Appendix J: BMP Economic Analysis Assumptions

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Table E-1. Assumptions Used for Economic Analysis of Water Conservation BMPs

BMP 1 – Water Survey Programs for Single-Family Residential and Multi-Family Residential Customers

Description: Conduct water surveys that include both indoor and outdoor components. Provide recommendations and install plumbing retrofit devices where needed.

Assumptions:

1. Number of surveys necessary to complete is 15% of the baseline number of housing units in 1997. 15% of single-family units and 15% of multi-family units will be surveyed within 10 years of the date implementation is to commence. Surveys will be conducted according to the following schedule: 1.5% by end of the first reporting period, 3.6% by end of second reporting period, 6.3% by end of third reporting period, 9.6% by end of fourth reporting period, and 15% by end of the fifth reporting period.

MOU, page 16 and page 17 Section E.d. California legislation requires that plumbing fixtures manufactured, sold or installed after early 1992 be low-water-use fixtures. Therefore, the greatest water savings can be achieved in pre-1992 homes.

2. Single-family water usage = 634 gpd/unit (64% is outdoor use)

Single-family water usage was calculated based on historical single family water use and single-family households. The monthly indoor water use is assumed to be equivalent to 90 percent of the total water used in the lowest water use month in 1997. Outdoor water is calculated as the difference between annual total use and the assumed annual indoor water use.

3. Multi-family water usage = 180 gpd/unit (25% is outdoor use)

Multi-family water usage was calculated based on historical multi-family water use and multi-family households. The monthly indoor water use is assumed to be equivalent to 90 percent of the total water used in the lowest water use month in 1997. Outdoor water is calculated as the difference between annual total use and the assumed annual indoor water use.

4. Water savings from indoor leak detection, not including toilet leaks = 0.5 gpd per residence

A & N Technical Services report (2000, page 2-20) (12.4 gpd per household repair; 4 percent of households audited have leaks).

5. Water surveys decrease outdoor water use by 10%

MOU estimate is 10% (page 17).

6. Each water survey costs $50

It is assumed that this BMP is done in conjunction with BMP 2.

7. The life span of a water survey is four years.

A & N Technical Services report (2000, page 2-20) gives life spans for various components of a water survey. Four years was selected as a reasonable average value based on that information.

8. Water savings from indoor plumbing retrofits are tracked under BMP 2. Only water savings from a decrease in outdoor water use and water savings from indoor leak detection are tracked in BMP 1 to avoid double counting of water savings.

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Table E-2. Economic Analysis Worksheets

BMP 1. Water Survey Programs for Single-Family and Multi-Family Residential Customers

Calendar Year	Single Family Interventions	Multi Family Interventions	Percent Units Surveyed[a]	Single-Family Outdoor Savings (AF/yr)	Multi-Family Outdoor Savings (AF/yr)	Total Outdoor Savings (AF/yr)	Total Indoor Savings (AF/yr)	Annual Water Savings (AF/yr)	Benefits ($): Avoided Capital Costs	Avoided Variable Costs	Avoided Purchase Costs	Total Undiscounted Benefits	Total Discounted Benefits	Costs ($): Capital Costs	Financial Incentives	Operating Expenses	Total Undiscounted Costs	Total Discounted Costs	Net Present Value ($)
Pre-1998	0	0	0.0%	0.0	0.00	0.0	0.000	0.0	0	0	0	0	0	0	0	0	0	0	0
1998	118	10	0.8%	5.4	0.05	5.4	0.072	5.5	0	3,294	0	3,294	3,940	0	0	6,386	6,386	7,638	-3,697
1999	118	10	0.8%	5.4	0.05	5.4	0.072	11.0	0	6,588	0	6,588	7,424	0	0	6,386	6,386	7,195	229
2000	165	13	1.1%	7.5	0.07	7.6	0.100	18.7	0	11,200	0	11,200	11,889	0	0	8,940	8,940	9,489	2,400
2001	165	13	1.1%	7.5	0.07	7.6	0.100	26.4	0	15,812	0	15,812	15,812	0	0	8,940	8,940	8,940	6,872
2002	213	17	1.4%	9.7	0.09	9.8	0.129	30.7	0	18,447	0	18,447	17,379	0	0	11,494	11,494	10,828	6,551
2003	213	17	1.4%	9.7	0.09	9.8	0.129	35.1	0	21,083	0	21,083	18,711	0	0	11,494	11,494	10,201	8,510
2004	260	21	1.7%	11.8	0.11	11.9	0.157	39.5	0	23,718	0	23,718	19,830	0	0	14,048	14,048	11,745	8,085
2005	260	21	1.7%	11.8	0.11	11.9	0.157	43.9	0	26,353	0	26,353	20,757	0	0	14,048	14,048	11,065	9,692
2006	425	35	2.7%	19.3	0.17	19.5	0.258	53.8	0	32,283	0	32,283	23,954	0	0	22,988	22,988	17,057	6,897
2007	425	35	2.7%	19.3	0.17	19.5	0.258	63.7	0	38,212	0	38,212	26,711	0	0	22,988	22,988	16,069	10,642
2008								51.6	0	30,965	0	30,965	20,391						20,391
2009								39.5	0	23,718	0	23,718	14,714						14,714
2010								19.8	0	11,859	0	11,859	6,931						6,931
2011																			
2012																			
2013																			
2014																			
2015																			
2016																			
2017																			
2018																			
2019																			
2020																			
Totals:	2,362	193	15%	107	1.0	108	1.43	439	0	263,534	0	263,534	208,440	0	0	127,710	127,710	110,226	98,214

[a]Percent surveyed from MOU, Exhibit 1,1.E(d)

Value of conserved water ($/AF) =	600
Discount rate (real) =	6.15%
Water savings from indoor leak detection (gpd/unit) =	0.50
Outdoor water savings =	10%
Single-family outdoor water usage (gpd/unit) =	406
Multi-family outdoor water usage (gpd/unit) =	45
Conservation measure unit cost ($) =	50
1997 single family units =	15,744
1997 multi-family units =	1,284

Benefit cost ratio:	1.9
Simple pay-back period (years):	7
Discounted cost / water saved ($/acre-feet):	251
NPV / water saved ($/acre-feet):	224

Credit Table for Previously Performed Surveys

Year	Single family units surveys	Multi-family units surveys	% Credit	Single family credits	Multi-family credits
Pre-1990	0	0	0.0%	0	0
1990	0	0	12.5%	0	0
1991	0	0	25.0%	0	0
1992	0	0	37.5%	0	0
1993	0	0	50.0%	0	0
1994	0	0	62.5%	0	0
1995	0	0	75.0%	0	0
1996	0	0	87.5%	0	0
1997	0	0	100.0%	0	0
				0	0

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Table E-1. Assumptions Used for Economic Analysis of Water Conservation BMPs

BMP 2 – Residential Plumbing Retrofit

Description: Install plumbing retrofit devices in single- and multi- family residences.

