

Appendix XIII.

**Hazen and Sawyer
Technical Memorandum:**

**Option 7:
Expand Cane Creek Reservoir**

and

**Supporting Tables Showing Results
of OWASA Analysis**

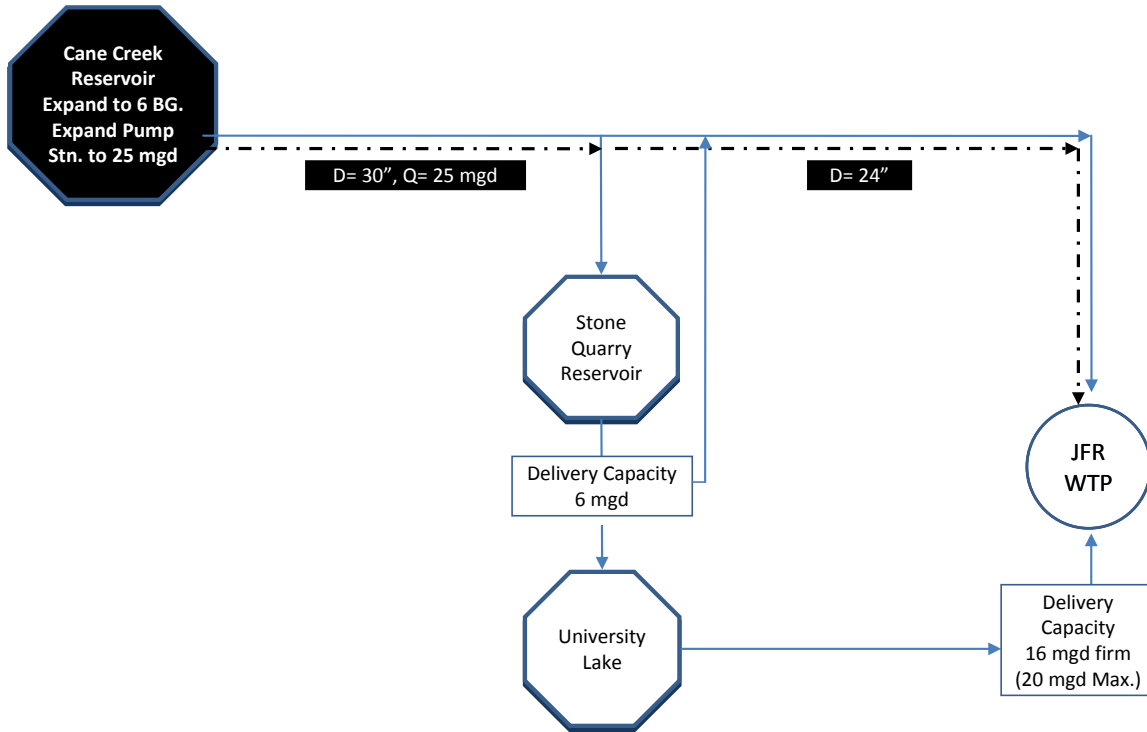
TECHNICAL MEMORANDUM
Option 7: Expand Cane Creek Reservoir

PREPARED FOR: Orange Water and Sewer Authority
PREPARED BY: Hazen and Sawyer, P.C
DATE: May 13, 2009 (Final: January 15, 2010)

1.0 Description and Scope

This water supply option, shown schematically in Figure 1, involves the expansion of Cane Creek Reservoir to a usable storage capacity of 6 billion gallons (BG). This technical memorandum (TM) updates the evaluation of this option presented in TM 5.2 of the 2001 OWASA Master Plan.¹ The present review is cursory only, as no evidence has been found to improve its low preferential ranking when compared to other water supply options in 2001.

Figure 1: Schematic Illustration of Option 10 Scenarios



¹ Section 3.2.4, Option 3.0: Cane Creek Reservoir Expansion, Technical Memorandum 5-2, OWASA Water and Sewer Master Plan – Planning Level Evaluation of Water Supply Options.

2.0 Background

The Cane Creek Reservoir was impounded by OWASA in 1989. Hazen and Sawyer served as project engineers from the project study phase through construction completion. The estimated total storage volume of the Cane Creek Reservoir is 3.01 BG with a current active (usable) volume of 2.87 BG at the normal pool elevation of 500 feet mean sea level (MSL). The reservoir's 30.4 square mile drainage area is slightly larger than University Lake's (28.7 square miles).

3.0 Conceptual Design

3.1 Major Elements

In order to increase storage in Cane Creek Reservoir to 6.0 BG, it would be necessary to raise the operating level (normal pool) by approximately 20 feet. It is unlikely that the existing dam and gated spillway could be modified to increase its structural height by the required amount, which was assumed for conceptual design and cost estimating purposed in TM 5.2.² It is more likely that this option would require the construction of a new dam located directly downstream of the existing dam. The existing intake structure could probably be modified and incorporated into the new facilities, but at considerable cost. This option would require the following additional improvements: increase pumping capacity at Cane Creek Reservoir to approximately 25 mgd and, consistent with this upgrade, parallel both the existing 24-inch and 30-inch sections of the existing Cane Creek raw water main to the JFR WTP with 30-inch and 24-inch diameter mains, respectively.

