JORDAN LAKE WATER SUPPLY ROUND FOUR ALLOCATION REQUEST

FINAL APPLICATION SUBMITTED BY ORANGE WATER AND SEWER AUTHORITY (OWASA)
NOVEMBER 14, 2014

OWASA

ABSTRACT

Orange Water and Sewer Authority (OWASA) is a public, non-profit agency which provides water, wastewater, and reclaimed water services to the Towns of Chapel Hill and Carrboro, University of North Carolina at Chapel Hill (UNC-CH), UNC Hospitals, and limited outlying areas of southeastern Orange County. OWASA prepared this application to support its request to maintain its existing Level I allocation of 5 percent of Jordan Lake's water supply pool (approximately 5 million gallons per day (mgd)). The application is consistent with the information and recommendations contained in the Triangle Regional Water Supply Plan prepared by the Jordan Lake Partnership (JLP), a collection of 13 local governments and water systems that was created to collaboratively plan for the future of water supply in the Triangle Region, including Jordan Lake.

The application presents OWASA's projected demands through 2060 and estimates of yield which were peer reviewed by the JLP. It also presents four alternatives to meet future needs. OWASA's preferred alternative is to develop its shallow Quarry Reservoir by the mid-2030s and maintain its Jordan Lake allocation to address the uncertainties in water supply planning, especially the increasing risk that OWASA will face between now and the time the expanded Quarry Reservoir is placed into service. Maintaining the Jordan Lake allocation addresses the following:

- Refill time of Cane Creek Reservoir prior to mid-2030s – Cane Creek Reservoir provides OWASA with the majority of its water supply, but has a small drainage area of about 30 square miles. Modeling indicates that it will take close to two years to refill Cane Creek Reservoir following an extended drought. Cane Creek Reservoir is also used to fill the Quarry Reservoir which would further extend the refill time. Thus, an extended drought or back-to-back droughts could greatly impede OWASA's ability to ensure an adequate supply of water for its customers. As noted below, droughts are expected to be more frequent and extreme in the future as our climate changes.

- Refill time of Cane Creek Reservoir after mid-2030s – OWASA has entered into contracts to expand its Quarry Reservoir, which is expected to be placed in service around the mid-2030s. This expansion will substantially increase the refill time of Cane Creek Reservoir and the Quarry Reservoir.

- Climate change uncertainty – OWASA's yield calculations are based on the historic drought (for an 82 year period of record from1926 to 2007). Climate change models indicate the southeast will likely receive about the same amount of average annual precipitation, but have more extreme droughts and storms. Thus, OWASA's current yield estimate may over-state the expected yield under future conditions, especially given the small drainage area of Cane Creek Reservoir.

- Demand projection and reclaimed water and recycling uncertainty – OWASA's demand projections assume that we will be able to meet more water demands with reclaimed water, that conservation practices will offset a substantial amount of demand growth in the future, and that we will be able to continue recycling process water at our drinking water treatment plant. If our reclaimed water system and water treatment plant recycle systems had to be taken off line for any reason, our current average demands would increase approximately 1.2 mgd.

OWASA plans to use Jordan Lake as an insurance policy to meet local water demands during extended droughts. Although we may not need to use the allocation every year, we would use it during drought conditions to provide better opportunity to restore the supply in our reservoir system. OWASA can access its Jordan Lake allocation currently through its Mutual Aid Agreements with the Town of Cary and City of Durham, and its two existing water system interconnections with the City of Durham system. OWASA is currently evaluating methods to permanently access its allocation and recently partnered with the City of Durham, Chatham County, and the Town of Pittsboro (Western Intake Partners) to evaluate the technical, environmental, and institutional feasibility of a proposed intake, treatment and transmission facilities on the western side of Jordan Lake. The City of Durham funded the initial study, and work continues with the Western Intake Partners.

November 14, 2014

Mr. Don Rayno
DWR – Water Planning Section
1611 Mail Service Center
Raleigh, NC 27699-1611

Dear Mr. Rayno:

I am pleased to submit this application for a Round 4 Jordan Lake water supply allocation to meet the water needs of the Orange Water and Sewer Authority (OWASA) service area, which includes Carrboro, Chapel Hill, the University of North Carolina at Chapel Hill (UNC-CH), and outlying areas in southeastern Orange County. We respectfully request that the NC Environmental Management Commission **reaffirm our existing Level I allocation of five percent of Jordan Lake's water supply storage pool, which is equivalent to approximately 5 million gallons per day (mgd).**

By maintaining this allocation, OWASA will have access to adequate and diversified water supply sources expected to meet projected needs under a range of supply and demand conditions through 2060.

Jordan Lake is Essential for Meeting Our Water Needs

The extreme droughts of 2001-2002 and 2007-2008 highlighted the limitations of OWASA's drinking water supplies, and the need for us to maintain a Jordan Lake water supply allocation to provide additional reliability and resiliency, especially for use during extended droughts. While we project that our upland water supply reservoirs will be adequate to meet "Expected" demands under most conditions, we believe that we should receive a Jordan Lake water supply allocation for the following key reasons.

1. Our ratio of watershed area to water supply storage volume is much less than other systems; therefore, our system takes much longer to refill and we are much more vulnerable to multi-year droughts. Our ratio of watershed area to water supply storage volume is about 71 percent lower than for the City of Durham; 42 percent lower than for Jordan Lake; and 17 percent lower than for Raleigh. That ratio will decline considerably when our expanded Quarry Reservoir comes on-line around the mid-2030s.

2. If reservoir inflows fall due to climate variability, the estimated yield of our system will be less than we have assumed, and our plans and projections will have to be adjusted accordingly, as we had to do following the two extreme droughts of 2001-2002 and 2007-2008.

   In the absence of downscaled climate modeling information, to prepare for the uncertainty of climate change, we have modeled how our system yield would change assuming that reservoir inflows were 30 percent lower than the drought of record. Under this scenario, the yield of our existing water supply system would be approximately 2 mgd less than we have assumed in our application.

3. Relative to other systems, our water supply risks are higher due to our extensive water recycling efforts. Our reclaimed water system was implemented in 2009 and now meets about 10 percent of the Chapel Hill-Carrboro community's water demands. However, unlike most reclaimed water systems, about 95 percent of our reclaimed water is used as make-up water to the cooling towers at the central chilled water plants serving UNC-CH and UNC Hospitals. When we implement denitrification to meet the total nitrogen limits for our Mason Farm Wastewater Treatment Plant, alkalinity levels in our reclaimed water will increase, and it could become economically infeasible to use it in cooling towers.

   As approved by the State, we recycle nearly 100 percent of our water treatment plant process water back to the head of our water plant, thereby reducing our raw water withdrawals by about seven percent.

   If we have to discontinue our process water recycling program due to regulatory or treatability problems, and/or if we have to substantially reduce reclaimed water service, the demand on our drinking water supply sources will be considerably greater than reflected in our application.

4. Our water supply risks are relatively high due to the substantial conservation savings we have already achieved and have assumed in our demand projections. It is unknown whether these assumptions are valid in our projections as our customers may have reduced water consumption as much as possible in response to our prior policy changes such as implementation of our seasonal rates and increasing block rates. If OWASA customers do not continue to reduce their water use, our demand projections would increase by approximately 0.5 mgd in 2045 and 0.7 mgd in 2060.

5. Our demand projections could understate our future demands, as local land use plans and development trends are changing and we are beginning to experience much higher density development, including high-density infill and redevelopment. Another factor is that certain weather-sensitive demands may increase as our climate warms.

6. Our estimate of system yield assumes we manage our supplies to optimize the yield; however, that can never be accomplished in the real world of utility operations. We never know the magnitude or duration of a drought in advance. We also must adjust our reservoir operations depending on water quality and treatability, energy use, and planned and unplanned maintenance activities, and all of those activities reduce the reliable yield of our system.

In light of the above uncertainties and risks, it is prudent that we maintain a diverse portfolio of water sources to meet our needs under a range of supply and demand scenarios. Jordan Lake is a very important part of our water supply portfolio.

We Have Invested in Jordan Lake as a Water Source

OWASA has invested substantial resources in our Jordan Lake option since the first round of allocations were made 1988 and we received a Level II allocation for 10 percent of Jordan Lake's water supply pool. During the Round 3 process, we requested and the Environmental Management Commission concurred that our allocation be reduced to 5 percent of the water supply pool, as we believe that would meet our long-term water supply needs. We have:

- ✓ acquired 125 acres adjacent to US Army Corps of Engineers' property on the west side of Jordan Lake for potential regional water supply facilities;
- ✓ installed an encasement pipe under US Highway 64 to accommodate a future water main from the lake;
- ✓ conducted an intake siting study;
- ✓ participated in regional partnerships for monitoring the quality of water in Jordan Lake;
- ✓ made annual payments as required to maintain and use our Jordan Lake allocation; and
- ✓ invested more than $1 million to ensure our access to Jordan Lake.

In partnership with other local governments, we are participating in ongoing engineering studies that will inform our decisions about the timing, capacity, and location of intake, pumping, treatment, and transmission, facilities that may be needed to enhance our access to our Jordan Lake allocation. Consistent with our prompt payments to the Division of Water Resources for our Jordan Lake water supply since 1988, OWASA is committed to meeting any and all financial obligations to state and federal agencies associated with a Jordan Lake allocation.

Our Request is Consistent with Regional Water Supply Plans

Our allocation request is fully consistent with the Triangle Regional Water Supply Plan (RWSP) prepared by members of the Jordan Lake Partnership (JLP), a collection of 13 local governments and water systems that was created to collaboratively plan for the future of water supply in the Triangle Region, including for the future use of Jordan Lake. OWASA is an active member of the JLP.

