City of Albuquerque

P.O. BOX 1293 ALBUQUERQUE, NEW MEXICO 87103

May 7, 2004

Mr. Ron Bohannan, PE
TIERRA WEST, LLC
8509 Jefferson St. NE
Albuquerque, NM 87113

RE: SANDIA SUNRISE SUBDIVISION (C-20/D025)
Engineers Certification for Release of Financial Guaranty
Engineers Stamp dated 05/13/2003
Engineers Certification dated 04/07/2004

Dear Ron:

Based upon the information provided in your Engineer's Certification Submittal dated 05/07/2004, the above referenced plan is adequate to satisfy the Grading and Drainage Certification for Release of Financial Guaranty.

If you have any questions, you can contact me at 924-3982

Sincerely,

Arlene V. Portillo

Arlene V. Portillo
Plan Checker, Planning Dept.- Hydrology
Development and Building Services
BLD

C: Marilyn Maldonado, COA# 713081
File

DRAINAGE REPORT

for

Sandia Sunrise

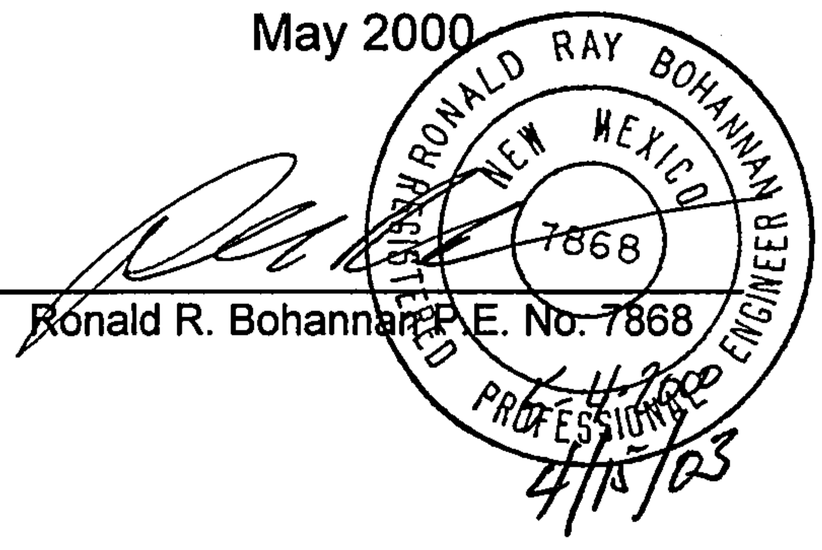
Prepared by

Tierra West, LLC
8509 Jefferson NE
Albuquerque, New Mexico 87113

Prepared for

Real Estate Services
12512 Modesto Ave NE
Albuquerque, New Mexico 87122

May 2000



Ronald R. Bohannan P.E. No. 7868

Location

Sandia Sunrise is a proposed 33 unit single family subdivision. It is located east of Barstow between Eagle Rock Avenue and Modesto Avenue. The site is shown on the attached Zone Atlas Map C-20 and contains approximately 7.03 acres. The site is identified as Lots 1-4, and 30-32, Block 1 North Albuquerque Acres Tract 3, Unit 3. The purpose of this report is to provide the drainage analysis and management plan for the subdivision.

Existing Drainage Conditions

The site is currently undeveloped. There is an existing drainage channel flowing west through the center of the site. The orthotopo maps show two offsite basins contributing to this channel. The existing offsite flows will be accepted into the site and allowed to pass through. Offsite Basin 1 (OS-1) has a flow of 16.08 cfs and Offsite Basin 2 (OS-2) has a flow rate of 12.21 cfs. These basins were calculated with a developed land treatment for low density residential. This is the land use recommended by the La Cueva Sector Plan, and the land treatment percentages were taken from the "North Albuquerque Acres Master Drainage Plan" (NAAMDP) by Resource Technology Inc.

FIRM Map and Soil Conditions

The site is located on FIRM Map 35001C0133 D and 35001C0141 D as shown on the attached excerpt. The map shows that the site does not lie within any 100 year flood plains. However, there are two large arroyos located north and south of the site. The erosion setbacks (ESB) for both arroyos were calculated. The ESB for the El Camino Arroyo, located north of the site, is estimated to be approximately 93.0 feet (using the developed flow rate of 924 cfs). This does not impact the site. The ESB for the La Cueva Arroyo, located south of the site, is estimated to be approximately 177 feet (using the developed flow rate of 3094 cfs). This impacts the site and is shown on the grading plan. Per conversations with the City of

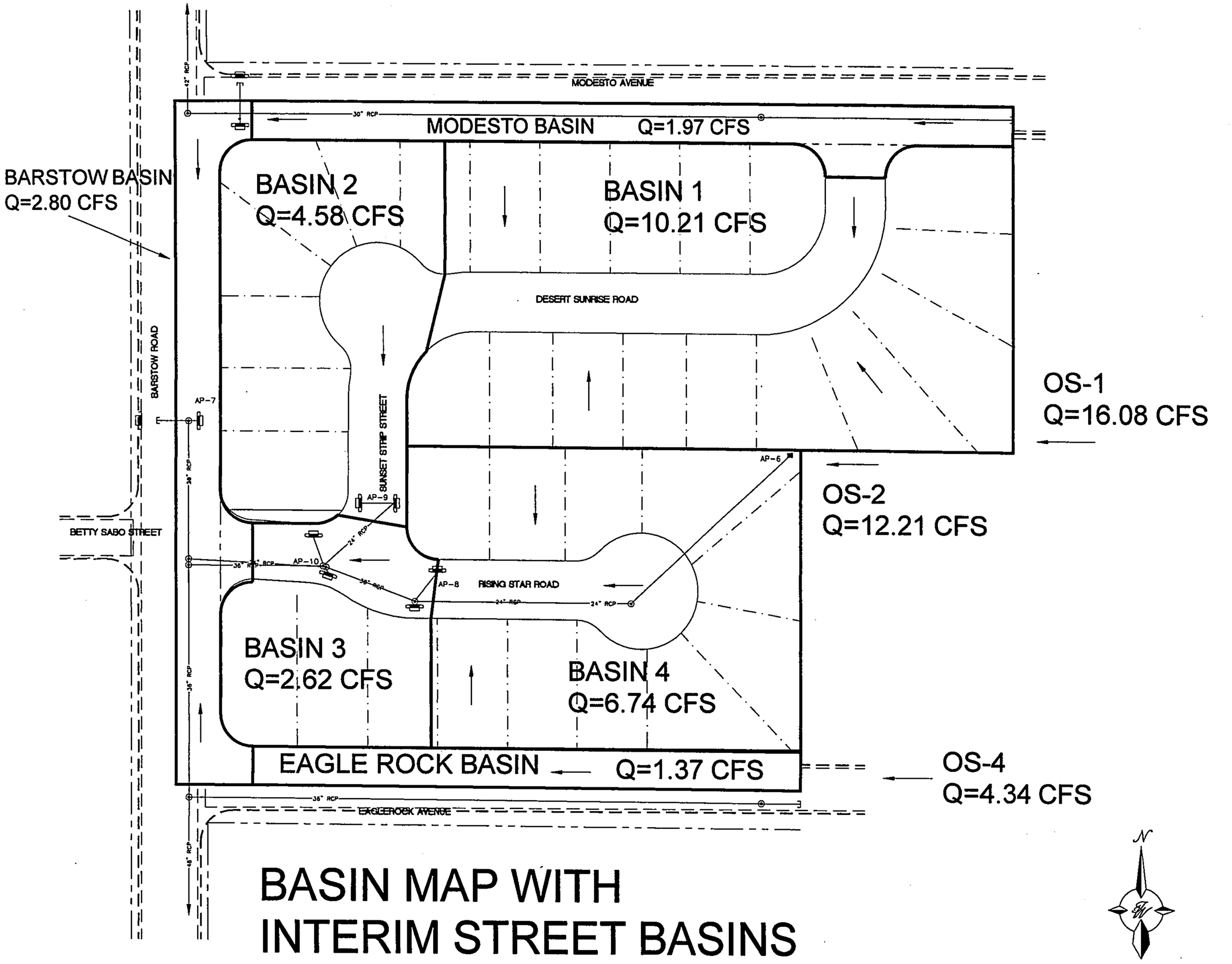
Albuquerque, Eagle Rock Avenue also needs to be protected from erosion. Consequently, a flood wall will be constructed south of Eagle Rock within the right-of-way. Preliminary scour calculations indicate the scour depth to be approximately 5.25 feet deep. This will not affect any utilities in the area as the water and sewer will be near the center of the road and the dry utilities are overhead.

The site contains one soil from the Soil Conservation Service Soil Survey of Bernalillo County. This soil is an Embudo-Tijeras complex and is a mixture of an Embudo gravelly fine loam and a Tijeras gravelly fine sandy loam. The soil has a medium runoff and the hazard of water erosion is moderate.

On-Site Drainage Management Plan

The site has been divided into four onsite basins. There are three offsite basins for the adjacent streets to the property. There are also two offsite basins from the east of the site (OS-1 and OS-2) that were briefly discussed above. The two offsite basins will be collected in a new storm drain at AP-6 as shown on the exhibit labeled "Basin Map with Interim Street Basins". A 24" storm sewer will convey the offsite basins through the site and connect to a new storm drain in Barstow.

The four on-site basins will drain to the adjacent internal streets. The streets have capacity for the flows with 4" curb. Basin 1 and 2 will drain to Sunset Strip Street with a total combined flow of 14.79 cfs. At AP-9, drop inlets will be located to catch as much flow as possible. A 24" storm drain will convey 10.50 cfs to AP-10 and the street will convey 4.29 cfs to AP-10. Basin 4 will drain to drop inlets located at AP-8. These drop inlets will capture the entire flow of 6.74 cfs from Basin 4. At AP-10, the flows from Basin 3 and the street flow from Basins 1 and 2 combine for a total flow of 6.91cfs. Because of the minimum slope of the street and the relatively small flow rate the storm drain inlets will capture 3.50 cfs. The remaining flow of 3.41 cfs from the subdivision will enter Barstow Road and be captured in the drop inlet north of Rising



BASIN MAP WITH INTERIM STREET BASINS

Star Road.