3.2 Implementation Issues

TM 5.2 estimated that this option would require the acquisition of 225 acres of private land surrounding Cane Creek Reservoir. This estimate has been doubled in the current evaluation based on recent permitting experiences with new dams and the likelihood that the project would impact wetlands and other environmentally sensitive property. OWASA faced strong opposition when acquiring property for the existing Cane Creek Reservoir. A proposal to expand the reservoir would likely face vigorous and widespread opposition. In addition to direct property impacts, construction would impact at least one secondary road. Permitting for this option would likely require preparation of a detailed Environmental Impact Statement (EIS) under the National Environmental Policy Act (NEPA).

²Considering the low preferential ranking this option received in the 2001 Master Plan evaluations, TM 5.2 did not include a conceptual drawing for this option, and none has been developed for this brief update. For present purposes, approximate cost estimating techniques and established cost indices have been used to update the TM 5.2 conceptual cost estimate.

4.0 Yield Performance Evaluation

OWASA-ROM modeling indicates that increasing storage in Cane Creek Reservoir to 6 BG would increase OWASA's operational yield by approximately 5 million gallons per day (mgd). This estimate does not include any allowance for possible increases in regulatory releases from Cane Creek Reservoir that NC-DENR's Division of Water Resources (DWR) might require. This option would also increase the time required to refill Cane Creek Reservoir and/or the existing Quarry Reservoir by 3 to almost 14 months during major droughts.

5.0 Economic Evaluation

Table 1 summarizes the conceptual-level estimates of capital, operation and maintenance (O&M), lifecycle, and levelized unit costs for this option. In general TM 5.2 of the 2001 Master Plan is the basis for these costs. All costs have been updated to 2009 dollars according to the indices discussed in the *Engineering Basis for Technical Evaluations of Water Supply Alternatives* TM. These planning-level order-of-magnitude estimates are intended for use in comparing alternatives and for long-range planning purposes.

Table 1: Summary of Option 7 Project Costs

DESCRIPTION	Project Costs (Million 2009 Dollars)
OPTION:	7
Construction Cost Subtotal	\$54.86
Contractor Mobilization, Overhead, Profit	\$10.97
TOTAL CONSTRUCTION COST	\$65.83
Engineering Design and Construction Services	\$9.88
Property and Easement Acquisition (Estimate)	\$4.50
Legal Fees, Permits, and Approvals	\$21.10
Contingency (25%)	\$25.33
ESTIMATED PROJECT CAPITAL COSTS	\$126.60
PRESENT WORTH OF LIFE-CYCLE COSTS	\$5.20
INCREASE IN OPERATIONAL YIELD (MGD)	4.98
<u>Estimated 50-Yr Levelized Cost (\$/1,000 gallons)</u>	
Based on Total Volume Pumped from Quarry R.	\$5.24
Based on Incremental increase in Yield	\$1.48

6.0 Conclusions and Recommendations

The following major factors identified at this conceptual planning level of study should be considered in any further evaluation or planning for this option:

1. Doubling the present volume of the Cane Creek Reservoir would require the acquisition of 225 acres of private land. In order to mitigate the

impacts on wetlands and other environmentally sensitive lands, the actual amount of land would likely be at least twice as much.

2. This option would likely face vigorous and widespread public opposition.
3. The proposal would require preparation of a detailed EIS.
4. This option would increase the operational yield of OWASA's water supply system by approximately 5 mgd, but would also increase the time needed to refill the expanded reservoir and/or OWASA's existing Quarry Reservoir by 3 to almost 14 months during major droughts.

OWASA Long-Range Water Supply Plan Update							
Conceptual-Level Project Cost Estimate							
Option 7: Expand Cane Creek Reservoir by Raising the Existing Dam							
2009 DOLLARS							
No.	Description	Pipe Diam.	Allocated Fraction	Quantity	Unit	Unit Cost	Total Cost
1	CAPITAL COST						
2	Raise Dam and Spillway			1	LS	\$24,018,000	\$24,018,000
3	Water Quality / Sediment Control			1	LS	\$500,000	\$500,000
4	Access Roads			1	LS	\$663,000	\$663,000
5	Road and Bridge Relocations / Modifications			36,000	SF	\$150	\$5,400,000
6	New Raw Water Intake Structure Steel Frame Tower w/ Multiple Level Screens			1	LS	\$6,150,000	\$6,150,000
7	Raw Water Pump Station Cane Creek 19 MGD Raw Water Pump Station Expansion			1	LS	\$3,730,000	\$3,730,000
8	Raw Water Transmission Parallel Raw Water Trans. Main from Cane Creek to Stone Q.R. Parallel Raw Water Trans. Main from Quarry to JFR WTP	30 in 24 in		33,000 27,800	LF LF	\$260 \$200	\$8,580,000 \$5,560,000
9	Raw Water Outlet Structure Energy Dissipation valve/structure			1	LS	\$250,000	\$250,000
10							
11	CONSTRUCTION COST SUBTOTAL						\$54,860,000
12	CAPITAL COST ALLOWANCES						
13						20%	\$10,972,000
14						18%	\$9,875,000
15							\$75,707,000
16				450	acres	\$10,000	\$4,500,000
17							\$80,207,000
18						30%	\$21,100,000
19							\$101,307,000
20						25%	\$25,327,000
21	ESTIMATED PROJECT CAPITAL COST						\$126,600,000
22	PRESENT WORTH OF LIFE-CYCLE COSTS: (2)						\$6,100,000
23	INCREASE IN OPERATIONAL YIELD, MGD:						4.98
24	Estimated 50-Yr Levelized Cost (\$/1,000 gallons):						Based on Volume Pumped: \$6.07
25							Based on Incremental Yield: (2) \$1.48

