LEVEL 2 SITE DRAINAGE STUDY

FOR

Hazel Ridge

APN: 223-0012-053 & 061
PLANNING CONTROL No. PLNP2022-00088
Datum NAVD 88

(NAVD 88 = NAGD29 +2.61')
WATER SHED
Fair Oaks Stream Group

December 8, 2023

Prepared by:

12/8/2023

Kent H. Baker
BAKER-WILLIAMS
ENGINEERING GROUP
6939 Sunrise Boulevard, Suite 112
Citrus Heights, California 95610
PH: 916-891-2027
Fax: 916-331-4430

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I. Project Information

The Hazel Ridge project is in Orangevale, California on the east side of Hazel Avenue across from Myhren Way. The project is a proposed rezone from RD-5 to RD 10, a special development for private roads and a tentative map for 35 single family homes, of the 35 homes 23 are detached and 12 are halfplexs. The roads and detention basin will be privately owned and maintained. The through drainage pipe system will be maintained by the County, in a County easement. The project has a gross area of 4.63 acres. This project is an infill development. It is currently developed with one home and a couple of out buildings The purpose of this report is to show that the project can be rezoned, developed and meets Sacramento County drainage requirements without impacting the downstream or upstream properties.

Figure 1 - Project Area

II. Existing Conditions

The United States Department of Agriculture soil survey website (https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx) shows that the existing site soil is Class B soils and a portion of the offsite shed to the north is Class D soils. The site is roughly 10% impervious with an existing drainage swale running across the project from the center on the north side to the southeast corner, where it is picked up by an existing drainage system. The site slopes at 3% to the existing swale, varying in elevation from 246 feet to 235 feet on the NGVD 88 datum. The existing swale has an upstream shed of 17.01 acres.

III. Assumptions

The site soil is Class B soil type with an infiltration rate of 0.057 in/hr. and a portion of the offsite shed is Class D soil type with an infiltration rate 0.028 in/hr. All other design assumptions shall be according to the current drainage design standards.

IV. Hydrologic Methods

The Sacramento Hydraulic Calculator SacCalc was used to calculate project flows for 24 hour duration 100-year, 10-year, and 2-year events. See Appendix A for calculations and Appendix C for the shed maps.

V. LID

The Sacramento County Residential Site: LID credits and BMP sizing spread sheet was used to calculate the LID Credits and BMP sizing. See Appendix B for spread sheet, LID Exhibit and Tree Planting Plan. To meet the lid requirements, the project will need three conditions:

1. Plant 45 deciduous trees per tree planting plan.
2. The homes will be required to have disconnected roof drains.
3. The front yard landscape areas will need to have amended soils.

The LID Credit spread sheet uses 27,600 square feet of front yard landscaping per the tree planting plant. Per the spread sheet the total credits are 133.2.

VI. Hydromodification And Water Quality

The Sacramento Area Hydromodification Map shows that the project is in an area where Hydromodification is not appliable. The project is a residential project less than 20 acres so water quality is not required.

VII. Drainage Pipe System

The drainage system pipe system will be designed using Nolte Flows and will be in the private road system and drainage lot, not crossing any residential lots. The outfall is a 24-inch pipe with a flowline of 229.97 feet, the length of pipe crossing the project is 625 feet. The swale that flows onto the site enters the project at an elevation of 237 feet, putting in a 24-inch pipe with 3 feet of cover would put the flowline 5 five deep at an elevation of 232 feet. The slope of the pipe would be 0.0032 foot/foot. The culvert that crosses Coan Lane has a flow line of 238.2 feet, six feet higher than the proposed flow line and is 600 feet away following property lines. The flow line of County structure 401 is 239.87 feet, eight feet higher than the proposed flow line and is 800 feet following property lines. The slope of a new pipe line following the property lines would be approximately S=0.01; 4 times the minimum slope of S=0.0026. The five foot depth of a 24-inch pipe requires a minimum easement width of 16 feet, the minimum road width is 25 feet.

VIII. Detention Basin

The detention basin was designed using the SacCalc HEC 1 modeling section. The 2 year 24 hour, 10 year 24 hour and the 100 year 24 hour events were used to design the detention pond to reduce the downstream flows. The combination of the small shed, longer water course and low infiltration rate of the soils makes the difference between the post and pre development flows very small. The Pre and Post development impervious areas are in Table B. With HEC 1 models, the larger the storm, the less the impact there is with the

increase of impervious area. See Appendix A for the modeling. Table A gives the results. The Detention Basin is shown on the preliminary grading found in Appendix C.

TABLE A PRE & POST DEVELOPMENT PEAK FLOWS				
24 HOUR EVENT	PRE DEVELOPMENT CFS	POST DEVELOPMENT CFS	POST DEVELOPMENT WITH DETENTION	PRE TO POST %
100-YEAR	53	47	45	85%
10-YEAR	31	32	22	71%
2-YEAR	16	17	7.6	48%

Table B					
Pre Development Impervious Area					
USE	Soil Type	Area Acres	% of Area	% Impervious	Impervious Acres
Com	D	6.58	31%	90%	5.9
Com	B	0.73	3%	90%	0.7
RES 4-6	D	5.71	26%	40%	2.3
RES 4-6	B	2.49	12%	40%	1.0
Ag Res	B	1.5	7%	10%	0.2
Ag Res Site	B	4.57	21%	10%	0.5
Total		21.58		48%	10.5
Post Development Impervious Area					
USE		Area	% of Area	% Impervious	Impervious Acres
Com	D	6.58	31%	90%	5.9
Com	B	0.73	3%	90%	0.7
Res 4-6	D	5.71	26%	40%	2.3
RES 4-6	B	3.99	19%	40%	1.6
RES 6-8	B	4.57	21%	50%	2.3
Total		21.58		59%	12.7

The Com areas are zoned RD5, but are developed as a Church so 90% imperious was used.

Ag Res is a 1.5 acre parcel with one house, so for pre developed 10% impervious was used. It is zoned RD5 so for post development RES 4-6 was used with 40% impervious anticipating the parcel mat develop in the future

Ag Res Site is the project site and is developed with one house and a number of out buildings, so for pre development Ag Res with 10% impervious was used. The proposed density is 7.5 units so Res 6-8 with 50% impervious was used for post development.

DETENION SIZE TABLE C							
ACTUAL SIZE						MODEL SIZE	
ELEVATION FT	WIDTH FT	LENGTH FT	AREA SFT	AREA ACRES	VOLUME ACRE-FT	AREA ACRES	VOLUME ACRE-FT
230.2	30	121.5	3645	0.0837	0.00	0.1	0.00
235.7	41	132.5	5432.5	0.1247	0.57	0.1	0.55
235.75	53.5	137.5	7356.25	0.1689	0.58	0.2	0.56
*236.29	53.5	137.5	7356.25	0.1689	0.67		*0.66
236.5	53.5	137.5	7356.25	0.1689	0.71	0.2	0.71

The Hec 1 model rounds the areas used to compute detention volume to the nearest tenth of acre. * elevation is the peak elevation and * Volume Acre-foot of detention for the 100yr event from the model. The table shows that actual size calculated volumes match the Hec 1 model volumes.

The proposed detention basin significantly reduces the downstream flows to less than the existing flows; reducing the existing and future drainage impacts.

IX. Overland Release

The onsite overland release path follows the proposed private roads and is not proposed to cross any lots. The private road ends at the north boundary of the project at the location where the natural swale enters the project, providing an overland release for the upstream properties to protect them from flooding.

The existing offsite overland release was field surveyed, including the finished floors of the existing homes. The existing swale drains into a large type F drop inlet located in the back yard of Assessor's Parcel 223-0300-009 (8951 Calvert Avenue). When the existing drainage system capacity is exceeded; the pre development 2 year, 10 year and 100 year storm flows overland release across both Assessors Parcels 223-0300-009 and 010. The parcels were developed in the early1960's with class C Streets. The pads are below the street so when the capacity of the drop inlet and pipe system is exceeded, the flow spreads out over both parcels. The house on parcel 010 (8945 Calvert Avenue) has a finished floor 235.65 feet and a garage finished floor of 233.79 feet. The main portion of the house on parcel 009 (8951 Calvert Avenue) has a finished floor of 234.93 feet, and a converted garage with a finished floor of 233.34 feet.

The Hec-RAS model includes 12 senecios:

1. The 100yr, 10yr and 2yr pre flow assumes no drainage flow enters the existing drainage system.
2. The 100yr, 10yr and 2yr pre pipe flows are reduced by the capacity of the existing drain pipe.
3. The 100yr, 10yr and 2yr post flow assumes no drainage flow enters the existing drainage system.
4. The 100yr, 10yr and 2yr post pipe flows are the flows that flow over weir from the Hec model.

The Hec-Ras Model results are in Tabel D. See Appendix D for the Hec-RAS Model and exhibits.

Table D
Hazel Ridge HEC-RAS Results at rear of Homes

River Sta	Profile	Q Total	W.S. Elev	Parcel 010 FF	Delta	Parcel 010 Garage FF	Delta	Parcel 009 FF	Delta	Parcel 009 Converted Garage FF	Delta
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
9909	100yr pre	53	233.89	235.65	1.76	233.79	-0.10	234.93	1.04	233.34	-0.55
9909	100yr pre-pipe	44	233.84	235.65	1.81	233.79	-0.05	234.93	1.09	233.34	-0.50
9909	100yr post	45	233.84	235.65	1.81	233.79	-0.05	234.93	1.09	233.34	-0.50
9909	100yr post-pipe	34	233.78	235.65	1.87	233.79	0.01	234.93	1.15	233.34	-0.44
9909	10yr pre	31	233.76	235.65	1.89	233.79	0.03	234.93	1.17	233.34	-0.42
9909	10yr pre-pipe	22	233.7	235.65	1.95	233.79	0.09	234.93	1.23	233.34	-0.36
9909	10yr post	22	233.7	235.65	1.95	233.79	0.09	234.93	1.23	233.34	-0.36
9909	10yr post - pipe	13	233.63	235.65	2.02	233.79	0.16	234.93	1.3	233.34	-0.29
9909	2yr pre	16	233.65	235.65	2.00	233.79	0.14	234.93	1.28	233.34	-0.31
9909	2yr pre-pipe	8	233.58	235.65	2.07	233.79	0.21	234.93	1.35	233.34	-0.24
9909	2yr post	17	233.66	235.65	1.99	233.79	0.13	234.93	1.27	233.34	-0.32
*	2YR post-pipe	0	NA	235.65	NA	233.79	NA	234.93	NA	233.34	NA

*The post 2 year storm is contained in the detention and pipe system, there is no overland flow.

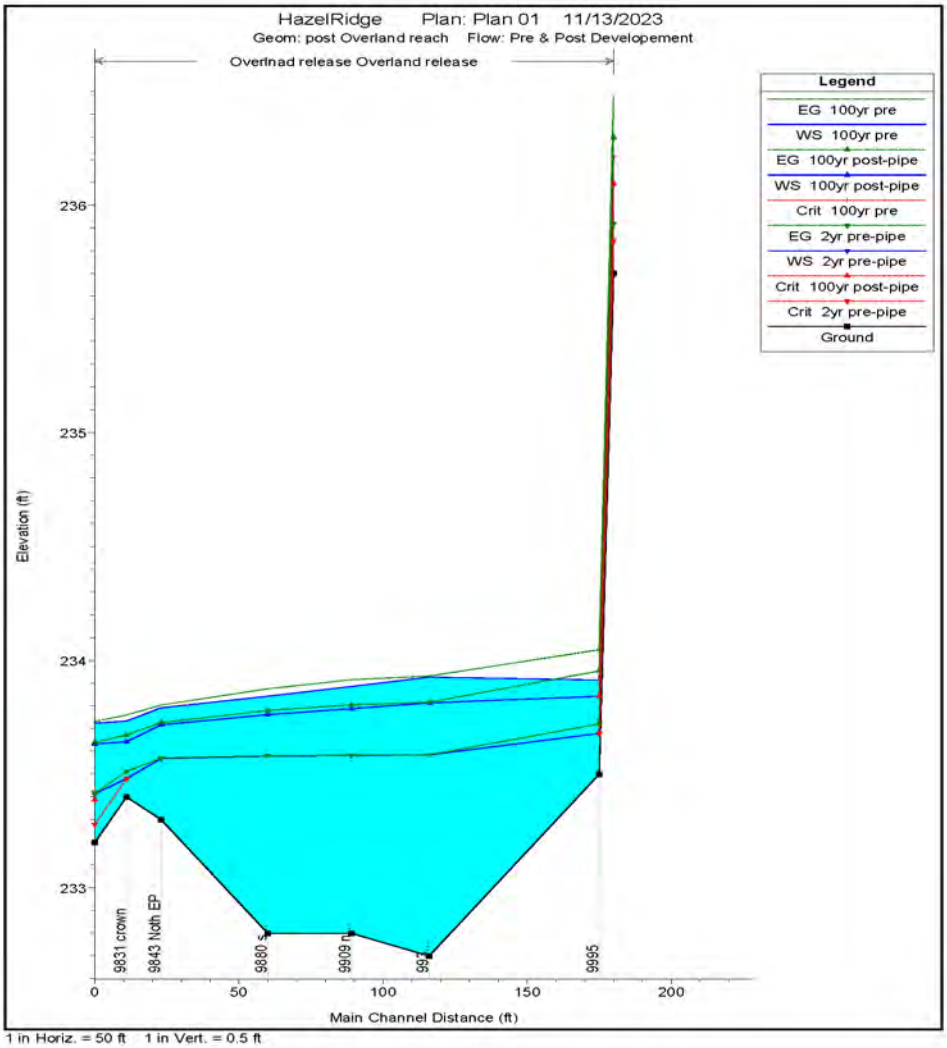
The flows used are from the SacCalc HEC-1 model results. The – pipe flow used is 9 cfs from the HEC-1 Model. River Station 9909 is at the upstream side of the homes.

