

APPENDIX E2

STORMWATER DRAINAGE ANALYSIS

TO: City of Napa
Community Development Department
Planning Division
1600 First Street
Napa, CA 94559

FROM: Brian Delemos, P.E., CA C66421
Laugenour and Meikle
608 Court Street
Woodland, CA 95695
(530) 662-1755



DATE: October 28, 2025

SUBJECT: Storm Drainage Analysis for the Napa Valley Vintners Park Project, 1030 Kaiser Road, Napa, California, APN 046-370-004 (Planning Application 23-0135)

INTRODUCTION:

This memorandum (Memo) was prepared for the Napa Valley Vintners Park Project (Project) at 1030 Kaiser Road, in the southern portion of the city of Napa. The Project is shown on the improvement plans in **Appendix A, Improvement Plans**. The Project includes a 153,300 square-foot industrial building and associated paved parking and drive isles on an undeveloped 10.21-acre parcel. The Project will include some improvements to the private road to the east (Syrar Road).



This Memo presents a summary of the preliminary design of the drainage and stormwater quality facilities for the Project. The amount of detail and analysis provided is intended for a planning-level design review by the city. The topics discussed in the following sections include:

- Drainage Basin and Existing Drainage Conditions
- Proposed Drainage Conditions
- Model Development
- Model Results
- Storm Drain and Drain Inlet Design
- Stormwater Quality
- Overland Release
- Floodplain Evaluation
- Conclusions

DRAINAGE BASIN AND EXISTING DRAINAGE CONDITIONS:

The Project is in the Napa South Basin of the city's 2006 Storm Drainage Master Plan. **Exhibit 1, Drainage Map, Existing Conditions**, shows the existing drainage conditions of the Project property. The site is ultimately tributary to an existing 96-inch storm drain along Kaiser Road. The Kaiser Road storm drain terminates at the Napa River, to the west of the Project.

As shown above, the Project property is undeveloped, covered mostly in grasses and weeds, with some trees. The areas adjacent to the Project property are developed with a mix of residential, commercial, and industrial uses. The property is bounded on the south by Kaiser Road, and on the east and north by private roads. To the west is an industrial development. Soils are predominantly low-infiltration-rate soils of Group D, per the USDA soil Webmap viewer. The site slopes, generally, from north to south, towards Kaiser Road. The topography shown on **Exhibit 1** indicates that run-on of offsite runoff onto the Project is minimal. Run-on is limited by the surrounding roads, and by the industrial site to the west having its own onsite drainage system.

The existing offsite storm drain system is shown on **Exhibit 1**. The existing storm drain system in the private road on the east side (Syr Road) collects some runoff from the Project site, and from the private road, and conveys it to the 96-inch storm drain in Kaiser Road. The discharge from the Project site and the offsite areas (Shed EX10 on **Exhibit 1**) is considered conceptually as one discharge to the Kaiser Road storm drain trunk so that comparisons with proposed conditions, discussed below, can be made conveniently.

PROPOSED DRAINAGE CONDITIONS:

Exhibit 2, Drainage Map, Proposed Conditions, shows the site plan and associated general drainage conditions for the Project; the grading and drainage features are shown in more detail on the improvement plans in **Appendix A, Improvement Plans**. On the Project property, the imperviousness will increase significantly with a proposed industrial building, paved parking lots and drive isles, and loading docks. Runoff from roof and paved areas will be disconnected, that is, will drain overland (or through bubble up structures for some areas) to bioretention facilities for water quality treatment and hydromodification control (described further below). Bioretention facilities will also provide storage space (detention/retention) to maintain peak discharges from the Project to levels at or below existing conditions for the 10-year and 25-year storm events. Some runoff reaching the bioretention facilities will be retained in and infiltrate and evapotranspire from the bioretention facilities. Excess runoff from larger storm events will be conveyed from the bioretention facilities to an onsite storm drain system through underdrains and overflow structures. The onsite storm drain system will convey runoff to the Kaiser Road storm drain system. Referring to **Exhibit 2, Drainage Map, Proposed Conditions**, the Project area was broken into five shed areas, four of which drain to the onsite bioretention facilities, and the fifth drain directly offsite to roadway drainage facilities. The five sheds combined are comparable to the one shed for existing conditions (**Exhibit 1, Drainage Map, Existing Conditions**). As discussed for existing drainage conditions above, there will continue to be some run-on of offsite runoff from adjacent areas onto the Project property,

For the offsite improvements to the private road (Syr Road), sidewalk, curb and gutter, and a small amount of AC paving will be added, and existing AC paving will be replaced. Roadway runoff in Sheds PROP30 and PROP40, including a large proportion of existing paving, will drain to the onsite bioretention facilities BMP 3 and BMP 4 for stormwater quality treatment and hydromodification management. Roadway runoff in Shed PROP50 will drain to the existing drain inlet in the private road,

which is connected to the Kaiser Road storm drain trunk, as it does under existing conditions.

MODEL DEVELOPMENT:

A hydrodynamic model was developed to design onsite detention/retention that will maintain peak discharges from the Project to levels at or below existing conditions for the 10-year and 25-year storm events (peak flow mitigation). The model was developed using the software SewerGEMS, version 2024. The model represents existing conditions and proposed conditions shown on **Exhibit 1, Drainage Map, Existing Conditions**, and on **Exhibit 2, Drainage Map, Proposed Conditions**, for the 10-year and 25-year storm events. **Exhibit 3, Model Schematic** (4 sheets), shows a schematic of the model. Model input and output for the 10-year storm event are included in **Appendix B, Model Input and Output for the 10-Year Storm Event**, and in **Appendix C, Model Input and Output for the 25-Year Storm Event** for the 25-year storm event.

Hydrology for sheds shown in **Exhibits 1 and 2** was developed as specified by Napa's Drainage Standards. Sheds are termed catchments in the model, and are shown on **Exhibit 3, Model Schematic**. NOAA Atlas 14 rainfall data used in the model is contained in **Appendix D, Rainfall Data**. The 10-year and 25-year, 24-hour storm events have depths of 4.38 inches and 5.34 inches, respectively. An SCS Type 1A storm distribution was used. NRCS TR-20/TR-55 methods were selected to transform rainfall to runoff. SCS curve numbers were used to estimate rainfall losses, based on USDA Group D soils. Weighted curve numbers by shed are shown in **Appendix E, Weighted Curve Number Calculations**. The SCS unit-hydrograph method was used to transform rainfall excess to runoff hydrographs. **Appendix F, Time of Concentration Calculations** includes calculations of the times of concentration for existing conditions (Shed EX10); calculations were made using methods indicated in the table footnotes. For proposed conditions, times of concentration were assumed to be 5 minutes for sheds that will be mostly impervious, and 10 minutes for sheds (PROP 50) that will have a significant proportion of pervious area.

Drainage facilities were modeled for proposed conditions with hydraulic model elements. Only drainage facilities needed to demonstrate peak flow mitigation were included in the model. Hydraulic model elements were configured to reflect the onsite storm drains and the bioretention facilities and associated structures shown on the improvement plans in **Appendix A, Improvement Plans**. Model elements that were used include conduits (denoted CO), manholes (denoted MH), ponds (denoted PO), pond outlet structures (denoted POS), and outfalls (denoted O), as termed in SewerGEMS---see **Exhibit 3, Model Schematic**. The storage space provided by each bioretention facility is represented using a pond element, which includes a stage-area relationship (see **Appendix B, Model Input and Output for the 10-Year Storm Event**). The pore space in the bio-soil mix soil and drain rock/gravel was estimated to be 40%, and is represented in the stage-area relationship by assigning a 40% void space in the table. The surface reservoir and incidental ponding outside of the reservoir are also represented in the stage-area relationship, with a 100% void space. The overflow drain inlet grate is represented as a weir in pond outlet structures (POS), and the underdrain openings in the overflow drop inlet were represented as orifices in POSs (see **Appendix B, Model Input and Output for the 10-Year Storm Event**). The storm drains and associated manholes/drain inlets were represented as conduits and manholes. The downstream end of the storm drain system is represented as a model outfall (O-1-PROP). The downstream boundary condition was set to normal depth.

MODEL RESULTS:

The model results are shown in **Appendix B, Model Input and Output for the 10-Year Storm Event**, for the 10-year storm event in **Appendix C, Model Input and Output for the 25-Year Storm Event**

for the 25-year storm event. Graphs of inflows/outflows and hydraulic grade lines over time for each bioretention facility/BMP are contained in **Appendix G, Time Series Plots for BMPs 1 through 4**. The graphs illustrate the flow mitigation provided by each bioretention/BMP for the 10-year and 25-year events. The model results are summarized below for the total discharges from the Project, and illustrates the mitigation provided overall. The model results show that the discharges will not be increased by the Project.

Modeled Peak Flows Discharged from the Project

Condition	10-Year, cfs	25-Year, cfs
Existing	6.85	8.86
Proposed	5.43	6.76

Profile plots of the modeled storm drains (downstream of the bioretention facilities) for the 10-year and 25-year events are contained in **Appendix H, Profile Plots of Modeled Storm Drains**. The profiles illustrate modeled storm drains have adequate flow capacity.

STORM DRAIN AND DRAIN INLET DESIGN:

As discussed above, the modeled storm drains (downstream of the bioretention facilities) were shown to have adequate flow capacity. The model results also show that the drain inlets (overflow structures) in the bioretention facilities have enough inflow capacity to keep the surface ponding within the expected ponding area (bioretention reservoir and incidental parking lot ponding area).

The storm drains and drain inlets upstream of the bioretention facilities were not analyzed for this design review, but will be analyzed for the building-permit phase of the Project. The analysis will focus on verifying that capacities of these facilities are sufficient to convey runoff into the bioretention facilities for the 10-year and 25-year events—this is a basic assumption of the modeling discussed above. The capacities of these facilities can be easily adjusted without resulting in any significant changes to the site design.

POST-CONSTRUCTION STORMWATER QUALITY DESIGN:

Design of the post-construction stormwater quality treatment (bioretention) facilities relative to stormwater quality and hydromodification requirements is presented in a separate report (see the Stormwater Control Plan Report).

OVERLAND RELEASE:

Overland release paths for the site are shown on **Exhibit 2, Drainage Map, Proposed Conditions**. Runoff from large storm events that exceeds the capacity of the onsite storm drains will follow these paths. As can be seen on the grading plans in see **Appendix A, Improvement Plans**, the proposed building finished floor is high relative to the release paths. Overland release runoff will flow away from the building towards Kaiser Road and towards the private Syar Road.

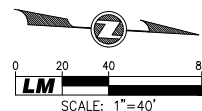
FLOODPLAIN EVALUATION:

As shown on **Exhibit 4, FEMA FIRMette in the Project Area**, the Project site does not lie within a FEMA special flood hazard area. A floodplain permit was not prepared for the Project.

CONCLUSIONS:

Analyses presented in this Memo show that the preliminary drainage design for the Project meets key city design requirements. The level of detail and analysis provided is intended for a planning-level design review by the city. Additional design detail and analysis will be provided for the building-permit phase of the Project.

EXHIBITS



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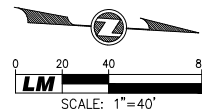
BY _____
BRYAN P. BONINO

DATE 10/08/2025 P.E. 41804



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DATE:	10/08/2025
JOB NO.	4808-1

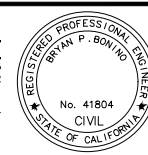
SHEET 1 OF 1



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BY BRYAN P. BONINO

DATE 10/08/2025 P.E. 41804



SCALE	
1"=40'	
DATE:	10/08/2025
JOB NO.	4808-1

EXH 2

SHEET 1 OF 1

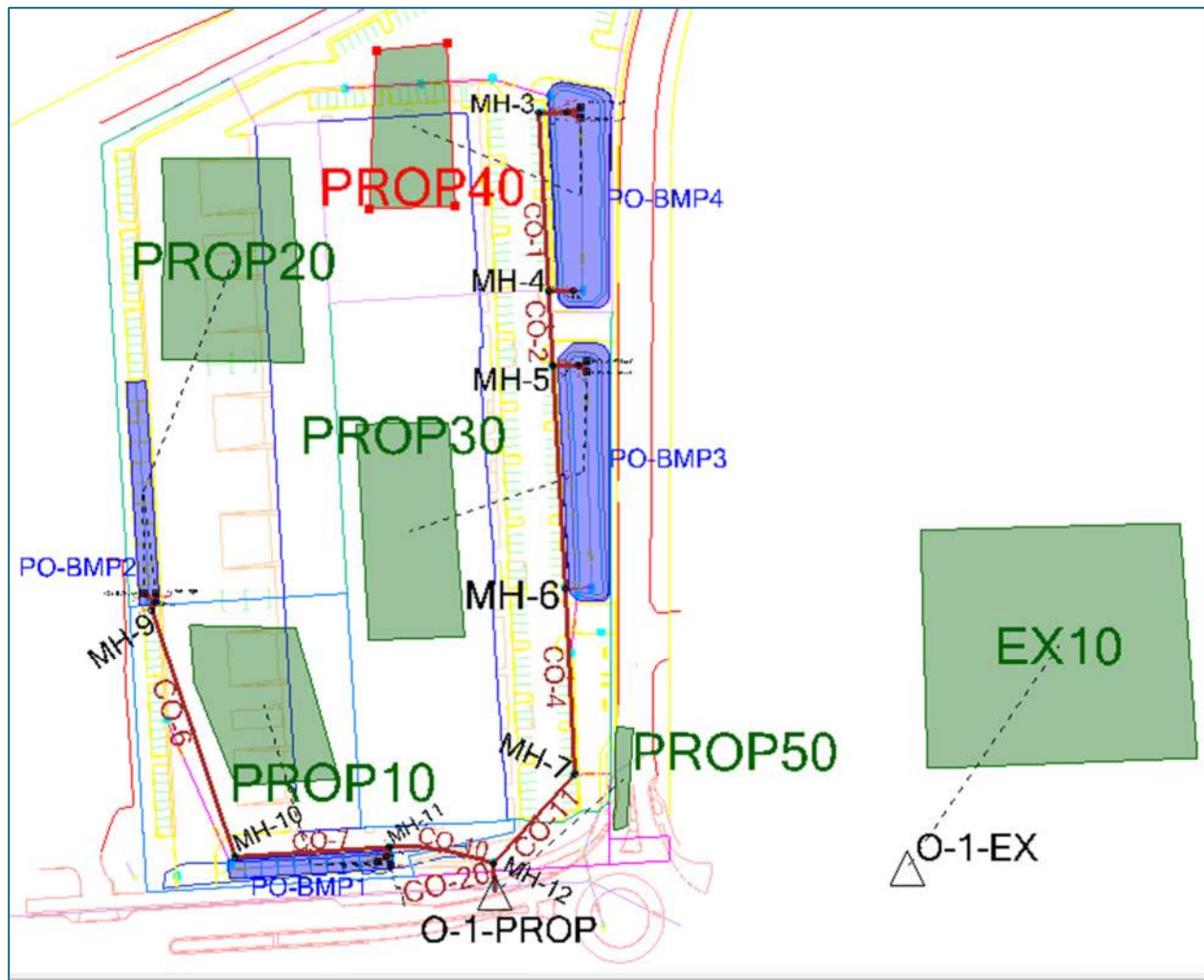


Exhibit 3, Model Schematic, Sheet 1 (Overview)