(1) Property to be purchased 225 acres from 2001 Master Plan plus 20% for environmental mitigation based on ratio from 1987 Sevenmile Creek study.

(2) Refer to attached life-cycle evaluation.

CALCULATION OF LIFE-CYCLE AND LEVELIZED COSTS			
Discount Rate:	5.0%	per year	
Annual Escalation Factor for Fixed O&M Costs:	6.0%	per year	
Annual Escalation Factor for Rehab & Replacement:	5.0%	per year	
Annual Escalation Factor for Variable O & M Costs:	4.0%	per year	
<u>Capital Costs/Debt Financing</u>			
Issuing Expense:	1.0%		
Rate:	5.0%	per year	
Term:	25	years	
<u>Improvements implemented in Year:</u>	2015		
<u>Fixed Annual O&M Costs</u>			
Incremental staffing and other costs, where applicable:		per annum	
<u>Variable O&M Costs for Pumping, etc.</u>			
Energy Cost:	\$0.08	per KW-hr electrical energy	
Pumping Rate:	19	mgd	
Pumping Head:	285	feet	
% effective yield pumped at Beginning & End of Life-Cycle:		18%	
<u>Periodic Rehabilitation & Replacement (R&R) of Capital Improvements</u>			
Cost of Replacement Components as % Total Construction Cost:	7.5%	per year (equals 52.0 % of project capital cost)	
Replacement Occurs Every:	20	years	
Life-cycle for Calculation of Salvage Value:	50	years	