Assumptions:

1. Plumbing retrofit devices will be installed at a minimum of 10% of residences per reporting period until it can be demonstrated that 75% of pre-1992 single-family residences and 75% of pre-1992 multi-family residences have low flow showerheads (LFSHs).

MOU, page 19.

2. 22.5% of residences have low-water-use fixtures.

Based on professional judgement, it was estimated that 45% of plumbing fixtures in pre-1992 residences have been replaced with low-water-use fixtures due to natural attrition. Assuming that one-half of these plumbing fixtures have replaced all fixtures in some pre-1992 residences and one-half of these plumbing fixtures are spreadout, replacing only a portion of the fixtures in some pre-1992 residences, then 22.5 percent of pre-1992 residences already have low-water-use fixtures.

3. It will take approximately 10.5 years to demonstrate that 75% of residences have LFSHs.

It was assumed that two LFSHs in a residence must be replaced to meet MOU requirements. If 22.5% of the residences have low-water-use fixtures, then 52.5% of the pre-1992 residences must still be replaced. At 5% of the residences replaced per year (10% replaced per reporting period) it would take 10.5 years to demonstrate that a total of 75% of residences have LFSHs.

4. There are an average of 1.1 showers, 1.7 toilets, and 2.6 faucets (1 kitchen faucet and 1.6 other faucets) per residence.

For BMP 14, it has been determined that there is an average of 1.7 toilets per residence (see BMP 14 for details). Based on professional judgement, it is assumed there are two-thirds the number of showers as toilets, and 1.5 times the number of faucets as toilets.

5. Water savings from one low-flow showerhead = 5.5 gpd

A & N Technical Services report (2000, page 2-16).

6. Water savings from one faucet aerator = 1.5 gpd

A & N Technical Services report (2000, page 2-16).

7. Water savings from one toilet flapper = 8 gpd; assume 8 percent of toilets leak.

A & N Technical Services report (2000, page 2-16).

8. Water savings from one kitchen "flip" aerator = 3.0 gpd.

Based on data provided by Southern California Water Company. Kitchen faucet water savings are due to the intermittent use of the flip feature during the rinse cycle.

9. Indoor water savings = 12.5 gpd/unit.

The following equation was used to calculate indoor water savings, based on assumptions 4 through 8:

$$[(1.1*5.5) + (1.0*3.0+1.6*1.5) + (1.7*8*0.08)]$$

10. The BMP will cost an average of $50 per residence.

It is assumed that this BMP is done in conjunction with BMP 1.

11. The life span of the retrofit devices is four years.

A & N Technical Services report (2000, page 2-16) gives life spans for a various components of a water survey. Four years was selected as a reasonable average value based on that information.

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Table E-2. Economic Analysis Worksheets

BMP 2. Residential Plumbing Retrofit

						Benefits ($)					Costs ($)					
Calendar Year	Single Family Interventions	Multi Family Interventions	Percent Units Receiving Retrofits	Incremental Water Savings (AF/yr)	Annual Water Savings (AF/yr)	Avoided Capital Costs	Avoided Variable Costs	Avoided Purchase Costs	Total Undiscounted Benefits	Total Discounted Benefits	Capital Costs	Financial Incentives	Operating Expenses	Total Undiscounted Costs	Total Discounted Costs	Net Present Value ($)
2001	771	63	5.0%	11.7	11.7	0	7,005	0	7,005	7,005	0	0	41,688	41,688	41,688	-34,683
2002	771	63	5.0%	11.7	23.3	0	14,009	0	14,009	13,198	0	0	41,688	41,688	39,272	-26,075
2003	771	63	5.0%	11.7	35.0	0	21,014	0	21,014	18,650	0	0	41,688	41,688	36,997	-18,347
2004	771	63	5.0%	11.7	46.7	0	28,019	0	28,019	23,425	0	0	41,688	41,688	34,853	-11,428
2005	771	63	5.0%	11.7	46.7	0	28,019	0	28,019	22,068	0	0	41,688	41,688	32,834	-10,766
2006	771	63	5.0%	11.7	46.7	0	28,019	0	28,019	20,790	0	0	41,688	41,688	30,932	-10,142
2007	771	63	5.0%	11.7	46.7	0	28,019	0	28,019	19,585	0	0	41,688	41,688	29,140	-9,555
2008	771	63	5.0%	11.7	46.7	0	28,019	0	28,019	18,450	0	0	41,688	41,688	27,451	-9,001
2009	771	63	5.0%	11.7	46.7	0	28,019	0	28,019	17,381	0	0	41,688	41,688	25,861	-8,480
2010	771	63	5.0%	11.7	46.7	0	28,019	0	28,019	16,374	0	0	41,688	41,688	24,363	-7,988
2011	385	31	2.5%	5.8	40.9	0	24,516	0	24,516	13,498	0	0	20,844	20,844	11,476	2,022
2012					29.2	0	17,512	0	17,512	9,083						9,083
2013					17.5	0	10,507	0	10,507	5,134						5,134
2014					5.8	0	3,502	0	3,502	1,612						1,612
2015																
2016																
2017																
2018																
2019																
2020																
Totals:	8,093	661	53%	123	490	0	294,196	0	294,196	206,253	0	0	437,719	437,719	334,867	-128,614

Value of conserved water ($/AF) =	600	Benefit cost ratio:	0.6
Discount rate (real) =	6.15%	Simple pay-back period (years):	23
Water savings (gpd/unit) =	12.5	Discounted cost / water saved ($/acre-feet):	683
Conservation measure unit cost ($) =	50	NPV / water saved ($/acre-feet):	-262
Percent units receiving retrofits =	5%		
1991 single family units =	15,416		
1991 multi-family units =	1,259		

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Table E-1. Assumptions Used for Economic Analysis of Water Conservation BMPs

BMP 5 – Large Landscape Conservation Programs and Incentives

Description: Conduct water surveys for accounts with large landscaped areas including schools, cemeteries, parks, and civic centers. Provide recommendations for water conservation.

