

MEMORIAL PARK DETENTION BASIN PROJECT

Attachment 8 – Benefits and Cost Analysis

<u>Contents</u>	<u>Page</u>
Summary of Monetized Benefits and Non-Monetized Benefits.....	2
1.0 Flood Damage Reduction Benefit Analysis.....	5
2.0 Water Supply Benefit Analysis.....	7
3.0 Water Quality Benefit Analysis.....	10
4.0 Ecosystem Restoration Benefit Analysis.....	11
5.0 Recreation and Public Access Benefit Analysis.....	12
6.0 Project’s Economic Costs.....	15
7.0 Project Costs and Benefits Summary.....	17

Appendices:

Appendix 1: Analysis of Flood Damage Reduction Economic Benefit of
Memorial Park Detention Basin Project

Summary of Monetized Benefits and Non-Monetized Benefits

This attachment analyzes the monetized and non-monetized benefits based on the physical benefit descriptions documented in Attachment 7. The benefits were analyzed for both without- and with-Project conditions. Considering the Phoenix Lake IRWM Retrofit project was awarded in the 1st round application for Proposition 1E Stormwater Flood Management Grant, the without-Project condition for the Memorial Park Detention Basin Project is the condition with the Phoenix Lake IRWM Retrofit project in place.¹ Table 1 is a summary of monetized benefits and non-monetized benefits for the Memorial Park Detention Basin Project. Table 2 is a more detailed checklist of non-monetized benefits.

Table 1 Summary of Monetized Benefits and Non-Monetized Benefits

Benefit Category	Monetized Benefits	Non-Monetized Benefits
Flood Damage Reduction	<ul style="list-style-type: none"> • Reduced flood damage to buildings • Reduced flood damage to building contents 	<ul style="list-style-type: none"> • Reduced physical damage to other urban features, including public infrastructure • Avoided emergency response costs • Avoided loss of functions • Avoided impacts to public safety and health <p>(Note: Refer to Section 1.9 of Attachment 7 for details)</p>
Water Supply	<ul style="list-style-type: none"> • Avoided purchase of water from MMWD for park irrigation and restroom toilets 	<ul style="list-style-type: none"> • Reduced MMWD purchase and dependency on imported water from Sonoma Co. • Improved MMWD water supply reliability • Improved irrigation water use efficiency
Water Quality		<ul style="list-style-type: none"> • Improved stormwater quality • Improved aquatic habitat in Sorich Creek and other downstream creeks resulting from improved stormwater quality
Ecosystem Restoration	<ul style="list-style-type: none"> • Increased values of nearby properties resulting from improved park and aesthetic environment 	<ul style="list-style-type: none"> • Restored riparian and aquatic habitat
Recreation and Public Access		<ul style="list-style-type: none"> • Enhanced recreation, public access, safety, and enjoyment. • Improved aesthetic environment • Increased property tax revenue resulting from increased values of nearby properties

¹ (Refer to Figure 2a of Attachment 3 – Work Plan for the relative locations of the Memorial Park Detention Basin Project and the Phoenix Lake IRWM Retrofit project.

Table 2 – 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: <ul style="list-style-type: none"> - 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: <ul style="list-style-type: none"> - 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: <ul style="list-style-type: none"> - 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: <ul style="list-style-type: none"> - 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?	Yes
	Examples are not limited to, but may include: <ul style="list-style-type: none"> - 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: <ul style="list-style-type: none"> - 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?	Yes
	Examples are not limited to, but may include: <ul style="list-style-type: none"> - 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?	Yes
	Examples are not limited to, but may include: <ul style="list-style-type: none"> - 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: <ul style="list-style-type: none"> - Reduce extraction of non-renewable groundwater? - Promote aquifer storage or recharge? 	
11	Reduce demand for net diversions for the regions from the Delta?	Yes
12	Provide a long-term solution in place of a short-term one?	Yes
	Examples are not limited to, but may include: <ul style="list-style-type: none"> - 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?	Yes
14	Promote energy savings or replace fossil fuel based energy sources with renewable energy and resources?	Yes
	Examples are not limited to, but may include: <ul style="list-style-type: none"> - 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: <ul style="list-style-type: none"> - 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)?	

1.0 Flood Damage Reduction Benefit Analysis

In this analysis, only structural and contents damages were estimated quantitatively. Appendix 1 of this attachment provides detailed information about the data, methods, and assumptions used in the analysis to quantify structural and contents damages.

The following steps were taken to conduct quantitative flood damage and benefits analysis for the without-Project and with-Project conditions:

- Estimate flood damage for a range of flood events under without-Project and with-Project conditions and the event damage prevented by the Project (i.e., event benefit) using the flood extent and inundation depth data analyzed in Attachment 7, Justification of Physical Benefits. The event damage was estimated on a parcel-by-parcel basis using first finished floor elevations, square footages, and types of buildings in the floodplain and the floodplain mapping results. Buildings were classified into four categories based on the County Assessor's records: residential, commercial, industrial, and "tax exempt" (which includes schools and government buildings). Depth-damage functions for residential and non-residential buildings and contents developed by the U.S. Army Corps of Engineers were used in the flood damage analysis. The construction value of the building was estimated using a unit construction value of \$200 per square foot for buildings in Ross Valley. Content values were estimated using the DWR-recommended content-to-structure value ratios, which are typically approximately 50 percent for residential, 100% for commercial, 150% for industrial, and 100% for public buildings.
- Estimated expected annual damage (EAD) under without-Project and with-Project conditions and prevented EAD by the Project (i.e., EAD benefit).

The MIKE FLOOD unsteady flow hydraulic model for the Ross Valley was used to map the flood extent and inundation depth (refer to Appendix 1 of Attachment 7 for descriptions of the MIKE FLOOD model).

Following the methods described above, flood damages for the 5-year, 10-year, 25-year, 50-year, 100-year, 250-year, and 500-year flood recurrences/probabilities under without-Project and with-Project conditions were estimated and are given in Table 1 and shown in Figure 1.

Expected annual damage (EAD), also called the average annual damage, is the probability-weighted average of all possible annual damages (i.e., annual damages that could occur under the full range of flood recurrences/probabilities). As expected, the damage-probability function assigns a higher damage to the rarer (i.e., low probability), larger magnitude floods and, conversely, assigns lower damage to the smaller magnitude, more frequent (i.e., higher probability) floods. Expected annual damage is the summation of all the possible products of probability times damage that are reflected in the damage-probability function, which is represented by the area below the respective curve shown in Figure 1. Expected annual damages and expected prevented annual damages for without-Project and with-Project conditions are given in Table 2. The expected prevented annual damage by the Project is estimated to be approximately \$1,180,000. Table 2 also gives the estimated present value of future benefits, which is the

expected prevented annual damage brought forward to a present worth at an assumed discount rate (i.e., 6%) over the Project lifetime (i.e., 50 years). The estimated present worth (in 2012 dollars) of future benefits of the Project in flood damage reduction is approximately \$14,738,200.

Table 1 Event Damage under Without- and With-Project Conditions								
Hydrologic Event	Event Probability	Without-Project			With-Project			Event Benefit (\$)
		Damage to Building (\$)	Damage to Contents (\$)	Total Damage (\$)	Damage to Building (\$)	Damage to Contents (\$)	Total Damage (\$)	
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
				(c) + (d)			(f) + (g)	(e) - (h)
5-Year	0.200	\$2,110,000	\$2,151,000	\$4,261,000	\$2,110,000	\$2,151,000	\$4,261,000	\$0
10-Year	0.100	\$8,467,000	\$8,024,000	\$16,491,000	\$5,048,000	\$5,222,000	\$10,270,000	\$6,221,000
25-Year	0.040	\$31,062,000	\$32,944,000	\$64,006,000	\$25,528,000	\$28,248,000	\$53,776,000	\$10,230,000
50-Year	0.020	\$47,792,000	\$46,378,000	\$94,170,000	\$42,286,000	\$42,470,000	\$84,755,000	\$9,415,000
100-Year	0.010	\$69,898,000	\$62,841,000	\$132,739,000	\$64,085,000	\$58,338,000	\$122,423,000	\$10,316,000
250-Year	0.004	\$92,189,000	\$78,873,000	\$171,062,000	\$86,564,000	\$74,955,000	\$161,519,000	\$9,543,000
500-Year	0.002	\$108,199,000	\$92,196,000	\$200,395,000	\$102,348,000	\$87,450,000	\$189,798,000	\$10,597,000

