Attachment 8
Benefits and Cost Analysis

8.1 Introduction

The Sonoma County Water Agency hired ESA PWA of San Francisco and ECONorthwest of Portland Oregon to perform benefit and costs analyses of the Proposition 1E grant application for City Watersheds of Sonoma Valley Phase 1 project.

Part D1, Flood Damage Reduction Benefits, was prepared by ESA PWA and begins on the next page. Following that, sections D2, Non-Monetized, and D3, Monetized Benefit Analysis, were prepared by ECONorthwest. The final section, D4, Project Benefits and Cost Summary, were prepared by the Sonoma County Water Agency.

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memorandum

date January 30, 2013

to Kent Gylfe, Sonoma County Water Agency
Greg Guensch, Sonoma County Water Agency

from Betty Andrews, PE, ESA PWA
Carlos Diaz, PE, ESA PWA

subject Sonoma Valley City Watersheds Proposition 1E Grant Proposal: Flood Damage Reduction Benefits

This memorandum describes work performed to support a Proposition 1E Stormwater Flood Management grant application for the Sonoma Valley City Watersheds Project. Specific components of the project included in this analysis of anticipated flood damage reduction benefits include detention/retention facilities at the Montini Open Space parcel and a culvert replacement at West MacArthur Street and associated channel modifications along Fryer Creek.

The City of Sonoma's Storm Drain Master Plan (SDMP) hydrologic and hydraulic model was utilized to assess benefits associated with the project for use in quantifying and monetizing flood damage reduction (FDR) benefit estimates. Model development and results are presented below.

1. Background

The Sonoma County Water Agency (SCWA) retained the services of ESA PWA to assist with technical analyses and materials needed to support a Proposition 1E grant application for the Sonoma Valley City Watersheds Project. The project incorporates several components including, but not limited to, a detention/retention basin, culvert replacement, and channel modifications along Fryer Creek aimed at providing multiple benefits including flood management, groundwater recharge, water quality improvements, and ecosystem restoration benefits.

The City of Sonoma Storm Drain Master Plan hydrologic and hydraulic model was used to characterize and assess project components and project benefits on flooding for the purposes of developing a flood damage reduction benefit estimate. The City's existing model was developed using DHI's MIKE v2009 software and incorporates the City storm drain infrastructure, Fryer and Nathanson Creeks, and associated streets, floodplain, and surface flooding. SCWA provided the model for use in developing the grant application.

The existing model was updated to develop additional baseline scenarios under different return period events, needed for the FDR analysis, and to simulate the effect of project components for several return period events. Model updates and results are presented in the following sections.

2. Model Development

This section describes the model development process and its use for the grant application. The City's MIKE model developed for the purposes of its SDMP was obtained from SCWA. The model was updated to v2012 of the software prior to use in establishing additional baseline scenarios and in developing the project components. The model uses a vertical datum of NAVD88.

The MIKE model incorporates MIKE URBAN for hydrology and storm drain hydraulics, MIKE 11 for one-dimensional channel hydraulics, and MIKE 21 for two-dimensional urban street and floodplain flooding. The City's SDMP model included only 10-year, 25-year, and 100-year events; therefore, the model hydrology was updated to assess several additional return period events.

The model was updated to reflect proposed project components. MIKE URBAN was updated to include the proposed detention basin, and MIKE 11 was updated to include the proposed culvert replacement and associated channel modifications. The following sections describe the hydrology used and the model updates associated with the detention/retention basin and improvements proposed along Fryer Creek and the culvert replacement at W MacArthur Street.

The simulated events included the 5-year, 10-year, 25-year, 100-year, and 200-year events for both existing and with- project conditions.

Model Hydrology

The hydrology used in the MIKE model is developed within MIKE URBAN for subsequent coupling with the MIKE FLOOD (coupled MIKE 11 and MIKE 21) model, which incorporates the one-dimensional channel hydraulics and two-dimensional floodplain and street flooding hydraulics. MIKE URBAN simulates precipitation and rainfall runoff modeling and routing using standard TR-55 hydrological methods. The MIKE URBAN model was updated to include additional rainfall return period events as stated above. No changes were made to the underlying assumptions used in the City's SDMP including watershed delineations, land use and hydrologic soil data, and routing and transform methods.

NOAA Atlas 14 rainfall depths were used in development of the additional return period events and associated flooding, consistent with the methodology used in developing the City's SDMP. The following table summarizes rainfall depths used in updating the model.

Table 1. Summary of rainfall depths used in developing MIKE URBAN hydrology

Rainfall Event	Rainfall Depth (in)
5-year, 24-hour	4
10-year, 24-hour	4.5
25-year, 24-hour	5.5
100-year, 24-hour	7
200-year, 24-hour	7.8

Rainfall depths were distributed using a Type IA distribution consistent with the City of Sonoma SDMP.

Montini Detention/Retention Basin

A detention/retention basin is proposed for the Montini site, located in the upper Fryer Creek watershed, to reduce flooding within Fryer Creek and also provide ancillary benefits for groundwater recharge. Given the sensitivity of the design to site aesthetics and performance, two alternative conceptual grading plans (a 20 AF alternative with larger berms and a 12 AF alternative with minimal berms) were initially developed and evaluated within the model to book end visual impacts while providing sufficient detention storage. It was determined that the 12 AF alternative would have less visual impacts and provided sufficient detention to greatly reduce flooding on Fryer Creek. Only results for the smaller detention alternative are presented herein.

The bottom elevation of the detention basin was set at 95 ft NAVD88, with a maximum water surface elevation of 100 ft NAVD88. Two feet of freeboard was incorporated into the conceptual design, setting the top of basin at a minimum 102 ft NAVD88. All cut slopes were set at 8H:1V to minimize visual impacts and create a rolling feature that integrates with its surroundings. A discharge structure was simulated by setting a series of orifices spaced vertically to establish a stage discharge curve.

The detention basin was simulated within MIKE URBAN by intercepting flow along storm drain Line F-12-3 at Node 988, routing flow through the detention basin using stage-area and stage-discharge curves input into the model, and discharging flow to storm drain Line F-12-3-2 at Node 587. For the purposes of the hydraulic modeling, the detention basin inlet and outlet piping was simulated as 42-inch piping similar to existing piping on Line F-12-3. This pipe sizing will be refined during design to minimize costs while providing the same flood reduction benefits shown herein.

The stage area and stage discharge curves used in the MIKE URBAN model are shown below.

Table 2. Stage-area curve used to characterize detention basin for MIKE modeling

Elevation (NAVD88)	Depth (ft)	Area (ft^2)	Area (acres)	Volume (acre-feet)
95.0	0.0	0	0.0	0.0
95.5	0.5	45,364	1.0	0.3
96.0	1.0	99,963	2.3	1.1
96.5	1.5	104,515	2.4	2.3
97.0	2.0	109,135	2.5	3.5
97.5	2.5	113,824	2.6	4.8
98.0	3.0	118,582	2.7	6.1
98.5	3.5	123,408	2.8	7.5
99.0	4.0	128,302	3.0	9.0
99.5	4.5	133,264	3.1	10.5
100.0	5.0	138,191	3.2	12.0

Table 3. Stage-discharge curve for detention basin for MIKE modeling

Elevation (ft NAVD88)	Depth (ft)	Discharge, Q (cfs)
95.0	0	0.01
95.5	0.5	0.1
96.0	1.0	0.7
96.5	1.5	1.6
97.0	2.0	2.8
97.5	2.5	4.2
98.0	3.0	6.2
98.5	3.5	8.6
99.0	4.0	11.4
99.5	4.5	15.8
100.0	5.0	21.2
101.0	6.0	500.0

Figure 1 shows a conceptual grading plan for the proposed detention basin.

Fryer Creek Channel Upgrades and Culvert Replacement

The existing culvert at West MacArthur Street is perched approximately 2 ft above the thalweg on the inlet and 4 ft on the outlet. This culvert was identified as needing replacement in the City's SDMP, and has also been identified as a critical fish passage barrier on Fryer Creek.

Previous modeling conducted as part of the City's SDMP did not result in the drop in water surface elevations expected from the project. Therefore, some revised assumptions for the culvert and upstream channel configuration were made for the purpose of this analysis. Modeling of this modified culvert replacement concept was conducted with additional cross section modifications to reflect proposed channel excavation needed to restore grade to the channel and remove what appears to be years of deposition upstream of the perched culvert inlet.

The West MacArthur Street culvert, located between stations 28+00 and 28+54, was dropped to match the inverts proposed in the SDMP and increased in size from an existing 5.5'x12.5' box culvert to an 8'x15' box culvert. Additionally cross sections in the MIKE FLOOD model were updated to reflect channel dredging needed to remove accumulated sediments, increase hydraulic capacity of Fryer Creek, and reduce the potential for flooding. (Lowering of the channel bed upstream of MacArthur Street will also likely reduce sediment deposition on the tributary East Fryer Creek, an area that was the site of a sediment removal project by the Sonoma County Water Agency in 2012. No changes in East Fryer Creek were included in the simulations conducted under this effort, however.)

The following table summarizes the proposed channel modifications, existing and proposed thalweg elevations, and estimates of required excavation.

Table 4. Summary of proposed channel cross section modifications and associated dredge volumes.

Creek Stationing [1]	Existing Thalweg Elevation (ft NAVD88)	Proposed Thalweg Elevation (ft NAVD88)	Difference in Cross Sectional Area (ft^2)	Average End Area Volume Calc (ft^3)	Average End Area Volume (yd^3)
16+08	61.09	61.09	0.0		
16+25	61.92	61.05	13.4	113.8	4.2
19+31	61.48	60.34	8.8	3,395.8	125.8
22+68	60.74	59.55	10.8	3,311.9	122.7
23+65	60.19	59.33	6.5	839.3	31.1
23+95	60.63	59.26	24.8	469.7	17.4
25+29	60.29	58.95	26.9	3,466.0	128.4
27+68	60.05	58.39	33.7	7,236.2	268.0
28+00	62.09	58.31	92.9	2,025.2	75.0
28+54	61.99	58.19	97.9	5,152.9	190.8
28+98	58.09	58.09	0.0	2,154.8	79.8
			TOTAL	**28,165.6 1,04**	**3.2**

NOTE: [1] Creek stationing matches City of Sonoma SDMP model stationing.

As shown, a total of 1,043 cubic yards of excavation was estimated for the proposed channel modifications. Model cross sections were updated to reflect the new proposed thalweg elevations and slopes were modified accordingly to minimize steep slopes to the extent practicable.

Attachment A includes existing and proposed cross sections as modeled.

3. Model Results

The model was updated as described and run for both with-project and baseline conditions for the 5-year, 10-year, 25-year, 100-year, and 200-year, 24-hour return period events. The 5-year, 24-hour event was considered the smallest event at which the project has no flood reduction benefit. The 200-year, 24-hour event was selected as a maximum flood event for analysis. It was expected to be a large enough event so that the project would provide no flood reduction benefit as well; however, the project was found to provide flood reduction even in the 200-year, 24-hour event. As a result, the flood benefits analysis will conservatively represent flood benefits, as benefits in events greater than a 100-year event will not be captured.

Baseline Conditions

Figures 2, 3, 4, 5, and 6 show existing flooding conditions in the Fryer Creek watershed under the 5-year, 10-year, 25-year, 100-year, and 200-year, 24-hour return period events. The figures show that a 5- year event is the largest flood event that does not result in flooding along Fryer Creek. Out of bank flooding occurs during the 10-year event, particularly in the area between the West MacArthur Street and Bettencourt Street culverts. Flooding becomes more pronounced in this area and around the Fryer Creek watershed during larger return period events.

For the purpose of the current analysis, the baseline ("without-project") condition is assumed to be most appropriately represented by implementation of the projects recommended in the SDMP. We have not developed new simulation models of the recommended SDMP projects, but rather relied on the analysis presented in the SDMP to describe the baseline conditions. The SDMP analysis assumed implementation of multiple projects, including CIP-1, CIP-4 and CIP-5 in the subwatersheds drained by the mainstem of

Fryer Creek and West Fryer Creek. SDMP Figures 7-6, 7-7, and 7-8 show the baseline conditions for the 10-year, 25-year, and 100-year events.

The proposed project would essentially replace CIP-1 and CIP-5. While CIP-4, enlargement of an existing stormdrain line, also affects the flood conditions shown in the SDMP Figures and modeling results relied upon to describe the baseline conditions, it is assumed that CIP-4 will still be implemented as described in the SDMP and that the reduction in stormdrain flows created by implementation of the proposed project will provide sufficient additional capacity to allow the additional stormdrain flows resulting from the CIP-4 improvement to be contained in the existing stormdrain system. Implementation of CIP-4 is assumed to eliminate the flooding in the upper northwest quadrant along Fano Lane, Robinson Road, and Junipero Serra Drive. That area has therefore been omitted from the comparative analysis of flood benefits. Because the SDMP analysis did not include the 200-year flood event, a conservative assumption has been made by omitting the 200-year flood event from our calculation of relative benefits, though incremental benefits from the proposed project are expected relative to the baseline. Lastly, the baseline and with-project conditions are assumed the same for the 5-year flood event.

With-Project Conditions

Figures 7, 8, 9, and 10 show the with-project flooding conditions in the Fryer Creek watershed under the 10-year, 25-year, 100-year, and 200-year, 24-hour return period events. A 5-year with-project conditions model was not developed since there is no flooding under baseline or existing conditions.

The figures show a significant reduction in flooding as a result of the proposed project components when compared to existing conditions. The projects decrease the severity of flooding in all events analyzed. The following table summarizes peak Fryer Creek inflows at Station 0+00, where the creek daylights behind the Safeway parking lot near W Napa St.

Table 5. MIKE model summary of peak inflow reductions to Fryer Creek resulting from detention basin.

Modeled Scenario	Peak Inflows at Fryer Creek Station 0+00 (cfs)			
	10-yr	25-yr	100-yr	200-yr
Existing Condition	242.2	312.1	359.7	373.8
With-Project	191.3	242.9	332.2	354.6
Peak Flow Reduction (cfs)	50.9	69.2	27.5	19.2

The table above shows that peak flow reductions occur during all return period events simulated. Peak flow reductions are significant for both the 10-year and 25-year events, and slightly less so for the larger 100-year and 200-year events. However, these results indicate that the detention basin is providing benefit to flood reduction even under the 200-year event.

When compared to baseline conditions, the proposed project also shows an incremental reduction in flooding.

4. Flood Damage Reduction Analysis

Maximum flood depth results for the model scenarios analyzed were evaluated for input into the Flood Rapid Analysis model (FRAM) developed by DWR to assess the incremental flood damage reduction benefits provided by the project in comparison to baseline conditions.

For simplicity, the evaluation was limited to the subarea defined as lying between MacArthur Street to the south, Fano Lane to the north, 3rd Street W to the east, and Sonoma Creek to the west but excluding the area that will be affected by implementation of CIP-4, as described in the preceding section. The analysis was limited to flood events at the 100-year level and less, to allow comparison to the existing SDMP modeling results. Both because anticipated incremental project benefits extend beyond the analysis area and the 100-year flood event, these benefits estimates are conservatively low.

For both the baseline and with-project conditions, estimates of flood impacts were developed through visual inspection of the graphical results combined with a query of the model results raster data for flood depths. The effects of flood events with average depths less than 0.1 ft were ignored.

The analysis concludes that the project provides an estimated annual incremental flood damages avoided value of $19183 when compared to baseline conditions (implementation of the SDMP CIP's).

The values shown in Table 6 below were determined from the model results for the existing conditions and with-project condition simulations. The with-project conditions were provided as input to the FRAM analysis.

The FRAM results summary is provided as Attachment B.

Table 6. Structures affected by flooding (input to FRAM)

Property	Type	Units	Typical depth (ft)	Baseline Conditions				12 AF Detention PROJECT			
				5 Yr	10 Yr	25 Yr	100 Yr	5 Yr	10 Yr	25 Yr	100 Yr
		estimated depth (ft):		0	0	0.3	0.4	0	0.05	0.2	0.2
Residential	Urban Res Single Story (No Basement)	# of homes		0	5	31	35	0	2	19	35
		estimated depth (ft):				0.25	0.25				0.25
Commercial	Med Value (assumed)	sq. ft.		0	0	0	32300	0	0	0	29500
Roads	Minor Roads (assumed)	miles		0.00	0.0	0.6	1.3	0.00	0.0	0.5	1.1

*FRAM allows only a single estimated depth value for each flood event. The estimated depth, based on the results shown in the rows above, is applied to the total number of homes in the row below.

5. Conclusions and Recommendations

In support of SCWA's Proposition 1E grant application for the Sonoma Valley City Watersheds Project, the impacts of the proposed project, including detention/retention facilities at the Montini Open Space and a culvert replacement at West MacArthur Street and associated channel modifications along Fryer Creek for flood damage reduction benefits, have been analyzed. The analysis utilized the City of Sonoma's Storm Drain Master Plan (SDMP) hydrologic and hydraulic model to assess benefits associated with the project for use in quantifying and monetizing flood damage reduction (FDR) benefit estimates. Significant flood reduction benefits are realized as a result of the project under all return period events analyzed.

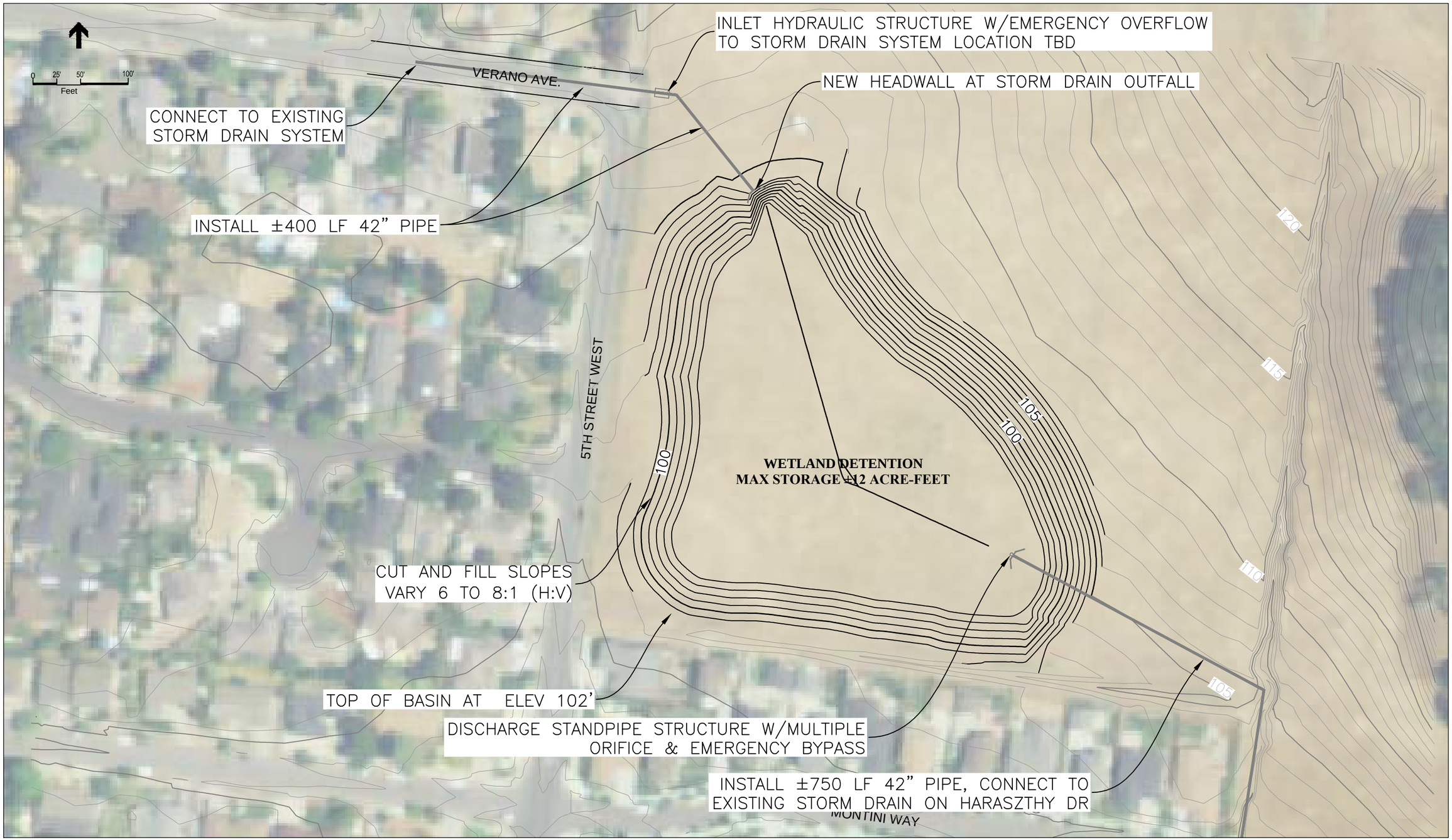
Given that the project provides peak flow reduction even under the larger return period events analyzed, we recommend providing hydraulic control at the detention basin inlet rather than at the point of proposed connection to the storm drain system. This would allow for larger inflows to be attenuated if the detention basin has capacity, while an approach implementing flow control upstream in the storm drain system would require that only certain flows be allowed to enter the detention basin. While this approach would require additional storm drain piping to convey excess flows, it provides for greater operational flexibility and the ability to handle peak flow attenuation above a smaller (e.g., 25-year) flood event.

6. References

Winzler & Kelly. 2011. City of Sonoma Storm Drain Master Plan, May.

