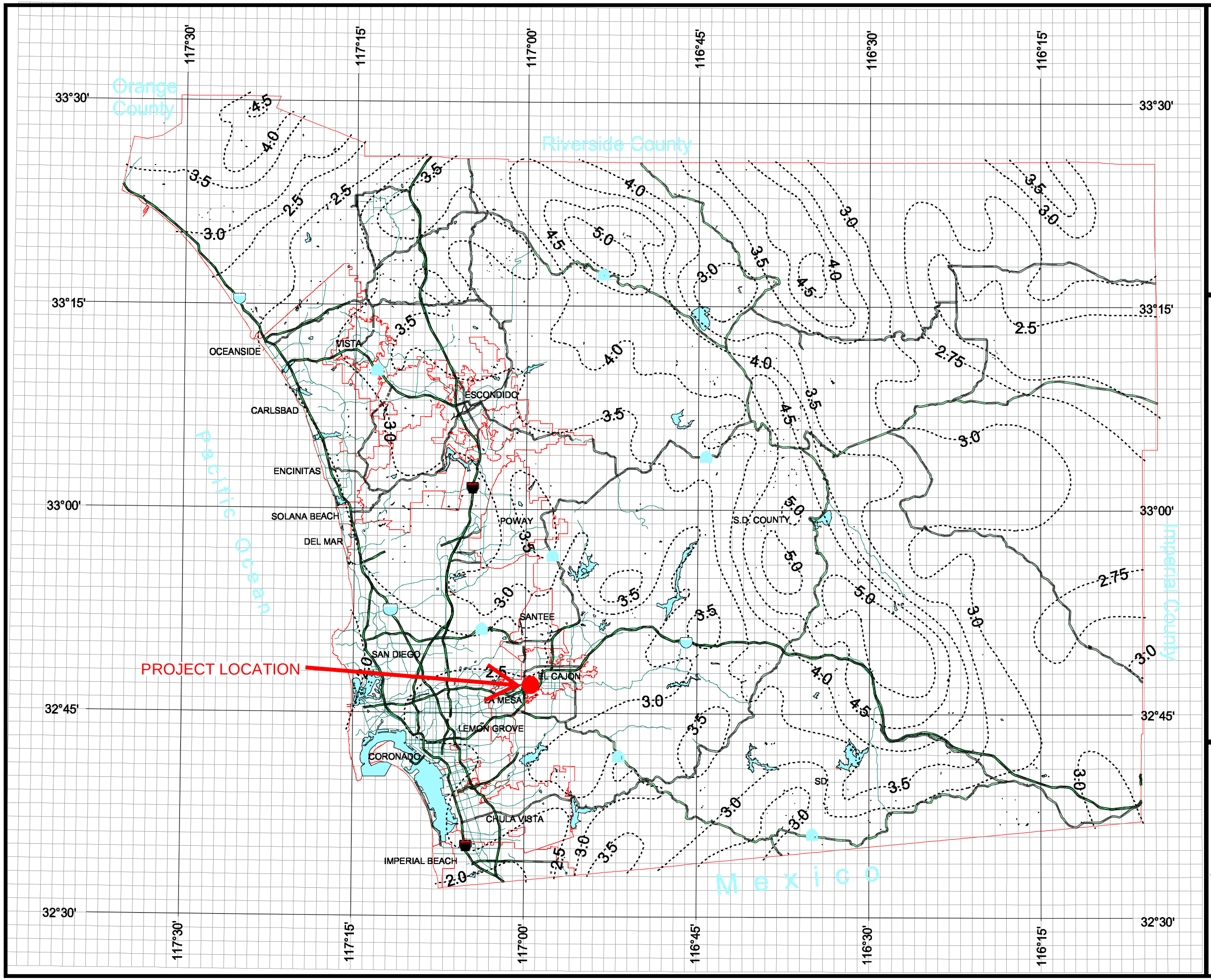
County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

Isopluvial (inches)

P6 = 2.6 INCHES



DPW GIS

SanGIS
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3 0 3 Miles

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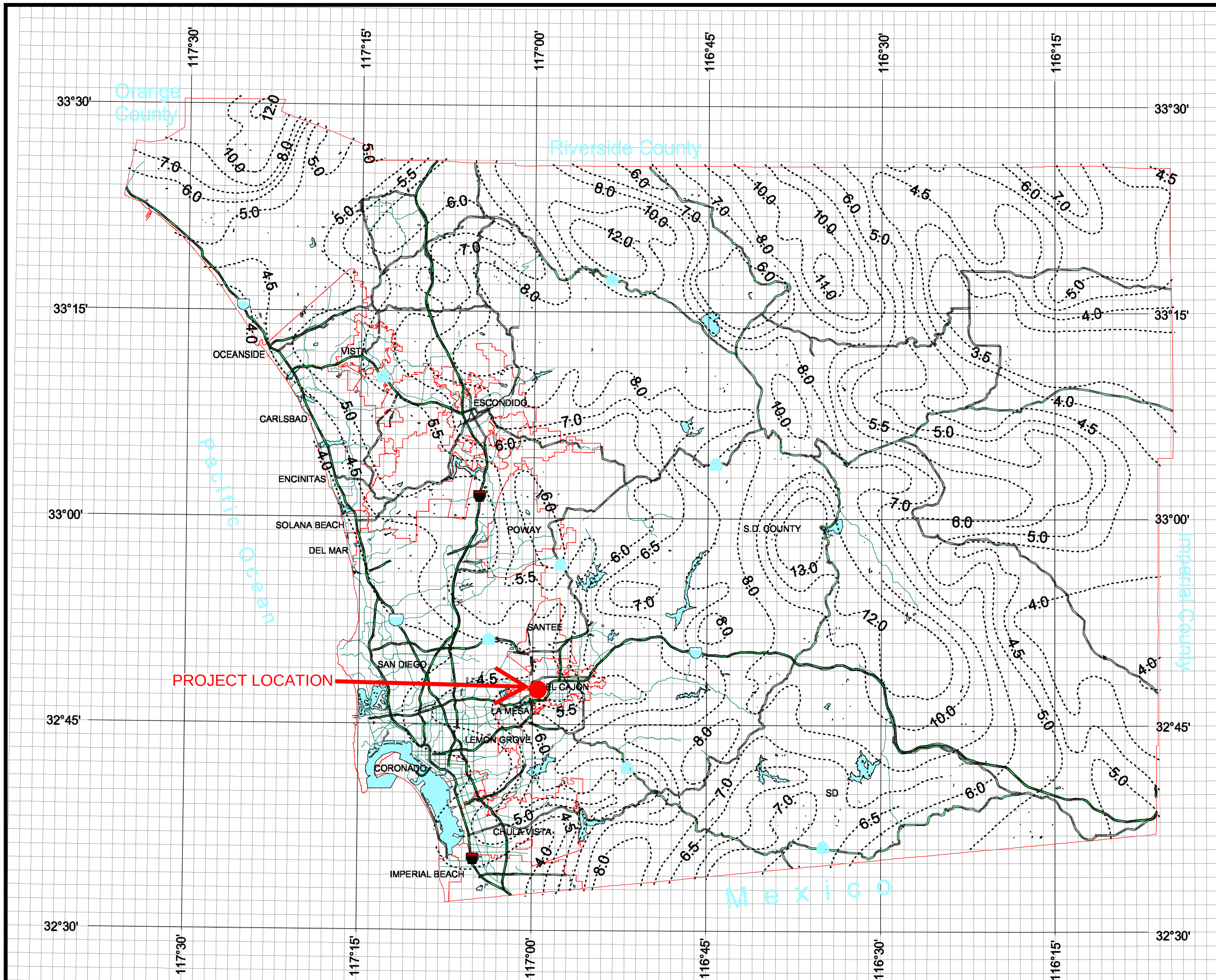
County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 24 Hours

Isopluvial (inches)

P24 = 5.0 INCHES



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N W E S

3 0 3 Miles

NOAA Atlas 14, Volume 6, Version 2
Location name: La Mesa, California, US*
Latitude: 32.7807°, Longitude: -117.0034°
Elevation: 653 ft*
* source: Google Maps

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	0.121 (0.102-0.146)	0.154 (0.129-0.186)	0.198 (0.165-0.239)	0.233 (0.193-0.284)	0.280 (0.224-0.354)	0.317 (0.248-0.409)	0.354 (0.270-0.469)	0.392 (0.290-0.535)	0.443 (0.314-0.632)	0.483 (0.330-0.714)
10-min	0.174 (0.146-0.209)	0.221 (0.185-0.266)	0.283 (0.237-0.342)	0.334 (0.276-0.407)	0.402 (0.321-0.507)	0.454 (0.355-0.586)	0.507 (0.387-0.672)	0.562 (0.416-0.766)	0.636 (0.451-0.906)	0.693 (0.474-1.02)
15-min	0.210 (0.176-0.253)	0.267 (0.224-0.322)	0.342 (0.286-0.414)	0.403 (0.334-0.492)	0.486 (0.389-0.613)	0.549 (0.430-0.709)	0.614 (0.468-0.813)	0.679 (0.503-0.927)	0.769 (0.545-1.10)	0.838 (0.573-1.24)
30-min	0.292 (0.245-0.351)	0.372 (0.312-0.448)	0.476 (0.398-0.576)	0.561 (0.465-0.684)	0.676 (0.541-0.853)	0.764 (0.598-0.986)	0.853 (0.651-1.13)	0.945 (0.700-1.29)	1.07 (0.758-1.52)	1.17 (0.797-1.72)
60-min	0.412 (0.346-0.496)	0.525 (0.440-0.633)	0.672 (0.562-0.812)	0.792 (0.656-0.965)	0.954 (0.763-1.21)	1.08 (0.844-1.39)	1.21 (0.919-1.60)	1.33 (0.988-1.82)	1.51 (1.07-2.15)	1.65 (1.13-2.43)
2-hr	0.570 (0.479-0.686)	0.721 (0.605-0.869)	0.918 (0.768-1.11)	1.08 (0.893-1.31)	1.29 (1.04-1.63)	1.46 (1.14-1.88)	1.63 (1.24-2.15)	1.80 (1.33-2.45)	2.03 (1.44-2.89)	2.21 (1.51-3.26)
3-hr	0.684 (0.574-0.823)	0.865 (0.725-1.04)	1.10 (0.921-1.33)	1.29 (1.07-1.58)	1.55 (1.24-1.96)	1.75 (1.37-2.26)	1.95 (1.49-2.58)	2.16 (1.60-2.94)	2.43 (1.72-3.46)	2.64 (1.81-3.91)
6-hr	0.908 (0.762-1.09)	1.16 (0.971-1.40)	1.49 (1.24-1.79)	1.75 (1.45-2.13)	2.10 (1.68-2.66)	2.38 (1.86-3.07)	2.65 (2.02-3.51)	2.93 (2.17-4.00)	3.31 (2.35-4.72)	3.60 (2.46-5.32)
12-hr	1.18 (0.990-1.42)	1.55 (1.30-1.86)	2.02 (1.69-2.44)	2.41 (2.00-2.93)	2.93 (2.34-3.69)	3.32 (2.60-4.29)	3.72 (2.84-4.93)	4.13 (3.06-5.63)	4.68 (3.32-6.67)	5.10 (3.49-7.54)
24-hr	1.47 (1.29-1.70)	1.96 (1.72-2.28)	2.61 (2.29-3.04)	3.13 (2.72-3.68)	3.84 (3.24-4.65)	4.38 (3.62-5.40)	4.92 (3.98-6.21)	5.48 (4.32-7.09)	6.23 (4.73-8.38)	6.81 (5.00-9.46)
2-day	1.85 (1.63-2.15)	2.46 (2.16-2.86)	3.26 (2.85-3.80)	3.90 (3.39-4.58)	4.77 (4.02-5.77)	5.43 (4.49-6.70)	6.09 (4.93-7.69)	6.78 (5.34-8.77)	7.70 (5.84-10.4)	8.41 (6.18-11.7)
3-day	2.09 (1.84-2.43)	2.78 (2.44-3.23)	3.67 (3.21-4.27)	4.38 (3.81-5.15)	5.35 (4.51-6.47)	6.08 (5.03-7.50)	6.82 (5.51-8.60)	7.58 (5.97-9.81)	8.59 (6.52-11.6)	9.38 (6.89-13.0)
4-day	2.29 (2.01-2.66)	3.04 (2.66-3.53)	4.00 (3.50-4.66)	4.77 (4.15-5.61)	5.82 (4.91-7.05)	6.62 (5.47-8.16)	7.42 (6.00-9.36)	8.24 (6.50-10.7)	9.35 (7.09-12.6)	10.2 (7.50-14.2)
7-day	2.74 (2.40-3.18)	3.62 (3.17-4.20)	4.76 (4.17-5.55)	5.68 (4.94-6.67)	6.93 (5.84-8.39)	7.89 (6.52-9.73)	8.85 (7.16-11.2)	9.85 (7.76-12.7)	11.2 (8.48-15.0)	12.2 (8.98-17.0)
10-day	3.02 (2.66-3.51)	4.00 (3.51-4.65)	5.27 (4.61-6.14)	6.30 (5.47-7.40)	7.69 (6.48-9.31)	8.75 (7.24-10.8)	9.83 (7.95-12.4)	10.9 (8.62-14.2)	12.4 (9.43-16.7)	13.6 (9.98-18.9)
20-day	3.67 (3.23-4.27)	4.89 (4.30-5.69)	6.47 (5.67-7.55)	7.75 (6.74-9.10)	9.47 (7.98-11.5)	10.8 (8.91-13.3)	12.1 (9.79-15.3)	13.5 (10.6-17.4)	15.3 (11.6-20.6)	16.7 (12.3-23.2)
30-day	4.39 (3.86-5.10)	5.87 (5.15-6.82)	7.78 (6.81-9.06)	9.31 (8.09-10.9)	11.4 (9.58-13.8)	12.9 (10.7-16.0)	14.5 (11.7-18.3)	16.1 (12.7-20.9)	18.3 (13.9-24.6)	19.9 (14.6-27.7)
45-day	5.13 (4.51-5.96)	6.88 (6.04-8.00)	9.12 (7.98-10.6)	10.9 (9.48-12.8)	13.3 (11.2-16.1)	15.1 (12.5-18.6)	16.9 (13.7-21.3)	18.7 (14.8-24.2)	21.2 (16.1-28.5)	23.1 (16.9-32.0)
60-day	5.94 (5.22-6.89)	7.95 (6.98-9.24)	10.5 (9.21-12.3)	12.6 (10.9-14.8)	15.3 (12.9-18.5)	17.3 (14.3-21.4)	19.4 (15.7-24.4)	21.4 (16.9-27.7)	24.2 (18.3-32.5)	26.3 (19.3-36.5)

[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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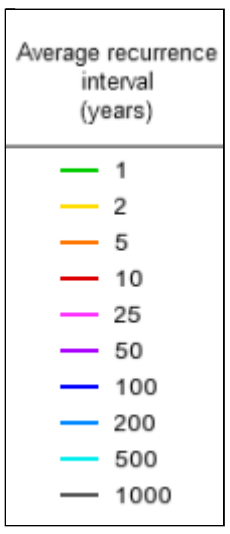
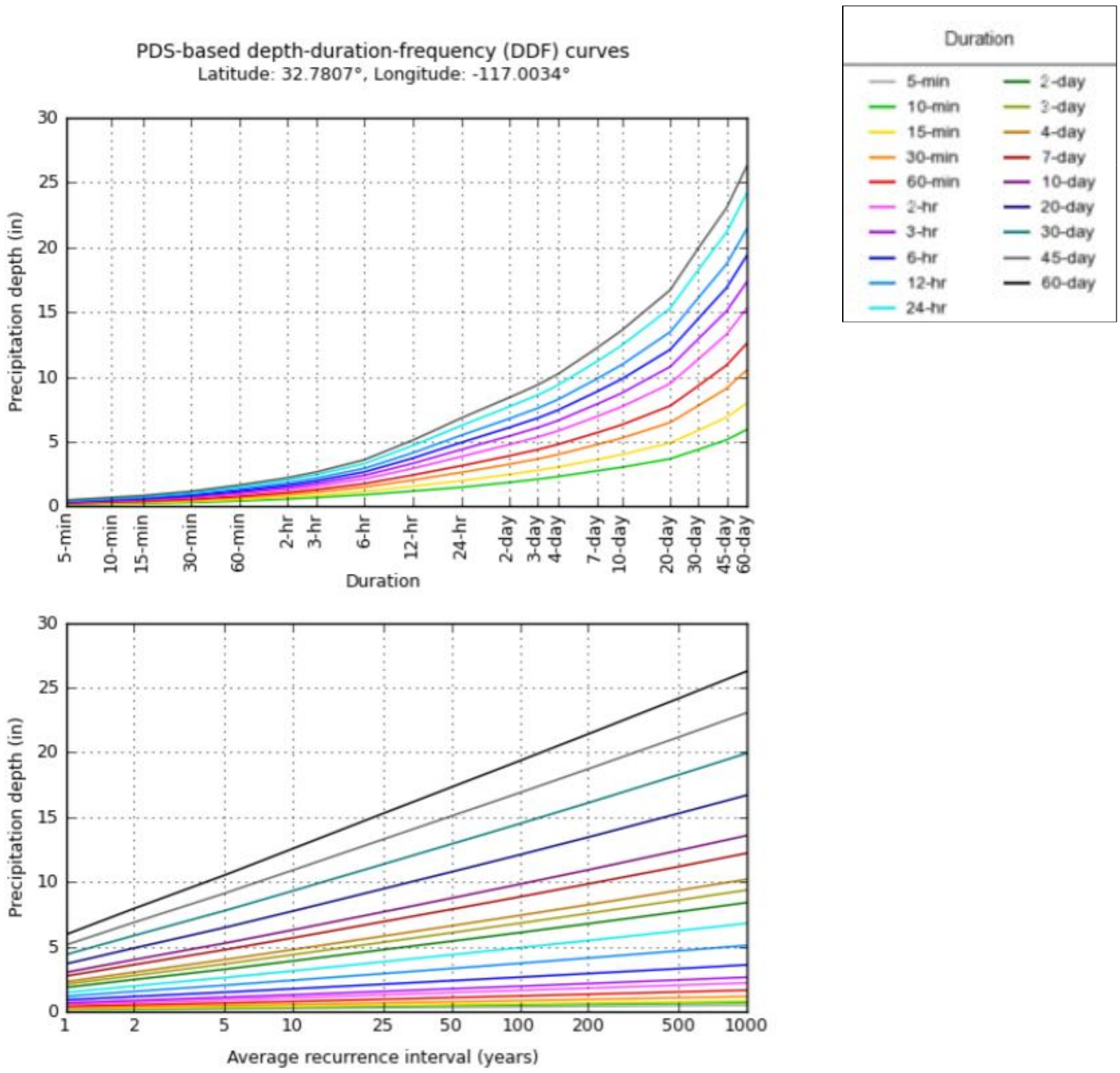
PF graphical





NOAA Atlas 14, Volume 6, Version 2 Created (GMT): Wed Dec 16 18:30:50 2015

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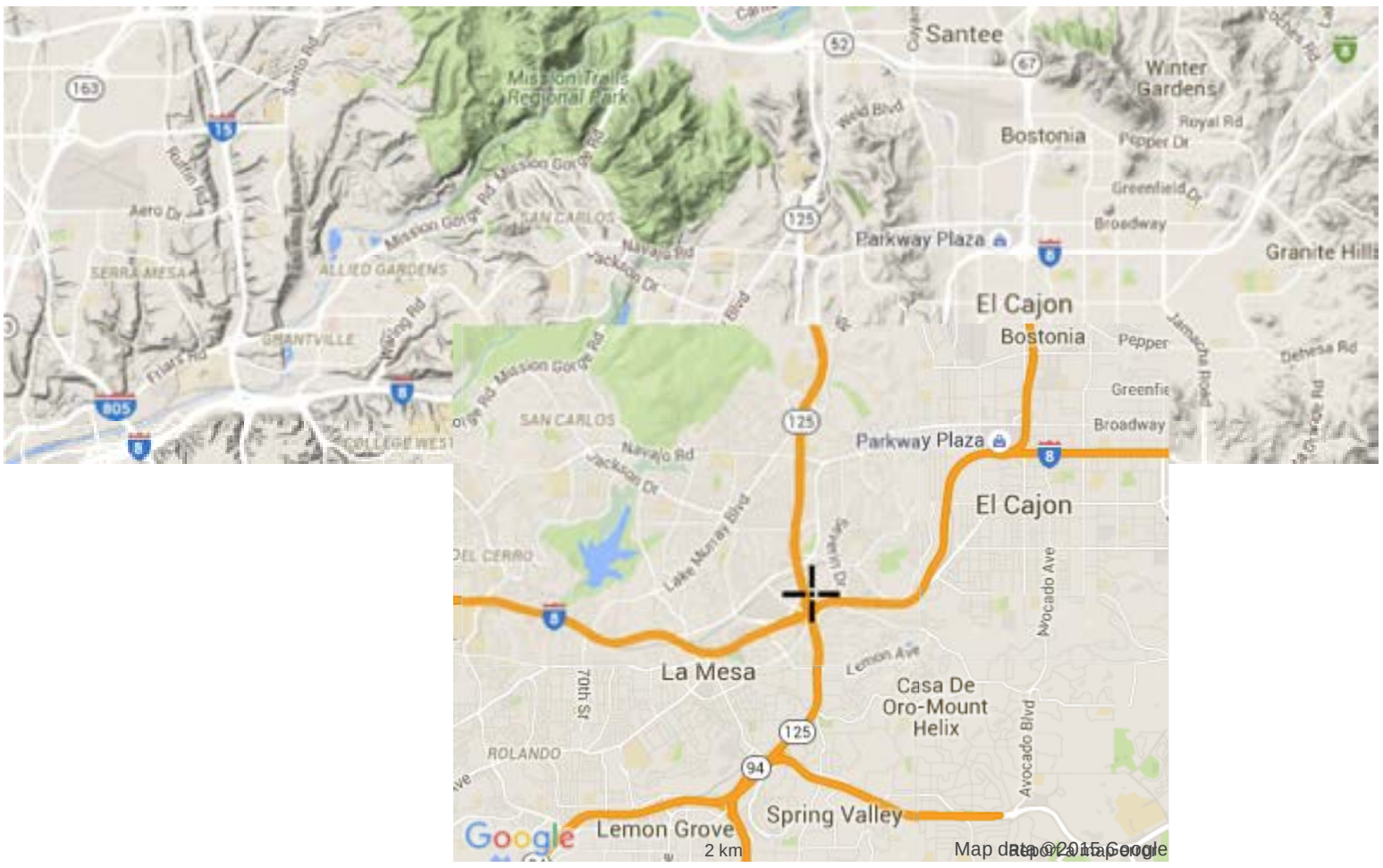
Maps & aerials

Small scale terrain

Large scale terrain



Large scale aerial

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

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NOAA Atlas 14, Volume 6, Version 2
Location name: La Mesa, California, US*
Latitude: 32.7807°, Longitude: -117.0034°
Elevation: 653 ft*
* source: Google Maps

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/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	1.45 (1.22-1.75)	1.85 (1.55-2.23)	2.38 (1.98-2.87)	2.80 (2.32-3.41)	3.36 (2.69-4.25)	3.80 (2.98-4.91)	4.25 (3.24-5.63)	4.70 (3.48-6.42)	5.32 (3.77-7.58)	5.80 (3.96-8.57)
10-min	1.04 (0.876-1.25)	1.33 (1.11-1.60)	1.70 (1.42-2.05)	2.00 (1.66-2.44)	2.41 (1.93-3.04)	2.72 (2.13-3.52)	3.04 (2.32-4.03)	3.37 (2.50-4.60)	3.82 (2.71-5.44)	4.16 (2.84-6.14)
15-min	0.840 (0.704-1.01)	1.07 (0.896-1.29)	1.37 (1.14-1.66)	1.61 (1.34-1.97)	1.94 (1.56-2.45)	2.20 (1.72-2.84)	2.46 (1.87-3.25)	2.72 (2.01-3.71)	3.08 (2.18-4.38)	3.35 (2.29-4.95)
30-min	0.584 (0.490-0.702)	0.744 (0.624-0.896)	0.952 (0.796-1.15)	1.12 (0.930-1.37)	1.35 (1.08-1.71)	1.53 (1.20-1.97)	1.71 (1.30-2.26)	1.89 (1.40-2.58)	2.14 (1.52-3.05)	2.33 (1.59-3.44)
60-min	0.412 (0.346-0.496)	0.525 (0.440-0.633)	0.672 (0.562-0.812)	0.792 (0.656-0.965)	0.954 (0.763-1.21)	1.08 (0.844-1.39)	1.21 (0.919-1.60)	1.33 (0.988-1.82)	1.51 (1.07-2.15)	1.65 (1.13-2.43)
2-hr	0.285 (0.240-0.343)	0.360 (0.302-0.434)	0.459 (0.384-0.555)	0.539 (0.446-0.657)	0.647 (0.518-0.816)	0.730 (0.571-0.942)	0.813 (0.620-1.08)	0.898 (0.666-1.23)	1.01 (0.719-1.44)	1.10 (0.754-1.63)
3-hr	0.228 (0.191-0.274)	0.288 (0.241-0.347)	0.367 (0.307-0.444)	0.431 (0.357-0.525)	0.517 (0.414-0.653)	0.583 (0.456-0.752)	0.649 (0.495-0.860)	0.718 (0.531-0.979)	0.810 (0.574-1.15)	0.880 (0.602-1.30)
6-hr	0.152 (0.127-0.183)	0.194 (0.162-0.233)	0.248 (0.207-0.300)	0.292 (0.242-0.356)	0.351 (0.281-0.444)	0.397 (0.311-0.512)	0.443 (0.338-0.586)	0.489 (0.363-0.668)	0.553 (0.392-0.787)	0.601 (0.411-0.888)
12-hr	0.098 (0.082-0.118)	0.128 (0.108-0.155)	0.168 (0.140-0.203)	0.200 (0.166-0.244)	0.243 (0.194-0.307)	0.276 (0.216-0.356)	0.309 (0.236-0.409)	0.343 (0.254-0.467)	0.388 (0.275-0.553)	0.423 (0.290-0.626)
24-hr	0.061 (0.054-0.071)	0.082 (0.072-0.095)	0.109 (0.095-0.127)	0.131 (0.114-0.153)	0.160 (0.135-0.194)	0.182 (0.151-0.225)	0.205 (0.166-0.259)	0.228 (0.180-0.296)	0.260 (0.197-0.349)	0.284 (0.208-0.394)
2-day	0.039 (0.034-0.045)	0.051 (0.045-0.060)	0.068 (0.059-0.079)	0.081 (0.071-0.095)	0.099 (0.084-0.120)	0.113 (0.093-0.139)	0.127 (0.103-0.160)	0.141 (0.111-0.183)	0.160 (0.122-0.216)	0.175 (0.129-0.243)
3-day	0.029 (0.026-0.034)	0.039 (0.034-0.045)	0.051 (0.045-0.059)	0.061 (0.053-0.071)	0.074 (0.063-0.090)	0.084 (0.070-0.104)	0.095 (0.077-0.120)	0.105 (0.083-0.136)	0.119 (0.091-0.161)	0.130 (0.096-0.181)
4-day	0.024 (0.021-0.028)	0.032 (0.028-0.037)	0.042 (0.036-0.049)	0.050 (0.043-0.058)	0.061 (0.051-0.073)	0.069 (0.057-0.085)	0.077 (0.063-0.098)	0.086 (0.068-0.111)	0.097 (0.074-0.131)	0.106 (0.078-0.148)
7-day	0.016 (0.014-0.019)	0.022 (0.019-0.025)	0.028 (0.025-0.033)	0.034 (0.029-0.040)	0.041 (0.035-0.050)	0.047 (0.039-0.058)	0.053 (0.043-0.066)	0.059 (0.046-0.076)	0.067 (0.050-0.090)	0.073 (0.053-0.101)
10-day	0.013 (0.011-0.015)	0.017 (0.015-0.019)	0.022 (0.019-0.026)	0.026 (0.023-0.031)	0.032 (0.027-0.039)	0.036 (0.030-0.045)	0.041 (0.033-0.052)	0.046 (0.036-0.059)	0.052 (0.039-0.070)	0.057 (0.042-0.079)
20-day	0.008 (0.007-0.009)	0.010 (0.009-0.012)	0.013 (0.012-0.016)	0.016 (0.014-0.019)	0.020 (0.017-0.024)	0.022 (0.019-0.028)	0.025 (0.020-0.032)	0.028 (0.022-0.036)	0.032 (0.024-0.043)	0.035 (0.026-0.048)
30-day	0.006 (0.005-0.007)	0.008 (0.007-0.009)	0.011 (0.009-0.013)	0.013 (0.011-0.015)	0.016 (0.013-0.019)	0.018 (0.015-0.022)	0.020 (0.016-0.025)	0.022 (0.018-0.029)	0.025 (0.019-0.034)	0.028 (0.020-0.038)
45-day	0.005 (0.004-0.006)	0.006 (0.006-0.007)	0.008 (0.007-0.010)	0.010 (0.009-0.012)	0.012 (0.010-0.015)	0.014 (0.012-0.017)	0.016 (0.013-0.020)	0.017 (0.014-0.022)	0.020 (0.015-0.026)	0.021 (0.016-0.030)
60-day	0.004 (0.004-0.005)	0.006 (0.005-0.006)	0.007 (0.006-0.009)	0.009 (0.008-0.010)	0.011 (0.009-0.013)	0.012 (0.010-0.015)	0.013 (0.011-0.017)	0.015 (0.012-0.019)	0.017 (0.013-0.023)	0.018 (0.013-0.025)

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

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

Please refer to NOAA Atlas 14 document for more information.

