

City of Annapolis Water Treatment Plant

Combined City / County Feasibility Study

City of Annapolis

January 11 2012

ATKINS

Plan Design Enable

Feasibility Study

To:	City of Annapolis		
From:	Bob Nelson, Brian Balchunas	Email:	
Phone:	301-210-6800	Date:	11 Jan 2012
Ref:	100023456	cc:	Anne Arundel County DPW
Subject:	City of Annapolis and Anne Arundel County--Feasibility Study		

1. Introduction

Both the City of Annapolis (City) and Anne Arundel County (County) are about to undertake capital improvements at their respective water treatment plants—the City of Annapolis WTP and the County’s Broad Creek II (BCII) WTP. The City expressed interest in first exploring the feasibility of a joint water treatment plant, located at the BC II WTP site. Four meetings have been held (Appendix A – presentations, Appendix B – minutes), and one technical memorandum has been issued (Appendix C). The purpose of this feasibility study is to perform a financial analysis of life cycle costs, including construction and operation & maintenance costs, for the options developed. It includes an outline of the assumptions made and a presentation of results, as well as cost factors that could impact the results..

The study does not consider other potential economic or non-economic impacts, nor does it provide recommendations. Rather, it is being completed to provide the leadership of both the City and County with an objective financial analysis to be used in combination with other considerations to make a decision.

2. Options

Three different, build-out scenarios were developed, in order to meet the combined City/County maximum day water demands. These options are shown on Figures 1 through 4 with the estimated maximum day water demand (separate County and City for Option 1, combined City/County for Options 2 and 3). These figures assume that the County would send 2-mgd, maximum day, to other pressure zones by 2025, and 4-mgd by 2040.

- **Option 1 (Baseline)** - Immediate (on-line 2015) construction of a new, 8-mgd WTP at the existing City WTP and a 4 mgd expansion at the County’s BC II WTP (8 mgd, total). Construction of a new, 5 mgd WTP at Withernsea (on-line 2018), with an expansion to 7.5 mgd (on-line 2025) and an expansion to 12.5 mgd (on-line 2035).
- **Option 2** - Immediate (on-line 2015) construction of a 9.88 mgd expansion at the County’s BC II WTP (13.88 mgd, total), with City/County interconnection. Immediate construction of a new, 5 mgd WTP at Withernsea (on-line 2015), with an expansion to 7.5 mgd (on-line 2022). Three-mgd expansion of BC II (on-line 2027). Withernsea expanded to 12.5 mgd (on-line 2035).
- **Option 3** - Immediate (on-line 2015) construction of a 13.33 mgd expansion at the County’s BC II WTP (17.33 mgd, total), with City/County interconnection. Construction of a new, 5 mgd WTP at Withernsea (on-line 2020), with an expansion to 7.5 mgd (on-line 2027) and another expansion (to 12.5 mgd – on-line 2035).

Figure 1. Option 1 – Baseline Water Demands vs. Capacity (City)

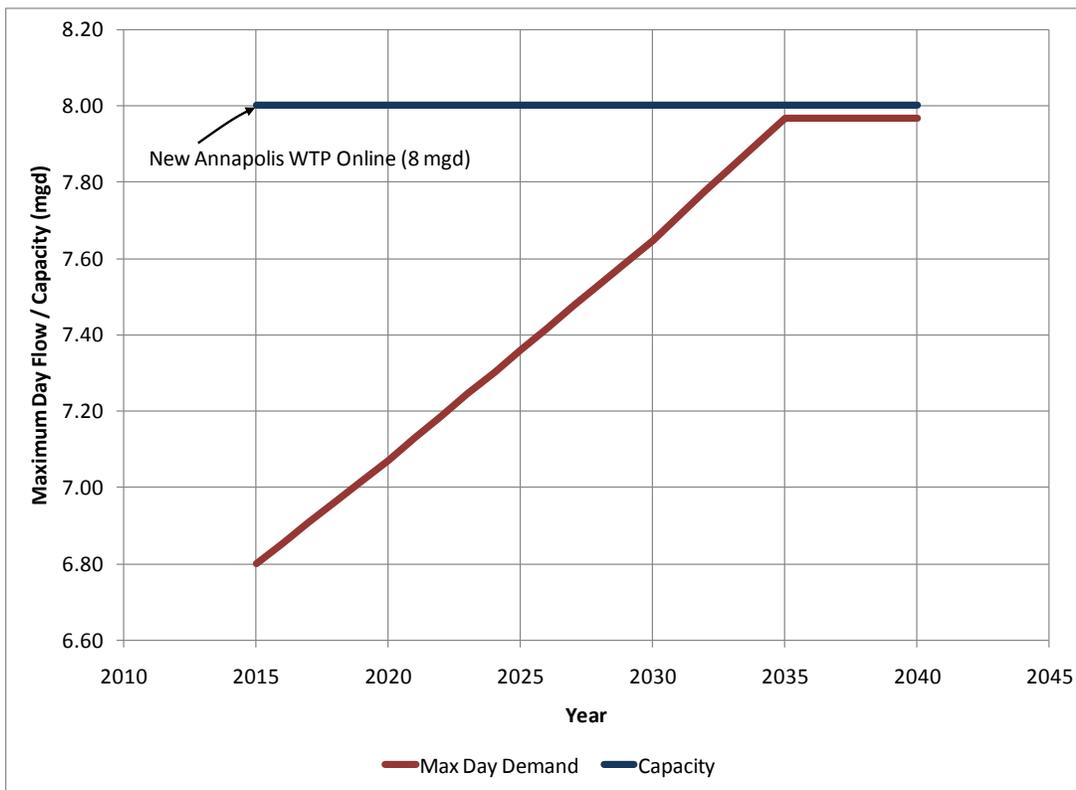


Figure 2. Option 1 – Baseline Water Demands vs. Capacity (County)

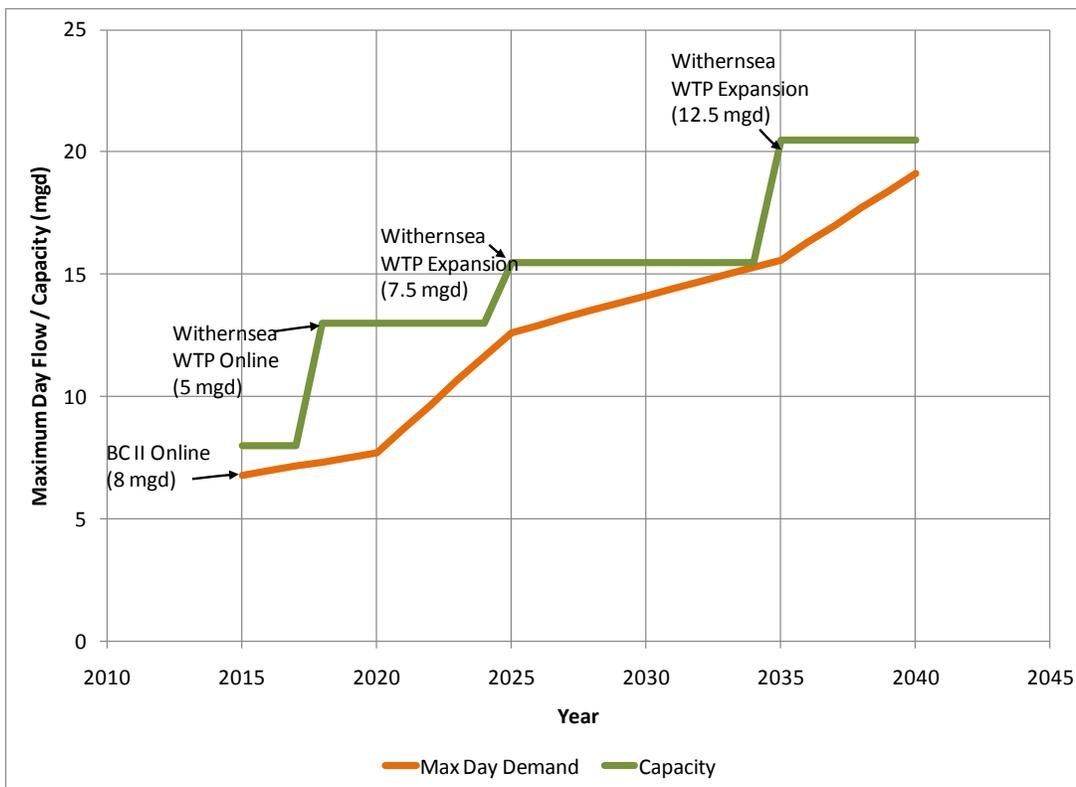


Figure 3. Option 2 – Combined City/Water Demands vs. Capacity

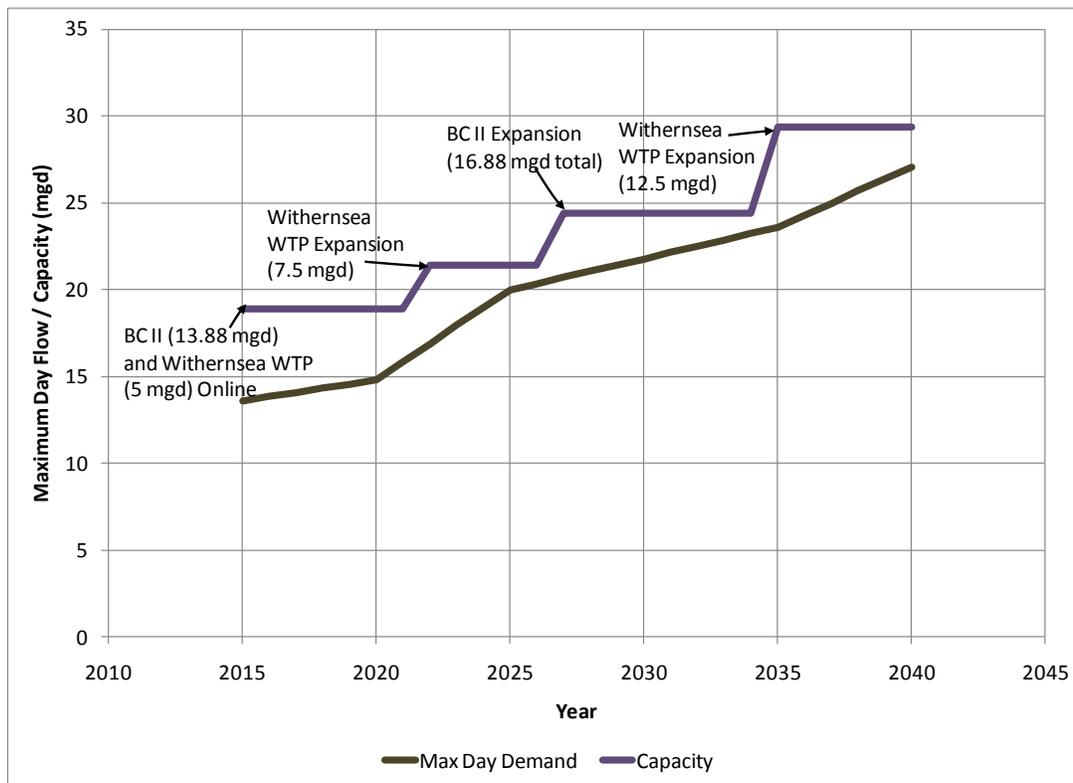
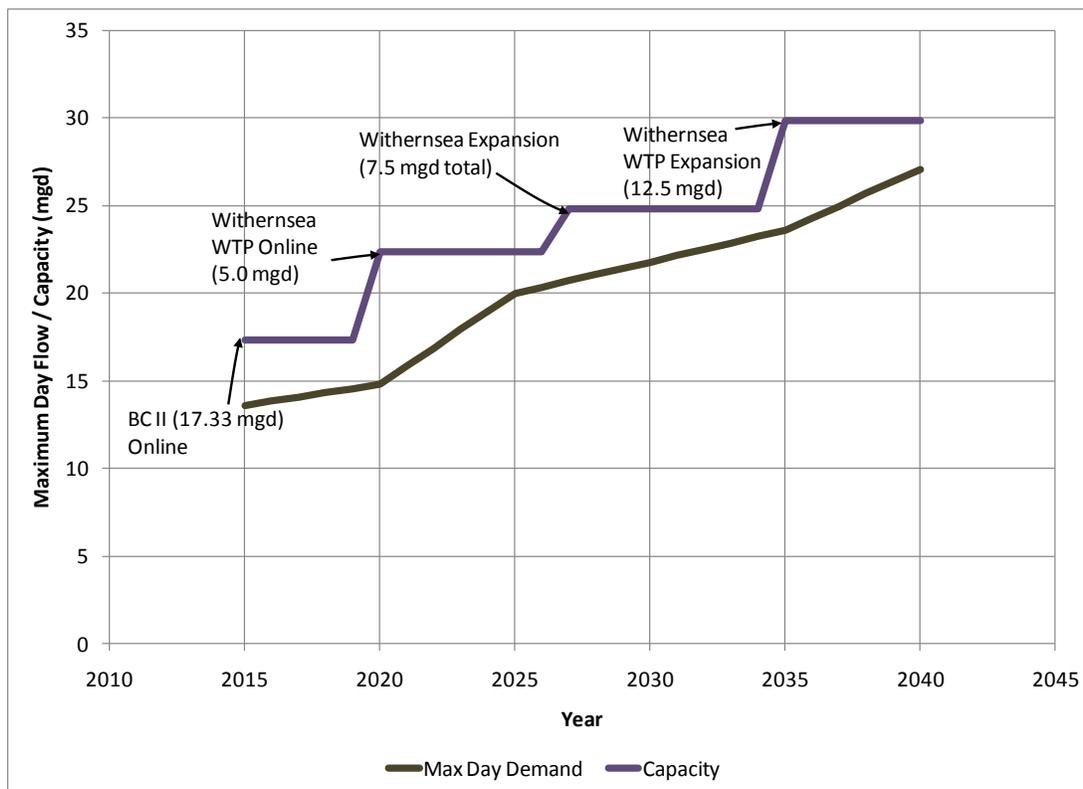


