MEMORANDUM

To: Kevin Fong, City of Davis

From: Steve Greenfield, Cunningham Engineering (CEC)
Amine Benchekroun, CEC

Date: 12 May 2023

Subject: The Promenade – Drainage Design Memo

The purpose of this memo is to demonstrate compliance with the City of Davis hydromodification management requirements for the proposed Promenade project located at 1501-1573 Arboretum Terrace in Davis, CA. The project proposes to limit the post-project storm runoff peak discharge to be no greater than the existing conditions for the 2 year-24 hour design storm.

EXISTING CONDITION

The existing project site is comprised of 46.9 acres of undeveloped land. The site is flat, and generally drains to the south and southwest, towards an existing Caltrans swale. The existing site is approximately 1.0% impervious.

The portion of the Promenade site to be developed is not located within a FEMA 100-year special flood hazard area. However, at the very northeast end, the narrow strip of Putah Creek is located within a FEMA 100-year flood zone.

Based on the NRCS soil maps, the approximately northern third of the site is comprised of Hydrologic soil group (HSG) C soils with the remaining two thirds comprised of HSG B soils – See Attachment A, NRCS Soils Map.

PROPOSED CONDITION

Based on the current site plan by Studio T Square Architects, dated 04/19/23, the developed site is anticipated to be approximately 49.0% impervious. See Attachment B, Drainage Exhibit.

The proposed improvements include 52 three-story apartment buildings and associated parking and pedestrian improvements, including widening the Olive Drive entrance to provide access limited to emergency vehicles, buses, bikes and pedestrians. The southeastern retaining wall supporting the existing land bridge between Olive Drive and the Project will remain at its current location and the northwestern retaining wall will be reconstructed farther west to provide enough width for the proposed improvements. The 12” culvert conveying Putah Creek runoff beneath the land bridge will need to be extended to daylight at the new location of the proposed retaining wall.

The proposed site has been divided into three Drainage Sheds. Shed 1 encompasses the majority of the site and drains to the detention basin located in the southern corner of the site. The bottom elevation of the detention basin is set to allow the site runoff to gravity discharge into the basin through the site storm drain system. The detention basin will be extended along the southern boundary of the site with a narrow finger of the pond. The finger extension will have a bottom elevation several feet higher than the main basin and will have two (2) 18" perforated pipes underneath that will serve to convey runoff from the main basin to a junction structure at the north end of the extension. The junction will connect to a 24" drain pipe that will discharge into Putah Creek.

Shed 2 encompasses a portion of the Olive Drive entrance and a large landscaping area which drains through a vegetated swale to the proposed on-site drain inlets and outlets into Putah Creek.

Shed 3 is located within an existing City of Davis easement for Putah Creek and encompasses a large landscaping area, a portion of the Olive Drive entrance and the existing concrete multi-use path. The entire surface area of Shed 3 will sheet flow to Putah Creek.

STORM WATER QUALITY

The proposed detention basin in Shed 1, the vegetated swale in Shed 2*, and the soil quality improvements in Shed 3 will provide water quality treatment in accordance with the City of Davis Stormwater Phase II General Permit – Development Standards Guidance, dated November 2015.

HYDROLOGIC ANALYSIS

The rainfall/runoff analysis and detention routing were conducted using an HEC-HMS model with the following parameters:

Rainfall:	2 year-24 hour, 10 year-24 hour & 100 year-24 hour Frequency Storms per NOAA Atlas 14
Transform:	SCS Unit Hydrograph
Loss:	Initial/Constant; 0.2 in (initial), 0.15 in/hr (constant)
	Hydrologic Soil Group B & C
Existing Shed:	46.95 ac; 1% impervious; 196.20 min lag time
Proposed Sheds:	
- Shed 1:	42.06 ac; 54% impervious, 30.00 min lag time
- Shed 2:	2.73 ac; 4% impervious, 18.95 min lag time
- Shed 3:	2.11 ac; 16% impervious, 15.00 min lag time

*Shed 2 was split into 5 small sub-sheds. 4 out of the 5 sub-sheds are fully impervious. Therefore, only one of the sub-sheds includes water quality improvements features.