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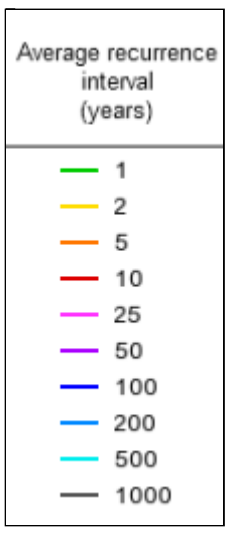
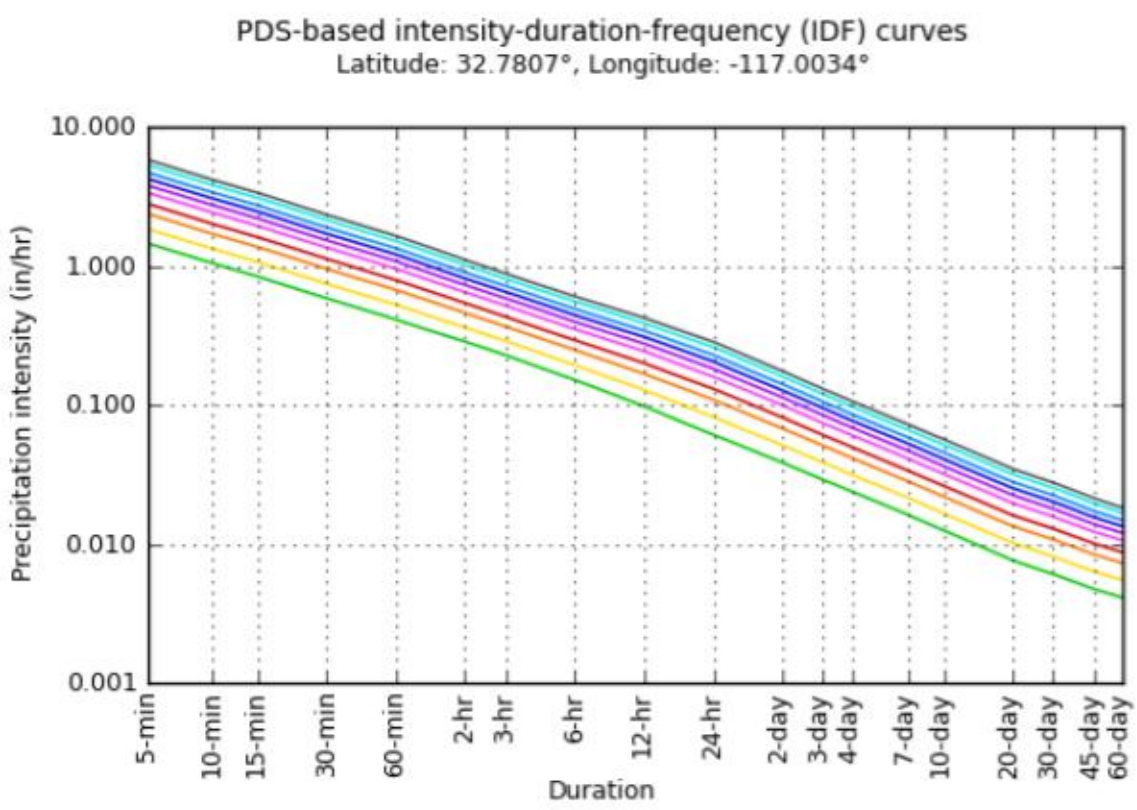
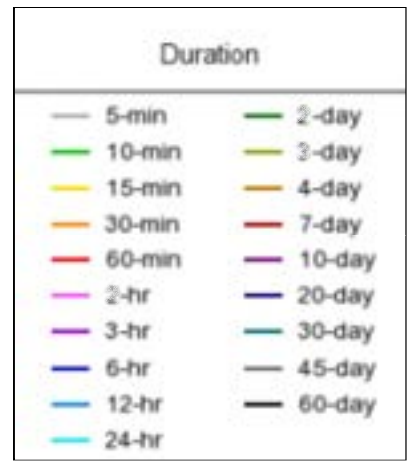
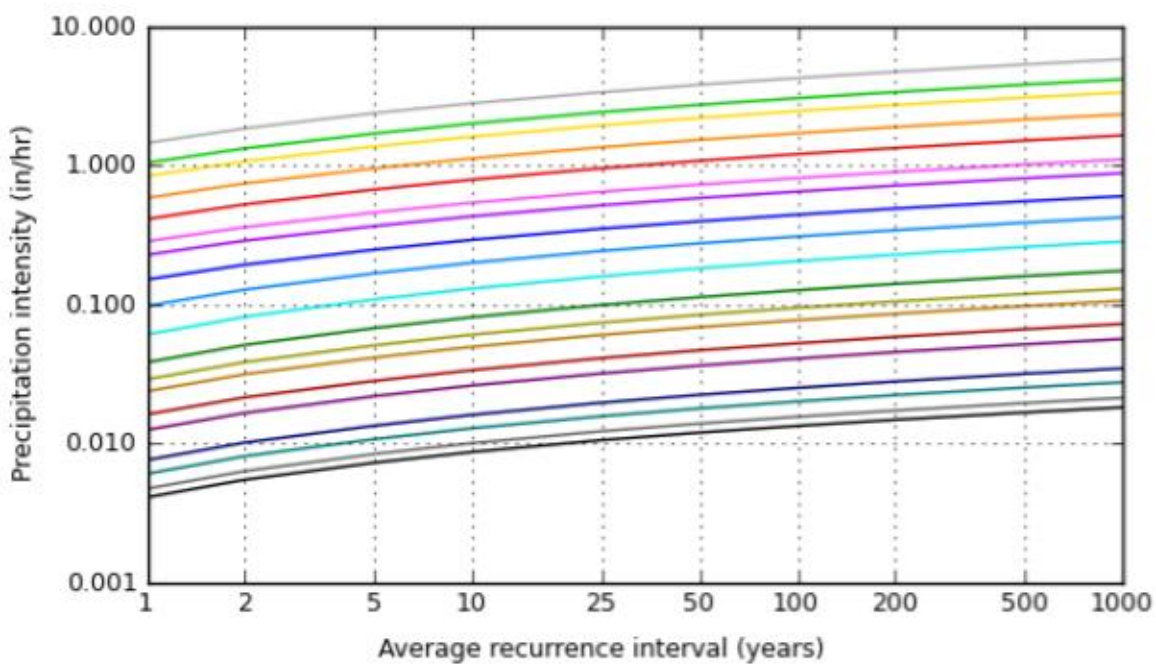
PF graphical









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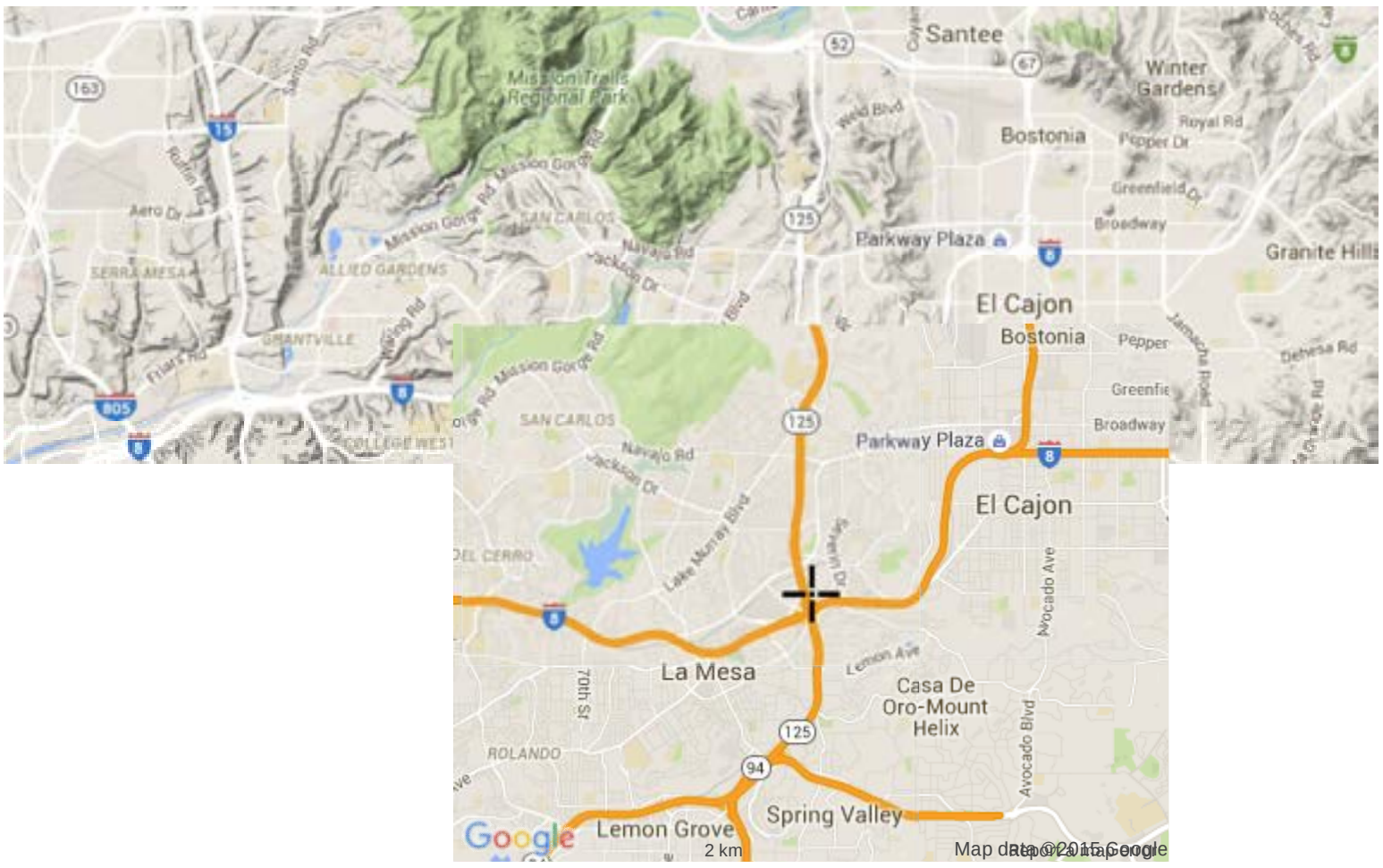
Maps & aerials

Small scale terrain

Large scale terrain



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

APPENDIX B

RICKRAT HYDROGRAPH CALCULATIONS

RATIONAL METHOD HYDROGRAPH PROGRAM
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DMA A

RUN DATE 3/24/2016
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 5 MIN.
6 HOUR RAINFALL 2.6 INCHES
BASIN AREA 0.49 ACRES
RUNOFF COEFFICIENT 0.75
PEAK DISCHARGE 2.52 CFS

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RATIONAL METHOD HYDROGRAPH PROGRAM
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DMA B

RUN DATE 3/24/2016
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 5 MIN.
6 HOUR RAINFALL 2.6 INCHES
BASIN AREA 0.51 ACRES
RUNOFF COEFFICIENT 0.75
PEAK DISCHARGE 2.62 CFS

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DMA C

RUN DATE 3/24/2016
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 5 MIN.
6 HOUR RAINFALL 2.6 INCHES
BASIN AREA 0.94 ACRES
RUNOFF COEFFICIENT 0.75
PEAK DISCHARGE 4.83 CFS

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DMA E

RUN DATE 3/24/2016
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 5 MIN.
6 HOUR RAINFALL 2.6 INCHES
BASIN AREA 0.88 ACRES
RUNOFF COEFFICIENT 0.75
PEAK DISCHARGE 4.52 CFS

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TIME (MIN) = 165	DISCHARGE (CFS) = 0.2
TIME (MIN) = 170	DISCHARGE (CFS) = 0.2
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TIME (MIN) = 215	DISCHARGE (CFS) = 0.4
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TIME (MIN) = 325	DISCHARGE (CFS) = 0.1
TIME (MIN) = 330	DISCHARGE (CFS) = 0.1
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TIME (MIN) = 360	DISCHARGE (CFS) = 0.1
TIME (MIN) = 365	DISCHARGE (CFS) = 0

RATIONAL METHOD HYDROGRAPH PROGRAM
COPYRIGHT 1992, 2001 RICK ENGINEERING COMPANY

DMA H

RUN DATE 3/24/2016
HYDROGRAPH FILE NAME Text1
TIME OF CONCENTRATION 5 MIN.
6 HOUR RAINFALL 2.6 INCHES
BASIN AREA 0.34 ACRES
RUNOFF COEFFICIENT 0.75
PEAK DISCHARGE 1.75 CFS

TIME (MIN) = 0	DISCHARGE (CFS) = 0
TIME (MIN) = 5	DISCHARGE (CFS) = 0
TIME (MIN) = 10	DISCHARGE (CFS) = 0
TIME (MIN) = 15	DISCHARGE (CFS) = 0
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TIME (MIN) = 200	DISCHARGE (CFS) = 0.1
TIME (MIN) = 205	DISCHARGE (CFS) = 0.1
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TIME (MIN) = 290	DISCHARGE (CFS) = 0.1

TIME (MIN) = 295	DISCHARGE (CFS) = 0.1
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TIME (MIN) = 315	DISCHARGE (CFS) = 0.1
TIME (MIN) = 320	DISCHARGE (CFS) = 0.1
TIME (MIN) = 325	DISCHARGE (CFS) = 0.1
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TIME (MIN) = 335	DISCHARGE (CFS) = 0
TIME (MIN) = 340	DISCHARGE (CFS) = 0
TIME (MIN) = 345	DISCHARGE (CFS) = 0
TIME (MIN) = 350	DISCHARGE (CFS) = 0
TIME (MIN) = 355	DISCHARGE (CFS) = 0
TIME (MIN) = 360	DISCHARGE (CFS) = 0
TIME (MIN) = 365	DISCHARGE (CFS) = 0

APPENDIX C

HYDRAFLOW HYDROGRAPH CALCULATIONS

Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2013 by Autodesk, Inc. v10

Legend

Hyd.	Origin	Description
1	Manual	DMA A
2	Manual	DMA B
3	Manual	DMA C
4	Manual	DMA E
5	Manual	DMA H
6	Reservoir	Basin A
7	Reservoir	Basin B
8	Reservoir	Basin C
9	Reservoir	Basin E
10	Reservoir	Basin H

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2013 by Autodesk, Inc. v10

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Manual	2.520	5	245	3,726	------	------	------	DMA A
2	Manual	2.620	5	245	3,846	------	------	------	DMA B
3	Manual	4.830	5	245	6,549	------	------	------	DMA C
4	Manual	4.520	5	245	6,066	------	------	------	DMA E
5	Manual	1.750	5	245	2,385	------	------	------	DMA H
6	Reservoir	2.210	5	245	3,722	1	648.68	807	Basin A
7	Reservoir	2.587	5	245	3,833	2	649.40	1,123	Basin B
8	Reservoir	1.478	5	250	6,510	3	648.19	3,848	Basin C
9	Reservoir	3.408	5	245	6,031	4	650.86	2,312	Basin E
10	Reservoir	0.059	5	325	2,374	5	648.13	1,680	Basin H

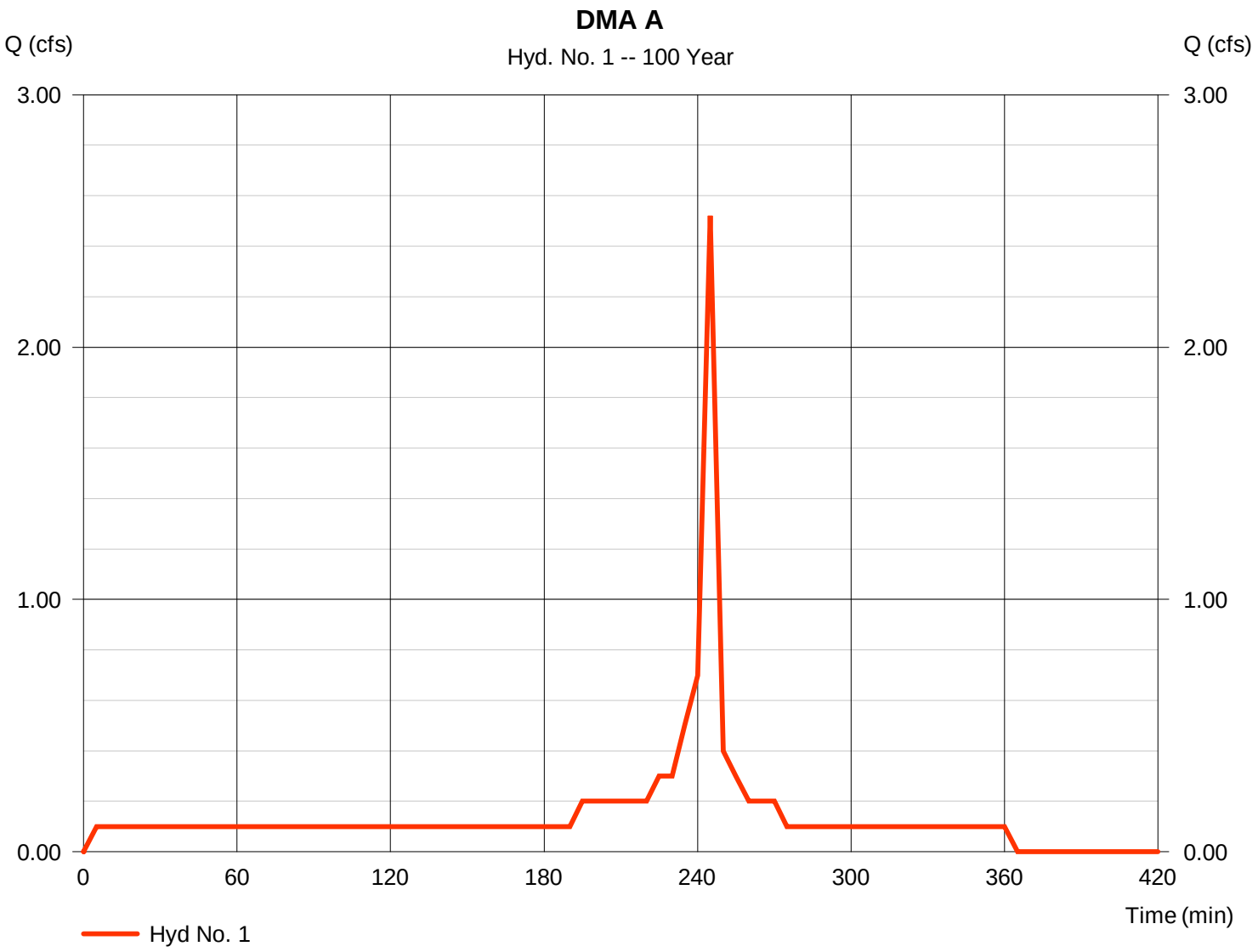
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2013 by Autodesk, Inc. v10 Friday, 04 / 1 / 2016

Hyd. No. 1

DMA A

Hydrograph type	= Manual	Peak discharge	= 2.520 cfs
Storm frequency	= 100 yrs	Time to peak	= 245 min
Time interval	= 5 min	Hyd. volume	= 3,726 cuft



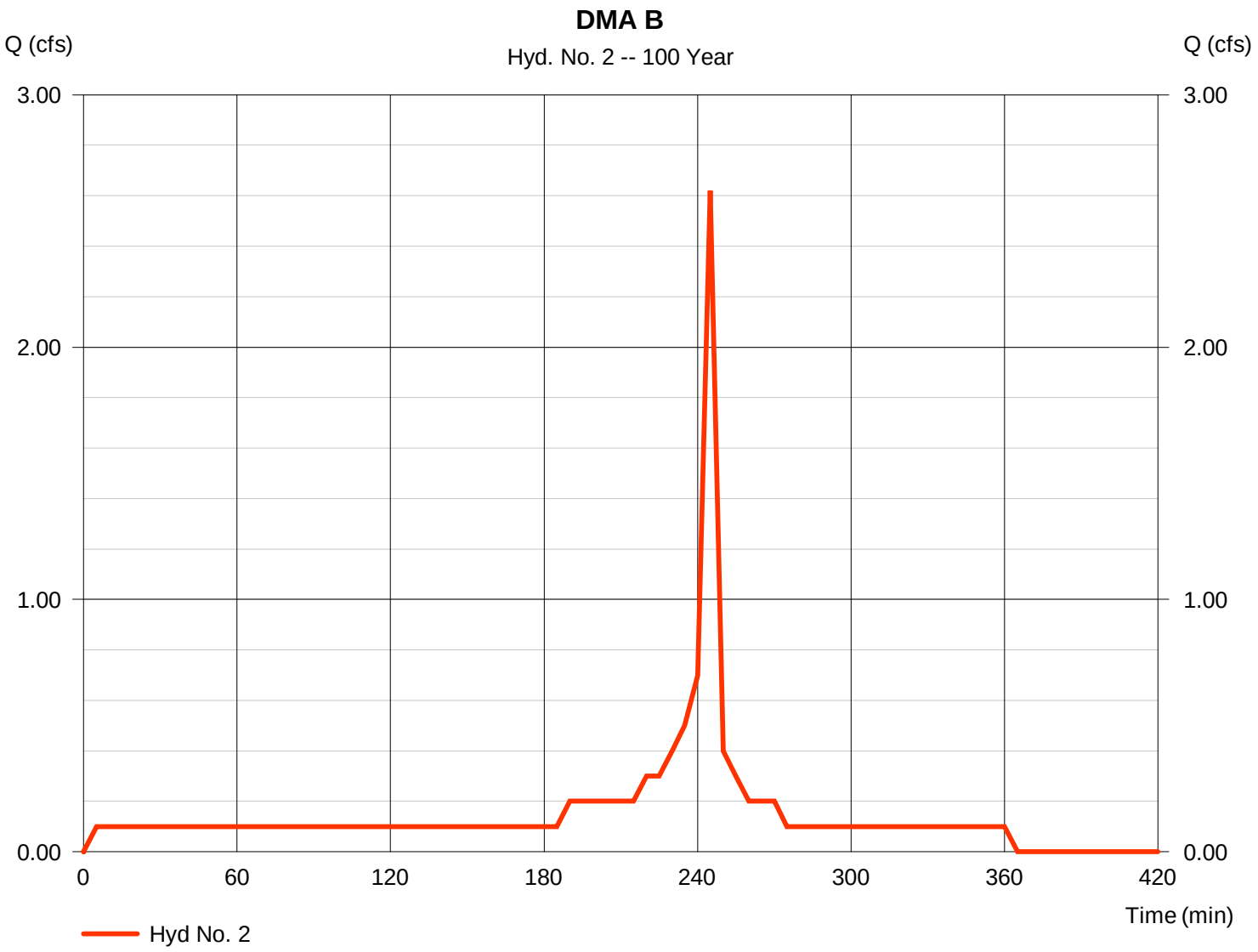
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2013 by Autodesk, Inc. v10 Friday, 04 / 1 / 2016

Hyd. No. 2

DMA B

Hydrograph type	= Manual	Peak discharge	= 2.620 cfs
Storm frequency	= 100 yrs	Time to peak	= 245 min
Time interval	= 5 min	Hyd. volume	= 3,846 cuft



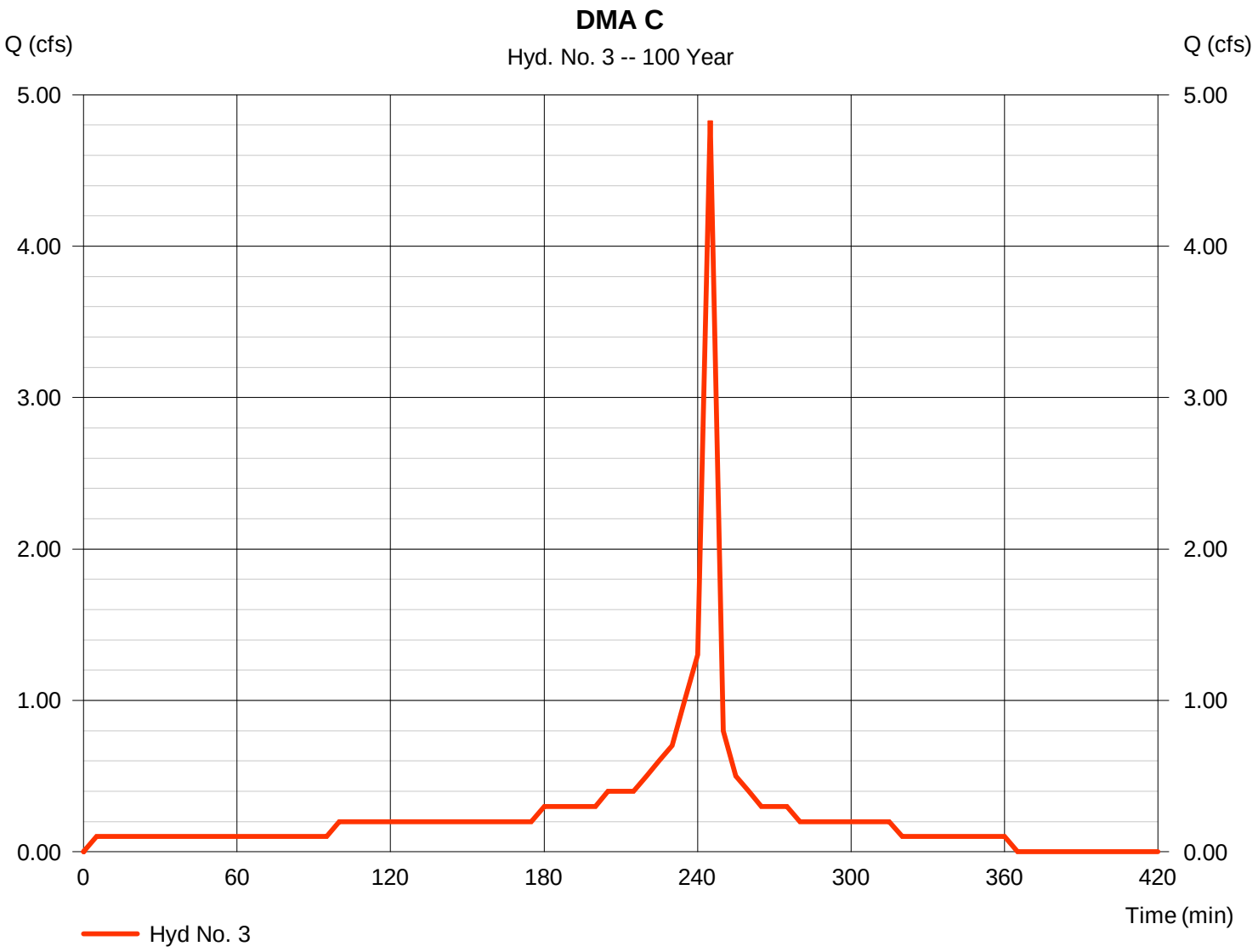
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2013 by Autodesk, Inc. v10 Friday, 04 / 1 / 2016

Hyd. No. 3

DMA C

Hydrograph type	= Manual	Peak discharge	= 4.830 cfs
Storm frequency	= 100 yrs	Time to peak	= 245 min
Time interval	= 5 min	Hyd. volume	= 6,549 cuft



