PRELIMINARY DETENTION ANALYSIS
FOR THE
4TH STREET EAST AND BRAZIL STREET PROJECTS

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Date: December 27, 2017

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DETENTION SUMMARY

1. Summary

Three separate projects (149 4th Street Residence, Lot 227 Residence, and Lot 228 Residence) were presented to city of Sonoma Planning Commission during 2017 and were approved. A typical condition of approval was offered by the applicant and accepted for all three projects to assist neighbor concerns about local drainage. The proposed condition is summarized as requiring the individual proposed projects to limit post-construction runoff at city right-of-way along 4th Street and Brazil Street to pre-construction values for the 10-year storm event. Three separate drainage analyses with detention calculations will be required to be submitted to the city engineer for review and approval before any permits are issued. This Preliminary Detention Analysis has been prepared to provide clarity on the detention volume required for the projects to meet the condition of approval.

2. Existing Watershed Characteristics

The existing watershed that includes the three proposed projects conveys drainage to a roadside swale along Brazil Street and 4th Street East and consists of hillside terrain with slopes between 5 and 25-percent. Soils in the watershed consist of loam with high rock content, which are well drained. Existing drainage patterns consist of sub-surface flow and sheet flow on the surface through the watershed. There are no creeks or any significant concentrations of runoff. Site coverage for the almost 24.9-acre watershed consists of woodland hillside terrain, existing driveways and homes.

3. Detention Analysis

Stormwater detention is a drainage concept the stores rainfall in order to manage excess runoff on a developed site. Holding a portion of the runoff and releasing it at a much slower rate reduces the peak flows of a watershed. Detention calculations provide the required volume to offset any impacts from additional impervious area for different storm intensities. Two different methods used to calculate hydrology and detention for a watershed are the Rational Method and SCS TR-55 method.

The Rational Method uses the calculation Q=ciA and results are flows in cubic-feet per second (cfs). Sonoma County added a k-factor, which adjusts the flows based upon rain gauge data. The Modified

Rational Method calculation used is Q=kciA. Intensity (i) is based upon a set of Intensity vs. Duration curves specific to Sonoma County. The time of concentration has a direct correlation to the intensity, which factors into the calculated runoff. The runoff coefficient (c) is a factor that establishes site coverage. A bigger c-value corresponds with more impervious area. Watershed area (A) is the area of a watershed or sub-shed expressed in acres. An Excel spreadsheet was selected to perform rational method analysis on the watershed. It combines flows and physical data of different sub-sheds and maintains a calculation of time of concentration between them. Refer to the Hydrology Maps for limits and sizes of sub-sheds. Pre-construction and post-construction data was used to evaluate the difference in runoff and establish the required detention that will offset any increase in project runoff for the 10 and 100-year storm events. Detention calculations are performed using a hydrograph. The time of concentration and peak flow at a point of concentration are used. The area between the pre-construction and post-construction hydrographs is used to calculate the detention required. Below is a summary of detention results for the Rational Method.

	10-Year Storm	100-Year Storm
Detention Volume Required (cu.ft.)	898	1340

The SCS Method is a similar but different method of calculating runoff from a watershed and detention analysis. The SCS Method uses an equation that inputs 24-hour rainfall depth, time of concentration, watershed slope and curve numbers. A curve number is a numeric value assigned to a watershed that directly relates to runoff and is based upon the hydrologic soil group, land used, and surface coverage. A bigger curve number corresponds with more runoff. We used Autodesk Storm and Sanitary Analysis to aid with hydrology and detention calculations using the SCS TR-55 method. Pre-construction and Post-construction drainage models were prepared to calculate runoff from the local watershed. Curve numbers have been calculated and are included within this analysis. The SCS TR-55 method uses a calculated curve number, precipitation data from local rain gauges, a Type 1A storm event, and a user specified time of concentration to calculate runoff. Drainage models were performed for 10-year and 100-year 24-hour storm events.

		Pre-Construction	Post-Construction
10-Year, 24-Hour	Total Precipitation (in);	4.30	4.30
	Peak Runoff (cfs):	11.50	12.14
100-Year, 24-Hour	Total Precipitation (in);	6.90	6.90
	Peak Runoff (cfs):	25.34	26.18

Autodesk Storm and Sanitary Analysis compares the pre and post-construction scenarios and calculates the required storage volume. Below is a table summary of the results of analysis.

	10-Year, 24-Hour	100-Year, 24-Hour
Detention Volume Required (cu.ft.)	701	1126

Detention volume calculated using the Rational Method exceeds the SCS Method and will be used for comparison of the projects. Proposed detention devices in the different projects include surface detention basins and oversized perforated tee-pipe dissipaters.

- 149 4th Street Residence has two detention basins designed. A 540-cubic foot basin is located below the residence in the existing dirt trail and the 296-cubic foot detention basins is located below the proposed garage.
- Lot 227 Residence includes two detention basins and an oversized perforated tee-pipe dissipater. A 191-cubic foot detention basin is located downhill of the proposed pool and a 147-cubic foot detention basin is located below the entrance to the residence. A 38-cubic foot perforated tee-pipe dissipater is located directly below the parking area.
- Lot 228 Residence includes two detention basins and an oversized perforated tee-pipe dissipater. Both detention basins are 191-cubic feet and located below the residence. A 38-cubic foot perforated tee-pipe dissipater is located below the fire department turnaround.
- The driveway serving lots 227 and 228 has three separate perforated tee-pipe dissipaters. All three pipes provide 62-cubic feet of storage.

The combined storage designed for the three projects is 1818-cubic feet, which exceeds the calculated 898-cubic feet of the 10-year storm event by more than 100-percent.

Untitled Map
Write a description for your map.
Legend
Google Earth
© 2017 Google
N
600 ft