Detention Basin (See Attachment C):

Basin Bottom: Elevation 39.00*; Surface Area 0.93 ac

Basin Top: Elevation 47.00; Surface Area 3.48 ac (including finger extension)

Basin Outlet:

- 2x18" Perforated Pipes, Invert: 41.20
- 48"x72" Drain Inlet (at the end of the finger extension), Grate Elevation: 44.00
- 24" Pipe with Flapgate** Daylight at Putah Creek, Invert: 39.50
- 36"x36" Overflow Outlet*** Structure, Grate Elevation: 42.50

Infiltration: an average of 0.4 in/hr was calculated based on the infiltration test results per the geotechnical report prepared by Geocon Consultants, Project No. S2333-05-02, dated March 2023.

By providing peak flow attenuation in the detention basin with a restricted outflow, the proposed project successfully limits the proposed runoff discharge to be less than the existing levels for the 2 year-24 hour storm – See Table 1:

Table 1 – Pre & Post Peak Discharge Rate to Putah Creek

Storm Event	Pre-Development (cfs)	Post-Development (cfs)
2 year-24 hour	4.363	3.460

* All elevations noted in this memo are Vertical Datum NAVD '88.

** Water surface elevations in Putah Creek are based on a hydraulic model prepared by West Yost Associates. See Table 3-9, Attachment D. The piped discharge into Putah Creek is set to be above the 10-year creek water surface elevation (39.46) with a flap gate. Calculations have been prepared based on a free flowing outlet for 10-year and smaller design storms, and a closed flap gate for storms greater than the 10-year.

*** The outlet is proposed to have a grated overflow set to be above the 100-year creek water surface elevation (42.35) to allow for discharge from the site when the flap gate is closed.

Simulation Run for 2 year-24 hour Design Storm:

Project: 1325-Promenade Simulation Run: 2YR-24HR

Start of Run: 01Jan1900, 00:00
End of Run: 10Jan1900, 00:00
Compute Time: 24Apr2023, 11:09:38
Basin Model: Basin 1
Meteorologic Model: 2YR-24HR
Control Specifications: Control 1

Show Elements: All Elements | Volume Units: IN / ACRE-FT | Sorting: Hydrologic

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (ACRE-FT)
SHED 1	0.0657	20.346	01Jan1900, 12:32	4.882
Reservoir-1	0.0657	1.456	01Jan1900, 18:16	4.882
SHED 2	0.00426	1.595	01Jan1900, 12:20	0.160
EX-PROMENADE	0.07328	4.363	01Jan1900, 15:20	1.677
SHED 3	0.00328	1.402	01Jan1900, 12:16	0.156
TOTAL OUT	0.07324	3.460	01Jan1900, 12:20	5.198

Simulation Run for 10 year-24 hour Design Storm:

Project: 1325-Promenade Simulation Run: 10YR-24HR

Start of Run: 01Jan1900, 00:00
End of Run: 10Jan1900, 00:00
Compute Time: 24Apr2023, 11:13:43
Basin Model: Basin 1
Meteorologic Model: 10YR-24HR
Control Specifications: Control 1

Show Elements: All Elements | Volume Units: IN / ACRE-FT | Sorting: Hydrologic

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (ACRE-FT)
SHED 1	0.0657	32.092	01Jan1900, 12:32	7.835
Reservoir-1	0.0657	4.644	01Jan1900, 15:08	7.835
SHED 2	0.00426	2.536	01Jan1900, 12:20	0.315
EX-PROMENADE	0.07328	9.075	01Jan1900, 15:24	3.768
SHED 3	0.00328	2.204	01Jan1900, 12:16	0.285
TOTAL OUT	0.07324	5.227	01Jan1900, 12:20	8.436

Simulation Run for 100 year-24 hour Design Storm:

Project: 1325-Promenade Simulation Run: 100YR-24HR

Start of Run: 01Jan1900, 00:00
End of Run: 10Jan1900, 00:00
Compute Time: 24Apr2023, 11:22:01
Basin Model: Basin 1
Meteorologic Model: 100YR-24HR
Control Specifications: Control 1

Show Elements: All Elements | Volume Units: IN / ACRE-FT | Sorting: Hydrologic

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (ACRE-FT)
SHED 1	0.0657	55.435	01Jan1900, 12:32	12.925
Reservoir-1	0.0657	11.308	01Jan1900, 14:16	12.925
SHED 2	0.00426	4.419	01Jan1900, 12:20	0.641
EX-PROMENADE	0.07328	17.861	01Jan1900, 15:28	8.106
SHED 3	0.00328	3.809	01Jan1900, 12:16	0.543
TOTAL OUT	0.07324	13.422	01Jan1900, 13:00	14.108