7. Attachments

Attachment A. Existing and proposed Fryer Creek cross-sectional data
Attachment B. FRAM spreadsheet results summary



Print Date: 12/26/2012

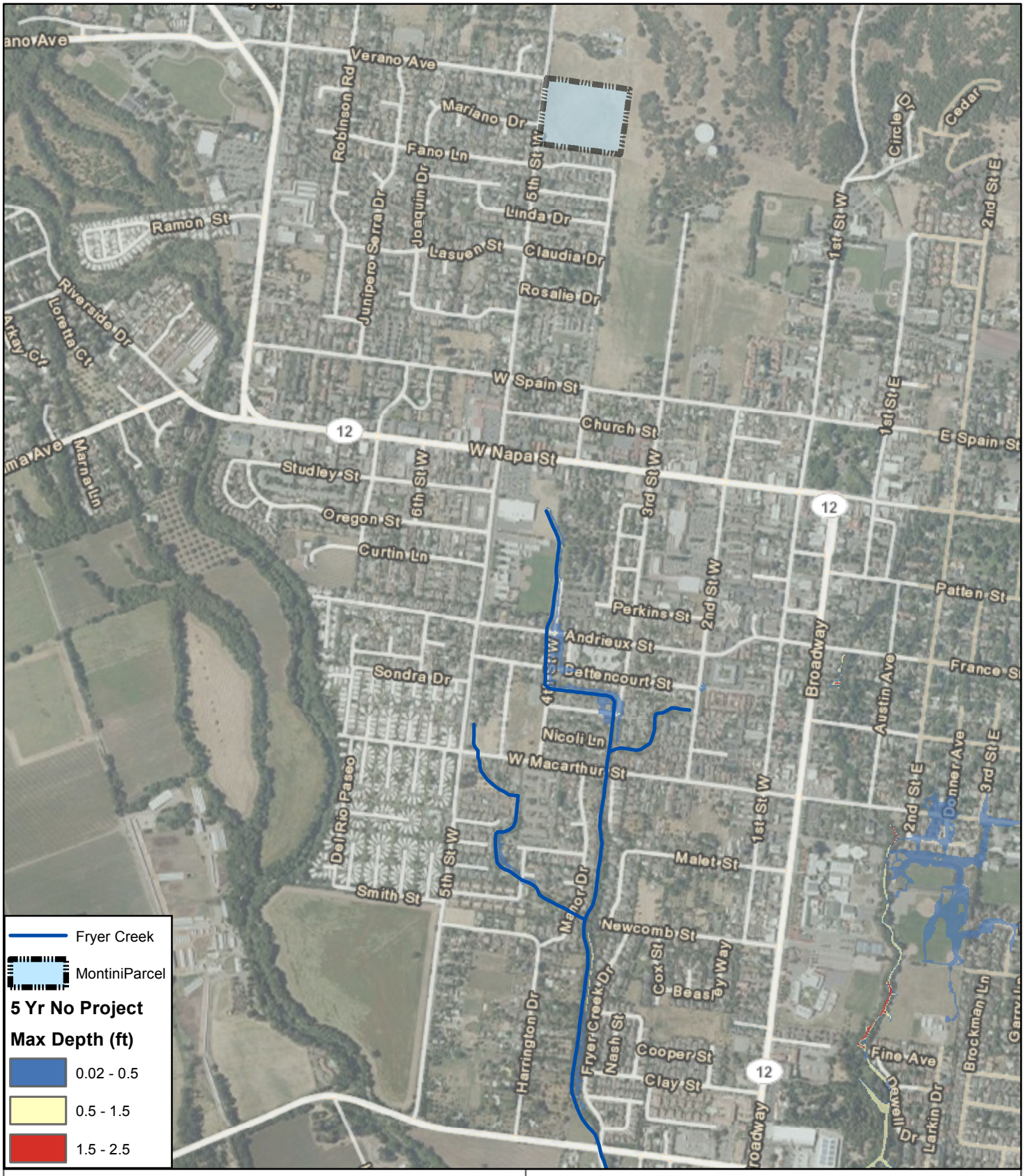
File: K:\projects_2012\2012\0852\00 - Sonoma Valley City Watersheds 1E\09 CAD\Dwgs\Base\XB-MONTINI_LARGE-WETLAND_v3.dwg

SOURCE:
ESA PWA

SONOMA VALLEY CITY WATERSHEDS 1E

Figure 1

LARGE DETENTION WETLAND



Source: MIKE FLOOD results

Figure 2

Sonoma Valley City Watersheds Prop 1E Project

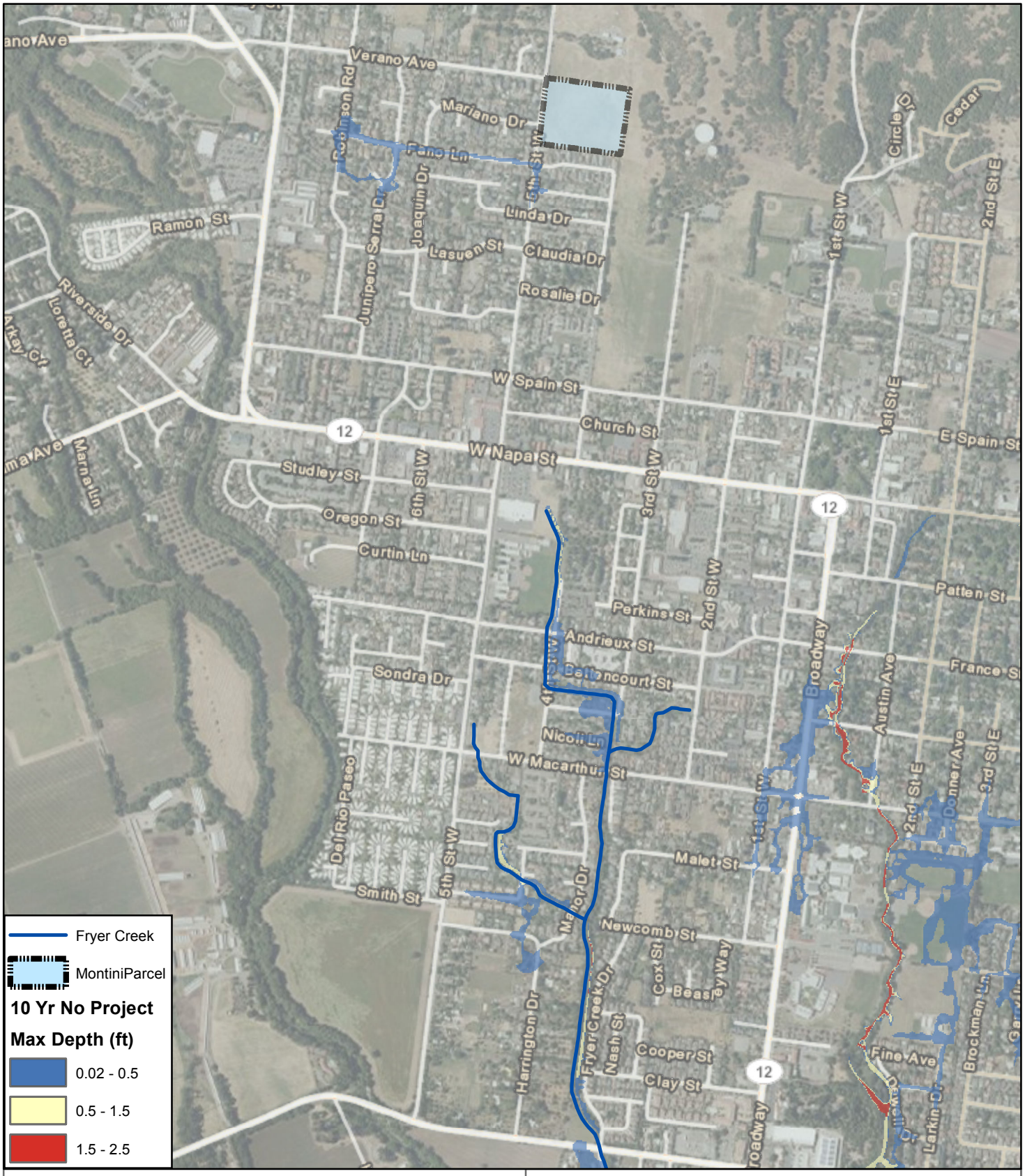
N

0 600 1,200 2,400 Feet

5 Year No Project Maximum Flood Conditions

PWA Ref# - D120852.00

ESA PWA



Source: MIKE FLOOD results

Figure 3

Sonoma Valley City Watersheds Prop 1E Project

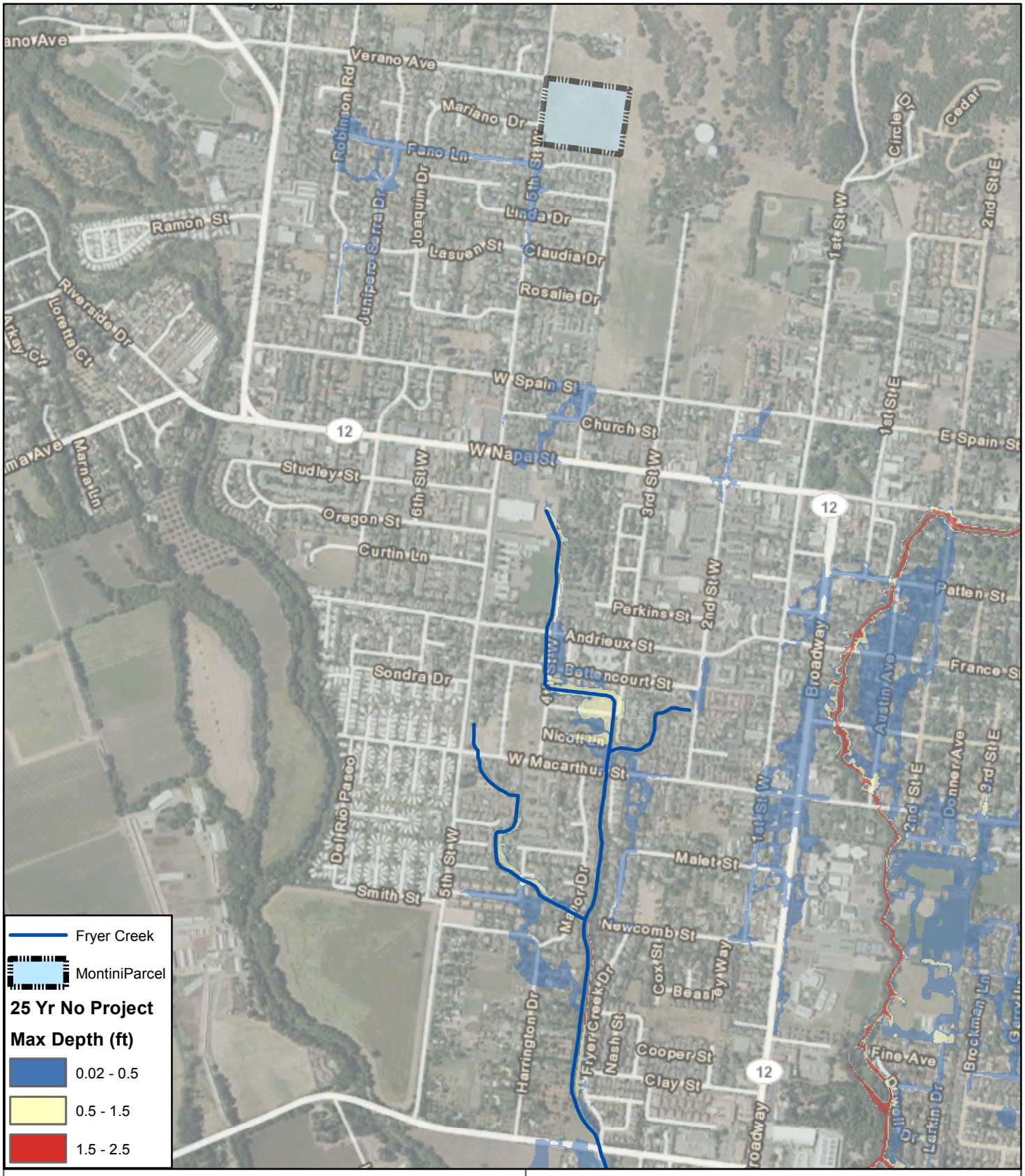
N

0 600 1,200 2,400 Feet

10 Year No Project Maximum Flood Conditions

PWA Ref# - D120852.00

ESA PWA



Source: MIKE FLOOD results

Figure 4

Sonoma Valley City Watersheds Prop 1E Project

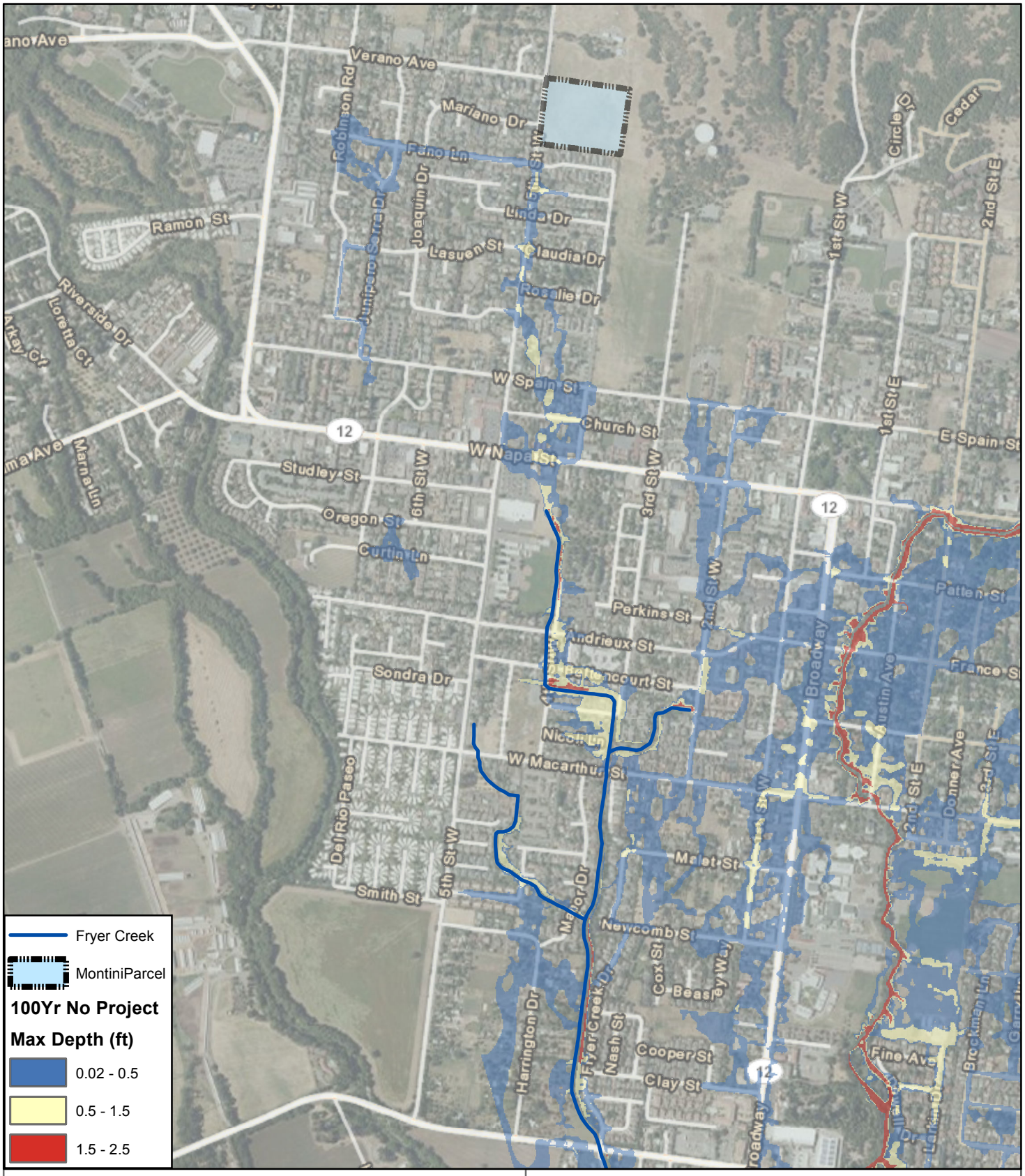
N

0 600 1,200 2,400 Feet

25 Year No Project Maximum Flood Conditions

PWA Ref# - D120852.00

ESA PWA



Source: MIKE FLOOD results

N

0 600 1,200 2,400 Feet

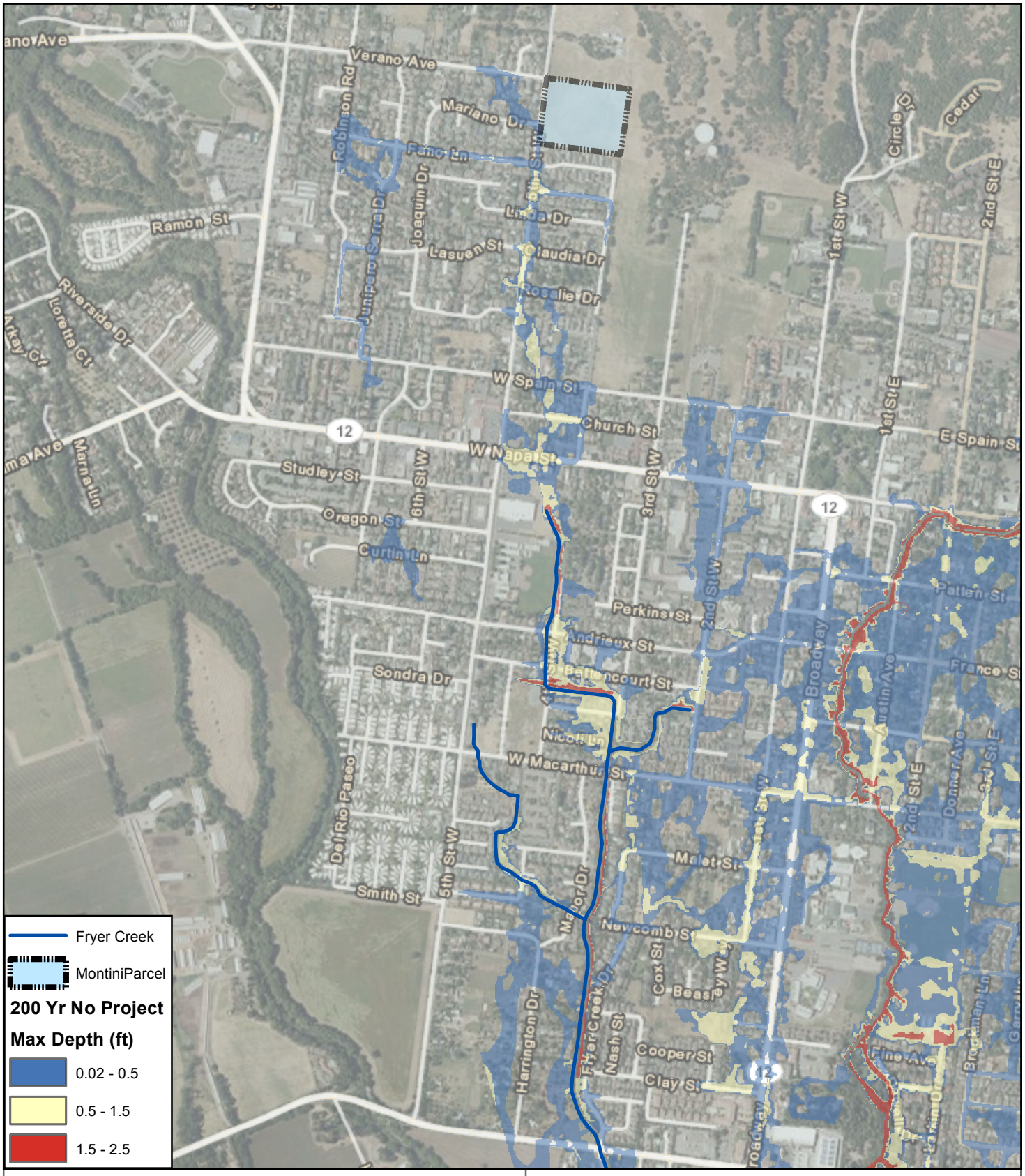
Figure 5

Sonoma Valley City Watersheds Prop 1E Project

100 Year No Project Maximum Flood Conditions

PWA Ref# - D120852.00

ESA PWA



Source: MIKE FLOOD results

N

0 600 1,200 2,400 Feet

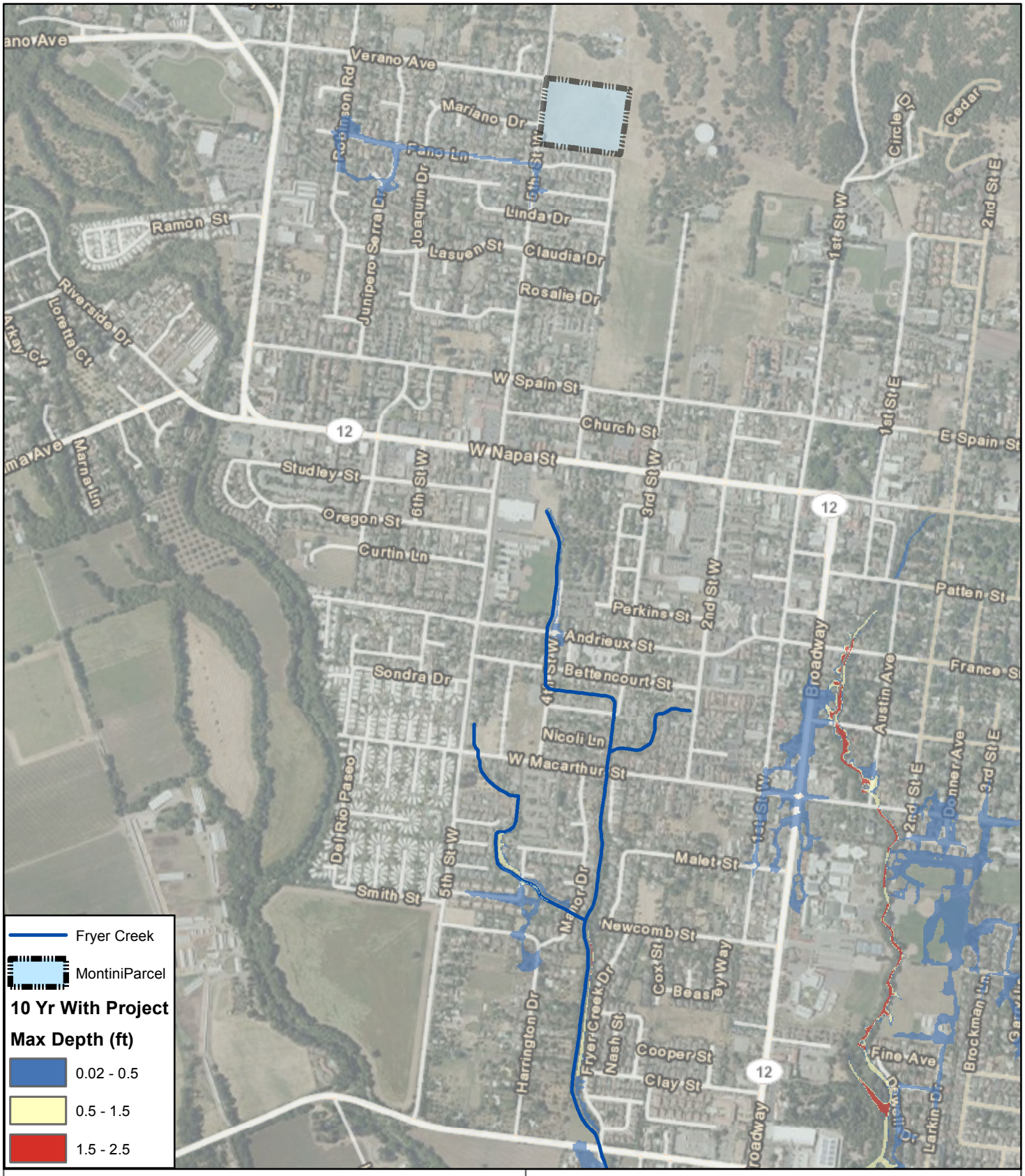
Figure 6

Sonoma Valley City Watersheds Prop 1E Project

200 Year No Project Maximum Flood Conditions

PWA Ref# - D120852.00

ESA PWA



Source: MIKE FLOOD results

Notes: Project results shown are reflective of the culvert replacement on West MacArthur St, channel modifications to Fryer Creek, and a 12 acre-foot detention/retention basin on the Montini parcel.

N

0 600 1,200 2,400 Feet

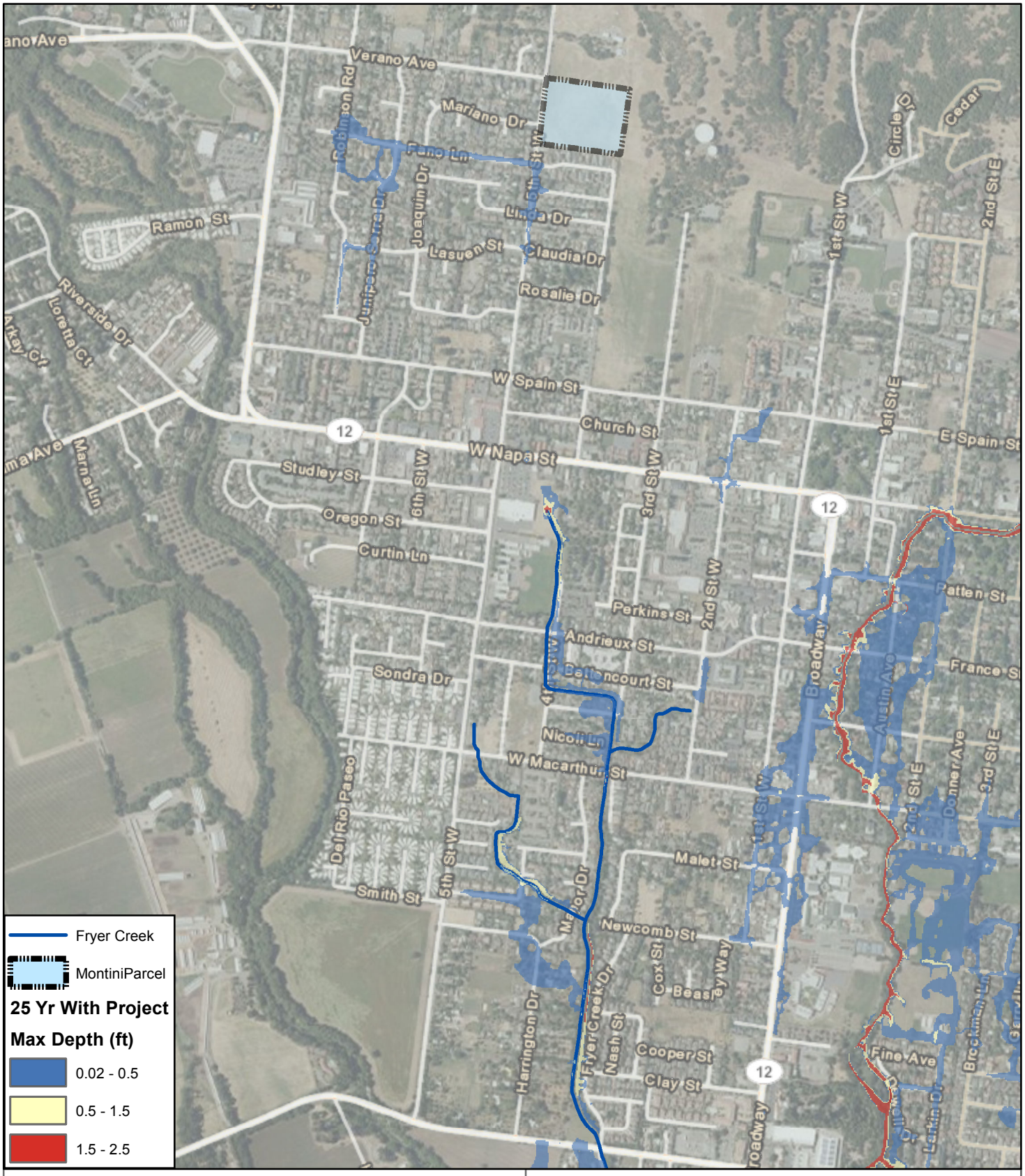
Figure 7

Sonoma Valley City Watersheds Prop 1E Project

10 Year With Project Maximum Flood Conditions

PWA Ref# - D120852.00

ESA PWA



Source: MIKE FLOOD results

Notes: Project results shown are reflective of the culvert replacement on West MacArthur St, channel modifications to Fryer Creek, and a 12 acre-foot detention/retention basin on the Montini parcel.