Option 7: Expand Cane Creek Reservoir by Raising the Existing Dam

		Except as Noted, All Costs in Actual (inflated) Dollars					2009 Dollars			
Year	Water Pumped (mgd) (2)	OWASA Capital Cost (on Year Implemented)	Rehab. & Replace-ment	O&M Costs (3)		Total Annual Costs		Levelized Costs (\$/1000 gals)		
				Fixed	Variable	Total Annual	Net Present Worth	Based on Vol. Pumped	Based on Inc. Yield	
Base Yr. (1)		Base Costs								
2015		\$171,353,000			\$708,700					
Year		Annual Costs					Running Totals			
2009										
2010										
2011										
2012										
2013										
2014										
2015		\$11,579,000				\$11,579,000	\$8,640,000		\$4.75	
2016		\$11,579,000				\$11,579,000	\$8,229,000		\$4.64	
2017		\$11,579,000				\$11,579,000	\$7,837,000		\$4.53	
2018		\$11,579,000				\$11,579,000	\$7,464,000		\$4.42	
2019		\$11,579,000				\$11,579,000	\$7,109,000		\$4.32	
2020		\$11,579,000			\$44,000	\$11,623,000	\$6,796,000		\$4.22	
2021	0.07	\$11,579,000			\$50,000	\$11,629,000	\$6,475,000	\$2,059.10	\$4.13	
2022	0.14	\$11,579,000			\$56,000	\$11,635,000	\$6,170,000	\$766.96	\$4.04	
2023	0.21	\$11,579,000			\$63,000	\$11,642,000	\$5,880,000	\$421.88	\$3.95	
2024	0.28	\$11,579,000			\$70,000	\$11,649,000	\$5,603,000	\$275.08	\$3.86	
2025	0.35	\$11,579,000			\$78,000	\$11,657,000	\$5,340,000	\$197.34	\$3.78	
2026	0.42	\$11,579,000			\$86,000	\$11,665,000	\$5,089,000	\$150.45	\$3.70	
2027	0.49	\$11,579,000			\$95,000	\$11,674,000	\$4,851,000	\$119.63	\$3.62	
2028	0.56	\$11,579,000			\$104,000	\$11,683,000	\$4,623,000	\$98.07	\$3.54	
2029	0.63	\$11,579,000			\$114,000	\$11,693,000	\$4,407,000	\$82.30	\$3.47	
2030	0.70	\$11,579,000			\$125,000	\$11,704,000	\$4,201,000	\$70.33	\$3.39	
2031	0.77	\$11,579,000			\$136,000	\$11,715,000	\$4,005,000	\$60.98	\$3.32	
2032	0.84	\$11,579,000			\$148,000	\$11,727,000	\$3,818,000	\$53.52	\$3.26	
2033	0.91	\$11,579,000			\$160,000	\$11,739,000	\$3,640,000	\$47.44	\$3.19	
2034	0.98	\$11,579,000			\$174,000	\$11,753,000	\$3,471,000	\$42.41	\$3.13	
2035	1.05	\$11,579,000	\$17,731,000		\$188,000	\$29,498,000	\$8,296,000	\$39.82	\$3.19	
2036	1.12	\$11,579,000			\$203,000	\$11,782,000	\$3,156,000	\$36.04	\$3.13	
2037	1.19	\$11,579,000			\$219,000	\$11,798,000	\$3,010,000	\$32.81	\$3.06	
2038	1.26	\$11,579,000			\$236,000	\$11,815,000	\$2,870,000	\$30.01	\$3.00	
2039	1.33	\$11,579,000			\$254,000	\$11,833,000	\$2,738,000	\$27.58	\$2.94	
2040	1.40				\$273,000	\$273,000	\$60,000	\$24.96	\$2.83	
2041	1.47				\$293,000	\$293,000	\$61,000	\$22.70	\$2.73	
2042	1.54				\$314,000	\$314,000	\$63,000	\$20.74	\$2.63	
2043	1.61				\$336,000	\$336,000	\$64,000	\$19.02	\$2.54	
2044	1.68				\$360,000	\$360,000	\$65,000	\$17.51	\$2.46	
2045	1.75				\$385,000	\$385,000	\$66,000	\$16.17	\$2.38	
2046	1.82				\$412,000	\$412,000	\$68,000	\$14.98	\$2.31	
2047	1.89				\$440,000	\$440,000	\$69,000	\$13.91	\$2.24	
2048	1.96				\$470,000	\$470,000	\$70,000	\$12.96	\$2.17	
2049	2.03				\$501,000	\$501,000	\$71,000	\$12.10	\$2.11	
2050	2.10				\$534,000	\$534,000	\$72,000	\$11.33	\$2.05	
2051	2.17				\$569,000	\$569,000	\$73,000	\$10.63	\$2.00	
2052	2.24				\$606,000	\$606,000	\$74,000	\$9.99	\$1.95	
2053	2.31				\$645,000	\$645,000	\$75,000	\$9.41	\$1.90	
2054	2.38				\$686,000	\$686,000	\$76,000	\$8.87	\$1.85	
2055	2.45		\$47,047,000		\$729,000	\$47,776,000	\$5,064,000	\$8.70	\$1.88	
2056	2.52				\$774,000	\$774,000	\$78,000	\$8.23	\$1.83	
2057	2.59				\$823,000	\$823,000	\$79,000	\$7.80	\$1.79	
2058	2.66				\$873,000	\$873,000	\$80,000	\$7.41	\$1.75	
2059	2.73				\$927,000					
Salvage Value (5):		-\$175,960,000	-\$45,750,000			-220,783,000	-19,253,000	\$6.07	\$1.48	
Total:			-\$221,710,000							
TOTALS:		54.5	\$289.5 M	\$64.8 M		\$13.6 M	\$146.1 M	\$120.8 M	\$6.07	\$1.48

- (1) Year(s) in which corresponding capital projects are implemented (and corresponding capital debt financing is transacted).
- (2) Used to calculate levelized costs based on volume of water pumped.
- (3) All base year O&M costs are in 2009 dollars. Calculated annual O&M costs are in actual (inflated) dollars and commence on the year in which the corresponding capital cost commences.
- (4) Levelized costs are calculated as the average of present worth of annual costs and effective yield.
- (5) Salvage values are calculated by straight-line depreciation of capital/R&R costs over indicated lifecycle and escalated to actual dollars using indicated discount rate.

Supporting Tables Showing Results of OWASA Analysis

OWASA Long-Range Water Supply Plan Update							
Conceptual-Level Project Cost Estimate							
Option 7: Expand Cane Creek Reservoir by Raising the Existing Dam							
2009 DOLLARS							
No.	Description	Pipe Diam.	Allocated Fraction	Quantity	Unit	Unit Cost	Total Cost
1	CAPITAL COST						
2	Raise Dam and Spillway			1	LS	\$24,018,000	\$24,018,000
3	Water Quality / Sediment Control			1	LS	\$500,000	\$500,000
4	Access Roads			1	LS	\$663,000	\$663,000
5	Road and Bridge Relocations / Modifications			36,000	SF	\$150	\$5,400,000
6	New Raw Water Intake Structure Steel Frame Tower w/ Multiple Level Screens			1	LS	\$6,150,000	\$6,150,000
7	Raw Water Pump Station Cane Creek 19 MGD Raw Water Pump Station Expansion			1	LS	\$3,730,000	\$3,730,000
8	Raw Water Transmission Parallel Raw Water Trans. Main from Cane Creek to Stone Q.R. Parallel Raw Water Trans. Main from Quarry to JFR WTP	30 in 24 in		33,000 27,800	LF LF	\$260 \$200	\$8,580,000 \$5,560,000
9	Raw Water Outlet Structure Energy Dissipation valve/structure			1	LS	\$250,000	\$250,000
10	CONSTRUCTION COST SUBTOTAL						\$54,860,000
11	CAPITAL COST ALLOWANCES						
12	Contractor Mobilization, Overhead & Profit (@ 20% x Line 10)						20%
13	TOTAL CONSTRUCTION COST						\$65,832,000
14	Engineering Studies, Design, and Construction Services (@ 18% x Line 10)						18%
15	Subtotal						\$75,707,000
16	450 acres						\$10,000
17	Subtotal						\$80,207,000
18	Legal Fees, Permits and Approvals (@ 30% x (Lines 13 + 16)						30%
19	Subtotal						\$101,307,000
20	Contingency (@ 25% x Line 19)						25%
21	ESTIMATED PROJECT CAPITAL COST						\$126,600,000
22	PRESENT WORTH OF LIFE-CYCLE COSTS: (2)						\$236,400,000
23	INCREASE IN OPERATIONAL YIELD, MGD:						4.98
24	Estimated 50-Yr Levelized Cost (\$/1,000 gallons):						Based on Volume Pumped: \$236.41
25	Based on Incremental Yield: (2)						\$1.42