Figure 4. Option 3 – Combined City/Water Demands vs. Capacity



3. Total Project Construction Costs

Total project construction costs were calculated for all options. These costs were based on previous work completed. Specifically, total project costs were based on:

- New 8-mgd City WTP: Facility Plan completed by Hazen and Sawyer in 2010, modified to reflect 8-mgd capacity vs. 10-mgd previously projected
- New finished water pumping station for City: Facility Plan completed by Hazen and Sawyer in 2010
- BC II WTP expansion to 8 mgd: Construction document opinion-of-construction-cost, completed by Atkins.
- BC II WTP expansion to 13.88 mgd: Construction document opinion-of-construction-cost, completed by Atkins, escalated with modified equipment, structural, sitework and other costs to facilitate larger expansion.
- BC II WTP expansion to 17.33 mgd: Construction document opinion-of-construction-cost, completed by Atkins, escalated with modified equipment, structural, sitework and other costs to facilitate larger expansion.
- Withernsea 5-mgd WTP treatment plan: Anne Arundel County CIP
- Withernsea expansion to 7.5 mgd: \$4/gallon, based on previous County water treatment plant expansions
- Withernsea expansion to 12.5 mgd: \$4/gallon, based on previous County water treatment plant expansions
- New 3-mgd WTP at Broad Creek I site: \$4/gallon, based on previous County water treatment plant expansions
- Pipelines between City of Annapolis WTP and BC II WTP sites: Unit-cost estimate, based on Atkins previous experience.

All total project construction costs included the following assumptions:

- Contractor overhead and profit: 15%
- Contingency: 25%
- Engineering, legal, and administration: 21%

Two different methods were investigated for allocation of capital costs between the City and County, as described below.

- Method 1
 - Determine net value of existing, 4-mgd BC II WTP and all County and City wells
 - Add to total construction costs for expansion
 - Appropriate total costs based on allocated flows
- Method 2
 - Neglect value of existing facilities
 - Appropriate total costs based on allocated flows for expansion (treatment plant only)

As discussed in Workshop No. 4, Method 1 resulted in disproportionate costs to the County. All project construction costs were appropriated based on Method 2. Total project construction costs allocated to the City and County are presented in Table 1 below

Table 1. Total Project Cost Allocation (2011 dollars)

Option	City	County
1: Baseline	<ul style="list-style-type: none"> New City WTP (8-mgd City capacity): \$37.6 million New finished water pumping station: \$3.9 million 	<ul style="list-style-type: none"> BC II expansion (8-mgd County capacity): \$16.8 million Withernsea WTP (5-mgd County capacity): \$55 million Withernsea WTP expansion (additional 2.5-mgd County capacity): \$10 million Withernsea WTP expansion (additional 5-mgd County capacity): \$20 million
2: BC II to 13.88 mgd, initially	<ul style="list-style-type: none"> BC II expansion (7.2-mgd City capacity): \$25.2 million BC I or II (0.8-mgd City capacity): \$3.2 million New finished water pumping station: \$3.9 million 	<ul style="list-style-type: none"> BC II expansion (6.7-mgd County capacity): \$9.5 million Withernsea WTP (5-mgd County capacity): \$55 million BC I or II (2.2-mgd County Capacity): \$8.8 million Withernsea WTP expansion (additional 2.5-mgd County capacity): \$10 million Withernsea WTP expansion (additional 5-mgd County capacity): \$20 million
3: BC II to 17.33 mgd	<ul style="list-style-type: none"> BC II expansion (8-mgd City capacity): \$24.8 million New finished water pumping station: \$3.9 million 	<ul style="list-style-type: none"> BC II expansion (9.3-mgd County capacity): \$16.4 million Withernsea WTP (5-mgd County capacity): \$55 million Withernsea WTP expansion (additional 2.5-mgd County capacity): \$10 million Withernsea WTP expansion (additional 5-mgd County capacity): \$20 million

Summaries of Total Project Costs are provided in Appendix D.

4. Operations and Maintenance Costs

Operations and maintenance (O&M) costs were based on projected costs for both the City and County, using information provided by both parties. The following assumptions were used:

- All options utilized the same costs for power and chemicals.
- Differential operating costs for the Withernsea WTP were not considered, as it is not known what proportion of flow would be treated by Broad Creek II and Withernsea.
- Administration and overhead costs were included based on information provided by the City and County. These costs are escalated for inflation only, not based on total plant flow.
- O&M costs for Option 1 were based on current operating costs for the County on a dollar per 1,000 gallon basis, and City-estimated operating costs taking into account that City O&M requirements would be reduced with a new modern water treatment plant.

- O&M costs for Options 2 and 3 were based on current operating costs for the County, with no flow-based escalation in administrative or overhead costs.

O&M costs for Option 1 are provided in Table 2 below.

Table 2. Option 1 - Operations and Maintenance Costs

Category	City Total (Annapolis WTP)		County Total (BCII WTP)	
	4.1 mgd (current ADF)	\$/1,000 gal	3.15 mgd (current ADF)	\$/1,000 gal
Labor (inc. Benefits)	\$ 397,000	\$ 0.27	\$ 335,000	\$ 0.29
Chemical	\$ 77,000	\$ 0.05	\$ 59,000	\$ 0.05
Electrical	\$ 405,000	\$ 0.27	\$ 311,000	\$ 0.27
Maintenance	\$ 105,000	\$ 0.07	\$ 91,000	\$ 0.17
Other	\$ 97,000	\$ 0.06	\$ 92,000	\$ 0.08
Subtotal	\$ 1,081,000	\$ 0.72	\$ 888,000	\$ 0.77
Overhead/Admin*	\$ 163,000	\$ 0.11	\$ 440,000	\$ 0.38
Total – Option 1	\$ 1,244,000	\$ 0.83	\$ 1,328,000	\$ 1.15

* Overhead/Admin costs only escalated with inflation, not with flow

O&M costs for Options 2 and 3 are provided in Table 3, as follows:

Table 3. Options 2 and 3 – Operations and Maintenance Costs

Category	City + County Total (BCII WTP)	
	7.25 mgd (total current ADF)	\$/1,000 gal
Labor (inc. Benefits)	\$ 771,000	\$ 0.29
Chemical	\$ 136,000	\$ 0.05
Electrical	\$ 716,000	\$ 0.27
Maintenance	\$ 209,000	\$ 0.17
Other	\$ 212,000	\$ 0.08
Subtotal	\$ 2,044,000	\$ 0.77
Overhead/Admin*	\$ 440,000	\$ 0.17
Total – Options 2 and 3	\$ 2,484,000	\$ 0.94
County (3.15 mgd)	\$ 1,080,000	\$ 0.94
City Adders		
Electrical (pump from BCII)	\$ 75,000	\$ 0.05
Administrative*	\$ 46,000	\$ 0.03
City (4.1 mgd)	\$ 1,525,000	\$ 1.02

* Overhead/Admin costs only escalated with inflation, not with flow

Summaries of O&M costs provided by the City and County are provided in Appendix E.

5. Life-Cycle-Cost Analysis

A 50-yr life-cycle-cost analysis was completed for all options to provide a comparison of both City and County costs. The following assumptions were used to complete the analysis:

- Inflation – 3% per year
- Construction-cost escalation – 4% per year (based on historical ENR data)
- Discount rate – 3.8%
- City financing
 - 92% low-interest loan, 30-year term, 1.35% interest rate
 - 8% conventional financing, 30-year term, 4.5% interest rate
- County financing
 - Conventional, 30-year term, 4.3% interest rate (3-yr average)
- O&M costs associated with administration and overhead are not a function of flow
- All other O&M costs were flow-proportioned based on projected average daily flows. Flows were left constant after 2040.
- No additional construction costs beyond 2040 were included.

Results of the 50-yr life-cycle analysis are provided in Table 4 as follows:

Table 4. 50-yr Life-Cycle Analysis

Option	Construction (\$1,000/yr)	O&M (\$1,000/yr)	Total (\$1,000/yr)	Total (\$ million)
City				
1 – Baseline	\$ 810	\$ 1,250	\$ 2,060	\$ 103
2 – BC II to 13.88 mgd	\$ 680	\$ 1,470	\$ 2,150	\$ 107
3 – BC II to 17.32 mgd	\$ 560	\$ 1,470	\$ 2,030	\$ 102
County				
1 – Baseline	\$ 3,110	\$ 1,910	\$ 5,020	\$ 251
2 – BC II to 13.88 mgd	\$ 3,170	\$ 1,740	\$ 4,910	\$ 246
3 – BC II to 17.32 mgd	\$ 3,130	\$ 1,740	\$ 4,870	\$ 243

6. Discussion and Conclusions

In terms of total life-cycle costs, Option 3 is the least expensive for both the City and County. However, the relative difference equates to approximately \$30,000 per year (likely within the error of the analysis) for the City and \$150,000 per year for the County to the baseline option (Option 1).

From the City’s perspective:

- Options 2 and 3 result in a significant reduction in project construction costs. These reductions are offset by an increase in O&M costs.
- To take advantage of low-interest financing from the State, the City must be under contract with a builder by November, 2012. Options 2 and 3 will pose more risk to the funding schedule.

From the County’s perspective:

- There is some near-term financial benefit to defrayed project construction costs for the Withernsea WTP with Option 3. However, all project construction costs are paid over the life of the analysis, so there is not a significant difference in annual costs.
- There is a reduction in O&M costs, as the administrative costs currently borne solely by the County would be shared with the City.

Other factors that could influence the financial analysis:

- Administrative costs for both parties increase at a rate higher than the assumed three percent per year inflation. An additional 1% escalation in administrative costs for both parties (over inflation) would lower the life-cycle difference between Option 1 and 3 to \$0.5 million (from \$1 million given in Table 4 above).
- Administrative costs for the County increase with the inclusion of the City into the Broad Creek service area. An increase of 25% would result in Option 1 having the lowest life-cycle cost for the City by approximately \$1 million over Option 3. This would also lower the life-cycle cost difference between Options 1 and 3 for the County from approximately \$8 million to \$5 million.
- Water demands are not as currently projected. Lower water demands could allow for the County to further delay the Withernsea WTP for Option 3, resulting in a greater net cost differential. This deferral would have no affect on the City life-cycle costs.
- MDE permits future withdrawals in the Patuxent aquifer only, which may increase County electrical costs for pumping water to the Broad Creek II WTP. This could increase O&M costs for all County options and lower the life-cycle cost difference between Option 1 and Option 3 for the City.
- Electrical and or chemical costs increase more than the assumed three percent per year inflation. As both the City and County would realize this increase, net impact should be minimal.
- Capital costs continue to remain low and escalate at less than four percent per year. A decrease in capital cost escalation to three percent would have minimal impact on the life-cycle cost analysis.
- Unforeseen difficulties with interconnection of Annapolis WTP and BC II WTP could increase the capital cost for Options 2 and 3 and make these options less advantageous.
- Unforeseen issues with expansion of BC II to 17.33 mgd could increase the capital cost for Options 2 and 3 and make these options less advantageous.
- Higher Withernsea WTP O&M costs could add further advantages to the County for Option 3, as that option defers construction of the Withernsea WTP the longest. There would be no impact to the City.
- Requirement for redundancy of raw and finished water lines across Route 50. An increase of 50 percent for this cost would result in a nearly identical life-cycle cost to the City for Options 1 and 3.

