Appendix F

Preliminary Hydrology Memorandum

TECHNICAL MEMORANDUM

Date: May 13, 2022 **BKF Job Number:** C20212113-10

Deliver To: Jenn Bodine, Smith Development

From: Mona Sadeghian, BKF
Tom Morse, BKF

Subject: 660 University Avenue
Preliminary Hydrology Memorandum

Purpose

The purpose of this memorandum is to provide a preliminary hydrology analysis for the redevelopment of the 660 University Avenue, 680 University Avenue, and 511 Byron Street parcels in Palo Alto, California. This analysis will estimate peak stormwater runoff from the site in both the existing and redeveloped conditions.

Background

The existing site is occupied by two buildings and a parking lot. The three lots will be merged into a single parcel totaling 0.52 acres. The site is bounded by Byron Street, University Avenue, Middlefield Road, Cardinal Dental, and a private residence. Drainage Area 1 is 0.52 acres which flows to University Avenue and eventually into the storm drain main in Middlefield Road.

The existing site conditions are shown in Exhibit A. The proposed redevelopment is shown in Exhibit B. Table 1 outlines the total impervious and pervious areas in the drainage area that are used in Attachment A: Runoff Calculations.

Table 1: Impervious and Pervious Areas

		Pervious Area	Impervious Area	% Pervious	% Pervious Change
Drainage Area 1	Existing Condition	0.05	0.47	10	+5
	Proposed Condition	0.08	0.44	15	

Methodology

This preliminary hydrology memorandum analyzes peak stormwater runoff from the site using the Rational Method for both the 10-year and 100-year storms in the existing and proposed conditions.

The Rational Method is defined by the formula:

Q = C I A, where:

Q = peak flow (cfs)

C = runoff coefficient factor (unitless)

I = rainfall intensity (in/hr) at the time of concentration

A = area (acres)

This analysis uses runoff coefficients (C) as documented in figures 819.2A and 819.2B of the Caltrans Highway Design Manual, and are summarized in Table 2.

Table 2: Runoff Coefficients

Surface Type	C
Roof	0.9
Pavement	0.9
Landscape	0.4

The rainfall intensities for the 10-year and 100-year design storm are determined using IDF (intensity-duration-frequency) Table: NOAA Atlas 14, Volume 6, and Version 2 for San Francisco International Airport, California. The rainfall intensity is based on the time of concentration (T_c), or the total time it takes rainfall to reach the analysis point along the longest path of travel. To simplify this preliminary analysis the existing time of concentration was conservatively set to be 10 minutes and the proposed time of concentration was set to be 15 minutes.

Analysis

Exhibit A shows the existing site topography and the existing breakdown of pervious and impervious areas. The runoff from the 0.52 acre site flows to University Avenue and eventually into the storm drain main in Middlefield Road.

Exhibit B shows the proposed site conditions and the proposed breakdown of pervious and impervious areas. The runoff will be directed to treatment planters prior to draining to the storm drain main in Middlefield Road. The proposed condition will match the existing condition.

The Rational Method was used to calculate peak stormwater runoff from the existing site and the proposed development for 10-year and 100-year storm events. The results are summarized in Tables 3 and 4. Calculation of existing condition and proposed development, peak stormwater runoff is shown in Attachment A: Runoff Calculations.

Table 3: Peak Stormwater Runoff, 10 Year Storm

	Existing Condition	Proposed Development	Difference	
	(CFS)	(CFS)	(CFS)	%
Drainage Area 1	0.80	0.62	-0.18	-22.1

Table 4: Peak Stormwater Runoff, 100 Year Storm

	Existing Condition	Proposed Development	Difference	
	(CFS)	(CFS)	(CFS)	%
Drainage Area 1	1.27	0.99	-0.28	-21.9