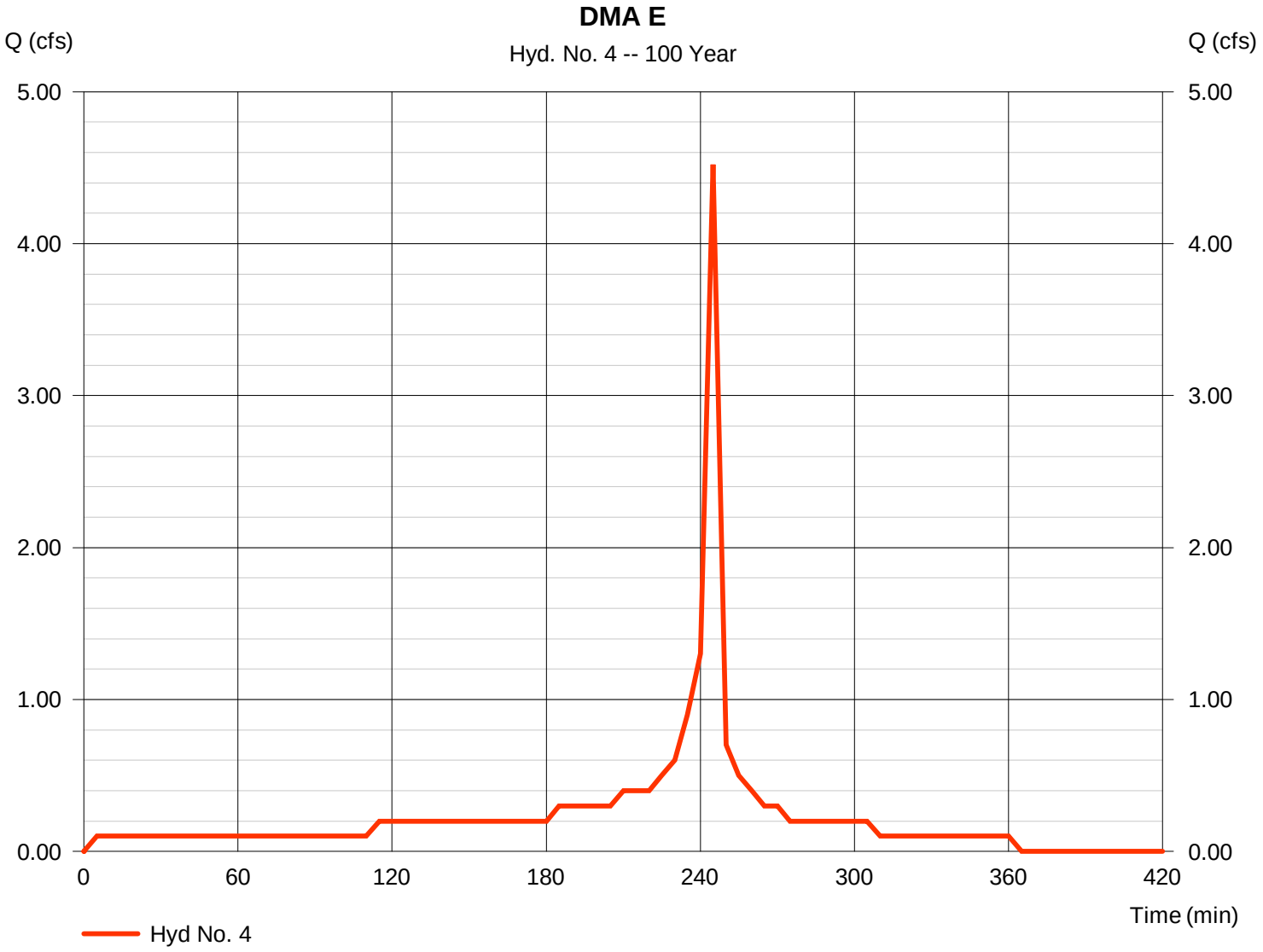
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2013 by Autodesk, Inc. v10 Friday, 04 / 1 / 2016

Hyd. No. 4

DMA E

Hydrograph type	= Manual	Peak discharge	= 4.520 cfs
Storm frequency	= 100 yrs	Time to peak	= 245 min
Time interval	= 5 min	Hyd. volume	= 6,066 cuft



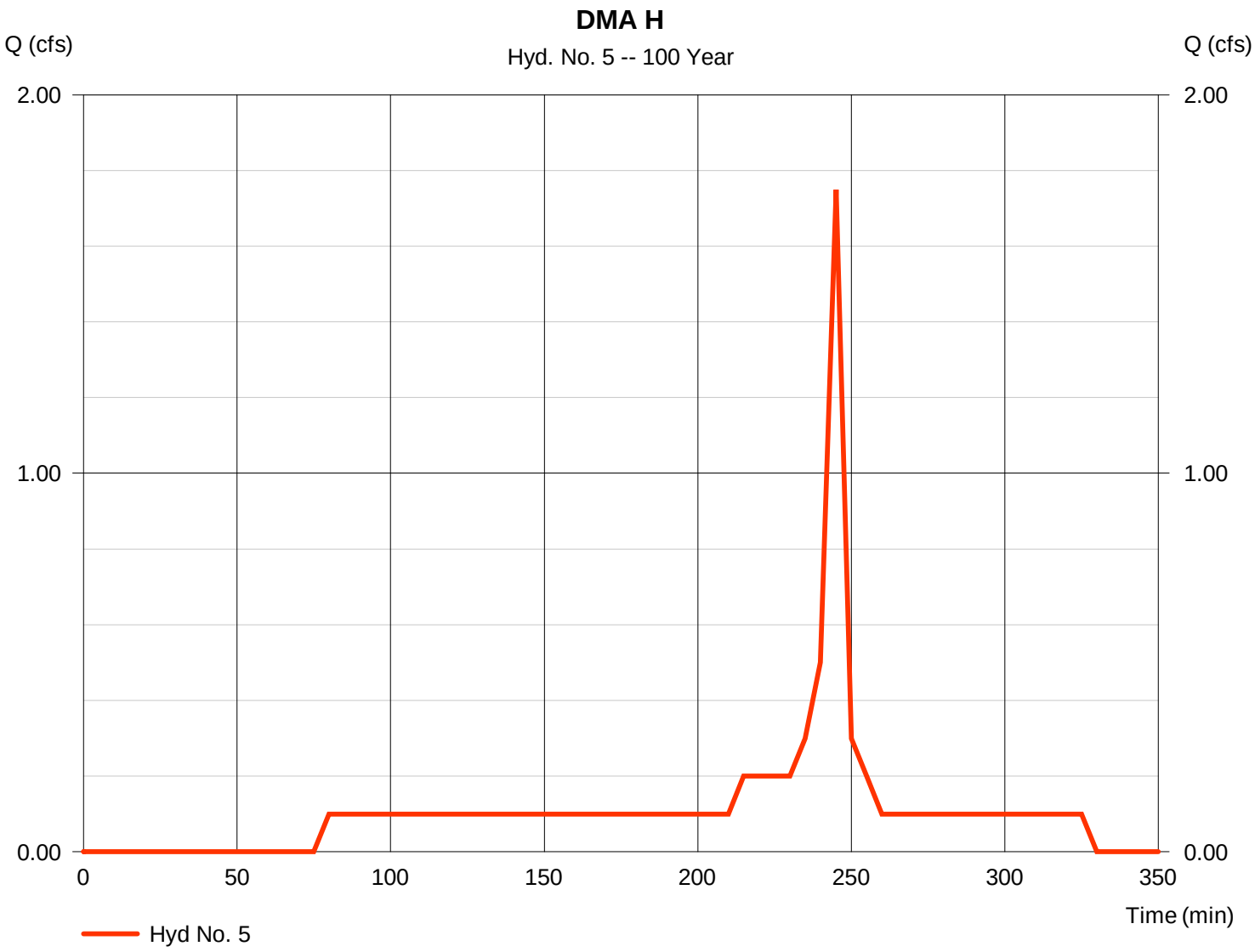
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2013 by Autodesk, Inc. v10 Friday, 04 / 1 / 2016

Hyd. No. 5

DMA H

Hydrograph type	= Manual	Peak discharge	= 1.750 cfs
Storm frequency	= 100 yrs	Time to peak	= 245 min
Time interval	= 5 min	Hyd. volume	= 2,385 cuft



Hydrograph Report

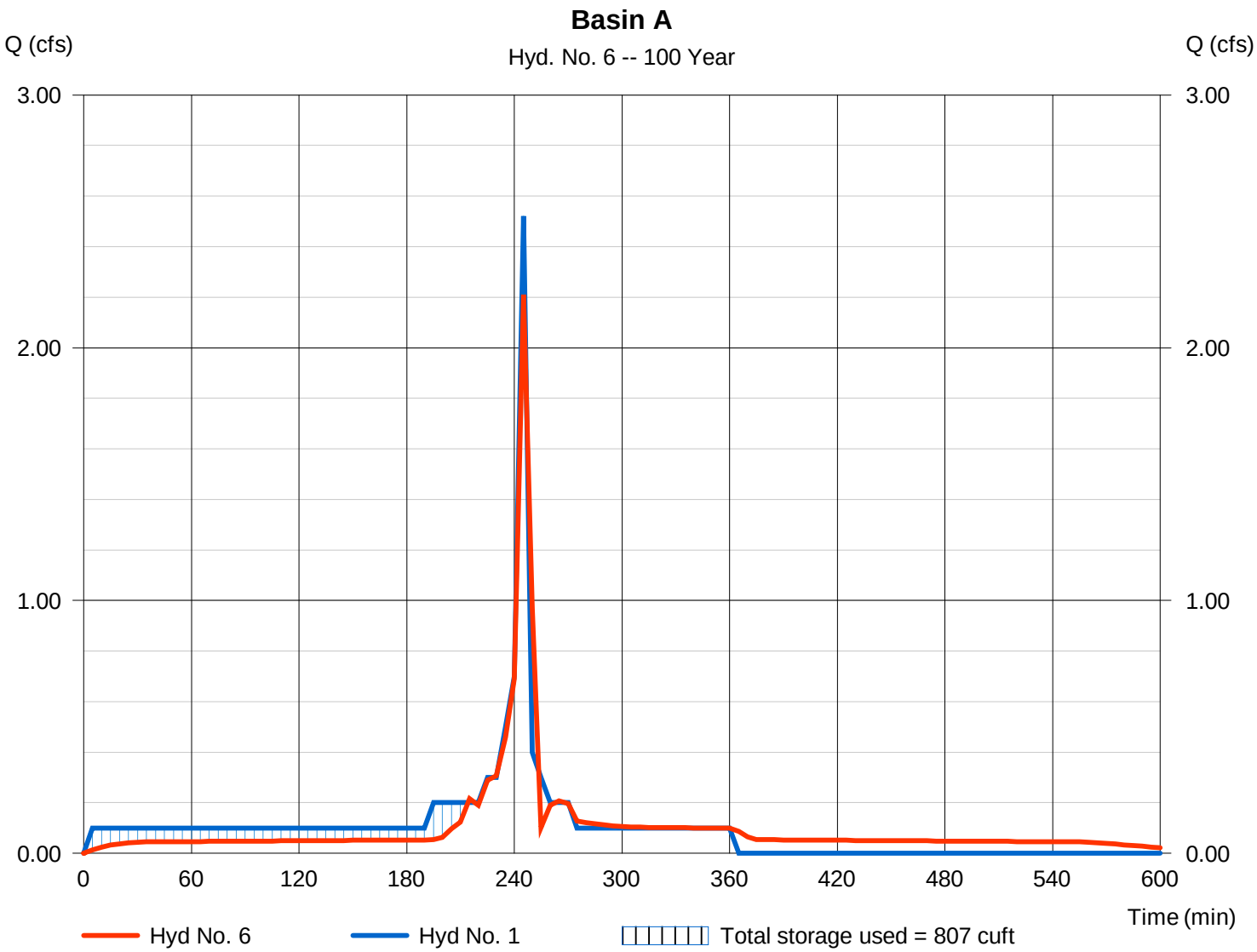
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2013 by Autodesk, Inc. v10 Friday, 04 / 1 / 2016

Hyd. No. 6

Basin A

Hydrograph type	=	Reservoir	Peak discharge	=	2.210 cfs
Storm frequency	=	100 yrs	Time to peak	=	245 min
Time interval	=	5 min	Hyd. volume	=	3,722 cuft
Inflow hyd. No.	=	1 - DMA A	Max. Elevation	=	648.68 ft
Reservoir name	=	Basin A	Max. Storage	=	807 cuft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2013 by Autodesk, Inc. v10 Friday, 04 / 1 / 2016

Pond No. 1 - Basin A

Pond Data

UG Chambers - Invert elev. = 643.90 ft , Rise x Span = 0.00 x 3.00 ft , Barrel Len = 33.00 ft , No. Barrels = 1 , Slope = 0.00% , Headers = No
Embankment - Invert elev. = 643.90 ft , Width = 20.00 ft , Height = 3.00 ft , Volume = 35 cuft , Slope = 3:1 , Beginning Elevation = 647.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	643.90	n/a	0	0
0.30	644.20	n/a	10	10
0.60	644.50	n/a	10	21
0.90	644.80	n/a	10	31
1.20	645.10	n/a	10	42
1.50	645.40	n/a	10	52
1.80	645.70	n/a	10	62
2.10	646.00	n/a	10	73
2.40	646.30	n/a	10	83
2.70	646.60	n/a	10	94
3.00	646.90	n/a	10	104
3.10	647.00	337	11	115
5.00	647.50	492	783	898
5.50	648.00	664	288	1,186
6.00	648.50	850	378	1,564
6.50	649.00	1,051	474	2,038

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 18.00	1.00	0.00	0.00
Span (in)	= 18.00	1.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 644.00	644.00	0.00	0.00
Length (ft)	= 10.00	1.00	0.00	0.00
Slope (%)	= 1.00	1.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 8.00	0.00	0.00	0.00
Crest El. (ft)	= 648.50	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	---	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)
TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	643.90	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
0.03	1	643.93	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
0.06	2	643.96	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
0.09	3	643.99	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
0.12	4	644.02	0.00 ic	0.00 ic	---	---	0.00	---	---	---	---	---	0.001
0.15	5	644.05	0.00 ic	0.00 ic	---	---	0.00	---	---	---	---	---	0.003
0.18	6	644.08	0.01 ic	0.01 ic	---	---	0.00	---	---	---	---	---	0.005
0.21	7	644.11	0.01 ic	0.01 ic	---	---	0.00	---	---	---	---	---	0.007
0.24	8	644.14	0.01 ic	0.01 ic	---	---	0.00	---	---	---	---	---	0.008
0.27	9	644.17	0.01 ic	0.01 ic	---	---	0.00	---	---	---	---	---	0.009
0.30	10	644.20	0.01 ic	0.01 ic	---	---	0.00	---	---	---	---	---	0.010
0.33	12	644.23	0.01 ic	0.01 ic	---	---	0.00	---	---	---	---	---	0.011
0.36	13	644.26	0.01 ic	0.01 ic	---	---	0.00	---	---	---	---	---	0.012
0.39	14	644.29	0.01 ic	0.01 ic	---	---	0.00	---	---	---	---	---	0.013
0.42	15	644.32	0.01 ic	0.01 ic	---	---	0.00	---	---	---	---	---	0.014
0.45	16	644.35	0.01 ic	0.01 ic	---	---	0.00	---	---	---	---	---	0.014
0.48	17	644.38	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.015
0.51	18	644.41	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.016
0.54	19	644.44	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.016
0.57	20	644.47	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.017
0.60	21	644.50	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.018
0.63	22	644.53	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.018
0.66	23	644.56	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.019
0.69	24	644.59	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.019
0.72	25	644.62	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.020
0.75	26	644.65	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.020

Continues on next page...

Basin A

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.78	27	644.68	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.021
0.81	28	644.71	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.021
0.84	29	644.74	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.022
0.87	30	644.77	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.022
0.90	31	644.80	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.023
0.93	32	644.83	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.023
0.96	33	644.86	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.023
0.99	34	644.89	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.024
1.02	35	644.92	0.03 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.024
1.05	36	644.95	0.03 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.025
1.08	37	644.98	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.025
1.11	39	645.01	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.026
1.14	40	645.04	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.026
1.17	41	645.07	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.026
1.20	42	645.10	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.027
1.23	43	645.13	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.027
1.26	44	645.16	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.027
1.29	45	645.19	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.028
1.32	46	645.22	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.028
1.35	47	645.25	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.029
1.38	48	645.28	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.029
1.41	49	645.31	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.029
1.44	50	645.34	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.030
1.47	51	645.37	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.030
1.50	52	645.40	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.030
1.53	53	645.43	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.031
1.56	54	645.46	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.031
1.59	55	645.49	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.031
1.62	56	645.52	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.032
1.65	57	645.55	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.032
1.68	58	645.58	0.04 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.032
1.71	59	645.61	0.04 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.033
1.74	60	645.64	0.04 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.033
1.77	61	645.67	0.04 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.033
1.80	62	645.70	0.04 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.033
1.83	63	645.73	0.04 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.034
1.86	65	645.76	0.04 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.034
1.89	66	645.79	0.04 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.034
1.92	67	645.82	0.04 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.035
1.95	68	645.85	0.04 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.035
1.98	69	645.88	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.035
2.01	70	645.91	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.036
2.04	71	645.94	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.036
2.07	72	645.97	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.036
2.10	73	646.00	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.036
2.13	74	646.03	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.037
2.16	75	646.06	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.037
2.19	76	646.09	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.037
2.22	77	646.12	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.037
2.25	78	646.15	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.038
2.28	79	646.18	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.038
2.31	80	646.21	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.038
2.34	81	646.24	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.039
2.37	82	646.27	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.039
2.40	83	646.30	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.039
2.43	84	646.33	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.039
2.46	85	646.36	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.040
2.49	86	646.39	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.040
2.52	87	646.42	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.040
2.55	88	646.45	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.040
2.58	89	646.48	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.041
2.61	91	646.51	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.041
2.64	92	646.54	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.041
2.67	93	646.57	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.041
2.70	94	646.60	0.05 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.042
2.73	95	646.63	0.05 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.042
2.76	96	646.66	0.05 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.042
2.79	97	646.69	0.05 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.042
2.82	98	646.72	0.05 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.043
2.85	99	646.75	0.05 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.043
2.88	100	646.78	0.05 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.043
2.91	101	646.81	0.05 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.043

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Basin A

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
2.94	102	646.84	0.05 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.044
2.97	103	646.87	0.05 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.044
3.00	104	646.90	0.05 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.044
3.01	105	646.91	0.05 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.044
3.02	106	646.92	0.05 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.044
3.03	107	646.93	0.05 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.044
3.04	109	646.94	0.05 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.044
3.05	110	646.95	0.05 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.044
3.06	111	646.96	0.05 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.045
3.07	112	646.97	0.05 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.045
3.08	113	646.98	0.05 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.045
3.09	114	646.99	0.05 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.045
3.10	115	647.00	0.05 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.045
3.29	194	647.19	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.046
3.48	272	647.38	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.048
3.67	350	647.57	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.049
3.86	428	647.76	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.050
4.05	507	647.95	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.052
4.24	585	648.14	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.053
4.43	663	648.33	0.06 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.054
4.62	742	648.52	0.13 ic	0.05 ic	---	---	0.08	---	---	---	---	---	0.130
4.81	820	648.71	2.64 oc	0.05 ic	---	---	2.56	---	---	---	---	---	2.614
5.00	898	647.50	2.58 oc	0.04 ic	---	---	0.00	---	---	---	---	---	0.041
5.05	927	647.55	2.55 oc	0.04 ic	---	---	0.00	---	---	---	---	---	0.042
5.10	956	647.60	2.52 oc	0.04 ic	---	---	0.00	---	---	---	---	---	0.042
5.15	984	647.65	2.49 oc	0.04 ic	---	---	0.00	---	---	---	---	---	0.043
5.20	1,013	647.70	2.45 oc	0.04 ic	---	---	0.00	---	---	---	---	---	0.043
5.25	1,042	647.75	2.42 oc	0.04 ic	---	---	0.00	---	---	---	---	---	0.044
5.30	1,071	647.80	2.42 oc	0.04 ic	---	---	0.00	---	---	---	---	---	0.044
5.35	1,100	647.85	2.39 oc	0.04 ic	---	---	0.00	---	---	---	---	---	0.045
5.40	1,128	647.90	2.36 oc	0.05 ic	---	---	0.00	---	---	---	---	---	0.045
5.45	1,157	647.95	2.32 oc	0.05 ic	---	---	0.00	---	---	---	---	---	0.046
5.50	1,186	648.00	2.29 oc	0.05 ic	---	---	0.00	---	---	---	---	---	0.046
5.55	1,224	648.05	2.26 oc	0.05 ic	---	---	0.00	---	---	---	---	---	0.046
5.60	1,262	648.10	2.22 oc	0.05 ic	---	---	0.00	---	---	---	---	---	0.047
5.65	1,299	648.15	2.19 oc	0.05 ic	---	---	0.00	---	---	---	---	---	0.047
5.70	1,337	648.20	2.15 oc	0.05 ic	---	---	0.00	---	---	---	---	---	0.048
5.75	1,375	648.25	2.12 oc	0.05 ic	---	---	0.00	---	---	---	---	---	0.048
5.80	1,413	648.30	2.08 oc	0.05 ic	---	---	0.00	---	---	---	---	---	0.049
5.85	1,450	648.35	2.05 oc	0.05 ic	---	---	0.00	---	---	---	---	---	0.049
5.90	1,488	648.40	2.01 oc	0.05 ic	---	---	0.00	---	---	---	---	---	0.050
5.95	1,526	648.45	1.98 oc	0.05 ic	---	---	0.00	---	---	---	---	---	0.050
6.00	1,564	648.50	1.94 oc	0.05 ic	---	---	0.00	---	---	---	---	---	0.050
6.05	1,611	648.55	1.91 oc	0.05 ic	---	---	0.30	---	---	---	---	---	0.349
6.10	1,658	648.60	1.87 oc	0.05 ic	---	---	0.84	---	---	---	---	---	0.893
6.15	1,706	648.65	1.84 oc	0.05 ic	---	---	1.55	---	---	---	---	---	1.599
6.20	1,753	648.70	2.45 oc	0.05 ic	---	---	2.38	---	---	---	---	---	2.433
6.25	1,801	648.75	3.38 oc	0.05 ic	---	---	3.33	---	---	---	---	---	3.377
6.30	1,848	648.80	4.42 oc	0.05 ic	---	---	4.38	---	---	---	---	---	4.423
6.35	1,896	648.85	5.56 oc	0.05 ic	---	---	5.51	---	---	---	---	---	5.561
6.40	1,943	648.90	6.78 oc	0.05 ic	---	---	6.74	---	---	---	---	---	6.783
6.45	1,990	648.95	8.08 oc	0.05 ic	---	---	8.04	---	---	---	---	---	8.084
6.50	2,038	649.00	9.46 oc	0.04 ic	---	---	9.42	---	---	---	---	---	9.463

...End

Hydrograph Report

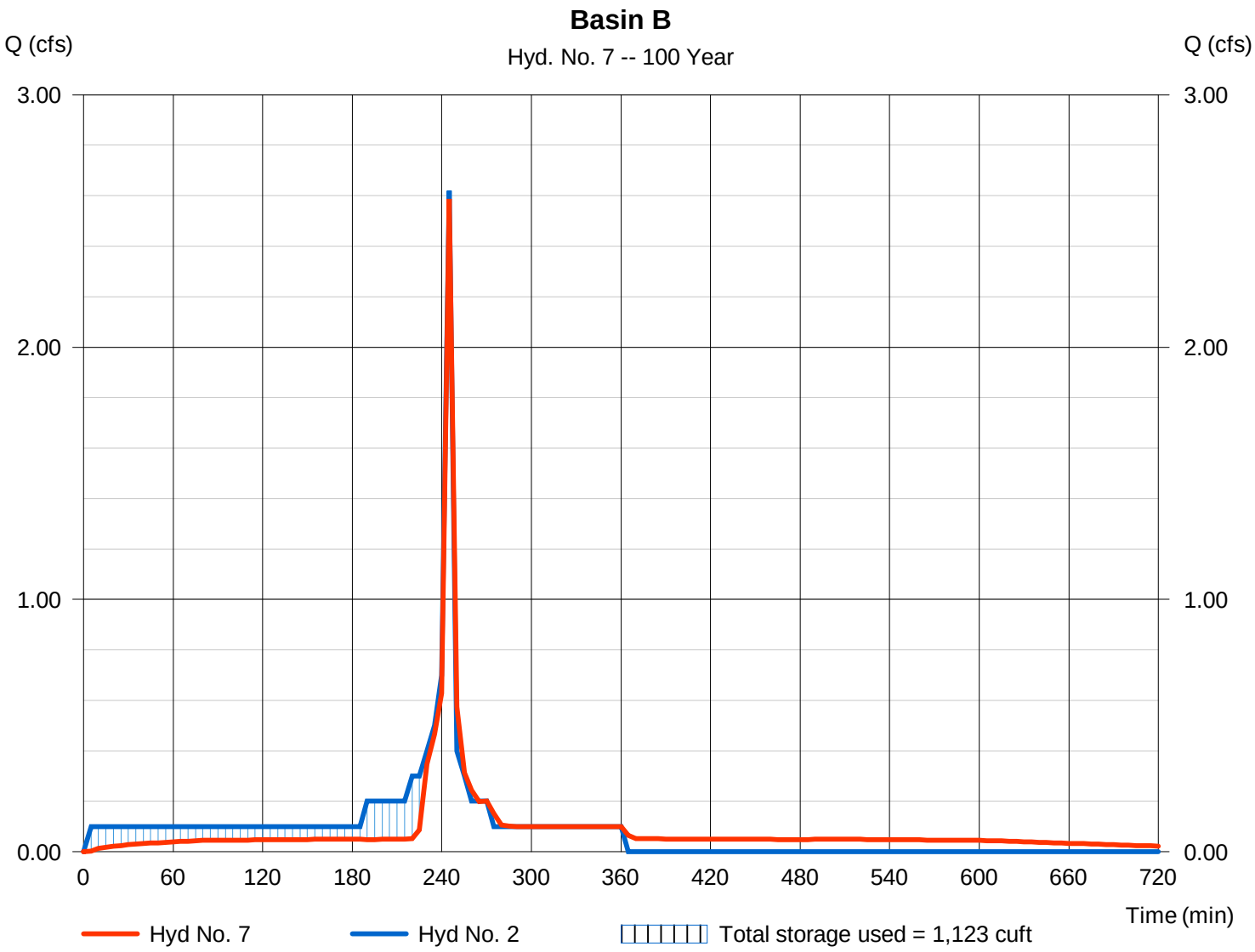
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2013 by Autodesk, Inc. v10 Friday, 04 / 1 / 2016

Hyd. No. 7

Basin B

Hydrograph type	=	Reservoir	Peak discharge	=	2.587 cfs
Storm frequency	=	100 yrs	Time to peak	=	245 min
Time interval	=	5 min	Hyd. volume	=	3,833 cuft
Inflow hyd. No.	=	2 - DMA B	Max. Elevation	=	649.40 ft
Reservoir name	=	Basin B	Max. Storage	=	1,123 cuft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2013 by Autodesk, Inc. v10 Friday, 04 / 1 / 2016

Pond No. 2 - Basin B

Pond Data

UG Chambers - Invert elev. = 644.90 ft , Rise x Span = 0.00 x 3.00 ft , Barrel Len = 100.00 ft , No. Barrels = 1 , Slope = 0.00% , Headers = No

Contours - User-defined contour areas. Conic method used for volumes. Begining Elevation = 648.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	644.90	n/a	0	0
0.30	645.20	n/a	32	32
0.60	645.50	n/a	32	63
0.90	645.80	n/a	32	95
1.20	646.10	n/a	32	126
1.50	646.40	n/a	32	158
1.80	646.70	n/a	32	189
2.10	647.00	n/a	32	221
2.40	647.30	n/a	32	252
2.70	647.60	n/a	32	284
3.00	647.90	n/a	32	315
3.10	648.00	241	8	323
4.00	648.50	553	348	671
4.50	649.00	880	355	1,026
4.60	649.50	1,222	105	1,131

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 12.00	1.00	0.00	0.00
Span (in)	= 12.00	1.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 645.00	645.00	0.00	0.00
Length (ft)	= 10.00	1.00	0.00	0.00
Slope (%)	= 1.00	1.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 8.00	0.00	0.00	0.00
Crest El. (ft)	= 649.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	---	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	644.90	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
0.03	3	644.93	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
0.06	6	644.96	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
0.09	10	644.99	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
0.12	13	645.02	0.00 ic	0.00 ic	---	---	0.00	---	---	---	---	---	0.000
0.15	16	645.05	0.00 ic	0.00 ic	---	---	0.00	---	---	---	---	---	0.003
0.18	19	645.08	0.01 ic	0.01 ic	---	---	0.00	---	---	---	---	---	0.005
0.21	22	645.11	0.01 ic	0.01 ic	---	---	0.00	---	---	---	---	---	0.007
0.24	25	645.14	0.01 ic	0.01 ic	---	---	0.00	---	---	---	---	---	0.008
0.27	29	645.17	0.01 ic	0.01 ic	---	---	0.00	---	---	---	---	---	0.009
0.30	32	645.20	0.01 ic	0.01 ic	---	---	0.00	---	---	---	---	---	0.010
0.33	35	645.23	0.01 ic	0.01 ic	---	---	0.00	---	---	---	---	---	0.011
0.36	38	645.26	0.01 ic	0.01 ic	---	---	0.00	---	---	---	---	---	0.012
0.39	41	645.29	0.01 ic	0.01 ic	---	---	0.00	---	---	---	---	---	0.013
0.42	44	645.32	0.01 ic	0.01 ic	---	---	0.00	---	---	---	---	---	0.014
0.45	47	645.35	0.01 ic	0.01 ic	---	---	0.00	---	---	---	---	---	0.014
0.48	51	645.38	0.01 ic	0.01 ic	---	---	0.00	---	---	---	---	---	0.015
0.51	54	645.41	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.016
0.54	57	645.44	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.016
0.57	60	645.47	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.017
0.60	63	645.50	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.017
0.63	66	645.53	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.018
0.66	70	645.56	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.019
0.69	73	645.59	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.019
0.72	76	645.62	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.020
0.75	79	645.65	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.020
0.78	82	645.68	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.021