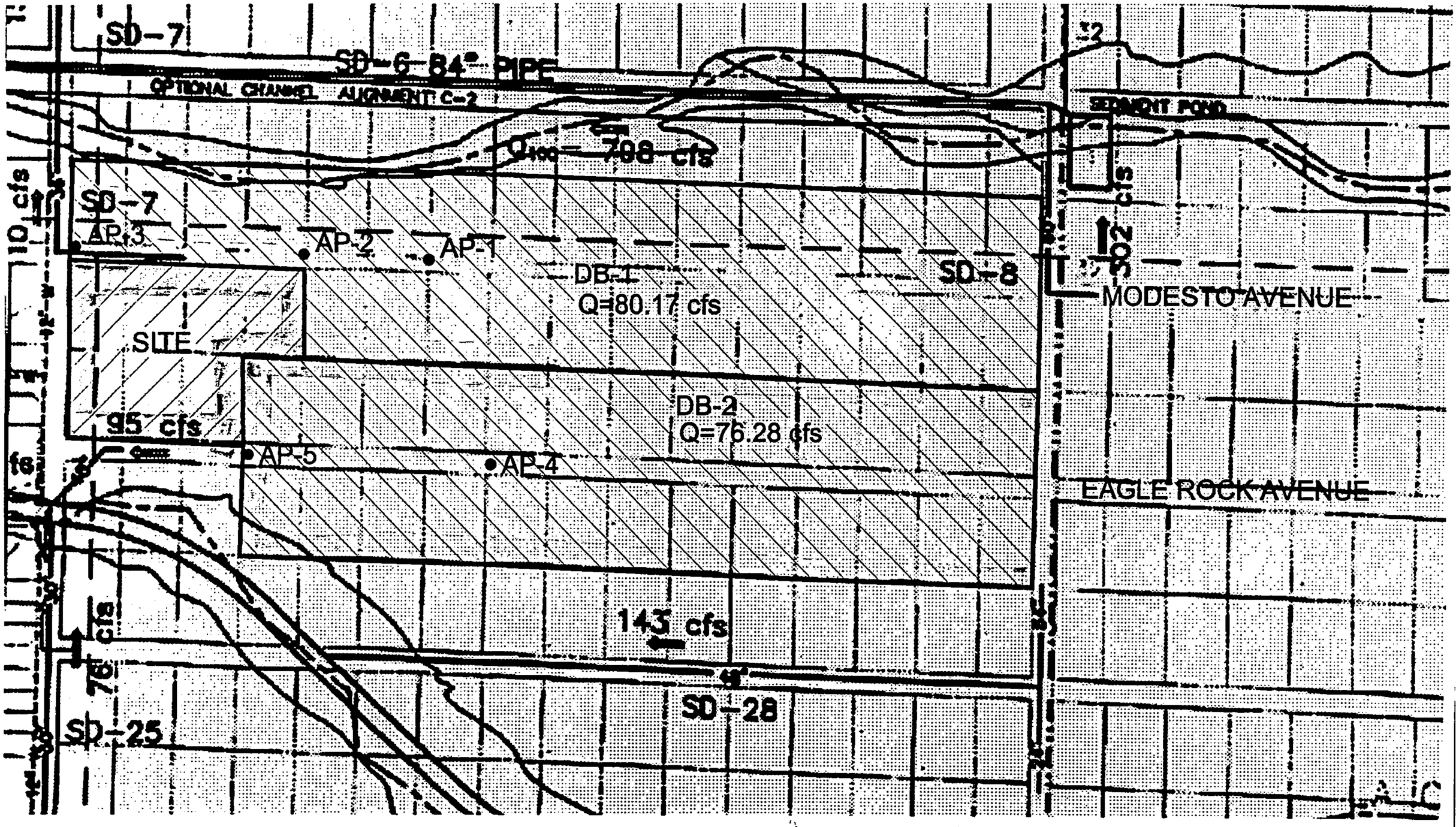
The exhibit titled "Basin Map with Interim Street Basins" shows the on-site basins and the basins for the adjacent streets. Half of Barstow, Modesto and Eagle Rock will be constructed with this project. The flows in these streets will drain to AP-7 and be collected in a new storm drain in Barstow. The half street basins have a combined flow of 6.14 cfs. Offsite Basin OS-4 drains to Eagle Rock Avenue in the undeveloped condition. This is a total flow of 10.48 cfs draining from the adjacent streets to Barstow Street. In the future developed condition Barstow has a developed flow of 8.98 cfs. The undeveloped flow of 10.48 cfs was used for all street and pipe capacity calculations as it is the maximum flow rate. The Sandia Sunrise site will convey 3.41 cfs into Barstow to be collected at AP-7 for a total flow of 13.89 cfs. This total of 13.89 cfs will be collected in a new 24" storm drain. The 24" storm drain will convey the flows south in Barstow Street and connect to the new storm drain in Rising Star Road. At Rising Star Road the storm drain will collect all of the offsite flows for a total flow of 75.44 cfs. This flow will be conveyed south to the La Cueva Arroyo.

The allowable discharge from the site is contingent upon the downstream capacity of the La Cueva Arroyo. According the NAAMDP the I-25 crossing structure limits the capacity of the arroyo. The I-25 crossing structure has a 100-year existing capacity of 4500 cfs. The future capacity of the La Cueva Arroyo at I-25 is estimated to be 3923 cfs. As the crossing structure has capacity for all the future developed flows, the basins draining to the La Cueva Arroyo have free discharge. Therefore, ~~there is no allowable discharge for the site~~.

Future Developed Conditions

The future storm drains in Eagle Rock and Modesto were designed with this project. The Eagle Rock developed flows will drain to the La Cueva Arroyo, and the Modesto developed flows will drain to the El Camino Arroyo.

The future developed basin for Modesto Avenue will drain to the El Camino Arroyo



DEVELOPED BASIN MAP FOR MODESTO AND EAGLE ROCK

located north of Modesto Avenue. The exhibit titled "Developed Basin Map for Modesto and Eagle Rock" shows the developed basins for the street. Modesto will have a developed flow rate of 80.17 cfs. The street was assumed to have a slope of 3.64% for a street capacity of 56.03 cfs. At this point, labeled AP-1 on the exhibit, two double C drop inlets will need to be installed in the street. A 36" pipe will carry the captured flow of 38.00 cfs to AP-2 where two more double C drop inlets will be installed. These inlets will capture 29.00 cfs for a total of 67.00 in a 42" pipe. The 42" pipe will carry the flow to AP-3 at the intersection of Modesto and Barstow. Two additional drop inlets will capture all the remaining flow in Modesto. This storm sewer will then turn north and discharge 80.17 cfs to the El Camino Arroyo.

The future developed basin for Eagle Rock Avenue will discharge to the La Cueva Arroyo located south of Eagle Rock. Eagle Rock Avenue was assumed to have a slope of 3.72% for a street capacity of approximately 50 cfs. At this point, labeled AP-4 on the exhibit, two double C drop inlets will need to be installed. These inlets will capture 37.00 cfs. A 30" pipe will carry the flow to AP-5 where two additional double C drop inlets will be installed. The storm drain will connect to the storm drain in Barstow and discharge to the La Cueva Arroyo.

The offsite Basins OS-1, OS-2, and OS-4 will disappear in the future developed condition. These basins will be incorporated into the developed flows of the Modesto and Eagle Rock Basins and will no longer impact the site. The site will discharge 24.15 cfs and Barstow Road will have a developed flow of 8.98 cfs. This is a total of 33.13 cfs that will be captured in the sump in Barstow Road. This flow will be conveyed south in Barstow Road to Eagle Rock Avenue. The proposed storm drain in Eagle Rock will convey a total developed flow of 76.28 cfs to Barstow Road. This will combine with the developed flows from the site for a total flow being discharged to the La Cueva Arroyo of 109.41 cfs.

Emergency Overflow

In the event of an emergency overflow or storm greater than 100 years the site will flow

into Barstow Road. The offsite basins will flow into the drainage easement and enter the on-site streets. The on-site streets will drain to Barstow Road. There is a sump condition in Barstow Road approximately 100' north of Betty Sabo Street. There will be a drop inlet and storm drain to drain the sump. In the case of an emergency the sump will pond approximately two feet to Modesto and then drain to the El Camino Arroyo. The grades drain towards the El Camino Arroyo north of Modesto and will provide an outfall. The ponding will not affect the homes adjacent to the sump as they are higher than the street.

Criteria

The site was analyzed using the procedures from the Development Process Manual Volume 2, Chapter 22. The Weighted-E method was used for estimating the volume and flow rate of runoff from each basin.

Summary

The site has a developed discharge of 24.15 cfs. The offsite basins, and adjacent streets increase this discharge to 62.92 cfs. The allowable discharge from the site is based on the existing capacity of the La Cueva Arroyo. The existing capacity of the arroyo is constrained by the I-25 crossing structures. The structures have a capacity of 4500 cfs. The future developed flow rate of the La Cueva Arroyo at I-25 is 3923 cfs. This is less than the capacity of the crossing structure. Consequently, there is no reason to limit the allowable discharge and Sandia Sunrise can free discharge to the arroyo.

The future basins for Eagle Rock and Modesto have been shown on the exhibit titled "Developed Basin Map for Modesto and Eagle Rock". The future basin for Modesto of 80.17 cfs will drain to the El Camino Arroyo located north of the site. The future basin of 76.28 cfs for Eagle Rock will drain to the La Cueva Arroyo located south of the site. The storm drains and drop inlets for Modesto and Eagle Rock have been designed for the developed conditions. The

portions of the storm drains that are adjacent to the site will be constructed with Sandia Sunrise. These storm drains will be dry until the future basins are developed and infrastructure requirements are made.

The erosion setback (ESB) for the La Cueva and El Camino Arroyos was calculated using the guidelines from AMAFCA's "Sediment and Erosion Design Guide". The El Camino Arroyo is located north of the site and the ESB does not affect the site. The La Cueva Arroyo is located directly south of the site and the ESB enters the site. We calculated the scour depth to be approximately 5.25 feet and will build a floodwall along the south side of Eagle Rock Avenue to protect the road and the subdivision.