The RWSP provides a path forward for meeting the needs of all JLP members while minimizing the impacts on other water users (including downstream water systems) and the environment. We are pleased that our allocation request, together with the allocation requests of other JLP members, would not result in an over-allocation of the Jordan Lake water supply storage pool, or a situation in which the JLP members will have to compete for their allocation.

As such, all Jordan Lake allocation requests submitted by the JLP member entities have been made transparent to other partners, and should match the designated allocation requests that are presented in the JLP's RWSP. **OWASA affirms that this request for a 5 percent Level I allocation (5 mgd) is in agreement with the RWSP.**

We respectfully request your support to maintain our Level I allocation of 5 percent of Jordan Lake's water supply pool.

If you have any questions about our application submittal or need additional information, please contact Ruth Rouse, OWASA's Planning and Development Manager, at rrouse@owasa.org or at 919-537-4214.

Thank you very much.

Sincerely,

Ed Kerwin
Executive Director

cc: OWASA Board of Directors

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FINAL APPLICATION SUBMITTED BY ORANGE WATER AND SEWER AUTHORITY (OWASA)

INTRODUCTION

Orange Water and Sewer Authority (OWASA) is a public, non-profit agency which provides water, wastewater, and reclaimed water services to the Towns of Chapel Hill and Carrboro, the University of North Carolina at Chapel Hill (UNC-CH), UNC Hospitals, and limited outlying areas of southeastern Orange County. OWASA has two upland water supply reservoirs and a small off-stream Quarry Reservoir, all of which are located in the Haw River basin. Cane Creek Reservoir was built in 1989 and has a usable storage volume of about 3 billion gallons. University Lake was built in the early-1930s and has a usable storage volume of about 450 million gallons. The Quarry Reservoir, located in the University Lake watershed, has a usable storage volume of about 200 million gallons.

Water from these reservoirs is treated at the Jones Ferry Road Water Treatment Plant (WTP) which has a permitted peak day capacity of 20 million gallons per day (mgd).

In addition, OWASA has a Level I allocation of 5 percent of the water supply pool of Jordan Lake (approximately 5 mgd). That water can be accessed via OWASA's existing mutual aid agreements with the Town of Cary and City of Durham and our two existing interconnections with the City of Durham water system.

Wastewater from the OWASA service area is treated at OWASA's Mason Farm Wastewater Treatment Plant (WWTP) which has a permitted (peak month flow) capacity of 14.5 mgd. A portion of the treated water is reclaimed and used for cooling tower make-up water, irrigation, and toilet flushing on UNC-CH's campus and at UNC Hospitals. OWASA can meet a peak demand of 3 mgd through its reclaimed water system. The remainder of the treated water is recycled to Morgan Creek, a tributary of Jordan Lake. The entire service area is located within the Haw River Basin.

OWASA prepared this application to support its request to maintain its existing Level I allocation of 5 percent of Jordan Lake's water supply pool. DWR has advised that this allocation corresponds to an average day withdrawal rate of approximately 5 mgd; therefore, this application may reference 5 mgd in some locations. Our application and allocation request is consistent with the information and recommendations contained in the Triangle Regional Water Supply Plan prepared by the Jordan Lake Partnership (JLP), a collection of 13 local governments and water systems that was created to collaboratively plan for the future of water supply in the Triangle Region, including Jordan Lake.

Regionally, the JLP's planning work can be summarized in two primary documents. The *Triangle Regional Water Supply Plan: Volume I – Water Needs Assessment* presents the demand projections and initial estimates of additional water supply need for all of the JLP members. The *Triangle Regional Water Supply Plan: Volume II – Regional Alternatives Analysis* presents the methodology the JLP used to identify and present regional water supply alternatives, evaluate them, and develop a regional water supply plan. These two documents serve as the basis for OWASA's and other JLP members' Jordan Lake Round 4 Application requests. These documents summarize each Partner's peer-reviewed water demand projections, projected need, and a plan to meet each Partner's long-term (2060) water supply need.

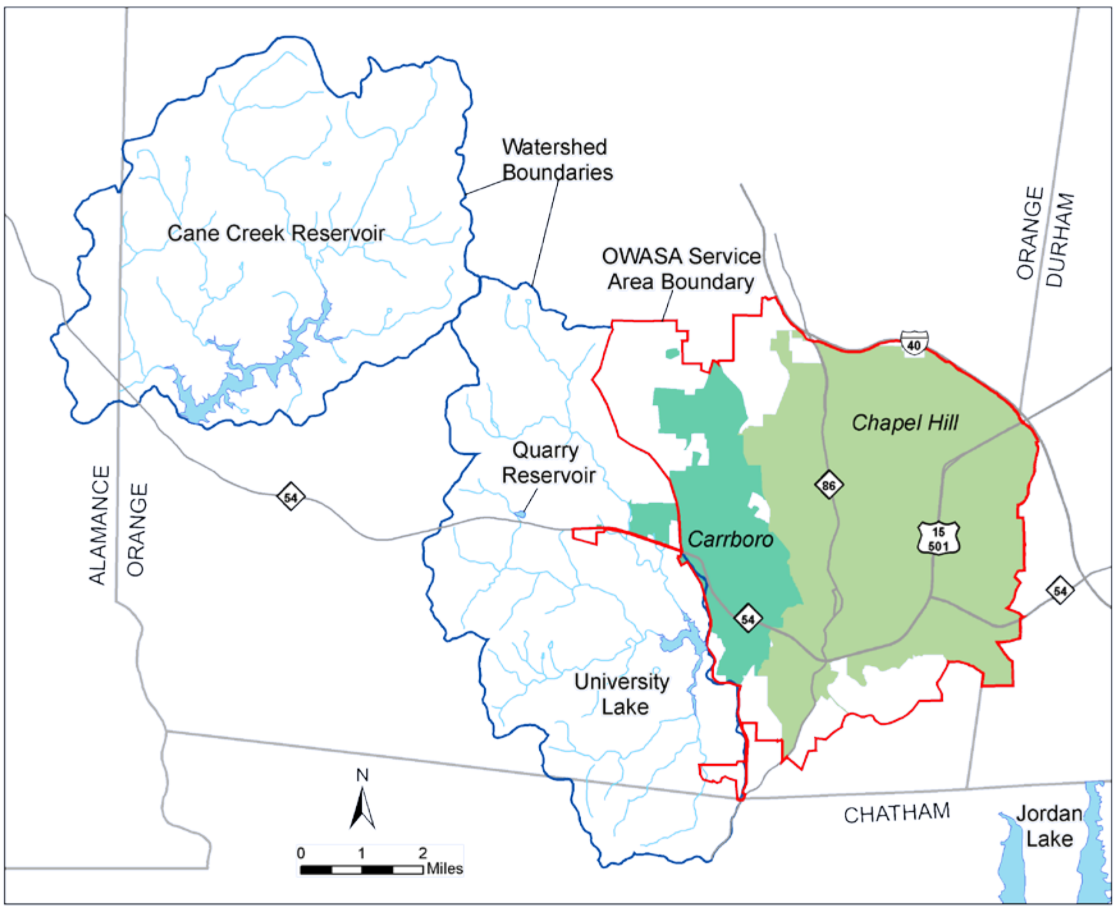
A thorough regional water supply alternatives analysis was completed through the JLP effort, and the selected alternative was found to be the most preferred alternative among any of the options chosen due to its implementability, comparatively low level of impacts, acceptable costs, and acceptability to local governments and the public. The selected alternative forms the basis of each Partner's Jordan Lake Round 4 allocation request, and was found to be acceptable in terms of impacts on the environment, downstream water users, and the public. As part of the selected JLP alternative, OWASA maintains its Level I allocation of 5 percent of Jordan Lake's water supply pool and expands its Quarry Reservoir and accesses the top 100 feet of storage in the Quarry Reservoir. This application provides further information to support OWASA's request to maintain its existing Level I allocation.

OWASA is beginning the process to update its Long-Range Water Supply Plan. As part of this process, OWASA plans to review its demand projections, further evaluate the potential impacts of climate change on its water supply, and evaluate supply and demand management alternatives to ensure we meet our water supply needs through 2065. OWASA is committed to update the Towns of Carrboro and Chapel Hill, Orange County, UNC-CH, UNC Hospitals, the JLP, and the North Carolina Division of Water Resources if new information is found that would impact OWASA's plans to meet our water supply needs.

SECTION I. WATER DEMAND FORECAST

Orange Water and Sewer Authority (OWASA) provides drinking water, wastewater, and reclaimed water services to the Towns of Carrboro and Chapel Hill, the University of North Carolina at Chapel Hill (UNC-CH) and UNC Hospitals, and limited outlying areas in southeastern Orange County (Figure I.1). OWASA is unlike other members of the JLP in that we do not have land use planning and growth management authority and we have contractual obligations to meet the water needs of the areas we serve. Thus, we do not make the land use, population and employment projections and decisions, but we must be prepared to meet the needs of the growth and development the towns and UNC-CH and UNC Hospitals determine appropriate.

Figure I.1 – Map of OWASA Service Area and Water Supply Watersheds



User Sectors

OWASA's major water use sectors are listed in Table I.1. Single family and multi-family residential uses comprised slightly more than half of OWASA's water use in 2013. The service area includes many large multi-family residential developments, such as apartment and condominium complexes, most of which are served by large master meters. About half of the dwelling units in master-metered residential developments have NC Utilities Commission-approved sub-metering arrangements in place, and tenants are privately rebilled for their water and sewer services.