In comparing the 100 year pre-pipe results highlighted in yellow:

1. The finished floor of the home located on parcel 010 is 1.87 feet higher than the post water surface and the garage does not get water in it.

2. The finished floor of the original home on parcel 009 is 1.15 feet higher than the post water surface but the converted garage does get 0.44 feet of water in it.
3. The post 100 year water surface at the upstream side of the homes is 0.06 feet lower than the pre 100 year water surface.
4. The post 2 year flow is contained by the detention basin.

The water surface elevations are controlled by the crown of the road as show in profile.



With the crown of the Calvert Avenue being higher than the converted garage on parcel 009 and higher than the pads on parcel 009 and 010 there is no way to build an effective overland release. By adding the detention to the proposed project, the flows are reduced and water surfaces are lowered, reducing the drainage impact on the downstream parcels.

X. Conclusion

The project meets the LID requirements by adding the following three conditions of approval to the project:

1. Plant 45 deciduous trees per tree planting plan.
2. The homes will be required to have disconnected roof drains.
3. Place amended soil in the front yard landscape areas.

The project is designed so the proposed drainage system will have the capacity and depth to serve the upstream properties. The project's private road system is designed to provide an overland release for the upstream properties. The proposed detention basin reduces the existing downstream flows for the 24 hour duration 2 year, 10 year, and 100 year storm events to significantly less than the existing conditions. The reduced flows reduce the existing and future downstream drainage impacts. The detention basin will be privately owned and maintained by the home owners and only used as a detention basin. The through drainage pipe system will be maintained by the County, in a County easement.

Appendix A
SacCalc Results

View HEC-1 output

Sacramento method results
(Project: Hazel Ridge Pre Development Zone 3)
(100-year, 1-day rainfall)

ID	Peak flow (cfs)	Time of peak (hours)	Basin area (sq. mi)	Peak stage (feet)	Peak storage (ac-ft)	Diversion volume (ac-ft)
HR7	53.	12:08	.03			

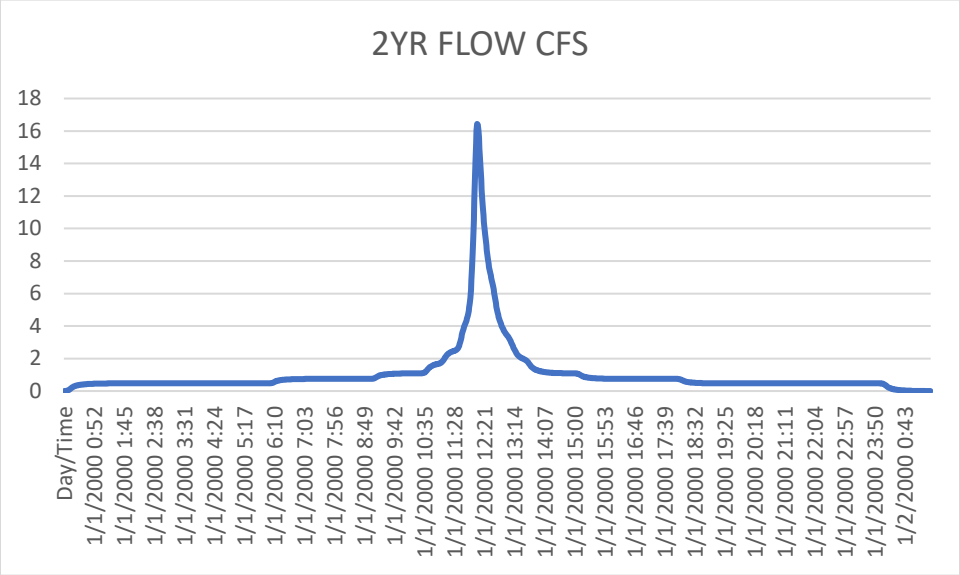
(10-year, 1-day rainfall)

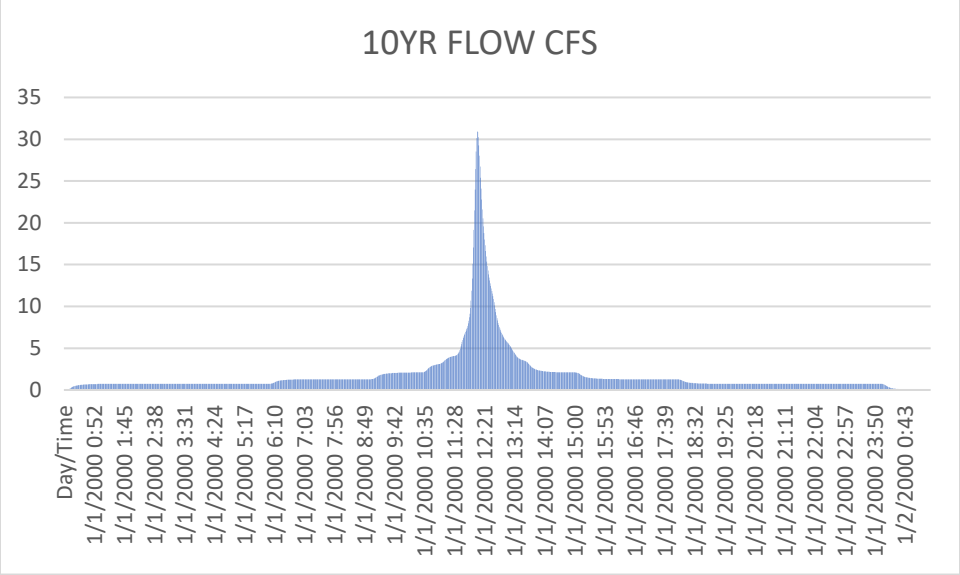
ID	Peak flow (cfs)	Time of peak (hours)	Basin area (sq. mi)	Peak stage (feet)	Peak storage (ac-ft)	Diversion volume (ac-ft)
HR7	31.	12:08	.03			

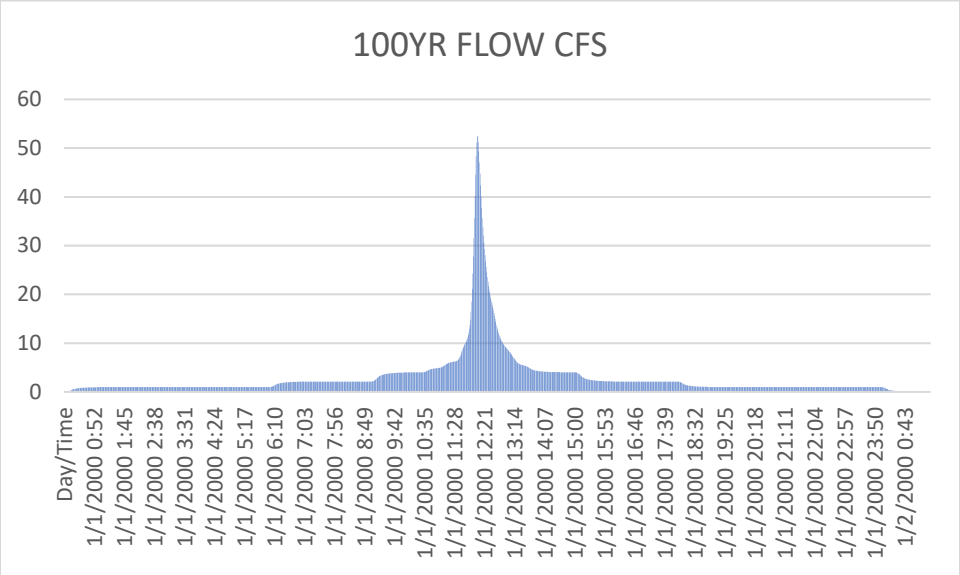
(2-year, 1-day rainfall)

ID	Peak flow (cfs)	Time of peak (hours)	Basin area (sq. mi)	Peak stage (feet)	Peak storage (ac-ft)	Diversion volume (ac-ft)
HR7	16.	12:08	.03			

PREDEVELOPEMENT PEAK FLOWS







Sacramento Hydrologic Calculator Report

November 4, 2023 6:34

Project Title: Hazel Ridge Pre Development Zone 3
Comments:
Prepared by: KHB

Method: Sacramento County HEC-1 method
Date: 11/4/2023

Watershed Hydrologic Summary Data

Watershed	Area (acres)	Mean Elevation (ft)	Lag Times		Basin "n"		Loss Rates		Percent Impervious	
			Method	Lag Time (min)	Method	Basin "n"	Method	Loss Rate (in/hr)	Method	Impervious Area (%)
HR7	21.58	245	Basin "n"	-	Computed	-	Computed	-	Computed	-

Basin "n" Method Data for Lag Time Computation

Watershed	Channel Length (ft)	Centroid Length (ft)	Slope (ft/ft)	Channelization	Land Use Impervious Area Percent (% or acres)																
					95	90	85	80	75	70	60	50	40	30	25	20	15	10	5	2	1	1*
HR7	1620	810	.01	Undeveloped		0							0					0				
				Developed		0.34							0.38					0.28				

Refer to the Drainage manual for Land Use Impervious Area Percent

*Dense Oaks, Shrubs, Vines

Infiltration Loss Rate Data

Watershed	Soil Cover Group	Land Use Impervious Area Percent (% or acres)																
		95	90	85	80	75	70	60	50	40	30	25	20	15	10	5	2	1	1*
HR7	B		0.03							0.12					0.28				
	C																		
	D		0.31							0.26									

Refer to the help file for Land Use Impervious Area Percent

*Dense Oaks, Shrubs, Vines

View HEC-1 output

Sacramento method results
(Project: Hazel Post Developement with Detention Zone 3)
(100-year, 1-day rainfall)

ID	Peak flow (cfs)	Time of peak (hours)	Basin area (sq. mi)	Peak stage (feet)	Peak storage (ac-ft)	Diversion volume (ac-ft)
WS001	47.	12:11	.03			
DE001	45.	12:14	.03	236.	.7	.00

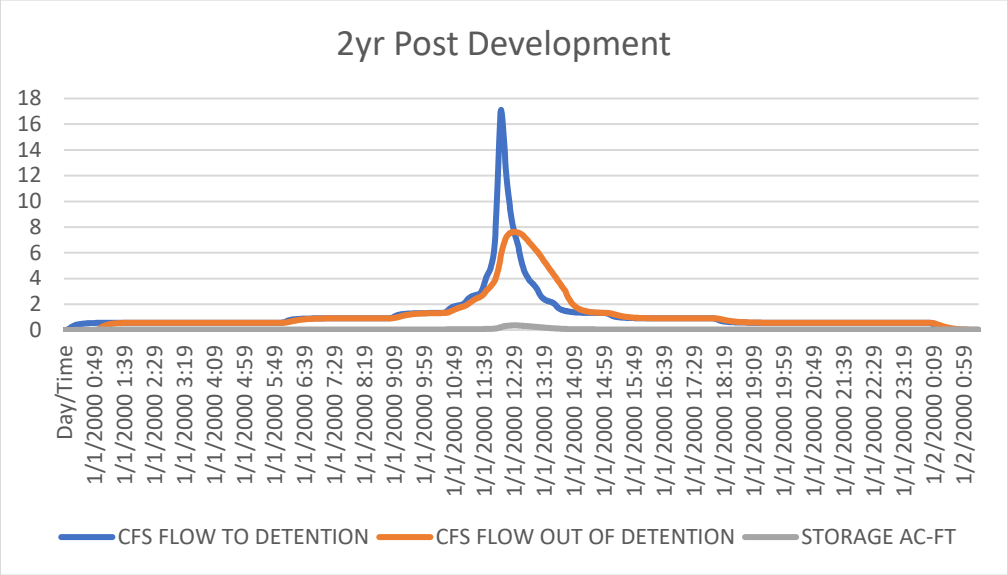
(10-year, 1-day rainfall)

