Prepard by Provost & Pritchard

March 2008

APPENDIX 5: HYDROLOGY ANALYSIS for preliminary LOW IMPACT DEVELOPMENT techniques

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1

HYDROLOGY ANALYSIS FOR PROPOSED VISALIA CIVIC CENTER EXPANSION

Introduction

The proposed Visalia Civic Center Expansion site is located north of East Center Avenue, south of East Goshen Avenue, east of North Santa Fe Ave. and west of North Ben Maddox Street within the City of Visalia, California.

This hydrology study is based on the City of Visalia Standards – Rational Method. The City of Visalia – *Storm Water Management Program* (November 2005) was used for determining Water Quality Volumes and Flows required for treatment.

The hydrology analysis was only within the area limited by East Center Ave., East Goshen Ave., North Santa Fe Ave. and North Ben Maddox St.. The proposed site was divided into two areas by Burke Street. Area 1 located west of Burke St. and Area 2 located east of Burke St.

The purpose of this study is to determine a hydrology analysis and design Low Impact Development (LID) Techniques to mimic existing hydrologic conditions through runoff volume control, peak runoff rate control, flow frequency/duration control and water quality control.

Existing Conditions

Currently, the exiting project consists of open land with Jennings Ditch running north to south and Mill Creek running east to west. Runoff from the site has a drainage pattern from west to east on Area 1 and a west to east pattern on Area 2, both discharging directly into Mill Creek and Jennings Ditch.

Table 1 and 2 below summarizes the rational method analysis for the project site. Per criteria set forth in the "City of Visalia Standards", a runoff coefficient of 0.15 and 0.65 was selected corresponding to Natural/Undeveloped area and existing developed area.

Summary Report | 06/2008 | Prepared by EDAW

Table 1 – 2 & 10 Year Runoff Flow & Volume for Existing Conditions (Area 1 – West of Burke St.)

		2-1	Year Storm	Event	10-Year Storm Event			
Location	Area (Acres)	Runoff Flow (cfs)	Tc (min)	Runoff Volume (Ac-ft)	Runoff Flow (cfs)	Tc (min)	Runoff Volume (Ac-ft)	
Mayth	10	0.5	18.1	0.09	0.8	18.1	0.12	
North South	3.4	0.4	16.5	0.06	0.7	15.2	0.09	

Table 2 – 2 & 10 Year Runoff Flow & Volume for Existing Conditions (Area 2 – East of Burke St.)

		2-1	Year Storm	Event	10-	Year Storm	Event
Location	Area (Acres)	Runoff Flow (cfs)	Tc (min)	Runoff Volume (Ac-ft)	Runoff Flow (cfs)	Tc (min)	Runoff Volume (Ac-ft)
	34.6	4.8	17.6	0.8	7.7	17.6	1.1

Proposed Conditions

The proposed Visalia Civic Center Expansion will consists of a Civic Center, Business Center, Office Campus, Park and associated local streets, sidewalks, internal storm drain system and various entrances.

Onsite flow will be collected and conveyed via an internal storm drain system which ultimately discharges to proposed Detention basins, located along Mill Creek for Area 1 and Jennings Ditch for Area 2 (See Alternatives A & B Maps). Using the proposed detention basins, peak flows for the 10-year storm event will be attenuated down to existing conditions.

In order to maintain existing conditions of runoff volume, each block will have Bioretention basins located strategically to convey flow from rooftops, parking lots, and walkways between buildings.

The combination of using detention and bioretention basins will contribute to maintain time of concentration for proposed conditions below existing.

The hydrologic analysis in proposed conditions has been done for Alternatives A & B.

Table 3, 4, 5 and 6 below summarizes the rational method analysis for the project site (Alternatives A & B). Per criteria set forth in the "City of Visalia Standards", a runoff coefficient of 0.15 and 0.85 was selected corresponding to Natural/Undeveloped area and proposed developed area (Commercial, Parking Lots, etc.).

Table 3 – 2 & 10 Year Runoff Flow & Volume for Proposed Conditions – Alternative A (Area 1 – West of Burke St.)

		2-1	Year Storm	Event	10-Year Storm Event		
Location	Area (Acres)	Runoff Flow (cfs)	Tc (min)	Runoff Volume (Ac-ft)	Runoff Flow (cfs)	Tc (min)	Runoff Volume (Ac-ft)
North	5.9	2.4	21.8	0.4	4	21.8	0.6
South	2.4	0.3	16.7	0.04	0.4	16.7	0.06

Table 4 – 2 & 10 Year Runoff Flow & Volume for Proposed Conditions – Alternative B (Area 1 – West of Burke St.)

	12000	2-`	Year Storm	Event	10-Year Storm Event		
Location	Area (Acres)	Runoff Flow (cfs)	Tc (min)	Runoff Volume (Ac-ft)	Runoff Flow (cfs)	Tc (min)	Runoff Volume (Ac-ft)
North	5.9	2.4	21.8	0.4	4	21.8	0.6
South	2.4	0.3	16.7	0.04	0.4	16.7	0.06

Table 5 – 2 & 10 Year Runoff Flow & Volume for Proposed Conditions - Alternative A (Area 2 – East of Burke St.)

		2-	Year Storm	Event	10-Year Storm Event		
Location	Area (Acres)	Runoff Flow (cfs)	Tc (min)	Runoff Volume (Ac-ft)	Runoff Flow (cfs)	Tc (min)	Runoff Volume (Ac-ft)
	34.6	12.6	23	2.4	20.6	23	3.5

Table 6 – 2 & 10 Year Runoff Flow & Volume for Proposed Conditions - Alternative B (Area 2 – East of Burke St.)

		2-1	ear Storm	Event	10-Year Storm Event		
Location	Area (Acres)	Runoff Flow (cfs)	Tc (min)	Runoff Volume (Ac-ft)	Runoff Flow (cfs)	Tc (min)	Runoff Volume (Ac-ft)
	34.6	12.6	24.3	2.5	20.6	24.3	3.6

Summary Report | 06/2008 | Prepared by EDAW

Summary of Results

Table 7, 8, 9 and 10 below summarizes the rational method analysis for the project site in existing and proposed (Alternatives A & B) conditions.

Table 7 – 2 & 10 Year Runoff Flow & Volume for Proposed Conditions - Alternative A (Area 1 – West of Burke St.)