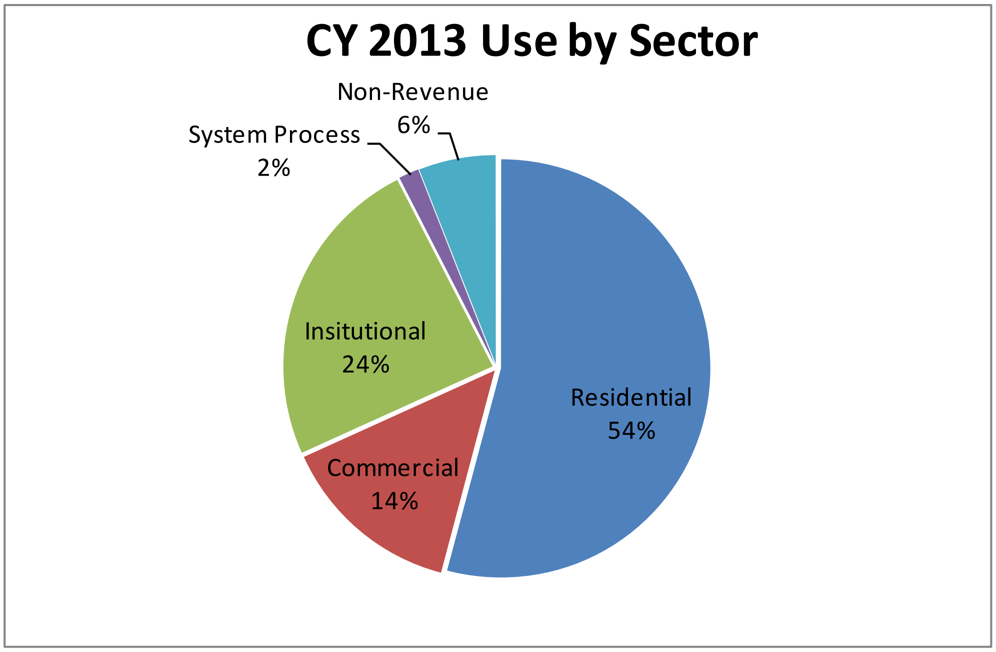
UNC-CH and UNC Hospitals are OWASA's largest customers; other institutional users are schools, government facilities, and churches in the service area. Office and retail customers account for about 15 percent of water use in the OWASA service area. There are no industrial or manufacturing customers in the service area.

OWASA has a process water recycling system in place at the Jones Ferry Road Water Treatment Plant (WTP); therefore, water treatment processes account for a very small portion of water use. Figure 1.2 illustrates OWASA's water use by sector in calendar year 2013.

Table I.1. Water Use Sectors

Use Sector	Use Sub-sector	Description
Residential	Single Family Residential	Single Family Homes
	Multi-Family Residential	Townhomes, condominiums, apartments - may be separately metered or master metered
Commercial	Commercial	Offices and Retail
Industrial	N/A	
Institutional	UNC	UNC-CH and UNC Hospital
	Other Institutional	Churches, Schools, Government Facilities
Unique	N/A	
Non-Revenue	WTP Process	Water used by the WTP in the production of finished water that is discharged and never enters the distribution system.
	Other Non-Revenue	Water used for maintenance of distribution system including flushing, fire flow testing, installing new connections; all other non-revenue water, which is primarily leakage, theft, unmetered use, meter error.

Figure I.2 – OWASA's Relative Use by Sector in Calendar Year 2013



Consistent with the American Water Works Association's Water Audit methodology, OWASA uses the term "Non-Revenue Water" rather than "Unaccounted-for Water". In general, non-revenue water falls into unbilled water use for system management, maintenance and operations purposes, and all other non-revenue water use.

Sector Projections

OWASA's 2010 – 2060 population projections are based on an average growth of approximately 1,500 persons per year, as derived from residential and mixed use development projections presented in OWASA's *2010 Long-Range Water Supply Plan* (see Appendix II, OWASA, 2011). This corresponds to approximately 560 new dwelling units per year at 2.26 persons per dwelling unit (2010 U.S. Census data for Carrboro/Chapel Hill). As explained below, OWASA's water demand projections are not driven by population projections *per se*, but by new meter equivalents (MEs) allocated among the various customer account sectors.

[One ME represents the water demand exerted by a typical single family residential customer. A non-residential or institutional customer with greater needs requires a larger meter, and therefore represents multiple MEs. Average consumption per ME varies among the customer classes.]

Sector projections are based on the following assumptions:

- OWASA's service area remains the same.
- The future development profile of OWASA's service area is expected to follow recent trends with respect to the overall mix of single versus multi-family residential,

commercial, and other uses. These recent trends include more multi-family and higher density development than in the past. Future development will likely be even higher density based on small area plans currently being developed by the Town of Chapel Hill and developments being planned in the Town of Carrboro.

- By 2015, the pace of development activity is expected to return to the 1980-2000 annual average of approximately 560 new MEs per year and is expected to continue at this (linear) rate through 2060. Overall growth projections through 2035 are consistent with data provided to the Durham-Chapel Hill-Carrboro Metropolitan Planning Organization (MPO) by the Towns of Carrboro and Chapel Hill for the *2035 Long Range Transportation Plan Alternative Analysis Report (2008)*. Because neither these data nor the Comprehensive Plans of Carrboro or Chapel Hill include longer range projections or ultimate build-out scenarios, the post-2035 water demand forecasts for OWASA's service area assume that pre-2035 growth and development trends will continue through 2060.

- UNC Central Campus and UNC Hospitals building space will increase by 4.6 million gross square feet (GSF) (per the *2006 UNC Campus Master Plan)* at a constant rate of approximately 0.16 million GSF per year through 2028, which is the projected build-out date for UNC's Central Campus. OWASA projections reflect UNC's estimates that at build-out of the main campus, reclaimed water (RCW) will meet 27 percent of all Central Campus water demands.

- UNC's proposed Carolina North satellite campus will build out to a total of 8 million GSF at a constant rate of 0.17 million GSF per year through 2060. Water demand projections are based on McKim & Creed's *Technical Memorandum: Carolina North Campus Utility Infrastructure Planning to Support US Army Corps of Engineers Permitting Submittal, March 26, 2010, Exhibits 1-2 and 1-3.* Per guidance from UNC Energy Services, OWASA's "Expected Demand" projection assumes that 8.7 percent of total Carolina North water needs will be met with non-potable water (NPW), including reclaimed water.

Usage Rates

Demand projections by sector were based on the expected growth in number of 5/8-inch MEs. Key assumptions in the demand projections include:

- Water consumption rates for major user groups are based on actual OWASA averages observed during non-drought periods.

- Demand reductions achieved since 2002 will be sustained in the future, and further decreases will be achieved through additional passive conservation and demand for reclaimed water at UNC. Passive conservation includes replacing conventional plumbing fixtures and appliances with more efficient devices as older homes and businesses are renovated and new development responds to more aggressive local water use efficiency requirements and OWASA's full-cost pricing and conservation rates.

In addition to demand reductions already in place, the following additional conservation savings have been assumed and are reflected in OWASA's 2010-2060 demand projections:

- Unit demand (gallons per account) for existing (pre-2010) development will be 15 percent lower in 2060 than it is today.
- Unit demand (gallons per account) for all new development will be 10 percent lower in 2060 than today.
- Future efficiencies and reductions for UNC's Central Campus and Carolina North expansion are reflected in the estimates provided to OWASA by the University.

Projected water use for all future years has been distributed proportionately to reflect the historical distribution patterns among OWASA's major customer sectors. Those percentages are as follows:

Residential	51%	(including master-metered multi-family accounts)
Commercial/Other	15%	
Industrial	0%	
Institutional	24%	
WTP System Process	1%	
Other Non-revenue Water	9%	(includes distribution system uses and losses)
Total Raw Water	**100%**	

Total Demand

OWASA's *2010 Long Range Water Supply Plan* includes three demand scenarios: "Higher," "Expected," and "Lower Demand." The Higher and Lower scenarios assume greater and lesser rates of local development activity, and the Lower Demand scenario also assumes a greater degree of non-potable water use on UNC's Carolina North campus. Expected Demand projections by sector are shown in Figure I.3; Expected Demands relative to the Higher and Lower scenarios are shown in Figure I-4. As shown in these summaries, 2060 Expected Demand is projected to be 12.9 mgd.

The Town of Chapel Hill has recently approved several high density infill development projects and is considering major changes to local small area land use plans, which could result in much higher development densities than reflected in the "Expected Demands" projection. In addition, some higher density developments have been recently approved or proposed within the Town of Carrboro.

