LDC

3000 W EMPIRE AVENUE
BURBANK, CA
DRAINAGE / HYDROLOGY STUDY

January 27, 2023

LDC

HYDROLOGY/DRAINAGE/LID STUDY

For:
3000 W Empire Avenue Affordable Housing Development Project
Burbank, CA

Submitted to:
City of Burbank
Community Development Department
Building Division
150 N. Third Street
Burbank, CA 91502

Prepared for:
ABS Burbank LLC
5500 Hollywood Boulevard
4th Floor, West Wing
Los Angeles, CA 90028

Project Site Location:
2814 W Empire Avenue
Burbank, CA 91504

Prepared by:
Victor Salazar, P.E.
Land Design Consultants, Inc.
800 Royal Oaks Drive, Suite 104
Monrovia, CA 91016

LDC Project No. 05015-835

Revised Report Date:
January 27, 2023

TABLE OF CONTENTS

1.0 Introduction

1.1 Project Background

The project is located at 3000 W. Empire Avenue in the City of Burbank and is located 350 feet west from the Robert E. Gross Park. The Site is located 0.84 mile from the 5 freeway, approximately. The project site is on the south side of Empire Avenue between North Niagara Street and Ontario Street. See location and vicinity map in Appendix 1. The project site is bounded by commercial business/offices. On the south side is bounded by the Union Pacific Railroad (UPRR) right-of-way and the Southern California Railroad Authority (SCRRA) right-of-way. The site is currently occupied by a commercial one (1) story building with on-grade parking lot on the northeast side of the property. The proposed project will be comprised of one 7-story building with one subterraneous basement level, which will be an affordable housing development project. The construction of the seven-story apartment will accommodate 340 affordable units. The site area is 85,924 sf (1.97 acres).

2.0 Site Characterization

Current Property Use: One (1) story commercial building with on-grade parking lot.

Proposed Property Use: A seven (7) story Affordable Apartment Housing Building.

Soils Type: The soil of the watershed is classified as Type 015, as shown in the Burbank quadrant of Hydrologic Map figure of the Los Angeles County Department of Public Works (LACDPW) 1-H1.28, found in Appendix 2.

3.0 Hydrology

3.1 General Approach

The watershed of the project was identified and characterized for both existing and proposed hydrology conditions. The LACDPW computer modeling was used to estimate the runoff peak flow rate in cubic feet/second (CFS) for the 50-year storm event.

3.2 Data Resources

The primary sources of data were obtained from the Los Angeles County Department of Public Works Hydrology Manual and the Low Impact Development (LID) Manual February 2014 Edition.

3.3 Watershed Characteristics

Rainfall and soil characteristics for the 3000 W. Empire Avenue project site are given in the Burbank Quadrant of Hydrologic Map figure LACDPW 1-H1.28 (appendix 2). The 50-year (24-hour) rainfall Isohyet nearest the project area is approximately 7.10 inches. As per the Isohyetal Map, the soil classification of the project site falls into Soil Type 015. The proposed project area to be disturbed is approximately 1.97 acres. The total tributary area to be studied is approximately 1.97 acres.

The isohyet for all of the storm events is listed as:

- LID: 85th Percentile
- 50-Year 24-Hour: 7.10 inches

The LACDPW HydroCalc program was used to calculate the time of concentration (Tc) and the peak runoff flow rate, in cubic feet per second (CFS) for the existing and proposed conditions. See Appendix 2 for Hydrology Calculations for both conditions.

3.4 Existing Condition Results

The existing condition hydrologic analysis was based on the Existing Site Condition Hydrology Plan prepared by Land Design Consultants, Inc., included in Appendix 3. The proportion of impervious site area for the project's entire tributary area was determined to be 96%. The existing site drainage area is consolidated into one designated Drainage-Area A. The existing condition hydrology results for the 50-year 24-hour storm event are summarized in Table 1 below:

Table 1: Existing Hydrology, 50-year, 24-Hour Storm Event

DRAINAGE-AREA	AREA (ACRE)	TC (MIN)	% IMP	Q50 (cfs)
1A	1.97	6	96	6.77

3.5 Proposed Condition Results

The proposed condition hydrologic analysis was based on the Proposed (Developed) Site Condition Hydrology Plan prepared by Land Design Consultants, Inc. included in Appendix 3.

The proposed site drainage area is consolidated into one designated Drainage-Area A.

The Drainage-Area A includes, the building roof runoff collected by the roof down spouts and the proposed site surface drainage areas around the perimeter of the proposed building. The surface drainage is channeled to the southern area of the site which will be collected and discharged into a system of three (3) drywells to comply with the required LID-Storm Water Quality Design Volume (SWQDV). An overflow storm drain in the interior of the drywell will allow stormwater to exit the drywell system and connect to the existing northerly vertical wall of the Lockheed Rectangular Drain Channel.

The portion of the impervious site area, based on proposed site conditions, was determined to be about 82%. The proposed hydrology condition results for the 50-year storm event are summarized in Table 2 below.

Table 2: Proposed Hydrology, 50-year Storm Event

DRAINAGE-AREA	AREA (ACRE)	TC (MIN)	% IMP	Q50 (cfs)
A	1.97	6	82	6.33

3.6 Baseline Hydrology Comparison

A comparison of existing and proposed peak flow rates is provided in Table 3 below.

Table 3: Existing vs. Proposed Condition Hydrology Comparison Summary

50-YEAR STORM EVENT					
DRAINAGE AREA		AREA (AC)		Q50 (cfs)	
EXISTING	PROPOSED	EXISTING	PROPOSED	EXISTING	PROPOSED
1A	A	0.90	0.90	6.77	6.33

In summary, the proposed development condition-peak flow rate for the overall site is determined to be less than the existing condition of the site. Therefore, as a result of this finding (existing versus proposed conditions), no detention of added peak flow (cfs) is required.

4.0 Best Management Practices

Source and Treatment Control Best Management Practices (BMPs) are required for this project under the LA County Low Impact Development (LID).

4.1 Site Design BMPs

4.1.1 Minimize Stormwater Pollutants of Concern

The project site will minimize pollutants of concern by maximizing the reduction of pollutant loadings to the Maximum Extent Practicable. Pollutants of concern are addressed through a pre-treatment settlement device connected to the underground reservoir within the project site as shown in the Low Impact Development Plan in Appendix 3.

4.1.2 Minimize Impervious Area

The proposed project will minimize the potential of pollutant discharges into storm water public channels as the percentage of impervious area is reduced and consequently reducing the pollutant load into the public systems.

4.2 Source Control BMPs

4.2.1 Protect Slopes and Channels

There are no slopes or channels on site.

4.2.2 Provide Storm Drain System Stenciling and Signage

Storm Drain System Stenciling and Signage will be provided at the proposed storm drain catch basins.

4.2.3 Properly Design Trash Storage Areas

Trash enclosures will be covered and walled inside of the building. Drainage from adjoining roofs and pavement will not enter the trash storage area. All trash container areas within the project will be covered and located at the appropriate locations. The trash bins will be leak proof and have attached covers or lids.

4.3 Treatment Control BMPs

4.3.1 Mitigation Design (Volumetric or Flow Based)

Volume-based or flow-based design standards may be used separately or in combination. Volume-based criteria are used in the sizing of detention or infiltration structures while flow-based criteria are used on swales, inlet devices or wetlands. The LID requirements, approved by the Regional Water Quality Control Board, call for the treatment of the peak mitigation flow rate or volume of runoff produced by the 85th percentile rainfall event.

The LID methodology was used to calculate the required treatment flow and volume for the single discharge point from the site. The runoff coefficient curve for Soil Type 015 and the LACDPW Intensity-Duration data and LID calculations are included in Appendix 2. The results are summarized in the Table 4 below.

Table 4: Peak Mitigation Flow and Volume Comparison Summary

TREATMENT REQUIRED					TREATMENT PROVIDED			
DRAINAGE-AREA	**AREA (AC)**	**IMPERVIOUS %**	**Q_{PM} [cfs]**	**V_M [ft3]**	**AREA [ft2]**	**Q_{PM} [cfs]**	**V_M [ft3]**	**TREATMENT TYPE**
A	1.97	82	0.28	4,021	X	X	4,389	Dry Well

The LID Site Plan included in Appendix 3 shows the Drainage-Area A and proposed BMPs.

4.3.2 Dry Well

Dry Well refers to a specific type of BMP that operates by receiving generated runoff and infiltrating the flow stormwater volume into the subsoil. The proposed project structural BMP has the capacity to mitigate, store, and infiltrate the SWQDV volume.

The LID Site Plan in Appendix 3 shows the location of the Dry Well. As mentioned above, the dry well is designed to infiltrate the required mitigation volume and allow the overflow to discharge through a storm drain. Per the Geotechnical Report by Byer Geotechnical, Inc., dated February 17, 2022, groundwater was not encountered in the borings up to a maximum depth of 70.1 feet below existing grade. Based on a Seismic Hazard Zone Report 016, the California Geological Survey (CGS) has estimated the historically highest groundwater level at the site was on the order of 47 feet below ground surface. Infiltration is feasible. The dry well was sized by analyzing the proposed 85th percentile storm event volume using the standard LID calculation. The proposed dry well system is to provide a treatment capacity of 4,389 cubic feet (CF), which exceeds the required mitigation volume of 4,021 CF. The dry well system is designed to infiltrate a volume of 12,882 CF in a 96-hour period. See appendix 2 and 3 for dry well capacity calculations.