DETENTION ANALYSIS

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RATIONAL METHOD

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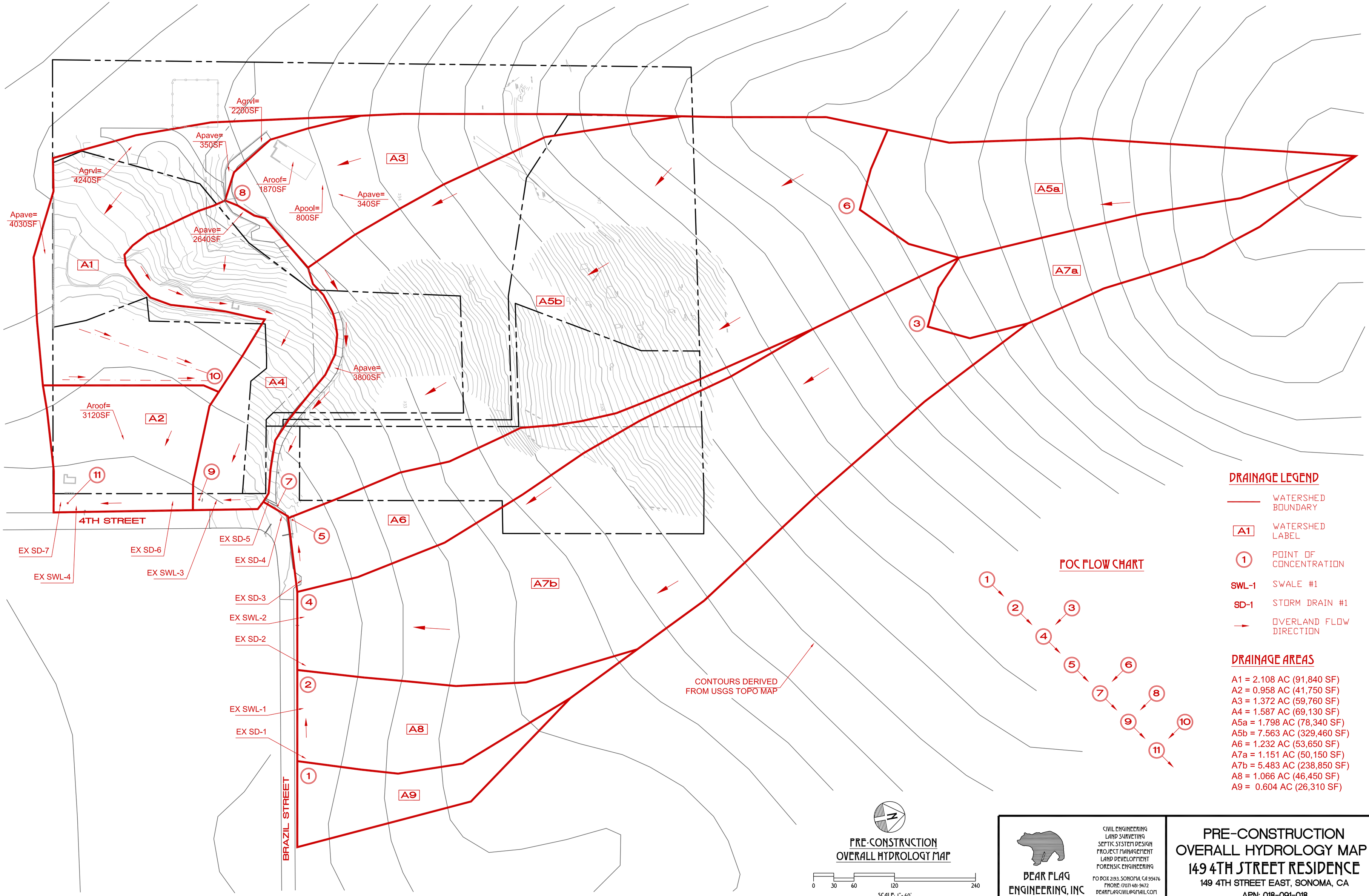

DRAINAGE LEGEND

- WATERSHED BOUNDARY
- A1 — WATERSHED LABEL
- (1) — POINT OF CONCENTRATION
- SWL-1 — SWALE #1
- SD-1 — STORM DRAIN #1
- OVERLAND FLOW DIRECTION

POC FLOW CHART

DRAINAGE AREAS

A1 = 2.108 AC (91,840 SF)
A2 = 0.958 AC (41,750 SF)
A3 = 1.372 AC (59,760 SF)
A4 = 1.587 AC (69,130 SF)
A5a = 1.798 AC (78,340 SF)
A5b = 7.563 AC (329,460 SF)
A6 = 1.232 AC (53,650 SF)
A7a = 1.151 AC (50,150 SF)
A7b = 5.483 AC (238,850 SF)
A8 = 1.066 AC (46,450 SF)
A9 = 0.604 AC (26,310 SF)

PRE-CONSTRUCTION
OVERALL HYDROLOGY MAP

0 30 60 120 240
SCALE: 1"= 60'

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PRE-CONSTRUCTION OVERALL HYDROLOGY MAP

149 4TH STREET RESIDENCE

149 4TH STREET EAST, SONOMA, CA
APN: 018-091-018

RATIONAL METHOD DRAINAGE STUDY

Date: 12/20/2017 Project: 4th Street and Brazil Analysis Sheet: 1 of 2

Storm: **10-Year (Pre-Construction)** By: CM

10-Year Storm Event

POC	Area	Elev (ft)	Dist (ft)	Slope (ft/ft)	V (ft/s)	Tc (min)	Time (min)	I (in/hr)	K	C	A (acres)	A_{total} (acres)	KAC	Sum KAC	Q (ft^3/s)	Description
1	A9					15.00	15.00	1.70376	1.0	0.500	0.604	0.604	0.302	0.302	0.51	(EX SD-1)
2	A8	3.2	130	0.025	1.47	1.47	16.47	1.62201	1.0	0.500	1.066	1.670	0.533	0.835	1.35	8 "SD (EX SD-2) (EX SWL-1)
3	A7a					15.00	15.00	1.70376	1.0	0.500	1.151	1.151	0.576	0.576	0.98	Overland Flow
POC 4 Combines Flows from POCs 2 and 3							15.00					2.821		1.411	2.33	Overland Flow
4	A7b	300	1070	0.280	6.69	2.67	17.67	1.56328	1.0	0.527	5.483	8.304	2.890	4.300	6.72	8 "SD (EX SD-3) (EX SWL-2)
5	A6	2.5	110	0.023	3.80	0.48	18.15	1.54131	1.0	0.549	1.232	9.536	0.676	4.976	7.67	18 "SD (EX SD-4)
6	A5a					15.00	15.00	1.70376	1.0	0.500	1.798	1.798	0.899	0.899	1.53	Overland Flow
POC 7 Combines Flows from POCs 5 and 6							18.15					11.334		5.875	9.20	Overland Flow
7	A5b	3	40	0.075	5.21	0.13	18.28	1.53562	1.0	0.505	7.563	18.897	3.819	9.695	14.89	18 "SD (EX SD-5) (EX SWL-3)
8	A3					15.00	15.00	1.70376	1.0	0.525	1.372	1.372	0.720	0.720	1.23	Overland Flow
POC 9 Combines Flows from POCs 7 and 8							18.28					20.269		10.415	16.11	Overland Flow
9	A4	7	100	0.070	5.13	0.32	18.60	1.52145	1.0	0.515	1.587	21.856	0.817	11.232	17.09	24 "SD (EX SD-6)
10	A1					15.00	15.00	1.70376	1.0	0.547	2.108	2.108	1.153	1.153	1.96	Overland Flow
POC 11 Combines Flows from POCs 9 and 10							18.60					23.964		12.385	19.05	Overland Flow
11	A2	4.5	204	0.022	6.07	0.56	19.16	1.49787	1.0	0.581	0.958	24.922	0.557	12.942	19.39	24 "SD (EX SD-7) (EX SWL-4)