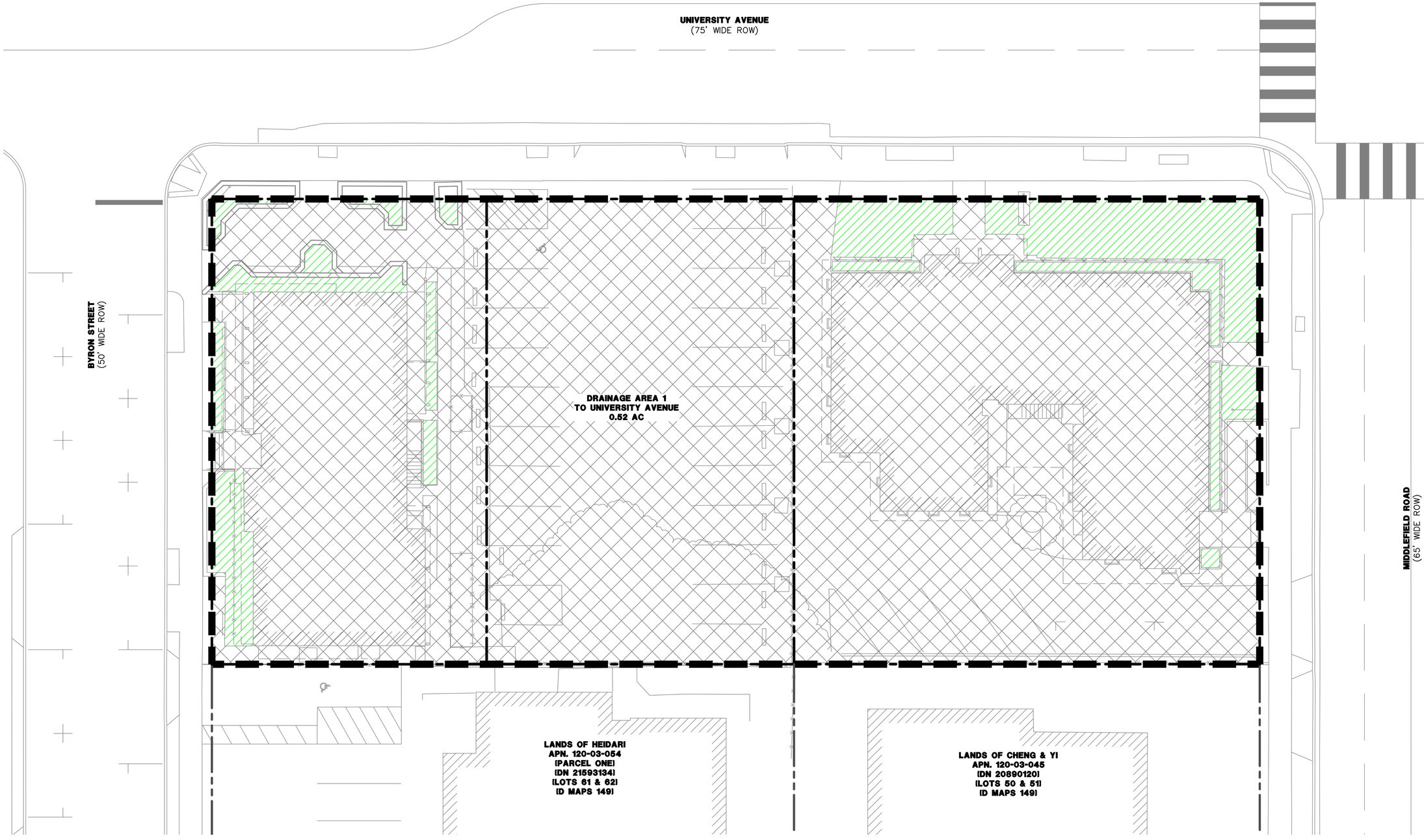
Conclusion

Development of the project will not increase runoff to the City of Palo Alto storm drain system. Development of the site will increase landscape area, which will decrease peak stormwater discharge to the Middlefield Road storm drain main by about 22% during the 10-year storm 100-year storm as shown in Tables 3 and 4.

A detailed storm drain study will be completed with development of the project improvement plans documenting the final design and hydraulics.