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Basin B

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.81	85	645.71	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.021
0.84	88	645.74	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.022
0.87	92	645.77	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.022
0.90	95	645.80	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.022
0.93	98	645.83	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.023
0.96	101	645.86	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.023
0.99	104	645.89	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.024
1.02	107	645.92	0.03 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.024
1.05	110	645.95	0.03 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.025
1.08	114	645.98	0.03 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.025
1.11	117	646.01	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.025
1.14	120	646.04	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.026
1.17	123	646.07	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.026
1.20	126	646.10	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.027
1.23	129	646.13	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.027
1.26	133	646.16	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.027
1.29	136	646.19	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.028
1.32	139	646.22	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.028
1.35	142	646.25	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.028
1.38	145	646.28	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.029
1.41	148	646.31	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.029
1.44	151	646.34	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.029
1.47	155	646.37	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.030
1.50	158	646.40	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.030
1.53	161	646.43	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.030
1.56	164	646.46	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.031
1.59	167	646.49	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.031
1.62	170	646.52	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.031
1.65	173	646.55	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.032
1.68	177	646.58	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.032
1.71	180	646.61	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.032
1.74	183	646.64	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.033
1.77	186	646.67	0.04 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.033
1.80	189	646.70	0.04 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.033
1.83	192	646.73	0.04 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.034
1.86	196	646.76	0.04 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.034
1.89	199	646.79	0.04 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.034
1.92	202	646.82	0.04 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.035
1.95	205	646.85	0.04 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.035
1.98	208	646.88	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.035
2.01	211	646.91	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.035
2.04	214	646.94	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.036
2.07	218	646.97	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.036
2.10	221	647.00	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.036
2.13	224	647.03	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.037
2.16	227	647.06	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.037
2.19	230	647.09	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.037
2.22	233	647.12	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.037
2.25	236	647.15	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.038
2.28	240	647.18	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.038
2.31	243	647.21	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.038
2.34	246	647.24	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.038
2.37	249	647.27	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.039
2.40	252	647.30	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.039
2.43	255	647.33	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.039
2.46	259	647.36	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.040
2.49	262	647.39	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.040
2.52	265	647.42	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.040
2.55	268	647.45	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.040
2.58	271	647.48	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.041
2.61	274	647.51	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.041
2.64	277	647.54	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.041
2.67	281	647.57	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.041
2.70	284	647.60	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.042
2.73	287	647.63	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.042
2.76	290	647.66	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.042
2.79	293	647.69	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.042
2.82	296	647.72	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.043
2.85	300	647.75	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.043
2.88	303	647.78	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.043
2.91	306	647.81	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.043
2.94	309	647.84	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.043

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Basin B

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
2.97	312	647.87	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.044
3.00	315	647.90	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.044
3.01	316	647.91	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.044
3.02	317	647.92	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.044
3.03	318	647.93	0.05 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.044
3.04	318	647.94	0.05 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.044
3.05	319	647.95	0.05 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.044
3.06	320	647.96	0.05 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.044
3.07	321	647.97	0.05 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.044
3.08	322	647.98	0.05 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.045
3.09	322	647.99	0.05 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.045
3.10	323	648.00	0.05 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.045
3.19	358	648.09	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.045
3.28	393	648.18	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.046
3.37	428	648.27	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.047
3.46	462	648.36	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.047
3.55	497	648.45	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.048
3.64	532	648.54	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.049
3.73	567	648.63	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.049
3.82	601	648.72	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.050
3.91	636	648.81	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.051
4.00	671	648.50	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.048
4.05	706	648.55	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.049
4.10	742	648.60	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.049
4.15	778	648.65	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.049
4.20	813	648.70	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.050
4.25	849	648.75	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.050
4.30	884	648.80	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.050
4.35	920	648.85	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.051
4.40	955	648.90	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.051
4.45	991	648.95	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.051
4.50	1,026	649.00	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.052
4.51	1,037	649.01	0.08 ic	0.05 ic	---	---	0.03	---	---	---	---	---	0.078
4.52	1,047	649.02	0.13 ic	0.05 ic	---	---	0.08	---	---	---	---	---	0.127
4.53	1,057	649.03	0.19 ic	0.05 ic	---	---	0.14	---	---	---	---	---	0.190
4.54	1,068	649.04	0.26 ic	0.05 ic	---	---	0.21	---	---	---	---	---	0.265
4.55	1,078	649.05	0.36 oc	0.05 ic	---	---	0.30	---	---	---	---	---	0.349
4.56	1,089	649.06	0.45 oc	0.05 ic	---	---	0.39	---	---	---	---	---	0.443
4.57	1,099	649.07	0.56 oc	0.05 ic	---	---	0.49	---	---	---	---	---	0.544
4.58	1,110	649.08	0.66 oc	0.05 ic	---	---	0.60	---	---	---	---	---	0.654
4.59	1,120	649.09	0.77 oc	0.05 ic	---	---	0.72	---	---	---	---	---	0.770
4.60	1,131	649.50	7.37 ic	0.01 ic	---	---	7.36 s	---	---	---	---	---	7.374

...End

Hydrograph Report

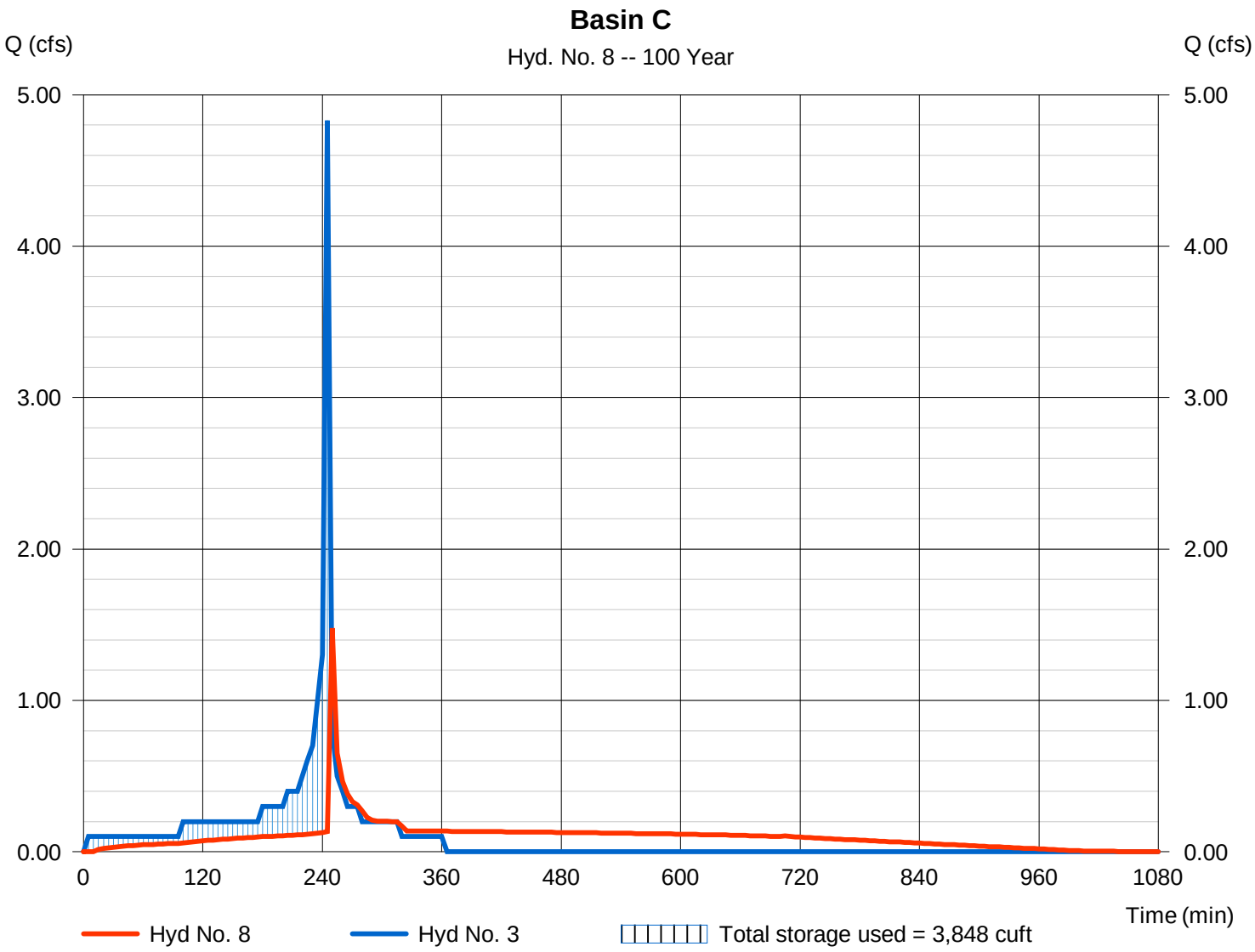
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2013 by Autodesk, Inc. v10 Friday, 04 / 1 / 2016

Hyd. No. 8

Basin C

Hydrograph type	=	Reservoir	Peak discharge	=	1.478 cfs
Storm frequency	=	100 yrs	Time to peak	=	250 min
Time interval	=	5 min	Hyd. volume	=	6,510 cuft
Inflow hyd. No.	=	3 - DMA C	Max. Elevation	=	648.19 ft
Reservoir name	=	Basin C	Max. Storage	=	3,848 cuft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2013 by Autodesk, Inc. v10 Friday, 04 / 1 / 2016

Pond No. 3 - Basin C

Pond Data

UG Chambers - Invert elev. = 642.40 ft , Rise x Span = 0.00 x 9.00 ft , Barrel Len = 100.00 ft , No. Barrels = 1 , Slope = 0.00% , Headers = No
Contours - User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 645.50 ft
Exclusion: Invert elev. = 642.40 ft, Width = 9.00 ft, Height = 3.00 ft, Volume = 35.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	642.40	n/a	0	0
0.30	642.70	n/a	95	95
0.60	643.00	n/a	95	190
0.90	643.30	n/a	95	284
1.20	643.60	n/a	95	379
1.50	643.90	n/a	95	473
1.80	644.20	n/a	95	568
2.10	644.50	n/a	95	662
2.40	644.80	n/a	95	757
2.70	645.10	n/a	95	851
3.00	645.40	n/a	95	946
3.60	645.50	397	79	1,025
4.10	646.00	615	251	1,276
4.60	646.50	872	370	1,646
5.10	647.00	1,148	503	2,149
5.60	647.50	1,440	646	2,795
6.10	648.00	1,745	795	3,590
6.60	648.50	2,064	951	4,541

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 18.00	1.50	0.00	0.00
Span (in)	= 18.00	1.50	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 642.50	642.50	0.00	0.00
Length (ft)	= 10.00	1.00	0.00	0.00
Slope (%)	= 1.00	1.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 8.00	0.00	0.00	0.00
Crest El. (ft)	= 648.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	---	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)
TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	642.40	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
0.03	10	642.43	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
0.06	19	642.46	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
0.09	29	642.49	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
0.12	38	642.52	0.00 ic	0.00 ic	---	---	0.00	---	---	---	---	---	0.001
0.15	48	642.55	0.00 ic	0.00 ic	---	---	0.00	---	---	---	---	---	0.004
0.18	57	642.58	0.01 ic	0.01 ic	---	---	0.00	---	---	---	---	---	0.008
0.21	67	642.61	0.01 ic	0.01 ic	---	---	0.00	---	---	---	---	---	0.013
0.24	76	642.64	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.016
0.27	86	642.67	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.019
0.30	95	642.70	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.022
0.33	105	642.73	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.024
0.36	114	642.76	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.026
0.39	123	642.79	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.028
0.42	133	642.82	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.029
0.45	142	642.85	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.031
0.48	152	642.88	0.04 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.033
0.51	161	642.91	0.04 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.034
0.54	171	642.94	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.036
0.57	180	642.97	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.037
0.60	190	643.00	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.038
0.63	199	643.03	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.040
0.66	209	643.06	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.041
0.69	218	643.09	0.05 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.042

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Basin C

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.72	227	643.12	0.05 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.043
0.75	237	643.15	0.05 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.044
0.78	246	643.18	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.045
0.81	256	643.21	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.046
0.84	265	643.24	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.048
0.87	275	643.27	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.049
0.90	284	643.30	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.050
0.93	294	643.33	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.051
0.96	303	643.36	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.052
0.99	312	643.39	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.053
1.02	322	643.42	0.06 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.054
1.05	331	643.45	0.06 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.055
1.08	341	643.48	0.06 ic	0.06 ic	---	---	0.00	---	---	---	---	---	0.055
1.11	350	643.51	0.06 ic	0.06 ic	---	---	0.00	---	---	---	---	---	0.056
1.14	360	643.54	0.06 ic	0.06 ic	---	---	0.00	---	---	---	---	---	0.057
1.17	369	643.57	0.06 ic	0.06 ic	---	---	0.00	---	---	---	---	---	0.058
1.20	379	643.60	0.06 ic	0.06 ic	---	---	0.00	---	---	---	---	---	0.059
1.23	388	643.63	0.06 ic	0.06 ic	---	---	0.00	---	---	---	---	---	0.060
1.26	398	643.66	0.06 ic	0.06 ic	---	---	0.00	---	---	---	---	---	0.061
1.29	407	643.69	0.06 ic	0.06 ic	---	---	0.00	---	---	---	---	---	0.062
1.32	416	643.72	0.06 ic	0.06 ic	---	---	0.00	---	---	---	---	---	0.062
1.35	426	643.75	0.06 ic	0.06 ic	---	---	0.00	---	---	---	---	---	0.063
1.38	435	643.78	0.06 ic	0.06 ic	---	---	0.00	---	---	---	---	---	0.064
1.41	445	643.81	0.06 ic	0.06 ic	---	---	0.00	---	---	---	---	---	0.065
1.44	454	643.84	0.07 ic	0.07 ic	---	---	0.00	---	---	---	---	---	0.066
1.47	464	643.87	0.07 ic	0.07 ic	---	---	0.00	---	---	---	---	---	0.066
1.50	473	643.90	0.07 ic	0.07 ic	---	---	0.00	---	---	---	---	---	0.067
1.53	483	643.93	0.07 ic	0.07 ic	---	---	0.00	---	---	---	---	---	0.068
1.56	492	643.96	0.07 ic	0.07 ic	---	---	0.00	---	---	---	---	---	0.069
1.59	502	643.99	0.07 ic	0.07 ic	---	---	0.00	---	---	---	---	---	0.069
1.62	511	644.02	0.07 ic	0.07 ic	---	---	0.00	---	---	---	---	---	0.070
1.65	520	644.05	0.07 ic	0.07 ic	---	---	0.00	---	---	---	---	---	0.071
1.68	530	644.08	0.07 ic	0.07 ic	---	---	0.00	---	---	---	---	---	0.072
1.71	539	644.11	0.07 ic	0.07 ic	---	---	0.00	---	---	---	---	---	0.072
1.74	549	644.14	0.07 ic	0.07 ic	---	---	0.00	---	---	---	---	---	0.073
1.77	558	644.17	0.07 ic	0.07 ic	---	---	0.00	---	---	---	---	---	0.074
1.80	568	644.20	0.08 ic	0.07 ic	---	---	0.00	---	---	---	---	---	0.074
1.83	577	644.23	0.08 ic	0.08 ic	---	---	0.00	---	---	---	---	---	0.075
1.86	587	644.26	0.08 ic	0.08 ic	---	---	0.00	---	---	---	---	---	0.076
1.89	596	644.29	0.08 ic	0.08 ic	---	---	0.00	---	---	---	---	---	0.076
1.92	606	644.32	0.08 ic	0.08 ic	---	---	0.00	---	---	---	---	---	0.077
1.95	615	644.35	0.08 ic	0.08 ic	---	---	0.00	---	---	---	---	---	0.078
1.98	624	644.38	0.08 ic	0.08 ic	---	---	0.00	---	---	---	---	---	0.078
2.01	634	644.41	0.08 ic	0.08 ic	---	---	0.00	---	---	---	---	---	0.079
2.04	643	644.44	0.08 ic	0.08 ic	---	---	0.00	---	---	---	---	---	0.080
2.07	653	644.47	0.08 ic	0.08 ic	---	---	0.00	---	---	---	---	---	0.080
2.10	662	644.50	0.08 ic	0.08 ic	---	---	0.00	---	---	---	---	---	0.081
2.13	672	644.53	0.08 ic	0.08 ic	---	---	0.00	---	---	---	---	---	0.082
2.16	681	644.56	0.09 ic	0.08 ic	---	---	0.00	---	---	---	---	---	0.082
2.19	691	644.59	0.09 ic	0.08 ic	---	---	0.00	---	---	---	---	---	0.083
2.22	700	644.62	0.09 ic	0.08 ic	---	---	0.00	---	---	---	---	---	0.083
2.25	709	644.65	0.09 ic	0.08 ic	---	---	0.00	---	---	---	---	---	0.084
2.28	719	644.68	0.09 ic	0.08 ic	---	---	0.00	---	---	---	---	---	0.085
2.31	728	644.71	0.09 ic	0.09 ic	---	---	0.00	---	---	---	---	---	0.085
2.34	738	644.74	0.09 ic	0.09 ic	---	---	0.00	---	---	---	---	---	0.086
2.37	747	644.77	0.09 ic	0.09 ic	---	---	0.00	---	---	---	---	---	0.087
2.40	757	644.80	0.09 ic	0.09 ic	---	---	0.00	---	---	---	---	---	0.087
2.43	766	644.83	0.09 ic	0.09 ic	---	---	0.00	---	---	---	---	---	0.088
2.46	776	644.86	0.09 ic	0.09 ic	---	---	0.00	---	---	---	---	---	0.088
2.49	785	644.89	0.09 ic	0.09 ic	---	---	0.00	---	---	---	---	---	0.089
2.52	795	644.92	0.09 ic	0.09 ic	---	---	0.00	---	---	---	---	---	0.090
2.55	804	644.95	0.09 ic	0.09 ic	---	---	0.00	---	---	---	---	---	0.090
2.58	813	644.98	0.09 ic	0.09 ic	---	---	0.00	---	---	---	---	---	0.091
2.61	823	645.01	0.10 ic	0.09 ic	---	---	0.00	---	---	---	---	---	0.091
2.64	832	645.04	0.10 ic	0.09 ic	---	---	0.00	---	---	---	---	---	0.092
2.67	842	645.07	0.10 ic	0.09 ic	---	---	0.00	---	---	---	---	---	0.092
2.70	851	645.10	0.10 ic	0.09 ic	---	---	0.00	---	---	---	---	---	0.093
2.73	861	645.13	0.10 ic	0.09 ic	---	---	0.00	---	---	---	---	---	0.093
2.76	870	645.16	0.10 ic	0.09 ic	---	---	0.00	---	---	---	---	---	0.094
2.79	880	645.19	0.10 ic	0.09 ic	---	---	0.00	---	---	---	---	---	0.095
2.82	889	645.22	0.10 ic	0.10 ic	---	---	0.00	---	---	---	---	---	0.095
2.85	899	645.25	0.10 ic	0.10 ic	---	---	0.00	---	---	---	---	---	0.096

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Basin C

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
2.88	908	645.28	0.10 ic	0.10 ic	---	---	0.00	---	---	---	---	---	0.096
2.91	917	645.31	0.10 ic	0.10 ic	---	---	0.00	---	---	---	---	---	0.097
2.94	927	645.34	0.10 ic	0.10 ic	---	---	0.00	---	---	---	---	---	0.097
2.97	936	645.37	0.10 ic	0.10 ic	---	---	0.00	---	---	---	---	---	0.098
3.00	946	645.40	0.10 ic	0.10 ic	---	---	0.00	---	---	---	---	---	0.098
3.06	954	645.46	0.10 ic	0.10 ic	---	---	0.00	---	---	---	---	---	0.099
3.12	962	645.52	0.10 ic	0.10 ic	---	---	0.00	---	---	---	---	---	0.100
3.18	970	645.58	0.11 ic	0.10 ic	---	---	0.00	---	---	---	---	---	0.101
3.24	978	645.64	0.11 ic	0.10 ic	---	---	0.00	---	---	---	---	---	0.102
3.30	985	645.70	0.11 ic	0.10 ic	---	---	0.00	---	---	---	---	---	0.103
3.36	993	645.76	0.11 ic	0.10 ic	---	---	0.00	---	---	---	---	---	0.104
3.42	1,001	645.82	0.11 ic	0.11 ic	---	---	0.00	---	---	---	---	---	0.105
3.48	1,009	645.88	0.11 ic	0.11 ic	---	---	0.00	---	---	---	---	---	0.106
3.54	1,017	645.94	0.11 ic	0.11 ic	---	---	0.00	---	---	---	---	---	0.107
3.60	1,025	645.50	0.10 ic	0.10 ic	---	---	0.00	---	---	---	---	---	0.100
3.65	1,050	645.55	0.11 ic	0.10 ic	---	---	0.00	---	---	---	---	---	0.101
3.70	1,075	645.60	0.11 ic	0.10 ic	---	---	0.00	---	---	---	---	---	0.102
3.75	1,100	645.65	0.11 ic	0.10 ic	---	---	0.00	---	---	---	---	---	0.103
3.80	1,126	645.70	0.11 ic	0.10 ic	---	---	0.00	---	---	---	---	---	0.103
3.85	1,151	645.75	0.11 ic	0.10 ic	---	---	0.00	---	---	---	---	---	0.104
3.90	1,176	645.80	0.11 ic	0.11 ic	---	---	0.00	---	---	---	---	---	0.105
3.95	1,201	645.85	0.11 ic	0.11 ic	---	---	0.00	---	---	---	---	---	0.106
4.00	1,226	645.90	0.11 ic	0.11 ic	---	---	0.00	---	---	---	---	---	0.107
4.05	1,251	645.95	0.11 ic	0.11 ic	---	---	0.00	---	---	---	---	---	0.108
4.10	1,276	646.00	0.11 ic	0.11 ic	---	---	0.00	---	---	---	---	---	0.108
4.15	1,313	646.05	0.11 ic	0.11 ic	---	---	0.00	---	---	---	---	---	0.109
4.20	1,350	646.10	0.11 ic	0.11 ic	---	---	0.00	---	---	---	---	---	0.110
4.25	1,387	646.15	0.11 ic	0.11 ic	---	---	0.00	---	---	---	---	---	0.111
4.30	1,424	646.20	0.12 ic	0.11 ic	---	---	0.00	---	---	---	---	---	0.111
4.35	1,461	646.25	0.12 ic	0.11 ic	---	---	0.00	---	---	---	---	---	0.112
4.40	1,498	646.30	0.12 ic	0.11 ic	---	---	0.00	---	---	---	---	---	0.113
4.45	1,535	646.35	0.12 ic	0.11 ic	---	---	0.00	---	---	---	---	---	0.114
4.50	1,572	646.40	0.12 ic	0.11 ic	---	---	0.00	---	---	---	---	---	0.115
4.55	1,609	646.45	0.12 ic	0.12 ic	---	---	0.00	---	---	---	---	---	0.115
4.60	1,646	646.50	0.12 ic	0.12 ic	---	---	0.00	---	---	---	---	---	0.116
4.65	1,696	646.55	0.12 ic	0.12 ic	---	---	0.00	---	---	---	---	---	0.117
4.70	1,747	646.60	0.12 ic	0.12 ic	---	---	0.00	---	---	---	---	---	0.118
4.75	1,797	646.65	0.12 ic	0.12 ic	---	---	0.00	---	---	---	---	---	0.118
4.80	1,847	646.70	0.12 ic	0.12 ic	---	---	0.00	---	---	---	---	---	0.119
4.85	1,898	646.75	0.12 ic	0.12 ic	---	---	0.00	---	---	---	---	---	0.120
4.90	1,948	646.80	0.12 ic	0.12 ic	---	---	0.00	---	---	---	---	---	0.120
4.95	1,998	646.85	0.12 ic	0.12 ic	---	---	0.00	---	---	---	---	---	0.121
5.00	2,049	646.90	0.13 ic	0.12 ic	---	---	0.00	---	---	---	---	---	0.122
5.05	2,099	646.95	0.13 ic	0.12 ic	---	---	0.00	---	---	---	---	---	0.123
5.10	2,149	647.00	0.13 ic	0.12 ic	---	---	0.00	---	---	---	---	---	0.123
5.15	2,214	647.05	0.13 ic	0.12 ic	---	---	0.00	---	---	---	---	---	0.124
5.20	2,278	647.10	0.13 ic	0.12 ic	---	---	0.00	---	---	---	---	---	0.125
5.25	2,343	647.15	0.13 ic	0.13 ic	---	---	0.00	---	---	---	---	---	0.125
5.30	2,408	647.20	0.13 ic	0.13 ic	---	---	0.00	---	---	---	---	---	0.126
5.35	2,472	647.25	0.13 ic	0.13 ic	---	---	0.00	---	---	---	---	---	0.127
5.40	2,537	647.30	0.13 ic	0.13 ic	---	---	0.00	---	---	---	---	---	0.127
5.45	2,601	647.35	0.13 ic	0.13 ic	---	---	0.00	---	---	---	---	---	0.128
5.50	2,666	647.40	0.13 ic	0.13 ic	---	---	0.00	---	---	---	---	---	0.129
5.55	2,730	647.45	0.13 ic	0.13 ic	---	---	0.00	---	---	---	---	---	0.129
5.60	2,795	647.50	0.13 ic	0.13 ic	---	---	0.00	---	---	---	---	---	0.130
5.65	2,874	647.55	0.13 ic	0.13 ic	---	---	0.00	---	---	---	---	---	0.131
5.70	2,954	647.60	0.13 ic	0.13 ic	---	---	0.00	---	---	---	---	---	0.131
5.75	3,033	647.65	0.13 ic	0.13 ic	---	---	0.00	---	---	---	---	---	0.132
5.80	3,113	647.70	0.13 ic	0.13 ic	---	---	0.00	---	---	---	---	---	0.133
5.85	3,192	647.75	0.14 ic	0.13 ic	---	---	0.00	---	---	---	---	---	0.133
5.90	3,272	647.80	0.14 ic	0.13 ic	---	---	0.00	---	---	---	---	---	0.134
5.95	3,351	647.85	0.14 ic	0.13 ic	---	---	0.00	---	---	---	---	---	0.135
6.00	3,431	647.90	0.14 ic	0.14 ic	---	---	0.00	---	---	---	---	---	0.135
6.05	3,510	647.95	0.14 ic	0.14 ic	---	---	0.00	---	---	---	---	---	0.136
6.10	3,590	648.00	0.14 ic	0.14 ic	---	---	0.00	---	---	---	---	---	0.137
6.15	3,685	648.05	0.45 oc	0.14 ic	---	---	0.30	---	---	---	---	---	0.433
6.20	3,780	648.10	1.00 oc	0.13 ic	---	---	0.84	---	---	---	---	---	0.976
6.25	3,875	648.15	1.69 oc	0.13 ic	---	---	1.55	---	---	---	---	---	1.678
6.30	3,970	648.20	2.52 oc	0.13 ic	---	---	2.38	---	---	---	---	---	2.510
6.35	4,065	648.25	3.45 oc	0.12 ic	---	---	3.33	---	---	---	---	---	3.451
6.40	4,161	648.30	4.50 oc	0.12 ic	---	---	4.38	---	---	---	---	---	4.497
6.45	4,256	648.35	5.64 oc	0.12 ic	---	---	5.51	---	---	---	---	---	5.635

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Basin C

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
6.50	4,351	648.40	6.86 oc	0.12 ic	---	---	6.74	---	---	---	---	---	6.857
6.55	4,446	648.45	8.16 oc	0.12 ic	---	---	8.04	---	---	---	---	---	8.157
6.60	4,541	648.50	9.53 oc	0.12 ic	---	---	9.42	---	---	---	---	---	9.534

...End

Hydrograph Report

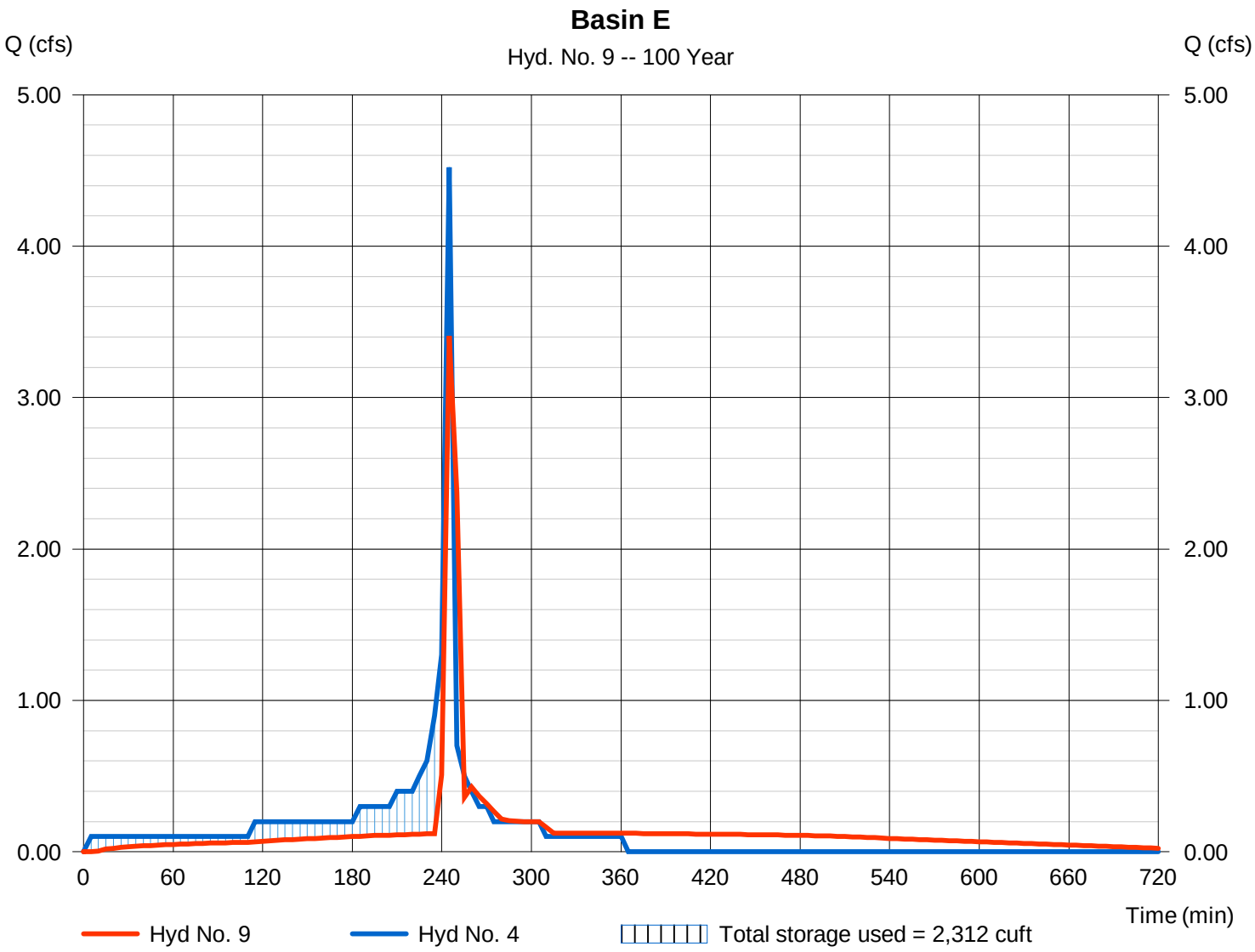
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2013 by Autodesk, Inc. v10 Friday, 04 / 1 / 2016

