Appendix G Infrastructure Reports

Appendix G1 Wastewater Infrastructure Technical Report
Appendix G2 Water Resources Technical Report
Appendix G3 Water Infrastructure Technical Report
Appendix G4 Water Supply Assessment

Appendices

This page intentionally left blank.

400 E Oceangate, Suite 500 Long Beach, CA 90802 562.437.9100 kpff.com

CENTURY VILLAGES AT CABRILLO SPECIFIC PLAN PROJECT

UTILITY INFRASTRUCTURE TECHNICAL REPORT: WASTEWATER

June 16, 2020

PREPARED BY:

KPFF Consulting Engineers
400 E Oceangate, Suite 500
Long Beach, CA 90802
(562) 437-9100

TABLE OF CONTENTS

1. INTRODUCTION 2

1.1. PROJECT DESCRIPTION 2

1.2. SCOPE OF WORK 2

2. EXISTING CONDITIONS 3

3. SIGNIFICANCE THRESHOLDS 4

4. METHODOLOGY 4

5. PROJECT IMPACTS 4

5.1. CONSTRUCTION 4

5.2. OPERATION 4

5.3. CUMULATIVE IMPACTS 6

6. LEVEL OF SIGNIFICANCE 6

1. INTRODUCTION

1.1. PROJECT DESCRIPTION

The Century Villages at Cabrillo campus, known herein as the "Project" was developed in the 1960's as part of the former Cabrillo/Savannah Naval Housing development which consisted of 135 acres of housing units. The Naval Housing development was in operation until the mid-1990s, after which the Navy abandoned the development and the land was broken up and transferred to the City of Long Beach, California State University of Long Beach, The Long Beach Job Corps, and the Long Beach Unified School District. In 1997, under the McKinney Act, a 26 acre portion of the formal Naval Housing development was transferred to Century Villages at Cabrillo for the purpose of providing transitional and permanent housing to those in need. Since the transfer of the 26 acres, the campus acquired an additional acre from the City of Long Beach bringing the area of the campus to 27 acres total.

Century Villages at Cabrillo (CVC) is engaged in a 20-year development of its property, where existing multi-family housing units will be replaced by larger, multi-story mixed use buildings. These buildings will have housing for low-income families, veterans, and seniors on the upper levels, and amenities like community centers, gymnasiums, and parking on the lower levels. Similarly, new administration buildings are planned to be built for CVC staff to work on-site with residents, visitors, and others who use the campus. Part of the campus' existing streets will be reconfigured to promote better traffic flow, more public transportation options, and ease of access for residents on site.

The City of Long Beach maintains a public easement for the streets throughout the CVC campus. Within these streets are multiple utilities, some of which are public, and some being private. The water lines under the streets are public lines belonging to Long Beach Water Department, and the storm drain and sewer lines under the streets and within the campus are privately owned and maintained by CVC.

1.2. SCOPE OF WORK

As a part of the Environmental Impact Report for the Project, the purpose of this report is to analyze the potential impact of the Project to the City's wastewater infrastructure systems.

2. EXISTING CONDITIONS

The project's existing sewer infrastructure was constructed in the 1960's consisting of two private sanitary sewer main lines which tied into Public point of connections (POC) along Technology Pl. Each private main line separately branches off to buildings serving the West and East portions of the campus. Based on available record data provided by the Long Beach Water Department (LBWD), the sewer main connected to the public POC West of River Ave is a 10 inch vitrified clay pipe (VCP) and has a calculated capacity of 0.300 cubic feet per second (cfs) (193,895 gallons per day (gpd)). The sewer mains connected to the public POC East of River Ave are two (2) 8 inch vitrified clay pipes (VCP) with a total calculated capacity of 0.864 cubic feet per second (cfs) (558,418 gallons per day (gpd)).

Wastewater Flow Analysis at the Public points of connection have been prepared using d/D Ratio Parameters from King's Hydraulics Hand Book as summarized in Table 1 below.

Table 1 - Flow Analysis using d/D Ratio Parameters from King's Hydraulic's Hand Book

D= Diameter of pipe in inches ; d = depth of flow; Slope =S								
Public SS Main Line	**D**	**S**	**Manning's n**	**d/D**	**Ca**	**Cr**	**Q**	**V**
West	10	0.001	0.015	**0.50**	0.393	0.250	**0.300**	1.100
East 1	8	0.007	0.015	**0.50**	0.393	0.250	**0.432**	2.473
East 2	8	0.007	0.015	**0.50**	0.393	0.250	**0.432**	2.473

Where:

Q = Flowrate (cfs)

$Q = VA$

$$Q = \frac{(1.486)(r^{2/3})(s^{1/2})(A)}{n}$$

$$Q = \frac{(1.486)(Cr*D)(s^{1/2})(Ca*D^2)}{n}$$

V = Velocity (ft/s)
A = Area (SF)
r = Hydraulic Radius
Ca = Area Coefficient (King's)
Cr = Circ. Pipe Hydraulic Radius Coefficient (King's)

3. SIGNIFICANCE THRESHOLDS

Appendix G of the CEQA Guidelines provides a set of sample questions that address impacts with regard to wastewater. These questions are as follows:

Would the project:

- Require or result in the relocation or construction of new or expanded water, wastewater treatment or storm water drainage, electric power, natural gas, or telecommunications facilities, the construction or relocation of which would cause significant environmental effects?

- Result in a determination by the wastewater treatment provider, which serves or may serve the project, that it has adequate capacity to serve the project's projected demand in addition to the provider's existing commitments?

These thresholds are applicable to the Project and as such are used to determine if the Project would have significant wastewater impacts.

4. METHODOLOGY

This report analyzes the potential impacts of the Project on the existing public sewer infrastructure by comparing the estimated Project wastewater generation with the calculated available capacity of the utility provider's existing mainline pipes at 50% depth over diameter, (or otherwise known as 50% full), which is the local agency requirement for sewer pipe capacity.

5. PROJECT IMPACTS

5.1. CONSTRUCTION

Wastewater generation would occur incrementally throughout construction of the Project as a result of construction workers on-site. However, construction workers would utilize portable restrooms, which would not contribute to wastewater flows to the City's wastewater system. Thus, wastewater generation from Project construction activities is not anticipated to cause any increase in wastewater flows. In other words, Project impacts associated with construction-period wastewater generation would be less than significant.

Furthermore, Project impacts on wastewater associated with construction activities would be less than significant.

5.2. OPERATION

In accordance with the publically available sewer generation rates provided by LA County Sanitation the estimated sewer flows were based on the sewer generation factors for the Project's uses. Based on the type of use and generation factors, the Project will generate a net increase of approximately 79,280 gallons per day (gpd) of wastewater in which 53,455

gpd is collected from the West private main line and 25,825 gpd from the East private main line. Wastewater generation estimates have been prepared based on the LA County Sanitation factors for Sewer Capacity Availability Requests (SCAR) for residential and commercial categories, and are summarized in Table 2 below.

Table 2 - Proposed Sewer Generation

Project Phase	Sewer Generation (GPD)	Sewer Mainline	Total GPD West	Total GPD East
6A	3,905	East	-	3,905
6B	3,080	East	-	3,080
7	10,500	West	10,500	-
8A	2,900	East	-	2,900
8B	15,940	East	-	15,940
9A	7,630	West	7,630	-
9B	9,690	West	9,690	-
10A	20,715	West	20,715	-
10B	4,200	West	4,200	-
A	720	West	720	-
Proposed Generation			**53,455**	**25,825**
Total Net Increase	**79,280**			

a. Sewage Generation Factors are based on LA County Sanitation factors for Sewer Capacity Availability Requests (SCAR) (latest version as of 2019).

b. For residential credits, assume residential apartment-1 bedroom per LA County SCAR

As stated within the *Existing Conditions* section of this report, the existing capacity of the 10 inch vitrified clay pipe (VCP) at the public POC West of River Ave is approximately 0.300 cfs (193,895 gpd). The existing capacity of the two (2) 8 inch vitrified clay pipes (VCP) sewer mains connected to the public POC's East of River Ave is approximately 0.864 cfs (558,418 gpd). The aforementioned public sewer mains serve only the CVC property and no other development, since CVC is the most upstream development on this particular public system.

The Project's net increase in sewage generation is approximately 0.12 cfs (79,280 gpd). The private sewer main line in the West portion of the campus will contribute approximately 0.08 cfs (53,455 gpd) of sewage into the public sewer system West of River Ave, which results in approximately 27% of the pipe's capacity at 50% full. Similarly, the private sewer main line in the East portion of the campus will contribute approximately 0.04 cfs (25,825 gpd) of sewage into the public sewer system East of River Ave, which results in approximately 5% of the pipe's capacity at 50% full. Due to this fact, impacts on wastewater infrastructure would be less than significant.

5.3. CUMULATIVE IMPACTS

The Project will result in the additional generation of sewer flow, but the impacts would be less than significant.

6. LEVEL OF SIGNIFICANCE

Based on the analysis contained in this report no significant impacts have been identified to wastewater infrastructure for this Project.

400 Oceangate, Suite 500, Long Beach CA 90813 562-437-9100 kpff.com

CVC SPECIFIC PLAN PROJECT
TECHNICAL REPORT: WATER RESOURCES
June 19, 2020

PREPARED BY:

KPFF Consulting Engineers

400 Oceangate, Suite 500

Long Beach, CA 90813 (562) 437-9100

TABLE OF CONTENTS

1. INTRODUCTION 3
   1.1. PROJECT DESCRIPTION 3
   1.2. SCOPE OF WORK 4
2. REGULATORY FRAMEWORK 5
   2.1. SURFACE WATER HYDROLOGY 5
   2.2. SURFACE WATER QUALITY 5
3. ENVIRONMENTAL SETTING 11
   3.1. SURFACE WATER HYDROLOGY 11
      3.1.1. REGIONAL 11
      3.1.2. LOCAL 12
      3.1.3. ON SITE 12
   3.2. SURFACE WATER QUALITY 14
      3.2.1. REGIONAL 14
      3.2.2. LOCAL 15
      3.2.3. ON SITE 15
4. SIGNIFICANCE THRESHOLDS 15
   4.1. SURFACE WATER HYDROLOGY 15
   4.2. SURFACE WATER QUALITY 16
5. METHODOLOGY 16
   5.1. SURFACE WATER HYDROLOGY 16
   5.2. SURFACE WATER QUALITY 17
      5.2.1. CONSTRUCTION 18
      5.2.2. OPERATION 18
6. PROJECT IMPACT ANALYSIS 20
   6.1. CONSTRUCTION 20
      6.1.1. SURFACE WATER HYDROLOGY 20
      6.1.2. SURFACE WATER QUALITY 21
   6.2. OPERATION 21
      6.2.1. SURFACE WATER HYDROLOGY 21
      6.2.2. SURFACE WATER QUALITY 25
   6.3. CUMULATIVE IMPACT ANALYSIS 26
      6.3.1. SURFACE WATER HYDROLOGY 26
      6.3.2. SURFACE WATER QUALITY 26

7. LEVEL OF SIGNIFICANCE....27
Works Cited....28
APPENDIX A....30
APPENDIX B....38
APPENDIX C....39

LIST OF FIGURES

Figure 1: Map of Los Angeles River Watershed....31
Figure 2: Not Used....32
Figure 3: Not Used....33
Figure 4: 24 hour, 50 year storm Isohyet Map of Long Beach....34
Figure 5: FEMA Flood Zone Map of Long Beach....35
Figure 6: Existing Hydrology Map of CVC Campus....36
Figure 7: Proposed Hydrology Map of CVC Campus....37

LIST OF TABLES

Table 1 – Existing CVC Campus Subareas and Flow Rates from a 10 year Storm Event....13
Table 2 – Existing CVC Campus Subareas and Volumes from a 10 year Storm Event....14
Table 3 - Proposed CVC Campus Subareas and Flow Rates from a 10 year Storm Event....23
Table 4 – Proposed CVC Campus Subareas and Volumes from a 10 year Storm Event....24
Table 5 – Comparison of Existing and Proposed CVC Campus Flow Rates and Volumes from a 10 year Storm Event....24

1. INTRODUCTION

1.1. PROJECT DESCRIPTION

Developed in the 1960s, the Century Villages at Cabrillo campus was part of the former Cabrillo/Savannah Naval Housing development which consisted of 135 acres of housing units. The Naval Housing development was in operation until the mid-1990s, after which the Navy abandoned the development and the land was broken up and transferred to the City of Long Beach, California State University of Long Beach, The Long Beach Job Corps, and the Long Beach Unified School District. In 1997, under the McKinney Act, a 26 acre portion of the formal Naval Housing development was transferred to Century Villages at Cabrillo for the purpose of providing transitional and permanent housing to those in need. Since the transfer of the 26 acres, the campus acquired an additional acre from the City of Long Beach bringing the area of the campus to 27 acres total.

Century Villages at Cabrillo (CVC) is engaged in a 20-yeardevelopment of its property, where existing multi-family housing units will be replaced by larger, multi-story mixed use buildings. These buildings will have housing for low-income families, veterans, and seniors on the upper levels, and amenities like community centers, gymnasiums, and parking on the lower levels. Similarly, new administration buildings are planned to be built for CVC staff to work on-site with residents, visitors, and others who use the campus. Part of the campus' existing streets will be reconfigured to promote better

traffic flow, more public transportation options, and ease of access for residents on site.

The City of Long Beach maintains a public easement for the streets throughout the CVC campus. Within these streets are multiple utilities, some of which are public, and some being private. The water lines under the streets are public lines belonging to Long Beach Water Department, and the storm drain and sewer lines under the streets and within the campus are privately owned and maintained by CVC.

1.2. SCOPE OF WORK

This report provides a description of the existing surface water hydrology, and surface water quality, at the Project Site. It also analyzes the Project's potential impacts related to surface water hydrology, and surface water quality,.

2. REGULATORY FRAMEWORK

2.1. SURFACE WATER HYDROLOGY

County of Los Angeles Hydrology Manual

The City of Long Beach (City) uses the Los Angeles County (County) Hydrology Manual for the basis of design of storm drain facilities. The manual defines the modified rational method (MODRAT) as the governing method to calculating stormwater flow rates and volumes resulting from an individual subareas physical characteristics, and storm recurrence interval. HydroCalc is a computer program developed by the County that uses the MODRAT to hydrologically analyze multiple subareas for a given storm interval.

2.2. SURFACE WATER QUALITY

Clean Water Act

The Clean Water Act (CWA) was first introduced in 1948 as the Water Pollution Control Act. The CWA authorizes Federal, state, and local entities to cooperatively create comprehensive programs for eliminating or reducing the pollution of state waters and tributaries. The primary goals of the CWA are to restore and maintain the chemical, physical, and biological integrity of the nation's waters and to make all surface waters fishable and swimmable. As such, the CWA forms the national framework for the management of water quality and the control of pollutant discharges. The CWA also sets forth a number of objectives in order to achieve the above-mentioned goals. These objectives include regulating pollutant and toxic pollutant discharges; providing for water quality that protects and fosters the propagation of fish, shellfish and wildlife; developing waste treatment management plans; and developing and implementing programs for the control of non-point sources of pollution.[1]

Since its introduction, major amendments to the CWA have been enacted (e.g., 1961, 1966, 1970, 1972, 1977, and 1987). Amendments enacted in 1970 created the U.S. Environmental Protection Agency (USEPA), while amendments enacted in 1972 deemed the discharge of pollutants into waters of the United States from any point source unlawful unless authorized by a USEPA National Pollutant Discharge Elimination System (NPDES) permit. Amendments enacted in 1977 mandated development of a "Best Management Practices" Program at the state level and provided the Water Pollution Control Act with the common name of "Clean Water Act," which is universally used today. Amendments enacted in 1987 required the USEPA to create specific requirements for discharges.

In response to the 1987 amendments to the CWA and as part of Phase I of its NPDES

[1] Non-point sources of pollution are carried through the environment via elements such as wind, rain, or stormwater and are generated by diffuse land use activities (such as runoff from streets and sidewalks or agricultural activities) rather than from an identifiable or discrete facility.

permit program, the USEPA began requiring NPDES permits for: (1) municipal separate storm sewer systems (MS4) generally serving, or located in, incorporated cities with 100,000 or more people (referred to as municipal permits); (2) 11 specific categories of industrial activity (including landfills); and (3) construction activity that disturbs five acres or more of land. Phase II of the USEPA's NPDES permit program, which went into effect in early 2003, extended the requirements for NPDES permits to: (1) numerous small MS4s[2],(2) construction sites of one to five acres, and (3) industrial facilities owned or operated by small municipal separate storm sewer systems. The NPDES permit program is typically administered by individual authorized states.

In 2008, the USEPA published draft Effluent Limitation Guidelines (ELGs) for the construction and development industry. On December 1, 2009 the EPA finalized its 2008 Effluent Guidelines Program Plan.

In California, the NPDES stormwater permitting program is administered by the State Water Resources Control Board (SWRCB). The SWRCB was created by the Legislature in 1967. Its joint authority over water distribution and water quality protection allows the Board to provide protection for the State's waters, through its nine Regional Water Quality Control Boards (RWQCBs). The RWQCBs develop and enforce water quality objectives and implement plans that will best protect California's waters, acknowledging areas of different climate, topography, geology, and hydrology. The RWQCBs develop "basin plans" for their hydrologic areas, issue waste discharge requirements, enforce action against stormwater discharge violators, and monitor water quality (United States Environmental Protection Agency, 2019).

Federal Anti-Degradation Policy

The Federal Anti-Degradation Policy (40 Code of Federal Regulations 131.12) requires states to develop statewide anti-degradation policies and identify methods for implementing them. Pursuant to the Code of Federal Regulations (CFR), state anti-degradation policies and implementation methods shall, at a minimum, protect and maintain (1) existing in-stream water uses; (2) existing water quality, where the quality of the waters exceeds levels necessary to support existing beneficial uses, unless the state finds that allowing lower water quality is necessary to accommodate economic and social development in the area; and (3) water quality in waters considered an outstanding national resource.

[2] A small MS4 is any MS4 not already covered by the Phase I program as a medium or large MS4. The Phase II Rule automatically covers on a nationwide basis all small MS4s located in "urbanized areas" as defined by the Bureau of the Census (unless waived by the NPDES permitting authority), and on a case-by-case basis those small MS4s located outside of urbanized areas that the NPDES permitting authority designates.

California Porter-Cologne Act

The Porter-Cologne Water Quality Control Act established the legal and regulatory framework for California's water quality control. The California Water Code (CWC) authorizes the SWRCB to implement the provisions of the CWA, including the authority to regulate waste disposal and require cleanup of discharges of hazardous materials and other pollutants.

As discussed above, under the CWC, the SWRCB is divided into nine RWQCBs, governing the implementation and enforcement of the CWC and CWA. The Project Site is located within Region 4, also known as the Los Angeles Region. Each RWQCB is required to formulate and adopt a Basin Plan for its region. This Basin Plan must adhere to the policies set forth in the CWC and established by the SWRCB. The RWQCB is also given authority to include within its regional plan water discharge prohibitions applicable to particular conditions, areas, or types of waste.

California Anti-Degradation Policy

The California Anti-Degradation Policy, otherwise known as the *Statement of Policy with Respect to Maintaining High Quality Water in California* was adopted by the SWRCB (State Board Resolution No. 68-16) in 1968. Unlike the Federal Anti-Degradation Policy, the California Anti-Degradation Policy applies to all waters of the State, not just surface waters. The policy states that whenever the existing quality of a water body is better than the quality established in individual Basin Plans, such high quality shall be maintained and discharges to that water body shall not unreasonably affect present or anticipated beneficial use of such water resource.

California Toxics Rule

In 2000, the USEPA promulgated the California Toxics Rule, which establishes water quality criteria for certain toxic substances to be applied to waters in the State. The USEPA promulgated this rule based on the USEPA's determination that the numeric criteria are necessary in the State to protect human health and the environment. The California Toxics Rule establishes acute (i.e., short-term) and chronic (i.e., long-term) standards for bodies of water such as inland surface waters and enclosed bays and estuaries that are designated by the Los Angeles RWQCB (LARWQCB) as having beneficial uses protective of aquatic life or human health.

Board Basin Plan for the Coastal Watersheds of Los Angeles and Ventura Counties

As required by the California Water Code, the LARWQCB has adopted a plan entitled "Water Quality Control Plan, Los Angeles Region: Basin Plan for the Coastal Watersheds of Los Angeles and Ventura Counties" (Basin Plan). Specifically, the Basin Plan designates beneficial uses for surface and groundwater, sets narrative and numerical objectives that must be attained or maintained to protect the designated beneficial uses and conform to the State's anti-degradation policy, and describes implementation programs to protect all

waters in the Los Angeles Region. In addition, the Basin Plan incorporates (by reference) all applicable State and Regional Board plans and policies and other pertinent water quality policies and regulations. Those of other agencies are referenced in appropriate sections throughout the Basin Plan.

The Basin Plan is a resource for the LARWQCB and others who use water and/or discharge wastewater in the Los Angeles Region. Other agencies and organizations involved in environmental permitting and resource management activities also use the Basin Plan. Finally, the Basin Plan provides valuable information to the public about local water quality issues.

NPDES Permit Program

The NPDES permit program was first established under authority of the CWA to control the discharge of pollutants from any point source into the waters of the United States. As indicated above, in California, the NPDES stormwater permitting program is administered by the SWRCB through its nine RWQCBs.

The General Permit

SWRCB Order No. 2012-0006-DWQ known as "The General Permit" was adopted on July 17, 2012. This NPDES permit establishes a risk-based approach to stormwater control requirements for construction projects by identifying three project risk levels. The main objectives of the General Permit are to:

1. Reduce erosion
2. Minimize or eliminate sediment in stormwater discharges
3. Prevent materials used at a construction site from contacting stormwater
4. Implement a sampling and analysis program
5. Eliminate unauthorized non-stormwater discharges from construction sites
6. Implement appropriate measures to reduce potential impacts on waterways both during and after construction of projects
7. Establish maintenance commitments on post-construction pollution control measures

California mandates requirements for all construction activities disturbing more than one acre of land to develop and implement Stormwater Pollution Prevention Plans (SWPPP).

The SWPPP documents the selection and implementation of Best Management Practices (BMPs) for a specific construction project, charging owners with stormwater quality management responsibilities. A construction site subject to the General Permit must prepare and implement a SWPPP that meets the requirements of the General Permit (California Water Board, 2019) (United States Environmental Protection Agency, 2019).

City of Long Beach Municipal Separate Storm Sewer (MS4) Permit

As described above, USEPA regulations require that MS4 permittees implement a program to monitor and control pollutants being discharged to the municipal system from both industrial and commercial projects that contribute a substantial pollutant load to the MS4.

The Regional Water Board regulated discharges from the City of Long Beach's MS4 from 1990 through 1999 under the Los Angeles countywide waste discharge requirements (WDR) contained in Order No. 90-079 and in Order No. 96-054 adopted on June 18, 1990, and on July 15, 1996, respectively. In addition to being WDRs, these orders were NPDES permits for the discharges from the MS4 serving the entire Los Angeles County area including those within the City of Long Beach. In 1999, the Los Angeles Regional Board decided to issue a separate MS4 Permit, Order No. 99-60 to the City of Long Beach. Order No. 99-060 expired in June 2004 but has been administratively extended in accordance with federal regulation. Order No. 99-60 remains in effect until the Los Angeles Regional Board adopts a new permit. (Los Angeles Regional Water Quality Board)

On February 6, 2014, the LARWQB adopted Order No. R4-2014-0024 under the NPDES Permit No. CAS004003. The Order granted the City of Long Beach its own MS4 permit (Permit) to monitor the water quality and discharge from its storm drain system, as well as limit non-stormwater discharges to the City's outlets to the Maximum Extent Practicable (MEP). The City of Long Beach has its own local regulations and requirements to require current facilities and future projects to comply with its Permit.

Report of Waste Discharge (ROWD)

The City is required to submit a report of waste discharge to the LARWQB to summarize the following information: (City of Long Beach, 2019)

- Statement of Accompishments and Future Goals
- Long Beach Stormwater Management Program
- Long Beach Monitoring Program

City of Long Beach Stormwater Management Program (LBSWMP)

In compliance with the Permit, the City is required to implement a stormwater management program (SWMP) with the goal of accomplishing the requirements of the Permit and reducing the amount of pollutants in stormwater runoff. The SWMP requires the City of Long Beach to: (City of Long Beach, 2019)

- Program Management

- Geographic Characterization
- Public Agency Activities Program
- Development Planning/ Construction Program
- Illicit Connection/ Illicit Discharges Elimination Program, and
- Education / Public Information Program
- Annual Reporting Program

City of Long Beach Program Monitoring

In compliance with the Permit, the City is required to implement a stormwater monitoring program with the goal of accomplishing the requirements of the Permit and monitoring the amount of pollutants in stormwater runoff. The monitoring program requires the City of Long Beach to: (City of Long Beach, 2019)

- Mass emissions monitoring
- Multi-species toxicity testing
- Toxicity identification evaluations
- Best management practices effectiveness evaluations
- Co-operative monitoring - Los Angeles River
- Co-operative monitoring - Los Cerritos Channel

City of Long Beach Municipal Code

Chapter 18.61 of the Long Beach Municipal Code (LBMC) relates to the NPDES and SUSMP Regulations for the City. Per Section 18.61.030, non-stormwater discharges into the storm drain systems or to receiving waters are prohibited except where such discharges are expressly permitted in the NPDES and SUSMP Regulations Manual. Per Section 18.61.40, new development projects and redevelopment projects in the City subject to the design and implementation of post-construction controls to mitigate stormwater pollution, prior to completion of the projects, shall apply if required in the NPDES and SUSMP Regulations Manual. (City of Long Beach, 2019)
Chapter 18.74 of the LBMC describes the Low Impact Development (LID) standards for certain future developments and projects. Sections 18.74.010 through 18.74.070 list the definitions, plan review procedure, and fees associated with LID implementation.

Low Impact Development (LID) and Standard Urban Stormwater Mitigation Plan (SUSMP)

LID is a stormwater management strategy with goals to mitigate the impacts of increased runoff and stormwater pollution as close to its source as possible. LID promotes the use of natural infiltration systems, evapotranspiration, and the reuse of stormwater. The goal of these LID practices is to remove nutrients, bacteria, and metals from stormwater while also reducing the quantity and intensity of stormwater flows. Through the use of various infiltration strategies, LID is aimed at minimizing impervious surface area. Where infiltration is not feasible, the use of bioretention, rain gardens, green roofs, and rain barrels that will store, evaporate, detain, and/or treat runoff may be used.

On November 16, 2010, the City adopted the LID regulations under Ordinance No. ORD-10-0035, and revised the regulations on November 12, 2013. The LID standards exercise the following tactics to address point-source pollution with various forms on on-site treatment, including:

- Requiring the use of LID standard and practices in future developments and redevelopments to encourage the beneficial use of rainwater and urban runoff
- Reducing stormwater/urban runoff while improving water quality
- Promoting rainwater harvesting
- Reducing offsite runoff and providing increased groundwater recharge
- Reducing erosion and hydrologic impacts downstream
- Enhancing the recreational and aesthetic values in our communities (City of Long Beach Development Services)

The LID manual sets criteria for whether a project is subject to LID requirements or not. Any project that cannot comply with LID requirements is subject to complying with all applicable Standard Urban Stormwater Mitigation Plan (SUSMP) requirements. SUSMP was developed as part of the municipal storm water program to address storm water pollution from new Development and Redevelopment by the private sector. This SUSMP contains a list of the minimum required Best Management Practices (BMPs) that must be used for a designated project. Additional BMPs may be required by ordinance or code adopted by the Permittee and applied generally or on a case by case basis. The Permittees are required to adopt the requirements set herein in their own SUSMP. Developers must incorporate appropriate SUSMP requirements into their project plans. Each Permittee will approve the project plan as part of the development plan approval process and prior to issuing building and grading permits for the projects covered by the SUSMP requirements. The City of Long Beach permit requires SUSMP for the following categories only: (i) 10- 99 home subdivisions; (ii) 100 or more subdivisions; (iii) 100,000 or more square foot commercial developments; and (iv) Projects located adjacent to or discharging to environmentally sensitive areas. (Los Angeles Regional Water Quality Board)

3. ENVIRONMENTAL SETTING

3.1. SURFACE WATER HYDROLOGY

3.1.1. REGIONAL

The Project Site is located with the Los Angeles River Watershed (Watershed) in the Los Angeles Basin. The Los Angeles River Watershed covers approximately 834 square miles and is bounded at its headwaters by the Santa Monica, Santa Susana, and San Gabriel mountains to the north and west. The southern portion of the watershed captures runoff from urbanized areas surrounding downtown Los Angeles. Jurisdictions in the watershed include the City of Los Angeles (33%), 42 other cities (29%) and eight agencies (37%).

Much of the watershed is highly developed, with residential (36%), open space and agricultural (44%), and commercial/industrial/transportation (20%) being the predominant land uses. Overall, the watershed is approximately one-third impervious.

Most portions of the Los Angeles River are completely channelized for flood protection as are many of its tributaries including Compton Creek, Rio Hondo, Arroyo Seco and Tujunga Wash. They are fed by a complex underground network of storm drains and a surface network of tributaries. Several dams and reservoirs have been constructed within the watershed for flood control and groundwater recharge. The river's two soft-bottom reaches consist of a 3.1-mile portion running adjacent to Los Angeles and Glendale known as the Glendale Narrows and a 2.4-mile portion in the Sepulveda Basin Recreational area behind the Sepulveda Dam.

The average dry weather flow at the watershed's most downstream monitoring station near Long Beach is 153 cubic feet per second. The average wet weather flow is two to three times higher or more during large storms. (LA Sanitation & Environment)

3.1.2. LOCAL

Stormwater runoff is directed towards curbs and gutters in the streets, and catch basins throughout the property. The existing campus drainage system consists of underground pipes, catch basins, and detention basins that manage the on-site storm water. The basic drainage pattern for the campus runs from north to south with the campus being serviced by varying sizes of storm drain pipes that range from 24" plastic (PVC/HDPE) pipes at the north of the campus to a 35"x24" corrugated metal arch pipe (CMP) at the south of the campus which then drains into a 42" reinforced concrete pipe (RCP) storm drain main line which in turn ties into an existing 54" public storm drain line in Pacific Coast Highway (PCH). The storm drain system within the campus is private and is maintained by Century Villages at Cabrillo.

3.1.3. ON SITE

The CVC Campus is approximately 27 acres, but the total contributing area to the campus drainage system is 35 acres. Those 35 acres are divided into 54 subareas, as seen in Figure 6 in Appendix A. Currently, there are 4 main roads that cross the campus: River Avenue, W Williams Street, San Gabriel Avenue, and W Willard Street. Most of the campus still has the original multi-family buildings from the Naval housing, with a few newer developments like the Anchor Place building (completed in 2018) and the Cabrillo Gateway building (completed in 2015). Phase 6 of the future campus development, which 1.9 acres will be used for construction of a multi-story residential and community center, is considered to be a part of the existing campus, though construction has not started yet. Table 1 shows the existing flow rate generated by a 10 year storm event, while Table 2 shows the existing volume from the same event.

Table 1 – Existing CVC Campus Subareas and Flow Rates from a 10 year Storm Event

Subarea	Area (Ac)	10-Yr (cfs)	Subarea	Area (Ac)	10-Yr (cfs)
1	1.73	3.00	28	0.67	1.34
2	1.06	1.21	29	0.09	0.20
3	1.05	2.06	30	0.39	0.85
4	0.32	0.56	31	0.47	1.03
5	0.35	0.65	32	0.58	1.07
6	0.39	0.86	33	0.33	0.72
7	0.76	1.38	34	0.4	0.62
8	0.71	1.42	35	0.71	1.32
9	1.14	2.13	36	0.45	0.98
10	0.48	1.03	37	0.44	0.69
11	0.19	0.42	38	0.36	0.72
12	0.4	0.87	39	0.44	0.96
13	0.21	0.45	40	0.79	1.58
14	0.48	1.03	41	2.31	2.63
15	1.65	2.48	42	0.5	0.85
16	0.61	1.06	43	0.18	0.39
17	1.06	1.96	44	0.47	0.75
18	0.47	1.01	45	1.25	1.85
19	0.31	0.68	46	1.17	1.62
20	0.54	1.08	47	0.46	0.53
21	0.18	0.39	48	3.31	3.87
22	0.26	0.56	49	0.08	0.18
23	1.12	1.84	50	0.08	0.18
24	0.19	0.38	51	0.23	0.51
25	0.96	1.57	52	1.13	1.92
26	0.15	0.33	53	0.34	0.54
27	0.2	0.44	54	0.49	1.05
			Total	35.09	59.78

Table 2 – Existing CVC Campus Subareas and Volumes from a 10 year Storm Event

Subarea	Area (Ac)	10-Yr (ac-ft)	Subarea	Area (Ac)	10-Yr (ac-ft)
1	1.73	0.47	28	0.67	0.18
2	1.06	0.29	29	0.09	0.02
3	1.05	0.26	30	0.39	0.11
4	0.32	0.09	31	0.47	0.13
5	0.35	0.10	32	0.58	0.16
6	0.39	0.11	33	0.33	0.09
7	0.76	0.19	34	0.40	0.11
8	0.71	0.19	35	0.71	0.19
9	1.14	0.33	36	0.45	0.12
10	0.48	0.12	37	0.44	0.13
11	0.19	0.05	38	0.36	0.10
12	0.40	0.11	39	0.44	0.12
13	0.21	0.05	40	0.79	0.22
14	0.48	0.12	41	2.31	0.63
15	1.65	0.47	42	0.50	0.12
16	0.61	0.17	43	0.18	0.04
17	1.06	0.29	44	0.47	0.11
18	0.47	0.11	45	1.25	0.11
19	0.31	0.08	46	1.17	0.10
20	0.54	0.15	47	0.46	0.13
21	0.18	0.04	48	3.31	0.28
22	0.26	0.06	49	0.08	0.02
23	1.12	0.31	50	0.08	0.02
24	0.19	0.05	51	0.23	0.07
25	0.96	0.26	52	1.13	0.28
26	0.15	0.04	53	0.34	0.08
27	0.20	0.05	54	0.49	0.12
			Total	35.09	8.37

3.2. SURFACE WATER QUALITY

3.2.1. REGIONAL

As noted above, the Project Site lies within the LA River Watershed. Constituents of concern listed for the LA River estuary at Queensway Bay include chlordane, DDT (sediment), polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), toxicity, and trash. (California Environmental Protection Agency, 2019)

3.2.2. LOCAL

In general, urban stormwater runoff occurs following precipitation events, with the volume of runoff flowing into the drainage system depending on the intensity and duration of the rain event. Contaminants that may be found in stormwater from developed areas include sediments, trash, bacteria, metals, nutrients, organics and pesticides. The source of contaminants includes surface areas where precipitation falls, as well as the air through which it falls. Contaminants on surfaces such as roads, maintenance areas, parking lots, and buildings, which are usually contained in dry weather conditions, may be carried by rainfall runoff into drainage systems. The City typically installs catch basins with screens to capture debris before entering the storm drain system. In addition, the City conducts routine street cleaning operations, as well as periodic cleaning and maintenance of catch basins, to reduce stormwater pollution within the City.

3.2.3. ON SITE

Throughout the site, stormwater quality is addressed using methods and requirements as outlined in the Los Angeles County SUSMP and City of Long Beach Low Impact Development (LID) design manuals. For example, catch basin grate filter inserts, detention basins, vegetated swale, tree planting, and CDS units are being used throughout the site. It is recommended these devices be inspected and cleaned *before and after every rain event*, or *every 3 months at minimum*. Consult the aforementioned SUSMP manual, LID manual, and manufacturer's recommendations for further detail and maintenance recommendations. The City of Long Beach requires new and improved developments to sign LID and SUSMP agreements for maintaining these stormwater quality devices. Therefore, covenants and agreements between the County of Los Angeles, The City of Long Beach, and Century Villages will be established under each future phase of development, as required by the permitting agencies, similar to the existing recent developments.

4. SIGNIFICANCE THRESHOLDS

4.1. SURFACE WATER HYDROLOGY

Appendix G of the State of California's CEQA Guidelines provides a set of sample questions that address impacts with regard to surface water hydrology. These questions are as follows:

Would the project:

- Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river or through the addition of impervious surfaces, in a manner which would:
    - Substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site;

- Result in substantial erosion or siltation on- or off-site;
- Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff; or
- Impede or redirect flows?

- In flood hazard, tsunami, or seiche zones, risk release of pollutants due to project inundation;
- Conflict with or obstruct implementation of a water quality control plan or sustainable groundwater management plan.

4.2. SURFACE WATER QUALITY

Appendix G of the CEQA Guidelines provides a set of sample questions that address impacts with regard to surface water quality. These questions are as follows:

Would the project:

- Violate any water quality standard or waste discharge requirements or otherwise substantially degrade surface or groundwater quality;
- Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river or through the addition of impervious surfaces, in a manner which would:
  - Result in substantial erosion or siltation on- or off-site;
  - Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff;
- In flood hazard, tsunami, or seiche zones, risk release of pollutants due to project inundation;
- Conflict with or obstruct implementation of a water quality control plan or sustainable groundwater management plan;

5. METHODOLOGY

5.1. SURFACE WATER HYDROLOGY

The Project Site is located within the City of Long Beach (City), and drainage collection, treatment and conveyance are regulated by the City. The City has adopted the Los Angeles County Department of Public Works (LACDPW) Hydrology Manual as its basis of design for storm drainage facilities. The City requires public and private storm drain infrastructure to be designed to the 10 year storm interval.

The Modified Rational Method was used to calculate storm water runoff. The "peak" (maximum value) runoff for a drainage area is calculated using the formula, **Q = CIA**

Where,

Q = Volumetric flow rate (cfs)

C = Runoff coefficient (dimensionless)

I = Rainfall Intensity at a given point in time (in/hr)

A = Basin area (acres)

The Modified Rational Method assumes that a steady, uniform rainfall rate will produce maximum runoff when all parts of the basin area are contributing to outflow. This occurs when the storm event lasts longer than the time of concentration. The time of concentration (Tc) is the time it takes for rain in the most hydrologically remote part of the basin area to reach the outlet.

The method assumes that the runoff coefficient (C) remains constant during a storm. The runoff coefficient is a function of both the soil characteristics and the percentage of impervious surfaces in the drainage area.

LACDPW has developed a time of concentration calculator, Hydrocalc, to automate time of concentration calculations as well as the peak runoff rates and volumes using the Modified Rational Method design criteria as outlined in the Hydrology Manual. The data input requirements include: sub-area size, soil type, land use, flow path length, flow path slope and rainfall isohyet. The Hydrocalc Calculator was used to calculate the storm water peak runoff flow rate for the Project conditions by evaluating an individual sub-area independent of all adjacent subareas. See Appendix B for the Hydrocalc Calculator results and Figure 4 in Appendix A for the Isohyet Map.

Appendix D of the LACDPW Hydrology Manual defines different land uses and their respective impervious percentages. Each subarea in the existing and proposed condition is associated to a land use based on the buildings in that area. Although the exact impervious percentage may differ from what the Hydrology Manual states versus what is physically at each subarea. However, this difference is minimal when all subareas are taken in to consideration over the 27 acre campus, and 35 acre tributary area that includes property outside of the campus. Land uses and their impervious percentages from Appendix D of the Hydrology Manual that were used for the hydrology study of the campus are listed below:

- Mixed Multi-Family Residential 74%
- Medium-Rise Apartments and Condominiums 86%
- High-Rise Apartments and Condominiums 90%
- Roads 91%
- Open Space and Recreation 10%

5.2. SURFACE WATER QUALITY

5.2.1. CONSTRUCTION

The campus will be developed at different phases, where each phase will require its own SWPPP. Construction BMPs will be designed and maintained as part of the implementation of the SWPPP in compliance with the Construction General Permit. The SWPPP shall begin when construction commences, before any site clearing and grubbing or demolition activity. During construction, the SWPPP will be referred to regularly and amended as changes occur throughout the construction process. The Notice of Intent (NOI), Amendments to the SWPPP, Annual Reports, Rain Event Action Plans (REAPs), and Non-Compliance Reporting will be posted to the State's SMARTS website in compliance with the requirements of the Construction General Permit. A list of typical BMPs to be used during construction are shown in Appendix C.

5.2.2. OPERATION

The Project will be required to implement the City's LID standards. Under section 13 of the City's LID Manual, post-construction stormwater runoff from certain new developments must be infiltrated, evapotranspirated, captured and used, and/or treated through high efficiency BMPs onsite for at least the volume of water produced by the greater of the 85th percentile storm or the 0.75 inch storm event. The LID Manual prioritizes the selection of BMPs used to comply with stormwater mitigation requirement. The order of priority is:

1. Infiltration Systems
2. Stormwater Capture and Use
3. High Efficient Biofiltration/Bioretention Systems
4. Combination of Any of the Above

Each forthcoming project development shall apply LID BMPs in accordance with the City LID Manual. Each development project shall complete the BMP feasibility screening procedures required under section 4 of the City LID Manual, since infiltration or capture and use may or may not be feasible for some projects, based on the feasibility tables provided in the City's LID Manual. See below for a list of BMPs that are referenced in the City's LID manual. The below list is copies from the city's LID Manual and the LA County SUSMP manual that is referenced within the City's LID Manual:

1. Infiltration Systems
    a. Infiltration Basins
    b. Infiltration Trenches
    c. Infiltration Galleries
    d. Bioretention
    e. Permeable Pavements
    f. Dry Wells
    g. Hybrid Bioretention Dry Wells
2. Stormwater Capture and Use
    a. Cistern

3. Combination of Above
    a. Bioretention With Underdrain
    b. Planter Boxes
    c. Bioinfiltration
    d. Vegetated Swales
    e. Filter Strips
4. Standard Urban Stormwater Mitigation (SUSMP)
    a. Bioretention Facility
    b. Catch Basin Insert
    c. Cistern
    d. Constructed Wetlands
    e. Dry Wells
    f. Extended Dry Detention Basins or Underground Detention Tanks
    g. Infiltration Basins
    h. Infiltration Trenches
    i. Media Filtration
    j. Porous Pavement
    k. Storm Drain Inserts
    l. Vegetated Filter Strips
    m. Vegetated Swale
    n. Wet Ponds

Feasibility screening delineated in the LID manual is applied to determine which BMPs will best suit the Project. Specifically, LID guidelines require that infiltration systems maintain at least 10 feet of clearance to the groundwater, property line, and any building structure. Likewise, capture and use systems have their own design requirements, relating to landscape water use and vector control. Biofiltration/biorention devices are used to mitigate the remaining amount of volume that infiltration and capture and use BMPs cannot treat.

Borings competed for the geotechnical investigation for the Anchor Place project found groundwater at depths of 7 feet and 11.5 feet below ground surface (Geotechnologies, Inc., 2015). Table 4.1 of the City of Long Beach LID BMP Manual states that infiltration measures are infeasible if the depth to groundwater is less than 5 feet below ground surface. In order for infiltration BMPs to be incorporated in to future development, individual borings and geotechnical investigations will need to be completed in order to determine the depth to ground water.

Individual LID design for each phase of development at the CVC campus has either already been approved and implemented, or will be designed in the future. For example, the most recent development on the campus was Phase V, Anchor Place, completed in July 2017. The 2.83 acre project used a combination of infiltration trenches and detention basins to mitigate approximately 6740 cubic feet of runoff from the site, while the LID requirements were approximately 4500 cubic feet to be mitigated (KPFF, 2015). Similar LID design would be incorporated to future projects at the 27 acre campus.

6. PROJECT IMPACT ANALYSIS

6.1. CONSTRUCTION

6.1.1. SURFACE WATER HYDROLOGY

As previously noted, the 27 acre CVC campus is in a 20-year development process that would see many changes to the existing facility. Designed to be completed in phases, some previous projects are already completed and currently have tenants. Other projects, such as the future projects considered within this study, are still under planning, and have not been formally designed or been reviewed by the City of Long Beach. Some parts of the campus still remains in its existing state from the Naval housing that was originally built there, and each phase of development would demolish the old housing for construction of new residential, retail, administration, and community service buildings. Similarly, some of the existing streets within the campus are planned to be redesigned to improve vehicular and pedestrian traffic throughout the property. As such, each project would have its own impact to its hydrologic subareas, and water quality within those subareas.

Each phase of development at the campus would implement an Erosion Control Plan that specifies BMPs and erosion control measures to be used during construction to manage runoff flows and prevent pollution. BMPs would be designed to reduce runoff and pollutant levels in runoff during construction. The Erosion Control Plan measures are designed to contain and treat, as necessary, stormwater or construction watering on the Project Site so runoff does not impact off-site drainage facilities or receiving waters. Construction activities are temporary and flow directions and runoff volumes during construction will be controlled.

In addition, the Project would be required to comply with all applicable City grading permit regulations that require necessary measures, plans, and inspections to reduce sedimentation and erosion. Thus, through compliance with all NPDES General Construction Permit requirements, implementation of BMPs, and compliance with applicable City grading regulations, the Project would not substantially alter the Project Site drainage patterns in a manner that would result in substantial erosion, siltation, or flooding on- or off-site. Similarly, adherence to standard compliance measurements in construction activities would ensure that construction of the Project would not substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site. As construction activities would be limited to the Project Site, such activities would not conflict with implementation of a water quality control plan. Therefore, construction-related impacts to surface water hydrology would be less than significant.

6.1.2. SURFACE WATER QUALITY

Construction activities such as earth moving, maintenance/operation of construction equipment, and handling/storage/disposal of materials could contribute to pollutant loading in stormwater runoff.

With implementation of the Erosion Control Plan, site-specific BMPs for each phase of campus development would reduce or eliminate the discharge of potential pollutants from stormwater runoff. In addition, the Project Applicant would be required to comply with City grading permit regulations and inspections to reduce sedimentation and erosion. Construction of the Project would not result in discharge that would cause: (1) pollution which would alter the quality of the water of the State water bodies to a degree which unreasonably affects beneficial uses of the waters; (2) contamination of the quality of the water of the State by waste to a degree which creates a hazard to the public health through poisoning or through the spread of diseases; or (3) nuisance that would be injurious to health; affect an entire community or neighborhood, or any considerable number of persons; and occurs during or as a result of the treatment or disposal of wastes.

Furthermore, development of the 27 acre campus would not result in discharges that would cause regulatory standards to be violated in the LA River Watershed. The Project would also not provide substantial additional sources of polluted runoff, nor would it conflict with the implementation of a water quality control plan. In addition, implementation of the Erosion Control Plan for each phase would ensure that construction activities would not result in substantial erosion or siltation on- or off-site, or risk release of other pollutants due to inundation. Therefore, temporary construction-related impacts on surface water quality would be less than significant.

6.2. OPERATION

6.2.1. SURFACE WATER HYDROLOGY

Per the LACDPW Hydrology Manual, the rainfall isohyet map at the CVC Campus falls within the 5.8 inches contour, as shown in Figure 4 in Appendix A. Likewise, the CVC Campus sits over soil type 006, seen in Figure 4 in Appendix A.

The land uses between the proposed and existing conditions do not change drastically, as the campus will still remain a low-income, senior, and veteran housing complex. The main difference from a hydrologic setting between the existing and proposed condition is the number of subareas. Where there are 54 subareas in the existing condition of the site and surrounding areas, there are 40 in the fully-developed condition of the site. However, after performing an analysis in Hydrocalc, the total runoff generated from the proposed site from a 10 year storm is less than that of the existing site. On the contrary, the total volume generated from the site increased from the proposed to the existing condition. This is possibly due to the larger subareas having similar or larger impervious percentages, which increases the time of concentration and decreases the flow rate from a subarea, but increases the total volume from that subarea. Tables 3 and 4 below

summarize the flow rate and volume generated from the total project area in its proposed condition, while Table 5 shows the difference in existing and proposed condition flow rates and volumes.

Table 3 - Proposed CVC Campus Subareas and Flow Rates from a 10 year Storm Event

Subarea	Area (Ac)	10-Yr (cfs)	Subarea	Area (Ac)	10-Yr (cfs)
1	1.39	2.41	21	0.31	0.51
2	1.2	1.97	22	0.61	0.71
3	2.29	3.36	23	1.17	1.62
4	1.32	2.29	24	1.25	1.85
5	0.19	0.38	25	3.31	3.87
6	0.15	0.33	26	1.36	2.54
7	0.39	0.85	27	0.71	1.42
8	0.09	0.20	28	0.31	0.68
9	1.06	1.24	29	0.18	0.39
10	0.4	0.62	30	1.2	2.40
11	0.44	0.69	31	1.79	3.57
12	0.71	1.32	32	0.5	0.81
13	0.47	1.03	33	1.32	2.11
14	0.59	1.18	34	0.34	0.54
15	0.08	0.18	35	0.49	1.06
16	0.36	0.79	36	1.17	2.04
17	1.01	2.17	37	1.03	1.79
18	0.88	1.92	38	1.17	2.55
19	0.27	0.59	39	1.34	2.11
20	0.75	1.36	40	1.49	1.85
			Total	35.09	59.31

Table 4 – Proposed CVC Campus Subareas and Volumes from a 10 year Storm Event

Subarea	Area (Ac)	10-Yr (ac-ft)	Subarea	Area (Ac)	10-Yr (ac-ft)
1	1.39	0.38	21	0.31	0.09
2	1.2	0.33	22	0.61	0.17
3	2.29	0.59	23	1.17	0.10
4	1.32	0.36	24	1.25	0.11
5	0.19	0.05	25	3.31	0.28
6	0.15	0.04	26	1.36	0.39
7	0.39	0.11	27	0.71	0.19
8	0.09	0.03	28	0.31	0.09
9	1.06	0.29	29	0.18	0.05
10	0.4	0.11	30	1.2	0.33
11	0.44	0.13	31	1.79	0.49
12	0.71	0.19	32	0.5	0.13
13	0.47	0.13	33	1.32	0.32
14	0.59	0.16	34	0.34	0.08
15	0.08	0.02	35	0.49	0.12
16	0.36	0.10	36	1.17	0.33
17	1.01	0.25	37	1.03	0.28
18	0.88	0.24	38	1.17	0.32
19	0.27	0.08	39	1.34	0.38
20	0.75	0.19	40	1.49	0.41
			Total	35.09	8.44

Table 5 – Comparison of Existing and Proposed CVC Campus Flow Rates and Volumes from a 10 year Storm Event

	Existing	Proposed	Δ
Q (cfs)	59.78	59.31	-0.48
V (ac-ft)	8.37	8.44	0.06

Throughout the 27 acre campus, runoff is directed to three main discharge locations. Most of the runoff is drained to underground storm drain pipes via sheet flow in the streets and catch basins throughout the property. The main outlet for these storm drain pipes occurs at River Ave, where the 35”x24” arch CMP trunk pipe connects to a 42” mainline, eventually leading to a 54” mainline in PCH. A small amount of runoff drains to the existing earthen channel on the west side of the campus, next to CA State Route 103. The third discharge location is to a branch line that runs eastward under Technology Place.

Currently, the 35”x24” arch CMP (private trunk pipe) is undersized to convey stormwater runoff from a 10 year storm via gravity flow out of the CVC campus. Having an undersized private trunk pipe that connects to the off-site main line pipe is typical for

developed sites. In accordance with the LA County Hydrology Manual, developed sites are not allowed to increase their off-site flow, and thus required to detain excess stormwater created by redevelopment. In order to meet the County Manual's storage requirements, detention basins were created on site to store the excess volume of runoff created by development. This excess volume is released from the basins over a period of time at a slower flow rate. Since the proposed runoff volume is 0.06 ac-ft higher than the existing, the increase in hydrologic volume can be considered nearly negligible. (See Table 5 for volume comparison.) The site's existing detention basins would be required to either remain in place, or be relocated in order to accommodate a new building development. Basins can be relocated to landscape areas or underground. Sufficient space is available to relocate.

Ultimately, the project does not negatively impact downstream water bodies via increased or decreased flow rates and volumes. Since the existing storm drain line off site is undersized, ponding will most likely remain an issue on the campus, without further addition of detention basins on the property. Therefore, future development of the campus will have a less than significant effect with mitigation incorporated that impacts flooding on- or off-site, and less than significant effect on exceeding the capacity of existing or planned stormwater drainage systems.

The CVC Campus lies within FEMA flood zone A, as shown in Figure 5 in Appendix A. Although inundation could impact the campus during a flood hazard, its impact would be less than significant, since little to no sediment, trash, pesticides, or other pollutants would be exposed to flood waters. Similarly, flood flows are not directed through the CVC campus, so development on the property would have no impact to impeding or redirecting flood flows.

6.2.2. SURFACE WATER QUALITY

The Project Site will not increase concentrations of the items listed as constituents of concern for the LA River Watershed.

Each new development of the campus will incorporate LID BMPs in its design to treat urban runoff from that specific project area. Temporary BMPs would be used for construction of the project as implemented through the project SWPPP, but long-term BMPswould be incorporated in to each future project, such as capture and use or biofiltration.

Due to the incorporation of the required LID BMP(s), operation of the Project would not result in discharges that would cause: (1) pollution which would alter the quality of the waters of the State to a degree which unreasonably affects beneficial uses of the waters; (2) contamination of the quality of the waters of the State by waste to a degree which creates a hazard to the public health through poisoning or through the spread of diseases; or (3) nuisance that would be injurious to health; affect an entire community or neighborhood, or any considerable number of persons; and occurs during or as a result of the treatment or disposal of wastes.

As is typical of most urban developments, stormwater runoff from the Project Site has the

potential to introduce pollutants into the stormwater system. Anticipated and potential pollutants generated by the Project are sediment, nutrients, pesticides, metals, pathogens, and oil and grease. The pollutants listed above are expected to, and would in fact, be mitigated through the implementation of approved LID BMPs.

Furthermore, operation of the Project would not result in discharges that would cause regulatory standards to be violated. The existing Project Site is varies in imperviousness where there are streets, parking lots, detention basins, residential complexes, etc. Future development will have similar residential impervious percentages, as listed under section 5.1 of this study, as the land uses do not alter significantly between the existing and proposed campus. However, each phase of campus development would include the installation of LID BMPs, which would cumulatively increase the amount of treated runoff leaving the Project Site. These BMPs would mitigate at minimum the first flush or the equivalent of the greater between the 85th percentile storm and first 0.75-inch of rainfall for any storm event. The installed BMP systems will be designed with an internal bypass or overflow system to prevent upstream flooding due to large storm events. The stormwater which bypasses the BMP systems would eventually discharge to an approved discharge point in the public right-of-way. As such, the Project would not interfere with the implementation of a water quality control plan.

Therefore, with the implementation of the SWPPP and LID BMPs throughout the future campus development, there will be no operational impacts on surface water quality.

6.3. CUMULATIVE IMPACT ANALYSIS

6.3.1. SURFACE WATER HYDROLOGY

The geographic context for the cumulative impact analysis on surface water hydrology is the LA River Watershed. The Project in conjunction with forecasted growth in the LA River Watershed could cumulatively increase stormwater runoff flows. However, as noted in Section 6.2.1 above, the Project would have no net impact on stormwater flows. Also, in accordance with City requirements, related projects and other future development projects would be required to implement BMPs to manage stormwater in accordance with LID guidelines. The City of Long Beach Building Department would review each future development project on a case-by-case basis to ensure sufficient local and regional infrastructure is available to accommodate stormwater runoff. Similar to the Project, related projects are located on sites that are fully developed and impervious. Any new development on the related project sites would need to implement LID BMPs to meet the City's requirements. Implementation of the LID BMPs would, at a minimum, maintain existing runoff conditions. Therefore, the impact of the Project combined with the related projects on surface water hydrology would be less than significant.

6.3.2. SURFACE WATER QUALITY

Future growth in the LA River Watershed would be subject to NPDES requirements relating to water quality for both construction and operation. In addition, since the Project

is located in a highly urbanized area, future land use changes or development are not likely to cause substantial changes in regional surface water quality. As noted above, the Project does not have an adverse impact on water quality, and would in fact improve the quality of on-site flows due to the introduction of new BMPs that would collect, treat, and discharge flows from the Project Site (which are not being treated under existing conditions). Also, it is anticipated that the Project and other future development projects would also be subject to LID requirements and implementation of measures to comply with TMDLs. Increases in regional controls associated with other elements of the MS4 Permit would improve regional water quality over time. The Project combined with the related projects would comply with all applicable laws, rules, and regulations, and therefore, cumulative impacts to surface water quality would be less than significant.

7. LEVEL OF SIGNIFICANCE

Based on the analysis contained in this report, no significant impacts have been identified for surface water quality, groundwater hydrology or groundwater quality for this Project. As seen in Section 6.2.1, due to the inadequate sizing of the public storm drain infrastructure downstream of the main campus outlet, engineered stormwater detention will continue to be implemented within future developments, thus the impact from surface water hydrology would be less than significant with mitigation incorporated.

Works Cited

California Department of Conservation. (1998). *SEISMIC HAZARD ZONE REPORT FOR THE LONG BEACH 7.5-MINUTE QUADRANGLE, LOS ANGELES COUNTY, CALIFORNIA.*

California Environmental Protection Agency. (2019, April 2). *Impaired Water Bodies*. Retrieved December 4, 2019, from State Water Resources Control Board: https://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2014_2016.shtml

California Water Board. (2019, October 17). *National Pollutant Discharge Elimination System (NPDES) - Wastewater*. Retrieved December 12, 2019, from CA Water Board Website: https://www.waterboards.ca.gov/water_issues/programs/npdes/

City of Long Beach. (2019). *Municipal Code.*

City of Long Beach Development Services. (n.d.). *Low Impact Development (LID) Best Management Practices (BMP) Design Manual.*

DWR. (1999). *Watermaster Service in the West Coast Basin, Los Angeles County, July 1, 1998 - June 30, 1999.*

Environment, L. S. (n.d.). *LA River*. Retrieved December 4, 2019, from lacitysan.org: https://www.lacitysan.org/san/faces/wcnav_externalId/s-lsh-wwd-wp-ewmp-lar?_adf.ctrl-state=5k9m7y2mh_82&_afrLoop=16748036418153296#!

Geotechnologies, Inc. (2015). *GEOTECHNICAL ENGINEERING INVESTIGATION PROPOSED AFFORDABLE HOUSING DEVELOPMENT NORTHEAST CORNER OF RIVER AVENUE AND WEST 20TH STREET.*

LARWQB. (2019). *LARWQB Basin Plan.*

Los Angeles Regional Water Quality Board. (2014). *WASTE DISCHARGE REQUIREMENTS FOR MUNICIPAL SEPARATE STORM SEWER.*

Los Angeles Regional Water Quality Board. (n.d.). *LOS ANGELES RIVER WATERSHED*. Retrieved from waterboards.ca.gov: https://www.waterboards.ca.gov/rwqcb4/water_issues/programs/regional_program/Water_Quality_and_Watersheds/los_angeles_river_watershed/la_summary.shtml

Los Angeles Regional Water Quality Board. (n.d.). *STANDARD URBAN STORM WATER MITIGATION PLAN FOR LOS ANGELES COUNTY AND CITIES IN LOS ANGELES COUNTY.*

United States Environmental Protection Agency. (2019, October 10). *Laws and Regulation*. Retrieved December 12, 2019, from US EPA Website: https://www.epa.gov/laws-regulations

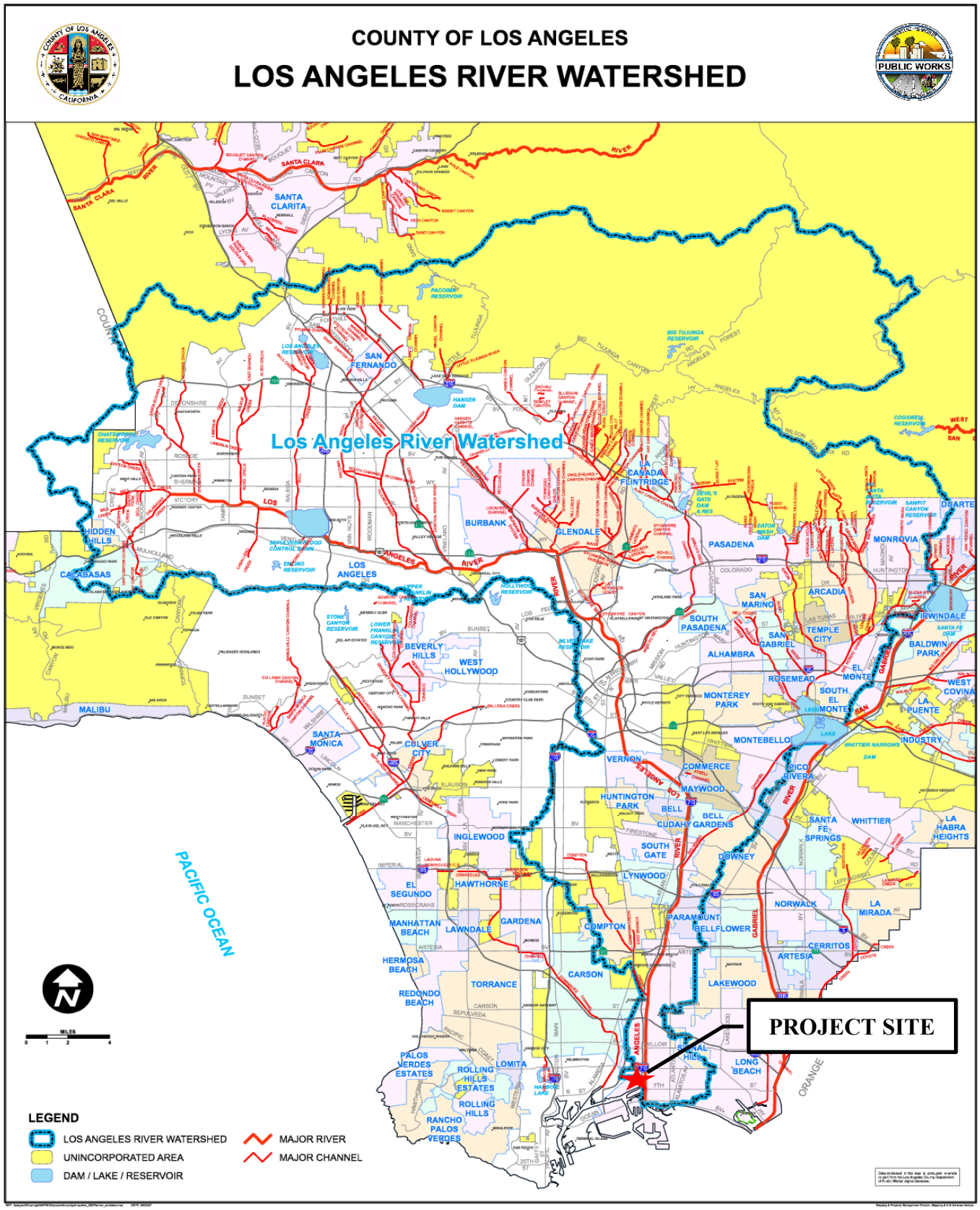
United States Environmental Protection Agency. (2019, December 10). *National Pollutant Discharge Elimination System (NPDES)*. Retrieved December 12, 2019, from US EPA Website: https://www.epa.gov/npdes

WRD. (n.d.). *WRD Well Search*. Retrieved December 12, 2019, from WRD Web site: https://gis-apps.wrd.org/Html5Viewer/Index.html?viewer=Well_Search.Well_Search

This page intentionally left blank.

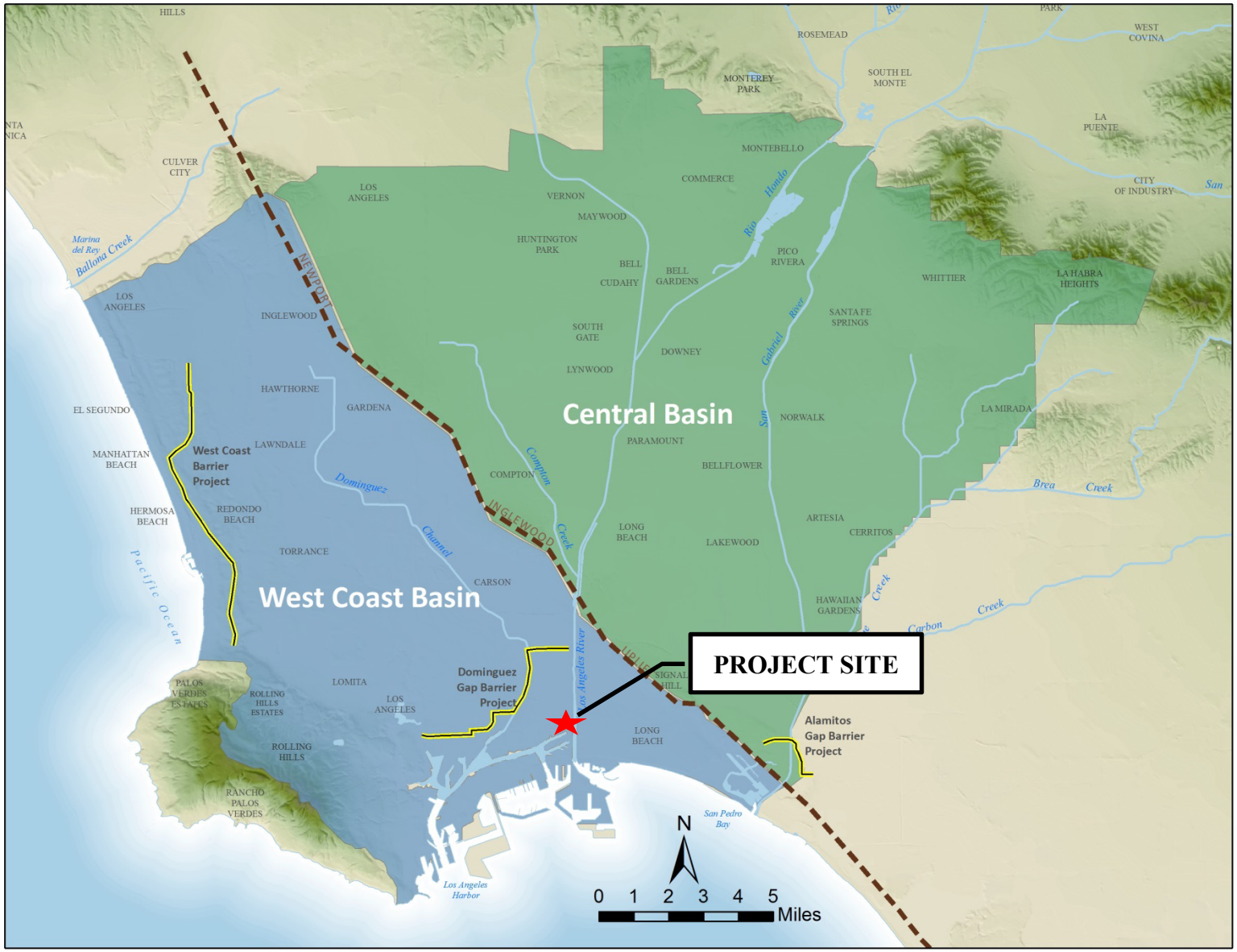
APPENDIX A

Figure 1: Map of Los Angeles River Watershed



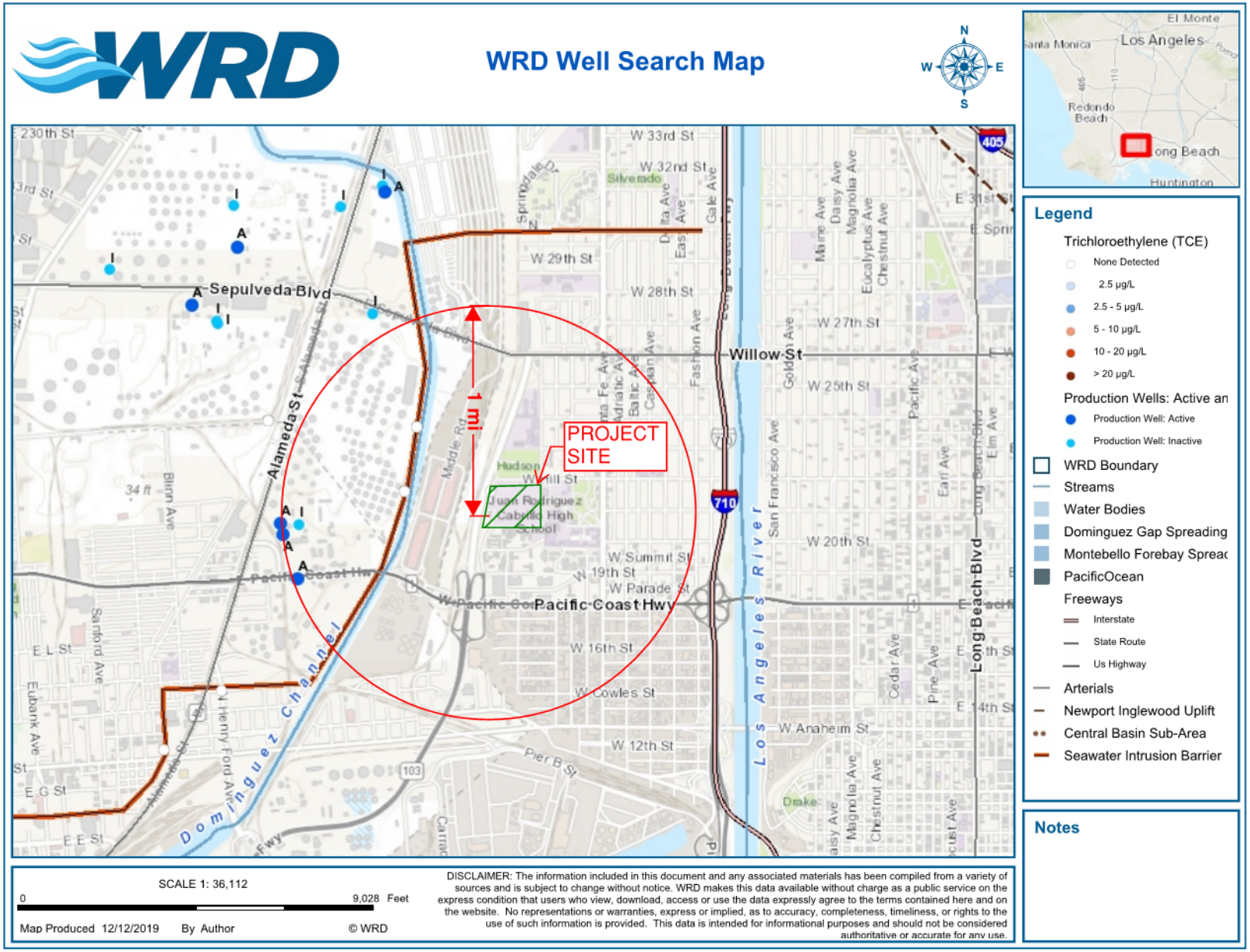
Source: Los Angeles County

Figure 2: Not Used



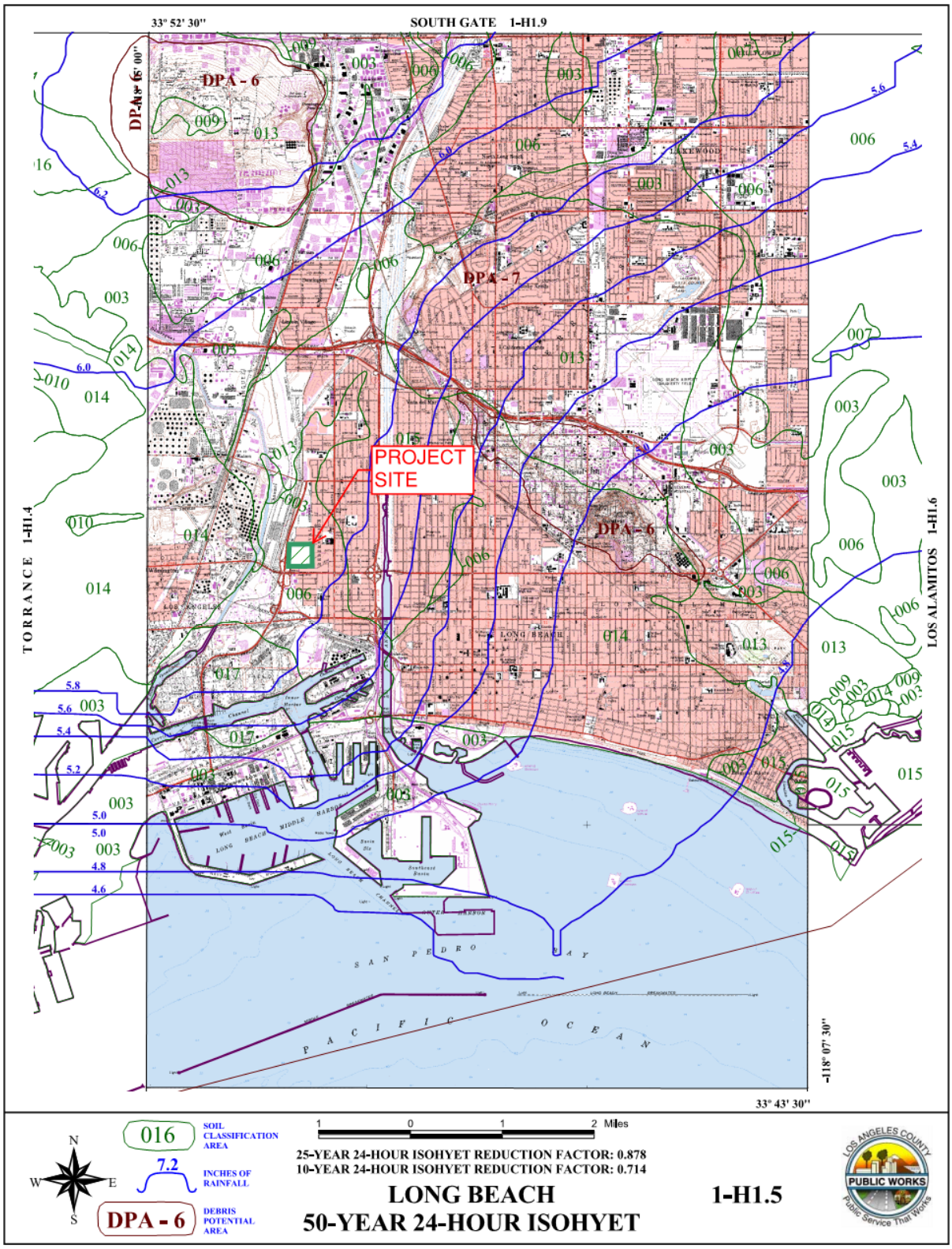
Source: Water Replenishment District

Figure 3: Not Used



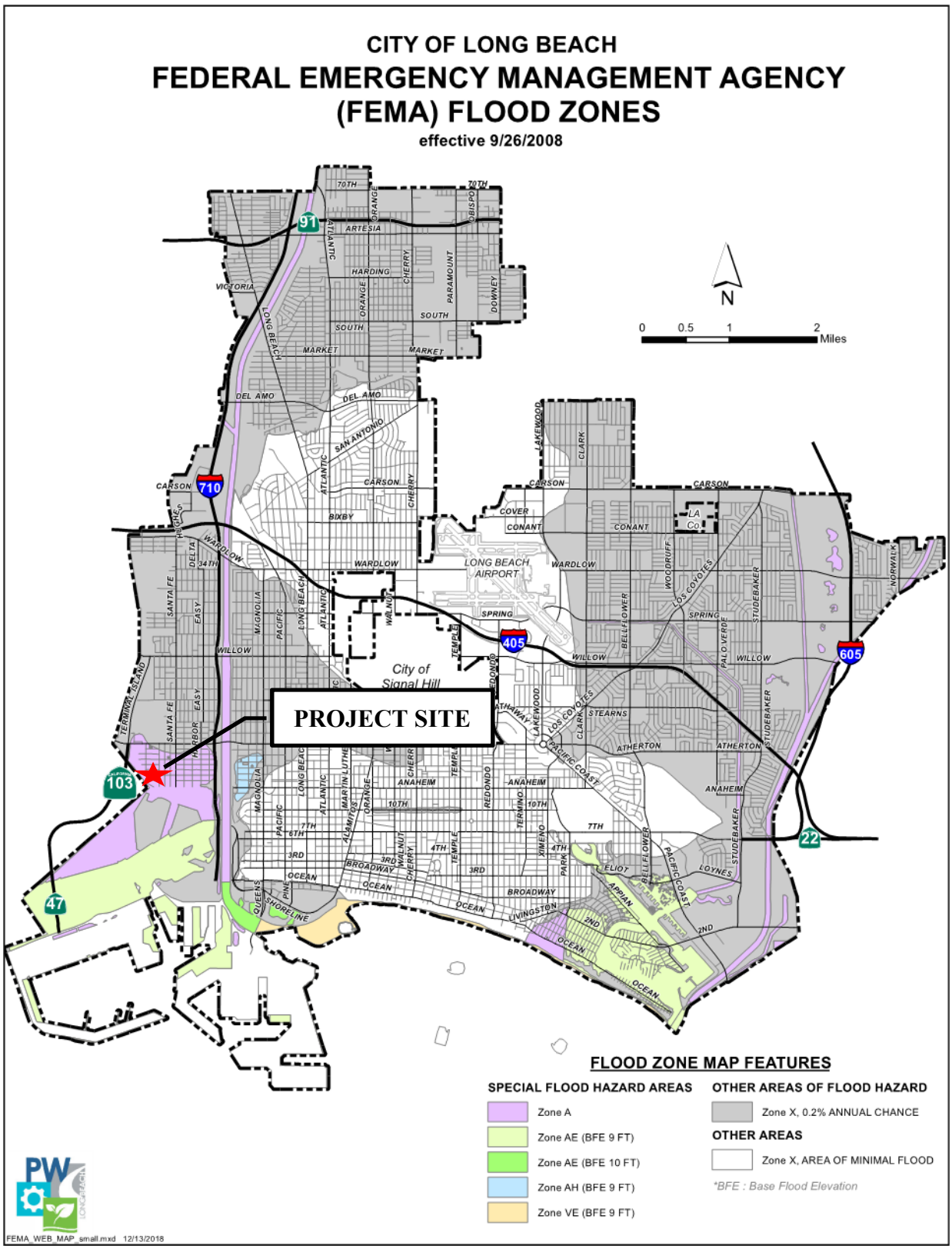
Source: Water Replenishment District

Figure 4: 24 hour, 50 year storm Isohyet Map of Long Beach



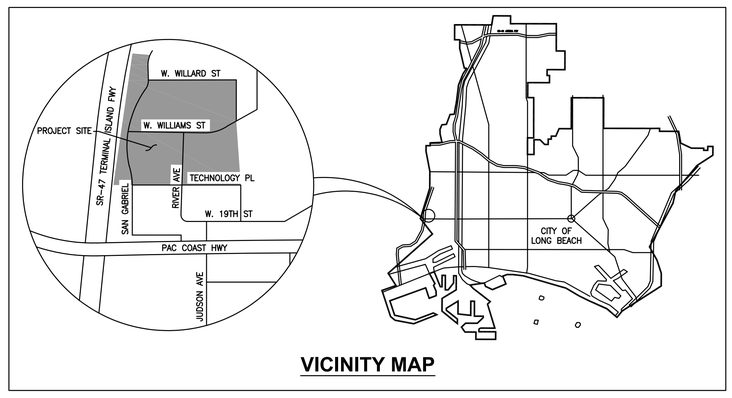
Source: LACDPW Hydrology Manual

Figure 5: FEMA Flood Zone Map of Long Beach



Source: Federal Emergency Management Agency

FIGURE 6: EXISTING HYDROLOGY MAP



VICINITY MAP

LEGEND:

- SUBAREA LIMIT
- FLOW LINE
- DETENTION BASIN OUTLINE
- FLOW DIRECTION
- 19 / 2.86 AC — SUBAREA DESIGNATION / AREA
- (±11.00) ELEV — FLOW LINE ELEVATION (SURVEY)
- 11.00 ELEV — FLOW LINE ELEVATION (ASSUMED, BASED ON CONTOURS)
- AREA SHEET FLOWS OFF SITE TOWARD EXISTING PUBLIC CHANNEL
- AREA FLOWS OFF SITE (WEST) INTO EXISTING CHANNEL OUTLET VIA STORM DRAIN
- AREA CONTROLLED BY PUMP REGULATED OUTFLOW @ 0.50 CFS
- AREA FLOWS TO EASTBOUND BRANCH LINE UNDER TECHNOLOGY PLACE

SITE DATA:

SOIL TYPE: 6

50-YR RAINFALL DEPTH: 5.8"

Subarea	Area (Ac)	10-Yr (cfs)	25-Yr (cfs)	50-Yr (cfs)	Subarea	Area (Ac)	10-Yr (cfs)	25-Yr (cfs)	50-Yr (cfs)
1	1.73	3.00301	3.971889	4.8952	28	0.67	1.33809	1.81069	2.07191
2	1.06	1.20847	1.627169	1.9206	29	0.09	0.19652	0.24323	0.27832
3	1.05	2.05749	2.808924	3.2272	30	0.39	0.85158	1.05398	1.20604
4	0.32	0.56085	0.739094	0.9088	31	0.47	1.033	1.27554	1.45712
5	0.35	0.6541	0.870328	1.0851	32	0.58	1.07441	1.43477	1.79359
6	0.39	0.85717	1.058429	1.2091	33	0.33	0.72057	0.89183	1.02049
7	0.76	1.3779	1.856507	2.1315	34	0.40	0.62304	0.81243	0.98431
8	0.71	1.41798	1.918791	2.1956	35	0.71	1.31523	1.75636	2.19561
9	1.14	2.1305	2.834782	3.5343	36	0.45	0.98259	1.21614	1.39158
10	0.48	1.03159	1.284079	1.4753	37	0.44	0.69286	0.90048	1.08845
11	0.19	0.4176	0.515645	0.589	38	0.36	0.71897	0.97291	1.11327
12	0.40	0.87342	1.081009	1.237	39	0.44	0.96076	1.18911	1.36066
13	0.21	0.45132	0.561785	0.6454	40	0.79	1.57775	2.13499	2.443
14	0.48	1.03159	1.284079	1.4753	41	2.31	2.63356	3.546	4.18554
15	1.65	2.48223	3.376793	3.8578	42	0.50	0.84774	1.13141	1.40233
16	0.61	1.05887	1.400492	1.726	43	0.18	0.38684	0.48153	0.55324
17	1.06	1.96358	2.62217	2.9994	44	0.47	0.75128	0.99478	1.22044
18	0.47	1.01009	1.257328	1.4446	45	1.25	1.85027	2.60807	3.33979
19	0.31	0.6769	0.837782	0.9586	46	1.17	1.61547	2.44116	2.85908
20	0.54	1.07846	1.459362	1.6699	47	0.46	0.5322	0.71399	0.84111
21	0.18	0.38684	0.48153	0.5532	48	3.31	3.86537	5.57741	7.00667
22	0.26	0.55878	0.695543	0.7991	49	0.08	0.17583	0.21711	0.24802
23	1.12	1.83982	2.574482	2.9431	50	0.08	0.17583	0.21711	0.24802
24	0.19	0.37946	0.513479	0.5876	51	0.23	0.50551	0.6242	0.71306
25	0.96	1.57372	2.065524	2.5204	52	1.13	1.91589	2.55699	3.16928
26	0.15	0.32753	0.405378	0.4639	53	0.34	0.54348	0.76936	0.88287
27	0.20	0.43671	0.540504	0.6185	54	0.49	1.05308	1.31083	1.50604
					Total	35.09	59.78	79.53	94.25

Subarea	Area (Ac)	10-Yr (ac-ft)	25-Yr (ac-ft)	50-Yr (ac-ft)	Subarea	Area (Ac)	10-Yr (ac-ft)	25-Yr (ac-ft)	50-Yr (ac-ft)
1	1.73	0.47	0.58	0.67	28	0.67	0.18	0.23	0.26
2	1.06	0.29	0.36	0.41	29	0.09	0.02	0.03	0.03
3	1.05	0.26	0.32	0.36	30	0.39	0.11	0.13	0.15
4	0.32	0.09	0.11	0.13	31	0.47	0.13	0.17	0.19
5	0.35	0.10	0.12	0.14	32	0.58	0.16	0.20	0.22
6	0.39	0.11	0.14	0.16	33	0.33	0.09	0.11	0.13
7	0.76	0.19	0.23	0.26	34	0.40	0.11	0.13	0.15
8	0.71	0.19	0.24	0.27	35	0.71	0.19	0.24	0.27
9	1.14	0.33	0.40	0.46	36	0.45	0.12	0.15	0.17
10	0.48	0.12	0.14	0.17	37	0.44	0.13	0.15	0.18
11	0.19	0.05	0.07	0.08	38	0.36	0.10	0.12	0.14
12	0.40	0.11	0.13	0.15	39	0.44	0.12	0.15	0.17
13	0.21	0.05	0.06	0.07	40	0.79	0.22	0.27	0.30
14	0.48	0.12	0.14	0.17	41	2.31	0.63	0.78	0.89
15	1.65	0.47	0.58	0.66	42	0.50	0.12	0.15	0.17
16	0.61	0.17	0.21	0.23	43	0.18	0.04	0.05	0.06
17	1.06	0.29	0.36	0.41	44	0.47	0.11	0.14	0.16
18	0.47	0.11	0.14	0.16	45	1.25	0.11	0.14	0.17
19	0.31	0.08	0.10	0.12	46	1.17	0.10	0.13	0.16
20	0.54	0.15	0.18	0.21	47	0.46	0.13	0.16	0.18
21	0.18	0.04	0.05	0.06	48	3.31	0.28	0.37	0.44
22	0.26	0.06	0.08	0.09	49	0.08	0.02	0.03	0.03
23	1.12	0.31	0.38	0.44	50	0.08	0.02	0.03	0.03
24	0.19	0.05	0.06	0.07	51	0.23	0.07	0.08	0.09
25	0.96	0.26	0.32	0.37	52	1.13	0.28	0.34	0.39
26	0.15	0.04	0.05	0.06	53	0.34	0.08	0.10	0.12
27	0.20	0.05	0.07	0.08	54	0.49	0.12	0.15	0.17
					Total	35.09	8.37	10.38	11.90

SCALE: 1"=40'