5.0 FEMA - Letter of Map (LOMR) Revision Determination Document Case No. 11-09-3187P

The proposed development site includes a portion of the property adjacent to the Lockheed Drain Channel, on the south side of the property, subject to inundation by the 1 percent annual channel flood of 100-year storm frequency, as depicted on the Federal Emergency Management Agency (FEMA), Firm Panel No. 06037C1345F, effective September 26, 2008, of the community of City of Burbank, Los Angeles County, California.

FEMA issued a Letter of Map Revision (LOMR) determination document reflecting the modifications made by the LOMR Report to the previous City Firm Panel.

A Base Flood Elevation (BFE) of 657.50 feet, at the 1% annual chance of flooding, was established in the rear of the property as included in the LOMR Determination document effective June 18, 2012.

The proposed 3000 W. Empire Housing Development will mitigate the Base Flood Elevation of 657.50 feet and protect the proposed building finish floor (657.77 FF) by adding an additional 1.27 feet of wall to the existing concrete retaining wall located along the rear of the property. The proposed retaining wall elevation will be 658.77 feet. Due to this, LDC will prepare and provide to the City of Burbank an Elevation Certificate (FEMA Form 086-0-033) signed by a Registered Civil Engineer in the State of California as required by the U.S. Department of Homeland Security, FEMA, and the National Flood Insurance Program.

6.0 Limitations

This report was prepared to comply with the guidelines established by the County of Los Angeles Department of Public Works (LACDPW). Evaluation of the appropriateness of the guidelines and the accuracy of the County data were beyond the scope of work.

Usage of this report is limited to address the purpose and scope of work for the proposed project as defined in this report. Land Design Consultants, Inc. shall not be held responsible for any unauthorized application of this report and the contents therein.

The opinions represented in this report have been derived in accordance with current Codes, Standards, and civil engineering practices. No other warranty is expressed or implied.

7.0 References

City of Burbank Community Development Department Building Division, Municipal Storm Water and Urban Runoff Discharges Manual (2015)

Los Angeles County Department of Public Works, LACDPW Hydrology/Sedimentation Manual and Appendices (1991, 1992, 1993, 2002, 2006)

Los Angeles County Department of Public Works, LACDPW HydroCalc (August 2015)

Los Angeles County Department of Public Works, Low Impact Development Standards Manual (February 2014)

FEMA - Letter of Map (LOMR) Revision Determination Document Case No. 11-09-3187P

Geotechnical Investigation Report, Byer Geotechnical, Inc. dated February 17, 2022