Attachments:

- Exhibit A: 660 University Existing Drainage Areas
- Exhibit B: 660 University Proposed Drainage Areas
- Attachment A: Runoff Calculations



LEGEND:

IMPERVIOUS AREA

PERVIOUS AREA

GRAPHIC SCALE

10 0 10 20

255 SHORELINE DRIVE
SUITE 200
REDWOOD CITY, CA 94065
(650) 482-6300
www.bkf.com

660 UNIVERSITY AVENUE
EXHIBIT A: EXISTING DRAINAGE AREAS

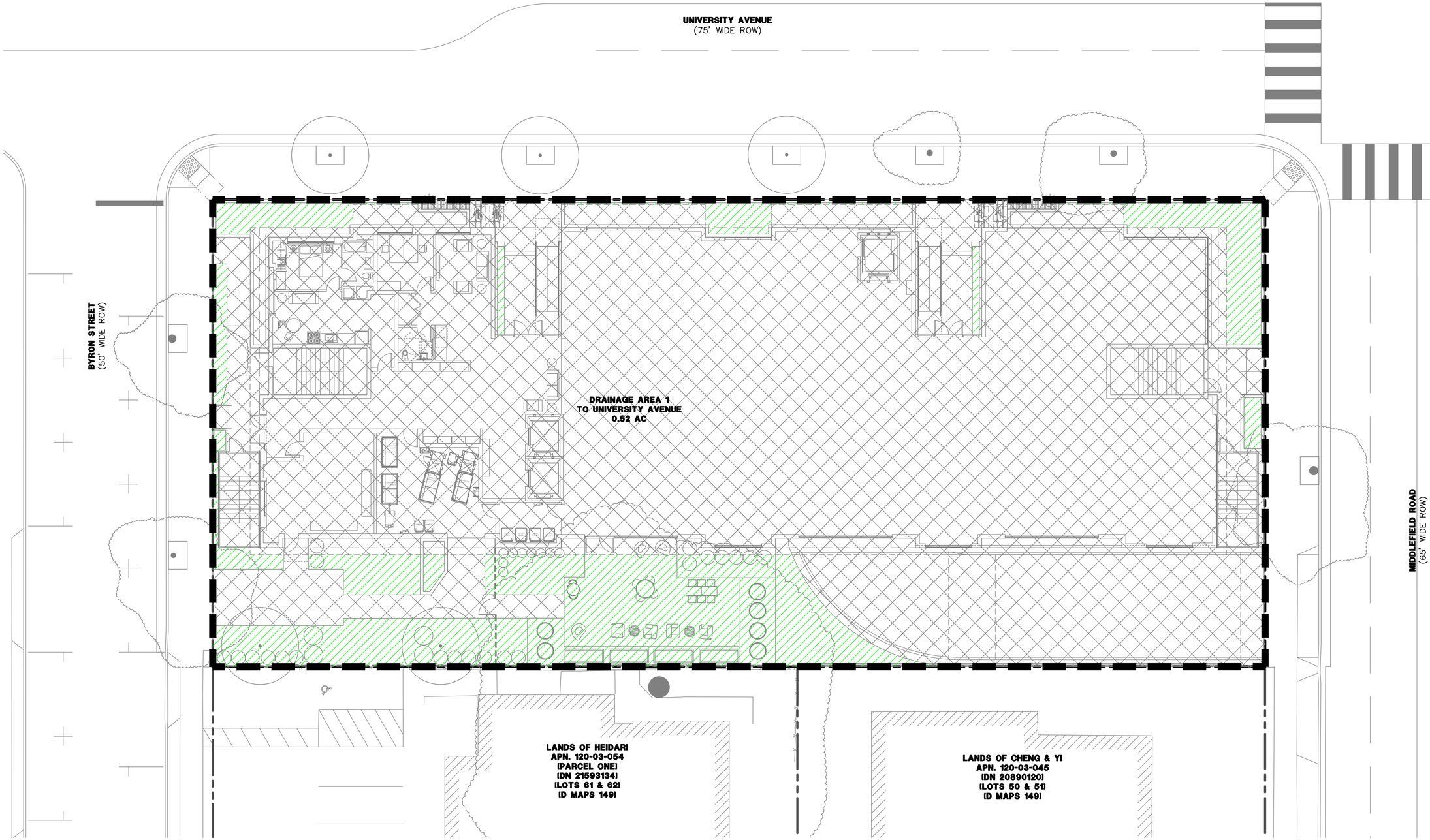
CITY OF PALO ALTO SANTA CLARA COUNTY CALIFORNIA

No.	Revisions
1	PLANNING RESUBMITTAL 05.13.2022

Date	12/01/2021
Scale	1" = 10'
Design	MS
Drawn	TKI
Approved	TRM
Job No	2021213

Drawing Number:

DRAWING NAME: K:\2021\212113_660_University_Ave\ENG\EXHIBITS\Hydrology\Exhibit A Existing Drainage Areas.dwg
PLOT DATE: 05-13-22 PLOTTED BY: inou



LEGEND:

IMPERVIOUS AREA

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GRAPHIC SCALE

10 0 10 20

BKF
255 SHORELINE DRIVE
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REDWOOD CITY, CA 94065
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660 UNIVERSITY AVENUE
EXHIBIT B: PROPOSED DRAINAGE AREAS

CITY OF PALO ALTO SANTA CLARA COUNTY CALIFORNIA

Revisions	No.
PLANNING RESUBMITTAL 05.13.2022	1

Date	12/01/2021
Scale	1" = 10'
Design	MS
Drawn	TKI
Approved	TRM
Job No	20212113

Drawing Number:

DRAWING NAME: K:\2021\21213_660_University_Ave\ENG\EXHIBITS\Hydrology\Exhibit B Proposed Drainage Areas.dwg
PLOT DATE: 05-13-22 PLOTTED BY: inou

ATTACHMENT A: RUNOFF CALCULATIONS

660 UNIVERSITY - EXISTING RUNOFF

1. Development Parameters

Area Draining to storm drain main in Middlefield Road = 0.52 acres
Assumed Time of Concentration (T_c) = 10 min