				2	-Year Storm Ever	nt	1	0-Year Storm Eve	nt
		Area	Runoff	Runoff Flow	Time of Concentration	Runoff Volume	Runoff Flow	Time of Concentration	Runoff Volume
		(Acres)	Coefficient	(cfs)	(min)	(Ac-ft)	(cfs)	(min)	(Ac-ft)
	Existing Conditions	4.9	0.15	0.5	18.1	0.09	0.8	18.1	0.12
North	Developed Conditions	5.9	0.65	2.4	21.8	0.4	4.0	21.8	0.6
	DIFFE		Ë	1.9	3.6	0.4	3.1	3.6	0.5
	Existing Conditions	3.4	0.15	0.4	16.5	0.06	0.7	15.2	0.09
South	Developed Conditions	2.4	0.65	0.3	16.7	0.04	0.4	16.7	0.06
		DIFFERENC	E	-0.1	0.2	-0.02	-0.2	1.5	-0.03

Table $8-2\ \&\ 10$ Year Runoff Flow $\&\ Volume$ for Proposed Conditions - Alternative A (Area 2- East of Burke St.)

			2	2-Year Storm Ever	nt	10-Year Storm Event		
	Area	Runoff	Runoff Flow	Time of Concentration	Runoff Volume	Runoff Flow	Time of Concentration	Runoff Volume
	(Acres)	Coefficient	(cfs)	(min)	(Ac-ft)	(cfs)	(min)	(Ac-ft)
Existing Conditions	34.60	0.19	4.8	17.6	0.8	7.7	17.6	1.1
Developed	34.60	0.60	12.6	23.0	2,4	20.6	23.0	3.5
Conditions	ERENCE	80,000	7.8	5.4	1.7	12.9	5.4	2.4

Table 9 - 2 & 10 Year Runoff Flow & Volume for Proposed Conditions - Alternative B (Area 1 - West of Burke St.)

				2	2-Year Storm Eve	nt	1	0-Year Storm Eve	nt
		Area	Runoff Coefficient	Runoff Flow	Time of Concentration	Runoff Volume	Runoff Flow	Time of Concentration	Runoff Volume
	1	(Acres)	Coemicient	(cfs)	(min)	(Ac-ft)	(cfs)	(min)	(Ac-fi)
	Existing Conditions	4.9	0.15	0.5	18.1	0.09	8.0	18.1	0.12
North Developed Conditions	5,9	0.65	2.4	21.8	0.4	4.0	21.8	0.6	
		DIFFERENC	E	1.9	3.6	0.4	3.1	3.6	0.5
	Existing Conditions	3.4	0.15	0.4	16.5	0.06	0.7	15.2	0.09
South	Developed Conditions	2.4	0.65	0.3	16.7	0.04	0.4	16.7	0.06
		DIFFERENC	E	-0.1	0.2	-0.02	-0.2	1.5	-0.03

Table 10 – 2 & 10 Year Runoff Flow & Volume for Proposed Conditions - Alternative B (Area 2 – East of Burke St.)

			2	2-Year Storm Eve	nt	1	0-Year Storm Eve	nt
	Area	Runoff Coefficient	Runoff Flow	Time of Concentration	Runoff Volume	Runoff Flow	Time of Concentration	Runoff Volume
	(Acres)		(cfs)	(min)	(Ac-ft)	(cfs)	(min)	(Ac-ft)
Existing Conditions	34.60	0.19	4.8	17.6	0.8	7.7	17.6	1.1
Developed Conditions	34.60	0.62	12.6	24.3	2.5	20.6	24.3	3.6
DIFF	ERENCE		7.8	6.7	1.7	12.9	6.7	2.5

Proposed Detention and Bioretention basins have been designed to maintain existing conditions of runoff flow and runoff volume for each alternative analyzed (See Table 11).

Table 11 – Detention and Bioretention Basin Volumes
Alternative A & B (Areas 1 & 2)

Location		Alternative	Detention Basin Volume (Acre-ft)	Bioretention Basin Volume (Acre-ft)
	West of Burke St Northern	Α	0.36	0.5
Area 1	Portion	В	0.36	0.5
		Α	1.25	2.4
Area 2	East of Burke St.	В	1.29	2.5

6

Water Quality Analysis

The water quality analysis consisted in addressing the treatment of the 85th percentile runoff from the proposed Civic Center Expansion. The design will utilize a combination of Best Management Practices (BMP's) in order to provide maximum water quality treatment.

Flows tributary to the Detention Basins will receive primary treatment (85th Percentile) via curb inlet filters, such as FloGard units. Secondary treatment will be provided via Vortex Separators, such as CDS units. This combination will provide a dual BMP "Treatment Train".

Street runoff will receive partial treatment via Vegetated Swales located adjacent to the internal streets, each designed to treat the 85th percentile flow. The proposed vegetated swales will consist of a bottom width of 4 ft, side slope of 3:1, water depth of 0.33 ft and length of 150 ft. Each swale will treat 85th percentile flows of 0.41 cfs.

The proposed BMP's have been designed for both alternatives A & B.

Additional Source Controls can be implemented within the proposed project site, such as follows:

- Site Design and Landscape Planning
- Roof Runoff Controls
- Efficient Irrigation
- Storm Drain System Signs
- Pervious Pavements (Parking Lots and Entrance Locations)

References

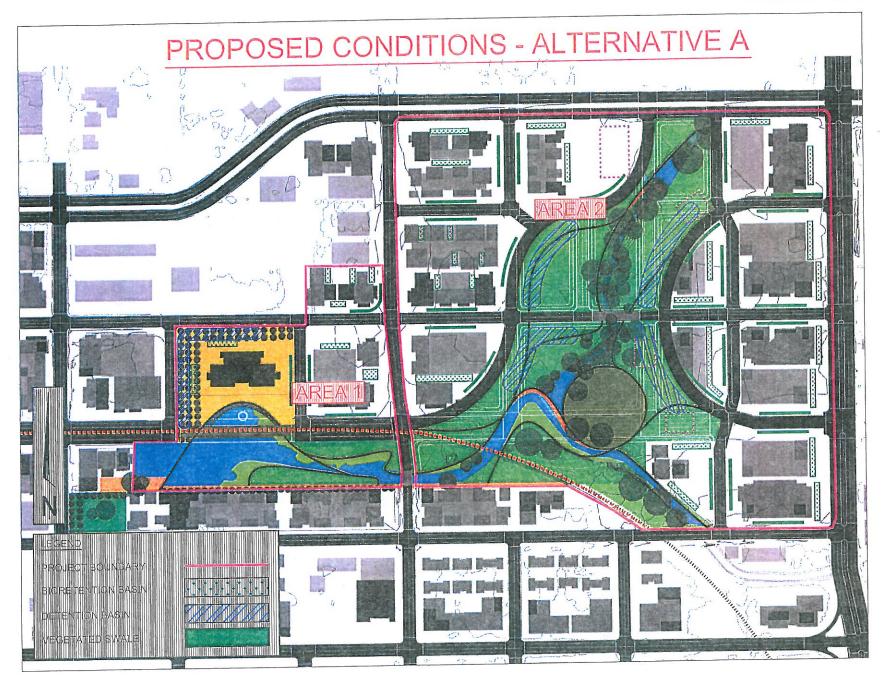
City of Visalia Improvement Standards.