Assumptions:

1. Eto-based water use budgets will be developed for 90 percent of the CII accounts with dedicated irrigation meters by the end of the second reporting period (22.5 percent per year for four years).

MOU (Page 27, Section C.a.)

2. Water surveys will be offered to 20 percent of the CII accounts with mixed use or no meters every reporting period (10 percent per year).

MOU (Page 27, Section C.b.)

3. Irrigation water use surveys will be completed for 15 percent of CII accounts with mixed use or no meters within 10 years of the date implementation was to commence. An agency will be considered on track if the percent of CII accounts with mixed use or no meters receiving landscape water use equals or exceeds the following: 1.5% by end of the first reporting period, 3.6% by end of second reporting period, 6.3% by end of third reporting period, 9.6% by end of fourth reporting period, and 13.5 percent by end of the 9th year. 15% must be reached by the end of the fifth reporting period.

MOU (Page 28, Section E.d.)

4. There are 0 dedicated landscape metered accounts and 1,369 CII mixed use accounts.

This is based on data provided by California Water Service Company in a spreadsheet entitled Water Supply and Demand Analysis and Projections, prepared October 16, 2000.

5. CII mixed use account landscape areas are assumed to be an average of 0.5 acre in size.

This is based on professional judgement.

6. Water use prior to the survey is 4.7 ft per year.

Irrigation allocation is equal to 100 percent of local evapotranspiration (ETo), and the MOU estimates that surveys will reduce water usage by 15 percent. The local ETo was determined (49 in/year based on California Irrigation Management Information System data) and multiplied by 1.15 to obtain 56 inches (4.7 ft) per year for current water use. (Most conservative approach for economic analysis)

7. Surveys will reduce water usage by 15%.

MOU, page 29.

8. The life span of the large landscape water surveys is four years.

A & N Technical Services report (2000) gives a life span of four years for turf audits (page 2-20). It is assumed that water surveys for large landscapes will have a similar life span.

9. Each survey will cost $250 per acre.

This estimate is based on information presented in Cal Poly's 1988/89 annual report on their landscape water management program. The estimate includes labor, administration, evaluation and overhead.

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Table E-2. Economic Analysis Worksheets

BMP 5. Large Landscape Conservation Programs and Incentives

Calendar Year	CII Accounts w/Dedicated Irr. Meters *Interventions*	CII Accounts w/Mixed Use or No Meters *Offered Surveys*	CII Accounts w/Mixed Use or No Meters *Percent Surveyed*[a]	CII Accounts w/Mixed Use or No Meters *Interventions*	Incremental Water Savings (AF/yr)	Annual Water Savings (AF/yr)	Benefits ($): Avoided Capital Costs	Avoided Variable Costs	Avoided Purchase Costs	Total Undiscounted Benefits	Total Discounted Benefits	Costs ($): Capital Costs	Financial Incentives	Operating Expenses	Total Undiscounted Costs	Total Discounted Costs	Net Present Value ($)
Pre-1999				0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	0.0	136.9	0.8%	10.3	3.6	3.6	0	2,185	0	2,185	2,463	0	0	1,283	1,283	1,446	1,016
2000	0.0	136.9	0.8%	10.3	3.6	7.3	0	4,371	0	4,371	4,640	0	0	1,283	1,283	1,362	3,277
2001	0.0	136.9	1.1%	14.4	5.1	12.4	0	7,430	0	7,430	7,430	0	0	1,797	1,797	1,797	5,634
2002	0.0	136.9	1.1%	14.4	5.1	17.5	0	10,490	0	10,490	9,882	0	0	1,797	1,797	1,693	8,190
2003		136.9	1.4%	18.5	6.6	20.4	0	12,238	0	12,238	10,861	0	0	2,310	2,310	2,050	8,811
2004		136.9	1.4%	18.5	6.6	23.3	0	13,987	0	13,987	11,694	0	0	2,310	2,310	1,931	9,762
2005		136.9	1.7%	22.6	8.0	26.2	0	15,735	0	15,735	12,393	0	0	2,824	2,824	2,224	10,170
2006		136.9	1.7%	22.6	8.0	29.1	0	17,483	0	17,483	12,973	0	0	2,824	2,824	2,095	10,878
2007		136.9	2.7%	37.0	13.1	35.7	0	21,417	0	21,417	14,971	0	0	4,620	4,620	3,230	11,741
2008		136.9	2.7%	37.0	13.1	42.3	0	25,351	0	25,351	16,694	0	0	4,620	4,620	3,043	13,651
2009						34.2	0	20,543	0	20,543	12,744						12,744
2010						26.2	0	15,735	0	15,735	9,196						9,196
2011						13.1	0	7,868	0	7,868	4,332						4,332
2012																	
2013																	
2014																	
2015																	
2016																	
2017																	
2018																	
2019																	
2020																	
Totals:	0	1369	15%	205	73	291	0	174,835	0	174,835	130,272	0	0	25,669	25,669	20,871	109,401

[a]Percent surveyed from MOU, Exhibit 1,5.E(d)

Credit Table for Previously Performed Surveys: Year	# of Surveys	% Credit	Credits
Surveyed prior to July 1, 1996 w/follow up inspection	0	100%	0
Surveyed prior to July 1, 1996 - have not received follow up inspection	0	50%	0
Surveyed after July 1, 1996	0	100%	0
Total			0