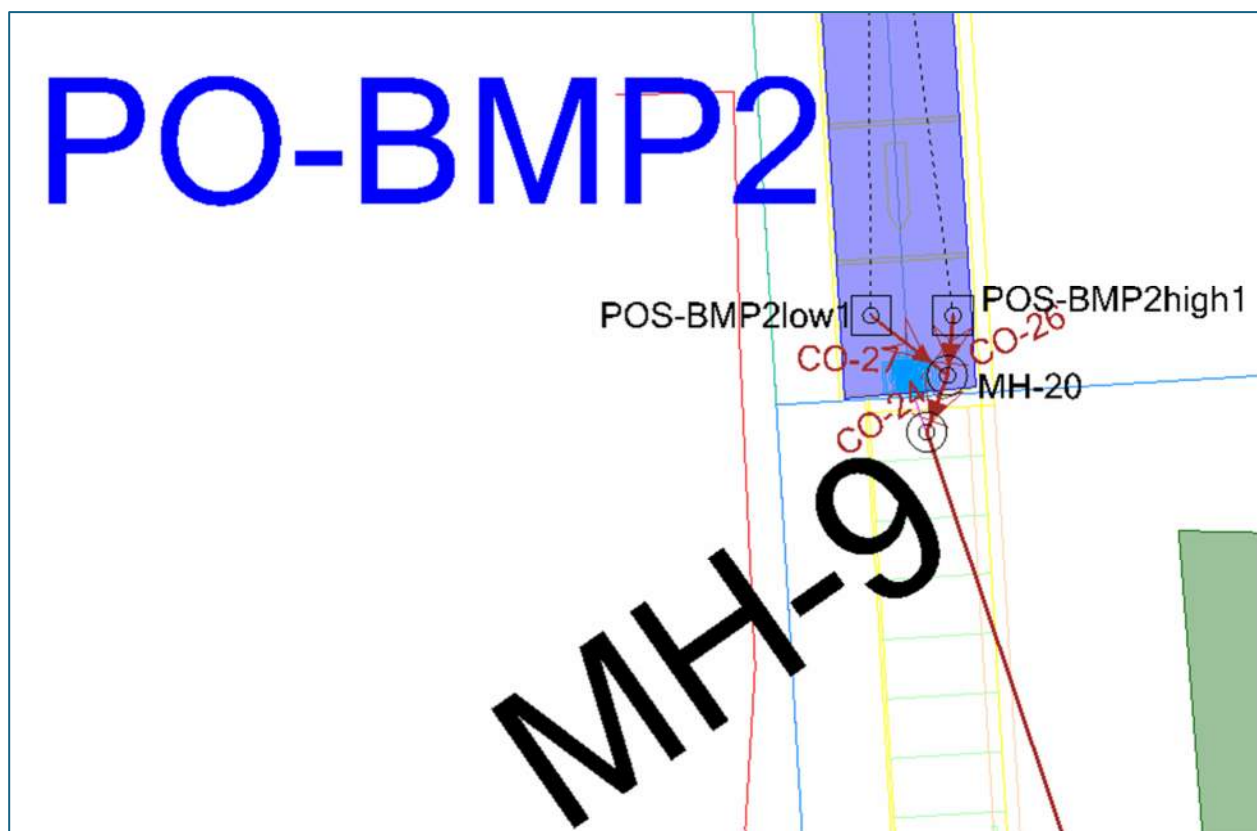
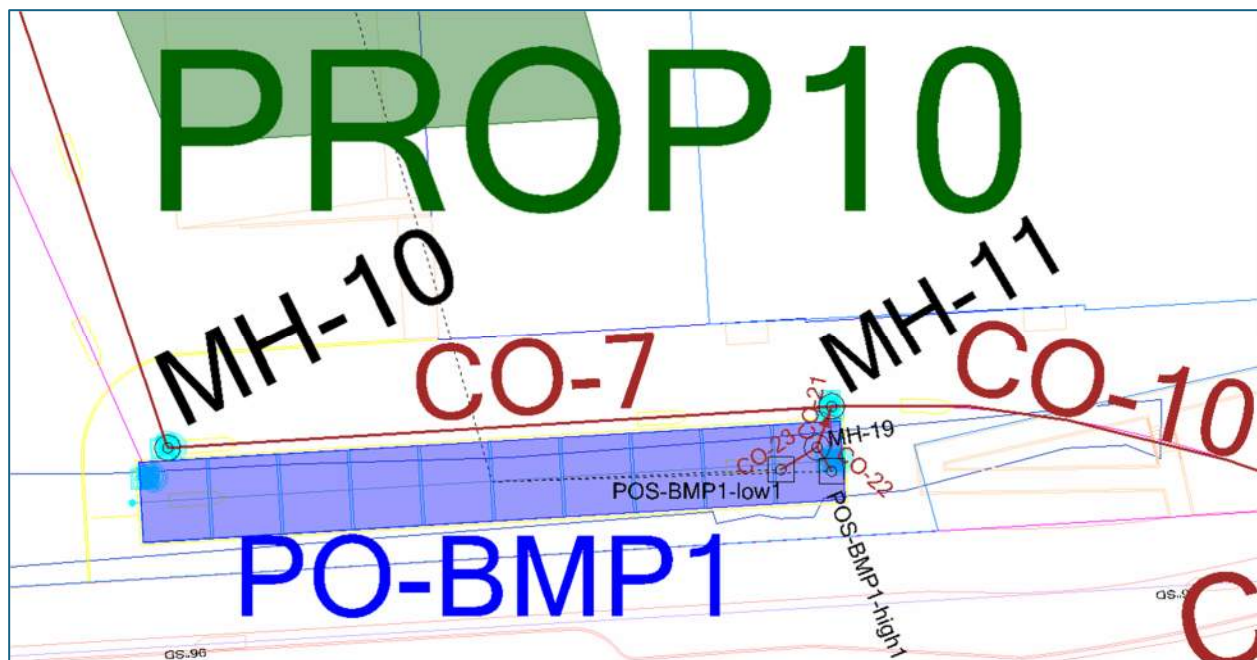


Exhibit 3, Model Schematic, Sheet 2 (Detail)

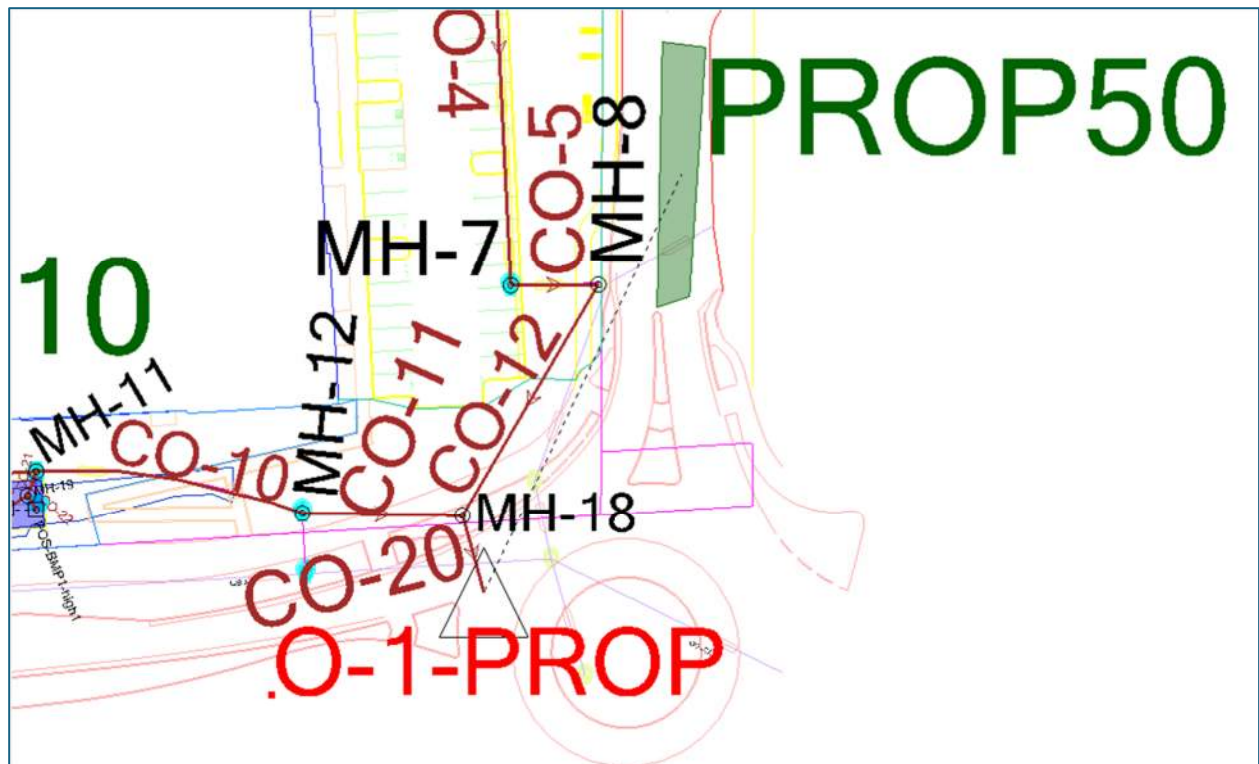
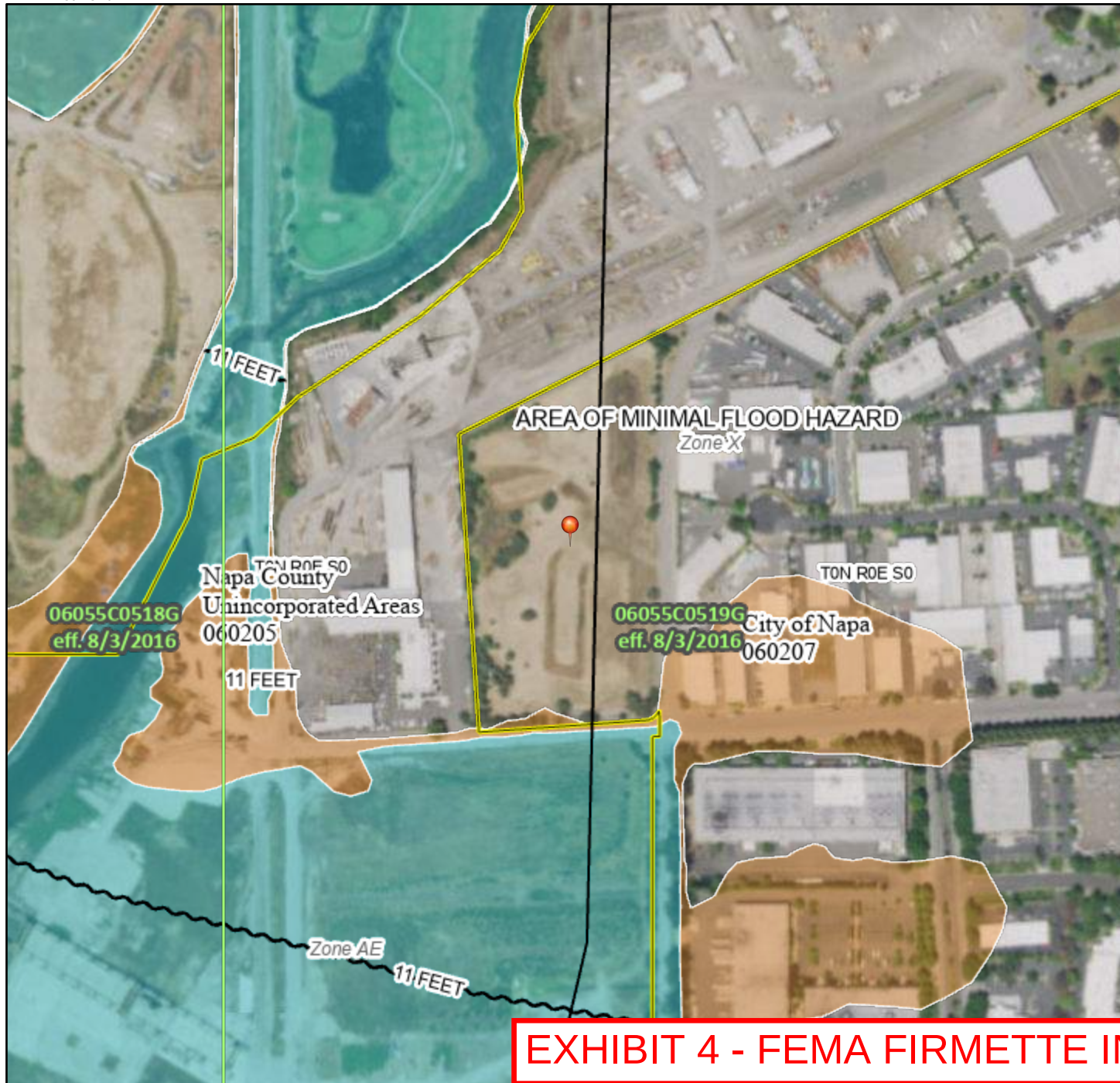


Exhibit 3, Model Schematic, Sheet 4 (Detail)

National Flood Hazard Layer FIRMette



122°17'W 38°15'46"N



Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) Zone A, V, A99
		With BFE or Depth Zone AE, AO, AH, VE, AR
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
		Future Conditions 1% Annual Chance Flood Hazard Zone X
		Area with Reduced Flood Risk due to Levee. See Notes. Zone X
		Area with Flood Risk due to Levee Zone D
OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard Zone X
		Effective LOMRs
GENERAL STRUCTURES		Area of Undetermined Flood Hazard Zone D
		Channel, Culvert, or Storm Sewer
OTHER FEATURES		Levee, Dike, or Floodwall
		20.2 Cross Sections with 1% Annual Chance Water Surface Elevation
		17.5 Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
		Coastal Transect Baseline
		Profile Baseline
		Hydrographic Feature
MAP PANELS		Digital Data Available
		No Digital Data Available
		Unmapped



The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on **1/12/2024 at 6:38 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

EXHIBIT 4 - FEMA FIRMETTE IN THE PROJECT AREA

0 250 500 1,000 1,500 2,000 Feet

1:6,000

122°16'22"W 38°15'18"N

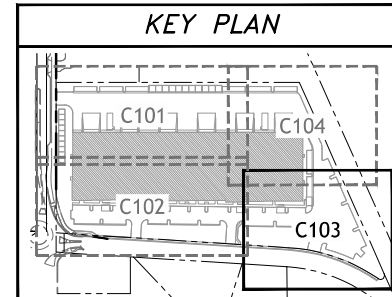
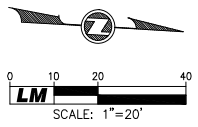
Basemap Imagery Source: USGS National Map 2023

FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

APPENDIX A

IMPROVEMENT PLANS

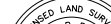
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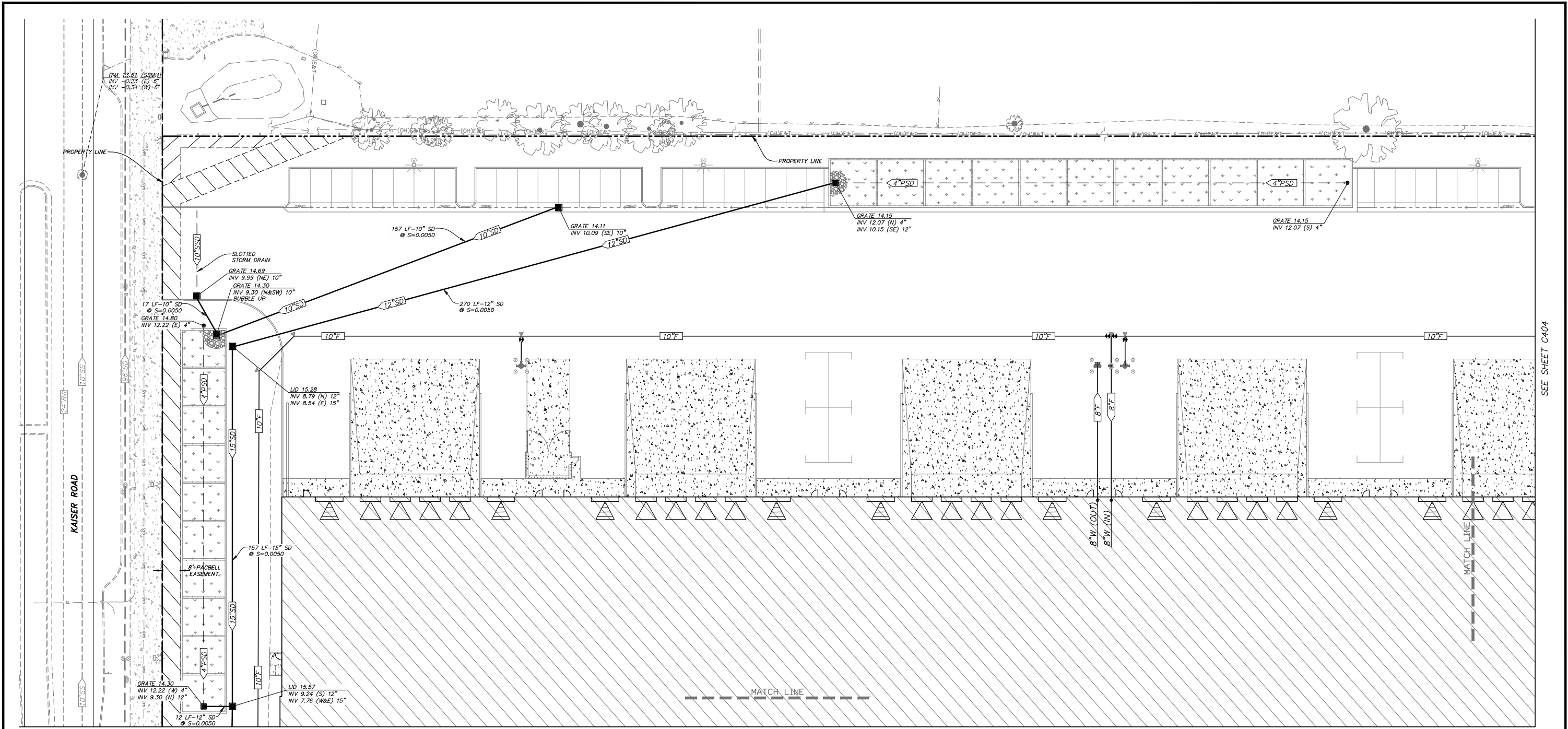
BY BRYAN P. BONINO

DATE 10/28/2025 L.S. 7521



SCALE 1"=20'	C103 SHEET 3 OF 19
DATE: 10/28/2025 JOB NO. 4808-1	

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SEE SHEET C402

SEE SHEET C404

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DRAWN BY **PF**

CHECKED BY **BPB**

REV.	DATE	DESCRIPTION	BY	APP'D.