Weighted E Method

Offsite Basins - Existing Condition

Basin	Area (sf)	Area (acres)	Treatment A		Treatment B		Treatment C		Treatment D		100-Year			10-Year		
			%	(acres)	%	(acres)	%	(acres)	%	(acres)	Weighted E (ac-ft)	Volume (ac-ft)	Flow cfs	Weighted E (ac-ft)	Volume (ac-ft)	Flow cfs
OS-1	229124.56	5.260	0%	0	100%	5.260	0%	0	0%	0.000	0.780	0.342	11.99	0.280	0.123	5.00
OS-2	173994.38	3.994	0%	0	100%	3.994	0%	0	0%	0.000	0.780	0.260	9.11	0.280	0.093	3.79
OS-4	61828.11	1.419	0%	0	100%	1.419	0%	0	0%	0.000	0.780	0.092	3.24	0.280	0.033	1.35
Total	464947.05	10.674		0		10.674		0		0.000		0.694	24.34		0.249	10.14

Offsite Basins - Developed Condition (Assuming Low Density Residential)

Basin	Area (sf)	Area (acres)	Treatment A		Treatment B		Treatment C		Treatment D		100-Year			10-Year		
			%	(acres)	%	(acres)	%	(acres)	%	(acres)	Weighted E (ac-ft)	Volume (ac-ft)	Flow cfs	Weighted E (ac-ft)	Volume (ac-ft)	Flow cfs
OS-1	229124.56	5.260	20%	1.051995	20%	1.052	34%	1.788392	26%	1.368	1.197	0.525	16.08	0.607	0.266	8.75
OS-2	173994.38	3.994	20%	0.798872	20%	0.799	34%	1.358083	26%	1.039	1.197	0.399	12.21	0.607	0.202	6.65
OS-4	61828.11	1.419	20%	0.283876	20%	0.284	34%	0.482589	26%	0.369	1.197	0.142	4.34	0.607	0.072	2.36
Total	464947.05	10.674		2.134743		2.135		3.629063		2.775		1.065	32.64		0.540	17.76

Developed Offsite Basin for Modesto and Eagle Rock (Assuming Low Density Residential)

Basin	Area (sf)	Area (acres)	Treatment A		Treatment B		Treatment C		Treatment D		100-Year			10-Year		
			%	(acres)	%	(acres)	%	(acres)	%	(acres)	Weighted E (ac-ft)	Volume (ac-ft)	Flow cfs	Weighted E (ac-ft)	Volume (ac-ft)	Flow cfs
DB-1	1142099.44	26.219	20%	5.243799	20%	5.244	34%	8.914458	26%	6.817	1.197	2.616	80.17	0.607	1.327	43.62
DB-2	1086703.00	24.947	20%	4.989454	20%	4.989	34%	8.482071	26%	6.486	1.197	2.489	76.28	0.607	1.262	41.51
AP-1	808397.47	18.558	20%	3.71165	20%	3.712	34%	6.309806	26%	4.825	1.197	1.852	56.74	0.607	0.939	30.88
AP-2	976047.59	22.407	20%	4.481394	20%	4.481	34%	7.61837	26%	5.826	1.197	2.236	68.51	0.607	1.134	37.28
AP-4	743696.19	17.073	20%	3.414583	20%	3.415	34%	5.804791	26%	4.439	1.197	1.704	52.20	0.607	0.864	28.41
Barstow - Dev	83239.35	1.911	0%	0	0%	0.000	0%	0	100%	1.911	2.120	0.338	8.98	1.340	0.213	6.00
Barstow - Int	25925.31	0.595	0%	0	0%	0.000	0%	0	100%	0.595	2.120	0.105	2.80	1.340	0.066	1.87
Modesto - Int	18251.98	0.419	0%	0	0%	0.000	0%	0	100%	0.419	2.120	0.074	1.97	1.340	0.047	1.32
Eagle Rock - Int	12689.15	0.291	0%	0	0%	0.000	0%	0	100%	0.291	2.120	0.051	1.37	1.340	0.033	0.91

On-Site Basins - Existing Condition

										100-Year			10-Year		
Basin	Area (sf)	Area (acres)	Treatment A		Treatment B		Treatment C		Treatment D		Weighted E (ac-ft)	Volume (ac-ft)	Flow cfs	Weighted E (ac-ft)	Volume (ac-ft)	Flow cfs
			%	(acres)	%	(acres)	%	(acres)	%	(acres)						
1	105328.58	2.418	0%	0	100%	2.418	0%	0	0%	0.000	0.920	0.185	6.29	0.360	0.073	2.88
2	47295.79	1.086	0%	0	100%	1.086	0%	0	0%	0.000	0.920	0.083	2.82	0.360	0.033	1.29
3	27031.63	0.621	0%	0	100%	0.621	0%	0	0%	0.000	0.920	0.048	1.61	0.360	0.019	0.74
4	69509.27	1.596	0%	0	100%	1.596	0%	0	0%	0.000	0.920	0.122	4.15	0.360	0.048	1.90
Total	249165.27	5.720		0		5.720		0		0.000		0.439	14.87		0.172	6.81

On-Site Basins - Developed Condition

										100-Year			10-Year		
Basin	Area (sf)	Area (acres)	Treatment A		Treatment B		Treatment C		Treatment D		Weighted E (ac-ft)	Volume (ac-ft)	Flow cfs	Weighted E (ac-ft)	Volume (ac-ft)	Flow cfs
			%	(acres)	%	(acres)	%	(acres)	%	(acres)						
1	105328.58	2.418	0%	0	20%	0.484	20%	0.483602	60%	1.451	1.858	0.374	10.21	1.096	0.221	6.46
2	47295.79	1.086	0%	0	20%	0.217	20%	0.217152	60%	0.651	1.858	0.168	4.58	1.096	0.099	2.90
3	27031.63	0.621	0%	0	20%	0.124	20%	0.124112	60%	0.372	1.858	0.096	2.62	1.096	0.057	1.66
4	69509.27	1.596	0%	0	20%	0.319	20%	0.319143	60%	0.957	1.858	0.247	6.74	1.096	0.146	4.26
Total	249165.27	5.720		0		1.144		1.14401		3.432		0.886	24.15		0.522	15.28

Equations:

Weighted E = Ea*Aa + Eb*Ab + Ec*Ac + Ed*Ad / (Total Area)

Volume = Weighted D * Total Area

Flow = Qa * Aa + Qb * Ab + Qc * Ac + Qd * Ad

RUNOFF CALCULATIONS

The site is @ Zone 3

LAND TREATMENT

Proposed
B = 20 %
C = 20 %
D = 60 %

Existing
B = 100 %

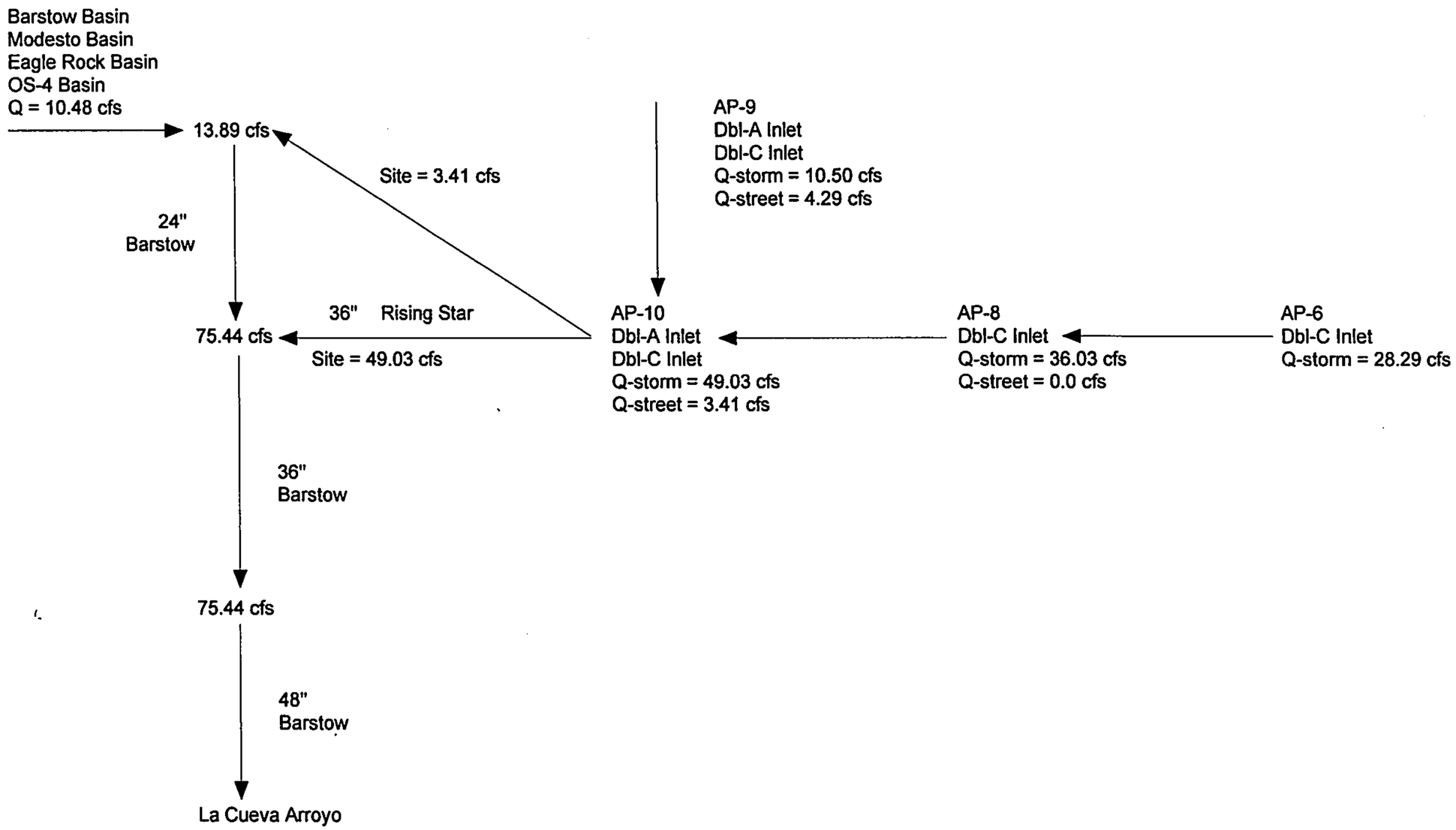
EXCESS PRECIPITATION, E (INCHES)

100-Year	10-Year
E_a = 0.66	E_a = 0.19
E_b = 0.92	E_b = 0.36
E_c = 1.29	E_c = 0.62
E_d = 2.36	E_d = 1.50

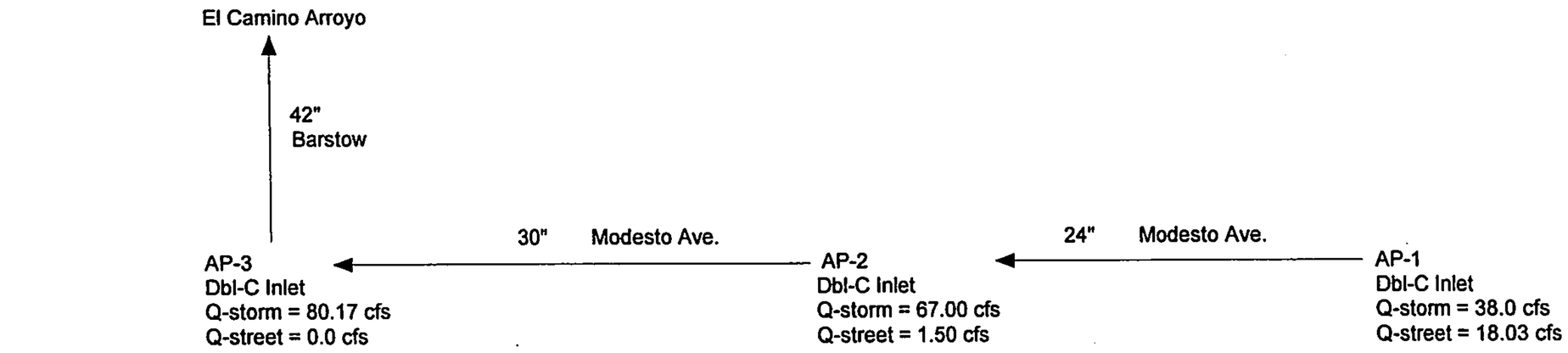
PEAK DISCHARGE (CFS/ACRE)