N

0 600 1,200 2,400 Feet

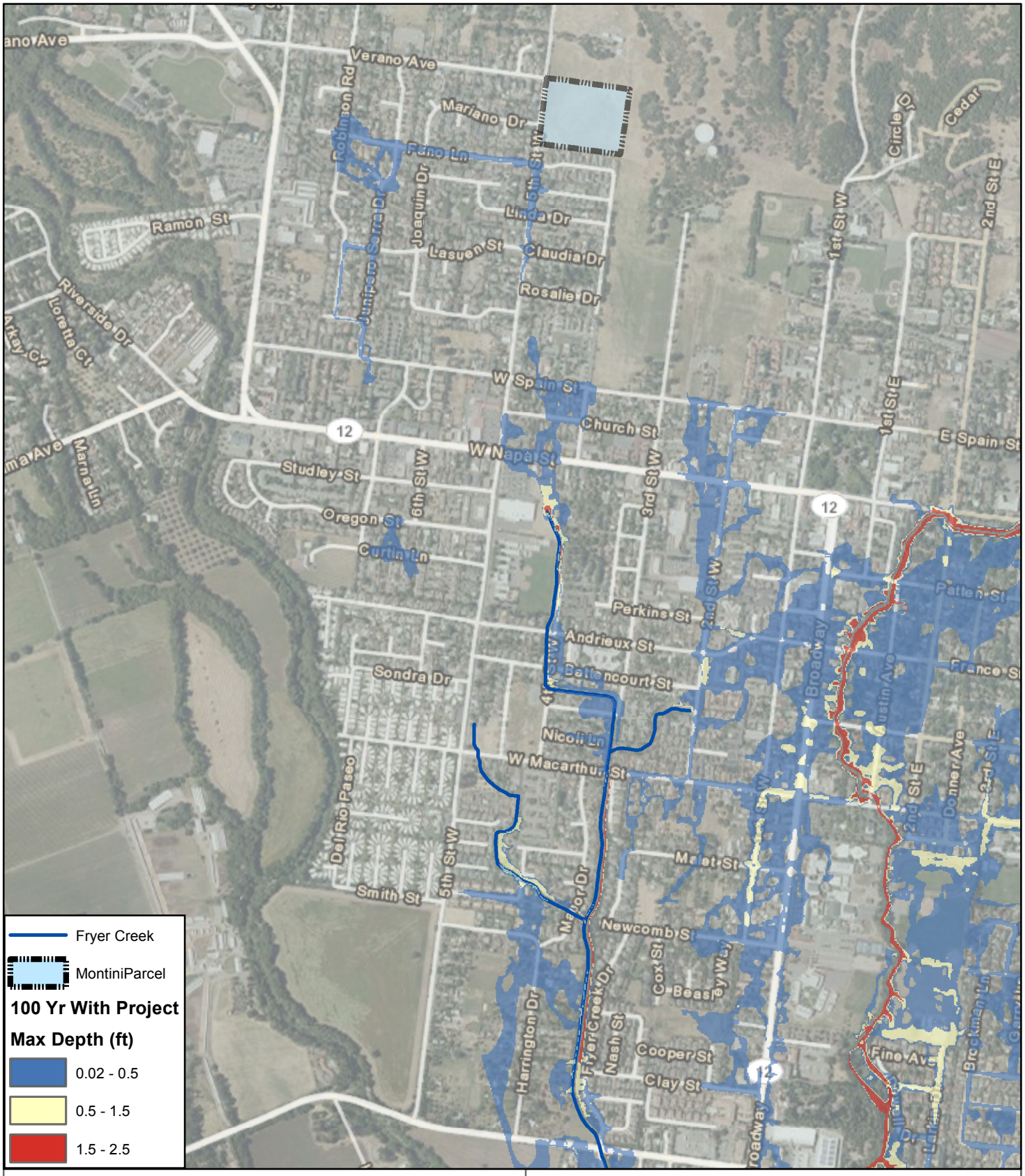
Figure 8

Sonoma Valley City Watersheds Prop 1E Project

25 Year With Project Maximum Flood Conditions

PWA Ref# - D120852.00

ESA PWA



Source: MIKE FLOOD results

Notes: Project results shown are reflective of the culvert replacement on West MacArthur St, channel modifications to Fryer Creek, and a 12 acre-foot detention/retention basin on the Montini parcel.

N

0 600 1,200 2,400 Feet

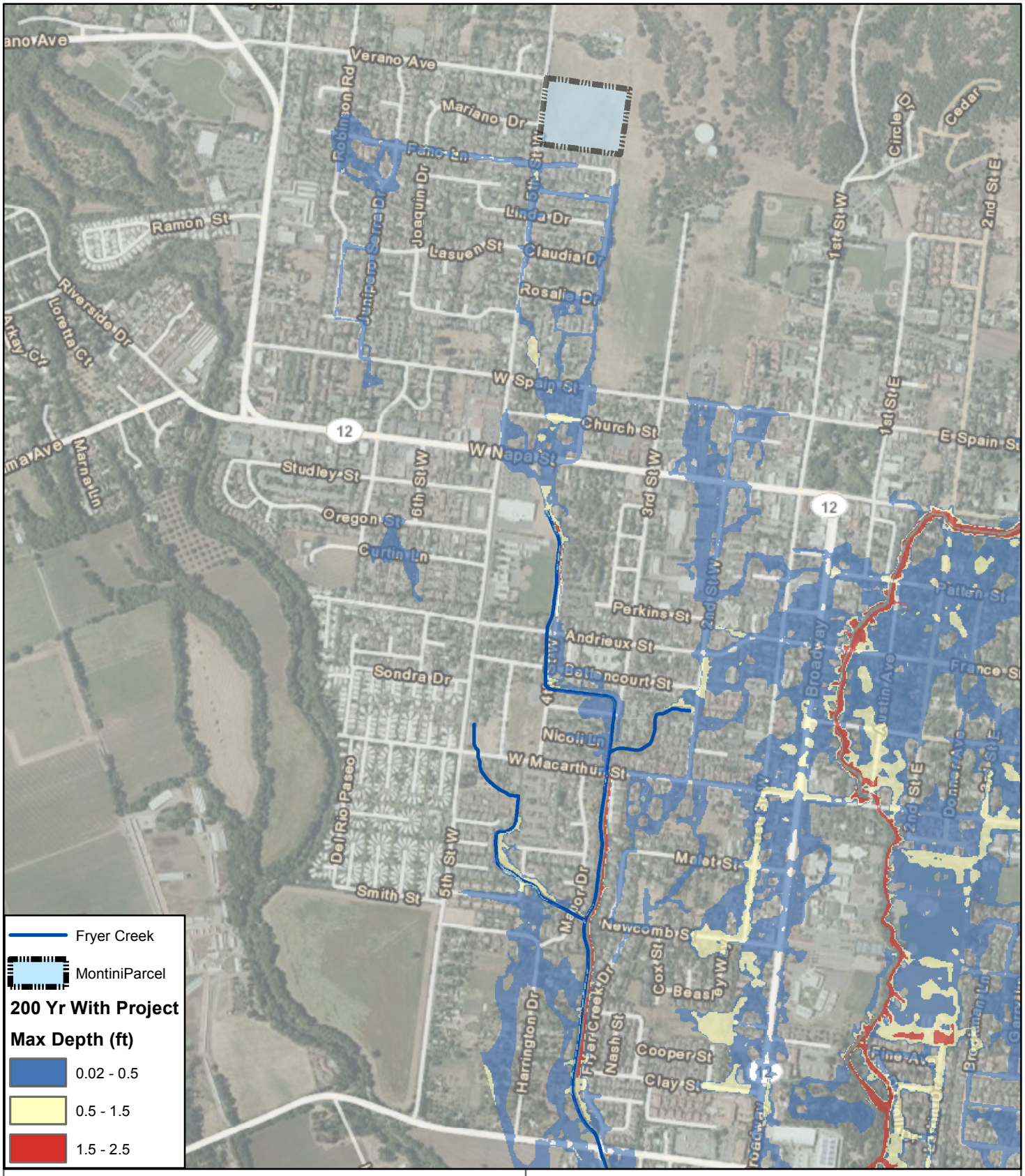
Figure 9

Sonoma Valley City Watersheds Prop 1E Project

100 Year With Project Maximum Flood Conditions

PWA Ref# - D120852.00

ESA PWA



Source: MIKE FLOOD results

Notes: Project results shown are reflective of the culvert replacement on West MacArthur St, channel modifications to Fryer Creek, and a 12 acre-foot detention/retention basin on the Montini parcel.

Figure 10

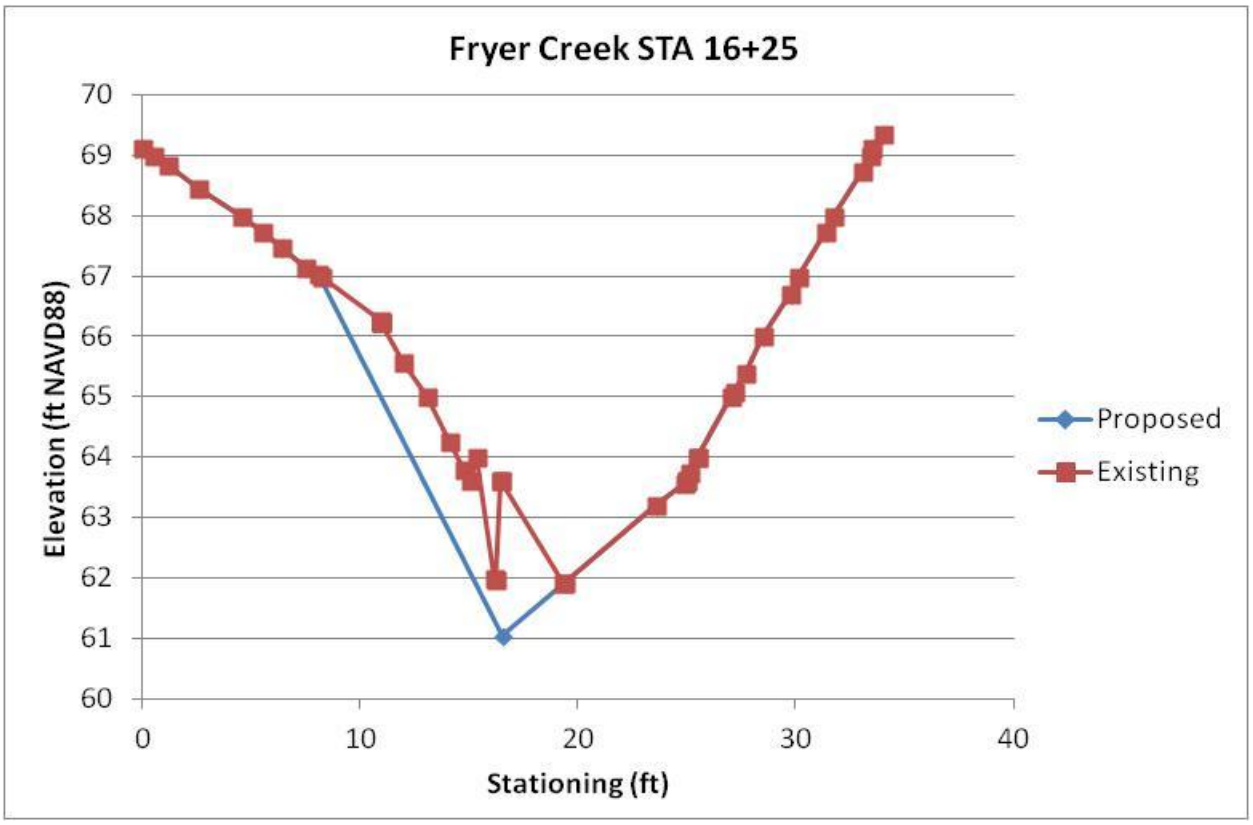
Sonoma Valley City Watersheds Prop 1E Project

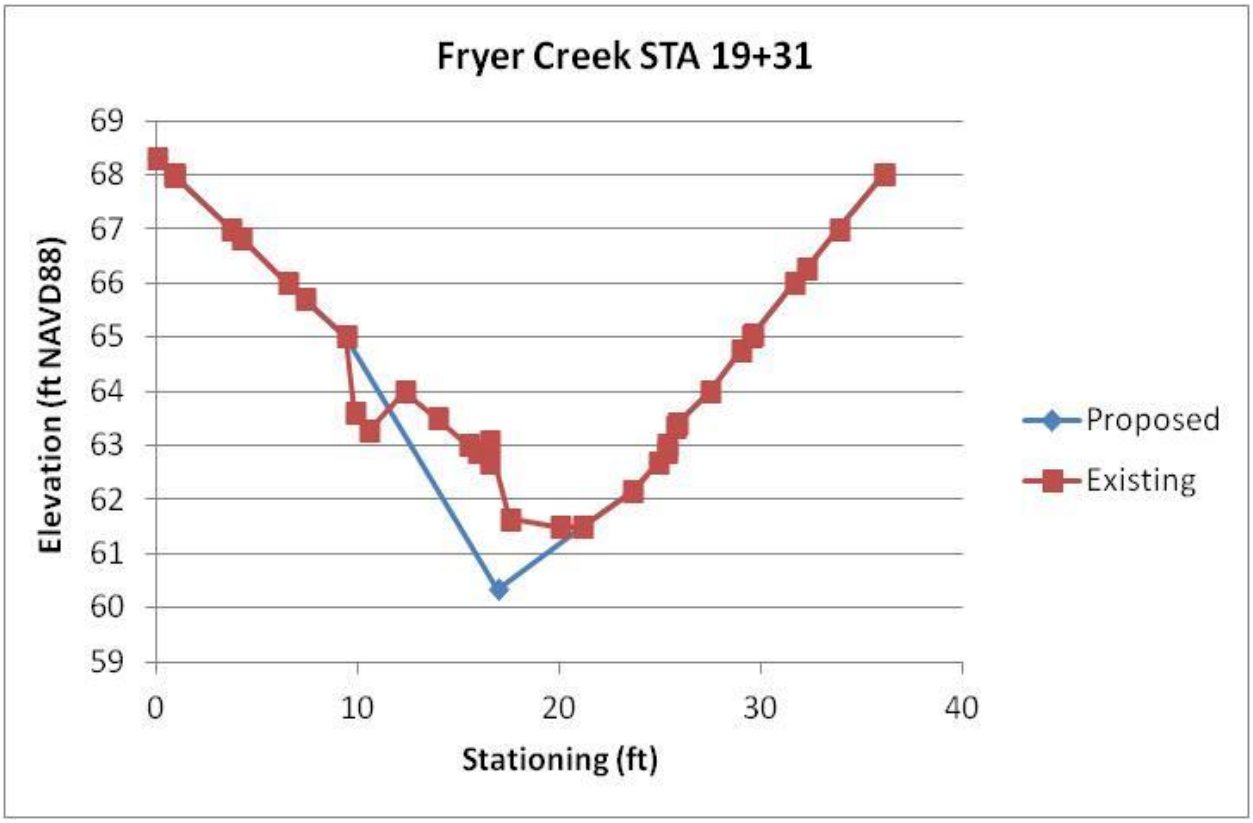
200 Year With Project Maximum Flood Conditions

PWA Ref# - D120852.00

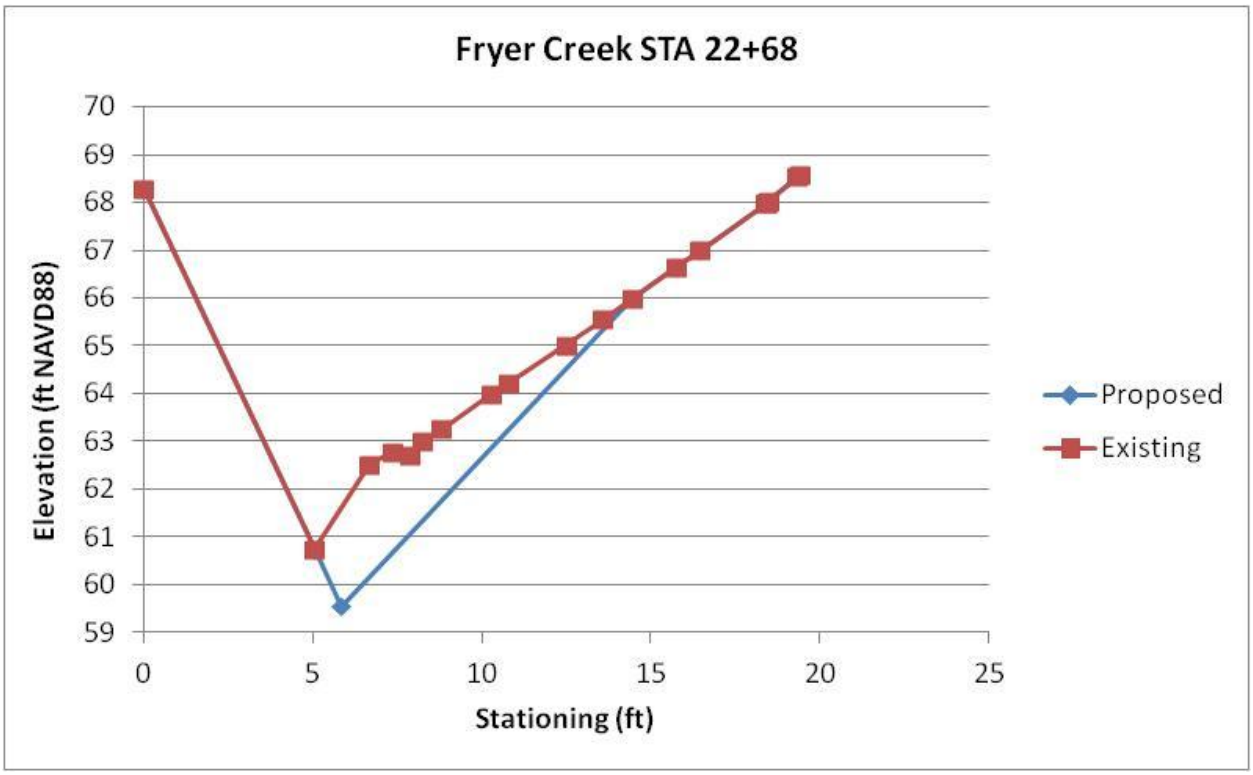
ESA PWA

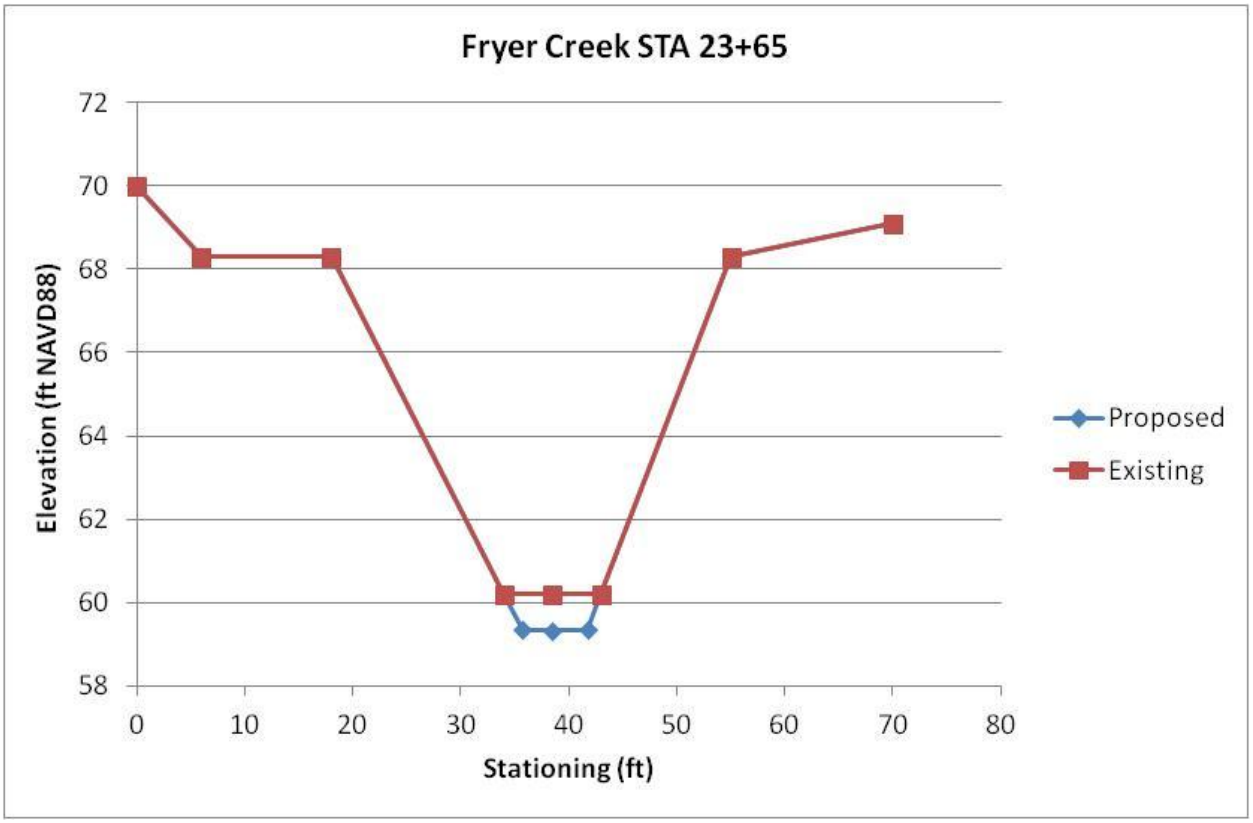
Attachment A. Existing Channel Conditions and Proposed Channel Improvements on Fryer Creek





Attachment A. Existing Channel Conditions and Proposed Channel Improvements on Fryer Creek