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BY **BRYAN P. BONINO**

DATE **10/28/2025** P.E. 41804

CIVIL IMPROVEMENT PLANS
FOR
NAPA VALLEY VINTNERS PARK

1030 KAISER ROAD

CITY OF NAPA, CA

UTILITIES PLAN

SCALE
1"=20'

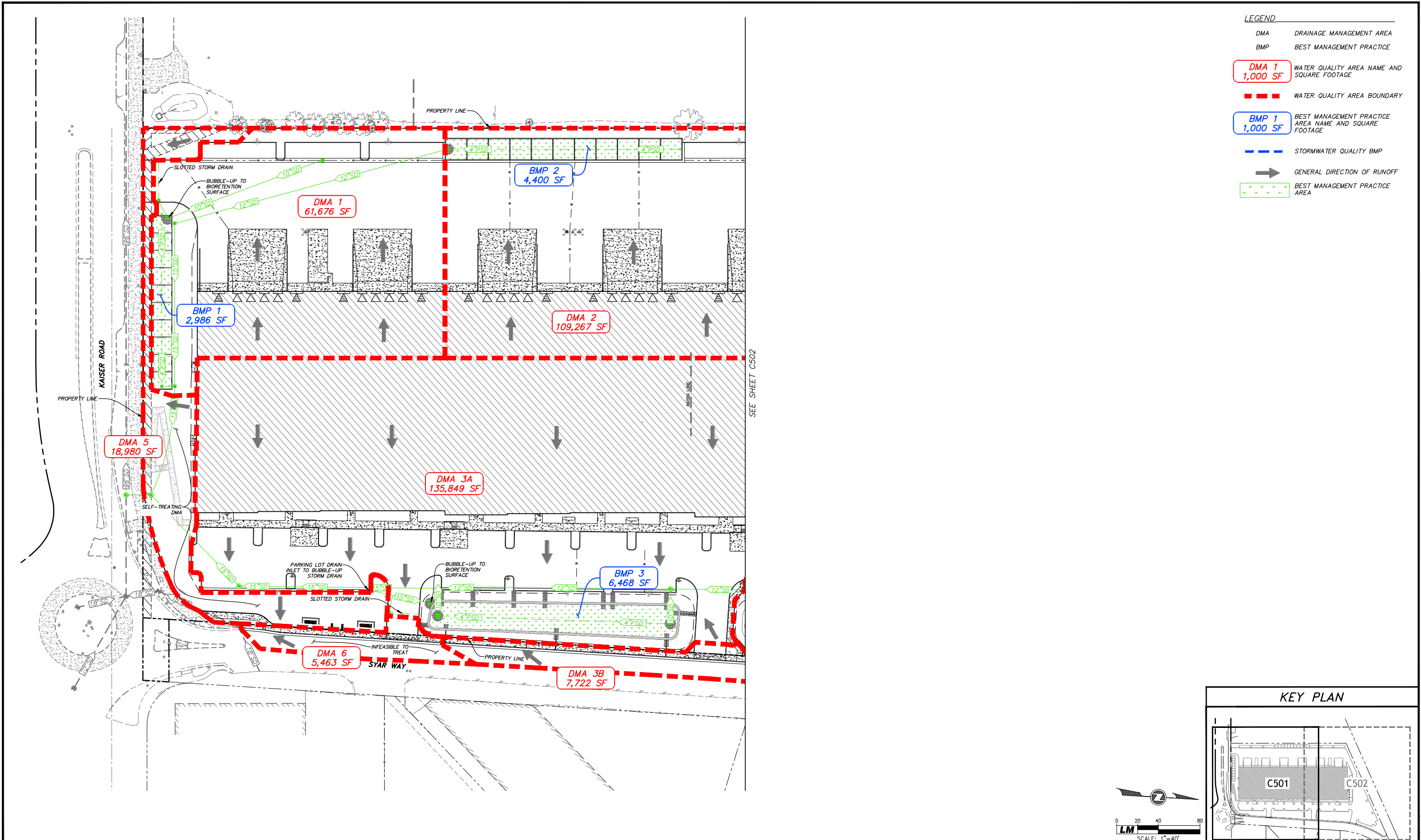
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JOB NO. **4808-1**

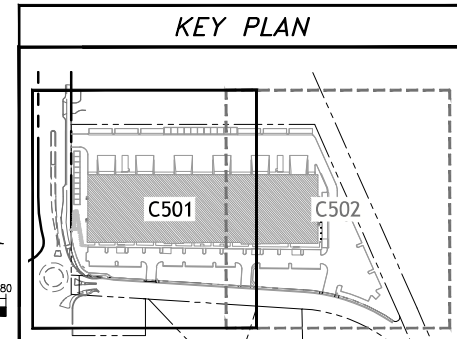
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SHEET 11 OF 19

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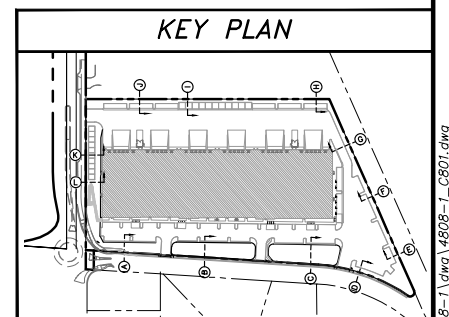
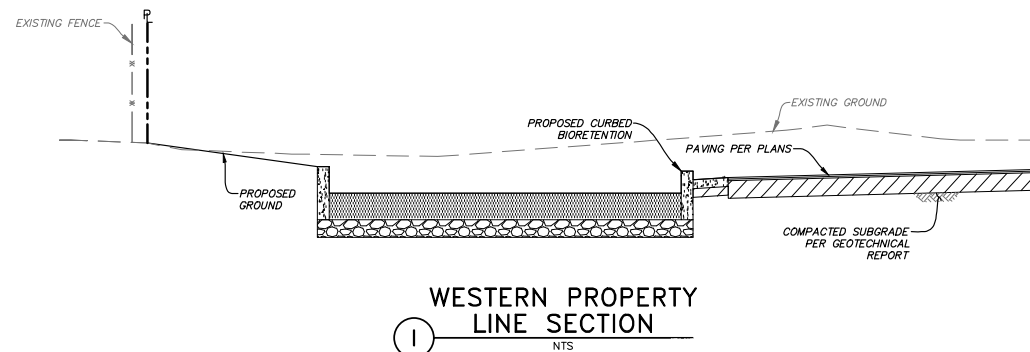
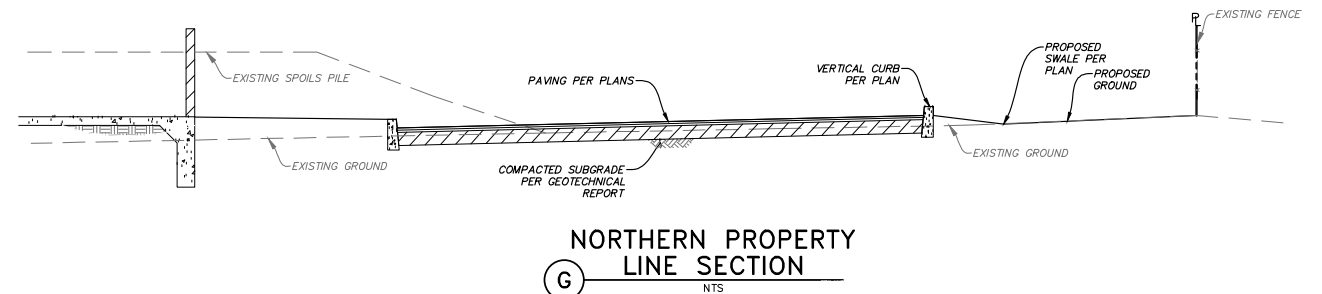
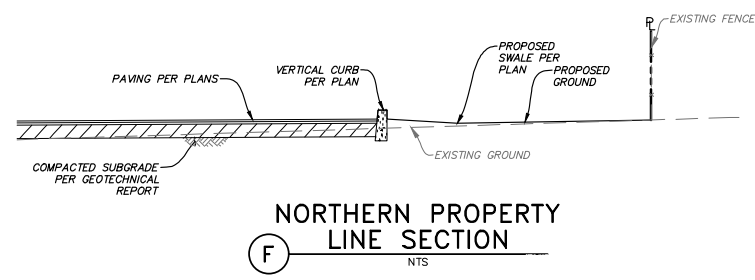
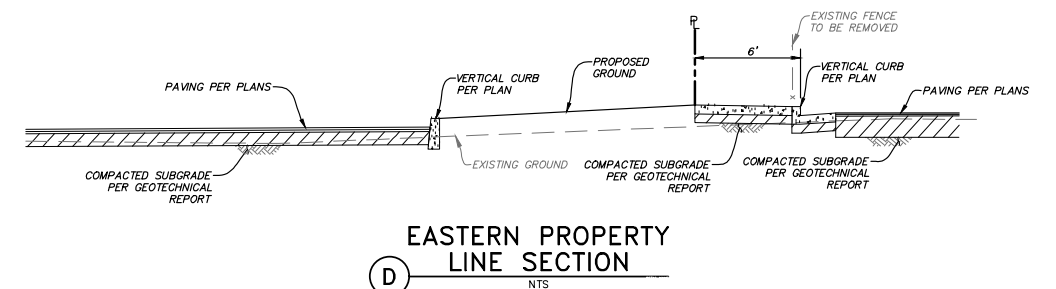
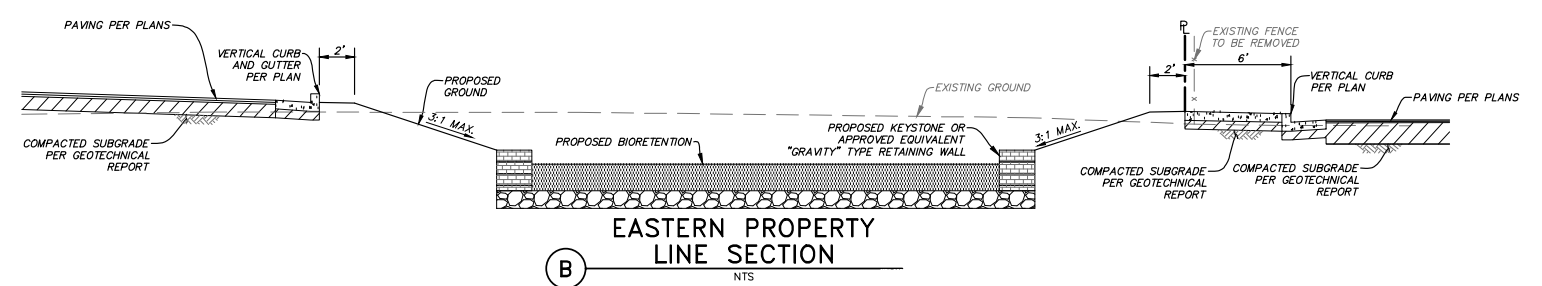


- LEGEND**
- DMA DRAINAGE MANAGEMENT AREA
 - BMP BEST MANAGEMENT PRACTICE
 - DMA 1**
1,000 SF WATER QUALITY AREA NAME AND SQUARE FOOTAGE
 - WATER QUALITY AREA BOUNDARY
 - BMP 1**
1,000 SF BEST MANAGEMENT PRACTICE AREA NAME AND SQUARE FOOTAGE
 - STORMWATER QUALITY BMP
 - ➔ GENERAL DIRECTION OF RUNOFF
 - BEST MANAGEMENT PRACTICE AREA



DESIGNED BY BPB						LM LAUGENOUR AND MEIKLE CIVIL ENGINEERING · LAND SURVEYING · PLANNING 608 COURT STREET, WOODLAND, CALIFORNIA 95695 · PHONE: (530) 662-1755 P.O. BOX 828, WOODLAND, CALIFORNIA 95776 · FAX: (530) 662-4602 BY BRYAN P. BONINO DATE 10/28/2025 P.E. 41804		CIVIL IMPROVEMENT PLANS FOR NAPA VALLEY VINTNERS PARK		SCALE 1"=40'	C501 SHEET 15 OF 19
DRAWN BY PF								1030 KAISER ROAD CITY OF NAPA, CA		DATE: 10/28/2025	
CHECKED BY BPB								STORMWATER CONTROL PLAN		JOB NO. 4808-1	
REV.	DATE	DESCRIPTION						BY	APP'D.		

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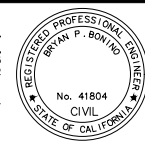


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BY BRYAN P. BONINO

DATE 10/28/2025 P.F. 41804

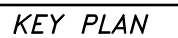


**CIVIL IMPROVEMENT PLANS
FOR
NAPA VALLEY VINTNERS PARK**

1030 KAISER ROAD CITY OF NAPA, CA

TYPICAL SECTIONS

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DATE: 10/28/2025 JOB NO. 4808-1	SHEET 17 OF 19

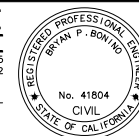


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BY _____
BRYAN P. BONINO

DATE 10/28/2025 P.E. 41804

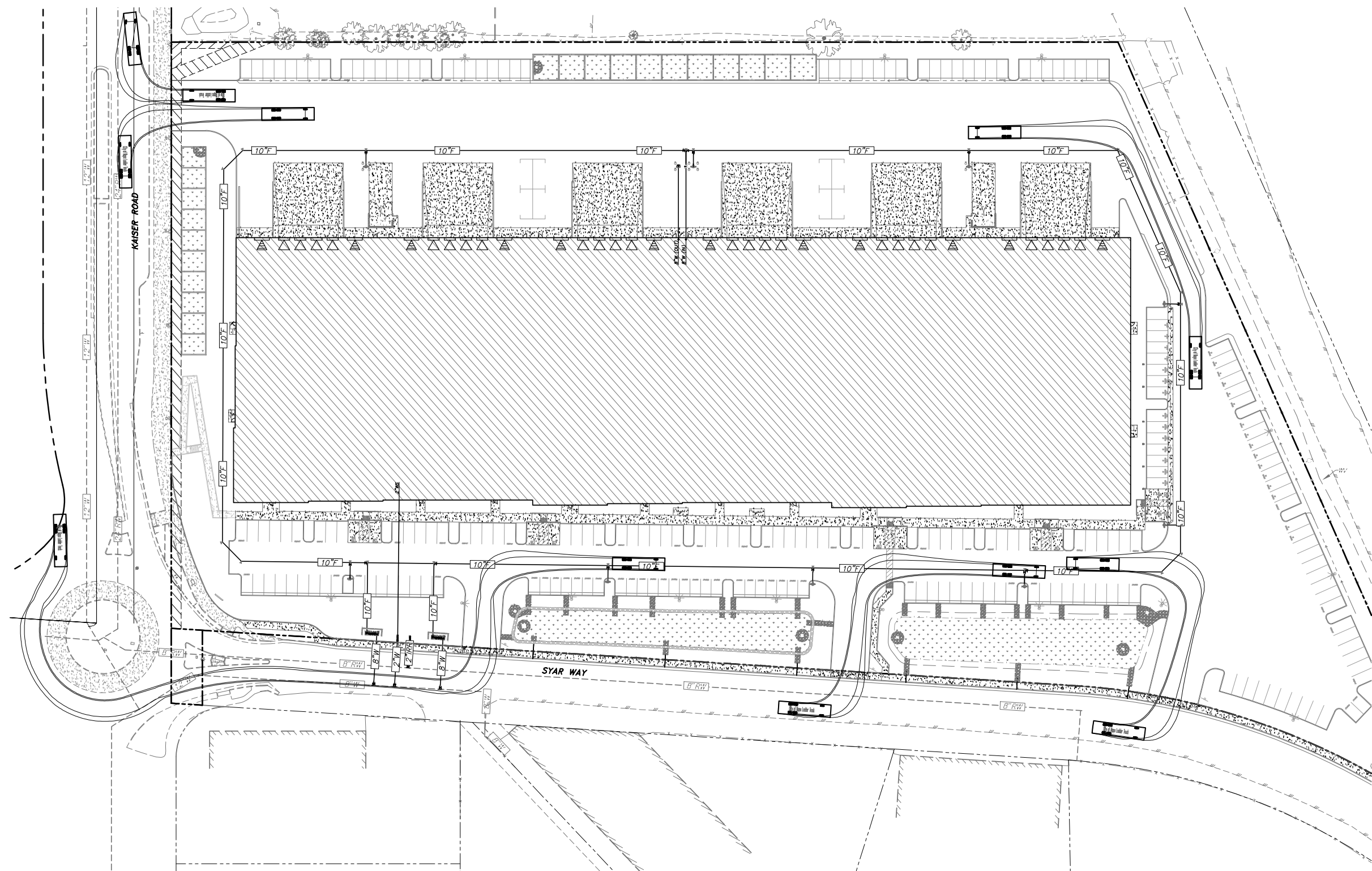


CIVIL IMPROVEMENT PLANS FOR NAPA VALLEY VINTNERS PARK	
1030 KAISER ROAD	CITY OF NAPA, CA
TYPICAL SECTIONS	

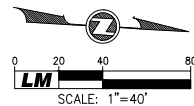
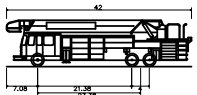
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JOB NO.	4808-1

C802

SHEET 18 OF 19



GENERAL NOTES:



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	REV.	DATE	DESCRIPTION	BY	APP'D.		1030 KAISER ROAD CITY OF NAPA, CA		DATE: 10/28/2025 JOB NO. 4808-1	SHEET 19 OF 19
							FIRE PLAN			