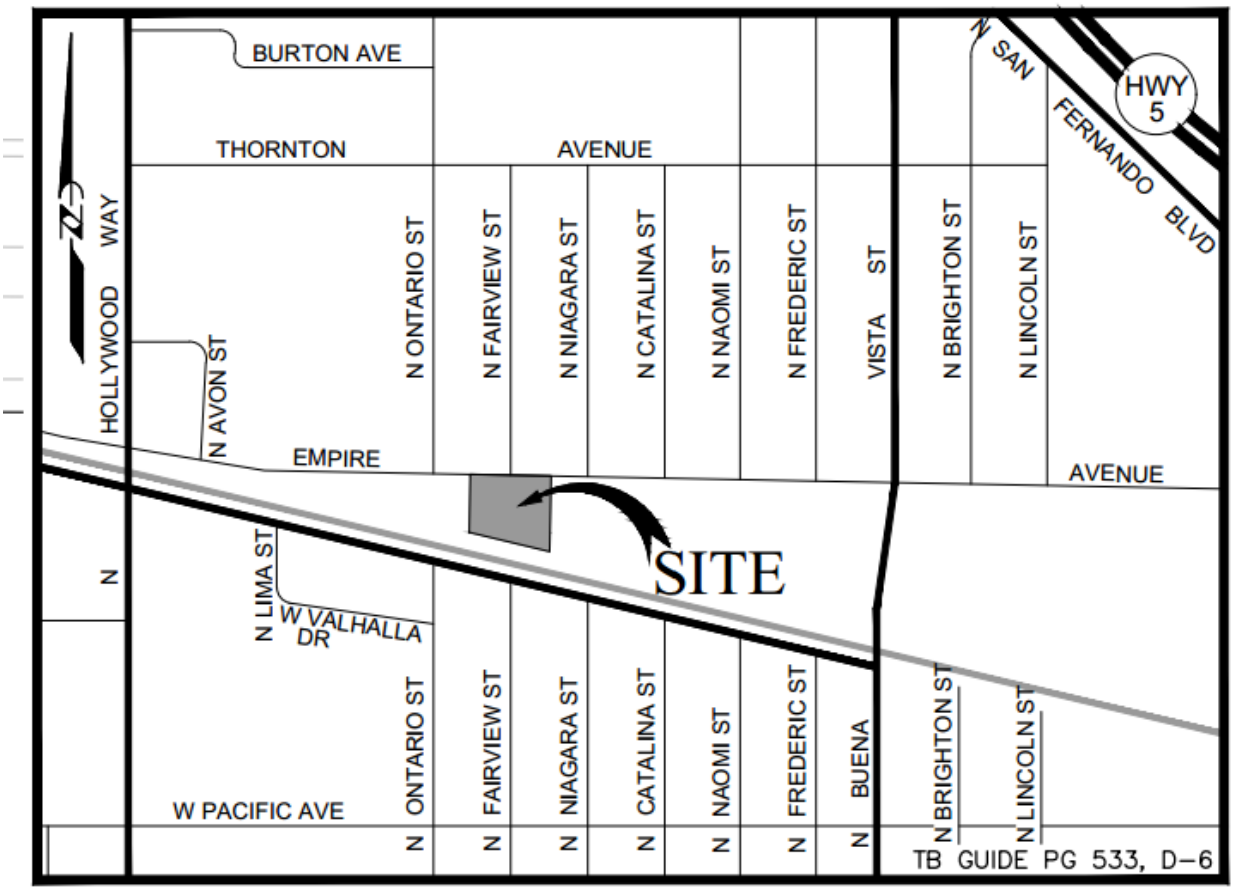
8.0 Appendices

Appendix 1 LACDPW Hydrology Data
Isohyet and Hydrologic Soil Classification Map

APPENDIX 1

VICINITY MAP AND SITE LOCATION

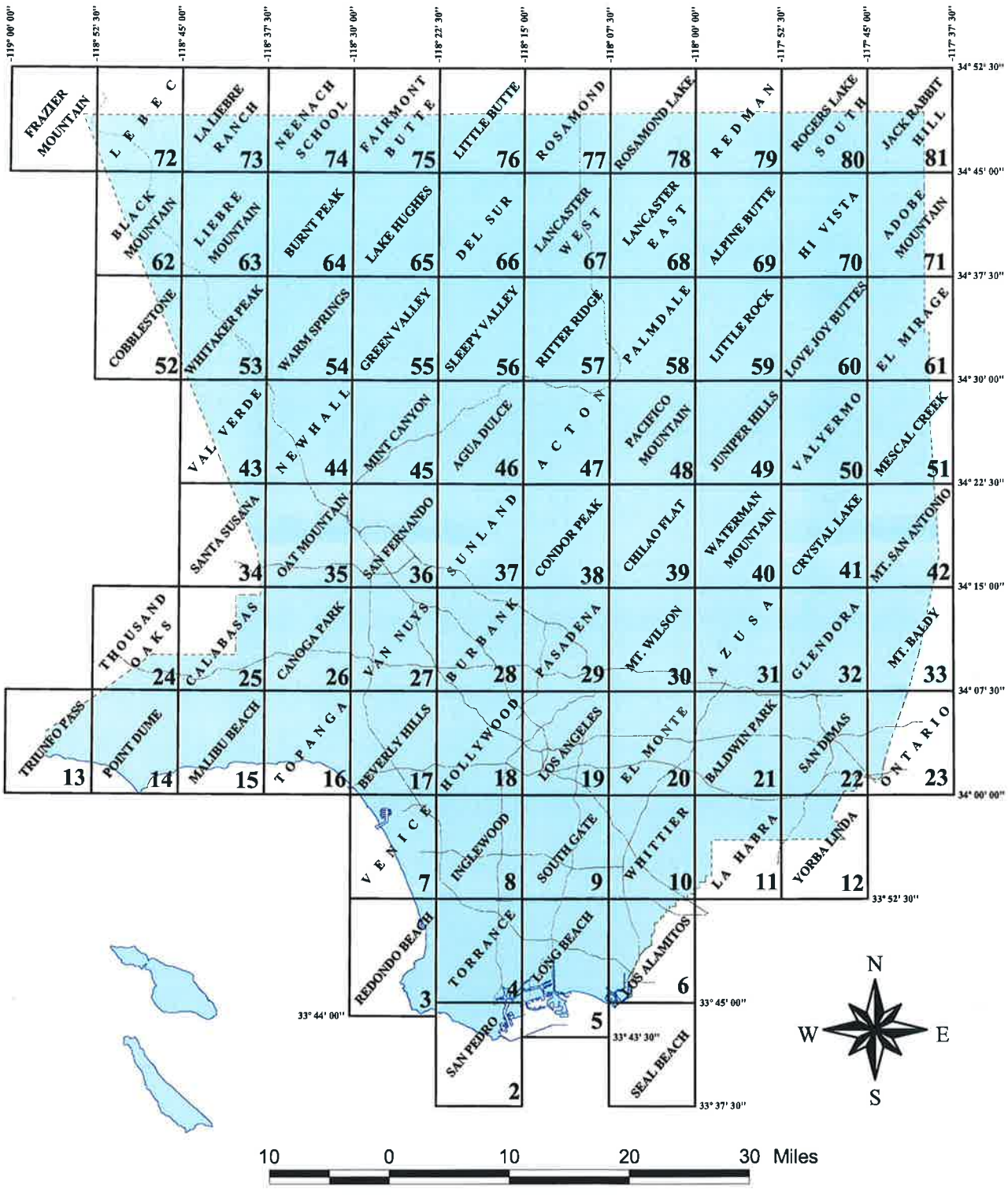
LDC



VICINITY MAP
NOT TO SCALE

APPENDIX 2

ISOHYET AND HYDROLOGIC SOIL CLASSIFICATION MAP

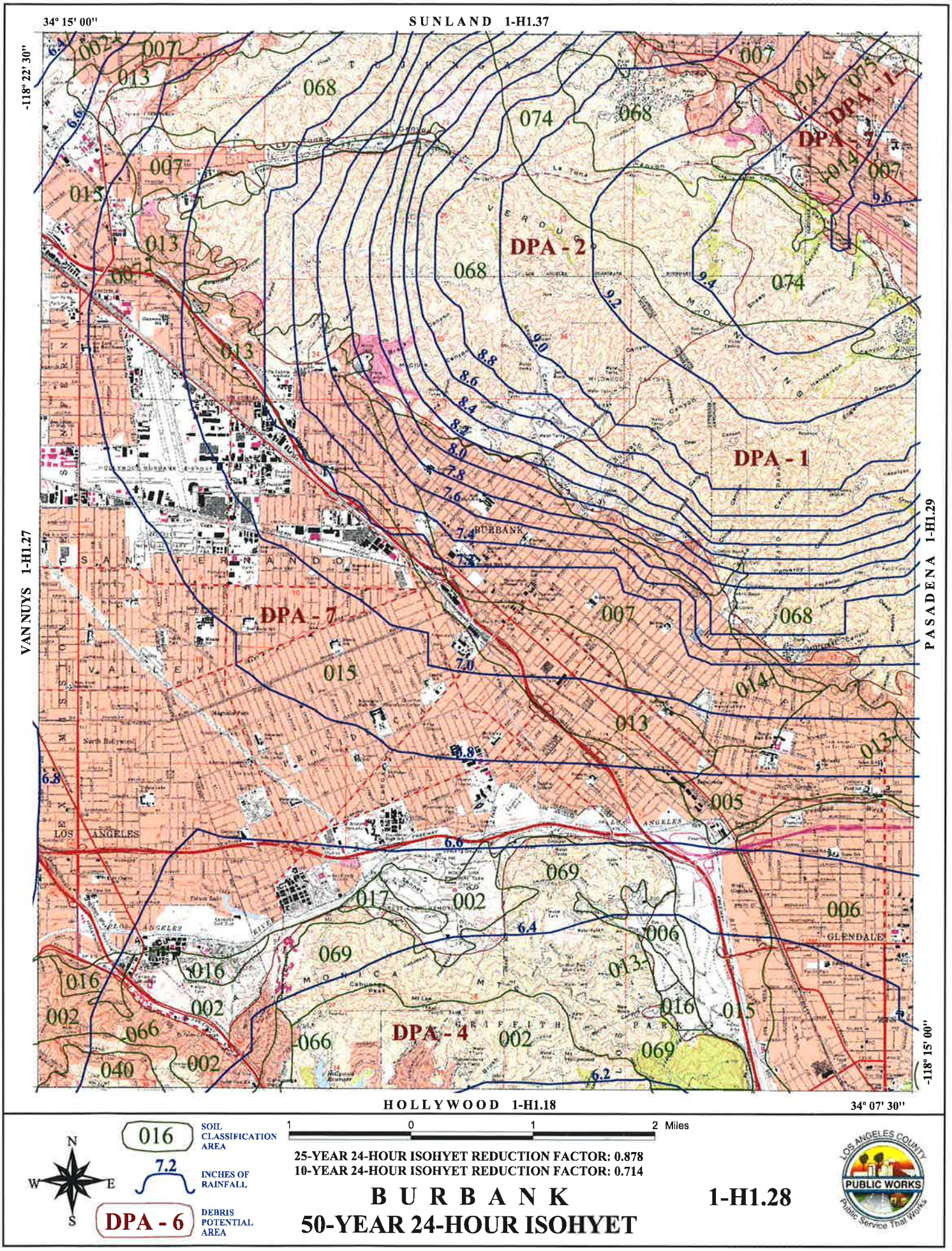


INDEX ISOHYETAL MAP

50-YEAR 24-HOUR ISOHYET

BASED ON USGS QUADRANGLE

LOS ANGELES COUNTY PUBLIC WORKS Public Service That Works



25-YEAR 24-HOUR ISOHYET REDUCTION FACTOR: 0.878
10-YEAR 24-HOUR ISOHYET REDUCTION FACTOR: 0.714

B U R B A N K

50-YEAR 24-HOUR ISOHYET

1-H1.28

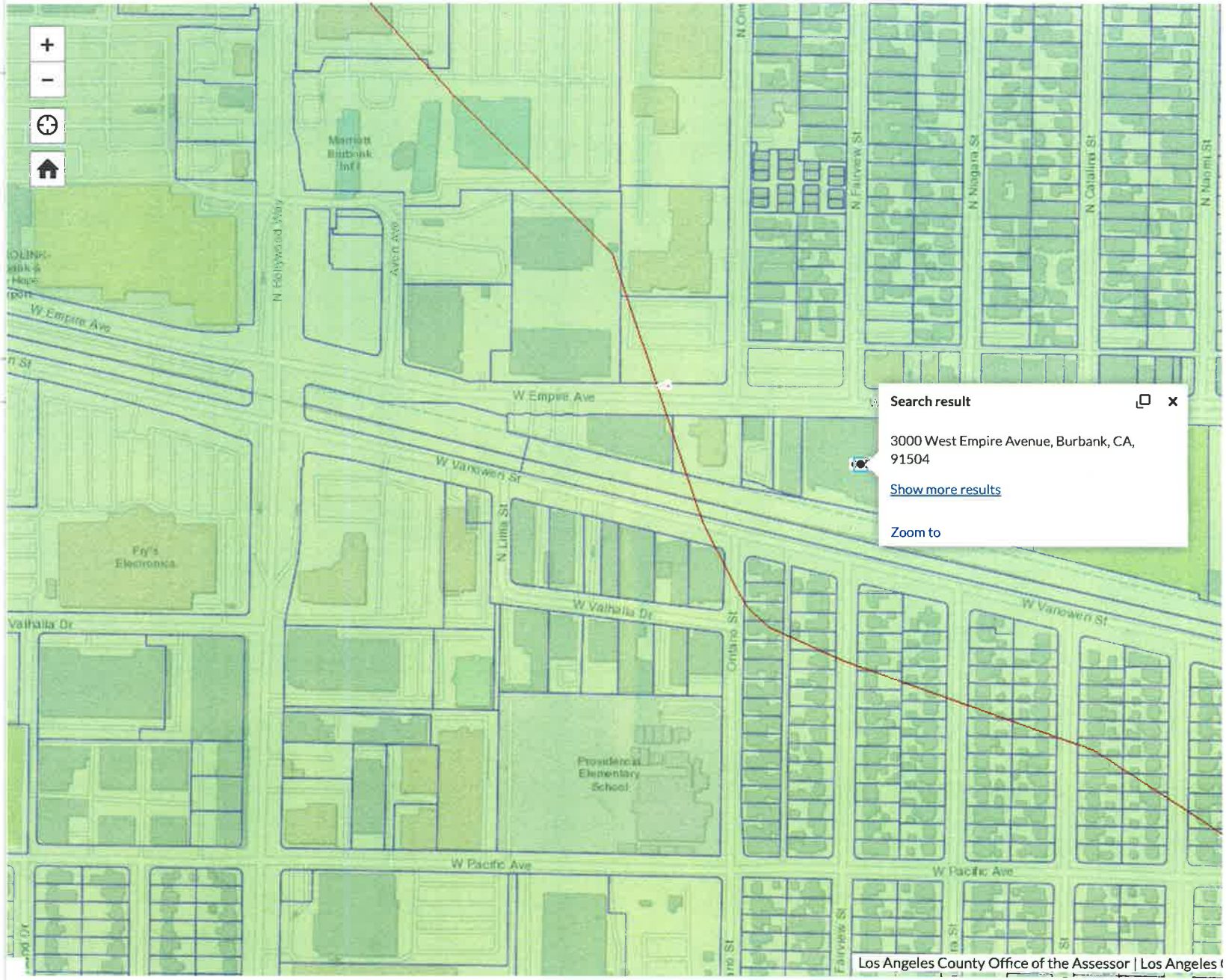
LOS ANGELES COUNTY PUBLIC WORKS
Public Service That Works

About | Legend | Layers

LA County Hydrology Map

Layers

- [x] Hydrology GIS
  - [x] 50yr Two Tenths (Rainfall)
  - [ ] DPA Zones
  - [x] Soils 2004
  - [x] Final 85th Percentile, 24-hr Rainfall
  - [ ] 1-year, 1-hour Rainfall Intensity
  - [ ] Final 95th Percentile, 24-hr Rainfall
- [x] LA County Parcels