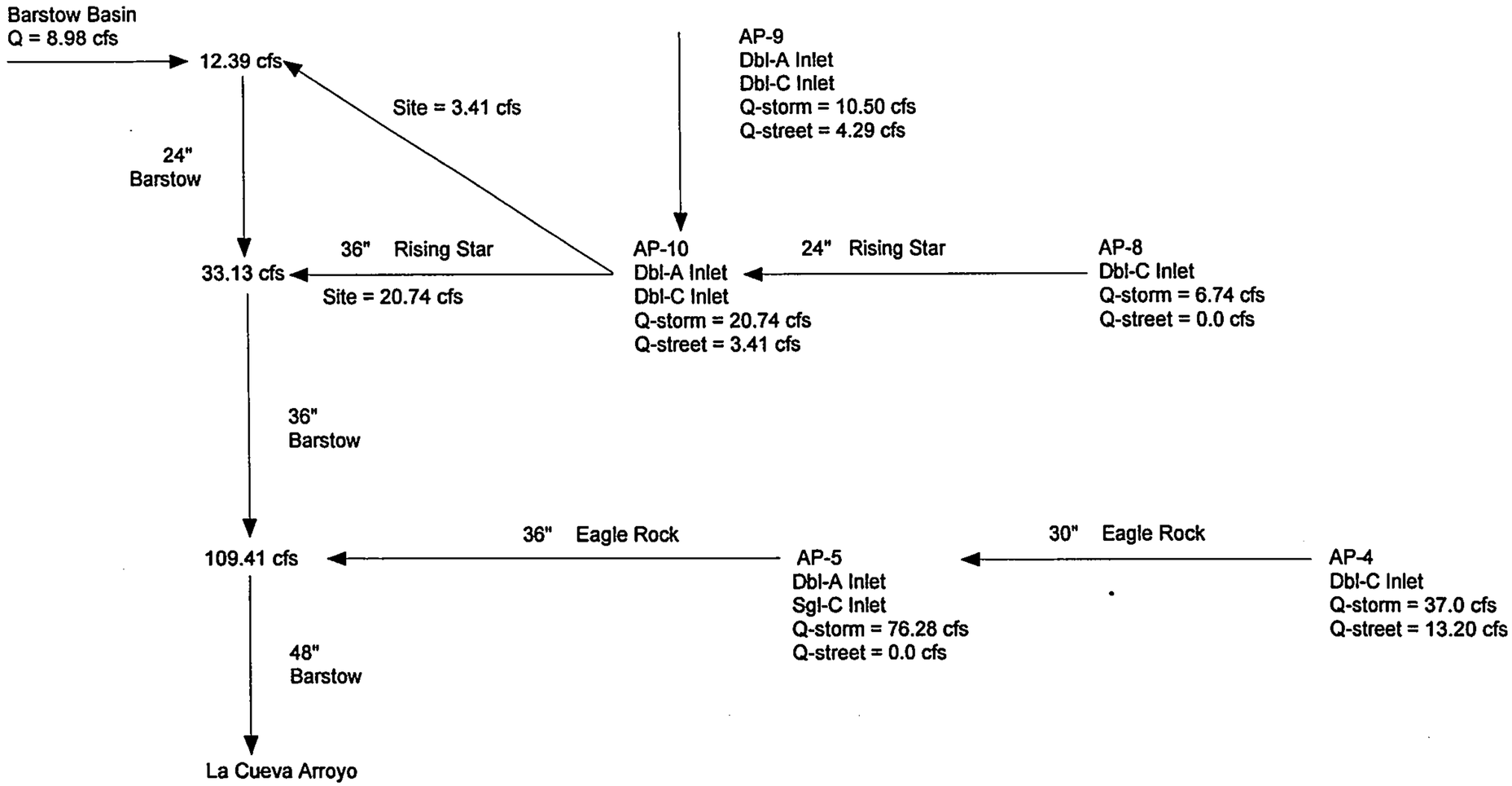
100-Year	10-Year
Q_a = 1.87	Q_a = 0.58
Q_b = 2.60	Q_b = 1.19
Q_c = 3.45	Q_c = 2.00
Q_d = 5.02	Q_d = 3.39

INTERIM RUNOFF FLOW PATH



DEVELOPED RUNOFF FLOW PATH





Storm Drain Pipe Capacity for Developed Conditions

Pipe	Location	D (in)	Slope (%)	Area (ft^2)	R	Q Provided (cfs)	Q Required (cfs)	Velocity (ft/s)
AP1 to AP2	Modesto	24	3	3.14	0.5	39.29	38.00	12.10
AP2 to AP3	Modesto	30	3	4.91	0.625	71.24	67.00	13.65
AP3 to El Camino	Barstow	42	1	9.62	0.875	100.88	80.17	8.33
AP4 to AP5	Eagle Rock	30	3	4.91	0.625	71.24	37.00	7.54
AP5 to Barstow	Eagle Rock	36	3	7.07	0.75	115.84	76.28	10.79
AP6 to AP8	Rising Star Rd.	24	2	3.14	0.5	32.08	28.29	9.00
AP9 to AP10	Sunset Strip St.	24	1	3.14	0.5	22.68	10.50	3.34
AP8 to AP10	Rising Star Rd.	30	1	4.91	0.625	41.13	36.03	7.34
AP10 to Barstow	Rising Star Rd.	36	1	7.07	0.75	66.88	49.03	6.94
AP7 to Rising Star Rd.	Barstow	24	1	3.14	0.5	22.68	13.89	4.42
Rising Star Rd to Eagle Rock	Barstow	36	1	7.07	0.75	66.88	61.55	8.71
Eagle Rock to La Cueva	Barstow	48	1	12.57	1	144.03	109.41	8.71

Manning's Equation:

$Q = 1.49/n * A * R^{(2/3)} * S^{(1/2)}$

A = Area
R = D/4
S = Slope
n = 0.013

Drop Inlet Calculations for Sump Condition

	TYPE OF INLET	AREA (SF)	Q (CFS)	H (FT)	H ALLOW (FT)
Barstow	Single 'C'	4.36	13.89	0.4378	0.67

ORIFICE EQUATION

Q = CA sqrt(2gH)

C = 0.6

g = 32.2

	Basin	Flow
Interim	Eagle Rock	1.37
	Barstow	2.80
	Modesto	1.97
	OS-4	4.34
	On-Site	3.41
	Total	13.89
Future	Barstow	8.98
	On-Site	3.41
	Total	12.39

STORM DROP INLET-EFFECTIVE AREA

Single 'C'

Area at the grate:

L = 38.375" - 7(½" $_{\text{middle bars}}$)
= 34.875"
= 2.906'

W = 25.5" - 13(½" $_{\text{middle bars}}$)
= 19"
= 1.583'

Area = 1.583' x 2.906'
= 4.601 ft^2

Effective Area = 4.601- 4.601 (0.5 $_{\text{clogging factor}}$)
= 2.30 ft^2 at the grate

Area at the throat:

L = 47.375"
= 3.95'

H = 10¾" - 4½"
= 6¼"
= 0.5208'

Area = 3.95' x 0.5208'
= 2.06 ft^2 at the throat

Total Area:

Area = $2.30_{grate} + 2.06_{throat}$
= 4.36 ft^2

Street Capacity Calculations

Sunset Strip Road
30' F-F Street Section with 4" curb
Slope= 0.006
Flow Required = 14.79
Basins 1, 2

For water depths less than 0.0625 feet

Y= Water depth
Area = 16*Y^2
P= SQRT(1025*Y^2) + Y
n= 0.017

Depth (ft)	Area (ft^2)	P (ft)	R (A/P)	Q (cfs)	2Q (cfs)	Vel (ft/s)	D*V	Fr	D2 (ft)
0.0100	0.0016	0.3302	0.0048	0.0003	0.0006	0.1939	0.0019	0.3417	0.0020
0.0175	0.0049	0.5778	0.0085	0.0014	0.0028	0.2816	0.0049	0.3751	0.0040
0.0250	0.0100	0.8254	0.0121	0.0036	0.0071	0.3572	0.0089	0.3981	0.0063
0.0325	0.0169	1.0730	0.0158	0.0072	0.0144	0.4254	0.0138	0.4159	0.0088
0.0400	0.0256	1.3206	0.0194	0.0125	0.0250	0.4886	0.0195	0.4305	0.0115
0.0475	0.0361	1.5682	0.0230	0.0198	0.0396	0.5479	0.0260	0.4430	0.0143
0.0550	0.0484	1.8159	0.0267	0.0292	0.0585	0.6042	0.0332	0.4540	0.0173
0.0625	0.0625	2.0635	0.0303	0.0411	0.0822	0.6579	0.0411	0.4638	0.0203

For water depths greater than 0.0625 ft but less than 0.333 ft

Y1= Y-0.0625
A2= A1 + 2*Y1 + 25*Y1^2
P2= P1 + SQRT(2501*Y1^2)

Depth (ft)	Area (ft^2)	P (ft)	R (A/P)	Q (cfs)	2Q (cfs)	Vel (ft/s)	D*V	Fr	D2 (ft)
0.0625	0.0625	2.0635	0.0303	0.0411	0.0822	0.6579	0.0411	0.4638	0.0203
0.0900	0.1364	3.4663	0.0394	0.1069	0.2137	0.7834	0.0705	0.4602	0.0289
0.1200	0.2602	4.9966	0.0521	0.2456	0.4912	0.9441	0.1133	0.4803	0.0412
0.1500	0.4289	6.5269	0.0657	0.4729	0.9458	1.1026	0.1654	0.5017	0.0552
0.1968	0.7820	8.9141	0.0877	1.0454	2.0908	1.3368	0.2631	0.5310	0.0792
0.2100	0.9014	9.5875	0.0940	1.2620	2.5239	1.4000	0.2940	0.5384	0.0863
0.2400	1.2052	11.1178	0.1084	1.8551	3.7102	1.5393	0.3694	0.5537	0.1030
0.3112	**2.1062**	**14.7497**	**0.1428**	**3.8960**	**7.7920**	**1.8498**	**0.5757**	**0.5844**	**0.1450**
0.3330	2.4328	15.8617	0.1534	4.7197	9.4393	1.9400	0.6460	0.5925	0.1584

For water depths greater than 0.333 ft but less than 0.513 ft

Y2= Y - 0.333
A3= A2 + Y2*15 + 25 Y2^2
P3= P2 + SQRT (2501 Y2^2)