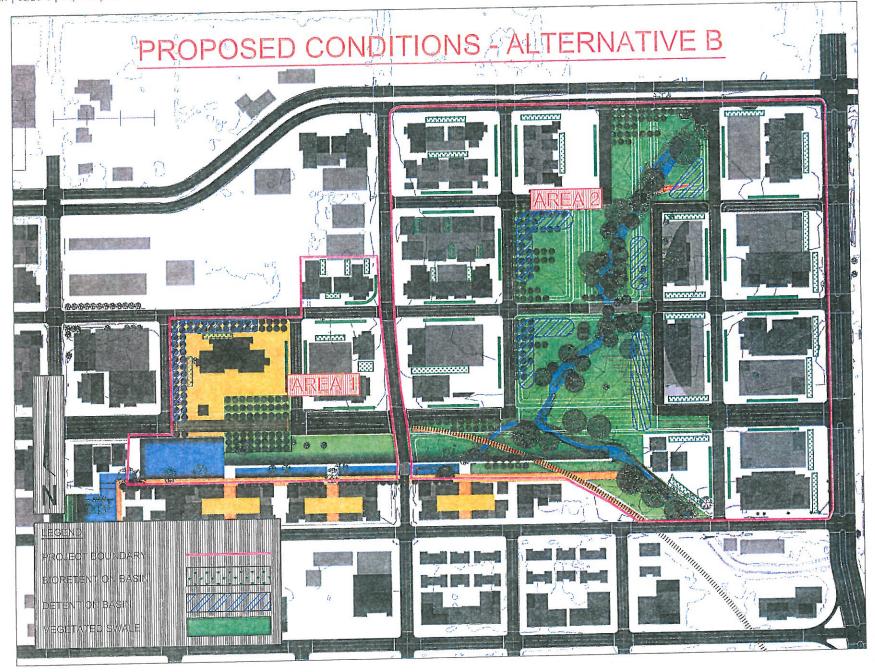
City of Visalia Storm Water Management Program (November 2005).

Stormwater Best Management Practice Handbook – New Development and Redevelopment (California Stormwater Quality Association - CASQA).

Low Impact Development Strategies - An Integrated Design Approach (July 1999). Prince George's County, Maryland (Department of Environmental Resources).

Integrated Stormwater Design: Using Runoff to Create Greate Site Ammenity. Stuart Echols, Penn State. (July 2007).







WATER QUALITY ANALYSIS - ALTERNATIVE A

Visalia Civic Center Expansion COMP. BY: A.D. PROJECT: 180406V1

JOB NO: DESCRIPTION:

1.6

CHKD. BY: Water Quality Analysis (ALTERNATIVE A)

DATE:

9/17/2007

AREA 1 (WEST OF BURKI	ST.) - NORTHERN 8	& SOUTHERN PORTION
-----------------------	-------------------	--------------------

Volume Based Design: Northern Portion			Flow Based Design: Northern & Southern Portion		
Regression Constant - a (24Hr-1.582 48Hr-1.963): Runoff Coefficient - C:	1.582 0.65 0.55		Runoff Coefficient - C: 85th Percentile Rainfall Intensity - I (in/hr): Contributing Area - A (Acres):	0.85 0.2 0.8	* 0.2 in/hr per RWQCB
85th Percentile Rainfall - P (inches): Contributing Area - A (Acres):	5.9		Total 85th Percentile Runoff Flow - Q (cfs):	0.1	Q = CIA
Total 85th Percentile Runoff Volume - V (Acre-ft):	3.3	V = aCPA	Number of Locations to Treat:	3	
Number of Locations to Treat:	3		Design 85th Percentile Runoff Volume - V (Acre-ft/Location):	0.05	
Design 85th Percentile Runoff Volume - V (Acre-ft/Location):	1.1				
AREA 2 (EAST OF BURKE ST.)					
Volume Based Design:			Flow Based Design:		
Regression Constant - a (24Hr-1.582 48Hr-1.963): Runoff Coefficient - C: 85th Percentile Rainfall - P (inches):	1.582 0.60 0.55		Runoff Coefficient - C: 85th Percentile Rainfall Intensity - I (in/hr): Contributing Area - A (Acres):	0.85 0.2 4.6	* 0.2 in/hr per RWQCB
Contributing Area - A (Acres):	34.6		Total 85th Percentile Runoff Flow - Q (cfs):	0.8	Q = CIA
Total 85th Percentile Runoff Volume - V (Acre-ft):	18.1	V = aCPA	Number of Locations to Treat:	11	
Number of Locations to Treat:	11		Design 85th Percentile Runoff Volume - V (Acre-ft/Location):	0.07	36

Reference:

City of Visalia - Storm Water Management Program (November 2005)

Design 85th Percentile Runoff Volume - V (Acre-ft/Location):



WATER QUALITY ANALYSIS - ALTERNATIVE B

Visalia Civic Center Expansion COMP. BY: A.D.

180406V1

CHKD. BY:

DATE: DATE: 9/17/2007

JOB NO: DESCRIPTION:

1.7

PROJECT:

Water Quality Analysis (ALTERNATIVE B)

AREA 1 (WEST OF BURKE ST.) - NORTHERN & SOUTH	ERN PORTION					
Volume Based Design: Northern Portion			Flow Based Design: Northern & Southern Portion			
Regression Constant - a (24Hr-1.582 48Hr-1.963): Runoff Coefficient - C: 85th Percentile Rainfall - P (inches):	1.582 0.65 0.55		Runoff Coefficient - C: 85th Percentile Rainfall Intensity - I (in/hr): Contributing Area - A (Acres):	0.85 0.2 0.8		* 0.2 in/hr per RWQCB
Contributing Area - A (Acres):	5.9		Total 85th Percentile Runoff Flow - Q (cfs):	0.1	*	Q = CIA
Total 85th Percentile Runoff Volume - V (Acre-ft):	3.3	V = aCPA	Number of Locations to Treat:	3		
Number of Locations to Treat:	3		Design 85th Percentile Runoff Volume - V (Acre-ft/Location):	0.05		
Design 85th Percentile Runoff Volume - V (Acre-ft/Location):	1.1					
AREA 2 (EAST OF BURKE ST.)						
Volume Based Design:			Flow Based Design:			
Regression Constant - a (24Hr-1.582 48Hr-1.963): Runoff Coefficient - C:	1.582 0.62 0.55		Runoff Coefficient - C: 85th Percentile Rainfall Intensity - I (in/hr): Contributing Area - A (Acres):	0.85 0.2 4.9		* 0.2 in/hr per RWQCB
85th Percentile Rainfall - P (inches): Contributing Area - A (Acres):	34.6		Total 85th Percentile Runoff Flow - Q (cfs):	0.8		Q = CIA
Total 85th Percentile Runoff Volume - V (Acre-ft):	18.7	V = aCPA	Number of Locations to Treat:	11		
Number of Locations to Treat:	11		Design 85th Percentile Runoff Volume - V (Acre-ft/Location):	0.07		

Reference:

City of Visalia - Storm Water Management Program (November 2005)

Design 85th Percentile Runoff Volume - V (Acre-ft/Location):



DETENTION UNITS SIZING - ALTERNATIVE A

Visalia Civic Center Expansion PROJECT:

COMP. BY: A.D.