Value of conserved water ($/AF) =	600
Discount rate (real) =	6.15%
Acres / CII accounts with dedicated irrigation meters =	0.0
Acres / CII accounts with mixed use meters =	0.5
Annual water use (ac-ft/acre) =	4.7
Water savings =	15%
Conservation measure unit cost ($/acre) =	250
Number of CII accounts with dedicated irrigation meters in 1997 =	0
Number of CII accounts with mixed use or no meter as of 1997 =	1,369
Percent of CII accounts with dedicated irrigation meters to receive Eto-based water use budgets annually for two reporting periods =	22.5%
Percent of CII accounts with mixed use or no meters offered surveys annually =	10%

Benefit cost ratio:	6.2
Simple pay-back period (years):	2.1
Discounted cost / water saved ($/acre-feet):	72
NPV / water saved ($/acre-feet):	375

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Table E-1. Assumptions Used for Economic Analysis of Water Conservation BMPs

BMP 6 – High-Efficiency Washing Machine Rebate Programs
Description: Provide rebates to single-family residences for high-efficiency washing machines.
Assumptions 1. Each rebate will cost $75. *The MOU does not require implementation of this BMP if the maximum cost-effective rebate is less than $50 (MOU, page 31). A $50 rebate plus an additional $25 per rebate for program administration and overhead was assumed.* 2. Each high efficiency washing machine will reduce water usage by 5,100 gallons per year. *MOU, page 32.* 3. Rebates will be accepted by one percent of single-family residences per year for 20 years. *Estimate based on professional judgement.* 4. The life span of a high efficiency washing machine is 12 years. *CUWCC, 1996, Guidelines for Preparing Cost Effective Analysis of Urban Water Conservation Best Management Practices, September 1996, page 3-2.*

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Table E-2. Economic Analysis Worksheets

BMP 6. High-Efficiency Washing Machine Rebate Programs

Calendar Year	Total Single-Family Units	Number of Units Accepting Rebates	Incremental Water Savings (AF/yr)	Annual Water Savings (AF/yr)	Benefits ($): Avoided Capital Costs	Avoided Variable Costs	Avoided Purchase Costs	Total Undiscounted Benefits	Total Discounted Benefits	Costs ($): Capital Costs	Financial Incentives	Operating Expenses	Total Undiscounted Costs	Total Discounted Costs	Net Present Value ($)
2001	15967	160	2.5	2.5	0	1,500	0	1,500	1,500	0	7,984	3,992	11,976	11,976	-10,476
2002	16024	160	2.5	5.0	0	3,004	0	3,004	2,830	0	8,012	4,006	12,018	11,322	-8,491
2003	16080	161	2.5	7.5	0	4,514	0	4,514	4,006	0	8,040	4,020	12,060	10,703	-6,697
2004	16137	161	2.5	10.0	0	6,030	0	6,030	5,041	0	8,068	4,034	12,102	10,118	-5,077
2005	16193	162	2.5	12.6	0	7,551	0	7,551	5,947	0	8,097	4,048	12,145	9,566	-3,618
2006	16250	163	2.5	15.1	0	9,077	0	9,077	6,735	0	8,125	4,063	12,188	9,043	-2,308
2007	16308	163	2.6	17.7	0	10,608	0	10,608	7,415	0	8,154	4,077	12,231	8,549	-1,134
2008	16365	164	2.6	20.2	0	12,145	0	12,145	7,998	0	8,183	4,091	12,274	8,082	-85
2009	16423	164	2.6	22.8	0	13,687	0	13,687	8,491	0	8,211	4,106	12,317	7,641	850
2010	16480	165	2.6	25.4	0	15,235	0	15,235	8,904	0	8,240	4,120	12,360	7,223	1,680
2011	16538	165	2.6	28.0	0	16,788	0	16,788	9,243	0	8,269	4,135	12,404	6,829	2,414
2012	16597	166	2.6	30.6	0	18,347	0	18,347	9,516	0	8,298	4,149	12,448	6,456	3,060
2013	16655	167	2.6	30.7	0	18,411	0	18,411	8,996	0	8,328	4,164	12,491	6,103	2,893
2014	16714	167	2.6	30.8	0	18,476	0	18,476	8,505	0	8,357	4,178	12,535	5,770	2,735
2015	16772	168	2.6	30.9	0	18,541	0	18,541	8,040	0	8,386	4,193	12,579	5,455	2,585
2016	16832	168	2.6	31.0	0	18,606	0	18,606	7,601	0	8,416	4,208	12,624	5,157	2,444
2017	16891	169	2.6	31.1	0	18,672	0	18,672	7,186	0	8,446	4,223	12,668	4,875	2,310
2018	16951	170	2.7	31.2	0	18,738	0	18,738	6,793	0	8,475	4,238	12,713	4,609	2,184
2019	17010	170	2.7	31.3	0	18,804	0	18,804	6,422	0	8,505	4,253	12,758	4,357	2,065
2020	17070	171	2.7	31.4	0	18,870	0	18,870	6,071	0	8,535	4,268	12,803	4,119	1,952
Totals:		3,303	52	446	0	267,604	0	267,604	137,239	165,129	165,129	82,564	247,693	147,954	-10,715

Value of conserved water ($/AF) =	600
Discount rate (real) =	6.15%
Water savings (gpy/unit) =	5,100
Amount of rebate ($) =	50
Cost to administer rebate ($) =	25
Percent accepting rebates =	1.0%
Single family units in year 2000 =	15,911
Single family units in year 2005 =	16,193
Single family units in year 2010 =	16,480
Single family units in year 2015 =	16,772
Single family units in year 2020 =	17,070

Benefit cost ratio:	0.9
Simple pay-back period (years):	22
Discounted cost / water saved ($/acre-feet):	332
NPV / water saved ($/acre-feet):	600

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Table E-1. Assumptions Used for Economic Analysis of Water Conservation BMPs

BMP 9 – Conservation Programs for Commercial, Industrial, and Institutional (CII) Accounts

Description: Implement a program to conduct water-use surveys and customer incentives programs for CII customers.

Assumptions:

1. Water-use surveys will be conducted at 10% of CII accounts within 10 years of the date implementation is to commence. Surveys will be conducted according to the following schedule: 0.5% of the total number of surveys required by the end of the first reporting period, 2.4% by end of second reporting period, 4.2% by end of third reporting period, 6.4% by end of fourth reporting period, and 10% by the end of the fifth reporting period. Those customers will also be included in an incentives program.