Figure 1 Flood Damage - Probability Curves

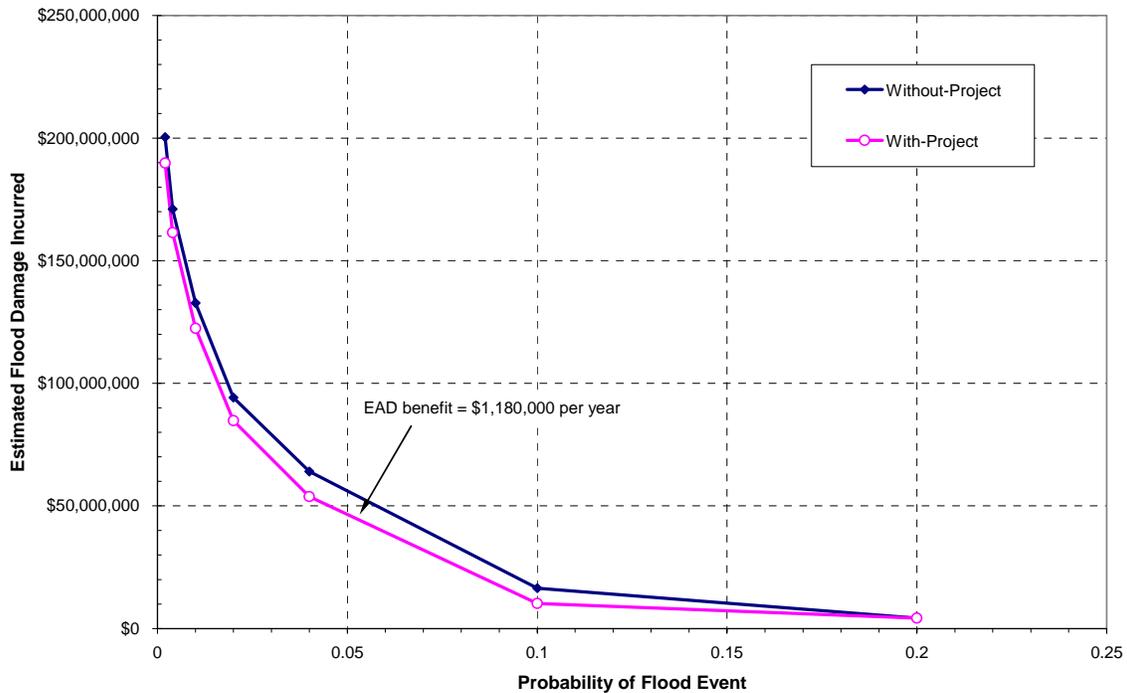


Table 2 Present Value of Expected Annual Damage Benefits			
(a)	Expected Annual Damage Without Project ⁽¹⁾		\$7,452,000
(b)	Expected Annual Damage With Project ⁽¹⁾		\$6,272,000
(c)	Expected Annual Damage Benefit	(a) – (b)	\$1,180,000
(d)	Present Value Coefficient ⁽²⁾		12.49
(e)	Present Value of Future Benefits (in 2012 dollars)	(c) × (d)	\$14,738,200

(1) This program assumes no population growth thus EAD will be constant over analysis period.

(2) 6% discount rate; 50-year analysis period from 2016 (base year) to 2066. The annual benefit will be realized starting in 2017.

2.0 Water Supply Benefit Analysis

The Memorial Park Detention Basin Project will install a groundwater irrigation supply system to provide water for irrigation and restroom toilets for the rehabilitated park and, thus, reduce the water demand from the current water service provider, Marin Municipal Water District (MMWD). The primary source of MMWD’s raw water supply, on average about 71.5 % of the total water delivered to customers, is runoff from the high-yielding local Marin County watersheds that is captured and stored in seven reservoirs.

Additional raw water, on average about 25.5 % of the total water delivered to customers, is imported Russian River water that is purchased and delivered through an interconnected system of the North Marin Water District and Sonoma County Water Agency. The cost to purchase and deliver Russian River water to MMWD is about \$850 per acre-ft. For a variety of reasons the current MMWD reliable water supply is close to the current water demand with little, if any, surplus supply reliability. If Marin County experiences another drought similar to that of 1976–77, water supplies may not be adequate to meet current demands. Decreasing its water demand would provide MMWD with much needed water supply reliability, particularly during droughts.

As described in Section 2.1.1 of Attachment 7, the groundwater supply system will reduce the water demand from MMWD by about 6.85 acre-ft per year on average (from 7.2 acre-ft per year to 0.35 acre-ft per year; Note: There will still be a need for MMWD water for drinking fountains, restroom faucets, and other potable uses), which in turn will reduce MMWD purchases from Sonoma County Water Agency of imported Russian River water by the same amount. The current average annual purchase cost for the 7.2 acre-ft water by the Town of San Anselmo is about \$14,590 according to MMWD historical water billing records. The avoided purchase of 6.85 acre-ft water from MMWD will save the Town about \$13,880 ($\$14,590 \times 6.85 \div 7.2 = \$13,880$). Table 3 shows the avoided annual purchase savings by the Town of San Anselmo.

The Project will provide regional water supply benefits to the greater Bay Area region to the extent that the reliability of MMWD's local supplies are improved and to the extent that the additional local supply created by the Project can replace imported supplies. These benefits result from potentially reducing the need for MMWD to draw from the Russian River during severe shortages, as occurred during the late 1980s and early 1990s when the District drew surplus water through its supply connection with the Sonoma County Water Agency. The regional beneficiaries of reduced reliance on Russian River water during shortages are the water users of the Russian River, including the Sonoma County Water Agency and other users, as well as public resources that depend on adequate flows in the Russian River (e.g., special-status anadromous salmonid species, recreation). In addition, the Project can provide statewide benefits by improving the reliability of MMWD's local water supply sources and thereby reducing the potential need to draw from the State Water Project during severe shortages, as occurred during the 1976-77 when State Project Water was transferred to MMWD via an emergency hook up to the EBMUD system. The Statewide beneficiaries of MMWD's reduced reliance on the State Water Project during an emergency are the users of the State Water Project, as well as public resources (e.g., anadromous salmonids, recreation) that depend on adequate flows in the rivers that supply the State Water Project. These regional water supply benefits were not monetized.

**Table 3 Annual Water Supply Benefits (in 2012 Dollars)
 - Avoided Purchase of MMWD Water by Town of San Anselmo**

(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 (d) - (e)	Unit \$ Value	Annual \$ Value (f) × (g)	Discount Factor	Discounted Benefit (\$) (h) × (i)
2012								1.000	
2013								0.943	
2014								0.890	
2015								0.840	
2016								0.792	
2017	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.747	\$1,0368
2018	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.705	\$9,785
2019	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.665	\$9,230
2020	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.627	\$8,703
2021	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.592	\$8,217
2022	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.558	\$7,745
2023	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.527	\$7,315
2024	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.497	\$6,898
2025	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.469	\$6,510
2026	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.442	\$6,135
2027	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.417	\$5,788
2028	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.394	\$5,469
2029	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.371	\$5,149
2030	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.350	\$4,858
2031	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.331	\$4,594
2032	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.312	\$4,331
2033	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.294	\$4,081
2034	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.278	\$3,859
2035	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.262	\$3,637
2036	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.247	\$3,428
2037	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.233	\$3,234
2038	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.220	\$3,054
2039	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.207	\$2,873
2040	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.196	\$2,720
2041	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.185	\$2,568
2042	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.174	\$2,415
2043	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.164	\$2,276
2044	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.155	\$2,151
2045	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.146	\$2,026
2046	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.138	\$1,915
2047	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.130	\$1,804
2048	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.123	\$1,707
2049	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.116	\$1,610
2050	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.109	\$1,513
2051	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.103	\$1,430
2052	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.097	\$1,346
2053	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.092	\$1,277
2054	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.087	\$1,208
2055	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.082	\$1,138
2056	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.077	\$1,069
2057	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.073	\$1,013
2058	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.069	\$958
2059	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.065	\$902
2060	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.061	\$847
2061	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.058	\$805
2062	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.054	\$750
2063	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.051	\$708
2064	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.048	\$666
2065	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.046	\$638
2066	Avoided purchase	Acre-ft	7.2	0.35	6.85		\$13,880	0.043	\$597
Project Life							\$694,000		
Total Present Value of Discounted Benefits Based on Unit Value (Sum of Column (j))									\$173,300

3.0 Water Quality Benefit Analysis

The Memorial Park Detention Basin Project will install a CONTECH CDS[®] hydrodynamic separation device (or other similar device) at the inlet of the replaced and rerouted Alderney storm drain to improve stormwater quality. The device can not only remove trash and debris by 100% at the design or below the design flow (≤ 3.2 cfs), it can also provide additional treatment of stormwater quality (including oil and grease and suspended solids, and any other pollutants that are bound with the suspended solids).