DATE:

9/17/2007

JOB NO:

180406V1

CHKD, BY:

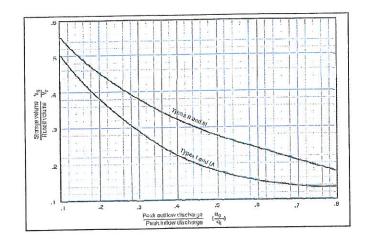
DATE:

DESCRIPTION: Detention Units Sizing (ALTERNATIVE A)

AREA 1 (WEST OF BURKE ST.) - NORTHERN PORTION

Existing Condition Flow (cfs) - Qo	Developed Condition Flow (cfs) - Qi	Contributing Area (acres) - A	P (in)	Weigthed Runoff Coefficient (Cw)	Inflow Runoff Volume (acre- ft) - Vr	Ratio (Qo/Qi)	Ratio (Vs/Vr)	Storage Volume (acre- ft) - Vs	Security Factor	Final Storage Volume (acre ft) - Vsf
0.8	4	5.9	2.0	0.65	0.64	0.20	0.38	0.24	1.5	0.50

Areas (acre) - Ai	Runoff Coefficient (Ci)
2.4 5.9	0,15 0,85
Total Area (acres)	8.3
Cw	0.65



DETENTION BASIN SIZING:

Detention Basin Water Depth (ft): Detention Basin Freeboard (ft): Detention Basin Side Slope - z:

1 1.5 2

Elevation	Area	Length	Width	Inc. Volume	Total Volume	
(ft)	(acres)	(acres)	(ft)	(ft)	(acre-ft.)	(acre-ft.)
1000	0.335	148.0	98.7		0.00	
				0.35		
1001	0.363	154.0	102.7		0.35	
1001				0.58		
1002.5	0.407	163.0	108.7		0.93	
	(ft) 1000 1001	(ft) (acres) 1000 0.335 1001 0.363	(ft) (acres) (ft) 1000 0.335 148.0 1001 0.363 154.0	(ft) (acres) (ft) (ft) 1000 0.335 148.0 98.7 1001 0.363 154.0 102.7	(ft) (acres) (ft) (ft) (acre-ft.) 1000 0.335 148.0 98.7 1001 0.363 154.0 102.7 0.58	

^{*} Detention Basin Dimension could vary due to Site Layout



DETENTION UNITS SIZING - ALTERNATIVE A

Visalia Civic Center Expansion

COMP. BY: A.D.

DATE:

9/17/2007

PROJECT: JOB NO: **DESCRIPTION:** Detention Units Sizing (ALTERNATIVE A)

180406V1

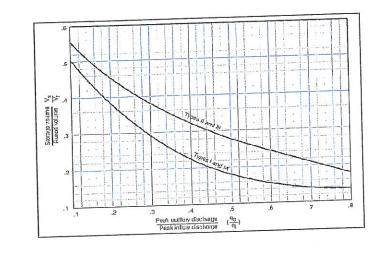
CHKD. BY:

DATE:

AREA 2 (EAST OF BURKE ST.)

Existing Condition Flow (cfs) - Qo	Developed Condition Flow (cfs) - Qi	Contributing Area (acres) - A	P (in)	Dunoff	Inflow Runoff Volume (acre- ft) - Vr	natio	Ratio (Vs/Vr)	Storage Volume (acre- ft) - Vs	Security Factor	Final Storage Volume (acre ft) - Vsf
(013) - 010	N. S. S. S.			N		0.37	0.24	0.83	1.5	1.25
7.7	20.6	34.6	2.0	0.60	3.47	0.37	0.24	-		

Areas (acre) - Ai	Runoff Coefficient (Ci)
12.3 22.3	0.15 0.85
Total Area (acres)	34.6
Cw	0.60



DETENTION BASIN SIZING:

Detention Basin Water Depth (ft): Detention Basin Freeboard (ft): Detention Basin Side Slope - z:

Γ	Elevation	Area	Length	Width	Inc. Volume	Total Volume
-	Washington and the same of the	(acres)	(ft)	(ft)	(acre-ft.)	(acre-ft.)
	(ft)	1.196	279.6	186.4		0.00
Bottom of	1000	1.130		*	1.22	
Basin	1001	1.248	285.6	190.4		1.22
W.S.E.	1001	1.210			1.93	
	1000.5	1,328	294.6	196.4		3.15
Top of Basin	1002.5	1.020				

^{*} Detention Basin Dimension could vary due to Site Layout

1

1.5

2



DETENTION UNITS SIZING - ALTERNATIVE B

Visalia Civic Center Expansion PROJECT:

COMP. BY: A.D.

DATE:

9/17/2007

JOB NO:

180406V1

CHKD, BY:

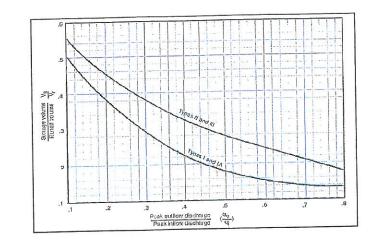
DATE:

DESCRIPTION: Detention Units Sizing (ALTERNATIVE B)

AREA 1 (WEST OF BURKE ST.) - NORTHERN PORTION

Existing Condition Flow (cfs) - Qo	Developed Condition Flow (cfs) - Qi	Contributing Area (acres) - A	P (in)	Weigthed Runoff Coefficient (Cw)	Inflow Runoff Volume (acre- ft) - Vr	Ratio (Qo/Qi)	Ratio (Vs/Vr)	Storage Volume (acre- ft) - Vs	Security Factor	Final Storag Volume (acre ft) - Vsf
		5.9	2.0	0.65	0.64	0.20	0.38	0.24	1.5	0.36

Areas (acre) - Ai	Runoff Coefficient (Ci)
2.4 5.9	0.15 0.85
Total Area (acres)	8.3
Cw	0.65



DETENTION BASIN SIZING:

Detention Basin Water Depth (ft): 1 Detention Basin Freeboard (ft): 1.5 Detention Basin Side Slope - z: 2

	Elevation	Area	Length	Width	Inc. Volume	Total Volume
+	(ft)	(acres)	(ft)	(ft)	(acre-ft.)	(acre-ft.)
Bottom of	1000	0.335	148.0	98.7		0.00
	1000				0.35	
Basin	1001	0.363	154.0	102.7		0.35
W.S.E.	1001	0,000			0.58	
- (D)	1002.5	0.407	163.0	108.7		0.93
Top of Basin						

^{*} Detention Basin Dimension could vary due to Site Layout



DETENTION UNITS SIZING - ALTERNATIVE B

Visalia Civic Center Expansion PROJECT:

COMP. BY: A.D.