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APPENDIX B

MODEL INPUT AND OUTPUT FOR THE 10-YEAR STORM EVENT

FlexTable: Catchment Table

Current Time: 0.00 hours

ID	Label	Outflow Element	Area (User Defined) (acres)	Loss Method	Unit Hydrograph Method	Time of Concentration (hours)	SCS CN (Composite)	Flow (Maximum) (cfs)
35	EX10	O-1-EX	11.330	SCS CN	SCS Unit Hydrograph	0.880	89.7	6.85
66	PROP10	PO-BMP1	1.410	SCS CN	SCS Unit Hydrograph	0.083	96.3	1.43
67	PROP20	PO-BMP2	2.510	SCS CN	SCS Unit Hydrograph	0.083	97.2	2.59
68	PROP40	PO-BMP4	3.420	SCS CN	SCS Unit Hydrograph	0.083	95.0	3.38
69	PROP30	PO-BMP3	3.300	SCS CN	SCS Unit Hydrograph	0.083	96.7	3.38
70	PROP50	O-1-PROP	0.670	SCS CN	SCS Unit Hydrograph	0.167	91.9	0.60

FlexTable: Conduit Table
Current Time: 0.00 hours

ID	Is Active?	Label	Start Node	Invert (Start) (ft)	Stop Node	Invert (Stop) (ft)	Length (Scaled) (ft)	Slope (Calculated) (ft/ft)	Length (User Defined) (ft)	Section Type	Diameter (in)	Manning's n	Velocity (Maximum Calculated) (ft/s)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	Hydraulic Grade (Maximum) (ft)	Flow (Maximum) (cfs)
42	True	CO-1	MH-3	12.46	MH-4	11.55	181.5	0.0050	12.0	Circle	12.0	0.013	3.05	18.97	18.98	12.94	1.12
44	True	CO-2	MH-4	11.55	MH-5	9.83	76.0	0.0226		Circle	12.0	0.013	5.43	18.98	18.58	11.88	1.12
46	True	CO-3	MH-5	9.83	MH-6	8.71	226.8	0.0049		Circle	12.0	0.013	3.62	18.58	18.20	10.62	2.29
48	True	CO-4	MH-6	8.71	MH-7	7.75	188.2	0.0051		Circle	12.0	0.013	3.69	18.20	18.53	9.47	2.29
53	True	CO-6	MH-9	10.15	MH-10	8.79	263.4	0.0052		Circle	12.0	0.013	3.65	14.52	15.28	10.89	2.26
55	True	CO-7	MH-10	8.54	MH-11	7.76	157.0	0.0050		Circle	15.0	0.013	3.66	15.28	15.57	9.17	2.25
61	True	CO-10	MH-11	7.76	MH-12	7.22	107.3	0.0050		Circle	15.0	0.013	3.94	15.57	14.05	8.50	2.79
73	True	CO-11	MH-7	7.75	MH-12	7.14	122.3	0.0050		Circle	15.0	0.013	3.71	18.53	14.05	8.39	2.29
77	True	CO-13	MH-14	12.67	MH-3	12.46	28.2	0.0074		Circle	10.0	0.013	3.53	18.90	18.97	13.14	1.12
79	True	CO-14	POS-BMP4-High1	12.72	MH-14	12.67	15.1	0.0033		Circle	10.0	0.013	0.00	18.90	18.90	13.14	0.00
83	True	CO-15	POS-BMP4-Low1	15.00	MH-14	14.90	15.7	0.0064		Circle	12.0	0.013	7.29	18.90	18.90	15.43	1.12
86	True	CO-16	MH-15	8.72	MH-4	11.55	24.9	-0.1135		Circle	10.0	0.013	0.00	18.70	18.98	12.38	0.00
89	True	CO-17	MH-17	10.25	MH-5	10.08	25.9	0.0066		Circle	10.0	0.013	3.46	18.30	18.58	10.75	1.17
92	True	CO-18	POS-BMP3-high1	10.40	MH-17	10.25	9.6	0.0157		Circle	10.0	0.013	0.00	16.70	18.30	10.75	0.00
95	True	CO-19	POS-BMP3-low1	10.40	MH-17	10.25	11.5	0.0131		Circle	10.0	0.013	3.90	0.00	18.30	10.80	1.17
97	True	CO-20	MH-12	6.89	O-1-PROP	6.77	29.9	0.0040		Circle	18.0	0.013	4.13	14.05	12.40	7.91	4.99
103	True	CO-21	MH-19	9.30	MH-11	9.24	10.2	0.0050		Circle	12.0	0.013	2.59	14.80	15.57	9.63	0.57
106	True	CO-22	POS-BMP1-high1	7.63	MH-19	9.30	9.1	-0.1830		Circle	10.0	0.013	0.00	14.80	14.80	9.63	0.00
107	True	CO-23	POS-BMP1-low1	7.63	MH-19	9.30	10.0	-0.1666		Circle	10.0	0.013	2.72	14.80	14.80	9.70	0.56
111	True	CO-24	MH-20	10.20	MH-9	10.15	9.1	0.0055		Circle	12.0	0.013	3.70	14.52	14.52	10.90	2.26
116	True	CO-26	POS-BMP2 high1	10.30	MH-20	10.20	9.1	0.0110		Circle	12.0	0.013	3.23	15.50	14.52	10.90	1.67
117	True	CO-27	POS-BMP2 low1	10.30	MH-20	10.20	14.7	0.0068		Circle	12.0	0.013	1.17	15.00	14.52	10.90	0.60

FlexTable: Manhole Table

Current Time: 0.00 hours

ID	Is Active?	Label	Elevation (Ground) (ft)	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Local Inflow (Maximum) (cfs)	Flow (Total In Maximum) (cfs)	Hydraulic Grade (Maximum) (ft)
40	True	MH-3	18.97	18.97	12.46	(N/A)	1.12	12.94
41	True	MH-4	18.98	18.98	11.55	(N/A)	1.12	12.00
43	True	MH-5	18.58	18.58	9.83	(N/A)	2.29	10.63
45	True	MH-6	18.20	18.20	8.71	(N/A)	2.29	9.47
47	True	MH-7	18.53	18.53	7.75	(N/A)	2.29	8.40
51	True	MH-9	14.52	14.52	10.15	(N/A)	2.26	10.90
52	True	MH-10	15.28	15.28	8.54	(N/A)	2.26	9.44
54	True	MH-11	15.57	15.57	7.76	(N/A)	2.80	8.50
56	True	MH-12	14.05	14.05	6.89	(N/A)	4.96	7.91
76	True	MH-14	18.90	18.90	12.67	(N/A)	1.12	13.14
85	True	MH-15	18.70	18.70	8.72	(N/A)	0.00	12.38
88	True	MH-17	18.30	18.30	10.25	(N/A)	1.17	10.75
102	True	MH-19	14.80	14.80	9.30	(N/A)	0.56	9.63
110	True	MH-20	14.52	14.52	10.20	(N/A)	2.27	10.90

FlexTable: Pond Table
Current Time: 0.00 hours

ID	Is Active?	Label	Volume Type	Storage (Maximum) (ft ³)	Flow (Out to Links Maximum) (cfs)	Hydraulic Grade (Maximum) (ft)	Local Inflow (Maximum) (cfs)	Flow (Total In Maximum) (cfs)
37	True	PO-BMP4	Elevation-Area	11,257	1.12	17.54	(N/A)	3.38
63	True	PO-BMP3	Elevation-Area	7,739	1.17	15.26	(N/A)	3.38
64	True	PO-BMP2	Elevation-Area	7,282	2.27	14.31	(N/A)	2.59
65	True	PO-BMP1	Elevation-Area	4,146	0.56	14.19	(N/A)	1.43

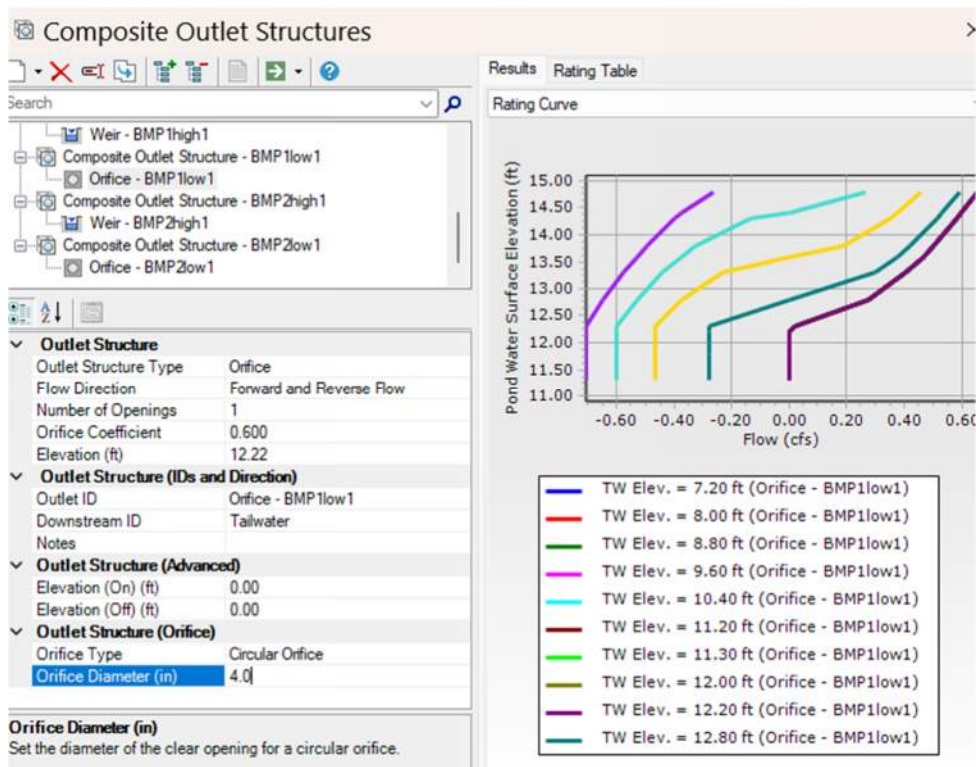
FlexTable: Outfall Table

Current Time: 0.00 hours

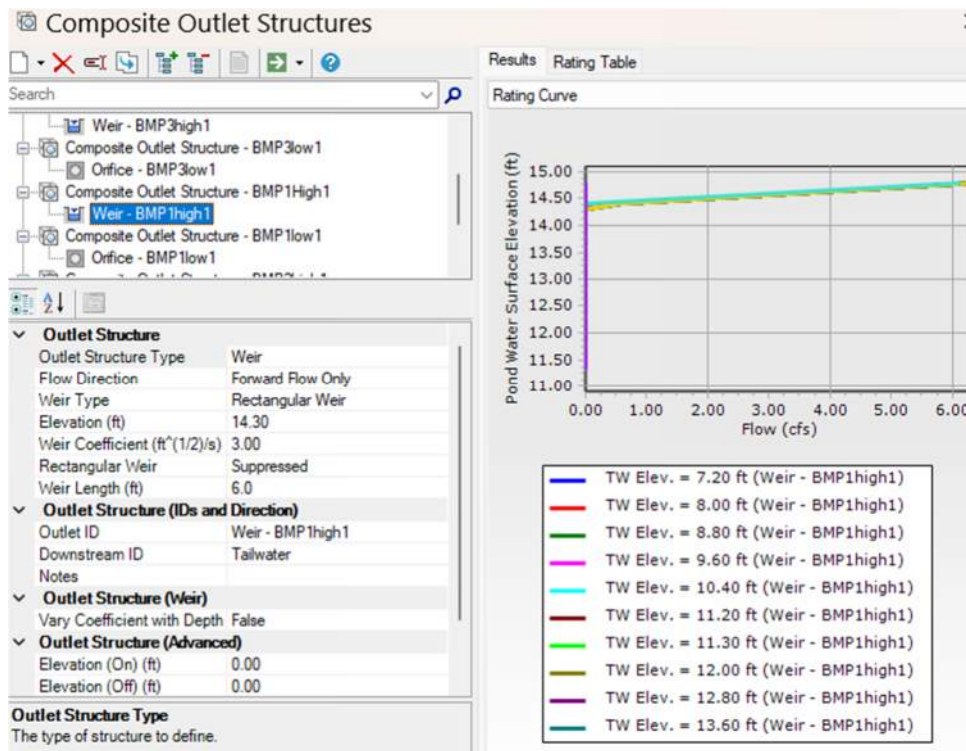
ID	Label	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Elevation (Rim) (ft)	Boundary Condition Type	Flow (Total In Maximum) (cfs)	Hydraulic Grade (Maximum) (ft)
36	O-1-EX	0.00	0.00	0.00	Free Outfall	(N/A)	(N/A)
62	O-1- PROP	12.40	6.77	12.40	Normal	5.43	7.80

	Elevation (ft)	Area (acres)	Percent Void Space (%)
1	11.30	0.069	40.0
2	12.30	0.069	40.0
3	12.31	0.069	40.0
4	13.80	0.069	40.0
5	13.81	0.06 0.069	100.0
6	14.80	0.069	100.0
*			

BMP 1, Stage-Storage Curve



BMP 1, Outlet Structure, Low Flow



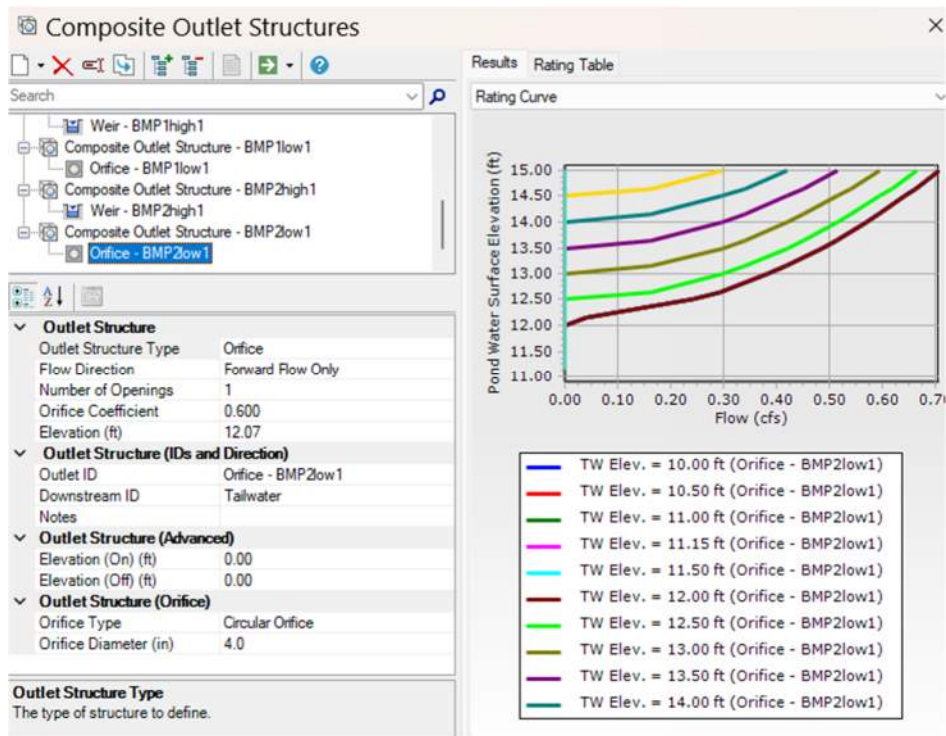
BMP 1, Outlet Structure, High Flow (18" x 18" Grate Inlet)

Elevation-Area - Pond (PO-BMP2)

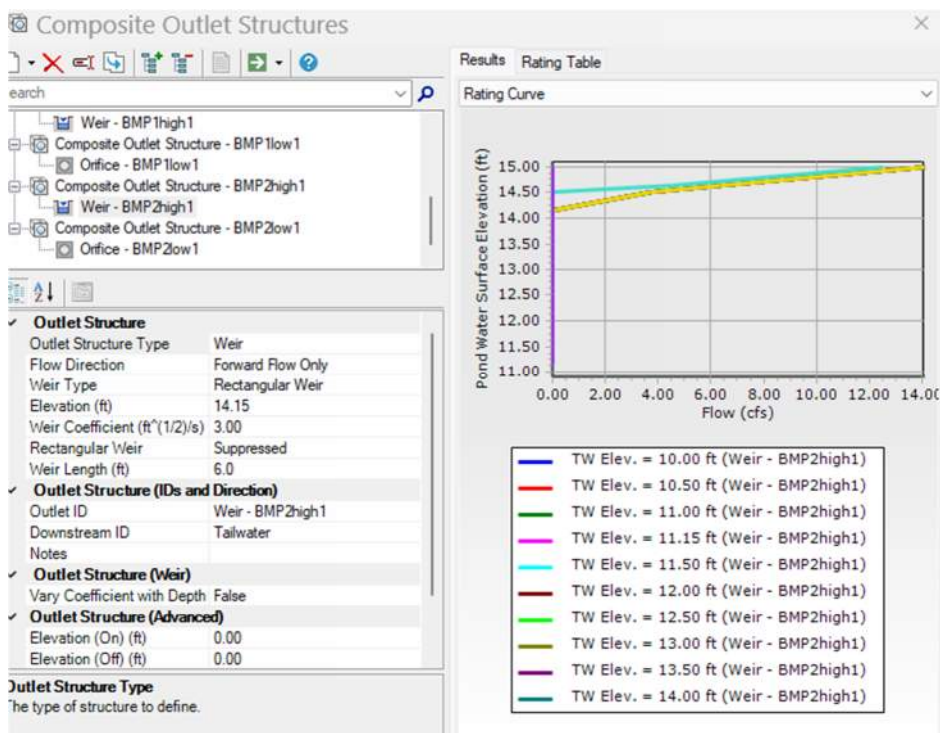
	Elevation (ft)	Area (acres)	Percent Void Space (%)
1	11.15	0.101	40.0
2	12.15	0.101	40.0
3	12.16	0.101	40.0
4	13.65	0.101	40.0
5	13.66	0.101	100.0
6	14.41	0.101	100.0
7	14.50	0.112	100.0
8	15.00	0.112	100.0