Hyd. No. 9

Basin E

Hydrograph type	= Reservoir	Peak discharge	= 3.408 cfs
Storm frequency	= 100 yrs	Time to peak	= 245 min
Time interval	= 5 min	Hyd. volume	= 6,031 cuft
Inflow hyd. No.	= 4 - DMA E	Max. Elevation	= 650.86 ft
Reservoir name	= Basin E	Max. Storage	= 2,312 cuft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2013 by Autodesk, Inc. v10 Friday, 04 / 1 / 2016

Pond No. 4 - Basin E

Pond Data

UG Chambers - Invert elev. = 645.90 ft , Rise x Span = 0.00 x 9.00 ft , Barrel Len = 88.00 ft , No. Barrels = 1 , Slope = 0.00% , Headers = No
Contours - User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 649.00 ft
Exclusion: Invert elev. = 645.90 ft , Width = 9.00 ft , Height = 3.00 ft , Volume = 35.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	645.90	n/a	0	0
0.30	646.20	n/a	84	84
0.60	646.50	n/a	83	167
0.90	646.80	n/a	83	250
1.20	647.10	n/a	83	333
1.50	647.40	n/a	83	416
1.80	647.70	n/a	83	500
2.10	648.00	n/a	83	583
2.40	648.30	n/a	83	666
2.70	648.60	n/a	83	749
3.00	648.90	n/a	83	832
3.10	649.00	249	8	841
3.60	649.50	551	195	1,036
4.10	650.00	900	359	1,395
4.60	650.50	1,290	545	1,939
5.10	651.00	1,723	751	2,690

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 12.00	1.50	0.00	0.00
Span (in)	= 12.00	1.50	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 646.00	646.00	0.00	0.00
Length (ft)	= 10.00	10.00	0.00	0.00
Slope (%)	= 1.00	1.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 8.00	0.00	0.00	0.00
Crest El. (ft)	= 650.50	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	---	---	---
Multi-Stage	= Yes	No	No	No
Exfil.(in/hr)	= 0.000 (by Wet area)			
TW Elev. (ft)	= 0.00			

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	645.90	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
0.03	8	645.93	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
0.06	17	645.96	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
0.09	25	645.99	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
0.12	33	646.02	0.00 ic	0.00 ic	---	---	0.00	---	---	---	---	---	0.001
0.15	42	646.05	0.00 ic	0.00 ic	---	---	0.00	---	---	---	---	---	0.003
0.18	50	646.08	0.01 ic	0.01 ic	---	---	0.00	---	---	---	---	---	0.008
0.21	59	646.11	0.01 ic	0.01 ic	---	---	0.00	---	---	---	---	---	0.013
0.24	67	646.14	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.016
0.27	75	646.17	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.019
0.30	84	646.20	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.021
0.33	92	646.23	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.024
0.36	100	646.26	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.026
0.39	109	646.29	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.027
0.42	117	646.32	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.029
0.45	125	646.35	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.031
0.48	134	646.38	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.032
0.51	142	646.41	0.04 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.034
0.54	150	646.44	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.035
0.57	159	646.47	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.036
0.60	167	646.50	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.038
0.63	175	646.53	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.039
0.66	184	646.56	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.040
0.69	192	646.59	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.042
0.72	200	646.62	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.043
0.75	208	646.65	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.044

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Basin E

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.78	217	646.68	0.05 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.045
0.81	225	646.71	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.046
0.84	233	646.74	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.047
0.87	242	646.77	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.048
0.90	250	646.80	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.049
0.93	258	646.83	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.050
0.96	267	646.86	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.051
0.99	275	646.89	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.052
1.02	283	646.92	0.06 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.053
1.05	292	646.95	0.06 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.054
1.08	300	646.98	0.06 ic	0.06 ic	---	---	0.00	---	---	---	---	---	0.055
1.11	308	647.01	0.06 ic	0.06 ic	---	---	0.00	---	---	---	---	---	0.056
1.14	317	647.04	0.06 ic	0.06 ic	---	---	0.00	---	---	---	---	---	0.057
1.17	325	647.07	0.06 ic	0.06 ic	---	---	0.00	---	---	---	---	---	0.058
1.20	333	647.10	0.06 ic	0.06 ic	---	---	0.00	---	---	---	---	---	0.059
1.23	342	647.13	0.06 ic	0.06 ic	---	---	0.00	---	---	---	---	---	0.060
1.26	350	647.16	0.06 ic	0.06 ic	---	---	0.00	---	---	---	---	---	0.060
1.29	358	647.19	0.06 ic	0.06 ic	---	---	0.00	---	---	---	---	---	0.061
1.32	366	647.22	0.06 ic	0.06 ic	---	---	0.00	---	---	---	---	---	0.062
1.35	375	647.25	0.07 ic	0.06 ic	---	---	0.00	---	---	---	---	---	0.063
1.38	383	647.28	0.07 ic	0.06 ic	---	---	0.00	---	---	---	---	---	0.064
1.41	391	647.31	0.07 ic	0.06 ic	---	---	0.00	---	---	---	---	---	0.064
1.44	400	647.34	0.07 ic	0.07 ic	---	---	0.00	---	---	---	---	---	0.065
1.47	408	647.37	0.07 ic	0.07 ic	---	---	0.00	---	---	---	---	---	0.066
1.50	416	647.40	0.07 ic	0.07 ic	---	---	0.00	---	---	---	---	---	0.067
1.53	425	647.43	0.07 ic	0.07 ic	---	---	0.00	---	---	---	---	---	0.068
1.56	433	647.46	0.07 ic	0.07 ic	---	---	0.00	---	---	---	---	---	0.068
1.59	441	647.49	0.07 ic	0.07 ic	---	---	0.00	---	---	---	---	---	0.069
1.62	450	647.52	0.07 ic	0.07 ic	---	---	0.00	---	---	---	---	---	0.070
1.65	458	647.55	0.07 ic	0.07 ic	---	---	0.00	---	---	---	---	---	0.071
1.68	466	647.58	0.07 ic	0.07 ic	---	---	0.00	---	---	---	---	---	0.071
1.71	475	647.61	0.07 ic	0.07 ic	---	---	0.00	---	---	---	---	---	0.072
1.74	483	647.64	0.07 ic	0.07 ic	---	---	0.00	---	---	---	---	---	0.073
1.77	491	647.67	0.07 ic	0.07 ic	---	---	0.00	---	---	---	---	---	0.073
1.80	500	647.70	0.08 ic	0.07 ic	---	---	0.00	---	---	---	---	---	0.074
1.83	508	647.73	0.08 ic	0.07 ic	---	---	0.00	---	---	---	---	---	0.075
1.86	516	647.76	0.08 ic	0.08 ic	---	---	0.00	---	---	---	---	---	0.075
1.89	525	647.79	0.08 ic	0.08 ic	---	---	0.00	---	---	---	---	---	0.076
1.92	533	647.82	0.08 ic	0.08 ic	---	---	0.00	---	---	---	---	---	0.077
1.95	541	647.85	0.08 ic	0.08 ic	---	---	0.00	---	---	---	---	---	0.077
1.98	549	647.88	0.08 ic	0.08 ic	---	---	0.00	---	---	---	---	---	0.078
2.01	558	647.91	0.08 ic	0.08 ic	---	---	0.00	---	---	---	---	---	0.079
2.04	566	647.94	0.08 ic	0.08 ic	---	---	0.00	---	---	---	---	---	0.079
2.07	574	647.97	0.08 ic	0.08 ic	---	---	0.00	---	---	---	---	---	0.080
2.10	583	648.00	0.08 ic	0.08 ic	---	---	0.00	---	---	---	---	---	0.081
2.13	591	648.03	0.08 ic	0.08 ic	---	---	0.00	---	---	---	---	---	0.081
2.16	599	648.06	0.08 ic	0.08 ic	---	---	0.00	---	---	---	---	---	0.082
2.19	608	648.09	0.08 ic	0.08 ic	---	---	0.00	---	---	---	---	---	0.083
2.22	616	648.12	0.08 ic	0.08 ic	---	---	0.00	---	---	---	---	---	0.083
2.25	624	648.15	0.08 ic	0.08 ic	---	---	0.00	---	---	---	---	---	0.084
2.28	633	648.18	0.08 ic	0.08 ic	---	---	0.00	---	---	---	---	---	0.084
2.31	641	648.21	0.09 ic	0.09 ic	---	---	0.00	---	---	---	---	---	0.085
2.34	649	648.24	0.09 ic	0.09 ic	---	---	0.00	---	---	---	---	---	0.086
2.37	658	648.27	0.09 ic	0.09 ic	---	---	0.00	---	---	---	---	---	0.086
2.40	666	648.30	0.09 ic	0.09 ic	---	---	0.00	---	---	---	---	---	0.087
2.43	674	648.33	0.09 ic	0.09 ic	---	---	0.00	---	---	---	---	---	0.087
2.46	683	648.36	0.09 ic	0.09 ic	---	---	0.00	---	---	---	---	---	0.088
2.49	691	648.39	0.09 ic	0.09 ic	---	---	0.00	---	---	---	---	---	0.089
2.52	699	648.42	0.09 ic	0.09 ic	---	---	0.00	---	---	---	---	---	0.089
2.55	708	648.45	0.09 ic	0.09 ic	---	---	0.00	---	---	---	---	---	0.090
2.58	716	648.48	0.09 ic	0.09 ic	---	---	0.00	---	---	---	---	---	0.090
2.61	724	648.51	0.09 ic	0.09 ic	---	---	0.00	---	---	---	---	---	0.091
2.64	732	648.54	0.09 ic	0.09 ic	---	---	0.00	---	---	---	---	---	0.091
2.67	741	648.57	0.09 ic	0.09 ic	---	---	0.00	---	---	---	---	---	0.092
2.70	749	648.60	0.09 ic	0.09 ic	---	---	0.00	---	---	---	---	---	0.093
2.73	757	648.63	0.10 ic	0.09 ic	---	---	0.00	---	---	---	---	---	0.093
2.76	766	648.66	0.10 ic	0.09 ic	---	---	0.00	---	---	---	---	---	0.094
2.79	774	648.69	0.10 ic	0.09 ic	---	---	0.00	---	---	---	---	---	0.094
2.82	782	648.72	0.10 ic	0.09 ic	---	---	0.00	---	---	---	---	---	0.095
2.85	791	648.75	0.10 ic	0.10 ic	---	---	0.00	---	---	---	---	---	0.095
2.88	799	648.78	0.10 ic	0.10 ic	---	---	0.00	---	---	---	---	---	0.096
2.91	807	648.81	0.10 ic	0.10 ic	---	---	0.00	---	---	---	---	---	0.096

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Basin E

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
2.94	816	648.84	0.10 ic	0.10 ic	---	---	0.00	---	---	---	---	---	0.097
2.97	824	648.87	0.10 ic	0.10 ic	---	---	0.00	---	---	---	---	---	0.098
3.00	832	648.90	0.10 ic	0.10 ic	---	---	0.00	---	---	---	---	---	0.098
3.01	833	648.91	0.10 ic	0.10 ic	---	---	0.00	---	---	---	---	---	0.098
3.02	834	648.92	0.10 ic	0.10 ic	---	---	0.00	---	---	---	---	---	0.098
3.03	835	648.93	0.10 ic	0.10 ic	---	---	0.00	---	---	---	---	---	0.099
3.04	836	648.94	0.10 ic	0.10 ic	---	---	0.00	---	---	---	---	---	0.099
3.05	836	648.95	0.10 ic	0.10 ic	---	---	0.00	---	---	---	---	---	0.099
3.06	837	648.96	0.10 ic	0.10 ic	---	---	0.00	---	---	---	---	---	0.099
3.07	838	648.97	0.10 ic	0.10 ic	---	---	0.00	---	---	---	---	---	0.099
3.08	839	648.98	0.10 ic	0.10 ic	---	---	0.00	---	---	---	---	---	0.099
3.09	840	648.99	0.10 ic	0.10 ic	---	---	0.00	---	---	---	---	---	0.100
3.10	841	649.00	0.10 ic	0.10 ic	---	---	0.00	---	---	---	---	---	0.100
3.15	860	649.05	0.11 ic	0.10 ic	---	---	0.00	---	---	---	---	---	0.101
3.20	880	649.10	0.11 ic	0.10 ic	---	---	0.00	---	---	---	---	---	0.101
3.25	899	649.15	0.11 ic	0.10 ic	---	---	0.00	---	---	---	---	---	0.102
3.30	919	649.20	0.11 ic	0.10 ic	---	---	0.00	---	---	---	---	---	0.103
3.35	938	649.25	0.11 ic	0.10 ic	---	---	0.00	---	---	---	---	---	0.104
3.40	958	649.30	0.11 ic	0.10 ic	---	---	0.00	---	---	---	---	---	0.105
3.45	977	649.35	0.11 ic	0.11 ic	---	---	0.00	---	---	---	---	---	0.106
3.50	997	649.40	0.11 ic	0.11 ic	---	---	0.00	---	---	---	---	---	0.106
3.55	1,016	649.45	0.11 ic	0.11 ic	---	---	0.00	---	---	---	---	---	0.107
3.60	1,036	649.50	0.11 ic	0.11 ic	---	---	0.00	---	---	---	---	---	0.108
3.65	1,072	649.55	0.11 ic	0.11 ic	---	---	0.00	---	---	---	---	---	0.109
3.70	1,107	649.60	0.11 ic	0.11 ic	---	---	0.00	---	---	---	---	---	0.110
3.75	1,143	649.65	0.11 ic	0.11 ic	---	---	0.00	---	---	---	---	---	0.110
3.80	1,179	649.70	0.11 ic	0.11 ic	---	---	0.00	---	---	---	---	---	0.111
3.85	1,215	649.75	0.11 ic	0.11 ic	---	---	0.00	---	---	---	---	---	0.112
3.90	1,251	649.80	0.11 ic	0.11 ic	---	---	0.00	---	---	---	---	---	0.113
3.95	1,287	649.85	0.11 ic	0.11 ic	---	---	0.00	---	---	---	---	---	0.114
4.00	1,323	649.90	0.11 ic	0.11 ic	---	---	0.00	---	---	---	---	---	0.114
4.05	1,359	649.95	0.11 ic	0.11 ic	---	---	0.00	---	---	---	---	---	0.115
4.10	1,395	650.00	0.12 ic	0.12 ic	---	---	0.00	---	---	---	---	---	0.116
4.15	1,449	650.05	0.12 ic	0.12 ic	---	---	0.00	---	---	---	---	---	0.116
4.20	1,504	650.10	0.12 ic	0.12 ic	---	---	0.00	---	---	---	---	---	0.117
4.25	1,558	650.15	0.12 ic	0.12 ic	---	---	0.00	---	---	---	---	---	0.118
4.30	1,613	650.20	0.12 ic	0.12 ic	---	---	0.00	---	---	---	---	---	0.119
4.35	1,667	650.25	0.12 ic	0.12 ic	---	---	0.00	---	---	---	---	---	0.119
4.40	1,722	650.30	0.12 ic	0.12 ic	---	---	0.00	---	---	---	---	---	0.120
4.45	1,776	650.35	0.12 ic	0.12 ic	---	---	0.00	---	---	---	---	---	0.121
4.50	1,830	650.40	0.12 ic	0.12 ic	---	---	0.00	---	---	---	---	---	0.122
4.55	1,885	650.45	0.12 ic	0.12 ic	---	---	0.00	---	---	---	---	---	0.122
4.60	1,939	650.50	0.12 ic	0.12 ic	---	---	0.00	---	---	---	---	---	0.123
4.65	2,014	650.55	0.42 oc	0.12 ic	---	---	0.30	---	---	---	---	---	0.419
4.70	2,089	650.60	0.97 oc	0.12 ic	---	---	0.84	---	---	---	---	---	0.960
4.75	2,164	650.65	1.66 oc	0.11 ic	---	---	1.55	---	---	---	---	---	1.660
4.80	2,240	650.70	2.49 oc	0.11 ic	---	---	2.38	---	---	---	---	---	2.493
4.85	2,315	650.75	3.44 oc	0.11 ic	---	---	3.33	---	---	---	---	---	3.436
4.90	2,390	650.80	4.48 ic	0.10 ic	---	---	4.38	---	---	---	---	---	4.476
4.95	2,465	650.85	5.60 ic	0.09 ic	---	---	5.51	---	---	---	---	---	5.601
5.00	2,540	650.90	6.80 ic	0.06 ic	---	---	6.74	---	---	---	---	---	6.801
5.05	2,615	650.95	7.67 ic	0.03 ic	---	---	7.63 s	---	---	---	---	---	7.668
5.10	2,690	651.00	7.81 ic	0.03 ic	---	---	7.78 s	---	---	---	---	---	7.811

...End

Hydrograph Report

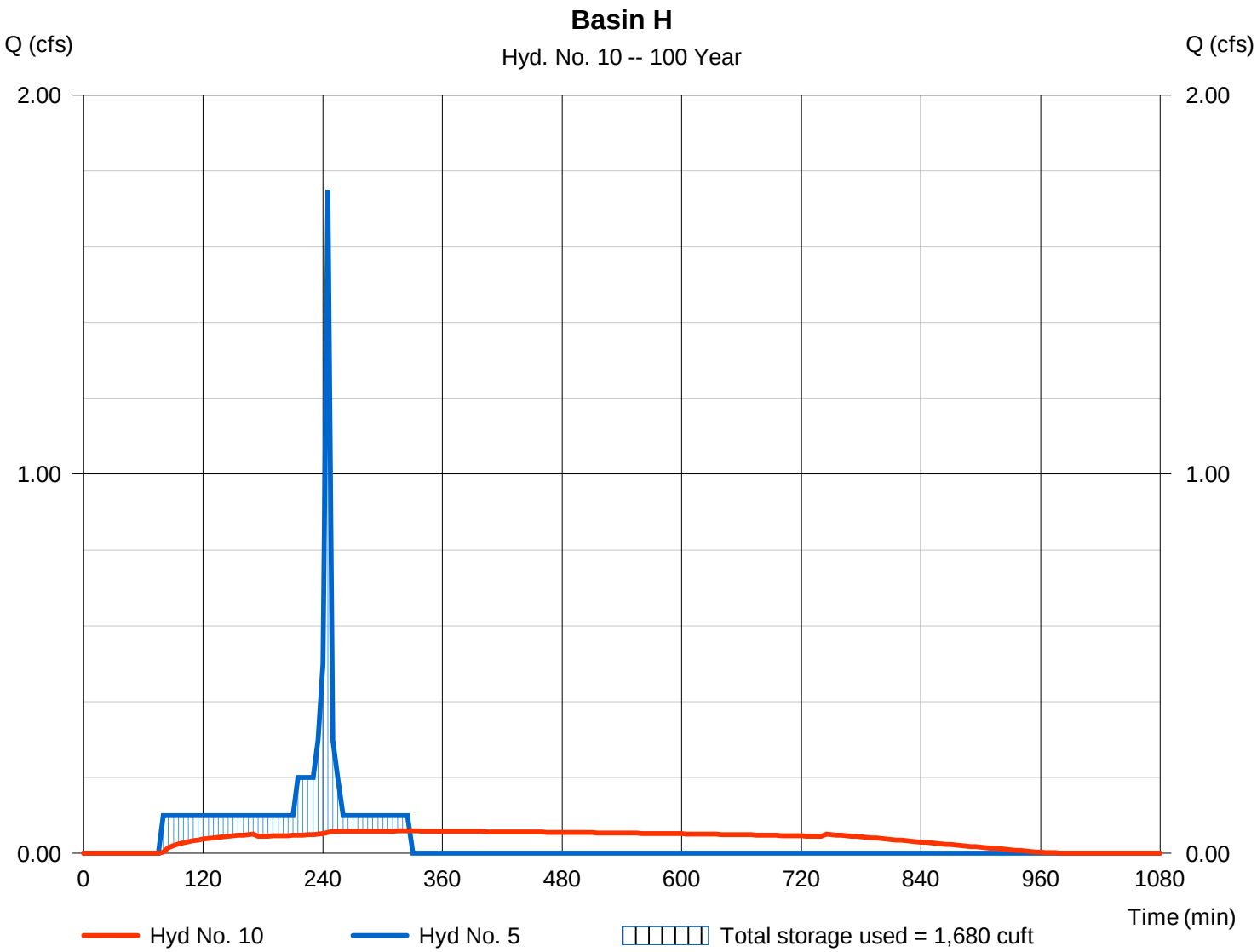
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2013 by Autodesk, Inc. v10 Friday, 04 / 1 / 2016

Hyd. No. 10

Basin H

Hydrograph type	=	Reservoir	Peak discharge	=	0.059 cfs
Storm frequency	=	100 yrs	Time to peak	=	325 min
Time interval	=	5 min	Hyd. volume	=	2,374 cuft
Inflow hyd. No.	=	5 - DMA H	Max. Elevation	=	648.13 ft
Reservoir name	=	Basin H	Max. Storage	=	1,680 cuft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2013 by Autodesk, Inc. v10 Friday, 04 / 1 / 2016

Pond No. 5 - Basin H

Pond Data

UG Chambers - Invert elev. = 642.90 ft , Rise x Span = 0.00 x 12.00 ft , Barrel Len = 21.00 ft , No. Barrels = 1 , Slope = 0.00% , Headers = No
Contours - User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 646.00 ft
Exclusion: Invert elev. = 642.90 ft , Width = 12.00 ft , Height = 1.00 ft , Length = 35.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	642.90	n/a	0	0
0.30	643.20	n/a	27	27
0.60	643.50	n/a	26	53
0.90	643.80	n/a	26	80
1.20	644.10	n/a	26	106
1.50	644.40	n/a	26	132
1.80	644.70	n/a	26	159
2.10	645.00	n/a	26	185
2.40	645.30	n/a	26	212
2.70	645.60	n/a	26	238
3.00	645.90	n/a	26	265
4.00	646.00	315	105	370
4.50	646.50	438	187	557
5.00	647.00	579	253	811
5.50	647.50	739	329	1,139
6.00	648.00	916	413	1,552
6.50	648.50	1,108	505	2,057
7.00	649.00	1,314	605	2,662

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 12.00	1.00	0.00	0.00
Span (in)	= 12.00	1.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 643.00	643.00	0.00	0.00
Length (ft)	= 10.00	1.00	0.00	0.00
Slope (%)	= 1.00	1.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 8.00	0.00	0.00	0.00
Crest El. (ft)	= 648.50	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	---	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)
TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	642.90	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
0.03	3	642.93	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
0.06	5	642.96	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
0.09	8	642.99	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
0.12	11	643.02	0.00 ic	0.00 ic	---	---	0.00	---	---	---	---	---	0.000
0.15	13	643.05	0.00 ic	0.00 ic	---	---	0.00	---	---	---	---	---	0.003
0.18	16	643.08	0.01 ic	0.01 ic	---	---	0.00	---	---	---	---	---	0.005
0.21	19	643.11	0.01 ic	0.01 ic	---	---	0.00	---	---	---	---	---	0.007
0.24	21	643.14	0.01 ic	0.01 ic	---	---	0.00	---	---	---	---	---	0.008
0.27	24	643.17	0.01 ic	0.01 ic	---	---	0.00	---	---	---	---	---	0.009
0.30	27	643.20	0.01 ic	0.01 ic	---	---	0.00	---	---	---	---	---	0.010
0.33	29	643.23	0.01 ic	0.01 ic	---	---	0.00	---	---	---	---	---	0.011
0.36	32	643.26	0.01 ic	0.01 ic	---	---	0.00	---	---	---	---	---	0.012
0.39	35	643.29	0.01 ic	0.01 ic	---	---	0.00	---	---	---	---	---	0.013
0.42	37	643.32	0.01 ic	0.01 ic	---	---	0.00	---	---	---	---	---	0.014
0.45	40	643.35	0.01 ic	0.01 ic	---	---	0.00	---	---	---	---	---	0.014
0.48	43	643.38	0.01 ic	0.01 ic	---	---	0.00	---	---	---	---	---	0.015
0.51	45	643.41	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.016
0.54	48	643.44	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.016
0.57	50	643.47	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.017
0.60	53	643.50	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.017
0.63	56	643.53	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.018
0.66	58	643.56	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.019
0.69	61	643.59	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.019

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Basin H

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.72	64	643.62	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.020
0.75	66	643.65	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.020
0.78	69	643.68	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.021
0.81	72	643.71	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.021
0.84	74	643.74	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.022
0.87	77	643.77	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.022
0.90	80	643.80	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.022
0.93	82	643.83	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.023
0.96	85	643.86	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.023
0.99	87	643.89	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.024
1.02	90	643.92	0.03 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.024
1.05	93	643.95	0.03 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.025
1.08	95	643.98	0.03 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.025
1.11	98	644.01	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.025
1.14	101	644.04	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.026
1.17	103	644.07	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.026
1.20	106	644.10	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.027
1.23	109	644.13	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.027
1.26	111	644.16	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.027
1.29	114	644.19	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.028
1.32	117	644.22	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.028
1.35	119	644.25	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.028
1.38	122	644.28	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.029
1.41	125	644.31	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.029
1.44	127	644.34	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.029
1.47	130	644.37	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.030
1.50	132	644.40	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.030
1.53	135	644.43	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.030
1.56	138	644.46	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.031
1.59	140	644.49	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.031
1.62	143	644.52	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.031
1.65	146	644.55	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.032
1.68	148	644.58	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.032
1.71	151	644.61	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.032
1.74	154	644.64	0.03 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.033
1.77	156	644.67	0.04 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.033
1.80	159	644.70	0.04 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.033
1.83	162	644.73	0.04 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.034
1.86	164	644.76	0.04 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.034
1.89	167	644.79	0.04 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.034
1.92	170	644.82	0.04 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.035
1.95	172	644.85	0.04 ic	0.03 ic	---	---	0.00	---	---	---	---	---	0.035
1.98	175	644.88	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.035
2.01	177	644.91	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.035
2.04	180	644.94	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.036
2.07	183	644.97	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.036
2.10	185	645.00	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.036
2.13	188	645.03	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.037
2.16	191	645.06	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.037
2.19	193	645.09	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.037
2.22	196	645.12	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.037
2.25	199	645.15	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.038
2.28	201	645.18	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.038
2.31	204	645.21	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.038
2.34	207	645.24	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.038
2.37	209	645.27	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.039
2.40	212	645.30	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.039
2.43	215	645.33	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.039
2.46	217	645.36	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.040
2.49	220	645.39	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.040
2.52	222	645.42	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.040
2.55	225	645.45	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.040
2.58	228	645.48	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.041
2.61	230	645.51	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.041
2.64	233	645.54	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.041
2.67	236	645.57	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.041
2.70	238	645.60	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.042
2.73	241	645.63	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.042
2.76	244	645.66	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.042
2.79	246	645.69	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.042
2.82	249	645.72	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.043
2.85	252	645.75	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.043

Continues on next page...