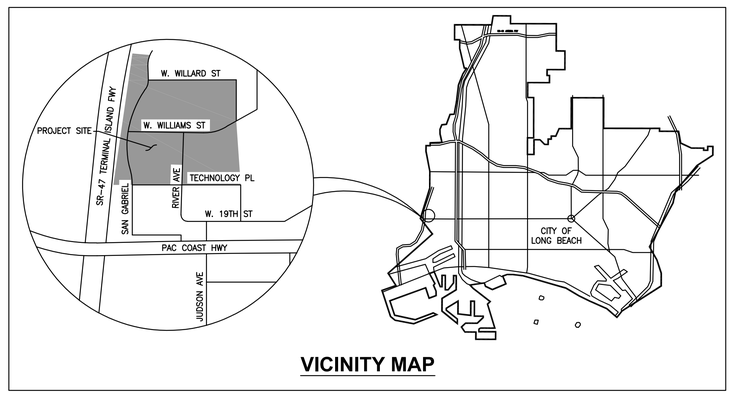
kpff
400 Oceangate, Suite 500
Long Beach, California 90802
(562) 437-9100 Fax (562) 437-9200

CENTURY VILLAGES AT CABRILLO
LONG BEACH, CA

CAMPUS HYDROLOGY MAP

DRAWN:	CJR	PROJECT NO.:	113053
DESIGN:	JLH	SCALE:	AS SHOWN
CHECKED:	TAG	DATE:	MAR 30, 2016
SHEET NO.	01 OF 01		

FIGURE 7: PROPOSED HYDROLOGY MAP



VICINITY MAP

LEGEND:

- SUBAREA LIMIT
- FLOW LINE
- DETENTION BASIN OUTLINE
- FLOW DIRECTION
- 19 / 2.86 AC — SUBAREA DESIGNATION / AREA
- (±11.00) ELEV — FLOW LINE ELEVATION (SURVEY)
- 11.00 ELEV — FLOW LINE ELEVATION (ASSUMED, BASED ON CONTOURS)
- AREA SHEET FLOWS OFF SITE TOWARD EXISTING PUBLIC CHANNEL
- AREA FLOWS OFF SITE (WEST) INTO EXISTING CHANNEL OUTLET VIA STORM DRAIN
- AREA CONTROLLED BY PUMP REGULATED OUTFLOW @ 0.50 CFS
- AREA FLOWS TO EASTBOUND BRANCH LINE UNDER TECHNOLOGY PLACE

SITE DATA:

SOIL TYPE: 6

50-YR RAINFALL DEPTH: 5.8"

Subarea	Area (Ac)	10-Yr (cfs)	25-Yr (cfs)	50-Yr (cfs)	Subarea	Area (Ac)	10-Yr (cfs)	25-Yr (cfs)	50-Yr (cfs)
1	1.39	2.41	3.19	3.93	21	0.31	0.51	0.67	0.82
2	1.2	1.97	2.58	3.15	22	0.61	0.71	0.95	1.12
3	2.29	3.36	4.61	5.29	23	1.17	1.62	2.44	2.86
4	1.32	2.29	3.03	3.47	24	1.25	1.85	2.61	3.34
5	0.19	0.38	0.51	0.59	25	3.31	3.87	5.58	7.01
6	0.15	0.33	0.41	0.46	26	1.36	2.54	3.38	4.21
7	0.39	0.85	1.05	1.21	27	0.71	1.42	1.92	2.20
8	0.09	0.20	0.24	0.28	28	0.31	0.68	0.84	0.96
9	1.06	1.24	1.68	1.99	29	0.18	0.39	0.49	0.56
10	0.4	0.62	0.81	0.98	30	1.2	2.40	3.24	3.71
11	0.44	0.69	0.90	1.09	31	1.79	3.57	4.84	5.54
12	0.71	1.32	1.76	2.20	32	0.5	0.81	1.07	1.31
13	0.47	1.03	1.28	1.46	33	1.32	2.11	2.79	3.43
14	0.59	1.18	1.60	1.83	34	0.34	0.54	0.77	0.88
15	0.08	0.18	0.22	0.25	35	0.49	1.06	1.31	1.51
16	0.36	0.79	0.97	1.11	36	1.17	2.04	2.69	3.32
17	1.01	2.17	2.70	3.10	37	1.03	1.79	2.36	2.91
18	0.88	1.92	2.38	2.72	38	1.17	2.55	3.16	3.62
19	0.27	0.59	0.73	0.84	39	1.34	2.11	2.74	3.31
20	0.75	1.36	1.84	2.11	40	1.49	1.85	2.45	2.90
					Total	35.09	59.31	78.79	93.54

Subarea	Area (Ac)	10-Yr (ac-ft)	25-Yr (ac-ft)	50-Yr (ac-ft)	Subarea	Area (Ac)	10-Yr (ac-ft)	25-Yr (ac-ft)	50-Yr (ac-ft)
1	1.39	0.38	0.47	0.54	21	0.31	0.09	0.11	0.12
2	1.2	0.33	0.40	0.46	22	0.61	0.17	0.21	0.24
3	2.29	0.59	0.73	0.84	23	1.17	0.10	0.13	0.16
4	1.32	0.36	0.45	0.51	24	1.25	0.11	0.14	0.17
5	0.19	0.05	0.07	0.08	25	3.31	0.28	0.37	0.44
6	0.15	0.04	0.05	0.06	26	1.36	0.39	0.47	0.54
7	0.39	0.11	0.13	0.15	27	0.71	0.19	0.24	0.27
8	0.09	0.03	0.03	0.04	28	0.31	0.09	0.11	0.12
9	1.06	0.29	0.36	0.41	29	0.18	0.05	0.06	0.07
10	0.4	0.11	0.13	0.15	30	1.2	0.33	0.40	0.46
11	0.44	0.13	0.15	0.18	31	1.79	0.49	0.60	0.69
12	0.71	0.19	0.24	0.27	32	0.5	0.13	0.16	0.19
13	0.47	0.13	0.17	0.19	33	1.32	0.32	0.40	0.46
14	0.59	0.16	0.20	0.23	34	0.34	0.08	0.10	0.12
15	0.08	0.02	0.03	0.03	35	0.49	0.12	0.15	0.17
16	0.36	0.10	0.12	0.14	36	1.17	0.33	0.40	0.46
17	1.01	0.25	0.30	0.35	37	1.03	0.28	0.35	0.40
18	0.88	0.24	0.30	0.34	38	1.17	0.32	0.39	0.45
19	0.27	0.08	0.10	0.11	39	1.34	0.38	0.47	0.54
20	0.75	0.19	0.23	0.26	40	1.49	0.41	0.51	0.58
					Total	35.09	8.44	10.46	11.98

N

40’ 0 40’ 80’

20’ 60’

SCALE: 1”=40’

kpff

400 Oceangate, Suite 500
Long Beach, California 90802
(562) 437-9100 Fax (562) 437-9200

CENTURY VILLAGES AT CABRILLO
LONG BEACH, CA

CAMPUS PROPOSED HYDROLOGY MAP

DRAWN:	MJF	PROJECT NO.:	1900126
DESIGN:	JLH	SCALE:	AS SHOWN
CHECKED:	TAG	DATE:	NOV 14, 2019
SHEET NO.	02 OF 02		

APPENDIX B

Peak Flow Hydrologic Analysis

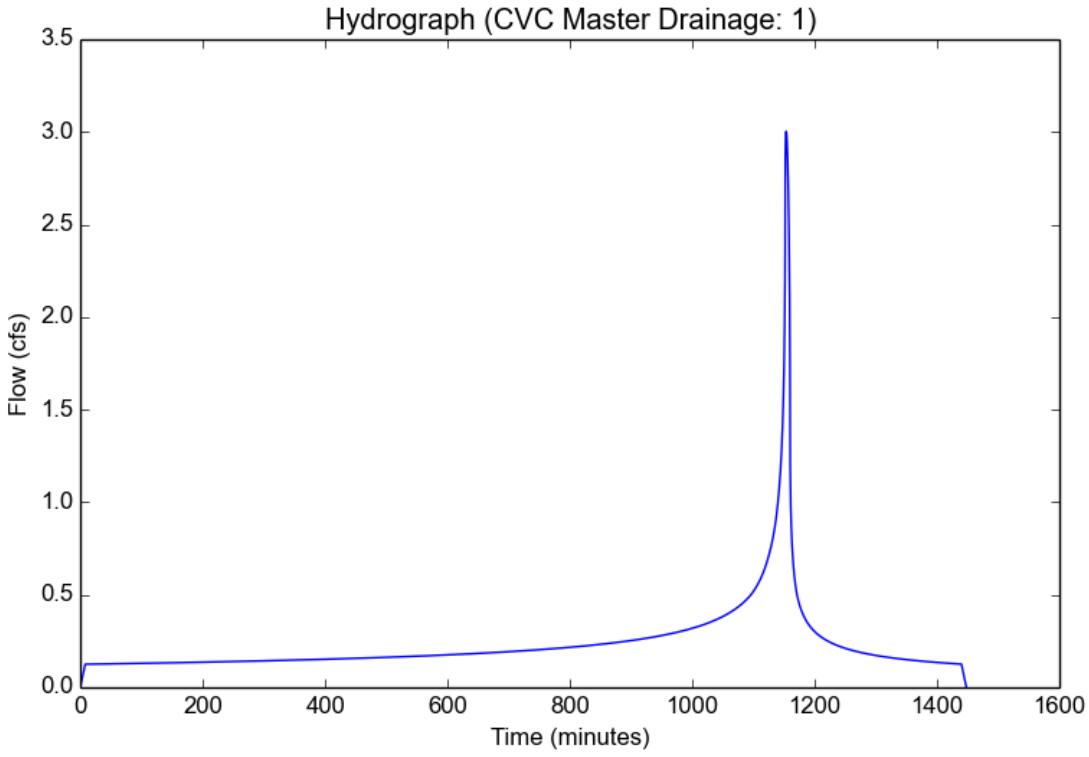
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	1
Area (ac)	1.73
Flow Path Length (ft)	325.0
Flow Path Slope (vft/hft)	0.0037
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.86
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	1.981
Undeveloped Runoff Coefficient (Cu)	0.7302
Developed Runoff Coefficient (Cd)	0.8762
Time of Concentration (min)	8.0
Clear Peak Flow Rate (cfs)	3.003
Burned Peak Flow Rate (cfs)	3.003
24-Hr Clear Runoff Volume (ac-ft)	0.4728
24-Hr Clear Runoff Volume (cu-ft)	20593.9908



Peak Flow Hydrologic Analysis

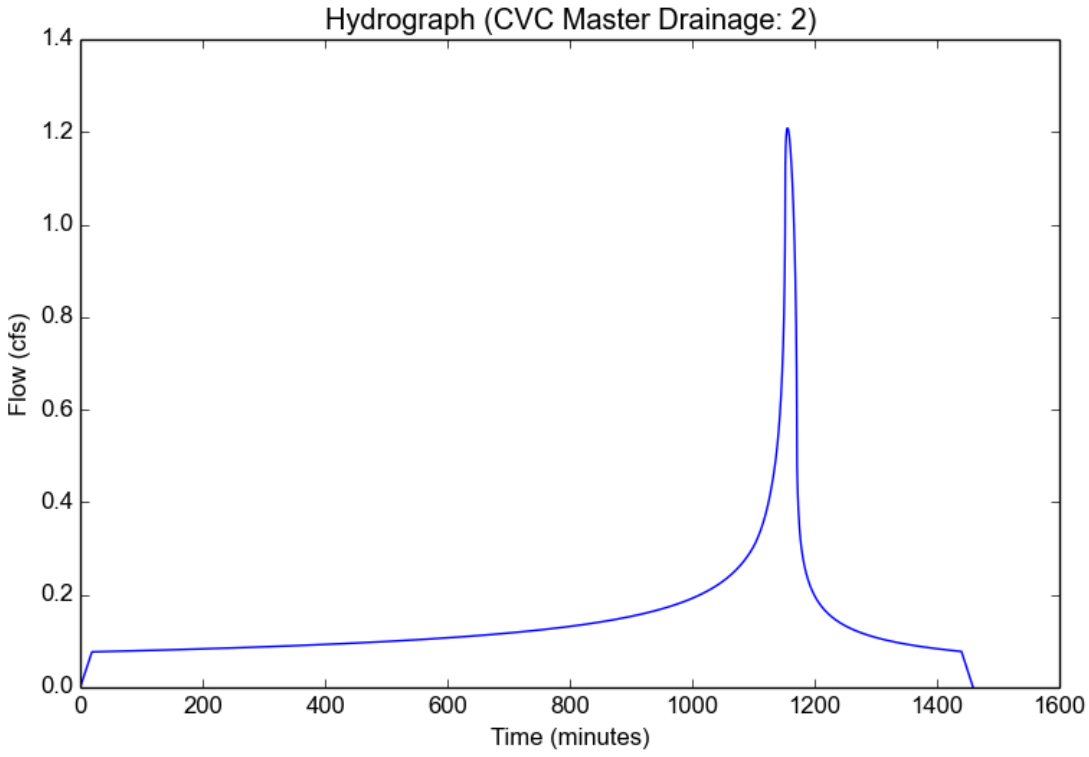
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	2
Area (ac)	1.06
Flow Path Length (ft)	860.0
Flow Path Slope (vft/hft)	0.0012
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.86
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	1.3193
Undeveloped Runoff Coefficient (Cu)	0.6441
Developed Runoff Coefficient (Cd)	0.8642
Time of Concentration (min)	19.0
Clear Peak Flow Rate (cfs)	1.2085
Burned Peak Flow Rate (cfs)	1.2085
24-Hr Clear Runoff Volume (ac-ft)	0.2896
24-Hr Clear Runoff Volume (cu-ft)	12615.5182



Peak Flow Hydrologic Analysis

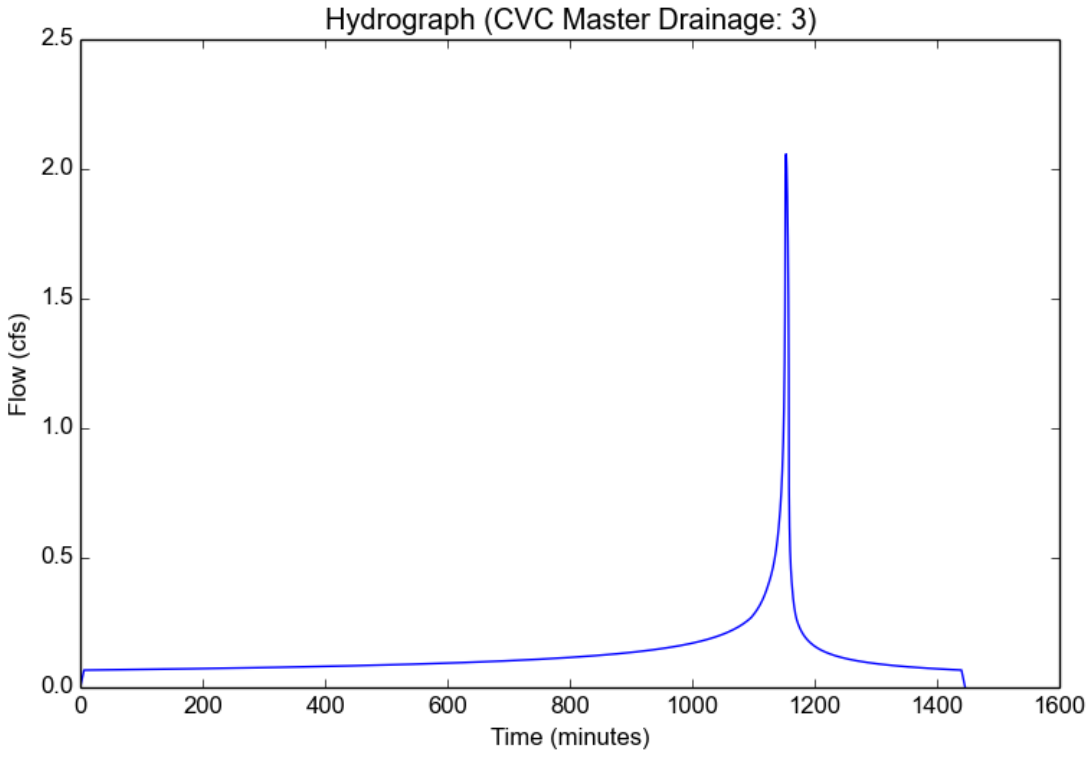
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	3
Area (ac)	1.05
Flow Path Length (ft)	250.0
Flow Path Slope (vft/hft)	0.0068
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.74
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.2678
Undeveloped Runoff Coefficient (Cu)	0.7617
Developed Runoff Coefficient (Cd)	0.864
Time of Concentration (min)	6.0
Clear Peak Flow Rate (cfs)	2.0575
Burned Peak Flow Rate (cfs)	2.0575
24-Hr Clear Runoff Volume (ac-ft)	0.2557
24-Hr Clear Runoff Volume (cu-ft)	11139.155



Peak Flow Hydrologic Analysis

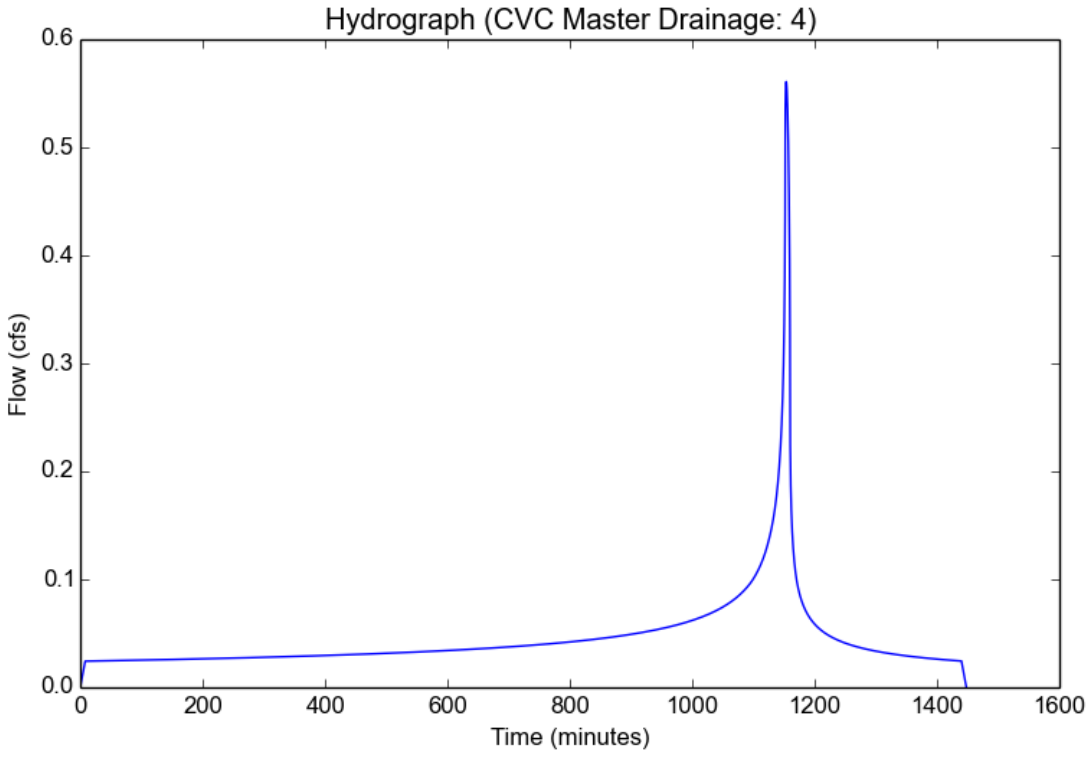
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	4
Area (ac)	0.32
Flow Path Length (ft)	310.0
Flow Path Slope (vft/hft)	0.0029
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.91
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	1.981
Undeveloped Runoff Coefficient (Cu)	0.7302
Developed Runoff Coefficient (Cd)	0.8847
Time of Concentration (min)	8.0
Clear Peak Flow Rate (cfs)	0.5609
Burned Peak Flow Rate (cfs)	0.5609
24-Hr Clear Runoff Volume (ac-ft)	0.0914
24-Hr Clear Runoff Volume (cu-ft)	3982.2597



Peak Flow Hydrologic Analysis

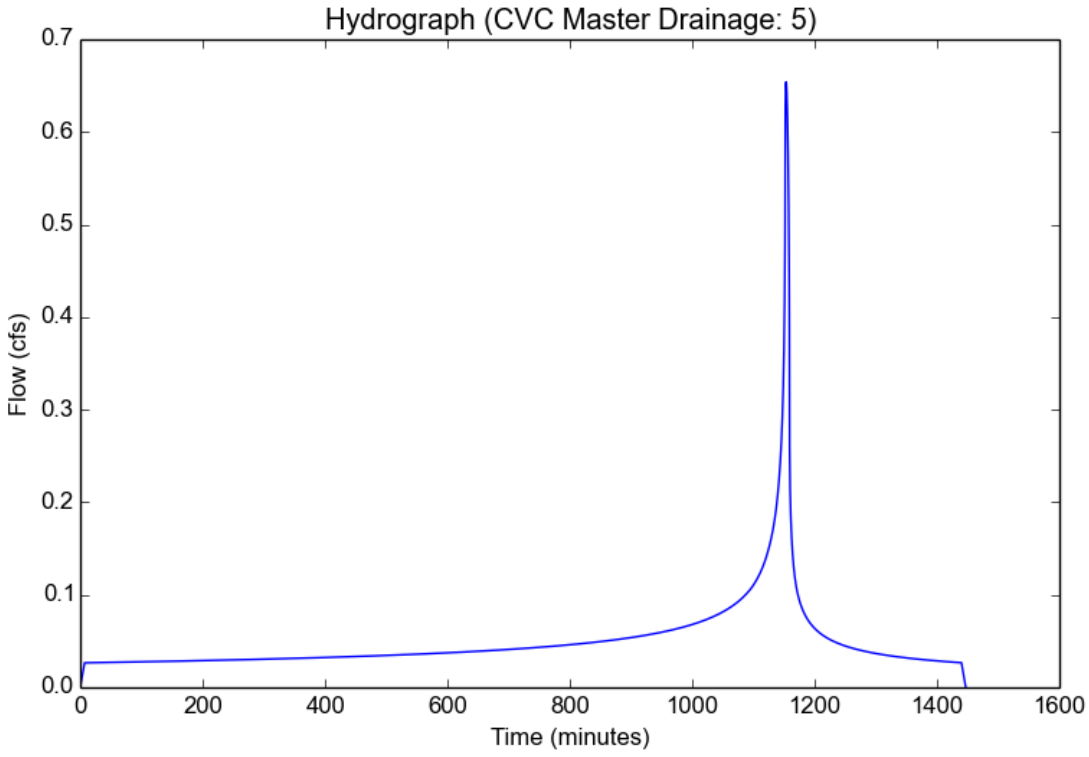
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	5
Area (ac)	0.35
Flow Path Length (ft)	215.0
Flow Path Slope (vft/hft)	0.0027
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.91
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.1094
Undeveloped Runoff Coefficient (Cu)	0.7443
Developed Runoff Coefficient (Cd)	0.886
Time of Concentration (min)	7.0
Clear Peak Flow Rate (cfs)	0.6541
Burned Peak Flow Rate (cfs)	0.6541
24-Hr Clear Runoff Volume (ac-ft)	0.1
24-Hr Clear Runoff Volume (cu-ft)	4355.6974



Peak Flow Hydrologic Analysis

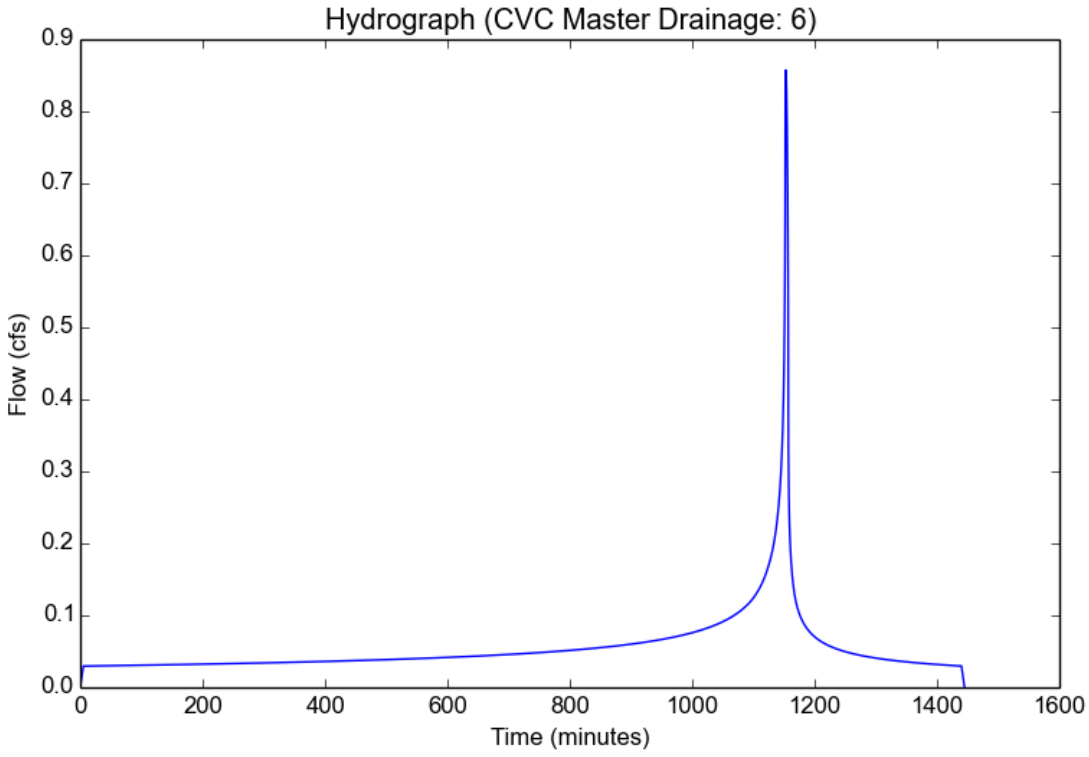
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	6
Area (ac)	0.39
Flow Path Length (ft)	130.0
Flow Path Slope (vft/hft)	0.0192
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.91
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.4708
Undeveloped Runoff Coefficient (Cu)	0.784
Developed Runoff Coefficient (Cd)	0.8896
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	0.8572
Burned Peak Flow Rate (cfs)	0.8572
24-Hr Clear Runoff Volume (ac-ft)	0.1114
24-Hr Clear Runoff Volume (cu-ft)	4853.8349



Peak Flow Hydrologic Analysis

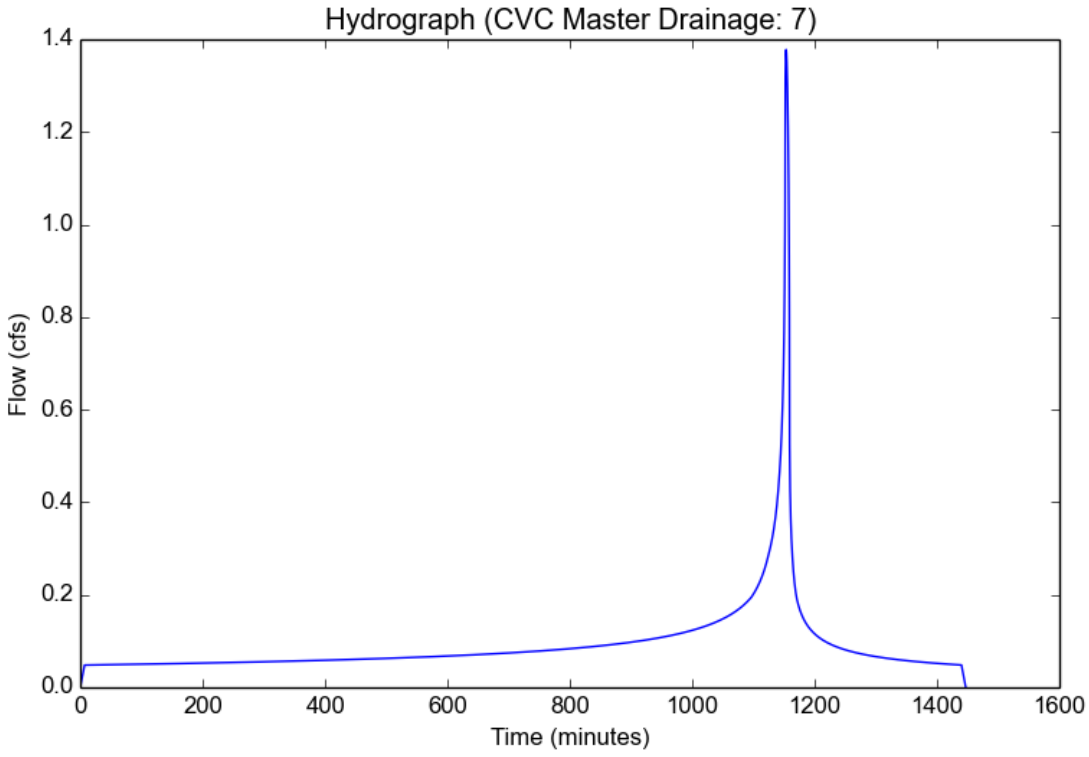
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	7
Area (ac)	0.76
Flow Path Length (ft)	305.0
Flow Path Slope (vft/hft)	0.0056
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.74
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.1094
Undeveloped Runoff Coefficient (Cu)	0.7443
Developed Runoff Coefficient (Cd)	0.8595
Time of Concentration (min)	7.0
Clear Peak Flow Rate (cfs)	1.3779
Burned Peak Flow Rate (cfs)	1.3779
24-Hr Clear Runoff Volume (ac-ft)	0.1851
24-Hr Clear Runoff Volume (cu-ft)	8061.7975



Peak Flow Hydrologic Analysis

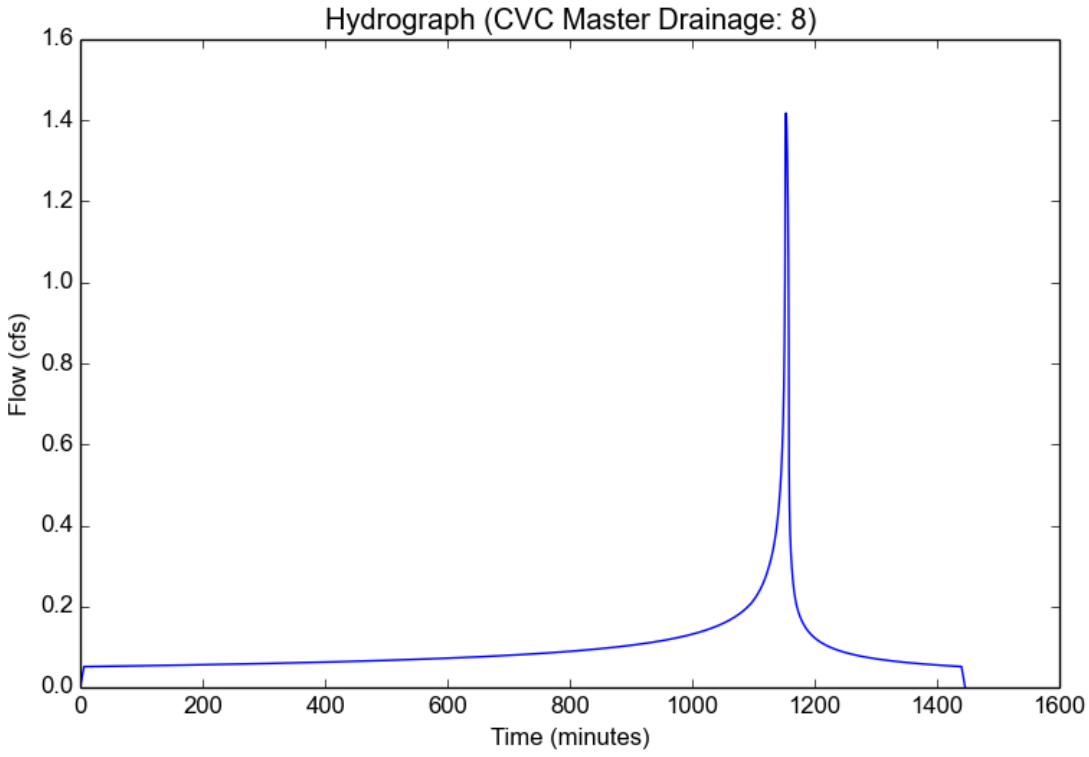
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	8
Area (ac)	0.71
Flow Path Length (ft)	195.0
Flow Path Slope (vft/hft)	0.0038
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.86
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.2678
Undeveloped Runoff Coefficient (Cu)	0.7617
Developed Runoff Coefficient (Cd)	0.8806
Time of Concentration (min)	6.0
Clear Peak Flow Rate (cfs)	1.418
Burned Peak Flow Rate (cfs)	1.418
24-Hr Clear Runoff Volume (ac-ft)	0.194
24-Hr Clear Runoff Volume (cu-ft)	8452.6045



Peak Flow Hydrologic Analysis

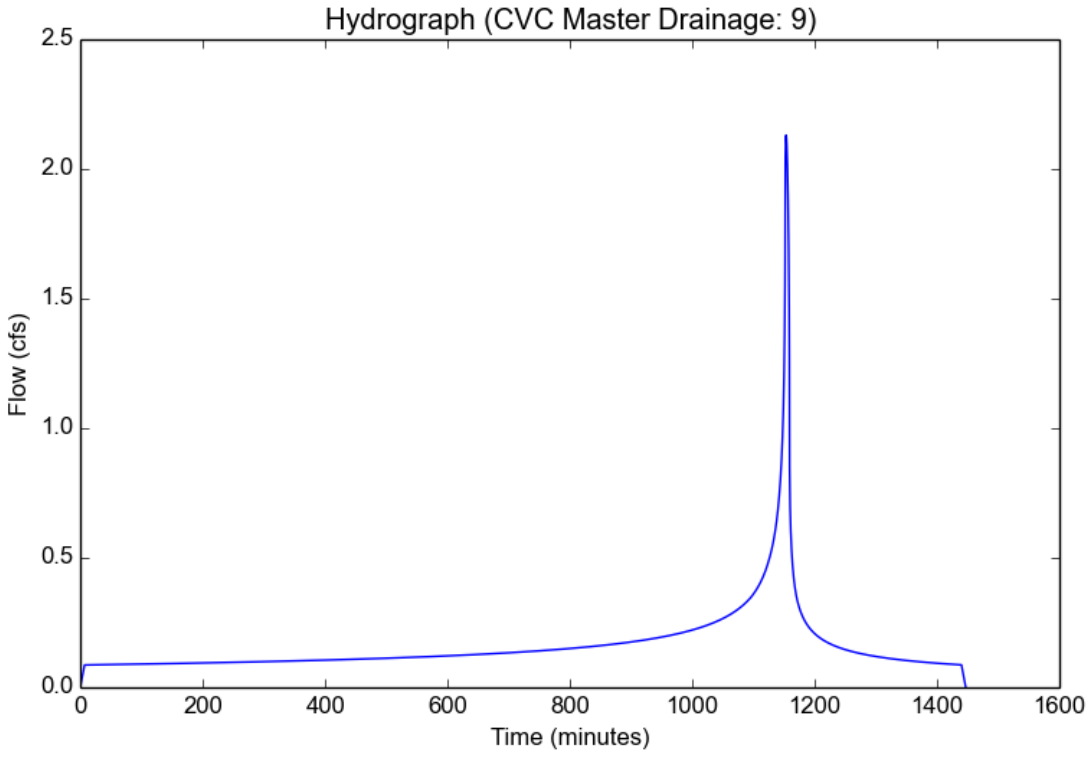
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	9
Area (ac)	1.14
Flow Path Length (ft)	330.0
Flow Path Slope (vft/hft)	0.0103
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.91
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.1094
Undeveloped Runoff Coefficient (Cu)	0.7443
Developed Runoff Coefficient (Cd)	0.886
Time of Concentration (min)	7.0
Clear Peak Flow Rate (cfs)	2.1305
Burned Peak Flow Rate (cfs)	2.1305
24-Hr Clear Runoff Volume (ac-ft)	0.3257
24-Hr Clear Runoff Volume (cu-ft)	14187.1286



Peak Flow Hydrologic Analysis

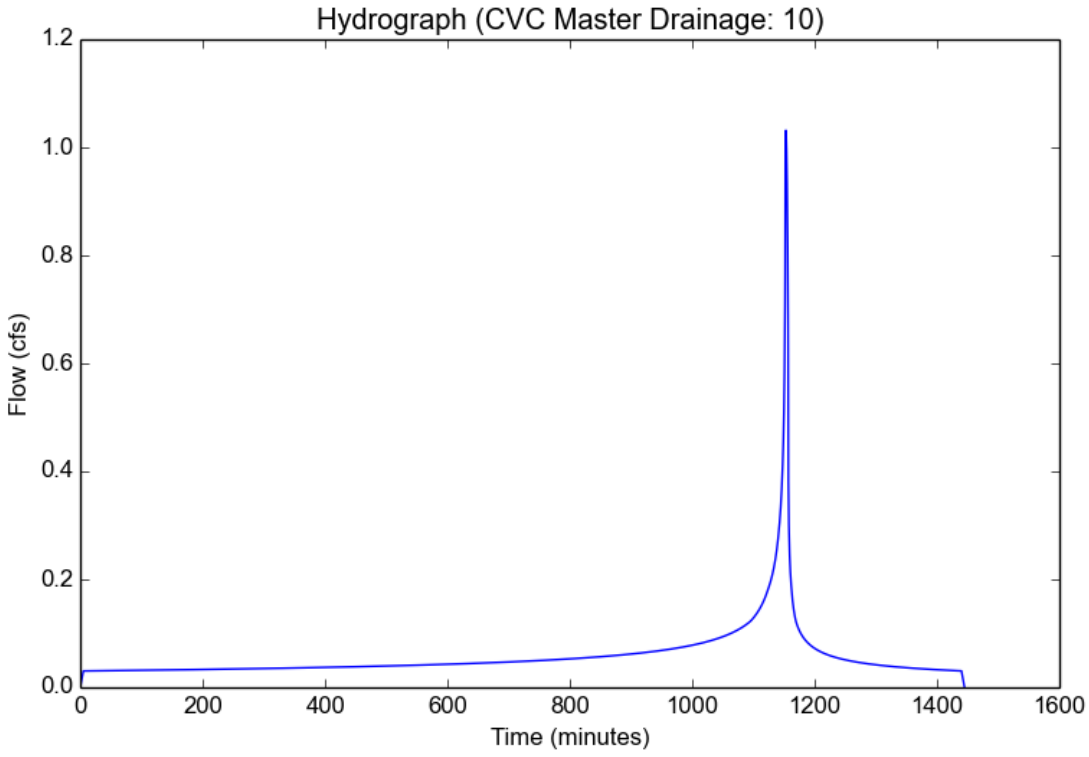
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	10
Area (ac)	0.48
Flow Path Length (ft)	210.0
Flow Path Slope (vft/hft)	0.011
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.74
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.4708
Undeveloped Runoff Coefficient (Cu)	0.784
Developed Runoff Coefficient (Cd)	0.8698
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	1.0316
Burned Peak Flow Rate (cfs)	1.0316
24-Hr Clear Runoff Volume (ac-ft)	0.1169
24-Hr Clear Runoff Volume (cu-ft)	5092.8868



Peak Flow Hydrologic Analysis

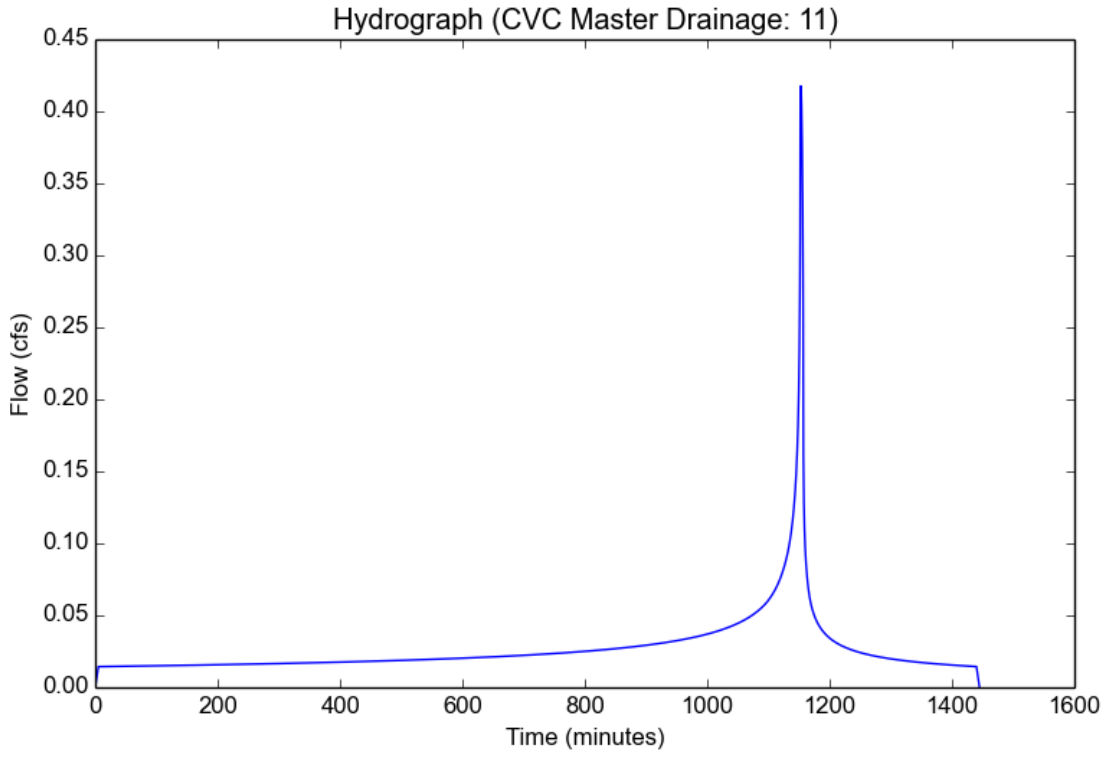
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	11
Area (ac)	0.19
Flow Path Length (ft)	90.0
Flow Path Slope (vft/hft)	0.0127
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.91
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.4708
Undeveloped Runoff Coefficient (Cu)	0.784
Developed Runoff Coefficient (Cd)	0.8896
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	0.4176
Burned Peak Flow Rate (cfs)	0.4176
24-Hr Clear Runoff Volume (ac-ft)	0.0543
24-Hr Clear Runoff Volume (cu-ft)	2364.6888



Peak Flow Hydrologic Analysis

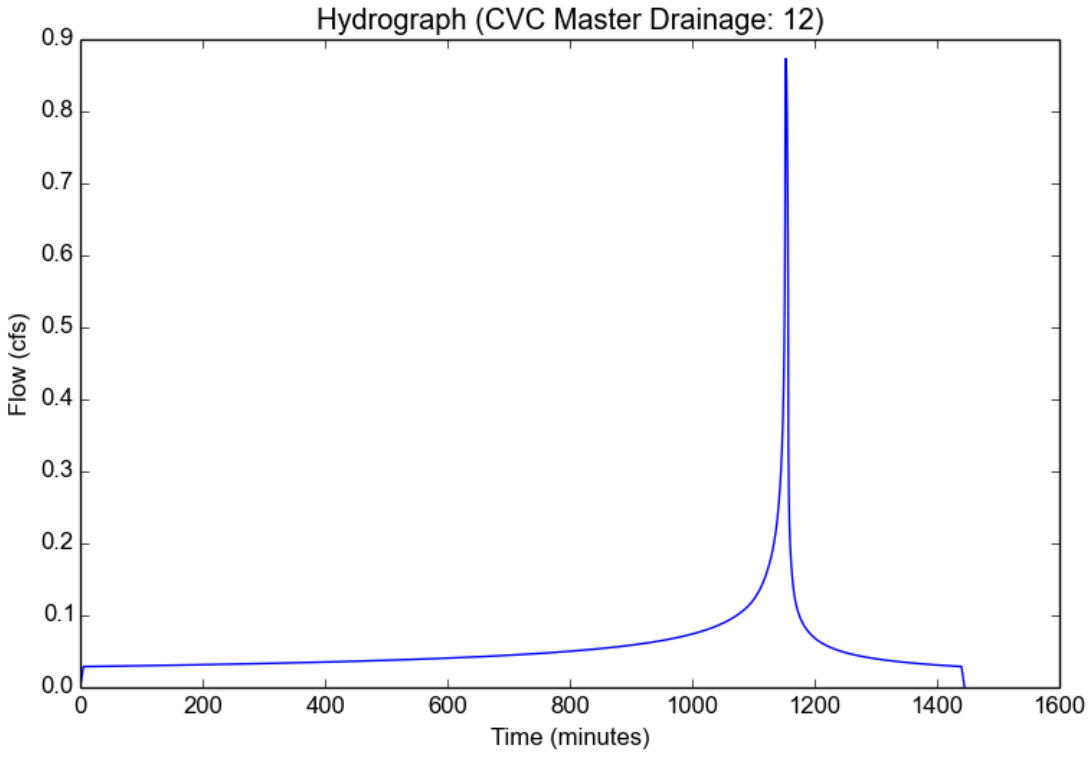
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	12
Area (ac)	0.4
Flow Path Length (ft)	135.0
Flow Path Slope (vft/hft)	0.0126
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.86
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.4708
Undeveloped Runoff Coefficient (Cu)	0.784
Developed Runoff Coefficient (Cd)	0.8838
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	0.8734
Burned Peak Flow Rate (cfs)	0.8734
24-Hr Clear Runoff Volume (ac-ft)	0.1093
24-Hr Clear Runoff Volume (cu-ft)	4762.3452



Peak Flow Hydrologic Analysis

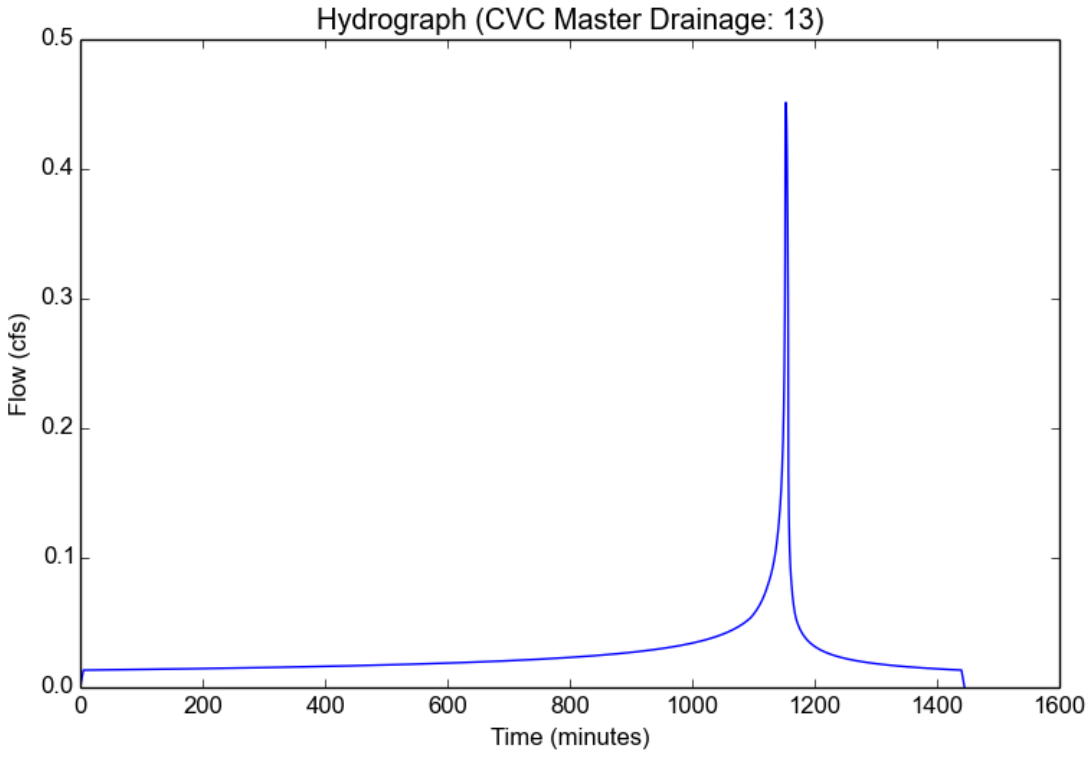
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	13
Area (ac)	0.21
Flow Path Length (ft)	115.0
Flow Path Slope (vft/hft)	0.0078
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.74
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.4708
Undeveloped Runoff Coefficient (Cu)	0.784
Developed Runoff Coefficient (Cd)	0.8698
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	0.4513
Burned Peak Flow Rate (cfs)	0.4513
24-Hr Clear Runoff Volume (ac-ft)	0.0512
24-Hr Clear Runoff Volume (cu-ft)	2228.138



Peak Flow Hydrologic Analysis

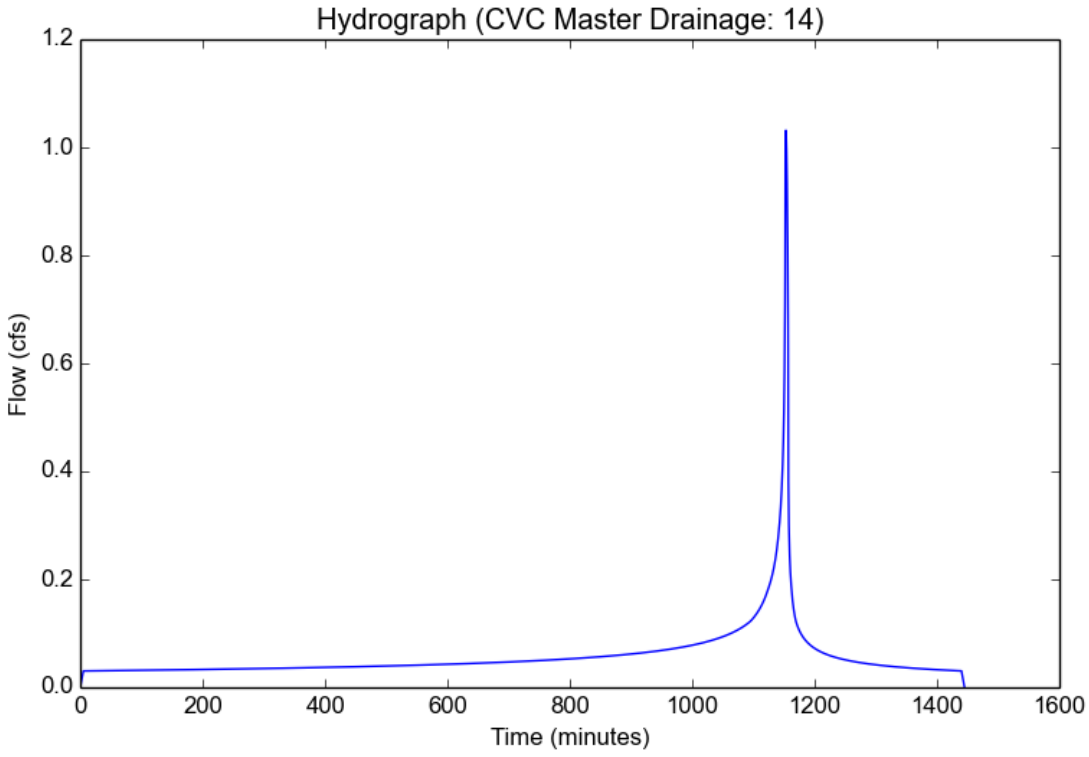
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	14
Area (ac)	0.48
Flow Path Length (ft)	115.0
Flow Path Slope (vft/hft)	0.0177
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.74
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.4708
Undeveloped Runoff Coefficient (Cu)	0.784
Developed Runoff Coefficient (Cd)	0.8698
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	1.0316
Burned Peak Flow Rate (cfs)	1.0316
24-Hr Clear Runoff Volume (ac-ft)	0.1169
24-Hr Clear Runoff Volume (cu-ft)	5092.8868



Peak Flow Hydrologic Analysis

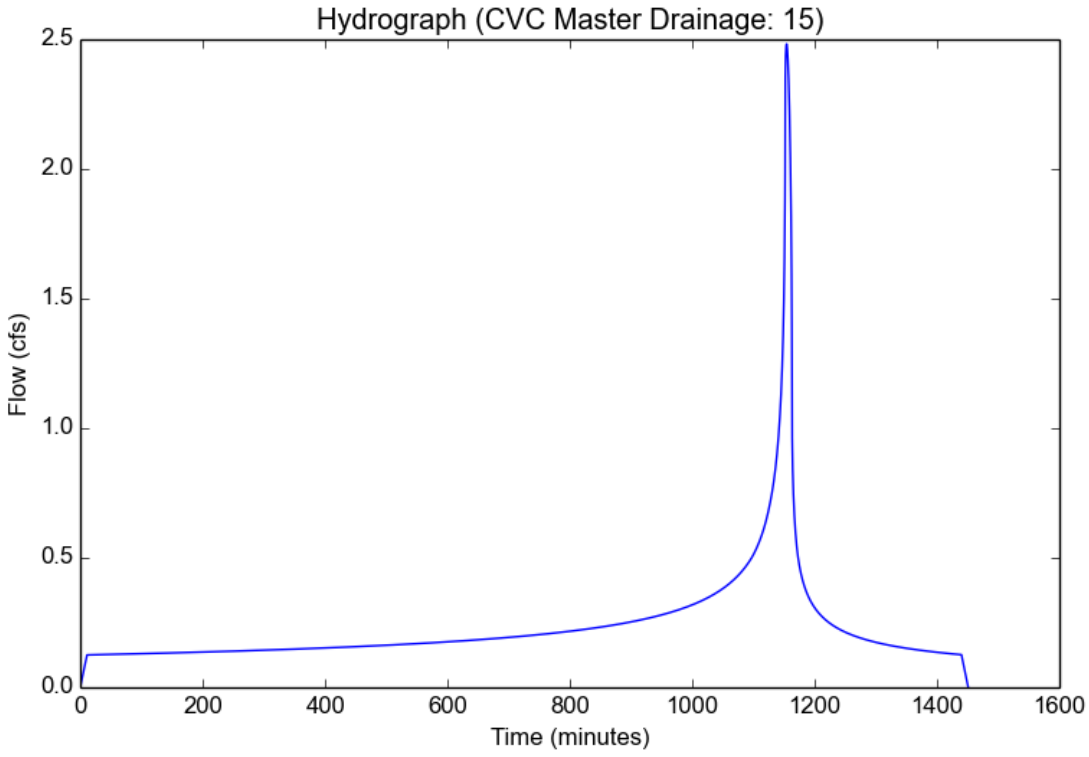
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	15
Area (ac)	1.65
Flow Path Length (ft)	600.0
Flow Path Slope (vft/hft)	0.0065
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.91
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	1.7057
Undeveloped Runoff Coefficient (Cu)	0.7
Developed Runoff Coefficient (Cd)	0.882
Time of Concentration (min)	11.0
Clear Peak Flow Rate (cfs)	2.4822
Burned Peak Flow Rate (cfs)	2.4822
24-Hr Clear Runoff Volume (ac-ft)	0.4714
24-Hr Clear Runoff Volume (cu-ft)	20532.6995



Peak Flow Hydrologic Analysis

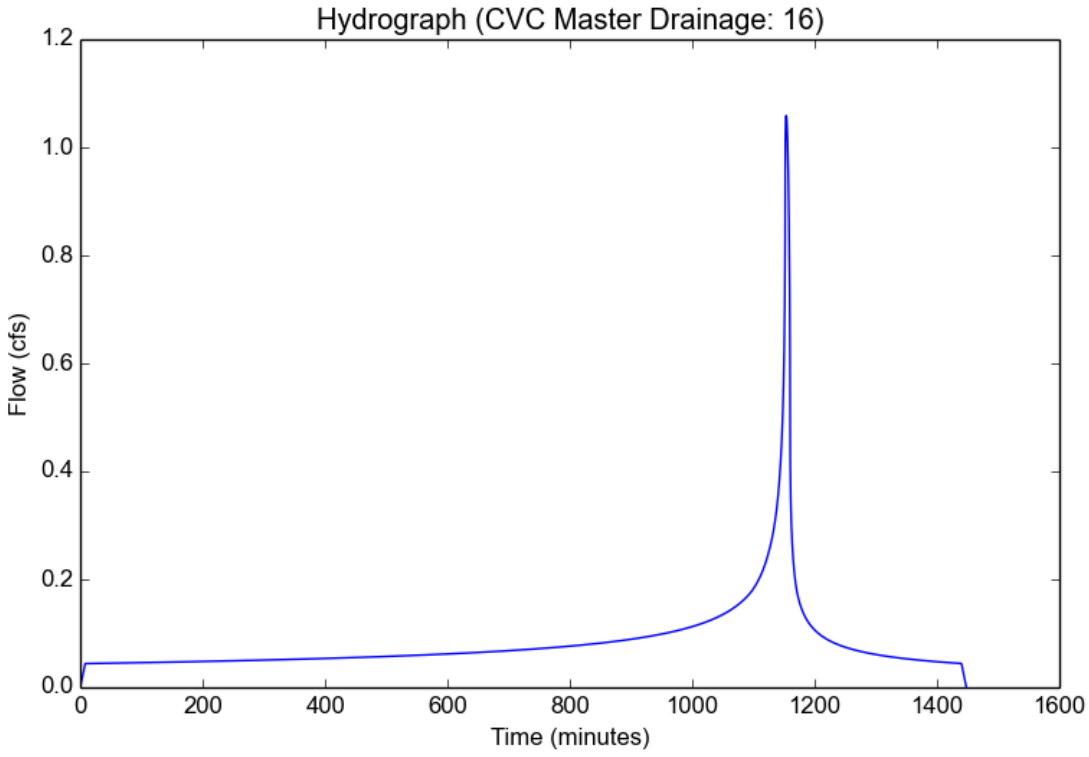
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	16
Area (ac)	0.61
Flow Path Length (ft)	350.0
Flow Path Slope (vft/hft)	0.0066
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.86
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	1.981
Undeveloped Runoff Coefficient (Cu)	0.7302
Developed Runoff Coefficient (Cd)	0.8762
Time of Concentration (min)	8.0
Clear Peak Flow Rate (cfs)	1.0589
Burned Peak Flow Rate (cfs)	1.0589
24-Hr Clear Runoff Volume (ac-ft)	0.1667
24-Hr Clear Runoff Volume (cu-ft)	7261.465



Peak Flow Hydrologic Analysis

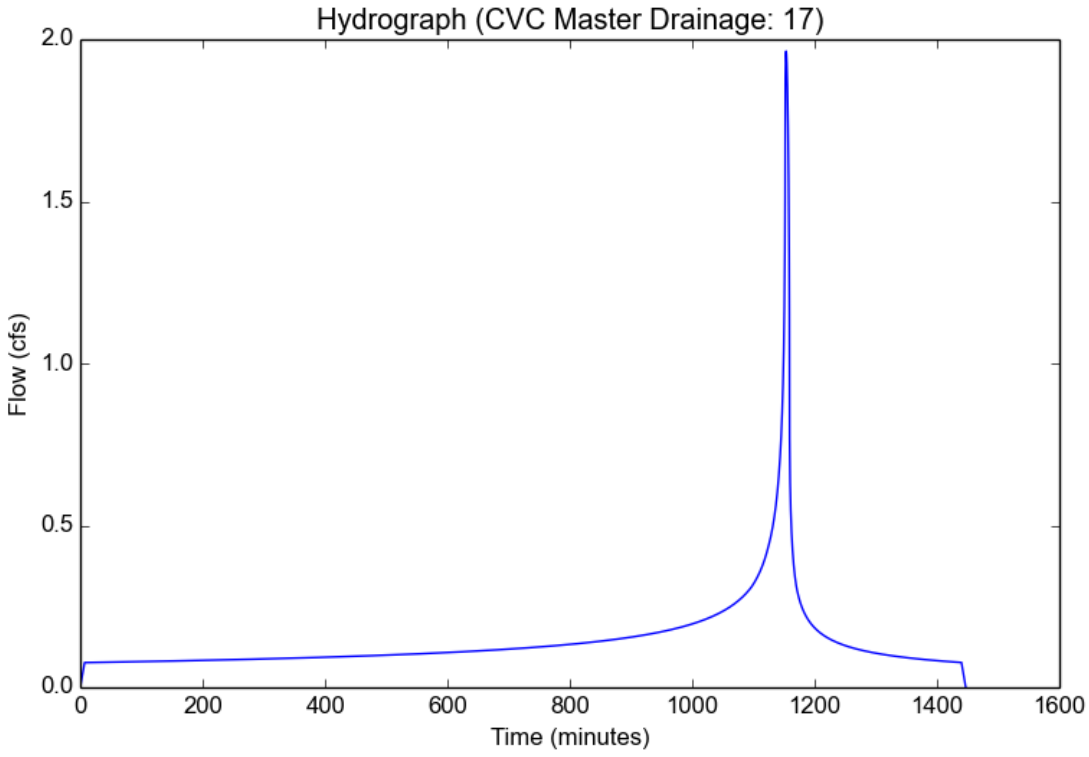
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	17
Area (ac)	1.06
Flow Path Length (ft)	285.0
Flow Path Slope (vft/hft)	0.0037
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.86
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.1094
Undeveloped Runoff Coefficient (Cu)	0.7443
Developed Runoff Coefficient (Cd)	0.8782
Time of Concentration (min)	7.0
Clear Peak Flow Rate (cfs)	1.9636
Burned Peak Flow Rate (cfs)	1.9636
24-Hr Clear Runoff Volume (ac-ft)	0.2897
24-Hr Clear Runoff Volume (cu-ft)	12618.7599



Peak Flow Hydrologic Analysis

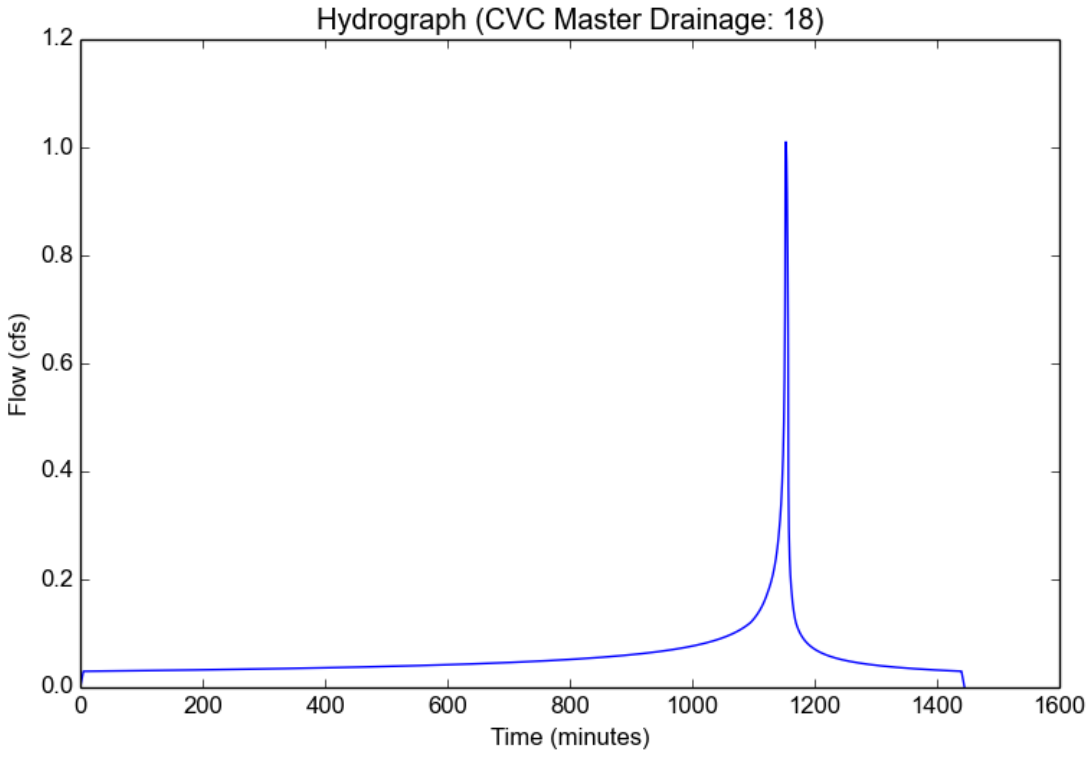
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	18
Area (ac)	0.47
Flow Path Length (ft)	175.0
Flow Path Slope (vft/hft)	0.0214
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.74
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.4708
Undeveloped Runoff Coefficient (Cu)	0.784
Developed Runoff Coefficient (Cd)	0.8698
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	1.0101
Burned Peak Flow Rate (cfs)	1.0101
24-Hr Clear Runoff Volume (ac-ft)	0.1145
24-Hr Clear Runoff Volume (cu-ft)	4986.785



Peak Flow Hydrologic Analysis

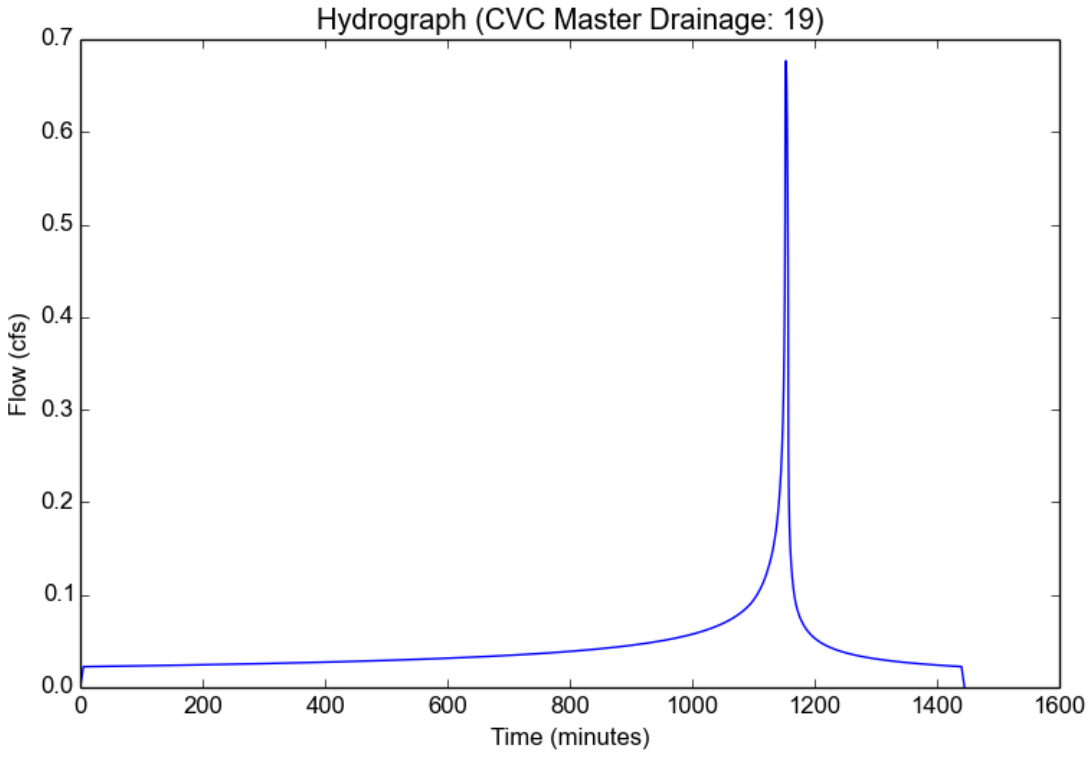
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	19
Area (ac)	0.31
Flow Path Length (ft)	220.0
Flow Path Slope (vft/hft)	0.0148
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.86
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.4708
Undeveloped Runoff Coefficient (Cu)	0.784
Developed Runoff Coefficient (Cd)	0.8838
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	0.6769
Burned Peak Flow Rate (cfs)	0.6769
24-Hr Clear Runoff Volume (ac-ft)	0.0847
24-Hr Clear Runoff Volume (cu-ft)	3690.8175



Peak Flow Hydrologic Analysis

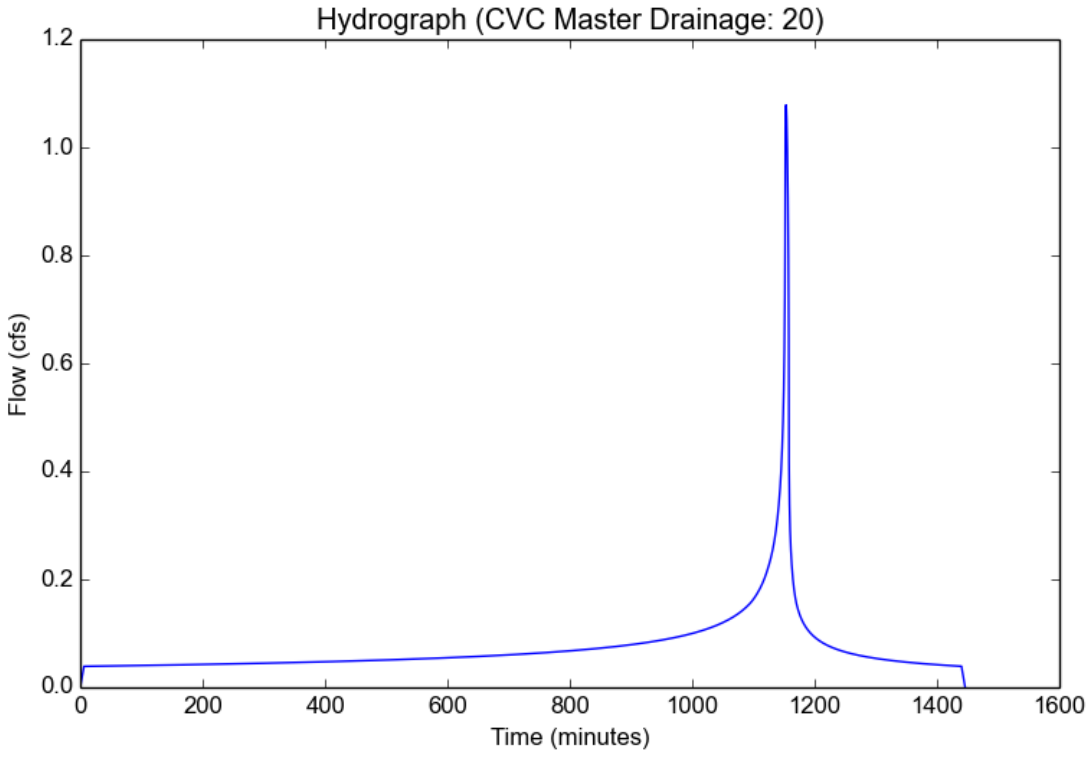
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	20
Area (ac)	0.54
Flow Path Length (ft)	295.0
Flow Path Slope (vft/hft)	0.0114
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.86
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.2678
Undeveloped Runoff Coefficient (Cu)	0.7617
Developed Runoff Coefficient (Cd)	0.8806
Time of Concentration (min)	6.0
Clear Peak Flow Rate (cfs)	1.0785
Burned Peak Flow Rate (cfs)	1.0785
24-Hr Clear Runoff Volume (ac-ft)	0.1476
24-Hr Clear Runoff Volume (cu-ft)	6428.7414



Peak Flow Hydrologic Analysis

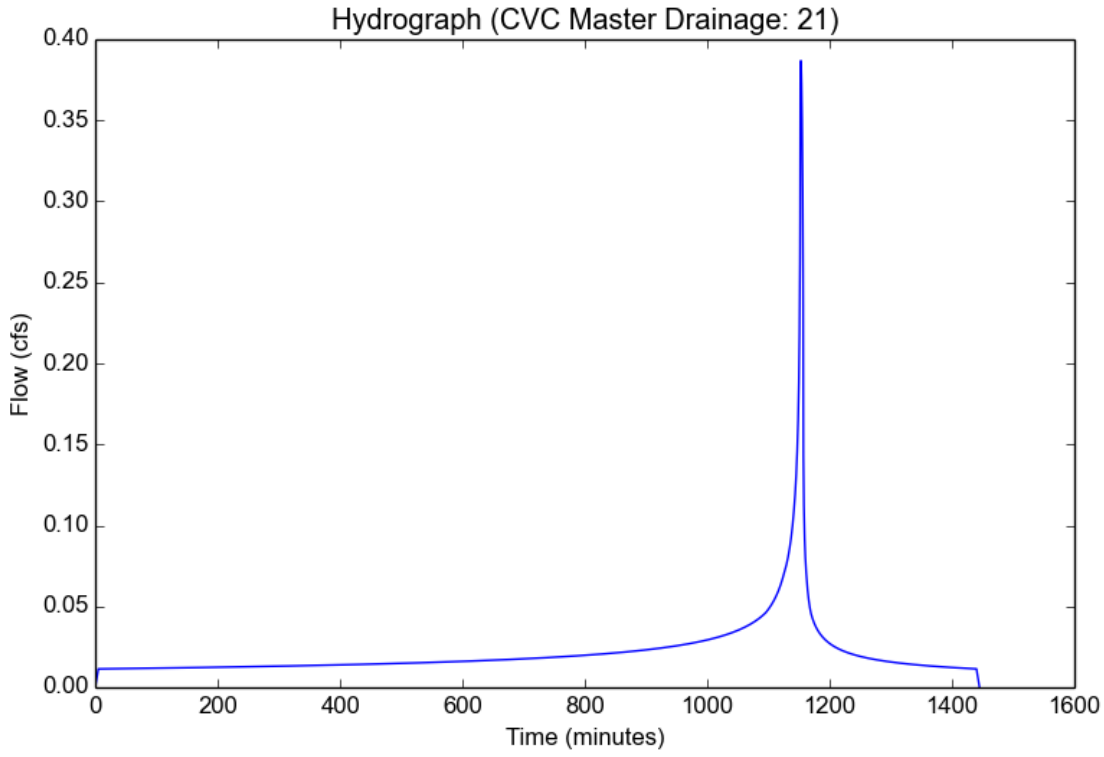
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	21
Area (ac)	0.18
Flow Path Length (ft)	55.0
Flow Path Slope (vft/hft)	0.0035
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.74
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.4708
Undeveloped Runoff Coefficient (Cu)	0.784
Developed Runoff Coefficient (Cd)	0.8698
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	0.3868
Burned Peak Flow Rate (cfs)	0.3868
24-Hr Clear Runoff Volume (ac-ft)	0.0438
24-Hr Clear Runoff Volume (cu-ft)	1909.8325



Peak Flow Hydrologic Analysis

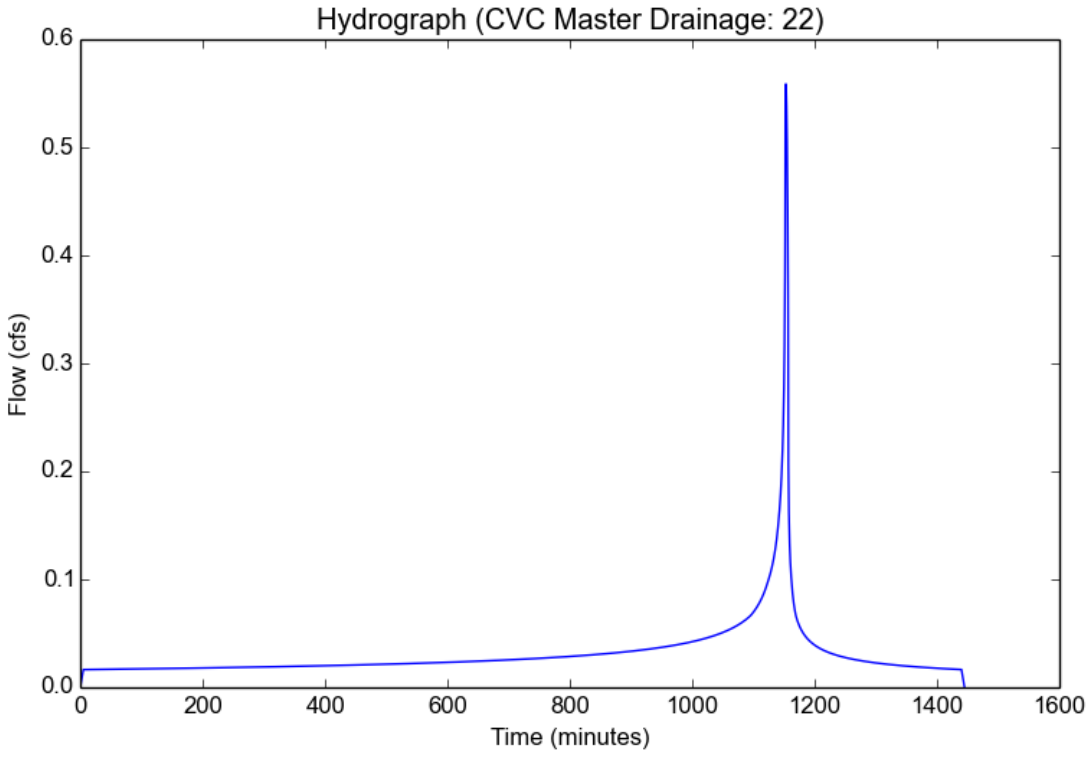
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	22
Area (ac)	0.26
Flow Path Length (ft)	95.0
Flow Path Slope (vft/hft)	0.0474
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.74
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.4708
Undeveloped Runoff Coefficient (Cu)	0.784
Developed Runoff Coefficient (Cd)	0.8698
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	0.5588
Burned Peak Flow Rate (cfs)	0.5588
24-Hr Clear Runoff Volume (ac-ft)	0.0633
24-Hr Clear Runoff Volume (cu-ft)	2758.647



Peak Flow Hydrologic Analysis

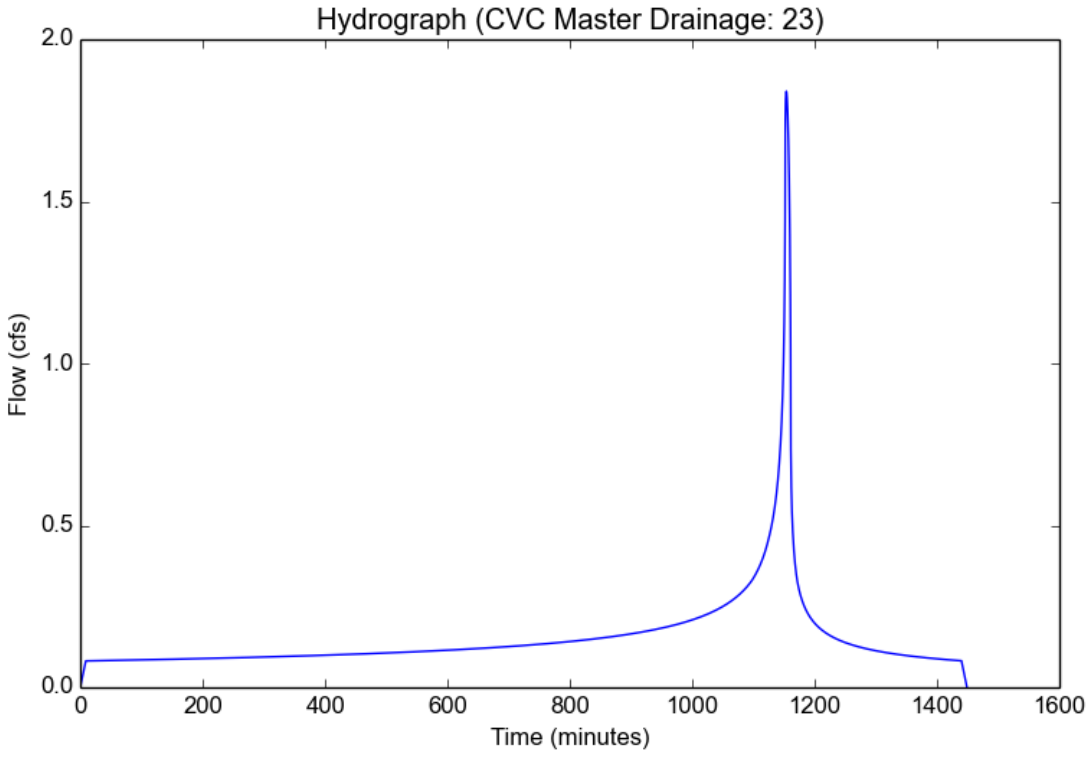
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	23
Area (ac)	1.12
Flow Path Length (ft)	290.0
Flow Path Slope (vft/hft)	0.0017
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.87
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	1.8744
Undeveloped Runoff Coefficient (Cu)	0.7185
Developed Runoff Coefficient (Cd)	0.8764
Time of Concentration (min)	9.0
Clear Peak Flow Rate (cfs)	1.8398
Burned Peak Flow Rate (cfs)	1.8398
24-Hr Clear Runoff Volume (ac-ft)	0.3088
24-Hr Clear Runoff Volume (cu-ft)	13453.2521



Peak Flow Hydrologic Analysis

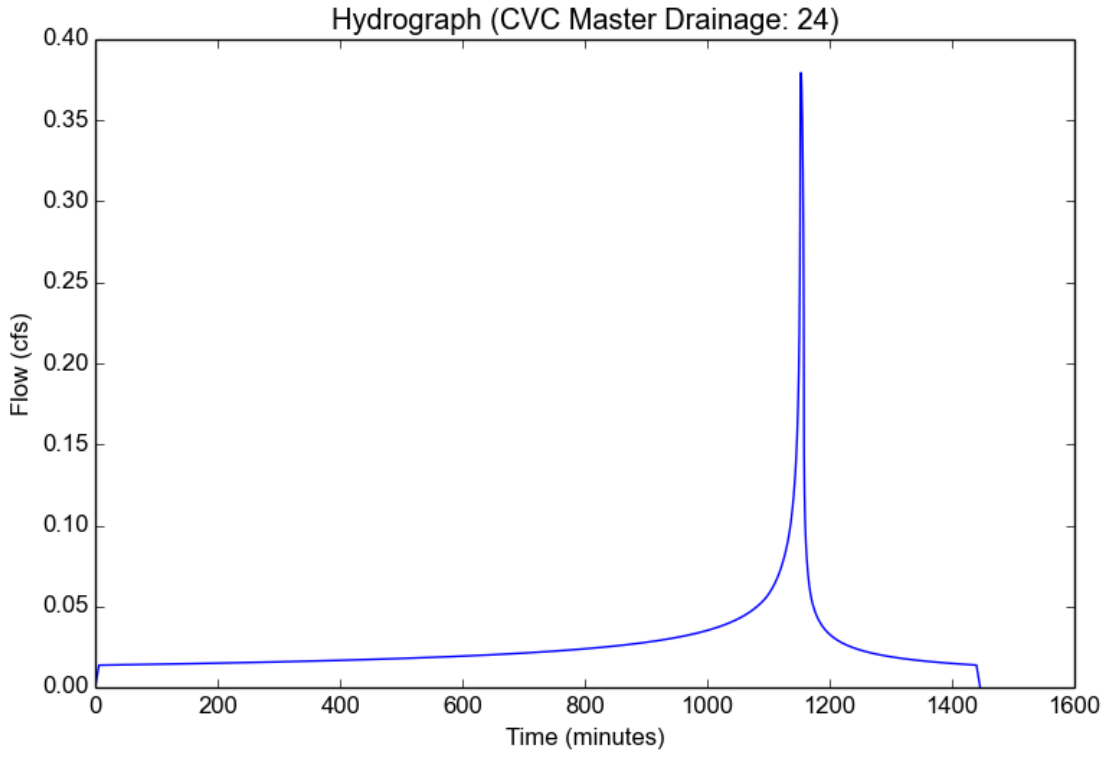
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	24
Area (ac)	0.19
Flow Path Length (ft)	180.0
Flow Path Slope (vft/hft)	0.0032
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.86
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.2678
Undeveloped Runoff Coefficient (Cu)	0.7617
Developed Runoff Coefficient (Cd)	0.8806
Time of Concentration (min)	6.0
Clear Peak Flow Rate (cfs)	0.3795
Burned Peak Flow Rate (cfs)	0.3795
24-Hr Clear Runoff Volume (ac-ft)	0.0519
24-Hr Clear Runoff Volume (cu-ft)	2261.9646



Peak Flow Hydrologic Analysis

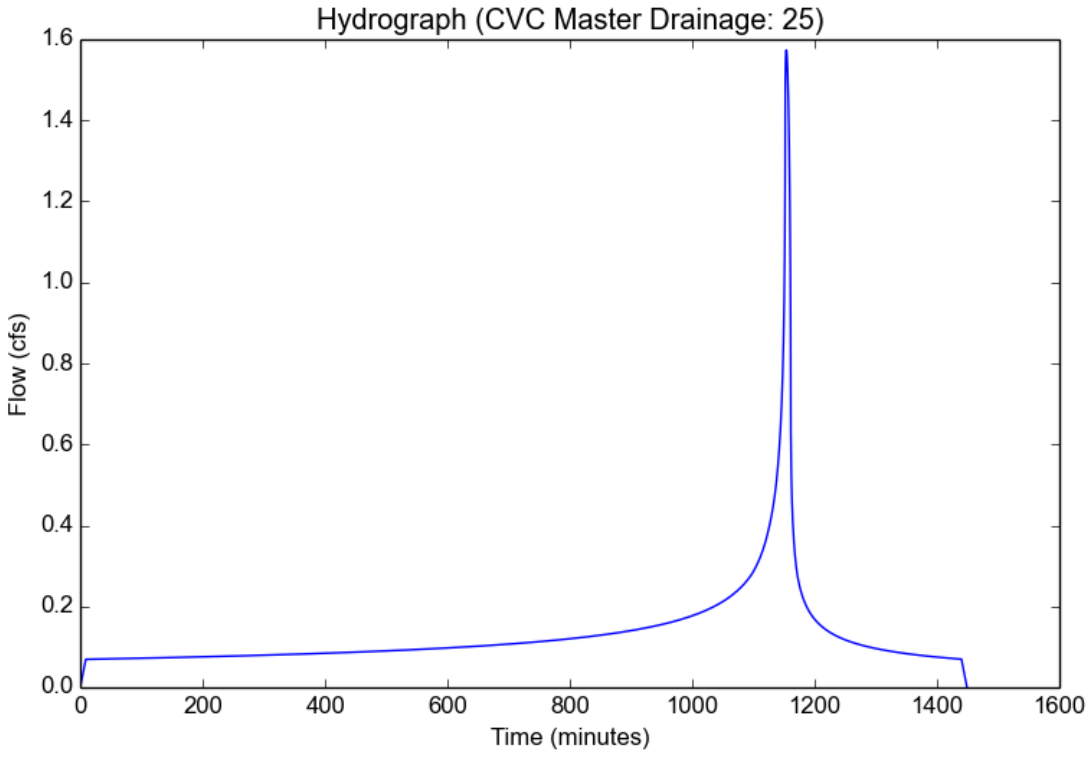
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	25
Area (ac)	0.96
Flow Path Length (ft)	445.0
Flow Path Slope (vft/hft)	0.0065
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.86
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	1.8744
Undeveloped Runoff Coefficient (Cu)	0.7185
Developed Runoff Coefficient (Cd)	0.8746
Time of Concentration (min)	9.0
Clear Peak Flow Rate (cfs)	1.5737
Burned Peak Flow Rate (cfs)	1.5737
24-Hr Clear Runoff Volume (ac-ft)	0.2623
24-Hr Clear Runoff Volume (cu-ft)	11427.5556