RATIONAL METHOD DRAINAGE STUDY

Date: 12/20/2017 Project: 4th Street and Brazil Analysis Sheet: 2 of 2

Storm: **100-Year (Pre-Construction)** By: CM

100-Year Storm Event

POC	Area	Elev (ft)	Dist (ft)	Slope (ft/ft)	V (ft/s)	Tc (min)	Time (min)	I (in/hr)	K	C	A (acres)	A_{total} (acres)	KAC	Sum KAC	Q (ft^3/s)	Description
1	A9					15.00	15.00	2.42278	1.0	0.500	0.604	0.604	0.302	0.302	0.73	(EX SD-1)
2	A8	3.2	130	0.025	2.10	1.03	16.03	2.33886	1.0	0.500	1.066	1.670	0.533	0.835	1.95	8 "SD (EX SD-2) (EX SWL-1)
3	A7a					15.00	15.00	2.42278	1.0	0.500	1.151	1.151	0.576	0.576	1.39	Overland Flow
POC 4 Combines Flows from POCs 2 and 3							15.00					2.821		1.411	3.35	Overland Flow
4	A7b	300	1070	0.280	4.26	4.18	19.18	2.12709	1.0	0.527	5.483	8.304	2.890	4.300	9.15	12 "SD (EX SD-3) (EX SWL-2)
5	A6	2.5	110	0.023	3.80	0.48	19.67	2.09935	1.0	0.549	1.232	9.536	0.676	4.976	10.45	21 "SD (EX SD-4)
6	A5a					15.00	15.00	2.42278	1.0	0.500	1.798	1.798	0.899	0.899	2.18	Overland Flow
POC 7 Combines Flows from POCs 5 and 6							19.67					11.334		5.875	12.63	Overland Flow
7	A5b	3	40	0.075	5.25	0.13	19.79	2.09221	1.0	0.505	7.563	18.897	3.819	9.695	20.28	21 "SD (EX SD-5) (EX SWL-3)
8	A3					15.00	15.00	2.42278	1.0	0.525	1.372	1.372	0.720	0.720	1.75	Overland Flow
POC 9 Combines Flows from POCs 7 and 8							19.79					20.269		10.415	22.03	Overland Flow
9	A4	7	100	0.070	5.54	0.30	20.09	2.07558	1.0	0.515	1.587	21.856	0.817	11.232	23.31	27 "SD (EX SD-6)
10	A1					15.00	15.00	2.42278	1.0	0.547	2.108	2.108	1.153	1.153	2.79	Overland Flow
POC 11 Combines Flows from POCs 9 and 10							20.09					23.964		12.385	26.11	Overland Flow
11	A2	4.5	204	0.022	6.57	0.52	20.61	2.04783	1.0	0.581	0.958	24.922	0.557	12.942	26.50	27 "SD (EX SD-7) (EX SWL-4)

Runoff Coefficient Worksheet
(Pre-Construction)

A1			
Surface	RC	Area (sq.ft)	RC x A
Pervious	0.50	81020	40510
Gravel	0.90	6440	5796
Pavement	0.90	4380	3942
Pool	1.00	0	0
Roof	1.00	0	0
	Subtotal	91840	50248
	0.547	Weighted RC	

A2			
Surface	RC	Area (sq.ft)	RC x A
Pervious	0.50	34384	17192
Gravel	0.90	0	0
Pavement	0.90	3000	2700
Pool	1.00	0	0
Roof	1.00	4366	4366
	Subtotal	41750	24258
	0.581	Weighted RC	

A3			
Surface	RC	Area (sq.ft)	RC x A
Pervious	0.50	56750	28375
Gravel	0.90	0	0
Pavement	0.90	340	306
Pool	1.00	800	800
Roof	1.00	1870	1870
	Subtotal	59760	31351
	0.525	Weighted RC	

A4			
Surface	RC	Area (sq.ft)	RC x A
Pervious	0.50	66490	33245
Gravel	0.90	0	0
Pavement	0.90	2640	2376
Pool	1.00	0	0
Roof	1.00	0	0
	Subtotal	69130	35621
	0.515	Weighted RC	

A5a			
Surface	RC	Area (sq.ft)	RC x A
Pervious	0.50	78340	39170
Gravel	0.90	0	0
Pavement	0.90	0	0
Pool	1.00	0	0
Roof	1.00	0	0
	Subtotal	78340	39170
	0.500	Weighted RC	

A5b			
Surface	RC	Area (sq.ft)	RC x A
Pervious	0.50	325660	162830
Gravel	0.90	0	0
Pavement	0.90	3800	3420
Pool	1.00	0	0
Roof	1.00	0	0
	Subtotal	329460	166250
	0.505	Weighted RC	

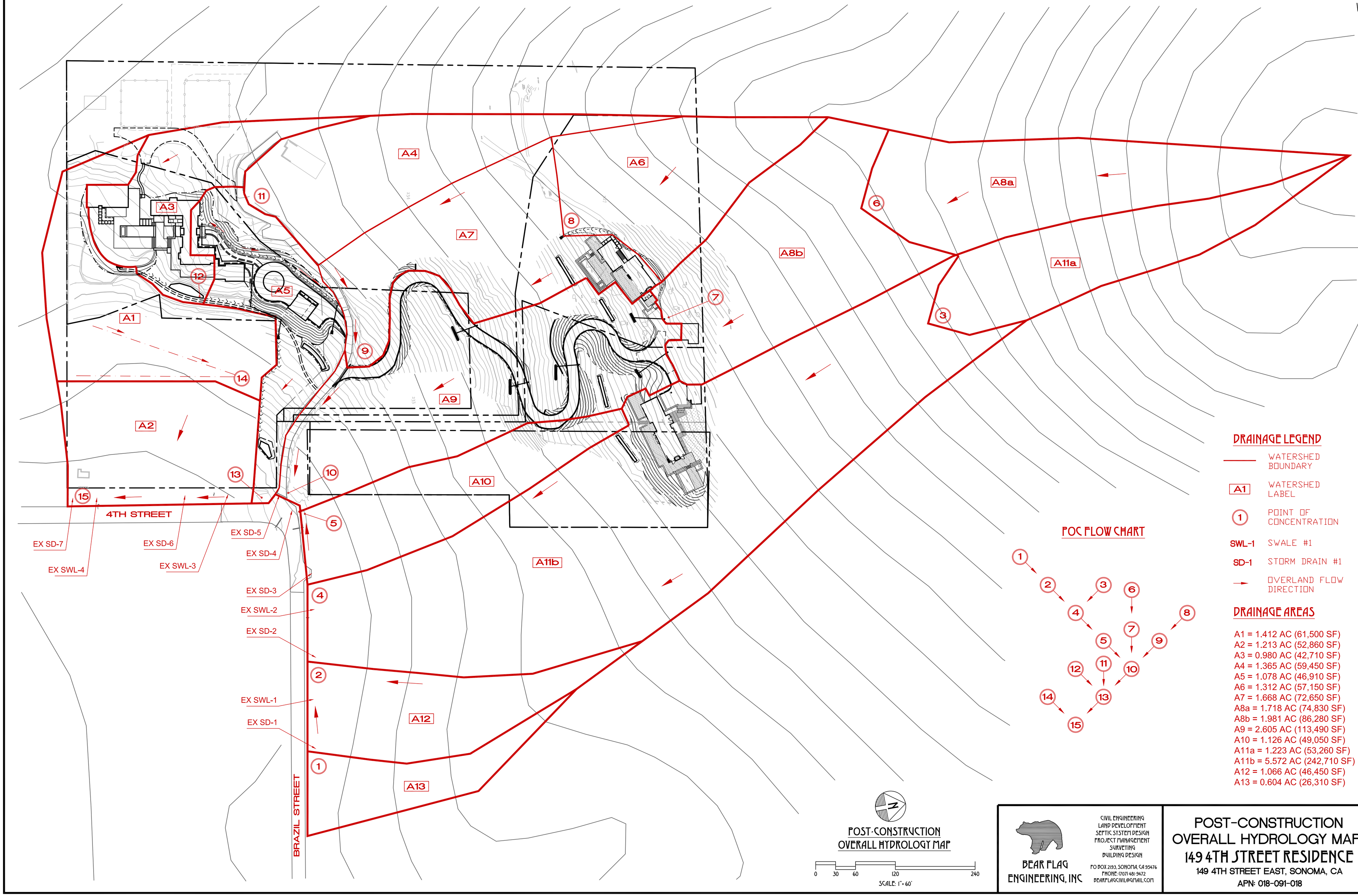
A6			
Surface	RC	Area (sq.ft)	RC x A
Pervious	0.50	47950	23975
Gravel	0.90	0	0
Pavement	0.90	2300	2070
Pool	1.00	0	0
Roof	1.00	3400	3400
	Subtotal	53650	29445
	0.549	Weighted RC	