MOU, page 37 and page 40, Section E.b.3

2. Ultra-low-flush toilets (ULFT) in CII establishments will be replaced to produce water savings over a 10 year implementation period equal to 15 percent of total water savings potential as determined in Table E-2. Economic Analysis Worksheets.

MOU, BMP 9, A.(b)ii.

3. Given the choice to implement BMP 9 A (c) or (d), BMP 9 A (c), CII Water Use Survey and Customer Incentives Program, was selected for implementation.

MOU BMP 9, A.(c)

4. The life span of a water survey is four years.

It was assumed that the life span for a CII water survey is the same as the life span for a residential survey. A & N Technical Services report (2000, page 2-20) gives life spans for various components of a residential water survey. Four years was selected as a reasonable average value based on that information.

5. The average annual water savings resulting from a commercial and institutional water survey is 0.83 acre-feet per account.

A & N Technical Services report (2000, page 2-35) gives average annual water savings for three types of surveys; "analyst surveys", "consultant surveys" and "water efficiency studies". Analyst surveys are conducted by non-engineers, consultant surveys are conducted by engineers for sites that have process water, and water efficiency studies are conducted at major industrial facilities that use very large quantities of water. For purposes of this economic analysis, it was assumed that only analyst surveys will be conducted for commercial and institutional account surveys. Values for water savings in the A & N report represent the maximum potential water savings that could occur if a customer were to implement every possible water conservation measure. Experience has shown that approximately 25% of the maximum potential water savings is actually realized, which is what was assumed (personal communication with John Sweeten, Metropolitan Water District, 5-9-00.)

6. The average annual water savings resulting from an industrial water survey is 2.1 acre-feet per account.

A & N Technical Services report (2000, page 2-35) gives average annual water savings for three types of surveys; "analyst surveys", "consultant surveys" and "water efficiency studies". Analyst surveys are conducted by non-engineers, consultant surveys are conducted by engineers for sites that have process water, and water efficiency studies are conducted at major industrial facilities that use very large quantities of water. For purposes of this economic analysis, it was assumed that only consultant surveys will be conducted for industrial account surveys. Values for water savings in the A & N report represent the maximum potential water savings that could occur if a customer were to implement every possible water conservation measure. Experience has shown that approximately 25% of the maximum potential water savings is actually realized, which is what was assumed (personal communication with John Sweeten, Metropolitan Water District, 5-9-00.)

7. Each analyst survey (for commercial and institutional accounts) will cost an average of $680 and each consultant survey (for industrial accounts) will cost an average of $1,680. These costs include the cost of conducting the survey and overhead.

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Table E-1. Assumptions Used for Economic Analysis of Water Conservation BMPs

BMP 9 – Conservation Programs for Commercial, Industrial, and Institutional (CII) Accounts
Description: Implement a program to conduct water-use surveys and customer incentives programs for CII customers.
A & N Technical Services report (2000, page 2-35). 8. The cost of toilets, advertising, administration, overhead, and toilet recycling is $126 per ULFT. The cost does not include installation, which will be covered by the customer. 9. The life span of the new ULFTs is 20 years. *MOU, page 70.* 10. Table E-2. Economic Analysis Worksheet for BMP 9 requires the input of toilet counts per CII subsector. Number of 1992 toilets per CII subgroup provided by CUWCC 10/4/00.

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Table E-2. Economic Analysis Worksheets

BMP 9. Conservation Programs for Commercial, Industrial, and Institutional (CII) Accounts

Calendar Year	From BMP 9 ULFT Coverage Calculator: No. of Installed Toilets	Annual Savings (AF/yr)	CII accounts surveyed: Percent Surveyed*	Commercial Interventions	Industrial Interventions	Institutional Interventions	Incremental Savings (Surveys) (AF/yr)	Annual Savings (Total) (AF/yr)	Benefits ($): Avoided Capital Costs	Avoided Variable Costs	Avoided Purchase Costs	Total Undiscounted Benefits	Total Discounted Benefits	Costs ($): Capital Costs	Financial Incentives	Operating Expenses	Total Undiscounted Costs	Total Discounted Costs	Net Present Value ($)
Pre-1999			0.0%	0.0	0.0	0.0	0.0	0.0	0	0	0	0	0	0	0	0	0	0	0
1999			0.25%	3.2	0.0	0.2	2.8	2.8	0	1,706	0	1,706	1,923	0	0	2,330	2,330	2,625	-703
2000			0.25%	3.2	0.0	0.2	2.8	5.7	0	3,413	0	3,413	3,622	0	0	2,330	2,330	2,473	1,149
2001	81	2.1	0.95%	12.1	0.0	0.9	10.8	18.6	0	11,177	0	11,177	11,177	0	0	19,105	19,105	19,105	-7,928
2002	81	4.3	0.95%	12.1	0.0	0.9	10.8	31.6	0	18,942	0	18,942	17,845	0	0	19,105	19,105	17,998	-153
2003	81	6.4	0.9%	11.5	0.0	0.9	10.2	41.1	0	24,659	0	24,659	21,885	0	0	18,639	18,639	16,542	5,343
2004	81	8.5	0.9%	11.5	0.0	0.9	10.2	50.6	0	30,376	0	30,376	25,397	0	0	18,639	18,639	15,583	9,813
2005	81	10.7	1.1%	14.0	0.0	1.0	12.5	54.5	0	32,681	0	32,681	25,740	0	0	20,503	20,503	16,149	9,592
2006	81	12.8	1.1%	14.0	0.0	1.0	12.5	58.3	0	34,985	0	34,985	25,959	0	0	20,503	20,503	15,213	10,746
2007	81	14.9	1.8%	22.9	0.0	1.7	20.5	70.7	0	42,409	0	42,409	29,644	0	0	27,026	27,026	18,891	10,753
2008	81	17.1	1.8%	22.9	0.0	1.7	20.5	83.1	0	49,832	0	49,832	32,815	0	0	27,026	27,026	17,797	15,018
2009	81	19.2						72.7	0	43,605	0	43,605	27,051	0	0	10,252	10,252	6,360	20,691
2010	81	21.3						62.3	0	37,378	0	37,378	21,844	0	0	10,252	10,252	5,991	15,853
2011								41.8	0	25,093	0	25,093	13,815						13,815
2012								21.3	0	12,807	0	12,807	6,643						6,643
2013								21.3	0	12,807	0	12,807	6,258						6,258
2014								21.3	0	12,807	0	12,807	5,895						5,895
2015								21.3	0	12,807	0	12,807	5,554						5,554
2016								21.3	0	12,807	0	12,807	5,232						5,232
2017								21.3	0	12,807	0	12,807	4,929						4,929
2018								21.3	0	12,807	0	12,807	4,643						4,643
2019								21.3	0	12,807	0	12,807	4,374						4,374
2020								21.3	0	12,807	0	12,807	4,121						4,121
Totals:	814	117	10%	127	0	10	114	786	0	471,525	0	471,525	306,365	0	0	195,709	195,709	154,727	151,638