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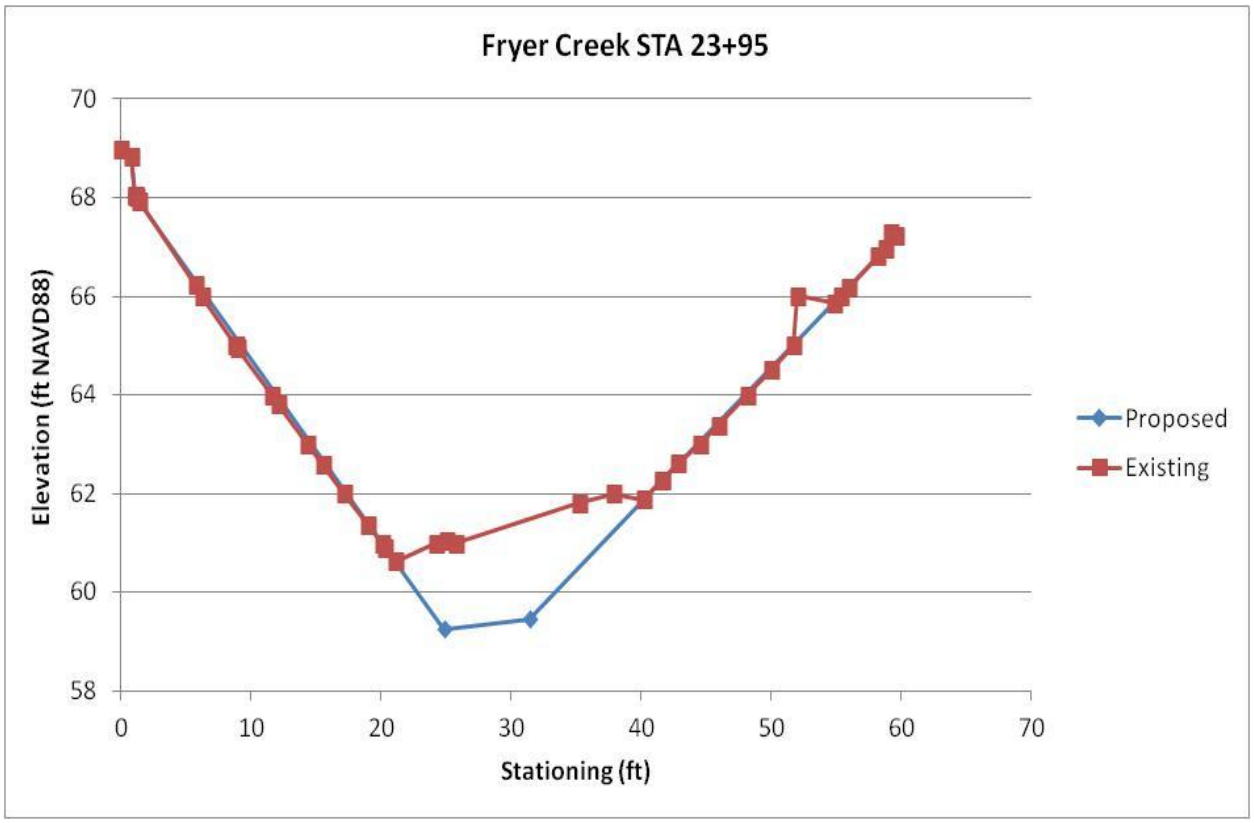
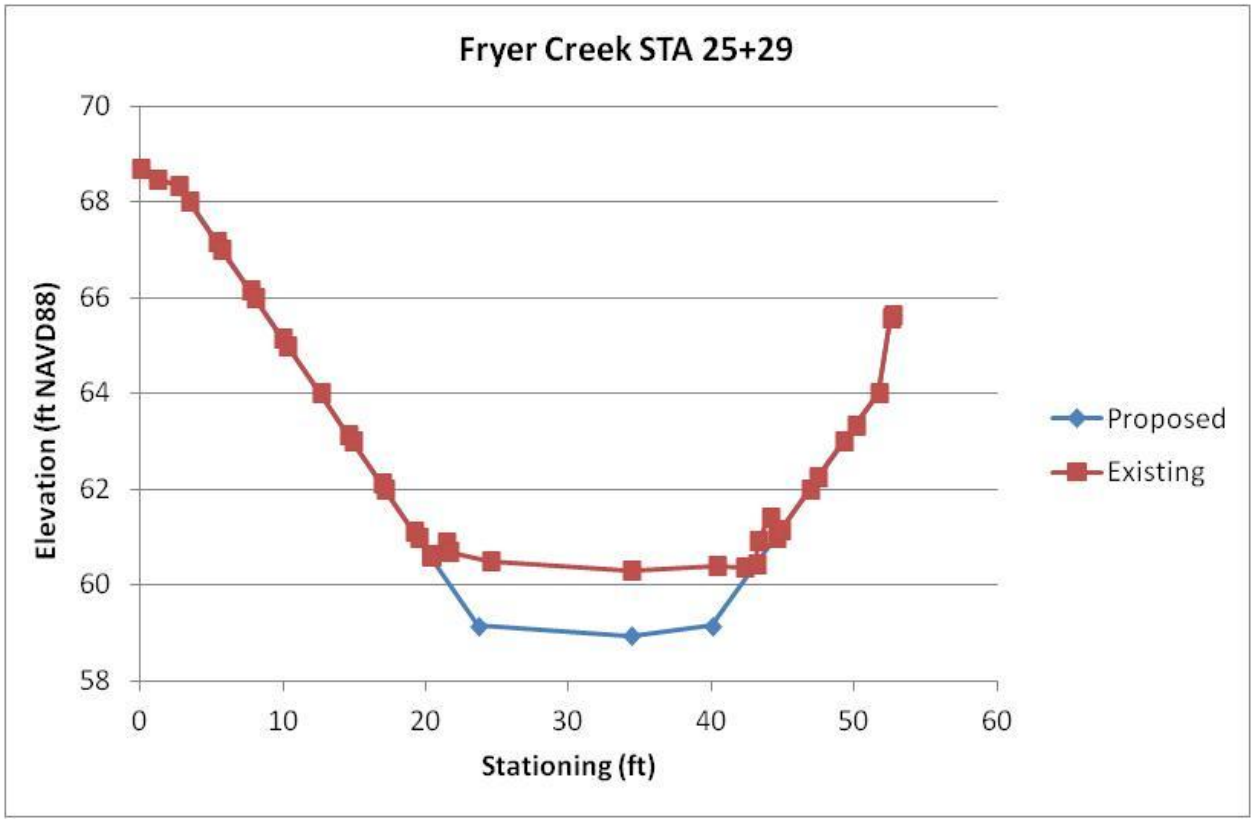
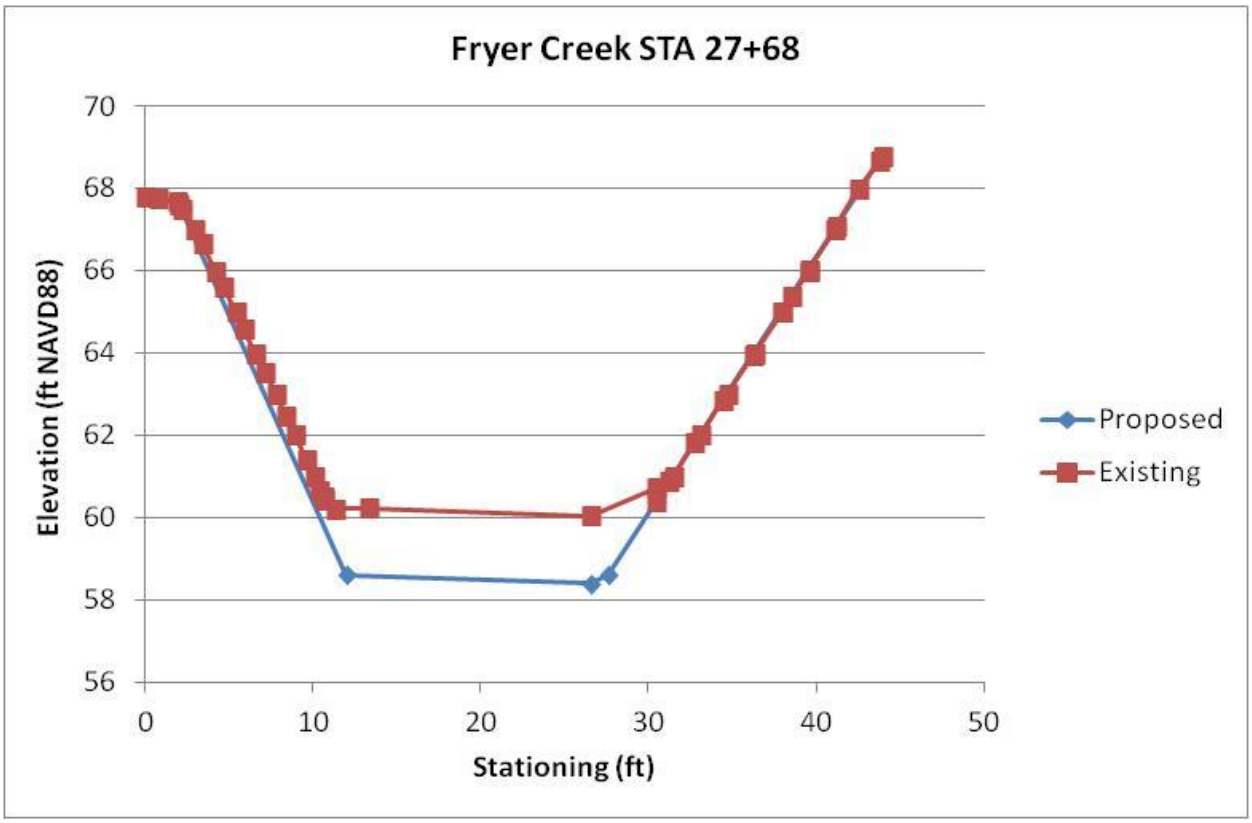
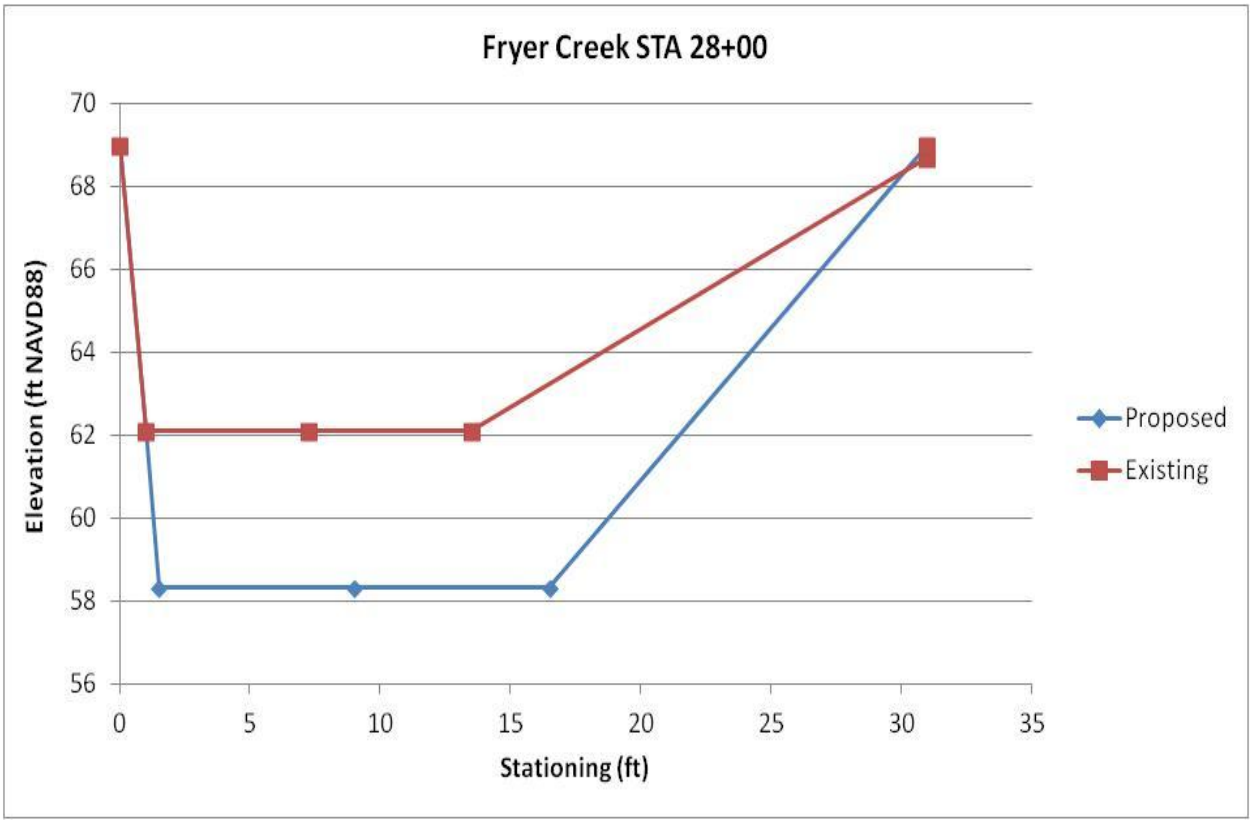




Attachment A. Existing Channel Conditions and Proposed Channel Improvements on Fryer Creek





Attachment A. Existing Channel Conditions and Proposed Channel Improvements on Fryer Creek

Table 1. Summary of proposed channel modifications and associated dredge volume estimates.

Sta	Ex Thalweg	Proposed Thalweg	Difference in Cross Sectional Area (ft2)	Average End Area Volume Calc (ft3)	Average End Area Volume (yd3)
1608	61.09	61.09	0.0		
1625	61.92	61.05	13.4	113.8	4.2
1931	61.48	60.34	8.8	3395.8	125.8
2268	60.74	59.55	10.8	3311.9	122.7
2365	60.19	59.33	6.5	839.3	31.1
2395	60.63	59.26	24.8	469.7	17.4
2529	60.29	58.95	26.9	3466.0	128.4
2768	60.05	58.39	33.7	7236.2	268.0
2800	62.09	58.31	92.9	2025.2	75.0
2854	61.99	58.19	97.9	5152.9	190.8
2898	58.09	58.09	0.0	2154.8	79.8
			TOTAL	**28165.6**	**1043.2**

Model Map

Sheet Name	Description
Menu:	Front page of model, with links to key sheets
Instructions:	Description of how this model should be used
Inputs:	Project information to be entered by user
BCA Summary:	Summary data resulting from Cost-Benefit Analysis
Assumptions:	Master page containing unit damage assumptions
Depth Damage Curves	Data describing stage damage relationships
Residential:	Direct residential building and contents costs
Commercial & Industrial:	Direct commercial and industrial building and contents costs
Agricultural:	Direct losses to agricultural production
Roads	Direct Losses to roads and infrastructure
Special Cases:	Table for entering information about special case buildings
Without Project EAD	Calculation of Estimated Annual Damages (EAD) without-project
Graph Data	Data used to develop graphical outputs
With Project EAD	Calculation of Estimated Annual Damages (EAD) with-project
Stage v Damage Curve	Graph of flood stage v flood damages
Loss Probability Curve	Graph of flood exceedance probability v flood damages

Inputs

Project Name: City Watersheds Project (Sonoma)

Cost of Project: $ 1,750,000

Description: This project includes the development of a detention/recharge basin at the Montini Open Space site in NW Sonoma as well as the replacement of a culvert on Fryer Creek at McArthur Street, together with associated modifications to the stream channel upstream of the culvert. Storm flows from the upper end of the stormdrain system draining to Fryer Creek will be diverted and routed to the basin.

Number of Events Modeled: 4

	Without Project						With Project					
	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6
Average Return Interval (ARI)	5	10	25	100	200		5	10	25	100	200	
Annual Probability of Exceedance	0.200	0.100	0.040	0.010	0.005	#DIV/0!	0.200	0.100	0.040	0.010	0.005	#DIV/0!
Probability of Levee Failure	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Water Surface Elevation - channel (f)												
Flood Warning Time (hours)	0	0	0	0	0		0	0	0	0	0	
Flood Experience	N	N	N	N	N		N	N	N	N	N	
Period of Inundation (days)												
HEC-FIA DATA INPUTS	N											
Residential Structural Damages ($)												
Residential Contents Damages ($)												
Residential Debris & Cleanup ($)												
Commercial Structural Damages ($)												
Commercial Contents Damages ($)												
Commercial Debris & Cleanup ($)												
Industrial Structural Damages ($)												
Industrial Contents Damages ($)												
Industrial Debris & Cleanup ($)												
Agricultural Structural Damages ($)												
Agricultural Contents Damages ($)												
Agricultural Debris & Cleanup ($)												
Residential Properties												
Ratio Depreciated Value to Replacement Value	100%	100%	100%	100%	100%		100%	100%	100%	100%	100%	
Average Flood depth above ground level (f)	0.00	0.00	0.30	0.40			0.00	0.00	0.20	0.20		
Rural - Res: Homesteads												
Rural - Other: Barns, sheds												
Urban Res: Single story (no base)	0	5	31	35			0	2	19	35		
Urban Res: Single story (basement)												
Urban Res: Two plus story (no base)												
Urban Res: Two plus story (basement)												
Mobile home												
Commercial Properties												
Ratio Depreciated Value to Replacement Value	100%	100%	100%	100%	100%		100%	100%	100%	100%	100%	
Average Flood depth above ground level (f)	0.00	0.00	0.25	0.25			0.00	0.00	0.00	0.25		
low value — building area inundated (sq.f.)												
medium value — building area inundated (sq.f.)				32300						29500		
high value — building area inundated (sq.f.)												
Industrial Properties												
Ratio Depreciated Value to Replacement Value												
Average Flood depth above ground level (f)												
low value — building area inundated (sq.f.)												
medium value — building area inundated (sq.f.)												
high value — building area inundated (sq.f.)												
Agricultural Production												
Corn — ac.												
Rice — ac.												
Walnuts — ac.												
Almonds — ac.												
Cotton — ac.												
Tomatoes — ac.												
Wine Grapes — ac.												
Alfalfa — ac.												
Pasture — ac.												
Safflower — ac.												
Sugar Beets — ac.												
Beans — ac.												
Other — ac.												
Roads												
length of arterial roads inundated (miles)												
length of major roads inundated (miles)												
length of minor roads inundated (miles)		0.0	0.6	1.3				0.0	0.5	1.1		
length of unsealed roads inundated (miles)												

Extrapolate Y-intercept: N

Summary of Cost-Benefit Analysis

Project Name:	**City Watersheds Project (Sonoma)**	
Description	This project includes the development of a detention/recharge basin at the Montini Open Space site in NW Sonoma as well as the replacement of a culvert on Fryer Creek at McArthur Street, together with associated modifications to the stream channel upstream of the culvert. Storm flows from the upper end of the stormdrain system draining to Fryer Creek will be diverted and routed to the basin.	
Proposed project capital cost:		[Note: construction costs which are assumed to occur in one year.]
Change in annual O&M costs:	$ -	[Note: the change in annual O&M costs compared to without project conditions.]
PV of future O&M costs:	$ -	(at 6% discount rate over 50 years)
PV of future costs	$ -	[Note: the sum of capital costs plus the PV of O&M costs.]

Benefits

	Actual	Potential	
EAD without project	$ 72,224	$ 74,281	[Note: for stormwater projects use "Potential" damage which ignores storm warning effects.]
EAD with project	$ 53,530	$ 55,098	
Annual Benefit:	$ 18,694	$ 19,183	
PV of Future Benefits:	$ 294,649	$ 302,363	(at 6% discount rate over 50 years)

Cost-Benefit Analysis

	Actual	Potential	
Net Present Value (NPV)	$ 294,649	$ 302,363	(at 6% discount rate over 50 years)
Benefit:Cost Ratio	0.000	0.000	

NPV Sensitivity to Discount Rate:

	Actual	Potential
4%	$ 401,584	$ 412,097
5%	$ 341,273	$ 350,207
6%	$ 294,649	$ 302,363
7%	$ 257,988	$ 264,743
8%	$ 228,690	$ 234,677

Model Assumptions

Residential

Foundation heights

Structure Category	Foundation Height (ft)
Rural - Res: Homesteads	1.5
Rural - Other: Barns, sheds	0
Urban Res: Single story (no base)	1.1
Urban Res: Two plus story (no base)	1.1
Mobile home	2.0
Commercial: Low	1
Commercial: Medium	1
Commercial: High	1
Industrial: Low	0.5
Industrial: Medium	0.5
Industrial: High	0.5

Estimate Replacement Value (assumed proxy for depreciated value)

Structure Category	Unit Cost $/ft^2 (2)	Average Size ft^2 (1)	Construction Cost
Rural - Res: Homesteads	159	1900	302100
Rural - Other: Barns, sheds	98	4000	392000
Urban Res: Single story (no base)	159	1900	302100
Urban Res: Two plus story (no base)	155	2200	341000
Mobile home (3)	98	1180	115640
Commercial: Low	120		0
Commercial: Medium	142		0
Commercial: High	207		0
Industrial: Low	120		0
Industrial: Medium	142		0
Industrial: High	207		0

1. Residential Square Footage Source: Sacramento County Tax Assessor Unit Cost and Commercial/Industrial/Public Square Footage Assumptions Source: Saylor Publications, Inc, 2007 Current Construction Costs

2. Replacement unit cost per square foot reflects average costs in the San Fran

3. According to FEMA guidance, replacement costs per square foot for mobile homes and barns and outbuildings are similar.

Other

External damages garden/outdoor areas $/building	$	5,000
Cleanup $/building	$	4,000
Number of residents per residential property		2.6

Commercial / Industrial Buildings

Clean-up costs as a percentage of direct structural damages	30%

Calculation of Other Direct Damages

Percentage of residential direct damages applied as indirect:	25%
Percentage of comm/ind. direct damages applied as indirect:	25%
HEC-FIA only: Percentage all building direct damages applied as indirect	25%
Percentage of roads direct damages applied as indirect:	25%

NPV Calculation

Discount Rate	6%	
Time Horizon	50	years

Roads

Cost per mile of highway road inundated	$	250,000
Cost per mile of major road inundated	$	100,000
Cost per mile of minor road inundated	$	30,000
Cost per mile of unsealed road inundated	$	10,000

Agricultural Damages

	Weighted, Average Annual Damages ($/acre)	Establishment Costs ($/acre)	Land Cleanup & rehabilitation ($/acre)	Total <5 d) ($/acre)	Total (>=5 d) ($/acre)
Corn	$48	$0	$246	$293	$293
Rice	$227	$0	$243	$471	$471
Walnuts	$585	$5,284	$243	$828	$6,112
Almonds	$1,618	$3,514	$243	$1,862	$5,376
Cotton	$301	$0	$246	$547	$547
Tomatoes	$1,015	$0	$235	$1,250	$1,250
Wine Grapes	$3,241	$3,240	$235	$3,476	$6,716
Alfalfa	$250	$246	$243	$493	$739
Pasture	($15)	$82	$272	$257	$339
Safflower	$164	$0	$241	$405	$405
Sugar Beets	$313	$0	$262	$575	$575
Beans	$111	$0	$246	$356	$356
Other	$0	0	$246	$246	$246

Source: Comp Study

Establishment Costs are 50% costs of total establishment costs

Calculation of Actual to Potential Damages Ratio

		Without Project						With Project					
		Event 1	Event 2	Event 3	Event 4	Event	Event 6	Event	Event 2	Event 3	Event 4	Event 5	Event 6
Warning Time:	hours	0	0	0	0	0	0	0	0	0	0	0	0
Recent Flood Exp	Y / N	N	N	N	N	N	0	N	N	N	N	N	0
Actual : Potential Ratio		0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9

Warning Time	Experienced Community	Inexperienced Community
< 2 hours	0.8	0.9
2-12 hours	Linear reduction from 0.8 at 2 hours to 0.4 at 12 hours	0.8
>12 hours	0.4	0.7

Occ_Name	Cat_Name	Occ_Description	Parameter	Depth (ft) above First Finished Floor (FFE)																								
1ST-NB	RES	one story, no basement	Stage	-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16						
1ST-NB	RES		S	0	2.5	13.4	23.3	32.1	40.1	47.1	53.2	58.6	63.2	67.2	70.5	73.2	75.4	77.2	78.5	79.5	80.2	80.7						
1ST-NB	RES		C	0	2.4	8.1	13.3	17.9	22	25.7	28.8	31.5	33.8	35.7	37.2	38.4	39.2	39.7	40	40	40	40						
2ST-NB	RES	two or more stories, no basement	Stage	-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16						
2ST-NB	RES		S	0	3	9.3	15.2	20.9	26.3	31.4	36.2	40.7	44.9	48.8	52.4	55.7	58.7	61.4	63.8	65.9	67.7	69.2						
2ST-NB	RES		C	0	1	5	8.7	12.2	15.5	18.5	21.3	23.9	26.3	28.4	30.3	32	33.4	34.7	35.6	36.4	36.9	37.2						
FARM	FAR	Farm Homesteads	Stage	-10	-3	-2	-1	0	1	2	3	4	5	6	7	8	10	13	15	19	21	25						
FARM	FAR		S	0	0	0	0	4	9	13	18	22	27	31	35	38	49	49	49	49	49	49						
FARM	FAR		C	0	0	0	0	0	6	30	54	69	75	78	80	80	80	100	100	100	100	100						
MOBILE	MOB	Mobile homes	Stage	-10	-3	-2	-1	0	1	2	3	4	5	6	7	8	10	13	15	19	21	25						
MOBILE	MOB		S	0	0	0	0	8	44	63	73	78	80	81	82	82	82	82	82	82	82	82						
MOBILE	MOB		C	0	0	0	0	0	27	49	64	70	76	78	79	81	83	83	83	83	83	83						
PUBLIC	PUB	Public buildings	Stage	-10	-3	-2	-1	0	1	2	3	4	5	6	7	8	10	13	15	19	21	25						
PUBLIC	PUB		S	0	0	0	0	8	22	30	35	39	41	44	46	48	49	49	49	49	49	49						
PUBLIC	PUB		C	0	0	0	0	0	17.5	25	30	34	37	39	40.5	41.5	42	42	42	42	42	42						
INDUSTRY	IND	Industrial Buildings	Stage	-10	-3	-2	-1	0	1	2	3	4	5	6	7	8	10	13	15	19	21	25						
INDUSTRY	IND		S	0	0	0	0	4	9	13	18	22	27	31	35	38	49	49	49	49	49	49						
INDUSTRY	IND		C	0	0	0	0	0	72	75	76.5	78	81	84	87	90	96	102	108	114	120	120						
COMMERCIAL	COM	Commercial Buildings	Stage	-10	-3	-2	-1	0	1	2	3	4	5	6	7	8	10	13	15	19	21	25						
COMMERCIAL	COM		S	0	0	0	0	4	9	13	18	22	27	31	35	38	49	49	49	49	49	49						
COMMERCIAL	COM		C	0	0	0	0	0	11	30	54	69	75	78	80	80	80	100	100	100	100	100						