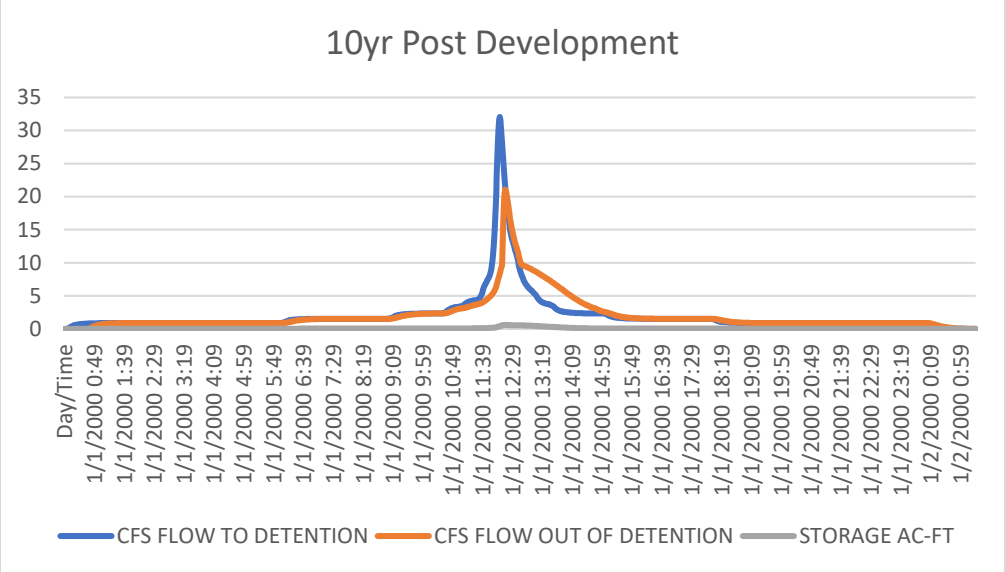
ID	Peak flow (cfs)	Time of peak (hours)	Basin area (sq. mi)	Peak stage (feet)	Peak storage (ac-ft)	Diversion volume (ac-ft)
WS001	32.	12:08	.03			
DE001	21.	12:17	.03	236.	.6	.00

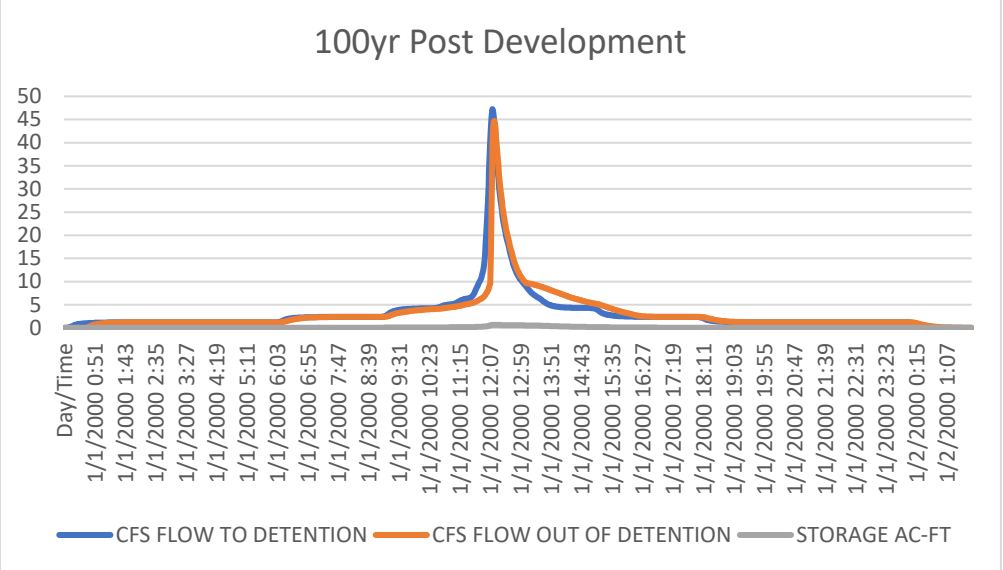
(2-year, 1-day rainfall)

ID	Peak flow (cfs)	Time of peak (hours)	Basin area (sq. mi)	Peak stage (feet)	Peak storage (ac-ft)	Diversion volume (ac-ft)
WS001	17.	12:08	.03			
DE001	7.6	12:30	.03	234.	.4	

POST DEVELOPMENT HYDROGRAPHS







100YR P0ST DEVELOPMENT FLOW FROM HEC 1 HYDRODGRAPH				
	CFS FLOW TO DETENTION	CFS FLOW OUT OF DETENTION	STORAGE AC-FT	STAGE ELEVATION FEET
Day/Time	WS001	DE001	DE001	DE001
1/1/2000 12:12	46.76135254	43.16950607	0.657546	236.2641602
1/1/2000 12:13	45.63376999	44.59626007	0.660734	236.2801056
1/1/2000 12:14	44.14259338	44.73381424	0.661042	236.2816315
1/1/2000 12:15	42.36332321	44.03605652	0.659483	236.2738342

Sacramento Hydrologic Calculator Report

December 8, 2023 10:40

Project Title: Hazel Post Developement with Detention Zone 3
Comments:
Prepared by:

Method: Sacramento County HEC-1 method
Date: 12/8/2023

Watershed Hydrologic Summary Data

Watershed	Area (acres)	Mean Elevation (ft)	Lag Times		Basin "n"		Loss Rates		Percent Impervious	
			Method	Lag Time (min)	Method	Basin "n"	Method	Loss Rate (in/hr)	Method	Impervious Area (%)
WS001	21.58	245	Basin "n"	-	Computed	-	Computed	-	Computed	-

Basin “n” Method Data for Lag Time Computation

Watershed	Channel Length (ft)	Centroid Length (ft)	Slope (ft/ft)	Channelization	Land Use Impervious Area Percent (% or acres)																
					95	90	85	80	75	70	60	50	40	30	25	20	15	10	5	2	1	1*
WS001	1836	918	.01	Undeveloped		0						0	0									
				Developed		0.34						0.21	0.45									

Refer to the Drainage manual for Land Use Impervious Area Percent

*Dense Oaks, Shrubs, Vines

Infiltration Loss Rate Data

Watershed	Soil Cover Group	Land Use Impervious Area Percent (% or acres)																
		95	90	85	80	75	70	60	50	40	30	25	20	15	10	5	2	1	1*
WS001	B		0.03						0.21	0.19									
	C																		
	D		0.31							0.26									

Refer to the help file for Land Use Impervious Area Percent

*Dense Oaks, Shrubs, Vines

Detention Basin Data

Detention Basin	Initial Condition		Pond Storage Relation										Outlet Data			
													Elev. (ft)	Area (sq ft)	Q Coef.	Exponent
DE001	Elevation (ft)	230.2	Elevation (ft)	230.2	235.7	235.75	236.5						230.5	.7854	0.66	0.5
			Area (ac)	0.0837	0.1247	0.1689	0.1689						235.7	25	3.1	1.5
	Pump Data															
	Pump Hydrograph Name						Pump 1		Pump 2		Pump 3		Pump 4		Pump 5	
			Pump Discharge (cfs)													
			Elevation at which Pump Turns On (ft)													
			Elevation at which Pump Turns Off (ft)													

Appendix B

LID Spread Sheet

LID Exhibit

Tree Planting Plan

Appendix D-1: Residential Sites: Low Impact Development (LID) Credits and Treatment BMP Sizing Calculations

Name of Drainage Shed: Hazel Ridge
Location of project: Sacramento

Fill in Blue Highlighted boxes

Step 1 - Open Space and Pervious Area Credits

Is your project within the drainage area of a common drainage plan that includes open space? If not, skip to 1 b.

1 a. Common Drainage Plan Area		acres	A_{CDP}	
Common Drainage Plan Open Space (Off-project)	0	acres	A_{OS}	see area example below
a. Natural storage reservoirs and drainage corridors	0	acres		
b. Buffer zones for natural water bodies	0	acres		
c. Natural areas including existing trees, other vegetation, and soil	0	acres		
d. Common landscape area/park	0	acres		
e. Regional Flood Control/Drainage basins	0	acres		
1 b. Project Drainage Shed Area (Total)	4.57	acres	A	
Project-Specific Open Space (In-project, communal)**	0.17	acres	A_{PSOS}	see area example below
a. Natural storage reservoirs and drainage corridors	0.00	acres		
b. Buffer zones for natural water bodies	0.00	acres		
c. Natural areas including existing trees, other vegetation, and soil	0.00	acres		
d. Landscape area/park	0.00	acres		
e. Flood Control/Drainage basins	0.17	acres		

** Doesn't include impervious areas within individual lots and surrounding individual units. That is accounted for below using Form D-1a in Step 2.

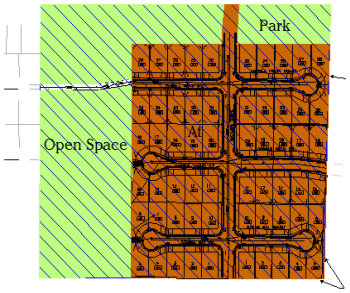
Area with Runoff Reduction Potential	$A - A_{PSOS}$ =	4.40	acres	A_T
Number of Units in A_T		35		
Number of units per acre in A_T	DU/A_T =	8		DUA
Assumed Initial Impervious Fraction of A_T (determined using Table D-1a)		0.55		I

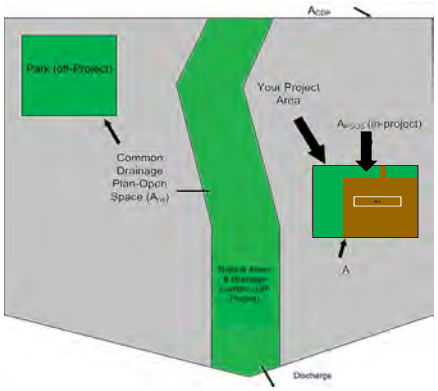
Open Space & Pervious Area LID Credit (Step 1)
$(A_{OS}/A_{CDP}+A_{PSOS}/A)x100$ = 4 pts

Table D-1a

Dwelling units per acre	Imperviousness
1	0.17
2	0.25
3,4	0.35
5,6	0.40
7	0.50
8,9	0.55
10-14	0.60
15-20	0.70

	A - Drainage Shed Area
A_{PSOS}	Parks and Open Space
A_T	Area with Runoff Reduction Potential





Step 2 - Runoff Reduction Credits

Runoff Reduction Measures			Effective Area Managed (A_C)		
Disconnected Roof Drains (see Fact Sheet)	use Form D-1a for credits	→	0.61	acres	
Disconnected Pavement (see Fact Sheet)	use Form D-1b for credits	→	0.00	acres	
Interceptor Trees (see Fact Sheet)	use Form D-1c for credits	→	0.02	acres	
Alternative Driveway Design (see Fact Sheet)	use Form D-1d for credits	→	0.00	acres	
Total Effective Area Managed (Credit Area)		A_C	0.63	acres	EAM

Runoff Reduction Credit (Step 2)
$(A_C / A_T)*100$ = 14 pts

Form D-1a: Disconnected Roof Drains Worksheet

See Fact Sheet for more information regarding Disconnected Roof Drain credit guidelines

Effective Area Managed (A_C)

1. Determine efficiency Multiplier

Runoff is directed to a dispersal trench or dry well (Type A and B soils only)		1.00
Runoff is directed across landscaping, determine setback		
25 ft +	Use multiplier of	1.00
≥ 20 and < 25 ft	Use multiplier of	0.90
≥ 15 and < 20 ft	Use multiplier of	0.70
≥ 10 and < 15 ft	Use multiplier of	0.45
≥ 5 and < 10 ft	Use multiplier of	0.25

Efficiency Multiplier → 0.70 Box J1

2. Determine percentage of roof drains disconnected → 100.0% Box J2

3. Select project density in dwelling units per acre:

1	Use reduction factor of	0.08
2	Use reduction factor of	0.13
3,4	Use reduction factor of	0.19
5,6	Use reduction factor of	0.23
7	Use reduction factor of	0.29
8,9	Use reduction factor of	0.33
10-14	Use reduction factor of	0.37
15-20	Use reduction factor of	0.44

Reduction Factor → 0.33 Box J3

4. Determine Area Managed

Multiply Box J3 by A_T, and enter the result in Box J4: 1.4 acres Box J4

5. Multiply Boxes J1, J2 and J4, and enter 60% of the Result in Box J: 0.6 acres Box J

This is the amount of area credit to enter into the "Disconnected Roof Drains" Box of Form D-1