Other factors to consider under Options 2 and 3, that are not part of this financial analysis:

- Higher potential for schedule delay with added risks to City's MDE low interest funding
- Higher potential for schedule delay with increased potential for mechanical/structural failure at the existing WTP
- Loss of reciprocity and emergency capacity
- Potential future disputes regarding quality and service dependability
- Potential service areas differences

Appendix A

Workshop Presentation Materials

**Annapolis Water Supply Feasibility Study
Workshop No. 2**

November 04, 2011



Plan Design Enable

Agenda

- Final TM1
- Draft TM2
- Key Decisions to be made
- Additional information required
- Schedule and subsequent work

2

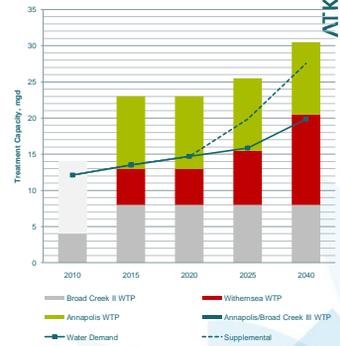
Final TM1

- Max day peaking factors
 - City – 1.6
 - County – 2.0
- County maintains 8-mgd to supplement other pressure zones (4-mgd by 2025, 4-mgd by 2040)
- Three options:
 - Option 1 – Separate Systems
 - Option 2 – Expand BC II to 13.88 mgd
 - Option 3 – Expand BC II to 17.33 mgd
- County update on GAP for BC II?

3

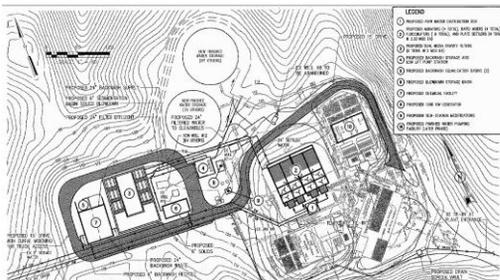
Option 1

- City builds, operates and maintains new 8-mgd WTP
- County continues with 4-mgd expansion to BC II
- County continues with plans for Witherssea WTP (6-mgd by 2015, 7.5-mgd by 2025, 12.5 mgd by 2040 (assumed))



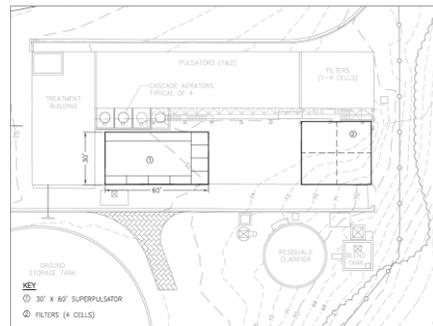
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Annapolis WTP – Proposed Site Layout



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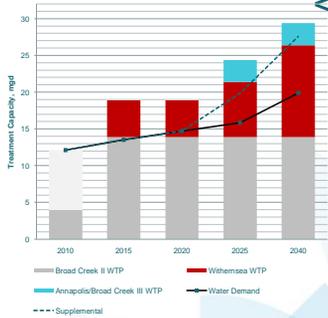
4 mgd Expansion BC II WTP Layout



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Option 2

- Expand BC II immediately to 13.88 mgd
 - Plate settlers in existing clarifiers
 - Additional filters
 - Upsize piping as required
- Double barrel crossing (36-inch) of Route 50
- 3-mgd BC III (at BC I site) in 2025
- County continues with plans for Witherensea WTP (5-mgd by 2015, 7.5-mgd by 2025, 12.5 mgd by 2040 (assumed))



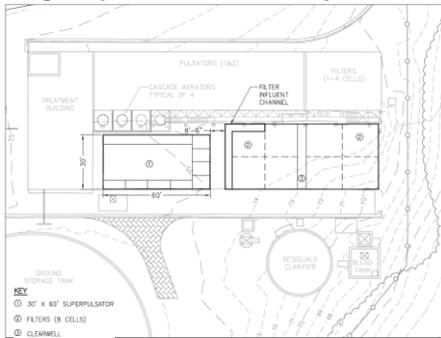
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36-inch-double-barrel interconnection (Options 2 and 3)



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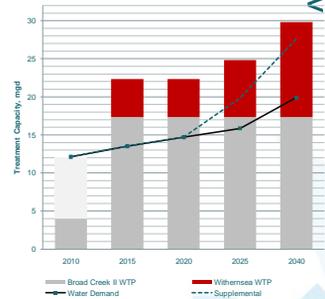
9.88 mgd Expansion BC II WTP Layout



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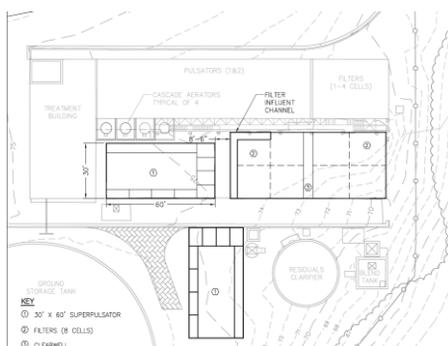
Option 3

- Expand BC II immediately to 17.33 mgd
 - Plate settlers in existing clarifiers
 - Fourth clarifier
 - Additional filters
 - Upsize piping as required
- Double barrel crossing (36-inch) of Route 50
- County continues with plans for Witherensea WTP (5-mgd by 2015, 7.5-mgd by 2025, 12.5 mgd by 2040 (assumed))



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13.33 mgd Expansion BC II WTP Layout



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Witherensea WTP

- All options include Witherensea at:
 - 5-mgd in 2015
 - 7.5-mgd in 2025
 - 12.5-mgd in 2040
- As no difference or escalation in planned capacity, does not need to be included in analysis.
- Only consider Annapolis and BC costs

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Capital Costs

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- Assumptions
 - Planning level estimates
 - Use same overhead structures for all cost estimates:
 - 15% contractor OH&P
 - 25% contingency
 - 21% engineering, administrative, legal, etc
 - Annapolis WTP costs based on H&S report with reduction to 8-mgd
 - Broad Creek II costs based on design to date, plus additional equipment/concrete/site/piping costs for different expansion options

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Capital Costs (in 2011 dollars)

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- Annapolis WTP (8 mgd): \$37.6 million
- Broad Creek II WTP (to 8 mgd): \$16.8 million
- Annapolis to Broad Creek Pipelines: \$4.8 million
- Broad Creek II WTP (to 13.88 mgd): \$29.9 million
- Broad Creek II WTP (to 17.33 mgd): \$36.4 million
- Broad Creek III WTP (3 mgd): \$12.0 million

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O&M Costs (in 2011 dollars)

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	Annapolis WTP (4.1 mgd)		Broad Creek II WTP (3.05 mgd)	
	\$	\$/1,000 gallons	\$	\$/1,000 gallons
Labor and Burden	\$397,022	0.27	\$110,577	0.10
Maintenance	\$152,570	0.10	\$33,000	0.03
Chemicals	\$128,500	0.09	\$88,673	0.08
Electrical	\$473,121	0.32	\$351,396	0.32
Contract Services	\$54,050	0.04	\$4,000	0.004
Total	\$1,205,263	0.81	\$587,646	0.53

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Key Decisions

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- Approach for expansion is acceptable
- Concurrence on capital costs / approach
- Concurrence on O&M costs / approach

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Additional Data Required for Financial Model

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- Financing plan (cash/debt ratio) – City and County
- Estimated interest rates based on current bond rates – City and County
- Debt term – City and County
- Coverage factor on existing debt?
- Asset value of existing Broad Creek II WTP
- Conference call with financial analyst?

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Schedule / Next Step

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- Finalize TM No. 2 – week of 11/7
- Complete financial model
 - 3 weeks after receipt of all data
- Workshop No. 3
- Draft/Final Feasibility Reports

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**Annapolis Water Supply Feasibility Study
Workshop No. 3**

December 1, 2011

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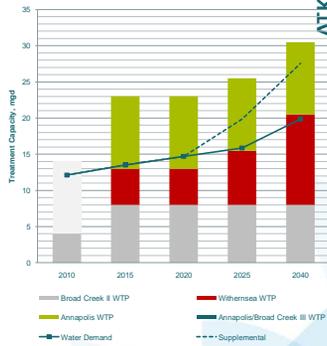
Agenda

- Gross level financial analysis
- O&M costs
- Remaining value of existing facilities
- Gross level sensitivity analysis
- Potential financing
- Outstanding data needs

2

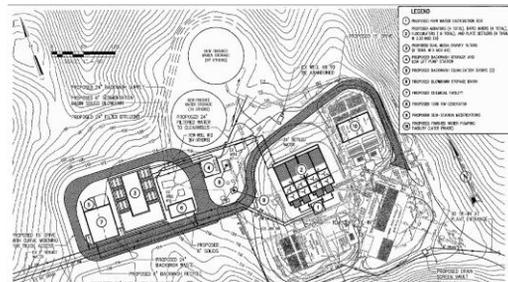
Option 1

- City builds, operates and maintains new 8-mgd WTP
- County continues with 4-mgd expansion to BC II
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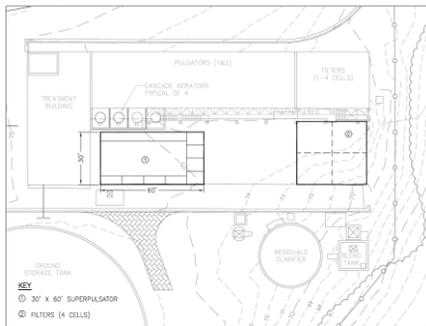
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Annapolis WTP – Proposed Site Layout



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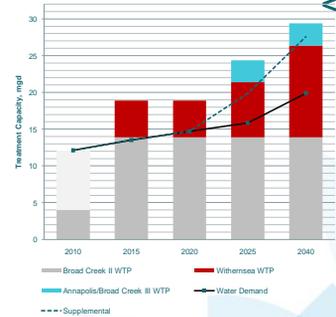
4 mgd Expansion BC II WTP Layout



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Option 2

- Expand BC II immediately to 13.88 mgd
 - Plate settlers in existing clarifiers
 - Additional filters
 - Upsize piping as required
- Double barrel crossing (36-inch) of Route 50
- 3-mgd BC III (at BC I site) in 2025
- County continues with plans for Witherensea WTP (5-mgd by 2015, 7.5-mgd by 2025, 12.5 mgd by 2040 (assumed))



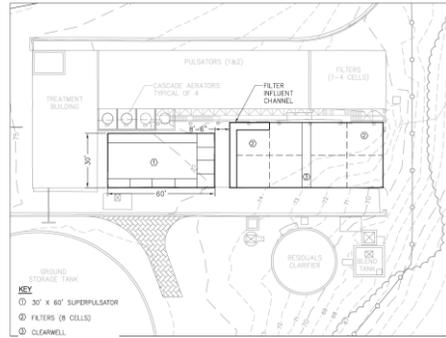
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36-inch-double-barrel interconnection (Options 2 and 3)



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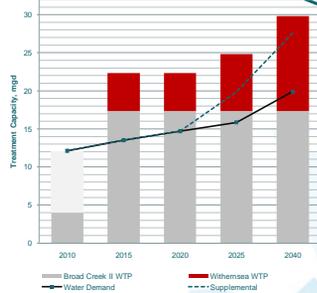
9.88 mgd Expansion BC II WTP Layout



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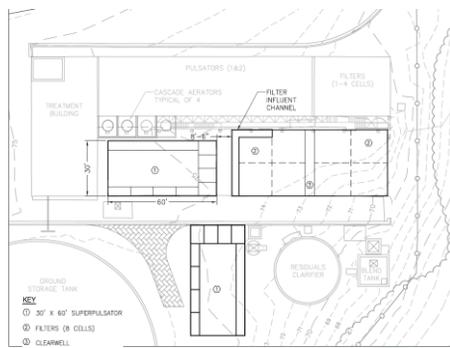
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13.33 mgd Expansion BC II WTP Layout



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Gross Level Financial Analysis

- Assumptions
 - Compare Option 1 (separate systems) to Option 3 (17.33 mgd at Broad Creek II)
 - Capital expenditures at same periods. Costs based on information presented in Workshop No. 2
 - No difference in remaining value of existing facilities
 - Operating costs similar on per volume basis (discuss further with next agenda item)
 - City obtains low interest loan for their entire capital commitment
- Based on assumptions, gross level analysis washes out to capital cost only

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Differential Capital Cost (\$ million)

Option	City	County
Option 1	\$37.6	\$16.8
Option 2	\$41.2	\$16.8

$\Delta \$24.4$ (between City costs of Option 1 and 2)
 $\Delta \$13.2$ (between County costs of Option 1 and 2)
 ~ \$400,000/year assuming 1.35% interest rate and 30 year term

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O&M Costs (in 2011 dollars)

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	Annapolis WTP (4.1 mgd)	Broad Creek II WTP (3.05 mgd)
	\$/1,000 gallons	\$/1,000 gallons
Operations Excluding Chem/Elec	0.27	0.14 – 0.29
Chemicals	0.09	0.08
Electrical	0.32	0.32
Maintenance/Other/Administrative	0.22	0.00 – 0.46
Total	0.90	0.54 – 1.15

Are we comparing "apples to apples"?