OK Cancel Help

BMP 2, Stage-Storage Curve



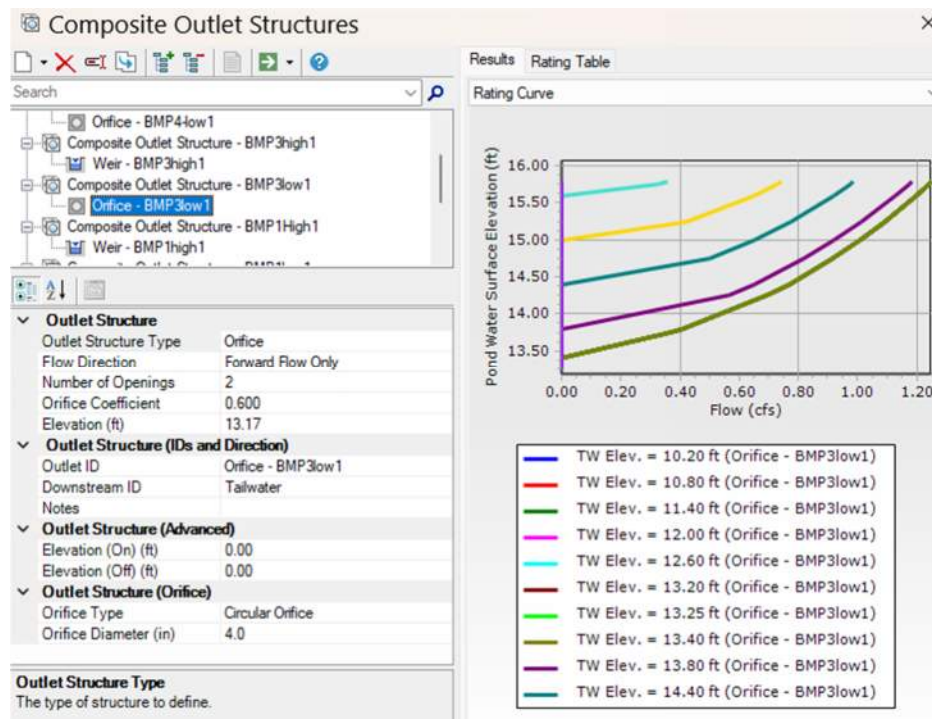
BMP 2, Outlet Structure, Low Flow



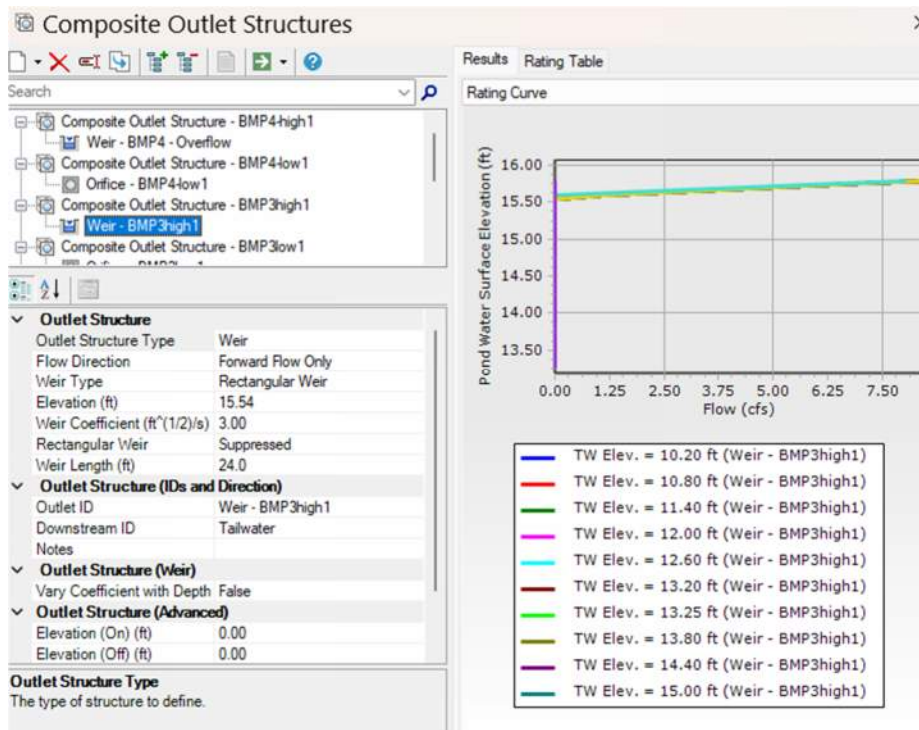
BMP 2, Outlet Structure, High Flow (18" x 18" Grate Inlet)

	Elevation (ft)	Area (acres)	Percent Void Space (%)
1	13.25	0.149	40.0
2	14.25	0.149	40.0
3	14.26	0.149	40.0
4	14.75	0.149	40.0
5	14.76	0.173	100.0
6	15.55	0.173	100.0
7	15.78	0.181	100.0

BMP 3, Stage-Storage Curve



BMP 3, Outlet Structure, Low Flow



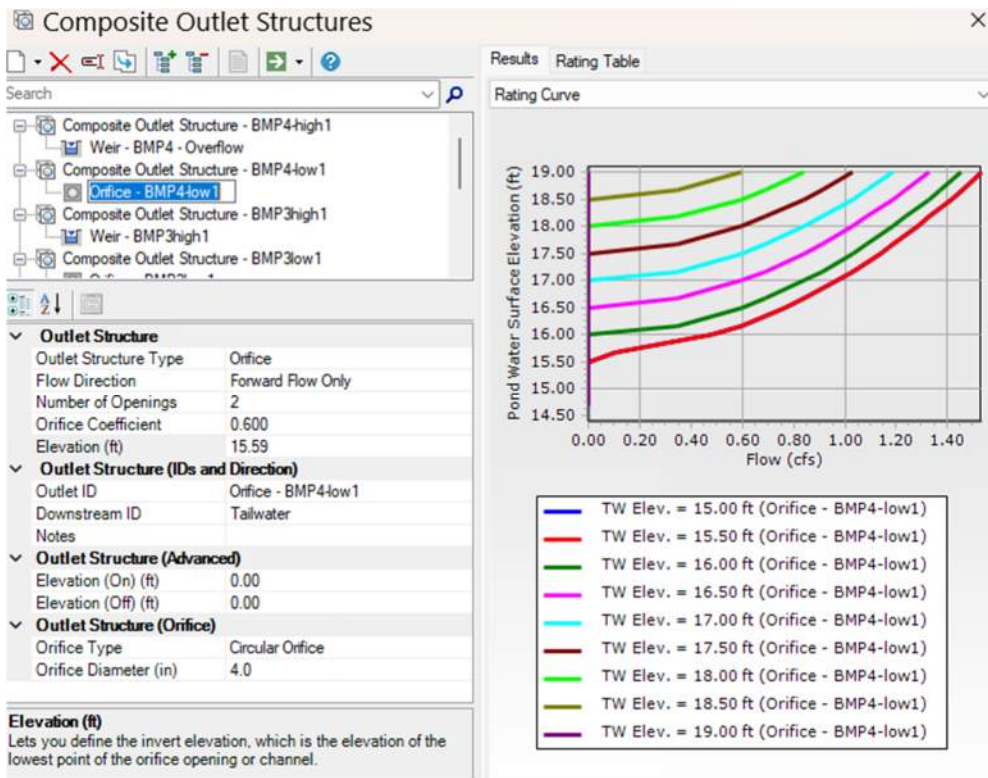
BMP 3, Outlet Structure, High Flow (2 -- 36" x 36" Grate Inlets)

Elevation-Area - Pond (PO-BMP4)

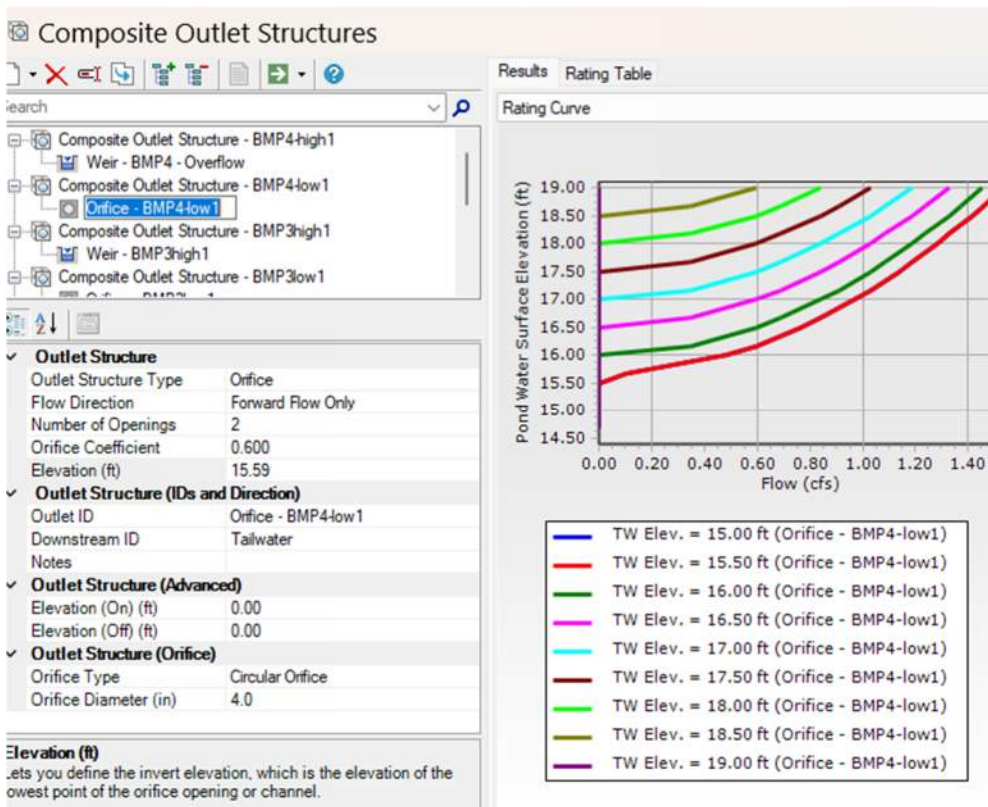
	Elevation (ft)	Area (acres)	Percent Void Space (%)
1	14.67	0.163	40.0
2	15.66	0.163	40.0
3	15.67	0.163	40.0
4	17.17	0.212	40.0
5	17.18	0.212	100.0
6	18.71	0.265	100.0
7	19.00	0.265	100.0
*			

OK Cancel Help

BMP 4, Stage-Storage Curve



BMP 4, Outlet Structure, Low Flow



BMP 4, Outlet Structure, High Flow (2 -- 36" x 36" Grate Inlets)

APPENDIX C

MODEL INPUT AND OUTPUT FOR THE 25- YEAR STORM EVENT

FlexTable: Catchment Table

Current Time: 8.10 hours

ID	Label	Outflow Element	Area (User Defined) (acres)	Loss Method	Unit Hydrograph Method	Time of Concentration (hours)	SCS CN (Composite)	Flow (Maximum) (cfs)
35	EX10	O-1-EX	11.330	SCS CN	SCS Unit Hydrograph	0.880	89.7	8.86
66	PROP10	PO-BMP1	1.410	SCS CN	SCS Unit Hydrograph	0.083	96.3	1.77
67	PROP20	PO-BMP2	2.510	SCS CN	SCS Unit Hydrograph	0.083	97.2	3.18
68	PROP40	PO-BMP4	3.420	SCS CN	SCS Unit Hydrograph	0.083	95.0	4.20
69	PROP30	PO-BMP3	3.300	SCS CN	SCS Unit Hydrograph	0.083	96.7	4.16
70	PROP50	O-1-PROP	0.670	SCS CN	SCS Unit Hydrograph	0.167	91.9	0.76

FlexTable: Conduit Table
Current Time: 8.10 hours

ID	Is Active?	Label	Start Node	Invert (Start) (ft)	Stop Node	Invert (Stop) (ft)	Length (Scaled) (ft)	Slope (Calculated) (ft/ft)	Length (User Defined) (ft)	Section Type	Diameter (in)	Manning's n	Velocity (Maximum Calculated) (ft/s)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	Hydraulic Grade (Maximum) (ft)	Flow (Maximum) (cfs)
42	True	CO-1	MH-3	12.46	MH-4	11.55	181.5	0.0050	12.0	Circle	12.0	0.013	3.12	18.97	18.98	12.96	1.21
44	True	CO-2	MH-4	11.55	MH-5	9.83	76.0	0.0226		Circle	12.0	0.013	6.02	18.98	18.58	11.90	1.21
46	True	CO-3	MH-5	9.83	MH-6	8.71	226.8	0.0049		Circle	12.0	0.013	3.71	18.58	18.20	11.13	2.91
48	True	CO-4	MH-6	8.71	MH-7	7.75	188.2	0.0051		Circle	12.0	0.013	3.89	18.20	18.53	9.73	2.90
53	True	CO-6	MH-9	10.15	MH-10	8.79	263.4	0.0052		Circle	12.0	0.013	3.86	14.52	15.28	11.45	3.03
55	True	CO-7	MH-10	8.54	MH-11	7.76	157.0	0.0050		Circle	15.0	0.013	3.94	15.28	15.57	9.30	3.02
61	True	CO-10	MH-11	7.76	MH-12	7.22	107.3	0.0050		Circle	15.0	0.013	4.32	15.57	14.05	8.69	3.90
73	True	CO-11	MH-7	7.75	MH-12	7.14	122.3	0.0050		Circle	15.0	0.013	3.95	18.53	14.05	8.48	2.90
77	True	CO-13	MH-14	12.67	MH-3	12.46	28.2	0.0074		Circle	10.0	0.013	3.61	18.90	18.97	13.16	1.21
79	True	CO-14	POS-BMP4-High1	12.72	MH-14	12.67	15.1	0.0033		Circle	10.0	0.013	0.00	18.90	18.90	13.16	0.00
83	True	CO-15	POS-BMP4-Low1	15.00	MH-14	14.90	15.7	0.0064		Circle	12.0	0.013	7.82	18.90	18.90	15.45	1.21
86	True	CO-16	MH-15	8.72	MH-4	11.55	24.9	-0.1135		Circle	10.0	0.013	0.00	18.70	18.98	12.38	0.00
89	True	CO-17	MH-17	10.25	MH-5	10.08	25.9	0.0066		Circle	10.0	0.013	3.16	18.30	18.58	11.20	1.72
92	True	CO-18	POS-BMP3-high1	10.40	MH-17	10.25	9.6	0.0157		Circle	10.0	0.013	0.98	16.70	18.30	11.20	0.52
95	True	CO-19	POS-BMP3-low1	10.40	MH-17	10.25	11.5	0.0131		Circle	10.0	0.013	2.38	0.00	18.30	11.20	1.25
97	True	CO-20	MH-12	6.89	O-1-PROP	6.77	29.9	0.0040		Circle	18.0	0.013	4.27	14.05	12.40	8.11	6.26
103	True	CO-21	MH-19	9.30	MH-11	9.24	10.2	0.0050		Circle	12.0	0.013	3.10	14.80	15.57	9.75	1.07
106	True	CO-22	POS-BMP1-high1	7.63	MH-19	9.30	9.1	-0.1830		Circle	10.0	0.013	1.73	14.80	14.80	9.75	0.48
107	True	CO-23	POS-BMP1-low1	7.63	MH-19	9.30	10.0	-0.1666		Circle	10.0	0.013	2.14	14.80	14.80	9.75	0.59
111	True	CO-24	MH-20	10.20	MH-9	10.15	9.1	0.0055		Circle	12.0	0.013	3.86	14.52	14.52	11.47	3.03
116	True	CO-26	POS-BMP2 high1	10.30	MH-20	10.20	9.1	0.0110		Circle	12.0	0.013	3.11	15.50	14.52	11.47	2.44
117	True	CO-27	POS-BMP2 low1	10.30	MH-20	10.20	14.7	0.0068		Circle	12.0	0.013	0.78	15.00	14.52	11.47	0.61