In addition to the 2-year hydromodification management design storm, the 10-year design storm was evaluated for the sizing of the onsite storm drainage infrastructure. The 100-year design storm was also evaluated for the purposes of establishing building finish floor elevations and an overland release flow path through the site. The 100-year storm will pond up to approximately elevation 46.55 covering small portions of the parking area at a maximum depth of 4.8 inches. The lowest building finish floors have been set at 48.57 - more than 1' above the anticipated 100-year water surface elevation. An overland release path has been provided to allow runoff to drain northeast into Putah Creek. The controlling overland release is taken as elevation 47.00 for Shed 1 and 46.00 for Shed 2.

RESULTS

Based on the above parameters, the hydromodification basin with outlet restriction is designed to detain the 2 year-24 hour design storm with total site discharge less than existing conditions. Drawdown time has been calculated as follows for the 2-year, 10-year, and 100-year storms to show that the basin will empty within 72 hours during the 2-year and 10-year storm events per City of Davis standards.

- In a 2 year-24 hour event, pond Water Surface Elevaton (WSE) will reach elevation 42.80. The pond outlet will empty the volume above elevation 41.20 within approximately 5.8 hours. Volume below elevation 41.20 will be infiltrated into the soil within approximately 60.9 hours. A total of 66.7 hours is required for the basin to fully empty.

- In a 10 year-24 hour event, pond WSE will reach elevation 44.55. The pond outlet will empty the volume above elevation 41.20 within approximately 10.1 hours. A total of 71.0 hours is required for the basin to fully empty.

- In a 100 year-24 hour event, pond WSE will reach elevation 46.55. The pond outlet will empty the volume above elevation 42.50 within approximately 45.4 hours. A total of 106.4 hours is required for the basin to fully empty.

While the infrequent 100-yearstorm exceeds the 72-hour drawdown time requirement, the project will prepare a detention basin maintenance plan to provide mosquito abatement when standing water is still present in the basin 72 hour after the large, infrequent storms.