(1) Property to be purchased 225 acres from 2001 Master Plan plus 20% for environmental mitigation based on ratio from 1987 Sevenmile Creek study.

(2) Refer to attached life-cycle evaluation.

CALCULATION OF LIFE-CYCLE AND LEVELIZED COSTS			
Discount Rate:	5.0%	per year	
Annual Escalation Factor for Fixed O&M Costs:	6.0%	per year	
Annual Escalation Factor for Rehab & Replacement:	5.0%	per year	
Annual Escalation Factor for Variable O & M Costs:	4.0%	per year	
<u>Capital Costs Debt Financing</u>			
Issuing Expense:	1.0%		
Rate:	5.0%	per year	
Term:	25	years	
<u>Improvements implemented in Year:</u>	2027		
<u>Fixed Annual O&M Costs</u>			
Incremental staffing and other costs, where applicable:		per annum	
<u>Variable O&M Costs for Pumping, etc.</u>			
Energy Cost:	\$0.08	per kW-hr electrical energy	
Pumping Rate:	19	mgd	
Pumping Head:	285	feet	
% effective yield pumped at Beginning & End of Life-Cycle:		18%	
<u>Periodic Rehabilitation & Replacement (R&R) of Capital Improvements</u>			
Cost of Replacement Components as % Total Construction Cost:	7.5%	per year (equals 52.0 % of project capital cost)	
Replacement Occurs Every:	20	years	
Life-cycle for Calculation of Salvage Value:	50	years	

Option 7: Expand Cane Creek Reservoir by Raising the Existing Dam

		Except as Noted, All Costs in Actual (inflated) Dollars					2009 Dollars			
Year	Water Pumped (mgd) (2)	OWASA Capital Cost (on Year Implemented)	Rehab. & Replacement	O&M Costs (3)		Total Annual Costs		Levelized Costs (\$/1000 gals)		
				Fixed	Variable	Total Annual	Net Present Worth	Based on Vol. Pumped	Based on Inc. Yield	
Base Yr. (1)		Base Costs								
2027		\$307,725,000			\$708,700					
Year		Annual Costs						Running Totals		
2009										
2010										
2011										
2012										
2013										
2014										
2015										
2016										
2017										
2018										
2019										
2020										
2021										
2022										
2023										
2024										
2025										
2026										
2027		\$20,794,000				\$20,794,000	\$8,640,000		\$4.75	
2028		\$20,794,000				\$20,794,000	\$8,229,000		\$4.64	
2029		\$20,794,000				\$20,794,000	\$7,837,000		\$4.53	
2030	0.06	\$20,794,000			\$20,000	\$20,814,000	\$7,471,000	\$1,458.35	\$4.43	
2031		\$20,794,000				\$20,794,000	\$7,108,000		\$4.32	
2032		\$20,794,000				\$20,794,000	\$6,770,000		\$4.22	
2033		\$20,794,000				\$20,794,000	\$6,448,000		\$4.13	
2034		\$20,794,000				\$20,794,000	\$6,141,000		\$4.03	
2035	0.92	\$20,794,000			\$188,000	\$20,982,000	\$5,901,000	\$179.95	\$3.95	
2036		\$20,794,000				\$20,794,000	\$5,570,000		\$3.86	
2037		\$20,794,000				\$20,794,000	\$5,304,000		\$3.77	
2038		\$20,794,000				\$20,794,000	\$5,052,000		\$3.69	
2039		\$20,794,000				\$20,794,000	\$4,811,000		\$3.61	
2040		\$20,794,000				\$20,794,000	\$4,582,000		\$3.53	
2041		\$20,794,000				\$20,794,000	\$4,364,000		\$3.46	
2042		\$20,794,000				\$20,794,000	\$4,156,000		\$3.38	
2043		\$20,794,000				\$20,794,000	\$3,958,000		\$3.31	
2044		\$20,794,000				\$20,794,000	\$3,770,000		\$3.24	
2045		\$20,794,000				\$20,794,000	\$3,590,000		\$3.18	
2046		\$20,794,000				\$20,794,000	\$3,419,000		\$3.11	
2047		\$20,794,000	\$31,843,000			\$52,637,000	\$8,243,000		\$3.18	
2048		\$20,794,000				\$20,794,000	\$3,101,000		\$3.11	
2049		\$20,794,000				\$20,794,000	\$2,954,000		\$3.05	
2050		\$20,794,000				\$20,794,000	\$2,813,000		\$2.99	
2051		\$20,794,000				\$20,794,000	\$2,679,000		\$2.92	
2052									\$2.81	
2053									\$2.71	
2054									\$2.61	
2055									\$2.52	
2056									\$2.44	
2057									\$2.36	
2058									\$2.29	
2059										
Salvage Value (5):		-\$527,860,000	-\$22,870,000			-550,730,000	-48,026,000	\$236.41	\$1.42	
Total:		-\$550,730,000								
TOTALS:	1.0	\$519.9 M	\$31.8 M			\$0.2 M	\$1.2 M	\$84.9 M	\$236.41	\$1.42