Figure I.3 – Demand Projections by Sector

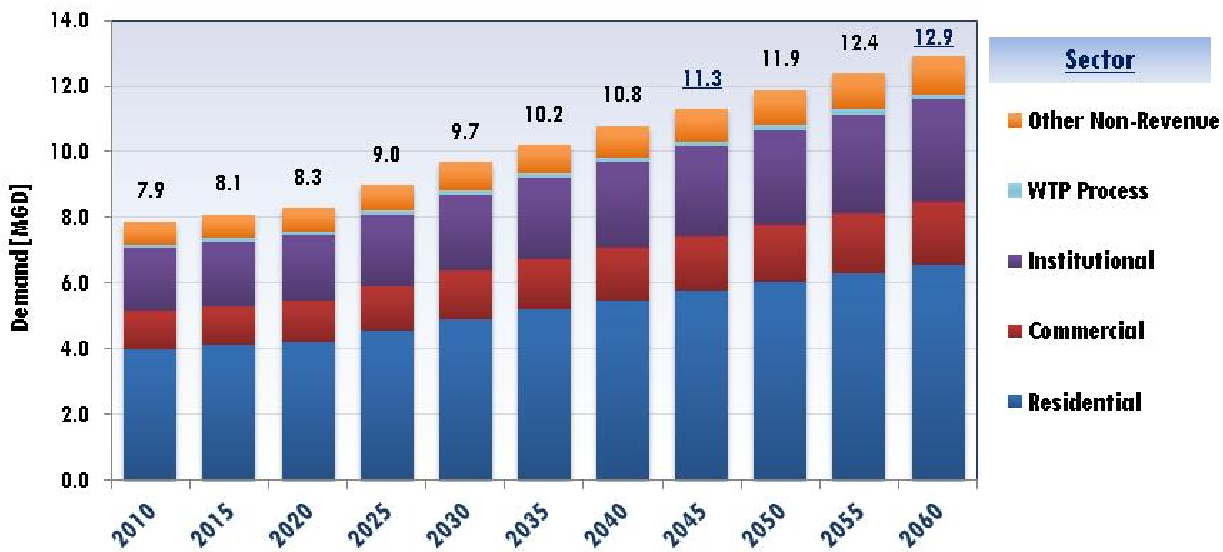
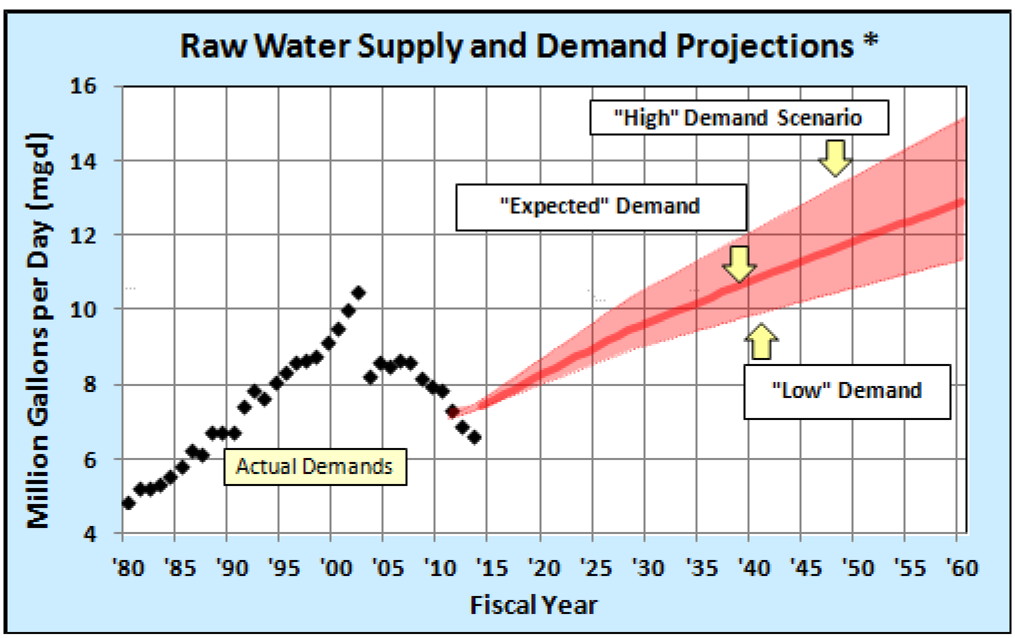


Figure I.4 – Expected Demand Projections and High and Low Demand Scenarios



Bulk or Wholesale Water Sales

OWASA has no planned bulk or wholesale water sales; however, under mutual aid agreements with adjacent water systems, OWASA may provide water supply assistance to adjacent systems during short-term emergencies, such as planned or unplanned maintenance events or extreme droughts.

Summary

Table I.2 summarizes expected water demand projections in 5-year increments by sector.

Table I.2 – Water Demand Projections by Sector

Sector	Subsector	2010	2015	2020	2025	2030	2035	2040	2045	2050	2055	2060
Residential	Residential	4.00	4.12	4.23	4.58	4.93	5.21	5.49	5.76	6.03	6.30	6.57
Commercial	Commercial	1.17	1.21	1.24	1.34	1.44	1.53	1.61	1.69	1.77	1.85	1.92
Industrial	Industrial	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Institutional	Institutional	1.90	1.96	2.01	2.18	2.34	2.48	2.61	2.74	2.87	3.00	3.12
System Process	WTP Process	0.09	0.10	0.10	0.11	0.11	0.12	0.12	0.13	0.14	0.15	0.15
Non-Revenue	Other Non-Revenue	0.70	0.72	0.74	0.80	0.86	0.91	0.96	1.01	1.05	1.10	1.15
Residential/ Commercial/Etc	Sales	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL		7.86	8.09	8.32	9.00	9.68	10.24	10.79	11.33	11.86	12.39	12.91

Two major factors distinguish OWASA from most other local water supply systems. First, OWASA has a process water recycling system at the Jones Ferry Road WTP, which reduces raw water demands by about seven percent. Second, OWASA's reclaimed water system currently meets about 0.7 mgd, or ten percent of the OWASA service area's demand for water. If one or both of these systems must be out-of-service for any extended period, OWASA's water supply needs would be considerably greater than shown above in Table 1.2.

If these systems were not in service, 2045 water demands would increase by about 1.6 mgd to a total of 12.9 mgd, and 2060 demands would increase by about 1.8 mgd to a total of 14.7 mgd.

References

Durham-Chapel Hill-Carrboro Metropolitan Planning Organization. 2008. 2035 Long Range Transportation Plan Alternatives Analysis Report.

McKim & Creed. 2010. Technical Memorandum: Carolina North Campus Utility Infrastructure Planning to Support US Army Corps of Engineers Permitting Submittal. March 26, 2010

OWASA. 2010. Long-Range Water Supply Plan. April 8, 2010.

OWASA. 2011. Technical Memorandum: 50-Year Demand Projections. June 21, 2009 and revised August 30, 2011.

Triangle J Council of Governments. 2012. Triangle Regional Water Supply Plan: Volume I – Regional Needs Assessment. Prepared for Jordan Lake Partnership. February 20, 2012 and revised May 14, 2012.

SECTION II. CONSERVATION AND DEMAND MANAGEMENT

The OWASA Board of Directors approved Long-Term Water Conservation and Demand Management Goals and Objectives in April 2005 (OWASA, 2005). In addition, OWASA's State-approved Water Shortage Response Plan (OWASA, 2010) and other programs include strategies that reduce water demand throughout the year including:

- Water Conservation Standards
- Water Conservation Rates (Increasing Block Rate Pricing and Seasonal Rates)
- Public Education
- Reclaimed Water
- Utility Management Measures (process water recycling at WTP; water system auditing; meter testing and replacement program)

Each of these strategies is described below.

Water Conservation Standards

In the 1970s, OWASA worked with the Towns of Chapel Hill and Carrboro and Orange County to develop and implement local water conservation ordinances that are implemented and enforced by the Towns and County. OWASA does not have legislative authority to adopt a water conservation ordinance; however, in 2003, OWASA adopted Water Conservation Standards which are a condition of receiving OWASA service. The Standards parallel the requirements in the water conservation ordinances enacted by the Towns and County. OWASA's Water Conservation Standards and the local conservation ordinances were most recently revised in June 2009 to reflect the experience of the 2007-2008 drought. The Standards and ordinances include year-round water use restrictions and four tiers of increasingly strict requirements depending on the severity of the water shortage conditions. These tiers are summarized in Table II.1. OWASA's current water conservation standards are found on OWASA's website at http://www.owasa.org/ under Conservation and Education (OWASA, 2009).

In addition to the water use restrictions, in 2007 OWASA approved a system of water rate surcharges that are to be imposed during declared water shortage conditions. The surcharges are intended to substantially increase the conservation pricing signal during declared droughts, and to help offset some of the revenue reduction effects that typically accompany imposition of mandatory water use restrictions.