NOT USED

SL-NB	RES	split level, no basement	Stage	-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16						
SL-NB	RES		S	0	6.4	7.2	9.4	12.9	17.4	22.8	28.9	35.5	42.3	49.2	56.1	62.6	68.6	73.9	78.4	81.7	83.8	84.4						
SL-NB	RES		SN	0	2.9	2.1	1.9	1.9	2	2.2	2.4	2.7	3.2	3.8	4.5	5.3	6	6.7	7.4	7.9	8.3	8.7						
SL-NB	RES		C	0	2.2	2.9	4.7	7.5	11.1	15.3	20.1	25.2	30.5	35.7	40.9	45.8	50.2	54.1	57.2	59.4	60.5	60.5						
SL-NB	RES		CN	0	2.2	1.5	1.2	1.3	1.4	1.5	1.6	1.8	2.1	2.5	3	3.5	4.1	4.6	5	5.4	5.7	6						
SL-NB	RES		Struct	N		0.8																						
1ST-B	RES	one story, with basement	Stage	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1ST-B	RES		S	0	0	0.7	0.8	2.4	5.2	9	13.8	19.4	25.5	32	38.7	45.5	52.2	58.6	64.5	69.8	74.2	77.7	80.1	81.1	81.1	81.1	81.1	81.1	81.1
1ST-B	RES		SN	0	0	1.34	1.06	0.94	0.91	0.88	0.85	0.83	0.85	0.96	1.14	1.37	1.63	1.89	2.14	2.35	2.52	2.66	2.77	2.88	2.88	2.88	2.88	2.88	2.88
1ST-B	RES		C	0	0.1	0.8	2.1	3.7	5.7	8	10.5	13.2	16	18.9	21.8	24.7	27.4	30	32.4	34.5	36.3	37.7	38.6	39.1	39.1	39.1	39.1	39.1	39.1
1ST-B	RES		CN	0	1.6	1.16	0.92	0.81	0.78	0.76	0.74	0.72	0.74	0.83	0.98	1.17	1.39	1.6	1.81	1.99	2.13	2.25	2.35	2.45	2.45	2.45	2.45	2.45	2.45
1ST-B	RES		Struct	N		0.8																						
2ST-B	RES	two or more stories, with basement	Stage	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
2ST-B	RES		S	0	1.7	1.7	1.9	2.9	4.7	7.2	10.2	13.9	17.9	22.3	27	31.9	36.9	41.9	46.9	51.8	56.4	60.8	64.8	68.4	71.4	73.7	75.4	76.4	76.4
2ST-B	RES		SN	0	2.7	2.7	2.11	1.8	1.66	1.56	1.47	1.37	1.32	1.35	1.5	1.75	2.04	2.34	2.63	2.89	3.13	3.38	3.71	4.22	5.02	6.19	7.79	9.84	12.36
2ST-B	RES		C	0	0	1	2.3	3.7	5.2	6.8	8.4	10.1	11.9	13.8	15.7	17.7	19.8	22	24.3	26.7	29.1	31.7	34.4	37.2	40	43	46.1	49.3	52.6
2ST-B	RES		CN	0	0	2.27	1.76	1.49	1.37	1.29	1.21	1.13	1.09	1.11	1.23	1.43	1.67	1.92	2.15	2.36	2.56	2.76	3.04	3.46	4.12	5.08	6.39	8.08	10.15
2ST-B	RES		Struct	N		0.8																						
SL-B	RES	split level, with basement	Stage	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
SL-B	RES		S	0	0	0	2.5	3.1	4.7	7.2	10.4	14.2	18.5	23.2	28.2	33.4	38.6	43.8	48.8	53.5	57.8	61.6	64.8	67.2	68.8	69.3	69.3	69.3	69.3
SL-B	RES		SN	0	0	0	1.8	1.6	1.5	1.6	1.6	1.6	1.6	1.7	1.9	2.1	2.4	2.6	2.9	3.2	3.4	3.6	3.9	4.2	4.8	5.7	5.7	5.7	5.7
SL-B	RES		C	0	0.6	0.7	1.4	2.4	3.8	5.4	7.3	9.4	11.6	13.8	16.1	18.2	20.2	22.1	23.6	24.9	25.8	26.3	26.3	26.3	26.3	26.3	26.3	26.3	26.3
SL-B	RES		CN	0	2.09	1.49	1.14	1.01	1	1.02	1.03	1.04	1.06	1.12	1.23	1.38	1.57	1.76	1.95	2.13	2.28	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44
SL-B	RES		Struct	N		0.8																						

Residential Buildings

	Without Project						With Project					
	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6
ARI:	5	10	25	100	200	0	5	10	25	100	200	0
Probability of Levee Failure	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00
Flood depth above ground level (ft)	0.00	0.00	0.30	0.40	0.00	0.00	0.00	0.00	0.20	0.20	0.00	0.00
Buildings Inundated (no.)												
Rural - Res: Homesteads	0	0	0	0	0	0	0	0	0	0	0	0
Rural - Other: Barns, sheds	0	0	0	0	0	0	0	0	0	0	0	0
Urban Res: Single story (no base)	0	5	31	35	0	0	0	2	19	35	0	0
Urban Res: Two plus story (no base)	0	0	0	0	0	0	0	0	0	0	0	0
Mobile home	0	0	0	0	0	0	0	0	0	0	0	0
Structural Damages												
Rural - Res: Homesteads	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Rural - Other: Barns, sheds	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Urban Res: Single story (no base)	$ -	$ -	$ 234,128	$ 264,338	$ -	$ -	$ -	$ -	$ 143,498	$ 264,338	$ -	$ -
Urban Res: Two plus story (no base)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Mobile home	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Structual Damages HEC-FIA	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Structural Damages	$ -	$ -	$ 234,128	$ 264,338	$ -	$ -	$ -	$ -	$ 143,498	$ 264,338	$ -	$ -
Content Damages												
Rural - Res: Homesteads	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Rural - Other: Barns, sheds	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Urban Res: Single story (no base)	$ -	$ -	$ 224,762	$ 253,764	$ -	$ -	$ -	$ -	$ 137,758	$ 253,764	$ -	$ -
Urban Res: Two plus story (no base)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Mobile home	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Contents Damage HEC-FIA	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Actual:Potential Ratio	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Total Contents Damages: Actual	$ -	$ -	$ 202,286	$ 228,388	$ -	$ -	$ -	$ -	$ 123,982	$ 228,388	$ -	$ -
Total Contents Damages: Potential	$ -	$ -	$ 224,762	$ 253,764	$ -	$ -	$ -	$ -	$ 137,758	$ 253,764	$ -	$ -
Clean-Up/ Other Costs												
External	$ -	$ 25,000	$ 155,000	$ 175,000	$ -	$ -	$ -	$ 10,000	$ 95,000	$ 175,000	$ -	$ -
Cleanup	$ -	$ 20,000	$ 124,000	$ 140,000	$ -	$ -	$ -	$ 8,000	$ 76,000	$ 140,000	$ -	$ -
Other Costs HEC-FIA	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Other Costs: Potential	$ -	$ 45,000	$ 279,000	$ 315,000	$ -	$ -	$ -	$ 18,000	$ 171,000	$ 315,000	$ -	$ -
Sum Actual Damages	**$ -**	**$ 45,000**	**$ 715,414**	**$ 807,725**	**$ -**	**$ -**	**$ -**	**$ 18,000**	**$ 438,479**	**$ 807,725**	**$ -**	**$ -**
Sum Potential Damages	**$ -**	**$ 45,000**	**$ 737,890**	**$ 833,102**	**$ -**	**$ -**	**$ -**	**$ 18,000**	**$ 452,255**	**$ 833,102**	**$ -**	**$ -**
Total Actual Damage with levee failure ($):	**$ -**	**$ 45,000**	**$ 715,414**	**$ 807,725**	**$ -**	**$ -**	**$ -**	**$ 18,000**	**$ 438,479**	**$ 807,725**	**$ -**	**$ -**
Total Potential Damage with levee failure ($):	**$ -**	**$ 45,000**	**$ 737,890**	**$ 833,102**	**$ -**	**$ -**	**$ -**	**$ 18,000**	**$ 452,255**	**$ 833,102**	**$ -**	**$ -**
Indirect Actual Damage	$ -	$ 11,250	$ 178,853	$ 201,931	$ -	$ -	$ -	$ 4,500	$ 109,620	$ 201,931	$ -	$ -
Indirect Potential Damage	$ -	$ 11,250	$ 184,472	$ 208,275	$ -	$ -	$ -	$ 4,500	$ 113,064	$ 208,275	$ -	$ -

Commercial & Industrial Buildings

	Without Project						With Project					
	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6
ARI:	5	10	25	100	200	0	5	10	25	100	200	0
Probability of Levee Failure	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00
Commercial												
'Flood depth above ground level (ft)	0.00	0.00	0.25	0.25	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00
low building size	0	0	0	0	0	0	0	0	0	0	0	0
medium building size	0	0	0	32300	0	0	0	0	0	29500	0	0
high building size	0	0	0	0	0	0	0	0	0	0	0	0
Industrial												
'Flood depth above ground level (ft)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
low building size	0	0	0	0	0	0	0	0	0	0	0	0
medium building size	0	0	0	0	0	0	0	0	0	0	0	0
high building size	0	0	0	0	0	0	0	0	0	0	0	0
Structural Damages												
Commercial												
low	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
medium	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
high	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Commercial HEC-FIA	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Industrial												
low	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
medium	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
high	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Industrial HEC-FIA	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Structural Damages	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Contents Damages												
Commercial												
low	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
medium	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
high	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Commercial HEC-FIA	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Industrial												
low	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
medium	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
high	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Industrial HEC-FIA	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Actual:Potential Ratio	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Total Contents Damages: Actual	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Contents Damages: Potential	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Clean-up/ Other Costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Clean-Up/ Other Costs: HEC-FIA	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Sum Actual Damages	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Sum Potential Damages	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Total Damage with levee failure ($):	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Total Damage with levee failure ($):	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Indirect Actual Damages	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Indirect Potentail Damages	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -

Agricultural Damages

	Without Project						With Project					
	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6
ARI:	5	10	25	100	200	0	5	10	25	100	200	0
Probability of Levee Failure	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00
Length of Inundation <5d Y/N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Agricultural Land Inundated												
Corn ac.	0	0	0	0	0	0	0	0	0	0	0	0
Rice ac.	0	0	0	0	0	0	0	0	0	0	0	0
Walnuts ac.	0	0	0	0	0	0	0	0	0	0	0	0
Almonds ac.	0	0	0	0	0	0	0	0	0	0	0	0
Cotton ac.	0	0	0	0	0	0	0	0	0	0	0	0
Tomatoes ac.	0	0	0	0	0	0	0	0	0	0	0	0
Wine Grape ac.	0	0	0	0	0	0	0	0	0	0	0	0
Alfalfa ac.	0	0	0	0	0	0	0	0	0	0	0	0
Pasture ac.	0	0	0	0	0	0	0	0	0	0	0	0
Safflower ac.	0	0	0	0	0	0	0	0	0	0	0	0
Sugar Beets ac.	0	0	0	0	0	0	0	0	0	0	0	0
Beans ac.	0	0	0	0	0	0	0	0	0	0	0	0
Other ac.	0	0	0	0	0	0	0	0	0	0	0	0
Potential Damages												
Corn	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Rice	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Walnuts	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Almonds	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Cotton	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Tomatoes	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Wine Grapes	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Alfalfa	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pasture	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Safflower	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Sugar Beets	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Beans	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Other	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Potential Damages	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Damage with levee failure ($):	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -

Roads

	Without Project						With Project					
	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6
ARI	5	10	25	100	200	0	5	10	25	100	200	0
Probability of Levee failure	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00
Roads Inundated												
length of arterial roads inundated (miles)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
length of major roads inundated (miles)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
length of minor roads inundated (miles)	0.00	0.02	0.57	1.30	0.00	0.00	0.00	0.00	0.47	1.10	0.00	0.00
length of unsealed roads inundated (miles)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Potential Damages												
length of arterial roads inundated (miles)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
length of major roads inundated (miles)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
length of minor roads inundated (miles)	$ -	$ 600	$ 17,100	$ 39,000	$ -	$ -	$ -	$ -	$ 14,100	$ 33,000	$ -	$ -
length of unsealed roads inundated (miles)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Damages:	*$ -*	*$ 600*	*$ 17,100*	*$ 39,000*	*$ -*	*$ -*	*$ -*	*$ -*	*$ 14,100*	*$ 33,000*	*$ -*	*$ -*
Total Damage with levee failure ($):	$ -	$ 600	$ 17,100	$ 39,000	$ -	$ -	$ -	$ -	$ 14,100	$ 33,000	$ -	$ -

Special Cases - Dollar Damages Incurred

	Without Project						With Project					
	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6
ARI	5	10	25	100	200	0	5	10	25	100	200	0
Probability of Levee failure	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00
Description / Site ID												
Total Damages:	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Damage with levee failure ($):	0	0	0	0	0	0	0	0	0	0	0	0

Calculation of Without Project EAD

	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Y Intercept
Average Recurrence Interval (ARI)	5	10	25	100	200	0	
AEP	0.200	0.100	0.040	0.010	0.005	#DIV/0!	0
Actual Damage to Residential Buildings ($)	$ -	$ 45,000	$ 715,414	$ 807,725	$ -	$ -	
Potential Damage to Residential Buildings ($)	$ -	$ 45,000	$ 737,890	$ 833,102	$ -	$ -	
Actual Damage to Commercial/Industrial Buildings ($)	$ -	$ -	$ -	$ -	$ -	$ -	
Potential Damage to Commercial/Industrial Buildings ($)	$ -	$ -	$ -	$ -	$ -	$ -	
Damage to Agriculture ($)	$ -	$ -	$ -	$ -	$ -	$ -	
Damage to Roads ($)	$ -	$ 600	$ 17,100	$ 39,000	$ -	$ -	
Actual Indirect Costs	$ -	$ 11,400	$ 183,128	$ 211,681	$ -	$ -	
Potential Indirect Costs	$ -	$ 11,400	$ 188,747	$ 218,025	$ -	$ -	
Special Cases	$ -	$ -	$ -	$ -	$ -	$ -	
Total Actual Damages	$ -	$ 57,000	$ 915,642	$ 1,058,406	$ -	$ -	$ 1,058,406
Total Potential Damages	$ -	$ 57,000	$ 943,737	$ 1,090,127	$ -	$ -	$ 1,090,127
EAD (Actual)	$ 72,224						
EAD (Potential)	$ 74,281						

Actual Damages				
No. of events	3	4	5	6
Extrap Y Intercept	$ 1,488,070	$ 1,105,994	-$ 1,058,406	#DIV/0!
Const Y Intercept	$ 915,642	$ 1,058,406	$ -	$ -
Actual EAD	$ 71,510	$ 72,224	$ 66,932	#DIV/0!

Potential Damages				
No. of events	3	4	5	6
Extrap Y Intercept	$ 1,534,896	$ 1,138,923	-$ 1,090,127	#DIV/0!
Const Y Intercept	$ 943,737	$ 1,090,127	$ -	$ -
Potential EAD	$ 73,549	$ 74,281	$ 68,831	#DIV/0!

Potential Damages

	Without Project							With Project						
Water Surface Elevation - channel (f)	0	0	0	0	0	0		0	0	0	0	0	0	
ARI	5	10	25	100	200	0		5	10	25	100	200	0	
Probability of Exceedence (AEP)	0.200	0.100	0.040	0.010	0.005	#DIV/0!		0.200	0.100	0.040	0.010	0.005	#DIV/0!	
Damages incurred	$ -	$ 57,000	$ 943,737	$ 1,090,127	$ -	$ -	$ 1,090,127	$ -	$ 22,500	$ 582,944	$ 1,082,627	$ -	$ -	$ 1,082,627

Actual Damages

	Without Project							With Project						
Water Surface Elevation - channel (f)	0	0	0	0	0	0		0	0	0	0	0	0	
ARI	5	10	25	100	200	0		5	10	25	100	200	0	
Probability of Exceedence (AEP)	0.200	0.100	0.040	0.010	0.005	#DIV/0!		0.200	0.100	0.040	0.010	0.005	#DIV/0!	
Damages incurred	$ -	$ 57,000	$ 915,642	$ 1,058,406	$ -	$ -	$ 1,058,406	$ -	$ 22,500	$ 565,724	$ 1,050,906	$ -	$ -	$ 1,050,906

Without Project

Water Surface Elevation - channel (f)	5	10	25	100	200	0
Probability of Exceedence (AEP)	0.200	0.100	0.040	0.010	0.010	0.010
Potential	$ -	$ 57,000	$ 943,737	$ 1,090,127	$ 1,090,127	$ 1,090,127
Actual	$ -	$ 57,000	$ 915,642	$ 1,058,406	$ 1,058,406	$ 1,058,406

With Project

Water Surface Elevation - channel (f)	5	10	25	100	200	0
Probability of Exceedence (AEP)	0.200	0.100	0.040	0.010	0.010	0.010
Potential	$ -	$ 22,500	$ 582,944	$ 1,082,627	$ 1,082,627	$ 1,082,627
Actual	$ -	$ 22,500	$ 565,724	$ 1,050,906	$ 1,050,906	$ 1,050,906

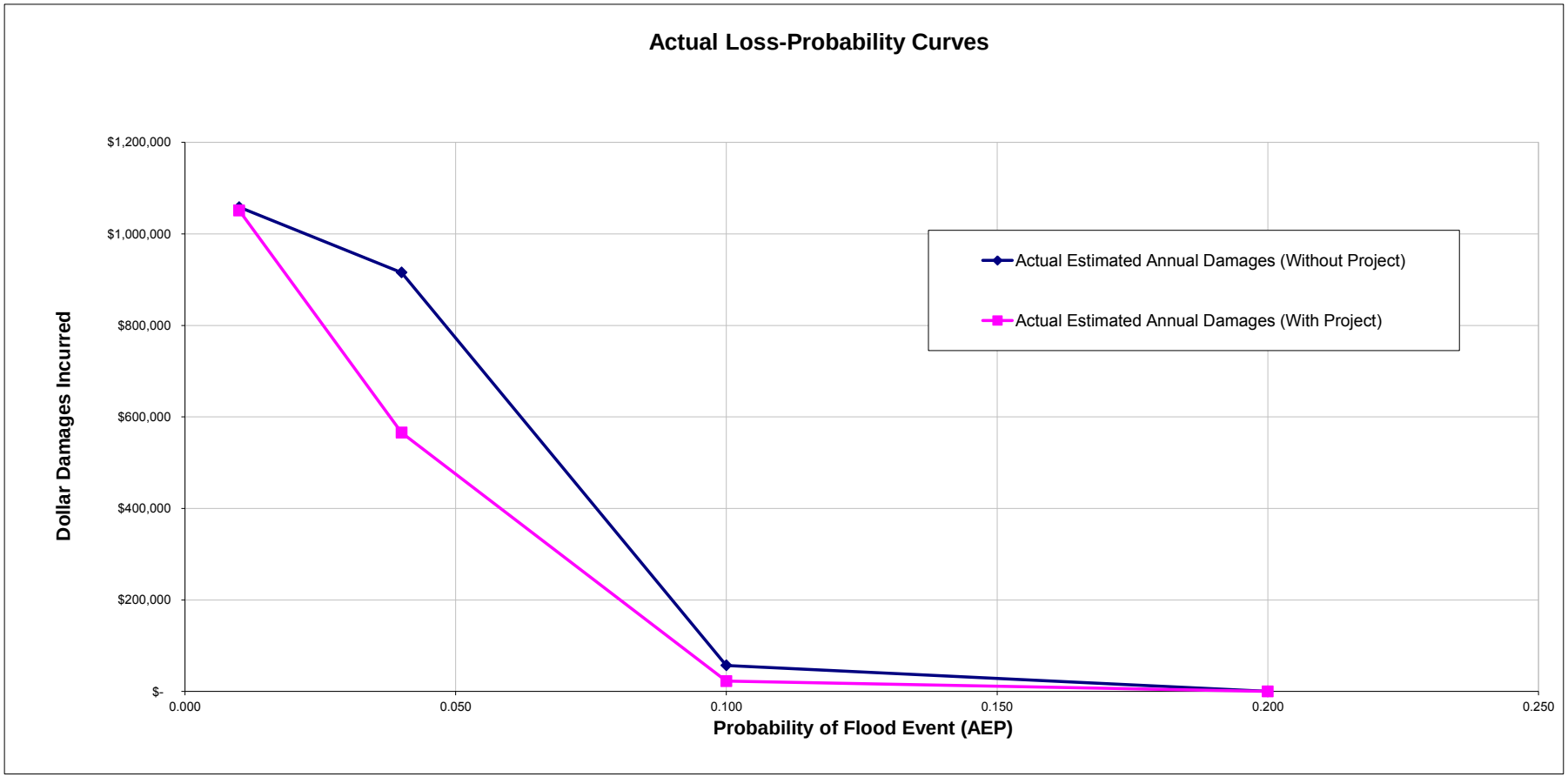
Calculation of With Project EAD

	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Y Intercept
Average Recurrence Interval (ARI)	5	10	25	100	200	0	
AEP	0.200	0.100	0.040	0.010	0.005	#DIV/0!	0
Actual Damage to Residential Buildings ($)	$ -	$ 18,000	$ 438,479	$ 807,725	$ -	$ -	
Potential Damage to Residential Buildings ($)	$ -	$ 18,000	$ 452,255	$ 833,102	$ -	$ -	
Actual Damage to Commercial/Industrial Buildings ($)	$ -	$ -	$ -	$ -	$ -	$ -	
Potential Damage to Commercial/Industrial Buildings ($)	$ -	$ -	$ -	$ -	$ -	$ -	
Damage to Agriculture ($)	$ -	$ -	$ -	$ -	$ -	$ -	
Damage to Roads ($)	$ -	$ -	$ 14,100	$ 33,000	$ -	$ -	
Actual Indirect Costs	$ -	$ 4,500	$ 113,145	$ 210,181	$ -	$ -	
Potential Indirect Costs	$ -	$ 4,500	$ 116,589	$ 216,525	$ -	$ -	
Special Cases	$ -	$ -	$ -	$ -	$ -	$ -	
Total Actual Damages	$ -	$ 22,500	$ 565,724	$ 1,050,906	$ -	$ -	$ 1,050,906
Total Potential Damages	$ -	$ 22,500	$ 582,944	$ 1,082,627	$ -	$ -	$ 1,082,627

EAD (Actual)	$ 53,530
EAD (Potential)	$ 55,098

Actual Damages				
No. of events	3	4	5	6
Extrap Y Intercep	$ 927,874	$ 1,212,634	-$ 1,050,906	#DIV/0!
Const Y Intercept	$ 565,724	$ 1,050,906	$ -	$ -
Actual EAD	$ 51,104	$ 53,530	$ 48,276	#DIV/0!

Potential Damages				
No. of events	3	4	5	6
Extrap Y Intercep	$ 956,573	$ 1,249,188	-$ 1,082,627	#DIV/0!
Const Y Intercept	$ 582,944	$ 1,082,627	$ -	$ -
Potential EAD	$ 52,600	$ 55,098	$ 49,685	#DIV/0!


Actual Loss-Probability Curves
$1,200,000
$1,000,000
$800,000
$600,000
$400,000
$200,000
$-
Dollar Damages Incurred
0.000
0.050
0.100
0.150
0.200
0.250
Probability of Flood Event (AEP)
Actual Estimated Annual Damages (Without Project)
Actual Estimated Annual Damages (With Project)

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DATE: January 25, 2013
TO: Betty Andrews, ESA-PWA; Kent Gylf, SCWA; Greg Guensch, SCWA
FROM: Sarah Reich, ECONorthwest
SUBJECT: ANALYSIS OF THE NON-MONETIZED AND MONETIZED BENEFITS OF THE SONOMA CITY WATERSHEDS PROJECT

The Sonoma County Water Agency (SCWA) is preparing an application under Proposition 1E to fund the City Watersheds of Sonoma Valley Project (the project). As part of this application, project sponsors must complete Exhibit D, a benefit-cost analysis of the project. ECONorthwest's role is to provide SCWA with information to satisfy the requirements of Section D2–Non-Monetized Benefits Analysis and Section D3–Monetized Benefits Analysis.

This memo presents the narrative description of the non-monetized and monetized benefits analyses for Exhibit D. Section D2 requires completion of Table 13, which we include below. Section D3 requires completion of Table 14–Annual Benefit and Table 15—Annual Costs of Avoided Projects for the monetized benefits analysis. Along with this narrative description, we also include calculations for Table 13, 14 and 15 in Excel format.

Section D2–Non-Monetized Benefits Analysis

In this section, we describe the economic importance of the project's effects for which sufficient information to quantify in monetary terms does not exist. From an economic perspective, these effects improve the well-being of Californians, so should be accounted for in the benefit-cost analysis. Ignoring them or discounting their importance relative to the monetized benefits would result in an incomplete and biased analysis. To support the argument that these effects have economic importance, we provide a narrative description for each benefit that includes these categories of information:

- The project's marginal effect on each category of benefit presented in Table 13, comparing the without-project conditions to the with-project conditions.
- Evidence of the economic importance of the effect. A biophysical effect is only important from an economic perspective if it provides something people want (and are willing to pay for). This is true even if the effect cannot be quantified in monetary terms. Thus, we describe the demand for the effect or the goods and services it might generate, including direct use, indirect use, and non-use demands. Wherever possible, we use local information to substantiate evidence of local demand. When local information does not exist, we provide evidence from the economic literature that demonstrates the value of the effect.
- When the benefit might materialize and how long it might persist.
- Who would benefit, and how the benefits would be distributed across stakeholders.