- (1) Year(s) in which corresponding capital projects are implemented (and corresponding capital debt financing is transacted).
- (2) Used to calculate levelized costs based on volume of water pumped.
- (3) All base year O&M costs are in 2009 dollars. Calculated annual O&M costs are in actual (inflated) dollars and commence on the year in which the corresponding capital cost commences.
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8	Raw Water Transmission Parallel Raw Water Trans. Main from Cane Creek to Stone Q.R. Parallel Raw Water Trans. Main from Quarry to JFR WTP	30 in 24 in		33,000 27,800	LF LF	\$260 \$200	\$8,580,000 \$5,560,000	
9	Raw Water Outlet Structure Energy Dissipation valve/structure			1	LS	\$250,000	\$250,000	
10	CONSTRUCTION COST SUBTOTAL							
							\$54,860,000	
11	CAPITAL COST ALLOWANCES							
12	Contractor Mobilization, Overhead & Profit (@ 20% x Line 10)						20%	\$10,972,000
13	TOTAL CONSTRUCTION COST							\$65,832,000
14	Engineering Studies, Design, and Construction Services (@ 18% x Line 10)						18%	\$9,875,000
15	Subtotal							\$75,707,000
16	450 acres						\$10,000	\$4,500,000
17	Subtotal							\$80,207,000
18	Legal Fees, Permits and Approvals (@ 30% x (Lines 13 + 16)						30%	\$21,100,000
19	Subtotal							\$101,307,000
20	Contingency (@ 25% x Line 19)						25%	\$25,327,000
21	ESTIMATED PROJECT CAPITAL COST							\$126,600,000
22	PRESENT WORTH OF LIFE-CYCLE COSTS: (2)							\$240,700,000
23	INCREASE IN OPERATIONAL YIELD, MGD:							4.98
24	Estimated 50-Yr Levelized Cost (\$/1,000 gallons):							\$240.67
25	Based on Volume Pumped:							\$1.36
	Based on Incremental Yield: (2)							\$1.36

(1) Property to be purchased 225 acres from 2001 Master Plan plus 20% for environmental mitigation based on ratio from 1987 Sevenmile Creek study.

(2) Refer to attached life-cycle evaluation.

CALCULATION OF LIFE-CYCLE AND LEVELIZED COSTS			
Discount Rate:	5.0%	per year	
Annual Escalation Factor for Fixed O&M Costs:	6.0%	per year	
Annual Escalation Factor for Rehab & Replacement:	5.0%	per year	
Annual Escalation Factor for Variable O & M Costs:	4.0%	per year	
<u>Capital Costs Debt Financing</u>			
Issuing Expense:	1.0%		
Rate:	5.0%	per year	
Term:	25	years	
<u>Improvements implemented in Year:</u>	2037		
<u>Fixed Annual O&M Costs</u>			
Incremental staffing and other costs, where applicable:		per annum	
<u>Variable O&M Costs for Pumping, etc.</u>			
Energy Cost:	\$0.08	per kW-hr electrical energy	
Pumping Rate:	19	mgd	
Pumping Head:	285	feet	
% effective yield pumped at Beginning & End of Life-Cycle:		18%	
<u>Periodic Rehabilitation & Replacement (R&R) of Capital Improvements</u>			
Cost of Replacement Components as % Total Construction Cost:	7.5%	per year (equals 52.0 % of project capital cost)	
Replacement Occurs Every:	20	years	
Life-cycle for Calculation of Salvage Value:	50	years	