Table II.1 - Summary of Key Conservation Standards for OWASA Drinking Water – Effective June 2009

SUMMARY OF KEY CONSERVATION STANDARDS FOR OWASA DRINKING WATER *

Effective June, 2009

Water Use	Year-Round	Stage 1	Stage 2	Stage 3	Emergency
Spray Irrigation of **Turf / Grass** (on designated days of the week as noted)	3 days per week, up to 1 inch per week, 6 pm - 10 am only ** Odd Addresses: Tu/Th/Sat Even Addresses: Sun/W/F	1 day per week, up to 1/2 inch per week, 6 pm - 10 am only ** Odd Addresses: Tues. Even Addresses: Thurs.	X**	X**	X
Spray Irrigation of **Non-Turf Plant Materials** (on designated days of the week as noted)	3 days per week, up to 1 inch per week, 6 pm - 10 am only ** Odd Addresses: Tu/Th/Sat Even Addresses: Sun/W/F	3 days per week, up to 1 inch per week, 6 pm - 10 am only ** Odd Addresses: Tu/Th/Sat Even Addresses: Sun/W/F	1 day per week, up to 1/2 inch per week, 6 pm - 10 am only ** Odd Addresses: Tues. Even Addresses: Thurs.	X***	X
Drip irrigation, underground drip emitters, soaker hose, hand-watering, and other non-spray methods allowed *at any time* or frequency	✓	✓	✓	✓	X
Washing of Building Exteriors **Before Painting**	✓	✓	✓	X	X
General Cleaning of Building Exteriors, Paved Areas, Etc.	✓	✓	X	X	X
Filling, Refilling, or Topping Off Ornamental Ponds, Fountains, etc.	✓	✓	X	X	X
Vehicle Washing	✓	✓	Only at commercial or institutional facilities where at least 50% of the water is being recycled, or is from a non-potable source or well	X	X
Filling, Refilling, or Topping Off of Swimming Pools and Backyard- Scale Facilities to Support Wildlife	✓	✓	✓	✓	X
Flushing or Pressure Testing New Water Lines	✓	✓	✓	✓	Only if captured and returned to system

Year-Round Requirements, Regardless of Water Shortage Condition

- Automatic controllers and rainfall or soil moisture sensors required on all irrigation systems
- "Wasteful" water use* prohibited at all times
- Water leaks must be repaired within 10 days of discovery and/or notification by OWASA
- Water may be served in restaurants and other dining facilities only at customer's request
- Hotel/motel linens may only be changed upon customer changeover, every 5 days, or upon customer request

Symbols and Notes

* *For the actual text of OWASA's Water Conservations Standards, please use the following link: http://www.owasa.org/conservationandeducation/ConservationStandardsMarch26_2009.aspx*

✓ *Water use is allowed.*

X *Water use is not allowed.*

** *Restrictions may not apply to public purpose athletic fields, recreational fields, or public purpose botanical sites operated in compliance with OWASA-approved Water Conservation Plans.*

*** *Restrictions may not apply to public purpose botanical sites operated in compliance with OWASA-approved Water Conservation Plans.*

Water Conservation Rates

Seasonal Rates for Commercial and Institutional Customers (Other than Irrigation Meters)

In May 2002, OWASA implemented a seasonal block water rate structure, and that structure remains in effect for all master-metered multi-family residential developments, commercial, and institutional customers. The current seasonal rates (October 2014 and reviewed annually) are: $7.91 per 1,000 gallons for all water use during the peak season demand period (May – September), and $4.16 per 1,000 gallons for all water use during the off-peak season (October – April). Seasonal rates provide a substantial incentive for conservation during the time of the year when reservoir inflows are typically the lowest and daily demands are the highest. OWASA's rate structure is found on its website http://www.owasa.org/ under Customer Service (OWASA, 2014).

Block Rate Pricing for Residential Customers

In 2007, OWASA decided to further strengthen its conservation pricing strategy by implementing a 5-tiered, increasing block rate structure applicable to all individually-metered residential customer accounts. The current rate (October 2014 and reviewed annually) for Block 1 (1,000 – 2,000 gallons per month) is $2.63 per 1,000 gallons as contrasted to the rate for Block 5 (all use above 15,000 gallons per month), which is $19.79 per 1,000 gallons.

Public Education

OWASA's website includes an extensive section on conservation which includes information on its conservation requirements as well as tips to effectively conserve water indoors and outdoors. In addition, the quarterly newsletter sent to OWASA customers often includes information on water conservation. Other efforts include occasional bill stuffers on conservation; public outreach at street fairs and festivals; conservation presentations to civic groups, professional groups, and in the classroom; and targeted technical assistance to customers.

Reclaimed Water

Following the record drought of 2001-2002, OWASA and UNC-CH collaborated to evaluate the technical, economic, and environmental feasibility of using reclaimed water to meet certain non-potable water needs on the main campus. The study concluded that such a strategy was feasible, and that OWASA, the University, and the community would realize substantial benefits if a reclaimed water system was implemented. OWASA and UNC-CH subsequently partnered to design, finance and construct the system, and it was placed into service in April 2009. UNC-CH now uses reclaimed water for cooling tower make-up water needs, irrigation of several major athletic fields, and for toilet flushing in some new buildings. The reclaimed water system currently meets approximately 0.7 mgd of demand on an annual average basis. The peak-day demand for reclaimed water has exceeded 1.7 mgd. The system is designed to meet a peak day demand of 3 mgd, but can be readily expanded to meet a peak day demand of more than 5 mgd.

Utility Management Measures

OWASA has implemented measures to reduce water use internally. OWASA treats and recycles its water treatment process water back to the head of the water plant. This measure has reduced raw water withdrawals, and the associated energy use for raw water pumping, by approximately seven percent.

OWASA has made major investments in repairing and replacing aging infrastructure, including replacing water mains which have a higher frequency of main breaks and leaks. Based on OWASA's 2012 water audit, completed using AWWA's software, our system has an Infrastructure Leakage Index (ILI) of 0.61, which indicates that the system is well managed and maintained. This is well below the threshold of an ILI of 1.2 where North Carolina requires a leak detection and repair program to be eligible for State drinking water program revolving loan and grant funds.

Conservation and Demand Management Effectiveness

OWASA's demand management efforts have resulted in a 28 percent reduction in water use between Fiscal Year (FY) 2002 and 2012 despite a 19 percent increase in the number of customer accounts over that same period. In 2002, customers used 8.9 mgd of finished water on an average basis while in 2012, that number dropped to 6.3 mgd. In fact, average-day water sales in FY 2012 were at the same level they were in 1992, even though OWASA now has about 60 percent more customer accounts than it did in 1992. The Association of Metropolitan Water Agencies awarded OWASA its Sustainability Water Utility Management Award in October 2014, in part because of its success in reducing drinking water demand through its aggressive conservation efforts and reclaimed water program.

OWASA Planned Conservation and Demand Management Efforts

OWASA's water conservation and demand management strategy has proven to be very effective in reducing the community's water demands, and it has been very cost-effective as OWASA has not needed to make major expenditures for program staffing, rebates or fixture give-away programs. Therefore, no major changes are planned.

However, OWASA will continue to enhance its conservation and demand management efforts through strategies such as: improving its conservation education and outreach efforts; helping target available resources for customers in financial need to reduce their water and sewer bills through cost-effective water use reduction strategies; and seeking cost-effective opportunities to expand the use of reclaimed water in the OWASA service area.

OWASA's capital improvements program budget for Fiscal Year 2015 includes funding for a multi-year project to implement advance metering infrastructure throughout its service area. If the system is implemented, OWASA will have the ability to (a) identify and inform customers about unusual water use patterns including potential water leaks, and (b) provide its customers on-line access to timely water use information which will enable them to detect and repair leaks quickly and identify other opportunities to reduce their water use.

OWASA Demand Projections and Water Conservation and Demand Management

As described in Section I, OWASA's demand projections assume that demand reductions achieved since 2002 will be sustained and that further decreases in demand will be achieved through additional passive conservation. The projections assume that demands from existing development will be 15 percent lower per ME in 2060 than they are today, all new development will be 10 percent lower per ME than today, and that UNC will achieve the efficiencies and reductions reflected in the demand projections they provided.

Other Conservation/Efficiency Information

The OWASA Board of Directors adopted a Drought Response Operating Protocol (DROP) in January 2013. The DROP reflects the graphs and management strategies described in OWASA's Water Shortage Response Plan (WSRP); however, it also provides for the declaration of a Water Shortage Advisory by OWASA no later than when water storage remaining in our reservoirs drops to within 10 percent of the mandatory Stage 1 drought trigger specified in OWASA's WSRP. At that time, OWASA will initiate communications with the Towns of Carrboro and Chapel Hill and UNC-Chapel Hill and its customers, indicating the likelihood that Stage 1 restrictions will go into effect if the drought continues. The DROP clarifies that the OWASA Board may declare drought stages with or without the corresponding drought surcharge earlier than noted on the WSRP graphs.

References

OWASA. 2005. Goals and Objective of OWASA's Long-Term Water Conservation and Demand Management Program. Adopted April 14, 2005 by OWASA Board of Directors.

OWASA. 2010. Water Shortage Response Plan. Adopted November 11, 2010 by OWASA Board of Directors.

OWASA. 2009. Orange Water and Sewer Authority Water Conservation Standards. Approved March 26, 2009.

OWASA. 2014. Rates adopted by the Board of Directors on June13, 2014 and a Summary of Rates are located at: http://www.owasa.org under Customer Service; Rates, Fees, and Charges. Accessed April 10, 2014.

SECTION III. CURRENT WATER SUPPLY

This section provides information on OWASA's water supply reservoirs and off-line quarry storage and the method used to calculate the yield of this system.

Available Supply

OWASA's primary drinking water supply sources are Cane Creek Reservoir and University Lake. OWASA also owns a small, off-stream emergency water source, the Quarry Reservoir, which is located in the headwaters of the University Lake watershed. Figure I-1 shows the general location of these water sources and Table III.1 summarizes some related information about those sources. OWASA's *2010 Long Range Water Supply Plan* describes the yield calculations for its current reservoir system; Appendix III-A of the Plan contains additional technical information and recommendations regarding the yield estimates for OWASA's water supply system (Hazen and Sawyer, 2008).

The length of the time-step in a yield model is very important for any alternatives which use a diversion from a river and for alternatives that fill the Quarry Reservoir with water from Cane Creek Reservoir or University Lake. Inappropriately large time steps can overestimate yield in these circumstances (Hazen and Sawyer, 2008). Thus, OWASA chose a method developed specifically for its reservoir system which uses a daily time step to minimize error in the yield calculations.