FlexTable: Manhole Table

Current Time: 8.10 hours

ID	Is Active?	Label	Elevation (Ground) (ft)	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Local Inflow (Maximum) (cfs)	Flow (Total In Maximum) (cfs)	Hydraulic Grade (Maximum) (ft)
40	True	MH-3	18.97	18.97	12.46	(N/A)	1.21	12.96
41	True	MH-4	18.98	18.98	11.55	(N/A)	1.21	12.01
43	True	MH-5	18.58	18.58	9.83	(N/A)	2.91	11.13
45	True	MH-6	18.20	18.20	8.71	(N/A)	2.91	9.73
47	True	MH-7	18.53	18.53	7.75	(N/A)	2.90	8.50
51	True	MH-9	14.52	14.52	10.15	(N/A)	3.03	11.46
52	True	MH-10	15.28	15.28	8.54	(N/A)	3.03	9.55
54	True	MH-11	15.57	15.57	7.76	(N/A)	3.95	8.69
56	True	MH-12	14.05	14.05	6.89	(N/A)	6.25	8.12
76	True	MH-14	18.90	18.90	12.67	(N/A)	1.21	13.16
85	True	MH-15	18.70	18.70	8.72	(N/A)	0.00	12.38
88	True	MH-17	18.30	18.30	10.25	(N/A)	1.77	11.20
102	True	MH-19	14.80	14.80	9.30	(N/A)	1.07	9.75
110	True	MH-20	14.52	14.52	10.20	(N/A)	3.06	11.47

FlexTable: Pond Table
Current Time: 8.10 hours

ID	Is Active?	Label	Volume Type	Storage (Maximum) (ft ³)	Flow (Out to Links Maximum) (cfs)	Hydraulic Grade (Maximum) (ft)	Local Inflow (Maximum) (cfs)	Flow (Total In Maximum) (cfs)
37	True	PO-BMP4	Elevation-Area	14,368	1.21	17.85	(N/A)	4.20
63	True	PO-BMP3	Elevation-Area	10,059	1.77	15.57	(N/A)	4.16
64	True	PO-BMP2	Elevation-Area	7,607	3.06	14.38	(N/A)	3.18
65	True	PO-BMP1	Elevation-Area	4,730	1.07	14.38	(N/A)	1.77

FlexTable: Outfall Table

Current Time: 8.10 hours

ID	Label	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Elevation (Rim) (ft)	Boundary Condition Type	Flow (Total In Maximum) (cfs)	Hydraulic Grade (Maximum) (ft)
36	O-1-EX	0.00	0.00	0.00	Free Outfall	(N/A)	(N/A)
62	O-1- PROP	12.40	6.77	12.40	Normal	6.76	7.99

APPENDIX D

RAINFALL DATA



POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

[PF tabular](#) | [PF graphical](#) | [Maps & aerals](#)

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches) ¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.111 (0.098-0.125)	0.141 (0.126-0.160)	0.182 (0.162-0.208)	0.217 (0.190-0.249)	0.265 (0.224-0.317)	0.303 (0.249-0.371)	0.342 (0.274-0.431)	0.383 (0.297-0.498)	0.440 (0.326-0.601)	0.485 (0.345-0.689)
10-min	0.158 (0.141-0.180)	0.202 (0.180-0.230)	0.262 (0.232-0.298)	0.311 (0.273-0.357)	0.379 (0.321-0.454)	0.434 (0.358-0.531)	0.490 (0.393-0.617)	0.549 (0.426-0.714)	0.631 (0.467-0.861)	0.696 (0.495-0.987)
15-min	0.192 (0.171-0.217)	0.245 (0.218-0.278)	0.316 (0.280-0.360)	0.376 (0.330-0.432)	0.459 (0.388-0.549)	0.524 (0.432-0.642)	0.592 (0.475-0.746)	0.664 (0.515-0.864)	0.763 (0.564-1.04)	0.841 (0.599-1.19)
30-min	0.273 (0.243-0.309)	0.348 (0.310-0.396)	0.450 (0.399-0.513)	0.535 (0.470-0.615)	0.653 (0.552-0.781)	0.746 (0.615-0.914)	0.843 (0.676-1.06)	0.944 (0.733-1.23)	1.08 (0.803-1.48)	1.20 (0.852-1.70)
60-min	0.390 (0.347-0.442)	0.498 (0.443-0.566)	0.643 (0.570-0.733)	0.765 (0.671-0.880)	0.934 (0.789-1.12)	1.07 (0.880-1.31)	1.20 (0.966-1.52)	1.35 (1.05-1.76)	1.55 (1.15-2.12)	1.71 (1.22-2.43)
2-hr	0.591 (0.526-0.670)	0.740 (0.658-0.841)	0.938 (0.831-1.07)	1.10 (0.966-1.26)	1.32 (1.12-1.58)	1.50 (1.23-1.83)	1.67 (1.34-2.11)	1.86 (1.44-2.41)	2.10 (1.56-2.87)	2.30 (1.64-3.26)
3-hr	0.753 (0.671-0.854)	0.940 (0.836-1.07)	1.19 (1.05-1.35)	1.39 (1.22-1.60)	1.66 (1.40-1.98)	1.87 (1.54-2.29)	2.08 (1.67-2.62)	2.30 (1.78-2.99)	2.60 (1.92-3.54)	2.82 (2.01-4.01)
6-hr	1.10 (0.982-1.25)	1.39 (1.23-1.58)	1.75 (1.56-2.00)	2.05 (1.80-2.36)	2.44 (2.06-2.92)	2.74 (2.26-3.36)	3.04 (2.44-3.84)	3.35 (2.60-4.36)	3.76 (2.78-5.12)	4.06 (2.89-5.77)
12-hr	1.47 (1.31-1.67)	1.94 (1.72-2.20)	2.52 (2.24-2.88)	2.99 (2.63-3.44)	3.61 (3.05-4.31)	4.07 (3.35-4.98)	4.52 (3.62-5.70)	4.98 (3.86-6.48)	5.58 (4.13-7.61)	6.02 (4.29-8.55)
24-hr	1.96 (1.76-2.22)	2.71 (2.43-3.07)	3.65 (3.27-4.15)	4.38 (3.91-5.02)	5.34 (4.63-6.29)	6.05 (5.16-7.24)	6.74 (5.63-8.24)	7.43 (6.06-9.29)	8.33 (6.56-10.8)	8.99 (6.88-12.0)
2-day	2.51 (2.26-2.84)	3.45 (3.10-3.92)	4.63 (4.16-5.27)	5.56 (4.95-6.36)	6.76 (5.86-7.95)	7.64 (6.51-9.15)	8.50 (7.10-10.4)	9.36 (7.64-11.7)	10.5 (8.26-13.6)	11.3 (8.65-15.1)
3-day	2.94 (2.65-3.34)	4.02 (3.62-4.57)	5.38 (4.82-6.11)	6.43 (5.73-7.36)	7.80 (6.76-9.18)	8.80 (7.50-10.5)	9.78 (8.17-11.9)	10.8 (8.77-13.4)	12.0 (9.46-15.5)	12.9 (9.90-17.2)
4-day	3.31 (2.98-3.75)	4.52 (4.07-5.14)	6.04 (5.42-6.87)	7.21 (6.43-8.26)	8.73 (7.57-10.3)	9.84 (8.38-11.8)	10.9 (9.11-13.3)	12.0 (9.77-15.0)	13.3 (10.5-17.3)	14.3 (11.0-19.1)
7-day	4.10 (3.69-4.65)	5.72 (5.14-6.49)	7.68 (6.89-8.74)	9.18 (8.18-10.5)	11.1 (9.59-13.0)	12.4 (10.6-14.9)	13.7 (11.4-16.7)	14.9 (12.2-18.7)	16.5 (13.0-21.3)	17.6 (13.5-23.5)
10-day	4.63 (4.17-5.25)	6.50 (5.85-7.38)	8.76 (7.86-9.96)	10.5 (9.32-12.0)	12.6 (10.9-14.8)	14.1 (12.0-16.8)	15.5 (12.9-18.9)	16.8 (13.7-21.0)	18.5 (14.6-24.0)	19.7 (15.1-26.2)
20-day	6.14 (5.53-6.96)	8.52 (7.66-9.67)	11.4 (10.2-12.9)	13.5 (12.0-15.5)	16.1 (14.0-19.0)	18.0 (15.3-21.5)	19.7 (16.5-24.1)	21.4 (17.4-26.7)	23.4 (18.5-30.3)	24.9 (19.0-33.1)
30-day	7.44 (6.70-8.44)	10.1 (9.10-11.5)	13.3 (12.0-15.2)	15.8 (14.0-18.0)	18.8 (16.3-22.1)	20.9 (17.8-25.0)	22.8 (19.1-27.9)	24.7 (20.2-30.9)	27.0 (21.3-35.0)	28.7 (21.9-38.2)
45-day	9.28 (8.36-10.5)	12.3 (11.0-13.9)	15.8 (14.2-18.0)	18.5 (16.5-21.2)	21.9 (19.0-25.8)	24.3 (20.7-29.1)	26.5 (22.1-32.4)	28.7 (23.4-35.8)	31.3 (24.7-40.5)	33.2 (25.4-44.2)
60-day	11.2 (10.1-12.7)	14.4 (13.0-16.4)	18.3 (16.4-20.8)	21.2 (18.9-24.3)	24.9 (21.6-29.3)	27.5 (23.4-32.9)	30.0 (25.0-36.6)	32.3 (26.4-40.5)	35.3 (27.8-45.7)	37.5 (28.7-49.9)

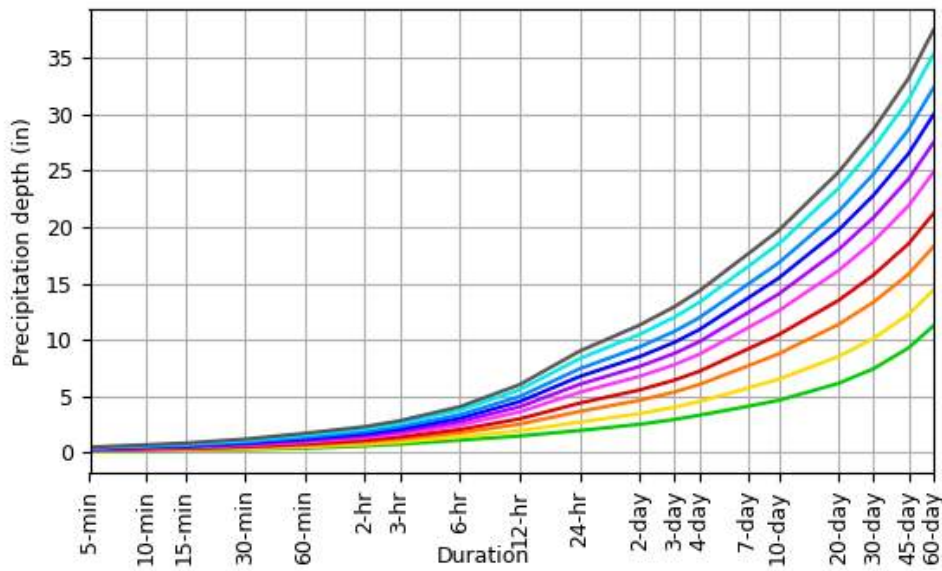
¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).
Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.
Please refer to NOAA Atlas 14 document for more information.

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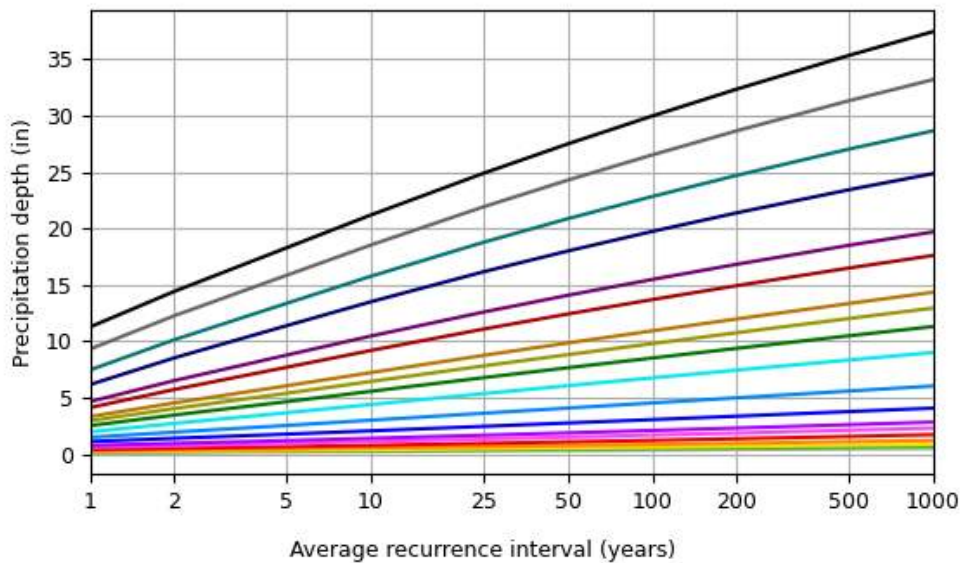
PF graphical

PDS-based depth-duration-frequency (DDF) curves

Latitude: 38.2587°, Longitude: -122.2780°



Average recurrence interval (years)
1
2
5
10
25
50
100
200
500
1000

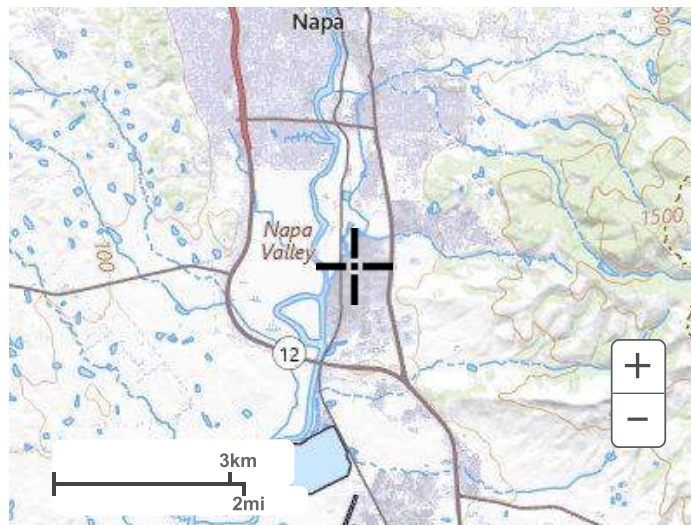


Duration	
5-min	2-day
10-min	3-day
15-min	4-day
30-min	7-day
60-min	10-day
2-hr	20-day
3-hr	30-day
6-hr	45-day
12-hr	60-day
24-hr	

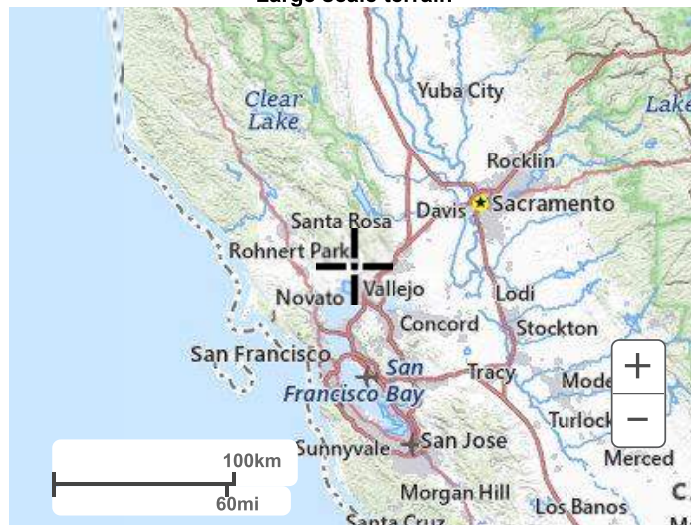
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Maps & aerials

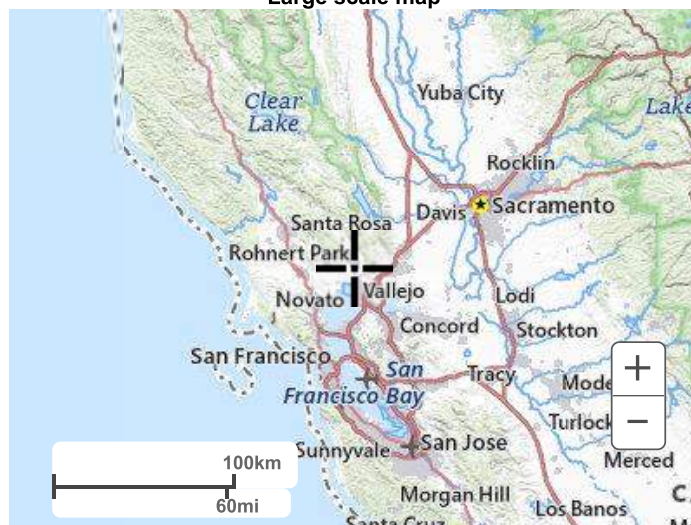
Small scale terrain



Large scale terrain



Large scale map



Large scale aerial



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[National Weather Service](#)
[National Water Center](#)
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

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APPENDIX E

WEIGHTED CURVE NUMBER CURVES

PROJECT: Napa Valley Vintners Park
 PROJECT #: 4808-1
 LOCATION: Napa, CA
 FILE:

DATE: 23-Sep-25
 CALC BY: BRD
 CHECKED BY: Draft
 SHEETS:

LAUGENOUR AND MEIKLE
 CIVIL ENGINEERS
 608 COURT STREET
 WOODLAND, CA 95695

Purpose: Calculate weighted average of NRCS curve numbers for model sheds

Table 2 - Site Land Uses and Runoff Curve Numbers

Shed	Impervious Coverage				Pervious Coverage 1				Pervious Coverage 2				Total	
	Equivalent Use ¹	Area, Ac	% Coverage	CN ²	Equivalent Use ¹	Area, Ac	% Coverage	CN ¹	Equivalent Use ¹	Area, Ac	% Coverage	CN ¹	Area, Ac	Weighted CN
EX10	Impervious Areas	0.88	7.8	98	Herbaceous, Fair, D Soil	10.43	92.2	89					11.31	89.7
PROP10	Impervious Areas	1.17	83.1	98	Western desert urban, D Soil	0.24	16.9	88					1.41	96.3
PROP20	Impervious Areas	2.31	92.0	98	Western desert urban, D Soil	0.20	8.0	88					2.51	97.2
PROP30	Impervious Areas	2.86	86.7	98	Western desert urban, D Soil	0.44	13.3	88					3.30	96.7
PROP40	Impervious Areas	2.40	70.2	98	Western desert urban, D Soil	1.02	29.8	88					3.42	95.0
PROP50	Impervious Areas	0.26	39.4	98	Western desert urban, D Soil	0.41	60.6	88					0.67	91.9

¹Most similar land use listed Table 2-2a/b of the NRCS TR-55 Hydrology Manual.