Option 7: Expand Cane Creek Reservoir by Raising the Existing Dam

		Except as Noted, All Costs in Actual (inflated) Dollars					2009 Dollars			
Year	Water Pumped (mgd) (2)	OWASA Capital Cost (on Year Implemented)	Rehab. & Replacement	O&M Costs (3)		Total Annual Costs		Levelized Costs (\$/1000 gals)		
				Fixed	Variable	Total Annual	Net Present Worth	Based on Vol. Pumped	Based on Inc. Yield	
Base Yr. (1)		Base Costs								
2037		\$501,251,000			\$708,700					
Year		Annual Costs						Running Totals		
2009										
2010										
2011										
2012										
2013										
2014										
2015										
2016										
2017										
2018										
2019										
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2021										
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2027										
2028										
2029										
2030										
2031										
2032										
2033										
2034										
2035										
2036										
2037		\$33,871,000				\$33,871,000	\$8,640,000		\$4.75	
2038		\$33,871,000				\$33,871,000	\$8,229,000		\$4.64	
2039		\$33,871,000				\$33,871,000	\$7,837,000		\$4.53	
2040		\$33,871,000				\$33,871,000	\$7,464,000		\$4.42	
2041		\$33,871,000				\$33,871,000	\$7,108,000		\$4.32	
2042		\$33,871,000				\$33,871,000	\$6,770,000		\$4.22	
2043		\$33,871,000				\$33,871,000	\$6,448,000		\$4.13	
2044		\$33,871,000				\$33,871,000	\$6,140,000		\$4.03	
2045	0.65	\$33,871,000			\$385,000	\$34,256,000	\$5,915,000	\$273.81	\$3.95	
2046		\$33,871,000				\$33,871,000	\$5,570,000		\$3.86	
2047		\$33,871,000				\$33,871,000	\$5,304,000		\$3.77	
2048		\$33,871,000				\$33,871,000	\$5,052,000		\$3.69	
2049		\$33,871,000				\$33,871,000	\$4,811,000		\$3.61	
2050		\$33,871,000				\$33,871,000	\$4,582,000		\$3.53	
2051		\$33,871,000				\$33,871,000	\$4,364,000		\$3.46	
2052		\$33,871,000				\$33,871,000	\$4,156,000		\$3.38	
2053		\$33,871,000				\$33,871,000	\$3,958,000		\$3.31	
2054		\$33,871,000				\$33,871,000	\$3,770,000		\$3.24	
2055		\$33,871,000				\$33,871,000	\$3,590,000		\$3.18	
2056		\$33,871,000				\$33,871,000	\$3,419,000		\$3.11	
2057		\$33,871,000	\$51,869,000			\$85,740,000	\$8,243,000		\$3.18	
2058		\$33,871,000				\$33,871,000	\$3,101,000		\$3.11	
2059		\$33,871,000				\$33,871,000	\$3,101,000		\$3.11	
Salvage Value (5):		-\$821,120,000	-\$51,470,000			-838,719,000	-67,647,000	\$240.67	\$1.36	
Total:			-\$872,590,000							
TOTALS:	0.6	\$779.0 M	\$51.9 M			\$0.4 M	-\$41.3 M	\$56.8 M	\$240.67	\$1.36

- (1) Year(s) in which corresponding capital projects are implemented (and corresponding capital debt financing is transacted).
- (2) Used to calculate levelized costs based on volume of water pumped.
- (3) All base year O&M costs are in 2009 dollars. Calculated annual O&M costs are in actual (inflated) dollars and commence on the year in which the corresponding capital cost commences.
- (4) Levelized costs are calculated as the average of present worth of annual costs and effective yield.
- (5) Salvage values are calculated by straight-line depreciation of capital/R&R costs over indicated lifecycle and escalated to actual dollars using indicated discount rate.

OWASA Long-Range Water Supply Plan Update							
Conceptual-Level Project Cost Estimate							
Option 7: Expand Cane Creek Reservoir by Raising the Existing Dam							
2009 DOLLARS							
No.	Description	Pipe Diam.	Allocated Fraction	Quantity	Unit	Unit Cost	Total Cost
1	CAPITAL COST						
2	Raise Dam and Spillway			1	LS	\$24,018,000	\$24,018,000
3	Water Quality / Sediment Control			1	LS	\$500,000	\$500,000
4	Access Roads			1	LS	\$663,000	\$663,000
5	Road and Bridge Relocations / Modifications			36,000	SF	\$150	\$5,400,000
6	New Raw Water Intake Structure Steel Frame Tower w/ Multiple Level Screens			1	LS	\$6,150,000	\$6,150,000
7	Raw Water Pump Station Cane Creek 19 MGD Raw Water Pump Station Expansion			1	LS	\$3,730,000	\$3,730,000
8	Raw Water Transmission Parallel Raw Water Trans. Main from Cane Creek to Stone Q.R. Parallel Raw Water Trans. Main from Quarry to JFR WTP	30 in 24 in		33,000 27,800	LF LF	\$260 \$200	\$8,580,000 \$5,560,000
9	Raw Water Outlet Structure Energy Dissipation valve/structure			1	LS	\$250,000	\$250,000
10	CONSTRUCTION COST SUBTOTAL						\$54,860,000
11	CAPITAL COST ALLOWANCES						
12	Contractor Mobilization, Overhead & Profit (@ 20% x Line 10)						20%
13	TOTAL CONSTRUCTION COST						\$65,832,000
14	Engineering Studies, Design, and Construction Services (@ 18% x Line 10)						18%
15	Subtotal						\$75,707,000
16	450 acres						\$10,000
17	Subtotal						\$80,207,000
18	Legal Fees, Permits and Approvals (@ 30% x (Lines 13 + 16)						30%
19	Subtotal						\$101,307,000
20	Contingency (@ 25% x Line 19)						25%
21	ESTIMATED PROJECT CAPITAL COST						\$126,600,000
22	PRESENT WORTH OF LIFE-CYCLE COSTS: (2)						\$21,800,000
23	INCREASE IN OPERATIONAL YIELD, MGD:						4.98
24	Estimated 50-Yr Levelized Cost (\$/1,000 gallons):						Based on Volume Pumped: \$21.78
25	Based on Incremental Yield: (2)						\$1.30