2. Time of Concentration & Rainfall Intensities

Rainfall intensities are taken from NOAA Atlas 14, Volume 6, and Version 2 for the San Francisco International Airport, California station. The rainfall intensity for the specified design storm over a duration equal to the time of concentration (10 min) is used.
I_{10} = 1.81 in/hr
I_{100} = 2.87 in/hr

3. Runoff Coefficient Calculations

Runoff coefficients (C) are documented in figures 819.2A and 819.2B from the Highway Design Manual, and are summarized below:

Table 1: Runoff Coefficients

Surface Type	C
Roof	0.9
Pavement	0.9
Landscape	0.4

In the existing conditions, there are a mix of impervious and pervious areas in the drainage basins. Drainage Area 1 contains 0.52 acres, and includes a total pervious area of 0.05 acres and a total impervious area of 0.47 acres. The runoff coefficients for the site can be calculated using a weighted average of the runoff coefficients for pavement and landscape.
$C_{\text{Drainage Area 1}}$ = (0.05 / 0.52) x (0.4) + (0.47 / 0.52) x (0.9) = 0.85

4. Runoff (Q) in cubic feet per second

Q = CIA, where:

Q = Peak Discharge (cubic feet of fluid per second)
C = Runoff Coefficient
I = Rainfall Intensity (inches per hour) at the time of concentration
A = Watershed Area (acres)

Drainage Area 1:

10 Year = (0.85) x (1.81 in/hr) x (0.52 acres) = 0.80 cfs
100 Year = (0.85) x (2.87 in/hr) x (0.52 acres) = 1.27 cfs

ATTACHMENT A: RUNOFF CALCULATIONS

660 UNIVERSITY - PROPOSED RUNOFF

1. Development Parameters

Area Draining to storm drain main in Middlefield Road = 0.52 acres
Assumed Time of Concentration (T_c) = 15 min