A7a			
Surface	RC	Area (sq.ft)	RC x A
Pervious	0.50	50150	25075
Gravel	0.90	0	0
Pavement	0.90	0	0
Pool	1.00	0	0
Roof	1.00	0	0
	Subtotal	50150	25075
	0.500	Weighted RC	

A7b			
Surface	RC	Area (sq.ft)	RC x A
Pervious	0.50	224300	112150
Gravel	0.90	0	0
Pavement	0.90	9400	8460
Pool	1.00	0	0
Roof	1.00	5150	5150
	Subtotal	238850	125760
	0.527	Weighted RC	

A8			
Surface	RC	Area (sq.ft)	RC x A
Pervious	0.50	46450	23225
Gravel	0.90	0	0
Pavement	0.90	0	0
Pool	1.00	0	0
Roof	1.00	0	0
	Subtotal	46450	23225
	0.500	Weighted RC	

A9			
Surface	RC	Area (sq.ft)	RC x A
Pervious	0.50	26310	13155
Gravel	0.90	0	0
Pavement	0.90	0	0
Pool	1.00	0	0
Roof	1.00	0	0
	Subtotal	26310	13155
	0.500	Weighted RC	



DRAINAGE LEGEND

- WATERSHED BOUNDARY
- A1 — WATERSHED LABEL
- 1 — POINT OF CONCENTRATION
- SWL-1 — SWALE #1
- SD-1 — STORM DRAIN #1
- OVERLAND FLOW DIRECTION

POC FLOW CHART

DRAINAGE AREAS

A1 = 1.412 AC (61,500 SF)
A2 = 1.213 AC (52,860 SF)
A3 = 0.980 AC (42,710 SF)
A4 = 1.365 AC (59,450 SF)
A5 = 1.078 AC (46,910 SF)
A6 = 1.312 AC (57,150 SF)
A7 = 1.668 AC (72,650 SF)
A8a = 1.718 AC (74,830 SF)
A8b = 1.981 AC (86,280 SF)
A9 = 2.605 AC (113,490 SF)
A10 = 1.126 AC (49,050 SF)
A11a = 1.223 AC (53,260 SF)
A11b = 5.572 AC (242,710 SF)
A12 = 1.066 AC (46,450 SF)
A13 = 0.604 AC (26,310 SF)

N

POST-CONSTRUCTION
OVERALL HYDROLOGY MAP

0 30 60 120 240
SCALE: 1" = 60'

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POST-CONSTRUCTION OVERALL HYDROLOGY MAP

149 4TH STREET RESIDENCE

149 4TH STREET EAST, SONOMA, CA
APN: 018-091-018

RATIONAL METHOD DRAINAGE STUDY

Date: 12/20/2017 Project: 4th Street and Brazil Analysis Sheet: 1 of 2

Storm: **10-Year (Post-Construction)** By: CM

10-Year Storm Event

POC	Area	Elev (ft)	Dist (ft)	Slope (ft/ft)	V (ft/s)	Tc (min)	Time (min)	I (in/hr)	K	C	A (acres)	A_{total} (acres)	KAC	Sum KAC	Q (ft^3/s)	Description
1	A13					15.00	15.00	1.70376	1.0	0.500	0.604	0.604	0.302	0.302	0.51	(EX SD-1)
2	A12	3.2	130	0.025	1.47	1.47	16.47	1.62201	1.0	0.500	1.066	1.670	0.533	0.835	1.35	8 "SD (EX SD-2) (EX SWL-1)
3	A11a					15.00	15.00	1.70376	1.0	0.500	1.223	1.223	0.612	0.612	1.04	Overland Flow
POC 4 Combines Flows from POCs 2 and 3							15.00					2.893		1.447	2.40	
4	A11b	300	1070	0.280	6.86	2.60	17.60	1.56647	1.0	0.541	5.572	8.465	3.014	4.461	6.99	8 "SD (EX SD-3) (EX SWL-2)
5	A10	2.5	110	0.023	3.95	0.46	18.06	1.54519	1.0	0.557	1.126	9.591	0.627	5.088	7.86	18 "SD (EX SD-4)
6	A8a					15.00	15.00	1.70376	1.0	0.500	1.718	1.718	0.859	0.859	1.46	Overland Flow
7	A8b	100	335	0.299	4.19	1.33	16.33	1.62922	1.0	0.504	1.981	3.699	0.998	1.857	3.03	8 "SD
8	A6					15.00	15.00	1.70376	1.0	0.500	1.312	1.312	0.656	0.656	1.12	Overland Flow
9	A7	112	396	0.283	3.20	2.06	17.06	1.59219	1.0	0.547	1.668	2.980	0.912	1.568	2.50	8 "SD
POC 10 Combines Flows from POCs 5, 7 and 9							18.06					16.270		8.514	13.385	
10	A9	1	20	0.050	5.57	0.06	18.12	1.5425	1.0	0.569	2.605	18.875	1.482	9.996	15.42	21 "SD (EX SD-5)
11	A4					15.00	15.00	1.70376	1.0	0.525	1.365	1.365	0.717	0.717	1.22	Overland Flow
12	A3					15.00	15.00	1.70376	1.0	0.695	0.980	0.980	0.681	0.681	1.16	Overland Flow
POC 13 Combines Flows from POCs 10, 11 and 12							18.12					21.220		11.394	17.801	
13	A5	1	20	0.050	5.67	0.06	18.18	1.53987	1.0	0.604	1.078	22.298	0.651	12.045	18.55	24 "SD (EX SD-6) (EX SWL-3)
14	A1					15.00	15.00	1.70376	1.0	0.528	1.412	1.412	0.746	0.746	1.27	Overland Flow
POC 15 Combines Flows from POCs 13 and 14							18.18					23.710		12.791	19.818	
15	A2	7	280	0.025	6.31	0.74	18.92	1.5079	1.0	0.564	1.213	24.923	0.684	13.475	20.32	24 "SD (EX SD-7) (EX SWL-4)