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Remaining Value of Existing Facilities

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- **City**
 - Wells ('03 and '10) - \$2.8 million
 - Onsite Water Storage ('10) - \$3.1 million
 - Did not include assets such as vehicles
 - Everything else fully depreciated
- **County**
 - Treatment Plant ('95) - \$3.8 million
 - Water Storage ('98) - \$0.4 million
 - New Wells ('00) - \$1.0 million
 - Everything else fully depreciated

What should be included?

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Gross Level Sensitivity Analysis

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- Framed in terms of net cost to City
- O&M
 - Costs at upper range (\$1.15/1,000 gallons) – additional \$0.25/1,000 gallons
 - Reduces overall cost to breakeven
 - Similar deduct for other direction
- Net difference of remaining value of existing facilities
 - \$2.5 million to County
 - Reduces overall cost advantage for combined facilities to \$325,000/year
- Additional capital costs – redundant pipelines
 - \$5.0 million additional capital
 - Reduces overall cost advantage for combined facilities to \$250,000/year
- Similar add/deduct for differences in capital (\$150 K/year per \$5 million in capital)

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Potential Financing

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- How capital costs split?
- How operational costs split?
- What information is needed to make a decision/establish financing?

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Additional Data Needs

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- Comparable City/County O&M costs
- County bond rates/terms
- County Cash/debt ratios
- County Coverage factors

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**Annapolis Water Supply Feasibility Study
Workshop No. 4**

December 12, 2011

Plan Design Enable

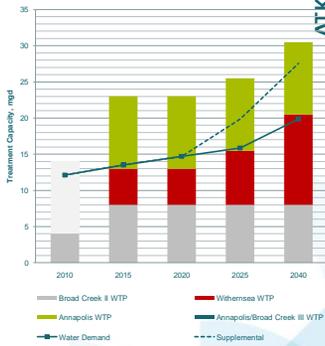


Agenda

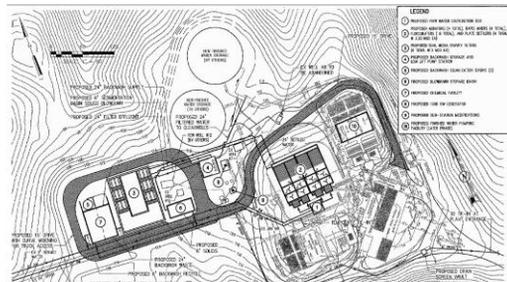
- Review Options
- Cost Allocation of Existing Facilities
- Valuation Methods
- Sensitivity Analysis

Option 1

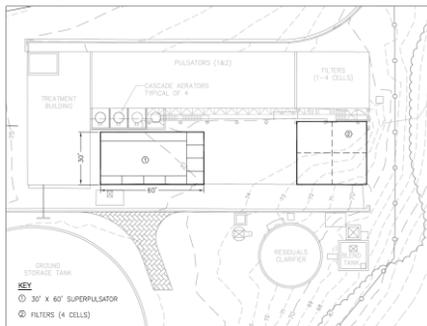
- City builds, operates and maintains new 8-mgd WTP
- County continues with 4-mgd expansion to BC II
- County continues with plans for Witherensea WTP (5-mgd by 2015, 7.5-mgd by 2025, 12.5 mgd by 2040 (assumed))



Annapolis WTP – Proposed Site Layout

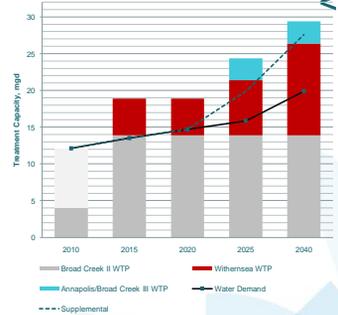


4 mgd Expansion BC II WTP Layout



Option 2

- Expand BC II immediately to 13.88 mgd
 - Plate settlers in existing clarifiers
 - Additional filters
 - Upsize piping as required
- Double barrel crossing (36-inch) of Route 50
- 3-mgd BC III (at BC I site) in 2025
- County continues with plans for Witherensea WTP (5-mgd by 2015, 7.5-mgd by 2025, 12.5 mgd by 2040 (assumed))

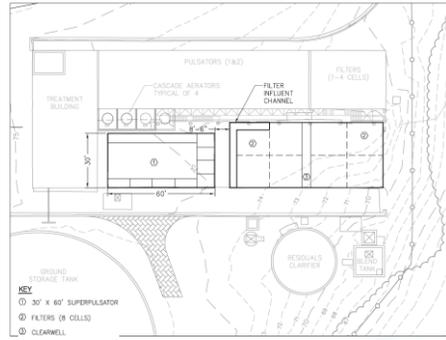


36-inch-double-barrel interconnection (Options 2 and 3)



ATKINS

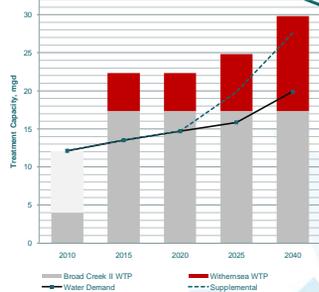
9.88 mgd Expansion BC II WTP Layout



ATKINS

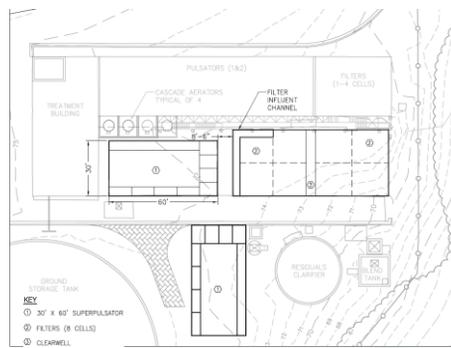
Option 3

- Expand BC II immediately to 17.33 mgd
 - Plate settlers in existing clarifiers
 - Fourth clarifier
 - Additional filters
 - Upsize piping as required
- Double barrel crossing (36-inch) of Route 50
- County continues with plans for Witherensea WTP (5-mgd by 2015, 7.5-mgd by 2025, 12.5 mgd by 2040 (assumed))



ATKINS

13.33 mgd Expansion BC II WTP Layout



ATKINS

Cost Allocation of Existing Facilities

- City and County wells valued at "reproduction" cost – initial cost escalated to current value:
 - County Wells 1-5: \$2.6 million
 - City Wells 10-14: \$3.4 million
- Broad Creek WTP valued at reproduction cost, then depreciated:
 - Current value: \$6.2 million
- Net transfer to County: \$5.4 million

ATKINS

Capital Cost Appropriation (Method1)

- Net value of existing 4 mgd WTP and Wells: \$5.4 million
- Add to total construction cost for expansion
- Appropriate total costs based on allocated flows

Option	Transfer	Total Capital (2011)	City	County
Option 2 (2013)	\$5.4 million	\$34.7 million	\$20.8 million (7.2 mgd)	\$19.3 million (total) \$13.9 million (net) (6.7 mgd)
Option 2 (2025)	--	\$12 million	\$3.2 million (8.0 mgd)	\$8.8 million (8.9 mgd)
Option 3 (2013)	\$5.4 million	\$41.2 million	\$21.5 million (8.0 mgd)	\$25.0 million (total) \$19.6 million (net) (9.3 mgd)

ATKINS

Present Value Summary (Method 1)

ATKINS

- 3% inflation, 4.5% discount rate
- Equal O&M Costs, except additional cost for pumping back to City

Avg. Annual PV	Option 1	Option 2	Option 3
City (\$1,000/yr)	\$2,240	\$2,010	\$1,920
-Capital	\$1,080	\$730	\$640
-O&M	\$1,160	\$1,280	\$1,280
TOTAL (\$ million)	\$62.8	\$56.1	\$53.6
County (\$1,000/yr)	\$2,250	\$2,400	\$2,390
-Capital	\$870	\$1,020	\$1,010
-O&M	\$1,380	\$1,380	\$1,380
TOTAL (\$ million)	\$63.0	\$67.3	\$67.1

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Capital Cost Appropriation (Method 2)

ATKINS

- Neglect value of existing facilities
- Appropriate total costs based on allocated flows for expansion

Option	Total Capital (2011)	City	County
Option 2 (2013)	\$34.7 million	\$25.2 million (7.2 mgd)	\$9.5 million (2.7 mgd expansion, 6.7 mgd total)
Option 2 (2025)	\$12 million	\$3.2 million (0.8 mgd expansion, 8.0 mgd total)	\$8.8 million (2.2 mgd expansion, 8.9 mgd)
Option 3 (2013)	\$41.2 million	\$24.8 million (8.0 mgd)	\$16.4 million (5.4 mgd expansion, 9.3 mgd total)

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Present Value Summary (Method 2)

ATKINS

- 3% inflation, 4.5% discount rate
- Equal O&M Costs, except additional cost for pumping back to City

Avg. Annual PV	Option 1	Option 2	Option 3
City (\$1,000/yr)	\$2,330	\$2,230	\$2,110
-Capital	\$1,080	\$860	\$730
-O&M	\$1,250	\$1,370	\$1,370
TOTAL (\$ million)	\$62.8	\$59.8	\$56.3
County (\$1,000/yr)	\$2,360	\$2,280	\$2,340
-Capital	\$870	\$790	\$840
-O&M	\$1,490	\$1,490	\$1,490
TOTAL (\$ million)	\$63.0	\$60.9	\$62.4

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Sensitivity Analysis (Method 2)

ATKINS

- Reduce County O&M Costs \$0.10/1,000 gallon (to \$0.79/1,000 gallons)

Avg. Annual PV	Option 1	Option 2	Option 3
City (\$1,000/yr)	\$2,330	\$2,090	\$1,960
-Capital	\$1,080	\$860	\$730
-O&M	\$1,250	\$1,230	\$1,230
TOTAL (\$ million)	\$62.8	\$56.0	\$52.5
County (\$1,000/yr)	\$2,190	\$2,120	\$2,170
-Capital	\$870	\$790	\$840
-O&M	\$1,320	\$1,320	\$1,320
TOTAL (\$ million)	\$58.7	\$56.6	\$58.1

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Present Value Summary (Method 2)

ATKINS

- 3% inflation, 4.5% discount rate
- Equal O&M Costs, except additional cost for pumping back to City

Avg. Annual PV	Option 1	Option 2	Option 3
City (\$1,000/yr)	\$2,330	\$2,230	\$2,110
-Capital	\$1,080	\$860	\$730
-O&M	\$1,250	\$1,370	\$1,370
TOTAL (\$ million)	\$62.8	\$59.8	\$56.3
County (\$1,000/yr)	\$2,360	\$2,280	\$2,340
-Capital	\$870	\$790	\$840
-O&M	\$1,490	\$1,490	\$1,490
TOTAL (\$ million)	\$63.0	\$60.9	\$62.4