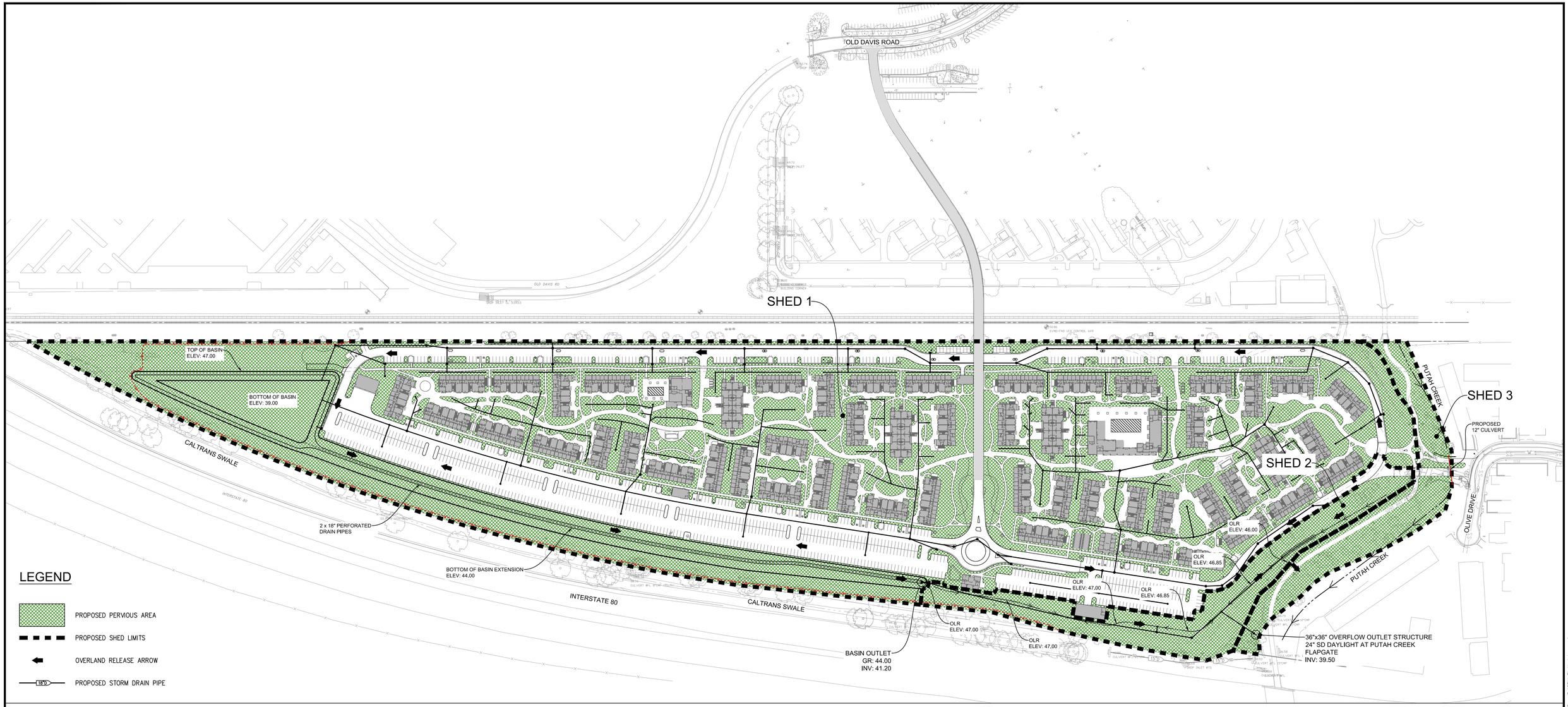
ATTACHMENTS

1. Attachment A – NRCS Soils Map
2. Attachment B – Drainage Exhibit
3. Attachment C – Detention Basin Sizing Summary table
4. Attachment D – West Yost Putah Creek Hydraulic Model, Table 3-9

ATTACHMENT A – NRCS SOILS MAP

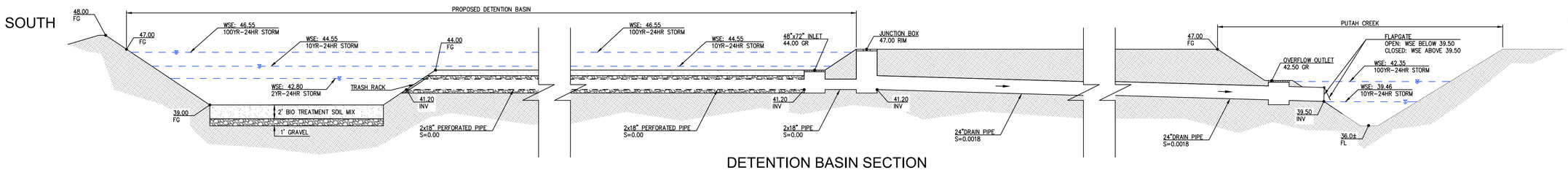
Table — Hydrologic Soil Group — Summary By Map Unit

Summary by Map Unit — Solano County, California (CA095)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
Ss	Sycamore silty clay loam, drained	C	15.6	36.70%
Yo	Yolo loam	B	27	63.30%
Totals for Area of Interest			42.6	100.00%



LEGEND

- PROPOSED PERVIOUS AREA
- PROPOSED SHED LIMITS
- OVERLAND RELEASE ARROW
- 18"D — PROPOSED STORM DRAIN PIPE



DETENTION BASIN SECTION

NTS

EXISTING SITE

TOTAL SITE AREA =	46.95 AC
EXISTING PERVIOUS AREA =	46.49 AC
EXISTING IMPERVIOUS AREA =	0.46 AC

PROPOSED SITE

TOTAL SITE AREA =	46.90 AC
PROPOSED SHED 1 AREA =	42.06 AC
PROPOSED SHED 1 PERVIOUS AREA =	19.40 AC
PROPOSED SHED 1 IMPERVIOUS AREA =	22.66 AC
PROPOSED SHED 2 AREA =	2.73 AC
PROPOSED SHED 2 PERVIOUS AREA =	2.62 AC
PROPOSED SHED 2 IMPERVIOUS AREA =	0.11 AC
PROPOSED SHED 3 AREA =	2.11 AC
PROPOSED SHED 3 PERVIOUS AREA =	1.77 AC
PROPOSED SHED 3 IMPERVIOUS AREA =	0.34 AC

ELEVATIONS ARE NAVD 88 ORTHOMETRIC HEIGHTS BASED ON THE VALUES SHOWN HEREON FOR UC DAVIS CONTROL POINTS.

