ATTACHMENT 8
Benefits and Cost Analysis

We have used the DWR Method of Analysis to calculate benefits and costs for the project. This method includes Sections D1 through D4.

Section D1 – Flood Damage Reduction Benefits Analysis includes the following attached tables:

- Table 11 – Calculation of Expected Annual Damage, Main Drain / V-Drain Enlargement Project
- Tables 11.A through 11.J – Depth Damage Calculations, Backup Information for Table 11
- Table 12 – Present Value of Expected Annual Damage Benefits, Main Drain / V-Drain Enlargement Project

Section D2 – Non Monetized Benefits Analysis

- Table 13 – Non Monetized Benefits Checklist

Section D3 – Monetized Benefits Analysis – NOT INCLUDED

Section D4 – Project Benefits and Costs Summary

- Table 16 – Annual Costs of Project, Main Drain / V-Drain Enlargement Project
- Table 17 – Proposal Benefits and Costs Summary

Table 11. Calculation of Expected Annual Damage Main Drain / V-Drain Expansion Project											
Hydrologic Event	Event Exceedance Probability	Event Damage if Flood Structures Fail	Probability Structural Failure		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	Without Project	With Project
(a)	(b)	(c)	(d)	(e)	(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	0.2				$0	$0				$0.00	$0
10-Year	0.1				$ 263,071.80	$0	0.1	$131,536	$0	$13,153.59	$0
100-Year	0.01				$682,225	$0	0.09	$472,648	$0	$4,726.48	$0
200-Year	0.005				$783,767	$0	0.005	$732,996	$0	$3,664.98	$0
Expected Annual Damages, Without and With Project										$21,545.05	$0.00

Note: Damage calculations are for the Main Drain/V-Drain Project prior to construction of any upstream improvements that will be constructed with the Eastside Drain Project. In this condition the Main Drain/V-Drain will have the capacity for the large storm events. If the Eastside Drain is constructed, the overall system will not have capacity for these large events.

Damage Estimates

Table 11.A

Category	Description	Units	Replacement Cost per Unit	Contents Value, % of Replacement Cost	Relocation Cost per month per unit
1	Residence Singe Family no basement	SF	$45.00	30%	$1.00
12	Livestock Barn	SF	$6.00	200%	$1.00
924	Hi Value Annuals	ACRE	$2,500.00		

Depth Damage Estimates for Infrastructure

Table 11.B

Category	Description	Depth				
		-1	0	1	2	3
1	Residence Singe Family no basement	0	10%	21%	28%	33%
12	Livestock Barn	0	0%	10%	10%	10%
924	Hi Value Annuals	0	0%	3%	10%	25%

Depth Damage Estimates for Contents

Table 11.C

Category	Description	Depth				
		-1	0	1	2	3
1	Residence Singe Family no basement	0	0%	44%	75%	85%
12	Livestock Barn	0	50%	100%	100%	100%
924	Hi Value Annuals	0	8%	11%	22%	28%

Note: Damage and depth drainage information is from Appendix V, VI, and VII of the following study, "Drainage Project Benefit and Agricultural Drainage Payment Capacity for the Dixon Watershed Drainage Plan Alternative, prepared by Hazard Mitigation Economics. A copy of this study is located in Appendix A of Attachment 3.

Depth Damage Estimates for Relocation Cost, Source: FEMA BCA Tables

Table 11.D

Category	Description	Depth				
		-1	0	1	2	3
	Residential and Commercial	0.0	0.0	2.1	4.3	5.6

Building and Infrastructure Inventory, Source: Aerial Photography and Flooded Areas Shown on Figure 7-1 in Attachment 7.

Table 11.E

Category	Description	Units	Area A, North of Sikes Rd			Total Area A
1	Residence Singe Family no basement	SF	1600	900	900	3400
12	Livestock Barn	SF	20000	4200		24200
924	Hi Value Annuals	ACRE	346			346

Table 11.F

Category	Description	Units	Area B, South of Sikes Road			Total Area B
1	Residence Singe Family no basement	SF				0
12	Livestock Barn	SF				0
924	Hi Value Annuals	ACRE	490			490

Depth Damage Calculations, Main Drain / V-Drain Project

Table 11.G

Category	Total Area A	Units	Infrastructure Cost	Contents Cost	Relocation Cost	Depth -1			Depth 0			Depth 1			Depth 2			Depth 3		
						Infrastructure	Contents	Relocation	Infrastructure	Contents	Relocation	Infrastructure	Contents	Relocation	Infrastructu	Contents	Relocation	Infrastructure	Contents	Relocation
1	3,400	SF	$153,000	$45,900	$3,400	$0	$0	$0	$15,300	$0	$0	$32,130	$20,196	$7,140	$42,840	$39,015	$14,620	$50,490	$39,015	$19,040
12	24,200	SF	$145,200	$290,400	$24,200	$0	$0	$0	$0	$145,200	$0	$14,520	$290,400	$50,820	$14,520	$290,400	$104,060	$14,520	$290,400	$135,520
924	346	ACRE	$865,000	$0	$0	$0	$0		$0	$0	$0	$25,950	$0	$0	$86,500	$0	$0	$216,250	$0	$0
					Sub-Totals	$0	$0	$0	$15,300	$145,200	$0	$72,600	$310,596	$57,960	$143,860	$329,415	$118,680	$281,260	$329,415	$154,560
					Area A Totals	**$0**			**$160,500**			**$441,156**			**$591,955**			**$765,235**		