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Sensitivity Analysis (Method 2)

ATKINS

- Increase County O&M Costs \$0.10/1,000 gallon (to \$0.99/1,000 gallons)

Avg. Annual PV	Option 1	Option 2	Option 3
City (\$1,000/yr)	\$2,330	\$2,380	\$2,250
-Capital	\$1,080	\$860	\$730
-O&M	\$1,250	\$1,520	\$1,520
TOTAL (\$ million)	\$62.8	\$63.6	\$60.1
County (\$1,000/yr)	\$2,520	\$2,450	\$2,500
-Capital	\$870	\$790	\$840
-O&M	\$1,660	\$1,660	\$1,660
TOTAL (\$ million)	\$67.3	\$65.3	\$66.7

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Sensitivity Analysis (Method 2)

ATKINS

- Decrease Capital Cost 10% (exclusive of Option 1)

Avg. Annual PV	Option 1	Option 2	Option 3
City (\$1,000/yr)	\$2,330	\$2,150	\$2,040
-Capital	\$1,080	\$770	\$660
-O&M	\$1,250	\$1,370	\$1,370
TOTAL (\$ million)	\$62.8	\$57.4	\$54.2
County (\$1,000/yr)	\$2,360	\$2,200	\$2,250
-Capital	\$870	\$710	\$760
-O&M	\$1,490	\$1,490	\$1,490
TOTAL (\$ million)	\$63.0	\$58.7	\$60.0

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Present Value Summary (Method 2)

ATKINS

- 3% inflation, 4.5% discount rate
- Equal O&M Costs, except additional cost for pumping back to City

Avg. Annual PV	Option 1	Option 2	Option 3
City (\$1,000/yr)	\$2,330	\$2,230	\$2,110
-Capital	\$1,080	\$860	\$730
-O&M	\$1,250	\$1,370	\$1,370
TOTAL (\$ million)	\$62.8	\$59.8	\$56.3
County (\$1,000/yr)	\$2,360	\$2,280	\$2,340
-Capital	\$870	\$790	\$840
-O&M	\$1,490	\$1,490	\$1,490
TOTAL (\$ million)	\$63.0	\$60.9	\$62.4

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Sensitivity Analysis (Method 2)

ATKINS

- Increase Capital Cost 10% (exclusive of Option 1)

Avg. Annual PV	Option 1	Option 2	Option 3
City (\$1,000/yr)	\$2,330	\$2,320	\$2,180
-Capital	\$1,080	\$950	\$810
-O&M	\$1,250	\$1,370	\$1,370
TOTAL (\$ million)	\$62.8	\$62.2	\$58.4
County (\$1,000/yr)	\$2,360	\$2,360	\$2,420
-Capital	\$870	\$870	\$930
-O&M	\$1,490	\$1,490	\$1,490
TOTAL (\$ million)	\$63.0	\$63.1	\$64.8

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Appendix B

Workshop Meeting Minutes

Meeting notes

Project:	Annapolis Water Supply Feasibility Study		
Subject:	Meeting 1—Design Criteria Review		
Date and time:	10 October 2011	Meeting no:	1
Meeting place:	AA County Offices	Minutes by:	Bob Nelson
Present:	David Jarrell Thora Burkhardt Michael Wojton Chris Phipps Bruce Wright Matt Mirenyi Eddie Cope Brian Balchunas Bob Nelson	Representing:	City of Annapolis Anne Arundel County Atkins

Note – action items italicized

ITEM	DESCRIPTION & ACTION	DEADLINE	RESPONSIBLE
1-1	<p>Technical Memorandum 1</p> <ul style="list-style-type: none"> Design criteria for treatment facilities should be based on meeting the combined maximum daily demands for the Broad Creek zone (15-mgd, using a 2.5 maximum-daily-to-average-annual peaking factor); the City of Annapolis (8-mgd); plus an additional 8-mgd to supplement other interconnected County zones. Based on historical data, maximum-daily-to-average-annual peaking factor for County pressure zone 210 will be reviewed. The peaking factor may be reduced, but should be no less than 2.0. At a peaking factor of 2.0, buildout water demand is reduced from 15-mgd to 12-mgd. Assumed phasing for treatment of 8-mgd supplemental demand: 4-mgd by 2025; additional 4-mgd by 2035. <i>Atkins to revise Technical Memorandum 1 to reflect additional 8-mgd demand, revised peaking factor, and assumed phasing.</i> <p>Discussion</p> <ul style="list-style-type: none"> County’s future Northeast WTP does not impact Feasibility Study. Considerations at Northeast include potential failure of 72-inch water main under the harbor near the Key Bridge. It also provides replaces several smaller planned facilities from the <i>2007 Master Plan</i>. County’s future Withernsea WTP would provide reliability and redundancy for pressure zone 210 south of South River, as well as other portions of the distribution system. 		<i>Atkins</i>

NOTE TO RECIPIENTS:

These meeting notes record Atkins understanding of the meeting and intended actions arising there from. Your agreement that the notes form a true record of the discussion will be assumed unless comments are received in writing within five days of receipt.

ITEM	DESCRIPTION & ACTION	DEADLINE	RESPONSIBLE
	south of South River. Londontowne (south side of South River) has inquired about annexation.		
2-1	Status of Data Needs		
	<p>Data received to date was discussed.</p> <ul style="list-style-type: none"> • Capital costs of existing facilities <ul style="list-style-type: none"> ○ County –Leslie Campbell (Finance) has been contacted and is assembling facilities costs. Costs should be forthcoming by Friday, October 14. • Operations and maintenance costs <ul style="list-style-type: none"> ○ City – Provide breakdown of water supply and treatment facilities “Supplies”, in order to estimate “Chemicals.” (Subsequent to meeting, City estimated percentage of chemical costs to be 67-percent.) ○ County labor costs do not include benefits. <i>Atkins to add.</i> <p>Discussion</p> <ul style="list-style-type: none"> • Discussed varying iron levels in the Magothy and LPAT aquifers for the City and County. No action required. 	October 28	<p>County (Leslie Campbell)</p> <p>City (Thora Burkhardt, Michael Wojton)</p> <p>Atkins</p>
3-1	Buy-in Regarding Treatment Process Options		
	<ul style="list-style-type: none"> • No comments regarding the three options presented in Technical Memorandum 1 • Atkins presented a sketch showing total maximum treatment capacity at existing Broad Creek II WTP is about 17.33 mgd, using existing Broad Creek II technologies (Pulsators and Greenleaf Filters). <i>Atkins to check space reserved for recycling/residuals handling, as well as compliance with 4-log virus inactivation/removal. Assuming space is available to treat the 17.33 mgd, this will replace the Broad Creek II Option 3 (16 mgd) and will not require pilot testing.</i> <p>Discussion</p> <ul style="list-style-type: none"> • Costs for re-design of Broad Creek II WTP for Option 3 must be added. • City’s loan conditions require construction contract by November 2012. 		Atkins
4-1	Technical Memorandum 2 and Next Meeting		
	<p>Next meeting scheduled for 9:00 a.m., Friday, November 4. <i>Technical Memorandum 2 (draft) routed to attendees by Friday, October 28</i></p>		Atkins

Meeting notes

Project:	Annapolis Water Supply Feasibility Study		
Subject:	Meeting 2—Costs		
Date and time:	4 November 2011	Meeting no:	2
Meeting place:	AA County Offices	Minutes by:	Bob Nelson
Present:	David Jarrell Thora Burkhardt Michael Wojton Jim FitzGerald Ron Bowen Chris Phipps Bruce Wright Eddie Cope Brian Balchunas Bob Nelson	Representing:	City of Annapolis Anne Arundel County Atkins

Note – action items italicized

ITEM	DESCRIPTION & ACTION	DEADLINE	RESPONSIBLE
1-1	<p>Finalize Technical Memorandum 1</p> <ul style="list-style-type: none"> • Question arose regarding whether MDE will appropriate additional groundwater withdrawals near Broad Creek. • Question arose regarding future Withernsea WTP. If expansion schedule is exactly the same for all options, why not delete from feasibility study? • Are future City annexations double-counted, with respect to water demand? • <i>Include IDI's proposal in TM1 appendix.</i> • <i>Atkins to revise TM1 if necessary, to reflect answers to above issues.</i> <p>Discussion</p> <ul style="list-style-type: none"> • County believes MDE will appropriate additional groundwater from the Patuxent aquifer. • Do not reveal County's 2.0 peaking factor (cited in TM1) to MDE. • <i>Delete Withernsea WTP expansion options.</i> 		Atkins
2-1	<p>Draft of Technical Memorandum 2</p> <ul style="list-style-type: none"> • Capital costs <ul style="list-style-type: none"> ○ <i>Atkins to determine whether City finished water storage tanks can be fed by gravity from Broad Creek II (BC II) WTP. (Following the meeting, it was</i> 		Atkins

NOTE TO RECIPIENTS:

These meeting notes record Atkins understanding of the meeting and intended actions arising there from. Your agreement that the notes form a true record of the discussion will be assumed unless comments are received in writing within five days of receipt.

ITEM	DESCRIPTION & ACTION	DEADLINE	RESPONSIBLE
	<p>determined that a gravity interconnection is not possible. BC II is 30 feet higher than City of Annapolis WTP.)</p> <ul style="list-style-type: none"> • Operations and maintenance costs <ul style="list-style-type: none"> ○ <i>Delete historical O&M costs for City of Annapolis</i> ○ County labor costs do not include benefits. (Following the meeting, it was determined that fringe benefits increase labor by 1.45.) <p>Discussion</p> <ul style="list-style-type: none"> • Discussed contingencies, and whether contingencies should be identical. • Discussed Count’s O&M costs, by line item. County labor costs do not include any “supervision.” County to add some pro-rata supervisory costs. (Following the meeting, Leslie Campbell reviewed Eddie Cope’s original O&M estimate and thought it didn’t represent actual costs. Leslie is reviewing O&M costs further.) • Discussed finished water storage. Should capital/O&M costs for storage be included in feasibility study? Consensus was “no.” 		<p><i>Atkins</i></p> <p><i>County</i></p>
3-1	<p>Key Decisions</p> <ul style="list-style-type: none"> • Omit Withernsea WTP from feasibility study options. • Do not include costs for storage and distribution in feasibility study options. • Wait for Leslie’s input regarding County’s costs to finalize TM2. <p>Discussion</p>		
4-1	<p>Additional Info Required for Financial Model</p> <ul style="list-style-type: none"> • <i>Financing plans (cash/debt ratios)</i> • <i>Interest rates</i> • <i>Debt terms</i> • <i>Coverage factors</i> • <i>Asset value of BCII</i> 		<p><i>City/County</i></p> <p><i>City/County</i></p> <p><i>City/County</i></p> <p><i>City/County</i></p> <p><i>County</i></p>
5-1	<p>Schedule and Subsequent Work/Next Meeting</p> <p>Tentative schedule for next meeting is 9:00 a.m., Friday, December 1.</p>		<i>Atkins</i>

Meeting notes

Project:	Annapolis Water Supply Feasibility Study		
Subject:	Meeting Number 3		
Date and time:	1 December 2011	Meeting no:	3
Meeting place:	AA County Offices	Minutes by:	Bob Nelson
Present:	David Jarrell Thora Burkhardt Michael Wojton Ron Bowen Chris Phipps Bruce Wright Eddie Cope Leslie Campbell Brian Balchunas Bob Nelson Karyn Keese (phone)	Representing:	City of Annapolis City of Annapolis City of Annapolis Anne Arundel County Anne Arundel County Anne Arundel County Anne Arundel County Anne Arundel County Atkins Atkins Atkins

Note – action items italicized

ITEM	DESCRIPTION & ACTION	DEADLINE	RESPONSIBLE
1	<p>Review Gross Financial Analysis (Option 1 and 3)</p> <p>Discussion</p> <ul style="list-style-type: none"> If there is no difference in remaining value of existing facilities, and operating costs are assumed similar (per-volume basis), on a gross level, analysis could be reduced to capital costs only. Differential capital cost adder (between Option 1 and Option 3) would be approximately \$13.2 million, to City. (about \$530,000 per year with assumed MDE loan funding) 		
2	<p>Actual O&M Costs to Utilize</p> <p>Discussion</p> <ul style="list-style-type: none"> Preliminary County's O&M costs were disaggregated by utility (water versus wastewater) and treatment plant (Broad Creek II versus the other plants). Based on preliminary analysis, range of possible O&M costs (\$0.54/1,000 gallons to \$1.15/1,000 gallons) is still relatively wide. <p><i>Leslie C. and Thora B. will work on County's O&M costs to assure that they correctly compare with the City's O&M costs.</i></p>	12/9/11	City/County

NOTE TO RECIPIENTS:

These meeting notes record Atkins understanding of the meeting and intended actions arising there from. Your agreement that the notes form a true record of the discussion will be assumed unless comments are received in writing within five days of receipt.