Form D-1b: Disconnected Pavement Worksheet

See Fact Sheet for more information regarding NDC Pavement credit guidelines

Effective Area Managed (A_C)

Divided Sidewalks

1. Determine percentage of units with divided Sidewalks: Box K1

Multiply Box K1, A_T, and 0.04 and enter 60% of the result in Box K: 0.00 acres Box K

This is the amount of area credit to enter into the "Disconnected Pavement" Box of Form D-1

Form D-1c: Interceptor Tree Worksheet

See Fact Sheet for more information regarding Interceptor Tree credit guidelines

Effective Area Managed (A_C)

New Evergreen Trees

1. Enter number of new evergreen trees that qualify as Interceptor Trees in Box L1: 0 trees Box L1

2. Multiply Box L1 by 200 and enter result in Box L2: 0 sq. ft. Box L2

New Deciduous Trees

3. Enter number of new deciduous trees that qualify as Interceptor Trees in Box L3: 45 trees Box L3

4. Multiply Box L3 by 100 and enter result in Box L4: 4500 sq. ft. Box L4

Existing Tree Canopy

5. Enter square footage of existing tree canopy that qualifies as Existing Tree canopy in Box L5: sq. ft. Box L5

6. Multiply Box L5 by 0.5 and enter the result in Box L6: 0 sq. ft. Box L6

Total Interceptor Tree Credits

Add Boxes L2, L4, and L6 and enter it into Box L7: 4500 sq. ft. Box L7

Divide Box L7 by 43,560 and multiply by 20% to get effective area managed and enter the result in Box L8: 0.02 acres Box L8

This is the amount of area credit to enter into the "Interceptor Trees" Box of Form D-1

Form D-1d: Alternative Driveway Design

See Fact Sheet for more information regarding Alternative Driveway Design credit guidelines

1. Select type of driveway

Pervious Driveway:	Multiplier:
Cobblestone Block P	0.40
Pervious Concrete/A	0.60
Modular Block Porous Pavement Porous Gravel	0.75
Not Directly-connected I	1.00

Box M1

2. Determine percentage of units with Alternative Driveways:

Box M2

4. Multiply Boxes M1, M2, A_T and 0.04, and enter the result in Box M
This is the amount of area credit to enter into the "Alternative Driveway Design" Box of Form D-1

0.00 acres

Step 3 - Runoff Management Credits

Capture and Use Credits

Impervious Area Managed by Rain barrels, Cisterns, and automatically-emptied systems
(see Fact Sheet) enter gallons, for simple rain barrels — 0.00 acres

Automated-Control Capture and Use System
(see Fact Sheet, then enter impervious area managed by the system) — 0.00 acres

Bioretention/Infiltration Credits

Impervious Area Managed by Bioretention BMPs
(see Fact Sheet)
Bioretention Area - sq ft
Subdrain Elevation inches
Ponding Depth, inches inches — 0.00 acres

Impervious Area Managed by Infiltration BMPs
(see Fact Sheet)
Drawdown Time, hrs — drawdown_hrs_inf
Soil Infiltration Rate, in/hr — soil_inf_rate
Sizing Option 1: Capture Volume, acre-ft — capture_vol_inf — 0.00 acres
Sizing Option 2: Infiltration BMP surface area, sq ft 0 soil_surface_area — 0.00 acres
Basin or trench? approximate BMP depth 0.00 ft

Impervious Area Managed by Amended Soil or Mulch Beds
(see Fact Sheet) Mulched Infiltration Area, sq ft 27,600 mulch_area — 2.53 acres

Total Effective Area Managed by Capture-and-Use/Bioretention/Infiltration BMPs — 2.53 A_{LIDc}

Runoff Management Credit (Step 3) A_{LIDC}/A_T*200 = 115.2 pts

Total LID Credits (Step 1+2+3) LID compliant, check for treatment sizing in Step 4 — 133.2

Does project require hydromodification management? If yes, proceed to using SacHM.

Adjusted Area for Flow-Based, Non-LID Treatment $A_T - A_C - A_{LIDC}$ = 1.24 A_{AT}

Adjusted Impervious Fraction of A for Volume-Based, Non-LID Treatment $(A_T*I-A_C-A_{LIDC}) / A$ = 0.000 I_A

STOP: No additional treatment needed

Step 4a Treatment - Flow-Based (Rational Method)

Form D-1e

Calculate treatment flow (cfs): Flow = Runoff Coefficient x Rainfall Intensity x Adjusted Treatment Area

Determine C Factor using Table D-1b — C

Determine i using Table D-1c (Rainfall Intensity) 0.18 — i

A_{AT} from Step 2 1.24 — A_{AT}

Flow = C * i * A_{AT} 0.00 cfs

TABLE D-1b

Development Type	Runoff Coefficient (Rational), C
Single-family areas	0.50
Multi-units, detached	0.60
Apartment dwelling areas	0.70
Multi-units, attached	0.75
User Specified	0.00

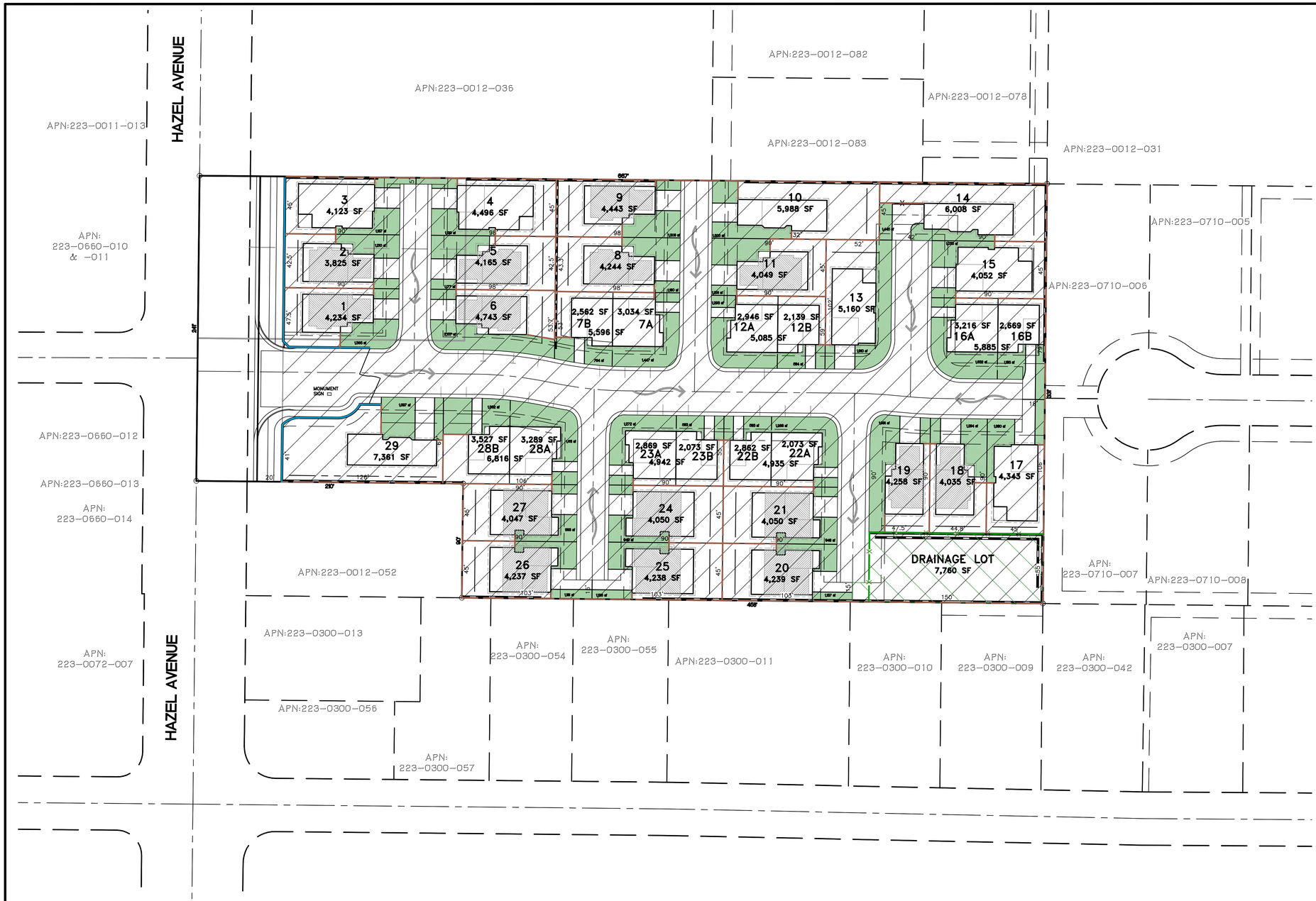
Table D-1c

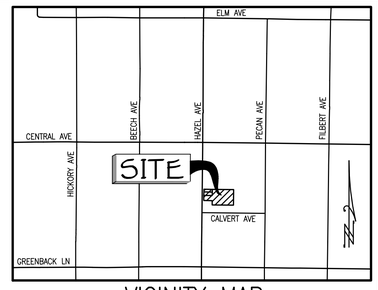
Rainfall Intensity			
Roseville	i =	0.20	in/hr
Sacramento	i =	0.18	in/hr
Folsom	i =	0.20	in/hr

Step 4b Treatment - Volume-Based (ASCE-WEF)

Calculate water quality volume (Acre-Feet):	WQV = Area x Maximized Detention Volume (P_0)			
Obtain A from Step 1	4.57	A	hrs	Specified Draw Down time
Obtain P_0: Maximized Detention Volume from figures E-1 to E-4 in Appendix E of this manual using I_A from Step 2.	0.00	P_0		
Calculate treatment volume (acre-ft): **Treatment volume = A x (P_0 / 12)**	0.00	Acre-Feet		

v06232012





VICINITY MAP
NO SCALE

SCALE: 1"=40'

40' 0' 40' 80' 120'
GRAPHIC SCALE: 1"=40'

LEGEND:

AMENDED SOIL

SHED AREA

DRAINAGE BASIN

FENCE
- REDWOOD
- OPEN FENCE
- MASONRY WALL

FRONT YARD AREA 993 sf

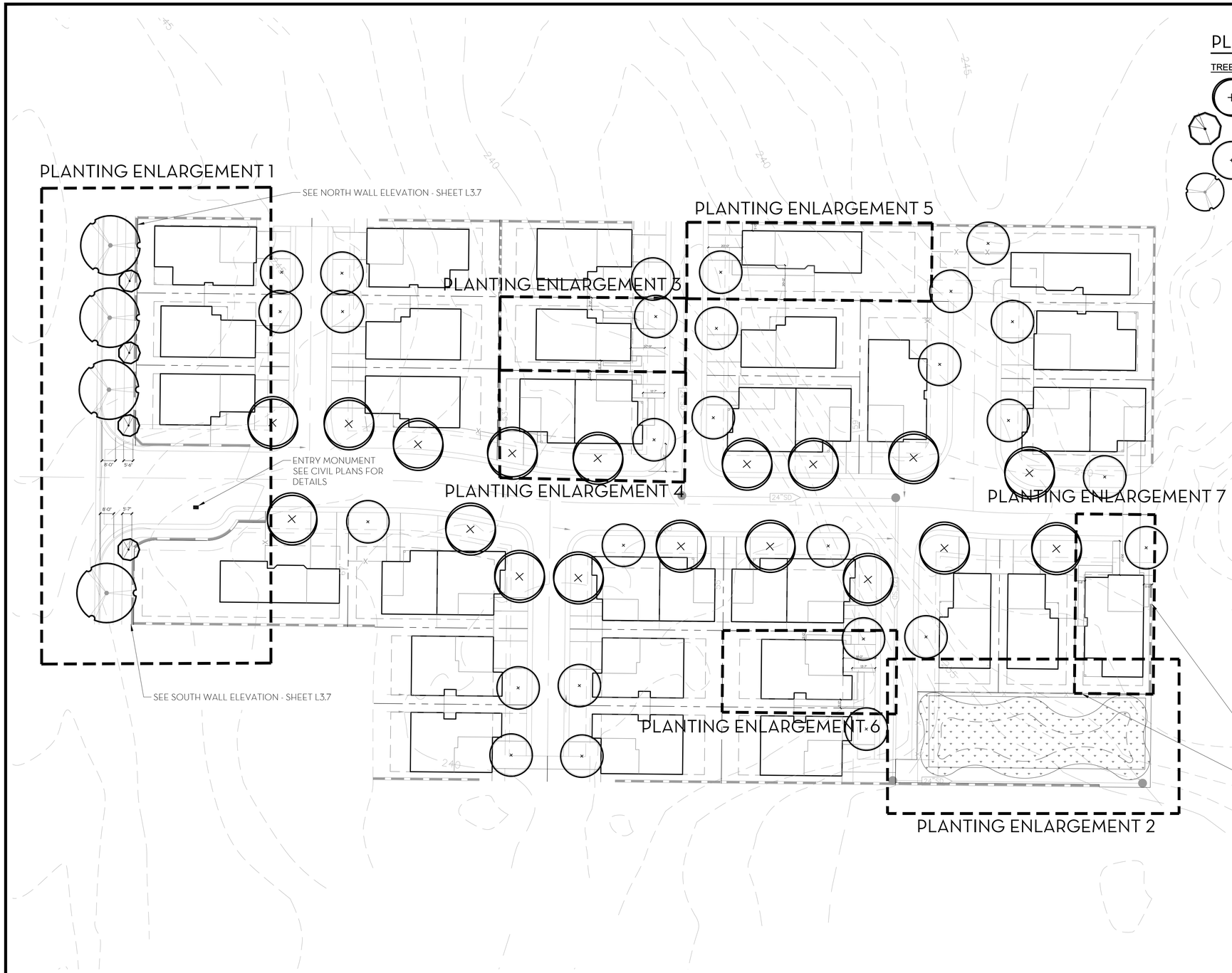
TOTAL FRONT YARD LANDSCAPING = 27,602 SF
FROM STREET TREE PLANTING PLAN

LID EXHIBIT
HAZEL RIDGE
ORANGEVALE
SACRAMENTO COUNTY, CA
JUNE 8, 2023
NOVEMBER 6, 2023
DECEMBER 7, 2023

BAKER WILLIAMS ENGINEERING GROUP
6939 SUNRISE BLVD, SUITE 112
CITRUS HEIGHTS, CA 95610-3153
Phone (916)331-4336~Fax (916)331-4430
EMAIL: office@bwengineers.com