Depth (ft)	Area (ft^2)	P (ft)	R (A/P)	Q (cfs)	2Q (cfs)	Vel (ft/s)	D*V	Fr	D2 (ft)
0.3330	2.4328	15.8617	0.1534	4.7197	9.4393	1.9400	0.6460	0.5925	0.1584
0.3700	3.0220	17.7121	0.1706	6.2944	12.5887	2.0829	0.7707	0.6034	0.1810
0.3919	**3.4030**	**18.8073**	**0.1809**	**7.3710**	**14.7421**	**2.1661**	**0.8489**	**0.6098**	**0.1947**
0.4200	3.9270	20.2126	0.1943	8.9193	17.8385	2.2713	0.9539	0.6176	0.2127
0.4344	4.2108	20.9327	0.2012	9.7882	19.5765	2.3245	1.0098	0.6215	0.2221
0.4496	4.5216	21.6928	0.2084	10.7629	21.5258	2.3803	1.0702	0.6256	0.2321
0.4800	5.1780	23.2132	0.2231	12.8951	25.7901	2.4904	1.1954	0.6335	0.2524
0.5130	5.9428	24.8635	0.2390	15.4971	30.9942	2.6077	1.3378	0.6416	0.2750

Street Capacity Calculations

Rising Star Road
30' F-F Street Section with 4" curb

Slope= 0.0675
Flow Required = 6.74
Basins 3

For water depths less than 0.0625 feet

Y= Water depth
Area = 16*Y^2
P= SQRT(1025*Y^2) + Y
n= 0.017

Depth (ft)	Area (ft^2)	P (ft)	R (A/P)	Q (cfs)	2Q (cfs)	Vel (ft/s)	D*V	Fr	D2 (ft)
0.0100	0.0016	0.3302	0.0048	0.0010	0.0021	0.6504	0.0065	1.1461	0.0120
0.0175	0.0049	0.5778	0.0085	0.0046	0.0093	0.9445	0.0165	1.2582	0.0236
0.0250	0.0100	0.8254	0.0121	0.0120	0.0240	1.1980	0.0299	1.3352	0.0363
0.0325	0.0169	1.0730	0.0158	0.0241	0.0482	1.4270	0.0464	1.3949	0.0499
0.0400	0.0256	1.3206	0.0194	0.0420	0.0839	1.6388	0.0656	1.4440	0.0641
0.0475	0.0361	1.5682	0.0230	0.0663	0.1327	1.8377	0.0873	1.4860	0.0789
0.0550	0.0484	1.8159	0.0267	0.0981	0.1962	2.0264	0.1115	1.5227	0.0941
0.0625	0.0625	2.0635	0.0303	0.1379	0.2758	2.2067	0.1379	1.5555	0.1097

For water depths greater than 0.0625 ft but less than 0.333 ft

Y1= Y-0.0625
A2= A1 + 2*Y1 + 25*Y1^2
P2= P1 + SQRT(2501*Y1^2)

Depth (ft)	Area (ft^2)	P (ft)	R (A/P)	Q (cfs)	2Q (cfs)	Vel (ft/s)	D*V	Fr	D2 (ft)
0.0625	0.0625	2.0635	0.0303	0.1379	0.2758	2.2067	0.1379	1.5555	0.1097
0.0900	0.1364	3.4663	0.0394	0.3584	0.7168	2.6275	0.2365	1.5434	0.1565
0.1200	0.2602	4.9966	0.0521	0.8238	1.6476	3.1666	0.3800	1.6109	0.2199
0.1500	0.4289	6.5269	0.0657	1.5862	3.1724	3.6982	0.5547	1.6828	0.2898
0.1941	**0.7587**	**8.7764**	**0.0864**	**3.3684**	**6.7369**	**4.4399**	**0.8618**	**1.7760**	**0.4000**
0.2100	0.9014	9.5875	0.0940	4.2327	8.4655	4.6957	0.9861	1.8058	0.4415
0.2400	1.2052	11.1178	0.1084	6.2223	12.4446	5.1630	1.2391	1.8573	0.5217
0.2505	1.3221	11.6534	0.1135	7.0366	14.0732	5.3223	1.3332	1.8740	0.5503
0.3330	2.4328	15.8617	0.1534	15.8302	31.6604	6.5071	2.1669	1.9872	0.7840

For water depths greater than 0.333 ft but less than 0.513 ft

Y2= Y - 0.333
A3= A2 + Y2*15 + 25 Y2^2
P3= P2 + SQRT (2501 Y2^2)

Depth (ft)	Area (ft^2)	P (ft)	R (A/P)	Q (cfs)	2Q (cfs)	Vel (ft/s)	D*V	Fr	D2 (ft)
0.3330	2.4328	15.8617	0.1534	15.8302	31.6604	6.5071	2.1669	1.9872	0.7840
0.3540	2.7588	16.9119	0.1631	18.7049	37.4098	6.7801	2.4002	2.0082	0.8438
0.3952	3.4625	18.9723	0.1825	25.3000	50.5999	7.3069	2.8877	2.0483	0.9641
0.4200	3.9270	20.2126	0.1943	29.9162	59.8323	7.6181	3.1996	2.0715	1.0382
0.4344	4.2108	20.9327	0.2012	32.8307	65.6614	7.7968	3.3869	2.0847	1.0818
0.4496	4.5216	21.6928	0.2084	36.0998	72.1996	7.9838	3.5895	2.0983	1.1282
0.4800	5.1780	23.2132	0.2231	43.2514	86.5027	8.3529	4.0094	2.1247	1.2221
0.5130	5.9428	24.8635	0.2390	51.9789	103.9578	8.7466	4.4870	2.1521	1.3257

Street Capacity Calculations

Rising Star Road
30' F-F Street Section with 4" curb
Slope= 0.01
Flow Required = 6.91
Basins 1, 2, 3, 4

For water depths less than 0.0625 feet

Y= Water depth
Area = 16*Y^2
P= SQRT(1025*Y^2) + Y
n= 0.017

Depth (ft)	Area (ft^2)	P (ft)	R (A/P)	Q (cfs)	2Q (cfs)	Vel (ft/s)	D*V	Fr	D2 (ft)
0.0100	0.0016	0.3302	0.0048	0.0004	0.0008	0.2503	0.0025	0.4411	0.0030
0.0175	0.0049	0.5778	0.0085	0.0018	0.0036	0.3635	0.0064	0.4843	0.0061
0.0250	0.0100	0.8254	0.0121	0.0046	0.0092	0.4611	0.0115	0.5139	0.0096
0.0325	0.0169	1.0730	0.0158	0.0093	0.0186	0.5492	0.0179	0.5369	0.0133
0.0400	0.0256	1.3206	0.0194	0.0161	0.0323	0.6308	0.0252	0.5558	0.0173
0.0475	0.0361	1.5682	0.0230	0.0255	0.0511	0.7073	0.0336	0.5719	0.0214
0.0550	0.0484	1.8159	0.0267	0.0378	0.0755	0.7800	0.0429	0.5861	0.0257
0.0625	0.0625	2.0635	0.0303	0.0531	0.1062	0.8494	0.0531	0.5987	0.0302

For water depths greater than 0.0625 ft but less than 0.333 ft

Y1= Y-0.0625
A2= A1 + 2*Y1 + 25*Y1^2
P2= P1 + SQRT(2501*Y1^2)

Depth (ft)	Area (ft^2)	P (ft)	R (A/P)	Q (cfs)	2Q (cfs)	Vel (ft/s)	D*V	Fr	D2 (ft)
0.0625	0.0625	2.0635	0.0303	0.0531	0.1062	0.8494	0.0531	0.5987	0.0302
0.0900	0.1364	3.4663	0.0394	0.1379	0.2759	1.0113	0.0910	0.5941	0.0430
0.1200	0.2602	4.9966	0.0521	0.3171	0.6342	1.2188	0.1463	0.6201	0.0611
0.1500	0.4289	6.5269	0.0657	0.6105	1.2211	1.4235	0.2135	0.6477	0.0815
0.1941	0.7587	8.7764	0.0864	1.2965	2.5930	1.7089	0.3317	0.6836	0.1142
0.2134	**0.9336**	**9.7609**	**0.0956**	**1.7067**	**3.4134**	**1.8281**	**0.3901**	**0.6974**	**0.1293**
0.2400	1.2052	11.1178	0.1084	2.3950	4.7899	1.9873	0.4769	0.7149	0.1507
0.2728	**1.5888**	**12.7909**	**0.1242**	**3.4572**	**6.9145**	**2.1761**	**0.5936**	**0.7342**	**0.1780**
0.3330	2.4328	15.8617	0.1534	6.0930	12.1861	2.5046	0.8340	0.7649	0.2303

For water depths greater than 0.333 ft but less than 0.513 ft

Y2= Y - 0.333
A3= A2 + Y2*15 + 25 Y2^2
P3= P2 + SQRT (2501 Y2^2)

Depth (ft)	Area (ft^2)	P (ft)	R (A/P)	Q (cfs)	2Q (cfs)	Vel (ft/s)	D*V	Fr	D2 (ft)
0.3330	2.4328	15.8617	0.1534	6.0930	12.1861	2.5046	0.8340	0.7649	0.2303
0.3540	2.7588	16.9119	0.1631	7.1995	14.3991	2.6097	0.9238	0.7730	0.2485
0.3952	3.4625	18.9723	0.1825	9.7380	19.4759	2.8124	1.1115	0.7884	0.2853
0.4200	3.9270	20.2126	0.1943	11.5147	23.0295	2.9322	1.2315	0.7973	0.3081
0.4344	4.2108	20.9327	0.2012	12.6365	25.2731	3.0010	1.3036	0.8024	0.3215
0.4496	4.5216	21.6928	0.2084	13.8948	27.7896	3.0730	1.3816	0.8076	0.3358
0.4800	5.1780	23.2132	0.2231	16.6475	33.2949	3.2150	1.5432	0.8178	0.3648
0.5130	5.9428	24.8635	0.2390	20.0067	40.0134	3.3666	1.7270	0.8283	0.3969

Street Capacity Calculations

MODESTO AVE

40' F-F Street Section with 8" curb

Slope= 0.0364

For water depths less than 0.125 feet

Y= Water depth
Area = 8*Y^2
P= SQRT(257*Y^2) + Y
n= 0.017

Depth (ft)	Area (ft^2)	P (ft)	R (A/P)	Q (cfs)	2Q (cfs)	Vel (ft/s)	D*V	Fr	D2 (ft)
0.01	0.0008	0.1703	0.0047	0.0004	0.0007	0.4678	0.0047	0.8243	0.0077
0.02	0.0032	0.3406	0.0094	0.0024	0.0048	0.7425	0.0149	0.9253	0.0180
0.04	0.0128	0.6812	0.0188	0.0151	0.0302	1.1787	0.0471	1.0386	0.0421
0.06	0.0288	1.0219	0.0282	0.0445	0.0890	1.5445	0.0927	1.1112	0.0689
0.08	0.0512	1.3625	0.0376	0.0958	0.1916	1.8710	0.1497	1.1657	0.0978
0.1	0.0800	1.7031	0.0470	0.1737	0.3474	2.1711	0.2171	1.2099	0.1283
0.12	0.1152	2.0437	0.0564	0.2824	0.5649	2.4517	0.2942	1.2472	0.1600
0.125	0.1250	2.1289	0.0587	0.3149	0.6298	2.5194	0.3149	1.2558	0.1681