Yields were derived from historical (daily) regional stream flow records from 1926 through 2007, and total system yield was determined with the OWASA-ROM (Reservoir Optimization Model) spreadsheet model developed by Hazen and Sawyer. Since OWASA operates its reservoirs as a water supply system to optimize yield with water quality, maintenance, and other objectives, the yield of the system was estimated rather than the yield of each individual source. Hazen and Sawyer has estimated the *operational yield* of the OWASA system to be 10.5 MGD. This is based on maintaining a 20 percent (700 MG) storage reserve, which would provide adequate time to implement emergency supply measures during extreme drought conditions. The yield calculation also assumes that the current operating requirements of our water supply reservoirs remain the same.

Table III.1 – Existing Source Summary, Available Supply

Source	PWSID	SW or GW	Basin	WQ Classification	Available Supply (MGD)	Drainage Area (sq mi)	Volume (MG)
Cane Creek Reservoir	03-68-010	SW	Haw (2-1)	WS-II		31	2906
University Lake	03-68-010	SW	Haw (2-1)	WS-II		30	687
Reservoir Quarry	03-68-010	SW	Haw (2-1)	WS-II		0.5	200
Total of 3 reservoirs	03-68-010				10.5		
Jordan Lake	03-68-010	SW	Haw (2-1)	WS-IV	5.0	1,690	70,005
TOTAL					15.5		

OWASA can access its existing allocation from Jordan Lake through mutual aid agreements with Town of Cary and City of Durham. OWASA plans to use its allocation during extended droughts or operational emergencies.

OWASA does not have direct access to its existing Jordan Lake allocation. As noted in the "Purchased Water" section below, during an extended drought or other operational emergency, OWASA can access Jordan Lake water through our mutual aid agreements and water system interconnections with the Town of Cary and City of Durham.

Purchased Water

OWASA has no wholesale water purchase agreements in place, but does have mutual aid agreements with the Towns of Cary and Hillsborough and the City of Durham. In an emergency or extended drought, OWASA could access its Jordan Lake allocation by purchasing drinking water from the Town of Cary through the Cary-Durham and Durham-OWASA water system interconnections. OWASA's purchase of Jordan Lake water is limited by the hydraulic capacity of the existing OWASA-Durham interconnections, which is 7 mgd.

References

Hazen and Sawyer. 2008. *Yield Metrics for OWASA Water Supply Planning*. Technical Memorandum prepared for OWASA, December 12, 2008.

OWASA. 2010. Long-Range Water Supply Plan. April 8, 2010.

SECTION IV. FUTURE WATER SUPPLY NEEDS

Table IV.1 summarizes OWASA's existing supply, projected demands, and the projected water supply needs that will not be met by current supplies. As described in Section III, our yield estimate shown in Table IV.1 was derived from statistically-adjusted daily stream flow records from 1926 through 2007 for Cane Creek Reservoir, University Lake and the Quarry Reservoir. The existing allocation of 5 percent of Jordan Lake's water supply pool provides an additional 5 mgd of estimated yield.

Table IV.1 - Projected Water Needs Assuming "Expected Demands" (5-year increments)

	2010	2015	2020	2025	2030	2035	2040	2045	2050	2055	2060
Demand	7.9	8.1	8.3	9.0	9.7	10.2	10.8	11.3	11.9	12.4	12.9
Supply	10.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5
Demand % of Supply	*75%*	*52%*	*54%*	*58%*	*62%*	*66%*	*70%*	*73%*	*77%*	*80%*	*83%*
Need	0	0	0	0	0	0	0	0	0	0	0

OWASA was granted a Level I allocation of 5 percent of Jordan Lake's water supply pool in 2013 (approximately 5 mgd). OWASA can access this allocation through mutual aid agreements with the Town of Cary and City of Durham. OWASA plans to use its allocation during extended droughts or operational emergencies.

The demand projections summarized in Table IV.1 are based on OWASA's "Expected Demands" scenario described in Section II. The projections are based on several key assumptions that include some conservative assumptions but could change in the future. Key areas of uncertainty in these projections are:

1. Uncertainty Regarding Future Increases in Water Use Efficiency – OWASA's customers are using less water today on a per capita basis than they have historically. The demand estimates included in Table IV.1 are based not only on these lower demands, but they also assume that customers will conserve even more water in the future. It is unknown whether customers will be able to achieve even greater conservation savings than has already occurred. If the assumed additional conservation savings was not factored into these projections, OWASA's projected demands would be approximately 11.8 mgd in 2045 and 13.6 mgd in 2060, and the deficits would be 1.3 mgd and 3.1 mgd, respectively, if OWASA did not maintain its Jordan Lake allocation.

2. Uncertainty Regarding Our Use of Reclaimed Water to Meet Additional Demands – The demand projections assume that some additional water needs will be met by expanding the use of reclaimed water, including at the planned Carolina North satellite campus. If that proves to be technically or economically infeasible, the increased demand for potable water would be approximately 0.5 mgd in 2045 and 0.6 mgd in 2060.

3. Long-Term Uncertainty of Reclaimed Water to Meet Existing Demands – As noted in Section I, approximately 10 percent of the OWASA service area's water demands are met by OWASA's reclaimed water system. About 95 percent of the reclaimed water

demands are for water used as make-up water to the cooling towers serving the chilled water plants on the UNC campus. These industrial type water uses require source water that does not adversely affect the thermal efficiency of the towers, or the structural integrity of the piping and equipment in the towers.

Other reclaimed water systems have experienced excessive alkalinity levels in their reclaimed water when they have implemented denitrification to meet stringent total nitrogen limits. This limits the suitability of their reclaimed water for use in cooling towers. Based on current State requirements, OWASA must implement advanced nitrogen removal starting in 2021. If the reclaimed water system has to be taken off-line because of excessive alkalinity or any other reason, our current demands would increase approximately 0.7 mgd on an average day basis. The demands would increase by approximately 1.5 mgd during warmer and drier months.

4. Uncertainty Regarding Process Water Recycling at WTP – OWASA treats and recycles its water treatment process water back to the head of the water plant. This measure has reduced raw water demands by approximately seven percent. If changes in water quality and/or treatment standards require OWASA to discontinue process water recycling, the projected water demands would increase by about seven percent above those shown in Table IV-1 (0.9 mgd in 2060).

In addition to the uncertainty around the demand projections, there is also uncertainty around the yield calculations. The yield presented is based on the 2001-2002 drought of record. If a new drought of record occurs, the yield of the reservoir system would be lower than presented.

In the absence of any downscaled climate change models for the region, OWASA has completed a very basic climate change scenario yield analysis that assumes reservoir inflows would be 30 percent lower than the historical record. Under this scenario, the yield of OWASA's current reservoir system (without Jordan Lake) is estimated to be only 8.6 mgd.

Finally, the majority of OWASA's yield of 10.5 mgd from its reservoir system is from Cane Creek Reservoir. However, University Lake and Cane Creek Reservoir have approximately equal drainage areas of 30 and 31 square miles, respectively. Thus, Cane Creek Reservoir takes a much longer period of time to refill following a drought. The refill time depends on the severity and extent of the drought and the actual demands. **Hazen and Sawyer estimated that Cane Creek Reservoir would take approximately 21 months to fill during a recurrence of the 2002 drought** assuming demands equal to yield (Hazen and Sawyer, 2008). Hazen and Sawyer recommended that OWASA consider refill time when evaluating long-range water supply alternatives because extended periods of drawdown result in a prolonged period of uncertainty for OWASA and its customers.

To illustrate the large volume to drainage area of Cane Creek Reservoir and the potential impact of extended or back-to-back droughts on OWASA's water supply, drainage areas and volumes of lakes serving other JLP members were compiled. The drainage area information was compiled from individual Local Water Supply Plans, and much of the storage volume information was compiled from a lakes report published by Division of Water Resources (DEM, 1992). The conservation pool volume is recorded for Falls and Jordan Lake; the conservation volume of Falls Lake was obtained from USACE (USACE, 2014). Table IV.2 summarizes the results.

As summarized in Table IV.2, Cane Creek Reservoir's ratio of storage volume to drainage area is 2 to 3 times the level of other water supply reservoirs. When the expanded Quarry Reservoir comes online, the ratio will increase. This analysis further illustrates OWASA's vulnerability to extended drought if it relies solely on Cane Creek Reservoir, University Lake, and the Quarry Reservoir for water supply.

Table IV.2 - Drainage Area and Storage Volume of JLP Water Supply Lakes

Lake	Drainage Area (sq mi)	Volume (MG)	Volume/DA (MG/sq mi)
University Lake	30	687	22.9
Lake Michie	168	4,121	24.5
Lake Benson	36	951	26.4
Jordan Lake	1,690	70,005	41.4
Little River Lake (Durham)	97	4,755	49.0
Falls Lake	772	42,815	55.5
Cane Creek Reservoir	31	2,906	93.7

By maintaining its Jordan Lake allocation OWASA will have the redundancy, diversity, and reliability required to ensure its customers have an adequate supply of water in the event of an extended drought, future climate change conditions, or change in one or more other factors, such as those described above.

(The Demand Projections presented in Section II and included in Table IV.1 have been peer-reviewed by the Jordan Lake Partnership, and represent the best available estimate of the future demand for OWASA for average day demand over the planning horizon. However, as noted previously, the Town of Chapel Hill has recently approved several high density infill projects, and is considering major changes to several local small area land use plans, and there are higher density developments under construction or planned in the Town of Carrboro, which could result in much higher development densities than reflected in the "Expected Demands" projection.)

References

DEM. 1992. *North Carolina Lake Assessment Report.* Report 92-02. North Carolina Department of Environment and Natural Resources, Division of Environmental Management, Water Quality Section. Approved for release on May 25, 1992.