120 60 0 120 240

SCALE: 1" = 120'

ATTACHMENT B - DRAINAGE EXHIBIT

CUNNINGHAM ENGINEERING
CECWEST.COM
Project Planning ■ Civil Engineering ■ Landscape Architecture
■ Sacramento Office
2120 20th Street, Suite Three
Sacramento, CA 95818
(916) 455-2026
■ Davis Office
2940 Spafford Street, Suite 200
Davis, CA 95618
(530) 758-2026

PROJECT:	PROMENADE
DESCRIPTION:	DRAINAGE EXHIBIT
DATE:	5/10/2023
BY:	AB
JOB NO:	1325.07
SCALE:	AS SHOWN

SHEET 1

ATTACHMENT C - DETENTION BASIN SIZING SUMMARY TABLE

BASIN DISCHARGE TIME FOR 2YR-24HR & 10YR-24 STORMS

				STORAGE			DISCHARGE RATE				DISCHARGE TIME		
	ELEVATION	AREA	INC DEPTH	INC STORAGE	STORAGE	STORAGE	INFILTRATION	PERFORATED PIPE	INLET	COMBINED RATES	DISCHARGE TIME	CUMMULATIVE DISCHARGE TIME	CUMMULATIVE DISCHARGE TIME
		(sf)	(ft)	(cf)	(cf)	(ac-ft)	(cfs)	(cfs)	(cfs)	(cfs)	(hr)	(hr)	(day)
POND BOT	36.00	40520	0.0	0.0	0.0	0.000	0.38	0.00	0.00	0.38	0.00	-	-
GRAVEL	37.00	40520	1.0	12156.0	12156.0	0.279	0.38	0.00	0.00	0.38	9.00	-	-
BIO SOIL	39.00	40520	2.0	24312.0	36468.0	0.837	0.38	0.00	0.00	0.38	18.00	-	-
PERF PIPE INV	41.20	47860	2.2	97218.0	133686.0	3.069	0.44	0.00	0.00	0.44	60.94	60.94	2.54
PERF PIPE CROWN	42.70	53230	1.5	75817.5	209503.5	4.810	0.49	3.4	0.00	3.89	5.41	66.35	2.76
2YR-24HR STORM	42.80	53600	0.1	5341.5	214845.0	4.932	0.50	3.6	0.00	4.10	0.36	66.71	2.78
OUTFLOW INLET GRATE	44.00	71660	1.2	92617.9	307462.9	7.058	0.66	6.6	0.00	7.26	3.54	70.25	2.93
10YR-24HR STORM	44.55	86300	0.5	43439.0	350901.9	8.056	0.80	0	13.75	14.55	0.83	71.08	2.96

BASIN DISCHARGE TIME FOR 100YR-24 STORM

				STORAGE			DISCHARGE RATE				DISCHARGE TIME		
	ELEVATION	AREA	INC DEPTH	INC STORAGE	STORAGE	STORAGE	INFILTRATION	PERFORATED PIPE	INLET	COMBINED RATES	DISCHARGE TIME	CUMMULATIVE DISCHARGE TIME	CUMMULATIVE DISCHARGE TIME
		(sf)	(ft)	(cf)	(cf)	(ac-ft)	(cfs)	(cfs)	(cfs)	(cfs)	(hr)	(hr)	(day)
POND BOT	36.00	40520	0.0	0.0	0.0	0.000	0.38	0.00	0.00	0.38	0.00	-	-
GRAVEL	37.00	40520	1.0	12156.0	12156.0	0.279	0.38	0.00	0.00	0.38	9.00	-	-
BIO SOIL	39.00	40520	2.0	24312.0	36468.0	0.837	0.38	0.00	0.00	0.38	18.00	-	-
PERF PIPE INV	41.20	47860	2.2	97218.0	133686.0	3.069	0.44	0.00	0.00	0.44	60.94	60.94	2.54
OVERFLOW OUTLET	42.50	52490	1.3	65227.5	198913.5	4.566	0.49	0.00	0.00	0.49	37.28	98.22	4.09
PERF PIPE CROWN	42.70	53230	0.2	10572.0	209485.5	4.809	0.49	3.4	0.00	3.89	0.75	98.97	4.12
2YR-24HR STORM	42.80	53600	0.1	5341.5	214827.0	4.932	0.50	3.6	0.00	4.10	0.36	99.34	4.14
OUTFLOW INLET GRATE	44.00	71660	1.2	92617.9	307444.9	7.058	0.66	6.6	0.00	7.26	3.54	102.88	4.29
10YR-24HR STORM	44.55	86300	0.5	43439.0	350883.9	8.055	0.80	0	13.75	14.55	0.83	103.71	4.32
100YR-24HR STORM	46.55	139500	2.0	225800.0	576683.9	13.239	1.29	0	17.50	18.79	3.34	107.04	4.46
TOP POND	47.00	151410	0.5	65454.8	642138.7	14.741							