For water depths greater than 0.125 ft but less than 0.485 ft

Y1= Y-0.125
A2= A1 + 2*Y1 + 25*Y1^2
P2= P1 + SQRT(2501*Y1^2)

Depth (ft)	Area (ft^2)	P (ft)	R (A/P)	Q (cfs)	2Q (cfs)	Vel (ft/s)	D*V	Fr	D2 (ft)
0.13	0.1356	2.3840	0.0569	0.3346	0.6691	2.4669	0.3207	1.2057	0.1660
0.17	0.2656	4.4244	0.0600	0.6792	1.3584	2.5570	0.4347	1.0929	0.1912
0.215	0.5075	6.7198	0.0755	1.5122	3.0244	2.9797	0.6406	1.1325	0.2532
0.26	0.8506	9.0153	0.0944	2.9401	5.8802	3.4564	0.8987	1.1946	0.3281
0.305	1.2950	11.3107	0.1145	5.0923	10.1845	3.9322	1.1993	1.2548	0.4098
0.35	1.8406	13.6062	0.1353	8.0892	16.1784	4.3948	1.5382	1.3091	0.4962
0.395	2.4875	15.9016	0.1564	12.0438	24.0877	4.8417	1.9125	1.3576	0.5862
0.44	3.2356	18.1971	0.1778	17.0628	34.1256	5.2734	2.3203	1.4010	0.6791
0.485	4.0850	20.4925	0.1993	23.2476	46.4951	5.6910	2.7601	1.4401	0.7746

For water depths greater than 0.485 ft but less than 0.667 ft

Y2= Y - 0.485
A3= A2 + Y2*18
P3= P2 + Y2

Depth (ft)	Area (ft^2)	P (ft)	R (A/P)	Q (cfs)	2Q (cfs)	Vel (ft/s)	D*V	Fr	D2 (ft)
0.485	4.0850	20.4925	0.1993	23.2476	46.4951	5.6910	2.7601	1.4401	0.7746
0.512	**4.5710**	**20.5195**	**0.2228**	**28.0131**	**56.0262**	**6.1284**	**3.1378**	**1.5093**	**0.8665**
0.535	4.9850	20.5425	0.2427	32.3440	64.6880	6.4883	3.4712	1.5632	0.9451
0.56	5.4350	20.5675	0.2643	37.3249	74.6498	6.8675	3.8458	1.6173	1.0310
0.585	5.8850	20.5925	0.2858	42.5819	85.1638	7.2357	4.2329	1.6671	1.1174
0.61	6.3350	20.6175	0.3073	48.1069	96.2138	7.5938	4.6322	1.7134	1.2043
0.635	6.7850	20.6425	0.3287	53.8926	107.7851	7.9429	5.0437	1.7566	1.2916
0.667	7.3610	20.6745	0.3560	61.6678	123.3356	8.3776	5.5879	1.8077	1.4040

For water depths greater than 0.667 ft but less than 0.867 ft

Y3= Y - 0.667
A4= A3 + 18 * Y3 + 25 * Y3^2
P4= P3 + SQRT(2501 * Y3^2)

Depth (ft)	Area (ft^2)	P (ft)	R (A/P)	Q (cfs)	2Q (cfs)	Vel (ft/s)	D*V	Fr	D2 (ft)
0.667	7.3610	20.6745	0.3560	61.6678	123.3356	8.3776	5.5879	1.8077	1.4040
0.7	7.9822	22.3248	0.3575	67.0607	134.1215	8.4013	5.8809	1.7696	1.4364
0.733	8.6579	23.9752	0.3611	73.2207	146.4414	8.4571	6.1991	1.7408	1.4749
0.766	9.3880	25.6255	0.3664	80.1609	160.3219	8.5386	6.5406	1.7193	1.5184
0.8	10.1972	27.3258	0.3732	88.1472	176.2943	8.6442	6.9154	1.7032	1.5680
0.832	11.0116	28.9262	0.3807	96.4597	192.9194	8.7598	7.2882	1.6924	1.6183
0.867	11.9610	30.6765	0.3899	106.4623	212.9246	8.9008	7.7170	1.6846	1.6770

Street Capacity Calculations

MODESTO AVE

40' F-F Street Section with 8" curb

Slope= 0.0364

For water depths less than 0.125 feet

Y= Water depth
Area = 8*Y^2
P= SQRT(257*Y^2) + Y
n= 0.017

Depth (ft)	Area (ft^2)	P (ft)	R (A/P)	Q (cfs)	2Q (cfs)	Vel (ft/s)	D*V	Fr	D2 (ft)
0.01	0.0008	0.1703	0.0047	0.0004	0.0007	0.4678	0.0047	0.8243	0.0077
0.02	0.0032	0.3406	0.0094	0.0024	0.0048	0.7425	0.0149	0.9253	0.0180
0.04	0.0128	0.6812	0.0188	0.0151	0.0302	1.1787	0.0471	1.0386	0.0421
0.06	0.0288	1.0219	0.0282	0.0445	0.0890	1.5445	0.0927	1.1112	0.0689
0.08	0.0512	1.3625	0.0376	0.0958	0.1916	1.8710	0.1497	1.1657	0.0978
0.1	0.0800	1.7031	0.0470	0.1737	0.3474	2.1711	0.2171	1.2099	0.1283
0.12	0.1152	2.0437	0.0564	0.2824	0.5649	2.4517	0.2942	1.2472	0.1600
0.125	0.1250	2.1289	0.0587	0.3149	0.6298	2.5194	0.3149	1.2558	0.1681

For water depths greater than 0.125 ft but less than 0.485 ft

Y1= Y-0.125
A2= A1 + 2*Y1 + 25*Y1^2
P2= P1 + SQRT(2501*Y1^2)

Depth (ft)	Area (ft^2)	P (ft)	R (A/P)	Q (cfs)	2Q (cfs)	Vel (ft/s)	D*V	Fr	D2 (ft)
0.13	0.1356	2.3840	0.0569	0.3346	0.6691	2.4669	0.3207	1.2057	0.1660
0.17	0.2656	4.4244	0.0600	0.6792	1.3584	2.5570	0.4347	1.0929	0.1912
0.215	0.5075	6.7198	0.0755	1.5122	3.0244	2.9797	0.6406	1.1325	0.2532
0.26	0.8506	9.0153	0.0944	2.9401	5.8802	3.4564	0.8987	1.1946	0.3281
0.305	1.2950	11.3107	0.1145	5.0923	10.1845	3.9322	1.1993	1.2548	0.4098
0.35	1.8406	13.6062	0.1353	8.0892	16.1784	4.3948	1.5382	1.3091	0.4962
0.395	2.4875	15.9016	0.1564	12.0438	24.0877	4.8417	1.9125	1.3576	0.5862
0.4249	**2.9733**	**17.4268**	**0.1706**	**15.2536**	**30.5073**	**5.1302**	**2.1798**	**1.3870**	**0.6476**
0.485	4.0850	20.4925	0.1993	23.2476	46.4951	5.6910	2.7601	1.4401	0.7746

For water depths greater than 0.485 ft but less than 0.667 ft

Y2= Y - 0.485
A3= A2 + Y2*18
P3= P2 + Y2

Depth (ft)	Area (ft^2)	P (ft)	R (A/P)	Q (cfs)	2Q (cfs)	Vel (ft/s)	D*V	Fr	D2 (ft)
0.485	4.0850	20.4925	0.1993	23.2476	46.4951	5.6910	2.7601	1.4401	0.7746
0.512	4.5710	20.5195	0.2228	28.0131	56.0262	6.1284	3.1378	1.5093	0.8665
0.535	4.9850	20.5425	0.2427	32.3440	64.6880	6.4883	3.4712	1.5632	0.9451
0.56	5.4350	20.5675	0.2643	37.3249	74.6498	6.8675	3.8458	1.6173	1.0310
0.585	5.8850	20.5925	0.2858	42.5819	85.1638	7.2357	4.2329	1.6671	1.1174
0.61	6.3350	20.6175	0.3073	48.1069	96.2138	7.5938	4.6322	1.7134	1.2043
0.635	6.7850	20.6425	0.3287	53.8926	107.7851	7.9429	5.0437	1.7566	1.2916
0.667	7.3610	20.6745	0.3560	61.6678	123.3356	8.3776	5.5879	1.8077	1.4040

For water depths greater than 0.667 ft but less than 0.867 ft

Y3= Y - 0.667
A4= A3 + 18 * Y3 + 25 * Y3^2
P4= P3 + SQRT(2501 * Y3^2)

Depth (ft)	Area (ft^2)	P (ft)	R (A/P)	Q (cfs)	2Q (cfs)	Vel (ft/s)	D*V	Fr	D2 (ft)
0.667	7.3610	20.6745	0.3560	61.6678	123.3356	8.3776	5.5879	1.8077	1.4040
0.7	7.9822	22.3248	0.3575	67.0607	134.1215	8.4013	5.8809	1.7696	1.4364
0.733	8.6579	23.9752	0.3611	73.2207	146.4414	8.4571	6.1991	1.7408	1.4749
0.766	9.3880	25.6255	0.3664	80.1609	160.3219	8.5386	6.5406	1.7193	1.5184
0.8	10.1972	27.3258	0.3732	88.1472	176.2943	8.6442	6.9154	1.7032	1.5680
0.832	11.0116	28.9262	0.3807	96.4597	192.9194	8.7598	7.2882	1.6924	1.6183
0.867	11.9610	30.6765	0.3899	106.4623	212.9246	8.9008	7.7170	1.6846	1.6770

Street Capacity Calculations

MODESTO AVE

40' F-F Street Section with 8" curb

Slope= 0.0364

For water depths less than 0.125 feet

Y= Water depth
Area = 8*Y^2
P= SQRT(257*Y^2) + Y
n= 0.017

Depth (ft)	Area (ft^2)	P (ft)	R (A/P)	Q (cfs)	2Q (cfs)	Vel (ft/s)	D*V	Fr	D2 (ft)
0.01	0.0008	0.1703	0.0047	0.0004	0.0008	0.4729	0.0047	0.8333	0.0078
0.02	0.0032	0.3406	0.0094	0.0024	0.0048	0.7506	0.0150	0.9354	0.0183
0.04	0.0128	0.6812	0.0188	0.0153	0.0305	1.1915	0.0477	1.0499	0.0427
0.06	0.0288	1.0219	0.0282	0.0450	0.0899	1.5614	0.0937	1.1233	0.0699
0.08	0.0512	1.3625	0.0376	0.0968	0.1937	1.8915	0.1513	1.1785	0.0992
0.1	0.0800	1.7031	0.0470	0.1756	0.3512	2.1948	0.2195	1.2231	0.1301
0.12	0.1152	2.0437	0.0564	0.2855	0.5711	2.4785	0.2974	1.2609	0.1622
0.125	0.1250	2.1289	0.0587	0.3184	0.6367	2.5469	0.3184	1.2695	0.1705