Hazen and Sawyer. 2008. *Yield Metrics for OWASA Water Supply Planning*. Technical Memorandum prepared for OWASA, December 12, 2008.

Orange Water and Sewer Authority. 2010. Long-Range Water Supply Plan. April 8, 2010.

USACE. 2014. http://epec.saw.usace.army.mil/fallpert.txt. Accessed March 25, 2014

SECTION V. WATER SUPPLY ALTERNATIVES

This section describes alternative strategies for meeting OWASA's projected water needs through 2060. Alternatives may consist of an individual water source option, or combinations of different projects.

Source Options

OWASA evaluated water supply alternatives that include combinations of the source options summarized in Table V.1 and illustrated in Figure V.1. A brief description of each option follows:

1. Jordan Lake – OWASA has an existing Level I allocation of 5 percent of the Jordan Lake water supply pool, which corresponds to approximately 5 mgd. OWASA seeks to maintain that allocation to provide the redundancy, diversity, and resilience needed to ensure an adequate supply of water to meet a range of potential supply and demand scenarios. OWASA can currently access its allocation by purchasing drinking water from the Town of Cary that is wheeled through the City of Durham; the capacity of the water system interconnections between Durham and OWASA is 7 mgd.

2. Expand Quarry Reservoir (Shallow Option – 1.5 BG total storage volume) – In 2001, OWASA entered into an agreement with American Stone Company under which OWASA will assume full rights to an expanded Quarry Reservoir at the end of 2030. Active quarrying is underway adjacent to OWASA's existing small Quarry Reservoir, and the active quarry pit will eventually be tied into the existing Quarry Reservoir, thereby providing a much greater water storage reservoir for OWASA.

   When quarrying ceases, OWASA will fill the quarry and then access that water using its existing pumping facilities located at the existing Quarry Reservoir. The Quarry Reservoir has a drainage area of only 0.5 square miles, so supplemental water would be required to fill it after extended drawdowns. It would be filled with water from Cane Creek Reservoir; however, that is expected to take several years due to the limited duration in which excess water from Cane Creek Reservoir will be available to refill the Quarry Reservoir. OWASA anticipates that the expanded Quarry Reservoir will be online around the mid-2030s, provided that refill is not delayed due to an extended drought or other problem.

   Based on the minimum stone extraction rate included in OWASA's lease agreement with American Stone and the estimated resulting storage (1.5 BG), the shallow Quarry Reservoir is expected to increase the yield of OWASA's system by about 2.1 mgd. To date, American Stone has met their minimum production rates.

   OWASA's Long-Range Water Supply Plan indicates that the expanded Quarry Reservoir option offers the greatest water supply benefit for the lowest economic and environmental costs, and represents the least challenging regulatory/political hurdle. However, the expanded Quarry Reservoir option does not add redundancy or increase the watershed area or total potential inflows to OWASA's reservoir system. Further, although this project would increase OWASA's total storage capacity and increase total system yield, it will have a very long refill time, since it will further reduce the ratio of watershed area to storage volume for the OWASA system. It does not meet Hazen and Sawyer's recommendation that OWASA find an alternative water supply with a shorter refill time.

3. Expand Quarry Reservoir (Deep Option – 2.2 BG total storage volume) - OWASA would expand its existing Quarry Reservoir by accessing all of the additional storage area that is currently being created by American Stone Company's quarrying operations which will end in 2030. Once quarrying ceases, OWASA would fill the quarry with water from Cane Creek Reservoir, and then access the quarry water by constructing a 250 foot deep vertical shaft and installing a multi-level pump station. The deep Quarry Reservoir project is expected to increase the yield of OWASA's system by about 3.4 mgd.

   OWASA's Long-Range Water Supply Plan indicates that the shallow Quarry Reservoir option is more cost-effective, but OWASA will continue to evaluate the deep option alternative through approximately 2025. This alternative has the same regulatory and political impacts as the shallow Quarry Reservoir option. Higher pumping costs and related energy and greenhouse gas emission impacts are associated with the deep Quarry Reservoir than the shallow option due to the required multi-level pumping station and much greater pumping capacity required to access the deeper water. The Quarry Reservoir alternatives do not add redundancy to OWASA's overall system or meet the recommendation provided by Hazen and Sawyer that OWASA find an alternative water supply with a shorter refill time. In addition, since water from Cane Creek Reservoir would be used to fill the quarry, Cane Creek Reservoir's refill time would be even longer following extended droughts.

4. Haw River - This option involves: (a) constructing a permanent intake on the Haw River in the vicinity of Old Greensboro Road on the border of Orange County and Alamance County; (b) installing approximately 5 miles of raw water pipeline from the Haw River to Cane Creek Reservoir; (c) improving the Cane Creek pumping station; and (d) constructing approximately 11 miles of new pipeline parallel to the existing raw water transmission main from Cane Creek Reservoir to the Jones Ferry Road WTP. The location of the intake and 5 mile pipeline are based on studies completed by OWASA during the 2007-2008 drought. This alternative would require local governments with land use planning jurisdiction in the upstream watershed to implement watershed protection measures in accordance with State law.

5. Expand Reclaimed Water System - Under this option, OWASA would expand its existing reclaimed water system to serve additional demands that would have otherwise been met with drinking water. Two potential configurations were examined. This first would extend reclaimed water service to NC 54 East, Meadowmont, and UNC's Friday Center and nearby areas. This alternative would require installation of about 21,000 feet of new reclaimed water lines and additional pumping capacity. The second configuration

would include the extension of 4,300 feet of 12-inch reclaimed water line to provide reclaimed water for use in the cooling towers at UNC's cogeneration plant.

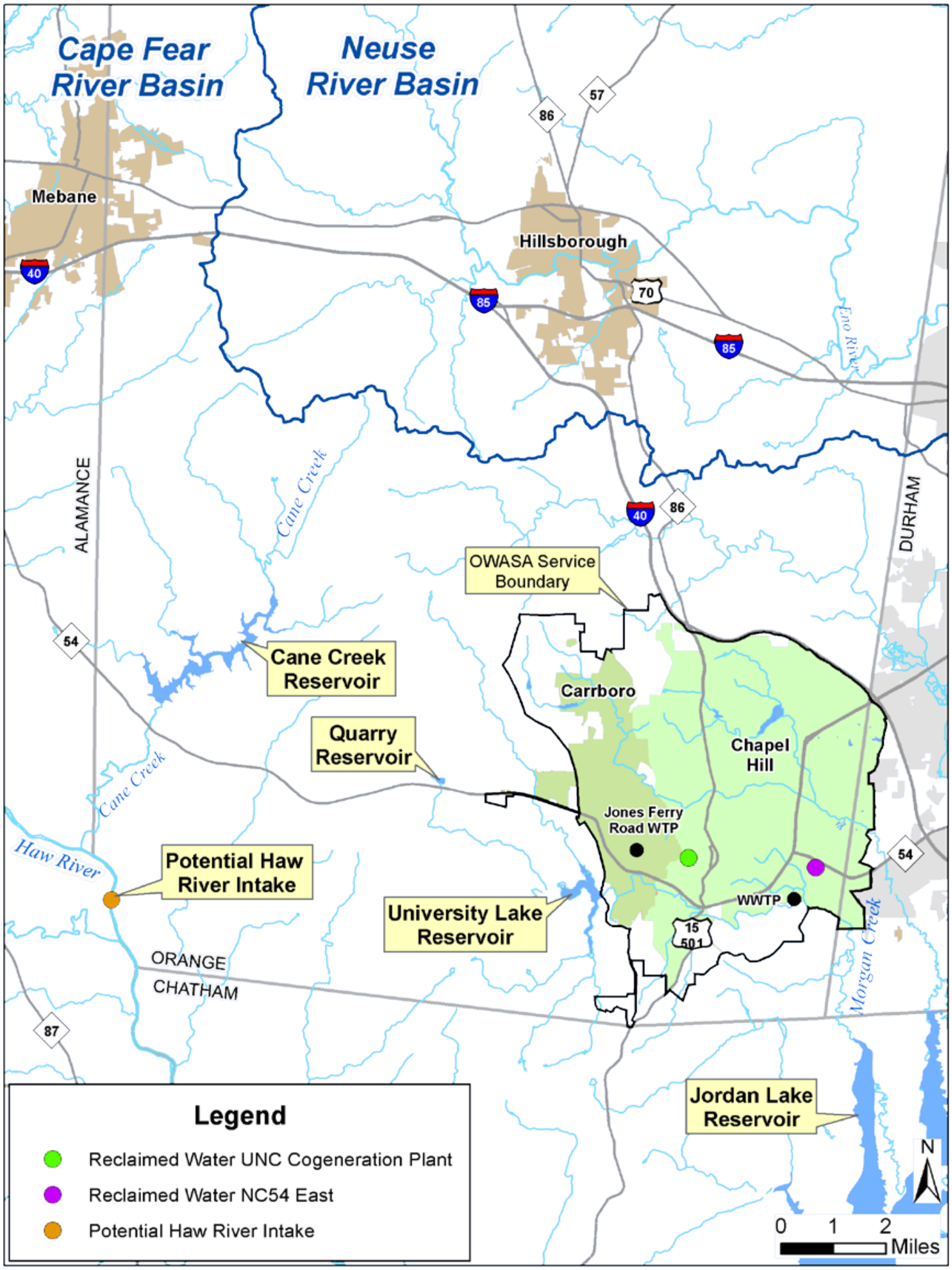
6. Purchase Water from Other Communities – Under this option, OWASA would develop a long-term purchase and sale agreement from a neighboring community that would guarantee OWASA's right to purchase an additional supply of water. The existing systems that could likely provide water to OWASA are the Town of Cary and the City of Durham. Based on discussions with those jurisdictions, OWASA would need to hold a Jordan Lake allocation which would serve as the source of supply for future water purchases from those systems.