The existing Alderney storm drain collects urban stormwater from a 23-acre drainage area upstream of Memorial Park. The storm drain runs beneath Memorial Park and directly discharges to the Sorich Creek culvert. The Alderney storm drain under the park will be removed and replaced along a new alignment beneath the park. Urban stormwater runoff has been cited as a major nonpoint pollution source (NPS). The typical pollutants associated with the urban stormwater are trash/debris, sediment, nutrients, bacteria and viruses, oil and grease, metals, organics, and pesticides². Table 4 is a summary of the water quality benefits in reduction of urban stormwater pollutant concentrations. These benefits were not monetized.

The improved stormwater quality can provide regional and statewide benefits by contributing to the recovery of steelhead and coho salmon in lower San Anselmo Creek and the downstream Corte Madera Creek. These creeks are considered “anchor” streams in statewide plans for the recovery of these special-status species of fish. These regional and statewide benefits were also not monetized.

² The sediment is typically originated from the construction of roads and parking lots, the disturbance of landscapes, and the removal of vegetation covers. The organic compounds are secondary products of automotive fluids, pesticides, and herbicides, whereas, nutrients (i.e., nitrogen and phosphorus) are mainly from organic litter, fertilizers, food waste, sewage, and sediment. Sources of trace metals include motor vehicles, roofing and construction materials, and chemicals. Pet waste and solid waste disposal areas contribute bacteria and viruses and motor vehicles are the dominant source of oil and grease compounds.

Table 4 – Annual Project Physical Benefits - Water Quality					
Project Name: Memorial Park Detention Basin					
Type of Benefit Claimed: Improved Stormwater Quality					
Measure of Benefit Claimed (Name of Units): mg/l or µg/l					
Additional Information About this Measure: Design Flow = 3.2 cfs ¹					
(a)		(b)	(c)	(d)	
			Median Stormwater Concentrations		
Year	Pollutant	Unit	Without Project	With Project (Removal Rate)	Change Resulting from Project (b) – (c)
Project Life (50 Years)	Trash/Debris		Not estimated	100%	Not estimated
	TSS ²	mg/l	67	81%	13
	Oil and Grease ²	mg/l	9	57%	4
Comments:					
1) The design flow is estimated to be about 3.2 cfs using the flow-based method documented in the California BMP Handbook (California Stormwater Quality Association, 2003).					
2) Source of urban stormwater quality concentrations and removal rates: U.S.EPA, 1999. Preliminary Data Summary of Urban Storm Water Best Management Practices.					

4.0 Ecosystem Restoration Benefit Analysis

The Memorial Park Detention Basin Project will daylight and restore Sorich Creek, which is currently contained in a buried culvert along its reach through the park. The 580-ft long daylighted Sorich Creek will be vegetated to restore the creek ecosystem and improve stormwater quality with respect to nutrients, pesticides (like sediment-bound diazinon), and heavy metals through the processes of plant uptake and natural filtration. The Memorial Park Detention Basin Project will also remove the 70-ft long Los Angeles Street culvert. The culvert will be replaced with a pre-fabricated, single lane vehicular/pedestrian bridge, resulting in an additional reach of daylighted creek with increased hydraulic capacity and improved riparian and aquatic habitat. The ecosystem restoration benefit is summarized in Table 5. The ecosystem restoration benefits were not monetized.

The creek daylighting and restoration would enhance the aesthetic environment which, in turn, would increase the values of nearby properties. This benefit together with the aesthetic enhancement by the park improvement will be monetized in Section 5.0.

Table 5 – Annual Project Physical Benefits - Ecosystem Restoration			
Project Name: Memorial Park Detention Basin			
Type of Benefit Claimed: Restored Creek Ecosystem Length			
Measure of Benefit Claimed (Name of Units): ft			
Additional Information About this Measure:			
(a)	(b)	(c)	(d)
	Ecosystem Restoration		
Year	Without Project	With Project	Change Resulting from Project (c) – (b)
Project Life (50 Years)	0	650	650
Comments:			

5.0 Recreation and Public Access Benefit Analysis

The Memorial Park Detention Basin Project will enhance opportunities for public enjoyment of the park, one of the most heavily used recreational areas in San Anselmo. The Project will daylight and restore Sorich Creek. Access to the creek will be encouraged by providing pathways leading to the creek, and the creek will be placed in a “nature grove” so as to integrate it into the overall park recreational area. An upgraded field and drainage system will be installed to increase public use of the park by allowing the expanded sports programs and use of the fields for longer periods throughout the year while reducing field upkeep and maintenance costs. Pathways and park elements will be ADA accessible, accommodating to a larger extent people with disabilities compared to the current park. All these improvements will aim to enhance public access, safety, aesthetics, and overall public enjoyment. All these benefits, except the improved aesthetic environment, were not monetized.

The enhanced recreation and public access can provide regional and statewide benefits by improving access to the park and enhancing the overall enjoyment of the park to recreationalists and other visitors who use the park. Recreational visitors come to enjoy the park from throughout the Bay Area region and Statewide, including disadvantaged persons who require ADA accessible pathways and low-income persons.

The creek daylighting and restoration and other park improvements would enhance the aesthetic environment which, in turn, would increase the values of nearby properties. This benefit was monetized by estimating the potential of increased values of nearby properties in the market. This method is called Hedonic Pricing Method under the “Revealed Willingness to Pay” approach documented in the DWR’s 2008 Economic Analysis Guidebook.

Many studies have shown that parks have a positive impact on nearby residential property values. In 2000, the East Bay Regional Park District (EBRPD) hired Economic & Planning Systems to conduct an economic impact analysis of the EBRPD system. The study found that EBRPD-owned open space increases the value of adjacent properties by as much as 30%. In 2007, Karin Marie Edwards from the Richard and Rhoda School of Public Policy at UC Berkeley prepared *Do Parks Make Cents? An Analysis of the Economic Value of Parks in San Francisco* for the San Francisco Neighborhood Parks Council. In her study, Edwards determined that properties within 500 feet of a park are worth approximately \$125,838 more than those between 500 to 1,000 feet of a park.

Any increase in nearby property values attributable to the Project would arise from the Project's improvement of the aesthetic environment, not from construction of a new park as documented in the above-cited studies. It follows that the increase in nearby property values attributable to the Project would not be as great as the increase documented in the above cited studies, e.g., 30%. Therefore, an estimated 5% increase in nearby property values attributable to the Project seems reasonable.

Figure 2 shows the residential properties whose values will be increased because of the aesthetic improvement to the Memorial Park. These residential properties have a total living area of 100,274 sq.ft with an estimated current market value of about \$40,000,000 (estimated market unit value of about \$400 per sq.ft; Zillow.com).

Table 6 summarizes the monetized benefits resulting from improved aesthetic environment. The benefit can be realized immediately after the Project is completed.

In addition to the monetized benefit shown in Table 6, increased property values will provide direct benefits to the Town of San Anselmo and Marin County in the form of increased property tax revenues. This benefit was not monetized.



Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

Document Path: J:\p2438\MemorialPark_Residential_Adjacent.mxd



- Residential properties with value affected by park improvements
- Residential properties not affected by park improvement
- Commercial
- Exempt
- Parcel Boundary

Residential Properties in Memorial Park Area



**Table 6 Aesthetic Environmental Benefits (in 2012 Dollars)
 - Increased Value of Nearby Properties**

(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	Annual \$ Value (f) × (g)	Discount Factor	Discounted Benefit (\$) (h) × (i)
2012								1.000	
2013								0.943	
2014								0.890	
2015								0.840	
2016								0.792	
2017	Increased Property Value	%	0	5%	5%	\$40,000,000	\$2,000,000	0.747	\$1,494,000
2018	Increased Property Value	%	0	5%	5%			0.705	
2019	Increased Property Value	%	0	5%	5%			0.665	
2020	Increased Property Value	%	0	5%	5%			0.627	
2021	Increased Property Value	%	0	5%	5%			0.592	
2022	Increased Property Value	%	0	5%	5%			0.558	
2023	Increased Property Value	%	0	5%	5%			0.527	
2024	Increased Property Value	%	0	5%	5%			0.497	
2025	Increased Property Value	%	0	5%	5%			0.469	
2026	Increased Property Value	%	0	5%	5%			0.442	
2027	Increased Property Value	%	0	5%	5%			0.417	
2028	Increased Property Value	%	0	5%	5%			0.394	
2029	Increased Property Value	%	0	5%	5%			0.371	
2030	Increased Property Value	%	0	5%	5%			0.350	
2031	Increased Property Value	%	0	5%	5%			0.331	
2032	Increased Property Value	%	0	5%	5%			0.312	
2033	Increased Property Value	%	0	5%	5%			0.294	
2034	Increased Property Value	%	0	5%	5%			0.278	
2035	Increased Property Value	%	0	5%	5%			0.262	
2036	Increased Property Value	%	0	5%	5%			0.247	
2037	Increased Property Value	%	0	5%	5%			0.233	
2038	Increased Property Value	%	0	5%	5%			0.220	
2039	Increased Property Value	%	0	5%	5%			0.207	
2040	Increased Property Value	%	0	5%	5%			0.196	
2041	Increased Property Value	%	0	5%	5%			0.185	
2042	Increased Property Value	%	0	5%	5%			0.174	
2043	Increased Property Value	%	0	5%	5%			0.164	
2044	Increased Property Value	%	0	5%	5%			0.155	
2045	Increased Property Value	%	0	5%	5%			0.146	
2046	Increased Property Value	%	0	5%	5%			0.138	
2047	Increased Property Value	%	0	5%	5%			0.130	
2048	Increased Property Value	%	0	5%	5%			0.123	
2049	Increased Property Value	%	0	5%	5%			0.116	
2050	Increased Property Value	%	0	5%	5%			0.109	
2051	Increased Property Value	%	0	5%	5%			0.103	
2052	Increased Property Value	%	0	5%	5%			0.097	
2053	Increased Property Value	%	0	5%	5%			0.092	
2054	Increased Property Value	%	0	5%	5%			0.087	
2055	Increased Property Value	%	0	5%	5%			0.082	
2056	Increased Property Value	%	0	5%	5%			0.077	
2057	Increased Property Value	%	0	5%	5%			0.073	
2058	Increased Property Value	%	0	5%	5%			0.069	
2059	Increased Property Value	%	0	5%	5%			0.065	
2060	Increased Property Value	%	0	5%	5%			0.061	
2061	Increased Property Value	%	0	5%	5%			0.058	
2062	Increased Property Value	%	0	5%	5%			0.054	
2063	Increased Property Value	%	0	5%	5%			0.051	
2064	Increased Property Value	%	0	5%	5%			0.048	
2065	Increased Property Value	%	0	5%	5%			0.046	
2066	Increased Property Value	%	0	5%	5%			0.043	
Project Life						\$40,000,000	\$2,000,000		
Total Present Value of Discounted Benefits Based on Unit Value (Sum of Column (j))									\$1,494,000

6.0 Project's Economic Costs

Economic costs associated with the Project include initial capital costs of its facility elements and future operations and maintenance costs. Initial capital costs are detailed in Attachment 4, Budget. These initial capital costs cover all costs associated with initial project implementation including a) direct project administration, b) land purchase and easement, c) planning, design, engineering, and environmental documentation, d) construction and implementation, e) environmental compliance, mitigation, and enhancement, f) construction administration, g) other costs, and h) construction and implementation contingency (20%).

Future operations and maintenance costs are recurring costs that are incurred over the life of the Project elements. Annual costs include administration, operation, maintenance, replacement and repairs, and others such as monitoring and inspections and reporting as well as pumping cost of groundwater wells. Annual costs are estimated as a percentage (1%) of the construction cost.

Table 7 shows the cost details of the initial capital costs and future operations and maintenance costs. Capital costs for the Project amount to about \$17,441,000 (2012 dollars). The capital costs will be incurred in 2013 through 2016 and distributed according to the schedule of Attachment 5. Capital costs that were already expended in the past are considered sunk costs and are not included in this analysis. The incremental costs associated with project administration, operation, maintenance, replacement, and others amount to a total of about \$7,843,000 (non-discounted 2012 dollars) over the useful lifetime of the project (assumed 50 years).

Together, the present value capital and O&M costs for the Project at 6% discount rate amount to about \$16,152,100 through 2066.

Table 7 Annual Cost of Project (in 2012 Dollars)
Project: Memorial Park Detention Basin

	Initial Costs		Operation and Maintenance Costs ⁽¹⁾						
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
Year	Grand Total Costs	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +...+ (f)	Discount Factor ⁽²⁾	Discounted Costs (g) x (h)
2012								1.000	
2013	\$63,588						\$63,588	0.943	\$59,963
2014	\$804,126						\$804,126	0.890	\$715,672
2015	\$6,080,707						\$6,080,707	0.840	\$5,107,794
2016	\$1,0492,328						\$1,0492,328	0.792	\$8,309,924
2017		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.747	\$117,174
2018		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.705	\$110,586
2019		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.665	\$104,312
2020		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.627	\$98,351
2021		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.592	\$92,861
2022		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.558	\$87,528
2023		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.527	\$82,665
2024		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.497	\$77,959
2025		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.469	\$73,567
2026		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.442	\$69,332
2027		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.417	\$65,411
2028		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.394	\$61,803
2029		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.371	\$58,195
2030		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.350	\$54,901
2031		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.331	\$51,921
2032		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.312	\$48,940
2033		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.294	\$46,117
2034		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.278	\$43,607
2035		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.262	\$41,097
2036		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.247	\$38,744
2037		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.233	\$36,548
2038		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.220	\$34,509
2039		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.207	\$32,470
2040		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.196	\$30,745
2041		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.185	\$29,019
2042		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.174	\$27,294
2043		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.164	\$25,725
2044		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.155	\$24,313
2045		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.146	\$22,902
2046		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.138	\$21,647
2047		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.130	\$20,392
2048		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.123	\$19,294
2049		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.116	\$18,196
2050		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.109	\$17,098
2051		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.103	\$16,157
2052		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.097	\$15,215
2053		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.092	\$14,431
2054		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.087	\$13,647
2055		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.082	\$12,863
2056		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.077	\$12,078
2057		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.073	\$11,451
2058		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.069	\$10,823
2059		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.065	\$10,196
2060		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.061	\$9,568
2061		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.058	\$9,098
2062		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.054	\$8,470
2063		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.051	\$8,000
2064		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.048	\$7,529
2065		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.046	\$7,216
2066		\$37,940	\$37,940	\$37,940	\$37,940	\$5,100	\$156,860	0.043	\$6,745
Project Life	\$17,441,000	\$1,897,000	\$1,897,000	\$1,897,000	\$1,897,000	\$255,000	\$25,391,000		
Total Present Value of Discounted Costs (Sum of Column (i))									\$16,152,100

(1) The incremental change in O&M costs attributable to the project; (2) 6% discount rate.

7.0 Project Costs and Benefits Summary

The table below is a project costs and benefits summary. Total present values of project benefits and costs are estimated to be \$16,405,500 and \$16,152,100, respectively. The benefit-cost ratio of the Memorial Park Detention Basin Project is about 1.02. In addition to the monetized benefits used in the calculation of benefit-cost ratio, the Project would also provide numerous non-monetized benefits which have not and cannot be quantified due to a lack of data needed for quantification.

Table 8 – Proposal Benefits and Costs Summary						
Proposal: Memorial Park Detention Basin						
Agency: Town of San Anselmo						
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 D2 – Monetized ⁽³⁾	Total	
(a)	(b)	(c)	(d)	(e)	(f) = (d) + (e)	(g)
Memorial Park Detention Basin	Town of San Anselmo	\$16,152,100	\$14,738,200	\$1,667,300	\$16,405,500	Refer to Table 1 for the main non-monetized benefits

(1) From Table 7

(2) From Table 2

(3) From Table 3 and Table 6

APPENDIX 1 TO ATTACHMENT 8

ANALYSIS OF FLOOD DAMAGE REDUCTION ECONOMIC BENEFIT OF MEMORIAL PARK DETENTION BASIN PROJECT

Stetson Engineers Inc.
December 17, 2012

An engineering economic analysis was prepared for the Memorial Park Detention Basin Project (Project). The analysis mainly included:

- Estimating flood damage for a range of flood events under without-Project and with-Project conditions and prevented event damage by the Project (i.e., event benefit) using the flood extent and inundation depth data analyzed in Attachment 7, Justification of Physical Benefits; and,
- Estimating expected annual damage (EAD) under without-Project and with-Project conditions and prevented EAD by the Project (i.e., EAD benefit).