Table 11.H

Category	Total Area B	Units	Infrastructure Cost	Contents Cost	Relocation Cost	Depth -1			Depth 0			Depth 1			Depth 2			Depth 3		
						Infrastructure	Contents	Relocation	Infrastructure	Contents	Relocation	Infrastructure	Contents	Relocation	Infrastructu	Contents	Relocation	Infrastructure	Contents	Relocation
1	0	SF	$0	$0	$0	$0	$0		$0	$0		$0	$0		$0	$0		$0	$0	
12	0	SF	$0	$0	$0	$0	$0		$0	$0		$0	$0		$0	$0		$0	$0	
924	490	ACRE	$1,225,000	$0	$0	$0	$0		$0	$0		$36,750	$0		$122,500	$0		$306,250	$0	
					Sub-Totals	$0	$0	$0	$0	$0	$0	$36,750	$0	$0	$122,500	$0	$0	$306,250	$0	$0
					Area B Totals	**$0**			**$0**			**$36,750**			**$122,500**			**$306,250**		

Expected Event Damage without Project

Table 11.I

Storm	Ground Elevation		Water Surface		Depth of Flooding		Damage		Total Damage
	Area A	Area B	Area A	Area B	Area A	Area B	Area A	Area B	
5-year	17.5	14	17.4	14	-0.1	0	$0	$0	$0
10-year	17.5	14	17.8	14.5	0.3	0.5	$244,697	$18,375	$263,072
100-year	17.5	14	19.4	15.8	1.9	1.8	$576,875	$105,350	$682,225
200-year	17.5	14	19.9	16	2.4	2	$661,267	$122,500	$783,767

Expected Event Damage with Project

Table 11.J

Storm	Ground Elevation		Water Surface		Depth of Flooding		Damage		Total Damage
	Area A	Area B	Area A	Area B	Area A	Area B	Area A	Area B	
5-year	17.5	14	14.8	12.2	-2.7	-1.8	$0	$0	$0
10-year	17.5	14	15	12.2	-2.5	-1.8	$0	$0	$0
100-year	17.5	14	16.1	13.5	-1.4	-0.5	$0	$0	$0
200-year	17.5	14	16.5	13.8	-1	-0.2	$0	$0	$0

Table 12. Present Value of Expected Annual Damage Benefits			
Project: Main Drain / V-Drain Expansion Project			
(a)	Expected Annual Damage Without Project [1]		**$21,545.05**
(b)	Expected Annual Damage With Project [1]		**$0.00**
(c)	Expected Annual Benefit	(a) – (b)	**$21,545.05**
(d)	Present Value Coefficient [2]		**15.76**
(e)	**Present Value of Future Benefits** **Transfer to Table 17, column (d).**	**(c) x (d)**	**$339,550.06**
(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 13. Non-monetized Benefits Checklist		
No.	Question	Enter "Yes", "No" or "Neg"
	Community/Social Benefits **Will the proposal**	
1	**Provide education or technology benefits?**	**No**
	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 - Provide some other education or technological benefit?	
2	**Provide social recreation or access benefits?**	No
	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**
	The watershed area (northeastern Solano County) has been fraught with conflict and court cases due to increasing runoff from urban development and changing agricultural practices. The lack of cooperation and deficiency in planning became apparent as a result of the flooding from storms in 1996 and 1997. This project was cooperatively developed to meet the needs of both the City and the different agricultural agencies. The project will improve regional drainage and flood control while resolving the regional conflict between the Dixon Watershed Joint Power Authority member agencies which have been in the courts since the 1980's.	
4	**Promote social health and safety?**	No
	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
	The Project will seed approximately 50 acres of uplands with a variety of native perennial grasses replacing existing non-native species in the area. Fencing will protect native vegetation from grazing cattle. Project will create approximately 5-6 acres of wetlands.	
7	**Improve water quality in ways that were not quantified in Attachment 7?**	yes
	The project restores native vegetation in the channel, decreases water velocity in the channel during high flow events and installs fencing to exclude cattle from the channel. These improvements will improve water quality in the channels and downstream in Haas Slough. The project will create 13 additional acres of wetlands which will be vegetated, approximately 50 acres of upland areas will be planted and 24 acres of channel area will be fenced off from cattle.	
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?**	
	Sustainability Benefits: **Will the proposal**	
10	**Improve the overall, long-term management of California groundwater resources?**	No
	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
12	**Provide a long-term solution in place of a short-term one?**	No
	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?**	No
	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)?**	

Table 16. Annual Costs of Project
(All costs should be in 2012 Dollars)
Project: Dixon Main Drain / V-Drain Enlargement Project