- Sources of uncertainty and how uncertainty might affect how or when the benefit materializes.

Table 13 identifies the non-monetized benefits the project would likely generate. This table is based on Table 13 in the Proposition 1E Proposal Solicitation Package. In some categories the project may generate positive effects on biophysical parameters, described in Attachment 7, that have no additional effects from an economic perspective. Following the instructions for completing Table 13, these effects are not included separately in Table 13. The benefits marked with a "yes" response are are described in more detail below the table, organized in order by their number in the table.

Table 13 – Non-monetized Benefits Checklist		
No.	*Will the proposal…*	*Response*
Community/Social Benefits		
1	Provide education or technology benefits?	Yes
2	Provide social recreation or access benefits?	Yes
3	Help avoid, reduce or resolve various public water resources conflicts?	Yes
4	Promote social health and safety?	Yes
5	Have other social benefits?	No
Environmental Stewardship Benefits		
6	Benefit wildlife or habitat in ways that were not quantified in Attachment 7?	Yes
7	Improve water quality in ways that were not quantified in Attachment 7?	No
8	Reduce net emissions in ways that were not quantified in Attachment 7?	No
9	Provide other environmental stewardship benefits, other than those claimed in Sections D1, D3, or D4?	Yes
Sustainability Benefits		
10	Improve the overall, long-term management of California groundwater resources?	Yes
11	Reduce demand for net diversions for the regions from the Delta?	No
12	Provide a long-term solution in place of a short-term one?	Yes
13	Reduce water consumption on a permanent basis?	No
14	Promote energy savings or replace fossil fuel based energy sources with renewable energy and resources?	No
15	Improve water supply reliability in ways not quantified in Attachment 7?	Yes
16	Other (If the above listed categories do not apply, provide non-monetized benefit description)?	No

1. Provide education benefits

Without project conditions: The Sonoma Ecology Center (SEC) has an extensive environmental education and volunteer program that involves people of all ages in improving the health of the Sonoma Creek watershed. In 2012, the program reached 1,400 people through organized restoration work parties, guided nature walks, curriculum in K-12 classrooms, community

lectures, and youth leadership internships.[1] Without the project, these programs would continue at current levels, subject to the ongoing leadership and funding of the SEC.

With project conditions: The project would support the educational programs of the SEC in several ways that would incrementally improve the quality of environmental education in the Sonoma Creek watershed:

- By expanding the network of trails across the Montini Open Space Preserve (see Recreation benefits below) and adding interpretive signage along a portion of the trail overlooking the proposed stormwater management basin, the project would provide the staff of the SEC with a place to demonstrate how a functional watershed serves the community and its residents. Walking the Montini Open Space Preserve is already part of SEC's K-12 school curriculum, but the location of the new trail adjacent to the Montini stormwater management basin would provide a better place to reinforce the students' classroom education. The SEC estimates that 400 students would visit the trail as part of its educational programs each year.[2]
- By placing signage along the trail, it will engage hikers not affiliated with an official guided trail walk or educational program to learn about stormwater and the Sonoma Creek watershed.[3] These people may be inspired to seek out additional information from the SEC, or participate in its official events. The signage along the trail will be in English, Spanish, and Braille.
- By engaging community members in the restoration of Fryer Creek upstream of the culvert replacement at MacArthur Street and in planting at the stormwater management basin, the SEC would use the project to further its watershed education and community engagement efforts. The SEC estimates that at least 45 to 60 people would be involved with restoration activities directly tied to this project, putting in between 720 and 960 hours of work.[4]

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[1] Personal communication with Caitlin Cornwall, Biologist and Grants Director, Sonoma Ecology Center.

[2] Personal communication with Caitlin Cornwall, Biologist and Grants Director, Sonoma Ecology Center. This represents the number of students who participated in 2012. SEC staff expect the number of participating students to stay the same in the future.

[3] Personal communication with Mark Newhouser, Program Manager, Sonoma Ecology Center.

[4] Personal communication with Mark Newhouser, Program Manager, Sonoma Ecology Center. This estimate is based on 30-40 volunteers per day participating in the Montini Basin planting and 15-20 volunteers per day participating in the Fryer Creek restoration. The Montini Basin planting is scheduled over 5 days, and the Fryer Creek restoration is scheduled over 2 days. Both projects would engage volunteers for a 4-hour workday. We assume that the same volunteers participate each day, but the number of volunteers could exceed 45-60 if different volunteers participated each day.

Evidence for demand and value: Drawing a cause-and-effect relationship between educational efforts and specific water-supply or water-quality outcomes is difficult, but there are several ways the project could produce tangible economic benefits through its education components:

- Outreach for this project specifically, and stormwater-related education made possible by this project over the long term, may increase the public's understand of and support or demand for future watershed-enhancement projects. Increased community support for and participation in future public projects may make future stormwater and watershed restoration projects easier to implement and less costly to complete, resulting in additional water quality and quantity benefits at lower cost to the community.
- The education efforts related to stormwater, illustrated by the stormwater management basin and demonstration project, may inspire homeowners in Sonoma to explore opportunities for installing low-impact-development infiltration features on their property. Increased public interest and support for these features on private property may generate more widespread and long-run improvements in water quality and water management in Sonoma. These private efforts may in turn lower the public costs for managing stormwater.
- Opportunities to participate in educational programs and restoration opportunities improve the well-being of people who choose to participate. These improvements may not result in water-supply or water-quality benefits directly, but they may better people's lives in other ways that have economic importance. Spending time outdoors may improve an individual's emotional and physical health, which constitutes an investment in human capital. Working with others in restoration efforts has the potential to strengthen the relationships among community members, which constitutes an investment in social capital. Both of these effects may contribute to an overall improvement in quality of life.

These effects may be small, but subtle changes arising from education should not be dismissed. For example, interactions among community members in the context of this project may be brief, compared to all of the other interactions that go on day-to-day, but the effect combined with all of the other small effects may accumulate into measurable improvements in quality of life in the long run. Similarly, staff who work with community members on watershed education attest that a public better educated about watershed issues generates dividends in future projects.[5] The efforts of this project, in combination with other sustained efforts in the long run, likely will translate to economic benefits for the community that reach beyond this project.

Timing and duration of benefit: The educational components of this project arising from volunteer engagement in restoration will begin when construction begins. In some cases, they may have already begun. We assume the trail and signage will be complete three years into the

[5] Personal communication with Mark Newhouser, Program Manager, Sonoma Ecology Center.

project, and will persist for the life of the project (50 years), assuming the trails and signs are maintained over the life of the project.

Beneficiaries: The K-12 educational curriculum reaches all students in Sonoma's public schools. All community members have the opportunity to volunteer in SEC's restoration activities. If educational efforts ultimately result in more projects being completed at a reduced cost, all residents of Sonoma will benefit, with benefits potentially extending to all taxpayers of Sonoma and California. The trails and signage will be ADA accessible and available in several languages, to reach as many people as possible.

Sources of uncertainty: Without detailed program evaluations of educational efforts, it is difficult to predict when particular benefits to education, outreach, and public engagement activities might emerge and what their impact might be. The peer-reviewed literature on this topic is scant, and results from one study may not be broadly transferrable to other programs because specifics of program design, delivery, and audience may affect the level of benefits achieved.

2. Provide recreation and access benefits

Without project conditions: Both urban and natural trails intersect the Sonoma Valley, providing opportunities for recreation and transportation by foot, bike, and horseback. The Overlook Trail, a 2.5-mile out-and-back trail with a small loop at the end, offers access to the hills overlooking the City of Sonoma at the northern edge of town. This trail is accessible by a parking lot at the Cemetery, and by a short walk from the Town Square. Bike paths cover much of the City and connect public spaces and commercial districts with residential areas. Other nearby trails offer casual hiking opportunities in Bartholomew Park, about 1.5 miles from Sonoma's Town Square, and in Jack London State Historic Park and Sugarloaf Ridge State Park, several miles outside of Sonoma to the north.[6] Without the project, these and other trails would continue to offer recreational opportunities. Some of these opportunities are available for free, while others, such as the hiking trails at the State Parks, require fees for entry or parking.

With project conditions: The proposed trail system on the Montini Open Space Preserve would offer 1.8 miles of new trails that would connect with the Overlook Trail.[7] This would increase the distance and routes people could hike, and improve access to views to the west. The western-most trail in the new system would offer views of the stormwater management basin, immediately to the west of the proposed trail. The map in Figure 1 shows the location of the new trails, in proximity to the stormwater management basin. Unlike the nearby State Parks, which charge a fee for entry, these trails would be free of charge to all members of the public.

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[6] Best in Sonoma. 2012. *The Best Hiking Trails in Sonoma Valley*. Retrieved December 28, 2012, from http://www.bestinsonoma.com/best_hikes.htm

[7] Sonoma County Agricultural Preservation and Open Space District. 2008. *Montini Open Space Preserve: Management Plan and Initial Study.* November. Pg. 35.

Figure 1. Montini Open Space Preserve Proposed Future Trails

al Trails

Source: Sonoma County Agricultural Preservation and Open Space District

Evidence for demand and value: The trails in the Sonoma Valley are popular with residents and visitors. The Overlook Trail is busy throughout the year, but demand is greatest during the spring and summer months. Official trail counts are not available to estimate the number of people who use the Overlook Trail, but staff with the Sonoma County Agricultural Preservation and Open Space District estimate unofficially that it receives at least 4,500 visits each year (a visit equals one person for one trip), and probably many more.[8]

The new trails would provide economic benefits if they:

- attracted new hikers who wouldn't have hiked elsewhere.
- attracted hikers who would have hiked elsewhere, but are able to enjoy an equivalent experience closer to home.
- improved the hiking experience for hikers who already hike in the area, by providing new amenities they care about such as views of scenery or wildlife, reducing the traffic and encounters with other hikers on the trail, or providing more diverse hiking routes of different lengths.
- reduced the wear-and-tear of the existing trail by spreading out the number of people using the same trail, potentially resulting in avoided maintenance costs.

Quantifying the extent to which any of these effects would occur is difficult, given that data about current trail usage are not collected in a systematic way. Anecdotally, however, individuals familiar with the Overlook Trail and its usage by residents and visitors suggest it is likely that an extended trail network would be popular, providing amenities not currently offered by the existing trail.[9] That the new trail is located close to town means that hikers choosing to use the expanded system over more distant trails would likely benefit from reduced travel costs.

Another source of value comes from people who haven't actually use the trail system, but are willing to pay to have the option of using it at some point in the future, if they choose. This value may partially be incorporated into real estate values nearby the trail–people are willing to pay more to live in a community with opportunities for safe outdoor recreation, even if they don't actually hike or use the trails. Data are not available to determine if this "option value" is an important component of the value of the project's trail expansion, but given that it is walking distance from Sonoma's town center, it is plausible that this would be a source of value.

Timing and duration of benefit: The trail system would be open for use within 3 years after construction begins. Assuming appropriate maintenance is completed, the trails would be

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[8] Personal communication with Leslie Lew, Sonoma County Agricultural Preservation and Open Space District.

[9] Personal communication with Leslie Lew, Sonoma County Agricultural Preservation and Open Space District, and Caitlin Cornwall, Biologist and Grants Director, Sonoma Ecology Center.

available for use for the life of the project (50 years), and would likely extend for years beyond this.

Beneficiaries: Anyone who recreates on the new trail system, or who would value the opportunity to recreate at some point in the future would benefit from the recreational aspects of the project. In particular, the disadvantaged populations surrounding Sonoma will especially benefit from the expansion of the no-fee trail system. These populations are often unable to enjoy recreation opportunities available at the nearby State Parks, which charge a fee, and no-fee recreation areas that are further away (and have higher transportation costs to access).

Sources of uncertainty: The value of recreation associated with the new trail depends on the demand from potential hikers, and the characteristics of the supply of potential hiking opportunities in the area. Both of these variables have the potential to change over time and affect the value of the new trail. It is likely that demand for outdoor recreation in close proximity to an urban area will increase over time, as population grows. If demand for outdoor recreation increases relative to other forms of recreation, that would also increase the value of the trail beyond demand from population growth. Conversely, if popularity of hiking, relative to other forms of recreation decreases, the value would decrease. The close proximity of the proposed trail to downtown Sonoma and the scarcity of open space available for developing public hiking trails in the region suggests that the availability of substitute hiking opportunities with similar proximity won't likely be developed.

3. Help avoid, reduce or resolve various public water resources conflicts

Without project conditions. Sonoma Valley faces future long-term challenges in groundwater management that may lead to public water resources conflicts in the future. Between 1970 and 2000 the area of irrigated agriculture within Sonoma Valley has more than tripled. USGS estimated groundwater storage in Sonoma Valley declined by an average of approximately 800 acre-feet per year with a total decline of 17,300 acre-feet (AF) between 1975 and 2000.[10] These trends are likely to continue; computer modeling conducted as part of the Sonoma Valley Groundwater Management Plan projects that by 2030 increased demand on groundwater will result in a reduction of 16,000 to 22,000 AF from storage in the groundwater basin if management actions, including enhanced recharge projects are not implemented.[11] National, state, and local agencies have determined that there is a growing demand for limited groundwater supplies and concomitant decline in availability.[12]

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[10] U.S. Geological Survey. 2006. "Geohydrological Characterization, Water-Chemistry, and Ground-Water Flow Simulation Model of the Sonoma Valley Area, Sonoma County, California." Scientific Investigations Report 2006-5092. U.S. Department of the Interior.

[11] Sonoma County Water Agency. 2007. *Sonoma Valley Groundwater Management Plan*. December.

[12] Sesser, B., D. DiPietro, and R. Lawton. 2011. "Sonoma Valley Groundwater Recharge Potential Mapping Project." Sonoma County Water Agency. SEC Report No. 20100922. February.

With project conditions. The stormwater management basin, the first of its kind in Sonoma Valley, will increase groundwater recharge to the aquifer between 10 and 150 acre-feet per year, and help manage urban stormwater runoff.[13] The western-most trail in proposed trail system on the Montini Open Space Preserve would offer views of the proposed stormwater management basin, immediately to the west of the proposed trail. Signage along a portion of the trail overlooking the stormwater management basin will explain the challenges and solutions for diminishing groundwater resources and urban stormwater management. Through these interpretive elements, the project may introduce local residents to this concept of water management and inspire them to learn more about water conservation and stormwater management measures they can accomplish at home.

While this project alone will not reverse the trends in declining groundwater storage in Sonoma Valley, part of the solution to Sonoma Valley's groundwater challenges may lie in citizen action and public support for sustainable water management. In the future, these efforts may lead to a marginal improvement in long-term management of groundwater resources that, cumulatively with other efforts, may reduce conflicts over water resources in the future.

Evidence for demand and value. There is evidence stakeholders in Sonoma Valley are willing to spend time and resources on improving groundwater management in the area. For example, SCWA also applied for and obtained an AB303 Grant from DWR for $249,908 for installation of two multilevel groundwater monitoring wells and a groundwater recharge map.[14] Recognizing the potential future problems related to groundwater in Sonoma Valley, Sonoma County Water Agency developed the voluntary, non-regulatory *Sonoma Valley Groundwater Management Plan* (the Plan). The Plan identifies a variety of objectives and actions that a broad range of stakeholders could take to sustain groundwater resources, including improving water use efficiency and conservation and improving the community's awareness of groundwater planning, water resources, and legal issues.[15]

Timing and duration of benefits. If any economic benefit materializes that addresses or helps to alleviate water resource conflicts in and around Sonoma, it would occur after project construction is completed, in 2015.

Beneficiaries: Beneficiaries would include water users, such as residents and agricultural producers in Sonoma Valley. They also would include the water-management agencies that expend funds and taxpayers that contribute funds to manage scare water resources.

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[13] Personal communication with Marcus Trotta, Sonoma County Water Agency.

[14] Sherwood, B. 2011. "Drilling of Sonoma Valley Groundwater Monitoring Wells Commences." Sonoma County Water Agency Press Release. Sonoma, CA. Available online, from: http://www.scwa.ca.gov/lower.php?url=press-releases&article=drilling-of-sonoma-valley-groundwater-monitoring-wells-commences-2011-06-02.

[15] Sonoma County Water Agency. 2007. *Sonoma Valley Groundwater Management Plan*. December.

Sources of uncertainty: This benefit depends on the extent to which people pay attention to and understand the relevant issues and then follow through on that knowledge by modifying their behavior. It also depends on programs and activities that happen concurrently with the project and could contribute cumulatively and synergistically to solving the water-management problem. Given these sources of uncertainty, and those inherent in predicting human behavior, quantifying the benefits attributable to this project in biophysical or economic terms is not possible.

4. Promote health and safety

For the reasons described above in non-monetized benefits #1 (Education) and #2 (Recreation and access) and below in #9 (Other flood-related benefits), the project would contribute positively to the health and well-being of the populations around Sonoma.

6. Wildlife and habitat benefits

Without project conditions: Fryer Creek runs north to south through the southwestern portion of the City of Sonoma. Throughout much of its reach, Fryer Creek's channel is confined by development on both sides.[16] Aquatic habitat is limited by a lack of complexity in these reaches. Most areas have shallow diffuse flow with no pools or riffles and no other features that would provide aquatic habitat.[17] Historically anadromous fish were found in the Fryer Creek watershed, and the creek is currently listed as providing habitat for endangered Steelhead. The draft recovery plan for the Steelhead identifies the culvert at MacArthur Street as a fish-passage barrier that should be removed.[18]

With project conditions: The project will eliminate the MacArthur Street culvert as a fish passage barrier, improve the stream channel and riparian vegetation upstream of the culvert, create riparian and aquatic habitat, and benefit other terrestrial and aquatic species. While potential stream habitat for salmonid populations exists above the culvert and the immediate upstream reaches of Fryer Creek that the project will restore, the quality of that habitat is currently listed as poor. Restoration efforts upstream and downstream on Fryer Creek will continue as financial resources and the biophysical characteristics of the urban landscape permits, although the high-density residential development on both sides of the creek may constrain opportunities for future restoration of highly functional fish habitat. In addition to the

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[16] Horizon Water and Environment. 2009. *Stream Maintenance Program Manual*. Prepared for Sonoma County Water Agency. HWE 08.002. Oakland, California. January.

[17] Horizon Water and Environment. 2009. *Stream Maintenance Program Manual*. Prepared for Sonoma County Water Agency. HWE 08.002. Oakland, California. January.

[18] Personal communication with Josh Fuller, Fish Biologist, National Marine Fisheries Service; the draft recovery plan references this source for the barrier identification: Katopothis, C., L. Micheli, M. Orme, C. Rossi, and R. Branciforte. 2005. "Fish Passage Barrier Assessment in Sonoma Creek Watershed: Final Report." Sonoma Ecology Center. January.

stream habitat described in this section, the project would also create wetland habitat, which we describe and quantify in Annual Benefits of Section D-3 Monetized Benefits Analysis.

Evidence for demand and value: Substantial evidence suggests that Californians are willing to pay to protect endangered Salmonid populations.[19] The fish passage barrier assessment for the endangered Steelhead identifies the MacArthur culvert on Fryer Creek as a barrier to fish accessing habitat in the Sonoma Creek Watershed.[20] To the extent that this project furthers the effort to rebuilding thriving populations of endangered Steelhead in the Bay-Delta region, it would produce economic benefits. Quantifying the benefits attributable to this project in biophysical or economic terms, however, is impossible given the lack of relevant data. Biophysical limitations to habitat quality on Fryer Creek, even in the long run, suggest the benefits are likely small, compared to other identified Steelhead barrier removal opportunities in the region.

Timing and duration of benefit: Economic benefits materializing from improving habitat for endangered Steelhead on Fryer Creek would occur after construction is completed, in 2015. Benefits are more likely to arise on a longer time horizon, especially as additional restoration work is completed in the Fryer Creek watershed.

Beneficiaries: The people of California.

Sources of uncertainty: It is possible that as Steelhead and other salmonid populations improve as a result of other restoration actions in the Sonoma Creek watershed, the Fryer Creek watershed may become more important in the overall strategy to bolster thriving fish populations. Although none are currently planned, if the community pursues large-scale actions to return Fryer Creek to more natural conditions, removing the MacArthur Street fish passage barrier may increase in importance.

9. Other flood-reduction benefits

Mitigating flooding along Fryer Creek will provide benefits in addition to the avoided costs described in Section D1 above. We describe two categories of benefits in this subsection: the reduced need and associated costs for first responders, and avoided environmental damages from flood-caused contamination.

Without project conditions: As described in Section D1, flooding is a problem along Fryer Creek. The extent of flooding and its interactions with the built environment has implications for economic costs related to first responders, including police, fire and ambulance staff. These staff provide critical services during and after flood events. Evacuating residents and workers,

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[19] *See,* for example, Pate, J. and J. Loomis. 1997. "The effect of distance on willingness to pay values: a case study of wetlands and salmon in California." *Ecological Economics* 20(3): 199-207.

[20] Katopothis, C., L. Micheli, M. Orme, C. Rossi, and R. Branciforte. 2005. "Fish Passage Barrier Assessment in Sonoma Creek Watershed: Final Report." Sonoma Ecology Center. January.

directing traffic, administering medical services, directing relief and clean up efforts all rely on first responders.[21] Local public works staff also may incur costs in these activities.

With project conditions. As described in Section D1, the project would reduce the incidence and magnitude of flood damage in the Fryer Creek watershed. As flood extent decreases and fewer properties and public infrastructure are affected, fewer calls may be made to first responders during flood events, and less effort would be required by public agency staff.

Evidence for demand and value: To the extent that the project reduces flooding along Fryer Creek and the number of buildings inundated under different flood events, it will also reduce the demand for, and costs incurred by first responders and other officials. The first responders include emergency services, such as police and fire, provided by the City of Sonoma and the Sonoma Valley Fire and Rescue Authority. Staff from the City of Sonoma public works and planning departments and the Sonoma County Water Agency may also have fewer obligations to respond to flood-related requests in the days and weeks following a flood event.

Flood events also can cause environmental damage when flood waters become contaminated with toxic materials and sewage. For example, flooding that damages fuel tanks can pollute waters with gasoline or diesel. The same would be true for storage tanks at industrial sites that contain solvents or other hazardous chemicals. Even household chemicals can be problematic for the environment and human health when mixed with flood waters. Stormwater from flood events may also overwhelm the sanitary sewer system, causing sewage to enter natural waterways and pose risks for the health of people and animals that come in contact with the water. Depending on the amount and type of contaminants involved, and on the volume and flow of flood waters, contamination can extend miles downstream from the source. Contamination events generate cleanup costs and may require habitat mitigation to restore degraded natural resources. Reducing the flood severity in Sonoma may reduce the risk of these types of events occurring.

Timing and duration of benefit: Other economic benefits from reduced flooding would occur as floods of various magnitudes are avoided over the life of the project. They are most likely to be avoided after construction is completed in 2015, and would continue to accrue over the 50-year life of the project.

Beneficiaries: The taxpayers of the City of Sonoma and other agencies and public entities whose first responders and staff reduce their time responding to periodic flood events.

Sources of uncertainty: The costs of first responders and environmental damages associated with past flood events on Fryer Creek are not well documented. If these costs were minimal historically, the benefits of the project would likely be small, looking forward. If these costs

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[21] Wright, J.M. 2008. *Floodplain Management—Principles and Current Practices.* Chapter 7 Flood Damage Reduction. Federal Emergency Management Agency.

were more substantial in the past, the project would generate larger benefits. While the project may not eliminate first-responder and environmental damage costs during flood events, its effect is almost certainly greater than zero.

10. Improve the overall, long-term management of California groundwater resources

For the reasons described above in non-monetized benefits #1 (Education) and #3 (Avoid, reduce or resolve various public water resources conflicts) and below in monetized benefit #1 (Value of increased groundwater recharge for water supply), the project has the potential to improve the overall, long-term management of California groundwater resources.

12. Provide a long-term solution in place of a short-term one

Without project conditions: Without the project, the City of Sonoma would implement several stormwater management projects, as described in the *Storm Drain Master Plan.*[22] These projects may address localized flooding and limited capacity issues with the storm drainage system, but may not adequately address stream-health degradation and groundwater depletion issues. Over time, the conventional drainage systems outlined in the *Master Plan* will contribute to further degrading recipient waterways and their associated water resources and habitat as well as reducing the opportunities for groundwater recharge. In the absence of corrective measures, the City of Sonoma may eventually need to conduct stream restoration activities to restore the damage to creek channels, or put into place larger and more expensive stormwater management infrastructure to protect public and private property.

With project conditions. The stormwater management basin—the first of its kind to be implemented in Sonoma—would provide a long-term solution that addresses multiple environmental issues at once, including groundwater depletion, high-velocity stormwater flows, and riparian and wetland habitat degradation. It would also incrementally reduce future stream-health degradation downstream, which would contribute to the City of Sonoma's ability to avoid future costs related to stream restoration and other similar activities, and protect the investments in restoration that have already been made.