The economic benefit of the Project can be expressed in terms of prevented flood damage, that is, the dollar value of the flood damage that is prevented by the Project over the long term (i.e., Project lifetime). The value of flood damage prevented was estimated by comparing the damage that would be expected to occur under without-Project conditions against the damage that would be expected to occur with the Project in place.

Analysis of Event Damage

Flood damage was evaluated on a parcel-by-parcel basis using assumed first finished floor elevations of buildings¹ and the floodplain mapping results. By overlaying these assumed first finished floor elevations on the model-derived floodplain maps, depth of inundation was estimated for all buildings. Depths of inundation for seven selected flood recurrences/probabilities (i.e., 5-year, 10-year, 25-year, 50-year, 100-year, 250-year, and 500-year) were estimated under without-Project and with-Project conditions.

In order to estimate flood damage, the functional relationship between depth of inundation and damage was necessary. Damage increases with depth of inundation. Depth-damage functions for residential and nonresidential buildings, with one story and

¹ Since survey data are available for few first finished floor elevations of buildings in the Ross Valley, assumptions were necessary. For the purpose of this engineering economic analysis, the first finished floor elevations of buildings upstream of Bon Air Road were uniformly assumed to be 1.0 ft above the ground elevation, and the first finished floor elevations of buildings downstream of Bon Air Road were assumed to be at the 100-year flood water surface elevation simulated under existing conditions. The estimation of flood damage is sensitive to this assumption. The reasonableness of this assumption was evaluated by examining the limited survey data on first finished floor elevations of buildings in the Ross Valley and survey data on first finished floor elevations of buildings in Mill Valley performed by the County in 2009. This examination verified that the assumptions are reasonable.

no basement, developed by the U.S. Army Corps of Engineers (USACE) were used in the analysis (see Tables 1 and 2 and Figures 1 and 2). These depth-damage functions express damage, in terms of percentage of the total construction value of the building, as a function of depth of inundation. These depth-damage functions account for damage that can occur when the floodwater surface is below the first finished floor elevation. The maximum damage does not exceed the construction value of the building, which was estimated assuming a unit construction value of \$200 per square foot. Data on building square footages and building types (residential, commercial, industrial, and public) were derived from the County Assessors database. In addition to damage to the building, damage to contents within the building was also considered. Content values were estimated using the DWR-recommended content-to-structure value ratios, which are typically approximately 50 percent for residential, 100% for commercial, 150% for industrial, and 100% for public buildings. Depth-damage functions for contents within residential and commercial buildings developed by the USACE were used in the analysis (see Tables 1 and 2 and Figures 1 and 2).

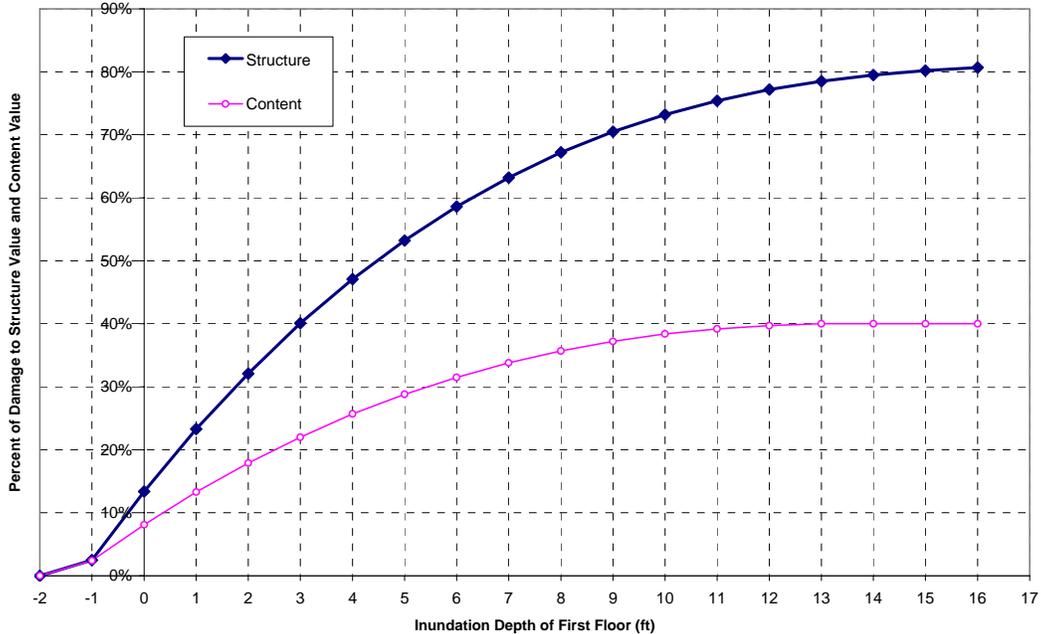
**Table 1 USACE Residential Depth-Damage Functions
(One Story, No Basement)**

First Floor Inundation Depth (ft)	Damage to Building (% of Construction Value)	Damage to Contents (% of Construction Value)
-2	0%	0%
-1	2.50%	2.40%
0	13.40%	8.10%
1	23.30%	13.30%
2	32.10%	17.90%
3	40.10%	22.00%
4	47.10%	25.70%
5	53.20%	28.80%
6	58.60%	31.50%
7	63.20%	33.80%
8	67.20%	35.70%
9	70.50%	37.20%
10	73.20%	38.40%
11	75.40%	39.20%
12	77.20%	39.70%
13	78.50%	40.00%
14	79.50%	40.00%
15	80.20%	40.00%
16	80.70%	40.00%

Note:

The residential depth-damage function was also used on buildings zoned as “tax exempt” which includes schools and government buildings.

**Figure 1 USACE Residential Depth-Damage Curves
(One Story, No Basement)**

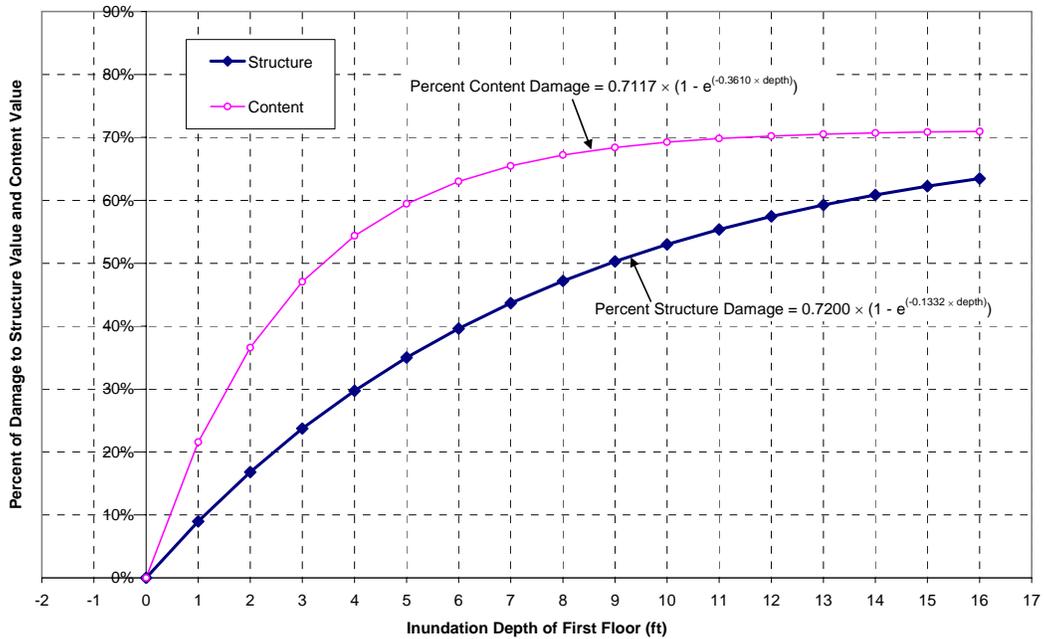


**Table 2 USACE Non-Residential Depth-Damage Functions
(No Basement)**

First Floor Inundation Depth (ft)	Damage to Building (% of Construction Value)	Damage to Contents (% of Contents Value)
0	0.00%	0.00%
1	8.98%	21.57%
2	16.84%	36.60%
3	23.72%	47.07%
4	29.74%	54.38%
5	35.01%	59.46%
6	39.62%	63.01%
7	43.66%	65.48%
8	47.19%	67.21%
9	50.29%	68.41%
10	53.00%	69.24%
11	55.37%	69.83%
12	57.44%	70.23%
13	59.26%	70.52%
14	60.85%	70.72%
15	62.24%	70.85%
16	63.45%	70.95%

Note:
Contents value was assumed at 100% of structure value for commercial and 150% for industrial.