²Based on land use of Impervious Area, Streets and Roads, Gravel, listed in Table 9-5 of National Engineering Handbook, Part 630.

APPENDIX F

TIME OF CONCENTRATION CALCULATIONS

PROJECT: Napa Vvalley Vintners Park
PROJECT #: 4808-1
LOCATION: Napa
FILE:

DATE: 24-Sep-25
CALC BY: BRD
CHECKED BY: draft
SHEETS:

LAUGENOUR AND MEIKLE
CIVIL ENGINEERS
608 COURT STREET
WOODLAND, CA 95695

Purpose: Calculate times of concentration for subsheds.

Table 1 -Time of Concentration Calculations.

Condition	Shed(s)	Sheet Flow					Shallow Flow				Channel/Pipe Flow						Total	
		L, ft	S, ft/ft	n ^(a)	P2	t _{sheet} , min. ^(b)	L, ft	S, ft/ft	V, ft/s ^(c)	t _{shallow} , min. ^(d)	L, ft	S, ft/ft	Pipe Diameter (in)	n	V, ft/s ^(e)	t _{pipe} , min. ^(f)	t _c , min ^(g)	t _c , hr ^(g)
Existing	EX10	200	0.0100	0.30	2.71	42.6	730	0.0055	1.2	10.1	1	0.0025	12	0.015	1.96	0.0	52.7	0.88

(a) Manning roughness coefficient selected from Yolo County City/County Drainage Manual, Table 13, Parameters for Overland Flow with Flow Depths Less than Two inches.

(b) $t_{sheet} = 0.007(nL)^{0.8}/((P_2)^{0.5}(S)^{0.4})$, where t_{sheet} = travel time (hr), n = Manning's roughness, L = flow length (ft), P_2 = 2-year, 24-hr rainfall depth (2.71 in. at this site), and S = slope of hydraulic grade line (land slope, ft/ft).
Value in column was converted to minutes. Maximum L = 300 feet. Reference: HEC-HMS Technical Reference Manual, March 2000.
N-value based on land use and Table 13 of the Yolo County Drainage Manual, 2010.

(c) $V = 16.1345(S)^{0.5}$, where V = average velocity (ft/s) for unpaved shallow flow, and S = slope of hydraulic grade line (water course slope, ft/ft).
Reference: HEC-HMS Technical Reference Manual, March 2000.

(d) $t_{shallow} = L/V$ x unit conversion.

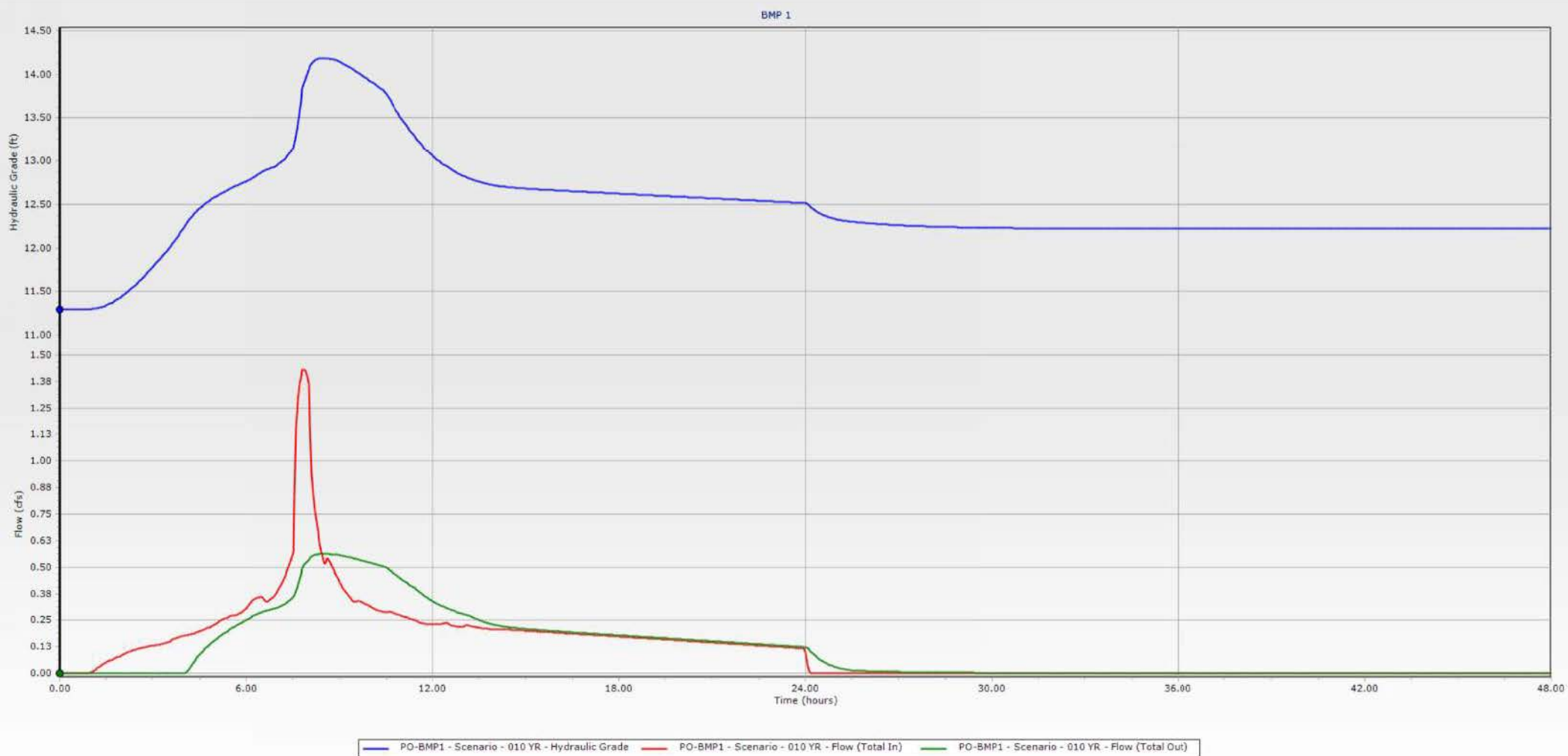
(e) V = pipe flow velocity, estimated using Mannings equation for pipe flowing full: $V = 1.49/n \cdot R^{0.67} \cdot S^{0.50}$
R= hydraulic radius, D/4 for full pipe flow, ft
n= Mannings "n", design value=0.015
Reference: Page 24, Pipe Flow Equation of the Putah Creek/Dry Creek Subbasins Drainage Report, Wood Rodgers, August 2005.

(f) $t_{pipe} = L/V$ x unit conversion.

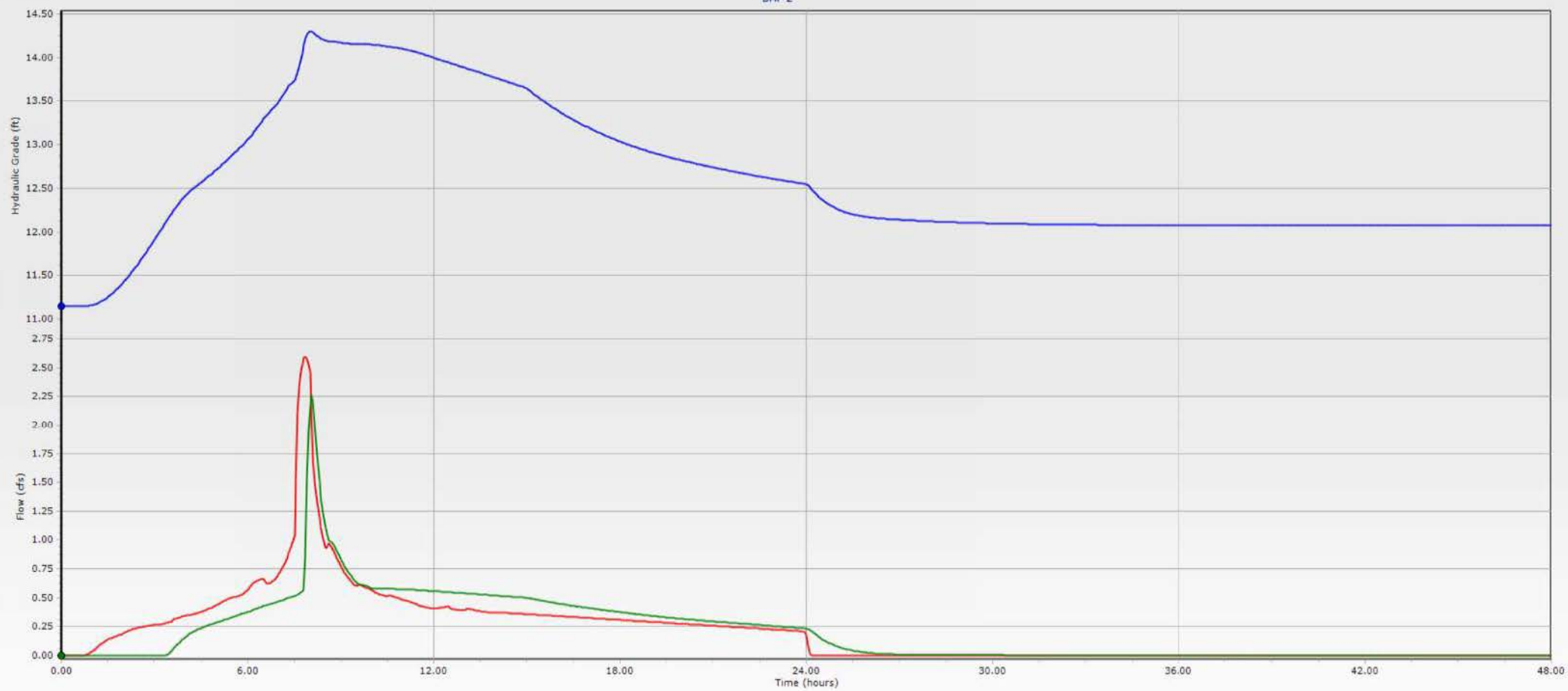
(g) t_c = Time of Concentration = $t_{sheet} + t_{shallow} + t_{pipe}$.

APPENDIX G

TIME SERIES PLOTS FOR BMP'S 1 THROUGH 4

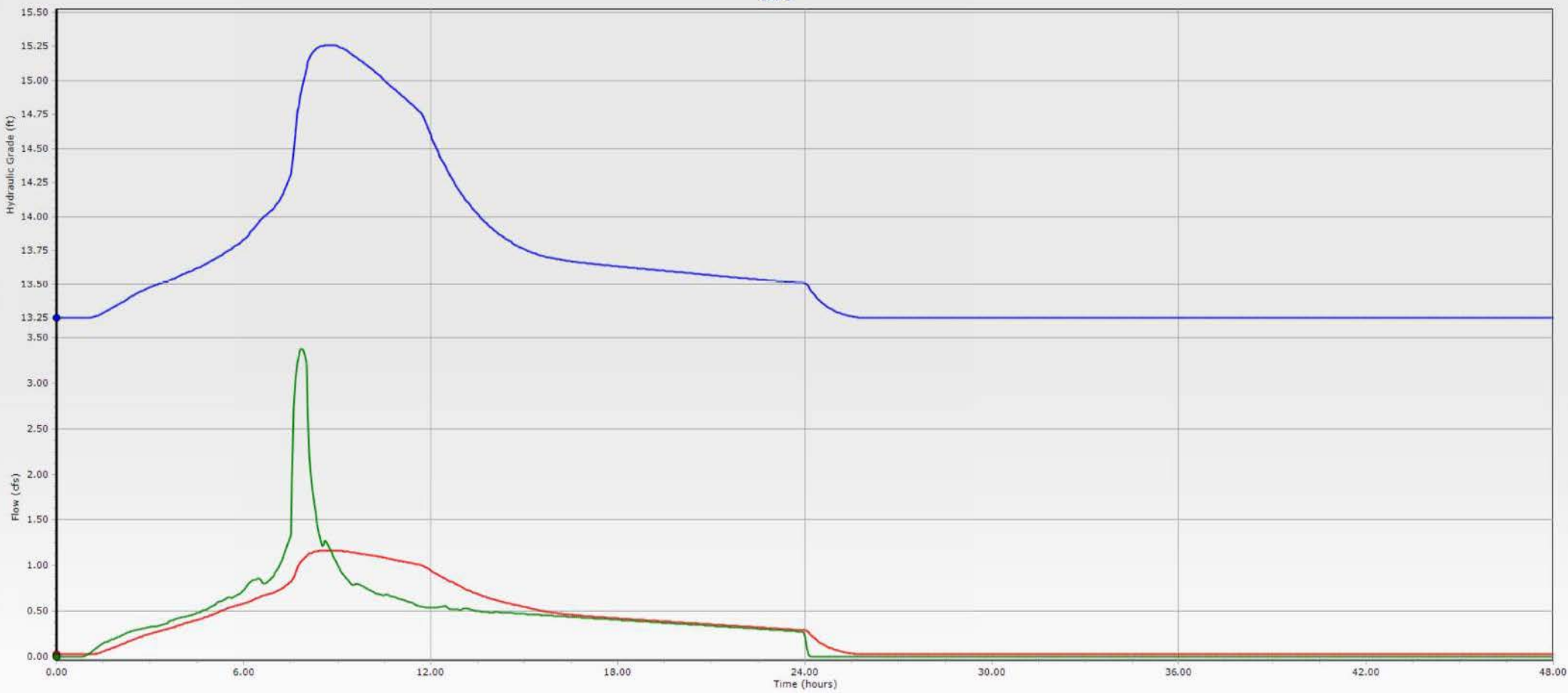


BMP 2



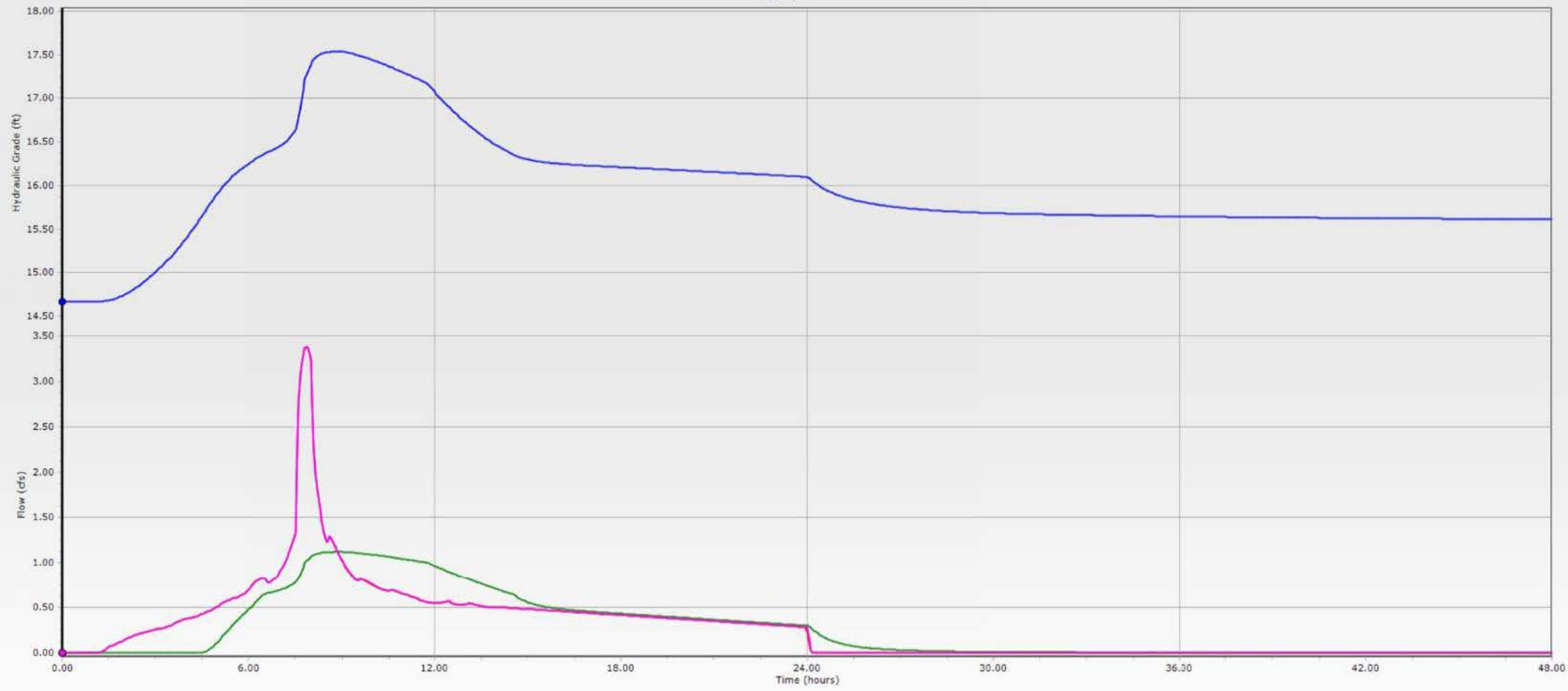
PO-BMP2 - Scenario - 010 YR - Hydraulic Grade PO-BMP2 - Scenario - 010 YR - Flow (Total In) PO-BMP2 - Scenario - 010 YR - Flow (Total Out)