JOB NO. 21-10-037

2110037-LID-EXHIBIT



PLANT SCHEDULE

TREES	QTY	BOTANICAL NAME	COMMON NAME	WATER USE
+	18	ACER RUBRUM `OCTOBER GLORY`	OCTOBER GLORY RED MAPLE	MODERATE
+	4	LAGERSTROEMIA INDICA X FAURIEI `MUSKOGEE`	MUSKOGEE CRAPE MYRTLE	LOW
+	27	PISTACIA CHINENSIS 'KEITH DAVEY'	FRUITLESS CHINESE PISTACHE	LOW
+	4	QUERCUS AGRIFOLIA	COAST LIVE OAK	VERY LOW

LOT	FRONT LANDSCAPE S.F
1	882
2	778
3	412
4	412
5	660
6	918
7	1802
8	690
9	632
10	872
11	752
12	1602
13	1592
14	1386
15	476
16	2158
17	592
18	746
19	860
20	440
21	334
22	1540
23	1532
24	444
25	528
26	556
27	472
28	2298
29	1236
AGGREGATE AREA	27602

WATER EFFICIENT LANDSCAPE ORDINANCE COMPLIANCE

I HAVE COMPLIED WITH THE CRITERIA OF THE WATER EFFICIENT LANDSCAPING ORDINANCE AND APPLIED THEM FOR THE EFFICIENT USE OF WATER IN THE LANDSCAPE DESIGN PLAN.

KEITH P. WILSON, ASLA, CRLA 4728

NOTES:

1. SEE DEVELOPMENT PLAN FOR BUILDING SETBACKS.
2. SEE CIVIL ENGINEERING PLANS FOR SLOPES AND GRADES WITHIN PLANTING AREAS.

LANDSCAPE DESIGN INTENT

THE DESIGNER HAS APPLIED THEIR EXPERTISE, KNOWLEDGE, AND UNDERSTANDING OF QUALITY DESIGN TO THE DEVELOPMENT WHICH INCLUDES NATIVE PLANTING IN ORDER TO SUPPORT WATER EFFICIENT LANDSCAPES AND MINIMAL MAINTENANCE REQUIREMENT ALL YEAR. THE PLANT PALETTE PROVIDES AESTHETIC ENHANCEMENT FOR THE DEVELOPMENT THROUGH COLOR, HIERARCHY, AND FOLLOWS ALL APPLICABLE CODES AND ORDINANCES.

0' 15' 30'
(1" = 30'-0")

HAZEL RIDGE

SACRAMENTO, CA

STREET TREE PLANTING PLAN L3.0

DECEMBER 29, 2022

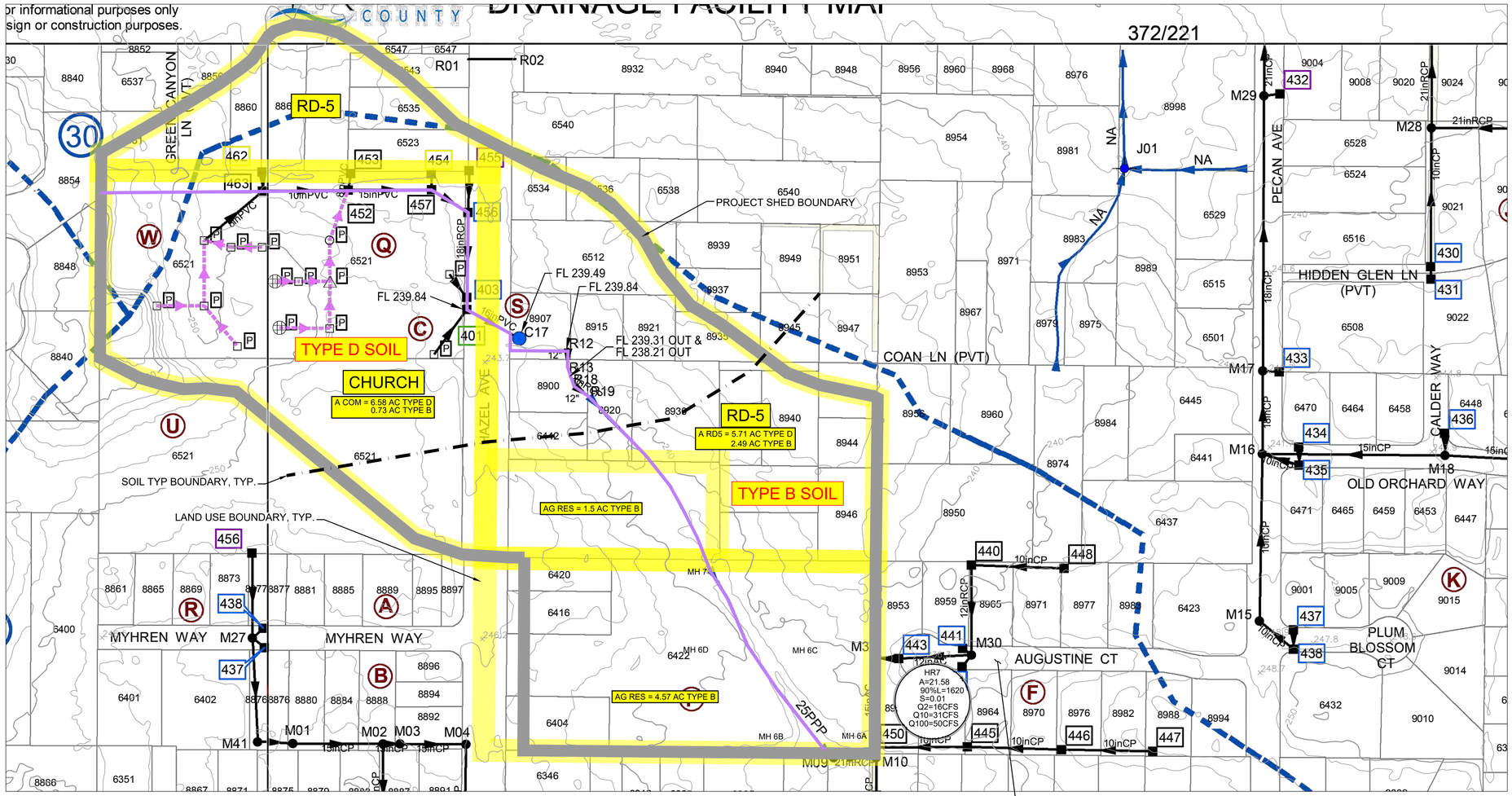
WDSLA
Wilson Design Studio Landscape Architecture
150 Redwood Street
San Francisco, CA 94102
319.450.3861 | www.wdsla.com

Appendix C

Shed Maps and Preliminary Grading Plan

DRAINAGE SHED MAP PRE-DEVELOPMENT
SACRAMENTO METHOD ZONE 3 - 1 DAY DURATION
HAZEL RIDGE

SACRAMENTO COUNTY ,CALIFORNIA
AUGUST, 2023
NOVEMBER, 2023



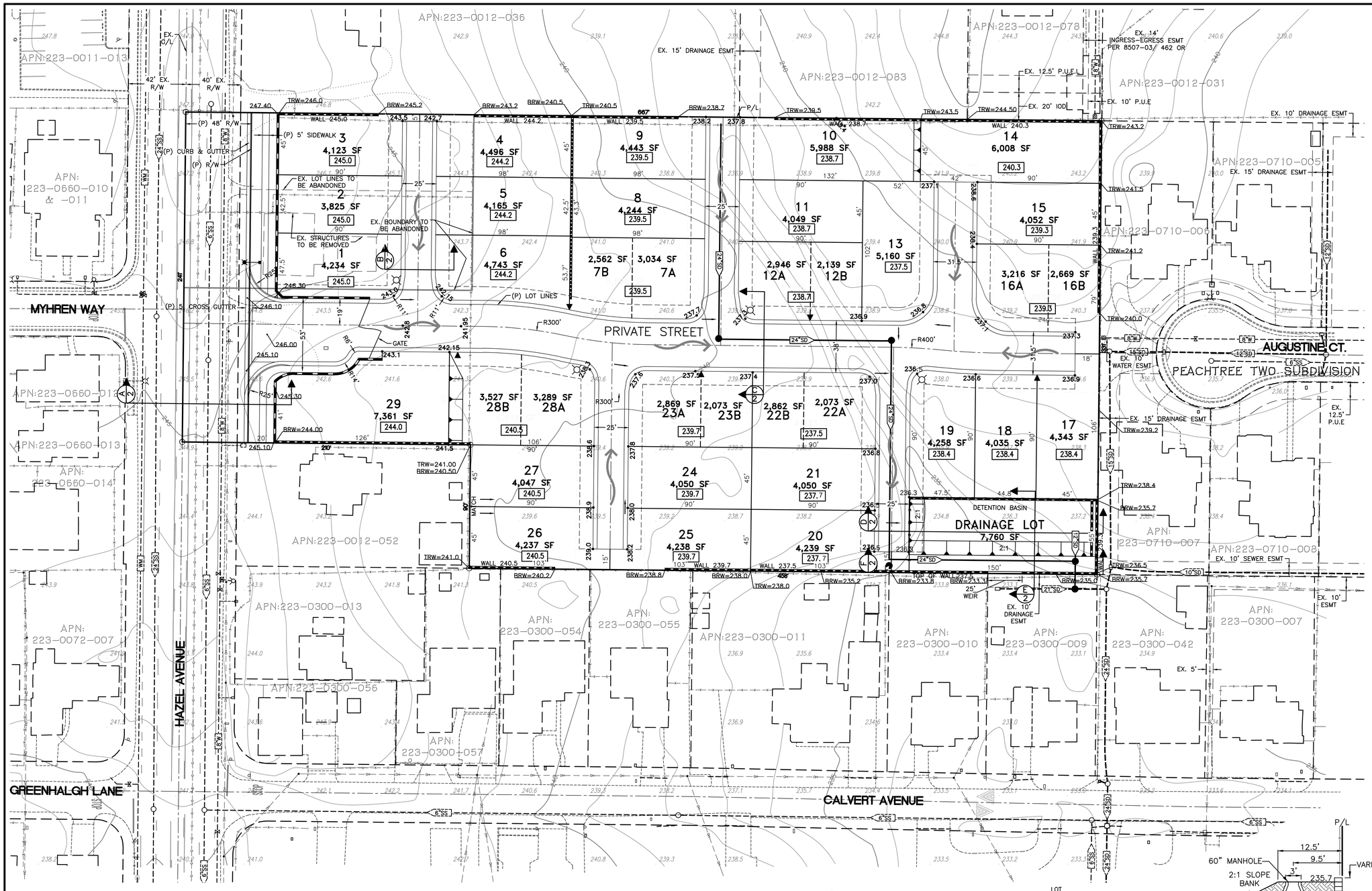
SCALE: 1"=100'

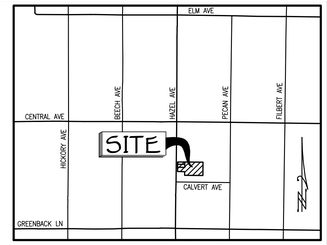
100' 0' 100' 200' 300'
GRAPHIC SCALE: 1"=100'