Peak Flow Hydrologic Analysis

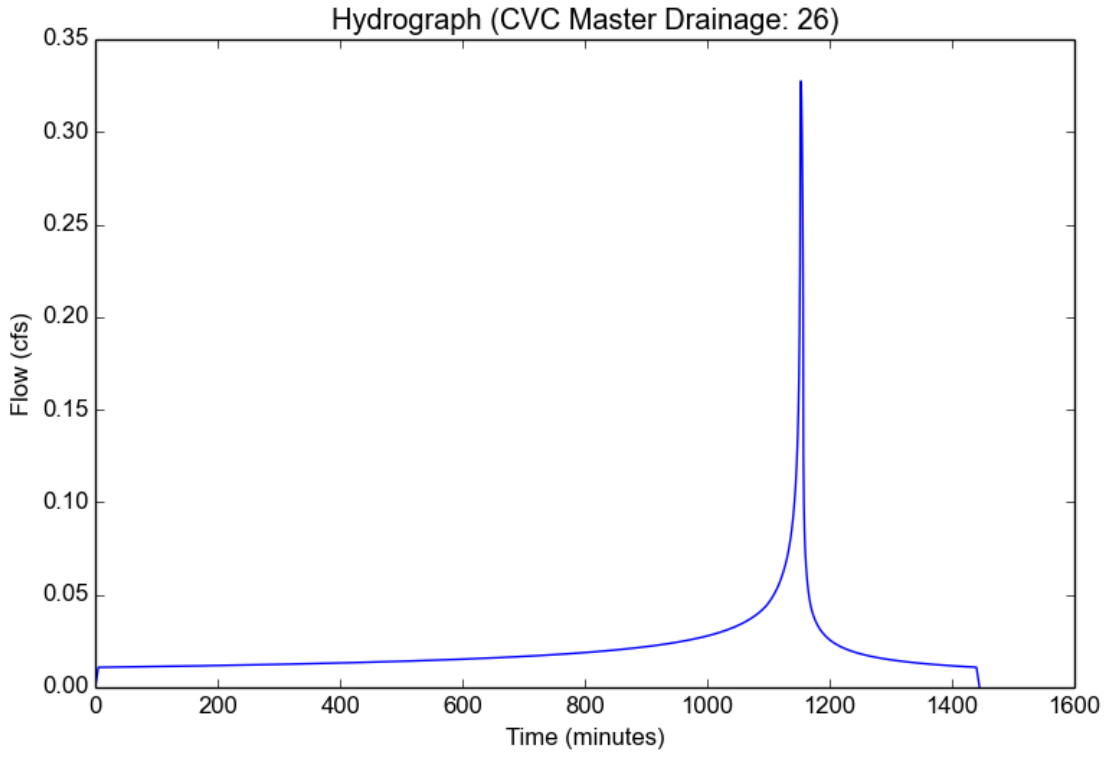
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	26
Area (ac)	0.15
Flow Path Length (ft)	100.0
Flow Path Slope (vft/hft)	0.0023
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.86
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.4708
Undeveloped Runoff Coefficient (Cu)	0.784
Developed Runoff Coefficient (Cd)	0.8838
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	0.3275
Burned Peak Flow Rate (cfs)	0.3275
24-Hr Clear Runoff Volume (ac-ft)	0.041
24-Hr Clear Runoff Volume (cu-ft)	1785.8794



Peak Flow Hydrologic Analysis

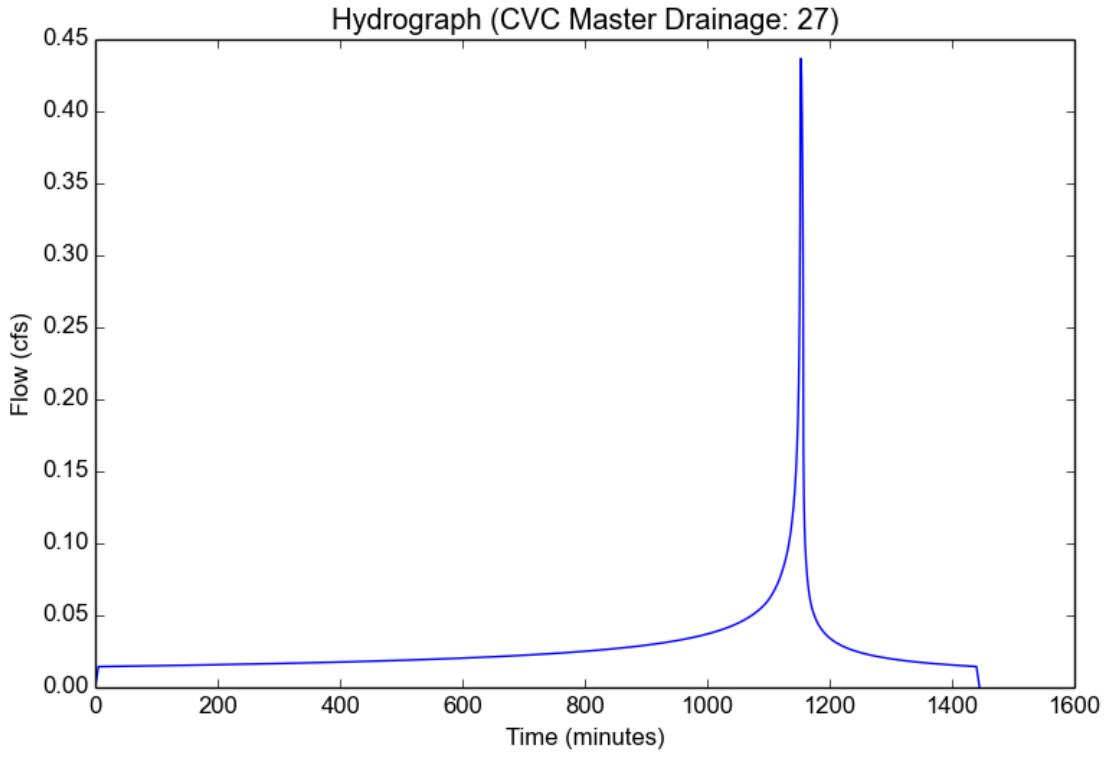
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	27
Area (ac)	0.2
Flow Path Length (ft)	130.0
Flow Path Slope (vft/hft)	0.0077
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.86
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.4708
Undeveloped Runoff Coefficient (Cu)	0.784
Developed Runoff Coefficient (Cd)	0.8838
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	0.4367
Burned Peak Flow Rate (cfs)	0.4367
24-Hr Clear Runoff Volume (ac-ft)	0.0547
24-Hr Clear Runoff Volume (cu-ft)	2381.1726



Peak Flow Hydrologic Analysis

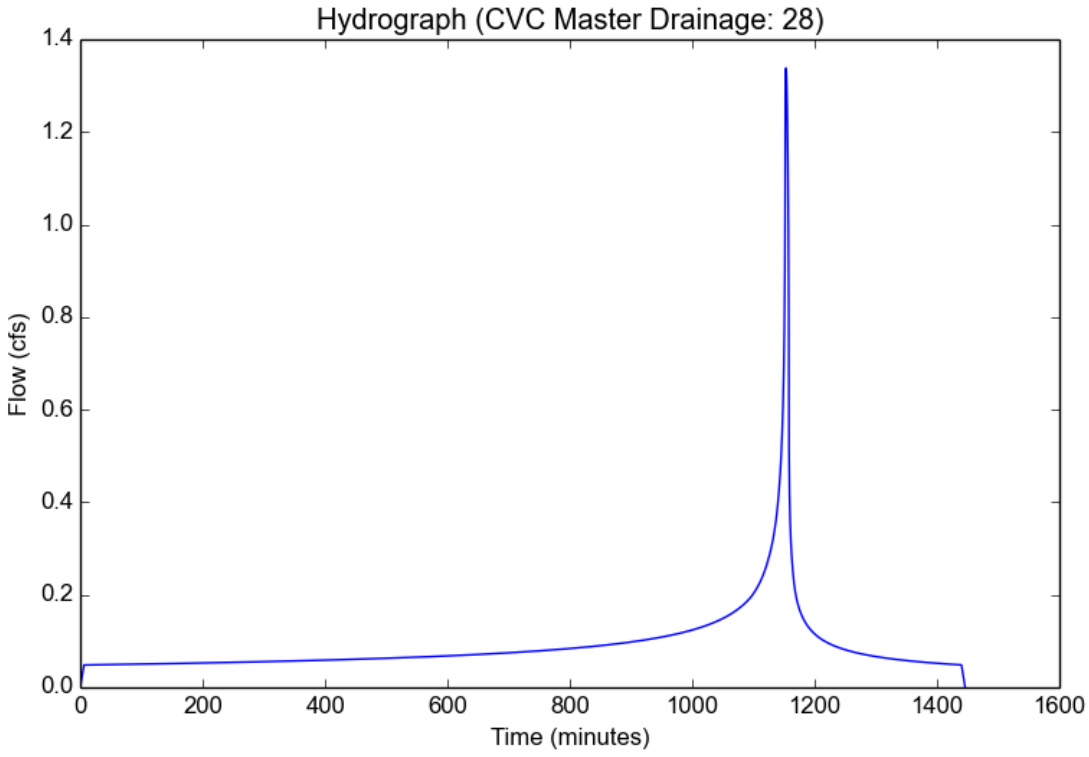
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	28
Area (ac)	0.67
Flow Path Length (ft)	240.0
Flow Path Slope (vft/hft)	0.0094
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.86
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.2678
Undeveloped Runoff Coefficient (Cu)	0.7617
Developed Runoff Coefficient (Cd)	0.8806
Time of Concentration (min)	6.0
Clear Peak Flow Rate (cfs)	1.3381
Burned Peak Flow Rate (cfs)	1.3381
24-Hr Clear Runoff Volume (ac-ft)	0.1831
24-Hr Clear Runoff Volume (cu-ft)	7976.4014



Peak Flow Hydrologic Analysis

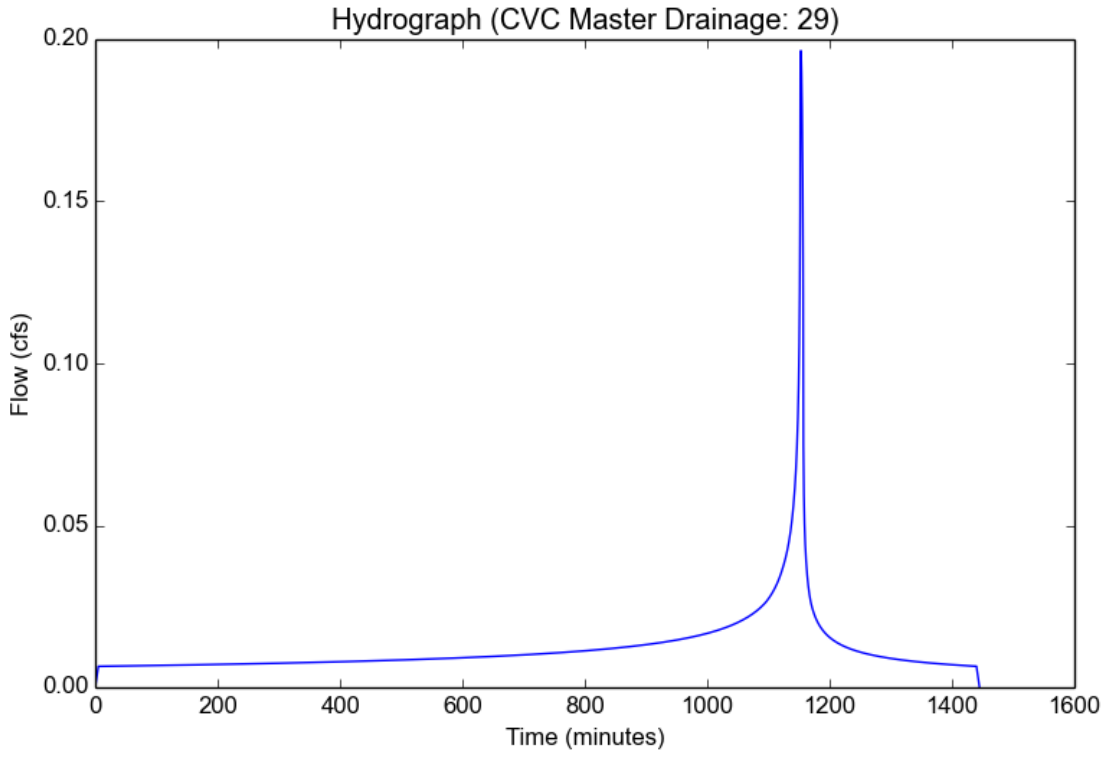
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	29
Area (ac)	0.09
Flow Path Length (ft)	140.0
Flow Path Slope (vft/hft)	0.0061
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.86
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.4708
Undeveloped Runoff Coefficient (Cu)	0.784
Developed Runoff Coefficient (Cd)	0.8838
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	0.1965
Burned Peak Flow Rate (cfs)	0.1965
24-Hr Clear Runoff Volume (ac-ft)	0.0246
24-Hr Clear Runoff Volume (cu-ft)	1071.5277



Peak Flow Hydrologic Analysis

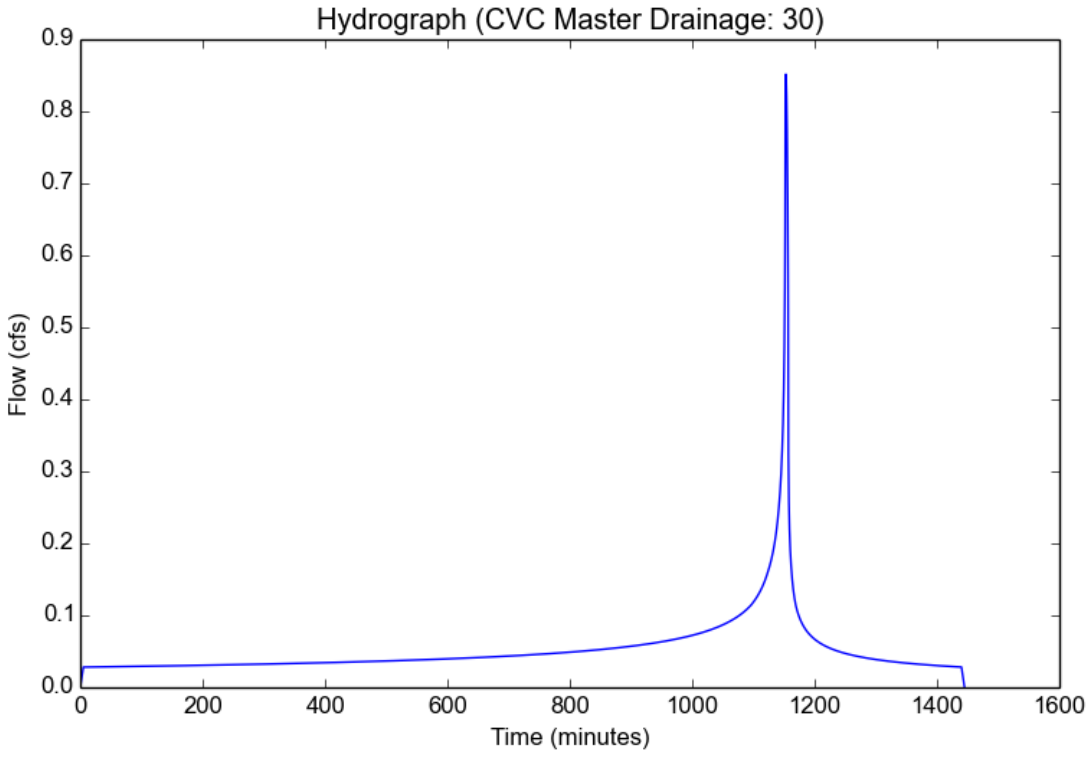
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	30
Area (ac)	0.39
Flow Path Length (ft)	210.0
Flow Path Slope (vft/hft)	0.0071
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.86
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.4708
Undeveloped Runoff Coefficient (Cu)	0.784
Developed Runoff Coefficient (Cd)	0.8838
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	0.8516
Burned Peak Flow Rate (cfs)	0.8516
24-Hr Clear Runoff Volume (ac-ft)	0.1066
24-Hr Clear Runoff Volume (cu-ft)	4643.2866



Peak Flow Hydrologic Analysis

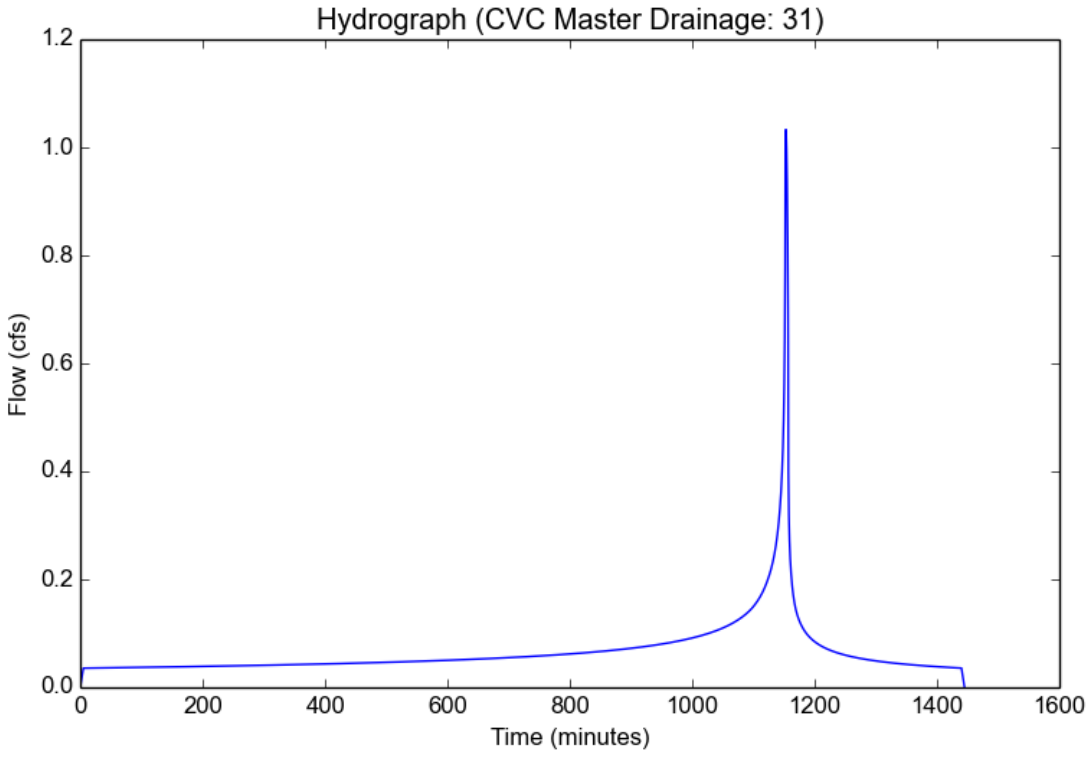
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	31
Area (ac)	0.47
Flow Path Length (ft)	260.0
Flow Path Slope (vft/hft)	0.0173
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.91
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.4708
Undeveloped Runoff Coefficient (Cu)	0.784
Developed Runoff Coefficient (Cd)	0.8896
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	1.033
Burned Peak Flow Rate (cfs)	1.033
24-Hr Clear Runoff Volume (ac-ft)	0.1343
24-Hr Clear Runoff Volume (cu-ft)	5849.4934



Peak Flow Hydrologic Analysis

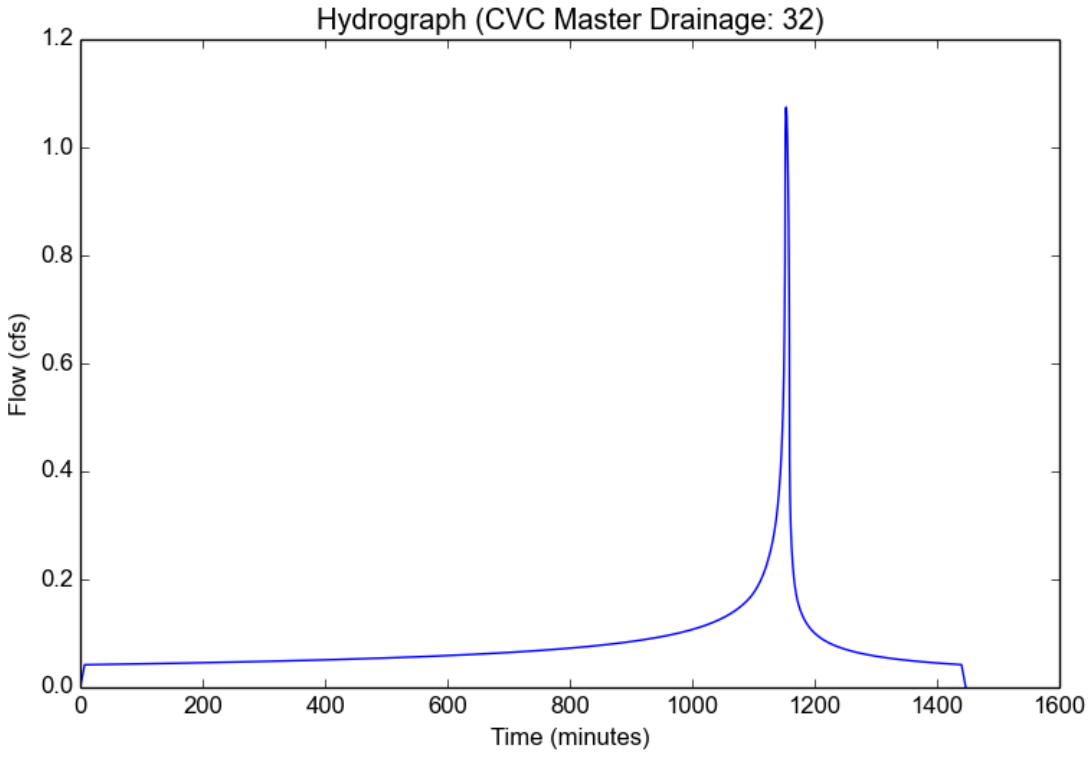
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	32
Area (ac)	0.58
Flow Path Length (ft)	285.0
Flow Path Slope (vft/hft)	0.0078
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.86
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.1094
Undeveloped Runoff Coefficient (Cu)	0.7443
Developed Runoff Coefficient (Cd)	0.8782
Time of Concentration (min)	7.0
Clear Peak Flow Rate (cfs)	1.0744
Burned Peak Flow Rate (cfs)	1.0744
24-Hr Clear Runoff Volume (ac-ft)	0.1585
24-Hr Clear Runoff Volume (cu-ft)	6904.6044



Peak Flow Hydrologic Analysis

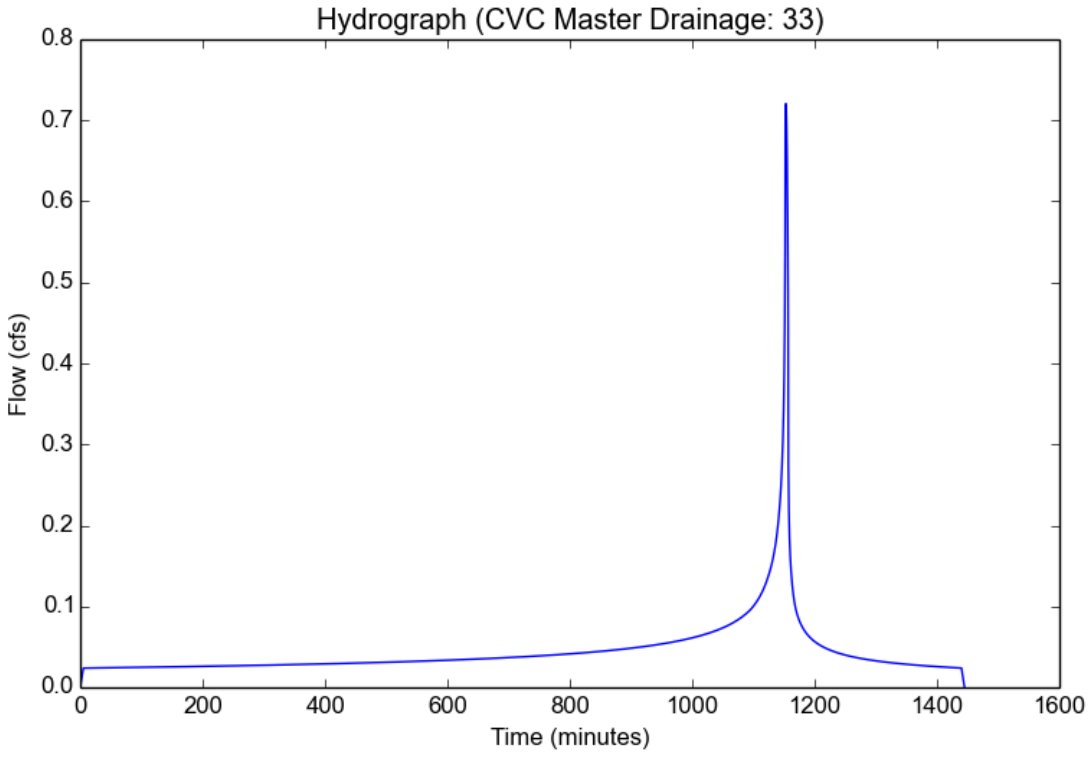
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	33
Area (ac)	0.33
Flow Path Length (ft)	170.0
Flow Path Slope (vft/hft)	0.0042
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.86
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.4708
Undeveloped Runoff Coefficient (Cu)	0.784
Developed Runoff Coefficient (Cd)	0.8838
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	0.7206
Burned Peak Flow Rate (cfs)	0.7206
24-Hr Clear Runoff Volume (ac-ft)	0.0902
24-Hr Clear Runoff Volume (cu-ft)	3928.9348



Peak Flow Hydrologic Analysis

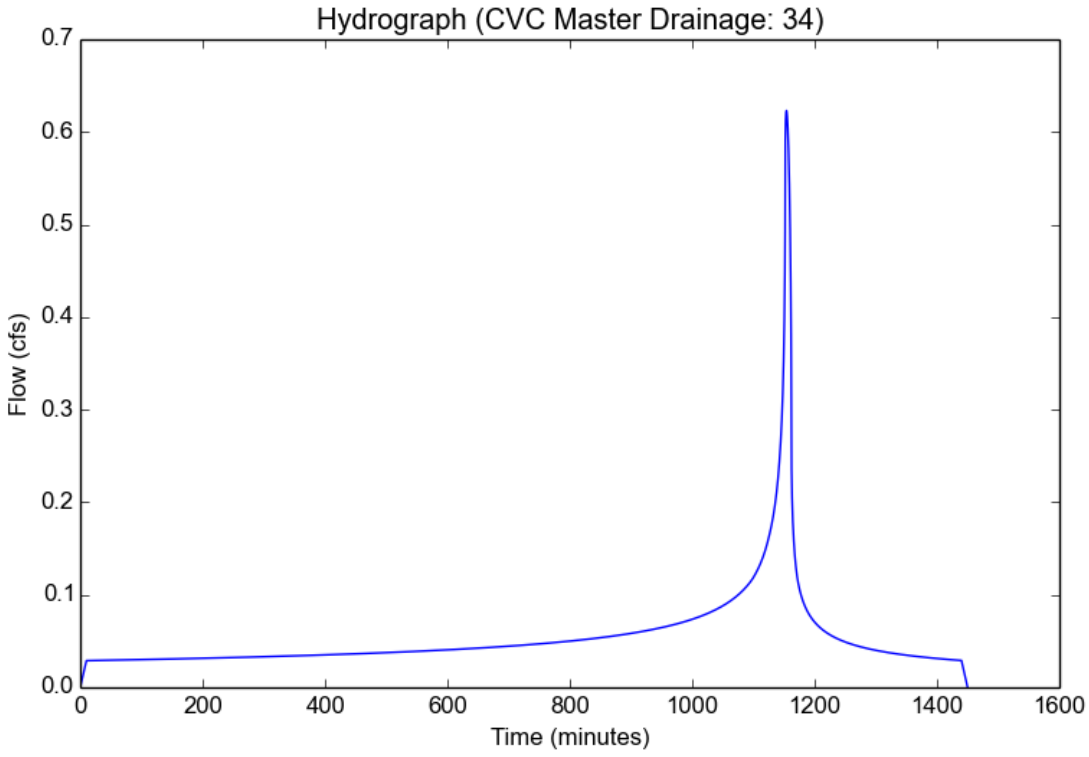
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	34
Area (ac)	0.4
Flow Path Length (ft)	440.0
Flow Path Slope (vft/hft)	0.0033
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.86
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	1.7838
Undeveloped Runoff Coefficient (Cu)	0.7086
Developed Runoff Coefficient (Cd)	0.8732
Time of Concentration (min)	10.0
Clear Peak Flow Rate (cfs)	0.623
Burned Peak Flow Rate (cfs)	0.623
24-Hr Clear Runoff Volume (ac-ft)	0.1093
24-Hr Clear Runoff Volume (cu-ft)	4761.3801



Peak Flow Hydrologic Analysis

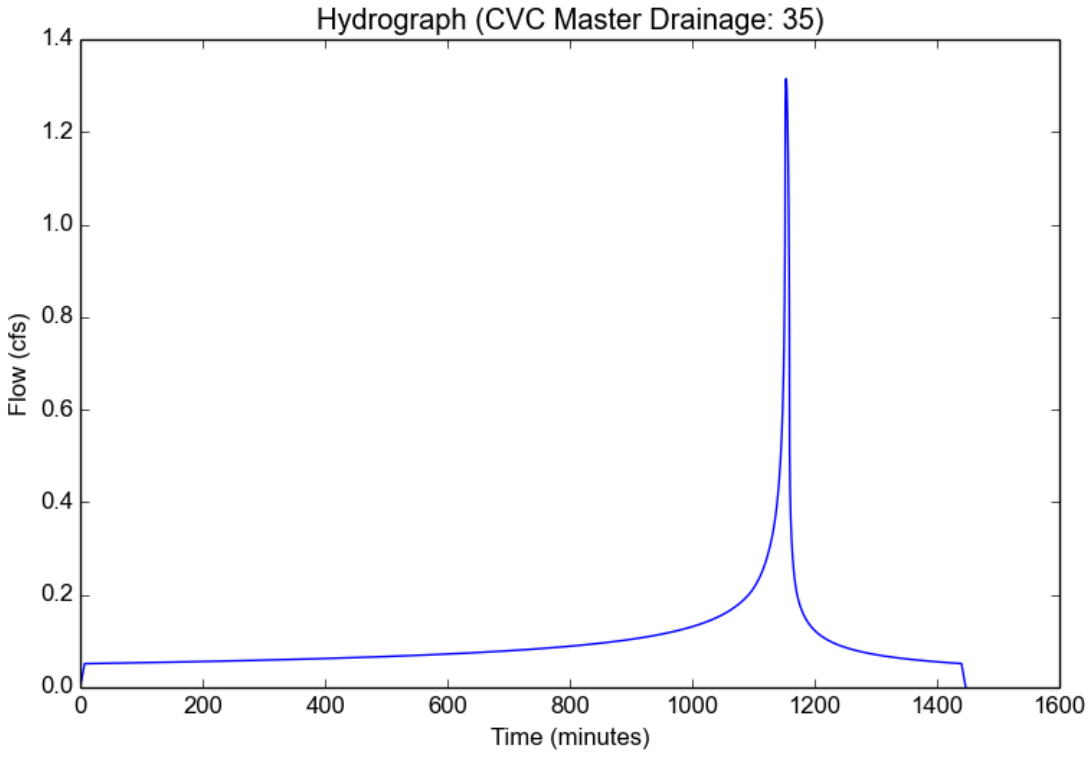
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	35
Area (ac)	0.71
Flow Path Length (ft)	275.0
Flow Path Slope (vft/hft)	0.0057
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.86
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.1094
Undeveloped Runoff Coefficient (Cu)	0.7443
Developed Runoff Coefficient (Cd)	0.8782
Time of Concentration (min)	7.0
Clear Peak Flow Rate (cfs)	1.3152
Burned Peak Flow Rate (cfs)	1.3152
24-Hr Clear Runoff Volume (ac-ft)	0.194
24-Hr Clear Runoff Volume (cu-ft)	8452.1882



Peak Flow Hydrologic Analysis

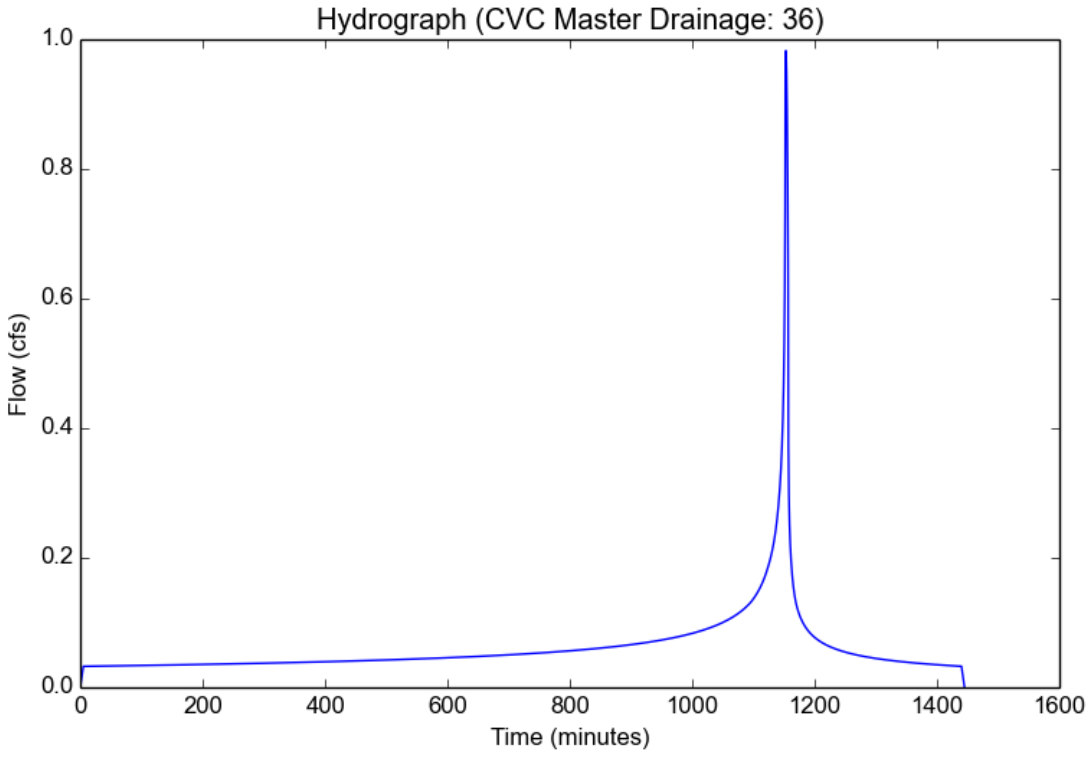
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	36
Area (ac)	0.45
Flow Path Length (ft)	125.0
Flow Path Slope (vft/hft)	0.0042
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.86
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.4708
Undeveloped Runoff Coefficient (Cu)	0.784
Developed Runoff Coefficient (Cd)	0.8838
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	0.9826
Burned Peak Flow Rate (cfs)	0.9826
24-Hr Clear Runoff Volume (ac-ft)	0.123
24-Hr Clear Runoff Volume (cu-ft)	5357.6383



Peak Flow Hydrologic Analysis

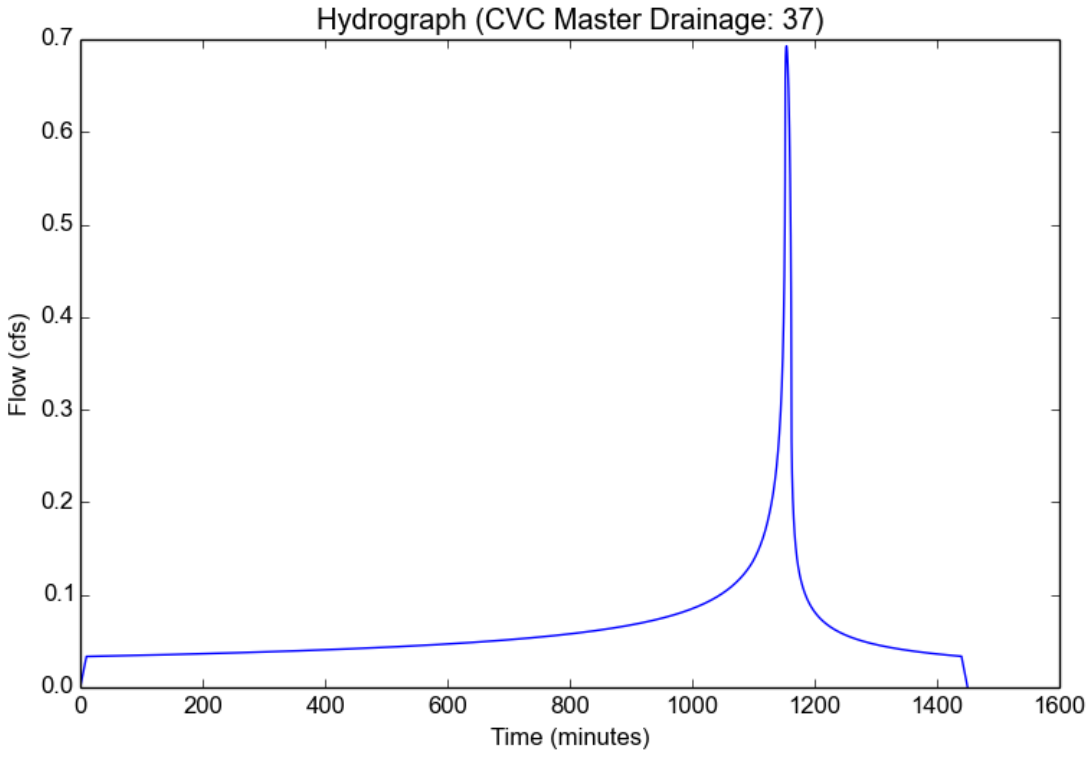
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	37
Area (ac)	0.44
Flow Path Length (ft)	460.0
Flow Path Slope (vft/hft)	0.0032
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.91
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	1.7838
Undeveloped Runoff Coefficient (Cu)	0.7086
Developed Runoff Coefficient (Cd)	0.8828
Time of Concentration (min)	10.0
Clear Peak Flow Rate (cfs)	0.6929
Burned Peak Flow Rate (cfs)	0.6929
24-Hr Clear Runoff Volume (ac-ft)	0.1257
24-Hr Clear Runoff Volume (cu-ft)	5475.441



Peak Flow Hydrologic Analysis

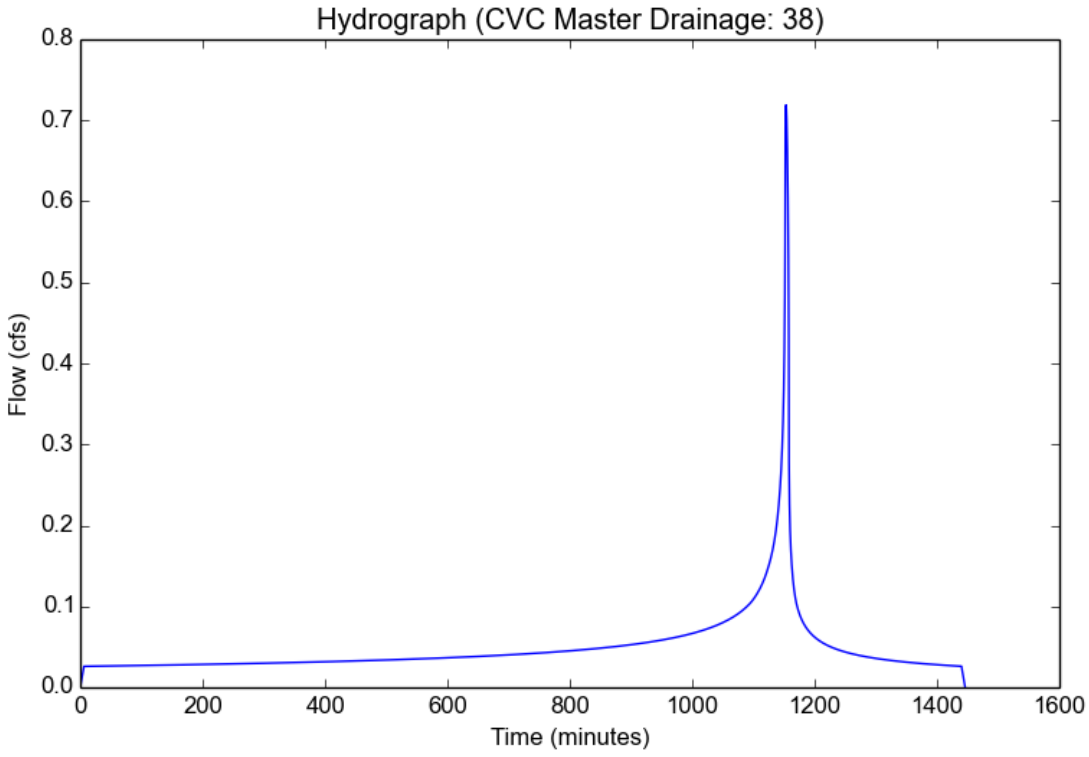
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	38
Area (ac)	0.36
Flow Path Length (ft)	220.0
Flow Path Slope (vft/hft)	0.0042
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.86
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.2678
Undeveloped Runoff Coefficient (Cu)	0.7617
Developed Runoff Coefficient (Cd)	0.8806
Time of Concentration (min)	6.0
Clear Peak Flow Rate (cfs)	0.719
Burned Peak Flow Rate (cfs)	0.719
24-Hr Clear Runoff Volume (ac-ft)	0.0984
24-Hr Clear Runoff Volume (cu-ft)	4285.8276



Peak Flow Hydrologic Analysis

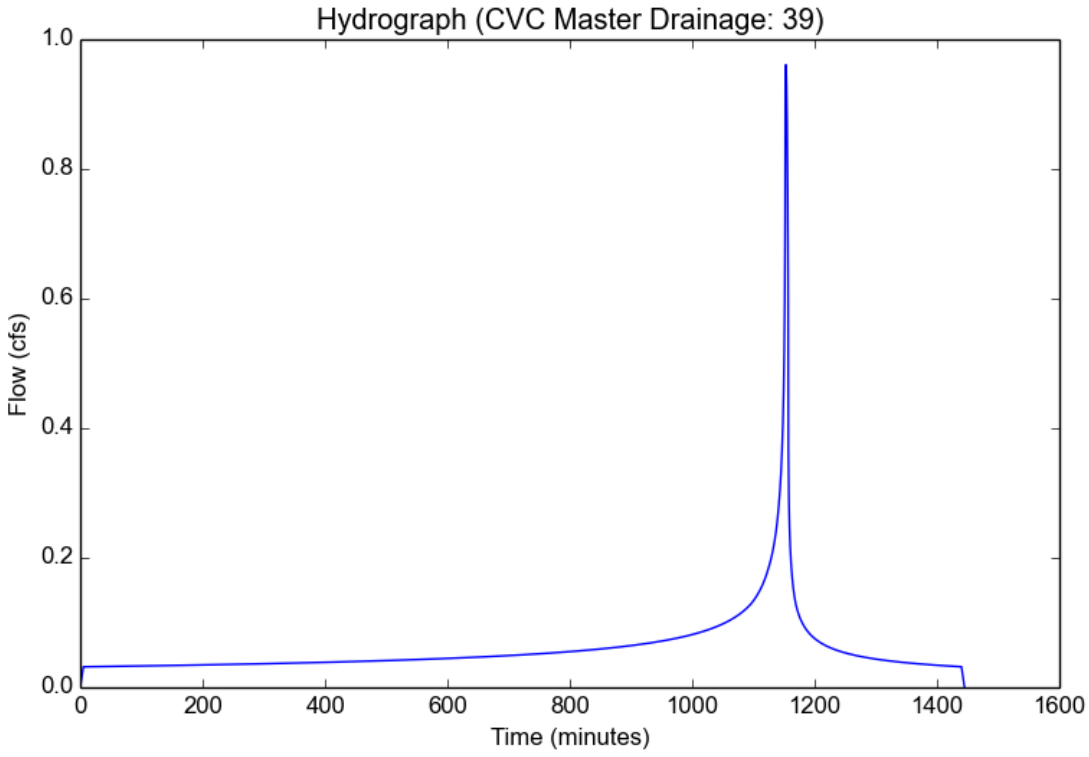
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	39
Area (ac)	0.44
Flow Path Length (ft)	230.0
Flow Path Slope (vft/hft)	0.0143
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.86
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.4708
Undeveloped Runoff Coefficient (Cu)	0.784
Developed Runoff Coefficient (Cd)	0.8838
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	0.9608
Burned Peak Flow Rate (cfs)	0.9608
24-Hr Clear Runoff Volume (ac-ft)	0.1203
24-Hr Clear Runoff Volume (cu-ft)	5238.5797



Peak Flow Hydrologic Analysis

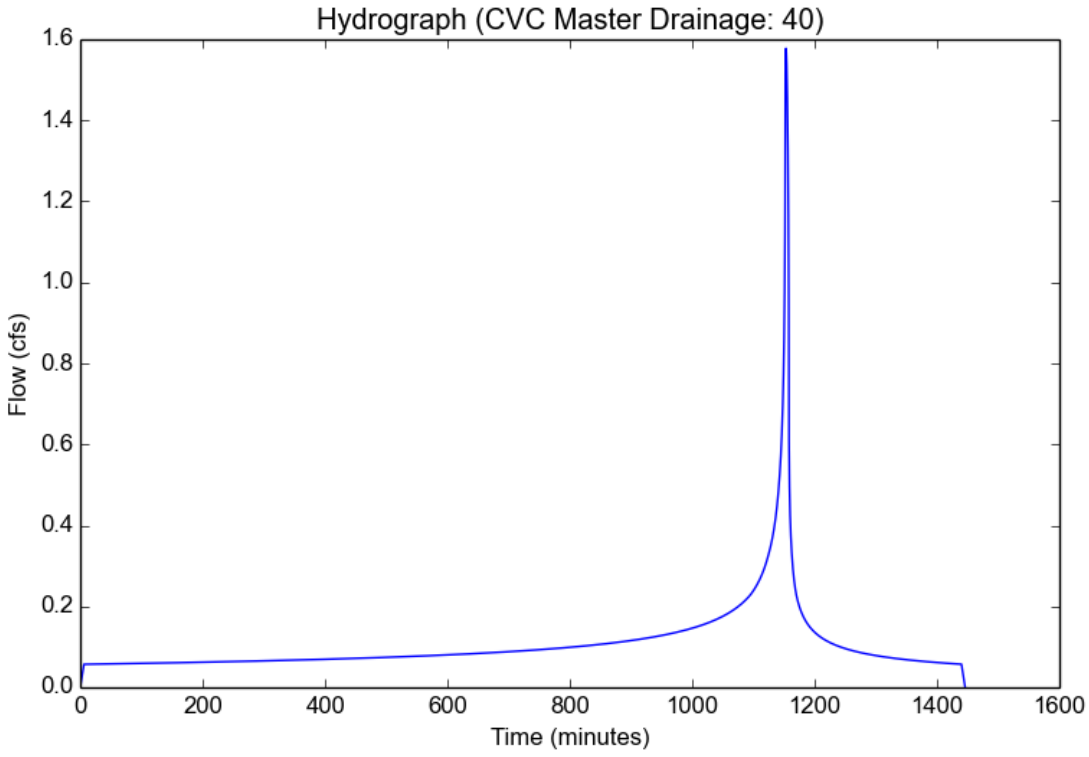
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	40
Area (ac)	0.79
Flow Path Length (ft)	270.0
Flow Path Slope (vft/hft)	0.0137
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.86
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.2678
Undeveloped Runoff Coefficient (Cu)	0.7617
Developed Runoff Coefficient (Cd)	0.8806
Time of Concentration (min)	6.0
Clear Peak Flow Rate (cfs)	1.5777
Burned Peak Flow Rate (cfs)	1.5777
24-Hr Clear Runoff Volume (ac-ft)	0.2159
24-Hr Clear Runoff Volume (cu-ft)	9405.0106



Peak Flow Hydrologic Analysis

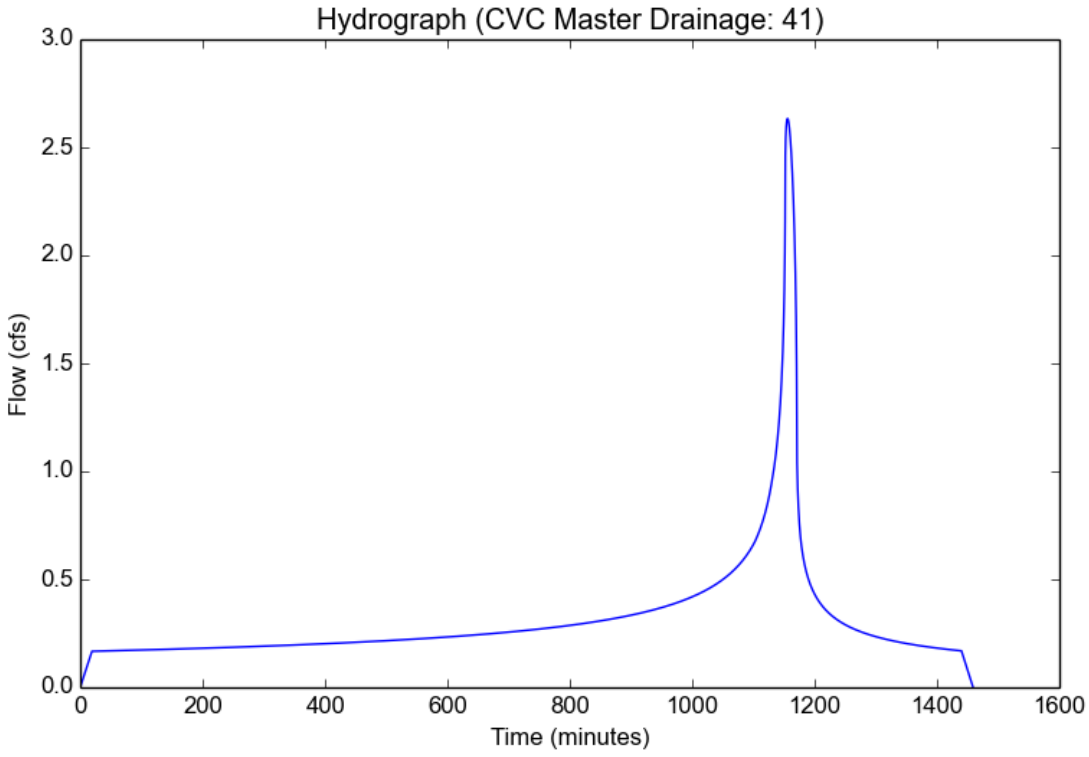
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	41
Area (ac)	2.31
Flow Path Length (ft)	1260.0
Flow Path Slope (vft/hft)	0.0049
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.86
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	1.3193
Undeveloped Runoff Coefficient (Cu)	0.6441
Developed Runoff Coefficient (Cd)	0.8642
Time of Concentration (min)	19.0
Clear Peak Flow Rate (cfs)	2.6336
Burned Peak Flow Rate (cfs)	2.6336
24-Hr Clear Runoff Volume (ac-ft)	0.6311
24-Hr Clear Runoff Volume (cu-ft)	27492.3085



Peak Flow Hydrologic Analysis

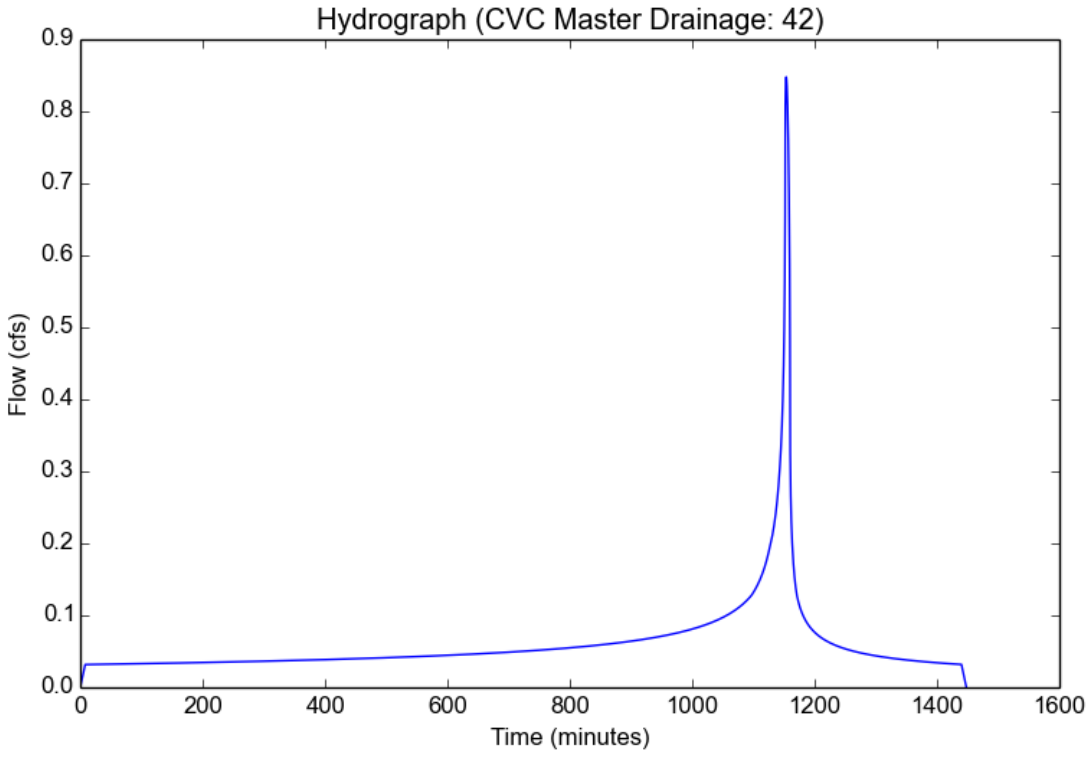
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	42
Area (ac)	0.5
Flow Path Length (ft)	390.0
Flow Path Slope (vft/hft)	0.0083
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.74
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	1.981
Undeveloped Runoff Coefficient (Cu)	0.7302
Developed Runoff Coefficient (Cd)	0.8559
Time of Concentration (min)	8.0
Clear Peak Flow Rate (cfs)	0.8477
Burned Peak Flow Rate (cfs)	0.8477
24-Hr Clear Runoff Volume (ac-ft)	0.1217
24-Hr Clear Runoff Volume (cu-ft)	5303.3957



Peak Flow Hydrologic Analysis

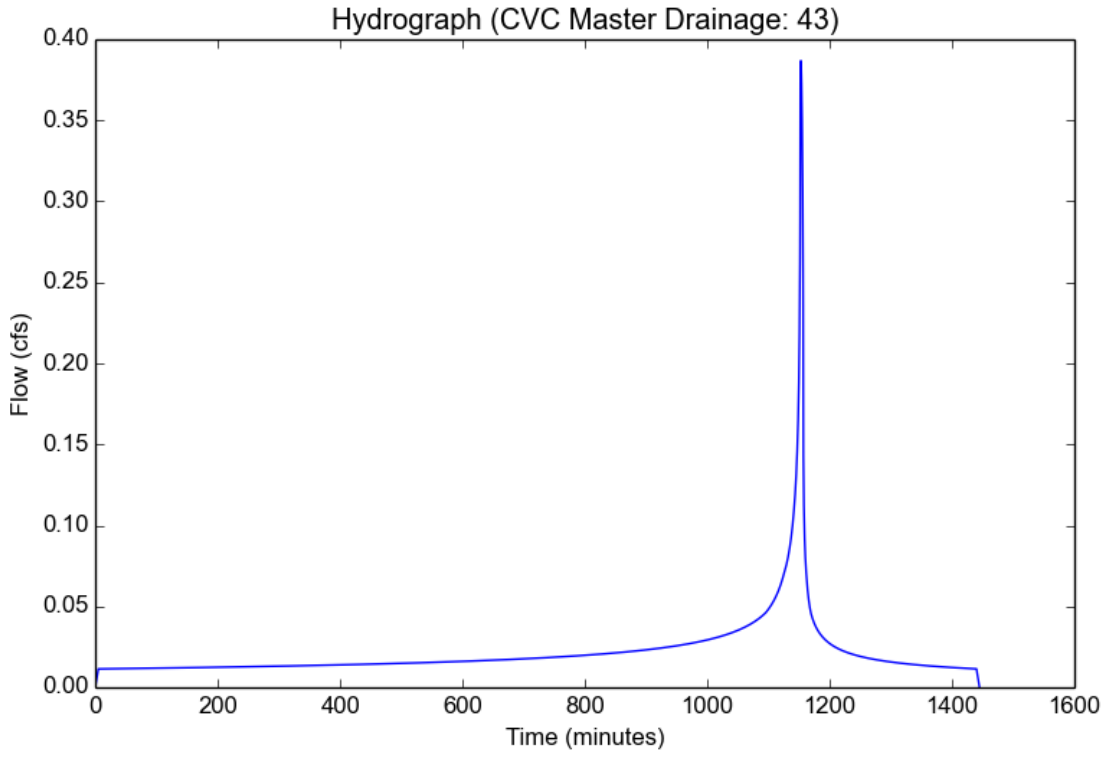
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	43
Area (ac)	0.18
Flow Path Length (ft)	160.0
Flow Path Slope (vft/hft)	0.005
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.74
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.4708
Undeveloped Runoff Coefficient (Cu)	0.784
Developed Runoff Coefficient (Cd)	0.8698
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	0.3868
Burned Peak Flow Rate (cfs)	0.3868
24-Hr Clear Runoff Volume (ac-ft)	0.0438
24-Hr Clear Runoff Volume (cu-ft)	1909.8325



Peak Flow Hydrologic Analysis

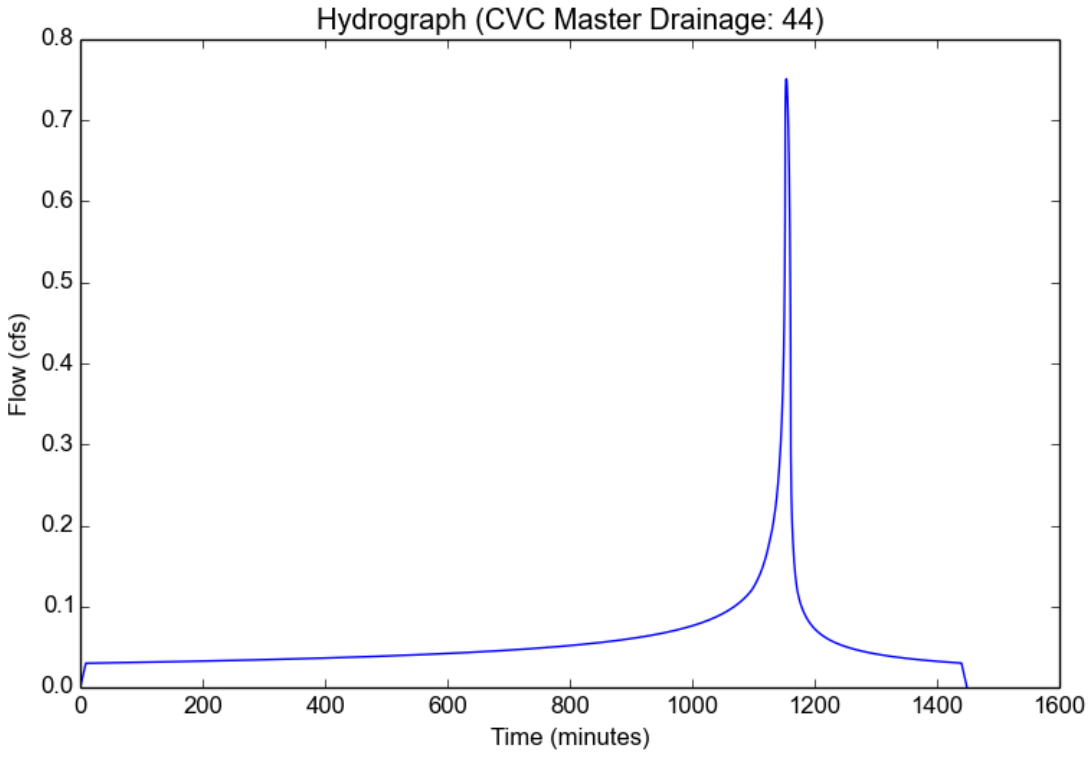
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	44
Area (ac)	0.47
Flow Path Length (ft)	430.0
Flow Path Slope (vft/hft)	0.0053
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.74
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	1.8744
Undeveloped Runoff Coefficient (Cu)	0.7185
Developed Runoff Coefficient (Cd)	0.8528
Time of Concentration (min)	9.0
Clear Peak Flow Rate (cfs)	0.7513
Burned Peak Flow Rate (cfs)	0.7513
24-Hr Clear Runoff Volume (ac-ft)	0.1144
24-Hr Clear Runoff Volume (cu-ft)	4984.8965



Peak Flow Hydrologic Analysis

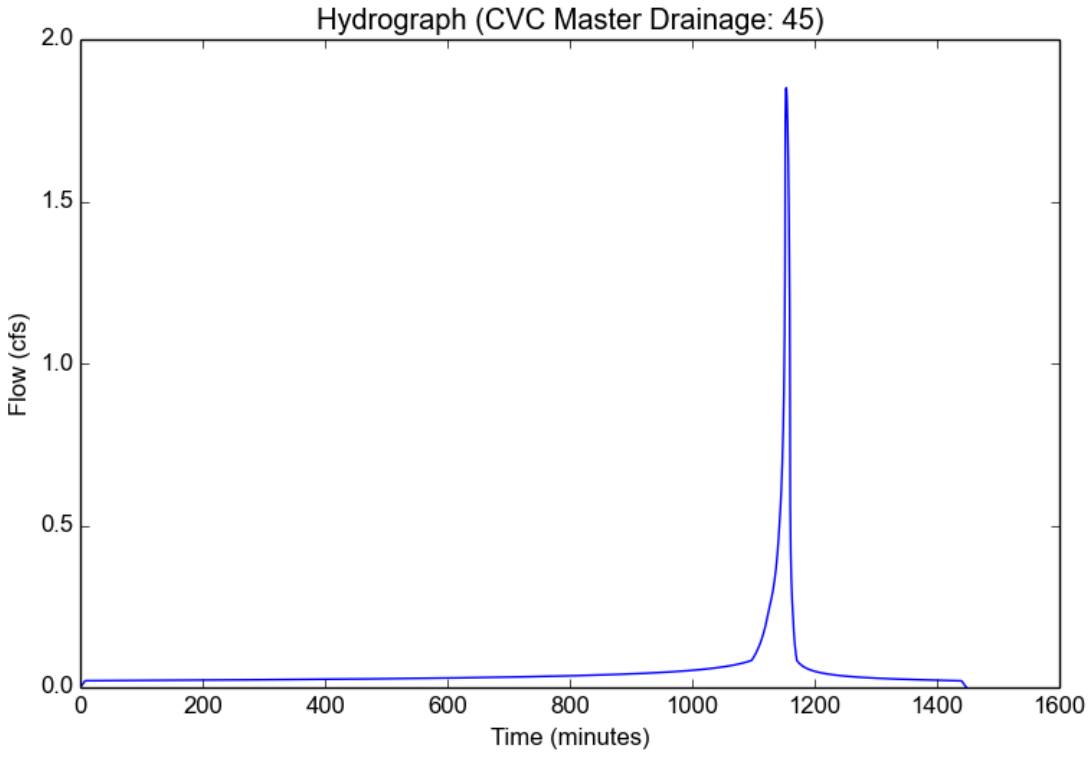
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	45
Area (ac)	1.25
Flow Path Length (ft)	360.0
Flow Path Slope (vft/hft)	0.0083
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.1
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	1.981
Undeveloped Runoff Coefficient (Cu)	0.7302
Developed Runoff Coefficient (Cd)	0.7472
Time of Concentration (min)	8.0
Clear Peak Flow Rate (cfs)	1.8503
Burned Peak Flow Rate (cfs)	1.8503
24-Hr Clear Runoff Volume (ac-ft)	0.1058
24-Hr Clear Runoff Volume (cu-ft)	4610.1585



Peak Flow Hydrologic Analysis

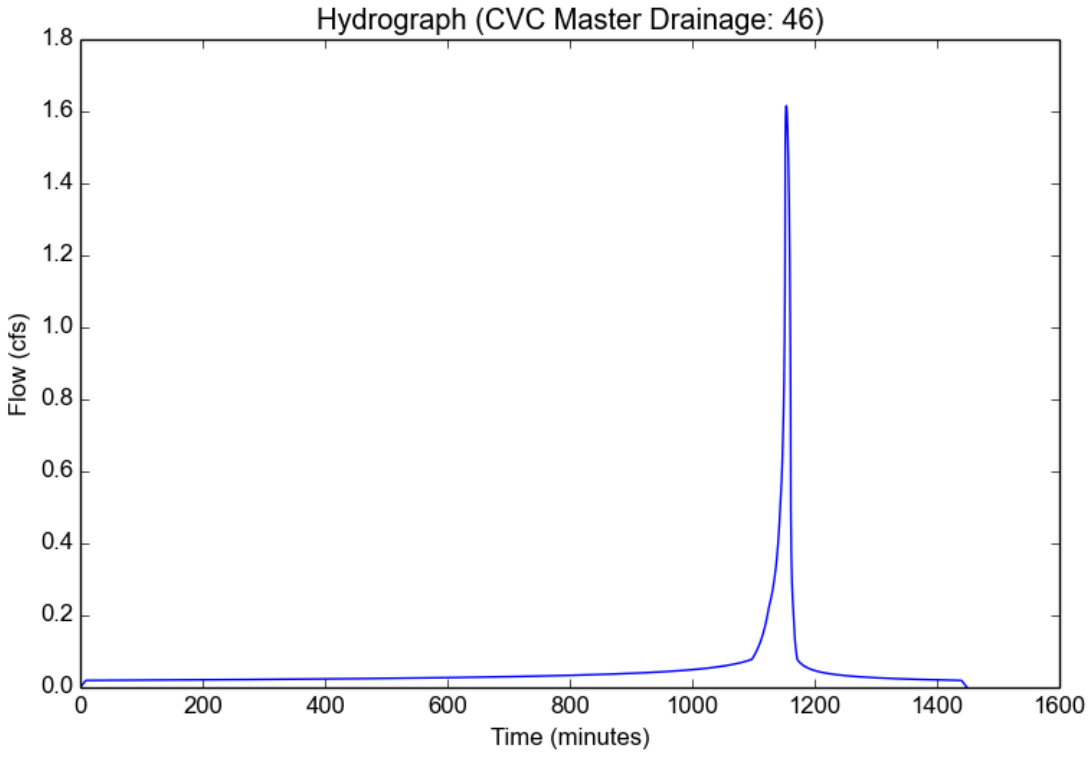
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	46
Area (ac)	1.17
Flow Path Length (ft)	385.0
Flow Path Slope (vft/hft)	0.0078
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.1
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	1.8744
Undeveloped Runoff Coefficient (Cu)	0.7185
Developed Runoff Coefficient (Cd)	0.7367
Time of Concentration (min)	9.0
Clear Peak Flow Rate (cfs)	1.6155
Burned Peak Flow Rate (cfs)	1.6155
24-Hr Clear Runoff Volume (ac-ft)	0.099
24-Hr Clear Runoff Volume (cu-ft)	4312.5543



Peak Flow Hydrologic Analysis

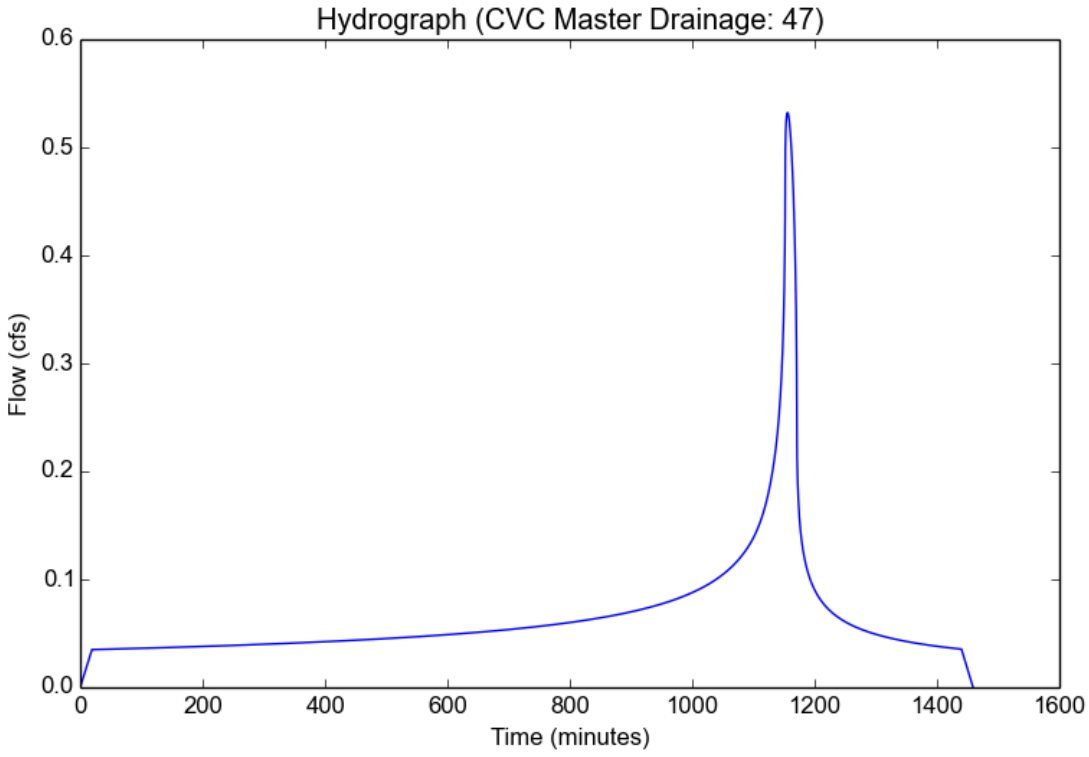
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	47
Area (ac)	0.46
Flow Path Length (ft)	850.0
Flow Path Slope (vft/hft)	0.0011
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.91
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	1.3193
Undeveloped Runoff Coefficient (Cu)	0.6441
Developed Runoff Coefficient (Cd)	0.877
Time of Concentration (min)	19.0
Clear Peak Flow Rate (cfs)	0.5322
Burned Peak Flow Rate (cfs)	0.5322
24-Hr Clear Runoff Volume (ac-ft)	0.1314
24-Hr Clear Runoff Volume (cu-ft)	5723.7352



Peak Flow Hydrologic Analysis

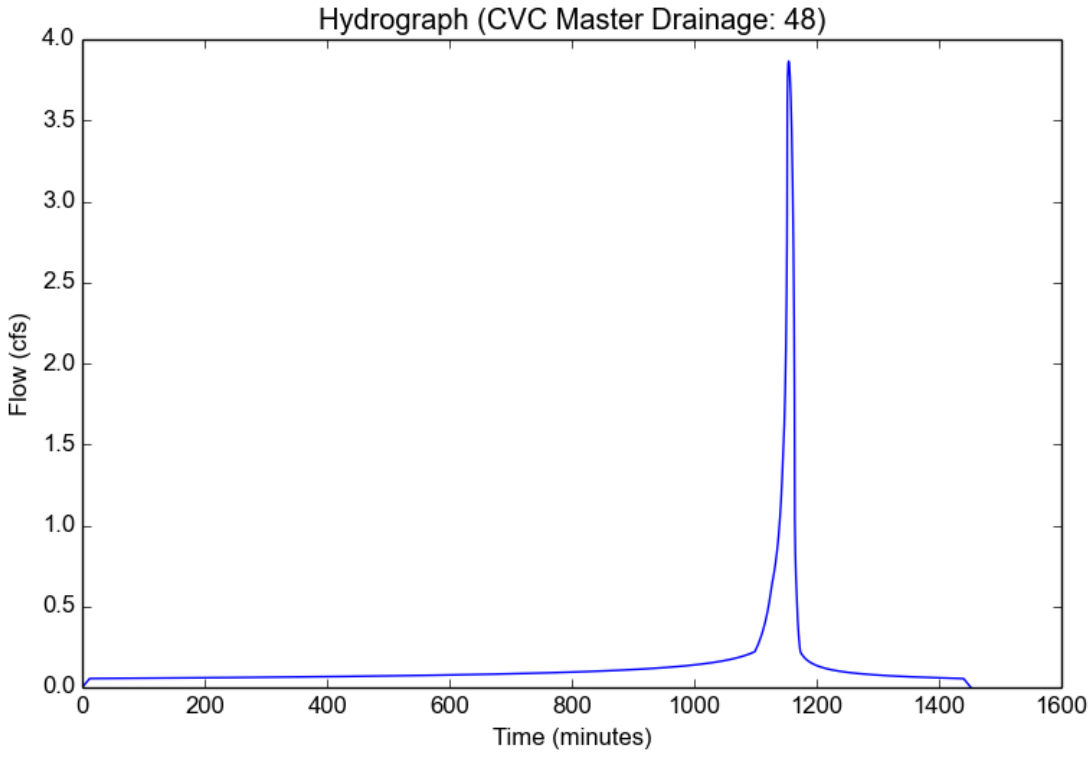
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	48
Area (ac)	3.31
Flow Path Length (ft)	510.0
Flow Path Slope (vft/hft)	0.0047
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.1
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	1.6373
Undeveloped Runoff Coefficient (Cu)	0.6925
Developed Runoff Coefficient (Cd)	0.7132
Time of Concentration (min)	12.0
Clear Peak Flow Rate (cfs)	3.8654
Burned Peak Flow Rate (cfs)	3.8654
24-Hr Clear Runoff Volume (ac-ft)	0.2798
24-Hr Clear Runoff Volume (cu-ft)	12187.4244



Peak Flow Hydrologic Analysis

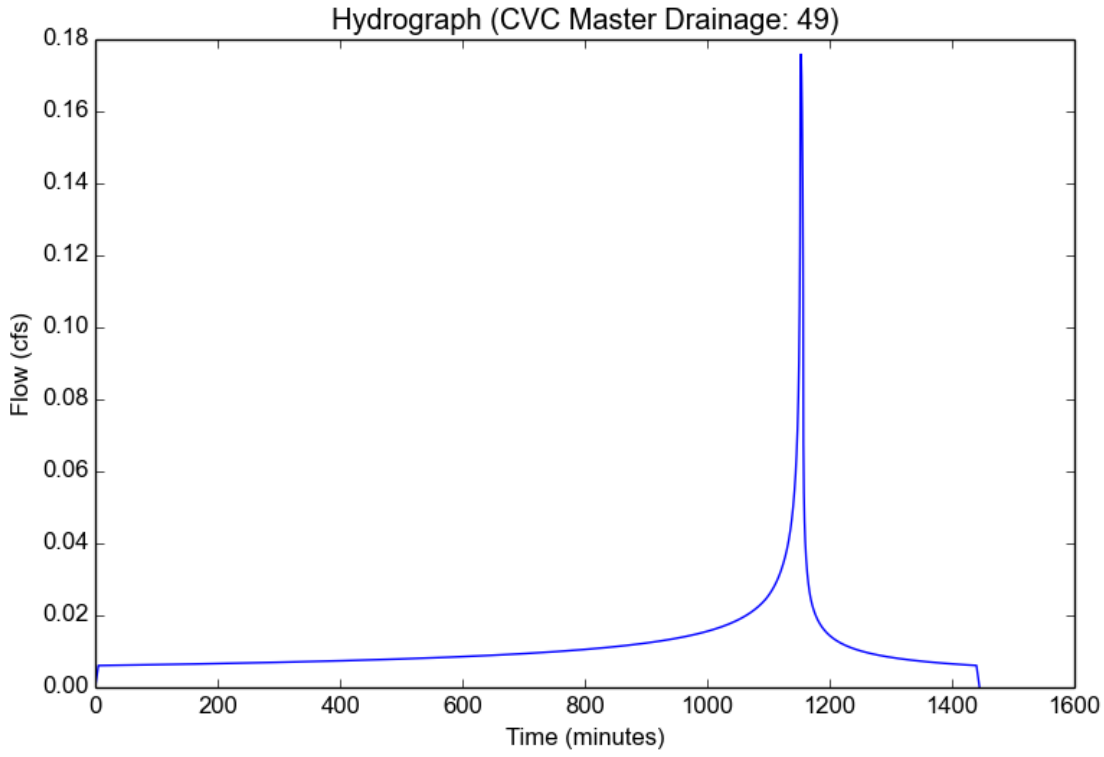
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	49
Area (ac)	0.08
Flow Path Length (ft)	140.0
Flow Path Slope (vft/hft)	0.0072
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.91
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.4708
Undeveloped Runoff Coefficient (Cu)	0.784
Developed Runoff Coefficient (Cd)	0.8896
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	0.1758
Burned Peak Flow Rate (cfs)	0.1758
24-Hr Clear Runoff Volume (ac-ft)	0.0229
24-Hr Clear Runoff Volume (cu-ft)	995.6584



Peak Flow Hydrologic Analysis

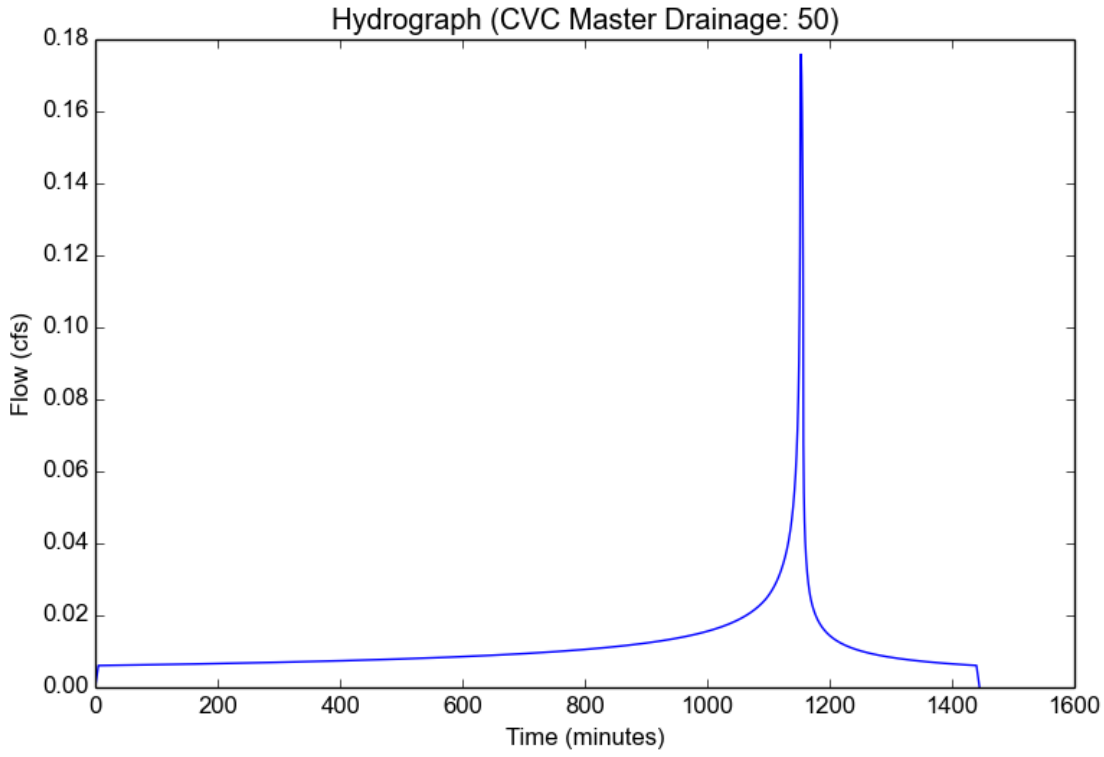
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	50
Area (ac)	0.08
Flow Path Length (ft)	70.0
Flow Path Slope (vft/hft)	0.0046
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.91
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.4708
Undeveloped Runoff Coefficient (Cu)	0.784
Developed Runoff Coefficient (Cd)	0.8896
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	0.1758
Burned Peak Flow Rate (cfs)	0.1758
24-Hr Clear Runoff Volume (ac-ft)	0.0229
24-Hr Clear Runoff Volume (cu-ft)	995.6584



Peak Flow Hydrologic Analysis

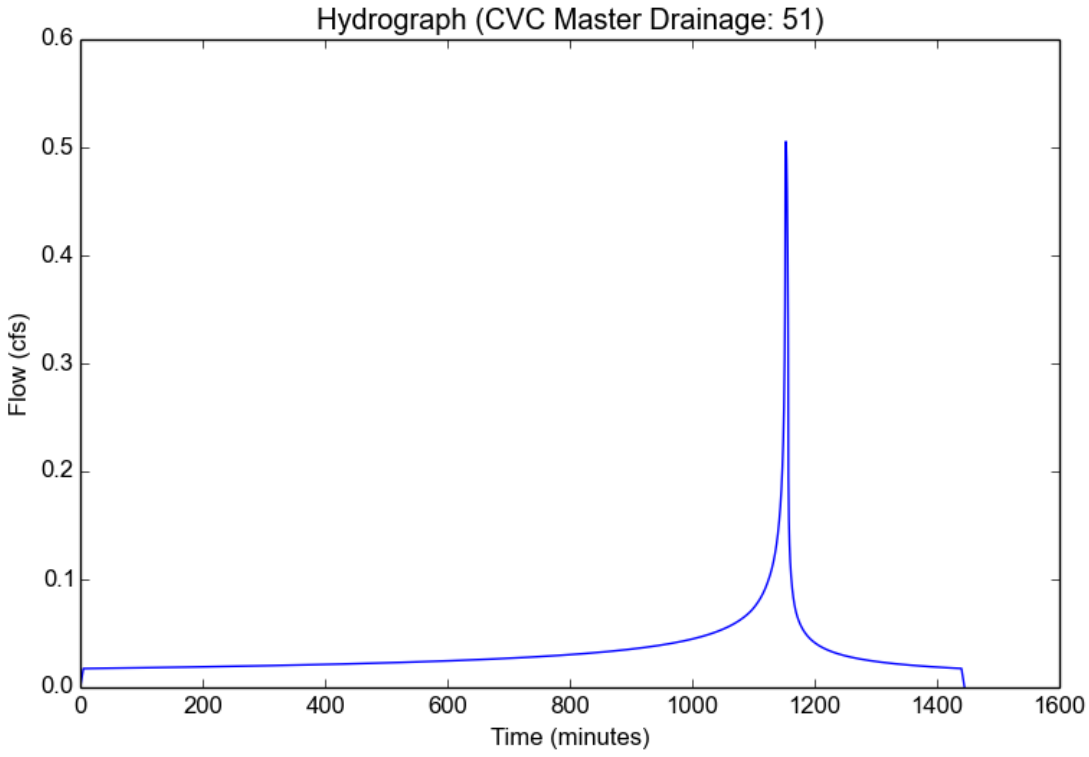
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	51
Area (ac)	0.23
Flow Path Length (ft)	120.0
Flow Path Slope (vft/hft)	0.0042
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.91
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.4708
Undeveloped Runoff Coefficient (Cu)	0.784
Developed Runoff Coefficient (Cd)	0.8896
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	0.5055
Burned Peak Flow Rate (cfs)	0.5055
24-Hr Clear Runoff Volume (ac-ft)	0.0657
24-Hr Clear Runoff Volume (cu-ft)	2862.518



Peak Flow Hydrologic Analysis

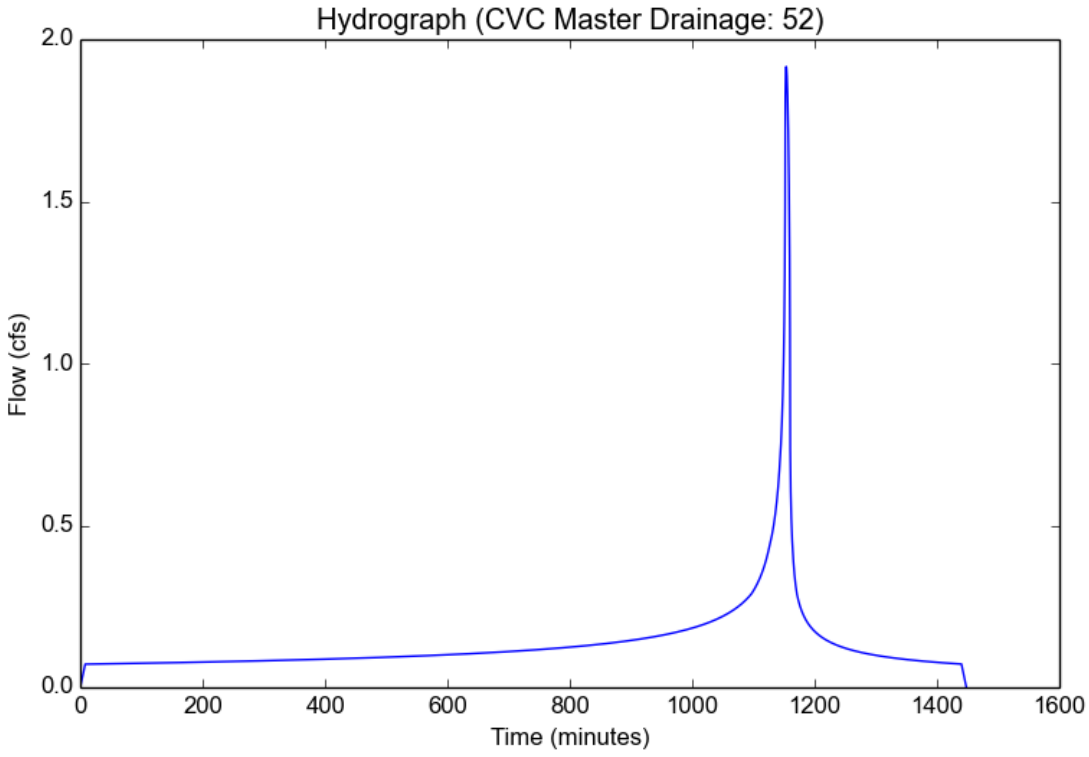
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	52
Area (ac)	1.13
Flow Path Length (ft)	360.0
Flow Path Slope (vft/hft)	0.0066
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.74
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	1.981
Undeveloped Runoff Coefficient (Cu)	0.7302
Developed Runoff Coefficient (Cd)	0.8559
Time of Concentration (min)	8.0
Clear Peak Flow Rate (cfs)	1.9159
Burned Peak Flow Rate (cfs)	1.9159
24-Hr Clear Runoff Volume (ac-ft)	0.2752
24-Hr Clear Runoff Volume (cu-ft)	11985.6742