*Percent surveyed from MOU, Exhibit 1,9.E(b.3)

Value of conserved water ($/AF) =	600
Discount rate (real) =	6.15%
Analyst survey - Annual water savings (AF/account) =	0.83
Analyst survey - Conservation measure unit cost ($) =	680
Consultant survey - Annual water savings (AF/account) =	2.1
Consultant survey - Conservation measure unit cost ($) =	1,680
Cost of conservation measure for ULFT replacement ($) =	126
Number of commercial accounts in 1997 =	1,273
Number of Industrial accounts in 1997 =	1
Number of Institutional accounts in 1997 =	95
Percent units surveyed =	10%

Benefit cost ratio:	2.0
Simple pay-back period (years):	11
Discounted cost / water saved ($/acre-feet):	197
NPV / water saved ($/acre-feet):	193

Credit Table for Previously Installed Toilets

Year	Avg. # of Installed Toilets	Incremental Water Savings (Ac-ft/yr)	Annual Water Savings (AF)
1991	0	0	0
1992	0	0	0
1993	0	0	0
1994	0	0	0
1995	0	0	0
1996	0	0	0
1997	0	0	0
1998	0	0	0
1999	0	0	0
2000	0	0	0
Total			0

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Table E-2. Economic Analysis Worksheets

BMP 9. Conservation Programs for Commercial, Industrial, and Institutional (CII) Accounts

Credit Table for Previously Performed Surveys								
Year	# of Surveys				Credits			
	Commercial	Industrial	Institutional	% Credit	Commercial	Industrial	Institutional	
Surveyed prior to July 1, 1996 w/follow up inspection	0	0	0	100%	0	0	0	
Surveyed prior to July 1, 1996 - have not received follow up inspection	0	0	0	50%	0	0	0	
Surveyed after July 1, 1996	0	0	0	100%	0	0	0	
Total					0	0	0	

Enter CII Toilet Census Results				Annual Savings (gpd)										
CII Subsector	Unadjusted Toilet Count	Adjusted Toilet Count	Savings Per ULFT (gpd)	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Hotels/Motels	629	492	16	7,563	7,260	6,970	6,691	6,423	6,166	5,920	5,683	5,456	5,237	63,368
Eating and Drinking	81	63	47	2,861	2,746	2,636	2,531	2,430	2,333	2,239	2,150	2,064	1,981	23,971
Health Services	650	509	21	10,257	9,847	9,453	9,075	8,712	8,363	8,029	7,708	7,399	7,103	85,947
Offices	1,645	1,288	20	24,723	23,734	22,784	21,873	20,998	20,158	19,352	18,578	17,835	17,121	207,155
Retail/Wholesale	700	548	40	21,041	20,199	19,391	18,615	17,871	17,156	16,470	15,811	15,178	14,571	176,302
Other	215	168	18	2,908	2,792	2,680	2,573	2,470	2,371	2,276	2,185	2,098	2,014	24,368
Industrial	399	312	23	6,896	6,620	6,355	6,101	5,857	5,623	5,398	5,182	4,975	4,776	57,783
Churches	75	59	28	1,578	1,515	1,454	1,396	1,340	1,287	1,235	1,186	1,138	1,093	13,223
Gov't	106	83	25	1,991	1,912	1,835	1,762	1,691	1,624	1,559	1,496	1,437	1,379	16,686
Schools K-12	238	186	20	3,577	3,434	3,296	3,165	3,038	2,916	2,800	2,688	2,580	2,477	29,971
Total	4,738	3,709	258	83,394	80,058	76,856	73,782	70,831	67,997	65,277	62,666	60,160	57,753	698,775
Estimated Rate of CII Toilet Turnover (percent of remaining stock per year)	0.04													
Average Savings per toilet (gpd)	23.42													

Coverage requirement is 15 percent of Total Savings Potential:

(gpd)	(ac-ft)
104,816	117

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Table E-1. Assumptions Used for Economic Analysis of Water Conservation BMPs

BMP 14 – Residential ULFT Replacement Programs

Description: Implement a program to replace existing high-water-using toilets with ultra-low-flush toilets (ULFT) in single- and multi-family residences.

Assumptions:

1. There are an average of 3.1 people per single-family residence and 2.3 people per multi-family residence.

Bear Gulch has an average of 2.7 people per household (California Department of Finance Report E-5, Table 2 "City/County Population and Housing Estimates" January 1, 2000). Because useful data quantifying single-family and multi-family household sizes in this CSA are unavailable, it is assumed that a ratio of multi-family to single-family household sizes is 0.7.

2. There are an average of 1.7 toilets per single-family residence and 1.5 toilets per multi-family residence.

An average of 1.7 toilets per unit was calculated using 1990 census data concerning the number of bedrooms per housing unit. Based on professional judgement, it was assumed a one bedroom unit has 1 toilet, a two bedroom unit has 1.5 toilets, a three bedroom unit has 2 toilets, a four bedroom unit has 2.5 toilets and a five bedroom unit has 3 toilets. Because multi-family units tend to have fewer toilets on average than single-family units, it was assumed 1.5 toilets per multi-family residence and calculated that the single-family units would need to have 1.7 toilets per unit to achieve an overall average of 1.5 toilets per dwelling unit.

3. Water savings from ULFTs are 37.5 gpd/unit for single-family residences and 50.3 gpd/unit for multi-family residences.

MOU, Exhibit 6, Table 1 and Table 2.