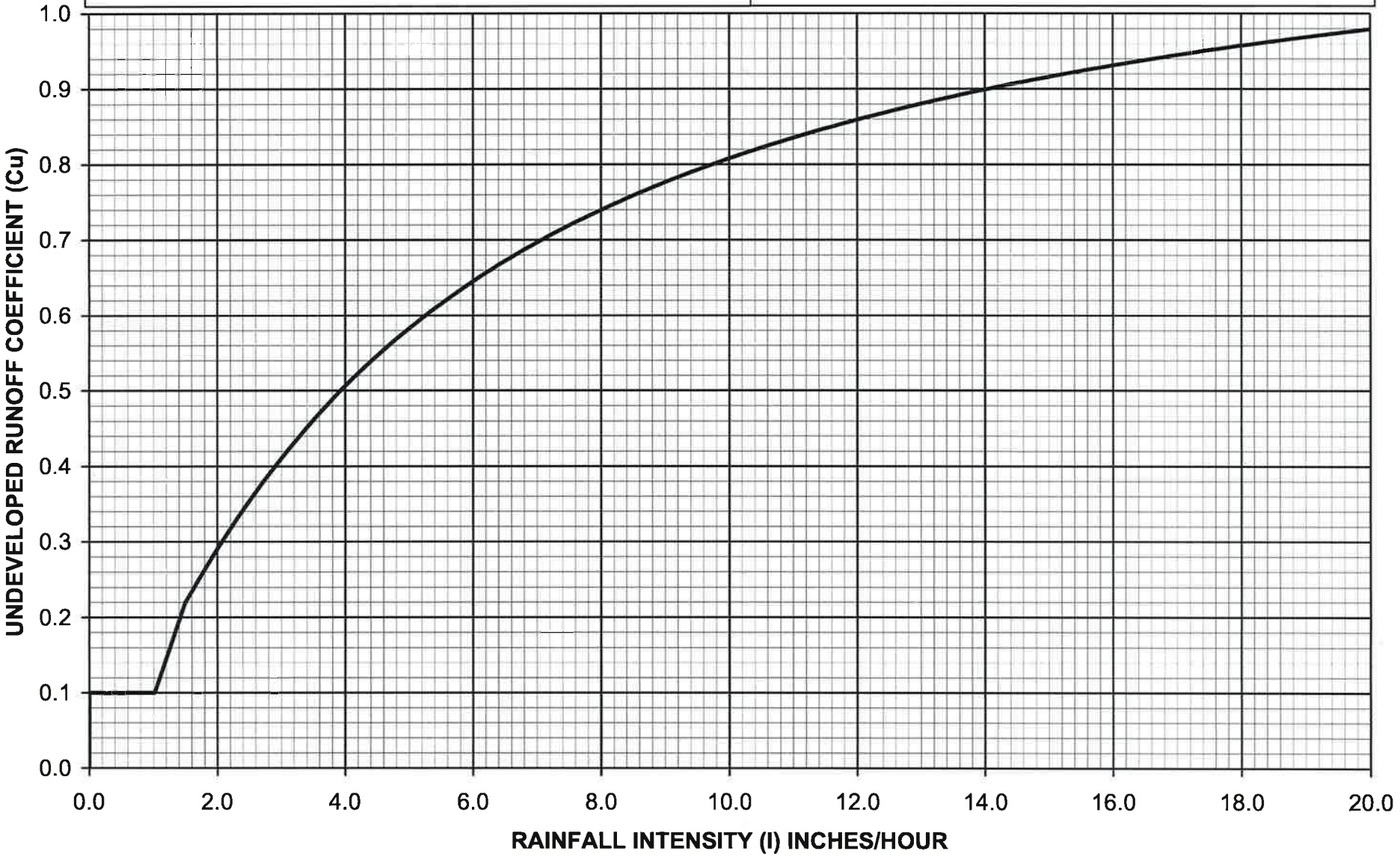


$C_D = (0.9 * IMP) + (1.0 - IMP) * C_U$

Where: C_D = Developed Runoff Coefficient
IMP = Proportion Impervious
C_U = Undeveloped runoff coefficient

Los Angeles County Department of Public Works

RUNOFF COEFFICIENT CURVE
SOIL TYPE NO. 015



Peak Flow Hydrologic Analysis

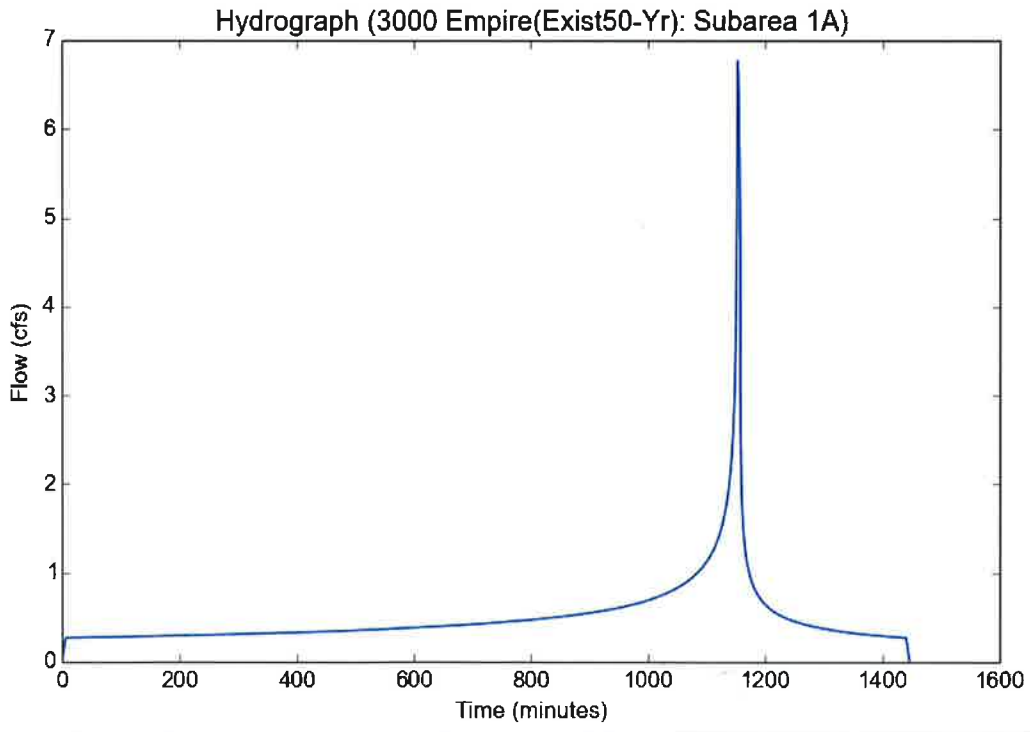
File location: C:/Users/vsalazar/Desktop/3000 Empire(Exist50-Yr) - Subarea 1A.pdf
Version: HydroCalc 1.0.2

Input Parameters

Project Name	3000 Empire(Exist50-Yr)
Subarea ID	Subarea 1A
Area (ac)	1.97
Flow Path Length (ft)	500.0
Flow Path Slope (vft/hft)	0.01
50-yr Rainfall Depth (in)	7.1
Percent Impervious	0.96
Soil Type	15
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	7.1
Peak Intensity (in/hr)	3.8882
Undeveloped Runoff Coefficient (Cu)	0.4956
Developed Runoff Coefficient (Cd)	0.8838
Time of Concentration (min)	6.0
Clear Peak Flow Rate (cfs)	6.7698
Burned Peak Flow Rate (cfs)	6.7698
24-Hr Clear Runoff Volume (ac-ft)	1.0046
24-Hr Clear Runoff Volume (cu-ft)	43758.971



Peak Flow Hydrologic Analysis

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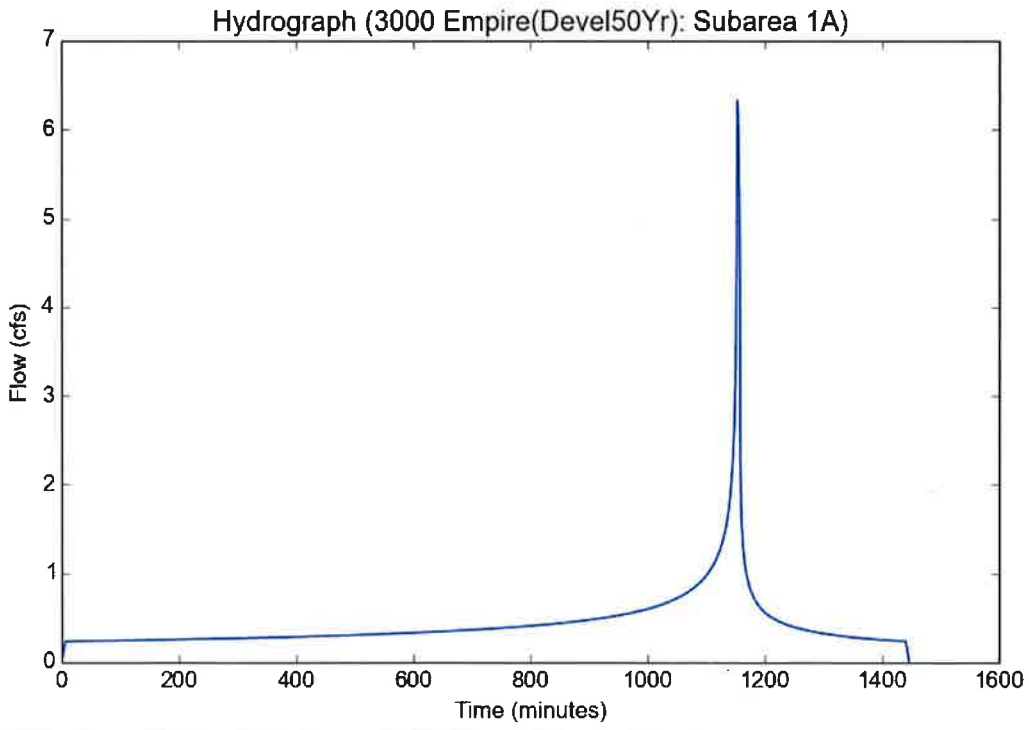
Version: HydroCalc 1.0.2