BAKER WILLIAMS ENGINEERING GROUP
6939 SUNRISE BLVD, SUITE 112
CITRUS HEIGHTS, CA 95610-3153
Phone (916)331-4336~Fax (916)331-4430
EMAIL: office@bwengineers.com

JOB # 21-10-037

2110037-DRAINAGE-SHED-MAP





VICINITY MAP

NO SCALE

PROJECT DATA:

OWNER:
JAMES E. and NANCY C. LUSE REVOCABLE TRUST and McVEY REVOCABLE TRUST

DEVELOPER:
JIM LUSE
6912 THAYER WAY
ORANGEVALE CA 95662
PH. (916)224-9314

ENGINEER:
BAKER WILLIAMS ENGINEERING GROUP
6939 SUNRISE BLVD., SUITE 112
CITRUS HEIGHTS, CA 95610-3153
PH. (916) 331-4336
FAX (916) 331-4430

ASSESSOR'S PARCEL NUMBER:
223-0012-053, 060, 061

ACREAGE:
4.63± ACRES GROSS
4.37± ACRES NET

EXISTING USE:
SINGLE FAMILY, VACANT

PROPOSED USE:
23 LOT SINGLE FAMILY SUBDIVISION
6 HALF-PLEX LOTS
1 PRIVATE STREET LOT
1 DRAINAGE LOT

EXISTING ZONE:
RD-5

PROPOSED ZONE:
RD-10

SEWER:
SASD

WATER SUPPLY:
ORANGEVALE WATER COMPANY

DRAINAGE:
SACRAMENTO COUNTY WATER RESOURCES

FIRE PROTECTION:
SAC METRO

ELECTRIC SERVICE:
SMUD

TELEPHONE SERVICE:
AT&T

GAS SUPPLY
PG&E

SCHOOL DISTRICT:
SAN JUAN UNIFIED

PARK DISTRICT:
ORANGEVALE

LOT SIZE:
MIN. 3,825 SF
MAX. 7,367 SF
AVERAGE 4,772 SF

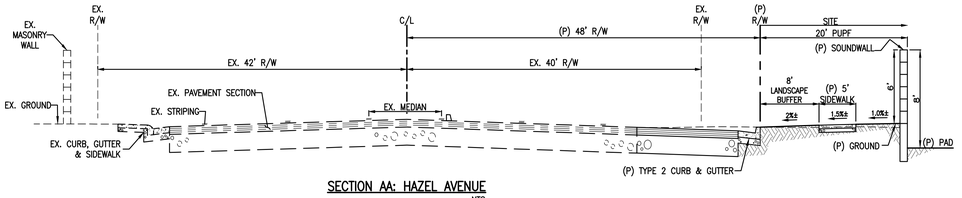
LEGEND:

EXISTING		PROPOSED
12"SD	STORM DRAIN	12"SD
	DRAIN INLET	
	MANHOLE	
8"W	WATER MAIN	W
6"SS	SEWER MAIN	6"SS
	STREET LIGHT	
OH	OVERHEAD LINE	
	GAS MAIN	
	ELECTRIC LINE	
	FENCE	
	LOT LINES	
	RIGHT OF WAY	
	BUILDING	
	C/G AND SIDEWALK	
	SITE BOUNDARY	
238.7	PAD GRADE	
	MASONRY SOUND WALL	
TRW=244.00 BRW=240.50	RETAINING WALL TOP RETAINING WALL BOTTOM RETAINING WALL	
	SLOPE BANK	
	OVERLAND RELEASE	
240.4	SPOT ELEVATION	241.0
	TOPOGRAPHIC CONTOUR	
	EDGE OF PAVEMENT	
	DIRT ROAD	

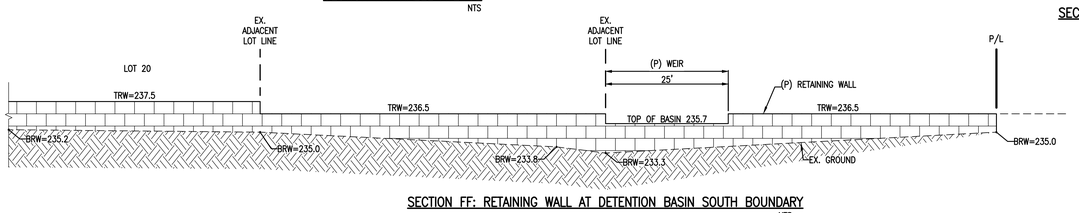
SCALE: 1"=30'

30' 0' 30' 60' 90'

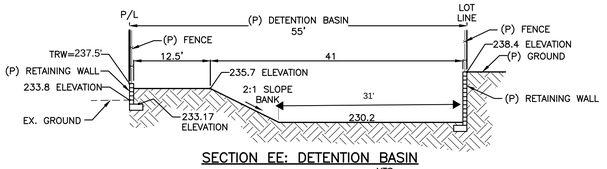
GRAPHIC SCALE: 1"=30'



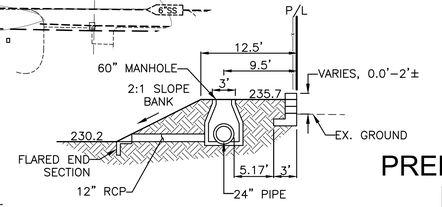
SECTION AA: HAZEL AVENUE
NTS



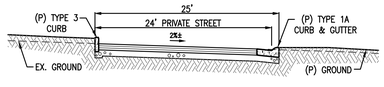
SECTION FF: RETAINING WALL AT DETENTION BASIN SOUTH BOUNDARY
NTS



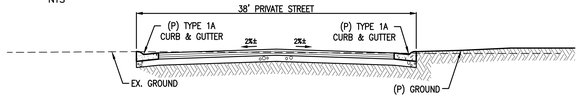
SECTION EE: DETENTION BASIN
NTS



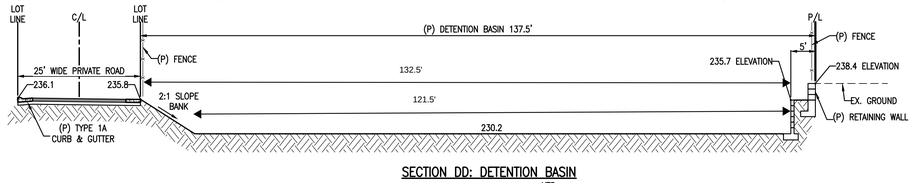
SECTION: DETENTION BASIN MANHOLE
NTS



SECTION BB: PRIVATE 25' WIDE STREET (TYP.)
NTS



SECTION CC: PRIVATE 38' WIDE STREET (TYP.)
NTS



SECTION DD: DETENTION BASIN
NTS

PRELIMINARY GRADING PLAN
HAZEL RIDGE

ORANGEVALE
SACRAMENTO COUNTY, CA
SEPTEMBER, 2022
DECEMBER 29, 2022
FEBRUARY 8, 2023 (NEW LOGO)
JUNE 12, 2023
AUGUST 31, 2023
NOVEMBER 6, 2023
DECEMBER 8, 2023

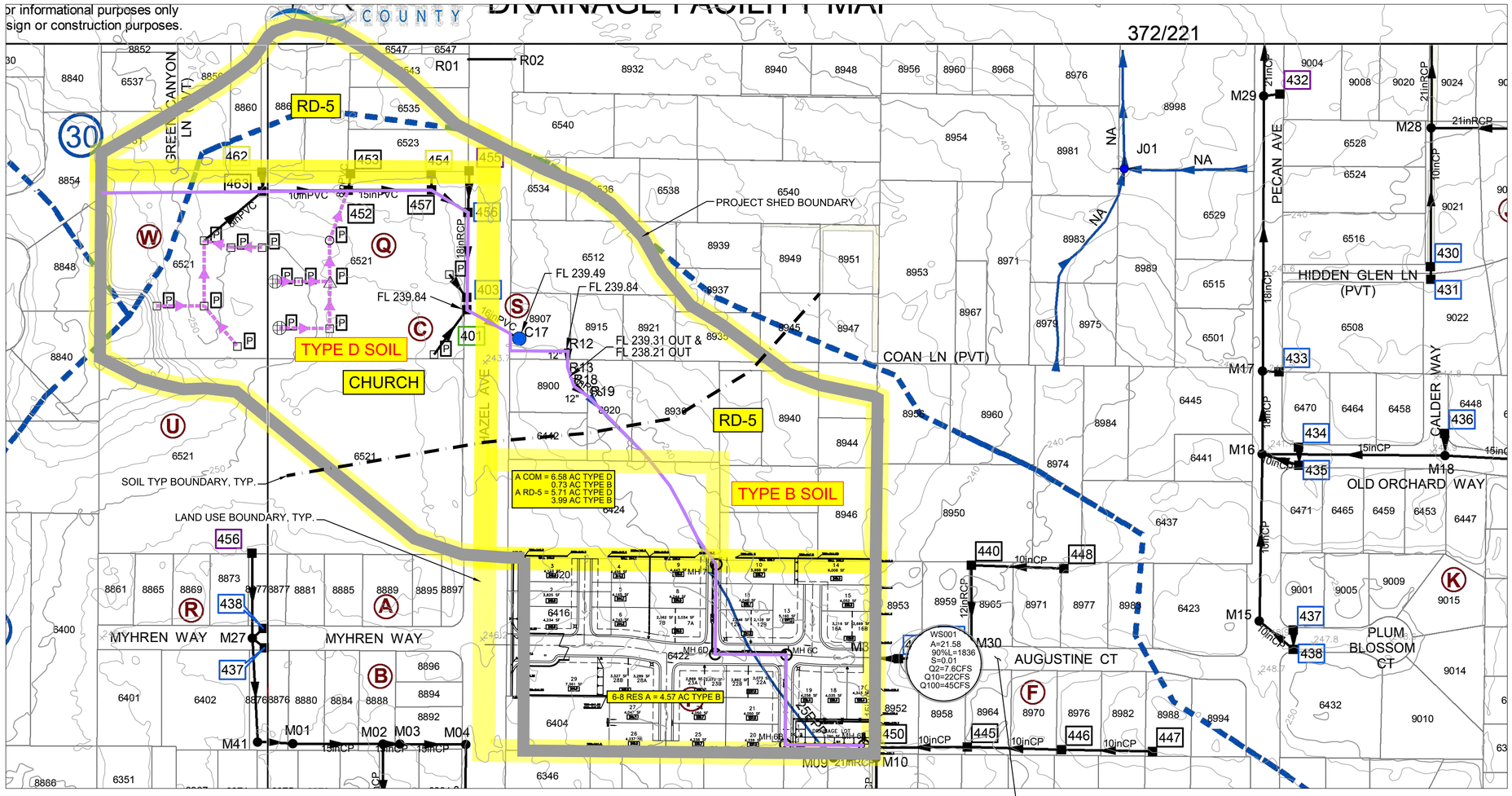
BAKER WILLIAMS ENGINEERING GROUP
6939 SUNRISE BLVD, SUITE 112
CITRUS HEIGHTS, CA 95610-3153
Phone (916)331-4336-Fax (916)331-4430
EMAIL: office@bwengineers.com

JOB NO. 21-10-037

2110037-PRELIM-GRADE

DRAINAGE SHED MAP POST-DEVELOPMENT
SACRAMENTO METHOD ZONE 3 - 1 DAY DURATION
HAZEL RIDGE

SACRAMENTO COUNTY ,CALIFORNIA
AUGUST, 2023
NOVEMBER, 2023



THIS SUBDIVISION WAS BUILT IN 1993 AND DOES NOT HAVE AN OVERLAND RELEASE.
THE PADS ON THE SOUTHWEST SIDE OF THE CUL-DE-SAC ARE 2+ FEET HIGHER THAN THE STREET.