RATIONAL METHOD DRAINAGE STUDY

Date: 12/20/2017 Project: 4th Street and Brazil Analysis Sheet: 2 of 2

Storm: **100-Year (Post-Construction)** By: CM

100-Year Storm Event

POC	Area	Elev (ft)	Dist (ft)	Slope (ft/ft)	V (ft/s)	Tc (min)	Time (min)	I (in/hr)	K	C	A (acres)	A_{total} (acres)	KAC	Sum KAC	Q (ft^3/s)	Description
1	A13					15.00	15.00	2.42278	1.0	0.500	0.604	0.604	0.302	0.302	0.73	(EX SD-1)
2	A12	3.2	130	0.025	2.10	1.03	16.03	2.33886	1.0	0.500	1.066	1.670	0.533	0.835	1.95	8 "SD (EX SD-2) (EX SWL-1)
3	A11a					15.00	15.00	2.42278	1.0	0.500	1.223	1.223	0.612	0.612	1.48	Overland Flow
POC 4 Combines Flows from POCs 2 and 3							15.00					2.893		1.447	3.43	
4	A11b	300	1070	0.280	4.37	4.08	19.08	2.13335	1.0	0.541	5.572	8.465	3.014	4.461	9.52	12 "SD (EX SD-3) (EX SWL-2)
5	A10	2.5	110	0.023	3.96	0.46	19.54	2.10644	1.0	0.557	1.126	9.591	0.627	5.088	10.72	21 "SD (EX SD-4)
6	A8a					15.00	15.00	2.42278	1.0	0.500	1.718	1.718	0.859	0.859	2.08	Overland Flow
7	A8b	100	335	0.299	5.96	0.94	15.94	2.34639	1.0	0.504	1.981	3.699	0.998	1.857	4.36	8 "SD
8	A6					15.00	15.00	2.42278	1.0	0.500	1.312	1.312	0.656	0.656	1.59	Overland Flow
9	A7	112	396	0.283	4.55	1.45	16.45	2.30739	1.0	0.547	1.668	2.980	0.912	1.568	3.62	8 "SD
POC 10 Combines Flows from POCs 5, 7 and 9							19.54					16.270		8.514	18.695	
10	A9	1	20	0.050	7.77	0.04	19.58	2.104	1.0	0.569	2.605	18.875	1.482	9.996	21.03	21 "SD (EX SD-5)
11	A4					15.00	15.00	2.42278	1.0	0.525	1.365	1.365	0.717	0.717	1.74	Overland Flow
12	A3					15.00	15.00	2.42278	1.0	0.695	0.980	0.980	0.681	0.681	1.65	Overland Flow
POC 13 Combines Flows from POCs 10, 11 and 12							19.58					21.220		11.394	24.418	
13	A5	1	20	0.050	6.14	0.05	19.64	2.10092	1.0	0.604	1.078	22.298	0.651	12.045	25.31	27 "SD (EX SD-6) (EX SWL-3)
14	A1					15.00	15.00	2.42278	1.0	0.528	1.412	1.412	0.746	0.746	1.81	Overland Flow
POC 15 Combines Flows from POCs 13 and 14							19.64					23.710		12.791	27.112	
15	A2	7	280	0.025	6.82	0.68	20.32	2.06319	1.0	0.564	1.213	24.923	0.684	13.475	27.80	27 "SD (EX SD-7) (EX SWL-4)

Runoff Coefficient Worksheet
(Post-Construction)

A1			
Surface	RC	Area (sq.ft)	RC x A
Pervious	0.50	57180	28590
Gravel	0.90	290	261
Pavement	0.90	4030	3627
Pool	1.00	0	0
Roof	1.00	0	0
	Subtotal	61500	32478
	0.528	Weighted RC	

A2			
Surface	RC	Area (sq.ft)	RC x A
Pervious	0.50	45494	22747
Gravel	0.90	0	0
Pavement	0.90	3000	2700
Pool	1.00	0	0
Roof	1.00	4366	4366
	Subtotal	52860	29813
	0.564	Weighted RC	

A3			
Surface	RC	Area (sq.ft)	RC x A
Pervious	0.50	23400	11700
Gravel	0.90	6150	5535
Pavement	0.90	7140	6426
Pool	1.00	930	930
Roof	1.00	5090	5090
	Subtotal	42710	29681
	0.695	Weighted RC	

A4			
Surface	RC	Area (sq.ft)	RC x A
Pervious	0.50	56440	28220
Gravel	0.90	0	0
Pavement	0.90	340	306
Pool	1.00	800	800
Roof	1.00	1870	1870
	Subtotal	59450	31196
	0.525	Weighted RC	

A5			
Surface	RC	Area (sq.ft)	RC x A
Pervious	0.50	35540	17770
Gravel	0.90	1180	1062
Pavement	0.90	6960	6264
Pool	1.00	0	0
Roof	1.00	3230	3230
	Subtotal	46910	28326
	0.604	Weighted RC	

A6			
Surface	RC	Area (sq.ft)	RC x A
Pervious	0.50	57150	28575
Gravel	0.90	0	0
Pavement	0.90	0	0
Pool	1.00	0	0
Roof	1.00	0	0
	Subtotal	57150	28575
	0.500	Weighted RC	

A7			
Surface	RC	Area (sq.ft)	RC x A
Pervious	0.50	65300	32650
Gravel	0.90	0	0
Pavement	0.90	2800	2520
Pool	1.00	480	480
Roof	1.00	4070	4070
	Subtotal	72650	39720
	0.547	Weighted RC	

A8a			
Surface	RC	Area (sq.ft)	RC x A
Pervious	0.50	74830	37415
Gravel	0.90	0	0
Pavement	0.90	0	0
Pool	1.00	0	0
Roof	1.00	0	0
	Subtotal	74830	37415
	0.500	Weighted RC	

A8b			
Surface	RC	Area (sq.ft)	RC x A
Pervious	0.50	85580	42790
Gravel	0.90	0	0
Pavement	0.90	0	0
Pool	1.00	0	0
Roof	1.00	700	700
	Subtotal	86280	43490
	0.504	Weighted RC	

A9			
Surface	RC	Area (sq.ft)	RC x A
Pervious	0.50	94050	47025
Gravel	0.90	0	0
Pavement	0.90	19440	17496
Pool	1.00	0	0
Roof	1.00	0	0
	Subtotal	113490	64521
	0.569	Weighted RC	