Peak Flow Hydrologic Analysis

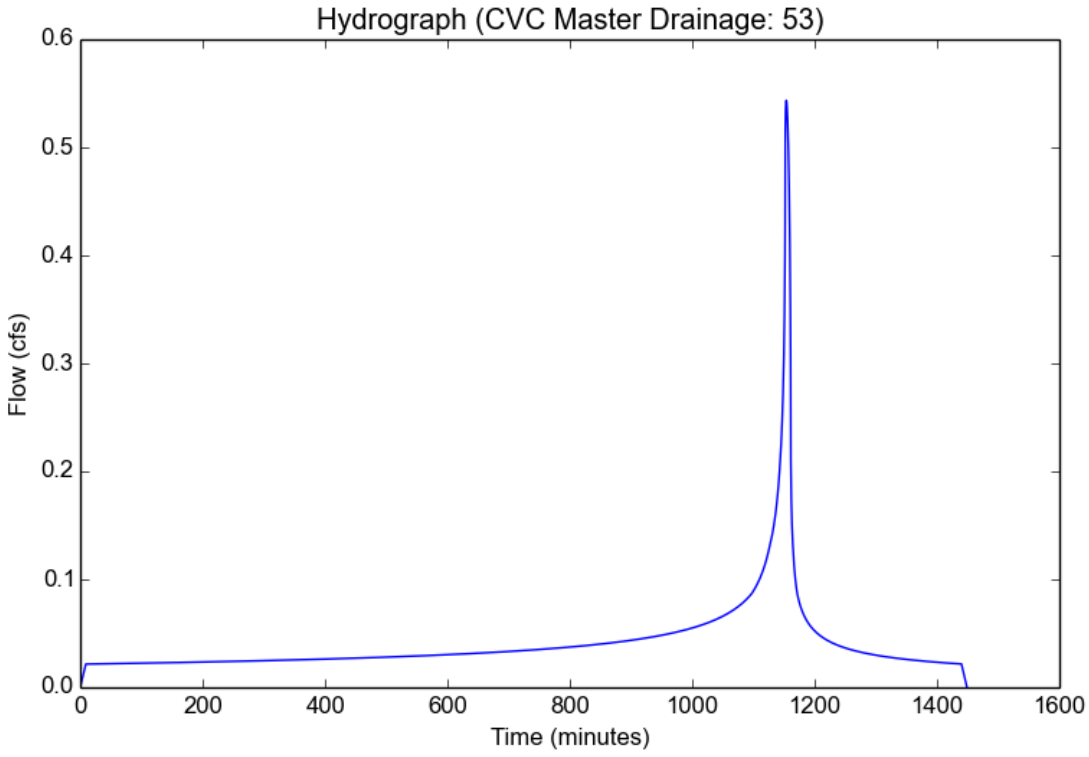
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	53
Area (ac)	0.34
Flow Path Length (ft)	370.0
Flow Path Slope (vft/hft)	0.005
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.74
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	1.8744
Undeveloped Runoff Coefficient (Cu)	0.7185
Developed Runoff Coefficient (Cd)	0.8528
Time of Concentration (min)	9.0
Clear Peak Flow Rate (cfs)	0.5435
Burned Peak Flow Rate (cfs)	0.5435
24-Hr Clear Runoff Volume (ac-ft)	0.0828
24-Hr Clear Runoff Volume (cu-ft)	3606.0953



Peak Flow Hydrologic Analysis

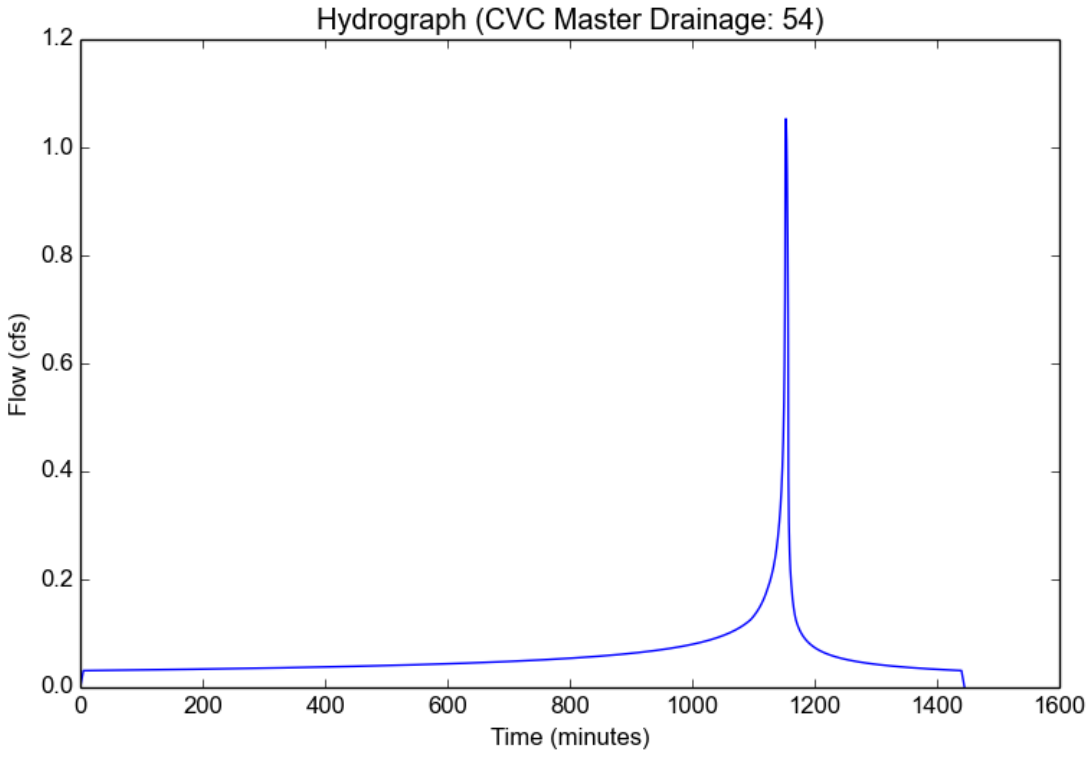
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Existing hydrology/10-yr/CVC Master Dr
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	54
Area (ac)	0.49
Flow Path Length (ft)	180.0
Flow Path Slope (vft/hft)	0.0111
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.74
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.4708
Undeveloped Runoff Coefficient (Cu)	0.784
Developed Runoff Coefficient (Cd)	0.8698
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	1.0531
Burned Peak Flow Rate (cfs)	1.0531
24-Hr Clear Runoff Volume (ac-ft)	0.1194
24-Hr Clear Runoff Volume (cu-ft)	5198.9886



Peak Flow Hydrologic Analysis

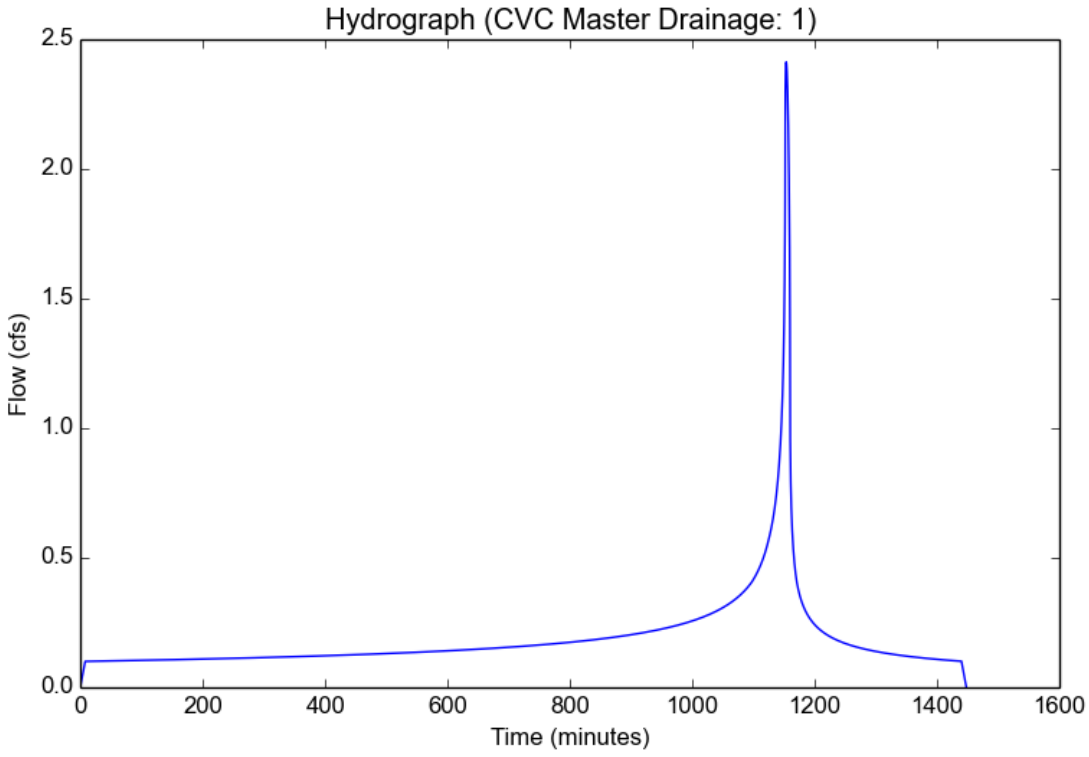
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Proposed hydrology/10-yr/CVC Master
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	1
Area (ac)	1.39
Flow Path Length (ft)	317.0
Flow Path Slope (vft/hft)	0.0038
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.86
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	1.981
Undeveloped Runoff Coefficient (Cu)	0.7302
Developed Runoff Coefficient (Cd)	0.8762
Time of Concentration (min)	8.0
Clear Peak Flow Rate (cfs)	2.4128
Burned Peak Flow Rate (cfs)	2.4128
24-Hr Clear Runoff Volume (ac-ft)	0.3799
24-Hr Clear Runoff Volume (cu-ft)	16546.6169



Peak Flow Hydrologic Analysis

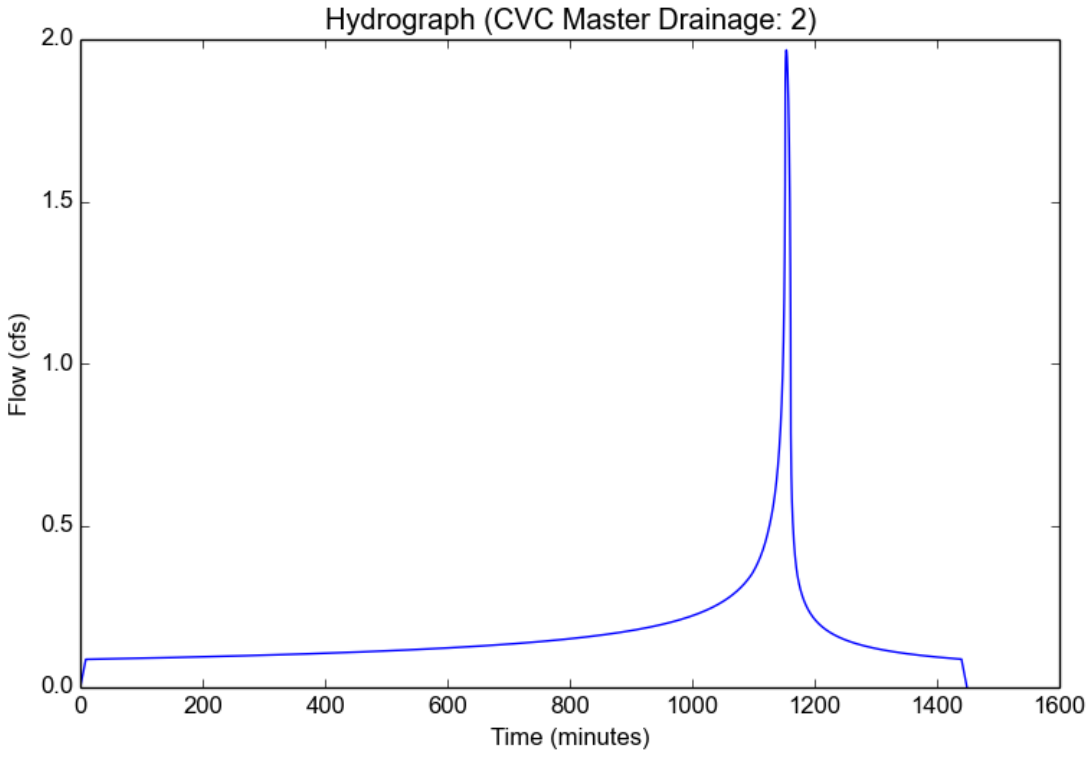
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Proposed hydrology/10-yr/CVC Master
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	2
Area (ac)	1.2
Flow Path Length (ft)	391.0
Flow Path Slope (vft/hft)	0.0043
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.86
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	1.8744
Undeveloped Runoff Coefficient (Cu)	0.7185
Developed Runoff Coefficient (Cd)	0.8746
Time of Concentration (min)	9.0
Clear Peak Flow Rate (cfs)	1.9671
Burned Peak Flow Rate (cfs)	1.9671
24-Hr Clear Runoff Volume (ac-ft)	0.3279
24-Hr Clear Runoff Volume (cu-ft)	14284.4446



Peak Flow Hydrologic Analysis

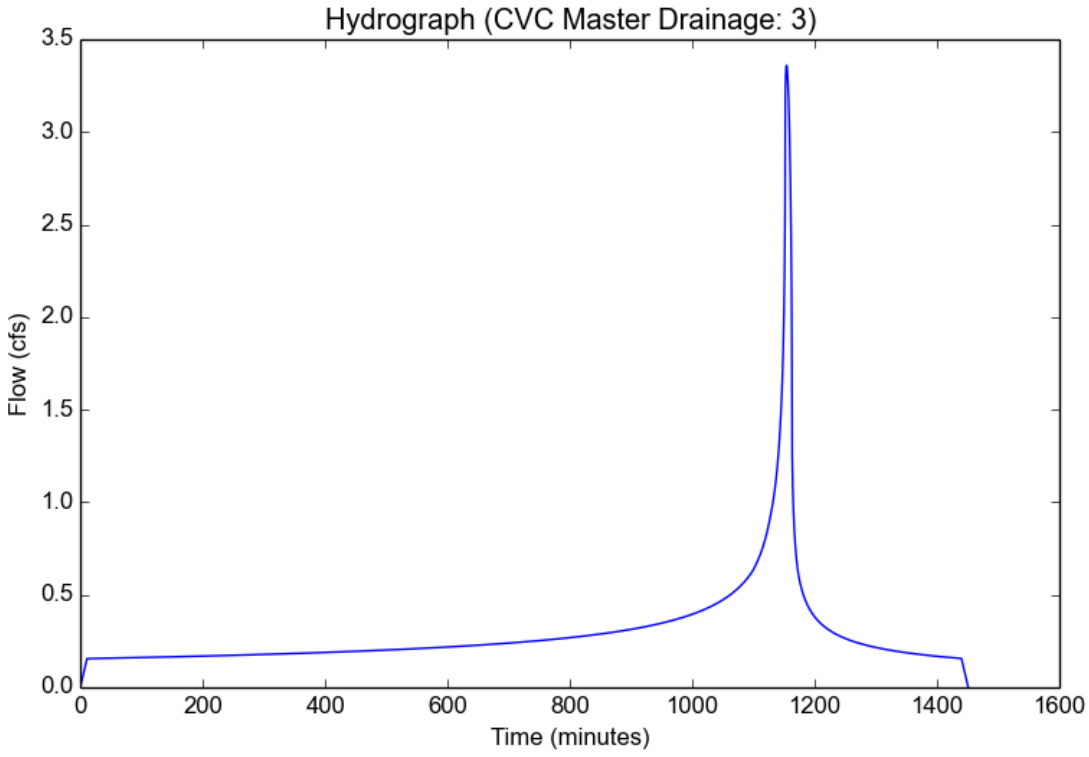
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Proposed hydrology/10-yr/CVC Master
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	3
Area (ac)	2.29
Flow Path Length (ft)	583.0
Flow Path Slope (vft/hft)	0.0062
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.8
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	1.7057
Undeveloped Runoff Coefficient (Cu)	0.7
Developed Runoff Coefficient (Cd)	0.86
Time of Concentration (min)	11.0
Clear Peak Flow Rate (cfs)	3.3591
Burned Peak Flow Rate (cfs)	3.3591
24-Hr Clear Runoff Volume (ac-ft)	0.5917
24-Hr Clear Runoff Volume (cu-ft)	25772.3248



Peak Flow Hydrologic Analysis

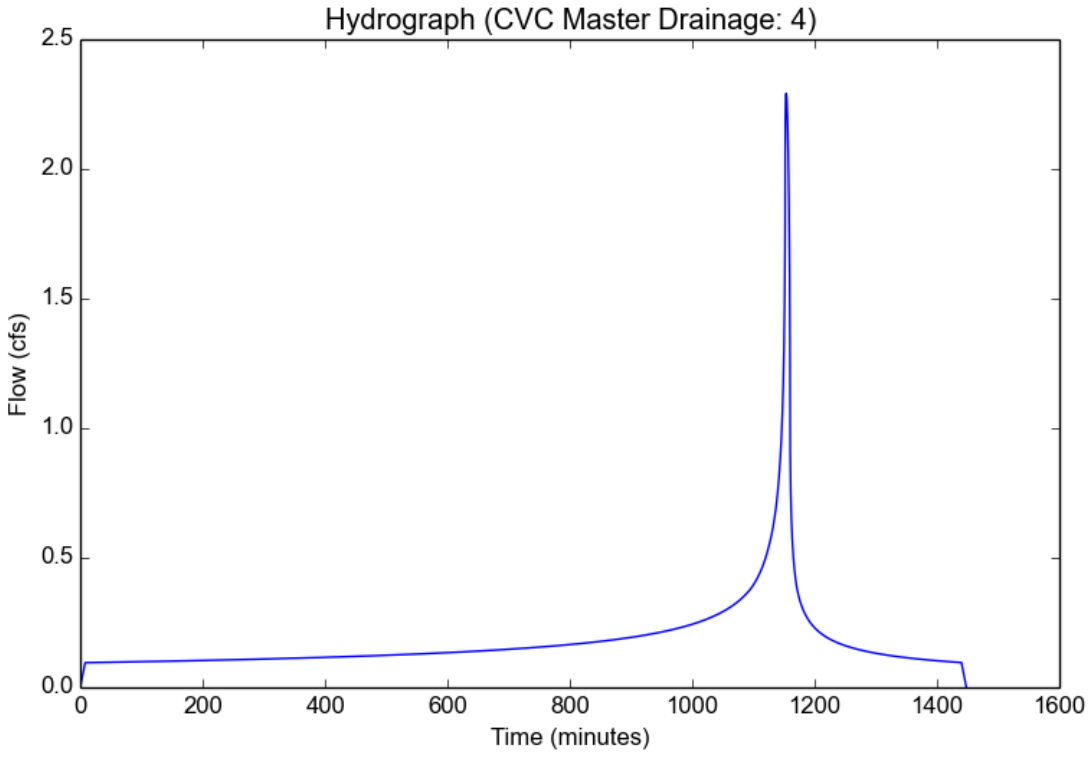
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Proposed hydrology/10-yr/CVC Master
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	4
Area (ac)	1.32
Flow Path Length (ft)	420.0
Flow Path Slope (vft/hft)	0.0079
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.86
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	1.981
Undeveloped Runoff Coefficient (Cu)	0.7302
Developed Runoff Coefficient (Cd)	0.8762
Time of Concentration (min)	8.0
Clear Peak Flow Rate (cfs)	2.2913
Burned Peak Flow Rate (cfs)	2.2913
24-Hr Clear Runoff Volume (ac-ft)	0.3607
24-Hr Clear Runoff Volume (cu-ft)	15713.334



Peak Flow Hydrologic Analysis

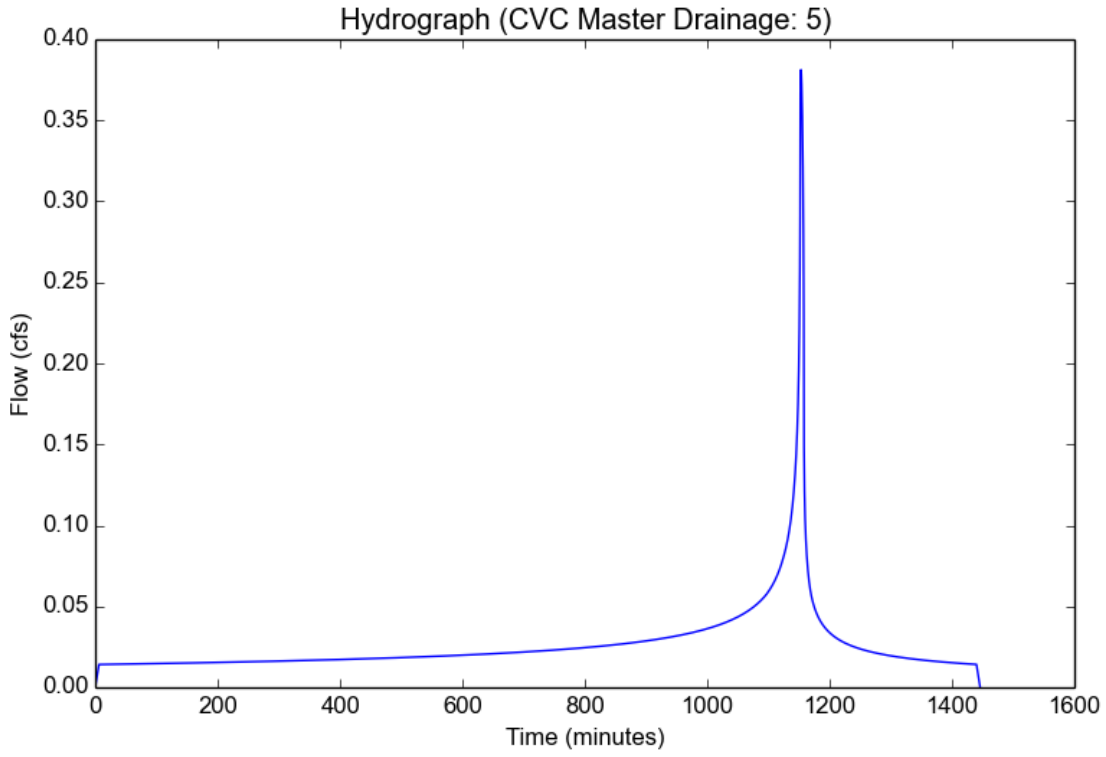
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Proposed hydrology/10-yr/CVC Master
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	5
Area (ac)	0.19
Flow Path Length (ft)	180.0
Flow Path Slope (vft/hft)	0.0032
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.89
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.2678
Undeveloped Runoff Coefficient (Cu)	0.7617
Developed Runoff Coefficient (Cd)	0.8848
Time of Concentration (min)	6.0
Clear Peak Flow Rate (cfs)	0.3812
Burned Peak Flow Rate (cfs)	0.3812
24-Hr Clear Runoff Volume (ac-ft)	0.0533
24-Hr Clear Runoff Volume (cu-ft)	2323.5416



Peak Flow Hydrologic Analysis

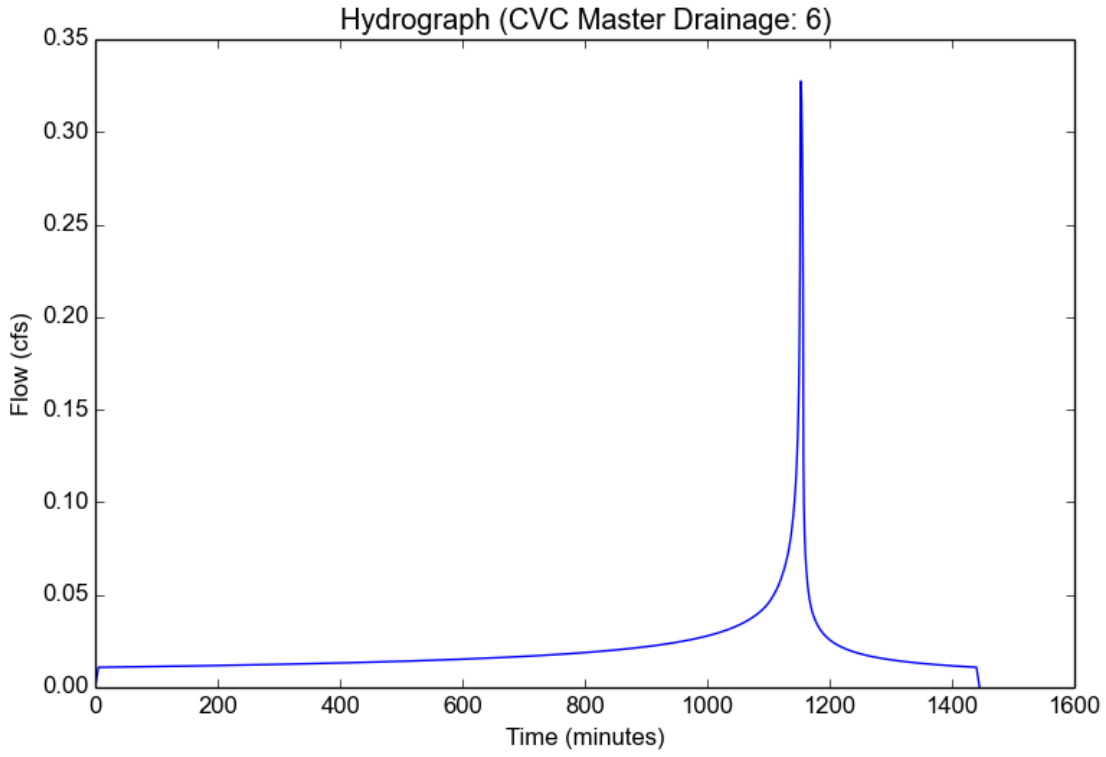
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Proposed hydrology/10-yr/CVC Master
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	6
Area (ac)	0.15
Flow Path Length (ft)	100.0
Flow Path Slope (vft/hft)	0.0023
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.86
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.4708
Undeveloped Runoff Coefficient (Cu)	0.784
Developed Runoff Coefficient (Cd)	0.8838
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	0.3275
Burned Peak Flow Rate (cfs)	0.3275
24-Hr Clear Runoff Volume (ac-ft)	0.041
24-Hr Clear Runoff Volume (cu-ft)	1785.8794



Peak Flow Hydrologic Analysis

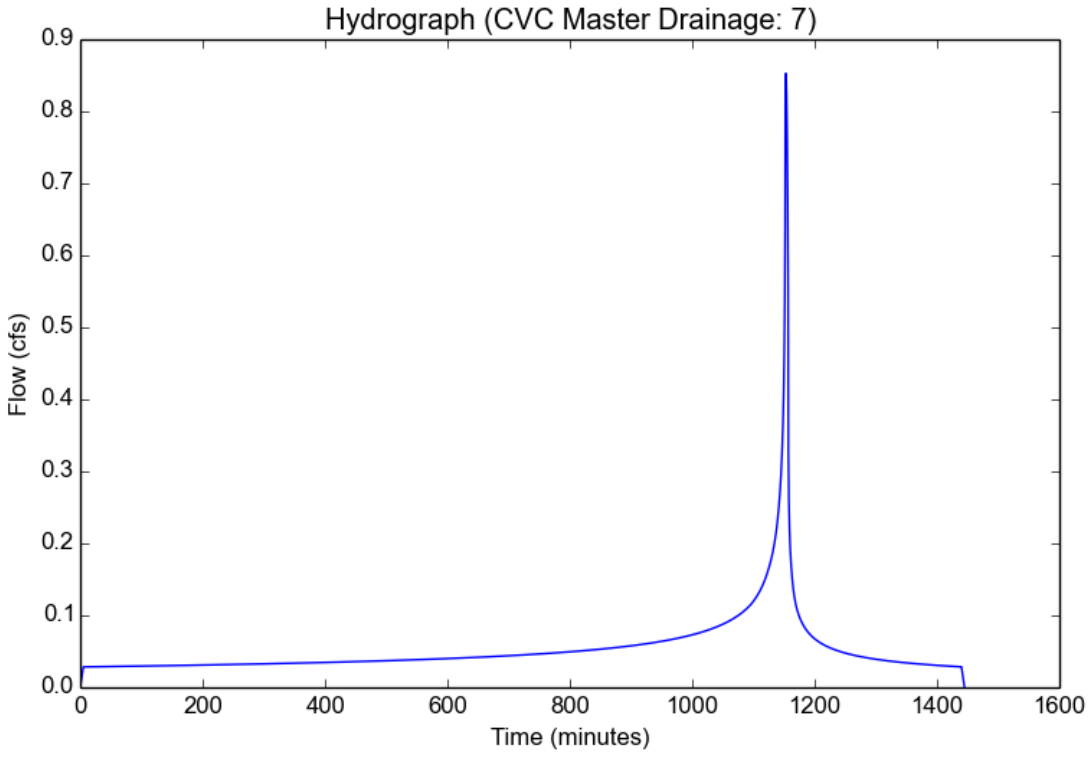
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Proposed hydrology/10-yr/CVC Master
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	7
Area (ac)	0.39
Flow Path Length (ft)	210.0
Flow Path Slope (vft/hft)	0.0071
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.87
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.4708
Undeveloped Runoff Coefficient (Cu)	0.784
Developed Runoff Coefficient (Cd)	0.8849
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	0.8527
Burned Peak Flow Rate (cfs)	0.8527
24-Hr Clear Runoff Volume (ac-ft)	0.1076
24-Hr Clear Runoff Volume (cu-ft)	4685.3962



Peak Flow Hydrologic Analysis

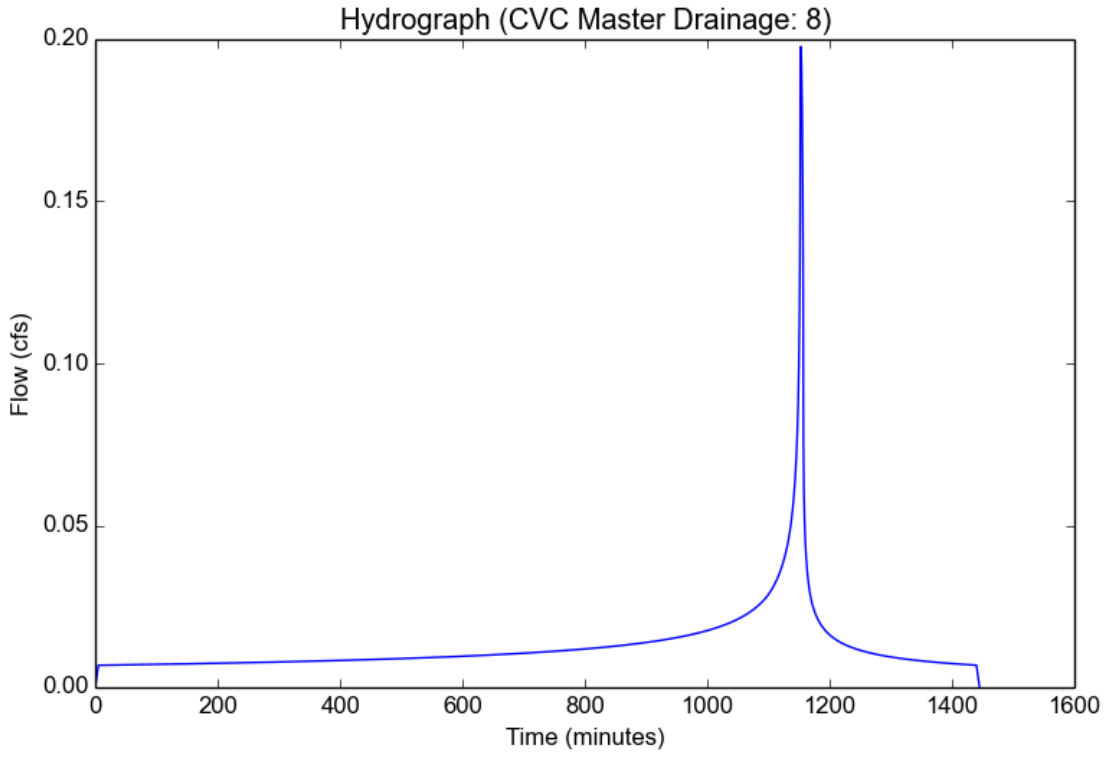
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Proposed hydrology/10-yr/CVC Master
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	8
Area (ac)	0.09
Flow Path Length (ft)	140.0
Flow Path Slope (vft/hft)	0.0061
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.91
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.4708
Undeveloped Runoff Coefficient (Cu)	0.784
Developed Runoff Coefficient (Cd)	0.8896
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	0.1978
Burned Peak Flow Rate (cfs)	0.1978
24-Hr Clear Runoff Volume (ac-ft)	0.0257
24-Hr Clear Runoff Volume (cu-ft)	1120.1158



Peak Flow Hydrologic Analysis

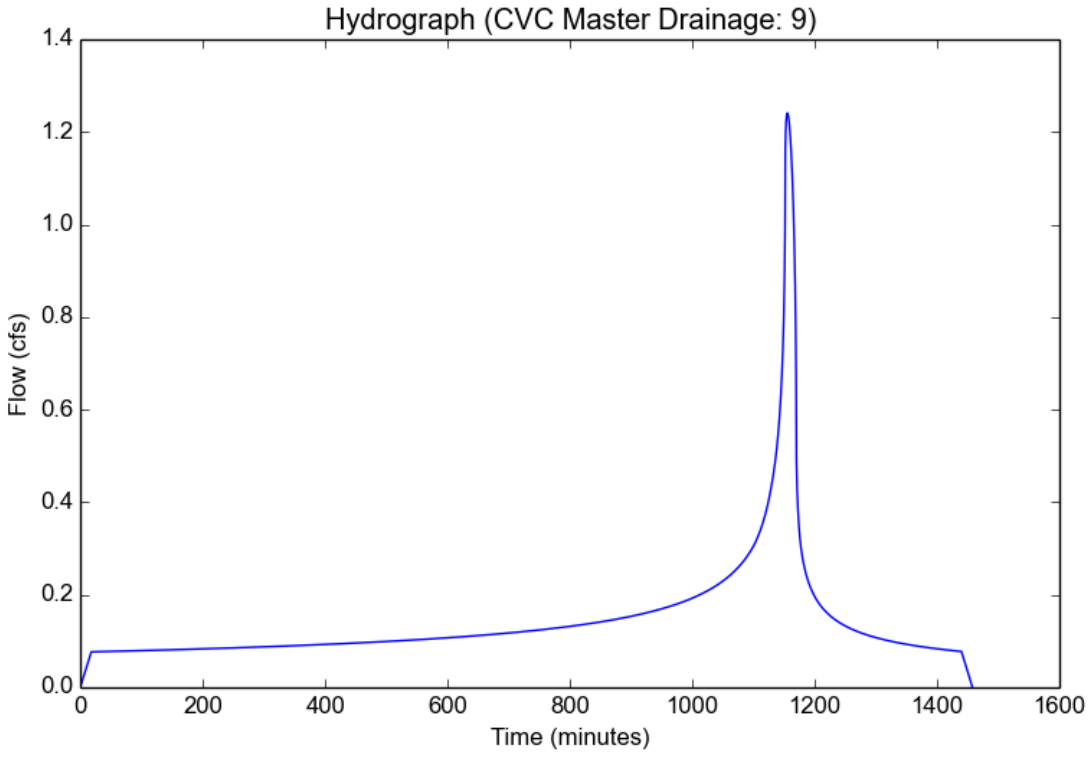
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Proposed hydrology/10-yr/CVC Master
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	9
Area (ac)	1.06
Flow Path Length (ft)	807.0
Flow Path Slope (vft/hft)	0.0012
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.86
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	1.3532
Undeveloped Runoff Coefficient (Cu)	0.6503
Developed Runoff Coefficient (Cd)	0.865
Time of Concentration (min)	18.0
Clear Peak Flow Rate (cfs)	1.2408
Burned Peak Flow Rate (cfs)	1.2408
24-Hr Clear Runoff Volume (ac-ft)	0.2896
24-Hr Clear Runoff Volume (cu-ft)	12615.7259



Peak Flow Hydrologic Analysis

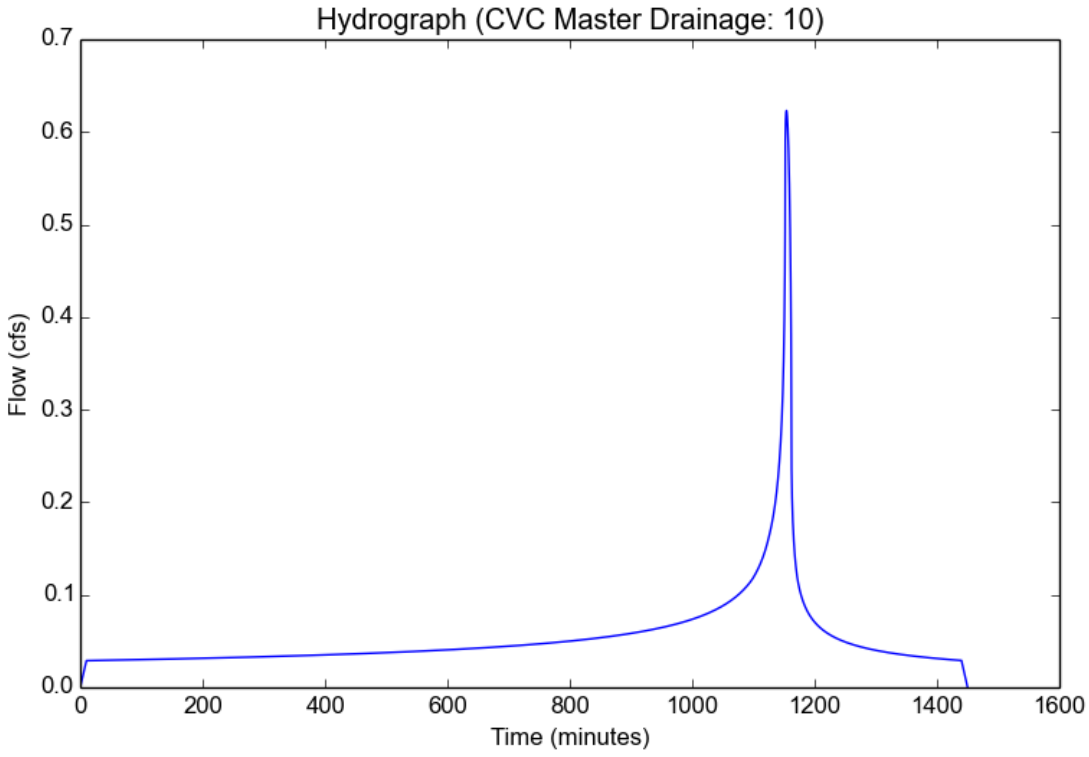
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Proposed hydrology/10-yr/CVC Master
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	10
Area (ac)	0.4
Flow Path Length (ft)	440.0
Flow Path Slope (vft/hft)	0.0033
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.86
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	1.7838
Undeveloped Runoff Coefficient (Cu)	0.7086
Developed Runoff Coefficient (Cd)	0.8732
Time of Concentration (min)	10.0
Clear Peak Flow Rate (cfs)	0.623
Burned Peak Flow Rate (cfs)	0.623
24-Hr Clear Runoff Volume (ac-ft)	0.1093
24-Hr Clear Runoff Volume (cu-ft)	4761.3801



Peak Flow Hydrologic Analysis

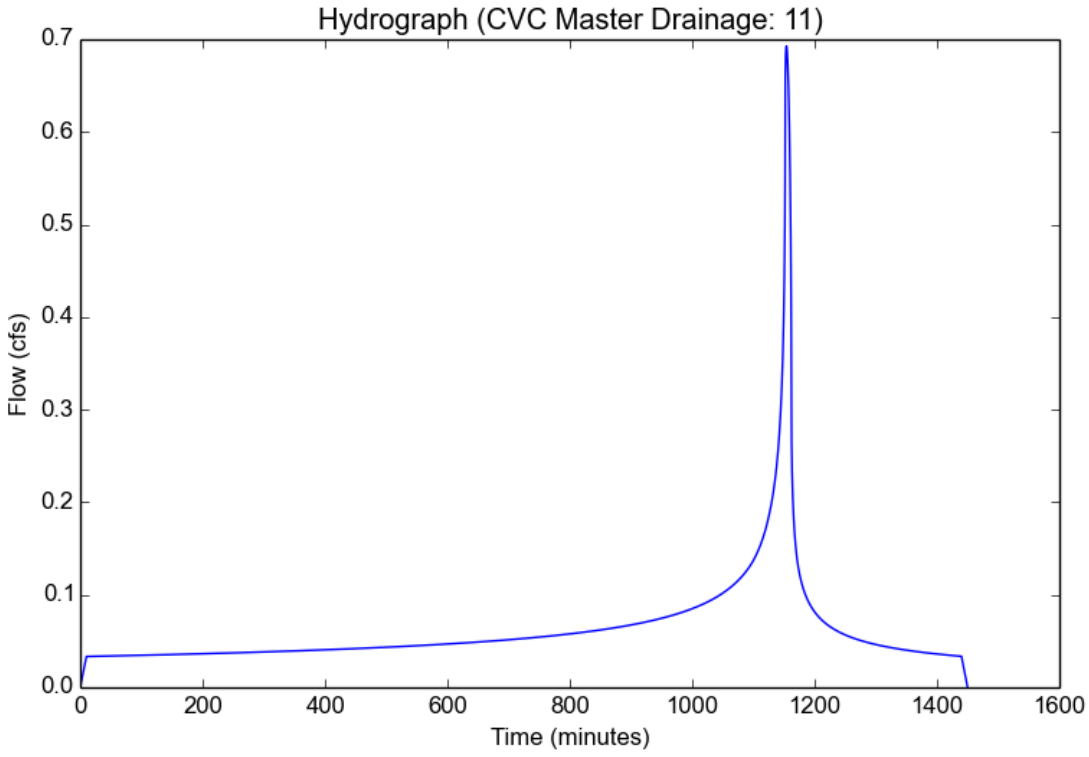
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Proposed hydrology/10-yr/CVC Master
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	11
Area (ac)	0.44
Flow Path Length (ft)	460.0
Flow Path Slope (vft/hft)	0.0032
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.91
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	1.7838
Undeveloped Runoff Coefficient (Cu)	0.7086
Developed Runoff Coefficient (Cd)	0.8828
Time of Concentration (min)	10.0
Clear Peak Flow Rate (cfs)	0.6929
Burned Peak Flow Rate (cfs)	0.6929
24-Hr Clear Runoff Volume (ac-ft)	0.1257
24-Hr Clear Runoff Volume (cu-ft)	5475.441



Peak Flow Hydrologic Analysis

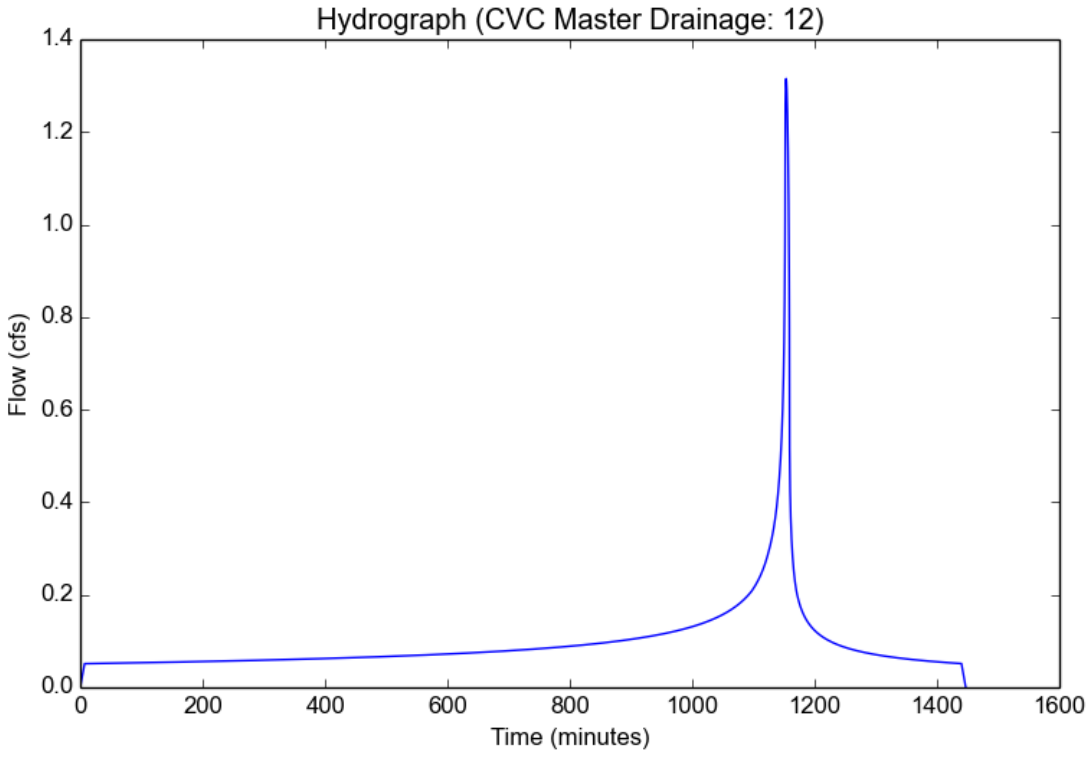
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Proposed hydrology/10-yr/CVC Master
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	12
Area (ac)	0.71
Flow Path Length (ft)	275.0
Flow Path Slope (vft/hft)	0.0057
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.86
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.1094
Undeveloped Runoff Coefficient (Cu)	0.7443
Developed Runoff Coefficient (Cd)	0.8782
Time of Concentration (min)	7.0
Clear Peak Flow Rate (cfs)	1.3152
Burned Peak Flow Rate (cfs)	1.3152
24-Hr Clear Runoff Volume (ac-ft)	0.194
24-Hr Clear Runoff Volume (cu-ft)	8452.1882



Peak Flow Hydrologic Analysis

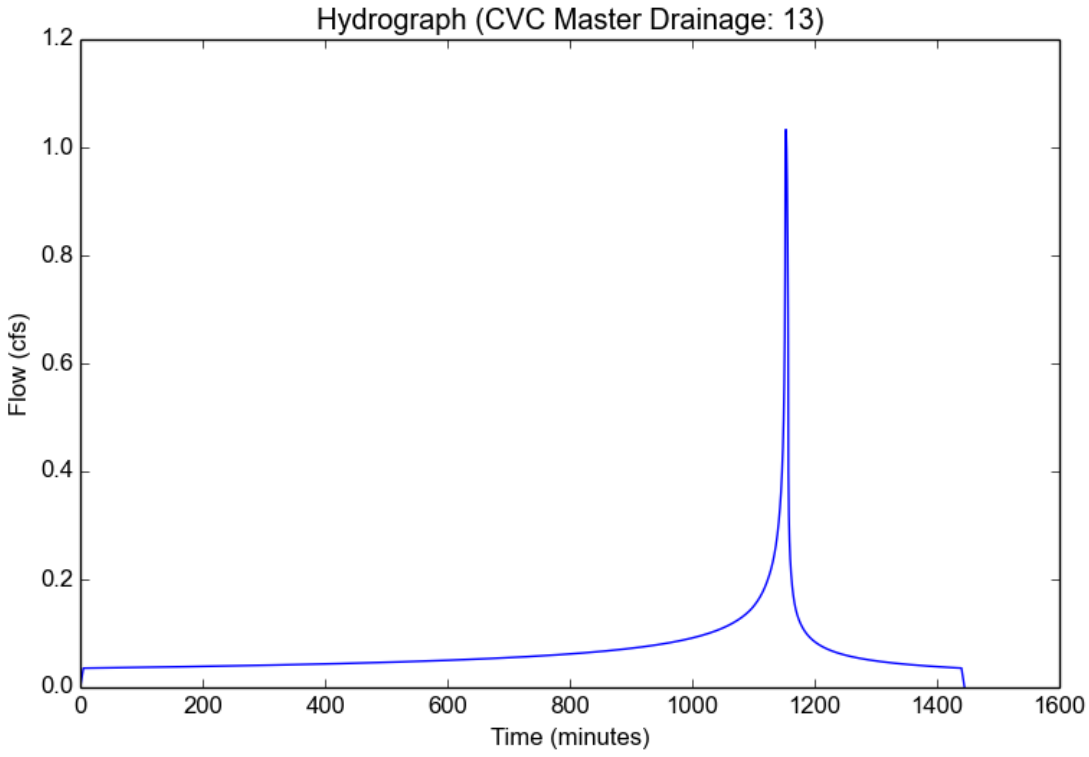
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Proposed hydrology/10-yr/CVC Master
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	13
Area (ac)	0.47
Flow Path Length (ft)	260.0
Flow Path Slope (vft/hft)	0.0173
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.91
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.4708
Undeveloped Runoff Coefficient (Cu)	0.784
Developed Runoff Coefficient (Cd)	0.8896
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	1.033
Burned Peak Flow Rate (cfs)	1.033
24-Hr Clear Runoff Volume (ac-ft)	0.1343
24-Hr Clear Runoff Volume (cu-ft)	5849.4934



Peak Flow Hydrologic Analysis

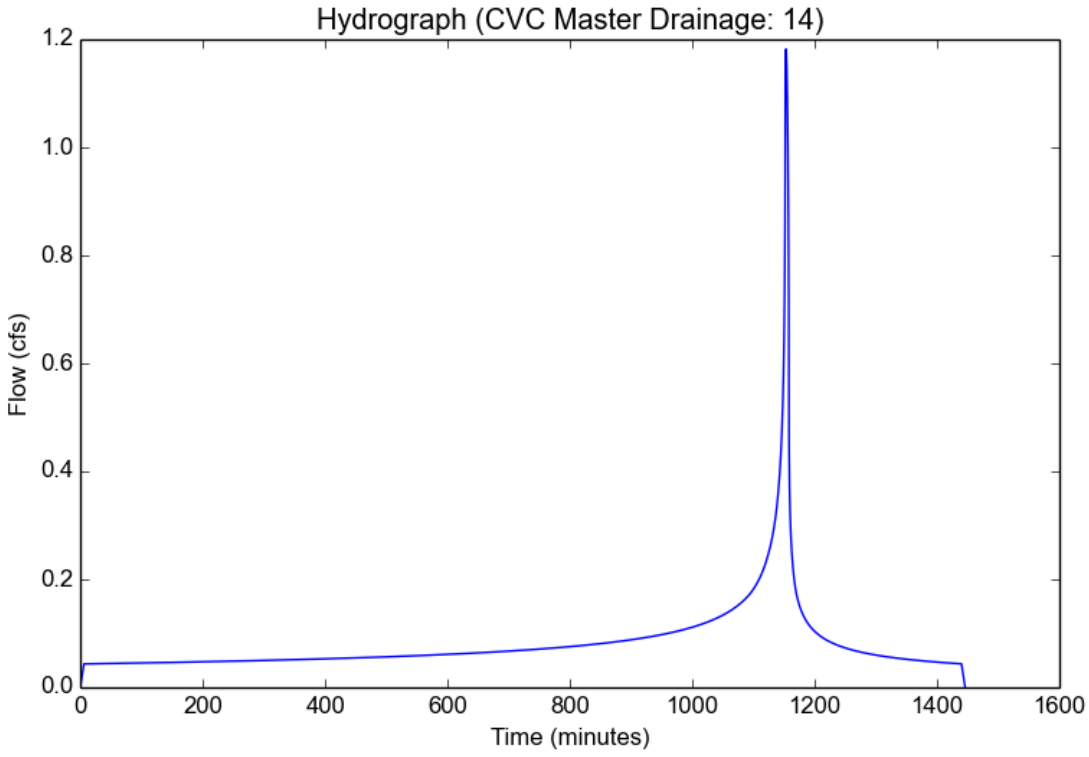
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Proposed hydrology/10-yr/CVC Master
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	14
Area (ac)	0.59
Flow Path Length (ft)	272.0
Flow Path Slope (vft/hft)	0.0078
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.88
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.2678
Undeveloped Runoff Coefficient (Cu)	0.7617
Developed Runoff Coefficient (Cd)	0.8834
Time of Concentration (min)	6.0
Clear Peak Flow Rate (cfs)	1.182
Burned Peak Flow Rate (cfs)	1.182
24-Hr Clear Runoff Volume (ac-ft)	0.1642
24-Hr Clear Runoff Volume (cu-ft)	7151.4705



Peak Flow Hydrologic Analysis

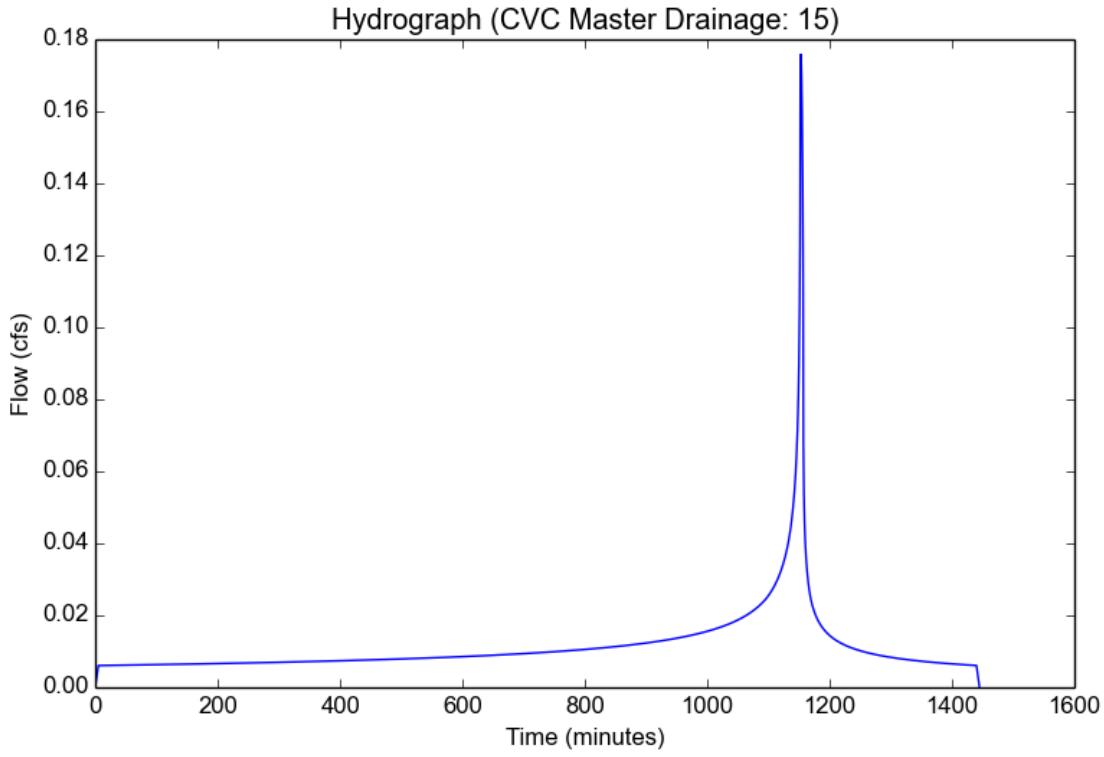
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Proposed hydrology/10-yr/CVC Master
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	15
Area (ac)	0.08
Flow Path Length (ft)	70.0
Flow Path Slope (vft/hft)	0.0046
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.91
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.4708
Undeveloped Runoff Coefficient (Cu)	0.784
Developed Runoff Coefficient (Cd)	0.8896
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	0.1758
Burned Peak Flow Rate (cfs)	0.1758
24-Hr Clear Runoff Volume (ac-ft)	0.0229
24-Hr Clear Runoff Volume (cu-ft)	995.6584



Peak Flow Hydrologic Analysis

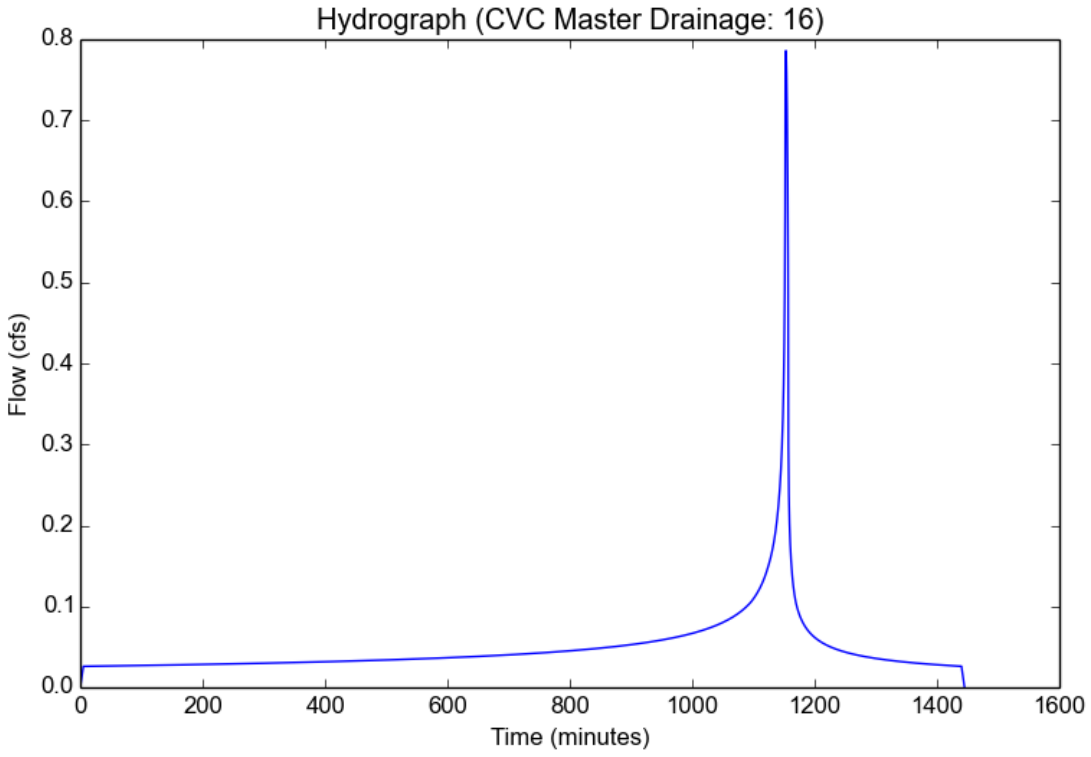
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Proposed hydrology/10-yr/CVC Master
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	16
Area (ac)	0.36
Flow Path Length (ft)	125.0
Flow Path Slope (vft/hft)	0.0064
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.86
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.4708
Undeveloped Runoff Coefficient (Cu)	0.784
Developed Runoff Coefficient (Cd)	0.8838
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	0.7861
Burned Peak Flow Rate (cfs)	0.7861
24-Hr Clear Runoff Volume (ac-ft)	0.0984
24-Hr Clear Runoff Volume (cu-ft)	4286.1107



Peak Flow Hydrologic Analysis

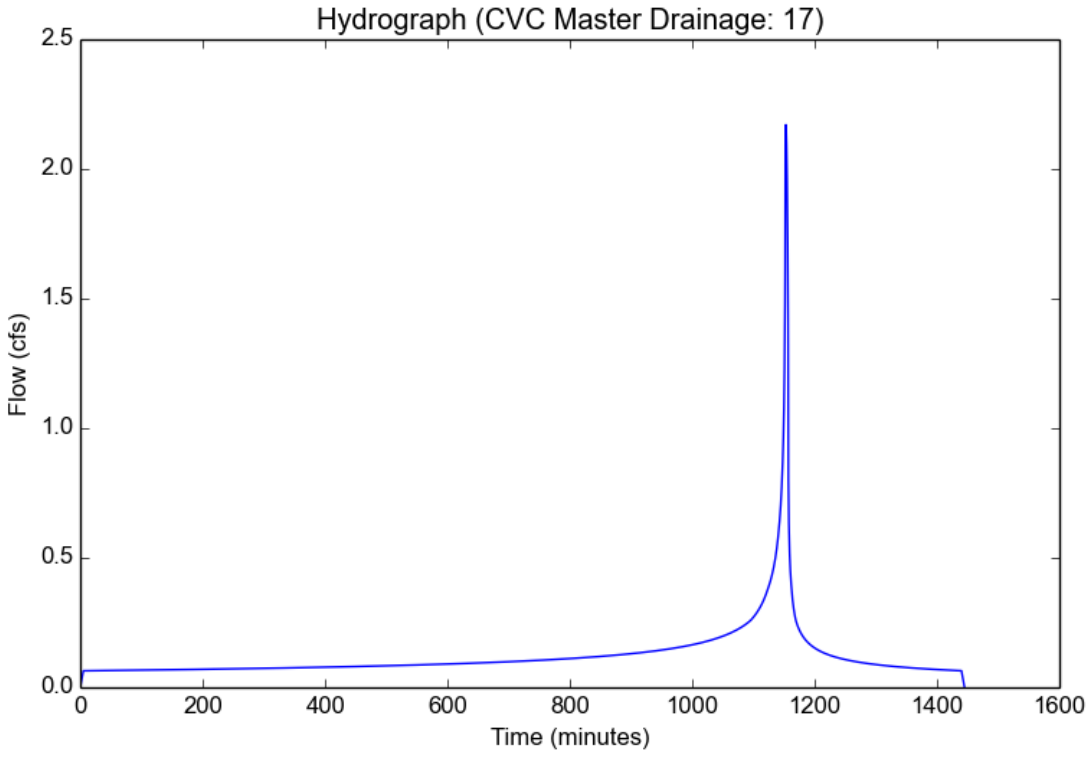
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Proposed hydrology/10-yr/CVC Master
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	17
Area (ac)	1.01
Flow Path Length (ft)	170.0
Flow Path Slope (vft/hft)	0.0071
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.74
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.4708
Undeveloped Runoff Coefficient (Cu)	0.784
Developed Runoff Coefficient (Cd)	0.8698
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	2.1706
Burned Peak Flow Rate (cfs)	2.1706
24-Hr Clear Runoff Volume (ac-ft)	0.246
24-Hr Clear Runoff Volume (cu-ft)	10716.2826



Peak Flow Hydrologic Analysis

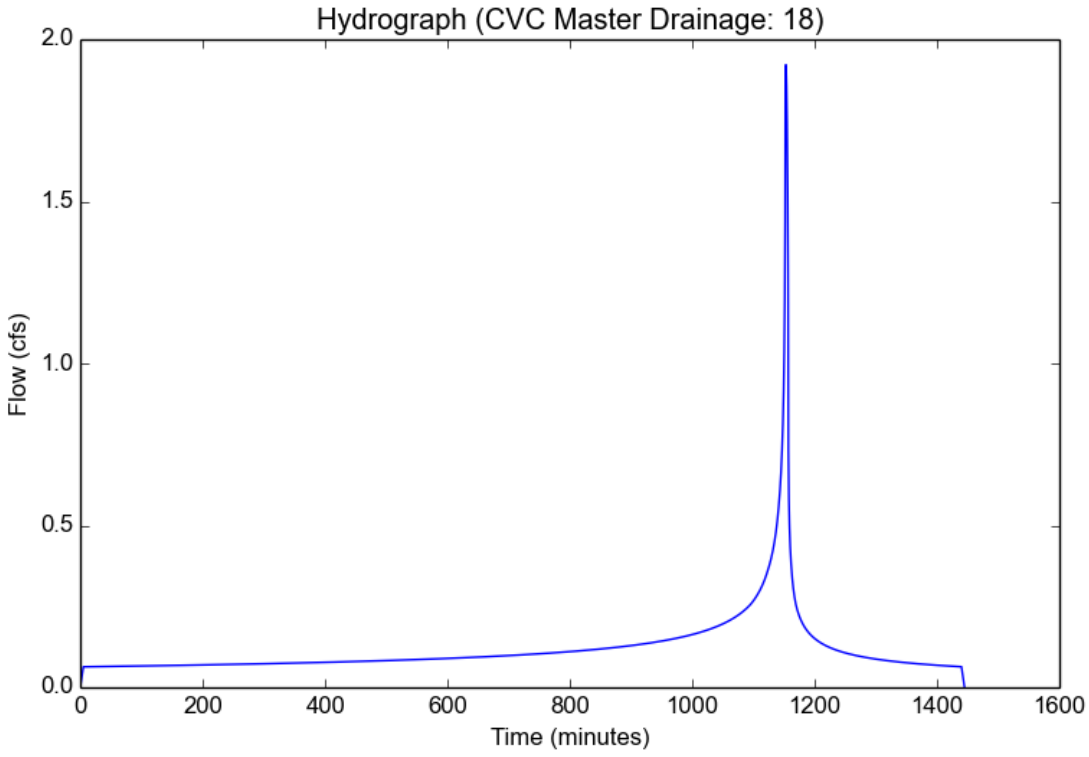
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Proposed hydrology/10-yr/CVC Master
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	18
Area (ac)	0.88
Flow Path Length (ft)	195.0
Flow Path Slope (vft/hft)	0.0099
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.86
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.4708
Undeveloped Runoff Coefficient (Cu)	0.784
Developed Runoff Coefficient (Cd)	0.8838
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	1.9215
Burned Peak Flow Rate (cfs)	1.9215
24-Hr Clear Runoff Volume (ac-ft)	0.2405
24-Hr Clear Runoff Volume (cu-ft)	10477.1594



Peak Flow Hydrologic Analysis

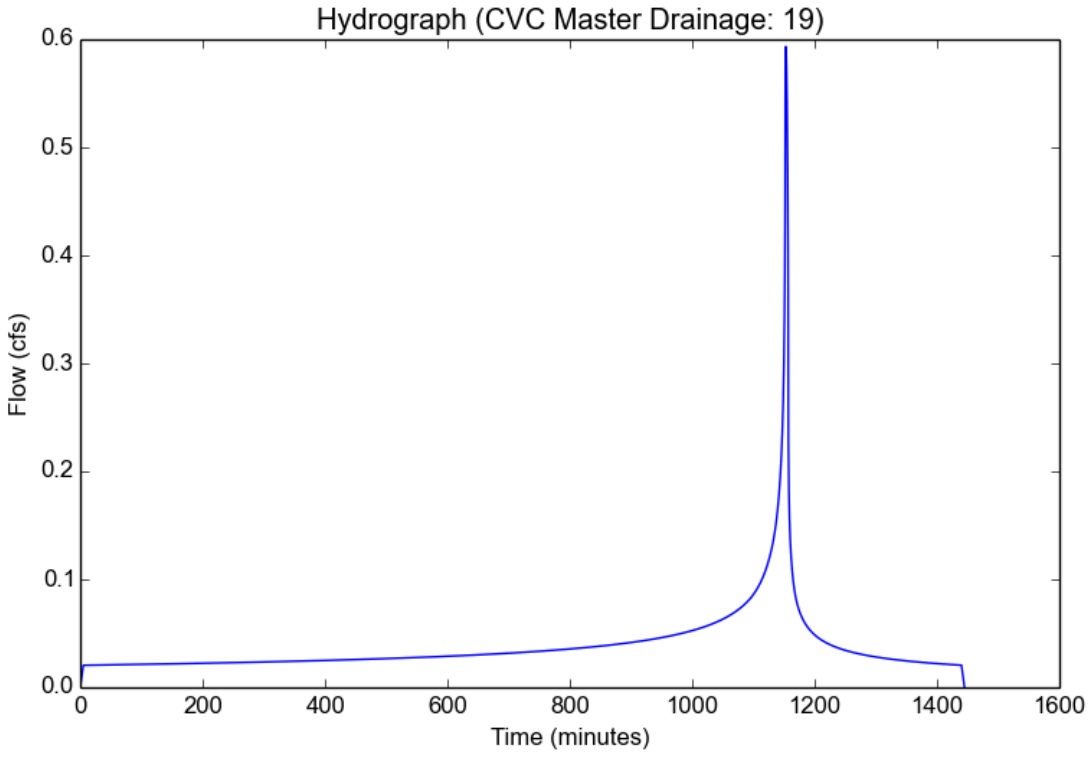
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Proposed hydrology/10-yr/CVC Master
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	19
Area (ac)	0.27
Flow Path Length (ft)	90.0
Flow Path Slope (vft/hft)	0.0126
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.91
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.4708
Undeveloped Runoff Coefficient (Cu)	0.784
Developed Runoff Coefficient (Cd)	0.8896
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	0.5934
Burned Peak Flow Rate (cfs)	0.5934
24-Hr Clear Runoff Volume (ac-ft)	0.0771
24-Hr Clear Runoff Volume (cu-ft)	3360.3473



Peak Flow Hydrologic Analysis

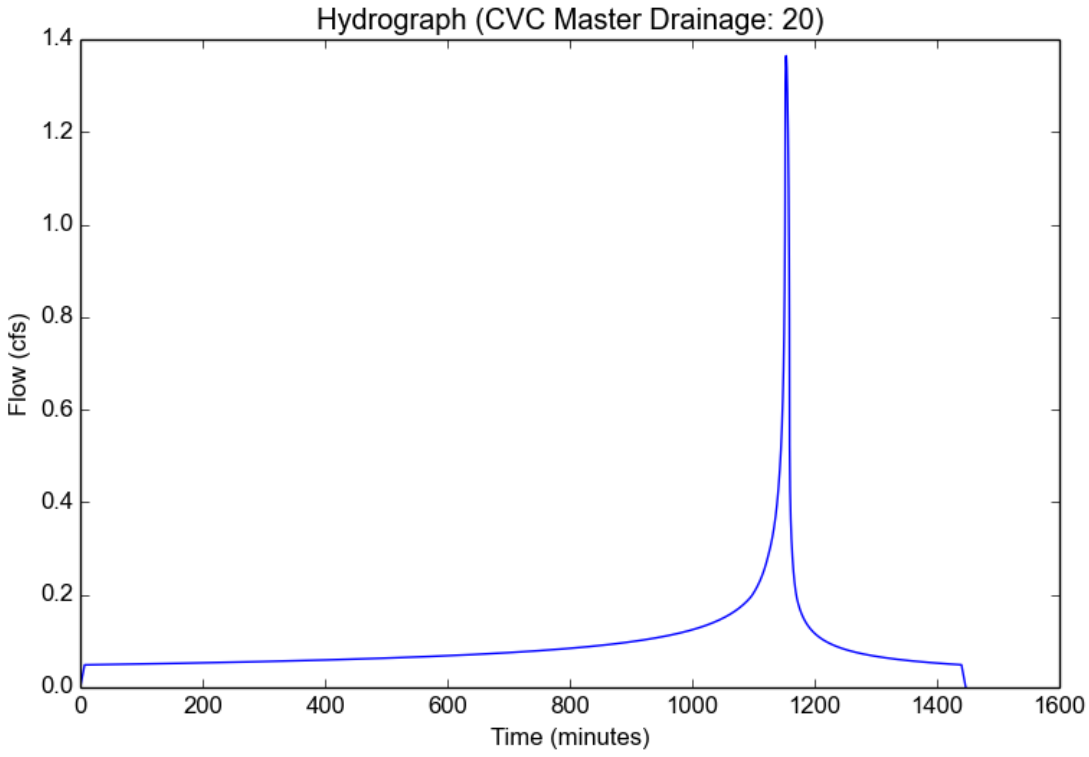
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Proposed hydrology/10-yr/CVC Master
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	20
Area (ac)	0.75
Flow Path Length (ft)	305.0
Flow Path Slope (vft/hft)	0.0056
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.76
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.1094
Undeveloped Runoff Coefficient (Cu)	0.7443
Developed Runoff Coefficient (Cd)	0.8626
Time of Concentration (min)	7.0
Clear Peak Flow Rate (cfs)	1.3647
Burned Peak Flow Rate (cfs)	1.3647
24-Hr Clear Runoff Volume (ac-ft)	0.1864
24-Hr Clear Runoff Volume (cu-ft)	8117.829



Peak Flow Hydrologic Analysis

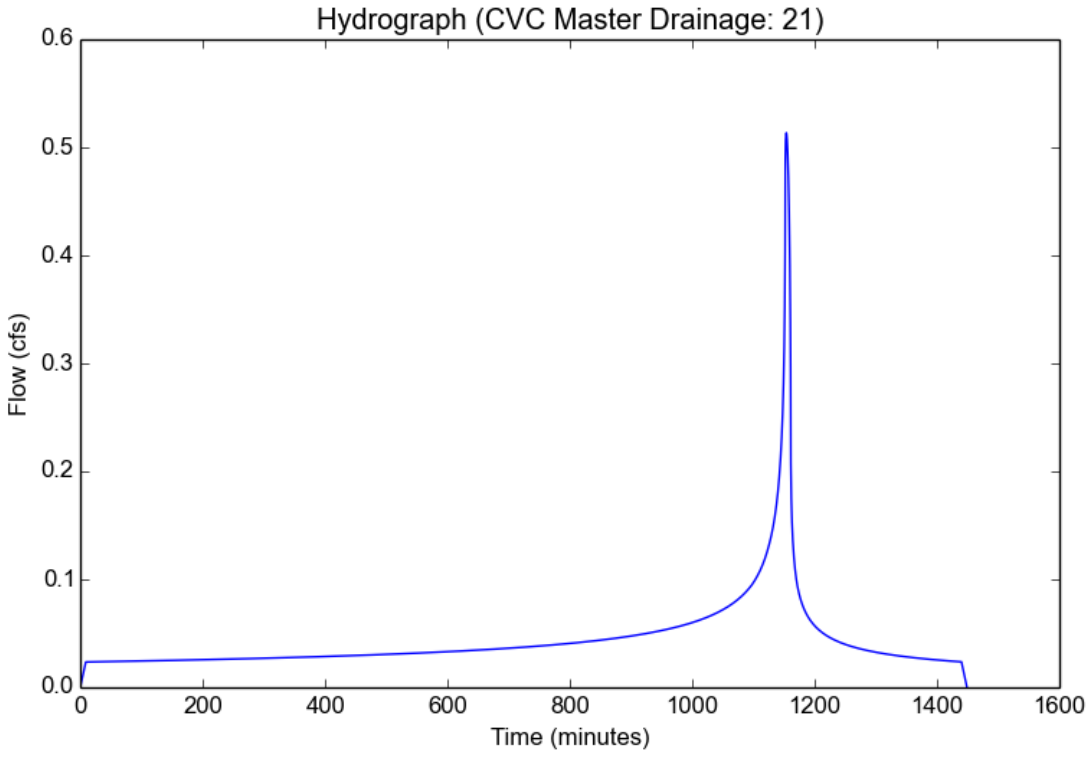
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Proposed hydrology/10-yr/CVC Master
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	21
Area (ac)	0.31
Flow Path Length (ft)	338.0
Flow Path Slope (vft/hft)	0.0024
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.91
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	1.8744
Undeveloped Runoff Coefficient (Cu)	0.7185
Developed Runoff Coefficient (Cd)	0.8837
Time of Concentration (min)	9.0
Clear Peak Flow Rate (cfs)	0.5135
Burned Peak Flow Rate (cfs)	0.5135
24-Hr Clear Runoff Volume (ac-ft)	0.0886
24-Hr Clear Runoff Volume (cu-ft)	3857.7472



Peak Flow Hydrologic Analysis

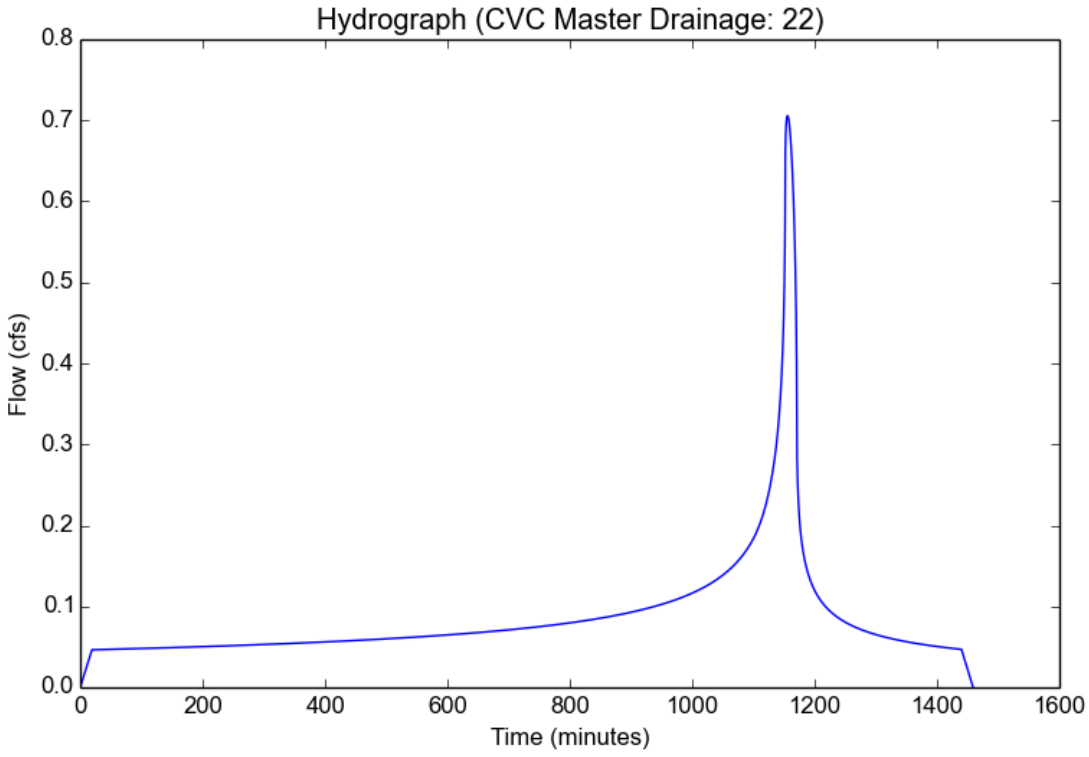
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Proposed hydrology/10-yr/CVC Master
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	22
Area (ac)	0.61
Flow Path Length (ft)	850.0
Flow Path Slope (vft/hft)	0.0011
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.91
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	1.3193
Undeveloped Runoff Coefficient (Cu)	0.6441
Developed Runoff Coefficient (Cd)	0.877
Time of Concentration (min)	19.0
Clear Peak Flow Rate (cfs)	0.7057
Burned Peak Flow Rate (cfs)	0.7057
24-Hr Clear Runoff Volume (ac-ft)	0.1742
24-Hr Clear Runoff Volume (cu-ft)	7590.1706



Peak Flow Hydrologic Analysis

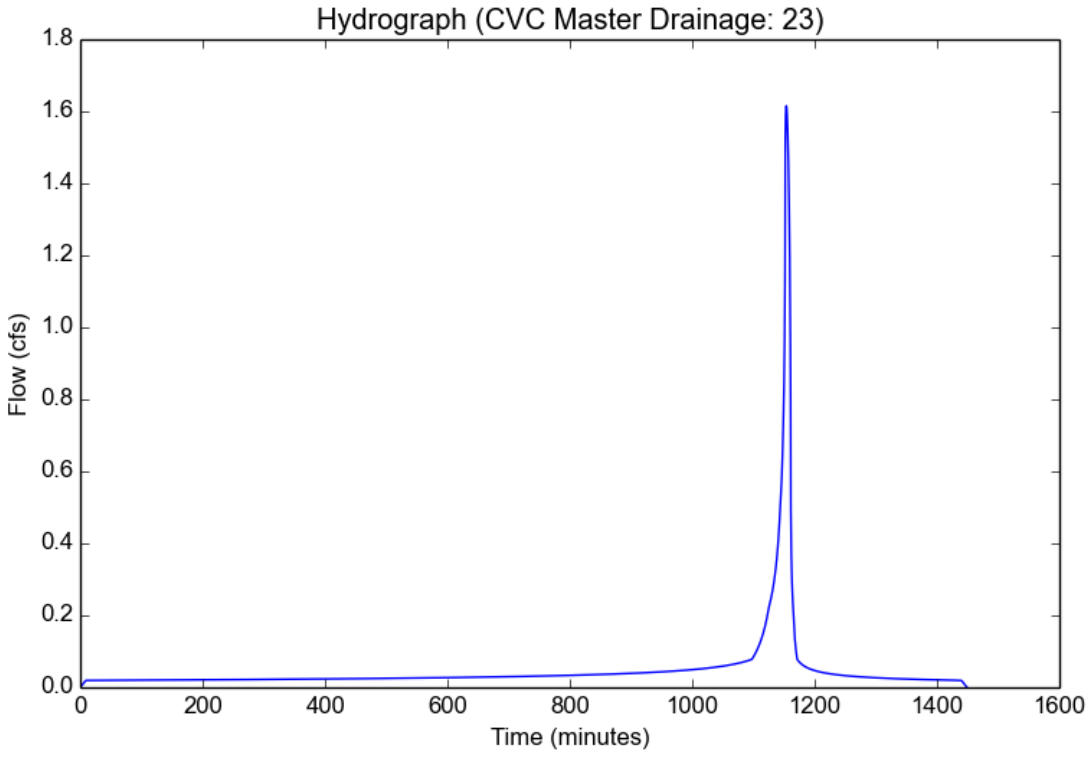
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Proposed hydrology/10-yr/CVC Master
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	23
Area (ac)	1.17
Flow Path Length (ft)	385.0
Flow Path Slope (vft/hft)	0.0078
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.1
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	1.8744
Undeveloped Runoff Coefficient (Cu)	0.7185
Developed Runoff Coefficient (Cd)	0.7367
Time of Concentration (min)	9.0
Clear Peak Flow Rate (cfs)	1.6155
Burned Peak Flow Rate (cfs)	1.6155
24-Hr Clear Runoff Volume (ac-ft)	0.099
24-Hr Clear Runoff Volume (cu-ft)	4312.5543



Peak Flow Hydrologic Analysis

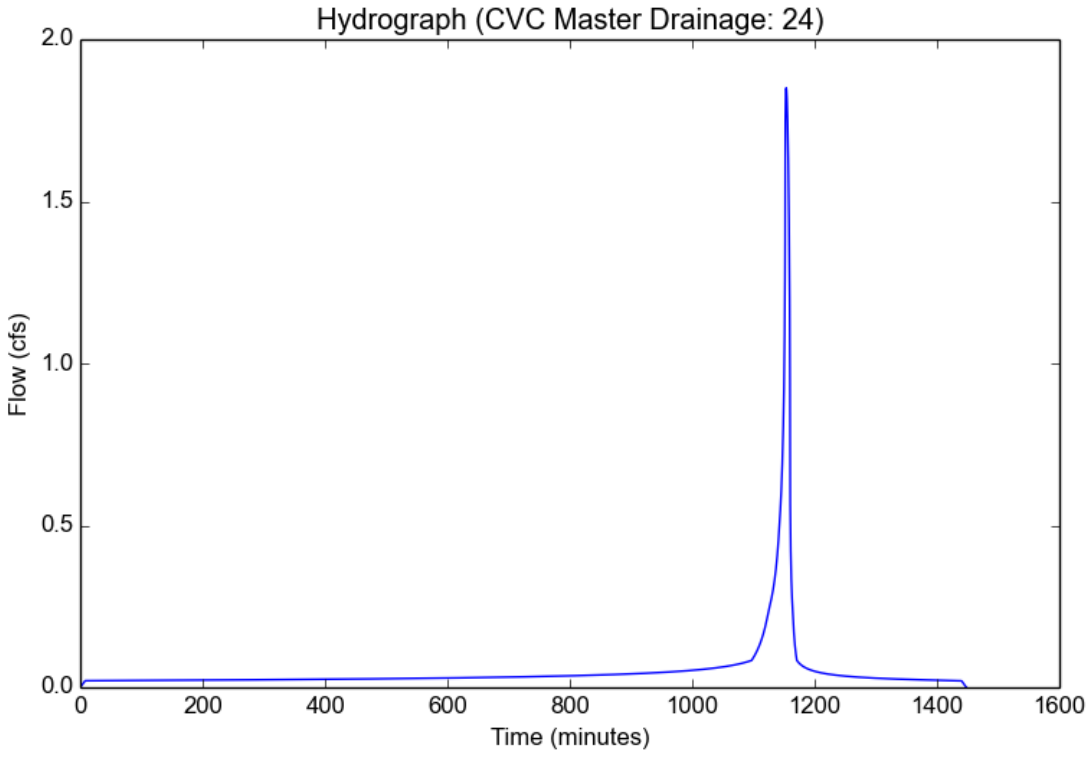
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Proposed hydrology/10-yr/CVC Master
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	24
Area (ac)	1.25
Flow Path Length (ft)	360.0
Flow Path Slope (vft/hft)	0.0083
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.1
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	1.981
Undeveloped Runoff Coefficient (Cu)	0.7302
Developed Runoff Coefficient (Cd)	0.7472
Time of Concentration (min)	8.0
Clear Peak Flow Rate (cfs)	1.8503
Burned Peak Flow Rate (cfs)	1.8503
24-Hr Clear Runoff Volume (ac-ft)	0.1058
24-Hr Clear Runoff Volume (cu-ft)	4610.1585