DATE:

9/17/2007

JOB NO: **DESCRIPTION:** Detention Units Sizing (ALTERNATIVE B)

180406V1

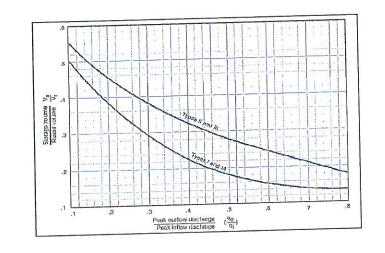
CHKD. BY:

DATE:

AREA 2 (EAST OF BURKE ST.)

Existing Condition Flow (cfs) - Qo	Developed Condition Flow (cfs) - Qi	Contributing Area (acres) - A	P (in)	Weigthed Runoff Coefficient (Cw)	Inflow Runoff Volume (acre- ft) - Vr	Ratio (Qo/Qi)	Ratio (Vs/Vr)	Storage Volume (acre- ft) - Vs	Security	Final Storage Volume (acre ft) - Vsf
(0.0)	• ************************************					0.07	0.24	0.86	1.5	1.29
7.7	20.6	34.6	2.0	0.62	3.58	0.37	0.24	1		

Areas (acre) - Ai	Runoff Coefficient (Ci)
11,3	0.15
23.3	0,85
Total Area (acres)	34.6
Cw	0.62



DETENTION BASIN SIZING:

Detention Basin Water Depth (ft): Detention Basin Freeboard (ft):

1 1.5

Detention Basin Side Slope - z:

2

	Elevation	Area	Length	Width	Inc. Volume	Total Volume
-	(ft)	(acres)	(ft)	(ft)	(acre-ft.)	(acre-ft.
	1000	1.237	284.3	189.6		0.00
Bottom of	1000	1.207			1.26	
Basin	1001	1,290	290.3	193.6		1.26
W.S.E.	1001	1.200			2.00	
Top of Basin	1002.5	1.371	299.3	199.6		3.26

^{*} Detention Basin Dimension could vary due to Site Layout



BIORETENTION UNITS SIZING - ALTERNATIVE A

Visalia Civic Center Expansion PROJECT:

COMP. BY: A.D.

DATE:

9/17/2007

JOB NO: **DESCRIPTION:** Detention Units Sizing (ALTERNATIVE A)

180406V1

CHKD. BY:

DATE:

AREA 1 (WEST OF BURKE ST.) - NORTHERN PORTION

Total Design Runoff Volume (Acre-ft - ft ³):	0.5	21,780
--	-----	--------

Number of Locations to be Installed:

* Number of Bioretention Unit per Developed Block 3

Design Runoff Volume per Unit (ft³/Location): 7,260

6.0 Ponding Water Depth (in - ft): Mulch Depth (in - ft):

2.5

* 6 inchs Maximum Ponding Depth

0.50 0.21

* 2 - 3 inches

4.0

* 2.5 ft Minimum Soil Depth - 4 ft Maximum Soil Depth * 0.5 in/hr Minimum Soil Infiltration Rate (Sand - 1.75 in/hr) - If Lower, Need to Install Underdrain

Planting Soil Depth (ft): 0.50 Soil Infiltration Rate (in/hr):

60.0 Dewatering Time (hr):

* Dewatering Time between 48 & 72 Hours

Bioretention Surface Area (ft²):

2,596

* 15 ft Minimum Width

* Bioretention Dimension could vary due to Site Layout

Bioretention Design Width (ft): Bioretention Design Length (ft): 36 72

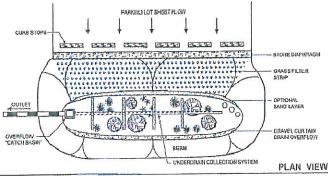
* 40 ft Minimum Length (L =+/- 2*W)

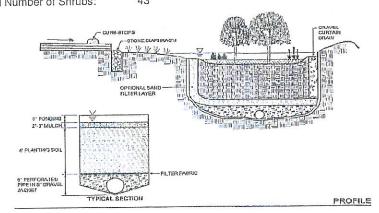
Approximate Number of Trees & Shrubs:

60

Total Number of Trees: Total Number of Shrubs: 17 43

FARKING LOT SHEET FLOW CURB STOPS





Reference:

California Stormwater Quality Association - Stormwater Best Management Practice Handbook (New Development and Redevelopment)



BIORETENTION UNITS SIZING - ALTERNATIVE A

PROJECT:

Visalia Civic Center Expansion

COMP. BY: A.D.

DATE: DATE: 9/17/2007

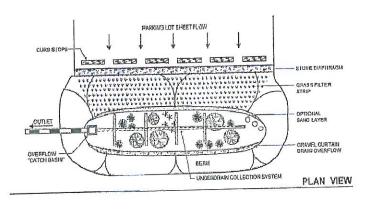
JOB NO:

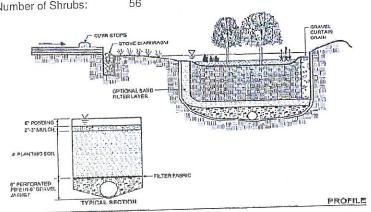
CHKD. BY: 180406V1

DESCRIPTION: Detention Units Sizing (ALTERNATIVE A)

AREA 2 (EAST OF BURKE ST.)

Total Design Runoff Volume (Acre-ft - ft ³):	2.4	104,544			-
Number of Locations to be Installed:	11		* Number of Bioretention Unit per Develo	ped Bloc	K
Design Runoff Volume per Unit (ft ³ /Location):	9,504				
Ponding Water Depth (in - ft): Mulch Depth (in - ft): Planting Soil Depth (ft): Soil Infiltration Rate (in/hr):	6.0 2.5 4.0 0.50	0.50 0.21	 6 inchs Maximum Ponding Depth 2 - 3 inches 2.5 ft Minimum Soil Depth - 4 ft Maximu 0.5 in/hr Minimum Soil Infiltration Rate 	um Soil D (Sand - 1	epth .75 in/hr) - If Lower, Need to Install Underdrain
Dewatering Time (hr):	60.0		* Dewatering Time between 48 & 72 Hou	urs	
Bioretention Surface Area (ft ²):	3,398				Lucyandra to Cita Lavout
Bioretention Design Width (ft): Bioretention Design Length (ft):	41 82		* 15 ft Minimum Width * 40 ft Minimum Length (L =+/- 2*W)		* Bioretention Dimension could vary due to Site Layout
Approximate Number of Trees & Shrubs:	78		Total Number of Trees: Total Number of Shrubs:	22 56	of Flow





California Stormwater Quality Association - Stormwater Best Management Practice Handbook (New Development and Redevelopment)



BIORETENTION UNITS SIZING - ALTERNATIVE B

Visalia Civic Center Expansion PROJECT:

COMP. BY: A.D.