Figure 2 USACE Non-Residential Depth-Damage Curves

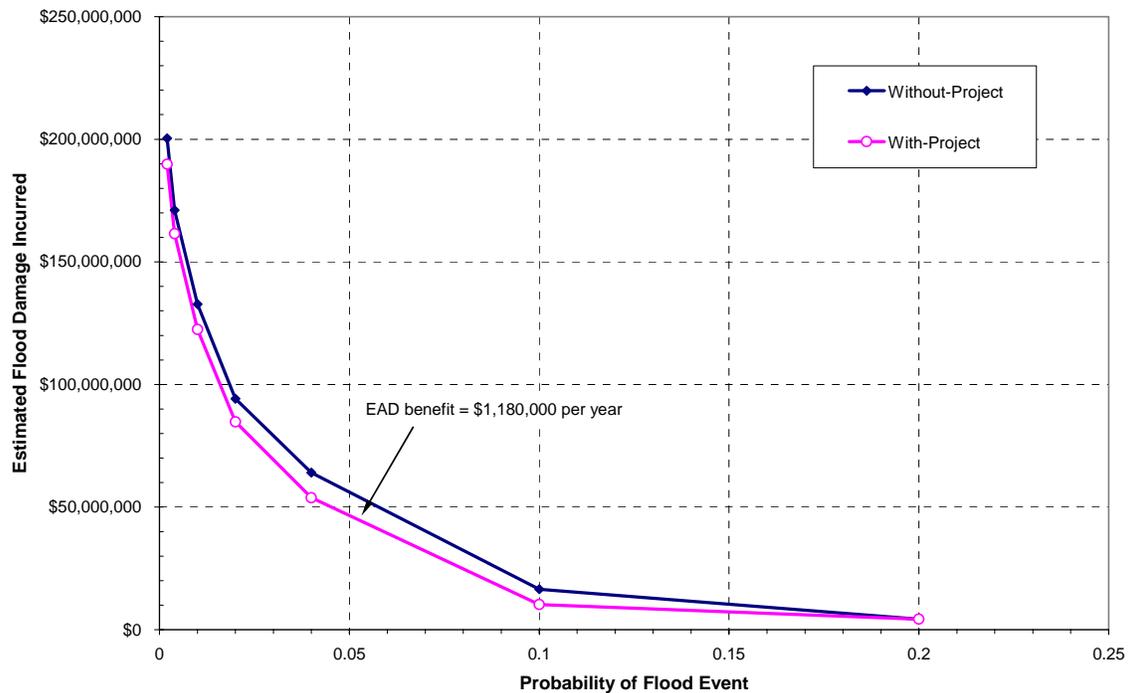


By coupling the depth of inundation-probability information with the depth of inundation-damage functions, damage to buildings and contents was evaluated for seven selected flood recurrences/probabilities under without-Project and with-Project conditions. The incremental damage that the Project prevents for a given flood recurrence/probability can be estimated by subtracting the with-Project damage from the without-Project damage. Damages for the 5-year, 10-year, 25-year, 50-year, 100-year, 250-year, and 500-year flood recurrences/probabilities under without-Project and with-Project conditions are given in Table 3 and shown in Figure 3.

Table 3 Flood Damages under Without- and With-Project Conditions for a Range of Flood Events

Hydrologic Event	Event Probability	Without-Project			With-Project			Event Benefit (\$)
		Damage to Building (\$)	Damage to Contents (\$)	Total Damage (\$)	Damage to Building (\$)	Damage to Contents (\$)	Total Damage (\$)	
5-Year	0.200	\$2,110,000	\$2,151,000	\$4,261,000	\$2,110,000	\$2,151,000	\$4,261,000	\$0
10-Year	0.100	\$8,467,000	\$8,024,000	\$16,491,000	\$5,048,000	\$5,222,000	\$10,270,000	\$6,221,000
25-Year	0.040	\$31,062,000	\$32,944,000	\$64,006,000	\$25,528,000	\$28,248,000	\$53,776,000	\$10,230,000
50-Year	0.020	\$47,792,000	\$46,378,000	\$94,170,000	\$42,286,000	\$42,470,000	\$84,755,000	\$9,415,000
100-Year	0.010	\$69,898,000	\$62,841,000	\$132,739,000	\$64,085,000	\$58,338,000	\$122,423,000	\$10,316,000
250-Year	0.004	\$92,189,000	\$78,873,000	\$171,062,000	\$86,564,000	\$74,955,000	\$161,519,000	\$9,543,000
500-Year	0.002	\$108,199,000	\$92,196,000	\$200,395,000	\$102,348,000	\$87,450,000	\$189,798,000	\$10,597,000

Figure 3 Flood Damage - Probability Curves



Analysis of Expected Annual Damage

Expected annual damage, also called the average annual damage, is the probability-weighted average of all possible annual damages (i.e., annual damages that could occur under the full range of flood recurrences/probabilities). As expected, the damage-probability function assigns a higher damage to the larger magnitude, rarer (i.e., low probability) floods and, conversely, assigns lower damage to the smaller magnitude, more frequent (i.e., higher probability) floods. Expected annual damage is the summation of all the possible products of probability times damage that are reflected in the damage-probability function, which is represented by the area below the respective curve shown in Figure 3. Expected annual damages and expected prevented annual damages for without-Project and with-Project conditions are given in Table 4. The expected prevented annual damage by the Project is estimated to be approximately \$1,180,000.

Table 4 Expected Annual Damages and Prevented Annual Damages for Without- and With-Project Conditions

Condition	Expected Annual Damage (\$/year)	Expected Prevented Annual Damage (i.e. Benefit; \$/year)
Without-Project	7,452,000	-
With-Project	6,272,000	1,180,000