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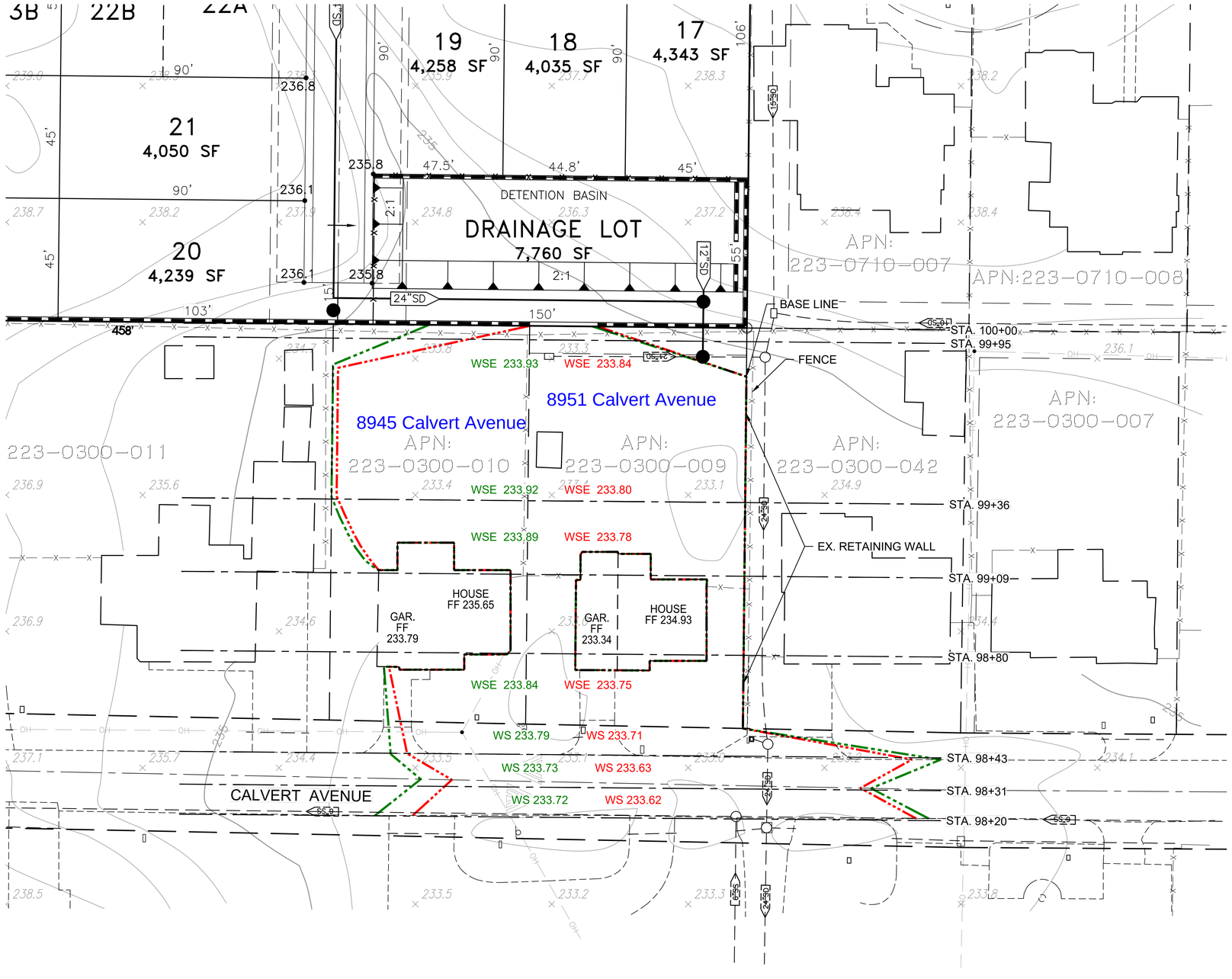
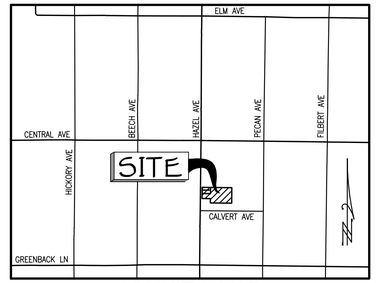
JOB # 21-10-037

2110037-DRAINAGE-SHED-MAP

Appendix D
Hec-Ras Model





VICINITY MAP
NO SCALE

LEGEND:

FF	FINISHED FLOOR ELEVATION
	PRE-DEVELOPMENT 100 YR. WATER SURFACE
WSE 233.93	PRE-DEVELOPMENT 100 YR. WATER SURFACE ELEVATION
	POST-DEVELOPMENT 100 YR. WATER SURFACE
WSE 233.84	POST-DEVELOPMENT 100 YR. WATER SURFACE ELEVATION
	STATION LINE

SCALE: 1"=30'

HYDROLOGY SECTION LINES
HAZEL RIDGE

ORANGEVALE
SACRAMENTO COUNTY, CA

NOVEMBER 13, 2023

BAKER WILLIAMS ENGINEERING GROUP
6939 SUNRISE BLVD, SUITE 112
CITRUS HEIGHTS, CA 95610-3153
Phone (916)331-4336~Fax (916)331-4430
EMAIL: office@bwengineers.com

JOB NO. 21-10-037

2110037-HYDROLOGY SECTION LINES

Hazel Ridge Pre HECRAS Results

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Overland re	10000	100yr pre	53	233.5	233.91	233.91	234.05	0.028336	2.93	18.1	68.96	1.01
Overland re	10000	100yr pre-pipe	44	233.5	233.88	233.88	234	0.029575	2.82	15.6	64.93	1.01
Overland re	10000	100yr post	45	233.5	233.88	233.88	234.01	0.029059	2.82	15.95	65.51	1.01
Overland re	10000	100yr post-pipe	34	233.5	233.84	233.84	233.94	0.029625	2.62	12.97	60.41	1
Overland re	10000	10yr pre	31	233.5	233.82	233.82	233.92	0.030018	2.56	12.1	58.82	1
Overland re	10000	10yr pre-pipe	22	233.5	233.77	233.77	233.86	0.03173	2.36	9.32	53.49	1
Overland re	10000	10yr post	22	233.5	233.77	233.77	233.86	0.03173	2.36	9.32	53.49	1
Overland re	10000	10yr post -pipe	13	233.5	233.71	233.71	233.78	0.034784	2.07	6.28	46.94	1
Overland re	10000	2yr pre	16	233.5	233.73	233.73	233.81	0.033583	2.18	7.33	49.29	1
Overland re	10000	2yr pre-pipe	8	233.5	233.68	233.68	233.72	0.027683	1.64	4.88	43.6	0.86
Overland re	10000	2yr post	17	233.5	233.74	233.74	233.82	0.033081	2.21	7.68	50.06	1
Overland re	9936	100yr pre	53	232.7	233.93		233.93	0.000255	0.53	99.53	141.58	0.11
Overland re	9936	100yr pre-pipe	44	232.7	233.87		233.87	0.000229	0.48	91.36	139.49	0.1
Overland re	9936	100yr post	45	232.7	233.88		233.88	0.000232	0.49	92.28	139.73	0.11
Overland re	9936	100yr post-pipe	34	232.7	233.8		233.8	0.000193	0.42	81.81	137	0.09
Overland re	9936	10yr pre	31	232.7	233.78		233.78	0.000178	0.39	78.93	135.31	0.09
Overland re	9936	10yr pre-pipe	22	232.7	233.71		233.71	0.000126	0.31	70.01	129.93	0.08
Overland re	9936	10yr post	22	232.7	233.71		233.71	0.000126	0.31	70.01	129.93	0.08
Overland re	9936	10yr post -pipe	13	232.7	233.63		233.63	0.000069	0.22	60.03	123.63	0.05
Overland re	9936	2yr pre	16	232.7	233.66		233.66	0.000088	0.25	63.56	125.9	0.06
Overland re	9936	2yr pre-pipe	8	232.7	233.59		233.59	0.000035	0.15	54.24	119.83	0.04
Overland re	9936	2yr post	17	232.7	233.67		233.67	0.000093	0.26	65.01	126.82	0.06

Hazel Ridge Pre HECRAS Results

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Overland re	9909	100yr pre	53	232.8	233.89		233.92	0.001275	1.39	38.24	40	0.25
Overland re	9909	100yr pre-pipe	44	232.8	233.84		233.86	0.001043	1.21	36.26	40	0.22
Overland re	9909	100yr post	45	232.8	233.84		233.87	0.001069	1.23	36.48	40	0.23
Overland re	9909	100yr post-pipe	34	232.8	233.78		233.79	0.000777	1	33.86	40	0.19
Overland re	9909	10yr pre	31	232.8	233.76		233.77	0.000693	0.94	33.12	40	0.18
Overland re	9909	10yr pre-pipe	22	232.8	233.7		233.71	0.000444	0.72	30.75	40	0.14
Overland re	9909	10yr post	22	232.8	233.7		233.71	0.000444	0.72	30.75	40	0.14
Overland re	9909	10yr post -pipe	13	232.8	233.63		233.63	0.000213	0.47	27.88	40	0.1
Overland re	9909	2yr pre	16	232.8	233.65		233.66	0.000286	0.55	28.93	40	0.11
Overland re	9909	2yr pre-pipe	8	232.8	233.58		233.58	0.0001	0.31	26.11	40	0.07
Overland re	9909	2yr post	17	232.8	233.66		233.67	0.000308	0.58	29.36	40	0.12
Overland re	9880	100yr pre	53	232.8	233.84		233.88	0.001478	1.45	36.53	40	0.27
Overland re	9880	100yr pre-pipe	44	232.8	233.8		233.83	0.001181	1.26	34.89	40	0.24
Overland re	9880	100yr post	45	232.8	233.81		233.83	0.001214	1.28	35.08	40	0.24
Overland re	9880	100yr post-pipe	34	232.8	233.75		233.77	0.000854	1.03	32.87	40	0.2
Overland re	9880	10yr pre	31	232.8	233.74		233.75	0.000756	0.96	32.25	40	0.19
Overland re	9880	10yr pre-pipe	22	232.8	233.69		233.69	0.00047	0.73	30.21	40	0.15
Overland re	9880	10yr post	22	232.8	233.69		233.69	0.00047	0.73	30.21	40	0.15
Overland re	9880	10yr post -pipe	13	232.8	233.62		233.62	0.000219	0.47	27.63	40	0.1
Overland re	9880	2yr pre	16	232.8	233.64		233.65	0.000298	0.56	28.58	40	0.12
Overland re	9880	2yr pre-pipe	8	232.8	233.58		233.58	0.000101	0.31	25.99	40	0.07
Overland re	9880	2yr post	17	232.8	233.65		233.66	0.000321	0.59	28.99	40	0.12

Hazel Ridge Pre HECRAS Results

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Overland re	9843	100yr pre	53	233.3	233.79		233.8	0.002136	0.88	60.31	201.18	0.28
Overland re	9843	100yr pre-pipe	44	233.3	233.75		233.76	0.002198	0.84	52.68	193.75	0.28
Overland re	9843	100yr post	45	233.3	233.76		233.77	0.002192	0.84	53.53	194.6	0.28
Overland re	9843	100yr post-pipe	34	233.3	233.71		233.72	0.002223	0.77	44.16	185.11	0.28
Overland re	9843	10yr pre	31	233.3	233.7		233.7	0.002179	0.74	41.81	182.66	0.27
Overland re	9843	10yr pre-pipe	22	233.3	233.66		233.66	0.001966	0.64	34.48	174.78	0.25
Overland re	9843	10yr post	22	233.3	233.66		233.66	0.001966	0.64	34.48	174.78	0.25
Overland re	9843	10yr post -pipe	13	233.3	233.6		233.61	0.001725	0.51	25.54	164.66	0.23
Overland re	9843	2yr pre	16	233.3	233.62		233.63	0.00179	0.55	28.87	168.5	0.24
Overland re	9843	2yr pre-pipe	8	233.3	233.57		233.57	0.00135	0.4	20.22	158.33	0.2
Overland re	9843	2yr post	17	233.3	233.63		233.64	0.00171	0.56	30.49	170.33	0.23
Overland re	9831	100yr pre	53	233.4	233.73		233.76	0.006317	1.32	40.25	165.14	0.47
Overland re	9831	100yr pre-pipe	44	233.4	233.69		233.72	0.008067	1.34	32.89	158.29	0.52
Overland re	9831	100yr post	45	233.4	233.69		233.72	0.007813	1.33	33.73	159.08	0.51
Overland re	9831	100yr post-pipe	34	233.4	233.63		233.66	0.012492	1.41	24.17	149.77	0.62
Overland re	9831	10yr pre	31	233.4	233.61		233.65	0.015194	1.45	21.4	146.96	0.67
Overland re	9831	10yr pre-pipe	22	233.4	233.55	233.54	233.6	0.029284	1.65	13.33	123.14	0.88
Overland re	9831	10yr post	22	233.4	233.55	233.54	233.6	0.029284	1.65	13.33	123.14	0.88
Overland re	9831	10yr post -pipe	13	233.4	233.52	233.52	233.55	0.026109	1.36	9.53	107.49	0.81
Overland re	9831	2yr pre	16	233.4	233.53	233.53	233.57	0.030326	1.53	10.48	111.59	0.88
Overland re	9831	2yr pre-pipe	8	233.4	233.48	233.48	233.51	0.044869	1.43	5.6	88.43	1
Overland re	9831	2yr post	17	233.4	233.52	233.52	233.57	0.040192	1.72	9.89	109.08	1.01