Input Parameters

Project Name	3000 Empire(Devel50Yr)
Subarea ID	Subarea 1A
Area (ac)	1.97
Flow Path Length (ft)	500.0
Flow Path Slope (vft/hft)	0.01
50-yr Rainfall Depth (in)	7.1
Percent Impervious	0.818
Soil Type	15
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	7.1
Peak Intensity (in/hr)	3.8882
Undeveloped Runoff Coefficient (Cu)	0.4956
Developed Runoff Coefficient (Cd)	0.8264
Time of Concentration (min)	6.0
Clear Peak Flow Rate (cfs)	6.3299
Burned Peak Flow Rate (cfs)	6.3299
24-Hr Clear Runoff Volume (ac-ft)	0.8775
24-Hr Clear Runoff Volume (cu-ft)	38224.7715



Peak Flow Hydrologic Analysis

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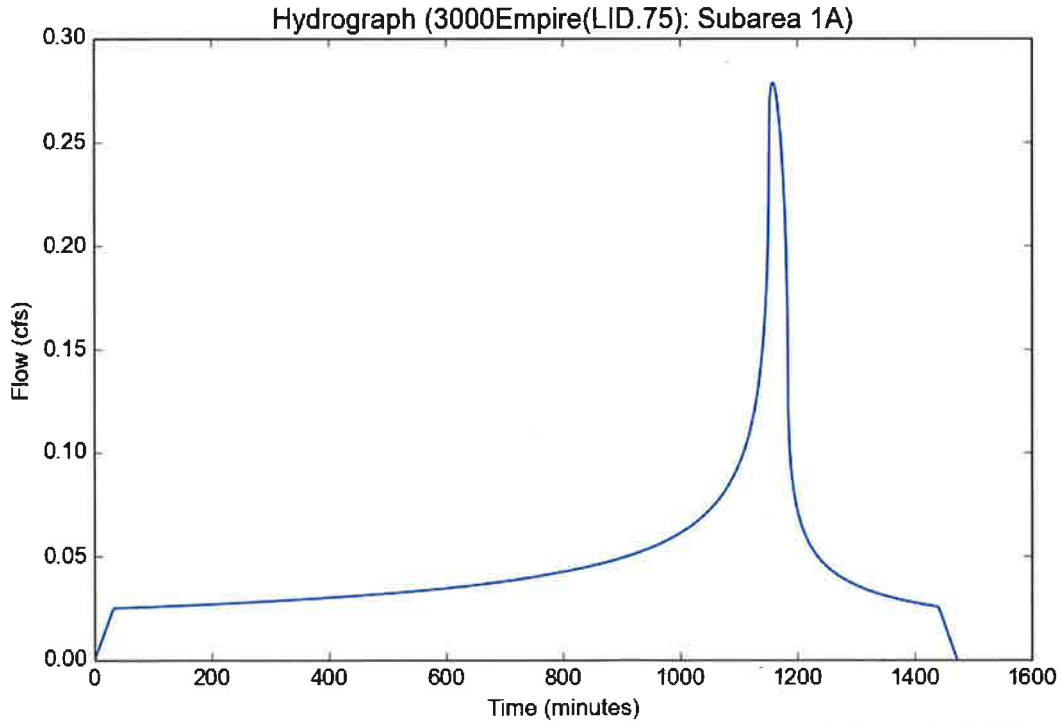
Version: HydroCalc 1.0.2

Input Parameters

Project Name	3000Empire(LID.75)
Subarea ID	Subarea 1A
Area (ac)	1.97
Flow Path Length (ft)	500.0
Flow Path Slope (vft/hft)	0.01
0.75-inch Rainfall Depth (in)	0.75
Percent Impervious	0.82
Soil Type	15
Design Storm Frequency	0.75 inch storm
Fire Factor	0
LID	True

Output Results

Modeled (0.75 inch storm) Rainfall Depth (in)	0.75
Peak Intensity (in/hr)	0.187
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.756
Time of Concentration (min)	32.0
Clear Peak Flow Rate (cfs)	0.2785
Burned Peak Flow Rate (cfs)	0.2785
24-Hr Clear Runoff Volume (ac-ft)	0.0923
24-Hr Clear Runoff Volume (cu-ft)	4021.2166



Peak Flow Hydrologic Analysis

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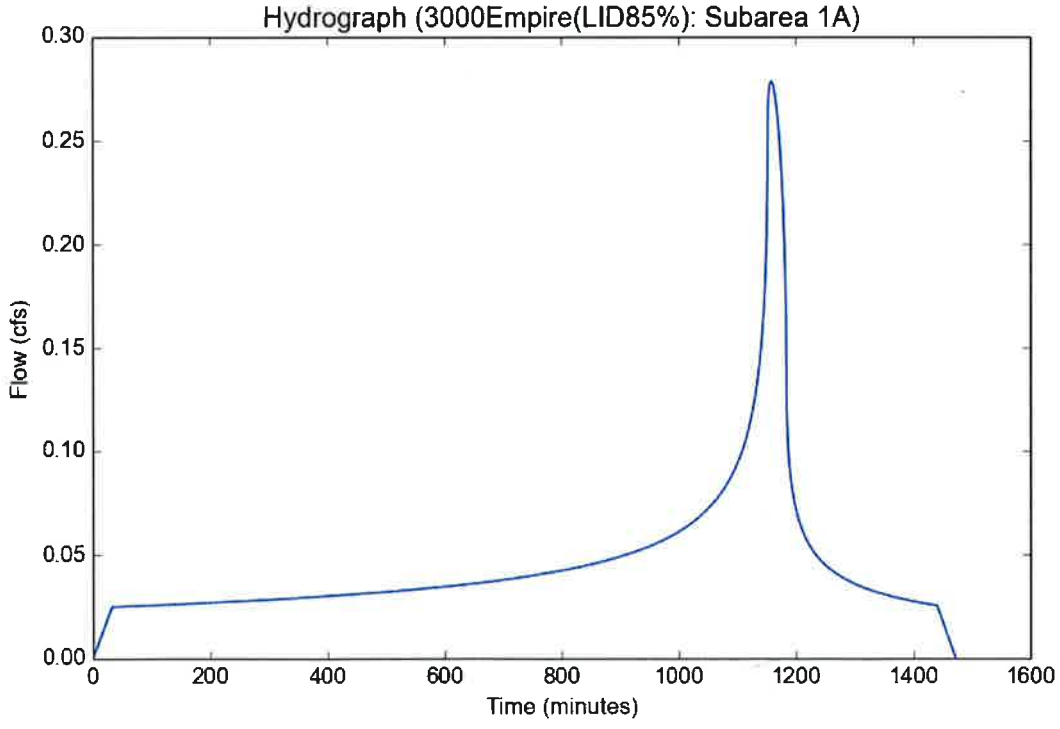
Version: HydroCalc 1.0.2

Input Parameters

Project Name	3000Empire(LID85%)
Subarea ID	Subarea 1A
Area (ac)	1.97
Flow Path Length (ft)	500.0
Flow Path Slope (vft/hft)	0.01
85th Percentile Rainfall Depth (in)	0.75
Percent Impervious	0.82
Soil Type	15
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.75
Peak Intensity (in/hr)	0.187
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.756
Time of Concentration (min)	32.0
Clear Peak Flow Rate (cfs)	0.2785
Burned Peak Flow Rate (cfs)	0.2785
24-Hr Clear Runoff Volume (ac-ft)	0.0923
24-Hr Clear Runoff Volume (cu-ft)	4021.2166