Peak Flow Hydrologic Analysis

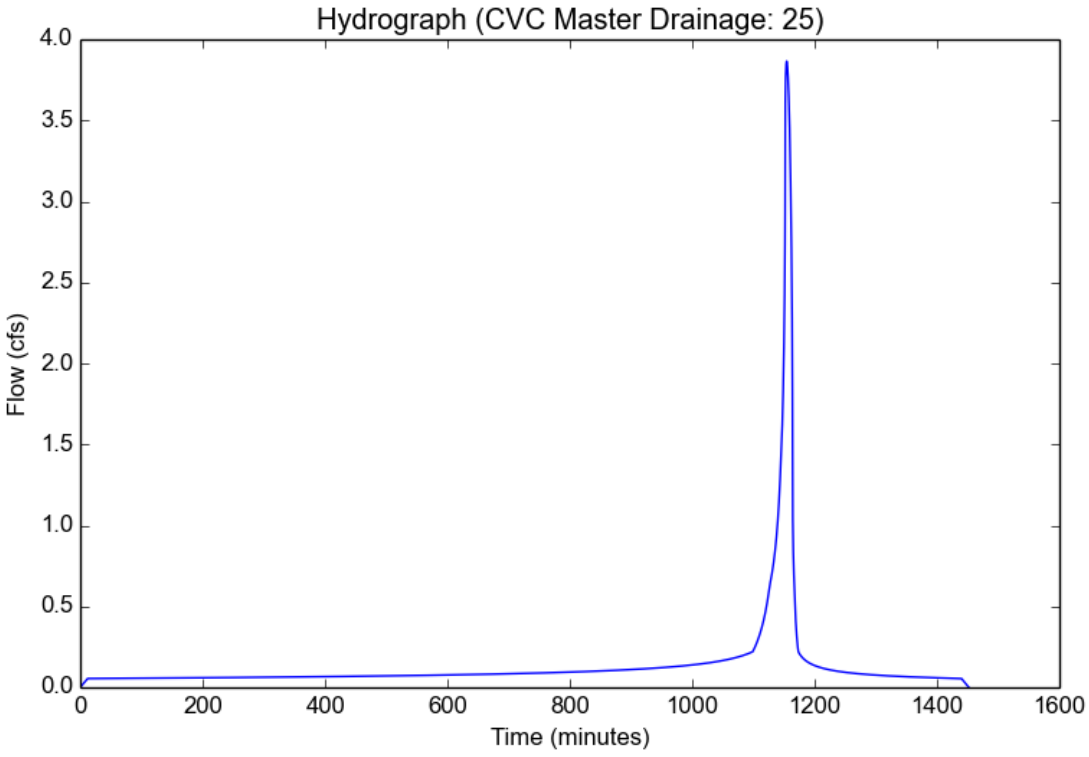
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Proposed hydrology/10-yr/CVC Master
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	25
Area (ac)	3.31
Flow Path Length (ft)	510.0
Flow Path Slope (vft/hft)	0.0047
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.1
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	1.6373
Undeveloped Runoff Coefficient (Cu)	0.6925
Developed Runoff Coefficient (Cd)	0.7132
Time of Concentration (min)	12.0
Clear Peak Flow Rate (cfs)	3.8654
Burned Peak Flow Rate (cfs)	3.8654
24-Hr Clear Runoff Volume (ac-ft)	0.2798
24-Hr Clear Runoff Volume (cu-ft)	12187.4244



Peak Flow Hydrologic Analysis

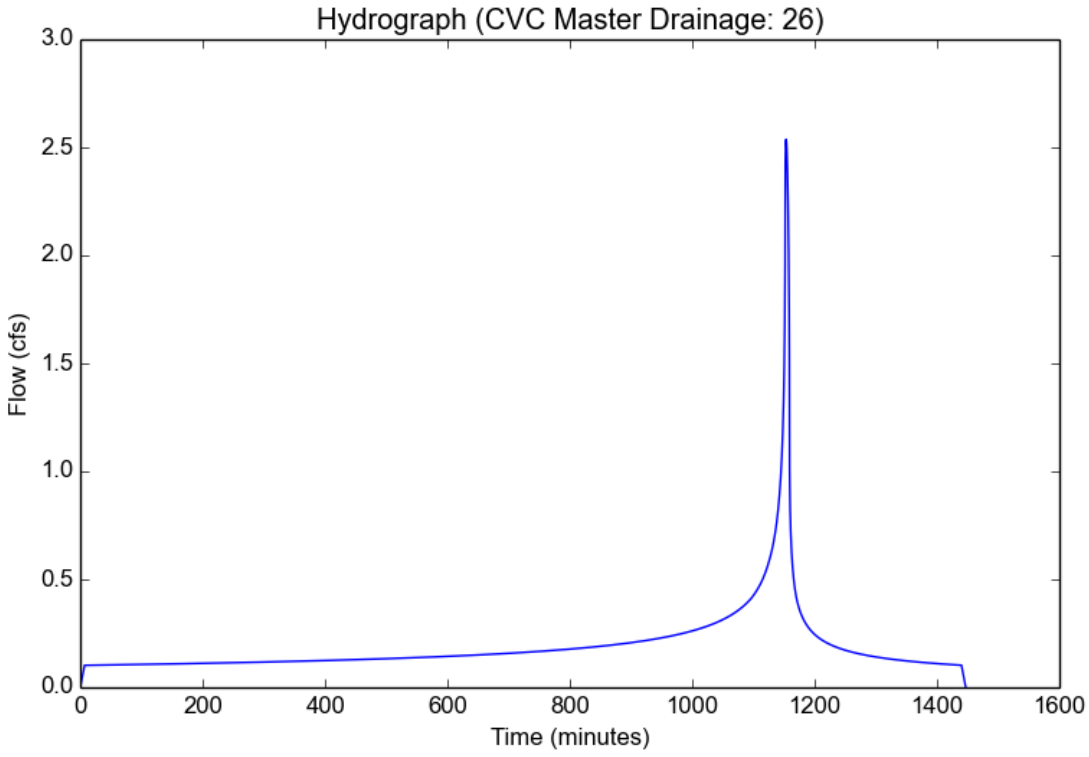
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Proposed hydrology/10-yr/CVC Master
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	26
Area (ac)	1.36
Flow Path Length (ft)	330.0
Flow Path Slope (vft/hft)	0.0103
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.9
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.1094
Undeveloped Runoff Coefficient (Cu)	0.7443
Developed Runoff Coefficient (Cd)	0.8844
Time of Concentration (min)	7.0
Clear Peak Flow Rate (cfs)	2.5372
Burned Peak Flow Rate (cfs)	2.5372
24-Hr Clear Runoff Volume (ac-ft)	0.3852
24-Hr Clear Runoff Volume (cu-ft)	16778.0178



Peak Flow Hydrologic Analysis

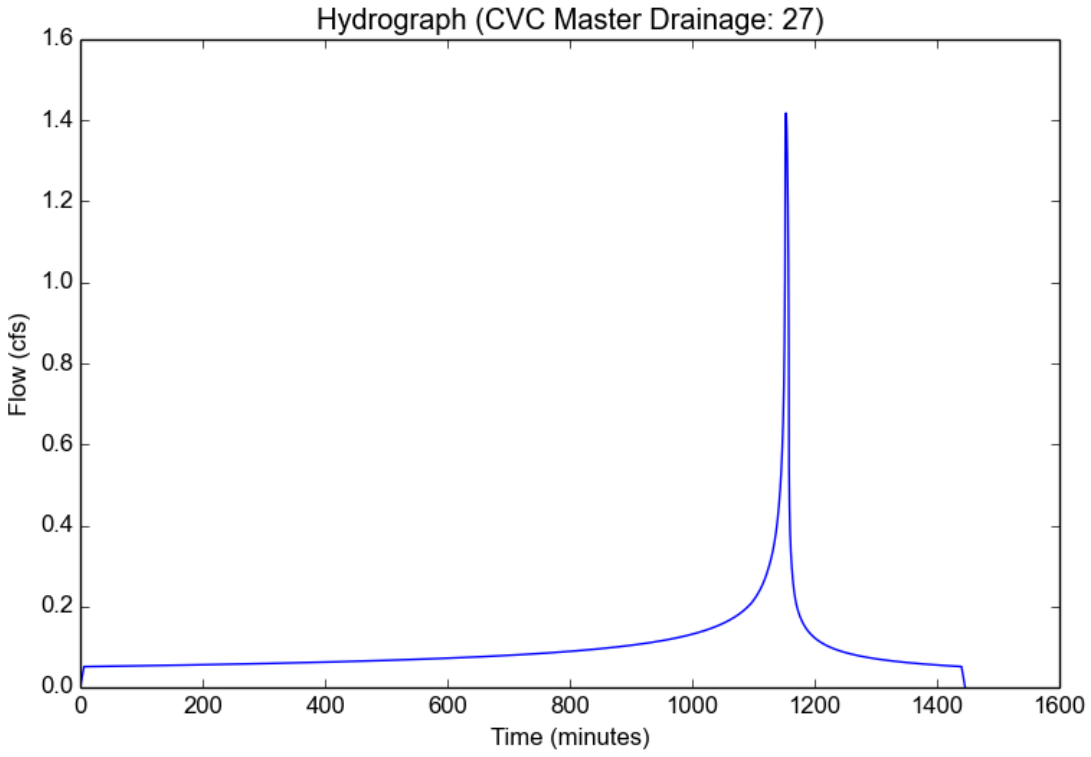
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Proposed hydrology/10-yr/CVC Master
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	27
Area (ac)	0.71
Flow Path Length (ft)	195.0
Flow Path Slope (vft/hft)	0.0038
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.86
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.2678
Undeveloped Runoff Coefficient (Cu)	0.7617
Developed Runoff Coefficient (Cd)	0.8806
Time of Concentration (min)	6.0
Clear Peak Flow Rate (cfs)	1.418
Burned Peak Flow Rate (cfs)	1.418
24-Hr Clear Runoff Volume (ac-ft)	0.194
24-Hr Clear Runoff Volume (cu-ft)	8452.6045



Peak Flow Hydrologic Analysis

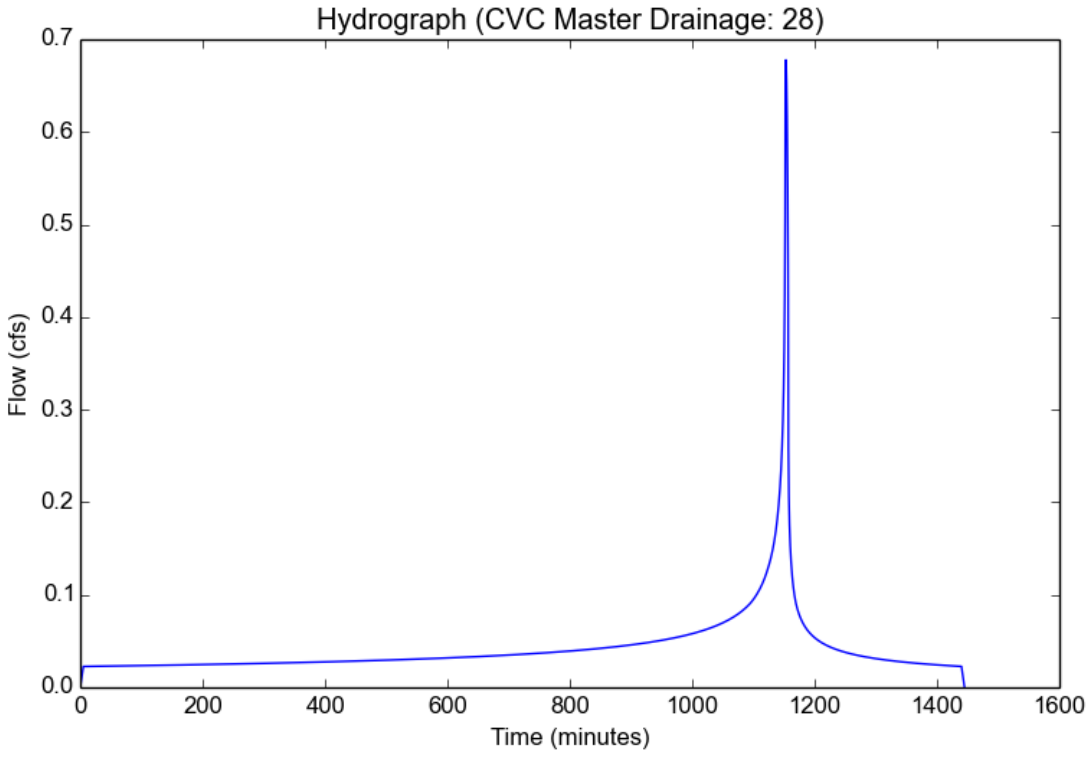
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Proposed hydrology/10-yr/CVC Master
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	28
Area (ac)	0.31
Flow Path Length (ft)	135.0
Flow Path Slope (vft/hft)	0.0126
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.87
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.4708
Undeveloped Runoff Coefficient (Cu)	0.784
Developed Runoff Coefficient (Cd)	0.8849
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	0.6778
Burned Peak Flow Rate (cfs)	0.6778
24-Hr Clear Runoff Volume (ac-ft)	0.0855
24-Hr Clear Runoff Volume (cu-ft)	3724.2893



Peak Flow Hydrologic Analysis

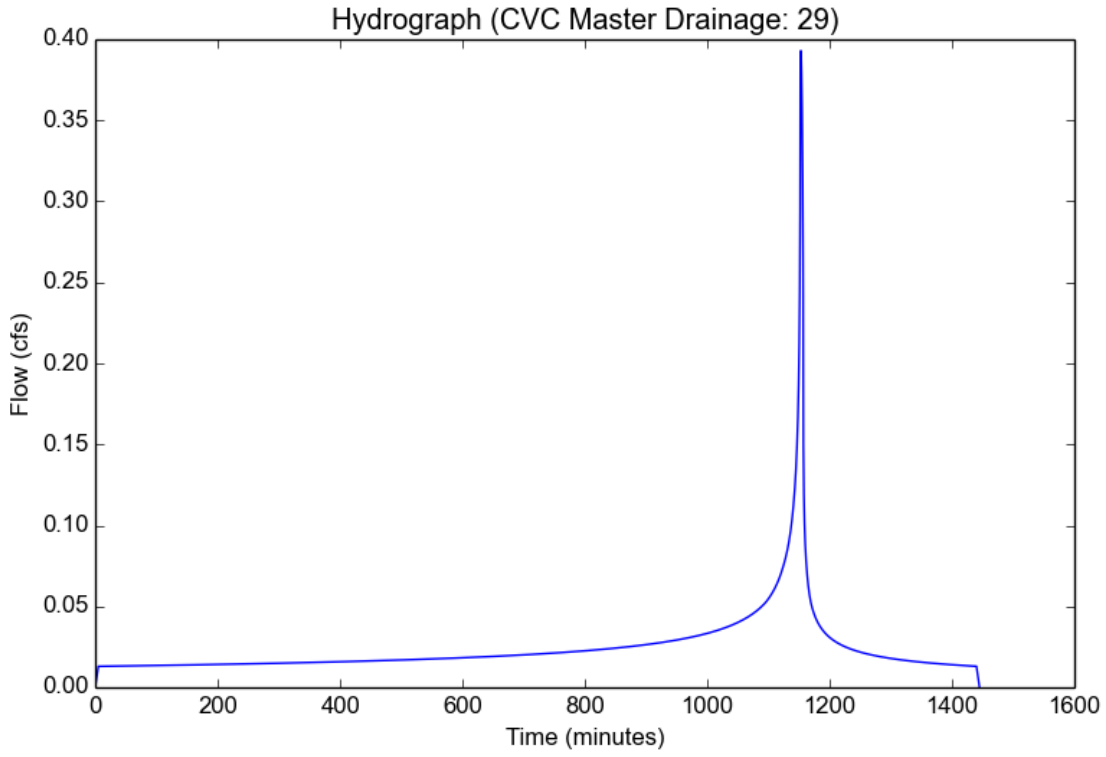
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Proposed hydrology/10-yr/CVC Master
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	29
Area (ac)	0.18
Flow Path Length (ft)	101.0
Flow Path Slope (vft/hft)	0.0089
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.86
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.4708
Undeveloped Runoff Coefficient (Cu)	0.784
Developed Runoff Coefficient (Cd)	0.8838
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	0.393
Burned Peak Flow Rate (cfs)	0.393
24-Hr Clear Runoff Volume (ac-ft)	0.0492
24-Hr Clear Runoff Volume (cu-ft)	2143.0553



Peak Flow Hydrologic Analysis

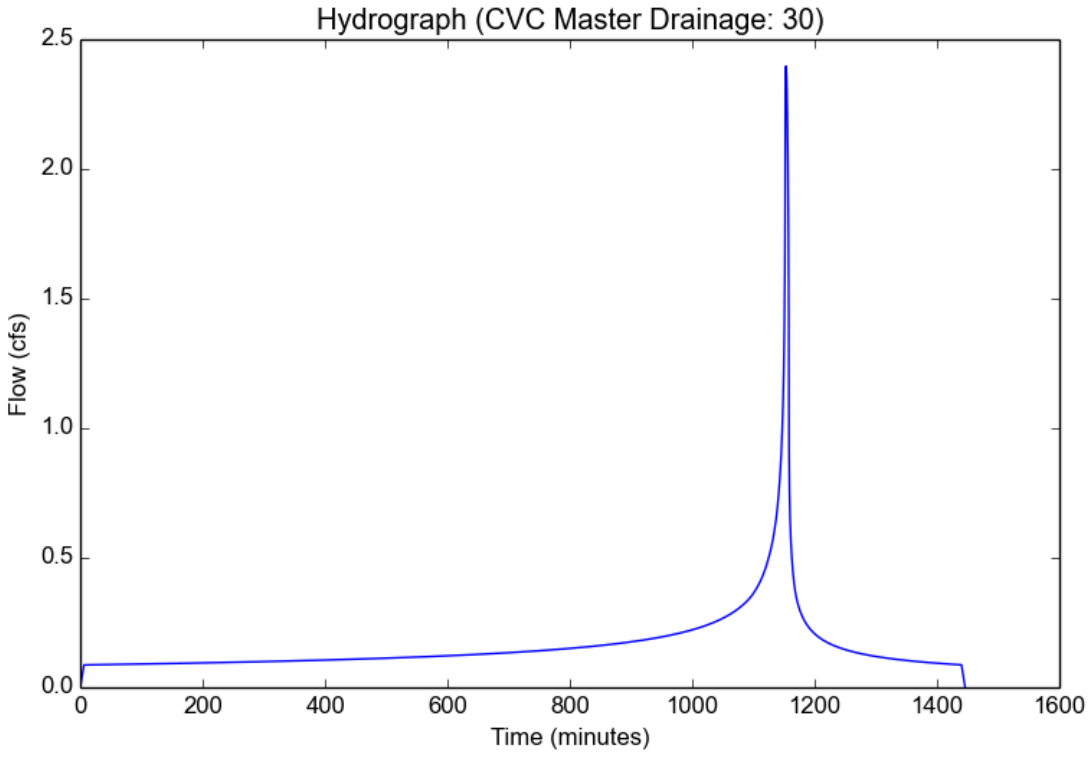
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Proposed hydrology/10-yr/CVC Master
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	30
Area (ac)	1.2
Flow Path Length (ft)	243.0
Flow Path Slope (vft/hft)	0.01
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.86
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.2678
Undeveloped Runoff Coefficient (Cu)	0.7617
Developed Runoff Coefficient (Cd)	0.8806
Time of Concentration (min)	6.0
Clear Peak Flow Rate (cfs)	2.3966
Burned Peak Flow Rate (cfs)	2.3966
24-Hr Clear Runoff Volume (ac-ft)	0.328
24-Hr Clear Runoff Volume (cu-ft)	14286.0921



Peak Flow Hydrologic Analysis

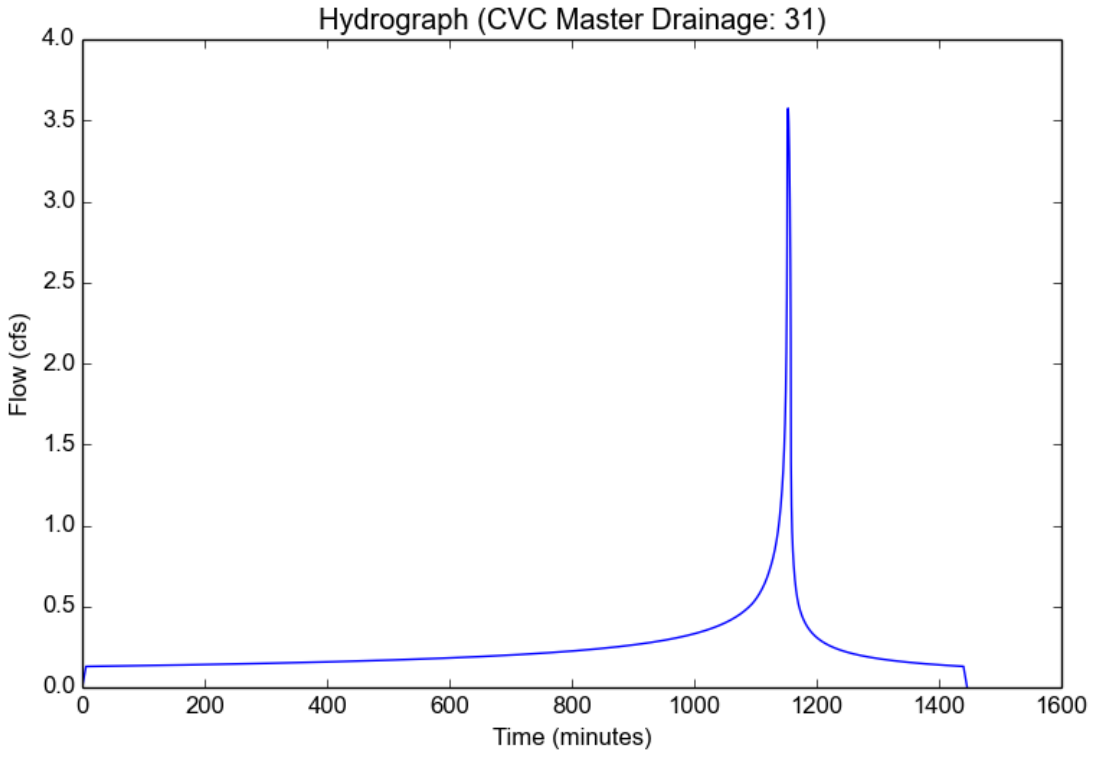
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Proposed hydrology/10-yr/CVC Master
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	31
Area (ac)	1.79
Flow Path Length (ft)	295.0
Flow Path Slope (vft/hft)	0.0112
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.86
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.2678
Undeveloped Runoff Coefficient (Cu)	0.7617
Developed Runoff Coefficient (Cd)	0.8806
Time of Concentration (min)	6.0
Clear Peak Flow Rate (cfs)	3.5749
Burned Peak Flow Rate (cfs)	3.5749
24-Hr Clear Runoff Volume (ac-ft)	0.4892
24-Hr Clear Runoff Volume (cu-ft)	21310.0874



Peak Flow Hydrologic Analysis

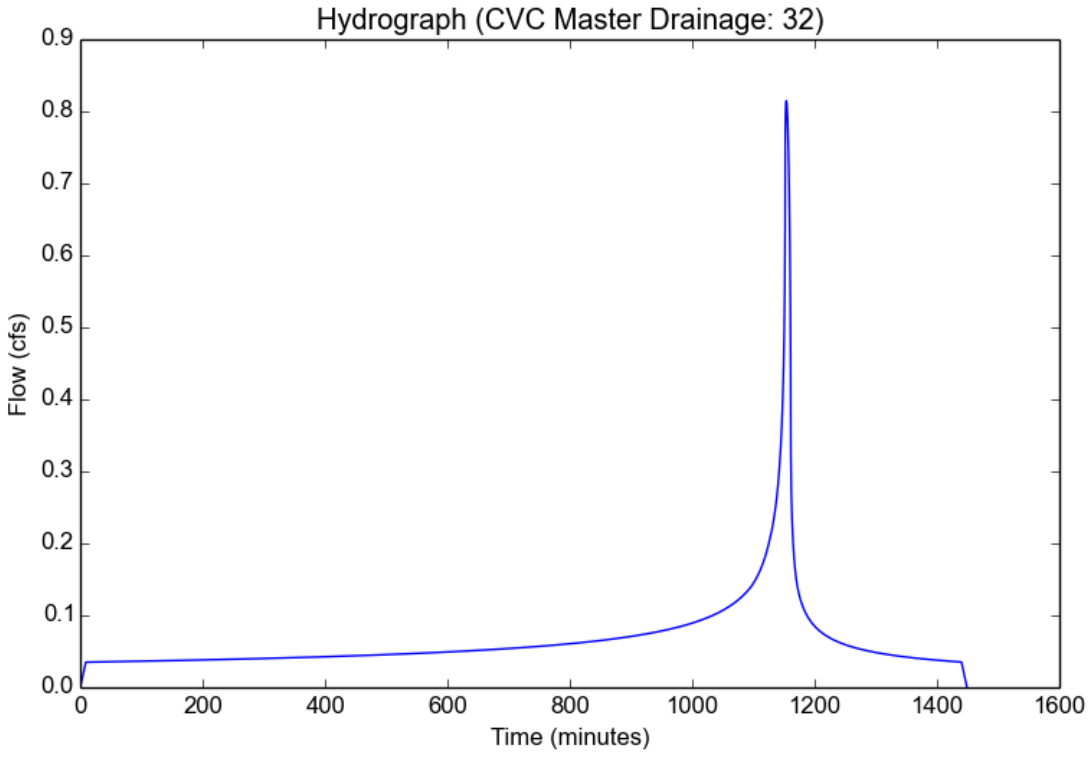
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Proposed hydrology/10-yr/CVC Master
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	32
Area (ac)	0.5
Flow Path Length (ft)	450.0
Flow Path Slope (vft/hft)	0.0053
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.83
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	1.8744
Undeveloped Runoff Coefficient (Cu)	0.7185
Developed Runoff Coefficient (Cd)	0.8691
Time of Concentration (min)	9.0
Clear Peak Flow Rate (cfs)	0.8145
Burned Peak Flow Rate (cfs)	0.8145
24-Hr Clear Runoff Volume (ac-ft)	0.1329
24-Hr Clear Runoff Volume (cu-ft)	5789.6593



Peak Flow Hydrologic Analysis

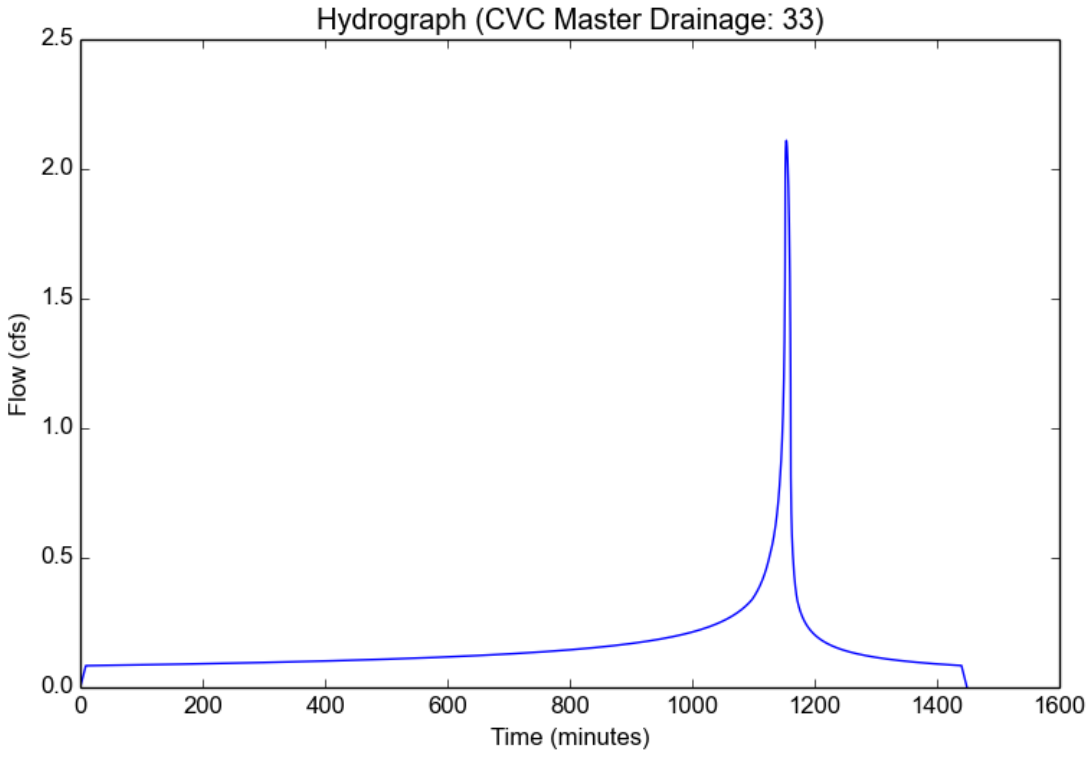
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Proposed hydrology/10-yr/CVC Master
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	33
Area (ac)	1.32
Flow Path Length (ft)	440.0
Flow Path Slope (vft/hft)	0.0066
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.74
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	1.8744
Undeveloped Runoff Coefficient (Cu)	0.7185
Developed Runoff Coefficient (Cd)	0.8528
Time of Concentration (min)	9.0
Clear Peak Flow Rate (cfs)	2.11
Burned Peak Flow Rate (cfs)	2.11
24-Hr Clear Runoff Volume (ac-ft)	0.3214
24-Hr Clear Runoff Volume (cu-ft)	14000.1348



Peak Flow Hydrologic Analysis

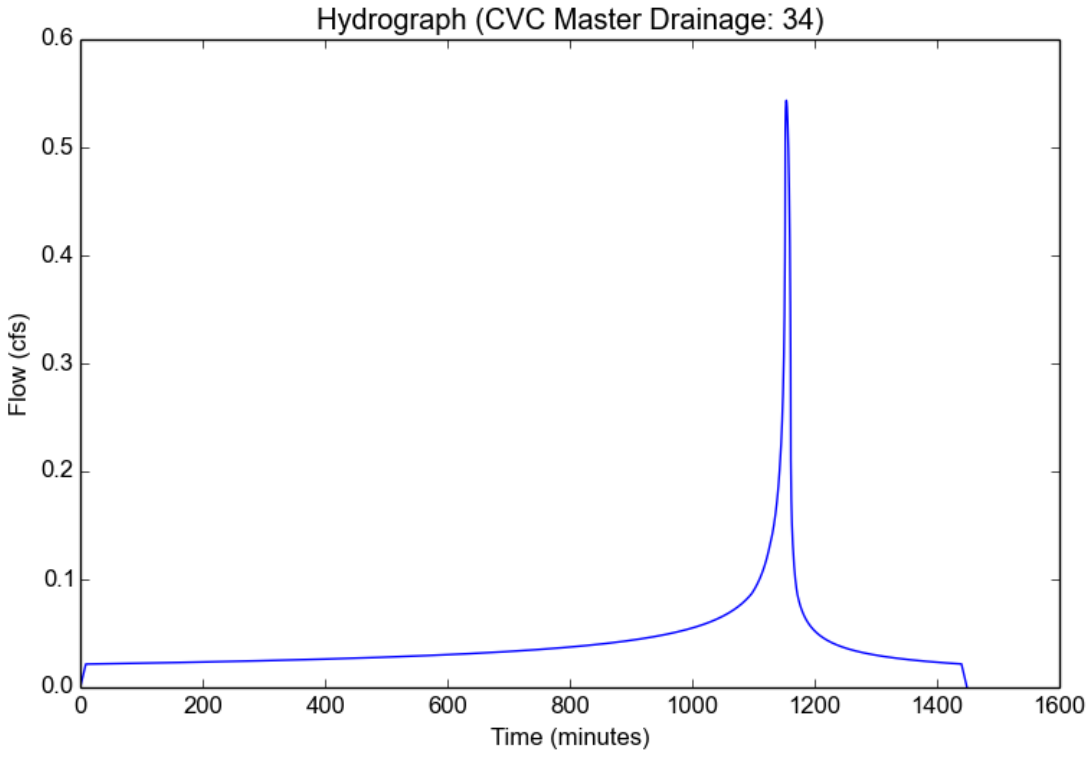
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Proposed hydrology/10-yr/CVC Master
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	34
Area (ac)	0.34
Flow Path Length (ft)	370.0
Flow Path Slope (vft/hft)	0.005
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.74
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	1.8744
Undeveloped Runoff Coefficient (Cu)	0.7185
Developed Runoff Coefficient (Cd)	0.8528
Time of Concentration (min)	9.0
Clear Peak Flow Rate (cfs)	0.5435
Burned Peak Flow Rate (cfs)	0.5435
24-Hr Clear Runoff Volume (ac-ft)	0.0828
24-Hr Clear Runoff Volume (cu-ft)	3606.0953



Peak Flow Hydrologic Analysis

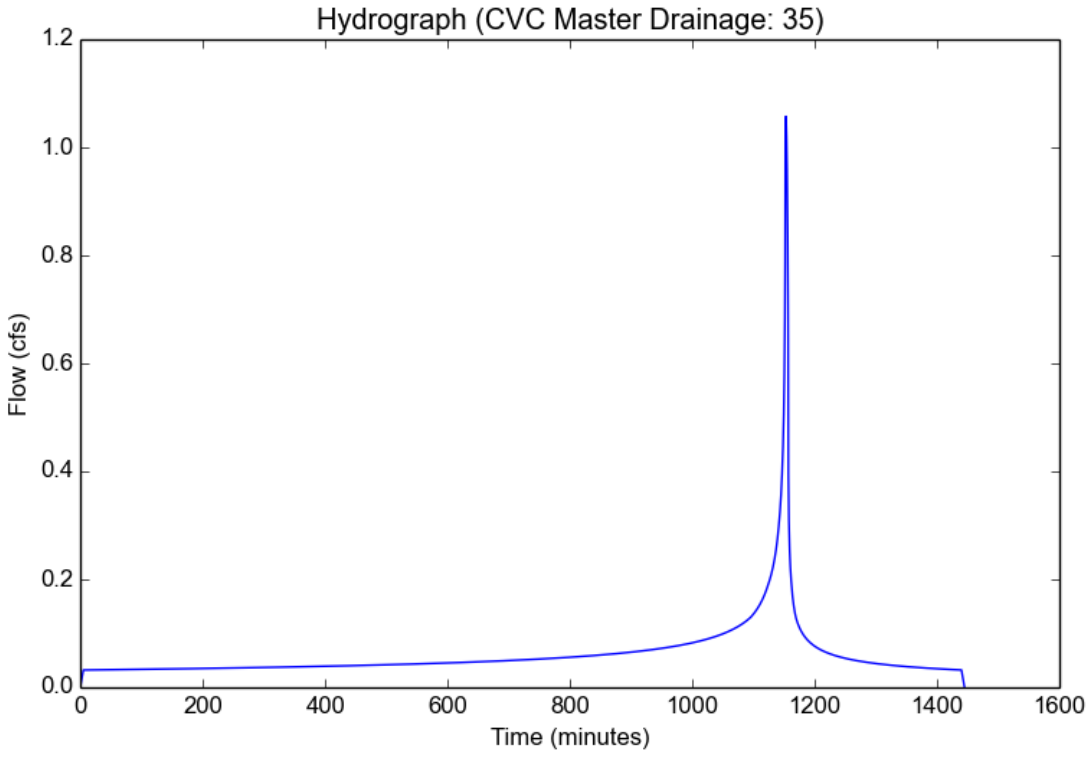
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Proposed hydrology/10-yr/CVC Master
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	35
Area (ac)	0.49
Flow Path Length (ft)	180.0
Flow Path Slope (vft/hft)	0.0111
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.77
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.4708
Undeveloped Runoff Coefficient (Cu)	0.784
Developed Runoff Coefficient (Cd)	0.8733
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	1.0573
Burned Peak Flow Rate (cfs)	1.0573
24-Hr Clear Runoff Volume (ac-ft)	0.123
24-Hr Clear Runoff Volume (cu-ft)	5357.7097



Peak Flow Hydrologic Analysis

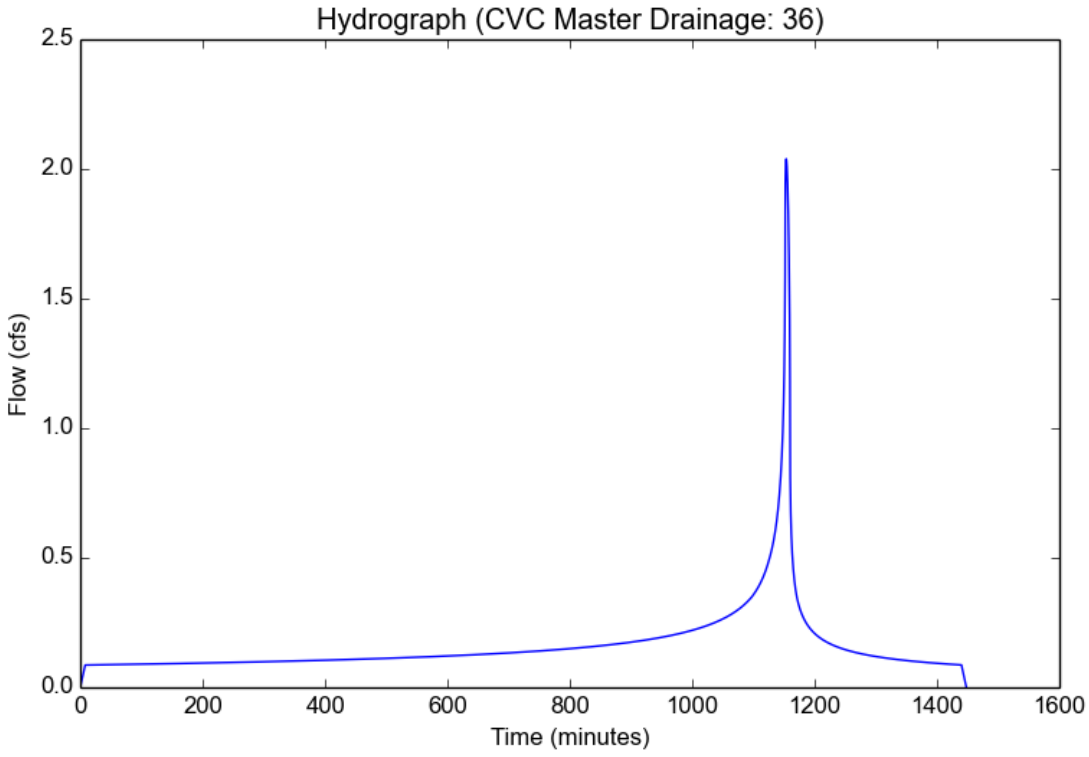
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Proposed hydrology/10-yr/CVC Master
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	36
Area (ac)	1.17
Flow Path Length (ft)	355.0
Flow Path Slope (vft/hft)	0.0066
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.88
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	1.981
Undeveloped Runoff Coefficient (Cu)	0.7302
Developed Runoff Coefficient (Cd)	0.8796
Time of Concentration (min)	8.0
Clear Peak Flow Rate (cfs)	2.0388
Burned Peak Flow Rate (cfs)	2.0388
24-Hr Clear Runoff Volume (ac-ft)	0.3255
24-Hr Clear Runoff Volume (cu-ft)	14180.6916



Peak Flow Hydrologic Analysis

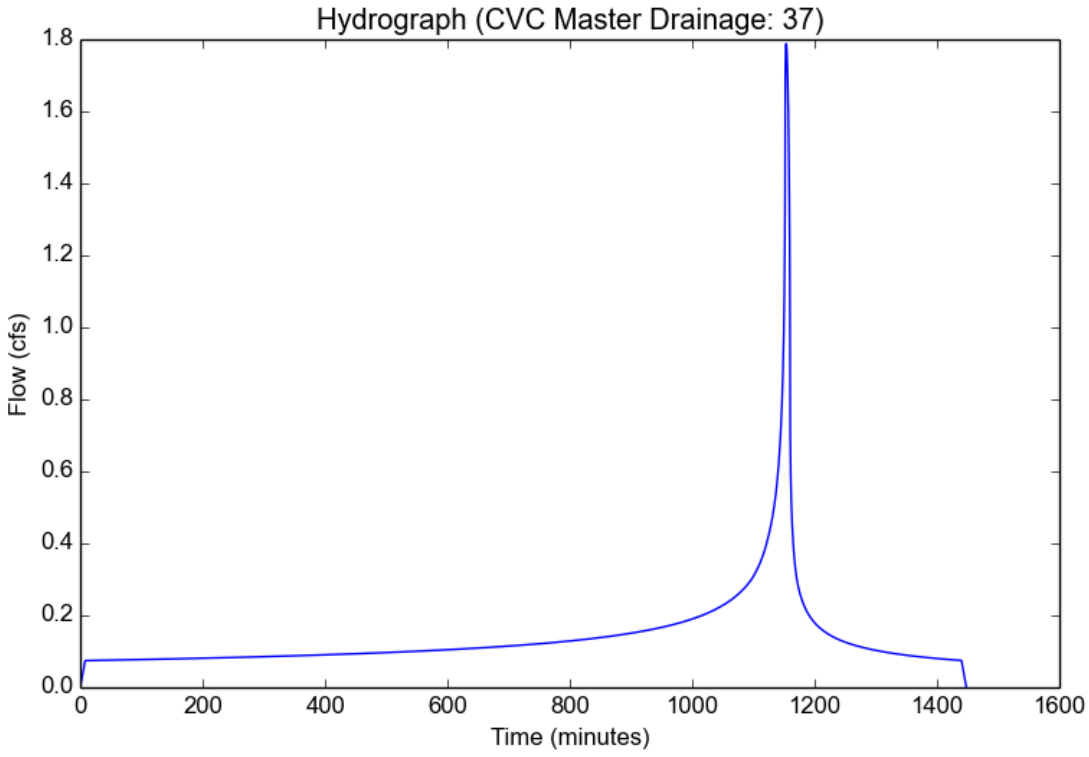
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Proposed hydrology/10-yr/CVC Master
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	37
Area (ac)	1.03
Flow Path Length (ft)	340.0
Flow Path Slope (vft/hft)	0.0044
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.86
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	1.981
Undeveloped Runoff Coefficient (Cu)	0.7302
Developed Runoff Coefficient (Cd)	0.8762
Time of Concentration (min)	8.0
Clear Peak Flow Rate (cfs)	1.7879
Burned Peak Flow Rate (cfs)	1.7879
24-Hr Clear Runoff Volume (ac-ft)	0.2815
24-Hr Clear Runoff Volume (cu-ft)	12261.1622



Peak Flow Hydrologic Analysis

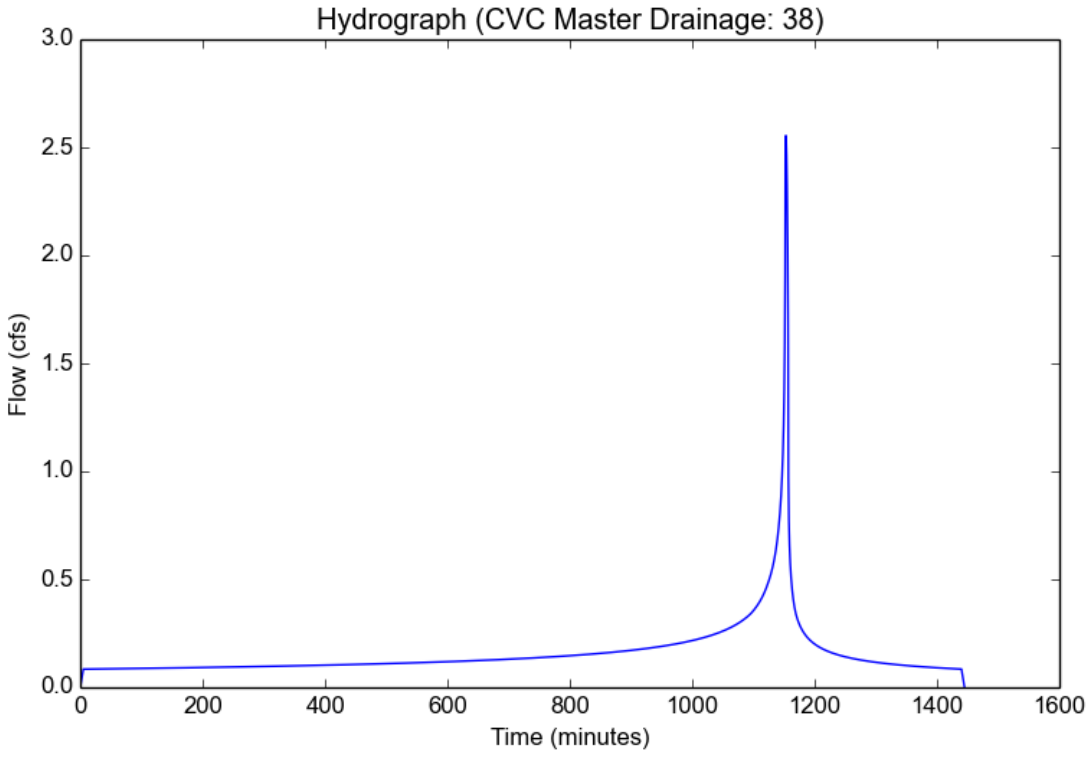
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Proposed hydrology/10-yr/CVC Master
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	38
Area (ac)	1.17
Flow Path Length (ft)	125.0
Flow Path Slope (vft/hft)	0.0162
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.86
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	2.4708
Undeveloped Runoff Coefficient (Cu)	0.784
Developed Runoff Coefficient (Cd)	0.8838
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	2.5547
Burned Peak Flow Rate (cfs)	2.5547
24-Hr Clear Runoff Volume (ac-ft)	0.3198
24-Hr Clear Runoff Volume (cu-ft)	13929.8597



Peak Flow Hydrologic Analysis

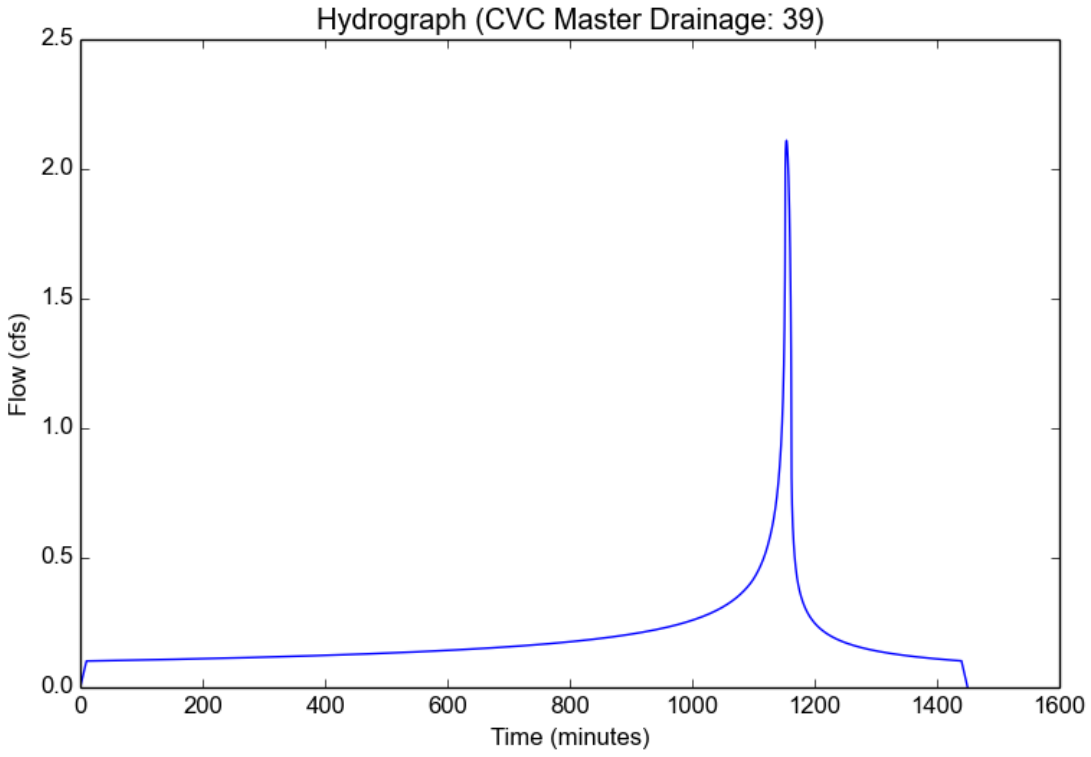
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Proposed hydrology/10-yr/CVC Master
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	39
Area (ac)	1.34
Flow Path Length (ft)	540.0
Flow Path Slope (vft/hft)	0.0065
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.91
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	1.7838
Undeveloped Runoff Coefficient (Cu)	0.7086
Developed Runoff Coefficient (Cd)	0.8828
Time of Concentration (min)	10.0
Clear Peak Flow Rate (cfs)	2.1101
Burned Peak Flow Rate (cfs)	2.1101
24-Hr Clear Runoff Volume (ac-ft)	0.3828
24-Hr Clear Runoff Volume (cu-ft)	16675.2067



Peak Flow Hydrologic Analysis

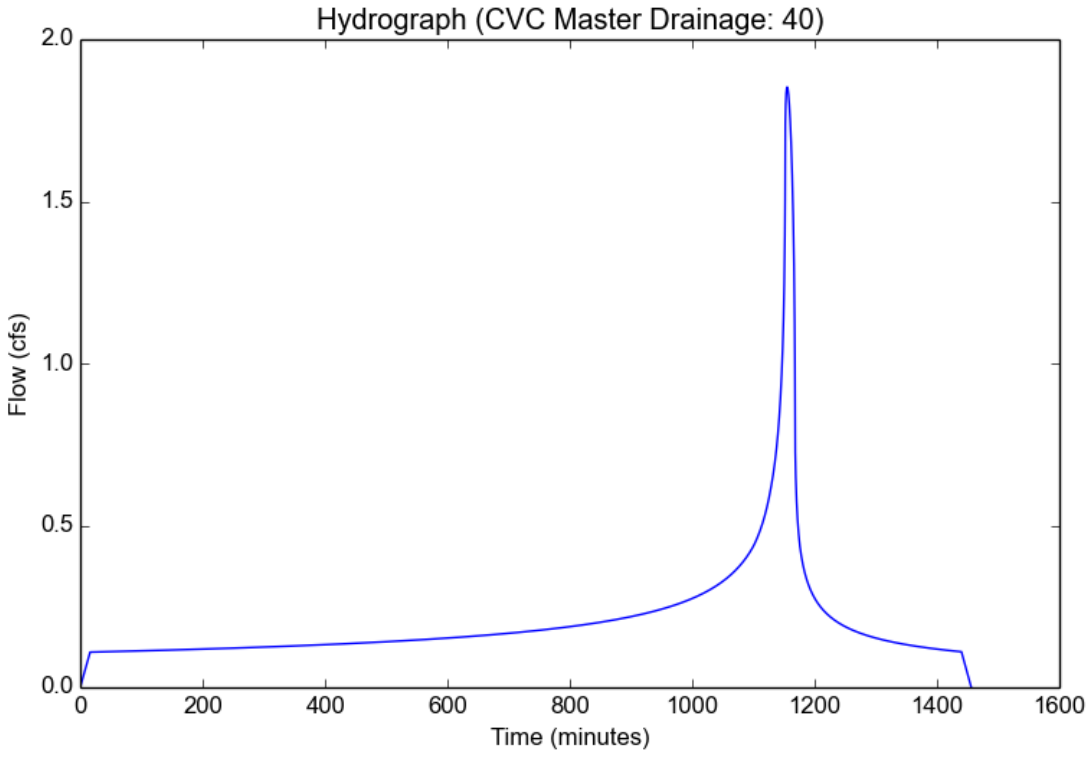
File location: L:/2019/1900126 - CVC Specific Site Plan Support/Design/Drainage/Reference Material/Hydrocalc/Proposed hydrology/10-yr/CVC Master
Version: HydroCalc 1.0.3

Input Parameters

Project Name	CVC Master Drainage
Subarea ID	40
Area (ac)	1.49
Flow Path Length (ft)	1030.0
Flow Path Slope (vft/hft)	0.0049
50-yr Rainfall Depth (in)	5.8
Percent Impervious	0.87
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

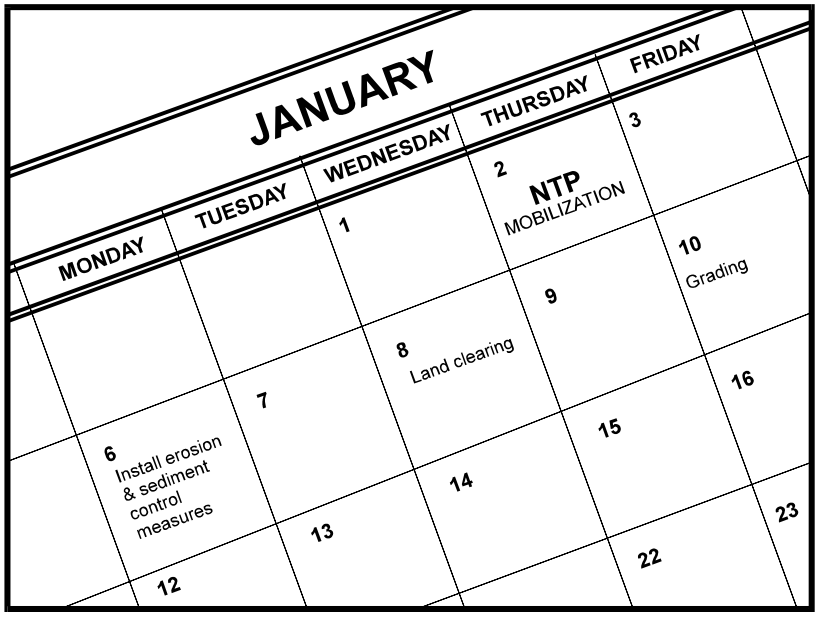
Output Results

Modeled (10-yr) Rainfall Depth (in)	4.1412
Peak Intensity (in/hr)	1.4302
Undeveloped Runoff Coefficient (Cu)	0.6645
Developed Runoff Coefficient (Cd)	0.8694
Time of Concentration (min)	16.0
Clear Peak Flow Rate (cfs)	1.8527
Burned Peak Flow Rate (cfs)	1.8527
24-Hr Clear Runoff Volume (ac-ft)	0.4108
24-Hr Clear Runoff Volume (cu-ft)	17895.4477



APPENDIX C

Scheduling EC-1



Description and Purpose

Scheduling is the development of a written plan that includes sequencing of construction activities and the implementation of BMPs such as erosion control and sediment control while taking local climate (rainfall, wind, etc.) into consideration. The purpose is to reduce the amount and duration of soil exposed to erosion by wind, rain, runoff, and vehicle tracking, and to perform the construction activities and control practices in accordance with the planned schedule.

Suitable Applications

Proper sequencing of construction activities to reduce erosion potential should be incorporated into the schedule of every construction project especially during rainy season. Use of other, more costly yet less effective, erosion and sediment control BMPs may often be reduced through proper construction sequencing.

Limitations

- Environmental constraints such as nesting season prohibitions reduce the full capabilities of this BMP.

Implementation

- Avoid rainy periods. Schedule major grading operations during dry months when practical. Allow enough time before rainfall begins to stabilize the soil with vegetation or physical means or to install sediment trapping devices.
- Plan the project and develop a schedule showing each phase of construction. Clearly show how the rainy season relates

Categories

EC	Erosion Control	☑
SE	Sediment Control	☒
TC	Tracking Control	☒
WE	Wind Erosion Control	☒
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

to soil disturbing and re-stabilization activities. Incorporate the construction schedule into the SWPPP.

- Include on the schedule, details on the rainy season implementation and deployment of:
  - Erosion control BMPs
  - Sediment control BMPs
  - Tracking control BMPs
  - Wind erosion control BMPs
  - Non-stormwater BMPs
  - Waste management and materials pollution control BMPs
- Include dates for activities that may require non-stormwater discharges such as dewatering, sawcutting, grinding, drilling, boring, crushing, blasting, painting, hydro-demolition, mortar mixing, pavement cleaning, etc.
- Work out the sequencing and timetable for the start and completion of each item such as site clearing and grubbing, grading, excavation, paving, foundation pouring utilities installation, etc., to minimize the active construction area during the rainy season.
  - Sequence trenching activities so that most open portions are closed before new trenching begins.
  - Incorporate staged seeding and re-vegetation of graded slopes as work progresses.
  - Schedule establishment of permanent vegetation during appropriate planting time for specified vegetation.
- Non-active areas should be stabilized as soon as practical after the cessation of soil disturbing activities or one day prior to the onset of precipitation.
- Monitor the weather forecast for rainfall.
- When rainfall is predicted, adjust the construction schedule to allow the implementation of soil stabilization and sediment treatment controls on all disturbed areas prior to the onset of rain.
- Be prepared year round to deploy erosion control and sediment control BMPs. Erosion may be caused during dry seasons by un-seasonal rainfall, wind, and vehicle tracking. Keep the site stabilized year round, and retain and maintain rainy season sediment trapping devices in operational condition.
- Apply permanent erosion control to areas deemed substantially complete during the project's defined seeding window.

Costs

Construction scheduling to reduce erosion may increase other construction costs due to reduced economies of scale in performing site grading. The cost effectiveness of scheduling techniques should be compared with the other less effective erosion and sedimentation controls to achieve a cost effective balance.

Inspection and Maintenance

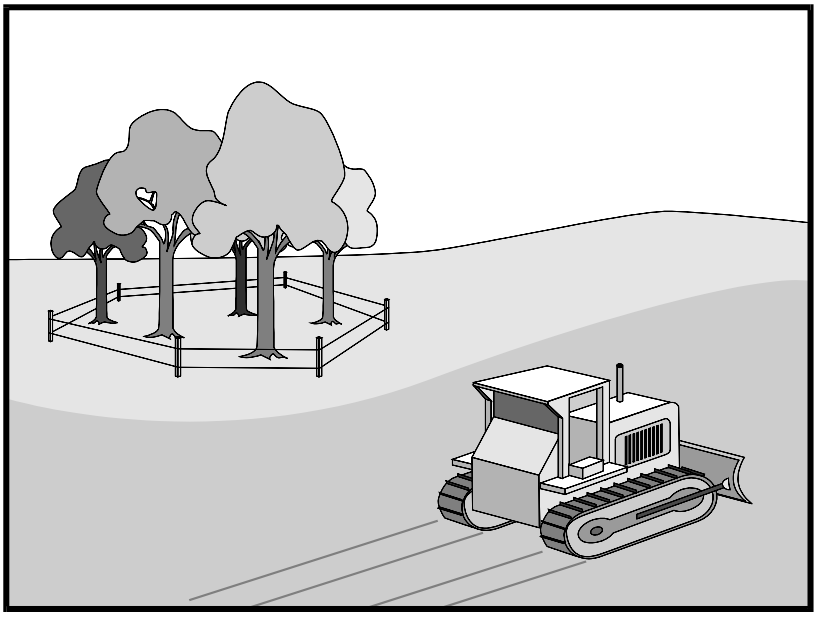
- Verify that work is progressing in accordance with the schedule. If progress deviates, take corrective actions.
- Amend the schedule when changes are warranted.
- Amend the schedule prior to the rainy season to show updated information on the deployment and implementation of construction site BMPs.

References

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities Developing Pollution Prevention Plans and Best Management Practices (EPA 832-R-92-005), U.S. Environmental Protection Agency, Office of Water, September 1992.

Preservation Of Existing Vegetation EC-2



Description and Purpose

Carefully planned preservation of existing vegetation minimizes the potential of removing or injuring existing trees, vines, shrubs, and grasses that protect soil from erosion.

Suitable Applications

Preservation of existing vegetation is suitable for use on most projects. Large project sites often provide the greatest opportunity for use of this BMP. Suitable applications include the following:

- Areas within the site where no construction activity occurs, or occurs at a later date. This BMP is especially suitable to multi year projects where grading can be phased.
- Areas where natural vegetation exists and is designated for preservation. Such areas often include steep slopes, watercourse, and building sites in wooded areas.
- Areas where local, state, and federal government require preservation, such as vernal pools, wetlands, marshes, certain oak trees, etc. These areas are usually designated on the plans, or in the specifications, permits, or environmental documents.
- Where vegetation designated for ultimate removal can be temporarily preserved and be utilized for erosion control and sediment control.

Categories

EC	Erosion Control	☑
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Preservation Of Existing Vegetation EC-2

Limitations

- Requires forward planning by the owner/developer, contractor, and design staff.
- Limited opportunities for use when project plans do not incorporate existing vegetation into the site design.
- For sites with diverse topography, it is often difficult and expensive to save existing trees while grading the site satisfactory for the planned development.

Implementation

The best way to prevent erosion is to not disturb the land. In order to reduce the impacts of new development and redevelopment, projects may be designed to avoid disturbing land in sensitive areas of the site (e.g., natural watercourses, steep slopes), and to incorporate unique or desirable existing vegetation into the site's landscaping plan. Clearly marking and leaving a buffer area around these unique areas during construction will help to preserve these areas as well as take advantage of natural erosion prevention and sediment trapping.

Existing vegetation to be preserved on the site must be protected from mechanical and other injury while the land is being developed. The purpose of protecting existing vegetation is to ensure the survival of desirable vegetation for shade, beautification, and erosion control. Mature vegetation has extensive root systems that help to hold soil in place, thus reducing erosion. In addition, vegetation helps keep soil from drying rapidly and becoming susceptible to erosion. To effectively save existing vegetation, no disturbances of any kind should be allowed within a defined area around the vegetation. For trees, no construction activity should occur within the drip line of the tree.

Timing

- Provide for preservation of existing vegetation prior to the commencement of clearing and grubbing operations or other soil disturbing activities in areas where no construction activity is planned or will occur at a later date.

Design and Layout

- Mark areas to be preserved with temporary fencing. Include sufficient setback to protect roots.
  - Orange colored plastic mesh fencing works well.
  - Use appropriate fence posts and adequate post spacing and depth to completely support the fence in an upright position.
- Locate temporary roadways, stockpiles, and layout areas to avoid stands of trees, shrubs, and grass.
- Consider the impact of grade changes to existing vegetation and the root zone.
- Maintain existing irrigation systems where feasible. Temporary irrigation may be required.
- Instruct employees and subcontractors to honor protective devices. Prohibit heavy equipment, vehicular traffic, or storage of construction materials within the protected area.

Costs

There is little cost associated with preserving existing vegetation if properly planned during the project design, and these costs may be offset by aesthetic benefits that enhance property values. During construction, the cost for preserving existing vegetation will likely be less than the cost of applying erosion and sediment controls to the disturbed area. Replacing vegetation inadvertently destroyed during construction can be extremely expensive, sometimes in excess of $10,000 per tree.

Inspection and Maintenance

During construction, the limits of disturbance should remain clearly marked at all times. Irrigation or maintenance of existing vegetation should be described in the landscaping plan. If damage to protected trees still occurs, maintenance guidelines described below should be followed:

- Verify that protective measures remain in place. Restore damaged protection measures immediately.
- Serious tree injuries shall be attended to by an arborist.
- Damage to the crown, trunk, or root system of a retained tree shall be repaired immediately.
- Trench as far from tree trunks as possible, usually outside of the tree drip line or canopy. Curve trenches around trees to avoid large roots or root concentrations. If roots are encountered, consider tunneling under them. When trenching or tunneling near or under trees to be retained, place tunnels at least 18 in. below the ground surface, and not below the tree center to minimize impact on the roots.
- Do not leave tree roots exposed to air. Cover exposed roots with soil as soon as possible. If soil covering is not practical, protect exposed roots with wet burlap or peat moss until the tunnel or trench is ready for backfill.
- Cleanly remove the ends of damaged roots with a smooth cut.
- Fill trenches and tunnels as soon as possible. Careful filling and tamping will eliminate air spaces in the soil, which can damage roots.
- If bark damage occurs, cut back all loosened bark into the undamaged area, with the cut tapered at the top and bottom and drainage provided at the base of the wood. Limit cutting the undamaged area as much as possible.
- Aerate soil that has been compacted over a trees root zone by punching holes 12 in. deep with an iron bar, and moving the bar back and forth until the soil is loosened. Place holes 18 in. apart throughout the area of compacted soil under the tree crown.
- Fertilization
  - Fertilize stressed or damaged broadleaf trees to aid recovery.
  - Fertilize trees in the late fall or early spring.

- Apply fertilizer to the soil over the feeder roots and in accordance with label instructions, but never closer than 3 ft to the trunk. Increase the fertilized area by one-fourth of the crown area for conifers that have extended root systems.

- Retain protective measures until all other construction activity is complete to avoid damage during site cleanup and stabilization.

References

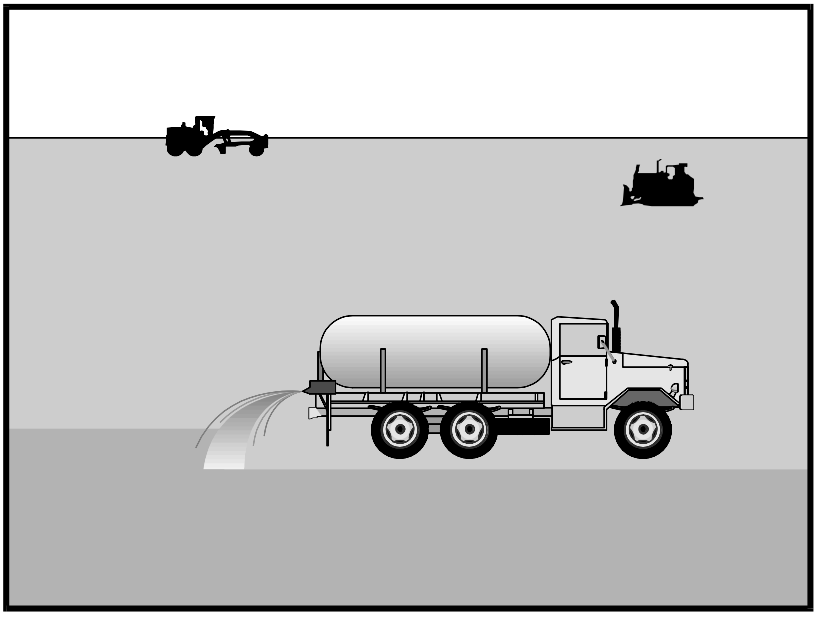
County of Sacramento Tree Preservation Ordinance, September 1981.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Water Quality Management Plan for The Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.

Soil Binders EC-5



Categories

EC	Erosion Control	☑
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	☒
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:
☑ **Primary Category**
☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

EC-3 Hydraulic Mulch
EC-4 Hydroseeding
EC-6 Straw Mulch
EC-7 Geotextiles and Mats
EC-8 Wood Mulching

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Soil binding consists of application and maintenance of a soil stabilizer to exposed soil surfaces. Soil binders are materials applied to the soil surface to temporarily prevent water and wind induced erosion of exposed soils on construction sites.

Suitable Applications

Soil binders are typically applied to disturbed areas requiring temporary protection. Because soil binders, when used as a stand-alone practice, can often be incorporated into the soil, they are a good alternative to mulches in areas where grading activities will soon resume. Soil binders are commonly used in the following areas:

- Rough graded soils that will be inactive for a short period of time
- Soil stockpiles
- Temporary haul roads prior to placement of crushed rock
- Compacted soil road base
- Construction staging, materials storage, and layout areas

Limitations

- Soil binders are temporary in nature and may need reapplication.
- Soil binders require a minimum curing time until fully effective, as prescribed by the manufacturer. Curing time

may be 24 hours or longer. Soil binders may need reapplication after a storm event.

- Soil binders will generally experience spot failures during heavy rainfall events. If runoff penetrates the soil at the top of a slope treated with a soil binder, it is likely that the runoff will undercut the stabilized soil layer and discharge at a point further down slope.
- Plant-material-based soil binders do not generally hold up to pedestrian or vehicular traffic across treated areas as well as polymeric emulsion blends or cementitious-based binders.
- Soil binders may not sufficiently penetrate compacted soils.
- Some soil binders are soil texture specific in terms of their effectiveness. For example, polyacrylamides (PAMs) work very well on silt and clayey soils but their performance decreases dramatically in sandy soils.
- Some soil binders may not perform well with low relative humidity. Under rainy conditions, some agents may become slippery or leach out of the soil.
- Soil binders may not cure if low temperatures occur within 24 hours of application.
- The water quality impacts of some chemical soil binders are relatively unknown and some may have water quality impacts due to their chemical makeup. Additionally, these chemical may require non-visible pollutant monitoring. Products should be evaluated for project-specific implementation by the SWPPP Preparer. Refer to the product Material Safety Data Sheet for chemical properties.

Implementation

General Considerations

- Soil binders should conform to local municipality specifications and requirements.
- Site soil types will dictate appropriate soil binders to be used.
- A soil binder must be environmentally benign (non-toxic to plant and animal life), easy to apply, easy to maintain, economical, and should not stain paved or painted surfaces. Soil binders should not pollute stormwater when cured. Obtain a Material Safety Data Sheet (MSDS) from the manufacturer to ensure non-toxicity.
- Stormwater runoff from PAM treated soils should pass through one of the following sediment control BMP prior to discharging to surface waters.
    - When the total drainage area is greater than or equal to 5 acres, PAM treated areas should drain to a sediment basin.
    - Areas less than 5 acres should drain to sediment control BMPs, such as a sediment trap, or a series of check dams. The total number of check dams used should be maximized to achieve the greatest amount of settlement of sediment prior to discharging from the site. Each check dam should be spaced evenly in the drainage channel through which stormwater flows are discharged off site.

- Performance of soil binders depends on temperature, humidity, and traffic across treated areas.
- Avoid over spray onto roads, sidewalks, drainage channels, existing vegetation, etc.
- Additional guidance on the comparison and selection of temporary slope stabilization methods is provided in Appendix F of the Handbook.

Selecting a Soil Binder

Properties of common soil binders used for erosion control are provided on Table 1 at the end of this Fact Sheet. Use Table 1 to select an appropriate soil binder. Refer to WE-1, Wind Erosion Control, for dust control soil binders.

Factors to consider when selecting a soil binder include the following:

- Suitability to situation - Consider where the soil binder will be applied, if it needs a high resistance to leaching or abrasion, and whether it needs to be compatible with any existing vegetation. Determine the length of time soil stabilization will be needed, and if the soil binder will be placed in an area where it will degrade rapidly. In general, slope steepness is not a discriminating factor for the listed soil binders.
- Soil types and surface materials - Fines and moisture content are key properties of surface materials. Consider a soil binder's ability to penetrate, likelihood of leaching, and ability to form a surface crust on the surface materials.
- Frequency of application - The frequency of application is related to the functional longevity of the binder, which can be affected by subgrade conditions, surface type, climate, and maintenance schedule.
- Frequent applications could lead to high costs. Application frequency may be minimized if the soil binder has good penetration, low evaporation, and good longevity. Consider also that frequent application will require frequent equipment clean up.

Plant-Material-Based (Short Lived, <6 months) Binders

Guar: Guar is a non-toxic, biodegradable, natural galactomannan-based hydrocolloid treated with dispersant agents for easy field mixing. It should be mixed with water at the rate of 11 to 15 lb per 1,000 gallons. Recommended minimum application rates are as follows:

Application Rates for Guar Soil Stabilizer

Slope (H:V):	Flat	4:1	3:1	2:1	1:1
lb/acre:	40	45	50	60	70

Psyllium: Psyllium is composed of the finely ground muciloid coating of plantago seeds that is applied as a dry powder or in a wet slurry to the surface of the soil. It dries to form a firm but rewettable membrane that binds soil particles together, but permits germination and growth of seed. Psyllium requires 12 to 18 hours drying time. Application rates should be from 80 to 200 lb/acre, with enough water in solution to allow for a uniform slurry flow.

Starch: Starch is non-ionic, cold water soluble (pre-gelatinized) granular cornstarch. The material is mixed with water and applied at the rate of 150 lb/acre. Approximate drying time is 9 to 12 hours.

Plant-Material-Based (Long Lived, 6-12 months) Binders

Pitch and Rosin Emulsion: Generally, a non-ionic pitch and rosin emulsion has a minimum solids content of 48%. The rosin should be a minimum of 26% of the total solids content. The soil stabilizer should be non-corrosive, water dilutable emulsion that upon application cures to a water insoluble binding and cementing agent. For soil erosion control applications, the emulsion is diluted and should be applied as follows:

- For clayey soil: 5 parts water to 1 part emulsion
- For sandy soil: 10 parts water to 1 part emulsion

Application can be by water truck or hydraulic seeder with the emulsion and product mixture applied at the rate specified by the manufacturer.

Polymeric Emulsion Blend Binders

Acrylic Copolymers and Polymers: Polymeric soil stabilizers should consist of a liquid or solid polymer or copolymer with an acrylic base that contains a minimum of 55% solids. The polymeric compound should be handled and mixed in a manner that will not cause foaming or should contain an anti-foaming agent. The polymeric emulsion should not exceed its shelf life or expiration date; manufacturers should provide the expiration date. Polymeric soil stabilizer should be readily miscible in water, non-injurious to seed or animal life, non-flammable, should provide surface soil stabilization for various soil types without totally inhibiting water infiltration, and should not re-emulsify when cured. The applied compound typically requires 12 to 24 hours drying time. Liquid copolymer should be diluted at a rate of 10 parts water to 1 part polymer and the mixture applied to soil at a rate of 1,175 gallons/acre.

Liquid Polymers of Methacrylates and Acrylates: This material consists of a tackifier/sealer that is a liquid polymer of methacrylates and acrylates. It is an aqueous 100% acrylic emulsion blend of 40% solids by volume that is free from styrene, acetate, vinyl, ethoxylated surfactants or silicates. For soil stabilization applications, it is diluted with water in accordance with the manufacturer's recommendations, and applied with a hydraulic seeder at the rate of 20 gallons/acre. Drying time is 12 to 18 hours after application.

Copolymers of Sodium Acrylates and Acrylamides: These materials are non-toxic, dry powders that are copolymers of sodium acrylate and acrylamide. They are mixed with water and applied to the soil surface for erosion control at rates that are determined by slope gradient:

Slope Gradient (H:V)	lb/acre
Flat to 5:1	3.0 – 5.0
5:1 to 3:1	5.0 – 10.0
2:1 to 1:1	10.0 – 20.0

Poly-Acrylamide (PAM) and Copolymer of Acrylamide**:** Linear copolymer polyacrylamide for use as a soil binder is packaged as a dry flowable solid, as a liquid. Refer to the manufacturer's recommendation for dilution and application rates as they vary based on liquid or dry form, site conditions and climate.

- Limitations specific to PAM are as follows:
  - Do not use PAM on a slope that flows into a water body without passing through a sediment trap or sediment basin.
  - The specific PAM copolymer formulation must be anionic. Cationic PAM should not be used in any application because of known aquatic toxicity problems. Only the highest drinking water grade PAM, certified for compliance with ANSI/NSF Standard 60 for drinking water treatment, should be used for soil applications.
  - PAM designated for erosion and sediment control should be "water soluble" or "linear" or "non-cross linked".
  - PAM should not be used as a stand-alone BMP to protect against water-based erosion. When combined with mulch, its effectiveness increases dramatically.

Hydro-Colloid Polymers: Hydro-Colloid Polymers are various combinations of dry flowable poly-acrylamides, copolymers and hydro-colloid polymers that are mixed with water and applied to the soil surface at rates of 55 to 60 lb/acre. Drying times are 0 to 4 hours.

Cementitious-Based Binders

Gypsum: This is a formulated gypsum based product that readily mixes with water and mulch to form a thin protective crust on the soil surface. It is composed of high purity gypsum that is ground, calcined and processed into calcium sulfate hemihydrate with a minimum purity of 86%. It is mixed in a hydraulic seeder and applied at rates 4,000 to 12,000 lb/acre. Drying time is 4 to 8 hours.

Applying Soil Binders

After selecting an appropriate soil binder, the untreated soil surface must be prepared before applying the soil binder. The untreated soil surface must contain sufficient moisture to assist the agent in achieving uniform distribution. In general, the following steps should be followed:

- Follow manufacturer's written recommendations for application rates, pre-wetting of application area, and cleaning of equipment after use.
- Prior to application, roughen embankment and fill areas.
- Consider the drying time for the selected soil binder and apply with sufficient time before anticipated rainfall. Soil binders should not be applied during or immediately before rainfall.
- Avoid over spray onto roads, sidewalks, drainage channels, sound walls, existing vegetation, etc.

- Soil binders should not be applied to frozen soil, areas with standing water, under freezing or rainy conditions, or when the temperature is below 40°F during the curing period.
- More than one treatment is often necessary, although the second treatment may be diluted or have a lower application rate.
- Generally, soil binders require a minimum curing time of 24 hours before they are fully effective. Refer to manufacturer's instructions for specific cure time.
- For liquid agents:
  - Crown or slope ground to avoid ponding.
  - Uniformly pre-wet ground at 0.03 to 0.3 gal/yd^2 or according to manufacturer's recommendations.
  - Apply solution under pressure. Overlap solution 6 to 12 in.
  - Allow treated area to cure for the time recommended by the manufacturer; typically at least 24 hours.
  - Apply second treatment before first treatment becomes ineffective, using 50% application rate.
  - In low humidities, reactivate chemicals by re-wetting with water at 0.1 to 0.2 gal/yd^2.

Costs

Costs vary according to the soil stabilizer selected for implementation. The following are approximate installed costs:

Soil Binder	Cost per Acre (2004)[1]	Estimated Cost per Acre (2009)[2]
Plant-Material-Based (Short Lived) Binders	$700-$900	$770-$990
Plant-Material-Based (Long Lived) Binders	$1,200-$1,500	$1,320-$1,650
Polymeric Emulsion Blend Binders	$700 -$1,500	$770-$1,650
Cementitious-Based Binders	$800-$1,200	$880-$1,350

1. Source: Cost information received from individual product manufacturers solicited by Geosyntec Consultants (2004).

2. 2009 costs reflect a 10% escalation over year 2004 costs. Escalation based on informal survey of industry trends. Note: Expected cost increase is offset by competitive economic conditions.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.

- Areas where erosion is evident should be repaired and BMPs re-applied as soon as possible. Care should be exercised to minimize the damage to protected areas while making repairs, as any area damaged will require re-application of BMPs.
- Reapply the selected soil binder as needed to maintain effectiveness.

Table 1 Properties of Soil Binders for Erosion Control

Evaluation Criteria	Binder Type			
	Plant Material Based (Short Lived)	Plant Material Based (Long Lived)	Polymeric Emulsion Blends	Cementitious-Based Binders
Relative Cost	Low	Moderate to High	Low to High	Low to Moderate
Resistance to Leaching	High	High	Low to Moderate	Moderate
Resistance to Abrasion	Moderate	Low	Moderate to High	Moderate to High
Longevity	Short to Medium	Medium	Medium to Long	Medium
Minimum Curing Time before Rain	9 to 18 hours	19 to 24 hours	0 to 24 hours	4 to 8 hours
Compatibility with Existing Vegetation	Good	Poor	Poor	Poor
Mode of Degradation	Biodegradable	Biodegradable	Photodegradable/ Chemically Degradable	Photodegradable/ Chemically Degradable
Labor Intensive	No	No	No	No
Specialized Application Equipment	Water Truck or Hydraulic Mulcher	Water Truck or Hydraulic Mulcher	Water Truck or Hydraulic Mulcher	Water Truck or Hydraulic Mulcher
Liquid/Powder	Powder	Liquid	Liquid/Powder	Powder
Surface Crusting	Yes, but dissolves on rewetting	Yes	Yes, but dissolves on rewetting	Yes
Clean Up	Water	Water	Water	Water
Erosion Control Application Rate	Varies (1)	Varies (1)	Varies (1)	4,000 to 12,000 lbs/acre

(1) See Implementation for specific rates.

References

Erosion Control Pilot Study Report, State of California Department of Transportation (Caltrans), June 2000.

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

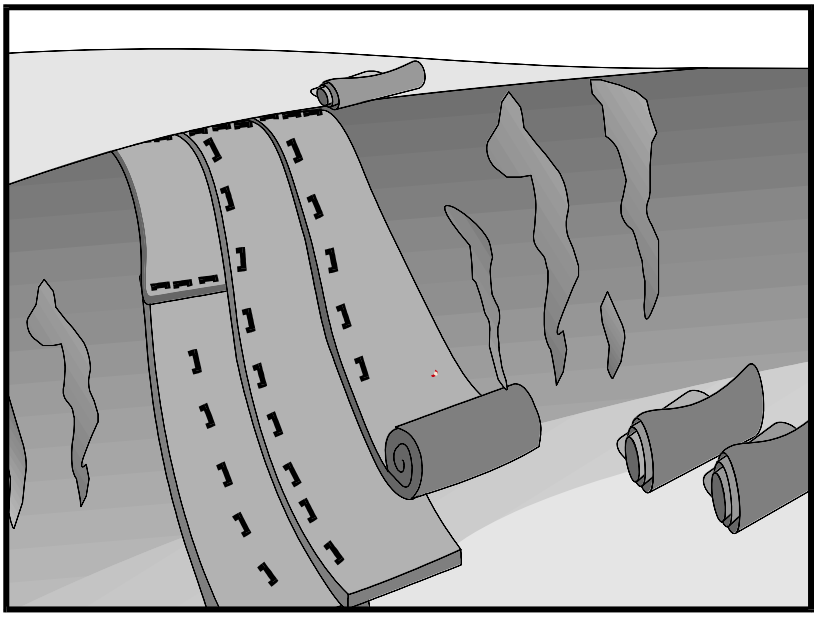
Sedimentation and Erosion Control, An Inventory of Current Practices Draft, US EPA, April 1990.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Guidance Document: Soil Stabilization for Temporary Slopes, State of California Department of Transportation (Caltrans), November 1999.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

Geotextiles and Mats EC-7



Description and Purpose

Mattings, or Rolled Erosion Control Products (RECPs), can be made of natural or synthetic materials or a combination of the two. RECPs are used to cover the soil surface to reduce erosion from rainfall impact, hold soil in place, and absorb and hold moisture near the soil surface. Additionally, RECPs may be used to stabilize soils until vegetation is established or to reinforce non-woody surface vegetation.

Suitable Applications

RECPs are typically applied on slopes where erosion hazard is high and vegetation will be slow to establish. Mattings are also used on stream banks, swales and other drainage channels where moving water at velocities between 3 ft/s and 6 ft/s are likely to cause scour and wash out new vegetation, and in areas where the soil surface is disturbed and where existing vegetation has been removed. RECPs may also be used when seeding cannot occur (e.g., late season construction and/or the arrival of an early rain season). RECPs should be considered when the soils are fine grained and potentially erosive. RECPs should be considered in the following situations.

- Steep slopes, generally steeper than 3:1 (H:V)
- Slopes where the erosion potential is high
- Slopes and disturbed soils where mulch must be anchored
- Disturbed areas where plants are slow to develop

Categories

EC	Erosion Control	☑
SE	Sediment Control	
TC	Tracking Control	
WE	Wind Erosion Control	☒
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

EC-3 Hydraulic Mulch

EC-4 Hydroseeding

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

- Channels with flows exceeding 3.3 ft/s
- Channels to be vegetated
- Stockpiles
- Slopes adjacent to water bodies

Limitations

- RECP installed costs are generally higher than other erosion control BMPs, limiting their use to areas where other BMPs are ineffective (e.g. channels, steep slopes).
- RECPs may delay seed germination, due to reduction in soil temperature.
- RECPs are generally not suitable for excessively rocky sites or areas where the final vegetation will be mowed (since staples and netting can catch in mowers). If a staple or pin cannot be driven into the soil because the underlying soil is too hard or rocky, then an alternative BMP should be selected.
- If used for temporary erosion control, RECPs should be removed and disposed of prior to application of permanent soil stabilization measures.
- The use of plastic should be limited to covering stockpiles or very small graded areas for short periods of time (such as through one imminent storm event) until more environmentally friendly measures, such as seeding and mulching, may be installed.
    - Plastic sheeting is easily vandalized, easily torn, photodegradable, and must be disposed of at a landfill.
    - Plastic sheeting results in 100% runoff, which may cause serious erosion problems in the areas receiving the increased flow.
- RECPs may have limitations based on soil type, slope gradient, or channel flow rate; consult the manufacturer for proper selection.
- Not suitable for areas that have foot traffic (tripping hazard) – e.g., pad areas around buildings under construction.
- RECPs that incorporate a plastic netting (e.g. straw blanket typically uses a plastic netting to hold the straw in place) may not be suitable near known wildlife habitat. Wildlife can become trapped in the plastic netting.
- RECPs may have limitations in extremely windy climates. However, when RECPs are properly trenched at the top and bottom and stapled in accordance with the manufacturer's recommendations, problems with wind can be minimized.

Implementation

Material Selection

- Natural RECPs have been found to be effective where re-vegetation will be provided by re-seeding. The choice of material should be based on the size of area, side slopes, surface conditions such as hardness, moisture, weed growth, and availability of materials.

- Additional guidance on the comparison and selection of temporary slope stabilization methods is provided in Appendix F of the Handbook.

- The following natural and synthetic RECPs are commonly used:

Geotextiles

- Material can be a woven or a non-woven polypropylene fabric with minimum thickness of 0.06 in., minimum width of 12 ft and should have minimum tensile strength of 150 lbs (warp), 80 lbs (fill) in conformance with the requirements in ASTM Designation: D 4632. The permittivity of the fabric should be approximately 0.07 sec^{-1} in conformance with the requirements in ASTM Designation: D4491. The fabric should have an ultraviolet (UV) stability of 70 percent in conformance with the requirements in ASTM designation: D4355. Geotextile blankets must be secured in place with wire staples or sandbags and by keying into tops of slopes to prevent infiltration of surface waters under geotextile. Staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.

- Geotextiles may be reused if they are suitable for the use intended.

Plastic Covers

- Generally plastic sheeting should only be used as stockpile covering or for very small graded areas for short periods of time (such as through one imminent storm event). If plastic sheeting must be used, choose a plastic that will withstand photo degradation.

- Plastic sheeting should have a minimum thickness of 6 mils, and must be keyed in at the top of slope (when used as a temporary slope protection) and firmly held in place with sandbags or other weights placed no more than 10 ft apart. Seams are typically taped or weighted down their entire length, and there should be at least a 12 in. to 24 in. overlap of all seams. Edges should be embedded a minimum of 6 in. in soil (when used as a temporary slope protection).