Year	Initial Costs Grand Total Cost from Table 6 (row (i), column (a)	Adjusted Grant Total Cost[1] (b)	Annual Costs [2] Admin (c)	Operation (d)	Maintenance (e)	Replacement (f)	Other (g)	Total Costs (a) +…+ (g) (h)	Discounting Calculations Discount Factor (i)	Discounted Project Costs (h) x (i) (j)
2012	$ 3,205,754.89							$ 3,205,754.89	1.000	**$ 3,205,754.89**
2013					7200			$ 7,200.00	0.943	**$ 6,789.60**
2014					7200			$ 7,200.00	0.890	**$ 6,408.00**
2015					7200			$ 7,200.00	0.840	**$ 6,048.00**
2016					7200			$ 7,200.00	0.792	**$ 5,702.40**
2017					7200			$ 7,200.00	0.747	**$ 5,378.40**
2018					7200			$ 7,200.00	0.705	**$ 5,076.00**
2019					7200			$ 7,200.00	0.665	**$ 4,788.00**
2020					7200			$ 7,200.00	0.627	**$ 4,514.40**
2021					7200			$ 7,200.00	0.592	**$ 4,262.40**
2022					7200			$ 7,200.00	0.558	**$ 4,017.60**
2023					7200			$ 7,200.00	0.527	**$ 3,794.40**
2024					7200			$ 7,200.00	0.497	**$ 3,578.40**
2025					7200			$ 7,200.00	0.469	**$ 3,376.80**
2026					7200			$ 7,200.00	0.442	**$ 3,182.40**
2027					7200			$ 7,200.00	0.417	**$ 3,002.40**
2028					7200			$ 7,200.00	0.394	**$ 2,836.80**
2029					7200			$ 7,200.00	0.371	**$ 2,671.20**
2030					7200			$ 7,200.00	0.350	**$ 2,520.00**
2031					7200			$ 7,200.00	0.331	**$ 2,383.20**
2032					7200			$ 7,200.00	0.312	**$ 2,246.40**
2033					7200			$ 7,200.00	0.294	**$ 2,116.80**
2034					7200			$ 7,200.00	0.278	**$ 2,001.60**
2035					7200			$ 7,200.00	0.262	**$ 1,886.40**
2036					7200			$ 7,200.00	0.247	**$ 1,778.40**
2037					7200			$ 7,200.00	0.233	**$ 1,677.60**
2038					7200			$ 7,200.00	0.220	**$ 1,584.00**
2039					7200			$ 7,200.00	0.207	**$ 1,490.40**
2040					7200			$ 7,200.00	0.196	**$ 1,411.20**
2041					7200			$ 7,200.00	0.185	**$ 1,332.00**
2042					7200			$ 7,200.00	0.174	**$ 1,252.80**
2043					7200			$ 7,200.00	0.164	**$ 1,180.80**
2044					7200			$ 7,200.00	0.155	**$ 1,116.00**
2045					7200			$ 7,200.00	0.146	**$ 1,051.20**
2046					7200			$ 7,200.00	0.138	**$ 993.60**
2047					7200			$ 7,200.00	0.130	**$ 936.00**
2048					7200			$ 7,200.00	0.123	**$ 885.60**
2049					7200			$ 7,200.00	0.116	**$ 835.20**
2050					7200			$ 7,200.00	0.109	**$ 784.80**
2051					7200			$ 7,200.00	0.103	**$ 741.60**
2052					7200			$ 7,200.00	0.097	**$ 698.40**
2053					7200			$ 7,200.00	0.092	**$ 662.40**
2054					7200			$ 7,200.00	0.087	**$ 626.40**
2055					7200			$ 7,200.00	0.082	**$ 590.40**
2056					7200			$ 7,200.00	0.077	**$ 554.40**
2057					7200			$ 7,200.00	0.073	**$ 525.60**
2058					7200			$ 7,200.00	0.069	**$ 496.80**
2059					7200			$ 7,200.00	0.065	**$ 468.00**
2060					7200			$ 7,200.00	0.061	**$ 439.20**
2061					7200			$ 7,200.00	0.058	**$ 417.60**
									Total Present Value of Discounted Costs (Sum of Column (j))	**$ 3,318,866.89**

Comments: Maintenance cost is based on the actual average JPA costs to maintain open channels of $2400 per mile for the three miles of channel in the project. The gravity flow channel has not operations costs and no mechanical component that would need replacing. No JPA administration cost will be charged to the project once it is constructed.

(1) If any, based on opportunity costs, sunk costs and associated costs
(2) The incremental change in O&M costs attributable to the project

Table 17. Proposal Benefits and Costs Summary

Proposal: Dixon Watershed Management Plan
Agency: Dixon Regional Watershed Joint Powers Authority

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)
Dixon Main Drain / V-Drain Enlargement Project	Dixon Regional Watershed Joint Powers Authority	$ 3,318,866.89	$ 339,550.06		$ 339,550.06	Enables construction of Eastside Drainage Project with a future benefit area of 11,600 acres, helps resolve public water resource conflicts, restores native vegetation, improves water quality, creates wetlands

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