Evidence for demand and value: The Sonoma Ecology Center and other agencies and organizations in the Sonoma region spend time and money on efforts to restore the ecological health of the Sonoma Creek watershed and its tributaries. These efforts help SCWA and other management agencies meet regulatory requirements for water quality and protecting special-status-species, in addition to other state and national environmental and planning goals and requirements. The Sonoma Ecology Center (SEC) estimates it spends, on average, around $1.5 million per mile to restore creek channels degraded by high-velocity stormwater flows, flood hazards, and other factors exacerbated by the built environment surrounding these natural

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[22] Winzler and Kelly. 2011. *City of Sonoma Storm Drain Master Plan*. Prepared for City of Sonoma Public Works. Sonoma, CA. May.

features.[23] To the extent that installing natural drainage and infiltration features reduce the stresses on these natural systems, it protects the SEC's and other group's investments in restoration.

Timing and duration of benefit: The stormwater management basin would provide these benefits as long as it is functioning—at least 50 years, with proper operation and maintenance. These benefits would begin to accrue after construction is completed in 2015, and would continue to accumulate over the 50-year life of the project.

Beneficiaries: The taxpayers of the City of Sonoma, the funders of Sonoma Ecology Center, and taxpayers for other local, state, and federal agencies who help meet regulatory requirements for water quality and protecting special species habitat in the area.

Sources of uncertainty: The stormwater management basin is designed to provide a wide range of benefits that traditional infrastructure solutions would not achieve. The system is expected to function for a long time period—potentially longer than conventional stormwater infrastructure. The basin is the first in the region, however, and so the understanding of the stream of benefits associated with the project may evolve as it operates. Uncertainty may be larger at first, and decrease as managers learn more about how the project interacts with the surrounding built and natural environment.

15. Improve water supply reliability

For the reasons described above in non-monetized benefits #1 (Education) and #3 (Avoid, reduce or resolve various public water resources conflicts) and below in monetized benefit #1 (Value of increased groundwater recharge for water supply), the project has the potential to improve water supply reliability for the customers who depend on water from the City of Sonoma. The project's public education components, as part of a larger effort to induce conservation and improve infiltration, have the potential to improve groundwater supply reliability for groundwater users throughout the Sonoma Valley.

[23] Personal communication with Mark Newhouser, Program Manager, Sonoma Ecology Center.

Section D3–Monetized Benefits Analysis

The project would produce several benefits for which data are available to quantify in monetary terms. These include increasing groundwater recharge for water supply, increasing the amount of wetland habitat in the Sonoma Valley, and avoiding the costs of several projects that the City of Sonoma and the SCWA would have to do without the project. The present value of these monetized benefits totals $4,099,412 in 2012 dollars, discounted at a rate of 6 percent per year. Tables 14 and 15-1, 15-2, and 15-3 show the annual value of each benefit for the lifespan of the project.

Note to editor: Tables 14, 15-1, 15-2, and 15-3 are included in the accompanying Excel file.

To estimate each benefit, we followed these steps:

- Used a with-vs.-without framework to describe the expected outcome of the project in terms of the expected net increase in the supply of different types of environmental goods and services, the avoided costs of project-related activities, and/or the change in the demand for environmental goods and services.
- Worked with water agency staff and other individuals to identify local information that would help us value the goods and services and avoided costs of the project. Where local information was not directly available, we reviewed the existing economic literature to identify relevant studies that identify the marginal value to Californians of each type of good and service.
- Adjusted each estimate of per-unit value of a good or service or avoided cost to its equivalent value in 2012 dollars, using the update factors provided in Table 10 of the *Proposition 1E Proposal Solicitation Package.* For updating values before 2008, we use the Consumer Price Index.
- Estimated the annual value of the expected increase in the supply of each type of good or service by multiplying the expected annual increase in the supply times the per-unit value, in 2012 dollars. For avoided costs, we placed expenditures in the appropriate years they would have occurred.
- Assessed the uncertainty embodied in each estimate of annual value for each type of good or service, and determined if it is reasonable to conclude that it offers an unbiased representation of the true value of the good or service. In all cases, we selected an estimate of per-unit value that more likely than not yields an *underestimate of the true value* of a project's benefits.

To support the quantification in Tables 14 and 15-1, 15-2, and 15-3, we provide a narrative description for each benefit below that outlines the analytical assumptions, beneficiaries, and sources of uncertainty.

Annual Benefits

1. Value of increased groundwater recharge for water supply

Without project conditions: The Sonoma Valley is one of several basins in Sonoma County that use a combination of groundwater and water delivered from the Russian River. Most groundwater uses are agricultural, primarily for vineyards. Between 1970 and 2000 the area of irrigated agriculture within the area has more than tripled. USGS estimated groundwater pumpage in the area increased from about 6,200 acre-feet in 1974 to about 8,400 acre-feet in 2000. USGS also estimated that from 1975 to 2000 groundwater storage in Sonoma Valley declined by an average of approximately 800 acre-feet per year with a total decline of 17,300 acre-feet.[24] National, state, and local agencies have determined that there is growing demand for limited groundwater supplies. At the same time, groundwater quality is declining in some areas from salt water intrusion.[25]

With project conditions: The stormwater management basin will increase groundwater recharge to the aquifer between 10 and 150 acre-feet per year.[26] The engineers we consulted believe the mid-value of this range is a realistic, if not conservative, estimate of this change. We use this value, 80 AF per year, in our calculations. Although the recharge has the potential to increase the reliability and quality of the aquifer for many groundwater users regionally, the City of Sonoma owns the wells in closest proximity to the recharge basin.[27] The groundwater recharge will raise the overall groundwater levels and likely will raise water levels in two of the city's wells.[28]

Evidence for demand and value: The City of Sonoma depends in part on groundwater to supply its residents with water. The groundwater resources in the Sonoma Valley are limited. Heavy use among municipal, domestic, and agricultural water users has led to a declining groundwater levels in some areas of Sonoma Valley. Saline intrusion has degraded the water quality in the southern extent of the Valley. Recharging the aquifer will provide regional benefits for water users.

Because of the proximity of its wells to the proposed stormwater management basin, the City of Sonoma has the greatest potential to benefit from recharging the aquifer. Already the City of

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[24] U.S. Geological Survey. 2006. "Geohydrological Characterization, Water-Chemistry, and Ground-Water Flow Simulation Model of the Sonoma Valley Area, Sonoma County, California." Scientific Investigations Report 2006-5092. U.S. Department of the Interior.

[25] Sesser, B., D. DiPietro, and R. Lawton. 2011. "Sonoma Valley Groundwater Recharge Potential Mapping Project." Sonoma County Water Agency. SEC Report No. 20100922. February.

[26] Personal communication with Marcus Trotta, Sonoma County Water Agency.

[27] Personal communication with Matt Winkleman, City Engineer, City of Sonoma.

[28] Personal communication with Matt Winkleman, City Engineer, City of Sonoma.

Sonoma purchases additional water supplies from the Sonoma County Water Agency (SCWA), which imports water from the Russian River via the Sonoma Aqueduct. One way to estimate the value of the recharged water is to assume that groundwater recharged through the project is water the City will not need to purchase from the next best available supply, from the Russian River. The SCWA charges the City of Sonoma a wholesale rate of $740 per acre foot for this water.[29] We use this value, multiplied by the number of acre feet of water the project is expected to recharge each year, to estimate the annual value of this benefit at $59,200 with a net present value of $830,457. Using the full range provided by the engineers, the true value of this benefit may lie between $7,400 and $111,000 per year, with a net present value between $103,807 and $1,557,107.

Timing and duration of benefit: The project will start recharging groundwater after construction is complete, in 2015. The recharge is expected to continue at the same rate (which will vary around the average recharge quantity from year to year depending on weather conditions) through the project's lifespan (50 years).

Beneficiaries: In our quantification, we assume the City of Sonoma is the primary beneficiary because of the proximity of its wells to the recharge site. Other potential beneficiaries may include other domestic and agricultural groundwater users who experience improvements in groundwater reliability from the increased recharge.

Sources of uncertainty: All sources of uncertainty surrounding the estimate of groundwater recharge from the project would also affect the economic benefit estimate described here. These biophysical sources of uncertainty are described in more detail in Attachment 7. To the extent that the true recharge volume as a result of the project is closer to the high end of the range presented above, we have underestimated the true value of this benefit. Additional uncertainty arises from the economic value, which represents the price paid for water in 2012. If water continues to become scarcer in California with climate change, and if demand continues to increase for water (both likely scenarios), this value likely underestimates the price the City of Sonoma is likely to pay for water over the next 50 years.

2. Value of wetland habitat

Without project conditions: The project site currently contains small "marginal seasonal wetlands" with sedges and rushes that remain wet during the rainy season and moist during the spring.[30] The site contains 0.42 acres of wetland habitat. Cattle graze the entire site, including the wetland areas.

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[29] Personal communication with Marcus Trotta, Sonoma County Water Agency.

[30] Sonoma County Agricultural Preservation and Open Space District. 2008. "Montini Open Space Preserve Draft Management Plan and Initial Study." November, page 18. (Montini Draft)

With project conditions: The project will expand and improve the site's wetland habitat. The habitat restoration involves grading and expanding the wetland area to 1.8 acres and planting native species. The stormwater management basin will be designed to retain water for only a brief period. However it could maintain saturated soils throughout much of the wet season, supporting native wetland vegetation. Grazing would continue, managed in a way to promote biodiversity. For example, hoof depressions would promote the growth of wetland species, and could support common aquatic invertebrates. The expanded wetland habitat would allow forage opportunities for waterfowl and wading birds during ponded periods. During the dry season, the wetland habitat would transition to upland grass habitat, providing groundcover throughout the basin.

Evidence for demand and value: The value of the improved and expanded wetland habitat is based on estimates of the existence value of wetland habitat as reported in Woodward and Wui (2001). In this case, existence value represents the value of protecting the wetland habitat for current and future generations. Woodward and Wui (2001) estimate the annual nonuse value of habitat of a single-service wetland is $167 to $1,723 per acre.[31] To reflect the uncertainty over the quality of the wetland habitat created by this project, we use the lower end of this range, $167. This value is multiplied by the number of acres of improved wetland based on the net increase in the number of acres of wetland that the project is expected to create, to estimate the annual value of this benefit at $230 per year. The net present value of this annualized benefit from wetland habitat is $3,233.

Timing and duration of benefit: The site would begin providing wetland habitat as soon as construction is complete, in 2015. Assuming appropriate maintenance is performed to sustain operation as intended, the wetland would provide benefits throughout the project lifespan (50 years).

Beneficiaries: Nearby residents and the people of California who value the existence of wetland habitat in the state.

Sources of uncertainty: All sources of uncertainty surrounding the estimate of acres of wetland habitat created would also affect the economic benefit estimate described here. These biophysical sources of uncertainty are described in more detail in Attachment 7. The value described above estimates society's willingness to pay for one fully-restored acre of wetland habitat in North America. This value is generally applicable to seasonal wetland habitat in California.

[31] We adjusted these values from 1990 dollars to 2012 dollars using the Consumer Price Index.

Annual Costs of Avoided Projects

1. Avoided costs of Fryer Creek bypass line capital improvement project

Without project conditions: The City of Sonoma's *Storm Drain Master Plan (*Master Plan*)* identifies as a priority Storm Drain Project CIP-5, a capital project designed to keep stormwater flows from the upper reaches of Fryer Creek from overwhelming the lower portion of the Fryer Creek basin. The project involves diverting stormwater through a bypass line away from Fryer Creek, which is undersized to handle current design stormwater flows and experiences extensive flooding during flood events. Although no funds have specifically been dedicated to the project, the City would likely implement CIP-5 within the 10-year window specified in the Master Plan.[32]

With project conditions: The stormwater management basin will hold water from Fryer Creek, increasing groundwater recharge to the aquifer and reducing drainage to Fryer Creek. As a result of the project, the City of Sonoma will no longer need to complete storm drain project CIP-5.

Evidence for demand and value: The Master Plan estimates the total costs associated with this project—including construction, engineering, and construction management costs—is $2,970,503, spread over a period of three years from 2018–2020.[33] The net present value of avoiding the costs of CIP-5 is $1,980,075.

Timing and duration of benefit: The Master Plan summarizes the suggested timing of the costs of the recommended projects for a ten year period beginning in 2010. It recommends the City of Sonoma outlay expenses for CIP-5 by $1,010,000 in FY 2017-2018, $1,010,000 in FY 2018-2019, and $950,503 in FY 2019-2020.[34] We assume each of these costs would have occurred in 2018, 2019, and 2020, respectively.

Beneficiaries: The project would benefit the taxpayers of the City of Sonoma by allowing the City to spend limited budget resources on other priorities.

Sources of uncertainty: Because the City of Sonoma has not officially dedicated funds to this project, it is possible that within the 10-year planning horizon covered by the Master Plan, the City would not begin construction on CIP-5. If this is the case, the avoided costs calculated in this analysis as occurring in year 2020 would overestimate the total present value of the avoided

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[32] Winzler and Kelly. 2011. *City of Sonoma Storm Drain Master Plan*. Prepared for City of Sonoma Public Works. Sonoma, CA. May.

[33] We adjusted these values from 2011 dollars to 2012 dollars using the update factor in Table 10 of the Stormwater Flood Management Proposal Solicitation Package.

[34] We adjusted these values from 2011 dollars to 2012 dollars using the update factor in Table 10 of the Stormwater Flood Management Proposal Solicitation Package.

costs. Other factors could occur over the next 10 years to change the scope and cost of CIP-5 (either positively or negatively), and these sources of uncertainty are not explicitly factored into the analysis.

2. Avoided costs of Fryer Creek culvert at West MacArthur St. capital improvement project

Without project conditions: The City of Sonoma's Master Plan identifies storm drain project CIP-1, a capital project involving the replacement of the existing culvert on Fryer Creek at MacArthur Street. The project would reduce water surface elevation immediately upstream of the culvert by approximately 1.5 feet. Although no funds have specifically been dedicated to the project, the City would likely implement CIP-5 within the 10-year window specified in the Master Plan.[35]

With project conditions: The proposed culvert replacement that is part of this project is a variation of the CIP-1, but would have several modifications to improve its function and support the natural ecological conditions in Fryer Creek. By replacing the MacArthur Street culvert as part of this project, the City of Sonoma will no longer need to complete storm drain project CIP-1.

Evidence for demand and value: The Master Plan estimates the total costs associated with this project—including construction, engineering, and construction management costs—is $1,253,306.[36] The net present value of the benefit from the avoided costs of the storm drain capital improvement project is $1,147,798.

Timing and duration of benefit: The Master Plan summarizes the timing of the costs of the recommended projects for a ten year period beginning in 2010. It recommends the City of Sonoma outlay expenses for CIP-1 by $600,000 in FY 2011-2012 and $640,897 in FY 2012-2013. Given that these costs have not yet occurred, we delay each by one year in our assumptions so that they occur in 2013 and 2014 in the attached Excel files.

Beneficiaries: The project would benefit the taxpayers of the City of Sonoma by allowing the City to spend limited budget resources on other priorities.

Sources of uncertainty: Because the City of Sonoma has not officially dedicated funds to this project, it is possible that within the 10-year planning horizon covered by the Master Plan, the City would not begin construction on CIP-1. If this is the case, the avoided costs calculated in this analysis as occurring in year 2013 and 2014 would overestimate the total present value of the avoided costs. Other factors could occur over the next 10 years to change the scope and cost

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[35] Winzler and Kelly. 2011. *City of Sonoma Storm Drain Master Plan*. Prepared for City of Sonoma Public Works. Sonoma, CA. May.

[36] We adjusted these values from 2011 dollars to 2012 dollars using the update factor in Table 10 of the Stormwater Flood Management Proposal Solicitation Package.

of CIP-1 (either positively or negatively), and these sources of uncertainty are not explicitly factored into the analysis.

3. Avoided costs of sediment dredging in Fryer Creek

Without project conditions: Fryer Creek is generally dominated by fine sands and silts.[37] These contribute to degraded water quality in the creek and downstream water bodies. Much of this sediment accumulates above the MacArthur street culvert around Arroyo Way and on the Lower East Fryer Creek reach. As a result, the SCWA expects to pay for sediment removal on both of these sections every ten years.

With project conditions: Replacing the MacArthur street culvert will remove a constriction point in the stream channel and reduce sediment accumulation upstream. The stormwater management basin will also retain stormwater destined for Fryer Creek, removing sediment from stormwater before it reaches Fryer Creek. As a result of both components of the project, less sediment will accumulate on the reaches of Fryer Creek, including above the MacArthur street culvert and on Lower East Fryer Creek. This will reduce the costs of sediment dredging projects on both of these sections.

Evidence for demand and value: By removing the culvert at MacArthur Creek and replacing it with a properly-sized culvert with an invert (bottom) elevation that would match the stream bed profile and with the stormwater management basin, the project would reduce the costs the SCWA, its ratepayers in Sonoma Valley, and other property owners incur to remove sediment from Fryer Creek upstream of the culvert and on Lower East Fork Creek. Based on previous maintenance costs and experience in similar drainages, every ten years, SCWA expects to pay approximately $100,000 in sediment removal fees upstream of the culvert and $45,000 in sediment removal fees for the section of Lower East Fork Creek every 10 years.[38] Assuming SCWA will still need to pay for some sediment removal and vegetation control, SCWA engineers expect the project will reduce these costs by approximately 75 percent.[39] The net present value of the benefit from the avoided costs of sediment dredging in these sections of Fryer Creek is $137,848.

Timing and duration of benefit: All aspects of the project would begin removing sediment from stormwater when it begins operation, after construction is completed in 2015. Assuming appropriate maintenance is completed throughout the project's life, this benefit would accrue annually for the lifespan of the project (50 years). SCWA completed sediment removal on this reach between MacArthur and Bettencourt in 2011.[40] Assuming these projects occur every ten

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[37] Horizon Water and Environment. 2009. *Stream Maintenance Program Manual*. Prepared for Sonoma County Water Agency. HWE 08.002. Oakland, California. January.

[38] Personal communication with Greg Guensch, Engineer/Geomorphologist, Sonoma County Water Agency.

[39] Personal communication with Greg Guensch, Engineer/Geomorphologist, Sonoma County Water Agency.

[40] Personal communication with Greg Guensch, Engineer/Geomorphologist, Sonoma County Water Agency.

years, SCWA would have paid for the next sediment removal project in 2021. We include $100,000 in avoided costs for sediment removal in that year, and subsequently again every ten years for the lifespan of the project. SCWA also completed sediment removal on the East Fryer Creek in 2012. Assuming these projects also occur every ten years and coincide with sediment removal on the reach between MacArthur and Bettencourt, we include an additional $45,000 in avoided costs for sediment removal in 2021 and subsequently again every ten years for the lifespan of the project. We reduce these collective avoided costs by 75 percent to account for the costs of continued, though dramatically reduced, sediment and vegetation removal activities on Fryer Creek after the project's completion.

Beneficiaries: The project would benefit the ratepayers of the SCWA by allowing the agency to spend limited budget resources on other priorities.

Sources of uncertainty: All sources of uncertainty surrounding the estimate of sediment removal from the project would also affect the economic benefit estimate described here. These biophysical sources of uncertainty are described in more detail in Attachment 7. Additional sources of uncertainty surround the costs of sediment removal in the future, including potential changes in sediment sources and stream features upstream of the culvert that could change the need for sediment removal, or the equipment and techniques used in the future. This could mean the historic costs underestimate or overestimate the future costs for sediment removal.

By allowing the sediment to pass through the culvert, the project theoretically has the potential to increase sediment buildup downstream of the project. This sediment could impact water quality or get trapped at another point downstream of the project, requiring sediment removal and possibly increasing costs for SCWA, its ratepayers, and other property owners. The engineers and stream maintenance staff at the SCWA and the engineer from ESA PWA that performed the hydraulic analyses noted that the channel has few constriction points downstream and generally adequate velocities below the MacArthur culvert, and thus would likely be able to transport the increased sediment load without building up downstream.[41]

Summary of Non-Monetized and Monetized Benefits Analysis

The present value of the monetized benefits for the project totals $4,099,412 in 2012 dollars, discounted at a rate of 6 percent per year. This value includes the monetary benefits generated annually (Table 14) and the avoided costs of projects that likely would have occurred without the proposed project (Tables 15-1, 15-2, and 15-3). This value does not include the benefits described in Section D2 and in Table 13, for which sufficient data are unavailable to quantify or monetize. Where appropriate, we selected an estimate of per-unit value that more likely than not yields an underestimate of the true value of the project's benefits. For these reasons, the

[41] Personal communication with Greg Guensch, Engineer/Geomorphologist, Jon Niehaus, W.A. Coordinator-Stream Maintenance, and Keenan Foster, Senior Environmental Specialist for the Sonoma County Water Agency; also Carlos Diaz, PE, ESA PWA.

analysis likely underestimates the monetary benefits of this project, and the quantified monetary value almost certainly underestimates the total benefits of the project to the people of California.

Table 13 – Non-monetized Benefits Checklist		
No.	Question	**Enter "Yes", "No" or "Neg"**
	Community/Social Benefits **Will the proposal**	
1	**Provide education or technology benefits?**	**Yes**
	Examples are not limited to, but may include: - Include educational features that should result in water supply, water quality, or flood damage reduction benefits? - Develop, test or document a new technology for water supply, water quality, or flood damage reduction management? - Provide some other education or technological benefit?	
2	**Provide social recreation or access benefits?**	**Yes**
	Examples are not limited to, but may include: - Provide new or improved outdoor recreation opportunities? - Provide more access to open space? - Provide some other recreation or public access benefit?	
3	**Help avoid, reduce or resolve various public water resources conflicts?**	**Yes**
	Examples are not limited to, but may include: - Provide more opportunities for public involvement in water management? - Help avoid or resolve an existing conflict as evidenced by recurring fines or litigation? - Help meet an existing state mandate (e.g., water quality, water conservation, flood control)?	
4	**Promote social health and safety?**	**Yes**
	Examples are not limited to, but may include: - Increase urban water supply reliability for fire-fighting and critical services following seismic events? - Reduce risk to life from dam failure or flooding? - Reduce exposure to water-related hazards?	
5	**Have other social benefits?**	**No**
	Examples are not limited to, but may include: - Redress or increase inequitable distribution of environmental burdens? - Have disproportionate beneficial or adverse effects on disadvantaged communities, Native Americans, or other distinct cultural groups?	
	Environmental Stewardship Benefits: **Will the proposal**	
6	**Benefit wildlife or habitat in ways that were not quantified in Attachment 7?**	**Yes**
	Examples are not limited to, but may include: - Cause an increase in the amount or quality of terrestrial, aquatic, riparian or wetland habitat? - Contribute to an existing biological opinion or recovery plan for a listed special status species? - Preserve or restore designated critical habitat of a listed species? - Enhance wildlife protection or habitat?	
7	**Improve water quality in ways that were not quantified in Attachment 7?**	**No**
	Examples are not limited to, but may include: - Cause an improvement in water quality in an impaired water body or sensitive habitat? - Prevent water quality degradation? - Cause some other improvement in water quality?	
8	**Reduce net emissions in ways that were not quantified in Attachment 7?**	**No**
	Examples are not limited to, but may include: - Reduce net production of greenhouse gasses? - Reduce net emissions of other harmful chemicals into the air or water?	
9	**Provide other environmental stewardship benefits, other than those claimed in Sections D1, D3 or D4?**	**Yes**
	Sustainability Benefits: **Will the proposal**	
10	**Improve the overall, long-term management of California groundwater resources?**	**Yes**
	Examples are not limited to, but may include: - Reduce extraction of non-renewable groundwater? - Promote aquifer storage or recharge?	
11	**Reduce demand for net diversions for the regions from the Delta?**	**No**

Table 13 – Non-monetized Benefits Checklist		
No.	Question	**Enter "Yes", "No" or "Neg"**
12	**Provide a long-term solution in place of a short-term one?**	**Yes**
	Examples are not limited to, but may include: - Replace a temporary water supply with a more permanent supply? - Replace a temporary water quality solution with a more permanent solution? - Replace temporary flood control management with a more permanent solution? - Replace temporary habitat with a more permanent solution?	
13	**Reduce water consumption on a permanent basis?**	**No**
14	**Promote energy savings or replace fossil fuel based energy sources with renewable energy and resources?**	**No**
	Examples are not limited to, but may include: - Reduce net energy use on a permanent basis? - Increase renewable energy production? - Include new buildings or modify buildings to include certified LEED features? - Provide a net increase in recycling or reuse of materials? - Replace unsustainable land or water management practices with recognized sustainable practices?	
15	**Improve water supply reliability in ways not quantified in Attachment 7?**	**Yes**
	Examples are not limited to, but may include: - Provide a more flexible mix of water sources? - Reduce likelihood of catastrophic supply outages? - Reduce supply uncertainty? - Reduce supply variability?	
16	**Other (If the above listed categories do not apply, provide non-monetized benefit description)?**	**No**