- All sheeting must be inspected periodically after installation and after significant rainstorms to check for erosion, undermining, and anchorage failure. Any failures must be repaired immediately. If washout or breakages occur, the material should be re-installed after repairing the damage to the slope.

Erosion Control Blankets/Mats

- Biodegradable RECPs are typically composed of jute fibers, curled wood fibers, straw, coconut fiber, or a combination of these materials. In order for an RECP to be considered 100% biodegradable, the netting, sewing or adhesive system that holds the biodegradable mulch fibers together must also be biodegradable. See typical installation details at the end of this fact sheet.

- **Jute** is a natural fiber that is made into a yarn that is loosely woven into a biodegradable mesh. The performance of jute as a stand-alone RECP is low. Most other RECPs outperform jute as a temporary erosion control product and therefore jute is not commonly used. It is designed to be used in conjunction with vegetation. The material is supplied in rolled strips, which should be secured to the soil with U-shaped staples or stakes in accordance with manufacturers' recommendations.

- **Excelsior** (curled wood fiber) blanket material should consist of machine produced mats of curled wood excelsior with 80 percent of the fiber 6 in. or longer. The excelsior blanket should be of consistent thickness. The wood fiber must be evenly distributed over the entire area of the blanket. The top surface of the blanket should be covered with a photodegradable extruded plastic mesh. The blanket should be smolder resistant without the use of chemical additives and should be non-toxic and non-injurious to plant and animal life. Excelsior blankets should be furnished in rolled strips, a minimum of 48 in. wide, and should have an average weight of 0.8 lb/yd^2, ±10 percent, at the time of manufacture. Excelsior blankets must be secured in place with wire staples. Staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.

- **Straw blanket** should be machine produced mats of straw with a lightweight biodegradable netting top layer. The straw should be attached to the netting with biodegradable thread or glue strips. The straw blanket should be of consistent thickness. The straw should be evenly distributed over the entire area of the blanket. Straw blanket should be furnished in rolled strips a minimum of 6.5 ft wide, a minimum of 80 ft long and a minimum of 0.5 lb/yd^2. Straw blankets must be secured in place with wire staples. Staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.

- **Wood fiber blanket** is composed of biodegradable fiber mulch with extruded plastic netting held together with adhesives. The material is designed to enhance re-vegetation. The material is furnished in rolled strips, which must be secured to the ground with U-shaped staples or stakes in accordance with manufacturers' recommendations.

- **Coconut fiber blanket** should be a machine produced mat of 100 percent coconut fiber with biodegradable netting on the top and bottom. The coconut fiber should be attached to the netting with biodegradable thread or glue strips. The coconut fiber blanket should be of consistent thickness. The coconut fiber should be evenly distributed over the entire area of the blanket. Coconut fiber blanket should be furnished in rolled strips with a minimum of 6.5 ft wide, a minimum of 80 ft. long and a minimum of 0.5 lb/yd^2. Coconut fiber blankets must be secured in place with wire staples. Staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.

- **Coconut fiber mesh** is a thin permeable membrane made from coconut or corn fiber that is spun into a yarn and woven into a biodegradable mat. It is designed to be used in conjunction with vegetation and typically has longevity of several years. The material is supplied in rolled strips, which must be secured to the soil with U-shaped staples or stakes in accordance with manufacturers' recommendations.

- **Straw coconut fiber blanket** should be machine produced mats of 70 percent straw and 30 percent coconut fiber with a biodegradable netting top layer and a biodegradable bottom net. The straw and coconut fiber should be attached to the netting with biodegradable thread or glue strips. The straw coconut fiber blanket should be of consistent thickness. The straw and coconut fiber should be evenly distributed over the entire area of the blanket. Straw coconut fiber blanket should be furnished in rolled strips a minimum of 6.5 ft wide, a minimum of 80 ft long and a minimum of 0.5 lb/yd^2. Straw coconut fiber blankets must be secured in place with wire staples. Staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.

- Non-biodegradable RECPs are typically composed of polypropylene, polyethylene, nylon or other synthetic fibers. In some cases, a combination of biodegradable and synthetic fibers is used to construct the RECP. Netting used to hold these fibers together is typically non-biodegradable as well.

  - **Plastic netting** is a lightweight biaxially oriented netting designed for securing loose mulches like straw or paper to soil surfaces to establish vegetation. The netting is photodegradable. The netting is supplied in rolled strips, which must be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations.

  - **Plastic mesh** is an open weave geotextile that is composed of an extruded synthetic fiber woven into a mesh with an opening size of less than ¼ in. It is used with re-vegetation or may be used to secure loose fiber such as straw to the ground. The material is supplied in rolled strips, which must be secured to the soil with U-shaped staples or stakes in accordance with manufacturers' recommendations.

  - **Synthetic fiber with netting** is a mat that is composed of durable synthetic fibers treated to resist chemicals and ultraviolet light. The mat is a dense, three dimensional mesh of synthetic (typically polyolefin) fibers stitched between two polypropylene nets. The mats are designed to be re-vegetated and provide a permanent composite system of soil, roots, and geomatrix. The material is furnished in rolled strips, which must be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations.

  - **Bonded synthetic fibers** consist of a three dimensional geomatrix nylon (or other synthetic) matting. Typically it has more than 90 percent open area, which facilitates root growth. It's tough root reinforcing system anchors vegetation and protects against hydraulic lift and shear forces created by high volume discharges. It can be installed over prepared soil, followed by seeding into the mat. Once vegetated, it becomes an invisible composite system of soil, roots, and geomatrix. The material is furnished in rolled strips that must be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations.

  - **Combination synthetic and biodegradable RECPs** consist of biodegradable fibers, such as wood fiber or coconut fiber, with a heavy polypropylene net stitched to the top and a high strength continuous filament geomatrix or net stitched to the bottom. The material is designed to enhance re-vegetation. The material is furnished in rolled strips,

which must be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations.

Site Preparation

- Proper soil preparation is essential to ensure complete contact of the RECP with the soil. Soil Roughening is not recommended in areas where RECPs will be installed.
- Grade and shape the area of installation.
- Remove all rocks, clods, vegetation or other obstructions so that the installed blankets or mats will have complete, direct contact with the soil.
- Prepare seedbed by loosening 2 to 3 in. of topsoil.

Seeding/Planting

Seed the area before blanket installation for erosion control and re-vegetation. Seeding after mat installation is often specified for turf reinforcement application. When seeding prior to blanket installation, all areas disturbed during blanket installation must be re-seeded. Where soil filling is specified for turf reinforcement mats (TRMs), seed the matting and the entire disturbed area after installation and prior to filling the mat with soil.

Fertilize and seed in accordance with seeding specifications or other types of landscaping plans. The protective matting can be laid over areas where grass has been planted and the seedlings have emerged. Where vines or other ground covers are to be planted, lay the protective matting first and then plant through matting according to design of planting.

Check Slots

Check slots shall be installed as required by the manufacturer.

Laying and Securing Matting

- Before laying the matting, all check slots should be installed and the seedbed should be friable, made free from clods, rocks, and roots. The surface should be compacted and finished according to the requirements of the manufacturer's recommendations.
- Mechanical or manual lay down equipment should be capable of handling full rolls of fabric and laying the fabric smoothly without wrinkles or folds. The equipment should meet the fabric manufacturer's recommendations or equivalent standards.

Anchoring

- U-shaped wire staples, metal geotextile stake pins, or triangular wooden stakes can be used to anchor mats and blankets to the ground surface.
- Wire staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.
- Metal stake pins should be 0.188 in. diameter steel with a 1.5 in. steel washer at the head of the pin, and 8 in. in length.
- Wire staples and metal stakes should be driven flush to the soil surface.

Installation on Slopes

Installation should be in accordance with the manufacturer's recommendations. In general, these will be as follows:

- Begin at the top of the slope and anchor the blanket in a 6 in. deep by 6 in. wide trench. Backfill trench and tamp earth firmly.
- Unroll blanket down slope in the direction of water flow.
- Overlap the edges of adjacent parallel rolls 2 to 3 in. and staple every 3 ft (or greater, per manufacturer's specifications).
- When blankets must be spliced, place blankets end over end (shingle style) with 6 in. overlap. Staple through overlapped area, approximately 12 in. apart.
- Lay blankets loosely and maintain direct contact with the soil. Do not stretch.
- Staple blankets sufficiently to anchor blanket and maintain contact with the soil. Staples should be placed down the center and staggered with the staples placed along the edges. Steep slopes, 1:1 (H:V) to 2:1 (H:V), require a minimum of 2 staples/yd^2. Moderate slopes, 2:1 (H:V) to 3:1 (H:V), require a minimum of 1 ½ staples/yd^2. Check manufacturer's specifications to determine if a higher density staple pattern is required.

Installation in Channels

Installation should be in accordance with the manufacturer's recommendations. In general, these will be as follows:

- Dig initial anchor trench 12 in. deep and 6 in. wide across the channel at the lower end of the project area.
- Excavate intermittent check slots, 6 in. deep and 6 in. wide across the channel at 25 to 30 ft intervals along the channels.
- Cut longitudinal channel anchor trenches 4 in. deep and 4 in. wide along each side of the installation to bury edges of matting, whenever possible extend matting 2 to 3 in. above the crest of the channel side slopes.
- Beginning at the downstream end and in the center of the channel, place the initial end of the first roll in the anchor trench and secure with fastening devices at 12 in. intervals. Note: matting will initially be upside down in anchor trench.
- In the same manner, position adjacent rolls in anchor trench, overlapping the preceding roll a minimum of 3 in.
- Secure these initial ends of mats with anchors at 12 in. intervals, backfill and compact soil.
- Unroll center strip of matting upstream. Stop at next check slot or terminal anchor trench. Unroll adjacent mats upstream in similar fashion, maintaining a 3 in. overlap.

- Fold and secure all rolls of matting snugly into all transverse check slots. Lay mat in the bottom of the slot then fold back against itself. Anchor through both layers of mat at 12 in. intervals, then backfill and compact soil. Continue rolling all mat widths upstream to the next check slot or terminal anchor trench.
- Alternate method for non-critical installations: Place two rows of anchors on 6 in. centers at 25 to 30 ft. intervals in lieu of excavated check slots.
- Staple shingled lap spliced ends a minimum of 12 in. apart on 12 in. intervals.
- Place edges of outside mats in previously excavated longitudinal slots; anchor using prescribed staple pattern, backfill, and compact soil.
- Anchor, fill, and compact upstream end of mat in a 12 in. by 6 in. terminal trench.
- Secure mat to ground surface using U-shaped wire staples, geotextile pins, or wooden stakes.
- Seed and fill turf reinforcement matting with soil, if specified.

Soil Filling (if specified for turf reinforcement mat (TRM))

Installation should be in accordance with the manufacturer's recommendations. Typical installation guidelines are as follows:

- After seeding, spread and lightly rake ½-3/4 inches of fine topsoil into the TRM apertures to completely fill TRM thickness. Use backside of rake or other flat implement.
- Alternatively, if allowed by product specifications, spread topsoil using lightweight loader, backhoe, or other power equipment. Avoid sharp turns with equipment.
- Always consult the manufacturer's recommendations for installation.
- Do not drive tracked or heavy equipment over mat.
- Avoid any traffic over matting if loose or wet soil conditions exist.
- Use shovels, rakes, or brooms for fine grading and touch up.
- Smooth out soil filling just exposing top netting of mat.

Temporary Soil Stabilization Removal

- Temporary soil stabilization removed from the site of the work must be disposed of if necessary.

Costs

Installed costs can be relatively high compared to other BMPs. Approximate costs for installed materials are shown below:

Rolled Erosion Control Products		Installed Cost per Acre (2004)[1]	Estimated Cost per Acre (2009)[2]
Biodegradable	Jute Mesh	$6,000-$7,000	$6,600-$7,700
	Curled Wood Fiber	$8,000-$10,500	$8,800-$11,050
	Straw	$8,000-$10,500	$8,800-$11,050
	Wood Fiber	$8,000-$10,500	$8,800-$11,050
	Coconut Fiber	$13,000-$14,000	$14,300-$15,400
	Coconut Fiber Mesh	$30,000-$33,000	$33,000-$36,300
	Straw Coconut Fiber	$10,000-$12,000	$11,000-$13,200
Non-Biodegradable	Plastic Netting	$2,000-$2,200	$2,200-$2,220
	Plastic Mesh	$3,000-$3,500	$3,300-$3,850
	Synthetic Fiber with Netting	$34,000-$40,000	$37,400-$44,000
	Bonded Synthetic Fibers	$45,000-$55,000	$49,500-$60,500
	Combination with Biodegradable	$30,000-$36,000	$33,000-$39,600

1. Source: Cost information received from individual product manufacturers solicited by Geosyntec Consultants (2004).

2. 2009 costs reflect a 10% escalation over year 2004 costs. Escalation based on informal survey of industry trends. Note: Expected cost increase is offset by competitive economic conditions.

Inspection and Maintenance

- RECPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Areas where erosion is evident shall be repaired and BMPs reapplied as soon as possible. Care should be exercised to minimize the damage to protected areas while making repairs, as any area damaged will require reapplication of BMPs.
- If washout or breakage occurs, re-install the material after repairing the damage to the slope or channel.
- Make sure matting is uniformly in contact with the soil.
- Check that all the lap joints are secure.
- Check that staples are flush with the ground.

References

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005

Erosion Control Pilot Study Report, State of California Department of Transportation (Caltrans), June 2000.

Guides for Erosion and Sediment Controls in California, USDA Soils Conservation Service, January 1991.

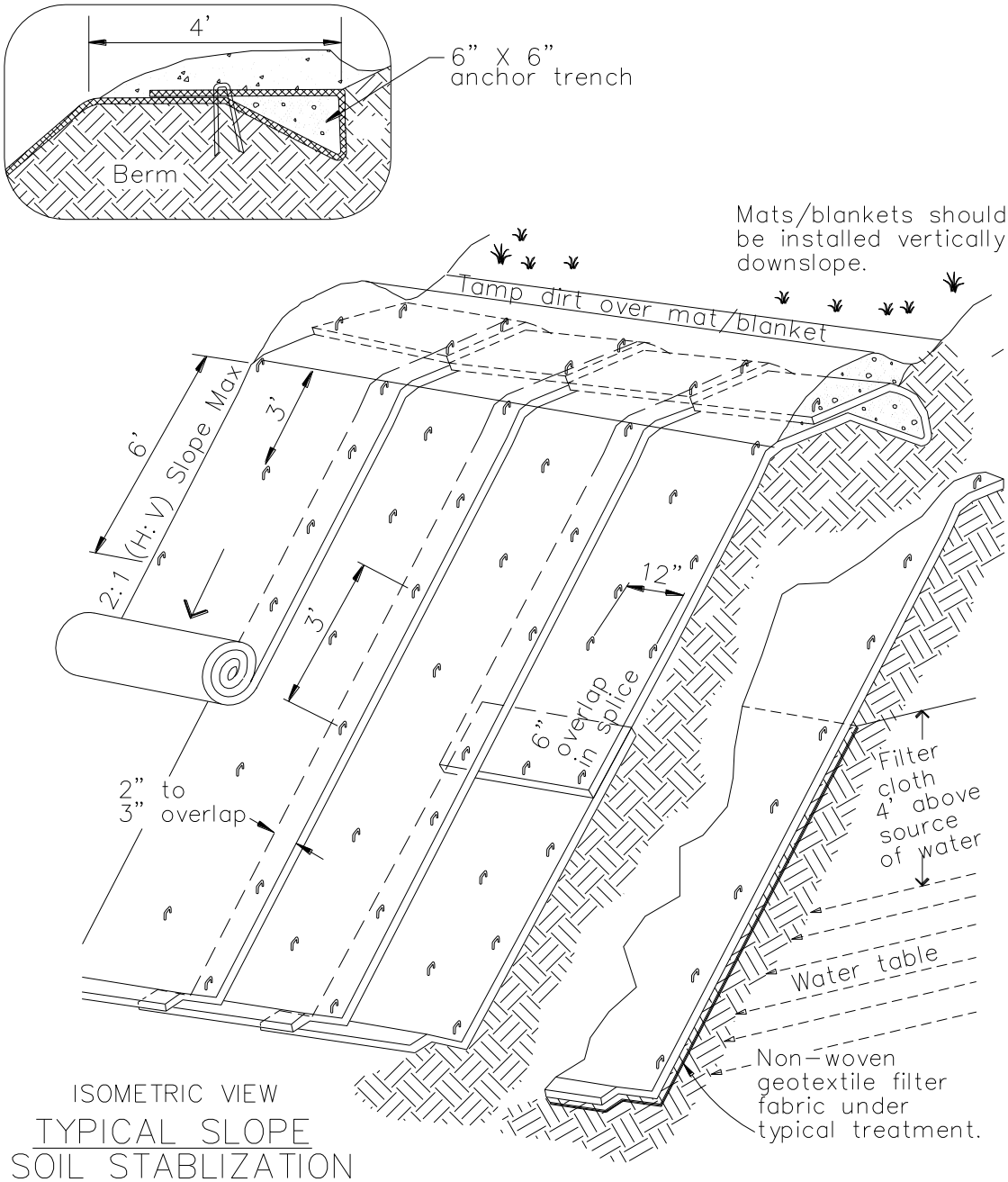
National Management Measures to Control Nonpoint Source Pollution from Urban Areas, United States Environmental Protection Agency, 2002.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Guidance Document: Soil Stabilization for Temporary Slopes, State of California Department of Transportation (Caltrans), November 1999.

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Water Quality Management Plan for The Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.



ISOMETRIC VIEW

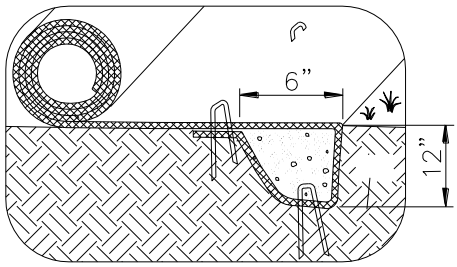
TYPICAL SLOPE
SOIL STABLIZATION
NTS

WET SLOPE LINING
NTS

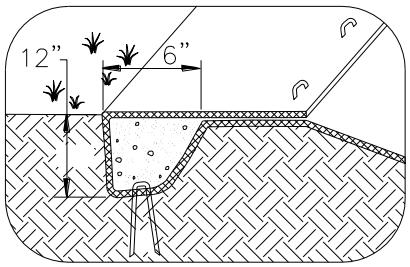
NOTES:

1. Slope surface shall be free of rocks, clods, sticks and grass. Mats/blankets shall have good soil contact.
2. Lay blankets loosely and stake or staple to maintain direct contact with the soil. Do not stretch.
3. Install per manufacturer's recommendations

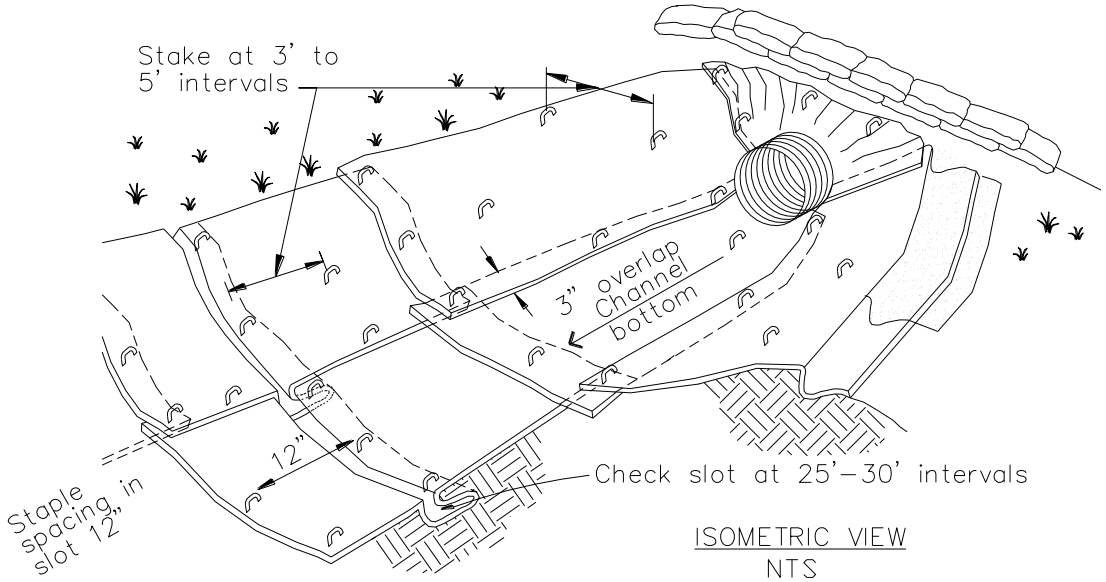
TYPICAL INSTALLATION DETAIL



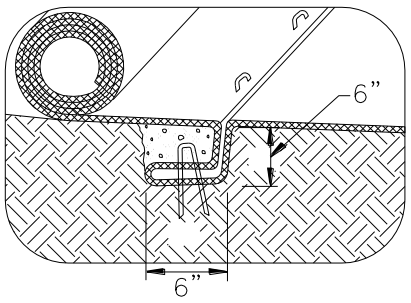
INITIAL CHANNEL ANCHOR TRENCH
NTS



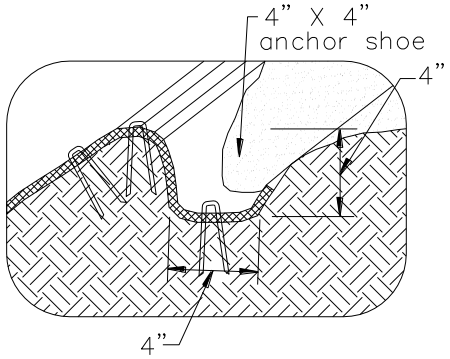
TERMINAL SLOPE AND CHANNEL ANCHOR TRENCH
NTS



ISOMETRIC VIEW
NTS



INTERMITTENT CHECK SLOT
NTS

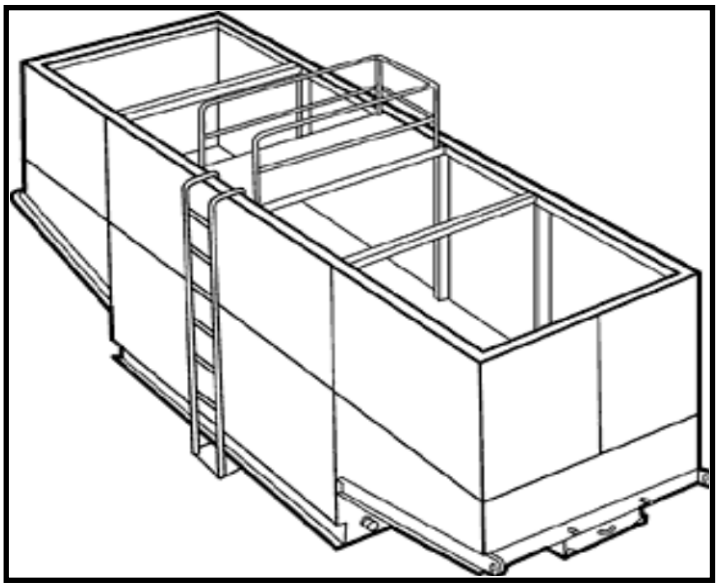


LONGITUDINAL ANCHOR TRENCH
NTS

NOTES:
1. Check slots to be constructed per manufacturers specifications.
2. Staking or stapling layout per manufacturers specifications.
3. Install per manufacturer's recommendations

TYPICAL INSTALLATION DETAIL

Dewatering Operations NS-2



Categories		
EC	Erosion Control	
SE	Sediment Control	☒
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	☑
WM	Waste Management and Materials Pollution Control	

Legend:
☑ **Primary Category**
☒ **Secondary Category**

Targeted Constituents	
Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	☑
Organics	

Potential Alternatives

SE-5: Fiber Roll

SE-6: Gravel Bag Berm

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Dewatering operations are practices that manage the discharge of pollutants when non-stormwater and accumulated precipitation (stormwater) must be removed from a work location to proceed with construction work or to provide vector control.

The General Permit incorporates Numeric Action Levels (NAL) for turbidity (see Section 2 of this handbook to determine your project's risk level and if you are subject to these requirements).

Discharges from dewatering operations can contain high levels of fine sediment that, if not properly treated, could lead to exceedances of the General Permit requirements or Basin Plan standards.

The dewatering operations described in this fact sheet are not Active Treatment Systems (ATS) and do not include the use of chemical coagulations, chemical flocculation or electrocoagulation.

Suitable Applications

These practices are implemented for discharges of non-stormwater from construction sites. Non-stormwaters include, but are not limited to, groundwater, water from cofferdams, water diversions, and waters used during construction activities that must be removed from a work area to facilitate construction.

Practices identified in this section are also appropriate for implementation when managing the removal of accumulated

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

precipitation (stormwater) from depressed areas at a construction site.

Stormwater mixed with non-stormwater should be managed as non-stormwater.

Limitations

- Dewatering operations will require, and should comply with applicable local and project-specific permits and regulations. In some areas, all dewatering activities, regardless of the discharge volume, require a dewatering permit.
- Site conditions will dictate design and use of dewatering operations.
- The controls discussed in this fact sheet primarily address sediment. Other secondary pollutant removal benefits are discussed where applicable.
- The controls detailed in this fact sheet only allow for minimal settling time for sediment particles. Use only when site conditions restrict the use of the other control methods.
- Avoid dewatering discharges where possible by using the water for dust control.

Implementation

- A Construction Site Monitoring Plan (CSMP) should be included in the project Stormwater Pollution Prevention Plan (SWPPP).
- Regional Water Quality Control Board (RWQCB) Regions may require notification and approval prior to any discharge of water from construction sites.
- The destination of discharge from dewatering activities will typically determine the type of permit required for the discharge. For example, when discharging to a water of the U.S., a dewatering permit may be required through the site's governing RWQCB. When discharging to a sanitary sewer or Municipal Separate Storm Sewer System (MS4), a permit may need to be obtained from the owner of the sanitary sewer or MS4 in addition to obtaining an RWQCB dewatering permit. Additional permits or permissions from other agencies may be required for dewatering cofferdams or diversions.
- Dewatering discharges should not cause erosion at the discharge point. Appropriate BMPs should be implemented to maintain compliance with all applicable permits.
- Maintain dewatering records in accordance with all local and project-specific permits and regulations.

Sediment Treatment

A variety of methods can be used to treat water during dewatering operations. Several devices are presented below and provide options to achieve sediment removal. The sediment particle size and permit or receiving water limitations on sediment or turbidity are key considerations for selecting sediment treatment option(s); in some cases, the use of multiple devices may be appropriate. Use of other enhanced treatment methods (i.e., introduction of chemicals or electric current to enhance flocculation and removal of sediment) must comply with: 1) for storm drain or surface water discharges, the requirements for Active Treatment Systems (see SE-11); or 2) for sanitary sewer discharges, the requirements of applicable sanitary sewer discharge permits.

Sediment Basin (see also SE-2)

Description:

- A sediment basin is a temporary basin with a controlled release structure that is formed by excavation or construction of an embankment to detain sediment-laden runoff and allow sediment to settle out before discharging. Sediment basins are generally larger than Sediment Traps (SE-3) and have a designed outlet structure.

Appropriate Applications:

- Effective for the removal of trash, gravel, sand, silt, some metals that settle out with the sediment.

Implementation:

- Excavation and construction of related facilities is required.
- Temporary sediment basins should be fenced if safety is a concern.
- Outlet protection is required to prevent erosion at the outfall location.

Maintenance:

- Maintenance is required for safety fencing, vegetation, embankment, inlet and outlet, as well as other features.
- Removal of sediment is required when the storage volume is reduced by one-third.

Sediment Trap (See also SE-3)

Description:

- A sediment trap is a temporary basin formed by excavation and/or construction of an earthen embankment across a waterway or low drainage area to detain sediment-laden runoff and allow sediment to settle out before discharging. Sediment traps are generally smaller than Sediment Basins (SE-2) and do not have a designed outlet (but do have a spillway or overflow).

Appropriate Applications:

Effective for the removal of large and medium sized particles (sand and gravel) and some metals that settle out with the sediment.

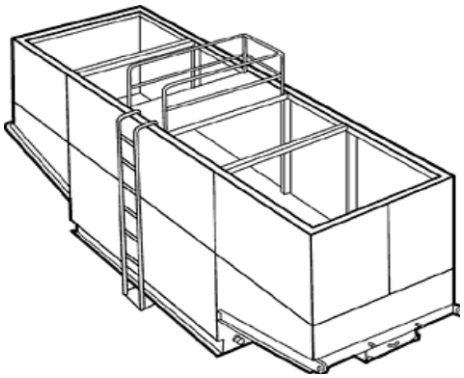
Implementation:

- Excavation and construction of related facilities is required.
- Trap inlets should be located to maximize the travel distance to the trap outlet.
- Use rock or vegetation to protect the trap outlets against erosion.

Maintenance:

- Maintenance is required for vegetation, embankment, inlet and outfall structures, as well as other features.
- Removal of sediment is required when the storage volume is reduced by one-third.

Weir Tanks



Description:

- A weir tank separates water and waste by using weirs. The configuration of the weirs (over and under weirs) maximizes the residence time in the tank and determines the waste to be removed from the water, such as oil, grease, and sediments.

Appropriate Applications:

- The tank removes trash, some settleable solids (gravel, sand, and silt), some visible oil and grease, and some metals (removed with sediment). To achieve high levels of flow, multiple tanks can be used in parallel. If additional treatment is desired, the tanks can be placed in series or as pre-treatment for other methods.

Implementation:

- Tanks are delivered to the site by the vendor, who can provide assistance with set-up and operation.
- Tank size will depend on flow volume, constituents of concern, and residency period required. Vendors should be consulted to appropriately size tank.
- Treatment capacity (i.e., volume and number of tanks) should provide at a minimum the required volume for discrete particle settling for treatment design flows.

Maintenance:

- Periodic cleaning is required based on visual inspection or reduced flow.
- Oil and grease disposal should be conducted by a licensed waste disposal company.

Dewatering Tanks



Description:

- A dewatering tank removes debris and sediment. Flow enters the tank through the top, passes through a fabric filter, and is discharged through the bottom of the tank. The filter separates the solids from the liquids.

Appropriate Applications:

- The tank removes trash, gravel, sand, and silt, some visible oil and grease, and some metals (removed with sediment). To achieve high levels of flow, multiple tanks can be used in parallel. If additional treatment is desired, the tanks can be placed in series or as pre-treatment for other methods.

Implementation:

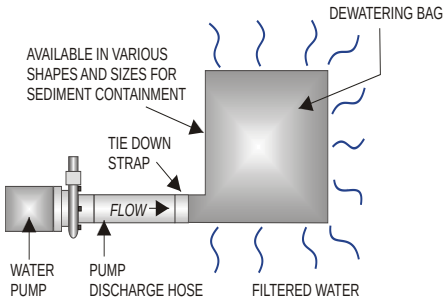
- Tanks are delivered to the site by the vendor, who can provide assistance with set-up and operation.
- Tank size will depend on flow volume, constituents of concern, and residency period required. Vendors should be consulted to appropriately size tank.

Maintenance:

- Periodic cleaning is required based on visual inspection or reduced flow.
- Oil and grease disposal should be conducted by licensed waste disposal company.

Gravity Bag Filter





Description:

- A gravity bag filter, also referred to as a dewatering bag, is a square or rectangular bag made of non-woven geotextile fabric that collects gravel, sand, silt, and fines.

Appropriate Applications:

- Effective for the removal of sediments (gravel, sand, silt, and fines). Some metals are removed with the sediment.

Implementation:

- Water is pumped into one side of the bag and seeps through the top, bottom, and sides of the bag.
- Place filter bag on pavement or a gravel bed or paved surface. Avoid placing a dewatering bag on unprotected bare soil. If placing the bag on bare soil is unavoidable, a secondary barrier should be used, such as a rock filter bed placed beneath and beyond the edges of the bag to, prevent erosion and capture sediments that escape the bag.
- Perimeter control around the downstream end of the bag should be implemented. Secondary sediment controls are important especially in the initial stages of discharge, which tend to allow fines to pass through the bag.

Maintenance:

- Inspection of the flow conditions, bag condition, bag capacity, and the secondary barrier (as applicable) is required.
- Replace the bag when it no longer filters sediment or passes water at a reasonable rate.
- Caution should be taken when removing and disposing of the bag, to prevent the release of captured sediment
- Properly dispose of the bag offsite. If sediment is removed from the bag prior to disposal (bags can potentially be reused depending upon their condition), dispose of sediment in accordance with the general maintenance procedures described at the end of this BMP Fact Sheet.

Sand Media Particulate Filter





Description:

- Water is treated by passing it through canisters filled with sand media. Generally, sand filters provide a final level of treatment. They are often used as a secondary or higher level of treatment after a significant amount of sediment and other pollutants have been removed using other methods.

Appropriate Applications:

- Effective for the removal of trash, gravel, sand, and silt and some metals, as well as the reduction of biochemical oxygen demand (BOD) and turbidity.
- Sand filters can be used for stand-alone treatment or in conjunction with bag and cartridge filtration if further treatment is required.
- Sand filters can also be used to provide additional treatment to water treated via settling or basic filtration.

Implementation:

- The filters require delivery to the site and initial set up. The vendor can provide assistance with installation and operation.

Maintenance:

- The filters require regular service to monitor and maintain the level of the sand media. If subjected to high loading rates, filters can plug quickly.
- Venders generally provide data on maximum head loss through the filter. The filter should be monitored daily while in use, and cleaned when head loss reaches target levels.
- If cleaned by backwashing, the backwash water may need to be hauled away for disposal, or returned to the upper end of the treatment train for another pass through the series of dewatering BMPs.

Pressurized Bag Filter





Description:

- A pressurized bag filter is a unit composed of single filter bags made from polyester felt material. The water filters through the unit and is discharged through a header. Vendors provide bag filters in a variety of configurations. Some units include a combination of bag filters and cartridge filters for enhanced contaminant removal.

Appropriate Applications:

- Effective for the removal of sediment (sand and silt) and some metals, as well as the reduction of BOD, turbidity, and hydrocarbons. Oil absorbent bags are available for hydrocarbon removal.

- Filters can be used to provide secondary treatment to water treated via settling or basic filtration.

Implementation:

- The filters require delivery to the site and initial set up. The vendor can provide assistance with installation and operation.

Maintenance:

- The filter bags require replacement when the pressure differential equals or exceeds the manufacturer's recommendation.

Cartridge Filter



Description:

- Cartridge filters provide a high degree of pollutant removal by utilizing a number of individual cartridges as part of a larger filtering unit. They are often used as a secondary or higher (polishing) level of treatment after a significant amount of sediment and other pollutants are removed. Units come with various cartridge configurations (for use in series with bag filters) or with a larger single cartridge filtration unit (with multiple filters within).

Appropriate Applications:

- Effective for the removal of sediment (sand, silt, and some clays) and metals, as well as the reduction of BOD, turbidity, and hydrocarbons. Hydrocarbons can effectively be removed with special resin cartridges.

- Filters can be used to provide secondary treatment to water treated via settling or basic filtration.

Implementation:

- The filters require delivery to the site and initial set up. The vendor can provide assistance.

Maintenance:

- The cartridges require replacement when the pressure differential equals or exceeds the manufacturer's recommendation.

Costs

- Sediment control costs vary considerably depending on the dewatering and sediment treatment system that is selected. Pressurized filters tend to be more expensive than gravity settling, but are often more effective. Simple tanks are generally rented on a long-term basis (one or more months) and can range from $360 per month for a 1,000 gallon tank to $2,660 per month for a 10,000 gallon tank. Mobilization and demobilization costs vary considerably.

Inspection and Maintenance

- Inspect and verify that dewatering BMPs are in place and functioning prior to the commencement of activities requiring dewatering.

- Inspect dewatering BMPs daily while dewatering activities are being conducted.

- Inspect all equipment before use. Monitor dewatering operations to ensure they do not cause offsite discharge or erosion.
- Sample dewatering discharges as required by the General Permit.
- Unit-specific maintenance requirements are included with the description of each unit.
- Sediment removed during the maintenance of a dewatering device may be either spread onsite and stabilized, or disposed of at a disposal site as approved by the owner.
- Sediment that is commingled with other pollutants should be disposed of in accordance with all applicable laws and regulations and as approved by the owner.

References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

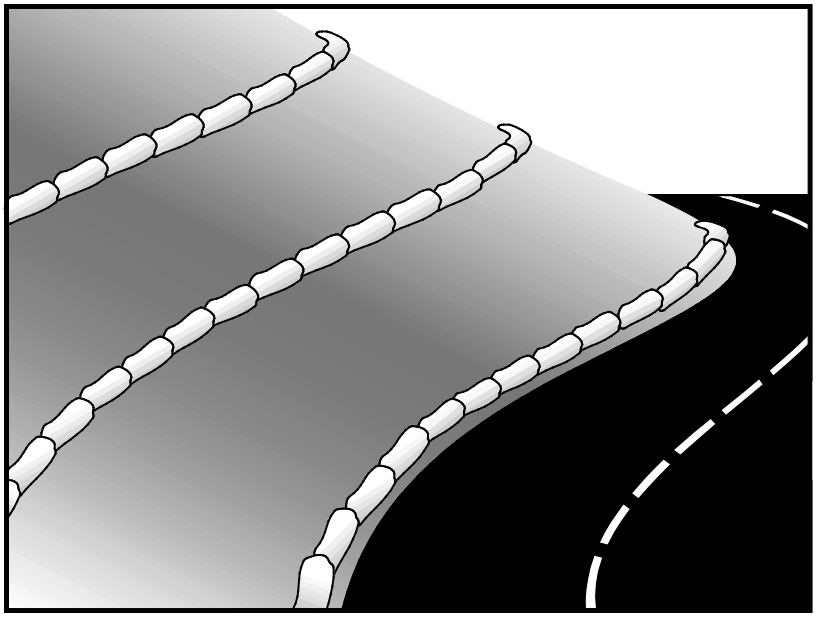
Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003; Updated March 2004.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

Labor Surcharge & Equipment Rental Rates, April 1, 2002 through March 31, 2003, California Department of Transportation (Caltrans).

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005.

Gravel Bag Berm SE-6



Description and Purpose

A gravel bag berm is a series of gravel-filled bags placed on a level contour to intercept sheet flows. Gravel bags pond sheet flow runoff, allowing sediment to settle out, and release runoff slowly as sheet flow, preventing erosion.

Suitable Applications

Gravel bag berms may be suitable:

- As a linear sediment control measure:
  - Below the toe of slopes and erodible slopes
  - As sediment traps at culvert/pipe outlets
  - Below other small cleared areas
  - Along the perimeter of a site
  - Down slope of exposed soil areas
  - Around temporary stockpiles and spoil areas
  - Parallel to a roadway to keep sediment off paved areas
  - Along streams and channels
- As a linear erosion control measure:
  - Along the face and at grade breaks of exposed and erodible slopes to shorten slope length and spread runoff as sheet flow.

Categories

EC	Erosion Control	☒
SE	Sediment Control	☑
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-1 Silt Fence

SE-5 Fiber Roll

SE-8 Sandbag Barrier

SE-12 Temporary Silt Dike

SE-14 Biofilter Bags

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

- At the top of slopes to divert runoff away from disturbed slopes.
- As chevrons (small check dams) across mildly sloped construction roads. For use check dam use in channels, see SE-4, Check Dams.

Limitations

- Gravel berms may be difficult to remove.
- Removal problems limit their usefulness in landscaped areas.
- Gravel bag berm may not be appropriate for drainage areas greater than 5 acres.
- Runoff will pond upstream of the berm, possibly causing flooding if sufficient space does not exist.
- Degraded gravel bags may rupture when removed, spilling contents.
- Installation can be labor intensive.
- Durability of gravel bags is somewhat limited and bags may need to be replaced when installation is required for longer than 6 months.
- Easily damaged by construction equipment.
- When used to detain concentrated flows, maintenance requirements increase.

Implementation

General

A gravel bag berm consists of a row of open graded gravel-filled bags placed on a level contour. When appropriately placed, a gravel bag berm intercepts and slows sheet flow runoff, causing temporary ponding. The temporary ponding allows sediment to settle. The open graded gravel in the bags is porous, which allows the ponded runoff to flow slowly through the bags, releasing the runoff as sheet flows. Gravel bag berms also interrupt the slope length and thereby reduce erosion by reducing the tendency of sheet flows to concentrate into rivulets, which erode rills, and ultimately gullies, into disturbed, sloped soils. Gravel bag berms are similar to sand bag barriers, but are more porous. Generally, gravel bag berms should be used in conjunction with temporary soil stabilization controls up slope to provide effective erosion and sediment control.

Design and Layout

- Locate gravel bag berms on level contours.
- When used for slope interruption, the following slope/sheet flow length combinations apply:
  - Slope inclination of 4:1 (H:V) or flatter: Gravel bags should be placed at a maximum interval of 20 ft, with the first row near the slope toe.
  - Slope inclination between 4:1 and 2:1 (H:V): Gravel bags should be placed at a maximum interval of 15 ft. (a closer spacing is more effective), with the first row near the slope toe.

Slope inclination 2:1 (H:V) or greater: Gravel bags should be placed at a maximum interval of 10 ft. (a closer spacing is more effective), with the first row near the slope toe.

- Turn the ends of the gravel bag barriers up slope to prevent runoff from going around the berm.
- Allow sufficient space up slope from the gravel bag berm to allow ponding, and to provide room for sediment storage.
- For installation near the toe of the slope, gravel bag barriers should be set back from the slope toe to facilitate cleaning. Where specific site conditions do not allow for a set-back, the gravel bag barrier may be constructed on the toe of the slope. To prevent flows behind the barrier, bags can be placed perpendicular to a berm to serve as cross barriers.
- Drainage area should not exceed 5 acres.
- In Non-Traffic Areas:
  - Height = 18 in. maximum
  - Top width = 24 in. minimum for three or more layer construction
  - Top width = 12 in. minimum for one or two layer construction
  - Side slopes = 2:1 (H:V) or flatter
- In Construction Traffic Areas:
  - Height = 12 in. maximum
  - Top width = 24 in. minimum for three or more layer construction.
  - Top width = 12 in. minimum for one or two layer construction.
  - Side slopes = 2:1 (H:V) or flatter.
- Butt ends of bags tightly.
- On multiple row, or multiple layer construction, overlap butt joints of adjacent row and row beneath.
- Use a pyramid approach when stacking bags.

Materials

- ***Bag Material:*** Bags should be woven polypropylene, polyethylene or polyamide fabric or burlap, minimum unit weight of 4 ounces/yd^2, Mullen burst strength exceeding 300 lb/in^2 in conformance with the requirements in ASTM designation D3786, and ultraviolet stability exceeding 70% in conformance with the requirements in ASTM designation D4355.

- ***Bag Size:*** Each gravel-filled bag should have a length of 18 in., width of 12 in., thickness of 3 in., and mass of approximately 33 lbs. Bag dimensions are nominal, and may vary based on locally available materials.

- ***Fill Material:*** Fill material should be 0.5 to 1 in. crushed rock, clean and free from clay, organic matter, and other deleterious material, or other suitable open graded, non-cohesive, porous gravel.

Costs

Material costs for gravel bags are average and are dependent upon material availability. $2.50-3.00 per filled gravel bag is standard based upon vendor research.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.

- Gravel bags exposed to sunlight will need to be replaced every two to three months due to degrading of the bags.

- Reshape or replace gravel bags as needed.

- Repair washouts or other damage as needed.

- Sediment that accumulates in the BMP should be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the barrier height.

- Remove gravel bag berms when no longer needed and recycle gravel fill whenever possible and properly dispose of bag material. Remove sediment accumulation and clean, re-grade, and stabilize the area.

References

Handbook of Steel Drainage and Highway Construction, American Iron and Steel Institute, 1983.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Stormwater Pollution Plan Handbook, First Edition, State of California, Department of Transportation Division of New Technology, Materials and Research, October 1992.

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005.

Street Sweeping and Vacuuming SE-7



Categories

EC	Erosion Control	
SE	Sediment Control	☒
TC	Tracking Control	☑
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

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

Potential Alternatives

None

Description and Purpose

Street sweeping and vacuuming includes use of self-propelled and walk-behind equipment to remove sediment from streets and roadways, and to clean paved surfaces in preparation for final paving. Sweeping and vacuuming prevents sediment from the project site from entering storm drains or receiving waters.

Suitable Applications

Sweeping and vacuuming are suitable anywhere sediment is tracked from the project site onto public or private paved streets and roads, typically at points of egress. Sweeping and vacuuming are also applicable during preparation of paved surfaces for final paving.

Limitations

Sweeping and vacuuming may not be effective when sediment is wet or when tracked soil is caked (caked soil may need to be scraped loose).

Implementation

- Controlling the number of points where vehicles can leave the site will allow sweeping and vacuuming efforts to be focused, and perhaps save money.
- Inspect potential sediment tracking locations daily.
- Visible sediment tracking should be swept or vacuumed on a daily basis.

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

- Do not use kick brooms or sweeper attachments. These tend to spread the dirt rather than remove it.
- If not mixed with debris or trash, consider incorporating the removed sediment back into the project

Costs

Rental rates for self-propelled sweepers vary depending on hopper size and duration of rental. Expect rental rates from $58/hour (3 yd^3 hopper) to $88/hour (9 yd^3 hopper), plus operator costs. Hourly production rates vary with the amount of area to be swept and amount of sediment. Match the hopper size to the area and expect sediment load to minimize time spent dumping.

Inspection and Maintenance

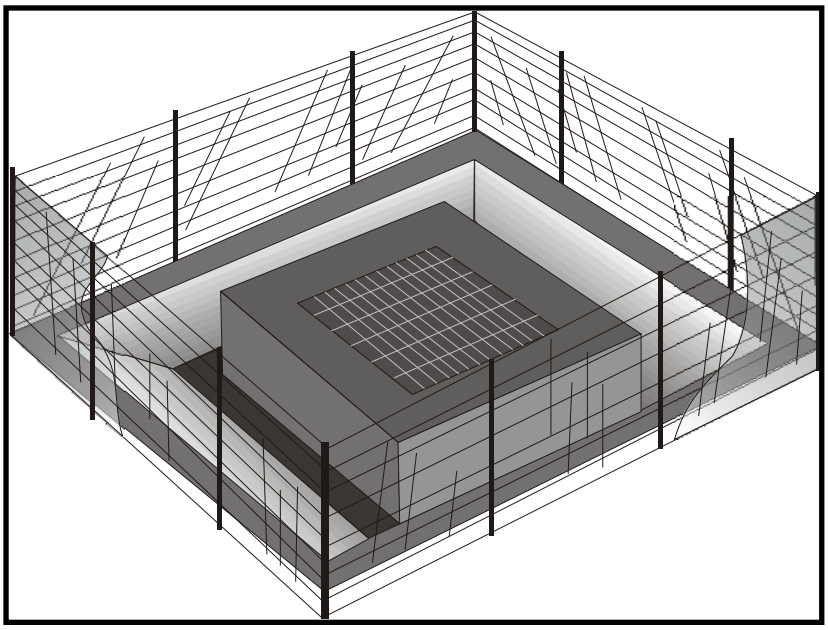
- Inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- When actively in use, points of ingress and egress must be inspected daily.
- When tracked or spilled sediment is observed outside the construction limits, it must be removed at least daily. More frequent removal, even continuous removal, may be required in some jurisdictions.
- Be careful not to sweep up any unknown substance or any object that may be potentially hazardous.
- Adjust brooms frequently; maximize efficiency of sweeping operations.
- After sweeping is finished, properly dispose of sweeper wastes at an approved dumpsite.

References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Labor Surcharge and Equipment Rental Rates, State of California Department of Transportation (Caltrans), April 1, 2002 – March 31, 2003.

Storm Drain Inlet Protection SE-10



Description and Purpose

Storm drain inlet protection consists of a sediment filter or an impounding area in, around or upstream of a storm drain, drop inlet, or curb inlet. Storm drain inlet protection measures temporarily pond runoff before it enters the storm drain, allowing sediment to settle. Some filter configurations also remove sediment by filtering, but usually the ponding action results in the greatest sediment reduction. Temporary geotextile storm drain inserts attach underneath storm drain grates to capture and filter storm water.

Suitable Applications

- Every storm drain inlet receiving runoff from unstabilized or otherwise active work areas should be protected. Inlet protection should be used in conjunction with other erosion and sediment controls to prevent sediment-laden stormwater and non-stormwater discharges from entering the storm drain system.

Limitations

- Drainage area should not exceed 1 acre.
- In general straw bales should not be used as inlet protection.
- Requires an adequate area for water to pond without encroaching into portions of the roadway subject to traffic.
- Sediment removal may be inadequate to prevent sediment discharges in high flow conditions or if runoff is heavily sediment laden. If high flow conditions are expected, use

Categories

EC	Erosion Control	
SE	Sediment Control	☑
TC	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:
☑ **Primary Category**
☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	☒
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-1 Silt Fence
SE-5 Fiber Rolls
SE-6 Gravel Bag Berm
SE-8 Sandbag Barrier
SE-14 Biofilter Bags
SE-13 Compost Socks and Berms

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

other onsite sediment trapping techniques in conjunction with inlet protection.

- Frequent maintenance is required.
- Limit drainage area to 1 acre maximum. For drainage areas larger than 1 acre, runoff should be routed to a sediment-trapping device designed for larger flows. See BMPs SE-2, Sediment Basin, and SE-3, Sediment Traps.
- Excavated drop inlet sediment traps are appropriate where relatively heavy flows are expected, and overflow capability is needed.

Implementation

General

Inlet control measures presented in this handbook should not be used for inlets draining more than one acre. Runoff from larger disturbed areas should be first routed through SE-2, Sediment Basin or SE-3, Sediment Trap and/or used in conjunction with other drainage control, erosion control, and sediment control BMPs to protect the site. Different types of inlet protection are appropriate for different applications depending on site conditions and the type of inlet. Alternative methods are available in addition to the methods described/shown herein such as prefabricated inlet insert devices, or gutter protection devices.

Design and Layout

Identify existing and planned storm drain inlets that have the potential to receive sediment-laden surface runoff. Determine if storm drain inlet protection is needed and which method to use.

- The key to successful and safe use of storm drain inlet protection devices is to know where runoff that is directed toward the inlet to be protected will pond or be diverted as a result of installing the protection device.
  - Determine the acceptable location and extent of ponding in the vicinity of the drain inlet. The acceptable location and extent of ponding will influence the type and design of the storm drain inlet protection device.
  - Determine the extent of potential runoff diversion caused by the storm drain inlet protection device. Runoff ponded by inlet protection devices may flow around the device and towards the next downstream inlet. In some cases, this is acceptable; in other cases, serious erosion or downstream property damage can be caused by these diversions. The possibility of runoff diversions will influence whether or not storm drain inlet protection is suitable; and, if suitable, the type and design of the device.
- The location and extent of ponding, and the extent of diversion, can usually be controlled through appropriate placement of the inlet protection device. In some cases, moving the inlet protection device a short distance upstream of the actual inlet can provide more efficient sediment control, limit ponding to desired areas, and prevent or control diversions.
- Seven types of inlet protection are presented below. However, it is recognized that other effective methods and proprietary devices exist and may be selected.

- Silt Fence: Appropriate for drainage basins with less than a 5% slope, sheet flows, and flows under 0.5 cfs.

- Excavated Drop Inlet Sediment Trap: An excavated area around the inlet to trap sediment (SE-3).

- Gravel bag barrier: Used to create a small sediment trap upstream of inlets on sloped, paved streets. Appropriate for sheet flow or when concentrated flow may exceed 0.5 cfs, and where overtopping is required to prevent flooding.

- Block and Gravel Filter: Appropriate for flows greater than 0.5 cfs.

- Temporary Geotextile Storm drain Inserts: Different products provide different features. Refer to manufacturer details for targeted pollutants and additional features.

- Biofilter Bag Barrier: Used to create a small retention area upstream of inlets and can be located on pavement or soil. Biofilter bags slowly filter runoff allowing sediment to settle out. Appropriate for flows under 0.5 cfs.

- Compost Socks: Allow filtered run-off to pass through the compost while retaining sediment and potentially other pollutants (SE-13). Appropriate for flows under 1.0 cfs.

- Select the appropriate type of inlet protection and design as referred to or as described in this fact sheet.

- Provide area around the inlet for water to pond without flooding structures and property.

- Grates and spaces around all inlets should be sealed to prevent seepage of sediment-laden water.

- Excavate sediment sumps (where needed) 1 to 2 ft with 2:1 side slopes around the inlet.

Installation

- ***DI Protection Type 1 - Silt Fence -*** Similar to constructing a silt fence; see BMP SE-1, Silt Fence. Do not place fabric underneath the inlet grate since the collected sediment may fall into the drain inlet when the fabric is removed or replaced and water flow through the grate will be blocked resulting in flooding. See typical Type 1 installation details at the end of this fact sheet.

  1. Excavate a trench approximately 6 in. wide and 6 in. deep along the line of the silt fence inlet protection device.

  2. Place 2 in. by 2 in. wooden stakes around the perimeter of the inlet a maximum of 3 ft apart and drive them at least 18 in. into the ground or 12 in. below the bottom of the trench. The stakes should be at least 48 in.

  3. Lay fabric along bottom of trench, up side of trench, and then up stakes. See SE-1, Silt Fence, for details. The maximum silt fence height around the inlet is 24 in.

  4. Staple the filter fabric (for materials and specifications, see SE-1, Silt Fence) to wooden stakes. Use heavy-duty wire staples at least 1 in. in length.

5. Backfill the trench with gravel or compacted earth all the way around.

- ***DI Protection Type 2 - Excavated Drop Inlet Sediment Trap -*** Install filter fabric fence in accordance with DI Protection Type 1. Size excavated trap to provide a minimum storage capacity calculated at the rate 67 yd^3/acre of drainage area. See typical Type 2 installation details at the end of this fact sheet.

- ***DI Protection Type 3 - Gravel bag -*** Flow from a severe storm should not overtop the curb. In areas of high clay and silts, use filter fabric and gravel as additional filter media. Construct gravel bags in accordance with SE-6, Gravel Bag Berm. Gravel bags should be used due to their high permeability. See typical Type 3 installation details at the end of this fact sheet.

  1. Construct on gently sloping street.

  2. Leave room upstream of barrier for water to pond and sediment to settle.

  3. Place several layers of gravel bags – overlapping the bags and packing them tightly together.

  4. Leave gap of one bag on the top row to serve as a spillway. Flow from a severe storm (e.g., 10 year storm) should not overtop the curb.

- ***DI Protection Type 4 – Block and Gravel Filter -*** Block and gravel filters are suitable for curb inlets commonly used in residential, commercial, and industrial construction. See typical Type 4 installation details at the end of this fact sheet.

  1. Place hardware cloth or comparable wire mesh with 0.5 in. openings over the drop inlet so that the wire extends a minimum of 1 ft beyond each side of the inlet structure. If more than one strip is necessary, overlap the strips. Place woven geotextile over the wire mesh.

  2. Place concrete blocks lengthwise on their sides in a single row around the perimeter of the inlet, so that the open ends face outward, not upward. The ends of adjacent blocks should abut. The height of the barrier can be varied, depending on design needs, by stacking combinations of blocks that are 4 in., 8 in., and 12 in. wide. The row of blocks should be at least 12 in. but no greater than 24 in. high.

  3. Place wire mesh over the outside vertical face (open end) of the concrete blocks to prevent stone from being washed through the blocks. Use hardware cloth or comparable wire mesh with 0.5 in. opening.

  4. Pile washed stone against the wire mesh to the top of the blocks. Use 0.75 to 3 in.

- ***DI Protection Type 5 – Temporary Geotextile Insert (proprietary) –*** Many types of temporary inserts are available. Most inserts fit underneath the grate of a drop inlet or inside of a curb inlet and are fastened to the outside of the grate or curb. These inserts are removable and many can be cleaned and reused. Installation of these inserts differs between manufacturers. Please refer to manufacturer instruction for installation of proprietary devices.

- ***DI Protection Type 6 - Biofilter bags*** – Biofilter bags may be used as a substitute for gravel bags in low-flow situations. Biofilter bags should conform to specifications detailed in SE-14, Biofilter bags.

    1. Construct in a gently sloping area.
    2. Biofilter bags should be placed around inlets to intercept runoff flows.
    3. All bag joints should overlap by 6 in.
    4. Leave room upstream for water to pond and for sediment to settle out.
    5. Stake bags to the ground as described in the following detail. Stakes may be omitted if bags are placed on a paved surface.

- ***DI Protection Type 7 – Compost Socks*** – A compost sock can be assembled on site by filling a mesh sock (e.g., with a pneumatic blower). Compost socks do not require special trenching compared to other sediment control methods (e.g., silt fence). Compost socks should conform to specification detailed in SE-13, Compost Socks and Berms.

Costs

- Average annual cost for installation and maintenance of DI Type 1-4 and 6 (one year useful life) is $200 per inlet.
- Temporary geotextile inserts are proprietary and cost varies by region. These inserts can often be reused and may have greater than 1 year of use if maintained and kept undamaged. Average cost per insert ranges from $50-75 plus installation, but costs can exceed $100. This cost does not include maintenance.
- See SE-13 for Compost Sock cost information.

Inspection and Maintenance

- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Silt Fences. If the fabric becomes clogged, torn, or degrades, it should be replaced. Make sure the stakes are securely driven in the ground and are in good shape (i.e., not bent, cracked, or splintered, and are reasonably perpendicular to the ground). Replace damaged stakes. At a minimum, remove the sediment behind the fabric fence when accumulation reaches one-third the height of the fence or barrier height.
- Gravel Filters. If the gravel becomes clogged with sediment, it should be carefully removed from the inlet and either cleaned or replaced. Since cleaning gravel at a construction site may be difficult, consider using the sediment-laden stone as fill material and put fresh stone around the inlet. Inspect bags for holes, gashes, and snags, and replace bags as needed. Check gravel bags for proper arrangement and displacement.

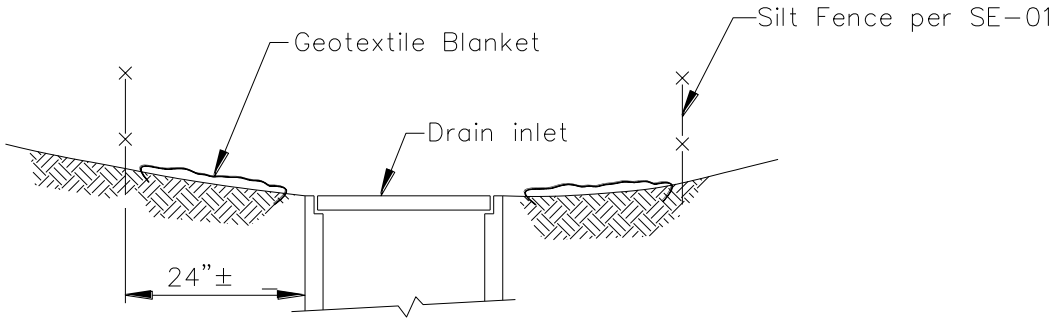
- Sediment that accumulates in the BMP should be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the barrier height.
- Inspect and maintain temporary geotextile insert devices according to manufacturer's specifications.
- Remove storm drain inlet protection once the drainage area is stabilized.
    - Clean and regrade area around the inlet and clean the inside of the storm drain inlet, as it should be free of sediment and debris at the time of final inspection.

References

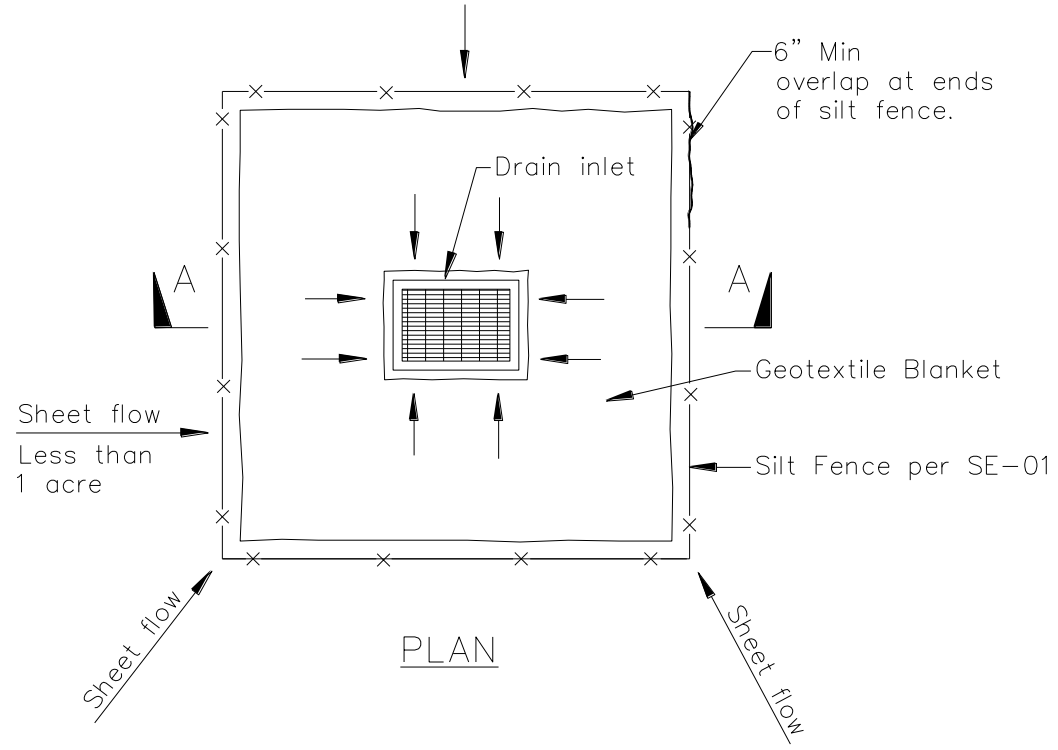
Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

Stormwater Management Manual for The Puget Sound Basin, Washington State Department of Ecology, Public Review Draft, 1991.

Erosion and Sediment Control Manual, Oregon Department of Environmental Quality, February 2005.



SECTION A–A

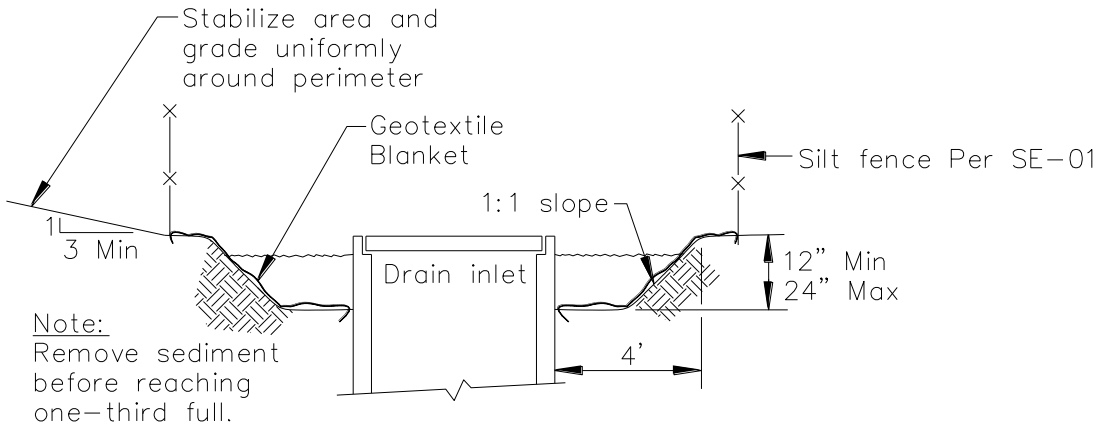


PLAN

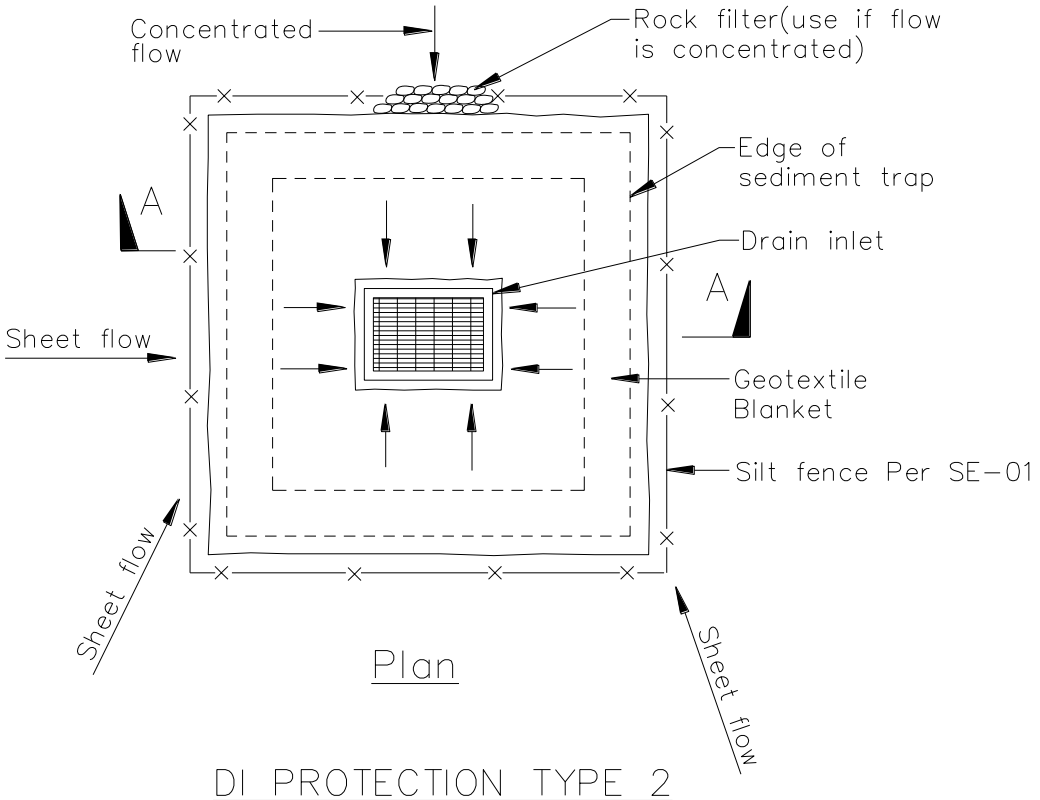
DI PROTECTION TYPE 1
NOT TO SCALE

NOTES:

1. For use in areas where grading has been completed and final soil stabilization and seeding are pending.
2. Not applicable in paved areas.
3. Not applicable with concentrated flows.



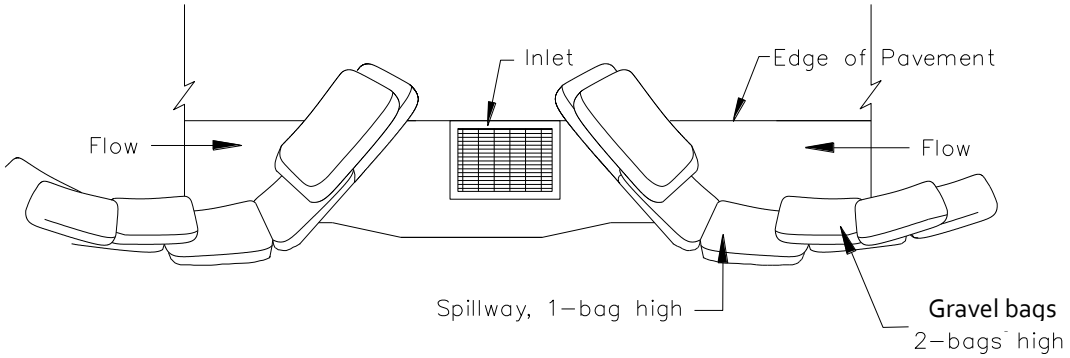
Section A–A



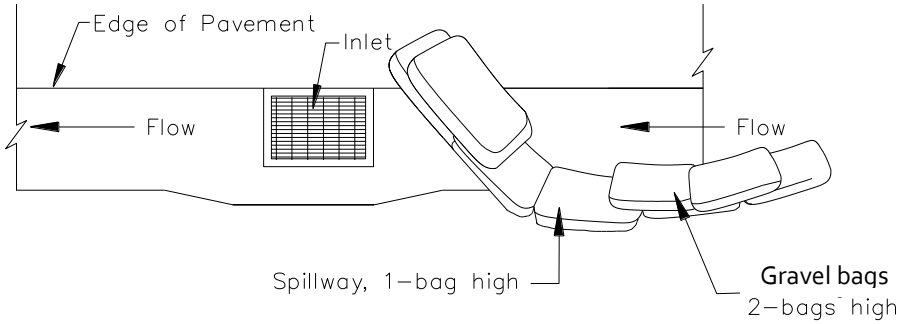
Plan

DI PROTECTION TYPE 2
NOT TO SCALE

Notes
1. For use in cleared and grubbed and in graded areas.
2. Shape basin so that longest inflow area faces longest length of trap.
3. For concentrated flows, shape basin in 2:1 ratio with length oriented towards direction of flow.



TYPICAL PROTECTION FOR INLET ON SUMP

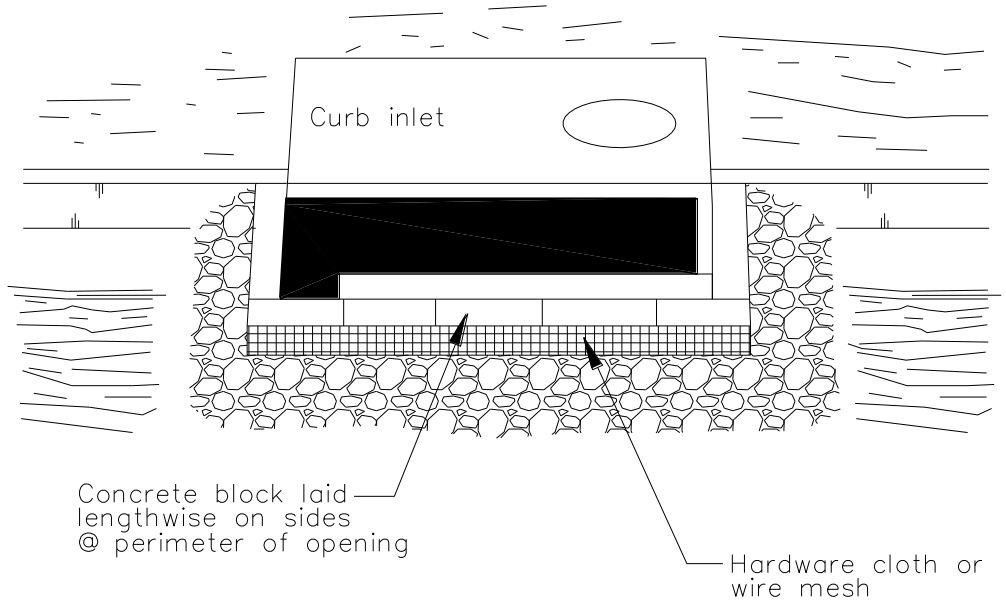


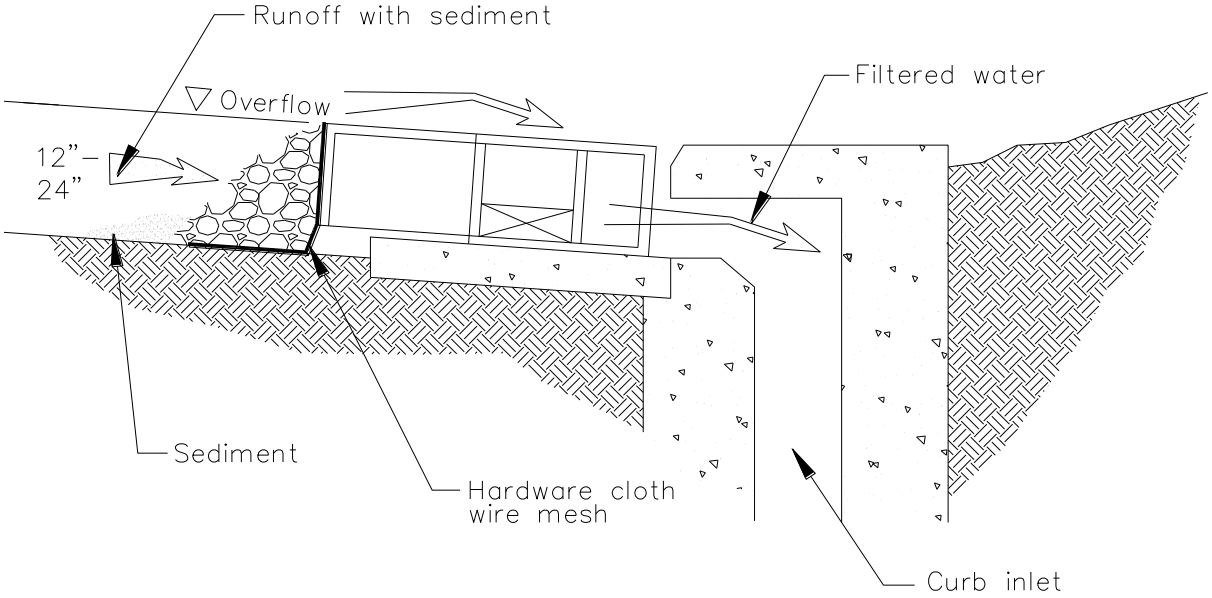
TYPICAL PROTECTION FOR INLET ON GRADE

NOTES:

1. Intended for short-term use.
2. Use to inhibit non-storm water flow.
3. Allow for proper maintenance and cleanup.
4. Bags must be removed after adjacent operation is completed
5. Not applicable in areas with high silts and clays without filter fabric.
6. Protection can be effective even if it is not immediately adjacent to the inlet provided that the inlet is protected from potential sources of pollution.

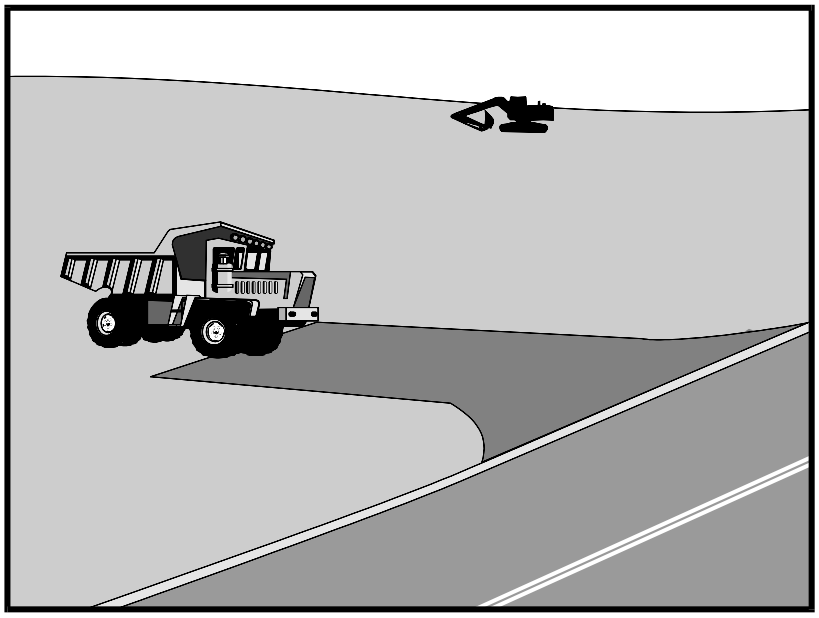
DI PROTECTION TYPE 3
NOT TO SCALE





DI PROTECTION – TYPE 4
NOT TO SCALE

Stabilized Construction Entrance / Exit TC-1



Categories

EC	Erosion Control	☒
SE	Sediment Control	☒
TC	Tracking Control	☑
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

A stabilized construction access is defined by a point of entrance/exit to a construction site that is stabilized to reduce the tracking of mud and dirt onto public roads by construction vehicles.

Suitable Applications

Use at construction sites:

- Where dirt or mud can be tracked onto public roads.
- Adjacent to water bodies.
- Where poor soils are encountered.
- Where dust is a problem during dry weather conditions.

Limitations

- Entrances and exits require periodic top dressing with additional stones.
- This BMP should be used in conjunction with street sweeping on adjacent public right of way.
- Entrances and exits should be constructed on level ground only.
- Stabilized construction entrances are rather expensive to construct and when a wash rack is included, a sediment trap of some kind must also be provided to collect wash water runoff.

Stabilized Construction Entrance/Exit TC-1

Implementation

General

A stabilized construction entrance is a pad of aggregate underlain with filter cloth located at any point where traffic will be entering or leaving a construction site to or from a public right of way, street, alley, sidewalk, or parking area. The purpose of a stabilized construction entrance is to reduce or eliminate the tracking of sediment onto public rights of way or streets. Reducing tracking of sediments and other pollutants onto paved roads helps prevent deposition of sediments into local storm drains and production of airborne dust.

Where traffic will be entering or leaving the construction site, a stabilized construction entrance should be used. NPDES permits require that appropriate measures be implemented to prevent tracking of sediments onto paved roadways, where a significant source of sediments is derived from mud and dirt carried out from unpaved roads and construction sites.

Stabilized construction entrances are moderately effective in removing sediment from equipment leaving a construction site. The entrance should be built on level ground. Advantages of the Stabilized Construction Entrance/Exit is that it does remove some sediment from equipment and serves to channel construction traffic in and out of the site at specified locations. Efficiency is greatly increased when a washing rack is included as part of a stabilized construction entrance/exit.

Design and Layout

- Construct on level ground where possible.
- Select 3 to 6 in. diameter stones.
- Use minimum depth of stones of 12 in. or as recommended by soils engineer.
- Construct length of 50 ft or maximum site will allow, and 10 ft minimum width or to accommodate traffic.
- Rumble racks constructed of steel panels with ridges and installed in the stabilized entrance/exit will help remove additional sediment and to keep adjacent streets clean.
- Provide ample turning radii as part of the entrance.
- Limit the points of entrance/exit to the construction site.
- Limit speed of vehicles to control dust.
- Properly grade each construction entrance/exit to prevent runoff from leaving the construction site.
- Route runoff from stabilized entrances/exits through a sediment trapping device before discharge.
- Design stabilized entrance/exit to support heaviest vehicles and equipment that will use it.

- Select construction access stabilization (aggregate, asphaltic concrete, concrete) based on longevity, required performance, and site conditions. Do not use asphalt concrete (AC) grindings for stabilized construction access/roadway.
- If aggregate is selected, place crushed aggregate over geotextile fabric to at least 12 in. depth, or place aggregate to a depth recommended by a geotechnical engineer. A crushed aggregate greater than 3 in. but smaller than 6 in. should be used.
- Designate combination or single purpose entrances and exits to the construction site.
- Require that all employees, subcontractors, and suppliers utilize the stabilized construction access.
- Implement SE-7, Street Sweeping and Vacuuming, as needed.
- All exit locations intended to be used for more than a two-week period should have stabilized construction entrance/exit BMPs.

Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMPs are under way, inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Inspect local roads adjacent to the site daily. Sweep or vacuum to remove visible accumulated sediment.
- Remove aggregate, separate and dispose of sediment if construction entrance/exit is clogged with sediment.
- Keep all temporary roadway ditches clear.
- Check for damage and repair as needed.
- Replace gravel material when surface voids are visible.
- Remove all sediment deposited on paved roadways within 24 hours.
- Remove gravel and filter fabric at completion of construction

Costs

Average annual cost for installation and maintenance may vary from $1,200 to $4,800 each, averaging $2,400 per entrance. Costs will increase with addition of washing rack, and sediment trap. With wash rack, costs range from $1,200 - $6,000 each, averaging $3,600 per entrance.

References

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

National Management Measures to Control Nonpoint Source Pollution from Urban Areas, USEPA Agency, 2002.

Proposed Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters, Work Group Working Paper, USEPA, April 1992.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

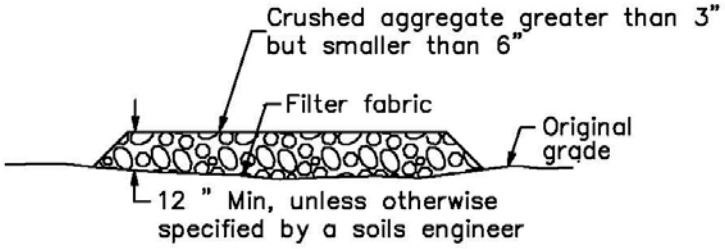
Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Virginia Erosion and Sedimentation Control Handbook, Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation, 1991.

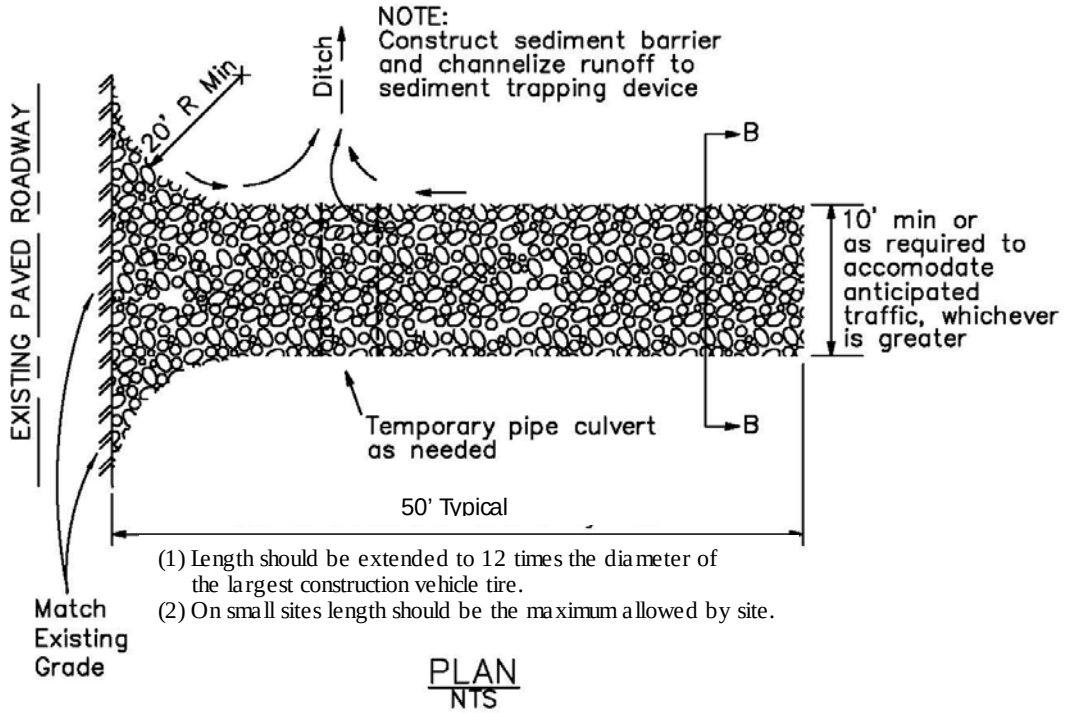
Guidance Specifying Management Measures for Nonpoint Pollution in Coastal Waters, EPA 840-B-9-002, USEPA, Office of Water, Washington, DC, 1993.

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.

Stabilized Construction Entrance / Exit TC-1



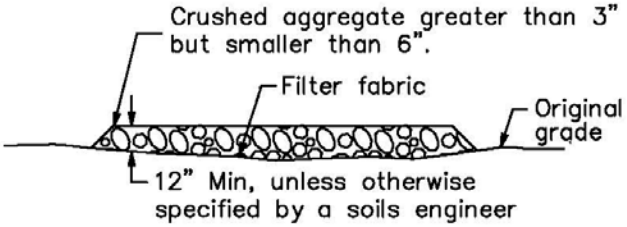
SECTION B–B
NTS



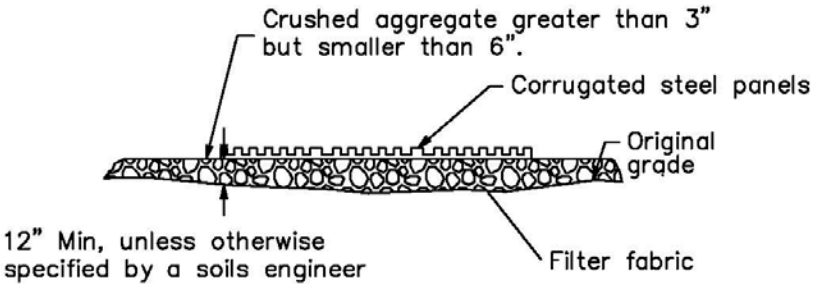
(1) Length should be extended to 12 times the diameter of the largest construction vehicle tire.
(2) On small sites length should be the maximum allowed by site.