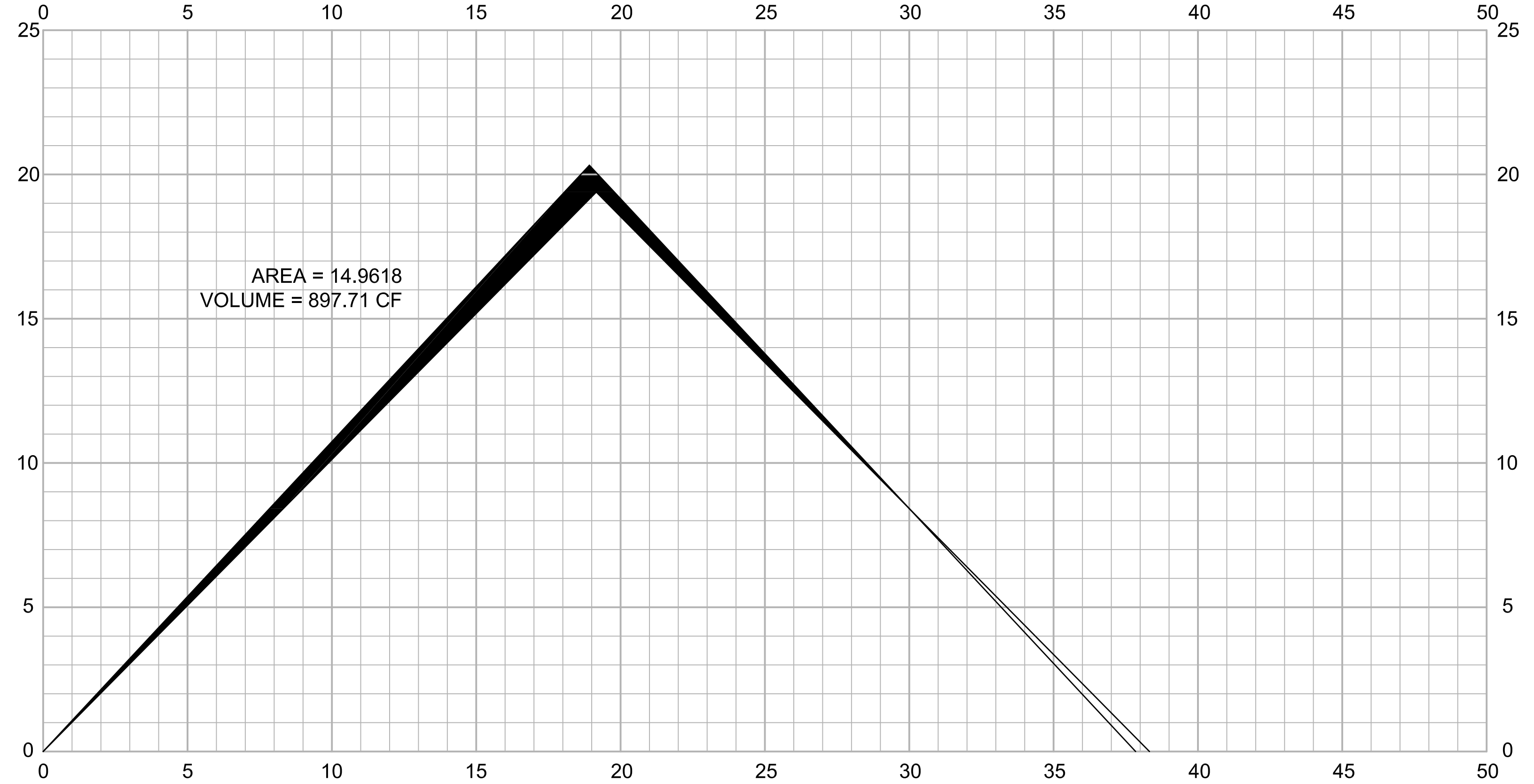
A10			
Surface	RC	Area (sq.ft)	RC x A
Pervious	0.50	42930	21465
Gravel	0.90	0	0
Pavement	0.90	2720	2448
Pool	1.00	0	0
Roof	1.00	3400	3400
	Subtotal	49050	27313
	0.557	Weighted RC	

A11a			
Surface	RC	Area (sq.ft)	RC x A
Pervious	0.50	53260	26630
Gravel	0.90	0	0
Pavement	0.90	0	0
Pool	1.00	0	0
Roof	1.00	0	0
	Subtotal	53260	26630
	0.500	Weighted RC	

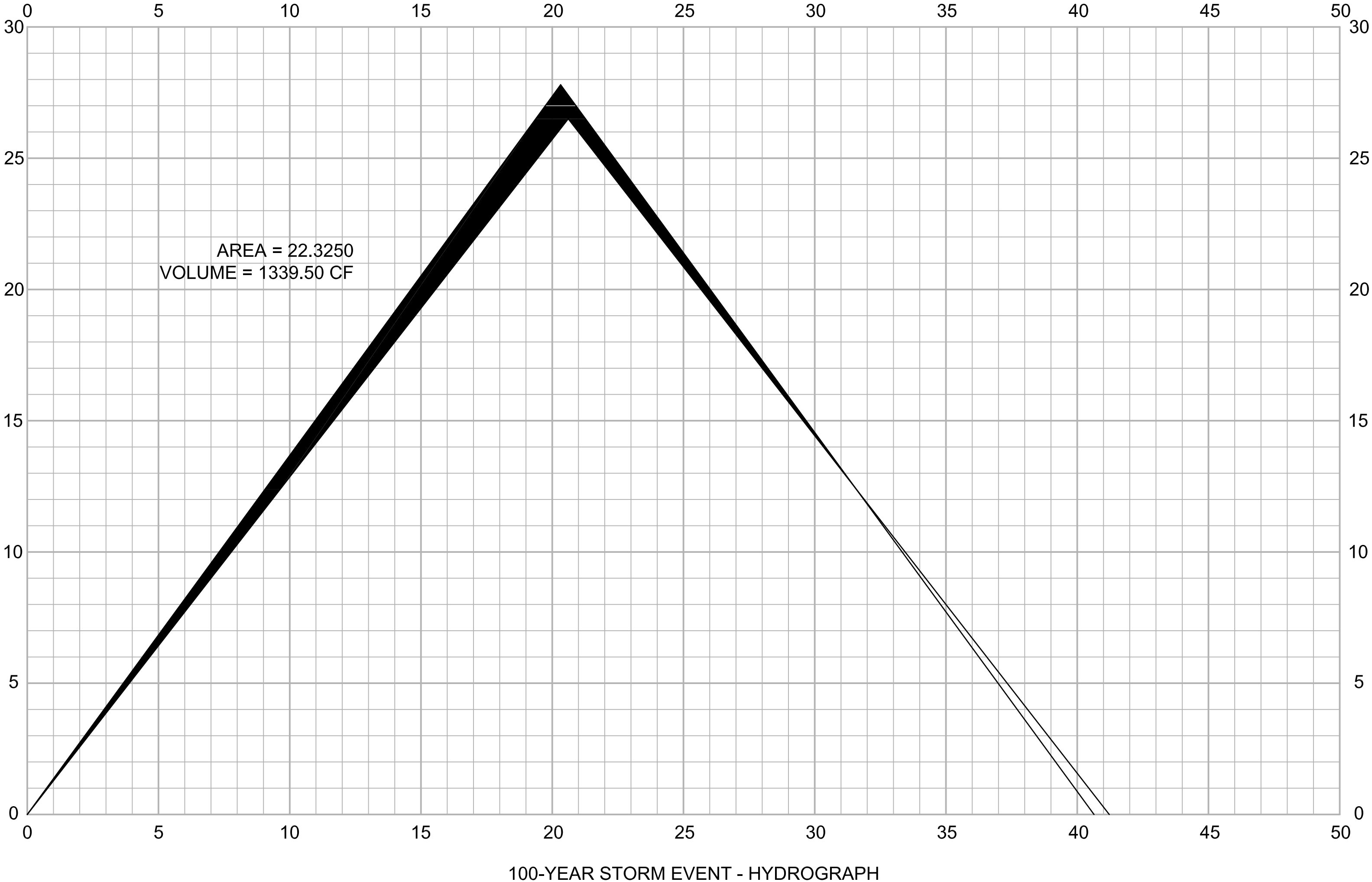
A11b			
Surface	RC	Area (sq.ft)	RC x A
Pervious	0.50	220200	110100
Gravel	0.90	740	666
Pavement	0.90	11780	10602
Pool	1.00	490	490
Roof	1.00	9500	9500
	Subtotal	242710	131358
	0.541	Weighted RC	

A12			
Surface	RC	Area (sq.ft)	RC x A
Pervious	0.50	46450	23225
Gravel	0.90	0	0
Pavement	0.90	0	0
Pool	1.00	0	0
Roof	1.00	0	0
	Subtotal	46450	23225
	0.500	Weighted RC	