ATTACHMENT D – WEST YOST ASSOCIATES PUTAH CREEK HYDRAULIC MODEL

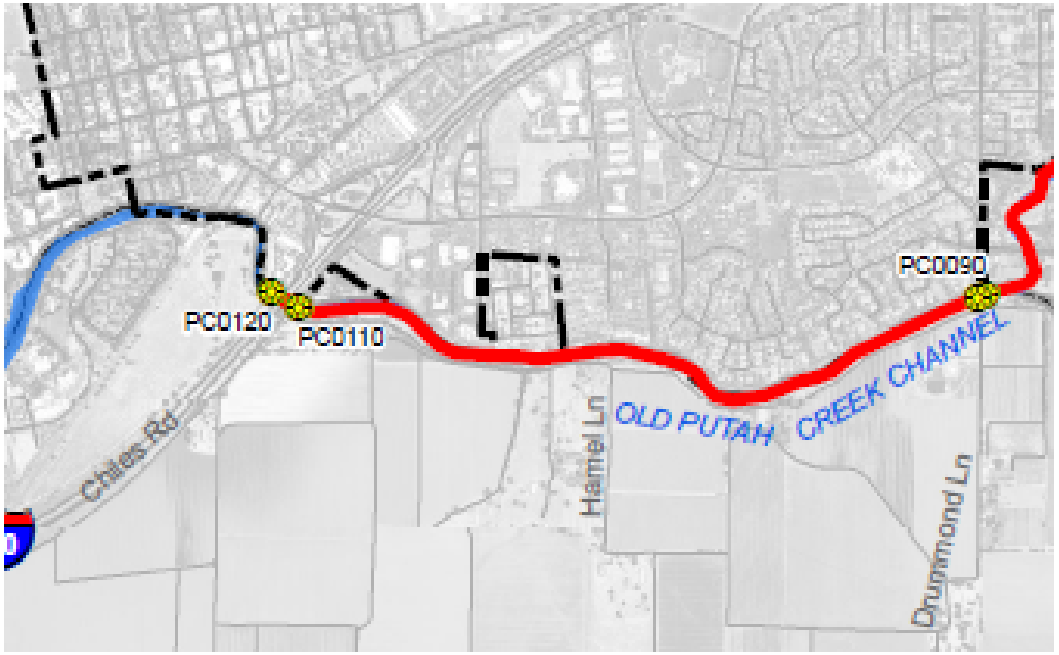


Table 3-9. Hydraulic Model Node Input Data and Model Node Results

Node Name	Ground Elevation , ft	Invert Elevation, ft	10-Year Maximum Water Surface Elevation, ft	10-Year Flooding (positive values) and Freeboard (negative values), ft	50-Year Maximum Water Surface Elevation, ft	50-Year Flooding (positive values) and Freeboard (negative values), ft	100-Year Maximum Water Surface Elevation, ft	100-Year Flooding (positive values) and Freeboard (negative values), ft
PC0110	53.00	35.70	39.46	-13.54	41.53	-11.47	42.35	-10.65
PC0120	53.00	36.46	39.46	-13.54	41.53	-11.47	42.35	-10.65

All elevations noted in this attachment are Vertical Datum NAVD ’88