2. Time of Concentration & Rainfall Intensities

Rainfall intensities are taken from NOAA Atlas 14, Volume 6, and Version 2 for the San Francisco International Airport, California station. The rainfall intensity for the specified design storm over a duration equal to the time of concentration (15 min) is used.
I_{10} = 1.46 in/hr
I_{100} = 2.32 in/hr

3. Runoff Coefficient Calculations

Runoff coefficients (C) are documented in figures 819.2A and 819.2B from the Highway Design Manual, and are summarized below:

Table 1: Runoff Coefficients

Surface Type	C
Roof	0.9
Pavement	0.9
Landscape	0.4

In the proposed conditions, there are a mix of impervious and pervious areas in the drainage basins. Drainage Area 1 contains 0.52 acres, and includes a total pervious area of 0.08 acres and a total impervious area of 0.44 acres. The runoff coefficients for the site can be calculated using a weighted average of the runoff coefficients for pavement and landscape.
$C_{\text{Drainage Area 1}}$ = (0.08 / 0.52) x (0.4) + (0.44 / 0.52) x (0.9) = 0.82

4. Runoff (Q) in cubic feet per second

Q = CIA, where:

Q = Peak Discharge (cubic feet of fluid per second)
C = Runoff Coefficient
I = Rainfall Intensity (inches per hour) at the time of concentration
A = Watershed Area (acres)

Drainage Area 1:

10 Year = (0.82) x (1.46 in/hr) x (0.52 acres) = 0.62 cfs
100 Year = (0.82) x (2.32 in/hr) x (0.52 acres) = 0.99 cfs

Santa Clara Valley
Urban Runoff
Pollution Prevention Program

Date Form Completed: 05/13/22

Completed by: Trini Inouye

Provision C.3 Data Form

Which Projects Must Comply with Stormwater Requirements?

All projects that create and/or replace **10,000 sq. ft.** or more of impervious surface on the project site must fill out this worksheet and submit it with the development project application.

All restaurants, auto service facilities, retail gasoline outlets, and uncovered parking lot projects (stand-alone or part of another development project, including the top uncovered portion of parking structures) that create and/or replace **5,000 sq. ft.** or more of impervious surface on the project site must also fill out this worksheet.

Interior remodeling projects, routine maintenance or repair projects such as re-roofing and re-paving, and single family homes that are not part of a larger plan of development are **NOT** required to complete this worksheet.

What is an Impervious Surface?

An impervious surface is a surface covering or pavement that prevents the land's natural ability to absorb and infiltrate rainfall/stormwater. Impervious surfaces include, but are not limited to rooftops, walkways, paved patios, driveways, parking lots, storage areas, impervious concrete and asphalt, and any other continuous watertight pavement or covering. Pervious pavement, underlain with pervious soil or pervious storage material (e.g., drain rock), that infiltrates rainfall at a rate equal to or greater than surrounding unpaved areas OR that stores and infiltrates the water quality design volume specified in Provision C.3.d of the Municipal Regional Stormwater Permit (MRP), is not considered an impervious surface.

For More Information

For more information regarding selection of Best Management Practices for stormwater pollution prevention or stormwater treatment contact:

1. Project Information

Project Name: 660 University Ave **APN #** 120-03-042, 120-03-043, 120-03-044

Project Address: 511 Byron St, 660 University Ave, 680 University Ave/500 Middlefield Rd, Palo Alto, CA 94301

Cross Streets: Byron St, University Ave, Middlefield Road

Applicant/Developer Name: Smith Development

Project Phase(s): 1 **of** 1 **Engineer:** BKF Engineers

Project Type (Check all that apply): ☐ New Development ☑ Redevelopment

☑ Private ☐ Public

☑ Residential ☑ Commercial ☐ Industrial ☑ Mixed Use ☐ Institutional

☐ Restaurant ☐ Uncovered Parking ☐ Retail Gas Outlet ☐ Auto Service (SIC code) (5013-5014, 5541, 7532-7534, 7536-7539)