DATE:

9/17/2007

JOB NO:

180406V1

CHKD. BY:

DATE:

DESCRIPTION: Detention Units Sizing (ALTERNATIVE B)

AREA 1 (WEST OF BURKE ST.) - NORTHERN PORTION

Total Design Runoff Volume (Acre-ft - ft ³):	0.5	21,780

Number of Locations to be Installed:

* Number of Bioretention Unit per Developed Block

Design Runoff Volume per Unit (ft³/Location): 7,260

6.0 Ponding Water Depth (in - ft): 2.5 Mulch Depth (in - ft):

0.50 0.21 * 6 inchs Maximum Ponding Depth

4.0 Planting Soil Depth (ft):

* 2 - 3 inches

0.50

60.0

3

* 2.5 ft Minimum Soil Depth - 4 ft Maximum Soil Depth * 0.5 in/hr Minimum Soil Infiltration Rate (Sand - 1.75 in/hr) - If Lower, Need to Install Underdrain

Soil Infiltration Rate (in/hr):

* Dewatering Time between 48 & 72 Hours

Dewatering Time (hr):

2,596 Bioretention Surface Area (ft²):

Bioretention Design Width (ft): 36 72 Bioretention Design Length (ft):

* 15 ft Minimum Width * 40 ft Minimum Length (L =+/- 2*W) * Bioretention Dimension could vary due to Site Layout

Approximate Number of Trees & Shrubs:

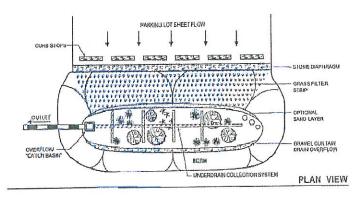
60

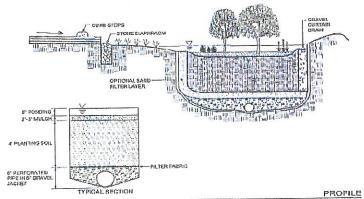
Total Number of Trees:

17

Total Number of Shrubs:

43





Reference:

California Stormwater Quality Association - Stormwater Best Management Practice Handbook (New Development and Redevelopment)



BIORETENTION UNITS SIZING - ALTERNATIVE B

PROJECT: 180406V1

JOB NO:

Visalia Civic Center Expansion

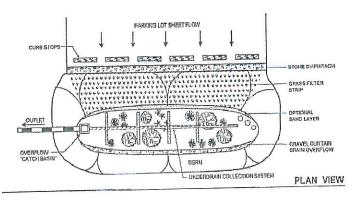
COMP. BY: A.D. CHKD. BY:

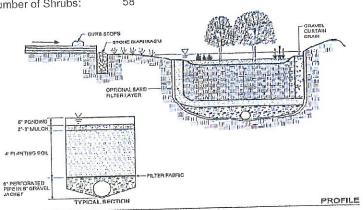
DATE: DATE: 9/17/2007

DESCRIPTION: Detention Units Sizing (ALTERNATIVE B)

AREA 2 (EAST OF BURKE ST.)

Total Design Runoff Volume (Acre-ft - ft ³):	2.5	108,900			
Number of Locations to be Installed:	11		* Number of Bioretention Unit per Develo	ped Block	
Design Runoff Volume per Unit (ft ³ /Location):	9,900				
Ponding Water Depth (in - ft): Mulch Depth (in - ft): Planting Soil Depth (ft): Soil Infiltration Rate (in/hr):	6.0 2.5 4.0 0.50	0.50 0.21	* 6 inchs Maximum Ponding Depth * 2 - 3 inches * 2.5 ft Minimum Soil Depth - 4 ft Maximu * 0.5 in/hr Minimum Soil Infiltration Rate	um Soil De (Sand - 1.	epth .75 in/hr) - If Lower, Need to Install Underdrain
Dewatering Time (hr):	60.0		* Dewatering Time between 48 & 72 Hor	urs	
Bioretention Surface Area (ft²):	3,539				and you due to Site Layout
Bioretention Design Width (ft): Bioretention Design Length (ft):	42 84		* 15 ft Minimum Width * 40 ft Minimum Length (L =+/- 2*W)		* Bioretention Dimension could vary due to Site Layout
Approximate Number of Trees & Shrubs:	81		Total Number of Trees: Total Number of Shrubs:	23 58	area artificati
					ATTEN AT INCOME.





California Stormwater Quality Association - Stormwater Best Management Practice Handbook (New Development and Redevelopment)



GRASSY SWALE DESIGN - ALTERNATIVE A

PROJECT:

Visalia Civic Center Expansion COMP. BY: A.D.

DATE:

9/17/2007

JOB NO: DESCRIPTION:

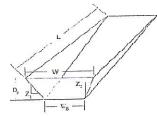
CHKD. BY: 180406V1 Grassy Swale Design (ALTERNATIVE A)

DATE:

AREA 1 (WEST OF BURKE ST.) - NORTHERN & SOUTHERN PORTION

Manning's - n: Bottom Width (ft): Side Slope - z: Longitudinal Slope - S (ft/ft): Water Depth - h (ft): Length of Swale - L (ft): Design Flow - Q (cfs):	0.25 4.0 3.0 0.01 0.33 150 0.05	 Manning "n" value of 0.25 is typical for grass 6" high 4 feet Minimum Bottom Width Minimum Side Slope, z=3 Maximum Slope of 0.025 Maximum Design Depth, 0.33 ft
Calculated Flow - Q (cfs): Flow Area - A (ft²) Wetted Perimeter - P (ft): Top Width - W (ft): Velocity - V (ft/s): Hydraulic Residence Time - t (min):	0.41 1.65 6.09 5.98 0.25 10.06	* Minimum Residence Time, 10 min





Dimensional view of swale impoundment area.

Notation: L = Length of swale improvadament area per check dain (it) (b) \mathbb{L}_{5} = Depth of check dain (it) \mathbb{L}_{5} = Depth of check dain (it) \mathbb{L}_{5} = Detton spee of swale furth \mathbb{L}_{5} = Detton and \mathbb{L}_{5} = Retton and \mathbb{L}_{5} = Retton in the \mathbb{L}_{5} retton \mathbb{L}_{5} = Retton in the \mathbb{L}_{5} retton of lorizontal to vertical cherge in swale side stope (it.ii) \mathbb{L}_{12} = Ratio of lorizontal to vertical cherge in swale side stope (it.ii)

Reference:

California Stormwater Quality Association - Stormwater Best Management Practice Handbook (New Development and Redevelopment)



GRASSY SWALE DESIGN - ALTERNATIVE A

PROJECT:

Visalia Civic Center Expansion COMP. BY: A.D.