PLAN
NTS

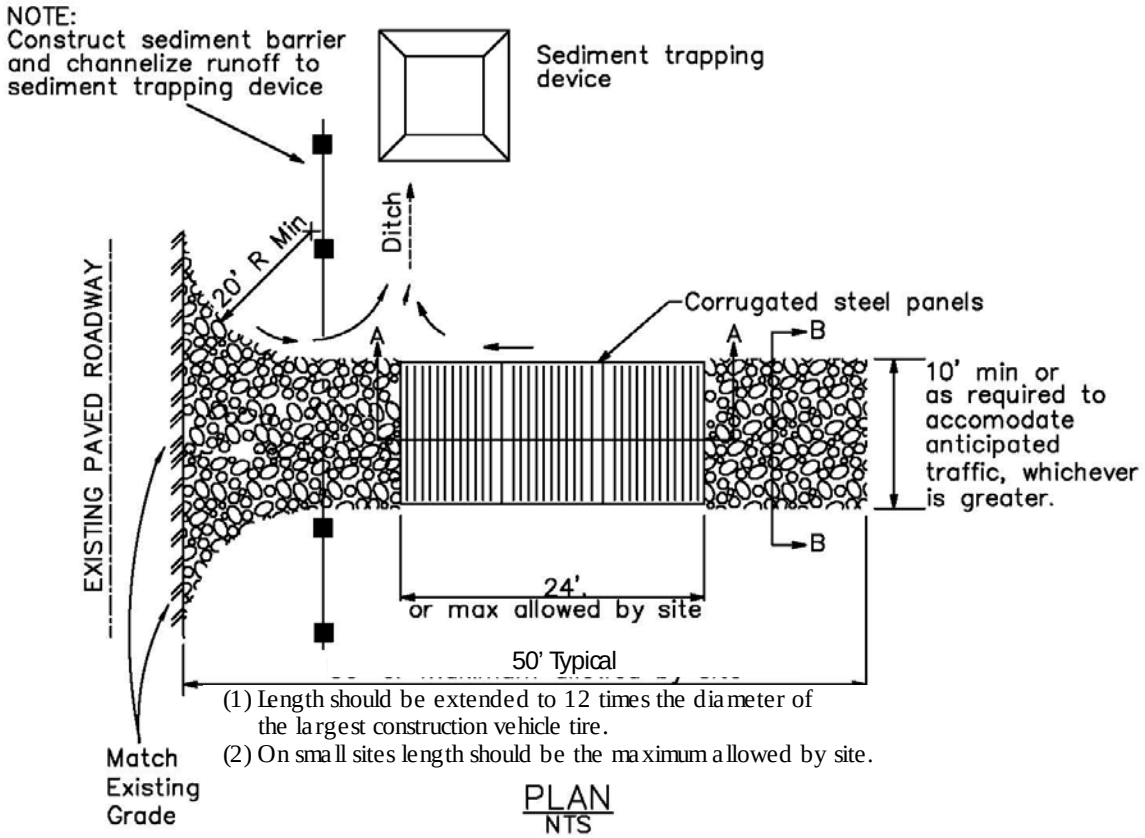
Stabilized Construction Entrance / Exit TC-1



SECTION B–B
NTS



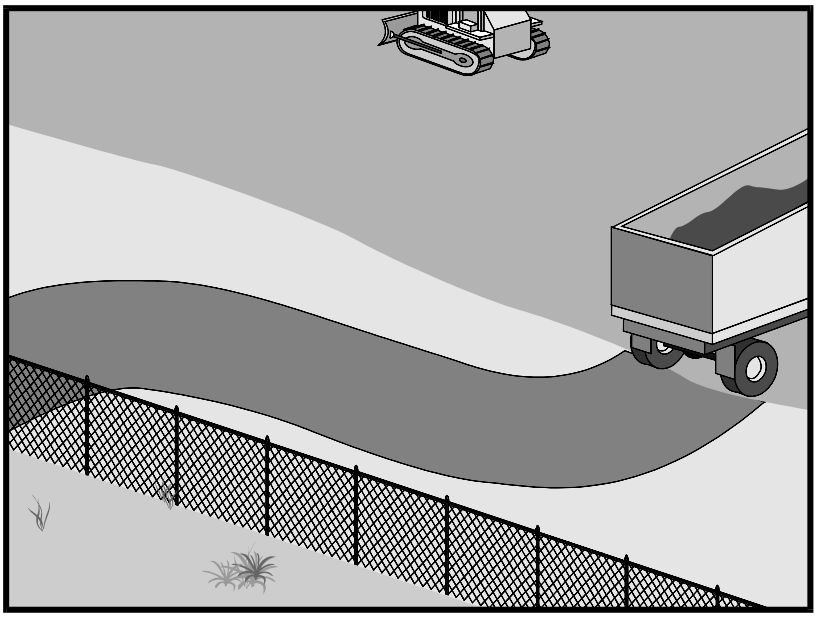
SECTION A–A
NOT TO SCALE



(1) Length should be extended to 12 times the diameter of the largest construction vehicle tire.
(2) On small sites length should be the maximum allowed by site.

PLAN
NTS

Stabilized Construction Roadway TC-2



Categories

EC	Erosion Control	☒
SE	Sediment Control	☒
TC	Tracking Control	☑
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

None

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Access roads, subdivision roads, parking areas, and other onsite vehicle transportation routes should be stabilized immediately after grading, and frequently maintained to prevent erosion and control dust.

Suitable Applications

This BMP should be applied for the following conditions:

- Temporary Construction Traffic:
  - Phased construction projects and offsite road access
  - Construction during wet weather
- Construction roadways and detour roads:
  - Where mud tracking is a problem during wet weather
  - Where dust is a problem during dry weather
  - Adjacent to water bodies
  - Where poor soils are encountered

Limitations

- The roadway must be removed or paved when construction is complete.

- Certain chemical stabilization methods may cause stormwater or soil pollution and should not be used. See WE-1, Wind Erosion Control.
- Management of construction traffic is subject to air quality control measures. Contact the local air quality management agency.
- Materials will likely need to be removed prior to final project grading and stabilization.
- Use of this BMP may not be applicable to very short duration projects.

Implementation

General

Areas that are graded for construction vehicle transport and parking purposes are especially susceptible to erosion and dust. The exposed soil surface is continually disturbed, leaving no opportunity for vegetative stabilization. Such areas also tend to collect and transport runoff waters along their surfaces. During wet weather, they often become muddy quagmires that generate significant quantities of sediment that may pollute nearby streams or be transported offsite on the wheels of construction vehicles. Dirt roads can become so unstable during wet weather that they are virtually unusable.

Efficient construction road stabilization not only reduces onsite erosion but also can significantly speed onsite work, avoid instances of immobilized machinery and delivery vehicles, and generally improve site efficiency and working conditions during adverse weather

Installation/Application Criteria

Permanent roads and parking areas should be paved as soon as possible after grading. As an alternative where construction will be phased, the early application of gravel or chemical stabilization may solve potential erosion and stability problems. Temporary gravel roadway should be considered during the rainy season and on slopes greater than 5%.

Temporary roads should follow the contour of the natural terrain to the maximum extent possible. Slope should not exceed 15%. Roadways should be carefully graded to drain transversely. Provide drainage swales on each side of the roadway in the case of a crowned section or one side in the case of a super elevated section. Simple gravel berms without a trench can also be used.

Installed inlets should be protected to prevent sediment laden water from entering the storm sewer system (SE-10, Storm Drain Inlet Protection). In addition, the following criteria should be considered.

- Road should follow topographic contours to reduce erosion of the roadway.
- The roadway slope should not exceed 15%.
- Chemical stabilizers or water are usually required on gravel or dirt roads to prevent dust (WE-1, Wind Erosion Control).
- Properly grade roadway to prevent runoff from leaving the construction site.
- Design stabilized access to support heaviest vehicles and equipment that will use it.

- Stabilize roadway using aggregate, asphalt concrete, or concrete based on longevity, required performance, and site conditions. The use of cold mix asphalt or asphalt concrete (AC) grindings for stabilized construction roadway is not allowed.
- Coordinate materials with those used for stabilized construction entrance/exit points.
- If aggregate is selected, place crushed aggregate over geotextile fabric to at least 12 in. depth. A crushed aggregate greater than 3 in. but smaller than 6 in. should be used.

Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Keep all temporary roadway ditches clear.
- When no longer required, remove stabilized construction roadway and re-grade and repair slopes.
- Periodically apply additional aggregate on gravel roads.
- Active dirt construction roads are commonly watered three or more times per day during the dry season.

Costs

Gravel construction roads are moderately expensive, but cost is often balanced by reductions in construction delay. No additional costs for dust control on construction roads should be required above that needed to meet local air quality requirements.

References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Coastal Nonpoint Pollution Control Program; Program Development and Approval Guidance, Working Group, Working Paper; USEPA, April 1992.

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

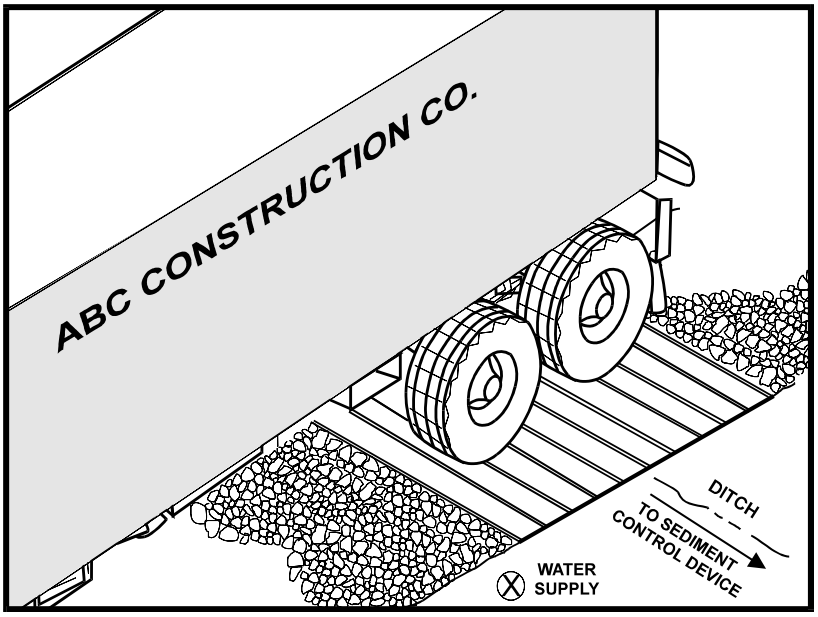
Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Virginia Erosion and Sedimentation Control Handbook, Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation, 1991.

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.

Entrance/Outlet Tire Wash TC-3



Description and Purpose

A tire wash is an area located at stabilized construction access points to remove sediment from tires and under carriages and to prevent sediment from being transported onto public roadways.

Suitable Applications

Tire washes may be used on construction sites where dirt and mud tracking onto public roads by construction vehicles may occur.

Limitations

- The tire wash requires a supply of wash water.
- A turnout or doublewide exit is required to avoid having entering vehicles drive through the wash area.
- Do not use where wet tire trucks leaving the site leave the road dangerously slick.

Implementation

- Incorporate with a stabilized construction entrance/exit. See TC-1, Stabilized Construction Entrance/Exit.
- Construct on level ground when possible, on a pad of coarse aggregate greater than 3 in. but smaller than 6 in. A geotextile fabric should be placed below the aggregate.
- Wash rack should be designed and constructed/manufactured for anticipated traffic loads.

Categories

EC	Erosion Control	
SE	Sediment Control	☒
TC	Tracking Control	☑
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

TC-1 Stabilized Construction Entrance/Exit

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

- Provide a drainage ditch that will convey the runoff from the wash area to a sediment trapping device. The drainage ditch should be of sufficient grade, width, and depth to carry the wash runoff.
- Use hoses with automatic shutoff nozzles to prevent hoses from being left on.
- Require that all employees, subcontractors, and others that leave the site with mud caked tires and undercarriages to use the wash facility.
- Implement SC-7, Street Sweeping and Vacuuming, as needed.

Costs

Costs are low for installation of wash rack.

Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect BMPs in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Inspect BMPs subject to non-stormwater discharge daily while non-stormwater discharges occur.
- Remove accumulated sediment in wash rack and/or sediment trap to maintain system performance.
- Inspect routinely for damage and repair as needed.

References

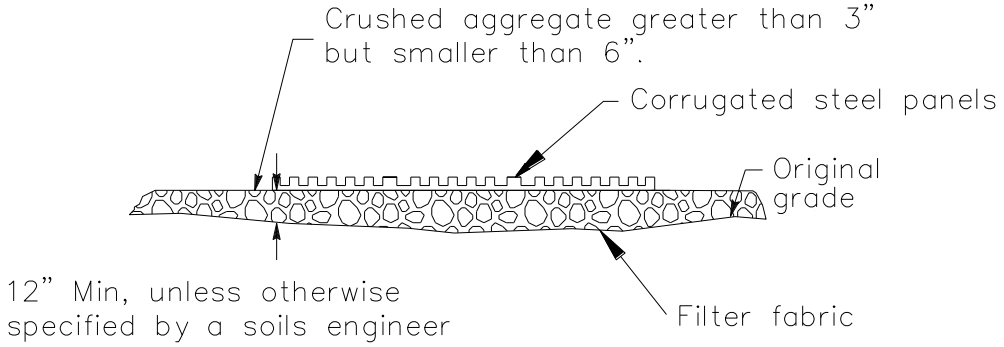
Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Coastal Nonpoint Pollution Control Program; Program Development and Approval Guidance, Working Group, Working Paper; USEPA, April 1992.

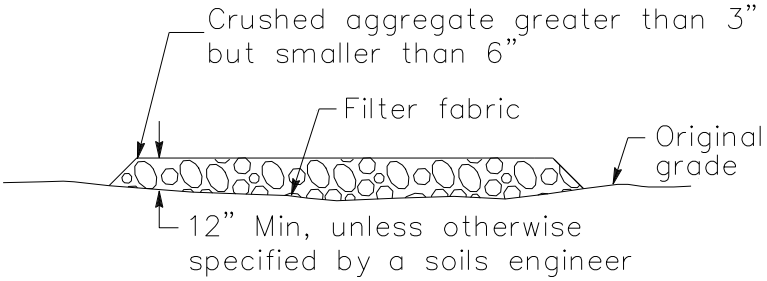
Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

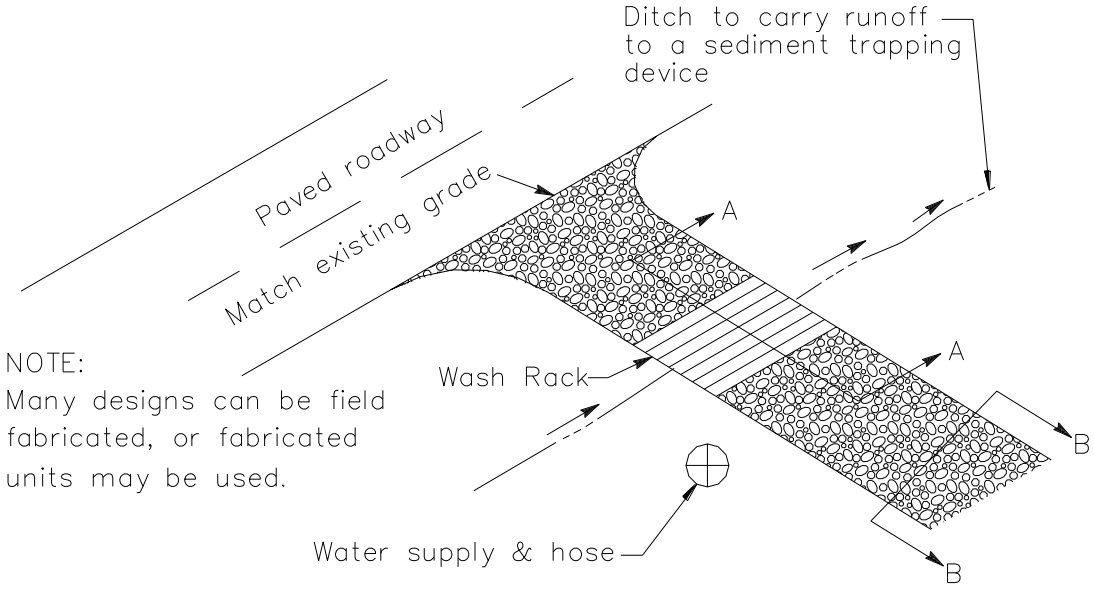
Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.



SECTION A–A
NOT TO SCALE

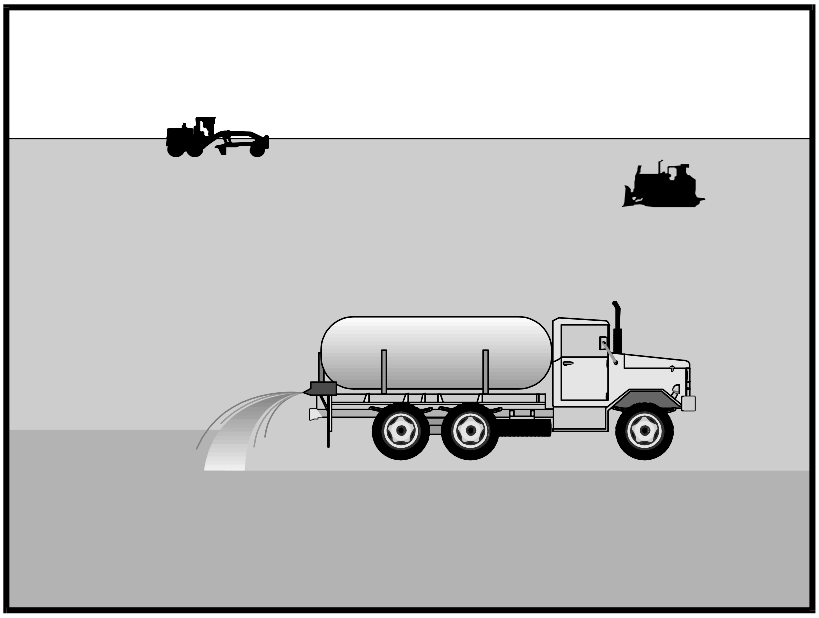


SECTION B–B
NTS



TYPICAL TIRE WASH
NOT TO SCALE

Wind Erosion Control WE-1



Categories

EC	Erosion Control	
SE	Sediment Control	☒
TC	Tracking Control	
WE	Wind Erosion Control	☑
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Category**

☒ **Secondary Category**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

EC-5 Soil Binders

If User/Subscriber modifies this fact sheet in any way, the CASQA name/logo and footer below must be removed from each page and not appear on the modified version.

Description and Purpose

Wind erosion or dust control consists of applying water or other chemical dust suppressants as necessary to prevent or alleviate dust nuisance generated by construction activities. Covering small stockpiles or areas is an alternative to applying water or other dust palliatives.

California's Mediterranean climate, with a short "wet" season and a typically long, hot "dry" season, allows the soils to thoroughly dry out. During the dry season, construction activities are at their peak, and disturbed and exposed areas are increasingly subject to wind erosion, sediment tracking and dust generated by construction equipment. Site conditions and climate can make dust control more of an erosion problem than water based erosion. Additionally, many local agencies, including Air Quality Management Districts, require dust control and/or dust control permits in order to comply with local nuisance laws, opacity laws (visibility impairment) and the requirements of the Clean Air Act. Wind erosion control is required to be implemented at all construction sites greater than 1 acre by the General Permit.

Suitable Applications

Most BMPs that provide protection against water-based erosion will also protect against wind-based erosion and dust control requirements required by other agencies will generally meet wind erosion control requirements for water quality protection. Wind erosion control BMPs are suitable during the following construction activities:

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

- Construction vehicle traffic on unpaved roads
- Drilling and blasting activities
- Soils and debris storage piles
- Batch drop from front-end loaders
- Areas with unstabilized soil
- Final grading/site stabilization

Limitations

- Watering prevents dust only for a short period (generally less than a few hours) and should be applied daily (or more often) to be effective.
- Over watering may cause erosion and track-out.
- Oil or oil-treated subgrade should not be used for dust control because the oil may migrate into drainageways and/or seep into the soil.
- Chemical dust suppression agents may have potential environmental impacts. Selected chemical dust control agents should be environmentally benign.
- Effectiveness of controls depends on soil, temperature, humidity, wind velocity and traffic.
- Chemical dust suppression agents should not be used within 100 feet of wetlands or water bodies.
- Chemically treated subgrades may make the soil water repellant, interfering with long-term infiltration and the vegetation/re-vegetation of the site. Some chemical dust suppressants may be subject to freezing and may contain solvents and should be handled properly.
- In compacted areas, watering and other liquid dust control measures may wash sediment or other constituents into the drainage system.
- If the soil surface has minimal natural moisture, the affected area may need to be pre-wetted so that chemical dust control agents can uniformly penetrate the soil surface.

Implementation

Dust Control Practices

Dust control BMPs generally stabilize exposed surfaces and minimize activities that suspend or track dust particles. The following table presents dust control practices that can be applied to varying site conditions that could potentially cause dust. For heavily traveled and disturbed areas, wet suppression (watering), chemical dust suppression, gravel asphalt surfacing, temporary gravel construction entrances, equipment wash-out areas, and haul truck covers can be employed as dust control applications. Permanent or temporary vegetation and mulching can be employed for areas of occasional or no construction traffic. Preventive measures include minimizing surface areas to be disturbed, limiting onsite vehicle traffic to 15 mph or less, and controlling the number and activity of vehicles on a site at any given time.

Chemical dust suppressants include: mulch and fiber based dust palliatives (e.g. paper mulch with gypsum binder), salts and brines (e.g. calcium chloride, magnesium chloride), non-petroleum based organics (e.g. vegetable oil, lignosulfonate), petroleum based organics (e.g. asphalt emulsion, dust oils, petroleum resins), synthetic polymers (e.g. polyvinyl acetate, vinyls, acrylic), clay additives (e.g. bentonite, montimorillonite) and electrochemical products (e.g. enzymes, ionic products).

Site Condition	Dust Control Practices							
	Permanent Vegetation	Mulching	Wet Suppression (Watering)	Chemical Dust Suppression	Gravel or Asphalt	Temporary Gravel Construction Entrances/Equipment Wash Down	Synthetic Covers	Minimize Extent of Disturbed Area
Disturbed Areas not Subject to Traffic	x	x	x	x	x			x
Disturbed Areas Subject to Traffic			x	x	x	x		x
Material Stockpiles		x	x	x			x	x
Demolition			x			x	x	
Clearing/ Excavation			x	x				x
Truck Traffic on Unpaved Roads			x	x	x	x	x	
Tracking					x	x		

Additional preventive measures include:

- Schedule construction activities to minimize exposed area (see EC-1, Scheduling).
- Quickly treat exposed soils using water, mulching, chemical dust suppressants, or stone/gravel layering.
- Identify and stabilize key access points prior to commencement of construction.
- Minimize the impact of dust by anticipating the direction of prevailing winds.
- Restrict construction traffic to stabilized roadways within the project site, as practicable.
- Water should be applied by means of pressure-type distributors or pipelines equipped with a spray system or hoses and nozzles that will ensure even distribution.
- All distribution equipment should be equipped with a positive means of shutoff.
- Unless water is applied by means of pipelines, at least one mobile unit should be available at all times to apply water or dust palliative to the project.
- If reclaimed waste water is used, the sources and discharge must meet California Department of Health Services water reclamation criteria and the Regional Water Quality

Control Board (RWQCB) requirements. Non-potable water should not be conveyed in tanks or drain pipes that will be used to convey potable water and there should be no connection between potable and non-potable supplies. Non-potable tanks, pipes, and other conveyances should be marked, "NON-POTABLE WATER - DO NOT DRINK."

- Pave or chemically stabilize access points where unpaved traffic surfaces adjoin paved roads.
- Provide covers for haul trucks transporting materials that contribute to dust.
- Provide for rapid clean up of sediments deposited on paved roads. Furnish stabilized construction road entrances and wheel wash areas.
- Stabilize inactive areas of construction sites using temporary vegetation or chemical stabilization methods.

For chemical stabilization, there are many products available for chemically stabilizing gravel roadways and stockpiles. If chemical stabilization is used, the chemicals should not create any adverse effects on stormwater, plant life, or groundwater and should meet all applicable regulatory requirements.

Costs

Installation costs for water and chemical dust suppression vary based on the method used and the length of effectiveness. Annual costs may be high since some of these measures are effective for only a few hours to a few days.

Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities.
- BMPs must be inspected in accordance with General Permit requirements for the associated project type and risk level. It is recommended that at a minimum, BMPs be inspected weekly, prior to forecasted rain events, daily during extended rain events, and after the conclusion of rain events.
- Check areas protected to ensure coverage.
- Most water-based dust control measures require frequent application, often daily or even multiple times per day. Obtain vendor or independent information on longevity of chemical dust suppressants.

References

Best Management Practices and Erosion Control Manual for Construction Sites, Flood Control District of Maricopa County, Arizona, September 1992.

California Air Pollution Control Laws, California Air Resources Board, updated annually.

Construction Manual, Chapter 4, Section 10, "Dust Control"; Section 17, "Watering"; and Section 18, "Dust Palliative", California Department of Transportation (Caltrans), July 2001.

Prospects for Attaining the State Ambient Air Quality Standards for Suspended Particulate Matter (PM10), Visibility Reducing Particles, Sulfates, Lead, and Hydrogen Sulfide, California Air Resources Board, April 1991.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), March 2003.

400 Oceangate, Suite 500 Long Beach CA 90802 562.437.9100 kpff.com

CENTURY VILLAGES AT CABRILLO SPECIFIC PLAN PROJECT
UTILITY INFRASTRUCTURE TECHNICAL REPORT: WATER
July 10, 2020

PREPARED BY:

KPFF Consulting Engineers

400 Oceangate, Suite 500

Long Beach, CA 90802

(562) 437-9100

TABLE OF CONTENTS

1. INTRODUCTION 2

1.1. PROJECT DESCRIPTION 2

1.2. SCOPE OF WORK 2

2. REGULATORY FRAMEWORK 2

2.1. STATE 2

2.2. REGIONAL 7

2.3. LOCAL 9

3. EXISTING CONDITIONS 11

3.1. WATER SUPPLY 11

3.2. WATER DEMAND 17

3.3. DOMESTIC INFRASTRUCTURE 18

4. SIGNIFICANCE THRESHOLDS 18

5. METHODOLOGY 19

6. ANALYSIS OF PROJECT IMPACTS 19

6.1. CONSTRUCTION 19

6.2. OPERATION 20

6.2.1. WATER SUPPLY 20

6.2.2. INFRASTRUCTURE CAPACITY 22

7. CUMULATIVE IMPACTS 23

7.1. WATER SUPPLY 23

7.2. WATER INFRASTRUCTURE 24

8. MITIGATION MEASURES 24

9. LEVEL OF SIGNIFICANCE 24

1. INTRODUCTION

1.1. PROJECT DESCRIPTION

The Century Villages at Cabrillo campus, known herein as the "Project" was developed in the 1960's as part of the former Cabrillo/Savannah Naval Housing development which consisted of 135 acres of housing units. The Naval Housing development was in operation until the mid-1990s, after which the Navy abandoned the development and the land was broken up and transferred to the City of Long Beach, California State University of Long Beach, The Long Beach Job Corps, and the Long Beach Unified School District. In 1997, under the McKinney Act, a 26 acre portion of the formal Naval Housing development was transferred to Century Villages at Cabrillo for the purpose of providing transitional and permanent housing to those in need. Since the transfer of the 26 acres, the campus acquired an additional acre from the City of Long Beach bringing the area of the campus to 27 acres total. (KPFF, 2013)

Century Villages at Cabrillo (CVC) is engaged in a 20-year development of its property, where existing multi-family housing units will be replaced by larger, multi-story mixed use buildings. These buildings will have housing for low-income families, veterans, and seniors on the upper levels, and amenities like community centers, gymnasiums, and parking on the lower levels. Similarly, new administration buildings are planned to be built for CVC staff to work on-site with residents, visitors, and others who use the campus. Part of the campus' existing streets will be reconfigured to promote better traffic flow, more public transportation options, and ease of access for residents on site.

The City of Long Beach maintains a public easement for the streets throughout the CVC campus. Within these streets are multiple utilities, some of which are public, and some being private. The water lines under the streets are public lines belonging to Long Beach Water Department, and the storm drain and sewer lines under the streets and within the campus are privately owned and maintained by CVC.

1.2. SCOPE OF WORK

As a part of the Environmental Impact Report for the Project, the purpose of this report is to analyze the potential impact of the Project to the existing water infrastructure systems.

2. REGULATORY FRAMEWORK

2.1. STATE

(a) California Urban Water Management Plan Act

The California Urban Water Management Planning Act (California Water Code, Sections 10610–10656) addresses several state policies regarding water conservation and development of water management plans to ensure the efficient use of available supplies. The California Urban Water Management Planning Act also requires water suppliers to develop water management plans every five years to identify short-term and long-term

demand management measures to meet growing water demands during normal, single dry, and multiple dry years. Specifically, municipal water suppliers that serve more than 3,000 customers or provide more than 3,000 acre-feet per year (AFY) of water must adopt an urban water management plan (UWMP).

(b) Senate Bill X7-7 (California Water Code Section 10608)

Senate Bill X7-7 (SB X7-7), codified in California Water Code Section 10608 requires all water suppliers to increase water use efficiency. This legislation sets an overall goal of reducing per capita urban water use, compared to 2009 use, by 20 percent by December 31, 2020. SB X7-7 requires cities to establish a per capita water use target for the year 2020, as well as interim targets.

(c) Senate Bill 610 (Water Code Sections 10910 et seq.)

Senate Bill 610 (SB 610), codified in the California Water Code, Sections 10910 et seq., became effective January 1, 2002. SB 610 requires counties and cities to consider the availability of adequate water supplies for certain new large development projects as part of the California Environmental Quality Act (CEQA) process. Specifically, SB 610 requires that for certain projects subject to CEQA, the urban water supplier must prepare a water supply assessment (WSA) that determines whether the projected water demand associated with a project is included as part of the most recently adopted UWMP. The WSA shall identify existing water supply entitlements, water rights, or water service contracts held by the public water system, and prior years' water deliveries received by the public water system. In addition, it must address water supplies over a 20-year future period and consider average, single dry, and multiple dry years. In accordance with Water Code Section 10912, projects subject to CEQA requiring submittal of a WSA include the following:

- Residential developments of more than 500 dwelling units;
- Shopping center or business establishment employing more than 1,000 persons or having more than 500,000 square feet of floor space;
- Commercial office buildings employing more than 1,000 persons or having more than 250,000 square feet of floor space;
- Hotels, motels, or both, having more than 500 rooms;
- Industrial, manufacturing, or processing plant, or industrial park of more than 40 acres of land, more than 650,000 square feet of floor area, or employing more than 1,000 persons;
- Mixed-use projects that include one or more of the above-identified categories; or

- A project that would demand an amount of water equivalent to or greater than the amount of water required by a 500-dwelling-unit project.

The WSA must be approved by the public water system at a regular or special meeting and must be incorporated into the CEQA document. The lead agency must then make certain findings related to water supply based on the WSA.

The project would involve the demolition of 215 dwelling units, 7,250 square feet of administrative and supportive services, and 20,230 square feet of amenities and educational uses. It will develop 8400 dwelling units, 48,000 square feet of administrative and supportive services, 92,000 square feet of amenities and educational uses, and 17,000 square feet of commercial/retail uses.

The proposed additional 625 units will result in an increase in water demand of the amount of water required by a 500-dwelling unit project, which would trigger one of the above thresholds, a WSA is anticipated for this Project. The WSA must be approved by the public water system at a regular or special meeting and must be incorporated into the CEQA document. The lead agency must then make certain findings related to water supply based on the WSA.

(d) California Plumbing Code

The Current California Plumbing Code [1] sets forth efficiency standards (i.e., maximum flow rates) for all new federally-regulated plumbing fittings and fixtures, including showerheads and lavatory faucets. The maximum flow rate for public lavatory faucets is 0.5 gallon per minute (gpm). In addition, all water closets (i.e., flush toilets) are limited to 1.28 gallons per flush, wall mounted urinals are limited to 0.125 gallon per flush, and floor mounted urinals are limited to 0.5 gallon per flush.

(e) Sustainable Groundwater Management Act of 2014[2]

The Sustainable Groundwater Management Act of 2014, passed in September 2014, is a comprehensive three-bill package that provides a framework for the sustainable management of groundwater supplies by local authorities. The Sustainable Groundwater Management Act requires the formation of local groundwater sustainability agencies to assess local water basin conditions and adopt locally-based management plans. The Sustainable Groundwater Management Act provides 20 years for groundwater sustainability agencies to implement plans, achieve long-term groundwater sustainability, and protect existing surface water and groundwater rights. The Act also provides local groundwater sustainability agencies with the authority to: require registration of groundwater wells, measure and manage extractions, require reports and assess fees, and request revisions of basin boundaries, including establishing new subbasins. Furthermore,

[1] *California Code of Regulations, Title 24.*

[2] *Association of California Water Agencies, October 2014, Sustainable Groundwater Management Act of 2014 and Sustainable Groundwater Management Act of 2014 Fact Sheet.*

under the Sustainable Groundwater Management Act, groundwater sustainability agencies responsible for high- and medium-priority basins must adopt groundwater sustainability plans within five to seven years, depending on whether the basin is in critical overdraft.

(f) Statewide Water Reductions—Executive Orders B-29-15, B-36-15, and B-37-16

In response to California's drought conditions, in January 2014, Governor Edmund G. Brown, Jr. (Governor Brown) proclaimed a State of Emergency and directed state officials to take all necessary action to make water available. The following April, Governor Brown issued Executive Order B-29-15 calling for mandatory water reduction measures directed at conserving water use, streamlining the state's drought response, and investing in new technologies to make the State more drought resilient. This executive order directed the State Water Resources Control Board (SWRCB) to work with cities in implementing water usage reduction measures such as replacing up to 50 million square feet of lawns with drought-tolerant landscaping; creating temporary consumer rebate programs to replace older, energy-inefficient appliances; banning the watering of ornamental grass on public street median; and prohibiting new residential developments from irrigating with potable water unless water-efficient drip systems are utilized. The goal of the executive order is to reduce urban water usage by 25 percent statewide. The executive order also seeks to prioritize state water infrastructure projects and incentivize new technology for water efficiencies, streamline permitting and review of emergency drought salinity barriers, and simplify the approval process for voluntary water transfers and emergency drinking water projects. In addition, the executive order directed the California Energy Commission (CEC) to adopt emergency regulations establishing standards to improve the efficiency of water appliances, including toilets, urinals, and faucets. On January 1, 2016, new efficiency standards for toilets, faucets, and other appliances became effective. These standards are now reflected in the California Plumbing Code.

In November 2015, Governor Brown issued Executive Order B-36-15, which called for additional actions to build on the State's response to record dry conditions and assist recovery efforts from devastating wildfires. These included extension of previous executive orders, prioritization of projects that enhance water conservation, support for the extension of water restrictions, and support for projects that remediate wildfire damage and restore power plant operation.

In May 2016, Governor Brown issued Executive Order B-37-16, which extends the requirements of Executive Order B-29-15 and further directs the Department of Water Resources (DWR) and the SWRCB to develop long term efficiency targets that go beyond the 20-percent reductions mandated by SB X7-7, discussed above. The executive order established longer-term water conservation measures that include permanent monthly water use reporting, new urban water use targets, reducing system leaks and eliminating wasteful practices, strengthening urban drought contingency plans and improving agricultural water management and drought plans.

As a result, on May 18, 2016, the SWRCB further revised emergency regulations in consideration of improved hydrologic conditions. The prior percentage reduction-based

water conservation standard was replaced by a localized "stress-test" approach, which requires local water agencies to ensure a three-year supply under three or more dry years like the State experienced from 2012—2015. Water agencies that would face shortages under three additional dry years are required to meet a conservation standard equal to the amount of the shortage. On November 30, 2016, state agencies, including the SWRCB released a public draft of Making Water Conservation A California Way of Life, which addresses elements of Executive Order B-37-16 that require state agencies to develop a framework for using water more wisely, eliminating water waste, strengthening local drought resilience, and improving agricultural water use efficiency and drought planning.[3]

On April 7, 2017, Governor Brown issued Executive Order B-40-17 which lifts the drought emergency in all California counties except Fresno, Kings, Tulare and Tuolumne, where emergency drinking water projects will continue to help address diminished groundwater supplies[4]. The order also rescinds two emergency proclamations from January and April 2014 and four drought-related executive orders issued in 2014 and 2015, including B-29-15 and B-36-15 discussed above. Executive Order B-37-16 remains in effect. In spite of improved conditions, the State will continue to maintain urban water use reporting requirements and prohibitions on wasteful practices such as watering during or after rainfall, hosing off sidewalks and irrigating ornamental turf on public street medians.

The regulatory requirements resulting from these Executive Orders have been codified in Article 22.5, Drought Emergency Water Conservation, of the California Code of Regulations.

(g) California Water Plan

Required by the Water Code Section 10005(a), the California Water Plan is the State's strategic plan for managing and developing water resources statewide for current and future generations. It provides a collaborative planning framework for elected officials, agencies, tribes, water and resource managers, businesses, academia, stakeholders, and the public to develop findings and recommendations and make informed decisions for California's water future.

The California Water Plan, updated every five years, presents the status and trends of California's water-dependent natural resources; water supplies; and agricultural, urban, and environmental water demands for a range of plausible future scenarios. The California Water Plan also evaluates different combinations of regional and statewide resource management strategies to reduce water demand, increase water supply, reduce flood risk, improve water quality, and enhance environmental and resource stewardship. The evaluations and assessments performed for the California Water Plan help identify effective actions and policies for meeting California's resource management objectives in

[3] *State Water Resources Control Board, Water Conservation Portal—Emergency Conservation Regulation, State Plan Seeks to Make Water Conservation A Way of Life, November 30, 2016.*

[4] *Office of Governor Edmund G. Brown, Jr., "Governor Brown Lifts Drought Emergency, Retains Prohibition on Wasteful Practices,"* https://www.ca.gov/archive/gov39/2017/04/07/news19748/index.html, *accessed December 10, 2019.*

the near term and for several decades to come. The California Water Plan was last updated in 2018.

2.2. REGIONAL

As discussed in detail below, the Metropolitan Water District of Southern California (MWD) is a primary source of water supply within Southern California. Based on the water supply planning requirements imposed on its member agencies and customers, the MWD has adopted a series of official reports on the state of its water supplies. As described in further detail below, in response to recent developments in the Sacramento Delta, the MWD has developed plans intended to provide solutions that, when combined with the rest of its supply portfolio, will ensure a reliable long-term water supply for its member agencies.

(a) MWD's 2015 Urban Water Management Plan

MWD's 2015 UWMP addresses the future of MWD's water supplies and demand through the year 2040.[5] Based on its 2015 UWMP, MWD has supply capabilities that would be sufficient to meet expended demands from 2020 through 2040 under single dry year and multiple dry year hydrologic conditions. MWD has comprehensive plans for stages of actions it would undertake to address up to a 50-percent reduction in its water supplies and a catastrophic interruption in water supplies through its Water Surplus and Drought Management and Water Supply Allocation Plans. MWD has also developed an Emergency Storage Requirement to mitigate against potential interruption in water supplies resulting from catastrophic occurrences within the Southern California region and is working with the State to implement a comprehensive improvement plan to address catastrophic occurrences that could occur outside of the Southern California region. MWD is working with the State on the Delta Risk Management Strategy to reduce the impacts of a seismic event in the Delta that would cause levee failure and disruption of State Water Project (SWP) deliveries. In addition, MWD has plans for supply implementation and continued development of a diversified resource mix including programs in the Colorado River Aqueduct, SWP, Central Valley transfers, local resource projects, and in-region storage that enables the region to meet its water supply needs. As set forth in their 2015 UWMP, MWD will continue investments in water use efficiency measures to help the region achieve the 20 percent per person potable water use reduction by 2020.

(b) MWD's Integrated Resources Plan

MWD first adopted its Integrated Resources Plan (IRP), which is updated every five years, in 1996. The goal of the IRP is for Southern California to have a reliable water system that extends to the future. The 2015 IRP Update, adopted in January 2016, provides the MWD's strategy for water resources reliability through the year 2040. The 2015 IRP Update calls for stabilizing and maintaining imported water supplies; meeting future

5 Metropolitan Water District of Southern California, 2015 Urban Water Management Plan, June 2016.

growth through increased water conservation and sustaining and developing new local supplies; pursuing a comprehensive transfers and exchanges strategy; building storage in wet and normal years to manage risks and drought; and preparing for uncertainty with Future Supply Actions. Overall, the strategies presented in the 2015 IRP Update include investments to maintain the reliability of imported water supplies, expansion of local water supplies, and reduction in water demand through a variety of conservation and water use efficiency initiatives.[6]

(c) MWD's Water Surplus and Drought Management Plan

In 1999, MWD incorporated the water shortage contingency analysis that is required as part of any UWMP into a separate and more detailed plan, called the Water Surplus and Drought Management Plan. The overall objective of the Water Surplus and Drought Management Plan is to ensure that a shortage allocation of MWD's imported water supplies is not required.[7] The Water Surplus and Drought Management Plan provides policy guidance to manage MWD's supplies and achieve the goals laid out in the agency's IRP. The Water Surplus and Drought Management Plan separates resource actions into two major categories: Surplus Actions and Shortage Actions. The Water Surplus and Drought Management Plan considers the region to be in surplus only after MWD has met all demands for water, including replenishment deliveries. The Surplus Actions store surplus water, first inside then outside of the region. The Shortage Actions are separated into three subcategories: Shortage, Severe Shortage, and Extreme Shortage. Each category has associated actions that could be taken as a part of the response to prevailing shortage conditions. Conservation and water efficiency programs are part of MWD's resource management strategy for all categories.

(d) MWD's Water Supply Allocation Plan

While the Water Surplus and Drought Management Plan included a set of general actions and considerations for MWD staff to address during shortage conditions, it did not include a detailed water supply allocation plan or implementation approach. Therefore, in February 2008, MWD adopted a water supply plan called the Water Supply Allocation Plan which has since been implemented three times, most recently in April 2015. The Water Supply Allocation Plan includes a formula for determining reductions of water deliveries to member agencies during extreme water shortages in MWD's service area conditions (i.e., drought conditions or unforeseen cuts in water supplies). The formula allocates shortages of MWD supplies and seeks to balance the impacts of a shortage at the retail level while maintaining equity on the wholesale level, and takes into account growth, local investments, changes in supply conditions, the demand hardening aspects of non-potable recycled water use, and the implementation of conservation savings programs. The allocation period covers 12 consecutive months from July of a given year through the

[6] *Metropolitan Water District of Southern California, Integrated Water Resources Plan 2015 Update, January 12, 2016.*

[7] *Metropolitan Water District of Southern California, Water Surplus and Drought Management Plan: Report No. 1150, August 1999.*

following June.

2.3. LOCAL

(a) Long Beach Water Department 2015 Urban Water Management Plan

In June 2016, the City of Long Beach Water Department (LBWD) adopted the 2015 UWMP. The 2015 UWMP is a detailed and comprehensive planning document that addresses a broad array of issues including: (1) future water demands in five-year increments over a minimum 20-year period; (2) the availability of future water supplies necessary to meet demands during average year conditions, both in a single dry water year and in multi-year droughts; (3) actions that will be taken if water supplies are reduced by as much as 50 percent; and (4) current and future water conservation, recycled water, and other important programs. The most significant factors altering water use between 2015 and 2040 would be the increase in water demand from the multi-family sector and the decrease in water use attributable to water conservation efforts. Furthermore, the need to purchase more expensive imported water or construct new water supply projects has been reduced as a result of cost-effective conservation programs and the expanded use of recycled water to replace the use of potable water. As concluded in the 2015 UWMP, over the next 25 years groundwater usage will increase 93 percent, but imported and recycled water usage will remain essentially the same.

(b) LBWD Water Conservation and Water Supply Shortage Plan

The purpose of the Water Conservation and Water Supply Shortage Plan, which was amended in July 2011, is to prevent water supply shortages. However, if a shortage were to occur, the actions described in the Water Conservation and Water Supply Shortage Plan would minimize its impact on the City's population and economy, providing first for public health, fire protection, and other essential services; next providing for the economic health of the City; and finally providing for other uses of water.[8] Objectives of the Water Conservation and Water Supply Shortage Plan include the following:

- To prevent water supply shortages through aggressive and effective water management programs such as conjunctive use, water conservation, water education and use reclaimed water;

- To minimize the impact of a water supply shortage on the City's population and economy;

- To provide first for public health and fire protection and other essential services, then to provide for the economic health of the City, and then to provide for other uses of water; and

- To ensure the water users who conserve water during normal-year hydrology and

[8] *Long Beach Water Department, Conservation and Water Supply Shortage Plan, July 2011.*

wet-year hydrology re not disadvantaged by the Plan during shortages.

(c) City of Long Beach Municipal Code

The City has adopted several ordinances, codified in the Long Beach Municipal Code (LBMC), in an effort to reduce water consumption. A summary of the City's key regulations regarding water conservation is provided below.

- City Ordinance No. 07-0024—LBMC Title 2, Chapter 2.38, Sustainable City Commission: This regulation establishes the Sustainable City Commission, which provides advisory policy recommendations to the City Council on issues relating to the environment including; recommendations on a sustainable City plan; efforts or programs to address environmental issues such as air quality, water quality, and resource conservation relating to the protection and integrity of the natural environment; and programs to increase education and awareness of the environment. The Sustainable City Commission also serves as a forum for community discussion of these environmental issues and to encourage input and participation from all sectors of the community on issues of sustainability and the environment.

- City Ordinance No. 11-0012—LBMC Title 3, Chapter 3.90, Development Services Center Surcharge: This regulation establishes a surcharge to fund the continuous upgrade, improvement, and maintenance of technology for development projects and services. Surcharges are imposed on potable water, reclaimed water, sewer service, and the emergency water conservation plan adopted by the Long Beach Board of Water Commissioners.

- City Ordinance No. 13-0024—LBMC Title 18, Chapter 18.43, Plumbing Code: This regulation adopts and incorporates by reference the 2013 Edition of the California Plumbing Code, which sets forth efficiency standards (i.e., maximum flow rates) for all new federally regulated plumbing fittings and fixtures, including showerheads and lavatory faucets.

- City Ordinance No. 13-0024—LBMC Title 18, Chapter 18.47, Green Building Standards Code: This regulation adopts and incorporates by reference the 2013 Edition of the California Green Building Standards Code, which includes measures regarding indoor and outdoor water use.

The City of Long Beach also has adopted numerous requirements related to the provision of water for purposes of fire protection. These requirements are set forth in the Fire Code (LBMC Title 18, Chapter 18.48). Section 18.48.770 of the Fire Code establishes fire water flow standards consistent with the California Fire Code. As set forth in the California Fire Code, Table B105.1, fire water flow requirements vary from 1,500 gpm in small square footage buildings to 8,000 gpm in large square footage buildings. A minimum residual water pressure of 20 pounds per square inch (psi) is to remain in the water system with the required gpm flowing. As set forth in the California Fire Code, Table C105.1, the number of fire hydrants is based on the building floor area, and the spacing between the fire

hydrants is based on the number of required fire hydrants.

3. EXISTING CONDITIONS

3.1. WATER SUPPLY

LBWD is responsible for providing water within the City and ensuring water quality meets applicable California health standards for drinking water. Potable (drinking) water is supplied to the City from two primary sources: groundwater and imported water purchased wholesale from the MWD. The City satisfies non-potable water demand through reclaimed water supplies originating from the Long Beach Water Reclamation Plant. Other potential sources of water discussed in the City's 2015 UWMP include desalinated seawater. The following Table shows the projected water supplies based on the 2015 UWMP. As provided therein, the LBWD had an available water supply of approximately 76,983 acre-feet per in 2015 and is projected to have an available water supply of approximately 77,291 acre-feet in 2020. The water supply for 2015 was comprised of approximately 46 percent MWD imported water, 42 percent groundwater, and 12 percent recycled water. For 2020, the available water supply is projected to consist of approximately 45 percent MWD imported water, 43 percent groundwater, and 12 percent recycled water.

Table 1 - Long Beach Water Department—Existing and Projected Water Supplies (AFY)

Water Supply	2015	2020	2025	2030	2035	2040
Wholesale Purchases: MWD (Imported)	35,100	35,100	35,100	35,100	35,100	35,100
Groundwater: LBWD Central Basin Aquifer Rights	32,693	33,001	33,501	34,001	34,501	35,001
Recycled Water	9,190	9,190	9,190	9,190	9,190	9,190
Total	**76,983**	**77,291**	**77,791**	**78,291**	**78,791**	**79,291**

AFY = acre-feet per year

Source: LBWD 2015 UWMP, 2016, Table 12.

(a) Metropolitan Water District of Southern California

MWD is the largest water wholesaler for domestic and municipal uses in Southern California. MWD imports a portion of its water supplies from the San Francisco/ Sacramento Delta region in Northern California through the SWP's California Aqueduct and from the Colorado River through MWD's own Colorado River Aqueduct. As one of the 26 member agencies of MWD, the LBWD purchases water from MWD to supplement the City's water supplies from local groundwater[9]. As discussed in LBWD's 2015 UWMP, as of 2015, the LBWD had a preferential right to approximately 2.34 percent or

[9] *Long Beach Water Department, 2015 Urban Water Management Plan, June 2016.*

32,692 acre-feet per year of groundwater from the Central Basin Aquifer.[10] As indicated in Table 1, in 2015, the LBWD received approximately 32,693 acre-feet of water from MWD. The LBWD will continue to rely on MWD to meet its current and future supplemental water needs. Summaries of MWD's individual supplies, along with each supply's challenges and specific responsive actions taken by MWD, are presented below.

(i) State Water Project

MWD imports water from the SWP, owned by the State and operated by the DWR. The SWP is a water storage and delivery system of reservoirs, aqueducts, power plants, and pumping plants. The main purpose of the SWP is to divert and store surplus water during wet periods and distribute it to areas throughout the State. Other purposes of the SWP include flood control, power generation, recreation, fish and wildlife protection, and water quality management in the Sacramento–San Joaquin River Delta (Delta). The SWP transports Feather River water stored in and released from Oroville Dam and conveyed through the Delta, as well as unregulated flows diverted directly from the Delta south via the California Aqueduct to four delivery points near the northern and eastern boundaries of MWD's service area. MWD is one of the 29 agencies that have long-term contracts for water service from the DWR and is the largest agency in terms of the number of people it serves (nearly 19 million), the share of the SWP that it has contracted to receive (approximately 46 percent), and the percentage of total annual payments made to the DWR by agencies with state water contracts (approximately 53 percent in 2015). [11]MWD's State Water Contract is set to expire in 2035, and MWD has the option to continue service under substantially the same terms and conditions.[12]

Under the original contract, the SWP provides MWD with 1,911,500 acre-feet of water.[13] However due to water quality and supply reliability challenges and conflicts due to variable hydrology and environmental standards that limit pumping operations, SWP deliveries in the most recent critically dry years were 5 percent of contractual amounts in 2014 and 20 percent of contractual amounts in 2015. [14] For calendar year 2020, the DWR's allocation estimate was announced as 10 percent of contracted amounts for all SWP contractors.[15] Depending on hydrologic and water supply conditions in 2020, the DWR may revise the initial allocations.

[10] *Long Beach Water Department, 2015 Urban Water Management Plan, June 2016.*

[11] *Metropolitan Water District of Southern California, 2015 Urban Water Management Plan, June 2016.*

[12] *Metropolitan Water District of Southern California, 2015 Urban Water Management Plan, June 2016.*

[13] *Metropolitan Water District of Southern California, 2015 Urban Water Management Plan, June 2016.*

[14] *Metropolitan Water District of Southern California, 2015 Urban Water Management Plan, June 2016.*

[15] *Department of Water Resources, State Water Project Analysis Office (SWPAO), Notices to Contractors, Notice to State Water Project Contractors, Number 19-12, 2020 State Water Project Initial Allocation— 10 Percent, December 2, 2019.*

Challenges to State Water Project Supply[16]

Litigation and various regulations have created challenges for the SWP. In particular, the listing of several fish species in the Delta as threatened or endangered under the federal and/or California Endangered Species Acts has constrained SWP operations and created more uncertainty in SWP supply reliability. Based on DWR's 2015 SWP Delivery Capability Report, future SWP deliveries will continue to be impacted by restrictions on SWP and Central Valley Project (CVP) Delta pumping, and climate change, which is altering the hydrologic conditions in the State.

Programs Addressing Challenges within the Delta

In November 2009, Governor Arnold Schwarzenegger passed the 2009 Comprehensive Water Package consisting of four policy bills and a $11.14 billion bond proposal designed to ensure reliable water supply for California's future and restore the Delta and other ecologically sensitive areas. Senate Bill X7-1 (SB X7-1) of the 2009 Comprehensive Water Package established co-equal goals for the Delta: to provide a reliable water supply for California; and protect, restore, and enhance the Delta ecosystem. SB X7-1 also created a new Delta governing structure to achieve these co-equal goals and established a process for determining the consistency of the Bay Delta Conservation Plan (BDCP) with the co-equal goals. The goal of the BDCP was to provide a basis for the issuance of endangered species permits for the operation of the SWP and CVP and for improvements related to the Delta conveyance. The BDCP will help reduce the risk posed by seismic activities to water supplies from the Delta, protect drinking water quality, and help alleviate conflicts between water management and environmental protection. The BDCP's success is crucial in providing long-term solutions in the Delta and will help maximize water supply reliability from the SWP.

The draft BDCP and associated Draft Environmental Impact Report/Environmental Impact Statement (EIR/EIS) were made available for public review and comment in December 2013. [17] In April 2015, state and federal lead agencies announced a modified preferred alternative referred to as California WaterFix, which includes design changes and refinements to address impacts to Delta communities and various environmental commitments. A separate ecosystem effort referred to as California EcoRestore was also announced with the purpose of restoring at least 30,000 acres of Delta habitat. A Recirculated Draft Environmental Impact Report/Supplemental Draft Environmental Impact Statement (RDEIR/SDEIS), which evaluated California WaterFix and cumulative impacts of California EcoRestore was prepared and released for public review in July 2015.'[18]

Together, California WaterFix and California EcoRestore are expected to make

[16] *Metropolitan Water District of Southern California, 2015 Urban Water Management Plan, June 2016.*

[17] *Bay Delta Conservation Plan, 2013-2014 Public Review Period (Closed July 29, 2014)*

[18] *California Department of Water Resources and U.S. Bureau of Reclamation, Bay Delta Conservation Plan/California WaterFix Partially Recirculated Draft EIR/Supplemental Draft EIR Executive Summary, 2015.*

significant contributions toward achieving the co-equal goals of providing a more reliable water supply in California and protecting, restoring, and enhancing the Delta ecosystem established in the Sacramento-San Joaquin Delta Reform Act of 2009. The DWR and the U.S. Bureau of Reclamation have now completed the BDCP/California WaterFix Final EIR/EIS, which has been submitted to state and federal regulatory agencies for approval and permit authorization.

(ii)The Colorado River

MWD owns and operates the Colorado River Aqueduct, which since 1941 has delivered water from the Colorado River to Southern California[19]. The Colorado River currently supplies approximately 17 percent of Southern California's water needs, and on average makes up about 1.8 percent of LBWD's purchases from MWD.[20] Although as stated above, as of 2015, the LBWD had a preferential right to approximately 2.34 percent of MWD's groundwater. MWD has a legal entitlement to receive water from the Colorado River under a permanent service contract with the Secretary of the Interior. California is apportioned the use of 4.4 million acre-feet of water from the Colorado River each year plus one-half of any surplus that may be available for use collectively in Arizona, California, and Nevada. [21] Since 2003, due to increased consumption, no such unused apportioned water has been available to California. Historically, MWD has been able to claim most of its legal entitlement of Colorado River water and could divert over 1.2 million acre-feet in any year, but persistent drought conditions have contributed to a decrease in these claim. [22] MWD's supplies from the Colorado River totaled approximately 900,000 acre-feet in 2015.[23] Challenges facing MWD's Colorado River supply include risk of future droughts in the Colorado River Basin, pending litigation, and environmental considerations. Federal and state environmental laws protecting fish species and other wildlife species also have the potential to affect Colorado River operations.

(iii) Additional MWD Actions to Address Supply

To improve water supply reliability for the entire Southern California region, MWD has also been pursuing voluntary water transfer and exchange programs with state and federal agencies, public and private water districts, and individuals. Programs include the Arvin-Edison Storage Program; the Semitropic Storage Program; the San Bernardino Storage Program, the San Gabriel Valley MWD Exchange Program; the Antelope Valley– East Kern Water Agency Exchange and Storage Program; the Kern-Delta Water District Storage Program; the Mojave Storage Program; and the Central Valley Transfer Programs.[24]

[19] *Metropolitan Water District of Southern California, 2015 Urban Water Management Plan, June 2016.*

[20] *Metropolitan Water District of Southern California, 2015 Urban Water Management Plan, June 2016.*

[21] *Metropolitan Water District of Southern California, 2015 Urban Water Management Plan, June 2016.*

[22] *Metropolitan Water District of Southern California, 2015 Urban Water Management Plan, June 2016*

[23] *Metropolitan Water District of Southern California, 2015 Urban Water Management Plan, June 2016*

[24] *Metropolitan Water District of Southern California, 2015 Urban Water Management Plan, June 2016*

In addition, MWD continues to develop plans and make efforts to provide additional water supply reliability for the entire Southern California region. The LBWD coordinates closely with MWD to ensure implementation of these water resource development plans.[25] As discussed above, MWD's long-term plans to meet its member agencies reliability needs include improvements to the SWP as outlined in the California WaterFix and EcoRestore Plans, conjunctive management efforts on the Colorado River, water transfer programs and outdoor conservation measures, and development of additional local resources, such as recycling brackish water desalination and seawater desalination.

Additionally, MWD and has more than 5 million acre-feet of storage capacity of available reservoirs and banking/transfer programs, with approximately 1.21 million acre- feet, inclusive of Intentionally Created Surplus in that storage, and 626,000 acre-feet in emergency storage as of January 1, 2015. MWD had plans to increase storage capacity in 2016 and the end-of-year 2016 storage balances are estimated to be 1.1 to 1.5 million acre-feet depending on SWP and Colorado River Aqueduct supply conditions.[26] As described in the MWD's 2015 UWMP, MWD has supply capabilities that would be sufficient to meet expected demands from 2020 through 2040 under average-year, single dry year and multiple dry year hydrologic conditions.

(b)Groundwater

The LBWD extracts groundwater from wellfields throughout the Central Basin. The LBWD currently has the right to pump 32,692 acre-feet per year of groundwater from the Central Basin and 0.7 acre-feet per year from the West Coast Basin. However, as the LBWD does not currently have wells located in the West Coast Basin, it does not pump those water rights.[27]

Existing (2015) and projected (2020 through 2040) groundwater pumping volumes from the Central Basin are shown in Table 1, page 11. LBWD is expected to continue to produce volumes of groundwater equal to the expected annual extraction rights. These amounts could increase in dry years if MWD "calls" its water stored in the conjunctive use account. These amounts could also increase when water shortages require the LBWD to extract additional water from storage, or if the LBWD were to purchase or lease additional water production rights at cost-effective prices from an owner of water production rights. The amount would decrease in wet years when MWD and the Water Replenishment District of Southern California both participate in the in-lieu replenishment program. The LBWD anticipates purchasing or leasing additional groundwater rights over the next 25 years and has projected total groundwater rights of 35,001 acre-feet by 2040.[28]

[25] *Long Beach Water Department, 2015 Urban Water Management Plan, June 2016.*

[26] *Long Beach Water Department, 2015 Urban Water Management Plan, June 2016.*

[27] *Long Beach Water Department, 2015 Urban Water Management Plan, June 2016.*

[28] *Long Beach Water Department, 2015 Urban Water Management Plan, June 2016.*

As indicated in the LBWD 2015 UWMP, groundwater supplies from the Central Basin are considered reliable, even during multi-year droughts, because sufficient storage is maintained in the Central Basin, extractions are strictly limited, and due to the multiple sources for replenishment. [29] In addition, the LBWD is exploring several potential opportunities to augment its groundwater production by cycling new sources of replenishment water through its Central Basin groundwater storage accounts.

(c) Recycled Water

Based on the LBWD 2015 UWMP, recycled water used in Long Beach is wastewater that has been fully treated by a primary, secondary (biological), and tertiary (filtration) process. The Long Beach Water Reclamation Plant, operated by the Sanitation Districts of Los Angeles County, provides reclaimed water to the LBWD and treats up to 25 million gallons per day (mgd) of wastewater. During preparation of the LBWD 2015 UWMP, recycled water use in the City included approximately 3,850 acre-feet per year for landscape irrigation (including golf courses) and 795 acre-feet per year for energy production. The total recycled water used during fiscal year 2015 totaled approximately 4,645 acre-feet or approximately 7 percent of the total City water supply. The LBWD expects an increased use in recycled water delivery over the next 25 years.

(d) Global Warming and Climate Change

Climate change also has been a factor for California's water supply. Potential impacts of climate change on California's water resources include increases in temperature that drive the snow line higher and reduce snowpack, resulting in less water storage; intense rainfall leading to more frequent and extensive flooding; the acceleration of sea level rise that can produce higher storm surges during coastal storms; and an increase in droughts.[30] Based on ongoing environmental and policy planning efforts, MWD has demonstrated a commitment to addressing climate change by evaluating the vulnerability of its water systems to global warming impacts and has developed appropriate response strategies and management tools that account for the impacts of climate change on future water supplies.

As provided in the LBWD 2015 UWMP, the LBWD does not expect climate change to have a major impact on its water supplies, including groundwater and recycled water, during the time projections considered in the plan.

(e) Water Conservation and Recycling

Water conservation and recycling will play an increasing role in meeting future water demands. As set forth in the LBWD 2015 UWMP, the LBWD has maintained a well-rounded water conservation program since the 1980s. The LBWD maintains an array of conservation programs, such as its turf replacement program, its residential and

[29] *Long Beach Water Department, 2015 Urban Water Management Plan, June 2016.*

[30] *Department of Water Resources, California Climate Science and Data For Water Resources Management, June 2015.*

commercial rebates programs for a host of water-saving devices, its water rate structure which rewards customers that use water wisely, its enviable system loss program, and its expansive public education and outreach programs that keep customers informed and conserving water. The success of all these programs is evidenced by the 35-percent reduction in per capita water use since the 1980s and the 22-percent reduction that has occurred since the SB X7-7 baseline period (1996 to 2005). Furthermore, the LBWD has increased water-use efficiency and conservation through the adoption of Citywide measures, including the adoption of a landscape ordinance requiring drought-tolerant plants and efficient irrigation system for new landscape areas; adoption of the Long Beach Sustainable City Action Plan that includes a per capita water use reduction goal of 20 percent by 2020; the creation of the Office of Sustainability; and a partnership with the City for the implementation of water saving strategies.

In addition, as further discussed in the LBWD 2015 UWMP, the LBWD maintains a highly effective water-main conservation program through a proactive strategy that includes repairing all water mains, water meters, and other equipment as soon as leaks are identified; identifying evidence of leaks from its largest water mains in the streets; and using sophisticated computer software to prioritize the replacement of its water mains each year. As a result of water conservation and recycling, water use in the City has steadily declined from 175 gpd per capita in 1984 to 102 gpd per capita in 2015.[31]

(f) Future Water Projects

The LBWD has several proposed future water supply projects, as documented in the 2015 UWMP, including an expansion of the recycled water infrastructure, improvement to the recycled water barrier injection system, building extraction wells, water extraction from the West Coast Basin, Los Angeles River water treatment, urban stormwater treatment, and integrating seawater desalination technologies by 2025.

3.2. WATER DEMAND

The LBWD's 2015 UWMP provides water supply and demand projections in five-year increments from 2020 to 2040, based on projected population estimates provided by the Southern California Association of Governments (SCAG). Based on these numbers, water supply and demand for the Project buildout year (2040) was calculated. Table 2 below summarizes the projected water supply and demand from the year 2020 through 2040 for the City. As shown therein, according to the LBWD 2015 UWMP, the City's annual water demand is forecasted to be 64,137 acre-feet per year by 2040 under normal hydrological conditions. Use of the current demand per capita within this demand forecast provides a conservative estimate of projected future water demand (since additional conservation efforts are anticipated to further reduce per capita water use) to ensure that water supplies are available to meet projected demands. As also shown in Table 2, the 2015 UWMP anticipates adequate water supplies will be available to the service area under normal, single dry, and multiple dry year conditions through 2040.

With regard to on-site water demand, the Project Site currently uses water for the existing buildings operations, and irrigation of existing landscaped areas. As provided in the water

[31] *Long Beach Water Department, 2015 Urban Water Management Plan, page 6, 2016.*

demand calculations included in Table 3, on page 21 of this Technical Report, the Project Site generates a water demand of approximately 120,338 gpd or approximately 134.80 acre-feet per year.

Table 2 - City of Long Beach Supply and Demand Projections (AFY)

Hydrological Conditions	Years				
	2020	2025	2030	2035	2040
Normal Year					
Supply Total	77,291	77,791	78,291	78,791	79,291
Demand Total	63,643	63,410	63,454	63,609	64,137
Single Dry Year					
Supply Total	77,291	77,791	78,291	78,791	79,291
Demand Total	63,643	63,410	63,454	63,609	64,137
Multiple Dry Year					
Supply Total	77,291	77,791	78,291	78,791	79,291
Demand Total	63,643	63,410	63,454	63,609	64,137

AFY = acre-feet per year
Source: Long Beach Water Department, 2015 Urban Water Management Plan, Table 13, 2016.

3.3. DOMESTIC INFRASTRUCTURE

The existing domestic water infrastructure in the Project vicinity includes water lines that are owned and maintained by the LBWD. Water to the Project Site consist of 6-inch and 8-inch water main lines located in the private streets and a system of private service laterals and separate meters that serves each individual development.

4. SIGNIFICANCE THRESHOLDS

Appendix G of the State of California's California Environmental Quality Act (CEQA) Guidelines (CEQA Guidelines) provides a set of sample questions that address impacts with regard to water supply. These questions are as follows:

Would the project:

- Require or result in the relocation or construction of new or expanded water, wastewater treatment or storm water drainage, electric power, natural gas, or telecommunication facilities, the construction or relocation of which would cause significant environmental effects?

- Have sufficient water supplies available to serve the Project and reasonably foreseeable future development during normal, dry, and multiple dry years?

5. METHODOLOGY

The analysis of the Project's impacts relative to water supply is based on a calculation of the Project's anticipated net water demand by applying the City's wastewater generation rates to the proposed uses. The Project's resulting net water demand was then analyzed relative to LBWD's existing and planned future water supplies to determine if LBWD would be able to accommodate the Project's water demands during a normal weather year, single dry year, and multiple dry years. The analysis with regard to water infrastructure evaluates the adequacy of the existing water conveyance system to accommodate the Project's water demand.

6. ANALYSIS OF PROJECT IMPACTS

6.1. CONSTRUCTION

Project construction activities would result in a temporary increase in water demand. Water use would be associated with earthwork and soil compaction, dust control, mixing and placement of concrete, equipment and site cleanup, irrigation for plant and landscaping establishment, water line testing and flushing, and other related short-term activities. These activities would occur intermittently throughout the construction period and would be temporary in nature. The amount of water used during construction would vary depending on weather, soil conditions, the size of the area being worked, and the specific activities being performed. However, the short-term and intermittent water use during construction is not expected to be substantial. Furthermore, the water demand generated by construction activities would be offset by the reduction in water consumption resulting from the removal of the existing buildings to be carried out during different phases. In addition, as concluded in LBWD's 2015 UWMP, projected water demand for the City will be met by available supplies during a normal year, single dry year, and multiple dry year hydrological conditions through 2040, as well as the intervening years.

The Project will require construction of new, on-site water distribution lines to serve the new buildings. Construction impacts associated with the installation of water distribution lines would primarily involve trenching in order to place the water distribution lines below surface and would be limited to on-site water distribution, and minor off-site work associated with connections to the public main. Prior to ground disturbance, Project contractors would coordinate with LBWD to identify the locations and depth of all lines. Further, LBWD would be notified in advance of proposed ground disturbance activities to avoid water lines and disruption of water service. Therefore, Project impacts on water infrastructure associated with construction activities would be less than significant.

Based on the above, Project construction activities would require minimal water usage and are not anticipated to have a substantial adverse impact on available water supplies or infrastructure. In addition, off-site construction impacts would be temporary in nature and would not result in a substantial inconvenience to other water users or motorists and

pedestrians. As such, construction-related impacts to water supply and infrastructure would be less than significant.

6.2. OPERATION

6.2.1. WATER SUPPLY

Development of the Project would increase the long-term water demand associated with consumption, operational uses, maintenance, and other on-site activities. As shown in Table 3, it is estimated that the Proposed Project Buildout would have an average daily domestic water demand of approximately 202,671 gpd or approximately 227.02 acre- feet per year. When accounting for the existing uses to be removed, the Project would result in a net increase in average daily water demand of approximately 82,332 gpd or approximately 92.22 acre-feet per year. It should be noted that the Project's estimated water demand is conservative as it does not account for water conservation features that would be included as part of the Project or that would be required by the City. These water saving features would reduce Project demand accordingly.

Table 3 - Estimated Net Increase in Project Water Demand

Existing Conditions					
Land use	**Units**	**Demand Factor**		**Project Demand (GPD)**	**Project Demand (AFY)**
Residential	**Number of Units**				
Residential Units	865	132	GPD per Dwelling Unit[1]	114,180	127.90
Commercial	**Total Area (sf)**				
Amenities	12,380	120	GPD per KGSF[2]	1,486	1.66
Education	10,200	120	GPD per KGSF[2]	1,224	1.37
Commercial/Retail	5,850	50	GPD per KGSF[2]	293	0.33
Admin/Services	26,300	120	GPD per KGSF[2]	3,156	3.54
			Subtotal Existing Conditions	**120,338**	**134.80**
Proposed Project Buildout					
Land use	**Units**	**Demand Factor**		**Project Demand (GPD)**	**Project Demand (AFY)**
Residential	**Number of Units**				
Residential Units	1,380	132	GPD per Dwelling Unit[1]	182,160	204.05
Commercial	**Total Area (sf)**				
Amenities	79,350	120	GPD per KGSF[2]	9,522	10.67
Education	15,000	120	GPD per KGSF[2]	1,800	2.02
Commercial/Retail	22,850	50	GPD per KGSF[2]	1,143	1.28
Admin/Services	67,050	120	GPD per KGSF[2]	8,046	9.01
			Subtotal Proposed Project Buildout	**202,671**	**227.02**
			Net Increase in Water Demand	**82,332**	**92.22**

AFY = acre-feet per year gpd = gallons per day

sf = square feet

1 acre-foot = 325,851 gallons

[1] Demand Factors for residential units are based on the average of studio and apartments (1-bedroom, 2-bedroom, 3-bedroom) per LA County Sewer Capacity Availability Requests (SCAR) (latest version as of 2019).

[2] Demand Factors for commercial land use are based on LA County SCAR (latest version as of 2019).

Based on LBWD's 2015 UWMP water demand projections through 2040 shown in Table 2, page 18, the water demand for the City in 2040 during normal year, single dry year, and multiple dry year hydrological conditions is expected to reach approximately 64,137 acre-feet per year[32]. The Project's estimated net increase in water demand of approximately 92.22 acre-feet per year would comprise approximately 0.14 percent of the City's water demand in 2040. Therefore, the Project would be well within the available and projected water supplies through the year 2040 and, as such, the LBWD would be able to meet the water demand for the Project in combination with existing and planned water demand in its future service area. It is further noted that the 2015 UWMP anticipates commercial growth throughout the City, such as would occur under the Project, as evidenced in its application of a 0.33 percent annual growth rate in commercial water use to calculate the City's water demand projections through 2040.[33]

As described above, MWD's water supplies are facing challenges due to environmental concerns and litigation. Additionally, changes in hydrological conditions due to climate change could also have an impact on MWD's water supplies. However, along with MWD's water management and reliability initiatives, the LBWD is committed to providing a reliable water supply for the City, as detailed in its 2015 UWMP. The LBWD's 2015 UWMP takes into account the concerns of drought and dry weather and notes that the City will meet all new demand for water due to projected population growth through a combination of water conservation and water recycling.

Based on the above, the estimated water demand for the Project would not exceed the available supplies projected by the LBWD. Thus, the LBWD would be able to meet the Project's water demand in combination with the existing and planned future water demands within its service area. Therefore, the Project's operational impacts on water supply would be less than significant, and no mitigation measures are required.

6.2.2. INFRASTRUCTURE CAPACITY

Water service to the Project Site would continue to be provided by the LBWD for domestic and fire protection uses. While domestic water demand is typically the main contributor to water consumption, fire flow demands have a much greater instantaneous impact on infrastructure and therefore are the primary means for analyzing infrastructure capacity. Per the current California Fire Code, fire flow requirements are based on building types and floor area and range from 1,500 to 8,000 gallons per minute at 20 pounds per square inch. In accordance with Section 18.48.420 of the Long Beach Fire Code, all new commercial, industrial, and non-residential buildings that require two or more exits or that are greater than 3,000 square feet shall be protected by an automatic sprinkler system. Per the Long Beach Fire Code, fire flows can be reduced by up to 50 percent when fire sprinklers are installed. Prior to the issuance of building permits, the LBFD would be required to grant approval of the final building design, including all fire prevention and suppression systems, which would ensure the Project is developed pursuant to Fire Code requirements. In addition, on-site water connections would be constructed, as necessary, to comply with the fire flow set for the Project by the LBFD

[32] *As noted above, the 2015 UWMP's projections begin with 2020.*

[33] *As stated in the LVWD 2015 UWMP, the projections for future commercial water demands use 2014 commercial water use as a baseline and apply a 0.33-percent annual growth rate, which is the growth rate for employment between 2020 and 2035 projected by SCAG. Source: Long Beach Water Department, 2015 Urban Water Management Plan, page 26, 2016.*

during the plan check process.

With implementation of on-site water system improvements, which include fire sprinkler suppression systems to reduce or eliminate the public hydrant demands and new metered domestic water distribution system, the Project would not exceed the available capacity within the distribution infrastructure that would serve the Project Site. Therefore, impacts with regard to water infrastructure would be less than significant.

7. CUMULATIVE IMPACTS

7.1. WATER SUPPLY

The geographic context for the cumulative impact analysis on water supply is the LBWD service area (i.e., the City). As previously discussed, the LBWD, as a public water service provider, is required to prepare and update every five years a UWMP to plan and provide for water supplies to serve existing and projected demands over a 20-year horizon. The 2015 UWMP prepared by the LBWD accounts for existing development within the City, as well as projected growth through the year 2040. The growth assumed in the UWMP water demand projections incorporate population, housing, and employment growth anticipated in the City based on both historical trends and official forecasts from SCAG and the California Department of Finance.[34]

The LBWD's 2015 UWMP acknowledges that growth in the City is expected to continue to be lower than that of other cities in Southern California and the region as a whole. In addition, the LBWD has determined it will be able to reliably provide water to its customers from 2015 through the year 2040, as well as during intervening years.

Additionally, under the provisions of SB 610, the LBWD is required to prepare a comprehensive water supply assessment for every new development "project" (as defined by Section 10912 of the Water Code) within its service area that meets certain thresholds. As described in the Regulatory Framework subsection above, the types of projects that are subject to the requirements of SB 610 tend to be larger projects that may or may not have been included within the growth projections of the LBWD 2015 UWMP. The water supply assessment for such projects would evaluate the quality and reliability of existing and projected water supplies, as well as alternative sources of water supply and measures to secure alternative sources if needed.

Compliance with regulatory requirements that promote water conservation, such as the LBWD Water Conservation and Water Supply Shortage Plan and the Sustainable City Plan, as well as implementation of water saving strategies, also will assist in assuring that adequate water supply is available on a cumulative basis.

Based on the above, it is anticipated that the LBWD would be able to supply the demands of the Project and future growth through 2040 and beyond. Therefore, Project impacts on water supply would not be cumulatively considerable.

[34] *Long Beach Water Department, 2015 Urban Water Management Plan, pages 21-22 and 26, 2016.*

7.2. WATER INFRASTRUCTURE

The geographic context for the cumulative impact analysis on water infrastructure is the Project vicinity. Development of the Project and future new development in the Project vicinity would cumulatively increase demands on the existing water conveyance system. However, new development projects would be subject to City review to assure that the existing public utility facilities would be adequate to meet the domestic and fire water demands of each project, and individual projects would be subject to City requirements regarding infrastructure improvements needed to meet respective water demands, fire flow and pressure requirements, etc. Furthermore, the LBWD, Long Beach Department of Public Works, and the LBFD would conduct ongoing evaluations to ensure facilities are adequate. Therefore, Project impacts on the water infrastructure system would not be cumulatively considerable.

8. MITIGATION MEASURES

Project-level and cumulative impacts with regard to water supply and water infrastructure would be less than significant. Therefore, no mitigation measures are required.

9. LEVEL OF SIGNIFICANCE

Based on the analysis contained in this report, no significant impacts have been identified to water supply or infrastructure for this Project.

Long Beach Water
Exceptional Water · Exceptional Service

1800 E. Wardlow Road, Long Beach, CA 90807-4931
562.570.2300 | lbwater.org

Board of Water Commissioners
May 28, 2020 Board Meeting

Christopher J. Garner, General Manager

Subject:

Approve the Water Supply Assessment prepared for Century Villages at Cabrillo Project pursuant to California Water Code Sections 10910 through 10914.

Executive Summary:

California Senate Bill 221, effective January 1, 2002, mandates that approval by a city or county of certain residential subdivisions requires an affirmative written verification of sufficient water supply. California Senate Bill 610, effective January 1, 2002, mandates that a water supply assessment (WSA) must be furnished to local governments for inclusion in any environmental documentation for projects expected to use an amount of water equivalent to, or greater than, that used by a 500 dwelling unit development subject to the California Environmental Quality Act.

A WSA has been requested for the Century Villages at Cabrillo (CVC) Project, a 27-acre site located on the former United States Naval housing facility on the western edge of the City of Long Beach. It is located approximately 2.5 miles northwest of Long Beach's downtown core, bordered by Cabrillo High School (north), California State Long Beach Technology (south), Job Corp (east) and Terminal Island Freeway, San Pedro Brach railroad and Southern California Edison's electricity transmission corridor (west). The Project would result in a total of 1,380 dwelling units. Per Water Code Section 10910(g)(1), the governing body of the water supplier (i.e., the Board of Water Commissioners) must approve the WSA.

The Century Villages at Cabrillo Project is exempt from the SB 221 requirement of an affirmative written verification of sufficient water supply (Government Code Section 66473.7) because it will be sited within an urbanized area that has been previously developed for urban uses, and also because the immediate contiguous properties surrounding the project area are developed for urban uses.

However, the Century Villages at Cabrillo Project is not exempt from the SB 610 requirement to furnish a WSA. LBWD staff has completed the SB 610 WSA. This WSA anticipates adequate water supplies will be available during normal, single- and multiple-dry water years to meet the projected water demand associated with the Century Villages at Cabrillo Project, in addition to the existing and other planned future uses of LBWD's system. This finding is based on LBWD's reliable supply of groundwater and imported water, the expanded use of recycled water, continued success with water conservation programs, and the growth accounted for within the LBWD 2015 Urban Water Management Plan.

Recommendation/Fiscal Impacts:

Approve the Water Supply Assessment prepared for Century Villages at Cabrillo Project pursuant to California Water Code Sections 10910 through 10914.

Fiscal Impact: None.

B. Anatole Falagan — 5/15/2020
B. Anatole Falagan — Date
Assistant General Manager

Christopher J. Garner — 5/15/2020
Christopher J. Garner — Date
General Manager

APPROVED 5/28/2020
BOARD OF WATER COMMISSIONERS

Attachment

Long Beach Water

Exceptional Water • Exceptional Service

Water Supply Assessment

Prepared for:

Century Villages at Cabrillo Project

Approved by:

The City of Long Beach
Board of Water Commissioners

May 28, 2020

Table of Contents

Findings 1
What is a Water Supply Assessment? 2
Century Villages at Cabrillo Project 3
SB 221 Verification of a Sufficient Water Supply is Not Required 4
SB 610 Water Supply Assessment is Required 4
Deadline for Approval of WSA 4
Estimating the Project's Demand for Water 6
Summary of Water Supply Reliability 8
Imported Water Supply 9
A. Preferential Rights to MWD Supplies 9
B. 100 GPCD floor during shortage 10
C. Reliability of Imported Water 11
Groundwater Supply and Its Reliability 11
A. Groundwater Supply 11
B. Groundwater Reliability 12
Water Supplies During Normal, Single-Dry, and Multiple-Dry Year Conditions 13
Attachments 14

Findings

The proposed Century Villages at Cabrillo Project (Project) is exempt from the SB 221 requirement of an affirmative written verification of sufficient water supply (Government Code 66473.7) because it will be sited within an urbanized area that has been previously developed for urban uses. The Project is further exempt from SB 221 requirements because the immediate contiguous properties surrounding the Project area are, or previously have been, developed for urban uses.

However, the Project is not exempt from SB 610 requirement that a water supply assessment be completed because Project is expected to use an amount of water equivalent to, or greater than, that used by 500 dwelling units.

In Long Beach, water supply assessments (WSA) must be approved by the Board of Water Commissioners and transmitted to the project's lead agency. State law allows the WSA to be based on the most recently adopted Urban Water Management Plan, which for LBWD is the Board-adopted 2015 Urban Water Management Plan.

This water supply assessment anticipates adequate water supplies will be available during normal, single- and multiple-dry water years to meet the projected water demand associated with the Project, in addition to the existing and other planned future uses, including agricultural and manufacturing uses, of Long Beach Water Department's (LBWD) system. This finding is based on LBWD's rights to a reliable supply of groundwater, continued success with water conservation programs, expanded use of recycled water, the Metropolitan Water District of Southern California (MWD) shortage allocation plan that guarantees 100 gallons per capita per day at the retail level, and LBWD's preferential rights to water from the MWD, per Section 135 of the Metropolitan Water District Act.

What is a Water Supply Assessment?

Effective January 1, 2002, California Senate Bill 221 and Senate Bill 610 improve the link between information on water availability and certain land use decisions made by cities and counties. SB 221 and SB 610 are companion measures which seek to promote more collaborative planning between local water suppliers and cities and counties.

Both statutes require certain information regarding water availability to be provided to the city and county decision-makers prior to approval of specified large development projects. Both statutes also require this information to be included in the administrative record that serves as the evidentiary basis for an approval action by the city or county on such projects. Both measures recognize local control and decision making regarding the availability of water approval of the projects.

SB 221 conditions approval by a city or county of certain residential subdivisions on an affirmative written verification of sufficient water supply.

SB 610 requires a water supply assessment to be furnished to local governments for inclusion in any environmental documentation for certain projects (as defined in Water Code 10912(a)) subject to the California Environmental Quality Act (Water Code 10910(a)).

Under SB 610 and Water Code section 10911(b), the assessment must be completed prior to the issuance of a draft Environmental Impact Report or proposed Negative Declaration.

LBWD has SB 221 and SB 610 responsibilities under the City Charter. Long Beach City Charter, Section 1400, states:

> *There is hereby created a Water Department which shall be under the exclusive jurisdiction and control of five commissioners who shall be known as the Board of Water Commissioners. Said Water Department shall have full and complete jurisdiction over all water works necessary and incidental to the use, sale and distribution of water owned and controlled by the City.*

Furthermore, per California Water Code 10910(b), LBWD is responsible for performing the SB 610 assessment because LBWD is a public water system of over 3,000 service connections and will provide domestic water to the site.

Century Villages at Cabrillo Project

The Century Villages at Cabrillo Project (Project) is a mixed-use development project proposed across a 27-acre portion of the former United States Naval housing facility located on the western edge of the City of Long Beach. The Project site is bordered by Cabrillo High School to the north, California State Long Beach Technology to the south, Job Corp community to the east and Terminal Island Freeway, San Pedro Brach railroad and Southern California Edison's electricity transmission corridor to the west. The Ports of Long Beach and Los Angeles are located to the south.

The project site has been developed and redeveloped over the past seventy years and the former Naval housing and facilities were either rehabilitated or removed for new construction. Existing land uses on the project site are comprised of a combination of one and two-story rehabilitated Naval housing and new one, two, three, four and five-story residential buildings some of which are built over enclosed garages that are lined with ground floor functions including service providers and community spaces. There are currently 845 dwelling units within the project site, 12,380 square feet of amenities, 10,200 square feet of education uses, 5,850 square feet of commercial and retail, and 26,300 square feet of services and administration. There is also about 5,000 square feet for play areas that consists of playground, mural, shade structures, tetherball, and other amenities. Open space and parking areas also spread throughout the project site.

The Project involves the demolition of 215 dwelling units, 10,030 square feet of amenities, 10,200 square feet of education uses, and 7,250 square feet of services and administration; and the development of 750 dwelling units, 77,000 square feet of amenities, 15,000 square feet of educational uses, 17,000 square feet of commercial/retail uses, and 48,000 square feet of administrative and supportive services. Buildout of the community would result in a total of 1,380 dwelling units, 79,350 square feet of amenities, 15,000 square feet of educational uses, 22,850 square feet of commercial/retail uses, and 67,050 square feet of administrative and supportive services.

Summary of Proposed Land Uses					
Land Uses	**Existing**	**Remain**	**Remove**	**Proposed**	**Buildout (Remain + Proposed)**
Residential Units	845 DU	630 DU	215 DU	750 DU	1,380 DU
Residential Square Footage	604,278 SF	511,457 SF	92,821 SF	1,301,597 SF	1,813,054 SF
Amenities	12,380 SF	2,350 SF	10,030 SF	77,000 SF	79,350 SF
Education	10,200 SF	0 SF	10,200 SF	15,000 SF	15,000 SF

Commercial/Retail	5,850 SF	5,850 SF	0 SF	17,000 SF	22,850 SF
Services/Administration	26,300 SF	19,050 SF	7,250 SF	48,000 SF	67,050 SF
Total	**659,008 SF**	**538,707 SF**	**120,301 SF**	**1,458,597 SF**	**1,997,304 SF**
DU=dwelling units; SF=square feet					

The Project is anticipated to be implemented in 3 Phases – "A," "B," and "C". Phase A is anticipated to be completed by 2022, Phase B by 2025, and Phase C by 2026. Project phasing would ultimately respond to market demands and would be contingent on the availability of supporting infrastructure.

SB 221 Verification of a Sufficient Water Supply is Not Required

The Project is exempt from the SB 221 requirement of an affirmative written verification of sufficient water supply (Government Code 66473.7) because it will be sited within an urbanized area that has been previously developed for urban uses. The Project is further exempt from SB 221 requirements because the immediate contiguous properties surrounding the proposed site are, or previously have been, developed for urban uses.

SB 610 Water Supply Assessment is Required

Water Code 10912(a) and (b) and SB 610 require that a water supply assessment be adopted if the development is expected to demand an amount of water equivalent to or greater than the amount of water needed for 500 dwelling units. The Project triggers the need for a SB 610 assessment because the buildout of 1,380 dwelling units alone exceeds the 500 dwelling unit threshold.

Deadline for Approval of WSA

The governing body of the public water system in this case is the City of Long Beach Board of Water Commissioners (Board). Because the Century Villages at Cabrillo Project is a "project" as defined by SB 610, the Board must approve the WSA and deliver it to the lead agency within 90 days after that agency requests the assessment (per Water Code section 10910(g)(1)).

T&B Planning Inc. submitted a request to LBWD on March 3, 2020 to conduct the WSA for the Project. Therefore, the Board must approve the WSA and transmit that assessment to the lead agency no later than June 1, 2020.