Table 14 – Annual Benefit
(All benefits should be in 2012 dollars)

Project: Sonoma City Watsheds Project

(a) Year	(b) Type of Benefit	(c) Measure of Benefit (Units)	(d) Without Project	(e) With Project	(f) Change Resulting from Project (e) – (d)	(g) Unit $ Value (1)	(h) Annual $ Value (1) (f) x (g)	(i) Discount Factor (1)	(j) Discounted Benefits (1) (h) x (i)
2012	Increased groundwater recharge for water	Acre-feet of water	0	0	0.0	$740	$0	1.000	**$ -**
	Value of improved wetland habitat	Acres of habitat	0	0	0.0	$167	$0	1.000	**$ -**
2013	Increased groundwater recharge for water	Acre-feet of water	0	0	0.0	$740	$0	0.943	**$ -**
	Value of improved wetland habitat	Acres of habitat	0	0	0.0	$167	$0	0.943	**$ -**
2014	Increased groundwater recharge for water	Acre-feet of water	0	0	0.0	$740	$0	0.890	**$ -**
	Value of improved wetland habitat	Acres of habitat	0	0	0.0	$167	$0	0.890	**$ -**
2015	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.840	**$ 49,705.46**
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.840	**$ 193.50**
2016	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.792	**$ 46,891.94**
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.792	**$ 182.55**
2017	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.747	**$ 44,237.68**
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.747	**$ 172.21**
2018	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.705	**$ 41,733.66**
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.705	**$ 162.47**
2019	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.665	**$ 39,371.38**
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.665	**$ 153.27**
2020	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.627	**$ 37,142.81**
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.627	**$ 144.59**
2021	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.592	**$ 35,040.39**
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.592	**$ 136.41**
2022	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.558	**$ 33,056.97**
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.558	**$ 128.69**
2023	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.527	**$ 31,185.82**
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.527	**$ 121.40**
2024	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.497	**$ 29,420.59**
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.497	**$ 114.53**
2025	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.469	**$ 27,755.27**
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.469	**$ 108.05**
2026	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.442	**$ 26,184.22**
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.442	**$ 101.93**
2027	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.417	**$ 24,702.09**
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.417	**$ 96.16**
2028	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.394	**$ 23,303.86**
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.394	**$ 90.72**
2029	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.371	**$ 21,984.77**
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.371	**$ 85.58**
2030	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.350	**$ 20,740.35**
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.350	**$ 80.74**
2031	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.331	**$ 19,566.37**
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.331	**$ 76.17**
2032	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.312	**$ 18,458.84**
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.312	**$ 71.86**
2033	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.294	**$ 17,414.00**
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.294	**$ 67.79**
2034	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.278	**$ 16,428.30**
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.278	**$ 63.95**
2035	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.262	**$ 15,498.40**
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.262	**$ 60.33**
2036	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.247	**$ 14,621.13**
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.247	**$ 56.92**
2037	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.233	**$ 13,793.52**
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.233	**$ 53.70**
2038	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.220	**$ 13,012.75**
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.220	**$ 50.66**
2039	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.207	**$ 12,276.18**
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.207	**$ 47.79**
2040	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.196	**$ 11,581.30**
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.196	**$ 45.08**
2041	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.185	**$ 10,925.76**
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.185	**$ 42.53**
2042	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.174	**$ 10,307.32**
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.174	**$ 40.13**
2043	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.164	**$ 9,723.89**
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.164	**$ 37.85**
2044	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.155	**$ 9,173.48**
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.155	**$ 35.71**
2045	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.146	**$ 8,654.22**
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.146	**$ 33.69**
2046	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.138	**$ 8,164.36**
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.138	**$ 31.78**
2047	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.130	**$ 7,702.23**

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	Type of Benefit	Measure of Benefit (Units)	Without Project	With Project	Change Resulting from Project (e) – (d)	Unit $ Value (1)	Annual $ Value (1) (f) x (g)	Discount Factor (1)	Discounted Benefits (1) (h) x (i)
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.130	$ 29.98
2048	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.123	$ 7,266.25
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.123	$ 28.29
2049	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.116	$ 6,854.96
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.116	$ 26.69
2050	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.109	$ 6,466.94
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.109	$ 25.18
2051	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.103	$ 6,100.89
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.103	$ 23.75
2052	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.097	$ 5,755.55
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.097	$ 22.41
2053	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.092	$ 5,429.77
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.092	$ 21.14
2054	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.087	$ 5,122.42
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.087	$ 19.94
2055	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.082	$ 4,832.47
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.082	$ 18.81
2056	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.077	$ 4,558.94
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.077	$ 17.75
2057	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.073	$ 4,300.88
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.073	$ 16.74
2058	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.069	$ 4,057.44
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.069	$ 15.80
2059	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.065	$ 3,827.77
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.065	$ 14.90
2060	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.061	$ 3,611.11
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.061	$ 14.06
2061	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.058	$ 3,406.70
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.058	$ 13.26
2062	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.054	$ 3,213.87
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.054	$ 12.51
2063	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.051	$ 3,031.95
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.051	$ 11.80
2064	Increased groundwater recharge for water	Acre-feet of water	0	80	80.0	$740	$59,200	0.048	$ 2,860.33
	Value of improved wetland habitat	Acres of habitat	0.42	1.8	1.4	$167	$230	0.048	$ 11.14
								Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)	$ 833,690.48

Comments:

(1) Complete these columns if dollar value is being claimed for the benefit.

Table 15– Annual Costs of Avoided Projects

(All avoided costs should be in 2012 dollars)

Project: Sonoma City Watersheds Project

	Costs				Discounting Calculations	
(a)	(b)	(c)	(d)	(e)	(f)	(g)
Year	Alternative (Avoided Project Name): Fryer Creek bypass line capital improvement project Avoided Project Description: The project would divert stormwater through a bypass line away from Fryer Creek, which is undersized to handle currently designed stormwater flows and experiences extensive flooding during flood events.				Discount Factor	Discounted Costs (e) x (f)
	Avoided Capital Costs	Avoided Replacement Costs	Avoided Operations and Maintenance Costs	Total Cost Avoided for Individual Alternatives (b) + (c) + (d)		
2012				$0	1.000	**$0**
2013				$0	0.943	**$0**
2014				$0	0.890	**$0**
2015				$0	0.840	**$0**
2016				$0	0.792	**$0**
2017				$0	0.747	**$0**
2018	$1,010,000			$1,010,000	0.705	**$712,010**
2019	$1,010,000			$1,010,000	0.665	**$671,708**
2020	$950,503			$950,503	0.627	**$596,357**
2021				$0	0.592	**$0**
2022				$0	0.558	**$0**
2023				$0	0.527	**$0**
2024				$0	0.497	**$0**
2025				$0	0.469	**$0**
2026				$0	0.442	**$0**
2027				$0	0.417	**$0**
2028				$0	0.394	**$0**
2029				$0	0.371	**$0**
2030				$0	0.350	**$0**
2031				$0	0.331	**$0**
2032				$0	0.312	**$0**
2033				$0	0.294	**$0**
2034				$0	0.278	**$0**
2035				$0	0.262	**$0**
2036				$0	0.247	**$0**
2037				$0	0.233	**$0**
2038				$0	0.220	**$0**
2039				$0	0.207	**$0**
2040				$0	0.196	**$0**
2041				$0	0.185	**$0**
2042				$0	0.174	**$0**
2043				$0	0.164	**$0**
2044				$0	0.155	**$0**
2045				$0	0.146	**$0**
2046				$0	0.138	**$0**
2047				$0	0.130	**$0**
2048				$0	0.123	**$0**
2049				$0	0.116	**$0**
2050				$0	0.109	**$0**
2051				$0	0.103	**$0**

	Costs				Discounting Calculations	
(a)	(b)	(c)	(d)	(e)	(f)	(g)
Year	Alternative (Avoided Project Name): Fryer Creek bypass line capital improvement project Avoided Project Description: The project would divert stormwater through a bypass line away from Fryer Creek, which is undersized to handle currently designed stormwater flows and experiences extensive flooding during flood events.				Discount Factor	Discounted Costs (e) x (f)
	Avoided Capital Costs	Avoided Replacement Costs	Avoided Operations and Maintenance Costs	Total Cost Avoided for Individual Alternatives (b) + (c) + (d)		
2052				$0	0.097	**$0**
2053				$0	0.092	**$0**
2054				$0	0.087	**$0**
2055				$0	0.082	**$0**
2056				$0	0.077	**$0**
2057				$0	0.073	**$0**
2058				$0	0.069	**$0**
2059				$0	0.065	**$0**
2060				$0	0.061	**$0**
2061				$0	0.058	**$0**
2062				$0	0.054	**$0**
2063				$0	0.051	**$0**
2064				$0	0.048	**$0**
Total Present Value of Discounted Costs (Sum of Column (g))						**$1,980,075**
(%) Avoided Cost Claimed by Project						**100%**
Total Present Value of Discounted Avoided Project Costs Claimed by alternative Project (Total Present Value of Discounted Costs x % Avoided Cost Claimed by Project)						**$1,980,075**
Comments:						

Table 15– Annual Costs of Avoided Projects

(All avoided costs should be in 2012 dollars)

Project: Sonoma City Watersheds Project

	Costs				Discounting Calculations	
(a)	(b)	(c)	(d)	(e)	(f)	(g)
Year	Alternative (Avoided Project Name): Fryer Creek Culvert at West MacArthur Street Capital Improvement Project Avoided Project Description: The project would replace the existing culvert on Fryer Creek at MacArthur Street, reducing surface water elevation upstream of the culvert.				Discount Factor	Discounted Costs (e) x (f)
	Avoided Capital Costs	Avoided Replacement Costs	Avoided Operations and Maintenance Costs	Total Cost Avoided for Individual Alternatives (b) + (c) + (d)		
2012				$0	1.000	**$0**
2013	$606,000			$606,000	0.943	**$571,698**
2014	$647,306			$647,306	0.890	**$576,100**
2015				$0	0.840	**$0**
2016				$0	0.792	**$0**
2017				$0	0.747	**$0**
2018				$0	0.705	**$0**
2019				$0	0.665	**$0**
2020				$0	0.627	**$0**
2021				$0	0.592	**$0**
2022				$0	0.558	**$0**
2023				$0	0.527	**$0**
2024				$0	0.497	**$0**
2025				$0	0.469	**$0**
2026				$0	0.442	**$0**
2027				$0	0.417	**$0**
2028				$0	0.394	**$0**
2029				$0	0.371	**$0**
2030				$0	0.350	**$0**
2031				$0	0.331	**$0**
2032				$0	0.312	**$0**
2033				$0	0.294	**$0**
2034				$0	0.278	**$0**
2035				$0	0.262	**$0**
2036				$0	0.247	**$0**
2037				$0	0.233	**$0**
2038				$0	0.220	**$0**
2039				$0	0.207	**$0**
2040				$0	0.196	**$0**
2041				$0	0.185	**$0**
2042				$0	0.174	**$0**
2043				$0	0.164	**$0**
2044				$0	0.155	**$0**
2045				$0	0.146	**$0**
2046				$0	0.138	**$0**
2047				$0	0.130	**$0**
2048				$0	0.123	**$0**
2049				$0	0.116	**$0**
2050				$0	0.109	**$0**
2051				$0	0.103	**$0**

	Costs				Discounting Calculations	
(a)	(b)	(c)	(d)	(e)	(f)	(g)
Year	Alternative (Avoided Project Name): Fryer Creek Culvert at West MacArthur Street Capital Improvement Project Avoided Project Description: The project would replace the existing culvert on Fryer Creek at MacArthur Street, reducing surface water elevation upstream of the culvert.				Discount Factor	Discounted Costs (e) x (f)
	Avoided Capital Costs	Avoided Replacement Costs	Avoided Operations and Maintenance Costs	Total Cost Avoided for Individual Alternatives (b) + (c) + (d)		
2052				$0	0.097	**$0**
2053				$0	0.092	**$0**
2054				$0	0.087	**$0**
2055				$0	0.082	**$0**
2056				$0	0.077	**$0**
2057				$0	0.073	**$0**
2058				$0	0.069	**$0**
2059				$0	0.065	**$0**
2060				$0	0.061	**$0**
2061				$0	0.058	**$0**
2062				$0	0.054	**$0**
2063				$0	0.051	**$0**
2064				$0	0.048	**$0**
Total Present Value of Discounted Costs (Sum of Column (g))						**$1,147,798**
(%) Avoided Cost Claimed by Project						**100%**
Total Present Value of Discounted Avoided Project Costs Claimed by alternative Project (Total Present Value of Discounted Costs x % Avoided Cost Claimed by Project)						**$1,147,798**
Comments:						

Table 15– Annual Costs of Avoided Projects (All avoided costs should be in 2012 dollars) Project: Sonoma City Watersheds Project						
	Costs				Discounting Calculations	
(a)	(b)	(c)	(d)	(e)	(f)	(g)
Year	Alternative (Avoided Project Name): Sediment Removal Avoided Project Description: By replacing the MacArthur culvert and reducing sediment dispostion, the project avoids sediment removal fees every 10 years.				Discount Factor	Discounted Costs (e) x (f)
	Avoided Capital Costs	Avoided Replacement Costs	Avoided Operations and Maintenance Costs	Total Cost Avoided for Individual Alternatives (b) + (c) + (d)		
2012				$0	1.000	**$0**
2013				$0	0.943	**$0**
2014				$0	0.890	**$0**
2015				$0	0.840	**$0**
2016				$0	0.792	**$0**
2017				$0	0.747	**$0**
2018				$0	0.705	**$0**
2019				$0	0.665	**$0**
2020				$0	0.627	**$0**
2021	$145,000			$145,000	0.592	**$85,825**
2022				$0	0.558	**$0**
2023				$0	0.527	**$0**
2024				$0	0.497	**$0**
2025				$0	0.469	**$0**
2026				$0	0.442	**$0**
2027				$0	0.417	**$0**
2028				$0	0.394	**$0**
2029				$0	0.371	**$0**
2030				$0	0.350	**$0**
2031	$145,000			$145,000	0.331	**$47,924**
2032				$0	0.312	**$0**
2033				$0	0.294	**$0**
2034				$0	0.278	**$0**
2035				$0	0.262	**$0**
2036				$0	0.247	**$0**
2037				$0	0.233	**$0**
2038				$0	0.220	**$0**
2039				$0	0.207	**$0**
2040				$0	0.196	**$0**
2041	$145,000			$145,000	0.185	**$26,761**
2042				$0	0.174	**$0**
2043				$0	0.164	**$0**
2044				$0	0.155	**$0**
2045				$0	0.146	**$0**
2046				$0	0.138	**$0**
2047				$0	0.130	**$0**
2048				$0	0.123	**$0**
2049				$0	0.116	**$0**
2050				$0	0.109	**$0**
2051	$145,000			$145,000	0.103	**$14,943**

	Costs				Discounting Calculations	
(a)	(b)	(c)	(d)	(e)	(f)	(g)
Year	Alternative (Avoided Project Name): Sediment Removal Avoided Project Description: By replacing the MacArthur culvert and reducing sediment dispostion, the project avoids sediment removal fees every 10 years.				Discount Factor	Discounted Costs (e) x (f)
	Avoided Capital Costs	Avoided Replacement Costs	Avoided Operations and Maintenance Costs	Total Cost Avoided for Individual Alternatives (b) + (c) + (d)		
2052				$0	0.097	**$0**
2053				$0	0.092	**$0**
2054				$0	0.087	**$0**
2055				$0	0.082	**$0**
2056				$0	0.077	**$0**
2057				$0	0.073	**$0**
2058				$0	0.069	**$0**
2059				$0	0.065	**$0**
2060				$0	0.061	**$0**
2061	$145,000			$145,000	0.058	**$8,344**
2062				$0	0.054	**$0**
2063				$0	0.051	**$0**
2064				$0	0.048	**$0**
Total Present Value of Discounted Costs (Sum of Column (g))						**$183,798**
(%) Avoided Cost Claimed by Project						**75%**
Total Present Value of Discounted Avoided Project Costs Claimed by alternative Project (Total Present Value of Discounted Costs x % Avoided Cost Claimed by Project)						**$137,848**
Comments:						

Table 11 – Calculation of Expected Annual Damage								
Proposal Title: City Watersheds of Sonoma Valley								
Hydrologic Event	Event Exceedance Probability	Expected Event Damage		Interval Probability	Average Damage in Interval		Average Damage in Interval times Interval Probability	
		Without Project	With Project		Without Project	With Project	Without Project	With Project
(a)	(b)	(f)	(g)	(i)	(j)	(k)	(l)	(m)
		(c) x (d)	(c) x (e)	from (b)	from (f)	from (g)	(i) x (j)	(i) x (k)
5-year	0.20	$0	$0	0.2	$0	$0	$0	$0
10-Year	0.10	$57,000	$22,500	0.10	$28,500	$11,250	$2,850	$1,125
25-yr	0.04	$943,737	$582,943	0.06	$500,369	$302,722	$30,022	$18,163
100-yr	0.01	$1,090,126	$1,082,626	0.03	$1,016,932	$832,785	$30,508	$24,984
200-yr	0.000	$1,090,126	$1,082,626	0.01	$1,090,126	$1,082,626	$10,901	$10,826
Expected Annual Damages, Without and With Project							$74,281	$55,098

Table 12 – Present Value of Expected Annual Damage Benefits Project: City Watersheds of Sonoma Valley			
Page	Expected Annual Damage Without Project (1)		**$74,281**
(b)	Expected Annual Damage With Project (1)		**$55,098**
(c)	Expected Annual Benefit	(a) – (b)	**$19,183**
(d)	Present Value Coefficient (2)		**15.76**
(e)	**Present Value of Future Benefits** **Transfer to Table 17, column (d).**	**(c) x (d)**	**$302,324**

(1) This program assumes no land use changes in the floodplain. So, EAD will be constant over analysis period.

(2) 6% discount rate; 50-year analysis period (could vary depending upon lifecycle of project).

Table 16 – Annual Costs of Project

(All costs should be in 2012 Dollars)

Project: City Watersheds of Sonoma Valley

	Initial Costs Grand Total Cost from Table 6 (row (i), column (d))	Adjusted Grant Total Cost[1]	Annual Costs [2]						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2012	$ 206,750				Detention Basins; Sed removal; veg maint.	Veg Replacement		$206,750	1.000	$206,750
2013	$ 413,500							$413,500	0.943	$389,931
2014	$ 3,101,250							$3,101,250	0.89	$2,760,113
2015	$ 413,500							$413,500	0.84	$347,340
2016			$ 300		$ 6,000			$6,300	0.792	$4,990
2017			$ 300		$ 6,000			$6,300	0.747	$4,706
2018			$ 300		$ 6,000			$6,300	0.705	$4,442
2019			$ 300		$ 6,000			$6,300	0.665	$4,190
2020			$ 300		$ 6,000			$6,300	0.627	$3,950
2021			$ 3,500		$ 50,000	$ 20,000		$73,500	0.592	$43,512
2022			$ 300		$ 6,000			$6,300	0.558	$3,515
2023			$ 300		$ 6,000			$6,300	0.527	$3,320
2024			$ 300		$ 6,000			$6,300	0.497	$3,131
2025			$ 300		$ 6,000			$6,300	0.469	$2,955
2026			$ 1,500		$ 30,000			$31,500	0.442	$13,923
2027			$ 300		$ 6,000			$6,300	0.417	$2,627
2028			$ 300		$ 6,000			$6,300	0.394	$2,482
2029			$ 300		$ 6,000			$6,300	0.371	$2,337
2030			$ 300		$ 6,000			$6,300	0.35	$2,205
2031			$ 3,500		$ 50,000	$ 20,000		$73,500	0.331	$24,329
2032			$ 300		$ 6,000			$6,300	0.312	$1,966
2033			$ 300		$ 6,000			$6,300	0.294	$1,852
2034			$ 300		$ 6,000			$6,300	0.278	$1,751
2035			$ 300		$ 6,000			$6,300	0.262	$1,651
2036			$ 1,500		$ 30,000			$31,500	0.247	$7,781
2037			$ 300		$ 6,000			$6,300	0.233	$1,468
2038			$ 300		$ 6,000			$6,300	0.22	$1,386
2039			$ 300		$ 6,000			$6,300	0.207	$1,304
2040			$ 300		$ 6,000			$6,300	0.196	$1,235
2041			$ 3,500		$ 50,000	$ 20,000		$73,500	0.185	$13,598
2042			$ 300		$ 6,000			$6,300	0.174	$1,096
2043			$ 300		$ 6,000			$6,300	0.164	$1,033
2044			$ 300		$ 6,000			$6,300	0.155	$977
2045			$ 300		$ 6,000			$6,300	0.146	$920
2046			$ 1,500		$ 30,000			$31,500	0.138	$4,347
2047			$ 300		$ 6,000			$6,300	0.13	$819
2048			$ 300		$ 6,000			$6,300	0.123	$775
2049			$ 300		$ 6,000			$6,300	0.116	$731
2050			$ 300		$ 6,000			$6,300	0.109	$687
2051			$ 3,500		$ 50,000	$ 20,000		$73,500	0.103	$7,571
2052			$ 300		$ 6,000			$6,300	0.097	$611
2053			$ 300		$ 6,000			$6,300	0.092	$580
2054			$ 300		$ 6,000			$6,300	0.087	$548
2055			$ 300		$ 6,000			$6,300	0.082	$517
2056			$ 1,500		$ 30,000			$31,500	0.077	$2,426
2057			$ 300		$ 6,000			$6,300	0.073	$460
2058			$ 300		$ 6,000			$6,300	0.069	$435
2059			$ 300		$ 6,000			$6,300	0.065	$410
2060			$ 300		$ 6,000			$6,300	0.061	$384

Table 16 – Annual Costs of Project

(All costs should be in 2012 Dollars)

Project: City Watersheds of Sonoma Valley

	Initial Costs Grand Total Cost from Table 6 (row (i), column (d))	Adjusted Grant Total Cost[1]	Annual Costs [2]						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2061			$ 3,500		$ 50,000	$ 20,000		$73,500	0.058	$4,263
2062			$ 300		$ 6,000			$6,300	0.054	$340
2063			$ 300		$ 6,000			$6,300	0.051	$323
2064			$ 300		$ 6,000			$6,300	0.048	$304
2065			$ 300		$ 6,000			$6,300	0.045	$284
2066			$ 300		$ 6,000			$6,300	0.042	$267
Project Life	$4,135,000									
Total Present Value of Discounted Costs (Sum of Column (i))										$3,895,842

The funding source for annual operations and maintenance is the Sonoma County Water Agency Flood Control Zone 3A property taxes.
Maintenance costs assume two staff, 8hrs/month x 12 months every 5 years to remove sediment, perform inspections, conduct monitoring/measurements, and document the monthly data.
Annual maintenance includes 3 staff, 20 hrs/year to perform inspections, conduct monitoring/measurements, perform vegegation maintnenace and document the monthly data.
It is expected that up to 2,500 plantings might require replacement every 20 years.
Administrative costs are expected to be 5% of O&M costs to track and analyze date and process invoices.
Sonoma County Water Agency uses reclaimed water from its treatment plants to irrigate plantings at no cost.

Table 17 – Proposal Benefits and Costs Summary Proposal: City Watersheds of Sonoma Valley Agency: Sonoma County Water Agency						
Project	Project Proponent	Total Present Value Project Costs (1)	Total Present Value Project Benefits			From Section D2 – Briefly describe the main Non-monetized benefits
			From Section D2 – Flood Damage Reduction (2)	From Section D3 – Monetized (3)	Total	
(a)	(b)	(c)	(d)	(e)	(f) = (d) + (e)	(g)
Sonoma City Watersheds Project	Sonoma County Water Agency	$ 3,895,842	$ 302,324	$ 833,690	$ 1,136,015	See below

(1) From Table 16 or RWMG method
(2) From Table 12 or RWMG method
(3) From Table 14 or RWMG method

- Removal of fish passage barrier
- Improvement of stream channel
- Restoration of aquatic habitat & species
- Improvement of overall, long-term management of CA GW resources
- Longterm solution to multiple env. issues - GW depletion, high velocity SW flows, and riparian and wetland habitat degradation.
- Incremental reduction of future stream-health degradation downstream
- The project's public education components, as part of a larger effort to induce conservation and improve infiltration, have the potential to improve groundwater supply reliability for groundwater users throughout the Sonoma Valley.
- Incremental improvement in the quality of environmental education in the Sonoma Creek watershed:
• by expanding the network of trails and interpretive signage across the Montini Open Space Preserve
• by engaging community members in restoration of Fryer Creek upstream of the culvert replacement and in planting at the stormwater management basin
- Increase in the distance and routes people hike, and improve access to views to the west - free of charge to all members of the public.