(1) Property to be purchased 225 acres from 2001 Master Plan plus 20% for environmental mitigation based on ratio from 1987 Sevenmile Creek study.

(2) Refer to attached life-cycle evaluation.

CALCULATION OF LIFE-CYCLE AND LEVELIZED COSTS			
Discount Rate:	5.0%	per year	
Annual Escalation Factor for Fixed O&M Costs:	6.0%	per year	
Annual Escalation Factor for Rehab & Replacement:	5.0%	per year	
Annual Escalation Factor for Variable O & M Costs:	4.0%	per year	
<u>Capital Costs Debt Financing</u>			
Issuing Expense:	1.0%		
Rate:	5.0%	per year	
Term:	25	years	
<u>Improvements implemented in Year:</u>	2047		
<u>Fixed Annual O&M Costs</u>			
Incremental staffing and other costs, where applicable:		per annum	
<u>Variable O&M Costs for Pumping, etc.</u>			
Energy Cost:	\$0.08	per kW-hr electrical energy	
Pumping Rate:	19	mgd	
Pumping Head:	285	feet	
% effective yield pumped at <u>Beginning</u> & <u>End</u> of Life-Cycle:		18%	
<u>Periodic Rehabilitation & Replacement (R&R) of Capital Improvements</u>			
Cost of Replacement Components as % <u>Total Construction Cost</u> :	7.5%	per year (equals 52.0 % of project capital cost)	
Replacement Occurs Every:	20	years	
Life-cycle for Calculation of Salvage Value:	50	years	

Option 7: Expand Cane Creek Reservoir by Raising the Existing Dam

		Except as Noted, All Costs in Actual (inflated) Dollars					2009 Dollars			
Year	Water Pumped (mgd) (2)	OWASA Capital Cost (on Year Implemented)	Rehab. & Replace-ment	O&M Costs (3)		Total Annual Costs		Levelized Costs (\$/1000 gals)		
				Fixed	Variable	Total Annual	Net Present Worth	Based on Vol. Pumped	Based on Inc. Yield	
Base Yr. (1)		Base Costs								
2047		\$816,485,000			\$708,700					
Year		Annual Costs						Running Totals		
2009										
2010										
2011										
2012										
2013										
2014										
2015										
2016										
2017										
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2045										
2046										
2047		\$55,173,000				\$55,173,000	\$8,640,000		\$4.75	
2048		\$55,173,000				\$55,173,000	\$8,229,000		\$4.64	
2049		\$55,173,000				\$55,173,000	\$7,837,000		\$4.53	
2050	1.51	\$55,173,000				\$55,707,000	\$7,536,000	\$58.59	\$4.43	
2051		\$55,173,000			\$534,000	\$55,173,000	\$7,108,000		\$4.33	
2052		\$55,173,000				\$55,173,000	\$6,770,000		\$4.23	
2053		\$55,173,000				\$55,173,000	\$6,448,000		\$4.13	
2054		\$55,173,000				\$55,173,000	\$6,141,000		\$4.04	
2055	2.37	\$55,173,000			\$729,000	\$55,902,000	\$5,925,000	\$45.67	\$3.95	
2056		\$55,173,000				\$55,173,000	\$5,570,000		\$3.86	
2057		\$55,173,000				\$55,173,000	\$5,304,000		\$3.78	
2058		\$55,173,000				\$55,173,000	\$5,052,000		\$3.69	
2059		\$55,173,000								
Salvage Value (5):		-\$1,114,380,000				-1,059,207,000	-49,723,000	\$21.78	\$1.30	
Total:		-\$1,114,380,000								
TOTALS:	3.9	\$717.2 M			\$1.3 M	-\$395.9 M	\$30.8 M	\$21.78	\$1.30	

(1) Year(s) in which corresponding capital projects are implemented (and corresponding capital debt financing is transacted).
 (2) Used to calculate levelized costs based on volume of water pumped.
 (3) All base year O&M costs are in 2009 dollars. Calculated annual O&M costs are in actual (inflated) dollars and commence on the year in which the corresponding capital cost commences.
 (4) Levelized costs are calculated as the average of present worth of annual costs and effective yield.
 (5) Salvage values are calculated by straight-line depreciation of capital/R&R costs over indicated lifecycle and escalated to actual dollars using indicated discount rate.