Estimating the Project's Demand for Water

According to the conventional assumptions for the amount of water use per household from the Department of Water Resources "Guidebook for Implementation of Senate Bill 610 and Senate Bill 221 of 2001", one dwelling unit typically consumes 0.3 to 0.5 acre-feet of water per year "depending upon several factors". This works out to about 150-250 acre-feet per year for 500 dwelling units.

In calendar year 2015, 500 dwelling units in Long Beach multi-family settings (apartments and condominiums) averaged 78 acre-feet of water use, 500 dwelling units in duplex settings used 96 acre-feet, and 500 single family homes used 130 acre-feet. The 130 acre-feet for 500 single family homes is close to the low end of DWR's estimate of 150 acre-feet.

California's Water Code 10912(a) (i.e., SB 610) defines a "project" as a development that meets or exceeds any one of a number of thresholds, not just the "500 dwelling units" trigger; see Table 2. These comparable thresholds also create a tool for us to estimate the water needs of different elements of a mixed-use project.

Table 2 - SB 610 Threshold for requiring WSA

Type of Development		Equivalency	
1. SFR or MFR		500	dwelling units
2. Shopping center or business	or	1,000	employees
	or	500,000	sf of floor space
3. Commercial office building:		1,000	employees
	or	250,000	sf of floor space
3. Hotel or motel		500	rooms
4. Industrial, manufacturing, or processing plant, or industrial park			
		1,000	employees
	or	650,000	sf of floor space
	or	40	acres of land
5. A mixed-use project that includes one or more of the projects specified above			
6. A project that would demand an amount of water equivalent to, or greater than the amount of water required by a 500 dwelling unit project.			

Using these equivalencies, the following estimates that the Project will result in an additional water demand of 192.3 acre-feet per year once it is fully built out (see Table 3). This assumption is based on the conservative estimate that each new dwelling unit will use an amount of water equal to that of a typical Long Beach single family home; therefore, each 500 new additional dwelling units will result in an increase demand of 130 acre-feet per year.

Table 3 – Expected Increase in Water Demand resulting from the Project

SB 610 Threshold	Expected Water Use in Long Beach
Water Use per year per 500 Single Family homes	130 AF per Year

EQUIVILANCIES			Project's Net Increase	Net Increase in Water Use	
SFR or MFR	500	dwelling units	535	139.1	AF per Year
Commercial office building:					
	250,000	sf of floor space	102,270	53.2	AF per Year
Hotel or motel	500	rooms	-	-	AF per Year
TOTAL				**192.3**	**AF per Year**

Summary of Water Supply Reliability

If the projected water demand associated with a project had been accounted for in a water supplier's most recently adopted Urban Water Management Plan (UWMP), the water supplier may rely on information from that plan in preparing certain elements of the WSA.

LBWD's most recently adopted urban water management plan, its 2015 UWMP, as adopted by the Board in 2016, hereafter referred to as the 2015 UWMP, did not articulate specific development projects. Rather, it took into consideration the expected demand of these projects by projecting increases in factors influencing demand, such as increases in housing, population, and employment.

The Project's expected water demand falls within the expected increase in employment and population used in the 2015 UWMP.

The Project's expected water demand is within LBWD's total projected water supplies available during normal, single dry, and multiple dry water years for the next 20 years; supplies that will be adequate to meet the projected water demand associated with the Project in addition to the existing and other planned future uses of LBWD's system.

MWD's shortage allocation plan guarantees a minimum amount of water to each member agency such that no member agency will be required to reduce retail demand to below 100 gallons per capita per day (GPCD). Because retail demand in LBWD's service area in FY 2015 essentially equaled 100 GPCD (100.25 GPCD), LBWD has nearly 100-percent reliability even during shortage conditions.

What has not materially changed from the water supply assumptions in the 2015 UWMP are the reliability of LBWD's groundwater and the Long Beach preferential rights to MWD supplies. Therefore, for the purposes of this WSA, the 2015 UWMP as it pertains to groundwater and preferential rights is an appropriate reference. The 2015 UWMP can be found at: http://www.lbwater.org/sites/default/files/documents/LBWD2015UWMP.pdf.

Imported Water Supply

LBWD purchases imported water from MWD to meet demand in excess of what can be satisfied through conservation and recycled water and LBWD's groundwater supplies. Imported water has historically accounted for approximately 40 to 50-percent of the LBWD water supply. The amount of imported water LBWD purchases from MWD fluctuates from year to year, but the fluctuations have been due primarily to resource management decisions and LBWD's total demand for water, rather than fluctuations in groundwater supply availability.

A. Preferential Rights to MWD Supplies

By virtue of certain capital investment in MWD since the early 1930's, Long Beach is entitled to a right to MWD's water. This entitlement is embedded in State law and comes in the form of a preferential right to MWD supplies. Section 135 of California's Metropolitan Water District Act states:

> *Each member public agency shall have a preferential right to purchase from the district for distribution by such agency, or any public utility therein empowered by such agency for the purposes, for domestic and municipal uses within the agency a portion of the water served by the district which shall, from time to time, bear the same ratio to all of the water supply of the district as the total accumulation of amounts paid by such agency to the district on tax assessments and otherwise, excepting purchase of water, toward the capital cost and operating expense of the district's works shall bear to the total payments received by the district on account of tax assessments and otherwise, excepting purchase of water, toward such capital cost and operating expense.*

A copy of the Metropolitan Water District Act can be found online at: http://mwdh2o.com/PDF_Who_We_Are/1.2_MWD_Act.pdf.

MWD has validated LBWD's preferential rights on many occasions, including the correspondence shown in Attachment A, third page. The letter reaffirms LBWD's Preferential Rights, stating:

> *Section 135 of the Metropolitan Water District Act does not relate to pricing but to amounts of water that can be purchased for domestic and municipal uses within a member agency service area. As such, any member agency is permitted to purchase supplies consistent with the Metropolitan Water District Act, including Section 135.*

MWD recalculates each of its member agency's preferential rights on an annual basis. Preferential rights are expressed as a percent of MWD's available supplies.

At the time of the adoption of the 2015 UWMP, LBWD had a preferential right to 2.34% of MWD supplies. Based on a conservative estimate that MWD will have a supply of 1.5 million acre-feet in multiple dry years, this 2.34% preferential right means that LBWD will have access to a supply of at least 35,100 acre-feet of imported water.

It is highly unlikely that MWD will have less than 1.5 million acre-feet of water. MWD's 2015 Regional UWMP assumes during multiple dry years that supplies will be more than 2 million acre-feet. Even the 1.75 million acre-feet MWD budgeted to sell in 2015 after multiple historically dry years was still more than 1.5 million acre-feet.

Table 4 – LBWD's Preferential Rights

LBWD Preferential Rights in Multiple-Dry Years		
LBWD Preferential Right (% of MWD supplies)	2.34	%
MWD supplies in multiple dry year	1,500,000	AF
LBWD Preferential Right in multiple dry year	**35,100**	**AF**

B. 100 GPCD floor during shortage

MWD's shortage allocation plan guarantees a minimum amount of water to each member agency such that no member agency will be required to reduce retail demand to below 100 gallons per capita per day (GPCD). As explained in MWD Board Letter 8-8, dated August 17, 2010, page 3 and 4 (Attachment B):

> *"Member agencies with lower per capita water use and higher levels of demand hardening are disproportionately affected by demand reductions under WSAP allocations. As absolute per capita water use decreases beyond certain thresholds, further reductions are more likely to come from indoor residential use as opposed to outdoor landscape use… Member agencies would receive additional Metropolitan allocation for an acre-foot equivalent of GPCD below the minimum threshold."*

The actual adjustment can be found in the official MWD "Water Supply Allocation Plan", December 2014 Revision. Because retail demand in LBWD's service area in FY 2015 essentially

equaled 100 GPCD (100.25 GPCD), LBWD has nearly 100-percent reliability even during shortage conditions.

Table 5 – Gallons per Capita per Day in FY 2015 (ending Sept 30, 2015)

Potable Demand (in acre-feet)	53,098
Average Population	473,231
= Gallons per Capita per Day	100

C. Reliability of Imported Water

MWD is a wholesale water provider serving most of southern California's coastal plain, and as such, MWD's reliability is essential for the water reliability of the region. MWD supplies are imported from the Sacramento-San Joaquin Delta region through the State Water Project and from the Colorado River through the Colorado River Aqueduct. Both of these supplies are projected to be less reliable in the future than they have been in the past.

Although projected decreases in the water supply reliability of the State Water Project and the Colorado River compromise the reliability of MWD imported water supplies to the MWD service area as a whole, LBWD has reliability in imported MWD supplies as a result of its preferential rights.

Groundwater Supply and Its Reliability

A. Groundwater Supply

The Central Basin is a groundwater aquifer under 277 square miles in mostly urbanized southern Los Angeles County. The basin was seriously over-drafted by the mid-1900's. The basin was adjudicated in the Los Angeles County Superior Court in the early 1960's, strictly limiting extractions to apportioned rights, and apportioning the pumping rights to certain parties. This adjudication provides the framework for groundwater management of this basin. LBWD now has the right to pump 32,692 acre-feet per year from the Central Basin Aquifer.

A copy of the judgment is available upon request or on the LBWD website at: http://www.lbwater.org/sites/default/files/documents/CentralBasinJudgment.pdf.

LBWD also has 0.7 acre-feet of rights in the West Coast Basin, but LBWD has no active wells in the West Coast Basin and, therefore, does not pump those water rights.

B. Groundwater Reliability

Because there are strict limits on the amount of water that can legally be extracted from the basin, and because there are multiple on-going projects for replenishing the basin, and because there is sufficient storage within the basin, the Central Basin provides LBWD with a very reliable supply of groundwater, even during multiple-dry years.

The Central Basin Judgement limits the extractions from the Central Basin and guarantees adequate replenishment. Although the annual pumping rights allocated in the Central Basin judgment exceed the natural yield of the basin, the judgment charges the Water Replenishment District of Southern California (WRDSC) with the responsibility of replenishing the basin. Parties extracting water from the basin pay an assessment to WRDSC on a per acre-foot extracted basis. This assessment is used by WRDSC to purchase replenishment water and to fund other programs for the replenishment and protection of the basin. Replenishment of the basin occurs through the following:

1. *Natural replenishment*

   To the extent possible, San Gabriel River stream flows are used for replenishing the groundwater basin. This water is captured and pooled in "spreading grounds" or "percolation basins" and allowed to filter into the groundwater basin. The quantity of water from this source fluctuates with changes in weather patterns.

2. *In-lieu replenishment*

   Under certain conditions, parties with extraction rights may forgo their right to pump a certain amount of groundwater in a given year and purchase MWD water instead. In this way, the groundwater basis in replenished "in-lieu" of pumping. In these cases, the pumper would normally receive some sort of financial consideration to offset the higher cost of purchasing the MWD water.

3. *Recycled water*

   Recycled water is mixed with imported water and/or natural runoff and allowed to percolate into the groundwater basin, where the waters will be filtered through the aquifer's soil, sometimes for many decades before being extracted. This supply is reliable even during fluctuations in weather, including multiple dry years.

4. *Imported water*

   MWD's imported water is sometimes available for purchased for replenishment purposes. Depending on the prevailing MWD Board policy, replenishment water may be available at either the full imported water price or at a discounted rate.

Water Supplies During Normal, Single-Dry, and Multiple-Dry Year Conditions

The demand for domestic water in Long Beach is met with a combination of groundwater and imported water purchased from MWD. LBWD has reliable rights to both of these sources of water in quantities sufficient to meet the projected water demand of the Project in addition to LBWD's existing and planned future uses, including agricultural and manufacturing uses, during normal, single-dry and multiple-dry water years through a 20-year projection period.

Attachments

Attachment A

THE METROPOLITAN WATER DISTRICT
OF SOUTHERN CALIFORNIA

Office of the General Manager

May 13, 2010

Mr. Kevin L. Wattier
General Manager
Long Beach Water Department
1800 East Wardlow Road
Long Beach, CA 90807-4994

Dear Mr. Wattier:

Request for documentation from Metropolitan Water District for a water assessment by the Long Beach Water Department for a proposed development in the City of Long Beach

Your letter dated April 2, 2010, on the above subject, requested two items from The Metropolitan Water District of Southern California (Metropolitan):

1. The most current 20-year forecast of the reliability of Metropolitan's domestic and municipal supplies for its service area in five-year increments, under the three hydrologic conditions specified by SB 221 and SB 610.

2. The expected Metropolitan differential rate, and/or any other fees or charges, for water purchases exceeding a Water Supply Allocation Plan (WSAP) amount, but less than a preferential right of the City of Long Beach.

Item 1

Attachment A contains the comparison of Metropolitan's supply capabilities and projected demands under the three hydrologies: Single-Dry-Year (repeat of 1977), Multiple-Dry-Year (repeat of 1990-1992) and Average Year (average of 1922-2004). The key assumptions for the analysis and each of Metropolitan's resources – the Colorado River Aqueduct, State Water Project, and In-Region Storage – are also described and summarized in Attachment A.

The tables show that Metropolitan's assumed supply capabilities would be sufficient to meet expected firm demands from 2015 through 2035 under the three specified hydrologies based on the assumptions outlined in Appendix A. It must be noted that a key component to the water supply capability is the amount of water in Metropolitan's storage facilities. Storage is a major component of Metropolitan's dry-year resource management strategy, and so the assumption as to the amount of available storage is critical. Simply put, if Metropolitan storage resources are empty at the time of the given hydrologic events, Metropolitan would likely not have adequate supply capability to meet projected demands without implementing the WSAP. For the purposes of constructing the tables attached to this letter, the assumption used is a simulated median storage level going into each five-year increment, based on the balances of supplies and demands

consistent with the overall assumptions shown in Attachment A. In practical terms, for each condition provided, there is an estimated 50 percent probability that storage levels would be higher than the assumption used, and a 50 percent probability that storage levels would be lower than the assumption used. All storage capability figures shown in the tables reflect actual storage program conveyance constraints. It is important to note that under some conditions, Metropolitan may choose to implement the WSAP in order to preserve storage reserves for a future year, instead of using the full supply capability. This can result in impacts at the retail level even under conditions where there may be adequate supply capabilities to meet firm demands.

The analyses included represent the most current available planning projections on supply and demands. Metropolitan is also in the processes of completing its Integrated Resources Adaptive Management Plan (IRAMP) and the 2010 Regional Urban Water Management Plan. Some of the assumptions may change as a result of those processes. For example, the retail demands included in this analysis incorporate an estimate of an additional 200,000 AF of water conservation. This savings amount represents a preliminary estimate resulting from retail water purveyors implementing minimal compliance to the water use efficiency target of a 20 percent per capita water use reduction by 2020 established under the Delta legislation SB 7x-7. This may be a conservative estimate and will be refined as we gather additional information on how member and local water agencies plan to comply with this legislation, including Metropolitan's effort through the IRAMP.

Item 2

It would be speculative for staff to define the expected Metropolitan penalty rates for differential water purchases exceeding future WSAP amounts. Metropolitan's Board of Directors sets its water rates annually. In addition, the WSAP adopted in February 2008 established a 12 month review of the Plan after implementation. Since Metropolitan implemented the WSAP in July 2009, the process of 12-month review has begun with staff and member agencies. The review process may result in recommendations for changes to the WSAP that could affect future implementation and penalty rates. One potential adjustment under discussion would be limiting reductions for member agencies with average per capita water use of 100 gallons per day or less. While this adjustment is not final, it could provide a benefit to the City of Long Beach in the future, if implemented and if per capita demands drop below 100 gallons per day within the service area of the Long Beach Water Department.

For your reference, the current penalty-rate policy for water purchases over a WSAP allocation is: (1) two times the fully loaded Untreated Tier 2 rate for use between 100 percent and 115 percent of a WSAP allocation and (2) four times the fully loaded Untreated Tier 2 rate for use exceeding 115 percent of a WSAP allocation. There is also a consideration for agencies that exceed a WSAP allocation but do not exceed an equivalent calculation based on an agency's preferential rights percentage. Penalty rates for these agencies are reduced by one times the fully loaded Untreated Tier 2 rate. Metropolitan is adopted water rates for 2010, 2011 and 2012 are included in Attachment B.

Your letter also requested information regarding Metropolitan's policy, if any, regarding charges for water upon the exercise of preferential rights under Section 135 of the Metropolitan Water District Act. Section 135 of the Metropolitan Water District Act does not relate to pricing but to amounts of water that can be purchased for domestic and municipal uses within a member agency service boundary. The Board adopted WSAP does not prevent the delivery of water to a member agency. As such, any member agency is permitted to purchase supplies consistent with the Metropolitan Water District Act, including Section 135.

We hope that the provided information will assist you in the preparation of your water supply assessment. If you have any questions, please contact me at (213) 217- 6686 or Dupadhyay@mwdh2o.com

Very truly yours,

Deven N. Upadhyay

BJG:tt
o:\s\c\2010\BJG_Long Beach Letter.docx

Attachment A
April, 2010

Metropolitan's firm supplies for its service area under Single Dry Year, Multiple Dry Years, and Average Years

Key Assumptions:

1. Retail Municipal and Industrial water demands are derived using Southern California Association of Governments and San Diego Association of Governments 2007 demographic projections to drive the estimating equations in Metropolitan's MWD-MAIN demand forecasting model.

2. Active Conservation levels are driven by calculating water savings from all active program device-based savings installed to date.

3. Code-Based Conservation levels are driven by calculating water savings from devices covered by existing water conservation ordinances and plumbing codes, with replacement and new construction rates driven by demographic growth consistent with those used to derive retail demand.

4. Additional water savings from retail-level compliance with "20 x 2020" conservation legislation was approximated by linearly ramping up to 200,000 acre-feet of demand reduction by 2020.

5. Local supply estimates, which include groundwater production, Los Angeles Aqueduct deliveries, surface supplies, recycled water and brackish groundwater desalination, are based on estimates of projects and yields that are currently existing and producing water supplies, or are currently under construction.

6. Water resources included are those developed and committed to date, and are shown to grow to their estimated full yields through 2035.

7. Additional Local Resources in the amount of 16 TAF were implemented beginning in 2015, reaching a total of 46 TAF by 2025 to approximate either additional Seawater Desalination or other local recycling or groundwater recovery projects.

8. Colorado River Aqueduct supplies include existing/committed programs along with planned QSA program ramp-up.

9. Colorado River transactions are available to supply additional water up to the CRA capacity of 1.25 MAF on an as-needed basis.

10. State Water Project supplies are estimated under restrictions from current Delta smelt and Chinook salmon Biological Opinions until 2012, after which an Interim Delta Solution was implemented to lessen the impact of the Biological Opinions. A Delta Fix was implemented in 2022, improving the State Water Project to yields approximating those estimated prior to the court rulings and Biological Opinions to protect Delta smelt and Chinook salmon.

11. No access to additional SWP water transfers in addition to any existing/committed water transfers, including State Drought Bank supplies.

12. Metropolitan's existing storage portfolio of approximately 4.9 MAF of surface and groundwater storage, and any existing/committed water transfers.

13. Storage resources reflect median level projections calculated using IRPSIM resource simulation modeling. Simulation modeling is based on the key assumptions listed above and starting storage conditions current as of January 1, 2010.

Attachment A

Single Dry-Year
Supply Capability[1] and Projected Demands
Repeat of 1977 Hydrology
(acre-feet per year)

Forecast Year	2015	2020	2025	2030	2035
Total Supply Programs					
In-Region Storage	666,000	840,000	1,009,000	888,000	756,000
California Aqueduct[2]	1,028,000	1,084,000	1,288,000	1,235,000	1,236,000
Colorado River Aqueduct[3]	1,250,000	1,250,000	1,250,000	1,250,000	1,250,000
Maximum Supply Capability	**2,944,000**	**3,174,000**	**3,547,000**	**3,373,000**	**3,242,000**
Firm Demands on Metropolitan	**2,168,000**	**2,155,000**	**2,162,000**	**2,203,000**	**2,254,000**
Remaining Shortage[4]	**0**	**0**	**0**	**0**	**0**

[1] Represents Supply Capability for resource programs under listed year type.
[2] California Aqueduct includes Central Valley transfers and storage program supplies conveyed by the aqueduct.
[3] Maximum CRA deliveries limited to 1.25 MAF including IID-SDCWA transfers and canal linings.
[4] Represents remaining shortage based upon supply capability. Additionally, Metropolitan's Water Supply Allocation Plan can be implemented by it's Board of Directors at any time to manage resources.

Attachment A

Multiple Dry-Year
Supply Capability[1] and Projected Demands
Repeat of 1990-1992 Hydrology
(acre-feet per year)

Forecast Year	2015	2020	2025	2030	2035
Total Supply Programs					
In-Region Storage	248,000	345,000	433,000	396,000	352,000
California Aqueduct[2]	987,000	1,050,000	1,241,000	1,211,000	1,212,000
Colorado River Aqueduct[3]	1,250,000	1,250,000	1,250,000	1,250,000	1,250,000
Maximum Supply Capability	**2,485,000**	**2,645,000**	**2,924,000**	**2,857,000**	**2,814,000**
Firm Demands on Metropolitan	**2,178,000**	**2,202,000**	**2,220,000**	**2,257,000**	**2,305,000**
Remaining Shortage[4]	**0**	**0**	**0**	**0**	**0**

[1] Represents Supply Capability for resource programs under listed year type.

[2] California Aqueduct includes Central Valley transfers and storage program supplies conveyed by the aqueduct.

[3] Maximum CRA deliveries limited to 1.25 MAF including IID-SDCWA transfers and canal linings.

[4] Represents remaining shortage based upon supply capability. Additionally, Metropolitan's Water Supply Allocation Plan can be implemented by it's Board of Directors at any time to manage resources.

Attachment A

AverageYear

Supply Capability[1] and Projected Demands

Average of 1922-2004 Hydrologies

(acre-feet per year)

Forecast Year	2015	2020	2025	2030	2035
Total Supply Programs					
In-Region Storage	666,000	840,000	1,009,000	888,000	756,000
California Aqueduct[2]	1,902,000	2,007,000	2,435,000	2,401,000	2,402,000
Colorado River Aqueduct[3]	1,250,000	1,250,000	1,250,000	1,250,000	1,250,000
Maximum Supply Capability	**3,818,000**	**4,097,000**	**4,694,000**	**4,539,000**	**4,408,000**
Firm Demands on Metropolitan	**1,974,000**	**1,960,000**	**1,962,000**	**2,002,000**	**2,051,000**
Remaining Shortage[4]	**0**	**0**	**0**	**0**	**0**

[1] Represents Supply Capability for resource programs under listed year type.

[2] California Aqueduct includes Central Valley transfers and storage program supplies conveyed by the aqueduct.

[3] Maximum CRA deliveries limited to 1.25 MAF including IID-SDCWA transfers and canal linings.

[4] Represents remaining shortage based upon supply capability. Additionally, Metropolitan's Water Supply Allocation Plan can be implemented by it's Board of Directors at any time to manage resources.

Attachment A

In-Region Storage
Program Capabilities
Year 2015
(acre-feet per year)

Hydrology	Multiple Dry Years (1990-92)	Single Dry Year (1977)	Average Year (1922-2004)
Current Programs			
Metropolitan Surface Storage			
(DVL, Mathews, Skinner)	121,000	362,000	362,000
Flexible Storage in Castaic & Perris	33,000	100,000	100,000
Groundwater Storage			
Conjunctive Use	55,000	115,000	115,000
Cyclic Storage	18,000	55,000	55,000
Subtotal of Current Programs	***227,000***	***632,000***	***632,000***
Programs Under Development			
Raymond Basin Groundwater Conjunctive Use	9,000	22,000	22,000
LADWP Groundwater Demonstration Project	12,000	12,000	12,000
Subtotal of Proposed Programs	***21,000***	***34,000***	***34,000***
Maximum Supply Capability	**248,000**	**666,000**	**666,000**

Attachment A

In-Region Storage
Program Capabilities
Year 2020
(acre-feet per year)

Hydrology	Multiple Dry Years (1990-92)	Single Dry Year (1977)	Average Year (1922-2004)
Current Programs			
Metropolitan Surface Storage (DVL, Mathews, Skinner)	156,000	469,000	469,000
Flexible Storage in Castaic & Perris	45,000	134,000	134,000
Groundwater Storage			
Conjunctive Use	89,000	115,000	115,000
Cyclic Storage	29,000	88,000	88,000
Subtotal of Current Programs	***319,000***	***806,000***	***806,000***
Programs Under Development			
Raymond Basin Groundwater Conjunctive Use	14,000	22,000	22,000
LADWP Groundwater Demonstration Project	12,000	12,000	12,000
Subtotal of Proposed Programs	***26,000***	***34,000***	***34,000***
Maximum Supply Capability	**345,000**	**840,000**	**840,000**

Attachment A

In-Region Storage
Program Capabilities
Year 2025
(acre-feet per year)

Hydrology	Multiple Dry Years (1990-92)	Single Dry Year (1977)	Average Year (1922-2004)
Current Programs			
Metropolitan Surface Storage			
(DVL, Mathews, Skinner)	191,000	574,000	574,000
Flexible Storage in Castaic & Perris	54,000	162,000	162,000
Groundwater Storage			
Conjunctive Use	115,000	115,000	115,000
Cyclic Storage	41,000	124,000	124,000
Subtotal of Current Programs	***401,000***	***975,000***	***975,000***
Programs Under Development			
Raymond Basin Groundwater Conjunctive Use	20,000	22,000	22,000
LADWP Groundwater Demonstration Project	12,000	12,000	12,000
Subtotal of Proposed Programs	***32,000***	***34,000***	***34,000***
Maximum Supply Capability	**433,000**	**1,009,000**	**1,009,000**

Attachment A

In-Region Storage
Program Capabilities
Year 2030
(acre-feet per year)

Hydrology	Multiple Dry Years (1990-92)	Single Dry Year (1977)	Average Year (1922-2004)
Current Programs			
Metropolitan Surface Storage (DVL, Mathews, Skinner)	156,000	467,000	467,000
Flexible Storage in Castaic & Perris	45,000	135,000	135,000
Groundwater Storage			
Conjunctive Use	115,000	115,000	115,000
Cyclic Storage	46,000	137,000	137,000
Subtotal of Current Programs	***362,000***	***854,000***	***854,000***
Programs Under Development			
Raymond Basin Groundwater Conjunctive Use	22,000	22,000	22,000
LADWP Groundwater Demonstration Project	12,000	12,000	12,000
Subtotal of Proposed Programs	***34,000***	***34,000***	***34,000***
Maximum Supply Capability	**396,000**	**888,000**	**888,000**

Attachment A

In-Region Storage
Program Capabilities
Year 2035
(acre-feet per year)

Hydrology	Multiple Dry Years (1990-92)	Single Dry Year (1977)	Average Year (1922-2004)
Current Programs			
Metropolitan Surface Storage (DVL, Mathews, Skinner)	120,000	360,000	360,000
Flexible Storage in Castaic & Perris	36,000	107,000	107,000
Groundwater Storage			
Conjunctive Use	115,000	115,000	115,000
Cyclic Storage	47,000	140,000	140,000
Subtotal of Current Programs	***318,000***	***722,000***	***722,000***
Programs Under Development			
Raymond Basin Groundwater Conjunctive Use	22,000	22,000	22,000
LADWP Groundwater Demonstration Project	12,000	12,000	12,000
Subtotal of Proposed Programs	***34,000***	***34,000***	***34,000***
Maximum Supply Capability	**352,000**	**756,000**	**756,000**

Attachment A

California Aqueduct
Program Capabilities
Year 2015
(acre-feet per year)

Hydrology	Multiple Dry Years (1990-92)	Single Dry Year (1977)	Average Year (1922-2004)
Current Programs			
MWD Table A	567,000	534,000	1,177,000
DWCV Table A	60,000	54,000	127,000
San Luis Carryover [1]	43,000	130,000	130,000
Article 21 Supplies	0	0	3,000
San Bernardino Valley MWD Minimum Purchase	8,000	5,000	20,000
San Bernardino Valley MWD Option Purchase	11,000	13,000	20,000
Yuba River Accord Purchase	22,000	22,000	5,000
Central Valley Storage and Transfers			
Semitropic Program	41,000	39,000	60,000
Arvin Edison Program	46,000	75,000	75,000
San Bernardino Valley MWD Program	7,000	20,000	20,000
Kern Delta Program	47,000	50,000	50,000
Subtotal of Current Programs	***852,000***	***942,000***	***1,687,000***
Programs Under Development			
Delta Improvements	47,000	17,000	119,000
Mojave Groundwater Storage Program	5,000	2,000	29,000
In-Delta Transfers	8,000	8,000	8,000
Drought Water Bank / North of Delta Transfers	25,000	25,000	25,000
SBVMWD Central Feeder	5,000	5,000	5,000
Shasta Return	18,000	18,000	18,000
Semitropic Agricultural Water Reuse Demonstration	11,000	11,000	11,000
IRP SWP Target [2]	16,000	0	0
Subtotal of Proposed Programs	***135,000***	***86,000***	***215,000***
Maximum Supply Capability	**987,000**	**1,028,000**	**1,902,000**

[1] Includes DWCV carryover.

[2] Remaining supply needed to meet IRP target.

Attachment A

California Aqueduct
Program Capabilities
Year 2020
(acre-feet per year)

Hydrology	Multiple Dry Years (1990-92)	Single Dry Year (1977)	Average Year (1922-2004)
Current Programs			
MWD Table A	567,000	534,000	1,177,000
DWCV Table A	60,000	54,000	127,000
San Luis Carryover [1]	58,000	175,000	175,000
Article 21 Supplies	0	0	52,000
San Bernardino Valley MWD Minimum Purchase	8,000	5,000	20,000
San Bernardino Valley MWD Option Purchase	11,000	13,000	20,000
Yuba River Accord Purchase	19,000	22,000	3,000
Central Valley Storage and Transfers			
Semitropic Program	41,000	39,000	60,000
Arvin Edison Program	63,000	75,000	75,000
San Bernardino Valley MWD Program	10,000	31,000	31,000
Kern Delta Program	47,000	50,000	50,000
Subtotal of Current Programs	***884,000***	***998,000***	***1,790,000***
Programs Under Development			
Delta Improvements	47,000	17,000	119,000
Mojave Groundwater Storage Program	5,000	2,000	31,000
In-Delta Transfers	8,000	8,000	8,000
Drought Water Bank / North of Delta Transfers	25,000	25,000	25,000
SBVMWD Central Feeder	5,000	5,000	5,000
Shasta Return	18,000	18,000	18,000
Semitropic Agricultural Water Reuse Demonstration	11,000	11,000	11,000
IRP SWP Target [2]	47,000	0	0
Subtotal of Proposed Programs	***166,000***	***86,000***	***217,000***
Maximum Supply Capability	**1,050,000**	**1,084,000**	**2,007,000**

[1] Includes DWCV carryover.

[2] Remaining supply needed to meet IRP target.

Attachment A

California Aqueduct
Program Capabilities
Year 2025
(acre-feet per year)

Hydrology	Multiple Dry Years (1990-92)	Single Dry Year (1977)	Average Year (1922-2004)
Current Programs			
MWD Table A	567,000	534,000	1,177,000
DWCV Table A	77,000	60,000	155,000
San Luis Carryover [1]	71,000	212,000	212,000
Article 21 Supplies	0	0	52,000
San Bernardino Valley MWD Minimum Purchase	12,000	8,000	20,000
San Bernardino Valley MWD Option Purchase	12,000	11,000	29,000
Yuba River Accord Purchase	19,000	22,000	3,000
Central Valley Storage and Transfers			
Semitropic Program	46,000	41,000	69,000
Arvin Edison Program	63,000	75,000	75,000
San Bernardino Valley MWD Program	15,000	44,000	44,000
Kern Delta Program	47,000	50,000	50,000
Subtotal of Current Programs	***929,000***	***1,057,000***	***1,886,000***
Programs Under Development			
Delta Improvements	234,000	159,000	439,000
Mojave Groundwater Storage Program	11,000	5,000	43,000
In-Delta Transfers	8,000	8,000	8,000
Drought Water Bank / North of Delta Transfers	25,000	25,000	25,000
SBVMWD Central Feeder	5,000	5,000	5,000
Shasta Return	18,000	18,000	18,000
Semitropic Agricultural Water Reuse Demonstration	11,000	11,000	11,000
IRP SWP Target [2]	0	0	0
Subtotal of Proposed Programs	***312,000***	***231,000***	***549,000***
Maximum Supply Capability	**1,241,000**	**1,288,000**	**2,435,000**

[1] Includes DWCV carryover.

[2] Remaining supply needed to meet IRP target.

Attachment A

California Aqueduct
Program Capabilities
Year 2030
(acre-feet per year)

Hydrology	Multiple Dry Years (1990-92)	Single Dry Year (1977)	Average Year (1922-2004)
Current Programs			
MWD Table A	567,000	534,000	1,177,000
DWCV Table A	77,000	60,000	155,000
San Luis Carryover [1]	59,000	176,000	176,000
Article 21 Supplies	0	0	52,000
San Bernardino Valley MWD Minimum Purchase	12,000	8,000	20,000
San Bernardino Valley MWD Option Purchase	12,000	11,000	29,000
Yuba River Accord Purchase	0	0	0
Central Valley Storage and Transfers			
Semitropic Program	46,000	41,000	69,000
Arvin Edison Program	63,000	75,000	75,000
San Bernardino Valley MWD Program	16,000	49,000	49,000
Kern Delta Program	47,000	50,000	50,000
Subtotal of Current Programs	***899,000***	***1,004,000***	***1,852,000***
Programs Under Development			
Delta Improvements	234,000	159,000	439,000
Mojave Groundwater Storage Program	11,000	5,000	43,000
In-Delta Transfers	8,000	8,000	8,000
Drought Water Bank / North of Delta Transfers	25,000	25,000	25,000
SBVMWD Central Feeder	5,000	5,000	5,000
Shasta Return	18,000	18,000	18,000
Semitropic Agricultural Water Reuse Demonstration	11,000	11,000	11,000
IRP SWP Target [2]	0	0	0
Subtotal of Proposed Programs	***312,000***	***231,000***	***549,000***
Maximum Supply Capability	**1,211,000**	**1,235,000**	**2,401,000**

[1] Includes DWCV carryover.

[2] Remaining supply needed to meet IRP target.

Attachment A

California Aqueduct
Program Capabilities
Year 2035
(acre-feet per year)

Hydrology	Multiple Dry Years (1990-92)	Single Dry Year (1977)	Average Year (1922-2004)
Current Programs			
MWD Table A	567,000	534,000	1,177,000
DWCV Table A	77,000	60,000	155,000
San Luis Carryover [1]	59,000	176,000	176,000
Article 21 Supplies	0	0	52,000
San Bernardino Valley MWD Minimum Purchase	12,000	8,000	20,000
San Bernardino Valley MWD Option Purchase	12,000	11,000	29,000
Yuba River Accord Purchase	0	0	0
Central Valley Storage and Transfers			
Semitropic Program	46,000	41,000	69,000
Arvin Edison Program	63,000	75,000	75,000
San Bernardino Valley MWD Program	17,000	50,000	50,000
Kern Delta Program	47,000	50,000	50,000
Subtotal of Current Programs	***900,000***	***1,005,000***	***1,853,000***
Programs Under Development			
Delta Improvements	234,000	159,000	439,000
Mojave Groundwater Storage Program	11,000	5,000	43,000
In-Delta Transfers	8,000	8,000	8,000
Drought Water Bank / North Of Delta Transfers	25,000	25,000	25,000
SBVMWD Central Feeder	5,000	5,000	5,000
Shasta Return	18,000	18,000	18,000
Semitropic Agricultural Water Reuse Demonstration	11,000	11,000	11,000
IRP SWP Target [2]	0	0	0
Subtotal of Proposed Programs	***312,000***	***231,000***	***549,000***
Maximum Supply Capability	**1,212,000**	**1,236,000**	**2,402,000**

[1] Includes DWCV carryover.

[2] Remaining supply needed to meet IRP target.

Attachment A

Colorado River Aqueduct
Program Capabilities
Year 2015
(acre-feet per year)

Hydrology	Multiple Dry Years (1990-92)	Single Dry Year (1977)	Average Year (1922-2004)
Current Programs			
Basic Apportionment – Priority 4	550,000	550,000	550,000
IID/MWD Conservation Program	85,000	85,000	85,000
Priority 5 Apportionment (Surplus)	0	0	91,000
PVID Land Management, Crop Rotation, and Water Supply Program	133,000	133,000	133,000
Lower Colorado Water Supply Project	6,000	6,000	6,000
Lake Mead Storage Program	306,000	400,000	400,000
Quechan Settlement Agreement Supply	13,000	13,000	13,000
Forbearance for Present Perfected Rights	(42,000)	(47,000)	(47,000)
CVWD SWP/QSA Transfer Obligation	(35,000)	(35,000)	(35,000)
DWCV SWP Table A Obligation	(60,000)	(54,000)	(127,000)
DWCV SWP Table A Transfer Callback	32,000	29,000	67,000
DWCV Advance Delivery Account	28,000	25,000	60,000
Drop 2 Reservoir Funding	22,000	66,000	66,000
SNWA Agreement	40,000	40,000	40,000
Subtotal of Current Programs	***1,078,000***	***1,211,000***	***1,302,000***
Programs Under Development			
Additional PVID Transfers (Crop Stressing/Fallowing)	66,000	66,000	66,000
Arizona Programs - CAP	50,000	50,000	50,000
California Indians / Other Ag	10,000	10,000	10,000
ICS Exchange	25,000	25,000	25,000
Expand SNWA Agreement	15,000	15,000	15,000
Agreements with CVWD	35,000	35,000	35,000
Hayfield Groundwater Extraction Project	5,000	5,000	5,000
Subtotal of Proposed Programs	***206,000***	***206,000***	***206,000***
Additional Non-Metropolitan CRA Supplies			
SDCWA/IID Transfer	100,000	100,000	100,000
Coachella & All-American Canal Lining			
To SDCWA	80,000	80,000	80,000
To San Luis Rey Settlement Parties[1]	16,000	16,000	16,000
Subtotal of Non-Metropolitan Supplies	***196,000***	***196,000***	***196,000***
Maximum CRA Supply Capability[2]	**1,480,000**	**1,613,000**	**1,704,000**
Less CRA Capacity Constraint (amount above 1.25 MAF)	*(230,000)*	*(363,000)*	*(454,000)*
Maximum Expected CRA Deliveries[3]	**1,250,000**	**1,250,000**	**1,250,000**
Less Non-Metropolitan Supplies[4]	*(196,000)*	*(196,000)*	*(196,000)*
Maximum Metropolitan Supply Capability[5]	**1,054,000**	**1,054,000**	**1,054,000**

[1] Subject to satisfaction of conditions specified in agreement among Metropolitan, the United States, and the San Luis Rey Settlement Parties

[2] Total amount of supplies available without taking into consideration CRA capacity constraint.

[3] The Colorado River Aqueduct delivery capacity is 1.250 MAF annually.

[4] Exchange obligation for the SDCWA-IID transfer and the Coachella and All American Canal Lining projects.

[5] The amount of CRA water available to Metropolitan after meeting its exchange obligations.

Attachment A

Colorado River Aqueduct
Program Capabilities
Year 2020
(acre-feet per year)

Hydrology	Multiple Dry Years (1990-92)	Single Dry Year (1977)	Average Year (1922-2004)
Current Programs			
Basic Apportionment – Priority 4	550,000	550,000	550,000
IID/MWD Conservation Program	85,000	85,000	85,000
Priority 5 Apportionment (Surplus)	500,000	356,000	61,000
PVID Land Management, Crop Rotation, and Water Supply Program	133,000	133,000	133,000
Lower Colorado Water Supply Project	6,000	6,000	6,000
Lake Mead Storage Program	400,000	400,000	400,000
Quechan Settlement Agreement Supply	13,000	13,000	13,000
Forbearance for Present Perfected Rights	(47,000)	(47,000)	(47,000)
CVWD SWP/QSA Transfer Obligation	(35,000)	(35,000)	(35,000)
DWCV SWP Table A Obligation	(60,000)	(54,000)	(127,000)
DWCV SWP Table A Transfer Callback	32,000	29,000	67,000
DWCV Advance Delivery Account	28,000	25,000	60,000
Drop 2 Reservoir Funding	22,000	25,000	25,000
SNWA Agreement	40,000	40,000	40,000
Subtotal of Current Programs	***1,667,000***	***1,526,000***	***1,231,000***
Programs Under Development			
Additional PVID Transfers (Crop Stressing/Fallowing)	66,000	66,000	66,000
Arizona Programs - CAP	50,000	50,000	50,000
California Indians / Other Ag	10,000	10,000	10,000
ICS Exchange	25,000	25,000	25,000
Expand SNWA Agreement	15,000	15,000	15,000
Agreements with CVWD	35,000	35,000	35,000
Hayfield Groundwater Extraction Project	5,000	5,000	5,000
Subtotal of Proposed Programs	***206,000***	***206,000***	***206,000***
Additional Non-Metropolitan CRA Supplies			
SDCWA/IID Transfer	161,000	193,000	193,000
Coachella & All-American Canal Lining			
To SDCWA	80,000	80,000	80,000
To San Luis Rey Settlement Parties[1]	16,000	16,000	16,000
Subtotal of Non-Metropolitan Supplies	***257,000***	***289,000***	***289,000***
Maximum CRA Supply Capability[2]	**2,130,000**	**2,021,000**	**1,726,000**
Less CRA Capacity Constraint (amount above 1.25 MAF)	*(880,000)*	*(771,000)*	*(476,000)*
Maximum Expected CRA Deliveries[3]	**1,250,000**	**1,250,000**	**1,250,000**
Less Non-Metropolitan Supplies[4]	*(257,000)*	*(289,000)*	*(289,000)*
Maximum Metropolitan Supply Capability[5]	**993,000**	**961,000**	**961,000**

[1] Subject to satisfaction of conditions specified in agreement among Metropolitan, the United States, and the San Luis Rey Settlement Parties

[2] Total amount of supplies available without taking into consideration CRA capacity constraint.

[3] The Colorado River Aqueduct delivery capacity is 1.250 MAF annually.

[4] Exchange obligation for the SDCWA-IID transfer and the Coachella and All American Canal Lining projects.

[5] The amount of CRA water available to Metropolitan after meeting its exchange obligations.

Attachment A

Colorado River Aqueduct
Program Capabilities
Year 2025
(acre-feet per year)

Hydrology	Multiple Dry Years (1990-92)	Single Dry Year (1977)	Average Year (1922-2004)
Current Programs			
Basic Apportionment – Priority 4	550,000	550,000	550,000
IID/MWD Conservation Program	85,000	85,000	85,000
Priority 5 Apportionment (Surplus)	0	250,000	53,000
PVID Land Management, Crop Rotation, and Water Supply Program	133,000	133,000	133,000
Lower Colorado Water Supply Project	6,000	5,000	5,000
Lake Mead Storage Program	400,000	400,000	400,000
Quechan Settlement Agreement Supply	13,000	13,000	13,000
Forbearance for Present Perfected Rights	(47,000)	(47,000)	(47,000)
CVWD SWP/QSA Transfer Obligation	(35,000)	(35,000)	(35,000)
DWCV SWP Table A Obligation	(77,000)	(60,000)	(155,000)
DWCV SWP Table A Transfer Callback	41,000	32,000	82,000
DWCV Advance Delivery Account	36,000	28,000	73,000
Drop 2 Reservoir Funding	22,000	25,000	25,000
SNWA Agreement	0	0	0
Subtotal of Current Programs	***1,127,000***	***1,379,000***	***1,182,000***
Programs Under Development			
Additional PVID Transfers (Crop Stressing/Fallowing)	66,000	66,000	66,000
Arizona Programs - CAP	50,000	50,000	50,000
California Indians / Other Ag	10,000	10,000	10,000
ICS Exchange	25,000	25,000	25,000
Expand SNWA Agreement	0	0	0
Agreements with CVWD	35,000	35,000	35,000
Hayfield Groundwater Extraction Project	5,000	5,000	5,000
Subtotal of Proposed Programs	***191,000***	***191,000***	***191,000***
Additional Non-Metropolitan CRA Supplies			
SDCWA/IID Transfer	200,000	200,000	200,000
Coachella & All-American Canal Lining			
To SDCWA	80,000	80,000	80,000
To San Luis Rey Settlement Parties[1]	16,000	16,000	16,000
Subtotal of Non-Metropolitan Supplies	***296,000***	***296,000***	***296,000***
Maximum CRA Supply Capability[2]	**1,614,000**	**1,866,000**	**1,669,000**
Less CRA Capacity Constraint (amount above 1.25 MAF)	*(364,000)*	*(616,000)*	*(419,000)*
Maximum Expected CRA Deliveries[3]	**1,250,000**	**1,250,000**	**1,250,000**
Less Non-Metropolitan Supplies[4]	*(296,000)*	*(296,000)*	*(296,000)*
Maximum Metropolitan Supply Capability[5]	**954,000**	**954,000**	**954,000**

[1] Subject to satisfaction of conditions specified in agreement among Metropolitan, the United States, and the San Luis Rey Settlement Parties

[2] Total amount of supplies available without taking into consideration CRA capacity constraint.

[3] The Colorado River Aqueduct delivery capacity is 1.250 MAF annually.

[4] Exchange obligation for the SDCWA-IID transfer and the Coachella and All American Canal Lining projects.

[5] The amount of CRA water available to Metropolitan after meeting its exchange obligations.

Attachment A

Colorado River Aqueduct
Program Capabilities
Year 2030
(acre-feet per year)

Hydrology	Multiple Dry Years (1990-92)	Single Dry Year (1977)	Average Year (1922-2004)
Current Programs			
Basic Apportionment – Priority 4	550,000	550,000	550,000
IID/MWD Conservation Program	85,000	85,000	85,000
Priority 5 Apportionment (Surplus)	0	0	13,000
PVID Land Management, Crop Rotation, and Water Supply Program	133,000	133,000	133,000
Lower Colorado Water Supply Project	5,000	5,000	5,000
Lake Mead Storage Program	400,000	400,000	400,000
Quechan Settlement Agreement Supply	13,000	13,000	13,000
Forbearance for Present Perfected Rights	(47,000)	(47,000)	(47,000)
CVWD SWP/QSA Transfer Obligation	(35,000)	(35,000)	(35,000)
DWCV SWP Table A Obligation	(77,000)	(60,000)	(155,000)
DWCV SWP Table A Transfer Callback	41,000	32,000	82,000
DWCV Advance Delivery Account	36,000	28,000	73,000
Drop 2 Reservoir Funding	22,000	25,000	25,000
SNWA Agreement	0	0	0
Subtotal of Current Programs	***1,126,000***	***1,129,000***	***1,142,000***
Programs Under Development			
Additional PVID Transfers (Crop Stressing/Fallowing)	66,000	66,000	66,000
Arizona Programs - CAP	50,000	50,000	50,000
California Indians / Other Ag	10,000	10,000	10,000
ICS Exchange	25,000	25,000	25,000
Expand SNWA Agreement	0	0	0
Agreements with CVWD	35,000	35,000	35,000
Hayfield Groundwater Extraction Project	0	0	0
Subtotal of Proposed Programs	***186,000***	***186,000***	***186,000***
Additional Non-Metropolitan CRA Supplies			
SDCWA/IID Transfer	200,000	200,000	200,000
Coachella & All-American Canal Lining			
To SDCWA	80,000	80,000	80,000
To San Luis Rey Settlement Parties[1]	16,000	16,000	16,000
Subtotal of Non-Metropolitan Supplies	***296,000***	***296,000***	***296,000***
Maximum CRA Supply Capability[2]	**1,608,000**	**1,611,000**	**1,624,000**
Less CRA Capacity Constraint (amount above 1.25 MAF)	*(358,000)*	*(361,000)*	*(374,000)*
Maximum Expected CRA Deliveries[3]	**1,250,000**	**1,250,000**	**1,250,000**
Less Non-Metropolitan Supplies[4]	*(296,000)*	*(296,000)*	*(296,000)*
Maximum Metropolitan Supply Capability[5]	**954,000**	**954,000**	**954,000**

[1] Subject to satisfaction of conditions specified in agreement among Metropolitan, the United States, and the San Luis Rey Settlement Parties

[2] Total amount of supplies available without taking into consideration CRA capacity constraint.

[3] The Colorado River Aqueduct delivery capacity is 1.250 MAF annually.

[4] Exchange obligation for the SDCWA-IID transfer and the Coachella and All American Canal Lining projects.

[5] The amount of CRA water available to Metropolitan after meeting its exchange obligations.

Attachment A

Colorado River Aqueduct
Program Capabilities
Year 2035
(acre-feet per year)

Hydrology	Multiple Dry Years (1990-92)	Single Dry Year (1977)	Average Year (1922-2004)
Current Programs			
Basic Apportionment – Priority 4	550,000	550,000	550,000
IID/MWD Conservation Program	85,000	85,000	85,000
Priority 5 Apportionment (Surplus)	0	0	10,000
PVID Land Management, Crop Rotation, and Water Supply Program	133,000	133,000	133,000
Lower Colorado Water Supply Project	5,000	5,000	5,000
Lake Mead Storage Program	332,000	400,000	400,000
Quechan Settlement Agreement Supply	13,000	13,000	13,000
Forbearance for Present Perfected Rights	(47,000)	(47,000)	(47,000)
CVWD SWP/QSA Transfer Obligation	(35,000)	(35,000)	(35,000)
DWCV SWP Table A Obligation	(77,000)	(60,000)	(155,000)
DWCV SWP Table A Transfer Callback	41,000	32,000	82,000
DWCV Advance Delivery Account	36,000	28,000	73,000
Drop 2 Reservoir Funding	22,000	25,000	25,000
SNWA Agreement	0	0	0
Subtotal of Current Programs	***1,058,000***	***1,129,000***	***1,139,000***
Programs Under Development			
Additional PVID Transfers (Crop Stressing/Fallowing)	66,000	66,000	66,000
Arizona Programs - CAP	50,000	50,000	50,000
California Indians / Other Ag	10,000	10,000	10,000
ICS Exchange	25,000	25,000	25,000
Expand SNWA Agreement	0	0	0
Agreements with CVWD	35,000	35,000	35,000
Hayfield Groundwater Extraction Project	0	0	0
Subtotal of Proposed Programs	***186,000***	***186,000***	***186,000***
Additional Non-Metropolitan CRA Supplies			
SDCWA/IID Transfer	200,000	200,000	200,000
Coachella & All-American Canal Lining			
To SDCWA	80,000	80,000	80,000
To San Luis Rey Settlement Parties[1]	16,000	16,000	16,000
Subtotal of Non-Metropolitan Supplies	***296,000***	***296,000***	***296,000***
Maximum CRA Supply Capability[2]	**1,540,000**	**1,611,000**	**1,621,000**
Less CRA Capacity Constraint (amount above 1.25 MAF)	*(290,000)*	*(361,000)*	*(371,000)*
Maximum Expected CRA Deliveries[3]	**1,250,000**	**1,250,000**	**1,250,000**
Less Non-Metropolitan Supplies[4]	*(296,000)*	*(296,000)*	*(296,000)*
Maximum Metropolitan Supply Capability[5]	**954,000**	**954,000**	**954,000**

[1] Subject to satisfaction of conditions specified in agreement among Metropolitan, the United States, and the San Luis Rey Settlement Parties

[2] Total amount of supplies available without taking into consideration CRA capacity constraint.

[3] The Colorado River Aqueduct delivery capacity is 1.250 MAF annually.

[4] Exchange obligation for the SDCWA-IID transfer and the Coachella and All American Canal Lining projects.

[5] The amount of CRA water available to Metropolitan after meeting its exchange obligations.

Attachment B

Metropolitan Water District of Southern California
Water Rates and Charges

	Effective 1/1/2010	Effective 1/1/2011	Effective 1/1/2012
Tier 1 Supply Rate (dollars per acre-foot)	$101	$104	$106
Delta Supply Surcharge (dollars per acre-foot)	$69	$51	$58
Tier 2 Supply Rate (dollars per acre-foot)	$280	$280	$290
System Access Rate (dollars per acre-foot)	$154	$204	$217
Water Stewardship Rate (dollars per acre-foot)	$41	$41	$43
System Power Rate (dollars per acre-foot)	$119	$127	$136
Full Service Untreated Volumetric Cost ($/AF)			
Tier 1	$484	$527	$560
Tier 2	$594	$652	$686
Replenishment Water Rate: untreated (dollars per acre-foot)	$366	$409	$442
Interim Agricultural Water Program: untreated (dollars per acre-foot)	$416	$482	$537
Treatment Surcharge (dollars per acre-foot)	$217	$217	$234
Full Service Treated Volumetric Cost ($/AF)			
Tier 1	$701	$744	$794
Tier 2	$811	$869	$920
Treated Replenishment Water Rate (treated dollars per acre-foot)	$558	$601	$651
Treated Interim Agricultural Water Program (dollars per acre-foot)	$615	$687	$765
Readiness-to-serve Charge (millions of dollars)	$114	$125	$146
Capacity Charge (dollars per cubic foot second)	$7,200	$7,200	$7,400

Definitions

Tier 1 Supply Rate - recovers the majority of the supply costs.

Tier 2 Supply Rate - a higher block rate that reflects Metropolitan's cost of developing additional supply applied to annual purchase of water above baseline.

Delta Supply Surcharge - recovers the additional supply costs and other costs due to the pumping restrictions on the State Water Project. The Delta Supply Surcharge replaced the Water Supply Surcharge effective with the 2009/10 rates.

System Access Rate - recovers a portion of the capital and operations maintenance costs associated with the delivery of supplies.

System Power Rate - recovers Metropolitan's power costs for pumping water to Southern California.

Water Stewardship Rate - recovers the cost of Metropolitan's financial commitment to conservation, water recycling,

groundwater clean-up and other local resource management programs.

Replenishment Water Rate - a discounted rate for surplus system supplies available for the purpose of replenishing local storage.

Treated Replenishment Water Rate - a discounted rate for surplus system supplies available for the purpose of replenishing local storage.

Interim Agricultural Water Rate - discounted rate for surplus system supplies available for agricultural use. Program is phasing out.

Treated Interim Agricultural Water Program Rate – a discounted rate for surplus system supplies available for the agricultural use. Program is phasing out.

Treatment Surcharge - recovers the costs of treating water.

Readiness-to-Serve Charge - a fixed charge that recovers the cost of the portion of system capacity that provides standby and emergency service.

Capacity Charge - a fixed charge to recover the cost of providing peak capacity within the distribution system.

Attachment B

THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

BOARD ACTION

- **Board of Directors**
  Water Planning and Stewardship Committee

8/17/2010 Board Meeting

8-8

Subject

Approve adjustments to Metropolitan's Water Supply Allocation Plan and implement the allocation of seawater barrier supplies for the 2010/11 Allocation Year

Description

Background

Between July 2007 and February 2008, Metropolitan staff worked with the member agency managers and the Board to develop a Water Supply Allocation Plan (WSAP). The WSAP includes the specific formulas for calculating member agency supply allocations and the key implementation elements needed for administering an allocation. The WSAP formula allocates Metropolitan supplies over ten regional shortage levels. The WSAP was adopted at the February 12, 2008, board meeting. Staff was also directed to review the WSAP 12 months following implementation to ensure opportunity for Metropolitan staff and the member agencies to re-evaluate the plan and recommend appropriate changes to the Board.

In April 2009, the Board voted to implement the WSAP for the first time. The WSAP was implemented at a Level 2 allocation level, and was in effect for the period of July 1, 2009, through June 30, 2010. Since implementation of the 2009/10 WSAP began in July 2009, a number of practical issues relating to the plan were identified by staff and the member agencies for further consideration. In the interest of ensuring a comprehensive review process that could produce appropriate changes in time for the next WSAP year, the 12-month review process for the 2009/10 WSAP commenced in January 2010, six months into the WSAP year. Over the course of the six months, staff consulted with the member agency managers to discuss the WSAP and collected feedback on potential modifications.

This letter provides the Board with staff recommendations for modifications to the WSAP that would address the issues identified and discussed during the review process. This letter also provides the Board with the staff recommendation for allocation of seawater barrier demands. Any actions to modify the WSAP are intended to take effect for the 2010/11 allocation year.

Process

Metropolitan staff engaged with the member agencies in a formal review of the WSAP beginning in January 2010. The purpose of the review was to collaborate with the member agencies to identify potential modifications to the WSAP and to recommend changes, if any, for board consideration. Since the review process began in 2010, the member agency managers participated in a series of six workshops. The focus of these workshops was to facilitate in-depth discussion on WSAP-related issues and lessons learned since the WSAP was implemented in July 2009.

The main topics of discussion in the review process generally fell into the following categories:

- Groundwater basin management
- Local supply production
- Demand hardening
- Growth adjustments

To prepare for the review process, Metropolitan staff collected WSAP-related issues from several sources, including an online feedback form, WSAP appeal submittals, internal staff meetings, and interactions with member agency managers and staff. Since June 2009, Metropolitan staff has maintained an online WSAP feedback form on the member agency website. The WSAP also includes a comprehensive "Appeals Process" for managing requested changes in member agency data and subsequent supply allocations. To date, Metropolitan has received 14 appeal submittals for the 2009/10 allocation year, which revealed additional issues and topics for clarification and discussion. **Attachment 1** shows a listing of the meetings that were held as part of the formal WSAP review process.

Metropolitan staff compiled WSAP-related issues from these various sources for presentation and discussion at the WSAP review workshops. Recommendations on how to deal with these issues were subsequently developed in conjunction with the member agency managers for Board direction.

Recommended Modifications to the Water Supply Allocation Plan

Metropolitan staff consulted with the member agency managers and staff to develop these recommendations. They are intended to be effective in the 2010/11 allocation year.

1. Remove references to Gains and Losses of Local Supply – Retail demands in the WSAP are calculated using 2004/06 Base Period Local Supplies. However, WSAP allocations are determined by each member agency's current Allocation Year Local Supplies. Under the WSAP, changes in Allocation Year Local Supplies are documented through communication with member agencies and verified through a formal local supply certification process at the end of each allocation year. Corrections to historical Base Period Local Supply data are made through the formal WSAP appeals process.

   Staff recommends removing references in the WSAP to "gains and losses of local supplies" in order to better facilitate the accounting of historical base year and allocation year local supplies. This recommended change would not affect the WSAP formula or allocations.

2. Remove references to Regional Shortage Percentage – Each WSAP Regional Shortage Level currently has a defined "Regional Shortage Percentage." This percentage is a factor within the WSAP formula and does not represent a shortage amount. However, the percentage figure has led to difficulty with public outreach and communication because it can be easily misinterpreted as an indicator of the depth of shortage or as a percentage of required cutbacks or reductions.

   Staff recommends removing references to the "Regional Shortage Percentage" in the WSAP to reduce unintended confusion between calculation factors and shortage amounts. This recommended change would not affect the WSAP formula or allocations.

3. Include the Retail Impact Adjustment in Regional Shortage Level 1 and Level 2 – The purpose of the Retail Impact Adjustment in the WSAP is to help ensure that member agencies that are highly reliant upon Metropolitan do not experience disparate shortages at the retail level compared to other agencies that are less reliant on Metropolitan. It is prorated on a linear scale based on each member agency's dependence on Metropolitan at the retail level. However, it is currently only applied when the WSAP Regional Shortage Level is 3 or greater. Extending the adjustment to Level 1 and Level 2 would provide additional allocation to agencies based on their retail-level needs as well as consistency in methodology across all shortage levels.

   Staff recommends inclusion of the Retail Impact Adjustment for Regional Shortage Level 1 and Level 2. This recommended change would result in additional allocations to Metropolitan-dependent agencies under Level 1 and Level 2 regional shortages. Implementing this change would result in approximately

56,000 acre-feet of additional allocation for the upcoming 2010/11 WSAP Allocation Year. Based on the water supply and demand balance as of June 2010, staff does not anticipate that the proposed modification would affect the WSAP Regional Shortage Level. A detailed accounting showing the estimated impact to each member agency from including the Retail Impact Adjustment can be found in **Attachment 2**.

4. Revise the Accounting for Extraordinary Supplies – In June 2010, the Board adopted principles to be considered in determining Extraordinary Supplies under the WSAP. Local supply production classified as Extraordinary Supply is accounted differently than "planned" or "ordinary" Allocation Year Local Supply. Under the current formula, Extraordinary Supplies are subject to a Base Period Local Supply threshold; this means that an agency must produce as much local supply as they did in the Base Period in order for an Extraordinary Supply to be counted as Extraordinary. Also, according to the current formula Extraordinary Supplies are only partially included in the WSAP allocation formula depending on the WSAP Level. This has the effect of overstating the agency's demand for Metropolitan supplies and providing significantly more benefit to the member agency in terms of total water supply. However, Extraordinary Supplies are increasingly shared with the rest of the region on a sliding-scale as WSAP Levels increase.

   During the 12-month review process, it was recognized that the Base Period Local Supply threshold provision and the sliding-scale sharing mechanism in the formula could have punitive outcomes. These impacts are particularly severe in deeper regional shortages and unintentionally create disincentives for member agencies to develop Extraordinary Supplies.

   Staff recommends modifying the methodology for accounting of Extraordinary Supply in the WSAP formula. This would be accomplished by:

   - Removing the Base Period Local Supply threshold provision,
   - Removing the sliding-scale sharing mechanism from the formula, and
   - Including the full amount of the Extraordinary Supply in the calculation of the Retail Impact Adjustment.

   Attachment 3 provides an example of how these changes would offer more of a benefit to agencies that procure Extraordinary Supplies. There would be no change in the sliding-scale sharing because the current formula does not apply a sliding scale until Level 3. The only impacts to the 2010/11 WSAP Allocation Year supply allocations under a Level 2 would come from the changes to the Base Period Local Supply threshold and the recalculation of the Retail Impact Adjustment. Quantifying the impact is not practicable because any quantification is dependent on knowing actual amounts of Extraordinary Supply that agencies would procure and the dependence on Metropolitan of the agency procuring the Extraordinary Supply.

5. Include a Minimum Per Capita Water Use Threshold – There is significant variation in per capita water use among the member agencies. Member agencies with lower per capita water use and higher levels of demand hardening are disproportionately affected by demand reductions under WSAP allocations. As absolute per capita water use decreases beyond certain thresholds, further reductions are more likely to come from indoor residential use as opposed to outdoor landscape use.

   Staff recommends comparing member agency water use, on a gallon per capita per day (GPCD) basis, to the following minimum thresholds:

   - 100 GPCD total use or
   - 55 GPCD residential indoor use

   Staff's proposed minimum thresholds are based upon compliance guidelines established under Senate Bill X7-7 (Water Conservation Act of 2009).

Member agencies would receive additional Metropolitan allocation for an acre-foot equivalent of GPCD below the minimum threshold. Implementing this change would result in about 900 acre-feet of additional allocation for the upcoming 2010/11 WSAP Allocation Year. The estimated impact to each member agency from including a Minimum Per Capita Water Use Threshold can be found in **Attachment 4**. **Attachment 4** also shows the total acre-feet of additional allocation that would result from this change at each of the WSAP Shortage Levels.

6. Exclude Seawater Barrier Supplies from the WSAP Formula – The WSAP formula currently includes sea water barrier deliveries as local supplies. However, unlike other local demands, seawater barrier deliveries cannot be cut during an allocation year because of obligations to protect groundwater basins, including blending requirements when recycled water is used. This creates a demand hardening effect where the other customers from member agencies that supply seawater barrier deliveries must curtail their demands even more to compensate during an allocation. For this reason, seawater barrier deliveries provide an important regional benefit but also have disparate impacts to individual member agencies and their customers.

   During the 2004/06 WSAP Base Period, Metropolitan seawater barrier deliveries averaged approximately 25,000 acre-feet per year. Using the current WSAP formula an estimated 22,000 acre-feet would be allocated to seawater barrier demands in the 2010/11 WSAP Allocation Year. Removing seawater barrier demands from the allocation formula would reduce the 2010/11 WSAP allocation by a like amount. An additional and separate allocation of supplies to meet seawater barrier demands would be determined by the Board of Directors. For the purposes of setting the allocation of supplies for seawater barrier, staff will use estimates of seawater barrier demands provided by the member agencies. At the conclusion of a WSAP Allocation Year, staff would require those agencies that have seawater barrier obligations to certify the actual demands for seawater barrier that occurred in that year. **Attachment 5** shows the estimated impacts to each member agency from this proposal, as well as the total change in allocation at each WSAP Shortage Level.

   Staff recommends excluding seawater barrier supplies from the 2004/06 Base Period and WSAP Allocation Year local supply calculations. This would allow the Board to determine allocations for seawater barrier demands separately from the WSAP. The current WSAP formula does not account for actual barrier requirements, or the changes in the use of recycled water to meet those requirements that have occurred since the Base Period. With the proposed revision, the Board would be able to consider actual barrier requirements in the Allocation Year, as well as the availability of recycled supplies for blending given current operational and regulatory constraints. Staff proposes that allocations to seawater barrier demands would be no deeper than the WSAP Wholesale Minimum Percentage implemented at that time.

Other Identified Items from the 12-Month Review

In addition to the WSAP modifications recommended in the preceding section, several other items of concern had been identified and discussed by staff and the member agencies during the WSAP 12-Month Review process. For some of these items, it was determined that they would be appropriately addressed on a case-by-case basis through the formal WSAP appeals process. For the remaining items, it was determined through discussions with the member agencies that that they did not necessitate changes in the WSAP during this review. The items are listed below:

Items to be addressed by appeal

- Losses of supply in basins used as distribution systems
- Exclude physically isolated areas from the WSAP formula
- Treatment of water quality and physical solution obligations in the WSAP formula

Other Identified Items

- Conversion of replenishment demands to firm demands
- Increase the Conserving Rate Structure Credit
- Modify how the Base Period Local Supplies are calculated
- Capacity charges should not be affected by the WSAP
- Fire suppression/maintenance water should be excluded from the WSAP
- Adjudications that require replenishment supplies
- Remove the Growth Adjustment from the WSAP formula
- WSAP Base Period selection

Of particular note is the issue of the Growth Adjustment in the WSAP formula. No change in the existing Growth Adjustment is recommended for the 2010/11 WSAP through this review process. However, staff and the member agencies are in agreement that the methodology for accounting for growth in the WSAP formula warrants continued review and discussion in the future.

Recommended Allocation of Seawater Barrier Supplies

The adjustment proposed in this letter to exclude seawater barrier supplies from the WSAP formula states that an "additional and separate allocation of supplies to meet seawater barrier demands will be determined by the Board of Directors". Separating the seawater barrier allocation from the WSAP allocation allows the Board to consider actual barrier requirements in the Allocation Year. The current WSAP formula does not account for actual barrier requirements, or the changes in the use of recycled water to meet those requirements that have occurred since the Base Period.

During the 2004/06 Base Period, Seawater Barrier purchases from Metropolitan averaged just over 25,000 acre-feet per year. Under the existing WSAP formula about 22,000 acre-feet of supplies would be allocated to meet seawater barrier demands at the current Level 2 implementation. Based on initial estimates provided by the member agencies, the total amount of Metropolitan supplies needed to meet barrier demands in the current Allocation Year is 16,000 acre-feet. The following table shows the total amount of seawater barrier demands in the Allocation Year by member agency, as well as the anticipated local recycled supplies that will be available to meet barrier demands and the resulting demands on Metropolitan.

Member Agency	Total Barrier Demand	Local Barrier Supply	Barrier Demand on Metropolitan
Long Beach	6,000	2,700	3,300
MWDOC	38,000	37,700	300
West Basin	24,800	12,400	12,400
Total	68,800	52,800	16,000

The proposal in this letter to exclude seawater barrier supplies from the WSAP formula states that the allocations to seawater barrier demands should be no deeper than the WSAP Wholesale Minimum Percentage implemented at that time. Under the current Level 2 WSAP implementation the Wholesale Minimum Percentage is 85 percent. The following table shows the amount of seawater barrier supplies that would be provided under various levels of allocation, with the minimum allocation equal to 85 percent of seawater barrier demands on Metropolitan.

Member Agency	100%	95%	90%	85%
Long Beach	3,300	3,135	2,970	2,805
MWDOC	300	285	270	255
West Basin	12,400	11,780	11,160	10,540
Total	16,000	15,200	14,400	13,600

Some key considerations in determining the allocation of seawater barrier demands are:

- the importance of the seawater barriers in protecting groundwater supplies for the region
- the demand hardening impacts associated with cutting seawater barrier supplies

In excluding seawater barrier deliveries from the WSAP allocation, Metropolitan would effectively isolate the actual demands for seawater barrier in the allocation year. Any reductions in seawater barrier deliveries would translate into real cuts to seawater barrier deliveries, or would shift supplies allocated under the WSAP away from potable customers to provide for the seawater barrier.

Given the key considerations outlined above, staff recommends that Metropolitan provide sufficient supplies to meet 100 percent of seawater barrier demands for the Allocation Year. Approving this action would reduce the WSAP allocation by just over 22,000 acre-feet, and add an additional 16,000 acre-feet of seawater barrier allocation; the net change would be a 6,000-acre-foot reduction in supplies allocated by Metropolitan. The allocation figures shown above are based on preliminary estimates provided by the member agencies; final allocations will be based on actual certified barrier demands and local supplies.

Next Steps

Changes to the WSAP as a result of board action this month are intended to be in effect for the 2010/11 WSAP Allocation Year. Metropolitan staff has communicated the process timeline to the member agencies through the 12-month review workshops and through meetings with the member agency managers.

For reference, **Attachment 6** provides a comparison of the estimated 2010/11 WSAP allocations under the current allocation formula and with all of the adjustments proposed in this letter. This comparison quantifies the cumulative impact of all of the proposed changes for each member agency.

Policy

By Minute Item 47393, dated February 12, 2008, the Board adopted the Water Supply Allocation Plan.

California Environmental Quality Act (CEQA)

CEQA determination for Option #1:

The proposed action is not defined as a project under CEQA because it involves continuing administrative activities, such as general policy and procedure making (Section 15378(b)(2) of the State CEQA Guidelines). In addition, where it can be seen with certainty that there is no possibility that the proposed action in question may have a significant effect on the environment, the proposed action is not subject to CEQA (Section 15061(b)(3) of the State CEQA Guidelines).

The CEQA determination is: Determine that the proposed action is not subject to CEQA pursuant to Sections 15378(b)(2) and 15061(b)(3) of the State CEQA Guidelines.

CEQA determination for Option #2:

None required

Board Options

Option #1

Adopt the CEQA determination and

a. approve the proposed adjustments to Metropolitan's Water Supply Allocation Plan; and
b. approve the proposed allocation of seawater barrier supplies.

Fiscal Impact: None

Business Analysis: Approving the proposed adjustments would address the major issues identified for refinement in the 12-month review process. Specifically the proposed adjustments would help clarify data requirements and accounting, alleviate potential confusion in public messaging regarding the size of required reductions, provide consistency in methodology across all shortage levels, lessen disincentives for member agencies to develop Extraordinary Supplies, protect agencies with lower per capita water use from

disproportionately high levels of demand hardening, and allow the Board to determine appropriate allocations for seawater barrier demands separately from the WSAP.

Option #2

Do not approve the proposed adjustments to Metropolitan's Water Supply Allocation Plan, and do not approve the proposed allocation of seawater barrier supplies.

Fiscal Impact: None

Business Analysis: Not approving the proposed adjustments maintains the existing Water Supply Allocation Plan formula

Staff Recommendation

Option #1

8/2/2010
Deven N. Upadhyay *Date*
Manager, Water Resource Management

8/3/2010
Jeffrey Kightlinger *Date*
General Manager

Attachment 1 – WSAP 12-Month Review Process Meeting Summary

Attachment 2 – Proposal to Include the Retail Impact Adjustment in Regional Shortage Level 1 and Level 2

Attachment 3 – Proposal to Revise the Extraordinary Supply Methodology

Attachment 4 – Proposal to Include a Minimum Per Capita Water Use Threshold

Attachment 5 – Proposal to Exclude Seawater Barrier Supplies from the WSAP Formula

Attachment 6 – Comparison of 2010/11 WSAP Allocations with Proposed Adjustments

Ref# wrm12606248

WSAP 12-Month Review Process Meeting Summary

Meetings with Member Agencies to Discuss Issues from 2009/10 Water Supply

Date	Meeting	Description
January 13, 2010	WSAP 12-Month Review Workshop #1	First meeting of the WSAP 12-Month Review process; focused discussion of WSAP issues identified by Metropolitan staff and by member agencies since 2009/10 WSAP implementation
February 1, 2010	WSAP 12-Month Review Workshop #2	Continuation of prior workshop
February 18, 2010	WSAP 12-Month Review Workshop #3	Continuation of prior workshop
March 1, 2010	WSAP 12-Month Review Workshop #4	Continuation of prior workshop
April 8, 2010	WSAP 12-Month Review Workshop #5	WSAP 12-Month Review process: Recap of identified issues and discussion of Metropolitan staff proposals for changes to the WSAP
April 16, 2010	Member Agency Managers Meeting	Update on the WSAP 12-Month Review process
April 19, 2010	WSAP 12-Month Review Workshop #6	Discussion of WSAP issues related to replenishment
April 23, 2010	Member Agency Managers Conference Call	Clarification of WSAP definition for Extraordinary Supply
May 14, 2010	Member Agency Managers Meeting	Discussion of Extraordinary Supply proposed policy principles and WSAP Local Supply Certification process
May 21, 2010	Member Agency Managers Conference Call	Discussion of Extraordinary Supply proposed policy principles

Proposal to Include the Retail Impact Adjustment in Regional Shortage Level 1 and Level 2

Under the current WSAP formula, the Retail Impact Adjustment is not included in Regional Shortage Level 1 and Level 2. The purpose of the Retail Impact Adjustment is to provide additional allocation to agencies based upon their dependence on Metropolitan and avoid disparate retail-level impacts around the service area.

The proposed adjustment to the WSAP formula is to include the Retail Impact Adjustment in Regional Shortage Level 1 and Level 2. This change would provide additional allocation to agencies based on retail level need in Shortage Level 1 and Level 2.

In the 2010/11 WSAP Allocation Year, this adjustment would result in approximately 56,000 acre-feet of total additional allocation at the current Level 2 implementation. The following table shows the Level 2 allocation by Member Agency with and without the retail impact adjustment, as well as the net change for each agency. The allocations shown below are based on local supply estimates as of June 1, 2010, and do not include any of the other proposed adjustments.

Member Agency	Current Methodology	Proposed Methodology	Change
Anaheim	29,417	30,088	**670**
Beverly Hills	10,927	11,437	**510**
Burbank	11,296	11,595	**298**
Calleguas	102,708	106,638	**3,930**
Central Basin	68,584	69,715	**1,131**
Compton	3,206	3,268	**63**
Eastern	98,339	101,144	**2,805**
Foothill	10,270	10,580	**310**
Fullerton	13,355	13,683	**328**
Glendale	19,722	20,421	**699**
Inland Empire	68,970	70,084	**1,114**
Las Virgenes	20,853	21,947	**1,094**
Long Beach	34,505	35,443	**938**
Los Angeles	320,406	328,867	**8,461**
MWDOC	230,707	236,987	**6,280**
Pasadena	24,765	25,673	**908**
SDCWA	455,379	470,837	**15,458**
San Fernando	322	324	**2**
San Marino	1,516	1,541	**24**
Santa Ana	19,075	19,524	**448**
Santa Monica	12,316	12,769	**452**
Three Valleys	64,796	66,872	**2,076**
Torrance	19,976	20,889	**913**
Upper San Gabriel	32,499	32,839	**340**
West Basin	129,562	135,025	**5,462**
Western	105,674	107,356	**1,683**
MWD Total	1,909,147	1,965,544	**56,398**

Proposal to Revise the Extraordinary Supply Methodology

Under the current WSAP formula, a percentage of all Extraordinary Supplies are "shared' with the region based upon the Regional Shortage Level; the following table shows the Extraordinary Supply Percentage at each Shortage Level. The Extraordinary Supply Percentage is the amount of an Extraordinary Supply that is included in the WSAP formula to determine each agency's Wholesale Minimum Allocation from Metropolitan.

Regional Shortage Level	Extraordinary Supply Percentage
1	0%
2	0%
3	15%
4	20%
5	25%
6	30%
7	35%
8	40%
9	45%
10	50%

The proposed adjustment to the WSAP removes the Extraordinary Supply Percentage from the allocation formula. Under this proposal, Extraordinary Supplies would no longer be used in calculating an agency's Wholesale Minimum Allocation from Metropolitan. In other words, Extraordinary Supplies would no longer be "shared" with the region at any of the Regional Shortage Levels.

The proposed adjustment would also revise the current formula to include the full amount of Extraordinary Supplies in the calculation of an agency's Allocation Year Dependence on Metropolitan. This adjustment serves to more accurately reflect an agency's true need for Metropolitan supplies in the Retail Impact Adjustment.

Another aspect of the proposed adjustment is to remove the Base Period Local Supply threshold provision from the WSAP formula. Under the current WSAP formula, agencies must produce as much local supplies in the Allocation Year as they did in the Base Period in order for Extraordinary Supplies to be accounted in the formula as Extraordinary.

The table below shows the net gain that an agency would receive from procuring 10,000 acre-feet of Extraordinary Supply at each of the Regional Shortage Levels. The value of the 10,000 acre-feet is shown under both the current and proposed formulas; the net change between the two methodologies is shown in the far right column. This analysis assumes that the agency in this example meets the Base Period Local Supply threshold provision under the current methodology, and that the entire 10,000 acre-feet qualify as Extraordinary Supply. This example is based on an agency that has 100,000 acre-feet of Allocation Year Retail Demand and is 50 percent dependent on Metropolitan. The results shown below do not include any of the other proposed adjustments.

Regional Shortage Level	Current Methodology	Proposed Methodology	Change
1	10,000	10,000	**0**
2	10,000	10,000	**0**
3	8,727	9,625	**898**
4	8,404	9,500	**1,096**
5	8,133	9,375	**1,242**
6	7,914	9,250	**1,337**
7	7,746	9,125	**1,379**
8	7,632	9,000	**1,368**
9	7,571	8,875	**1,304**
10	7,563	8,750	**1,188**

Proposal to Include a Minimum Per Capita Water-Use Threshold

Under the current WSAP formula, there is no mechanism to adjust WSAP Allocations for Member Agencies with low per capita water use.

The proposed adjustment would create a minimum per capita water use threshold. Member agencies' retail-level water use under the WSAP formula would be compared to two different thresholds. The proposed minimum thresholds are based upon compliance guidelines established under Senate Bill X7-7

- 100 GPCD total water use
- 55 GPCD residential water use

Agencies that fall below either threshold under the WSAP would receive additional allocation from Metropolitan to bring them up to the minimum GPCD water use level. If an agency qualified under both thresholds, the one resulting in the maximum allocation adjustment would be given.

This adjustment would result in almost 900 acre-feet of total additional allocation at the current Level 2 implementation. The table below shows the Level 2 allocation by member agency with and without the Minimum Per Capita Water Use Adjustment, as well as the net change for each agency.

Member Agency	Current Methodology	Proposed Methodology	Change
Anaheim	29,417	29,417	**0**
Beverly Hills	10,927	10,927	**0**
Burbank	11,296	11,296	**0**
Calleguas	102,708	102,708	**0**
Central Basin	68,584	68,584	**0**
Compton	3,206	4,075	**869**
Eastern	98,339	98,339	**0**
Foothill	10,270	10,270	**0**
Fullerton	13,355	13,355	**0**
Glendale	19,722	19,722	**0**
Inland Empire	68,970	68,970	**0**
Las Virgenes	20,853	20,853	**0**
Long Beach	34,505	34,505	**0**
Los Angeles	320,406	320,406	**0**
MWDOC	230,707	230,707	**0**
Pasadena	24,765	24,765	**0**
SDCWA	455,379	455,379	**0**
San Fernando	322	322	**0**
San Marino	1,516	1,516	**0**
Santa Ana	19,075	19,075	**0**
Santa Monica	12,316	12,316	**0**
Three Valleys	64,796	64,796	**0**
Torrance	19,976	19,976	**0**
Upper San Gabriel	32,499	32,499	**0**
West Basin	129,562	129,562	**0**
Western	105,674	105,674	**0**
MWD Total	1,909,147	1,910,016	**869**

The following table shows the total impact of including a minimum per capita water use threshold under each Regional Shortage Level. The maximum credit that would be given under the proposal would be just over 12,000 acre-feet in a Regional Shortage Level 10. The allocations shown in this analysis are based on local supply estimates as of June 1, 2010, and do not include any of the other proposed adjustments.

Regional Shortage Level	Current Methodology	Proposed Methodology	Change
1	0	621	**621**
2	0	869	**869**
3	0	1,024	**1,024**
4	0	1,241	**1,241**
5	0	1,458	**1,458**
6	0	1,675	**1,675**
7	0	2,764	**2,764**
8	0	4,205	**4,205**
9	0	7,564	**7,564**
10	0	12,419	**12,419**

Proposal to Exclude Seawater Barrier Supplies from the WSAP Formula

Under the current WSAP formula, seawater barrier purchases from Metropolitan are included in the calculation of Base Period Local Supplies.

This proposal would remove seawater barrier purchases from the Base Period calculation and create a separate allocation for seawater barrier demands. This change would allow the Board to determine allocation of barrier demands separately from WSAP.

Seawater Barrier purchases from Metropolitan averaged just over 25,000 acre-feet per year during the 2004/06 Base Period. The following table shows the averages for the three agencies that purchased seawater barrier supplies from Metropolitan during the base period.

Member Agency	Base Period Average
Long Beach	3,456
MWDOC	8,461
West Basin	13,195
MWD Total	**25,111**

In the 2010/11 WSAP Allocation Year, this adjustment would result in a 22,000-acre-foot reduction in the total allocation at the current Level 2 implementation. The following table compares the Level 2 allocation by member agency under the current formula with what it would be with the proposed exclusion of seawater barrier supplies, and shows the net change for each agency in the far-right column. Because the proposal includes a provision that seawater barrier demands be allocated separately, the figures shown below may not represent an actual reduction in demands on Metropolitan. Ultimately, the net impact on Metropolitan will depend upon how the Board chooses to allocate supplies to seawater barrier demands.

Member Agency	Current Methodology	Proposed Methodology	Change
Anaheim	29,417	29,417	**0**
Beverly Hills	10,927	10,927	**0**
Burbank	11,296	11,296	**0**
Calleguas	102,708	102,708	**0**
Central Basin	68,584	68,584	**0**
Compton	3,206	3,206	**0**
Eastern	98,339	98,339	**0**
Foothill	10,270	10,270	**0**
Fullerton	13,355	13,355	**0**
Glendale	19,722	19,722	**0**
Inland Empire	68,970	68,970	**0**
Las Virgenes	20,853	20,853	**0**
Long Beach	34,505	31,453	**(3,052)**
Los Angeles	320,406	320,406	**0**
MWDOC	230,707	223,148	**(7,559)**
Pasadena	24,765	24,765	**0**
SDCWA	455,379	455,379	**0**
San Fernando	322	322	**0**
San Marino	1,516	1,516	**0**
Santa Ana	19,075	19,075	**0**
Santa Monica	12,316	12,316	**0**

Three Valleys	64,796	64,796	**0**
Torrance	19,976	19,976	**0**
Upper San Gabriel	32,499	32,499	**0**
West Basin	129,562	117,997	**(11,565)**
Western	105,674	105,674	**0**
MWD Total	1,909,147	1,886,970	**(22,177)**

The following table shows the total impact of removing seawater barrier purchases from the WSAP formula at each Regional Shortage Level. The maximum impact of this proposal would be just over 24,000 acre-feet in a Regional Shortage Level 1. The allocations shown in this analysis are based on local supply estimates as of June 1, 2010, and do not include any of the other proposed adjustments.

Regional Shortage Level	Current Methodology	Proposed Methodology	Change
1	24,046	0	**(24,046)**
2	22,177	0	**(22,177)**
3	21,916	0	**(21,916)**
4	20,583	0	**(20,583)**
5	19,251	0	**(19,251)**
6	17,918	0	**(17,918)**
7	16,585	0	**(16,585)**
8	15,253	0	**(15,253)**
9	13,920	0	**(13,920)**
10	12,587	0	**(12,587)**

Comparison of 2010/11 WSAP Allocations with Proposed Adjustments

This attachment summarizes the net impact that would result from implementing all of the proposed adjustments to the WSAP:

- Include the Retail Impact Adjustment in Regional Shortage Level 1 and Level 2
- Revise the Extraordinary Supply Methodology
- Include a Minimum Per Capita Water Use Threshold
- Exclude Seawater Barrier Deliveries from the WSAP Formula
- Allocate supplies to meet 100 percent of estimated seawater barrier demands on Metropolitan for the 2010/11 allocation year

For the 2010/11 WSAP Allocation Year, the impact of all of the proposed adjustments would be an increase of approximately 34,000 acre-feet in the total amount of water allocated under the current Level 2 implementation. Providing an allocation of Metropolitan supplies sufficient to meet 100 percent of the estimated seawater barrier demands would add an additional 16,000 acre-feet; for a net increase of nearly 50,000 acre-feet. The following table shows the Level 2 allocation by member agency under the current formula and with all of the proposed adjustments. The net change for each agency is shown in the far-right column. The allocations shown below are based on local supply estimates as of June 1, 2010.

Member Agency	Current Methodology	Proposed Methodology	Change
Anaheim	29,417	30,088	671
Beverly Hills	10,927	11,437	510
Burbank	11,296	11,595	299
Calleguas	102,708	106,638	3,930
Central Basin	68,584	69,715	1,131
Compton	3,206	4,075	869
Eastern	98,339	101,144	2,805
Foothill	10,270	10,580	310
Fullerton	13,355	13,683	328
Glendale	19,722	20,421	699
Inland Empire	68,970	70,084	1,114
Las Virgenes	20,853	21,947	1,094
Long Beach	34,505	35,564	1,059
Los Angeles	320,406	328,867	8,461
MWDOC	230,707	229,410	-1,297
Pasadena	24,765	25,673	908
SDCWA	455,379	470,837	15,458
San Fernando	322	324	2
San Marino	1,516	1,541	24
Santa Ana	19,075	19,524	448
Santa Monica	12,316	12,769	452
Three Valleys	64,796	66,872	2,076
Torrance	19,976	20,889	913
Upper San Gabriel	32,499	32,839	340
West Basin	129,562	135,231	5,669
Western	105,674	107,356	1,683
MWD Total	**1,909,147**	**1,959,103**	**49,956**