4. Homes constructed after 1991 already have ULFTs.

As of January 1992, California legislation requires that ULFTs be installed in all newly constructed homes.

5. The life span of the new ULFTs is 20 years.

MOU, page 70.

6. Natural toilet replacement rate is 4% per year.

MOU, page 70.

7. Average resale rate for single-family units in San Mateo is 4.7%

Assumption based on the 1996 single-family average resale rate for San Mateo County. This rate was obtained from the CUWCC Website, WWW.CUWCC.ORG, November 2000.

8. Average resale rate for multi-family units in San Mateo County is 2.2%

Assumption based on the 1998 multi-family average resale rate for San Mateo County. This rate was obtained from the CUWCC Website, WWW.CUWCC.ORG, November 2000.

9. The cost of toilets, advertising, administration, overhead, and toilet recycling is $126 per ULFT. The cost does not include installation, which will be covered by the customer.

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Table E-2. Economic Analysis Worksheets

BMP 14. Residential ULFT Replacement Programs (3 pages)

	Determination of Water Conservation Goal: Single-Family Units										
Calendar Year	Single-Family Units	SF Units Naturally Retrofitted	SF Toilets Naturally Retrofitted	Water Savings from Natural Replacement SF (AF/yr)	Single-Family Units	SF Units Naturally Retrofitted	Single-Family Turnover	Combined SF Homes Retrofitted	Combined SF Toilets Retrofitted	Water Savings from Natural Replacement and Turnover SF (AF/yr)	Water Savings from Turnover SF (AF/yr)
1998	11,584	0	0	0.0	11,584	0	0	0	0	0.0	0.0
1999	11,121	463	788	19.5	10,581	463	540	1,003	1,705	42.1	22.7
2000	10,676	445	756	18.7	9,665	423	493	916	1,558	38.5	19.8
2001	10,249	427	726	17.9	8,828	387	450	837	1,423	35.2	17.2
2002	9,839	410	697	17.2	8,063	353	411	764	1,300	32.1	14.9
2003	9,446	394	669	16.5	7,365	323	376	698	1,187	29.3	12.8
2004	9,068	378	642	15.9	6,727	295	343	638	1,084	26.8	10.9
2005	8,705	363	617	15.2	6,145	269	313	583	990	24.5	9.2
2006	8,357	348	592	14.6	5,613	246	286	532	905	22.4	7.7
2007	8,023	334	568	14.0	5,126	225	262	486	826	20.4	6.4
2008	7,702	321	546	13.5	4,683	205	239	444	755	18.6	5.2
2009	7,394	308	524	12.9	4,277	187	218	406	689	17.0	4.1
2010	7,098	296	503	12.4	3,907	171	199	370	630	15.6	3.1
2011	6,814	284	483	11.9	3,568	156	182	338	575	14.2	2.3
2012	6,541	273	463	11.4	3,259	143	166	309	525	13.0	1.5
2013	6,280	262	445	11.0	2,977	130	152	282	480	11.9	0.9
2014	6,029	251	427	10.6	2,719	119	139	258	438	10.8	0.3
2015	5,787	241	410	10.1	2,484	109	127	235	400	9.9	0.0
2016	5,556	231	394	9.7	2,269	99	116	215	366	9.0	0.0
2017	5,334	222	378	9.3	2,072	91	106	196	334	8.3	0.0
2018	5,120	213	363	9.0	1,893	83	97	179	305	7.5	0.0
2019	4,915	205	348	8.6	1,729	76	88	164	279	6.9	0.0
2020	4,719	197	334	8.3	1,579	69	81	150	255	6.3	0.0
Totals:											

Credit Table for Previously Installed ULF Toilets

Year	Avg. # of Installed Toilets: Single Family	Avg. # of Installed Toilets: Multi-family	Incremental Water Savings (Ac-ft/yr)	Annual Water Savings (Ac-ft/yr)
1991	0	0	0	0
1992	0	0	0	0
1993	0	0	0	0
1994	0	0	0	0
1995	0	0	0	0
1996	0	0	0	0
1997	63	64	4	4
1998	0	0	0	4
1999	0	0	0	4
2000	0	0	0	4
	63	64		16

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Table E-2. Economic Analysis Worksheets

BMP 14. Residential ULFT Replacement Programs (3 pages)

	Determination of Water Conservation Goal: Multi-Family Units											Conservation Goal - Combined	
Calendar Year	Multi-Family Units	MF Units Naturally Retrofitted	MF Toilets Naturally Retrofitted	Water Savings from Natural Replacement MF (AF/yr)	Multi-Family Units	MF Units Naturally Retrofitted	Multi-Family Turnover	Combined MF Homes Retrofitted	Combined MF Toilets Retrofitted	Water Savings from Natural Replacement and Turnover MF (AF/yr)	Water Savings from Turnover MF (AF/yr)	Annual Water Savings from Turnover (AF/yr)	Cumulative Water Savings from Turnover (AF/yr)
1998	946	0	0	0.0	946	0	0	0	0	0.0	0.00	0	0
1999	908	38	57	2.1	887	38	21	59	88	3.3	1.18	24	24
2000	872	36	54	2.0	832	35	20	55	83	3.1	1.06	45	69
2001	837	35	52	2.0	781	33	18	52	78	2.9	0.95	63	131
2002	804	33	50	1.9	732	31	17	48	73	2.7	0.84	79	210
2003	771	32	48	1.8	687	29	16	45	68	2.6	0.75	92	302
2004	741	31	46	1.7	644	27	15	43	64	2.4	0.66	104	406
2005	711	30	44	1.7	604	26	14	40	60	2.3	0.58	114	520
2006	682	28	43	1.6	566	24	13	38	56	2.1	0.51	122	641
2007	655	27	41	1.5	531	23	13	35	53	2.0	0.44	129	770
2008	629	26	39	1.5	498	21	12	33	49	1.9	0.38	134	904
2009	604	25	38	1.4	467	20	11	31	46	1.7	0.33	139	1,043
2010	580	24	36	1.4	438	19	10	29	44	1.6	0.27	142	1,185
2011	556	23	35	1.3	411	18	10	27	41	1.5	0.23	145	1,329
2012	534	22	33	1.3	386	16	9	26	38	1.4	0.18	146	1,476
2013	513	21	32	1.2	362	15	9	24	36	1.3	0.15	147	1,623
2014	492	21	31	1.2	339	14	8	22	34	1.3	0.11	148	1,771
2015	473	20	30	1.1	318	14	7	21	32	1.2	0.08	148	1,918
2016	454	19	28	1.1	298	13	7	20	30	1.1	0.05	148	2,066
2017	436	18	27	1.0	280	12	7	19	28	1.0	0.02	148	2,214
2018	418	17	26	1.0	262	11	6	17	26	1.0	0.00	148	2,362
2019	401	17	25	0.9	246	10	6	16	24	0.9	0.00	148	2,509
2020	385	16	24	0.9	231	10	5	15	23	0.9	0.00	148	2,657