Hazel Ridge Pre HECRAS Results

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Overland re	9820	100yr pre	53	233.2	233.72	233.43	233.73	0.001001	0.7	75.96	202.89	0.2
Overland re	9820	100yr pre-pipe	44	233.2	233.68	233.41	233.69	0.001001	0.66	66.81	194.68	0.2
Overland re	9820	100yr post	45	233.2	233.68	233.41	233.69	0.001001	0.66	67.85	195.63	0.2
Overland re	9820	100yr post-pipe	34	233.2	233.62	233.38	233.63	0.001002	0.61	56.02	184.53	0.19
Overland re	9820	10yr pre	31	233.2	233.6	233.37	233.61	0.001001	0.59	52.63	181.22	0.19
Overland re	9820	10yr pre-pipe	22	233.2	233.54	233.34	233.55	0.001	0.53	41.79	170.22	0.19
Overland re	9820	10yr post	22	233.2	233.54	233.34	233.55	0.001	0.53	41.79	170.22	0.19
Overland re	9820	10yr post -pipe	13	233.2	233.47	233.32	233.47	0.001001	0.44	29.49	156.8	0.18
Overland re	9820	2yr pre	16	233.2	233.49	233.32	233.5	0.001002	0.47	33.8	161.63	0.18
Overland re	9820	2yr pre-pipe	8	233.2	233.41	233.28	233.42	0.001001	0.37	21.5	147.44	0.17
Overland re	9820	2yr post	17	233.2	233.5	233.32	233.51	0.001001	0.48	35.19	163.16	0.18

Hazel Ridge Post HECRAS Results

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Overland rele	10000	100yr pre	53	235.7	236.22	236.22	236.48	0.023715	4.1	12.93	25	1.01
Overland rele	10000	100yr pre-pipe	44	235.7	236.16	236.16	236.39	0.024437	3.85	11.44	25	1
Overland rele	10000	100yr post	45	235.7	236.16	236.16	236.4	0.024287	3.87	11.62	25	1
Overland rele	10000	100yr post-pipe	34	235.7	236.09	236.09	236.28	0.025523	3.52	9.65	25	1
Overland rele	10000	10yr pre	31	235.7	236.06	236.06	236.24	0.026274	3.43	9.04	25	1
Overland rele	10000	10yr pre-pipe	22	235.7	235.99	235.99	236.13	0.027789	3.05	7.22	25	1
Overland rele	10000	10yr post	22	235.7	235.99	235.99	236.13	0.027789	3.05	7.22	25	1
Overland rele	10000	10yr post -pipe	13	235.7	235.9	235.9	236.01	0.032052	2.58	5.03	25	1.01
Overland rele	10000	2yr pre	16	235.7	235.93	235.93	236.05	0.029877	2.75	5.83	25	1
Overland rele	10000	2yr pre-pipe	8	235.7	235.85	235.85	235.92	0.034621	2.18	3.67	25	1
Overland rele	10000	2yr post	17	235.7	235.94	235.94	236.06	0.029367	2.8	6.08	25	1
Overland rele	9995	100yr pre	53	233.5	233.91	233.91	234.05	0.028336	2.93	18.1	68.96	1.01
Overland rele	9995	100yr pre-pipe	44	233.5	233.88	233.88	234	0.029575	2.82	15.6	64.93	1.01
Overland rele	9995	100yr post	45	233.5	233.88	233.88	234.01	0.029059	2.82	15.95	65.51	1.01
Overland rele	9995	100yr post-pipe	34	233.5	233.84	233.84	233.94	0.029625	2.62	12.97	60.41	1
Overland rele	9995	10yr pre	31	233.5	233.82	233.82	233.92	0.030018	2.56	12.1	58.82	1
Overland rele	9995	10yr pre-pipe	22	233.5	233.77	233.77	233.86	0.03173	2.36	9.32	53.49	1
Overland rele	9995	10yr post	22	233.5	233.77	233.77	233.86	0.03173	2.36	9.32	53.49	1
Overland rele	9995	10yr post -pipe	13	233.5	233.71	233.71	233.78	0.034784	2.07	6.28	46.94	1
Overland rele	9995	2yr pre	16	233.5	233.73	233.73	233.81	0.033583	2.18	7.33	49.29	1
Overland rele	9995	2yr pre-pipe	8	233.5	233.68	233.68	233.72	0.027683	1.64	4.88	43.6	0.86
Overland rele	9995	2yr post	17	233.5	233.74	233.74	233.82	0.033081	2.21	7.68	50.06	1

Hazel Ridge Post HECRAS Results

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Overland rele	9936	100yr pre	53	232.7	233.93		233.93	0.000255	0.53	99.53	141.58	0.11
Overland rele	9936	100yr pre-pipe	44	232.7	233.87		233.87	0.000229	0.48	91.35	139.49	0.1
Overland rele	9936	100yr post	45	232.7	233.88		233.88	0.000232	0.49	92.28	139.73	0.11
Overland rele	9936	100yr post-pipe	34	232.7	233.8		233.8	0.000193	0.42	81.8	137	0.09
Overland rele	9936	10yr pre	31	232.7	233.78		233.78	0.000178	0.39	78.92	135.31	0.09
Overland rele	9936	10yr pre-pipe	22	232.7	233.71		233.71	0.000126	0.31	70.01	129.93	0.08
Overland rele	9936	10yr post	22	232.7	233.71		233.71	0.000126	0.31	70.01	129.93	0.08
Overland rele	9936	10yr post -pipe	13	232.7	233.63		233.63	0.000069	0.22	60.03	123.63	0.05
Overland rele	9936	2yr pre	16	232.7	233.66		233.66	0.000088	0.25	63.56	125.9	0.06
Overland rele	9936	2yr pre-pipe	8	232.7	233.59		233.59	0.000035	0.15	54.24	119.83	0.04
Overland rele	9936	2yr post	17	232.7	233.67		233.67	0.000093	0.26	65.01	126.82	0.06
Overland rele	9909	100yr pre	53	232.8	233.89		233.92	0.001275	1.39	38.24	40	0.25
Overland rele	9909	100yr pre-pipe	44	232.8	233.84		233.86	0.001044	1.21	36.25	40	0.22
Overland rele	9909	100yr post	45	232.8	233.84		233.87	0.00107	1.23	36.48	40	0.23
Overland rele	9909	100yr post-pipe	34	232.8	233.78		233.79	0.000777	1	33.86	40	0.19
Overland rele	9909	10yr pre	31	232.8	233.76		233.77	0.000693	0.94	33.12	40	0.18
Overland rele	9909	10yr pre-pipe	22	232.8	233.7		233.71	0.000444	0.72	30.75	40	0.14
Overland rele	9909	10yr post	22	232.8	233.7		233.71	0.000444	0.72	30.75	40	0.14
Overland rele	9909	10yr post -pipe	13	232.8	233.63		233.63	0.000213	0.47	27.88	40	0.1
Overland rele	9909	2yr pre	16	232.8	233.65		233.66	0.000286	0.55	28.93	40	0.11
Overland rele	9909	2yr pre-pipe	8	232.8	233.58		233.58	0.0001	0.31	26.11	40	0.07
Overland rele	9909	2yr post	17	232.8	233.66		233.67	0.000308	0.58	29.36	40	0.12

Hazel Ridge Post HECRAS Results

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Overland rele	9880	100yr pre	53	232.8	233.84		233.88	0.001478	1.45	36.53	40	0.27
Overland rele	9880	100yr pre-pipe	44	232.8	233.8		233.83	0.001181	1.26	34.89	40	0.24
Overland rele	9880	100yr post	45	232.8	233.81		233.83	0.001214	1.28	35.08	40	0.24
Overland rele	9880	100yr post-pipe	34	232.8	233.75		233.77	0.000855	1.03	32.87	40	0.2
Overland rele	9880	10yr pre	31	232.8	233.74		233.75	0.000756	0.96	32.25	40	0.19
Overland rele	9880	10yr pre-pipe	22	232.8	233.69		233.69	0.00047	0.73	30.21	40	0.15
Overland rele	9880	10yr post	22	232.8	233.69		233.69	0.00047	0.73	30.21	40	0.15
Overland rele	9880	10yr post -pipe	13	232.8	233.62		233.62	0.000219	0.47	27.63	40	0.1
Overland rele	9880	2yr pre	16	232.8	233.64		233.65	0.000298	0.56	28.58	40	0.12
Overland rele	9880	2yr pre-pipe	8	232.8	233.58		233.58	0.000101	0.31	25.99	40	0.07
Overland rele	9880	2yr post	17	232.8	233.65		233.66	0.000321	0.59	28.99	40	0.12
Overland rele	9843	100yr pre	53	233.3	233.79		233.8	0.002136	0.88	60.31	201.18	0.28
Overland rele	9843	100yr pre-pipe	44	233.3	233.75		233.76	0.0022	0.84	52.66	193.74	0.28
Overland rele	9843	100yr post	45	233.3	233.76		233.77	0.002193	0.84	53.52	194.59	0.28
Overland rele	9843	100yr post-pipe	34	233.3	233.71		233.72	0.002225	0.77	44.15	185.1	0.28
Overland rele	9843	10yr pre	31	233.3	233.7		233.7	0.00218	0.74	41.8	182.65	0.27
Overland rele	9843	10yr pre-pipe	22	233.3	233.66		233.66	0.001966	0.64	34.48	174.78	0.25
Overland rele	9843	10yr post	22	233.3	233.66		233.66	0.001966	0.64	34.48	174.78	0.25
Overland rele	9843	10yr post -pipe	13	233.3	233.6		233.61	0.001725	0.51	25.54	164.66	0.23
Overland rele	9843	2yr pre	16	233.3	233.62		233.63	0.00179	0.55	28.87	168.5	0.24
Overland rele	9843	2yr pre-pipe	8	233.3	233.57		233.57	0.00135	0.4	20.22	158.33	0.2
Overland rele	9843	2yr post	17	233.3	233.63		233.64	0.00171	0.56	30.49	170.33	0.23

Hazel Ridge Post HECRAS Results

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Overland rele	9831	100yr pre	53	233.4	233.73		233.76	0.006317	1.32	40.25	165.14	0.47
Overland rele	9831	100yr pre-pipe	44	233.4	233.69		233.72	0.008087	1.34	32.87	158.26	0.52
Overland rele	9831	100yr post	45	233.4	233.69		233.72	0.00783	1.34	33.7	159.06	0.51
Overland rele	9831	100yr post-pipe	34	233.4	233.63		233.66	0.012595	1.41	24.11	149.7	0.62
Overland rele	9831	10yr pre	31	233.4	233.61		233.65	0.015543	1.46	21.25	146.8	0.68
Overland rele	9831	10yr pre-pipe	22	233.4	233.55	233.54	233.6	0.029284	1.65	13.33	123.14	0.88
Overland rele	9831	10yr post	22	233.4	233.55	233.54	233.6	0.029284	1.65	13.33	123.14	0.88
Overland rele	9831	10yr post -pipe	13	233.4	233.52	233.52	233.55	0.026109	1.36	9.53	107.49	0.81
Overland rele	9831	2yr pre	16	233.4	233.53	233.53	233.57	0.030326	1.53	10.48	111.59	0.88
Overland rele	9831	2yr pre-pipe	8	233.4	233.48	233.48	233.51	0.044869	1.43	5.6	88.43	1
Overland rele	9831	2yr post	17	233.4	233.52	233.52	233.57	0.040192	1.72	9.89	109.08	1.01
Overland rele	9820	100yr pre	53	233.2	233.72	233.43	233.73	0.001001	0.7	75.96	202.89	0.2
Overland rele	9820	100yr pre-pipe	44	233.2	233.68	233.41	233.69	0.001001	0.66	66.81	194.68	0.2
Overland rele	9820	100yr post	45	233.2	233.68	233.41	233.69	0.001001	0.66	67.85	195.63	0.2
Overland rele	9820	100yr post-pipe	34	233.2	233.62	233.38	233.63	0.001002	0.61	56.02	184.53	0.19
Overland rele	9820	10yr pre	31	233.2	233.6	233.37	233.61	0.001001	0.59	52.63	181.22	0.19
Overland rele	9820	10yr pre-pipe	22	233.2	233.54	233.34	233.55	0.001	0.53	41.79	170.22	0.19
Overland rele	9820	10yr post	22	233.2	233.54	233.34	233.55	0.001	0.53	41.79	170.22	0.19
Overland rele	9820	10yr post -pipe	13	233.2	233.47	233.32	233.47	0.001001	0.44	29.49	156.8	0.18
Overland rele	9820	2yr pre	16	233.2	233.49	233.32	233.5	0.001002	0.47	33.8	161.63	0.18
Overland rele	9820	2yr pre-pipe	8	233.2	233.41	233.28	233.42	0.001001	0.37	21.5	147.44	0.17
Overland rele	9820	2yr post	17	233.2	233.5	233.32	233.51	0.001001	0.48	35.19	163.16	0.18