☐ Other

Project Description: Mixed-use building with basement parking on a 0.52 acre lot

Project Watershed/Receiving Water (creek, river or bay): San Francisquito Creek

2. Project Size

a. Total Site Area: 0.52 acres		b. Total Site Area Disturbed: 0.52 acres (including clearing, grading, or excavating)			
Site Totals	Total Existing (Pre-project) Area (ft^2)	Existing Area Retained[1] (ft^2)	Existing Area Replaced[2] (ft^2)	New Area Created[2] (ft^2)	Total Post-Project Area (ft^2)
c. Total Impervious Area **(IA)**	20,390	0	19,118	0	19118
d. Total new and replaced impervious area			19,118		
e. Total Pervious Area **(PA)**[3]	2,136				3,408
f. Total Area **(IA+PA)**	22,526				22,526
g. Percent Replacement of IA in Redevelopment Projects: (Existing IA Replaced ÷ Existing Total IA) x 100% 93.76 %					

3. State Construction General Permit Applicability:

a. Is #2.b. equal to 1 acre or more?

☐ Yes, applicant must obtain coverage under the State Construction General Permit (see https://www.waterboards.ca.gov/water_issues/programs/stormwater/construction.html)

☑ No, applicant does not need coverage under the State Construction General Permit.

4. MRP Provision C.3 Applicability:

a. Is #2.d. equal to **10,000** sq. ft. or more, or **5,000** sq. ft. or more for restaurants, auto service facilities, retail gas outlets, and stand-alone uncovered parking?

☑ Yes, C.3. source control, site design and treatment requirements apply

☐ No, C.3. source control and site design requirements may apply – check with local agency

b. For redevelopment projects, is #2.g. equal to 50% or more?

☑ Yes, C.3. requirements (site design and source control, as appropriate, and stormwater treatment) apply to the entire site

☐ No, C.3. requirements only apply to the impervious area created and/or replaced

c. Does the project create and/or replace 5,000 sf or more of impervious surface parking?

☐ Yes, C.3. requirements may apply to the entire site – check with local agency

☑ No

5. Hydromodification Management (HM) Applicability:

a. Does the project create and/or replace one acre or more of impervious surface AND is the total post-project impervious area greater than the pre-project (existing) impervious area?

☐ Yes (continue) ☑ No – exempt from HM, go to page 3

b. Is the project located in an area of HM applicability (green area) on the HM Applicability Map? (www.scvurppp.org/hmp-map)

☐ Yes, the project must implement HM requirements

☐ No, the project is exempt from HM requirements

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[1] "Retained" means to leave existing IA in place. An IA that goes through maintenance (e.g., pavement resurfacing/slurry seal/grind), but no change in grade is considered "retained".

[2] The "new" and "replaced" IA are based on the total area of the site and not specific locations on site. For example, impervious parking created over a pervious area is not "new" IA, if an equal amount of pervious area replaces IA somewhere else on the site. Constructed IA on a site that does not exceed the total pre-project IA will be considered "replaced" IA. A site will have "new" IA only if the total post-project IA exceeds the total pre-project IA (total post-project IA – total pre-project IA = New IA).

[3] Include bioretention areas, infiltration areas, green roofs, and pervious pavement in PA calculations.

6. Selection of Specific Stormwater Control Measures:

Site Design Measures

- [x] Minimize land disturbed (e.g., protect trees and soil)
- [x] Minimize impervious surfaces (e.g., reduction in post-project impervious surface)
- [x] Minimum-impact street or parking lot design (e.g., parking on top of or under buildings)
- [ ] Cluster structures/ pavement
- [ ] Disconnected downspouts (direct runoff from roofs, sidewalks, patios to landscaped areas)
- [ ] Pervious pavement
- [ ] Green roof
- [x] Other self-treating[4] area (e.g., landscaped areas)
- [ ] Self-retaining[4] area
- [x] Interceptor trees[3]
- [ ] Rainwater harvesting and use (e.g., rain barrel, cistern for designated use) [5]
- [ ] Preserved open space: _____ ac. or sq. ft. (circle one)
- [ ] Protected riparian and wetland areas/buffers (Setback from top of bank: _____ft.)
- [ ] Other _____