Value of conserved water ($/AF) =	600
Discount rate (real) =	6.15%
Natural toilet replacement rate =	4.0%
Annual single-family housing turnover rate =	4.7%
Annual multi-family housing turnover rate =	2.2%
Water savings due to toilet replacement at SF homes (gal/dwelling unit/day) =	37.5
Water savings due to toilet replacement at MF homes (gal/dwelling unit/day) =	50.3
Number of toilets per SF home =	1.7
Number of toilets per MF home =	1.5
Cost of conservation measure ($) =	126
1991 single family units =	15,416
1991 multi-family units =	1,259

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Table E-2. Economic Analysis Worksheets

BMP 14. Residential ULFT Replacement Programs (3 pages)

	Water Savings from ULFT Replacement Program						Benefits ($)					Costs ($)					
Calendar Year	No. of SF Toilets Required to be Replaced	Incremental[a] Water Savings SF (AF/yr)	No. of MF Toilets Required to be Replaced	Incremental[a] Water Savings MF (AF/yr)	Annual[b] Water Savings (AF/yr)	Cummulative[c] Water Savings (AF/yr)	Avoided Capital Costs	Avoided Variable Costs	Avoided Purchase Costs	Total Undiscounted Benefits	Total Discounted Benefits	Capital Costs	Financial Incentives	Operating Expenses	Total Undiscounted Costs	Total Discounted Costs	Net Present Value ($)
Pre-2001	63	2	64	2	4	16	0										
2001	600	15	200	8	26	42	0	15,780	0	15,780	15,780	0	0	100,800	100,800	100,800	-85,020
2002	600	15	200	8	49	91	0	29,183	0	29,183	27,492	0	0	100,800	100,800	94,960	-67,468
2003	600	15	200	8	71	162	0	42,586	0	42,586	37,794	0	0	100,800	100,800	89,458	-51,664
2004	600	15	200	8	93	255	0	55,989	0	55,989	46,811	0	0	100,800	100,800	84,275	-37,465
2005	600	15	200	8	116	371	0	69,393	0	69,393	54,655	0	0	100,800	100,800	79,393	-24,737
2006	600	15	200	8	138	509	0	82,796	0	82,796	61,434	0	0	100,800	100,800	74,793	-13,359
2007	600	15	200	8	160	669	0	96,199	0	96,199	67,244	0	0	100,800	100,800	70,460	-3,216
2008	600	15	200	8	183	852	0	109,602	0	109,602	72,174	0	0	100,800	100,800	66,377	5,796
2009					183	1,034	0	109,602	0	109,602	67,992	0	0	0	0	0	67,992
2010					183	1,217	0	109,602	0	109,602	64,053	0	0	0	0	0	64,053
2011					183	1,400	0	109,602	0	109,602	60,342	0	0	0	0	0	60,342
2012					183	1,582	0	109,602	0	109,602	56,846	0	0	0	0	0	56,846
2013					183	1,765	0	109,602	0	109,602	53,552	0	0	0	0	0	53,552
2014					183	1,948	0	109,602	0	109,602	50,450	0	0	0	0	0	50,450
2015					183	2,130	0	109,602	0	109,602	47,527	0	0	0	0	0	47,527
2016					183	2,313	0	109,602	0	109,602	44,773	0	0	0	0	0	44,773
2017					183	2,496	0	109,602	0	109,602	42,179	0	0	0	0	0	42,179
2018					183	2,678	0	109,602	0	109,602	39,736	0	0	0	0	0	39,736
2019					183	2,861	0	109,602	0	109,602	37,433	0	0	0	0	0	37,433
2020					183	3,044	0	109,602	0	109,602	35,265	0	0	0	0	0	35,265
	4,800		1,600		3,032		0	1,816,753	0	1,816,753	983,532	0	0	806,400	806,400	660,516	323,015

[a]Incremental Water Savings is water savings from replaced toilets during corresponding year only.

[b]Annual Water Savings is water savings from all replaced toilets through corresponding year.

[c]Cummulative Water Savings is running total of water saved through corresponding year. "Cummulative Water Savings" must match "Cummulative Water Savings from Turnover" within 10% each reporting period through 2008.

Benefit cost ratio:	1.5
Simple pay-back period (years):	13
Discounted cost / water saved ($/acre-feet):	218
NPV / water saved ($/acre-feet):	106.5

Bear Gulch
Results of Economic Analysis of Water Conservation BMPs

BMP No.	BMP Name	Total Discounted Cost ($)	Total Water Saved (acre-feet)	Benefit / Cost Ratio	Simple Payback Analysis (years)	Discounted Cost / Water Saved ($/acre-feet)	Net Present Value / Water Saved ($/acre-feet)
1	Water Survey Programs for Single-family Residential and Multi-family Residential Customers	110,226	439	1.9	7	251	224
2	Residential Plumbing Retrofits	334,867	490	0.6	23	683	-262
5	Large Landscape Conservation Programs and Incentives	20,871	291	6.2	2	72	375
6	High-efficiency Washing Machine Rebate Programs	147,954	446	0.9	22	332	600
9	Conservation Programs for Commercial, Industrial, and Institutional (CII) Accounts	154,727	786	2.0	11	197	193
14	Residential ULFT Replacement Programs	660,516	3,032	1.5	13	218	107

Value of conserved water ($/AF) = 600
Discount rate (real) = 6.15%
System name = Bear Gulch