Ross Valley Flood Damage Analysis - Event Damage
Without-Project Conditions

		Flood Events						
		5yr	10yr	25yr	50yr	100yr	250yr	500yr
For Ross Valley - Corte Madera Creek	Ross Valley Watershed							
	Number of Inundated Buildings	176	507	1,272	1,522	1,715	2,577	2,889
	Number of Inundated Parcels	122	314	835	1,004	1,132	1,576	1,819
	Total Structural Damage	\$2,109,755	\$8,467,055	\$31,061,658	\$47,792,324	\$69,898,467	\$92,189,286	\$108,198,715
	Total Content Damage	\$2,151,022	\$8,023,460	\$32,944,328	\$46,377,744	\$62,840,870	\$78,872,676	\$92,196,317
	Total Damage*	\$4,260,778	\$16,490,514	\$64,005,986	\$94,170,069	\$132,739,337	\$171,061,962	\$200,395,032
	Total Damage by Category Type¹	5yr	10yr	25yr	50yr	100yr	250yr	500yr
	Commercial	\$589,507	\$1,426,392	\$18,811,983	\$26,191,357	\$34,394,536	\$42,287,264	\$48,709,071
	Industrial	\$0	\$0	\$0	\$0	\$0	\$32,368	\$62,571
	Residential	\$3,636,459	\$13,886,771	\$38,979,019	\$57,234,549	\$79,931,193	\$103,942,331	\$122,104,750
Tax Exempt	\$34,812	\$1,177,352	\$6,214,984	\$10,744,163	\$18,413,608	\$24,799,999	\$29,518,641	
Total	\$4,260,778	\$16,490,514	\$64,005,986	\$94,170,069	\$132,739,337	\$171,061,962	\$200,395,032	
Total Damage by Category Structure and Content	5yr	10yr	25yr	50yr	100yr	250yr	500yr	
Total Commercial Content	\$416,224	\$1,006,792	\$12,904,777	\$17,828,691	\$23,243,387	\$28,444,283	\$32,700,355	
Total Commercial Structure	\$173,282	\$419,600	\$5,907,206	\$8,362,666	\$11,151,149	\$13,842,981	\$16,008,716	
Total Industrial Content	\$0	\$0	\$0	\$0	\$0	\$30,266	\$58,508	
Total Industrial Structure	\$0	\$0	\$0	\$0	\$0	\$2,102	\$4,063	
Total Residential Content	\$1,717,252	\$6,306,744	\$17,368,233	\$24,117,146	\$32,153,855	\$40,813,238	\$48,015,625	
Total Residential Structure	\$1,919,208	\$7,580,027	\$21,610,786	\$33,117,403	\$47,777,338	\$63,129,093	\$74,089,124	
Total Tax Exempt Content	\$17,546	\$709,924	\$2,671,317	\$4,431,908	\$7,443,628	\$9,584,889	\$11,421,829	
Total Tax Exempt Structure	\$17,265	\$467,428	\$3,543,667	\$6,312,255	\$10,969,980	\$15,215,110	\$18,096,812	
Total	\$4,260,778	\$16,490,514	\$64,005,986	\$94,170,069	\$132,739,337	\$171,061,962	\$200,395,032	
By City/Town	Total Damage by City/Town²	5yr	10yr	25yr	50yr	100yr	250yr	500yr
	Corte Madera	\$0	\$0	\$0	\$0	\$0	\$591,078	\$2,020,189
	Fairfax	\$2,288,585	\$3,486,458	\$5,105,914	\$6,745,644	\$8,105,666	\$10,205,910	\$11,100,204
	Greenbrae	\$0	\$0	\$0	\$0	\$0	\$694,187	\$1,394,473
	Kentfield	\$0	\$5,645,269	\$12,369,986	\$17,717,493	\$26,533,328	\$33,438,858	\$43,436,486
	Larkspur	\$0	\$0	\$609,054	\$1,096,988	\$2,660,361	\$4,697,469	\$6,824,878
	Ross	\$1,627,092	\$6,082,648	\$12,827,308	\$18,405,485	\$25,682,309	\$31,755,797	\$36,018,111
	San Anselmo	\$345,101	\$1,276,139	\$3,093,725	\$50,204,458	\$69,757,672	\$89,678,663	\$99,600,692
	Total	\$4,260,778	\$16,490,514	\$64,005,986	\$94,170,069	\$132,739,337	\$171,061,962	\$200,395,032
	Total Inundated Parcels by City/Town³	5yr	10yr	25yr	50yr	100yr	250yr	500yr
Corte Madera	0	0	0	0	0	47	65	
Fairfax	80	89	130	163	178	187	188	
Greenbrae	0	0	0	0	0	95	106	
Kentfield	0	82	110	120	125	134	210	
Larkspur	0	0	15	20	42	264	353	
Ross	32	109	178	198	215	223	230	
San Anselmo	10	34	402	503	572	626	667	
Total	122	314	835	1,004	1,132	1,576	1,819	
By City/Town	Total Damage by Category for Corte Madera	5yr	10yr	25yr	50yr	100yr	250yr	500yr
	Commercial	\$0	\$0	\$0	\$0	\$0	\$568,625	\$1,956,110
	Industrial	\$0	\$0	\$0	\$0	\$0	\$454	\$905
	Residential	\$0	\$0	\$0	\$0	\$0	\$17,244	\$45,685
	Tax Exempt	\$0	\$0	\$0	\$0	\$0	\$4,756	\$17,490
	Subtotal	\$0	\$0	\$0	\$0	\$0	\$591,078	\$2,020,189
	Total Damage by Category for Fairfax	5yr	10yr	25yr	50yr	100yr	250yr	500yr
	Commercial	\$589,507	\$870,533	\$1,290,615	\$1,571,809	\$1,945,643	\$2,450,509	\$2,760,514
	Industrial	\$0	\$0	\$0	\$0	\$0	\$0	\$0
	Residential	\$1,699,078	\$2,528,854	\$3,577,256	\$4,788,362	\$5,802,574	\$7,217,619	\$7,718,109
Tax Exempt	\$0	\$87,071	\$238,043	\$385,473	\$357,449	\$537,782	\$621,580	
Subtotal	\$2,288,585	\$3,486,458	\$5,105,914	\$6,745,644	\$8,105,666	\$10,205,910	\$11,100,204	
Total Damage by Category for Greenbrae	5yr	10yr	25yr	50yr	100yr	250yr	500yr	
Commercial	\$0	\$0	\$0	\$0	\$0	\$632,864	\$1,257,158	
Industrial	\$0	\$0	\$0	\$0	\$0	\$31,915	\$61,666	
Residential	\$0	\$0	\$0	\$0	\$0	\$27,918	\$72,548	
Tax Exempt	\$0	\$0	\$0	\$0	\$0	\$1,490	\$3,101	
Subtotal	\$0	\$0	\$0	\$0	\$0	\$694,187	\$1,394,473	
Total Damage by Category for Kentfield	5yr	10yr	25yr	50yr	100yr	250yr	500yr	
Commercial	\$0	\$32,713	\$749,538	\$1,274,630	\$2,033,970	\$2,818,198	\$4,027,056	
Industrial	\$0	\$0	\$0	\$0	\$0	\$0	\$0	
Residential	\$0	\$5,295,720	\$9,102,350	\$11,753,610	\$14,913,625	\$18,998,913	\$25,439,511	
Tax Exempt	\$0	\$316,836	\$2,518,097	\$4,689,253	\$9,585,733	\$11,621,747	\$13,969,919	
Subtotal	\$0	\$5,645,269	\$12,369,986	\$17,717,493	\$26,533,328	\$33,438,858	\$43,436,486	
Total Damage by Category for Larkspur	5yr	10yr	25yr	50yr	100yr	250yr	500yr	
Commercial	\$0	\$0	\$0	\$246,486	\$606,358	\$627,673	\$720,165	
Industrial	\$0	\$0	\$0	\$0	\$0	\$0	\$0	
Residential	\$0	\$0	\$609,054	\$840,156	\$2,017,398	\$3,908,167	\$5,660,298	
Tax Exempt	\$0	\$0	\$0	\$10,347	\$36,605	\$161,630	\$444,416	
Subtotal	\$0	\$0	\$609,054	\$1,096,988	\$2,660,361	\$4,697,469	\$6,824,878	
Total Damage by Category for Ross	5yr	10yr	25yr	50yr	100yr	250yr	500yr	
Commercial	\$0	\$523,146	\$1,009,848	\$1,379,850	\$1,781,232	\$2,120,474	\$2,348,904	
Industrial	\$0	\$0	\$0	\$0	\$0	\$0	\$0	
Residential	\$1,592,280	\$4,786,057	\$9,983,707	\$14,502,664	\$20,143,180	\$25,105,471	\$28,311,722	
Tax Exempt	\$34,812	\$773,445	\$1,833,752	\$2,522,971	\$3,757,897	\$4,529,852	\$5,357,485	
Subtotal	\$1,627,092	\$6,082,648	\$12,827,308	\$18,405,485	\$25,682,309	\$31,755,797	\$36,018,111	
Total Damage by Category for San Anselmo	5yr	10yr	25yr	50yr	100yr	250yr	500yr	
Commercial	\$0	\$0	\$15,761,982	\$21,718,583	\$28,027,333	\$33,068,922	\$35,639,164	
Industrial	\$0	\$0	\$0	\$0	\$0	\$0	\$0	
Residential	\$345,101	\$1,276,139	\$5,706,651	\$25,349,757	\$37,054,416	\$48,667,000	\$54,856,876	
Tax Exempt	\$0	\$0	\$1,625,091	\$3,136,118	\$4,675,924	\$7,942,741	\$9,104,652	
Subtotal	\$345,101	\$1,276,139	\$33,093,725	\$50,204,458	\$69,757,672	\$89,678,663	\$99,600,692	

Notes:

* All damage estimates based on \$200/sq. ft. of building footprint.

¹ Categories summarized from tax records.

² City/Town as designated in tax records.