CHKD. BY:

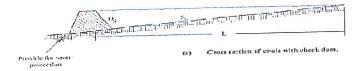
DATE: DATE: 9/17/2007

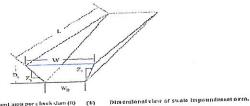
JOB NO: DESCRIPTION:

180406V1 Grassy Swale Design (ALTERNATIVE A)

AREA 2 (EAST OF BURKE ST.)

Manning's - n: Bottom Width (ft): Side Slope - z: Longitudinal Slope - S (ft/ft): Water Depth - h (ft): Length of Swale - L (ft): Design Flow - Q (cfs):	0.25 4.0 3.0 0.01 0.33 150 0.07	 Manning "n" value of 0.25 is typical for grass 6" high 4 feet Minimum Bottom Width Minimum Side Slope, z=3 Maximum Slope of 0.025 Maximum Design Depth, 0.33 ft
Calculated Flow - Q (cfs): Flow Area - A (ft²) Wetted Perimeter - P (ft): Top Width - W (ft): Velocity - V (ft/s): Hydraulic Residence Time - t (min):	0.41 1.65 6.09 5.98 0.25 10.06	* Minimum Residence Time, 10 min





Motation:

L = Largill of ywale ingoverdment area per check dam (ii) [ii)

L = Largill of check dam (ii)

S_0 = Betten alpeof swelc (iii)

W = Top width of check dam (ii)

W_0 = Ration width of check dam (ii)

Z_12 = Ration of the stronator in westfall change in swale side alope (init)

Reference:

California Stormwater Quality Association - Stormwater Best Management Practice Handbook (New Development and Redevelopment)



GRASSY SWALE DESIGN - ALTERNATIVE B

PROJECT:

Visalia Civic Center Expansion COMP. BY: A.D.

180406V1

CHKD. BY:

DATE: DATE:

9/17/2007

JOB NO: DESCRIPTION:

Grassy Swale Design (ALTERNATIVE B)

AREA 1 (WEST OF BURKE ST.) - NORTHERN & SOUTHERN PORTION

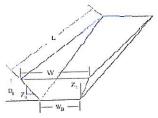
Manningly n	0.25	* Manning "n" value of 0.25 is typical for grass 6" high
Manning's - n: Bottom Width (ft):	4.0	* 4 feet Minimum Bottom Width
Side Slope - z:	3.0	* Minimum Side Slope, z=3
Longitudinal Slope - S (ft/ft):	0.01	* Maximum Slope of 0.025
Water Depth - h (ft):	0.33	* Maximum Design Depth, 0.33 ft
Malei Debili ii (ii).	150	

150 Length of Swale - L (ft): 0.05 Design Flow - Q (cfs):

0.41 Calculated Flow - Q (cfs): 1.65 Flow Area - A (ft2) 6.09 Wetted Perimeter - P (ft): 5.98 Top Width - W (ft): 0.25 Velocity - V (ft/s):

Hydraulic Residence Time - t (min): 10.06 * Minimum Residence Time, 10 min





Dimensional view of swale impoundment area.

Notation:

L = Length of swale impoundment area per clicck dam (ft) (h)

5 = Depth of check dam (ft)

5 = Bettom supe of swale (turn)

V = Top which of leteck dam (ft)

V = Estion which of check dam (ft)

Z = Ratio of horizontal to vertical change in swale side slope (futt)

Reference:

California Stormwater Quality Association - Stormwater Best Management Practice Handbook (New Development and Redevelopment)



GRASSY SWALE DESIGN - ALTERNATIVE B

PROJECT:

Visalia Civic Center Expansion COMP. BY: A.D.

CHKD. BY:

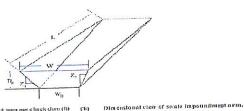
DATE: DATE: 9/17/2007

JOB NO: DESCRIPTION: 180406V1 Grassy Swale Design (ALTERNATIVE B)

AREA 2 (EAST OF BURKE ST.)

Manning's - n: Bottom Width (ft): Side Slope - z: Longitudinal Slope - S (ft/ft): Water Depth - h (ft): Length of Swale - L (ft): Design Flow - Q (cfs):	0.25 4.0 3.0 0.01 0.33 150 0.07	 Manning "n" value of 0.25 is typical for grass 6" high 4 feet Minimum Bottom Width Minimum Side Slope, z=3 Maximum Slope of 0.025 Maximum Design Depth, 0.33 ft
Calculated Flow - Q (cfs): Flow Area - A (ft²) Wetted Perimeter - P (ft): Top Width - W (ft): Velocity - V (ft/s): Hydraulic Residence Time - t (min):	0.41 1.65 6.09 5.98 0.25 10.06	* Minimum Residence Time, 10 min





 $\begin{array}{ll} MotaHon; \\ L_1 & Length of swale impoundment area per check dam (II) \\ L_2 & Repths of check dam (II) \\ S_3 & Batton sipe of swale (IIII) \\ W & The shell of check dam (II) \\ W_2 & Retiron width of check dam (II) \\ W_3 & Retiron width of check dam (II) \\ W_4 & Retiron width of check dam (III) \\ W_4 & Retiron width of check dam (III) \\ W_4 & Retiron width of check dam (III) \\ W_5 & Retiron width of check dam (III) \\ W_6 & Retiron width of check dam (III) \\ W_8 & Retiron width of check dam (III) \\ W_9 & Retiron width of check dam (III) \\ W_9 & Retiron width of check dam (III) \\ W_{10} & Retiron width of check dam (III) \\ W_{11} & Retiron width of check dam (III) \\ W_{12} & Retiron width of check dam (III) \\ W_{13} & Retiron width of check dam (III) \\ W_{14} & Retiron width of check dam (III) \\ W_{15} & Retiron width of check dam (III) \\ W_{$

Reference:

California Stormwater Quality Association - Stormwater Best Management Practice Handbook (New Development and Redevelopment)



LID DESIGN SUMMARY (ALTERNATIVE A)

PROJECT: Visalia Civic Center Expansion

COMP. BY: A.D.