A13			
Surface	RC	Area (sq.ft)	RC x A
Pervious	0.50	26310	13155
Gravel	0.90	0	0
Pavement	0.90	0	0
Pool	1.00	0	0
Roof	1.00	0	0
	Subtotal	26310	13155
	0.500	Weighted RC	



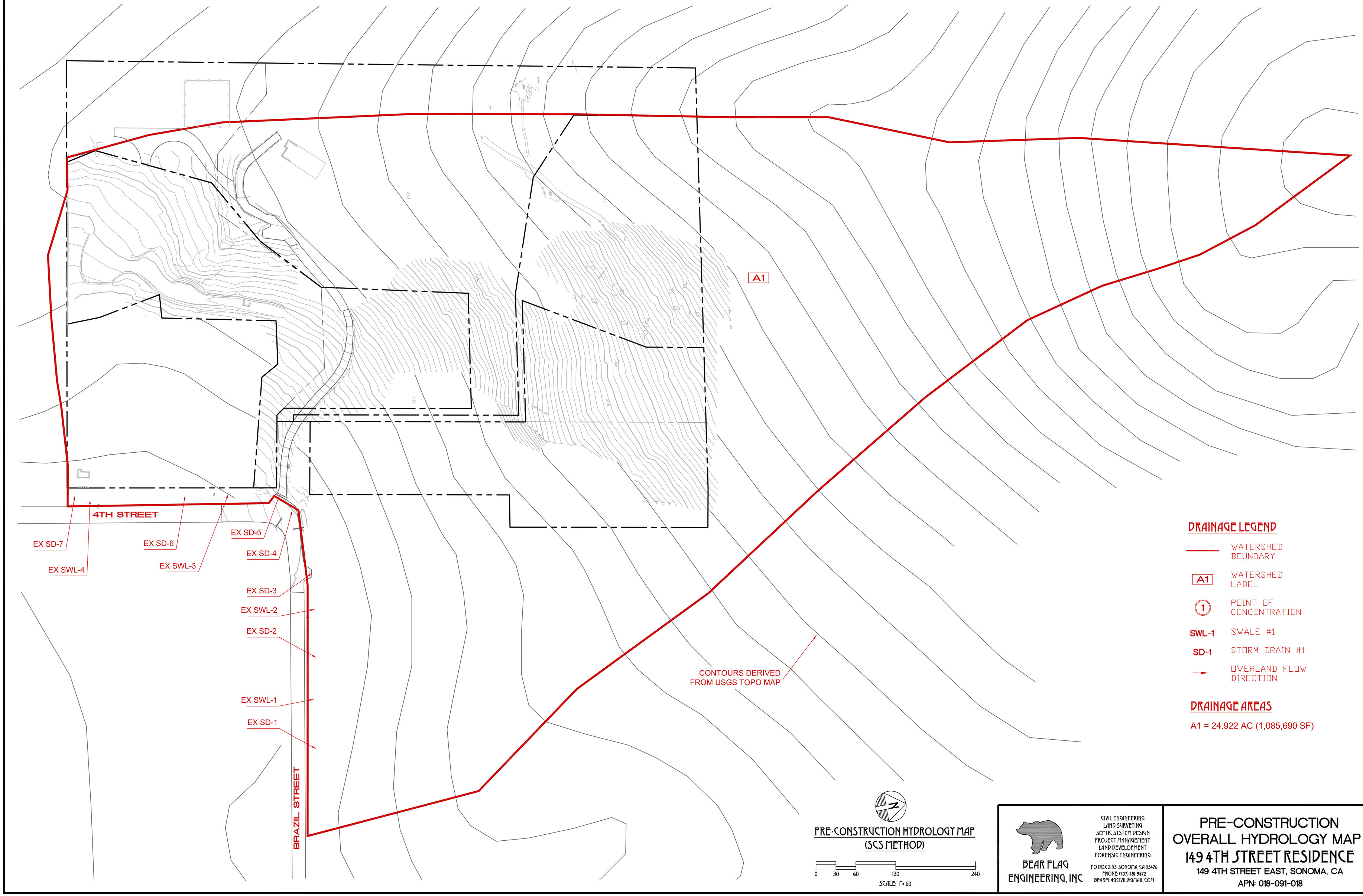
10-YEAR STORM EVENT - HYDROGRAPH



100-YEAR STORM EVENT - HYDROGRAPH

SCS TR-55 METHOD

BEAR FLAG ENGINEERING, INC.
Civil Engineering - Land SURVEYING – SEPTIC SYSTEM DESIGN
Project management – LAND DEVELOPMENT – FORENSIC ENGINEERING
15 West Macarthur Street, Sonoma, Ca 95476
Phone: (707) 996-8449



DRAINAGE LEGEND

- WATERSHED BOUNDARY
- A1 — WATERSHED LABEL
- (1) — POINT OF CONCENTRATION
- SWL-1 — SWALE #1
- SD-1 — STORM DRAIN #1
- OVERLAND FLOW DIRECTION

DRAINAGE AREAS

A1 = 24.922 AC (1,085,690 SF)

N

PRE-CONSTRUCTION HYDROLOGY MAP
(SCS METHOD)

0 30 60 120 240

SCALE: 1" = 60'