Basin H

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
2.88	254	645.78	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.043
2.91	257	645.81	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.043
2.94	260	645.84	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.043
2.97	262	645.87	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.044
3.00	265	645.90	0.04 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.044
3.10	275	646.00	0.05 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.045
3.20	286	646.10	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.045
3.30	296	646.20	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.046
3.40	307	646.30	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.047
3.50	317	646.40	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.048
3.60	328	646.50	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.048
3.70	338	646.60	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.049
3.80	349	646.70	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.050
3.90	359	646.80	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.050
4.00	370	646.00	0.05 ic	0.04 ic	---	---	0.00	---	---	---	---	---	0.045
4.05	389	646.05	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.045
4.10	407	646.10	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.045
4.15	426	646.15	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.046
4.20	445	646.20	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.046
4.25	464	646.25	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.047
4.30	482	646.30	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.047
4.35	501	646.35	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.047
4.40	520	646.40	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.048
4.45	538	646.45	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.048
4.50	557	646.50	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.048
4.55	583	646.55	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.049
4.60	608	646.60	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.049
4.65	633	646.65	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.049
4.70	659	646.70	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.050
4.75	684	646.75	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.050
4.80	709	646.80	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.050
4.85	735	646.85	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.051
4.90	760	646.90	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.051
4.95	785	646.95	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.051
5.00	811	647.00	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.052
5.05	843	647.05	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.052
5.10	876	647.10	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.052
5.15	909	647.15	0.05 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.053
5.20	942	647.20	0.06 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.053
5.25	975	647.25	0.06 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.053
5.30	1,008	647.30	0.06 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.054
5.35	1,041	647.35	0.06 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.054
5.40	1,074	647.40	0.06 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.054
5.45	1,106	647.45	0.06 ic	0.05 ic	---	---	0.00	---	---	---	---	---	0.055
5.50	1,139	647.50	0.06 ic	0.06 ic	---	---	0.00	---	---	---	---	---	0.055
5.55	1,181	647.55	0.06 ic	0.06 ic	---	---	0.00	---	---	---	---	---	0.055
5.60	1,222	647.60	0.06 ic	0.06 ic	---	---	0.00	---	---	---	---	---	0.056
5.65	1,263	647.65	0.06 ic	0.06 ic	---	---	0.00	---	---	---	---	---	0.056
5.70	1,304	647.70	0.06 ic	0.06 ic	---	---	0.00	---	---	---	---	---	0.056
5.75	1,346	647.75	0.06 ic	0.06 ic	---	---	0.00	---	---	---	---	---	0.057
5.80	1,387	647.80	0.06 ic	0.06 ic	---	---	0.00	---	---	---	---	---	0.057
5.85	1,428	647.85	0.06 ic	0.06 ic	---	---	0.00	---	---	---	---	---	0.057
5.90	1,470	647.90	0.06 ic	0.06 ic	---	---	0.00	---	---	---	---	---	0.057
5.95	1,511	647.95	0.06 ic	0.06 ic	---	---	0.00	---	---	---	---	---	0.058
6.00	1,552	648.00	0.06 ic	0.06 ic	---	---	0.00	---	---	---	---	---	0.058
6.05	1,603	648.05	0.06 ic	0.06 ic	---	---	0.00	---	---	---	---	---	0.058
6.10	1,653	648.10	0.06 ic	0.06 ic	---	---	0.00	---	---	---	---	---	0.059
6.15	1,704	648.15	0.06 ic	0.06 ic	---	---	0.00	---	---	---	---	---	0.059
6.20	1,754	648.20	0.06 ic	0.06 ic	---	---	0.00	---	---	---	---	---	0.059
6.25	1,805	648.25	0.06 ic	0.06 ic	---	---	0.00	---	---	---	---	---	0.060
6.30	1,855	648.30	0.06 ic	0.06 ic	---	---	0.00	---	---	---	---	---	0.060
6.35	1,906	648.35	0.06 ic	0.06 ic	---	---	0.00	---	---	---	---	---	0.060
6.40	1,956	648.40	0.06 ic	0.06 ic	---	---	0.00	---	---	---	---	---	0.060
6.45	2,007	648.45	0.06 ic	0.06 ic	---	---	0.00	---	---	---	---	---	0.061
6.50	2,057	648.50	0.06 ic	0.06 ic	---	---	0.00	---	---	---	---	---	0.061
6.55	2,118	648.55	0.37 oc	0.06 ic	---	---	0.30	---	---	---	---	---	0.358
6.60	2,178	648.60	0.91 oc	0.06 ic	---	---	0.84	---	---	---	---	---	0.901
6.65	2,239	648.65	1.60 oc	0.06 ic	---	---	1.55	---	---	---	---	---	1.604
6.70	2,299	648.70	2.44 oc	0.06 ic	---	---	2.38	---	---	---	---	---	2.438
6.75	2,360	648.75	3.38 oc	0.05 ic	---	---	3.33	---	---	---	---	---	3.383
6.80	2,420	648.80	4.43 ic	0.05 ic	---	---	4.38	---	---	---	---	---	4.428
6.85	2,481	648.85	5.56 ic	0.05 ic	---	---	5.51	---	---	---	---	---	5.561

Continues on next page...

Basin H

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
6.90	2,541	648.90	6.78 ic	0.04 ic	---	---	6.74	---	---	---	---	---	6.776
6.95	2,602	648.95	8.06 ic	0.02 ic	---	---	8.04	---	---	---	---	---	8.064
7.00	2,662	649.00	8.60 ic	0.01 ic	---	---	8.59 s	---	---	---	---	---	8.604

...End

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Prop_100yr Volume_Westmont_bottom_width_UG.gpw

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2013 by Autodesk, Inc. v10

Friday, 04 / 1 / 2016

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100 - Year

Summary Report **2**

Hydrograph Reports **3**

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Hydrograph No. 10, Reservoir, Basin H 25

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APPENDIX D

EXISTING DRAINAGE EXHIBIT

DMA	Total Area AC	Runoff Coeff	intensity_50yr (in/hr)	Q50 (cfs)	intensity_100yr (in/hr)	Q100 (cfs)
A (North)	0.74	0.35	6.06	1.57	6.85	1.77
B (South)	1.8	0.35	6.06	3.82	6.85	4.32
C (South)	0.53	0.35	6.06	1.12	6.85	1.27
D (South, off-site)	0.26	0.35	6.06	0.55	6.85	0.62

LEGEND

X — DMA ID

XX — DMA ACREAGE

DMA BOUNDARY

OVERLAND FLOW DIRECTION

EXISTING STORM DRAIN

NORTH

GRAPHIC SCALE IN FEET
0 15 30 60

No.	REVISIONS	DATE	BY

Kimley»Horn
401 B STREET, SUITE 600, SAN DIEGO, CA 92101
PHONE: 619-234-9411
WWW.KIMLEY-HORN.COM

KHA PROJECT 195023000
DATE APRIL 2016
SCALE AS SHOWN
DESIGNED BY JSB
DRAWN BY BMA
CHECKED BY JSB

WESTMONT ASSISTED LIVING

MURRAY DRIVE
LA MESA, CA

EXISTING DRAINAGE EXHIBIT

SHEET NUMBER
1 OF 1

Plotted By:Becker, Justin Sheet Set:Kha Layout:Layout1 April 11, 2016 07:42:31pm K:\SND_LDEV\195023000 - Westmont La Mesa Assisted Living\Drainage\Drainage Study\Exhibit\Existing Drainage Exhibit.dwg
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APPENDIX E

PROPOSED DRAINAGE EXHIBIT

DMA	DMA Description	Total Area (acre)	Runoff Coefficient	50 Year Rainfall Intensity (in/hr)	50 Year Flow Rate (cfs)	100 Year Rainfall Intensity (in/hr)	100 Year Flow Rate (cfs)
A	South	0.49	0.75	6.06	2.23	6.85	2.52
B	South	0.51	0.75	6.06	2.32	6.85	2.62
H	South	0.34	0.75	6.06	1.55	6.85	1.75
Sub-Total:		**1.34**			**6.09**		**6.88**
C	North	0.94	0.75	6.06	4.27	6.85	4.83
E	East	0.88	0.75	6.06	4.00	6.85	4.52
Site Total:		**3.16**			**14.36**		**16.23**
F	Run-off	0.04	0.75	6.06	0.18	6.85	0.21
G	Run-off	0.06	0.75	6.06	0.27	6.85	0.31
D	Run-off	0.07	0.75	6.06	0.32	6.85	0.36
Run-off Total:		**0.17**			**0.77**		**0.87**

LEGEND

- X — DMA ID
- XX — DMA ACREAGE
- DMA BOUNDARY
- OVERLAND FLOW DIRECTION
- PROPOSED STORM DRAIN
- EXISTING STORM DRAIN
- PROPOSED BIORETENTION AREA

NORTH

GRAPHIC SCALE IN FEET
0 15 30 60

No.	REVISIONS	DATE	BY

Kimley»Horn
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KHA PROJECT 195023000
DATE APRIL 2016
SCALE AS SHOWN
DESIGNED BY JSB
DRAWN BY BMA
CHECKED BY JSB

WESTMONT ASSISTED LIVING

MURRAY DRIVE
LA MESA, CA

PROPOSED DRAINAGE EXHIBIT

SHEET NUMBER
1 OF 1

Plotted By:Becker, Justin Sheet Set:Kha Layout:Layout1 April 11, 2016 10:37:12pm K:\SND_LDEV\195023000 - Westmont La Mesa Assisted Living\Drainage\Drainage Study\Exhibit\Proposed Drainage Exhibit.dwg
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ATTACHMENT 6
Copy of Project's Geotechnical and Groundwater Investigation Report

This is the cover sheet for Attachment 6.

GEOTECHNICAL INVESTIGATION

WESTMONT OF LA MESA
LA MESA, CALIFORNIA

GEOCON
INCORPORATED

GEOTECHNICAL
ENVIRONMENTAL
MATERIALS

PREPARED FOR

WESTMONT DEVELOPMENT LP
LA JOLLA, CALIFORNIA

DECEMBER 29, 2015
PROJECT NO. G1931-32-01

GEOCON
INCORPORATED
GEOTECHNICAL ■ ENVIRONMENTAL ■ MATERIALS

Project No. G1931-32-01
December 29, 2015

Westmont Development LP
7660 Fay Avenue, Suite N
La Jolla, California 92037

Attention: Mr. Andrew Plant

Subject: GEOTECHNICAL INVESTIGATION
WESTMONT OF LA MESA
LA MESA, CALIFORNIA

Dear Mr. Plant:

In accordance with your request, we have performed a geotechnical investigation to address the proposed senior care facility located in La Mesa, California. The results of our study indicate that the site can be developed as planned, provided the recommendations of this report are followed.

Should you have any questions regarding this report, or if we may be of further service, please contact the undersigned at your convenience.

Very truly yours,

GEOCON INCORPORATED

Troy K. Reist	Trevor E. Myers	David B. Evans
CEG 2408	RCE 63773	CEG 1860

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PROFESSIONAL GEOLOGIST
DAVID B. EVANS
NO. 1860
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

TKR:TEM:DBE:dmc

(1) Lenity Architecture
Attention: Ms. Sierra Henderson

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GEOTECHNICAL INVESTIGATION

1. PURPOSE AND SCOPE

This report presents the results of a geotechnical study for the proposed Westmont of La Mesa project located in La Mesa, California (see *Vicinity Map*, Figure 1). The purpose of the study was to investigate the soil and geologic conditions at the site, as well as evaluate geotechnical constraints, if any, that may impact areas of proposed development. This report provides recommendations relative to the geotechnical engineering aspects of developing the property as presently proposed based on the conditions encountered during this study.

The scope of the investigation included a review of aerial photographs, satellite imagery, and readily available published and unpublished geologic literature. The scope also included performing a field investigation, laboratory testing of soils collected at the site and preparation of this report.

The field investigation was conducted on December 15, 2015, and consisted of performing a site reconnaissance by an engineering geologist and excavating twelve exploratory trenches. The trenches were performed to evaluate the soil and geologic units within the areas of planned development. Details of the field exploration, as well as descriptive trench logs, are presented in Appendix A.

Laboratory tests were performed on selected representative soil samples obtained during the field investigation to evaluate the pertinent physical and chemical properties of the soils encountered. A summary of the laboratory test results are presented in Appendix B.

The exhibit used as a base map to depict the trench locations consists of a reproducible copy of a compilation of digital information provided by Lenity Architecture (*Site Plan,* Figure 2). The plan depicts the proposed conceptual development superimposed on an aerial image of the property. We added the approximate locations of the exploratory trenches and other notable features observed during our field reconnaissance. The conclusions and recommendations presented herein are based on an analysis of the data obtained from the field investigation, laboratory tests, and our experience with similar soil and geologic conditions.

2. SITE AND PROJECT DESCRIPTION

The senior care facility is proposed northeast of the undercrossing of Murray Drive and State Highway SR-125 in La Mesa, California. Our review of 1953 aerial photos indicates the site was once a residential neighborhood with surrounding open space. The historical satellite imagery dating back to 1994, indicates the site was sheet graded sometime after 1996 in several phases and was most recently leased to a general contractor for use as a staging area for the Grossmont Hospital expansion project.

Improvements observed on site include an approximately 150-foot long, 16-foot high, mechanically stabilized earth (MSE) retaining wall located along the southwestern edge of the site, two desiliting basins located along the southern portion of the site and a hardened construction entrance off of Murray Drive. In general, the property drains from north to south.

We understand that the approximately 3.3-acre site will be graded to accommodate a three-story, 197,675-square-foot retirement care facility with 140 assisted living suites, 36 memory care suites, and 74 parking stalls. A pool is planned in the southern portion of the site, however, no subterranean parking or basements are planned. The proposed grading for the project is not known at this time, however, based on the relatively flat site, cuts and fills are anticipated to be 3 feet or less.

3. SOIL AND GEOLOGIC CONDITIONS

One surficial soil type and one geologic formation was encountered during the field investigation. The surficial deposit consists of undocumented fill and the geologic formation consists of the Stadium Conglomerate. The surficial soil and geologic unit are discussed below in order of increasing age.

3.1 Undocumented Fill

Undocumented fill deposits were encountered in each of the exploratory trenches and varied in thickness between ½ and 4½ feet. The fill generally consists of medium dense, moist, silty, fine- to medium-grained sands with varying amounts of gravel and cobble size rock fragments up to 10 inches in size. A thin layer (less than 6 inches) of aggregate base has been placed across the majority of the site, likely by the previous general contractor that leased the property for a construction staging area.

The embankment placed in conjunction with the approximately 16-foot high MSE wall located along the southwestern boundary (shown on Figure 2) could not be evaluated without removing an existing chain link fence and disturbing the wall reinforcement. However, the wall appears to be performing adequately and is located outside of any proposed improvements for the project.

An inquiry was made with the City of La Mesa in order to obtain any as-graded reports for the embankments placed on site, however, we received no response. Therefore, because no documentation is available, we have assumed the fill deposits were placed without geotechnical observation and have been classified as “undocumented”. These deposits are unsuitable in their present condition and will require removal and compaction in the areas proposed to be graded and/or where settlement sensitive improvements are planned.

3.2 Stadium Conglomerate

The Eocene-age Stadium Conglomerate was encountered at existing grade and underlying the undocumented fill deposits across the site. As encountered in exploratory trenches, this deposit generally consists of dense to very dense, white to light brown, sandy to clayey, gravel and cobble conglomerate with interbedded silty sands. In general, the trenches advanced through this unit encountered moderate difficulty and refusal due to cemented layers (Trench T-1); therefore, moderate to heavy ripping should be anticipated during grading or underground improvement construction within the Stadium Conglomerate.

4. GROUNDWATER

Groundwater was not encountered during the field investigation and is not anticipated to significantly impact project development as presently proposed. However, it is not uncommon for groundwater or seepage conditions to develop where none previously existed.

5. GEOLOGIC HAZARDS

5.1 Faulting and Seismicity

Based on our reconnaissance and a review of published geologic maps and reports, the site is not located on any known "active," "potentially active" or "inactive" fault traces as defined by the California Geological Survey (CGS).

The Rose Canyon Fault zone and the Newport-Inglewood Fault, located approximately 10 miles west of the site, are the closest known active faults. The CGS considers a fault seismically active when evidence suggests seismic activity within roughly the last 11,000 years. The CGS has included portions of the Rose Canyon Fault zone within an Alquist-Priolo Earthquake Fault Zone.

According to the computer program *EZ-FRISK* (Version 7.65), 6 known active faults are located within a search radius of 50 miles from the property. The nearest known active faults are the Newport-Inglewood and Rose Canyon Faults, located approximately 10 miles west of the site and are the dominant sources of potential ground motion. Earthquakes that might occur on the Newport-Inglewood or Rose Canyon Fault Zones or other faults within the southern California and northern Baja California area are potential generators of significant ground motion at the site. The estimated deterministic maximum earthquake magnitude and peak ground acceleration for the Newport Inglewood Fault are 7.5 and 0.25g, respectively. Table 5.1.1 lists the estimated maximum earthquake magnitude and peak ground acceleration for the most dominant faults in relationship to the site location. We calculated peak ground acceleration (PGA) using Boore-Atkinson (2008) NGA USGS 2008, Campbell-Bozorgnia (2008) NGA USGS 2008, and Chiou-Youngs (2007) NGA USGS 2008 acceleration-attenuation relationships.

TABLE 5.1.1
DETERMINISTIC SPECTRA SITE PARAMETERS

Fault Name	Distance from Site (miles)	Maximum Earthquake Magnitude (Mw)	Peak Ground Acceleration		
			Boore-Atkinson 2008 (g)	Campbell-Bozorgnia 2008 (g)	Chiou-Youngs 2008 (g)
Newport-Inglewood	10	7.5	0.23	0.20	0.25
Rose Canyon	10	6.9	0.19	0.18	0.19
Coronado Bank	22	7.4	0.15	0.11	0.12
Palos Verdes Connected	22	7.7	0.16	0.12	0.15
Elsinore	32	7.85	0.13	0.09	0.12
Earthquake Valley	37	6.8	0.07	0.06	0.05

We used the computer program *EZ-FRISK* to perform a probabilistic seismic hazard analysis. The computer program *EZ-FRISK* operates under the assumption that the occurrence rate of earthquakes on each mappable Quaternary fault is proportional to the faults slip rate. The program accounts for fault rupture length as a function of earthquake magnitude, and site acceleration estimates are made using the earthquake magnitude and distance from the site to the rupture zone. The program also accounts for uncertainty in each of following: (1) earthquake magnitude, (2) rupture length for a given magnitude, (3) location of the rupture zone, (4) maximum possible magnitude of a given earthquake, and (5) acceleration at the site from a given earthquake along each fault. By calculating the expected accelerations from considered earthquake sources, the program calculates the total average annual expected number of occurrences of site acceleration greater than a specified value. We utilized acceleration-attenuation relationships suggested by Boore-Atkinson (2008) NGA USGS, Campbell-Bozorgnia (2008) NGA USGS, and Chiou-Youngs (2008) in the analysis. Table 5.1.2 presents the site-specific probabilistic seismic hazard parameters including acceleration-attenuation relationships and the probability of exceedence.

TABLE 5.1.2
PROBABILISTIC SEISMIC HAZARD PARAMETERS

Probability of Exceedence	Peak Ground Acceleration		
	Boore-Atkinson, 2007 (g)	Campbell-Bozorgnia, 2008 (g)	Chiou-Youngs, 2008 (g)
2% in a 50 Year Period	0.35	0.35	0.39
5% in a 50 Year Period	0.25	0.25	0.27
10% in a 50 Year Period	0.19	0.19	0.19

While listing peak accelerations is useful for comparison of potential effects of fault activity in a region, other considerations are important in seismic design, including the frequency and duration of motion and the soil conditions underlying the site. Seismic design of the structures should be evaluated in accordance with the California Building Code (CBC) guidelines currently adopted by the City of La Mesa.

The site could be subjected to moderate to severe ground shaking in the event of a major earthquake on any of the referenced faults or other faults in Southern California. With respect to seismic shaking, the site is considered comparable to the surrounding developed area.

5.2 Liquefaction

Liquefaction typically occurs when a site is located in a zone with seismic activity, onsite soils are cohesionless, groundwater is encountered within 50 feet of the surface, and soil densities are less than about 70 percent of the maximum dry densities. If all four criteria are met, a seismic event could result in a rapid increase in pore water pressure from the earthquake-generated ground accelerations. The potential for liquefaction at the site is considered to be negligible due to the dense formational material encountered, remedial grading recommended, and lack of a shallow groundwater condition.

5.3 Landslides

No evidence of landslide deposits was encountered at the site during the geotechnical investigation.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 General

6.1.1 No soil or geologic conditions were encountered that, in the opinion of Geocon Incorporated, would preclude the development of the property as proposed, provided the recommendations of this report are followed.

6.1.2 The site is underlain by undocumented fill that is unsuitable in its present condition and will require remedial grading where improvements are planned. The actual extent of unsuitable soil removal will be determined in the field by the geotechnical engineer and/or engineering geologist.

6.1.3 The embankment associated with the MSE wall located along the southwestern boundary will not require remedial grading provided no structural improvements are planned above or adjacent to the wall that would impact its integrity. Geocon Incorporated should review the grading plans for the project prior to final design submittal to evaluate whether or not additional analyses and/or recommendations are required.

6.2 Excavation and Soil Characteristics

6.2.1 Excavation of the undocumented fill should be possible with light to moderate effort using conventional heavy-duty equipment. Excavations within the Stadium Conglomerate will require moderate to very heavy effort due to the high cobble percentage and random occurrence of highly cemented zones. Oversize material (12-inches or greater) and cemented chunks of conglomerate may be generated that will require special handling and placement in deeper fill areas or exportation depending on the availability of suitable fill areas.

6.2.2 The soil encountered in the field investigation is considered to be “expansive” (expansion index [EI] of 90 or less) as defined by 2013 California Building Code (CBC) Section 1803.5.3. Table 6.2 presents soil classifications based on the expansion index. The soil materials collected and tested for expansion index indicate a “very low” to “medium” expansion potential (expansion index of 90 or less).

TABLE 6.2
EXPANSION CLASSIFICATION BASED ON EXPANSION INDEX

Expansion Index (EI)	Expansion Classification	2013 CBC Expansion Classification
0 – 20	Very Low	Non-Expansive
21 – 50	Low	Expansive
51 – 90	Medium	
91 – 130	High	
Greater Than 130	Very High	

6.3 Corrosion

6.3.1 Laboratory tests were performed on soil samples to evaluate the water-soluble sulfate content (California Test No. 417), pH and minimum resistivity (California Test Method 643), and Chloride Ion Content (AASHTO T291-94) to generally evaluate the corrosion potential to structures in contact with soil. The results of the laboratory tests are summarized in Appendix B. The results should be considered for design of concrete, underground structures and metallic pipes.

6.3.2 Results from the laboratory water-soluble sulfate content tests indicate that the materials at the locations tested possesses *Not Applicable* and *S0* sulfate exposure to concrete structures as defined by 2013 CBC Section 1904 and ACI 318-11 Sections 4.2 and 4.3. 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. Table 6.3 presents a summary of concrete requirements set forth by 2013 CBC Section 1904 and ACI 318.

TABLE 6.3
REQUIREMENTS FOR CONCRETE EXPOSED TO SULFATE-CONTAINING SOLUTIONS

Sulfate Severity	Exposure Class	Water-Soluble Sulfate (SO_4) Percent by Weight	Cement Type (ASTM C 150)	Maximum Water to Cement Ratio by Weight	Minimum Compressive Strength (psi)
Not Applicable	S0	$SO_4<0.10$	--	--	2,500
Moderate	S1	$0.10\leq SO_4<0.20$	II	0.50	4,000
Severe	S2	$0.20\leq SO_4\leq 2.00$	V	0.45	4,500
Very Severe	S3	$SO_4>2.00$	V+Pozzolan or Slag	0.45	4,500

6.3.3 Geocon Incorporated does not practice in the field of corrosion engineering; therefore, further evaluation by a corrosion engineer may be needed to incorporate the necessary precautions to avoid premature corrosion of underground pipes and buried metal in direct contact with the soils.

6.4 Grading

6.4.1 All grading should be performed in accordance with the attached *Recommended Grading Specifications* (Appendix C). Where the recommendations of this section conflict with Appendix C, the recommendations of this section take precedence. All earthwork should be observed and all fills tested for proper compaction by Geocon Incorporated.

6.4.2 Earthwork should be observed and compacted fill tested by representatives of Geocon Incorporated.

6.4.3 A pre-construction conference with a City of La Mesa representative, owner, contractor, civil engineer, and geotechnical engineer should be held at the site prior to the beginning of grading. Special soil handling requirements can be discussed at that time.

6.4.4 Site preparation should begin with the removal of all deleterious material and vegetation. The depth of removal should be such that material exposed in cut areas or soils to be used as fill are relatively free of organic matter. Material generated during stripping and/or site demolition should be exported from the site.

6.4.5 All undocumented fill and any other surficial deposits (i.e. topsoil, colluvium) present within areas where structural improvements are planned should be removed to firm natural ground and properly compacted prior to placing additional fill and/or structural loads. The actual extent of unsuitable soil removals will be determined in the field during grading by the geotechnical engineer and/or engineering geologist.

6.4.6 After removal of unsuitable materials is performed, the site should then be brought to final subgrade elevations with structural fill compacted in layers. In general, soils native to the site are suitable for re-use as fill if free from vegetation, debris and other deleterious material. Layers of fill should be no thicker than will allow for adequate bonding and compaction. All fill, including backfill and scarified ground surfaces, should be compacted to at least 90 percent of maximum dry density at or above optimum moisture content, as determined in accordance with ASTM Test Procedure D1557. Fill materials below optimum moisture content will require additional moisture conditioning prior to placing additional fill.

6.4.7 Oversize material (defined as material greater than 12 inches in nominal dimension) may be generated during grading within the Stadium Conglomerate. The placement of oversize material should be in accordance with the recommendations in Appendix C, at least 3 feet below finish grade and a minimum of 2 feet below all utilities.

6.4.8 Where practical, the upper 3 feet of the building pads should be comprised of soil with a "very low" to "low" expansion potential. The more highly expansive fill soils should be placed in the deeper fill areas and properly compacted, if encountered. "Very low" to "low" expansive soils are defined by the 2013 California Building Code (CBC) Section 1803.5.3 as those soils that have an Expansion Index of 50 or less.

6.4.9 The bedrock portion of cut/fill transitions exposed in building pads should be undercut at least 3 feet and replaced with properly compacted granular materials having a "low" to "very low" expansion potential. The lateral limits of the undercut should extend a minimum of 5 feet outside the building footprint. Alternatively, consideration may be given to deepening footings through the compacted fill and supporting the proposed structure entirely on the Stadium Conglomerate. The deepened portion of the footing excavations may be filled with a 2-sack cement slurry to bottom of planned footing elevation.

6.4.10 It is the responsibility of the contractor to ensure that all excavations and trenches are properly shored and maintained in accordance with applicable OSHA rules and regulations in order to maintain safety and maintain the stability of adjacent existing improvements.

6.4.11 Import fill (if necessary) should consist of granular materials with a "very low" to "low" expansion potential (EI of 50 or less) free of deleterious material or stones larger than 3 inches and should be compacted as recommended above. 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.

6.5 Seismic Design Criteria

6.5.1 We used the computer program *U.S. Seismic Design Maps*, provided by the USGS. Table 6.5.1 summarizes site-specific design criteria obtained from the 2013 California Building Code (CBC; Based on the 2012 International Building Code [IBC] and ASCE 7-10), Chapter 16 Structural Design, Section 1613 Earthquake Loads. The short spectral response uses a period of 0.2 second. The building structure and improvements should be designed using a Site Class C. We evaluated the Site Class based on the discussion in Section 1613.3.2 of the 2013 CBC and Table 20.3-1 of ASCE 7-10. The values presented in Table 6.5.1 are for the risk-targeted maximum considered earthquake (MCE_R).

TABLE 6.5.1
2013 CBC SEISMIC DESIGN PARAMETERS

Parameter	Value	2013 CBC Reference
Site Class	C	Section 1613.3.2
MCE_R Ground Motion Spectral Response Acceleration – Class B (short), S_S	0.866g	Figure 1613.3.1(1)
MCE_R Ground Motion Spectral Response Acceleration – Class B (1 sec), S_1	0.336g	Figure 1613.3.1(2)
Site Coefficient, F_A	1.053	Table 1613.3.3(1)
Site Coefficient, F_V	1.464	Table 1613.3.3(2)
Site Class Modified MCE_R Spectral Response Acceleration (short), S_{MS}	0.913g	Section 1613.3.3 (Eqn 16-37)
Site Class Modified MCE_R Spectral Response Acceleration (1 sec), S_{M1}	0.492g	Section 1613.3.3 (Eqn 16-38)
5% Damped Design Spectral Response Acceleration (short), S_{DS}	0.608g	Section 1613.3.4 (Eqn 16-39)
5% Damped Design Spectral Response Acceleration (1 sec), S_{D1}	0.328g	Section 1613.3.4 (Eqn 16-40)

6.5.2 Table 6.5.2 presents additional seismic design parameters for projects located in Seismic Design Categories of D through F in accordance with ASCE 7-10 for the mapped maximum considered geometric mean (MCE_G).

TABLE 6.5.2
2013 CBC SITE ACCELERATION DESIGN PARAMETERS

Parameter	Value	ASCE 7-10 Reference
Mapped MCE_G Peak Ground Acceleration, PGA	0.331g	Figure 22-7
Site Coefficient, F_{PGA}	1.069	Table 11.8-1
Site Class Modified MCE_G Peak Ground Acceleration, PGA_M	0.354g	Section 11.8.3 (Eqn 11.8-1)

6.5.3 Conformance to the criteria in Tables 6.5.1 and 6.5.2 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.

6.6 Foundations

6.6.1 The proposed structure can be supported on a shallow foundation system founded entirely in compacted fill. Foundations for the structure should consist of continuous strip footings and/or isolated spread footings. Continuous footings should be at least 12 inches wide and extend at least 18 inches below lowest adjacent pad grade. Isolated spread footings should have a minimum width of 2 feet and should extend at least 18 inches below lowest adjacent pad grade. Steel reinforcement for continuous footings should consist of at least four No. 4 steel reinforcing bars placed horizontally in the footings, two near the top and two near the bottom. Steel reinforcement for the spread footings should be designed by the project structural engineer. A footing dimension detail, depicting the depth to lowest adjacent grade, is presented in Figure 3.