DATE:

9/17/2007

JOB NO:

180406V1

CHKD. BY:

DESCRIPTION: LID Design Summary (ALTERNATIVE A)

AREA 1 (WEST OF BURKE ST.) - NORTHERN & SOUTHERN PORTION

Water Quality - Volume Based (Northern Portion):		
Total 85th Percentile Runoff Volume - V (Acre-ft): Number of Locations to Treat:	3.3 3	
Design 85th Percentile Runoff Volume - V (Acre-ft/Location):	1.1	

Bioretention Basin:

Volume of Bioretention Basin (Acre-ft): Number of Locations to be Installed:	0.5 3
Volume of Bioretention Basin per Location (ft ³ /Location):	7,260
	60
Dewatering Time (hr):	36
Bioretention Design Width (ft): Bioretention Design Length (ft):	72
Total Number of Trees:	17
Total Number of Shrubs:	43

Detention Basin:

Flow to Detain (cfs):	3.2
Volume of Detention Basin (Acre-ft):	0.36
Heigth of Basin (ft):	1
Freeboard (ft):	1.5
Side Slopes:	2

Water Quality - Flow Based (Northern & Southern Portion):

Total 85th Percentile Runoff Flow - Q (cfs):	0.1
Number of Locations to Treat:	3
Design 85th Percentile Runoff Volume - V (Acre-ft/Location):	0.05

Grassy Swale:

Bottom Width (ft): Side Slope - z:	4 3
Longitudinal Slope - S (ft/ft):	0.01
Water Depth - h (ft):	0.33
Length of Swale - L (ft):	150
Design Flow - Q (cfs):	0.05
Calculated Flow - Q (cfs):	0.41
Hydraulic Residence Time - t (min):	10.06



LID DESIGN SUMMARY (ALTERNATIVE A)

Visalia Civic Center Expansion PROJECT:

COMP. BY: A.D. CHKD. BY:

DATE: DATE: 9/17/2007

180406V1 JOB NO:

DESCRIPTION: LID Design Summary (ALTERNATIVE A)

AREA 2 (EAST OF BURKE ST.)

Water Quality - Volume Based:

Total 85th Percentile Runoff Volume - V (Acre-ft):	18.1
Total 85th Percentile Autor Volume V (Nors Ny	11
Number of Locations to Treat: Design 85th Percentile Runoff Volume - V (Acre-ft/Location):	1.6

Bioretention Basin:

Volume of Bioretention Basin (Acre-ft): Number of Locations to be Installed:	2.4 11
Volume of Bioretention Basin per Location (ft3/Location):	9,504 60
Dewatering Time (hr): Bioretention Design Width (ft):	41 82
Bioretention Design Length (ft): Total Number of Trees:	22
Total Number of Shrubs:	56

Detention Basin:

Heigth of Basin (ft): Freeboard (ft):	1.25 1 1.5
Side Slopes:	2

Water Quality - Flow Based:

Total 85th Percentile Runoff Flow - Q (cfs):	8.0
Total optil referring ration 1900 4 (1-1)	11
Number of Locations to Treat:	0.07
Design 85th Percentile Runoff Volume - V (Acre-ft/Location):	0.07

Grassy Swale:

Bottom Width (ft):	4
Side Slope - z:	3
Longitudinal Slope - S (ft/ft):	0.01
Water Depth - h (ft):	0.33
Length of Swale - L (ft):	150
Design Flow - Q (cfs):	0.05
Calculated Flow - Q (cfs):	0.41
Hydraulic Residence Time - t (min):	10.06



LID DESIGN SUMMARY (ALTERNATIVE B)

Visalia Civic Center Expansion PROJECT:

COMP. BY: A.D. CHKD, BY:

DATE:

DATE:

9/17/2007

JOB NO:

180406V1

DESCRIPTION: LID Design Summary (ALTERNATIVE B)

AREA 1 (WEST OF BURKE ST.) - NORTHERN & SOUTHERN PORTION

Water Quality - Volume Based (Northern Portion):		Water Quality - Flow Based (Northe	rn & Southern Portion):	
Total 85th Percentile Runoff Volume - V (Acre-ft): Number of Locations to Treat: Design 85th Percentile Runoff Volume - V (Acre-ft/Location):	3.3 3 1.1	Total 85th Percentile Runoff Flow - Q Number of Locations to Treat: Design 85th Percentile Runoff Volume		0.1 3 0.05
Bioretention Basin:	0.5	Grassy Swale: Bottom Width (ft):	4	
Volume of Bioretention Basin (Acre-ft): Number of Locations to be Installed:	3	Side Slope - z:	3	
Volume of Bioretention Basin per Location (ft ³ /Location):	7,260	Longitudinal Slope - S (ft/ft):	0.01	
Dewatering Time (hr):	60	Water Depth - h (ft):	0.33	
Bioretention Design Width (ft):	36	Length of Swale - L (ft):	150 0.05	
Bioretention Design Length (ft):	72	Design Flow - Q (cfs):	0.41	
Total Number of Trees:	17 43	Calculated Flow - Q (cfs): Hydraulic Residence Time - t (min):	10.06	
Total Number of Shrube:	40	Tiyaraano Tababaha Time		

Detention Basin:

Total Number of Shrubs:

Flow to Detain (cfs):	3.2
Volume of Detention Basin (Acre-ft):	0.36
Heigth of Basin (ft):	1
Freeboard (ft):	1.5
Side Slopes:	2



LID DESIGN SUMMARY (ALTERNATIVE B)

Visalia Civic Center Expansion PROJECT:

COMP. BY: A.D.

DATE:

9/17/2007

JOB NO: DESCRIPTION: LID Design Summary (ALTERNATIVE B)

180406V1

CHKD. BY:

DATE:

AREA 2 (EAST OF BURKE ST.)

Water Quality - Volume Based: Total 85th Percentile Runoff Volume - V (Acre-ft): Number of Locations to Treat: Design 85th Percentile Runoff Volume - V (Acre-ft/Location):	18.7 11 1.7	Water Quality - Flow Based: Total 85th Percentile Runoff Flow - Q (cfs): Number of Locations to Treat: Design 85th Percentile Runoff Volume - V (Acre-ft/Location):		0.8 11 0.07
Bioretention Basin: Volume of Bioretention Basin (Acre-ft): Number of Locations to be Installed: Volume of Bioretention Basin per Location (ft³/Location): Dewatering Time (hr): Bioretention Design Width (ft): Bioretention Design Length (ft): Total Number of Trees: Total Number of Shrubs:	2.5 11 9,900 60 42 84 23 58	Grassy Swale: Bottom Width (ft): Side Slope - z: Longitudinal Slope - S (ft/ft): Water Depth - h (ft): Length of Swale - L (ft): Design Flow - Q (cfs): Calculated Flow - Q (cfs): Hydraulic Residence Time - t (min):	4 3 0.01 0.33 150 0.05 0.41 10.06	

Detention Basin:

Flow to Detain (cfs):	12.9
Volume of Detention Basin (Acre-ft):	1.29
Heigth of Basin (ft):	1
Freeboard (ft):	1.5
Side Slopes:	2