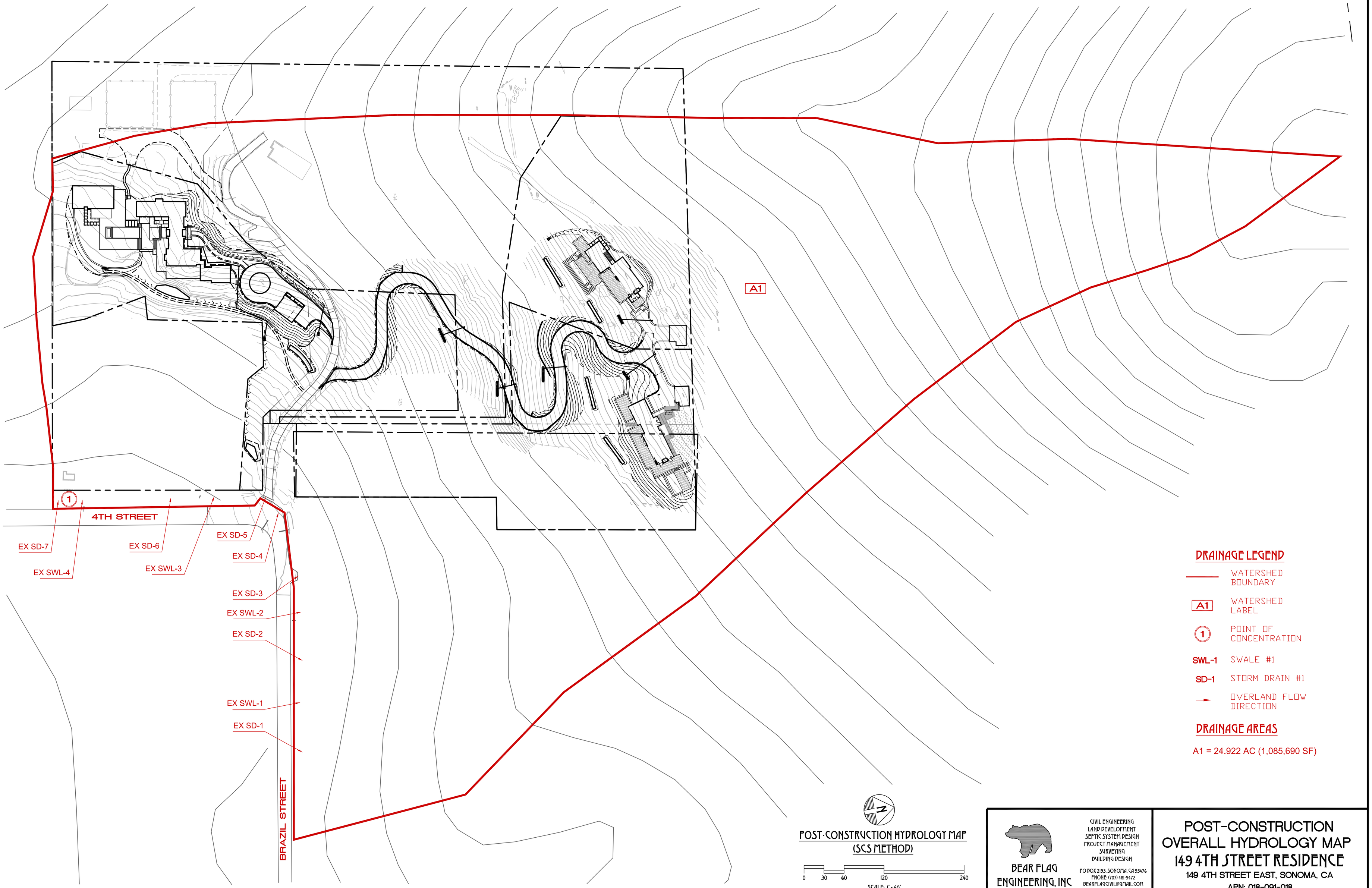
BEAR FLAG ENGINEERING, INC

CIVIL ENGINEERING
LAND SURVEYING
SEPTIC SYSTEM DESIGN
PROJECT MANAGEMENT
LAND DEVELOPMENT
FORENSIC ENGINEERING

PO BOX 2193, SONOMA, CA 95476
PHONE: (707) 481-9472
BEARFLAGCIVIL@GMAIL.COM

PRE-CONSTRUCTION OVERALL HYDROLOGY MAP
149 4TH STREET RESIDENCE

149 4TH STREET EAST, SONOMA, CA
APN: 018-091-018



DRAINAGE LEGEND

- WATERSHED BOUNDARY
- A1 — WATERSHED LABEL
- 1 — POINT OF CONCENTRATION
- SWL-1 — SWALE #1
- SD-1 — STORM DRAIN #1
- OVERLAND FLOW DIRECTION

DRAINAGE AREAS

A1 = 24.922 AC (1,085,690 SF)

POST-CONSTRUCTION HYDROLOGY MAP
(SCS METHOD)

0 30 60 120 240
SCALE: 1" = 60'

BEAR FLAG ENGINEERING, INC

CIVIL ENGINEERING
LAND DEVELOPMENT
SEPTIC SYSTEM DESIGN
PROJECT MANAGEMENT
SURVEYING
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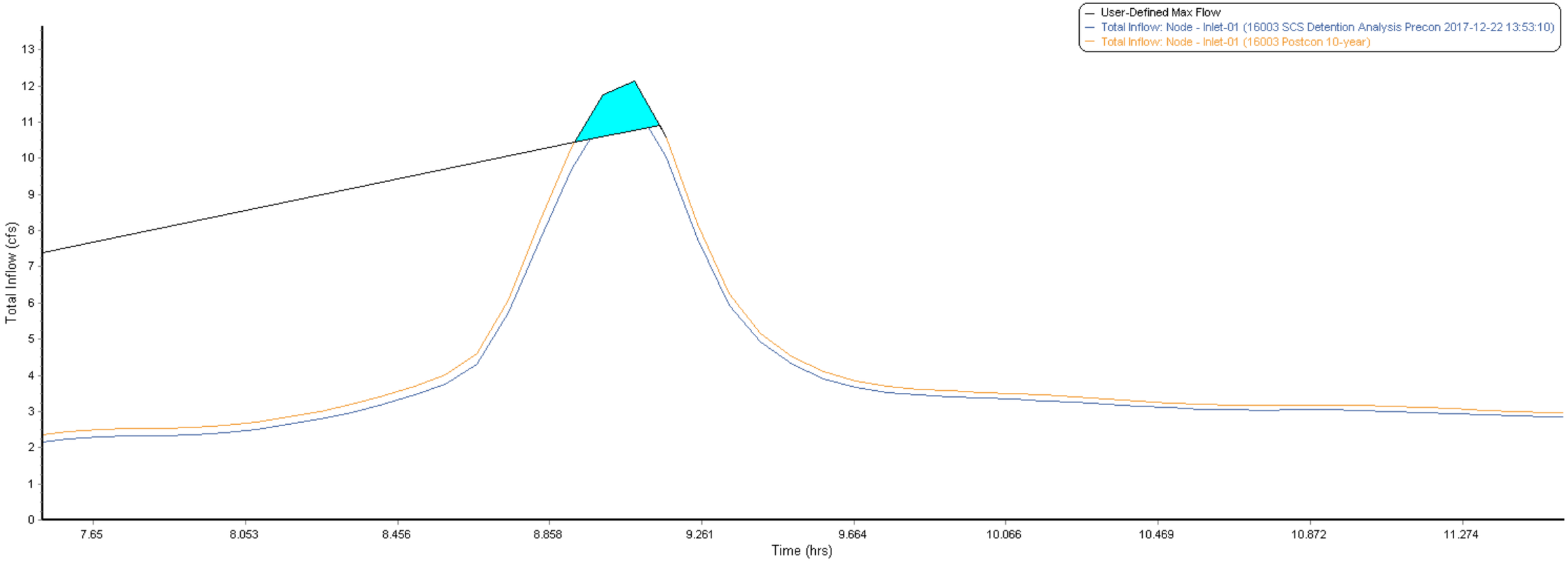
POST-CONSTRUCTION OVERALL HYDROLOGY MAP

149 4TH STREET RESIDENCE

149 4TH STREET EAST, SONOMA, CA
APN: 018-091-018

Overall Curve Number Worksheet
(Pre and Post-Construction)

A1 (Pre-Construction)				A1 (Post-Construction)			
Surface	CN	Area (sq.ft)	CN x A	Surface	CN	Area (sq.ft)	CN x A
Pervious	74	1037724	76791576	Pervious	74	984114	72824436
Gravel	89	6440	573160	Gravel	89	8360	744040
Pavement	98	25860	2534280	Pavement	98	58210	5704580
Pool	100	800	80000	Pool	100	2700	270000
Roof	100	14786	1478600	Roof	100	32226	3222600
	Subtotal	1085610	81457616		Subtotal	1085610	82765656
	75.03	Weighted CN			76.24	Weighted CN	


User-Defined Max Flow
Total Inflow: Node - Inlet-01 (16003 SCS Detention Analysis Precon 2017-12-22 13:53:10)
Total Inflow: Node - Inlet-01 (16003 Postcon 10-year)
Total Inflow (cfs)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
7.65
8.053
8.456
8.858
9.261
9.664
10.066
10.469
10.872
11.274
Time (hrs)