ITEM	DESCRIPTION & ACTION	DEADLINE	RESPONSIBLE
3	Remaining Value of Existing Facilities (Depreciation)		
	Discussion		
	<ul style="list-style-type: none"> Both City and County use 50-year depreciation. It was agreed that the City's water tank should not be included in the value of existing facilities for the City. Only the value of the wells and the water appropriation will be considered. 		
4	Gross Level Sensitivity Analysis		
	Discussion		
	<ul style="list-style-type: none"> It appears that for this preliminary analysis, O&M costs would be about the same. At the upper range of the County's O&M estimate (\$1.15/1,000 gallons, City would be paying \$0.25/1,000 gallons more (~ \$400,000 per year) for Options 2 and 3. If net difference for remaining facility's were \$2.5 million in County's favor, it would reduce the overall cost advantage for combined facilities by \$100,000 per year. There will be some differences in capital costs, depending upon the City's level of redundancy with raw and finished water interconnections under Highway 50; or whether a new, low-pressure pump station and interconnection is preferable to using a high-pressure interconnection on Nichols Road (where City and County water mains are in close proximity). If City spent \$5 million dollars on redundancy, it would reduce the overall cost advantage for combined facilities by \$200,000 per year. 		
5	Potential Financing		
	Discussion		
	<ul style="list-style-type: none"> Discussions centered on possible City financing the differential of the capital cost for Option 3 (versus the County's original cost for planned 4MGD upgrade) using MDE low interest loan. Under the scenario above, County would get benefit of additional 1.3 mgd of treatment capacity above current plan for 8 mgd. Capital costs could also be split based on total capacity for each system. Chris Phipps asked how economy of scale could be factored in. Bruce Wright noted that considering plant increase from 4 mgd to 17.33 mgd, with approximately 60% of capacity going to City and 40% going to County, cost split presented appeared reasonable. 		

ITEM	DESCRIPTION & ACTION	DEADLINE	RESPONSIBLE
	<ul style="list-style-type: none"> O&M costs split would likely be based on percentage of flow. Determining which costs should be included in O&M would not be as simple as at the wastewater treatment plant, as these plants have their own cost center. The same approach may need to be taken for the water plants. <i>Thora Burkhardt and Leslie Campbell to discuss cost split during the week of 12/5.</i> 		
6	<p>Outstanding Data Needs</p> <p>Discussion</p> <ul style="list-style-type: none"> The following information was provided: <ul style="list-style-type: none"> County uses general obligation bonds, with 30 year terms. The 3-year average rate is 4.8%. To finalize the financial analysis, the following additional information is required: <ul style="list-style-type: none"> <i>Comparable City/County O&M costs.</i> <i>County's cash/debt ratios, coverage rates (from Financial Department)</i> 	<p>12/9/11</p> <p>12/9/11</p>	<p>City/County</p> <p>County</p>

Schedule for next meeting is 12:00 PM, Monday, December 12. Additional financial information will be presented.

Appendix C

Technical Memorandum No. 1

Technical Memorandum 1

To:	City of Annapolis		
From:	Bob Nelson, Karthik Manchala	Email:	
Phone:	301-210-6800	Date:	09-20-2011
Ref:	100023456	cc:	Anne Arundel County DPW
Subject:	Annapolis Water Treatment Plant (WTP) and Broad Creek WTP – Design Criteria		

1.1. Background

The existing Annapolis Water Treatment Plant (WTP) provides drinking water to the City of Annapolis (City). The plant was constructed in 1933, and has been modified several times. Raw water is currently provided by eight wells, located near the treatment plant. Wells are screened in the Magothy, Lower Patapsco (LPAT), and Upper Patapsco (UPAT) aquifers. The water treatment process is designed for iron removal and includes tray-type (cascade) aerators, lime and alum addition, incidental mixing in the flocculation-basin influent channel, walking-beam flocculation, rectangular clarifiers with tube settlers, and dual-media filters. The City recently constructed two, 1-million-gallon, finished water storage tanks at the plant. According to the City's October 2009 Facility Plan Report (Hazen and Sawyer), there were no treatment performance issues, and the plant is in compliance with all applicable County and Federal regulations. The Annapolis WTP serves the City of Annapolis pressure zone 173.

Broad Creek II WTP is owned and operated by Anne Arundel County (AACo). The plant was constructed in 1989, and was designed to treat an average flow of 4 mgd. Raw water to the plant is provided by wells screened in the LPAT, UPAT, and Patuxent (PTX) aquifers. The treatment process, designed for iron removal, includes cascade aerations, lime and polymer addition, vertical-shaft flocculation, pulsating-sludge-blanket ("Pulsator") clarifiers, and self-backwashing, vacuum-controlled ("Greenleaf") filters. The plant serves the Broad Creek pressure zone 210.

The plants are approximately ½-mile apart. The City's distribution system and AACO's distribution system are currently interconnected at two locations. The interconnections have never been used. The City's Facility Plan Report recommended that the City build a new, 10-mgd water treatment plant, adjacent to the existing 10-mgd (nominal) plant. Estimated Phase I costs were \$50,100,000. Recently, Atkins completed design on a 4-mgd expansion of Broad Creek II WTP. Estimated costs were \$9,200,000. The City is interested in exploring the feasibility of a joint water treatment plant. The purpose of this memorandum is to establish water demand projections for both entities, design criteria, and determine strategies to accommodate the future demands.

Once agreement is reached regarding these matters, Atkins will produce a feasibility study. The objectives of feasibility study are two-fold:

- Determine 20-year strategy for meeting City's and County's water demands.
- Develop 50-year life-cycle costs for strategies identified herein. Based on cost-sharing allocation scenarios provided by the City and AACO, Atkins will generate respective costs-per-thousand-gallons, for each entity.

1.2. Review of Existing Information

A review of the existing information was performed. These documents include:

- *2007 Master Plan for Water Supply & Sewerage Systems* (AACo, amended February 2010)
- *Facility Plan Report, City of Annapolis, Maryland, Annapolis Water Treatment Plant Evaluation* (Hazen and Sawyer, October 2009)
- *Annapolis Comprehensive Plan* (City of Annapolis, October 2009)
- City of Annapolis amendments to *2007 Master Plan for Water Supply & Sewerage Systems* (June 2011)

Information from the above documents—including population and water demand projections—is presented below.

Water Demand Projections

Maximum day and peak hour water demands were estimated using the peaking factors and average flow. Figure 1 and Figure 2 show the average daily, maximum daily, and peak hourly water demand projections, for Broad Creek and City of Annapolis pressure zones.

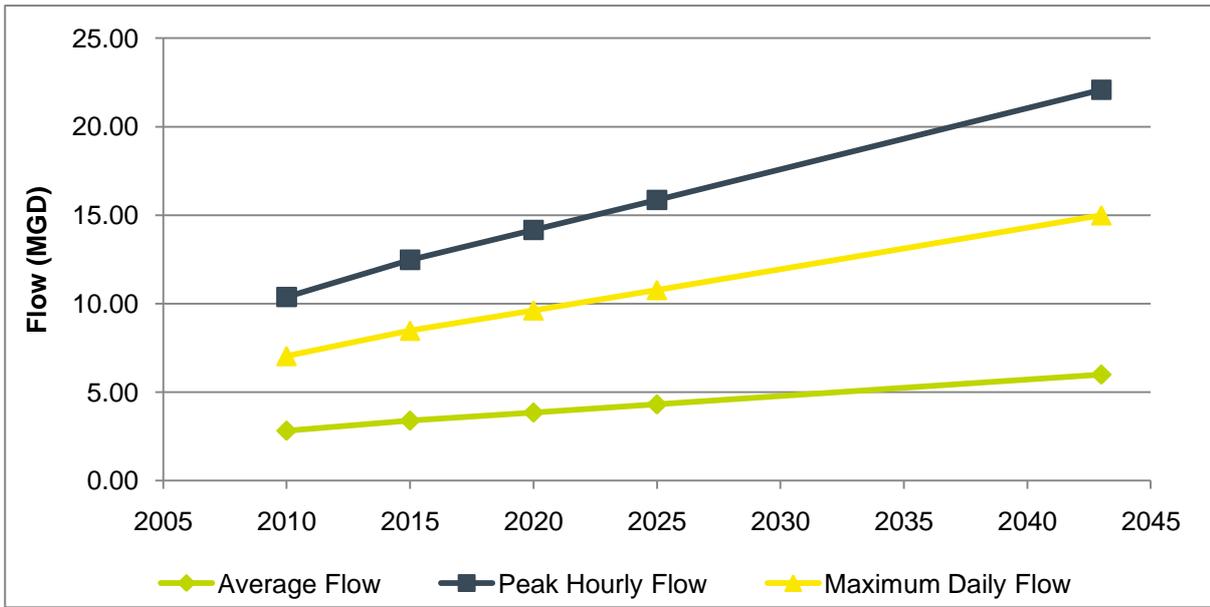


Figure 1. Flow Projection – Broad Creek Pressure Zone

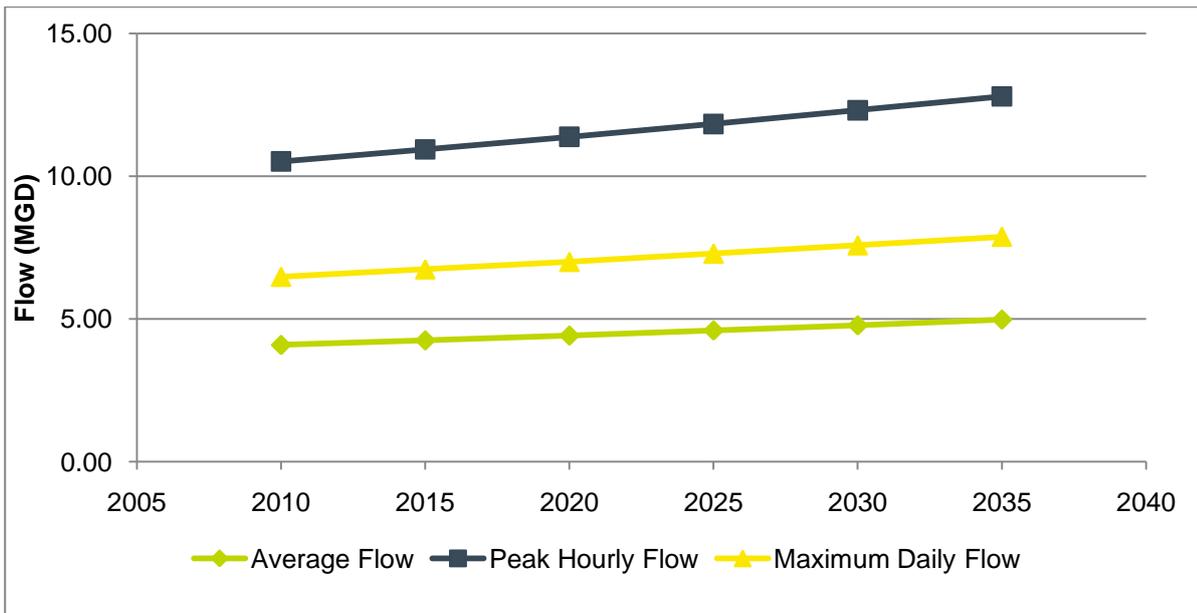


Figure 2. Flow Projection – City of Annapolis Pressure Zone

1.3. Design Criteria

Both the City and County water demand projections assume average flow per equivalent dwelling unit (EDU) is 250 gallons. The City’s projected maximum-daily-to-average-annual peaking factor is 1.6. The County’s projected maximum-daily-to-average-annual peaking factor for Broad Creek zone is 2.5.