For water depths greater than 0.125 ft but less than 0.485 ft

Y1= Y-0.125
A2= A1 + 2*Y1 + 25*Y1^2
P2= P1 + SQRT(2501*Y1^2)

Depth (ft)	Area (ft^2)	P (ft)	R (A/P)	Q (cfs)	2Q (cfs)	Vel (ft/s)	D*V	Fr	D2 (ft)
0.13	0.1356	2.3840	0.0569	0.3382	0.6765	2.4938	0.3242	1.2189	0.1683
0.17	0.2656	4.4244	0.0600	0.6866	1.3733	2.5850	0.4394	1.1048	0.1939
0.215	0.5075	6.7198	0.0755	1.5287	3.0575	3.0123	0.6476	1.1448	0.2568
0.26	0.8506	9.0153	0.0944	2.9723	5.9445	3.4942	0.9085	1.2076	0.3327
0.305	1.2950	11.3107	0.1145	5.1479	10.2958	3.9752	1.2124	1.2685	0.4155
0.3281	**1.5624**	**12.4890**	**0.1251**	**6.5891**	**13.1783**	**4.2172**	**1.3837**	**1.2975**	**0.4599**
0.395	2.4875	15.9016	0.1564	12.1755	24.3510	4.8947	1.9334	1.3724	0.5942
0.4249	2.9733	17.4268	0.1706	15.4203	30.8407	5.1863	2.2036	1.4021	0.6565
0.485	4.0850	20.4925	0.1993	23.5016	47.0033	5.7532	2.7903	1.4558	0.7851

For water depths greater than 0.485 ft but less than 0.667 ft

Y2= Y - 0.485
A3= A2 + Y2*18
P3= P2 + Y2

Depth (ft)	Area (ft^2)	P (ft)	R (A/P)	Q (cfs)	2Q (cfs)	Vel (ft/s)	D*V	Fr	D2 (ft)
0.485	4.0850	20.4925	0.1993	23.5016	47.0033	5.7532	2.7903	1.4558	0.7851
0.512	4.5710	20.5195	0.2228	28.3193	56.6386	6.1954	3.1721	1.5258	0.8781
0.535	4.9850	20.5425	0.2427	32.6975	65.3950	6.5592	3.5092	1.5803	0.9577
0.56	5.4350	20.5675	0.2643	37.7328	75.4657	6.9426	3.8878	1.6349	1.0447
0.585	5.8850	20.5925	0.2858	43.0473	86.0946	7.3148	4.2791	1.6854	1.1322
0.61	6.3350	20.6175	0.3073	48.6327	97.2654	7.6768	4.6829	1.7322	1.2201
0.635	6.7850	20.6425	0.3287	54.4816	108.9631	8.0297	5.0989	1.7758	1.3085
0.667	7.3610	20.6745	0.3560	62.3418	124.6836	8.4692	5.6490	1.8275	1.4223

For water depths greater than 0.667 ft but less than 0.867 ft

Y3= Y - 0.667
A4= A3 + 18 * Y3 + 25 * Y3^2
P4= P3 + SQRT(2501 * Y3^2)

Depth (ft)	Area (ft^2)	P (ft)	R (A/P)	Q (cfs)	2Q (cfs)	Vel (ft/s)	D*V	Fr	D2 (ft)
0.667	7.3610	20.6745	0.3560	62.3418	124.6836	8.4692	5.6490	1.8275	1.4223
0.7	7.9822	22.3248	0.3575	67.7937	135.5873	8.4931	5.9452	1.7889	1.4552
0.733	8.6579	23.9752	0.3611	74.0209	148.0419	8.5495	6.2668	1.7598	1.4942
0.766	9.3880	25.6255	0.3664	81.0370	162.0741	8.6320	6.6121	1.7381	1.5384
0.8	10.1972	27.3258	0.3732	89.1105	178.2211	8.7387	6.9910	1.7218	1.5886
0.832	11.0116	28.9262	0.3807	97.5139	195.0278	8.8555	7.3678	1.7109	1.6396
0.867	11.9610	30.6765	0.3899	107.6259	215.2517	8.9981	7.8013	1.7030	1.6991

Street Capacity Calculations

EAGLE ROCK AVE

40' F-F Street Section with 8" curb

Slope= 0.0372

For water depths less than 0.125 feet

Y= Water depth
Area = 8*Y^2
P= SQRT(257*Y^2) + Y
n= 0.017

Depth (ft)	Area (ft^2)	P (ft)	R (A/P)	Q (cfs)	2Q (cfs)	Vel (ft/s)	D*V	Fr	D2 (ft)
0.01	0.0008	0.1703	0.0047	0.0004	0.0008	0.4729	0.0047	0.8333	0.0078
0.02	0.0032	0.3406	0.0094	0.0024	0.0048	0.7506	0.0150	0.9354	0.0183
0.04	0.0128	0.6812	0.0188	0.0153	0.0305	1.1915	0.0477	1.0499	0.0427
0.06	0.0288	1.0219	0.0282	0.0450	0.0899	1.5614	0.0937	1.1233	0.0699
0.08	0.0512	1.3625	0.0376	0.0968	0.1937	1.8915	0.1513	1.1785	0.0992
0.1	0.0800	1.7031	0.0470	0.1756	0.3512	2.1948	0.2195	1.2231	0.1301
0.12	0.1152	2.0437	0.0564	0.2855	0.5711	2.4785	0.2974	1.2609	0.1622
0.125	0.1250	2.1289	0.0587	0.3184	0.6367	2.5469	0.3184	1.2695	0.1705

For water depths greater than 0.125 ft but less than 0.485 ft

Y1= Y-0.125
A2= A1 + 2*Y1 + 25*Y1^2
P2= P1 + SQRT(2501*Y1^2)

Depth (ft)	Area (ft^2)	P (ft)	R (A/P)	Q (cfs)	2Q (cfs)	Vel (ft/s)	D*V	Fr	D2 (ft)
0.13	0.1356	2.3840	0.0569	0.3382	0.6765	2.4938	0.3242	1.2189	0.1683
0.17	0.2656	4.4244	0.0600	0.6866	1.3733	2.5850	0.4394	1.1048	0.1939
0.215	0.5075	6.7198	0.0755	1.5287	3.0575	3.0123	0.6476	1.1448	0.2568
0.26	0.8506	9.0153	0.0944	2.9723	5.9445	3.4942	0.9085	1.2076	0.3327
0.305	1.2950	11.3107	0.1145	5.1479	10.2958	3.9752	1.2124	1.2685	0.4155
0.35	1.8406	13.6062	0.1353	8.1776	16.3552	4.4428	1.5550	1.3234	0.5030
0.395	2.4875	15.9016	0.1564	12.1755	24.3510	4.8947	1.9334	1.3724	0.5942
0.44	3.2356	18.1971	0.1778	17.2493	34.4986	5.3311	2.3457	1.4163	0.6883
0.485	4.0850	20.4925	0.1993	23.5016	47.0033	5.7532	2.7903	1.4558	0.7851

For water depths greater than 0.485 ft but less than 0.667 ft

Y2= Y - 0.485
A3= A2 + Y2*18
P3= P2 + Y2

Depth (ft)	Area (ft^2)	P (ft)	R (A/P)	Q (cfs)	2Q (cfs)	Vel (ft/s)	D*V	Fr	D2 (ft)
0.485	4.0850	20.4925	0.1993	23.5016	47.0033	5.7532	2.7903	1.4558	0.7851
0.4942	**4.2506**	**20.5017**	**0.2073**	**25.1034**	**50.2067**	**5.9058**	**2.9187**	**1.4805**	**0.8167**
0.535	4.9850	20.5425	0.2427	32.6975	65.3950	6.5592	3.5092	1.5803	0.9577
0.56	5.4350	20.5675	0.2643	37.7328	75.4657	6.9426	3.8878	1.6349	1.0447
0.585	5.8850	20.5925	0.2858	43.0473	86.0946	7.3148	4.2791	1.6854	1.1322
0.61	6.3350	20.6175	0.3073	48.6327	97.2654	7.6768	4.6829	1.7322	1.2201
0.635	6.7850	20.6425	0.3287	54.4816	108.9631	8.0297	5.0989	1.7758	1.3085
0.667	7.3610	20.6745	0.3560	62.3418	124.6836	8.4692	5.6490	1.8275	1.4223

For water depths greater than 0.667 ft but less than 0.867 ft

Y3= Y - 0.667
A4= A3 + 18 * Y3 + 25 * Y3^2
P4= P3 + SQRT(2501 * Y3^2)

Depth (ft)	Area (ft^2)	P (ft)	R (A/P)	Q (cfs)	2Q (cfs)	Vel (ft/s)	D*V	Fr	D2 (ft)
0.667	7.3610	20.6745	0.3560	62.3418	124.6836	8.4692	5.6490	1.8275	1.4223
0.7	7.9822	22.3248	0.3575	67.7937	135.5873	8.4931	5.9452	1.7889	1.4552
0.733	8.6579	23.9752	0.3611	74.0209	148.0419	8.5495	6.2668	1.7598	1.4942
0.766	9.3880	25.6255	0.3664	81.0370	162.0741	8.6320	6.6121	1.7381	1.5384
0.8	10.1972	27.3258	0.3732	89.1105	178.2211	8.7387	6.9910	1.7218	1.5886
0.832	11.0116	28.9262	0.3807	97.5139	195.0278	8.8555	7.3678	1.7109	1.6396
0.867	11.9610	30.6765	0.3899	107.6259	215.2517	8.9981	7.8013	1.7030	1.6991

Street Capacity Calculations

EAGLE ROCK AVE
40' F-F Street Section with 8" curb

Slope= 0.0372

For water depths less than 0.125 feet

Y= Water depth
Area = 8*Y^2
P= SQRT(257*Y^2) + Y
n= 0.017

Depth (ft)	Area (ft^2)	P (ft)	R (A/P)	Q (cfs)	2Q (cfs)	Vel (ft/s)	D*V	Fr	D2 (ft)
0.01	0.0008	0.1703	0.0047	0.0004	0.0008	0.4729	0.0047	0.8333	0.0078
0.02	0.0032	0.3406	0.0094	0.0024	0.0048	0.7506	0.0150	0.9354	0.0183
0.04	0.0128	0.6812	0.0188	0.0153	0.0305	1.1915	0.0477	1.0499	0.0427
0.06	0.0288	1.0219	0.0282	0.0450	0.0899	1.5614	0.0937	1.1233	0.0699
0.08	0.0512	1.3625	0.0376	0.0968	0.1937	1.8915	0.1513	1.1785	0.0992
0.1	0.0800	1.7031	0.0470	0.1756	0.3512	2.1948	0.2195	1.2231	0.1301
0.12	0.1152	2.0437	0.0564	0.2855	0.5711	2.4785	0.2974	1.2609	0.1622
0.125	0.1250	2.1289	0.0587	0.3184	0.6367	2.5469	0.3184	1.2695	0.1705