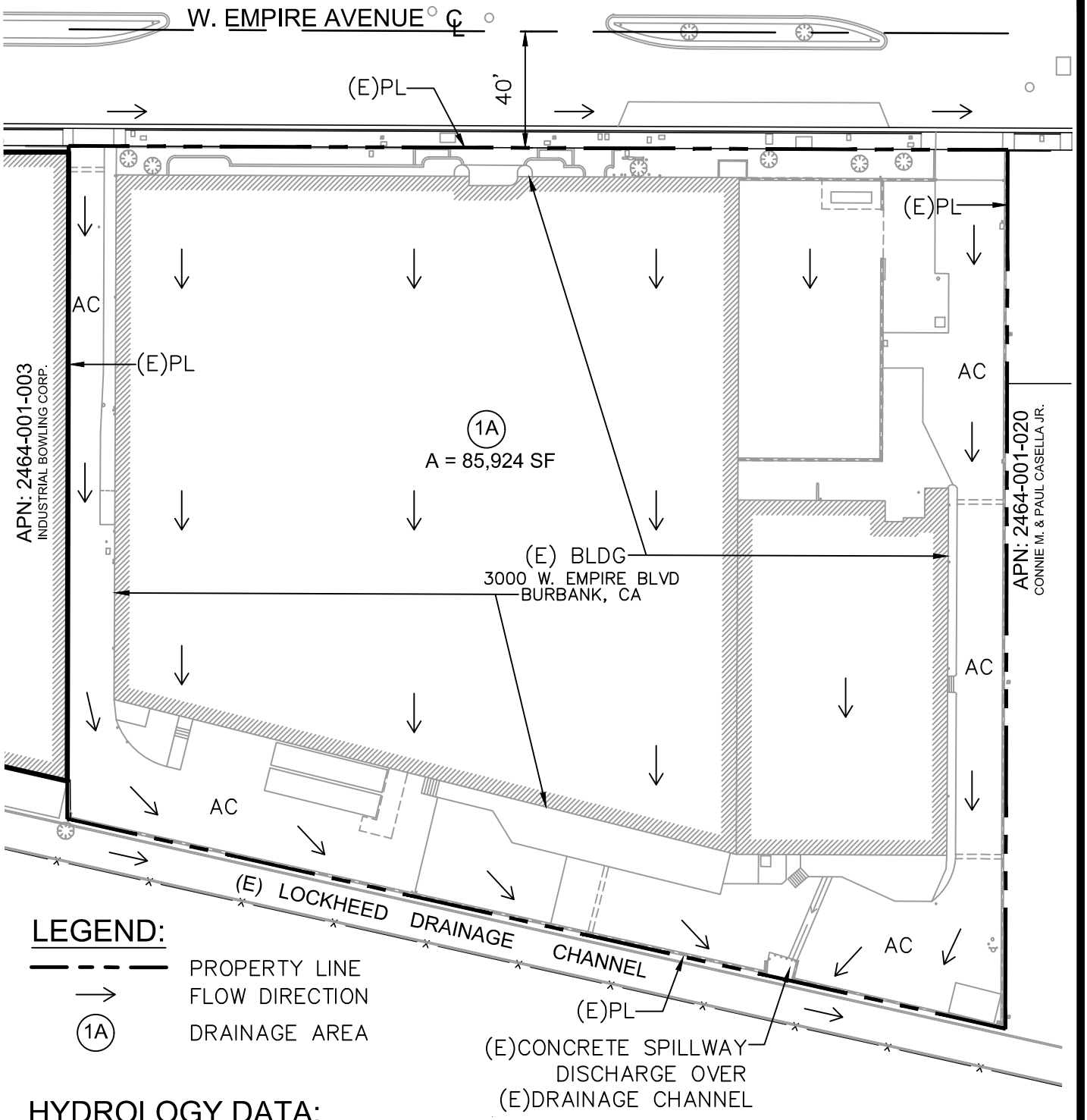
APPENDIX 3

EXISTING CONDITION SITE HYDROLOGY

PROPOSED CONDITION SITE HYDROLOGY

LID SITE PLAN

EXISTING CONDITION - SITE HYDROLOGY



LEGEND:

- PROPERTY LINE
- FLOW DIRECTION
- (1A) DRAINAGE AREA

HYDROLOGY DATA:

DRAINAGE AREA	1A
TOTAL AREA	1.97 AC
SOIL TYPE	015
STORM EVENT	50 YR–24 HR
SITE IMPERVIOUS	96%
TC	6 MIN.
Q_{50} PEAK	6.77 cfs

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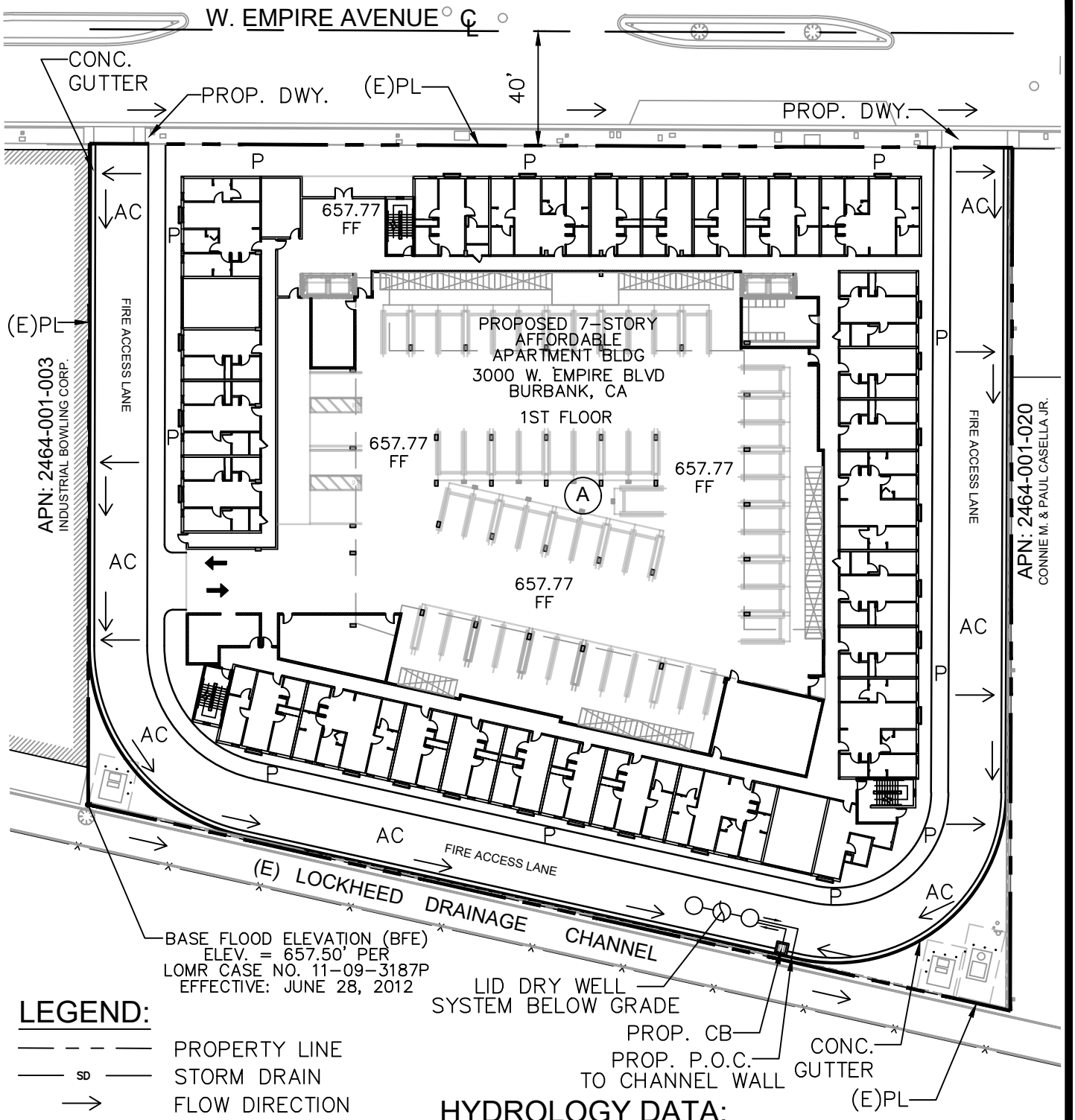
PROPOSED CONDITION - SITE HYDROLOGY



LEGEND:

— — — —	PROPERTY LINE
—— SD ——	STORM DRAIN
→	FLOW DIRECTION
(A)	DRAINAGE AREA
▥	CATCH BASIN
P	PLANTER/ LANDSCAPING/ PERMEABLE PAVERS
AC	ASPHALT CONCRETE

HYDROLOGY DATA:

DRAINAGE AREA	A
TOTAL AREA	1.97 AC
STORM EVENT	50 YR-24 HR
SITE IMPERVIOUS	82%
TC	6 MIN.
Q_{50} PEAK	6.33 cfs

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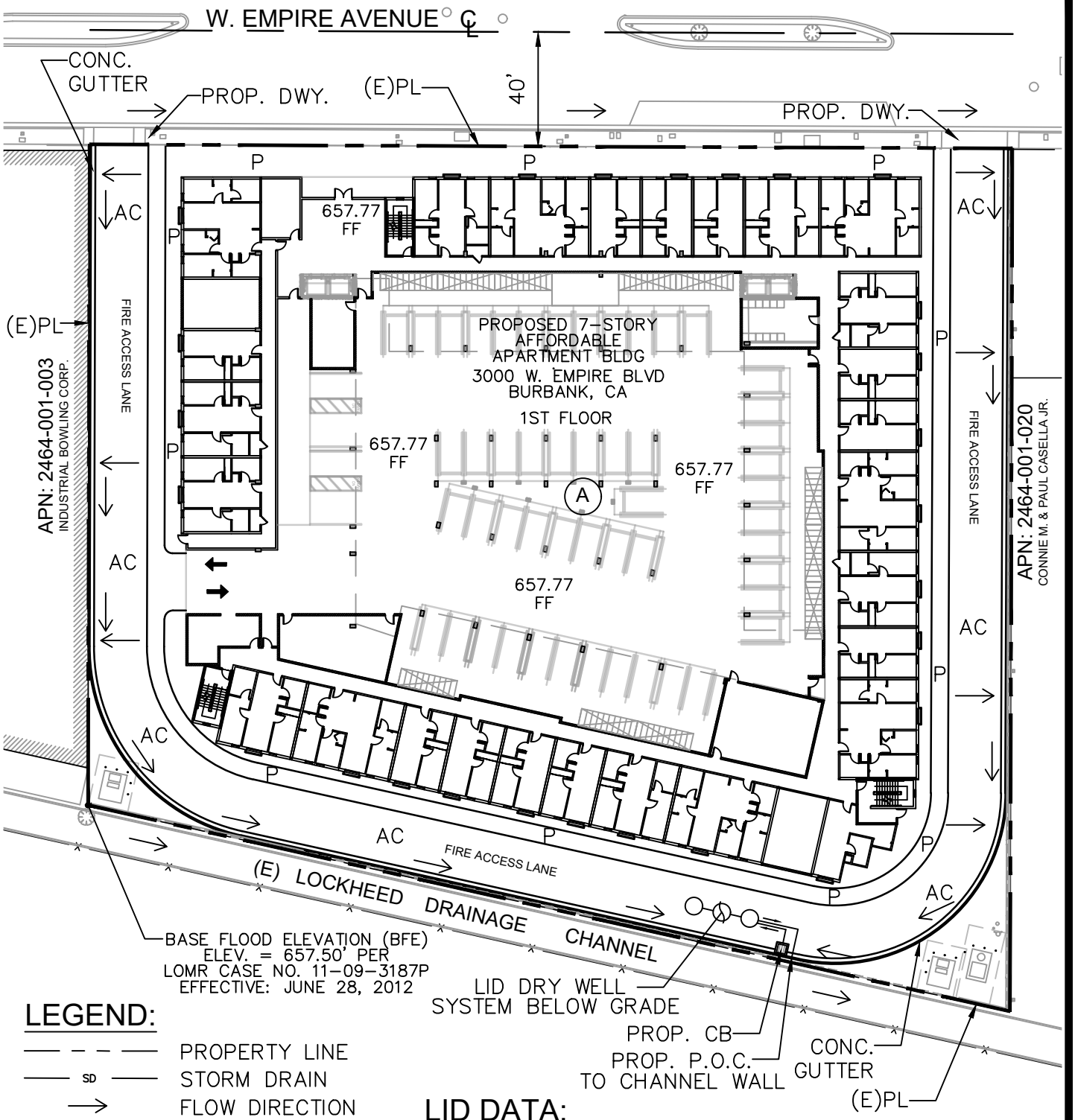
LID SITE PLAN



LEGEND:

— — —	PROPERTY LINE
— SD —	STORM DRAIN
→	FLOW DIRECTION
(A)	DRAINAGE AREA
▥	CATCH BASIN
P	PLANTER/ LANDSCAPING/ PERMEABLE PAVERS
AC	ASPHALT CONCRETE

LID DATA:

SITE AREA	1.97 AC
SWQDV	4,021 CFS
% IMPERVIOUS	82%
% PERVIOUS	18%
V_M REQUIRED	4,021 CF
V_M PROVIDED	4,389 CF

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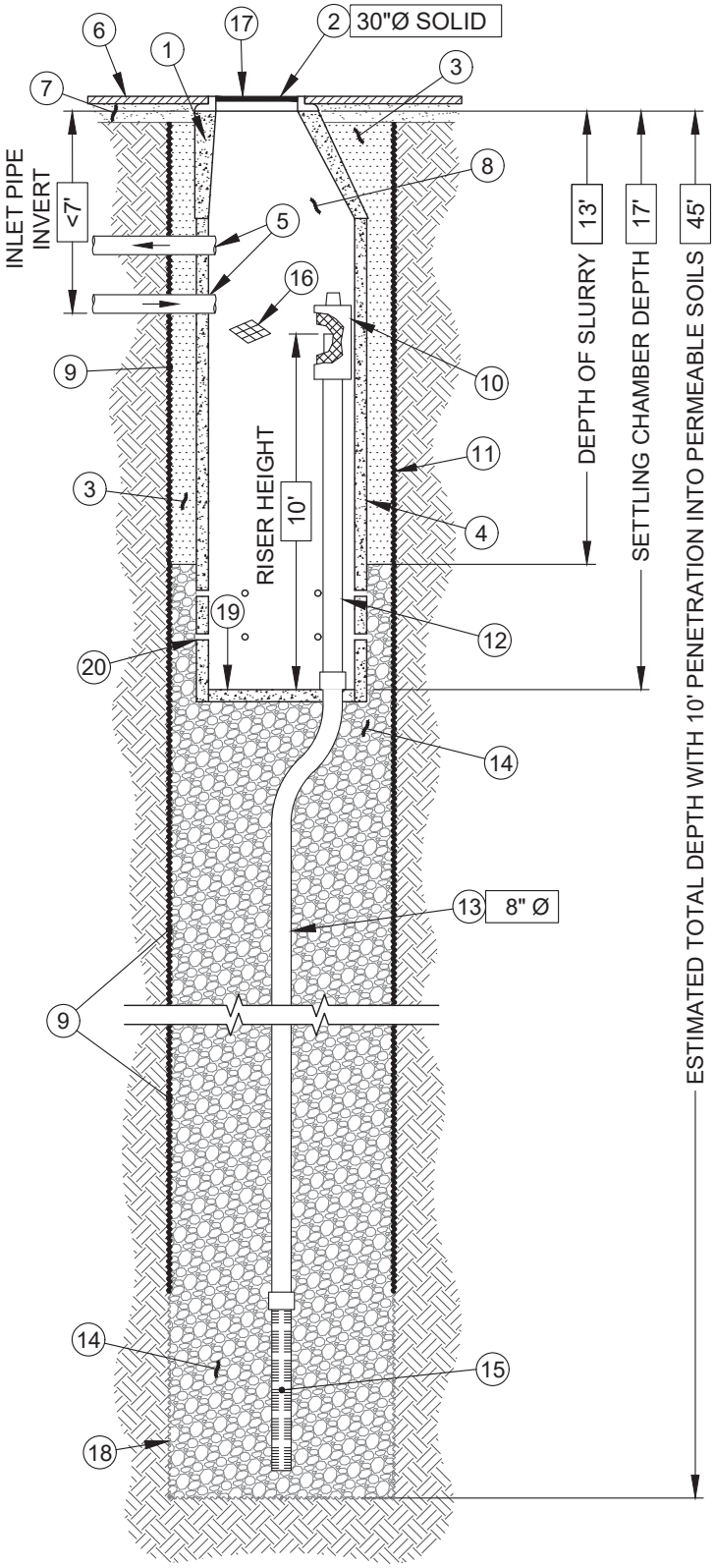
The MaxWell® IV

DRAINAGE SYSTEM DETAILS AND SPECIFICATIONS

3000 Empire Ave

Burbank, CA



AZ Lic. ROC070465 A, ROC047067 B-4, ADWR 363
CA Lic. 886759, C-42, C-57, HAZ.
Also licensed in the following states: MT, NM, NV, OR, TX, UT, and WA.

ITEM NUMBERS

1. **MANHOLE CONE** - MODIFIED FLAT BOTTOM.
2. **BOLTED RING & GRATE/COVER** - DIAMETER & TYPE AS SHOWN. CLEAN CAST IRON WITH WORDING **"STORM WATER ONLY"** IN RAISED LETTERS. **BOLTED IN 2 LOCATIONS** AND SECURED TO CONE WITH MORTAR. RIM ELEVATION ±0.02' OF PLANS.
3. **STABILIZED BACKFILL** - TWO-SACK SLURRY MIX.
4. **PRE-CAST LINER -** 4000 PSI CONCRETE 48" ID. X 54" OD. **CENTER IN HOLE** AND ALIGN SECTIONS **TO MAXIMIZE BEARING SURFACE.**
5. **INLET PIPE/OUTLET PIPE (BY OTHERS).** SEE SEPARATE PLAN FOR INVERT ELEVATIONS.
6. **GRADED BASIN OR PAVING** (BY OTHERS).
7. **COMPACTED BASE MATERIAL**, IF REQUIRED (BY OTHERS).
8. **FREEBOARD DEPTH VARIES** WITH INLET PIPE ELEVATION. INCREASE SETTLING CHAMBER DEPTH AS NEEDED TO MAINTAIN ALL INLET PIPE ELEVATIONS ABOVE RISER PIPE.
9. **NON-WOVEN GEOTEXTILE SLEEVE** - MIRAFI 140 NL. MIN. 6 FT Ø. HELD APPROX. 10 FEET OFF THE BOTTOM OF EXCAVATION.
10. **PUREFLO® DEBRIS SHIELD** - ROLLED 16 GA. STEEL X 24" LENGTH WITH VENTED ANTI-SIPHON AND INTERNAL 0.265" MAX. SWO FLATTENED EXPANDED STEEL SCREEN X 12" LENGTH. **FUSION BONDED EPOXY COATED**.
11. **MIN. 6' Ø DRILLED SHAFT.**
12. **RISER PIPE** - SCH. 40 PVC MATED TO DRAINAGE PIPE AT BASE SEAL.
13. **DRAINAGE PIPE** - ADS HIGHWAY GRADE OR SCH. 40 PVC WITH TRI-A COUPLER. SUSPEND PIPE DURING BACKFILL OPERATIONS. DIAMETER AS NOTED.
14. **ROCK** - WASHED, SIZED BETWEEN 3/8" AND 1-1/2".
15. **FLOFAST® DRAINAGE SCREEN** - SCH. 40 PVC 0.120" SLOTTED WELL SCREEN WITH 32 SLOTS PER ROW/FT. OVERALL LENGTH VARIES, UP TO 120" WITH TRI-B COUPLER.
16. **ABSORBENT** - HYDROPHOBIC PETROCHEMICAL SPONGE. MIN. 128 OZ. CAPACITY. TYPICAL, 2 PER CHAMBER.
17. **FABRIC SEAL** - U.V. RESISTANT GEOTEXTILE - **TO BE REMOVED BY CUSTOMER** AT PROJECT COMPLETION. GRATED ONLY.
18. **MIN. 6' Ø DRILLED SHAFT.**
19. **BASE SEAL** - CONCRETE SLURRY.
20. **6 PERFORATIONS MINIMUM PER FOOT, 2 ROWS MINIMUM.**