Ross Valley Flood Damage Analysis - Event Damage
With-Project Conditions

		Flood Events						
		5yr	10yr	25yr	50yr	100yr	250yr	500yr
Ross Valley Watershed								
Number of Inundated Buildings		176	405	1,171	1,490	1,684	2,537	2,781
Number of Inundated Parcels		122	255	768	982	1,108	1,547	1,726
Total Structural Damage		\$2,109,755	\$5,048,330	\$25,528,406	\$42,285,550	\$64,085,055	\$86,563,715	\$102,348,133
Total Content Damage		\$2,151,022	\$5,221,360	\$28,247,549	\$42,469,634	\$58,338,027	\$74,955,294	\$87,449,521
Total Damage*		\$4,260,778	\$10,269,691	\$53,775,955	\$84,755,184	\$122,423,082	\$161,519,008	\$189,797,654
Total Damage by Category Type¹								
Commercial		\$589,507	\$1,027,428	\$16,250,302	\$24,230,750	\$32,236,613	\$40,360,983	\$46,944,726
Industrial		\$0	\$0	\$0	\$0	\$0	\$33,337	\$60,546
Residential		\$3,636,459	\$8,908,820	\$32,945,343	\$52,136,707	\$74,298,424	\$97,579,114	\$114,900,091
Tax Exempt		\$34,812	\$333,443	\$4,580,310	\$8,387,727	\$15,888,044	\$23,545,574	\$27,892,291
Total		\$4,260,778	\$10,269,691	\$53,775,955	\$84,755,184	\$122,423,082	\$161,519,008	\$189,797,654
Total Damage by Category Structure and Content								
Total Commercial Content		\$416,224	\$725,420	\$11,163,856	\$16,512,699	\$21,823,807	\$27,201,592	\$31,549,426
Total Commercial Structure		\$173,282	\$302,008	\$5,086,446	\$7,718,051	\$10,412,806	\$13,159,391	\$15,395,301
Total Industrial Content		\$0	\$0	\$0	\$0	\$0	\$31,172	\$56,615
Total Industrial Structure		\$0	\$0	\$0	\$0	\$0	\$2,165	\$3,932
Total Residential Content		\$1,717,252	\$4,291,434	\$14,938,664	\$22,398,276	\$30,188,140	\$38,580,032	\$45,020,267
Total Residential Structure		\$1,919,208	\$4,617,386	\$18,006,679	\$29,738,431	\$44,110,284	\$58,999,082	\$69,879,824
Total Tax Exempt Content		\$17,546	\$204,506	\$2,145,029	\$3,558,660	\$6,326,080	\$9,142,497	\$10,823,214
Total Tax Exempt Structure		\$17,265	\$128,937	\$2,435,281	\$4,829,068	\$9,561,964	\$14,403,077	\$17,069,077
Total		\$4,260,778	\$10,269,691	\$53,775,955	\$84,755,184	\$122,423,082	\$161,519,008	\$189,797,654

		5yr	10yr	25yr	50yr	100yr	250yr	500yr
Total Damage by City/Town²								
Corte Madera		\$0	\$0	\$0	\$0	\$0	\$507,505	\$1,613,662
Fairfax		\$2,288,585	\$2,626,726	\$5,105,378	\$6,753,095	\$8,119,930	\$10,069,653	\$11,137,688
Greenbrae		\$0	\$0	\$0	\$0	\$0	\$721,408	\$1,337,636
Kentfield		\$2,008,035	\$9,421,288	\$14,015,169	\$23,351,025	\$30,771,728	\$39,276,723	\$45,020,267
Larkspur		\$0	\$0	\$359,815	\$772,512	\$1,854,025	\$4,070,123	\$6,336,945
Ross		\$1,627,092	\$3,635,681	\$10,293,418	\$16,079,427	\$23,594,302	\$29,824,597	\$33,426,933
San Anselmo		\$345,101	\$1,139,249	\$28,596,056	\$47,134,982	\$65,503,799	\$85,553,994	\$96,668,068
Total		\$4,260,778	\$9,409,691	\$53,775,955	\$84,755,184	\$122,423,082	\$161,519,008	\$189,797,654

		5yr	10yr	25yr	50yr	100yr	250yr	500yr
Total Inundated Parcels by City/Town²								
Corte Madera		0	0	0	0	0	37	62
Fairfax		80	89	130	163	178	187	188
Greenbrae		0	0	0	0	0	98	101
Kentfield		0	51	94	113	122	129	146
Larkspur		0	0	13	17	32	254	341
Ross		32	87	168	192	214	223	226
San Anselmo		10	28	363	497	562	619	662
Total		122	255	768	982	1,108	1,547	1,726

		5yr	10yr	25yr	50yr	100yr	250yr	500yr
Total Damage by Category for Corte Madera								
Commercial		\$0	\$0	\$0	\$0	\$0	\$491,159	\$1,558,191
Industrial		\$0	\$0	\$0	\$0	\$0	\$454	\$905
Residential		\$0	\$0	\$0	\$0	\$0	\$11,544	\$38,913
Tax Exempt		\$0	\$0	\$0	\$0	\$0	\$4,348	\$15,654
Subtotal		\$0	\$0	\$0	\$0	\$0	\$507,505	\$1,613,662

		5yr	10yr	25yr	50yr	100yr	250yr	500yr
Total Damage by Category for Fairfax								
Commercial		\$589,507	\$870,533	\$1,290,615	\$1,571,809	\$1,948,878	\$2,498,512	\$2,762,958
Industrial		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Residential		\$1,699,078	\$2,529,123	\$3,576,720	\$4,795,813	\$5,813,099	\$7,033,359	\$7,749,848
Tax Exempt		\$0	\$87,071	\$238,043	\$385,473	\$357,953	\$537,782	\$624,882
Subtotal		\$2,288,585	\$3,486,726	\$5,105,378	\$6,753,095	\$8,119,930	\$10,069,653	\$11,137,688

		5yr	10yr	25yr	50yr	100yr	250yr	500yr
Total Damage by Category for Greenbrae								
Commercial		\$0	\$0	\$0	\$0	\$0	\$664,915	\$1,204,038
Industrial		\$0	\$0	\$0	\$0	\$0	\$32,883	\$59,642
Residential		\$0	\$0	\$0	\$0	\$0	\$22,120	\$70,896
Tax Exempt		\$0	\$0	\$0	\$0	\$0	\$1,490	\$3,061
Subtotal		\$0	\$0	\$0	\$0	\$0	\$721,408	\$1,337,636

		5yr	10yr	25yr	50yr	100yr	250yr	500yr
Total Damage by Category for Kentfield								
Commercial		\$0	\$0	\$378,221	\$966,038	\$1,760,341	\$2,528,547	\$3,729,231
Industrial		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Residential		\$0	\$1,896,584	\$7,296,363	\$10,043,456	\$13,594,336	\$17,381,821	\$22,125,318
Tax Exempt		\$0	\$111,451	\$1,746,704	\$3,005,674	\$7,996,348	\$10,861,360	\$13,422,173
Subtotal		\$0	\$2,008,035	\$9,421,288	\$14,015,169	\$23,351,025	\$30,771,728	\$39,276,723

		5yr	10yr	25yr	50yr	100yr	250yr	500yr
Total Damage by Category for Larkspur								
Commercial		\$0	\$0	\$0	\$44,519	\$371,447	\$579,620	\$705,700
Industrial		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Residential		\$0	\$0	\$359,815	\$727,993	\$1,459,209	\$3,348,065	\$5,263,912
Tax Exempt		\$0	\$0	\$0	\$0	\$23,370	\$142,438	\$367,334
Subtotal		\$0	\$0	\$359,815	\$772,512	\$1,854,025	\$4,070,123	\$6,336,945

		5yr	10yr	25yr	50yr	100yr	250yr	500yr
Total Damage by Category for Ross								
Commercial		\$0	\$156,896	\$720,407	\$1,153,447	\$1,622,461	\$1,925,026	\$2,159,380
Industrial		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Residential		\$1,592,280	\$3,343,863	\$8,372,305	\$12,808,317	\$18,793,778	\$23,548,096	\$26,685,941
Tax Exempt		\$34,812	\$134,922	\$1,200,706	\$2,117,662	\$3,178,063	\$4,351,475	\$4,581,612
Subtotal		\$1,627,092	\$3,635,681	\$10,293,418	\$16,079,427	\$23,594,302	\$29,824,597	\$33,426,933

		5yr	10yr	25yr	50yr	100yr	250yr	500yr
Total Damage by Category for San Anselmo								
Commercial		\$0	\$0	\$13,861,059	\$20,494,937	\$26,533,487	\$31,673,204	\$34,825,229
Industrial		\$0	\$0	\$0	\$0	\$0	\$0	\$0
Residential		\$345,101	\$1,139,249	\$13,340,140	\$23,761,127	\$34,638,002	\$46,234,108	\$52,965,263
Tax Exempt		\$0	\$0	\$1,394,857	\$2,878,918	\$4,332,311	\$7,646,681	\$8,877,575
Subtotal		\$345,101	\$1,139,249	\$28,596,056	\$47,134,982	\$65,503,799	\$85,553,994	\$96,668,068

Notes:
 * All damage estimates based on \$200/sq. ft. of building footprint.
¹ Categories summarized from tax records.
² City/Town as designated in tax records.

For Ross Valley - Corte Madera Creek

By City/Town