6.6.2 The minimum reinforcement recommended above is based on soil characteristics only (Expansion Index of 90 or less) and is not intended to replace reinforcement required for structural considerations.

6.6.3 The recommended allowable bearing capacity for foundations with minimum dimensions described above and bearing in compacted fill is 2,000 pounds per square foot (psf). This allowable soil bearing pressure may be increased by an additional 500 psf for each additional foot of depth and 300 psf for each additional foot of width, to a maximum allowable bearing capacity of 4,000 psf. The values presented above are for dead plus live loads and may be increased by one-third when considering transient loads due to wind or seismic forces.

6.6.4 Footings that must be placed within 7 feet of the top of slopes should be extended in depth such that the outer bottom edge of the footing is at least 7 feet horizontally inside the face of the slope.

6.6.5 Static settlement of the building founded on properly compacted fill is expected to be less than 1-inch. Differential static settlement is expected to be one-half of the total settlement.

6.6.6 As an alternative to the conventional foundation recommendations, consideration should be given to the use of post-tensioned concrete slab and foundation systems for the support of the proposed structure. The post-tensioned system should be designed by a structural engineer experienced in post-tensioned slab design and design criteria of the Post-Tensioning Institute (PTI), Third Edition, as required by the 2013 California Building Code (CBC Section 1808.6). Although this procedure was developed for expansive soil conditions, it can also be used to reduce the potential for foundation distress due to

differential fill settlement. The post-tensioned design should incorporate the geotechnical parameters presented on Table 6.6. The parameters presented in Table 6.6 are based on the guidelines presented in the PTI, Third Edition design manual.

TABLE 6.6
POST-TENSIONED FOUNDATION SYSTEM DESIGN PARAMETERS

Post-Tensioning Institute (PTI),Third Edition Design Parameters	
Thornthwaite Index	-20
Equilibrium Suction	3.9
Edge Lift Moisture Variation Distance, e_M (feet)	5.1
Edge Lift, y_M (inches)	1.10
Center Lift Moisture Variation Distance, e_M (feet)	9.0
Center Lift, y_M (inches)	0.47

6.6.7 The foundations for the post-tensioned slabs should be embedded in accordance with the recommendations of the structural engineer. If a post-tensioned mat foundation system is planned, the slab should possess a thickened edge with a minimum width of 12 inches and extend below the clean sand or crushed rock layer.

6.6.8 Our experience indicates post-tensioned slabs are susceptible to excessive edge lift, regardless of the underlying soil conditions. Placing reinforcing steel at the bottom of the perimeter footings and the interior stiffener beams may mitigate this potential. Current PTI design procedures primarily address the potential center lift of slabs but, because of the placement of the reinforcing tendons in the top of the slab, the resulting eccentricity after tensioning reduces the ability of the system to mitigate edge lift. The structural engineer should design the foundation system to reduce the potential of edge lift occurring for the proposed structures.

6.6.9 During the construction of the post-tension foundation system, the concrete should be placed monolithically. Under no circumstances should cold joints be allowed to form between the footings/grade beams and the slab during the construction of the post-tension foundation system.

6.6.10 The exposed foundation and slab subgrade soil should be moisture conditioned to maintain a moist condition as would be expected in any such concrete placement. The elevated moisture content should be maintained until concrete placement.

6.6.11 Geocon Incorporated should be consulted to provide additional design parameters as required by the structural engineer.

6.6.12 Foundation excavations should be observed by the geotechnical engineer (a representative of Geocon Incorporated) prior to the placement of reinforcing steel and concrete to verify that the exposed soil conditions are consistent with those anticipated and have been extended to appropriate bearing strata. If unanticipated soil conditions are encountered, foundation modifications may be required.

6.7 Concrete Slabs-on-Grade

6.7.1 Concrete slabs-on-grade for the structure should be at least 5 inches thick and reinforced with No. 3 steel reinforcing bars at 24 inches on center in both horizontal directions.

6.7.2 Slabs that may receive moisture-sensitive floor coverings or may be used to store moisture-sensitive materials should be underlain by a vapor retarder. The vapor retarder design should be consistent with the guidelines presented in the American Concrete Institute's (ACI) *Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials* (ACI 302.2R-06). In addition, the membrane should be installed in accordance with manufacturer's recommendations and ASTM requirements and installed in a manner that prevents puncture. The vapor retarder used should be specified by the project architect or developer based on the type of floor covering that will be installed and if the structure will possess a humidity controlled environment.

6.7.3 The bedding sand thickness should be determined by the project foundation engineer, architect, and/or developer. However, we should be contacted to provide recommendations if the bedding sand is thicker than 6 inches. Typically, concrete slabs on grade are underlain by 4 inches of clean sand (or crushed rock), with the vapor inhibitor placed at the midpoint. The foundation design engineer should provide appropriate concrete mix design criteria and curing measures to assure proper curing of the slab by reducing the potential for rapid moisture loss and subsequent cracking and/or slab curl. We suggest that the foundation design engineer present the concrete mix design and proper curing methods on the foundation plans. It is critical that the foundation contractor understands and follows the recommendations presented on the foundation plans.

6.7.4 As a substitute, the layer of clean sand (or crushed rock) beneath the vapor inhibitor recommended in the previous section can be omitted if a vapor inhibitor that meets or exceeds the requirements of ASTM E 1745 (Class A), and that exhibits permeance not greater than 0.012 perm (measured in accordance with ASTM E 96) is used. This vapor

inhibitor may be placed directly on properly compacted fill or formational materials. The vapor inhibitor should be installed in general conformance with ASTM E 1643 and the manufacturer's recommendations. Two inches of clean sand should then be placed on top of the vapor inhibitor to reduce the potential for differential curing, slab curl, and cracking. Floor coverings should be installed in accordance with the manufacturer's recommendations.

6.7.5 The concrete slab-on-grade recommendations are based on soil support characteristics only. The project structural engineer should evaluate the structural requirements of the concrete slabs for supporting vehicle, equipment and storage loads.

6.7.6 Exterior concrete flatwork not subject to vehicular traffic should be constructed in accordance with the recommendations herein. Slab panels should be a minimum of 4 inches thick and should be reinforced with 6x6-6/6 welded wire mesh or No. 3 reinforcing bars at 24 inches on center in both directions to reduce the potential for cracking. In addition, 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 checked prior to placing concrete.

6.7.7 Proper moisture conditioning of subgrade soil supporting flatwork and concrete pavement is critical to reduce the effects of expansive soils. Prior to concrete placement, the upper 1 foot of subgrade should be scarified, moisture conditioned, and compacted to at least 90 percent of the maximum dry density at slightly over optimum moisture content in sidewalk areas and at least 95 percent for subgrade supporting pavement. Soils placed below optimum moisture content should be reworked and retested prior to placing concrete. It is imperative that the moisture content be maintained until the concrete pour.

6.7.8 The recommendations presented herein are intended to reduce the potential for cracking of slabs and foundations as a result of differential movement. However, even with the incorporation of the recommendations presented herein, foundations and slabs-on-grade will still exhibit some cracking. 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 Cement Association (PCA) and American Concrete Institute (ACI) present recommendations for proper concrete mix, construction, and curing practices, and should be incorporated into project construction.

6.8 Preliminary Pavement Recommendations

6.8.1 The pavement recommendations presented herein are based on an R-Value of 18. Final pavement sections should be calculated once subgrade elevations have been attained and R-Value testing on actual subgrade samples is performed. Asphalt concrete pavement thicknesses were calculated using procedures outlined in the *California Highway Design Manual* (Caltrans). We expect the majority of traffic will consist of automobile and delivery truck traffic and periodic trash and fire truck traffic. Summarized on Table 6.8 are recommended pavement sections for various traffic indices. The architect, civil engineer, or developer should determine the appropriate Traffic Index (TI) for the traffic loading expected on the project. In our opinion, a TI of 4.5 is appropriate for parking stalls and a TI of 5 or 6 for parking areas.

TABLE 6.8
FLEXIBLE PAVEMENT SECTION RECOMMENDATIONS

Location	Traffic Index	R-Value	Asphalt Concrete Thickness (inches)	Class 2 Aggregate Base Thickness (inches)
Parking Lot	4.5	18	3	6
	5.0	18	3	7.5
	5.5	18	3	9.5
	6.0	18	3.5	10
	7.0	18	3.5	13.5

6.8.2 The subgrade soils for pavement areas should be compacted to a minimum relative compaction of 95 percent at or slightly above the optimum moisture content. The depth of subgrade compaction should be approximately 12 inches.

6.8.3 Class 2 base should conform to Section 26-1-02B of the *Standard Specifications for The State of California Department of Transportation (Caltrans)* and should be compacted to a minimum of 95 percent of the maximum dry density at near optimum moisture content. The asphalt concrete should conform to Section 203-6 of the *Standard Specifications for Public Works Construction (Greenbook).*

6.8.4 The performance of asphalt concrete pavements is highly dependent upon providing positive surface drainage away from the edge of the pavement. Ponding of water on or adjacent to the pavement will likely result in pavement distress and subgrade failure. If planter islands are proposed, the perimeter curb should extend at least 12 inches below proposed subgrade elevations. In addition, the surface drainage within the planter should be such that ponding will not occur.

6.8.5 Our experience indicates that even with these provisions, a groundwater condition can develop as a result of increased irrigation, landscaping and surface runoff.

6.9 Retaining Walls

6.9.1 The structural engineer should determine the seismic design category for the project. If the project possesses a seismic design category of D, E, or F, the proposed retaining walls should be designed with seismic lateral pressure. A seismic load of 18H should be used for design on walls that support more than 6 feet of backfill in accordance with Section 1803.5.12 of the 2013 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. We used the peak site acceleration, PGA_M, of 0.354g calculated from ASCE 7-10 Section 11.8.3 and applied a pseudo-static coefficient of 0.33.

6.9.2 Retaining walls not restrained at the top and having a level backfill surface should be designed for an active soil pressure equivalent to the pressure exerted by a fluid with a density of 35 pounds per cubic foot (pcf). Where the backfill will be inclined at no steeper than 2.0 to 1.0, an active soil pressure of 50 pcf is recommended. These soil pressures assume that the backfill materials within an area bounded by the wall and a 1:1 plane extending upward from the base of the wall possess an Expansion Index of less than 50.

6.9.3 Unrestrained walls are those that are allowed to rotate more than 0.001H (where H equals the height of the retaining wall portion of the wall in feet) at the top of the wall. Where walls are restrained from movement at the top, an additional uniform pressure of 7H psf should be added to the above active soil pressure.

6.9.4 Retaining walls should be provided with a drainage system adequate to prevent the buildup of hydrostatic forces and should be waterproofed as required by the project architect. The use of drainage openings through the base of the wall (weep holes) is not recommended where the seepage could be a nuisance or otherwise adversely affect the property adjacent to the base of the wall. The above recommendations assume a properly compacted granular

(EI less than 50) free-draining backfill material with no hydrostatic forces or imposed surcharge load. A typical retaining wall drain detail is shown as Figure 4. If conditions different than those described are anticipated, or if specific drainage details are desired, Geocon Incorporated should be contacted for additional recommendations.

6.9.5 Retaining wall footings should be at least 12 inches wide and 12 inches below lowest adjacent grade. An allowable bearing capacity for retaining wall footings founded in compacted fill can be taken as 2,000 psf.

6.9.6 Footings that must be placed within seven feet of the top of slopes should be extended in depth such that the outer bottom edge of the footing is at least seven feet horizontally inside the face of the slope.

6.9.7 To resist lateral loads, a passive pressure exerted by an equivalent fluid weight of 300 pounds per cubic foot (pcf) should be used for the design of footings or shear keys poured neat against properly compacted granular fill soils. The allowable passive pressure assumes a horizontal surface extending at least 5 feet away from the base of the wall or three times the height of 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 the design for passive resistance.

6.9.8 If friction is to be used to resist lateral loads, an allowable coefficient of friction between soil and concrete of 0.35 should be used for the design. This friction coefficient may be combined with the allowable passive earth pressure when determining resistance to lateral loads.

6.9.9 The recommendations presented above are generally applicable to the design of rigid concrete or masonry retaining walls having a maximum height of approximately 12 feet. In the event that walls higher than 12 feet or other types of walls are planned, such as crib-type walls, Geocon Incorporated should be consulted for additional recommendations.

6.10 Storm Water Management

6.10.1 If low-impact development (LID) integrated management practices (IMP's) are being considered, Geocon should review the design and provide specific geotechnical recommendations to reduce the potential adverse impacts to both on and off-site properties.

6.10.2 If not property 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. Based on our experience with similar soil conditions, infiltration IMP's are considered infeasible due to the poor percolation characteristics of the bedrock. Down-gradient and adjacent properties/improvements may be subjected to seeps, springs, slope instability, raised groundwater, movement of foundations and slabs, or other impacts as a result of water infiltration.

6.10.3 Due to the site geologic conditions, a heavy duty, non-permeable liner is recommended beneath any hydro-modification areas or IMP's where water infiltration into the underlying soils is planned. If permeable pavers are planned, the design should include a subdrain to prevent subgrade saturation and pavement distress. The strength and thickness of the membrane, and construction method should be adequate to assure that the liner will not be compromised throughout the life of the system. In addition, civil engineering provisions should be implemented to assure that the capacity of the system is never exceeded resulting in over topping or malfunctioning of the device. The system should also include a long-term maintenance program or periodic cleaning to prevent clogging of the filter media or drain envelope. Geocon Incorporated has no opinion regarding the design of the filtration system or its effectiveness. A typical bioretention basin detail is presented as Figure 5. A subdrain cut-off wall detail is shown as Figure 6. A typical subdrain outlet headwall detail is provided as Figure 7.

6.11 Site Drainage and Moisture Protection

6.11.1 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 2013 CBC 1804.3 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.

6.11.2 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 Plan Review

6.12.1 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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WESTMONT OF LA MESA
LA MESA, CALIFORNIA

TR / CW		DSK/GTYPD	DATE 12 - 29 - 2015	PROJECT NO. G1931 - 32 - 01	FIG. 1

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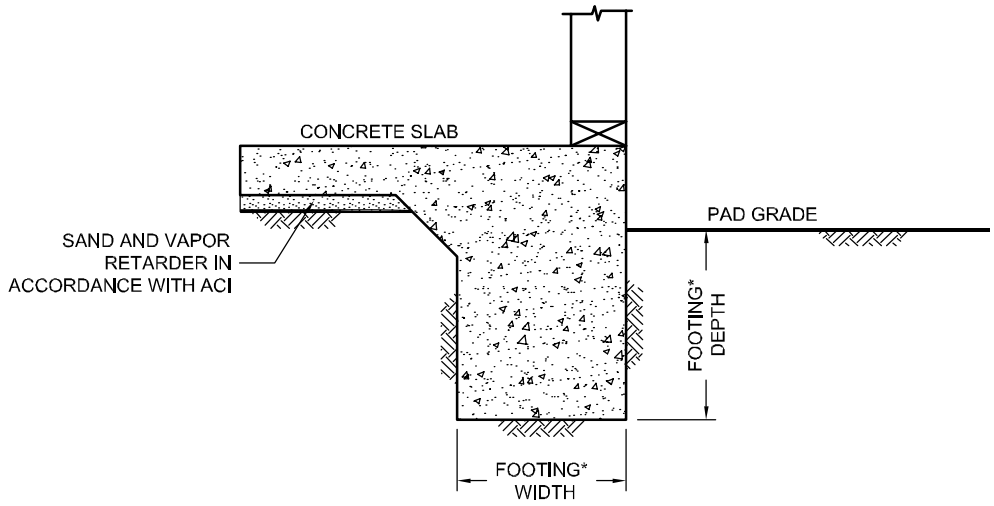

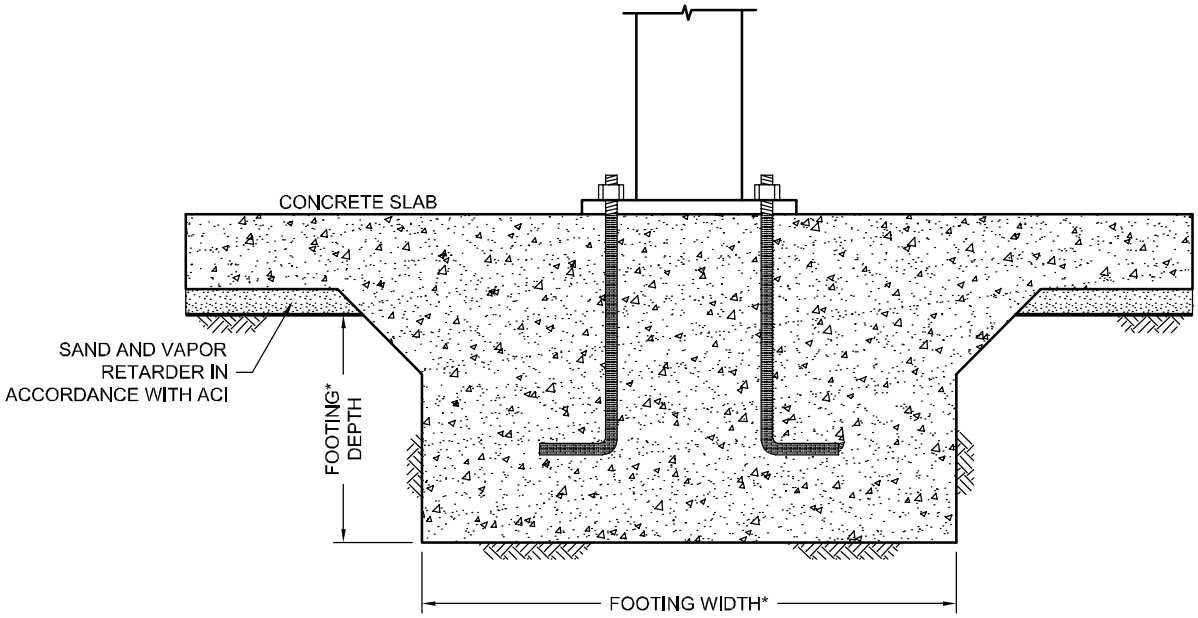

*....SEE REPORT FOR FOUNDATION WIDTH AND DEPTH RECOMMENDATION

NO SCALE

WALL / COLUMN FOOTING DIMENSION DETAIL

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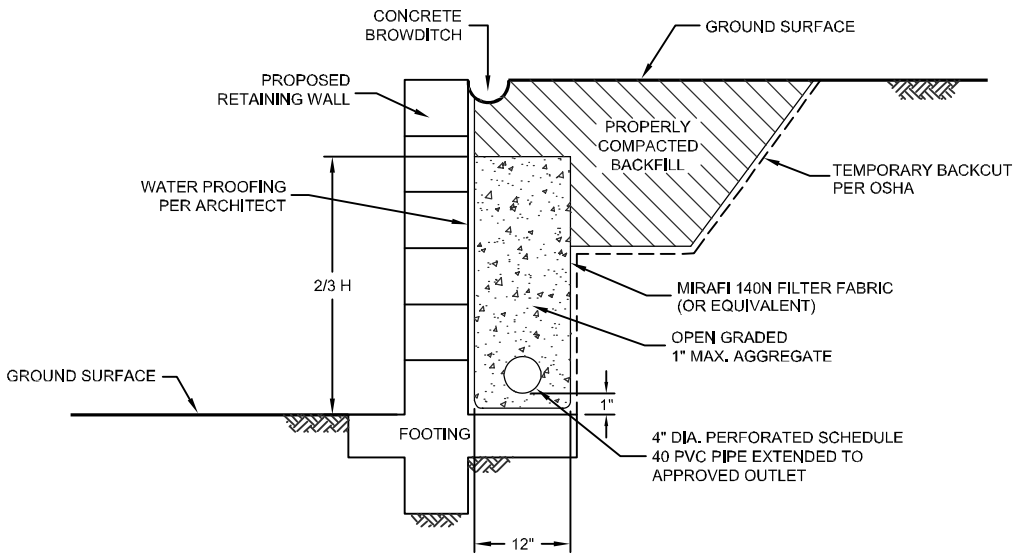
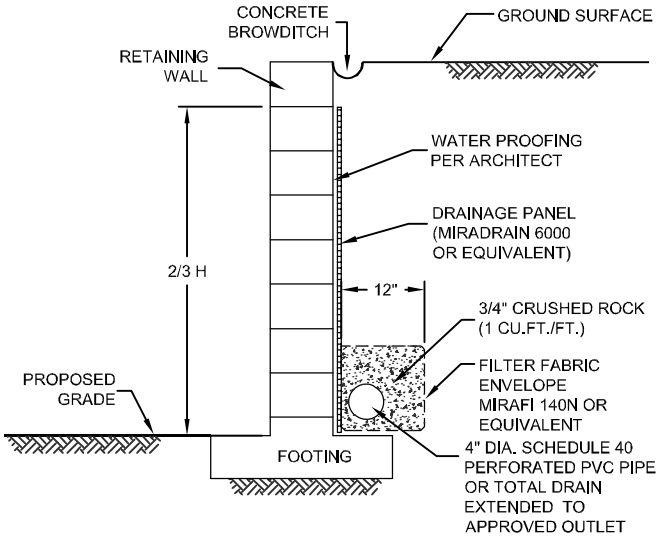
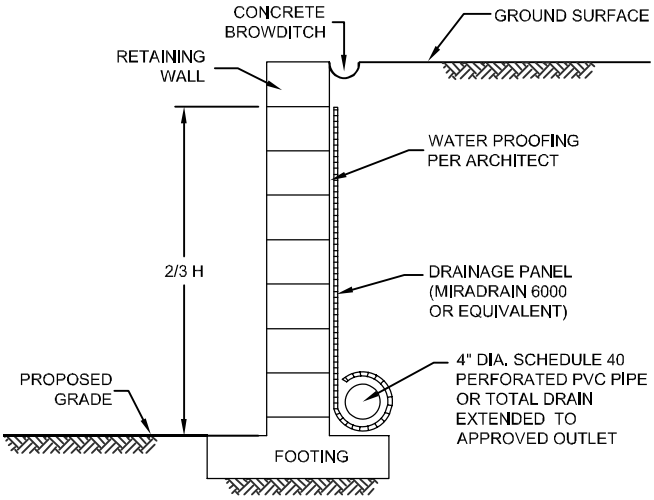
TR / CW		DSK/GTYPD	DATE 12 - 29 - 2015	PROJECT NO. G1931 - 32 - 01	FIG. 3







NOTE :

DRAIN SHOULD BE UNIFORMLY SLOPED TO GRAVITY OUTLET OR TO A SUMP WHERE WATER CAN BE REMOVED BY PUMPING

NO SCALE

TYPICAL RETAINING WALL DRAIN DETAIL

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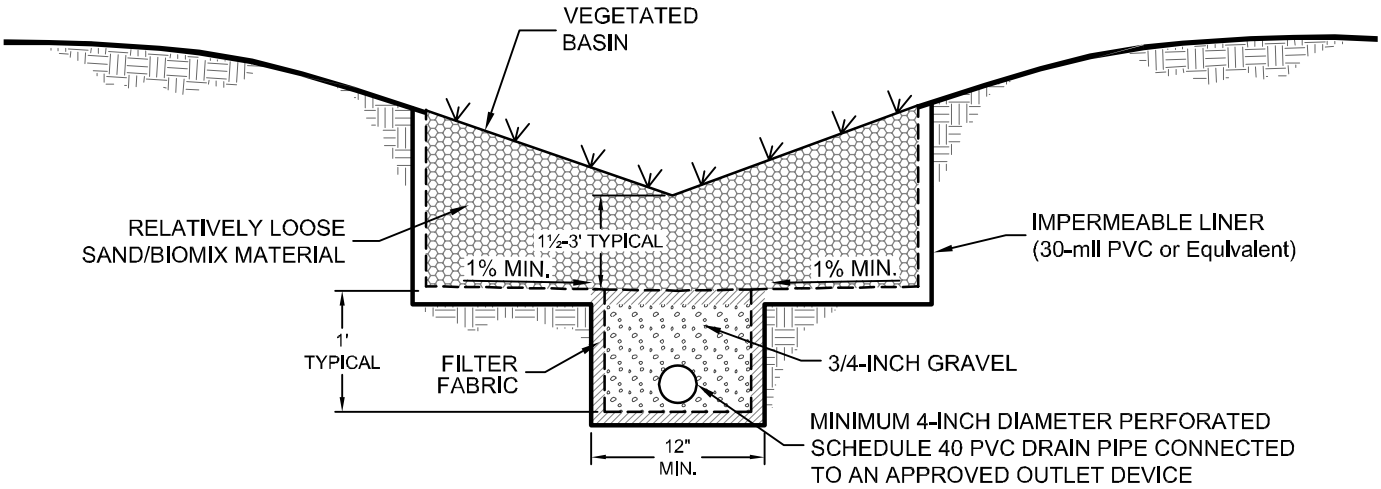
TR / CW		DSK/GTYPD	DATE 12 - 29 - 2015	PROJECT NO. G1931 - 32 - 01	FIG. 4

Plotted:12/29/2015 11:15AM | By:ALVIN LADRILLONO | File Location:Y:\PROJECTS\G1931-32-01 Westmont of La Mesa\DETAILS\Typical Retaining Wall Drainage Detail (RWDD7A).dwg



NOTE: CLASS II PERMEABLE BASE MAY BE USED AS AN ALTERNATIVE TO 3/4" GRAVEL AND FILTER FABRIC.

NO SCALE

TYPICAL BIORETENTION BASIN DETAIL

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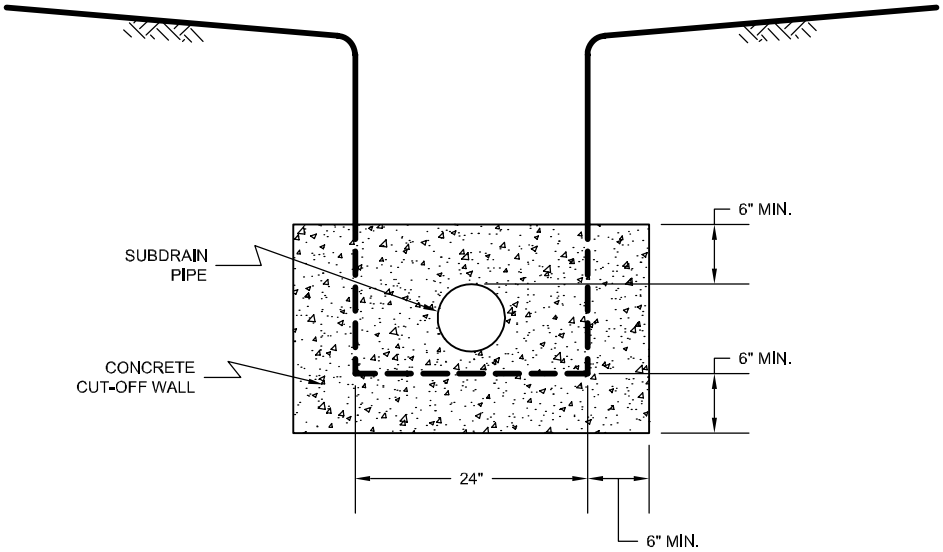
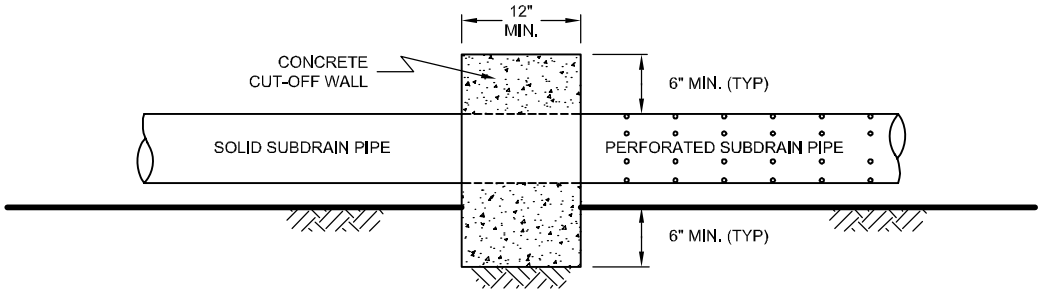
TR / CW		DSK/GTYPD	DATE 12 - 29 - 2015	PROJECT NO. G1931 - 32 - 01	FIG. 5

FRONT VIEW



NO SCALE

SIDE VIEW



NO SCALE

RECOMMENDED SUBDRAIN CUT-OFF WALL DETAIL

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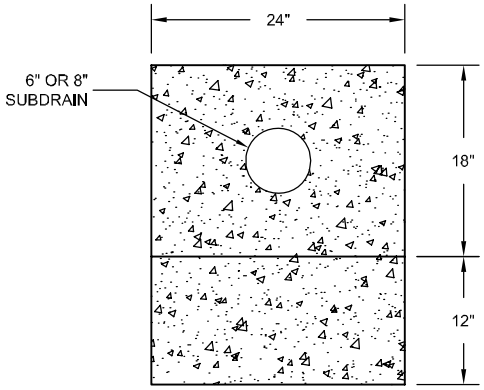
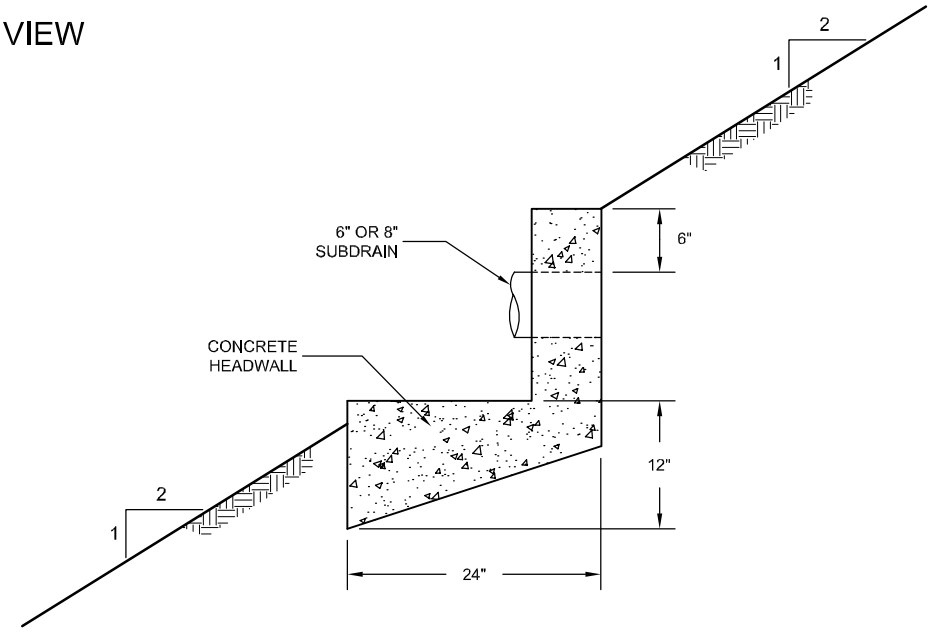
TR / CW		DSK/GTYPD	DATE 12 - 29 - 2015	PROJECT NO. G1931 - 32 - 01	FIG. 6

FRONT VIEW



NO SCALE

SIDE VIEW



NOTE: HEADWALL SHOULD OUTLET AT TOE OF FILL SLOPE
OR INTO CONTROLLED SURFACE DRAINAGE

NO SCALE

SUBDRAIN OUTLET HEADWALL DETAIL

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TR / CW		DSK/GTYPD	DATE 12 - 29 - 2015	PROJECT NO. G1931 - 32 - 01	FIG. 7

APPENDIX A

APPENDIX A

FIELD INVESTIGATION

The field investigation was performed on December 15, 2015, and consisted of a visual site reconnaissance and excavating twelve exploratory trenches (Trench Nos. T-1 through T-12) at various locations across the subject site. The approximate locations of the trenches are shown on the *Site Plan*, Figure 2.