Based on these assumptions, the City projects an 8-mgd, maximum day water demand in Year 2035. This quantity of treated water is assumed to be sufficient for population increases within the 173 zone, plus future redevelopment and annexations.

Similarly, the County projects a 15-mgd, maximum day water demand for the Broad Creek zone in Year 2043. Per the County’s *2007 Master Plan*, this quantity of treated water is sufficient for population increases within the Broad Creek zone, plus Annapolis Neck. However, the *2007 Master Plan* also identifies an additional 8-mgd to be sent from the Broad Creek zone to the Glen Burnie low zone. Capacity increases per the *2007 Master Plan* are identified in Table 1.

Table 1. 2007 Master Plan Broad Creek Treatment Capacities

Water Supply Source	2010 Production	2015 Production	2020 Production	2025 Production	2030 Production	2035 Production	2040 Production	Ultimate Production
Broad Creek I&II	4.0	4.0	4.0	0.0	0.0	0.0	0.0	0.0
Broad Creek III	0.0	7.8	7.8	15.5	15.5	15.5	15.5	15.5
Witherensea	5.0	5.0	5.0	5.0	5.0	5.0	7.5	7.5
<i>Total</i>	<i>9.0</i>	<i>16.8</i>	<i>16.8</i>	<i>20.5</i>	<i>20.5</i>	<i>20.5</i>	<i>23.0</i>	<i>23.0</i>

Since release of the *2007 Master Plan*, timing for capacity improvements has changed. The County is currently still relying on Broad Creek II WTP to supply all water to the Broad Creek zone, with emergency use of Broad Creek I, if needed. Maximum day flows in 2009-2011 were approximately 5.5 mgd. As stated previously, Broad Creek II is planned for expansion to 8-mgd, with construction completion in 2013. The 5-mgd Witherensea WTP is in the planning stages, with completion expected by 2015. Broad Creek III is not currently in the 2012-2016 CIP. Current known planned facilities for the Broad Creek zone are identified in Table 2.

Table 2. Current Planned Broad Creek Treatment Capacities

Water Supply Source	2010 Production	2015 Production	2020 Production	2025 Production
Broad Creek I&II	6.0	8.0	8.0	8.0
Broad Creek III	0.0	0.0	0.0	0.0
Witherensea	0.0	5.0	5.0	7.5
<i>Total</i>	<i>6.0</i>	<i>13.0</i>	<i>13.0</i>	<i>15.5</i>

The County is also planning for construction of the 6.0-mgd Northeast WTP to serve the Glen Burnie low zone. It is assumed that this treatment plant replaces the 2.3-mgd Marley Creek WTP identified in the *2007 Master Plan*, thus supplying an addition 3.7-mgd to the Glen Burnie low zone. As needs for the Glen Burnie low zone may have changed since the *2007 Master Plan* was completed, design criteria for treatment facilities have been developed based on meeting the combined maximum daily demands for the Broad Creek zone (15-mgd) and the City of Annapolis (8-mgd) only.

For purposes of this technical memorandum, it is assumed that no technical or regulatory hurdles constrain treatment plant location. Potential hurdles include: groundwater appropriations, future well-field locations, site size, storage and distribution issues.

The following options for meeting combined maximum daily demands are illustrated in the graphs below. All three options provide at least 23 mgd (15-mgd to the Broad Creek pressure zone and 8-mgd to City), the currently-projected, combined maximum-day water demands shown in Figures 1 and 2, above. If the City and County agree, these options will be developed further in the next phase of this feasibility study.

- **Option 1 (Baseline)-** Immediate construction of a new, 8-mgd WTP at the existing City WTP and a 4-mgd expansion at the County’s Broad Creek II WTP (8-mgd, total). Construction of a new, 5-mgd WTP at Withernsea by 2015, with an expansion to 7.5-mgd by 2025.
- **Option 2-** Immediate construction of an 8-mgd expansion at the County’s Broad Creek II WTP (12-mgd, total). Construction of a new, 5-mgd WTP at Withernsea by 2015, with an expansion to 7.5-mgd by 2020. Construction of new, 4-mgd WTP at either the current Annapolis WTP site or at the abandoned Broad Creek I WTP site, by Year 2025.
- **Option 3-** Immediate construction of a 12-mgd expansion at the County’s Broad Creek II WTP (16-mgd, total—pending piloting. Piloting is required in order for IDI—the existing clarifier manufacturer—to confirm higher loading rates.). Construction of a new, 5-mgd WTP at Withernsea by 2015, with an expansion to 7.5-mgd by 2025.

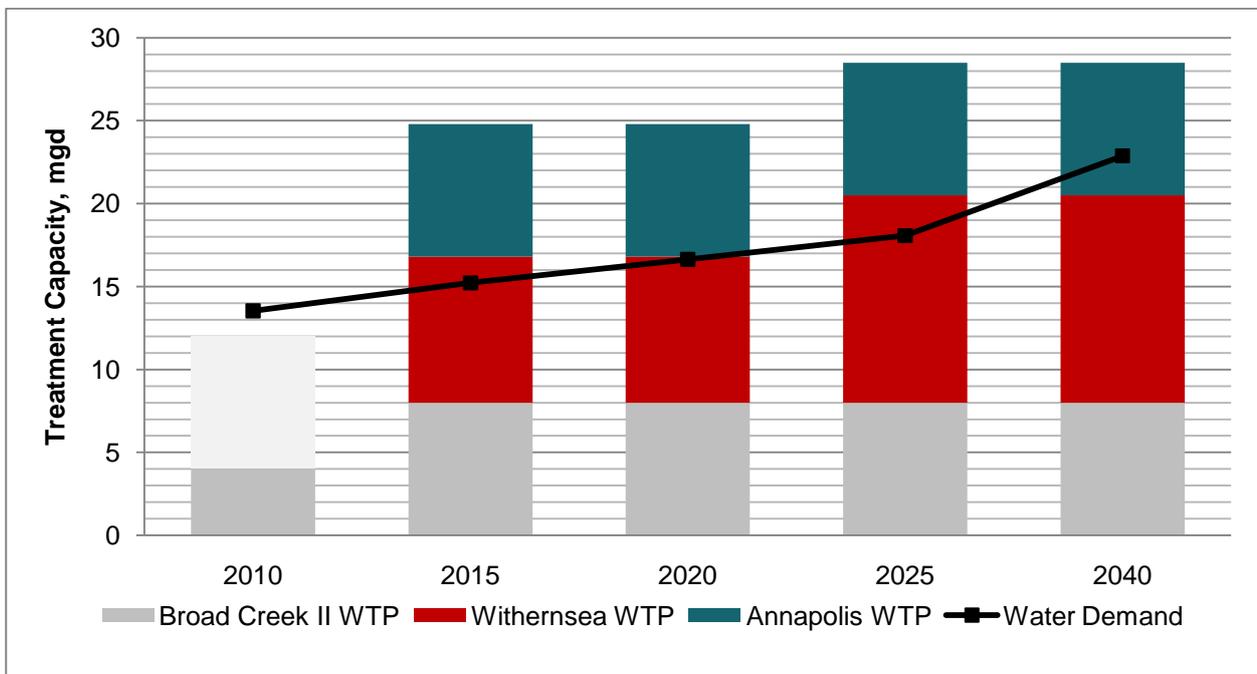


Figure 3. Option 1

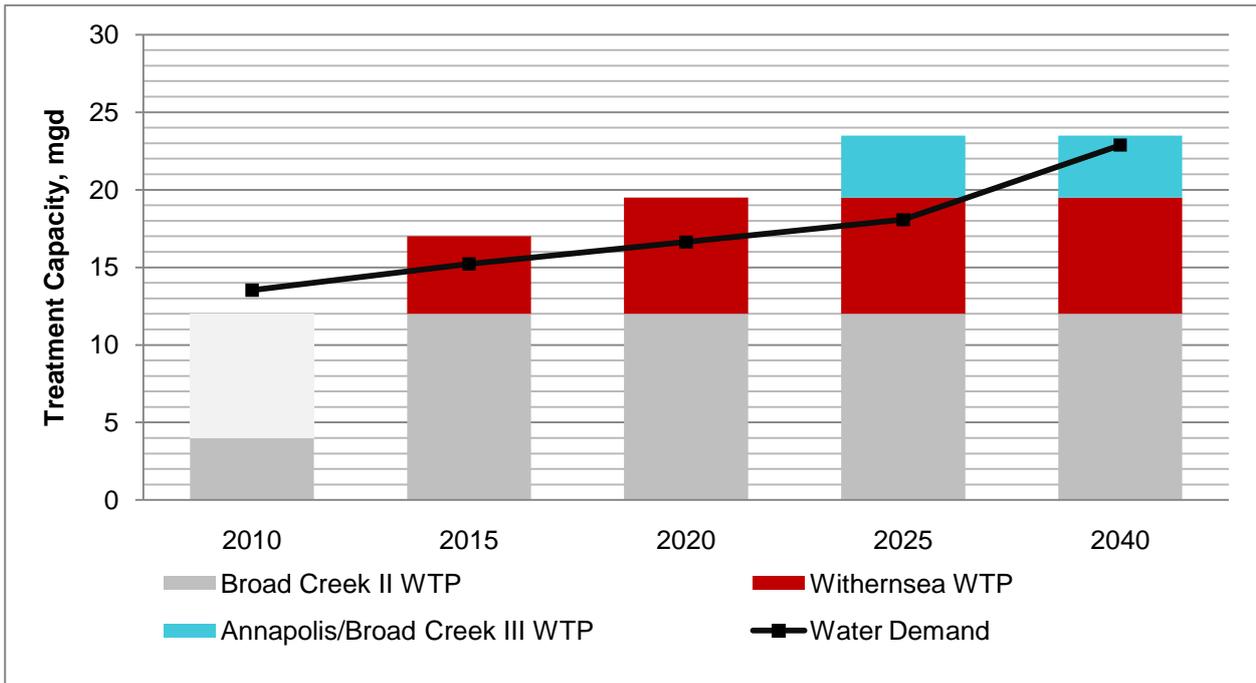


Figure 4. Option 2

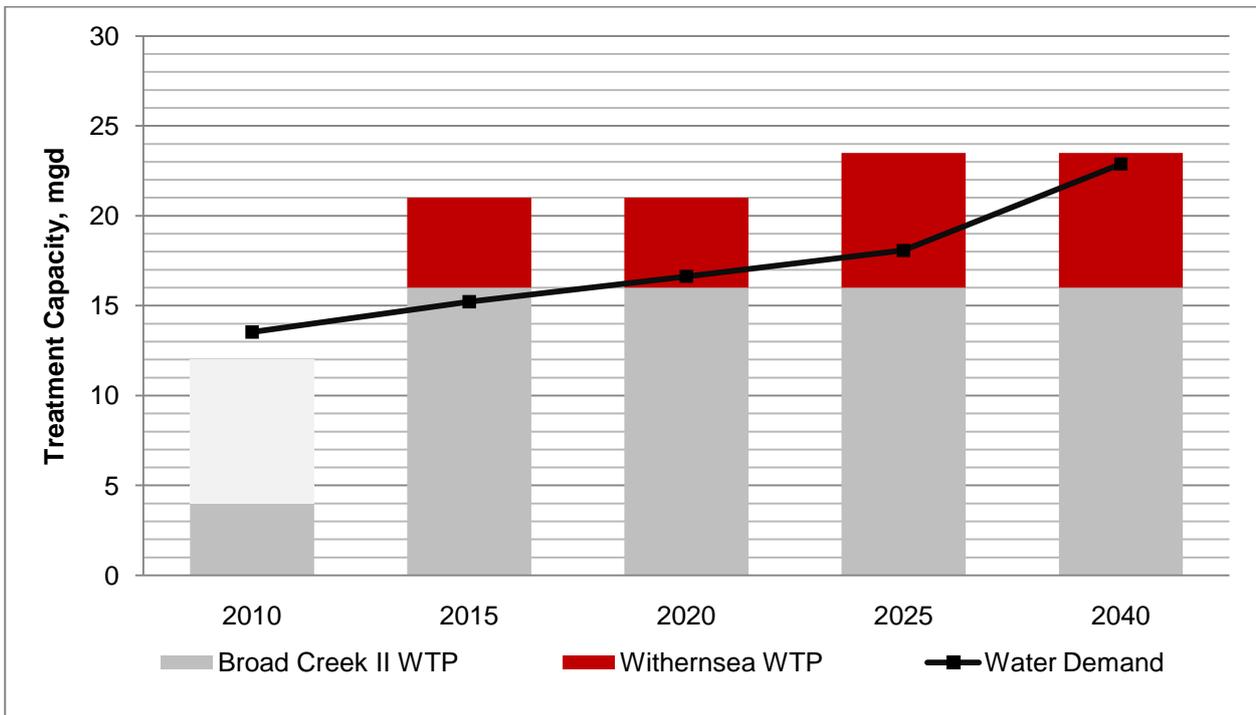


Figure 5. Option 3

Appendix D

Total Project Cost Summary Sheets

OPINION OF PROBABLE CONSTRUCTION COST

Client: City of Annapolis
Project: Annapolis 8 mgd WTP - H&S Estimate
Facility: Annapolis WTP - Use Same Assumptions as Others
Location: Annapolis, MD