Source Control Measures

- [ ] Wash area/racks, drain to sanitary sewer[5]
- [x] Covered dumpster area, drain to sanitary sewer[6]
- [ ] Sanitary sewer connection or accessible cleanout for swimming pool/spa/fountain[6]
- [x] Beneficial landscaping (minimize irrigation, runoff, pesticides and fertilizers; promotes treatment)
- [ ] Outdoor material storage protection
- [ ] Covers, drains for loading docks, maintenance bays, fueling areas
- [x] Maintenance (pavement sweeping, catch basin cleaning, good housekeeping)
- [x] Storm drain labeling
- [ ] Other _____

Treatment Measures

- [ ] None (all impervious surface drains to self-retaining areas)

LID Treatment

- [ ] Bioretention area
- [x] Flow-through planter
- [ ] Tree Well Filter or Trench with bioretention soils
- [ ] Rainwater harvest/use (e.g., cistern or rain barrel for designated use, sized for C.3.d treatment)
- [ ] Infiltration trench
- [ ] Infiltration well/dry well
- [ ] Subsurface Infiltration System (e.g. vault or large diameter conduit over drain rock)
- [ ] Other _____

Non-LID Treatment Methods

- [ ] Proprietary high flow rate tree box filter[7]
- [ ] Proprietary high flow media filter (sand, compost, or proprietary media)[7]
- [ ] Vegetated filter strip[8]
- [ ] Extended detention basin[8]
- [ ] Vegetated swale[8]
- [ ] Other _____

Flow Duration Controls for Hydromodification Management (HM)

- [ ] Extended Detention basin
- [ ] Underground tank or vault
- [ ] Bioretention with outlet control
- [ ] Other _____

[4] See SCVURPPP C3 Handbook for definitions. https://scvurppp.org/2016/06/20/c-3-stormwater-handbook-june-2016/
[5] Optional site design measure; does not have to be sized to comply with Provision C.3.d treatment requirements.
[6] Subject to sanitary sewer authority requirements.
[7] These treatment measures are only allowed if the project qualifies as a "Special Project".
[8] These treatment measures are only allowed as part of a multi-step treatment process (i.e., for pretreatment).

7. Stormwater Treatment Measure (STM) Sizing for Projects with Treatment Requirements

Stormwater Treatment Measure (STM)	Hydraulic Sizing Criteria Used*
Flow-through planter	3
	Choose from list
	Choose from list
	Choose from list

*Key: 1a: Volume – WEF Method
1b: Volume – CASQA BMP Handbook Method
2a: Flow – Factored Flood Flow Method
2b: Flow – CASQA BMP Handbook Method
2c: Flow – Uniform Intensity Method
3: Combination Flow and Volume Design Basis

8. Alternative Certification: Was the treatment system sizing and design reviewed by a qualified third-party professional that is not a member of the project team or agency staff?

☐ Yes ☑ No Name of Third-party Reviewer _____

9. Operation & Maintenance Information

A. Property Owner's Name: Smith Development

B. Responsible Party for Stormwater Treatment/Hydromodification Control O&M:

a. Name: Jenn Bodine

b. Address: 862 Villa Street, Suite G, Mountain View, CA 94041

c. Phone/E-mail: jenn@smithdevelopment.com

This section to be completed by Municipal staff.

O&M Responsibility Mechanism

Indicate how responsibility for O&M is assured. Check all that apply:

☐ O&M Agreement

☐ Other mechanism that assigns responsibility (describe below):

_____

This section to be completed by Municipal staff (Note: This is an optional section that agencies should modify per their internal review and tracking process.)

Reviewed By:

Community Development Department

Planning Division: _____

Building Division: _____

Public Works Department

Engineering: _____

Other (Specify): _____

Return form to: _____

Data entry performed by: _____