For water depths greater than 0.125 ft but less than 0.485 ft

Y1= Y-0.125
A2= A1 + 2*Y1 + 25*Y1^2
P2= P1 + SQRT(2501*Y1^2)

Depth (ft)	Area (ft^2)	P (ft)	R (A/P)	Q (cfs)	2Q (cfs)	Vel (ft/s)	D*V	Fr	D2 (ft)
0.13	0.1356	2.3840	0.0569	0.3382	0.6765	2.4938	0.3242	1.2189	0.1683
0.17	0.2656	4.4244	0.0600	0.6866	1.3733	2.5850	0.4394	1.1048	0.1939
0.215	0.5075	6.7198	0.0755	1.5287	3.0575	3.0123	0.6476	1.1448	0.2568
0.2757	**0.9942**	**9.8161**	**0.1013**	**3.6418**	**7.2835**	**3.6631**	**1.0099**	**1.2294**	**0.3609**
0.305	1.2950	11.3107	0.1145	5.1479	10.2958	3.9752	1.2124	1.2685	0.4155
0.35	1.8406	13.6062	0.1353	8.1776	16.3552	4.4428	1.5550	1.3234	0.5030
0.395	2.4875	15.9016	0.1564	12.1755	24.3510	4.8947	1.9334	1.3724	0.5942
0.4583	**3.5688**	**19.1305**	**0.1866**	**19.6441**	**39.2881**	**5.5044**	**2.5226**	**1.4329**	**0.7274**
0.485	4.0850	20.4925	0.1993	23.5016	47.0033	5.7532	2.7903	1.4558	0.7851

For water depths greater than 0.485 ft but less than 0.667 ft

Y2= Y - 0.485
A3= A2 + Y2*18
P3= P2 + Y2

Depth (ft)	Area (ft^2)	P (ft)	R (A/P)	Q (cfs)	2Q (cfs)	Vel (ft/s)	D*V	Fr	D2 (ft)
0.485	4.0850	20.4925	0.1993	23.5016	47.0033	5.7532	2.7903	1.4558	0.7851
0.4942	4.2506	20.5017	0.2073	25.1034	50.2067	5.9058	2.9187	1.4805	0.8167
0.535	4.9850	20.5425	0.2427	32.6975	65.3950	6.5592	3.5092	1.5803	0.9577
0.56	5.4350	20.5675	0.2643	37.7328	75.4657	6.9426	3.8878	1.6349	1.0447
0.585	5.8850	20.5925	0.2858	43.0473	86.0946	7.3148	4.2791	1.6854	1.1322
0.61	6.3350	20.6175	0.3073	48.6327	97.2654	7.6768	4.6829	1.7322	1.2201
0.635	6.7850	20.6425	0.3287	54.4816	108.9631	8.0297	5.0989	1.7758	1.3085
0.667	7.3610	20.6745	0.3560	62.3418	124.6836	8.4692	5.6490	1.8275	1.4223

For water depths greater than 0.667 ft but less than 0.867 ft

Y3= Y - 0.667
A4= A3 + 18 * Y3 + 25 * Y3^2
P4= P3 + SQRT(2501 * Y3^2)

Depth (ft)	Area (ft^2)	P (ft)	R (A/P)	Q (cfs)	2Q (cfs)	Vel (ft/s)	D*V	Fr	D2 (ft)
0.667	7.3610	20.6745	0.3560	62.3418	124.6836	8.4692	5.6490	1.8275	1.4223
0.7	7.9822	22.3248	0.3575	67.7937	135.5873	8.4931	5.9452	1.7889	1.4552
0.733	8.6579	23.9752	0.3611	74.0209	148.0419	8.5495	6.2668	1.7598	1.4942
0.766	9.3880	25.6255	0.3664	81.0370	162.0741	8.6320	6.6121	1.7381	1.5384
0.8	10.1972	27.3258	0.3732	89.1105	178.2211	8.7387	6.9910	1.7218	1.5886
0.832	11.0116	28.9262	0.3807	97.5139	195.0278	8.8555	7.3678	1.7109	1.6396
0.867	11.9610	30.6765	0.3899	107.6259	215.2517	8.9981	7.8013	1.7030	1.6991

Scour Depth for Flood Wall

The scour depth was determined from the "Sediment and Erosion Design Guide" for the Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA). Equation 3.88 is for flow in an arroyo infringing on a wall at an angle.

Where:
θ = angle between flow direction and flood wall
Ys = depth of scour
Y = average depth of upstream flow depth in main channel
= 2.09 feet (average from HEC-RAS output)
Fr = Froude number
= 0.99 (average from HEC-RAS output)

$$\frac{Y_s}{Y} = (0.73 + 0.14\pi F_r^2)\cos\theta + (4F_r^{0.33})\sin\theta$$

$$\frac{Y_s}{Y} = (0.73 + 0.14\ \pi\ 0.99^2)\cos 20 + (4 * 0.99^{0.33})\sin 20$$

$$\frac{Y_s}{Y} = 2.45$$

$$\frac{Y_s}{2.09} = 2.45$$

$$Y_s = 5.12\ ft$$

Erosion Setback Line

Arroyo	100-year Flow (cfs)	Dominant Discharge (cfs)	Critical Slope (ft/ft)	Slope (ft/ft)	Channel Width (ft)	Δmax (ft)
La Cueva - Existing	2954	590.80	0.0158	0.03	59.07	175.51
La Cueva - Developed	3094	618.80	0.0157	0.03	60.17	180.00
El Camino - Existing	726	145.20	0.0191	0.03	33.69	84.23
El Camino - Developed	924	184.80	0.0185	0.03	37.11	92.76

Equations:

Dominant Discharge (Q_d)

$Q_d = 0.2*Q_{100}$

Channel Width (Wd)

when $S_c>S$ then $W_d = 4.6 * Q_d^{0.4}$

when $S_c<S$ then $W_d = 2.46 * Q_d^{0.375} * S^{-0.133}$

Critical Slope (S_c)

$S_c=0.037 * Q_d^{-0.133}$

Maximum Lateral Erosion Distance (Δmax) when $S>S_c$

$\Delta max = 11.5 * Q_d 0.4$ when $Q_d <= 200$ cfs

$\Delta max = (0.92 + 4.6 * \log Q_d) * Q_d^{0.4}$ when 200 cfs < Q_d < 2000 cfs

$\Delta max = 16.1 * Q_d^{0.4}$ when $Q_d >= 2000$ cfs

TABLE 7a

COMPARISON OF 100-YEAR HYDROLOGIC RESULTS

STUDY LOCATION	THIS STUDY (CSF)	AMAFCA 1996 DMP (CFS)	NDB/SDB DMP 1991 (CFS)	FEMA 1983 (CFS)	AMAFCA WORST CASE 1997 (CFS)
NORTH DOMINGO BACA					
Ventura Existing	518	*NA*	228	1002	*NA*
Future	**1189**		**1420**		
Barstow Existing	631	*NA*	360	*NR*	*NA*
Future	**1748**		**2030**		
Wyoming Existing	674	*NA*	535	*NR*	*NA*
Future	**1869**		**2646**		
Louisiana Existing	802	*NA*	535	*NR*	*NA*
(at Dam) Future	**2340**		**3113**		
I-25 Existing	423	*NA*	1049	903	*NA*
Future	**738**		**781**		
LA CUEVA					
Ventura Existing	2938	2939	*NA*	3494	3537
Future	**3048**	**3048**			**3693**
Barstow Existing	2954	2953	*NA*	*NR*	3530
Future	**3094**	**3066**			**3727**
Wyoming Existing	2984	2986	*NA*	*NR*	3562
Future	**3128**	**3094**			**3774**
Louisiana Existing	2988	2989	*NA*	*NR*	3548
Future	**3908**	**3106**			**3799**
I-25 Existing	2992	2994	*NA*	3302	3546
Future	**3923**	**3108**			**3809**

NA: Not part of study area or not impacted by major avulsion.
NR: No flow data reported for this location or condition.

TABLE 7b

COMPARISON OF 100-YEAR HYDROLOGIC RESULTS

STUDY LOCATION	THIS STUDY (CSF)	AMAFCA 1996 DMP (CFS)	NDB/SDB DMP 1991 (CFS)	FEMA 1983 (CFS)	AMAFCA WORST CASE 1997 (CFS)
EL CAMINO					
Ventura Existing	637	638	*NA*	3301	3165
Future	707	710			**3237**
Barstow Existing	726	726	*NA*	*NR*	3213
Future	924	920			**3310**
Wyoming Existing	790	790	*NA*	*NR*	3243
Future	967	1130			**3380**
Louisiana Existing		*NR*	*NA*	*NR*	*NR*
Future	312				
I-25 Existing	908	908	*NA*	3033	3286
Future	873	1335			**3438**
NORTH CAMINO					
Ventura Existing	1739	1736	*NA*	640	*NA*
Future	1800	1798			
Barstow Existing	1753	1739	*NA*	*NR*	*NA*
Future	1829	1829			
Wyoming Existing	1743	*NR*	*NA*	*NR*	*NA*
Future	1822				
Louisiana Existing	*NR*	*NR*	*NA*	*NR*	*NA*
Future					
I-25 Existing	1846	1846	*NA*	1760	2127
Future	2043	1982			**2399**

NA: Not part of study or not impacted by major avulsion.
NR: No flow data reported for this location or condition.

HEC-RAS Plan: 9949-lc River: La Cueva Arroyo Reach: Eagle Rock

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	Crit Depth	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Eagle Rock	9	3094.00	102.00	103.62	103.62	1.62	104.34	0.011823	6.80	455.31	321.14	1.01
Eagle Rock	8	3094.00	98.00	99.37	99.37	1.37	100.01	0.012246	6.45	480.02	376.33	1.01
Eagle Rock	7	3094.00	94.00	96.94	96.94	2.94	97.68	0.011138	6.93	458.00	322.89	0.99
Eagle Rock	6	3094.00	92.00	93.72	93.72	1.72	94.57	0.011226	7.36	420.10	252.24	1.01
Eagle Rock	5	3094.00	88.00	90.59	90.59	2.59	91.38	0.009375	7.26	471.18	336.61	0.94
Eagle Rock	4	3094.00	86.00	87.82	87.82	1.82	88.66	0.011201	7.38	419.32	250.94	1.01
Eagle Rock	3	3094.00	82.00	84.56	84.56	2.56	85.56	0.009959	8.03	394.12	222.78	0.98
Eagle Rock	2	3094.00	78.00	81.78	81.78	3.78	82.93	0.010175	8.59	360.87	162.01	1.01
Eagle Rock	1	3094.00	74.00	77.99	77.99	3.99	79.62	0.008332	10.33	314.16	104.92	0.98