Document: Opinion of Probable Construction Cost
Compiled by: KRM
Date: 10/21/2011

DESCRIPTION	COST
Contractor	\$ 21,000,000
Subtotal 1	\$ 21,000,000
Overhead and Profit 15% of subtotal 1	\$ 3,150,000
Subtotal 2	\$ 24,150,000
Contingency 25% of subtotal 2	\$ 6,037,500
Subtotal 3	\$ 30,187,500
Engin/Legal/Misc 21% of subtotal 3	\$ 6,339,400
TOTAL PROJECT COSTS (WTP ONLY)	\$ 36,526,900
Escalation 3% of subtotal 3	\$ 1,095,807
TOTAL PROJECT COSTS	\$ 37,622,707

OPINION OF PROBABLE CONSTRUCTION COST

Client: City of Annapolis
Project: Annapolis 8 mgd WTP - H&S Estimate
Facility: Annapolis FWPS - Use Same Assumptions as Others
Location: Annapolis, MD

Document: Opinion of Probable Construction Cost
Compiled by: KRM
Date: 10/21/2011

DESCRIPTION	COST
Contractor	\$ 2,190,000
Subtotal 1	\$ 2,190,000
Overhead and Profit 15% of subtotal 1	\$ 328,500
Subtotal 2	\$ 2,518,500
Contingency 25% of subtotal 2	\$ 629,700
Subtotal 3	\$ 3,148,200
Engin/Legal/Misc 21% of subtotal 3	\$ 661,200
TOTAL PROJECT COSTS (WTP ONLY)	\$ 3,809,400
Escalation 3% of subtotal 3	\$ 114,282
TOTAL PROJECT COSTS	\$ 3,923,682

OPINION OF PROBABLE CONSTRUCTION COST

Client: Anne Arundel County Department of Public Works
Project: Broad Creek II WTP Expansion
Facility: 8-mgd to County
Location: Annapolis, MD

Document: Opinion of Probable Construction Cost
Compiled by: KRM/RMN
Date: 7/1/2010

DESCRIPTION	COST
Contractor	
Division 1 : General Requirements	\$ 490,000
Division 2 : Civil	\$ 540,300
Division 3 : Concrete	\$ 946,700
Division 4 : Masonry	\$ 18,200
Division 5 : Metals	\$ 92,400
Division 6 : Woods and Plastics	\$ -
Division 7 : Thermal and Moisture Protection	\$ 11,900
Division 8 : Doors and Windows	\$ 9,400
Division 9 : Finishes	\$ 70,000
Division 10 : Specialties	\$ -
Division 11 : Equipment	\$ 2,196,100
Division 13 : Specialty Construction	\$ 453,400
Division 14 : Conveying Equipment	\$ 30,000
Division 15 : Mechanical	\$ 321,500
Division 16 : Electrical 15% of Div-1 to Div-15	\$ 777,000
Subtotal 1	\$ 5,956,900
Labor 8% of subtotal 1	\$ 476,600
Material 15% of subtotal 1	\$ 893,500
Overhead and Profit 15% of subtotal 1	\$ 893,500
Subtotal 2	\$ 7,327,000
Contingency 25% of subtotal 2	\$ 1,831,800
Subtotal 3	\$ 9,158,800
Engin/Legal/Misc 21% of subtotal 3	\$ 1,923,400
TOTAL PROJECT COSTS (WTP ONLY)	\$ 11,082,200
Wells and Raw Water Pipelines Total Project Cost (includes mark-ups)	\$ 5,700,000
TOTAL PROJECT COSTS	\$ 16,782,200

OPINION OF PROBABLE CONSTRUCTION COST

Client: City of Annapolis in Conjunction with AA Co DPW
Project: Broad Creek II WTP Expansion to 13.88 mgd
Facility: 7.2 mgd to City of Annapolis, 6.7 mgd to County
Location: Annapolis, MD

Document: Opinion of Probable Construction Cost
Compiled by: KRM
Date: 10/21/2011

DESCRIPTION	COST
Contractor	
Division 1 : General Requirements	\$ 500,000
Division 2 : Civil	\$ 1,013,100
Division 3 : Concrete	\$ 2,700,300
Division 4 : Masonry	\$ 36,400
Division 5 : Metals	\$ 164,700
Division 6 : Woods and Plastics	\$ -
Division 7 : Thermal and Moisture Protection	\$ 23,800
Division 8 : Doors and Windows	\$ 15,000
Division 9 : Finishes	\$ 90,000
Division 10 : Specialties	\$ -
Division 11 : Equipment	\$ 4,153,200
Division 13 : Specialty Construction	\$ 680,100
Division 14 : Conveying Equipment	\$ 40,000
Division 15 : Mechanical	\$ 1,898,500
Division 16 : Electrical 15% of Div-1 to Div-15	\$ 1,697,300
Subtotal 1	\$ 13,012,400
Labor 8% of subtotal 1	\$ 1,041,000
Material 15% of subtotal 1	\$ 1,951,900
Overhead and Profit 15% of subtotal 1	\$ 1,951,900
Subtotal 2	\$ 16,005,300
Contingency 25% of subtotal 2	\$ 4,001,400
Subtotal 3	\$ 20,006,700
Engin/Legal/Misc 21% of subtotal 3	\$ 4,201,500
TOTAL PROJECT COSTS (WTP ONLY)	\$ 24,208,200
Wells and Raw Water Pipelines Total Project Cost (includes mark-ups)	\$ 5,700,000
TOTAL PROJECT COSTS	\$ 29,908,200

OPINION OF PROBABLE CONSTRUCTION COST

Client: City of Annapolis in Conjunction with AA Co DPW
Project: Broad Creek II WTP Expansion to 17.33 mgd
Facility: 8 mgd to City of Annapolis, 9.33 mgd to County
Location: Annapolis, MD

Document: Opinion of Probable Construction Cost
Compiled by: KRM
Date: 10/21/2011

DESCRIPTION	COST
Contractor	
Division 1 : General Requirements	\$ 600,000
Division 2 : Civil	\$ 1,275,200
Division 3 : Concrete	\$ 3,278,000
Division 4 : Masonry	\$ 36,400
Division 5 : Metals	\$ 214,000
Division 6 : Woods and Plastics	\$ -
Division 7 : Thermal and Moisture Protection	\$ 35,700
Division 8 : Doors and Windows	\$ 18,800
Division 9 : Finishes	\$ 100,000
Division 10 : Specialties	\$ -
Division 11 : Equipment	\$ 5,422,200
Division 13 : Specialty Construction	\$ 906,800
Division 14 : Conveying Equipment	\$ 50,000
Division 15 : Mechanical	\$ 2,398,400
Division 16 : Electrical 15% of Div-1 to Div-15	\$ 2,150,300
Subtotal 1	\$ 16,485,800
Labor 8% of subtotal 1	\$ 1,318,900
Material 15% of subtotal 1	\$ 2,472,900
Overhead and Profit 15% of subtotal 1	\$ 2,472,900
Subtotal 2	\$ 20,277,600
Contingency 25% of subtotal 2	\$ 5,069,400
Subtotal 3	\$ 25,347,000
Engin/Legal/Misc 21% of subtotal 3	\$ 5,322,900
TOTAL PROJECT COSTS (WTP ONLY)	\$ 30,669,900
Wells and Raw Water Pipelines Total Project Cost (includes mark-ups)	\$ 5,700,000
TOTAL PROJECT COSTS	\$ 36,369,900

Appendix E

O&M Costs Provided by City and County

CITY OF ANNAPOLIS NEW WATER PLANT O&M COSTS

POSITION	STATUS	ANNUAL SALARY	DUTIES
Superintendent	Full Time	\$101,642.00	Performs responsible supervisory work in the operation and maintenance of water treatment plant. Operates water treatment plant .
Water Plant Operator IV	Full Time	\$54,530.00	Operates, maintains, and monitors water treatment plant. Calibrates some/all of the process control monitoring systems. Calibrates laboratory equipment Possesses a Class IV Water Certification.
Water Plant Technician I	Full Time	\$40,832.00	Operates, maintains, and monitors water treatment plant. Calibrates some/all of the process control monitoring systems. Calibrates laboratory equipment Conducts general housekeeping, building and ground maintenance. Possesses a Temporary Certificate.
Utility Mechanic II	Full Time	\$47,186.00	Performs maintenance on all of water treatment plant equipment.
Office Associate	4 hrs/week	\$4,083.00	Performs clerical duties at the direction of Superintendent
Subtotal		\$248,273.00	
Overtime		\$31,530.67	Line item in FY 12 budget is 12.7% of the salaries of overtime eligible employees
Benefits		\$106,605.20	Line Item in FY'12 budget is 38.1 % of salaries and overtime.
Subtotal		\$386,408.87	
Contractual Operations Assistance	25 days/yr	\$7,613.00	Provides a Class IV certified operator for fill in during emergencies and unanticipated leave. Assumes 8 hr. days at \$43.50/ hr.

Instrument Technician Services	5 days/yr	\$3,000.00	Provides instrument technician services for repair and calibration of plant instrumentation. Assumes 8 hr. days at \$75.00/ hr
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TOTAL		\$397,021.87	
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REVISED LINE ITEMS

LINE ITEM	FY'12 BUDGET	NEW WTP BUDGET	DESCRIPTION
6600 Supplies	\$42,934.00	\$43,000.00	Supplies other than chemicals
7720 Building & Grounds R&M	\$65,600.00	\$35,000.00	Mowing, alarm system, building repairs
7750 Equipment R&M	\$86,970.00	\$70,000.00	Electrical & mechanical repair of equipment, new equipment
7996 Contract Services	\$54,050.00	\$54,050.00	Maintenance agreements, cell phone service, water testing
TOTAL	\$249,554.00	\$202,050.00	

ANNE ARUNDEL COUNTY BROAD CREEK II O&M COSTS

Estimated production: 1,150,000 kGal per year

ADF 3.15 MGD

Line Item	Description	Water FY 11 actuals)	BC II Proportion	\$/1,000 gal	SOURCE
4013 (excl. elec and chem)	Water Fac. Ops.	3,723,000	335,070	0.291	FY11 Actual BU 4013 less elec & chem
4057	Elec & Inst Maint	1,010,000	90,900	0.079	FY11 year-end 2,526,580 x 40%
4015	Emerg. Services	750,000	67,500	0.059	FY11 year-end 1,502,654 x 50%
4044, 4051	Tech admin & Safety	269,834	24,285	0.021	FY11 year-end tech Admin & Safety (477,095 + 197,489) x 40%
	subtotal	<u>5,752,834</u>	<u>517,755</u>	<u>0.45</u>	
BU 4013 Electricity		3,459,106	311,320	0.271	
BU 4013 Chemicals		654,191	58,877	0.051	
	subtotal	<u>4,113,297</u>	<u>370,197</u>	<u>0.32</u>	
	total variable	<u>9,866,131</u>	<u>887,952</u>	<u>0.77</u>	
407,140,724,073	F & A includes pro rata	3,392,417	305,318		FY11 year-end F/A 8,481,043 x 40%
4060	Oper Admin	1,170,154	105,314		FY11 year-end 2,340,308 x 50%
4018	Water admin	313,000	28,170		FY11 Actual salaries
	Total mostly fixed	<u>4,875,571</u>	<u>438,801</u>		
			1,326,753		