BMP 3



PO-BMP3 - Scenario - 010 YR - Hydraulic Grade PO-BMP3 - Scenario - 010 YR - Flow (Total Out) PO-BMP3 - Scenario - 010 YR - Flow (Total In)

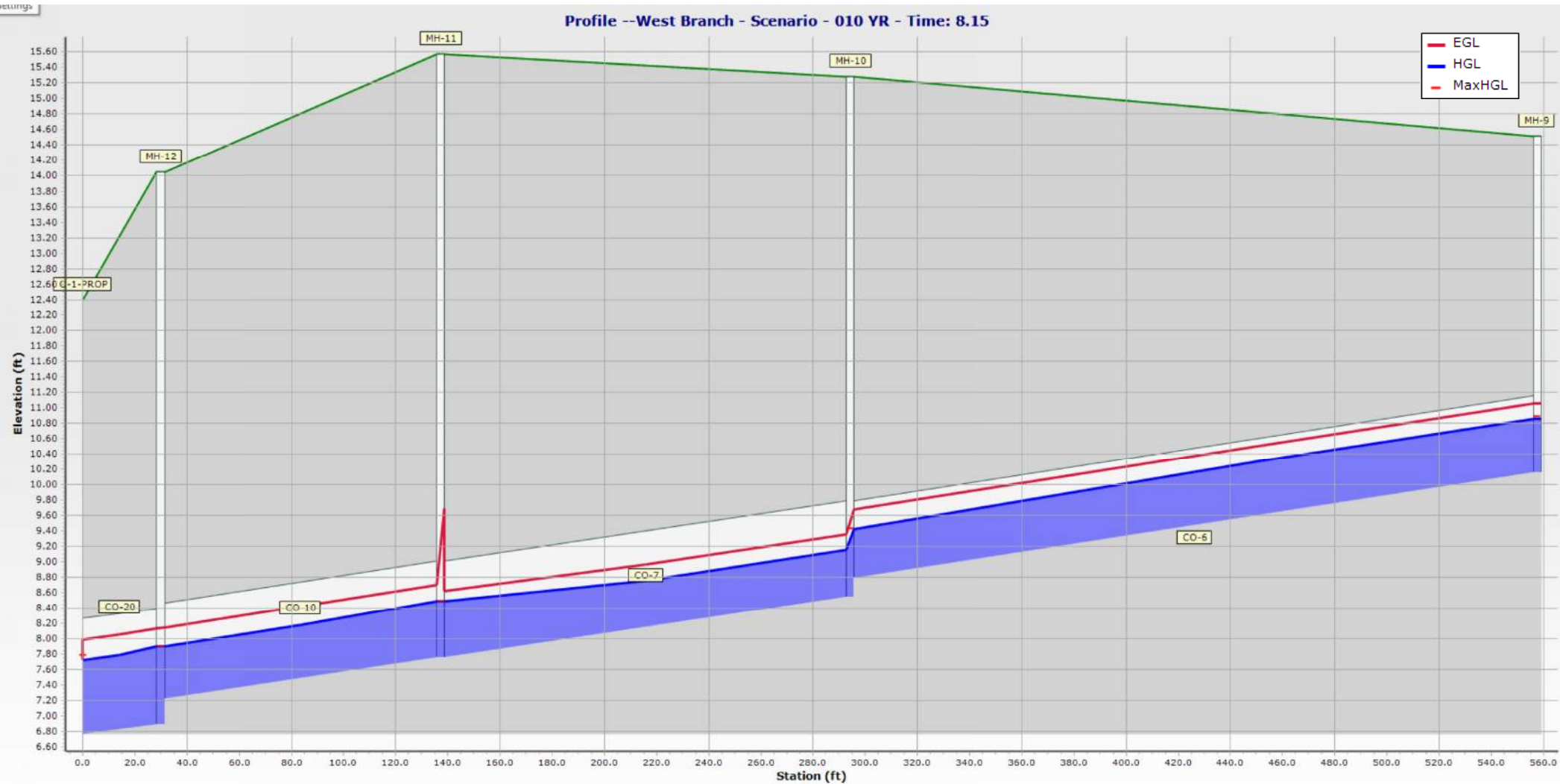
BMP 4



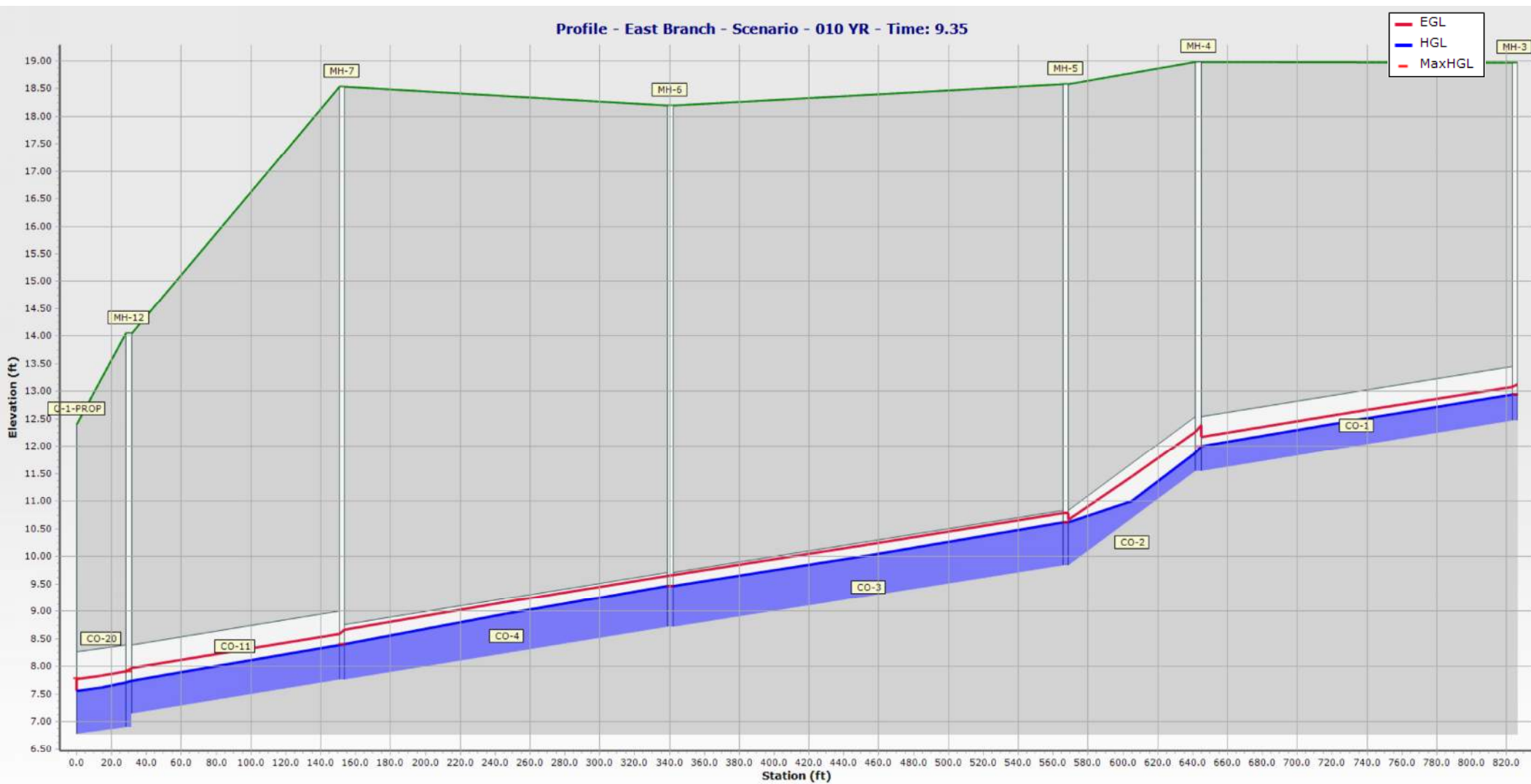
PO-BMP4 - Scenario - 010 YR - Hydraulic Grade PO-BMP4 - Scenario - 010 YR - Flow (Total In) PO-BMP4 - Scenario - 010 YR - Flow (Total Out) PROP40 - Scenario - 010 YR - Flow (Total Out)

APPENDIX H

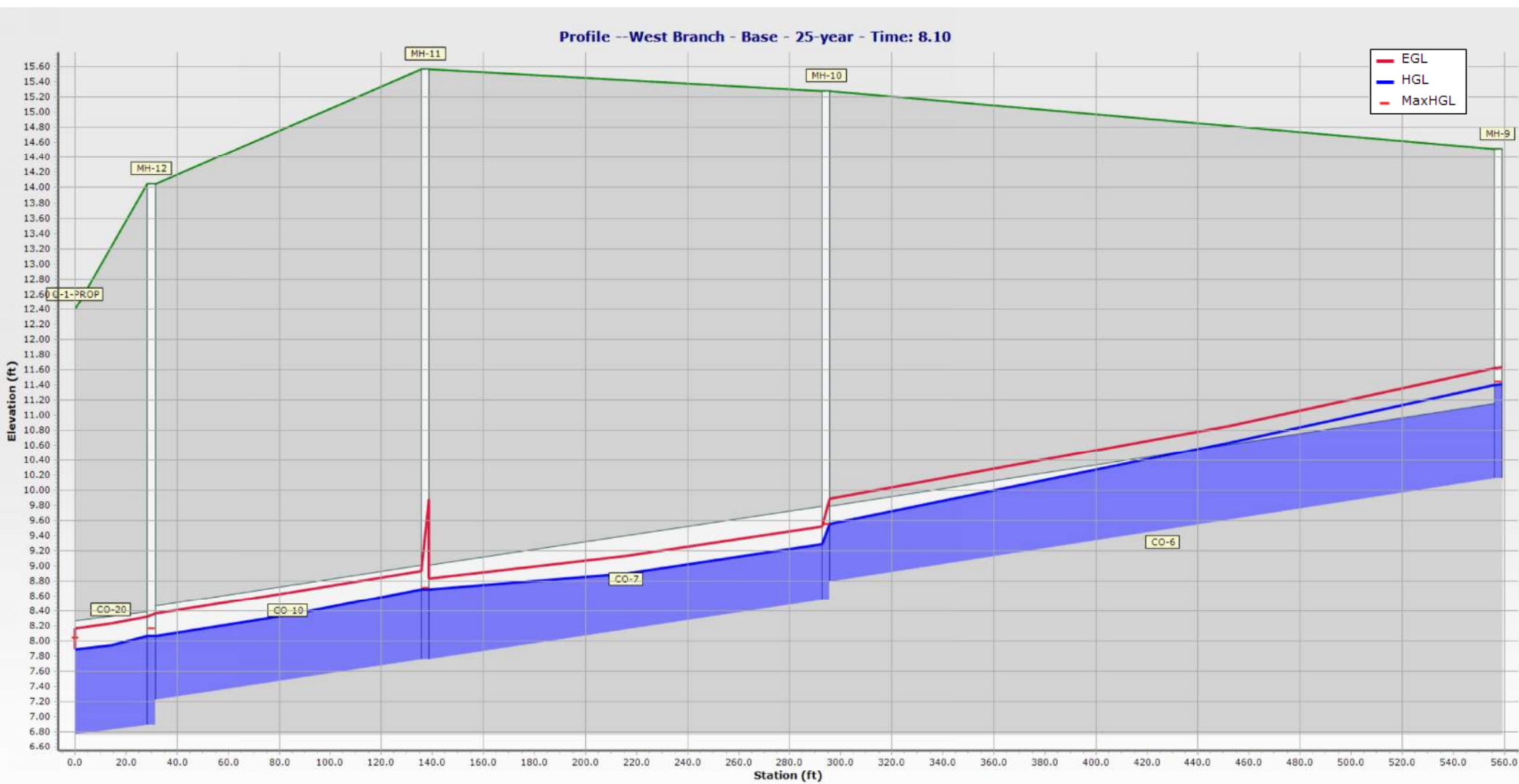
PROFILE PLOTS OF MODELED STORM DRAINS



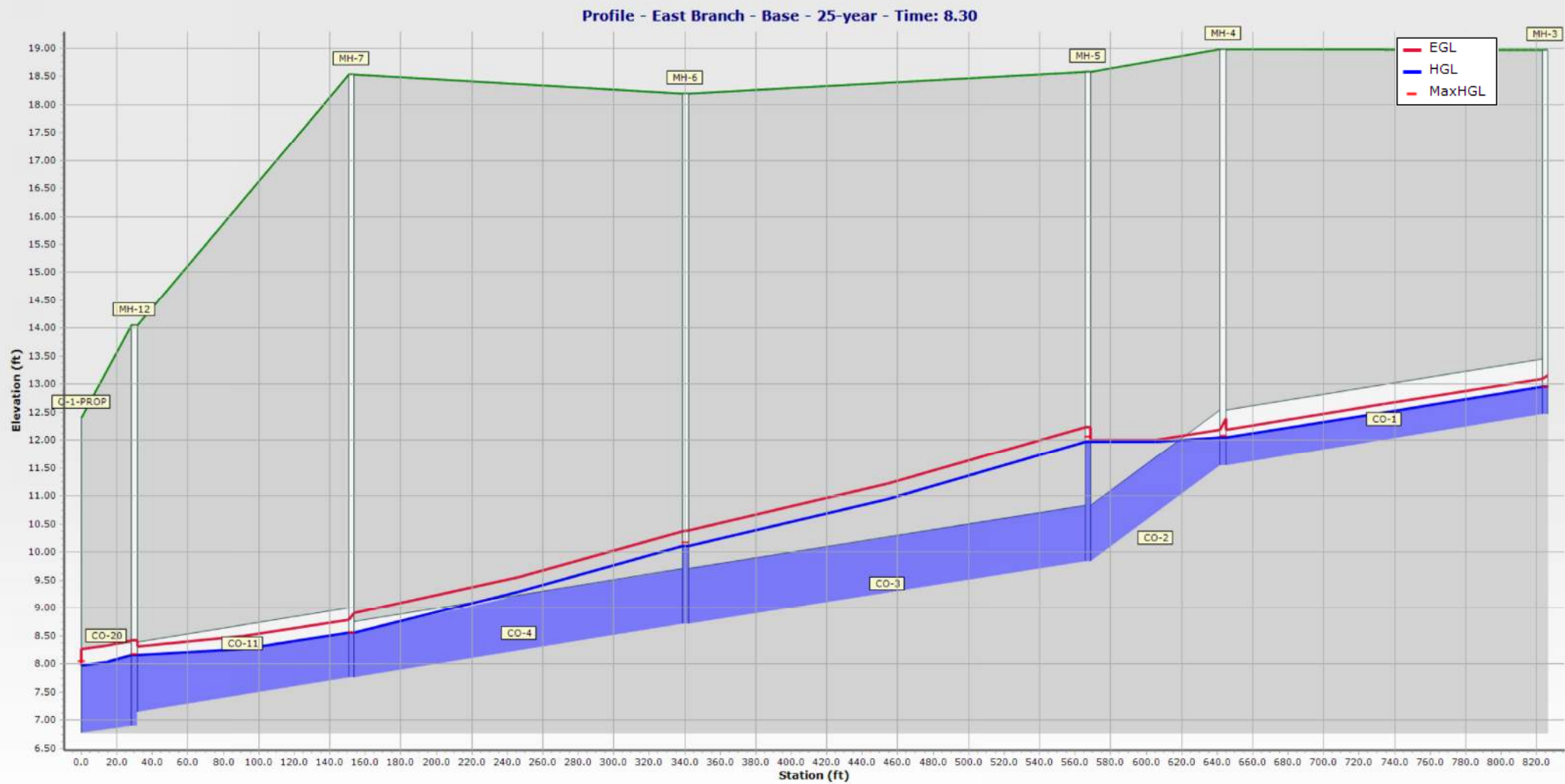
MODELED STORM DRAIN
PROFILE, WEST BRANCH,
10-YEAR EVENT



MODELED STORM DRAIN
PROFILE, EAST BRANCH,
10-YEAR EVENT



MODELED STORM DRAIN
PROFILE, WEST BRANCH,
25-YEAR EVENT



MODELED STORM DRAIN
PROFILE, EAST BRANCH,
25-YEAR EVENT