DETAIL : IV-6-SS-CA	REVISED BY: AB		
DRAWN ON: 05-14-19	REVISED DATE: 01-16-23	SCALE: N.T.S	

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Maxwell® IV Drainage System Calculations Prepared on January 16, 2023

Project: **3000 Empire Ave - Burbank, CA**

Contact: Victor Salazar at Land Design Consultants - Monrovia, CA

Torrent Resources
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Given:

Design Infiltration Rate	0.85	in/hr
Mitigated Volume	4021	cf
Required Drawdown Time	96	hours
Min. Depth to Infiltration	10	ft
Groundwater Depth for Design	70	ft

Proposed:

Drywell Rock Shaft Diameter	6	ft
Drywell Chamber Depth	17	ft
Rock Porosity	40	%
Depth to Infiltration	13	ft
Drywell Bottom Depth	45	ft

Convert Design Rate from in/hr to ft/sec.

$0.85 \frac{in}{hr} \times \frac{1\ ft}{12\ in} \times \frac{1\ hr}{3600\ sec} = 0.000020 \frac{ft}{sec}$

A 6 foot diameter drywell provides 18.85 SF of infiltration area per foot of depth, plus 28.27 SF at the bottom.

For a 45 foot deep drywell, infiltration occurs between 13 feet and 45 feet below grade. This provides 32 feet of infiltration depth in addition to the bottom area. Infiltration area per drywell is calculated below.

$(32\ ft \times 18.85 \frac{ft^2}{ft}) + 28.27\ ft^2 = 631\ ft^2$

Combine design rate with infiltration area to get infiltration flowrate for each drywell.

$0.000020 \frac{ft}{sec} \times 631\ ft^2 = 0.01242 \frac{ft^3}{sec}$

Infiltration volume for each drywell based on various time frames are included below.

96 hrs: 0.0124 CFS x 96 hours x $\frac{3600\ sec}{1\ hr}$ = 4,294 cubic feet of water infiltrated.

Chamber diameter = 4 feet. Drywell rock shaft diameter = 6 feet.

Volume provided in each drywell with chamber depth of 17 feet and a depth to overflow of 1 feet.

$(16\ ft \times 12.57\ ft^2) + (28\ ft \times 28.27\ ft^2 \times 40\ \%) = 518\ ft^3$

The proposed MaxWell System is composed of 3 drywell(s) .

Total volume provided = 1554 ft^3

Total 96 hour infiltration volume = 12,882 ft^3

Total infiltration flowrate = 0.03727 $\frac{ft^3}{sec}$

Based on the total mitigated volume of 4021 CF, after subtracting the volume infiltrated as quickly as it enters the drywell of 2835 CF, the remaining volume is 1186 CF. The storage provided in the drywell system is 1554 CF which exceeds the remaining volume of 1186 CF. See HydroCalc Summary and Volume Analysis on following pages.

For any questions, please contact Alex Bennett at 213-248-4167 or via email at Alex.Bennett@Oldcastle.com

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HydroCalc Summary

Using the hydrograph produced by the HydroCalc Calculator, the area below the drywell flow disposal rate and the hydrograph curve is estimated as the volume infiltrated in the drywell as it enters. 3 different phases will occur during the 85th percentile storm event. Phase 1 will occur during the beginning of the storm event at the initial increase of flow produced by the storm. When the storm flow is equal to the drywell flow disposal rate, phase 1 ends and phase 2 begins. Phase 2 is when the drywell performs at the flow rate it was design at. Any additional runoff that is produced due to the increase of storm flow will require a detention system. The storm will then hit its peak flow and begin to decrease. When the storm flow decreases to an amount equal to the drywell flow disposal rate, phase 2 ends and phase 3 begins. Phase 3 will occur near the end the storm when the drywell infiltrates the residual runoff until the end of the event.

Phase 1 – Initial Filling of Drywell

From time 0 minutes to 689.2 minutes, the 85th storm event flowrate that enters the drywell is less than the drywell steady-state infiltration flowrate (flow disposal rate). Therefore, the entire volume entering the drywell from 0 minutes to 689.2 minutes will infiltrate without overwhelming the drywell. This volume is 1197.1 CF.

Time (min)	Incremental Masscurve	Incremental Design Storm Depth (in)	Intensity (in/hr)	Undeveloped Runoff Coefficient (Cu)	Developed Runoff Coefficient (Cd)	Clear Peak Flow Rate (cfs)	Incremental Volume (cu-ft)	Cumulative Volume (cu-ft)	Volume infiltrated by drywell (CF)
689	0.306510294	0.22988272	0.02502112	0.1	0.756	0.037264	0.4471295	1196.61963	0.4471295
689.2	0.306623285	0.229967464	0.02502603	0.1	0.756	0.037272	0.44721731	1197.06685	0.44724
689.4	0.3067363	0.230052225	0.02503095	0.1	0.756	0.037279	0.44730516	1197.51415	0.44724

Phase 2 – Drywell Performing at the Design Rate

From time 689.2 minutes to 1288.2 minutes, the flowrate that enters the drywell exceeds the drywell steady-state infiltration flowrate (flow disposal rate). Therefore, the drywell can only infiltrate up to its flow disposal rate which is 0.03727 CFS. Over this period, we multiply the time by the flowrate (and covert as needed) to determine the volume infiltrated in this phase. This volume is 1339.5 CF.

(1288.2-689.2) x 60 SEC/MIN x 0.03727 CFS = 1339.5 CF

Time (min)	Incremental Masscurve	Incremental Design Storm Depth (in)	Intensity (in/hr)	Undeveloped Runoff Coefficient (Cu)	Developed Runoff Coefficient (Cd)	Clear Peak Flow Rate (cfs)	Incremental Volume (cu-ft)	Cumulative Volume (cu-ft)	Volume infiltrated by drywell (CF)
1288	0.934377822	0.700783367	0.02504495	0.1	0.756	0.0373	0.44777639	3722.2824	0.44724
1288.2	0.934482522	0.700861891	0.02502518	0.1	0.756	0.037271	0.44742268	3722.72982	0.44724
1288.4	0.934587149	0.700940362	0.02500546	0.1	0.756	0.037241	0.44706984	3723.17689	0.44706984

Phase 3 – End of the Storm Event

From time 1288.2 to 1472 minute (end of storm event), the 85th storm event flowrate that enters the drywell is less than the drywell steady-state infiltration flowrate (flow disposal rate). Therefore, the entire volume entering the drywell from 1288.2 minutes to 1472 minutes will infiltrate without overwhelming the drywell. This volume is 298.5 CF.

4021.2 CF - 3722.7 CF = 298.5 CF

Time (min)	Incremental Masscurve	Incremental Design Storm Depth (in)	Intensity (in/hr)	Undeveloped Runoff Coefficient (Cu)	Developed Runoff Coefficient (Cd)	Clear Peak Flow Rate (cfs)	Incremental Volume (cu-ft)	Cumulative Volume (cu-ft)	Volume infiltrated by drywell (CF)
1471.8	1	0.75	0.00010353	0.1	0.756	0.000154	0.00277578	4021.21567	0.00277578
1472	1	0.75	0	0.1	0.756	0	0.00092516	4021.2166	0.00092516
	0	0	0	0	0	0	0	0	0

The total volume infiltrated as it enters the drywell during the 85th percentile storm event is 1197.1 + 1339.5 + 298.5 = 2835.1 CF (2835 CF)

HydroCalc Volume Analysis

Project: 3000 Empire - Subarea Site

** (Values from project "Peak Flow Hydrologic Analysis")*

HydroCalc Output Results*

Clear Peak Flow (CFS)	0.2785
24-Hr Clear Runoff Volume (AC-FT)	0.0923
24-Hr Clear Runoff Volume (CF)	4021

Analysis

Drywell Disposal Rate (CFS)	***0.03727***
Total Volume Infiltrated During 1st Phase (CF)	1197.1
[2nd Phase] Storm Flow Rate Exceeds Drywell Disposal Rate @ (MIN)	689.2
Total Volume Infiltrated During 2nd Phase (CF)	1339.5
[3rd Phase] Drywell Disposal Rate Exceeds Storm Flow Rate @ (MIN)	1288.2
Total Volume Infiltrated During 3rd Phase (CF)	298.5
Total Time of Storm Event (MIN)*	1472
Total Volume Infiltrated as it Enters Drywell (CF)	***2835***
Total Storage within MaxWell System (CF)	1554
Remaining Detention Required (CF)	N/A

Hydrograph: 3000 Empire - Site