The exploratory trenches performed by Hillside Excavating were advanced to depths of 4 to 6 feet using a John Deere 410G rubber tire backhoe equipped with a 24-inch-wide bucket. Bulk samples were obtained for laboratory testing.

The soils encountered in the excavations were visually classified and logged in general accordance with American Society for Testing and Materials (ASTM) practice for Description and Identification of Soils (Visual Manual Procedure D 2488).

PROJECT NO. G1931-32-01

TRENCH T 1

ELEV. (MSL.)_____ DATE COMPLETED **12-15-2015**

EQUIPMENT **RUBBER TIRE BACKHOE** BY: **T. REIST**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	T1-1			SM	**UNDOCUMENTED FILL** Medium dense, damp to moist, dark brown to light brown, Silty, fine to medium SAND with some gravel and trace asphalt chunks			
2								
4				GM	***STADIUM CONGLOMERATE*** Very dense, damp, light brown, fine to medium, Sandy CONGLOMERATE with 50-60% gravel size rock fragments up to 8-inches; cemented			
					REFUSAL AT 5 FEET			

Figure A-1,
Log of Trench T 1, Page 1 of 1

G1931-32-01.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.

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PROJECT NO. G1931-32-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	**TRENCH T 2** ELEV. (MSL.)_____ DATE COMPLETED **12-15-2015** EQUIPMENT **RUBBER TIRE BACKHOE** BY: **T. REIST**	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**UNDOCUMENTED FILL** Medium dense, moist, light brown to dark brown, Silty, fine to medium SAND with 10% gravel and cobble size rock fragments up to 6-inches			
2					-Abandoned 2-inch gray conduit pipe present at 2 feet			
4				GM/GC	**STADIUM CONGLOMERATE** Very dense, damp, light brown, fine to coarse, Sandy to Clayey CONGLOMERATE with 50-60% gravel and cobble size rock fragments up to 4-inches			
					TRENCH TERMINATED AT 5.5 FEET			

Figure A-2,
Log of Trench T 2, Page 1 of 1

G1931-32-01.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. G1931-32-01

TRENCH T 3

ELEV. (MSL.)_____ DATE COMPLETED **12-15-2015**

EQUIPMENT **RUBBER TIRE BACKHOE** BY: **T. REIST**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				GM	**4-inches of AGGREGATE BASE**			
				SM	**UNDOCUMENTED FILL** Medium dense, moist, light brown, Silty, fine to medium SAND with 20% gravel and cobble size rock fragments up to 6-inches			
2				GM/GC	**STADIUM CONGLOMERATE** Dense to very dense, damp, light brown, fine to coarse, Sandy to Clayey CONGLOMERATE with 50-60% gravel and cobble size rock fragments up to 6-inches			
	T3-1							
4								
					TRENCH TERMINATED AT 5.5 FEET			

Figure A-3,
Log of Trench T 3, Page 1 of 1

G1931-32-01.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. G1931-32-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	**TRENCH T 4** ELEV. (MSL.)_____ DATE COMPLETED **12-15-2015** EQUIPMENT **RUBBER TIRE BACKHOE** BY: **T. REIST**	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				GM	**2-inches of AGGREGATE BASE**			
				SM	**UNDOCUMENTED FILL** Medium dense, moist, light brown, Silty, fine to medium SAND with some gravel			
				GM/GC	**STADIUM CONGLOMERATE** Dense to very dense, damp, light brown, fine to coarse, Sandy to Clayey CONGLOMERATE with 50-60% gravel and cobble size rock fragments up to 6-inches			
2								
4					TRENCH TERMINATED AT 4 FEET			

Figure A-4,
Log of Trench T 4, Page 1 of 1

G1931-32-01.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. G1931-32-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	**TRENCH T 5** ELEV. (MSL.)_____ DATE COMPLETED **12-15-2015** EQUIPMENT **RUBBER TIRE BACKHOE** BY: **T. REIST**	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				GM	**2-inches of AGGREGATE BASE**			
				SM	**UNDOCUMENTED FILL** Medium dense, moist, light brown, Silty, fine to medium SAND with some gravel			
				GM/GC	**STADIUM CONGLOMERATE** Dense to very dense, damp, light brown, fine to coarse, Sandy to Clayey CONGLOMERATE with 50-60% gravel and cobble size rock fragments up to 6-inches			
2								
4								
					TRENCH TERMINATED AT 5 FEET			

Figure A-5,
Log of Trench T 5, Page 1 of 1

G1931-32-01.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. G1931-32-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	**TRENCH T 6** ELEV. (MSL.)_____ DATE COMPLETED **12-15-2015** EQUIPMENT **RUBBER TIRE BACKHOE** BY: **T. REIST**	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				GM	**6-inches of AGGREGATE BASE**			
				SM	**STADIUM CONGLOMERATE** Dense, damp, white, Silty, fine to medium SANDSTONE			
2				GM	Dense, damp, white, fine to medium, Sandy CONGLOMERATE with 50-60% gravel and cobble size rock fragments up to 4-inches			
				SM	Dense, damp, light gray, Silty, fine to medium SANDSTONE			
4								
				GM	Dense, damp, white, fine to medium, Sandy CONGLOMERATE with 50-60% gravel and cobble size rock fragments up to 4-inches			
6					TRENCH TERMINATED AT 6 FEET			

Figure A-6,
Log of Trench T 6, Page 1 of 1

G1931-32-01.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. G1931-32-01

TRENCH T 7

ELEV. (MSL.)_____ DATE COMPLETED **12-15-2015**

EQUIPMENT **RUBBER TIRE BACKHOE** BY: **T. REIST**

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	**UNDOCUMENTED FILL** Medium dense, moist, light brown, Silty, fine to medium SAND with 10% gravel and cobble size rock fragments up to 6-inches			
				SM	**STADIUM CONGLOMERATE** Dense, damp, white, Silty, fine to medium SANDSTONE			
2								
				GM	Dense, damp, white, fine to coarse, Sandy CONGLOMERATE with 50-60% gravel and cobble size rock fragments up to 8-inches			
4								
6					TRENCH TERMINATED AT 6 FEET			

Figure A-7,
Log of Trench T 7, Page 1 of 1

G1931-32-01.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. G1931-32-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	**TRENCH T 8** ELEV. (MSL.)_____ DATE COMPLETED **12-15-2015** EQUIPMENT **RUBBER TIRE BACKHOE** BY: **T. REIST**	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**UNDOCUMENTED FILL** Medium dense, moist, light brown, Silty, fine to medium SAND with 20-25% gravel and cobble size rock fragments up to 10-inches			
2				GM	**STADIUM CONGLOMERATE** Dense to very dense, damp, white, fine to medium, Sandy CONGLOMERATE with 50-60% gravel and cobble size rock fragments up to 10-inches			
4								
6					TRENCH TERMINATED AT 6 FEET			

Figure A-8,
Log of Trench T 8, Page 1 of 1

G1931-32-01.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. G1931-32-01

TRENCH T 9

ELEV. (MSL.)_____ DATE COMPLETED **12-15-2015**

EQUIPMENT **RUBBER TIRE BACKHOE** BY: **T. REIST**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				GM	**6-inches of AGGREGATE BASE**			
	T9-1			SM	**STADIUM CONGLOMERATE** Dense, damp, white, Silty, fine to medium SANDSTONE			
2								
				GM	Dense to very dense, damp, white, fine to coarse, Sandy CONGLOMERATE with 50-60% gravel and cobble size rock fragments up to 8-inches			
4								
6					TRENCH TERMINATED AT 6 FEET			

Figure A-9,
Log of Trench T 9, Page 1 of 1

G1931-32-01.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. G1931-32-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	**TRENCH T 10** ELEV. (MSL.)_____ DATE COMPLETED **12-15-2015** EQUIPMENT **RUBBER TIRE BACKHOE** BY: **T. REIST**	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**UNDOCUMENTED FILL** Medium dense, moist, gray and brown, Silty, fine to medium SAND with 20-25% gravel			
2				GM	**STADIUM CONGLOMERATE** Dense to very dense, damp, light brown to gray, fine to medium, Sandy CONGLOMERATE with 50-60% gravel and cobble size rock fragments up to 10-inches			
4								
6					TRENCH TERMINATED AT 6 FEET			

Figure A-10,
Log of Trench T 10, Page 1 of 1

G1931-32-01.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. G1931-32-01

TRENCH T 11

ELEV. (MSL.)_____ DATE COMPLETED **12-15-2015**

EQUIPMENT **RUBBER TIRE BACKHOE** BY: **T. REIST**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	T11-1			GM	**3-inch of AGGREGATE BASE**			
				SM/SC	**UNDOCUMENTED FILL** Medium dense, moist, brown, Silty/Clayey, fine to medium SAND with 10% gravel and cobble size rock fragments up to 6-inches			
2				SM	**STADIUM CONGLOMERATE** Dense, damp, white, Silty, fine to medium SANDSTONE			
4				GM	Dense to very dense, damp, white, fine to medium, Sandy CONGLOMERATE with 50-60% gravel and cobble size rock fragments up to 10-inches			
6					TRENCH TERMINATED AT 6 FEET			

Figure A-11,
Log of Trench T 11, Page 1 of 1

G1931-32-01.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. G1931-32-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	**TRENCH T 12** ELEV. (MSL.)_____ DATE COMPLETED **12-15-2015** EQUIPMENT **RUBBER TIRE BACKHOE** BY: **T. REIST**	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**UNDOCUMENTED FILL** Loose to medium dense, moist, brown, Silty, fine to medium SAND with 10-15% gravel			
2				GM	**STADIUM CONGLOMERATE** Dense, damp, white, fine to medium, Sandy CONGLOMERATE with 50-60% gravel and cobble size rock fragments up to 10-inches -Lower cohesion from 3-4 feet			
4								
					TRENCH TERMINATED AT 5.5 FEET			

Figure A-12,
Log of Trench T 12, Page 1 of 1

G1931-32-01.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

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 bulk samples were tested for maximum dry density and optimum moisture content, pH, resistivity, chloride ion content, water-soluble sulfate content, R-value, and expansion characteristics. The results of our laboratory tests are summarized on Tables B-I through B-VII.

TABLE B-I
SUMMARY OF LABORATORY MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT TEST RESULTS
ASTM D 1557

Sample No.	Description	Maximum Dry Density (pcf)	Optimum Moisture Content (% dry wt.)
T3-1	Light brown, fine to coarse, Sandy GRAVEL	133.9	7.9
T9-1	Light gray to white, Silty, fine to medium SAND	122.9	11.9

TABLE B-II
SUMMARY OF LABORATORY DIRECT SHEAR TEST RESULTS
ASTM D 3080

Sample No.	Dry Density (pcf)	Moisture Content (%)	Unit Cohesion – Peak (psf)	Angle of Shear Resistance – Peak (degrees)
*T3-1	121.1	7.7	435	33
*T9-1	109.1	11.6	770	24

*Sample was remolded to 90 percent relative density at near optimum moisture content.

TABLE B-III
SUMMARY OF LABORATORY EXPANSION INDEX TEST RESULTS
ASTM D 4829

Sample No.	Moisture Content		Dry Density (pcf)	Expansion Index
	Before Test (%)	After Test (%)		
T1-1	9.4	15.6	111.2	8
T3-1	10.1	21.7	108.6	53
T9-1	9.9	19.3	108.7	22

TABLE B-IV
SUMMARY OF LABORATORY WATER SOLUBLE SULFATE TEST RESULTS
CALIFORNIA TEST NO. 417

Sample No.	Water Soluble Sulfate (%)
T1-1	0.042
T3-1	0.024
T9-1	0.026

TABLE B-V
SUMMARY OF LABORATORY POTENTIAL OF
HYDROGEN (PH) AND RESISTIVITY TEST RESULTS

Sample No.	pH	Resistivity (ohm centimeters)
T1-1	7.2	690
T3-1	7.6	570
T9-1	6.7	700

TABLE B-VI
SUMMARY OF LABORATORY CHLORIDE ION CONTENT TEST RESULTS

Sample No.	Chloride Ion Content (%)	Chloride Ion Content (ppm)
T1-1	0.048	484
T3-1	0.084	843
T9-1	0.070	703

TABLE B-VII
SUMMARY OF LABORATORY RESISTANCE (R-VALUE) TEST RESULTS

Sample No.	Description	R-Value
T11-1	Light brown, Silty, fine to medium SAND with little gravel	18

APPENDIX C

APPENDIX C

RECOMMENDED GRADING SPECIFICATIONS

FOR

WESTMONT OF LA MESA
LA MESA, CALIFORNIA

PROJECT NO. G1931-32-01

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

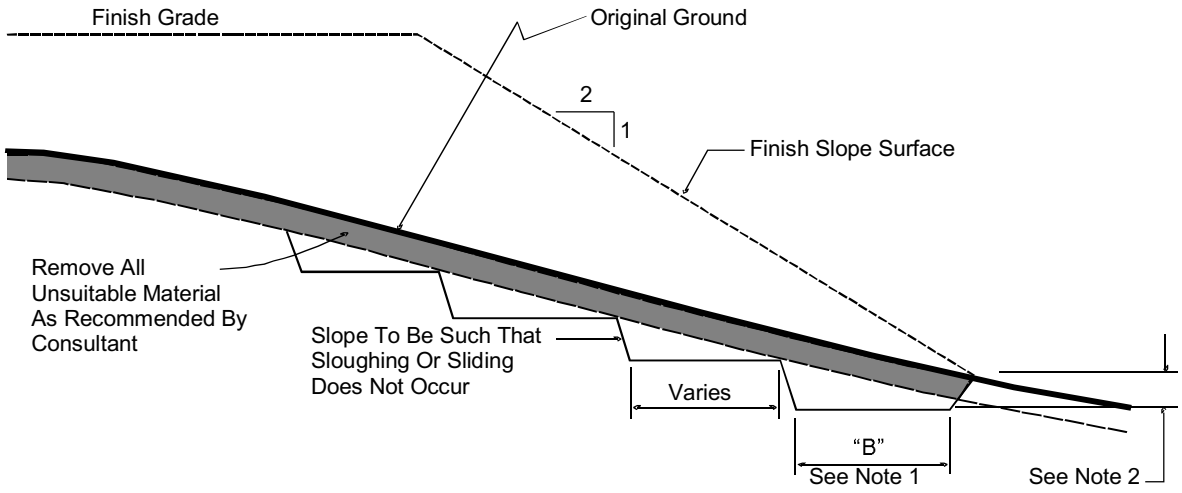
4.1 Areas to be excavated and filled shall be cleared and grubbed. Clearing shall consist of complete removal above the ground surface of trees, stumps, brush, vegetation, man-made structures, and similar debris. Grubbing shall consist of removal of stumps, roots, buried logs and other unsuitable material 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



No Scale

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.

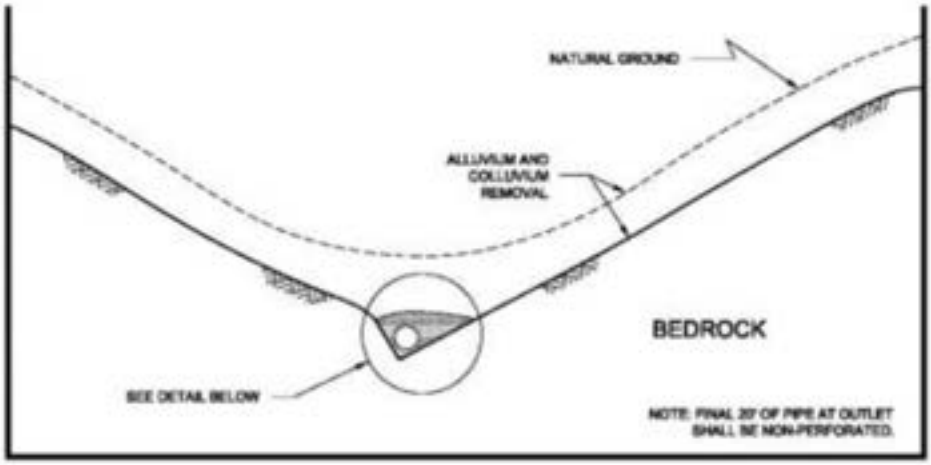
6.3.6 To reduce the potential for "piping" of fines into the *rock* fill from overlying *soil* fill material, a 2-foot layer of graded filter material shall be placed above the uppermost lift of *rock* fill. The need to place graded filter material below the *rock* should be determined by the Consultant 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.

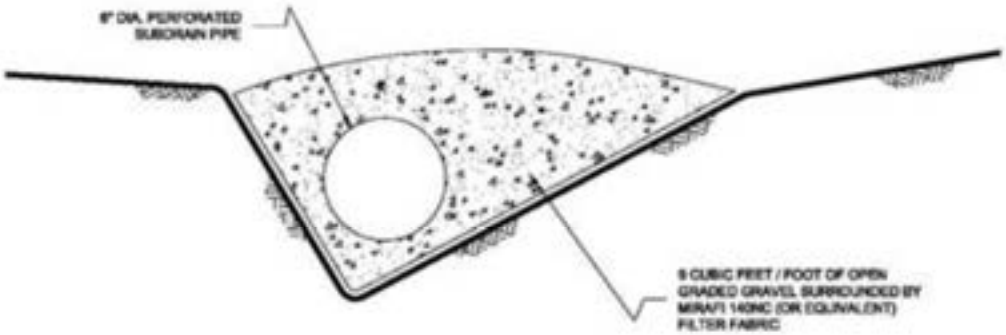
6.3.7 *Rock* fill placement should be continuously observed during placement by the Consultant.

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:

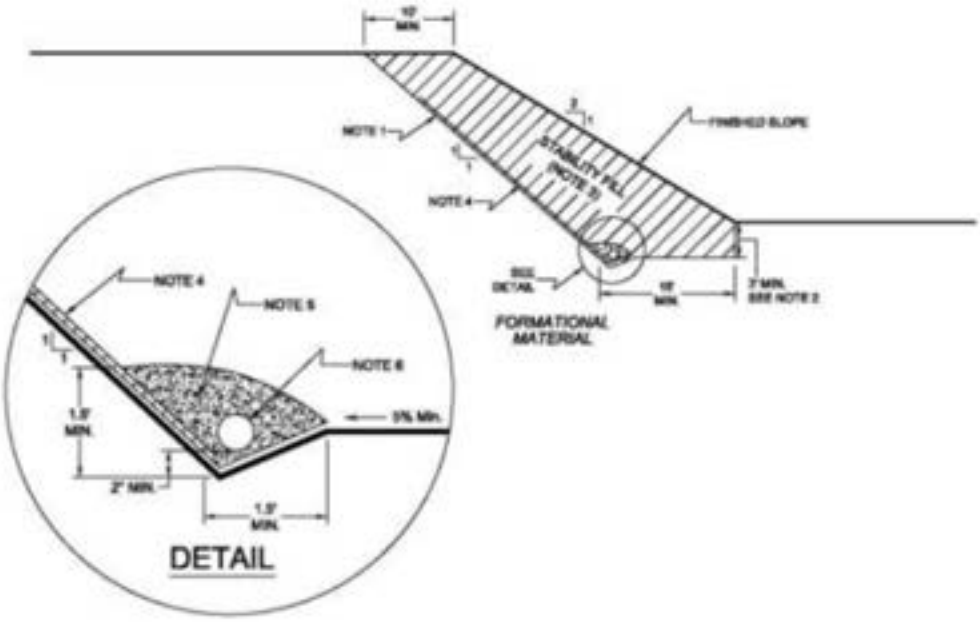
1. 8-INCH DIAMETER, SCHEDULE 80 PVC PERFORATED PIPE FOR FILLS IN EXCESS OF 100-FEET IN DEPTH OR A PIPE LENGTH OF LONGER THAN 500 FEET.

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

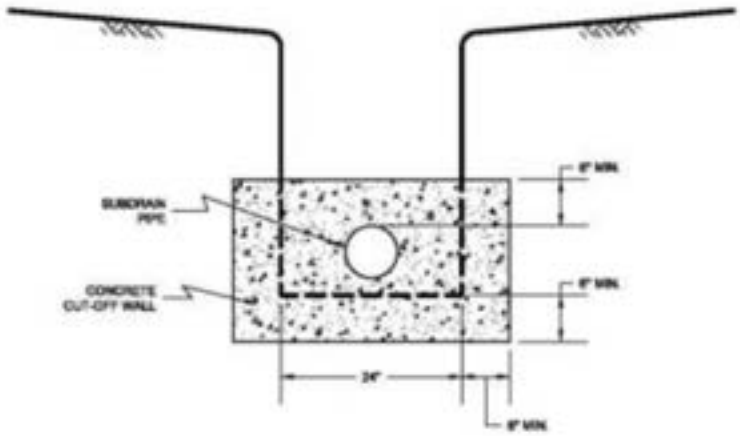
7.3 The actual subdrain locations will be evaluated in the field during the remedial grading operations. Additional drains may be necessary depending on the conditions observed and the requirements of the local regulatory agencies. Appropriate subdrain outlets should be evaluated prior to finalizing 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.

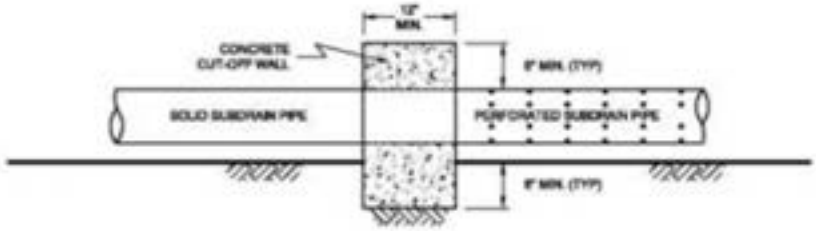
TYPICAL CUT OFF WALL DETAIL

FRONT VIEW



NO SCALE

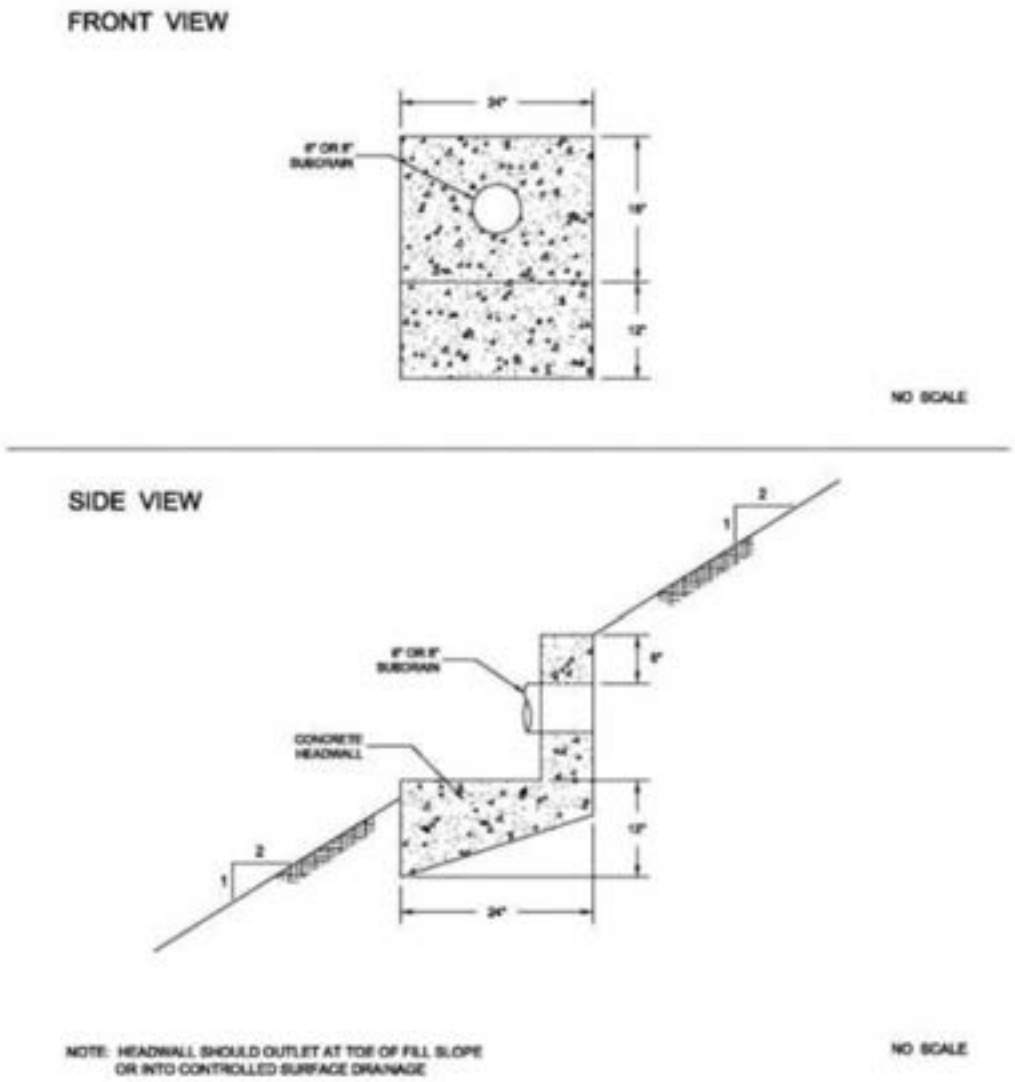
SIDE VIEW



NO SCALE

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.

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3. California Department of Conservation, Division of Mines and Geology, *Probabilistic Seismic Hazard Assessment for the State of California,* Open File Report 96-08, 1996.

4. California Department of Water Resources, Water Data Library. http://www.water.ca.gov/waterdatalibrary.

5. California Geological Survey, *Seismic Shaking Hazards in California,* Based on the USGS/CGS Probabilistic Seismic Hazards Assessment (PSHA) Model, 2002 (revised April 2003). 10% probability of being exceeded in 50 years. http://redirect.conservation.ca.gov/cgs/rghm/pshamap/pshamain.html

6. Campbell, K. W., and Y. Bozorgnia, *NGA Ground Motion Model for the Geometric Mean Horizontal Component of PGA, PGV, PGD and 5% Damped Linear Elastic Response Spectra for Periods Ranging from 0.01 to 10 s*, Preprint of version submitted for publication in the NGA Special Volume of Earthquake Spectra, Volume 24, Issue 1, pages 139-171, February 2008.

7. Chiou, Brian S. J., and Robert R. Youngs, *A NGA Model for the Average Horizontal Component of Peak Ground Motion and Response Spectra*, preprint for article to be published in NGA Special Edition for Earthquake Spectra, Spring 2008.

8. Kennedy, M. P., and S. S. Tan, *Geologic Map of the San Diego 30'x60' Quadrangle, California,* USGS Regional Map Series Map No. 3, Scale 1:100,000, 2008.

9. Risk Engineering, *EZ-FRISK*, 2015.

10. Unpublished reports and maps on file with Geocon Incorporated.

11. USGS computer program, *Seismic Hazard Curves and Uniform Hazard Response Spectra.*

12. United States Department of Agriculture, *1953 Stereoscopic Aerial Photographs, Flight AXN-10M,* Photos Nos. 11 and 12 (scale 1:20,000).