Table V.1 – Source Options

Source	Type	Basin	WQ Classification	Year Online (earliest)	Available Supply (MGD)	Supply Range (MGD)
Jordan Lake Allocation	Jordan Lake	Haw (2-1)	WS-IV, NSW	N/A	5	N/A
Expand Quarry - Shallow Option	Offstream Storage	Haw (2-1)	WS-II, HQW, NSW	2035	2.1	N/A
Expand Quarry - Deep Option	Offstream Storage	Haw (2-1)	WS-II, HQW, NSW	2035	3.4	N/A
Haw River to Cane Creek	Stream Withdrawal	Haw (2-1)	WS-V, NSW	2030	7.7	N/A
Expand Reclaimed Water	Reclaimed Water	N/A	N/A	2025	0.25	0.09-0.34

OWASA could access its Jordan Lake allocation now through its Mutual Aid Agreements with the Town of Cary and City of Durham, but these agreements do not guarantee capacity. This application evaluates OWASA partnering with other facilities to develop infrastructure to access the lake, but guaranteed capacity could also potentially be obtained through modified or new agreements with the Town of Cary and City of Durham.

Figure V.1 – Map of Water Supply Source Options



Water Supply Alternatives

OWASA identified 4 water supply alternatives using the potential source options listed in Table V.1. OWASA has made a commitment to fill and use the Quarry Reservoir after mining ceases in 2030. Thus, most of these alternatives include the planned shallow quarry (1.5 BG) as recommended in the Long-Range Water Supply Plan (2010). Total capital cost information for each alternative is shown in 2010 dollars; total capital cost per mgd of additional supply yield is also shown for each alternative.

Alternatives Analysis

Alternative 1 – Maintain a 5 percent (5 MGD) Jordan Lake Allocation and Access through New Intake/WTP Shared with City of Durham, Town of Pittsboro, Chatham County; Expand Quarry Reservoir in 2035 (Shallow Option)

OWASA maintains its existing Level I allocation of 5 percent of Jordan Lake's water supply pool (approximately 5 mgd) in this alternative. In addition, OWASA expands the Quarry Reservoir and accesses the quarry water down to a depth of 385 feet using its existing pumping facilities. Water from Cane Creek Reservoir will be used to initially fill the expanded quarry, as well as to refill it after it has been drawn down during extended droughts.

OWASA can currently access its Jordan Lake allocation by having the Town of Cary withdraw and treat that water, send it to the City of Durham system, and then have the City of Durham wheel it to OWASA through the OWASA-Durham system interconnections (Figure V.2). The Town of Cary and City of Durham have informed OWASA that in order to have a guaranteed water purchase arrangement with them, OWASA would need to secure a Level I allocation from Jordan Lake. Thus, OWASA requested and received the Environmental Management Commission's approval to modify its Level II allocation to a Level I allocation in March 2013.

OWASA has actively participated in interlocal discussions and studies concerning the potential development and use of water supply facilities at Jordan Lake, and has considered different options to access its allocation. Three key conclusions have emerged from those evaluations, and are reflected in the Jordan Lake water supply development alternative presented in this Jordan Lake water allocation application:

1. The most economical way for OWASA to access its Jordan Lake allocation will be through a partnership arrangement with one or more neighboring utilities.
2. Based on information developed for OWASA's 2010 Long-Range Water Supply Plan, raw water intake, pumping and transmission facilities developed in partnership with other jurisdictions likely represents OWASA's least expensive capital option for obtaining Jordan Lake water in the future; however, that option will be precluded if other utilities, such as the City of Durham, decide to build a regional water treatment plant and pump finished water, rather than raw water, to their respective service area.

3. For OWASA to obtain water from Jordan Lake, that water will almost certainly need to be transferred through water system facilities owned either wholly or in part by the City of Durham, to which OWASA has two existing water system interconnections. The City of Durham's preferred Jordan Lake alternative is to build a new intake and regional water treatment plant and deliver treated drinking water to the Durham system.

Based on the above, OWASA's assumed strategy for permanently accessing and using its Jordan Lake allocation would be to partner with the City of Durham and others in the design, financing, construction, operation and maintenance of new intake, pumping, water treatment, and transmission facilities in close proximity to the west side of Jordan Lake. At this time, this strategy includes the City of Durham, Town of Pittsboro, Chatham County, and OWASA. In addition, it was assumed that the City of Durham would provide Orange County any water it obtained from Jordan Lake.

The initial concept, for which the technical, economic, institutional, and environmental feasibility were recently estimated, includes a new intake structure, pumping facilities, and water treatment plant located south of U.S. Highway 64 near the western shore of Jordan Lake, as well as major drinking water transmission lines to serve the Partners. Raw water intake and pumping facilities would be constructed within the lake and/or on land leased from the Army Corps of Engineers. The treatment plant is assumed to be constructed on property currently owned by OWASA adjacent to Corps land. Figure V-3 illustrates this alternative. Additional concept-level configurations are being developed and will be evaluated, but the five Partners have agreed that the scenario outlined in this narrative provides a consistent technical and economic basis to include in their respective Jordan Lake allocation requests.

Between now and the time such regional facilities are constructed and placed into service, OWASA would access its Jordan Lake allocation when needed through existing mutual aid agreements or modified interim agreements with the City of Durham and Town of Cary which would guarantee short-term capacity from Jordan Lake.

Figure V.2 – Locations of Interconnections with Town of Cary and City of Durham

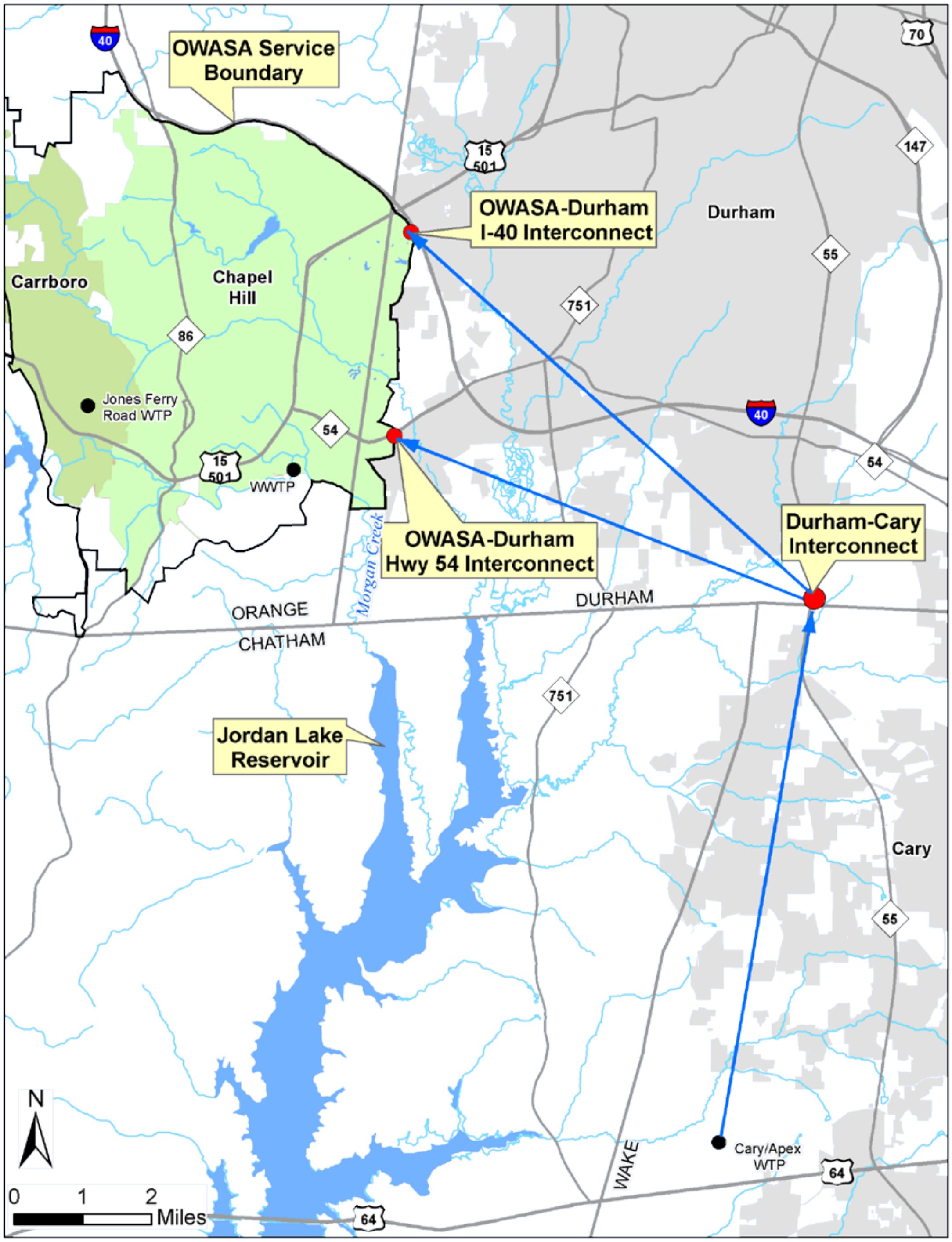
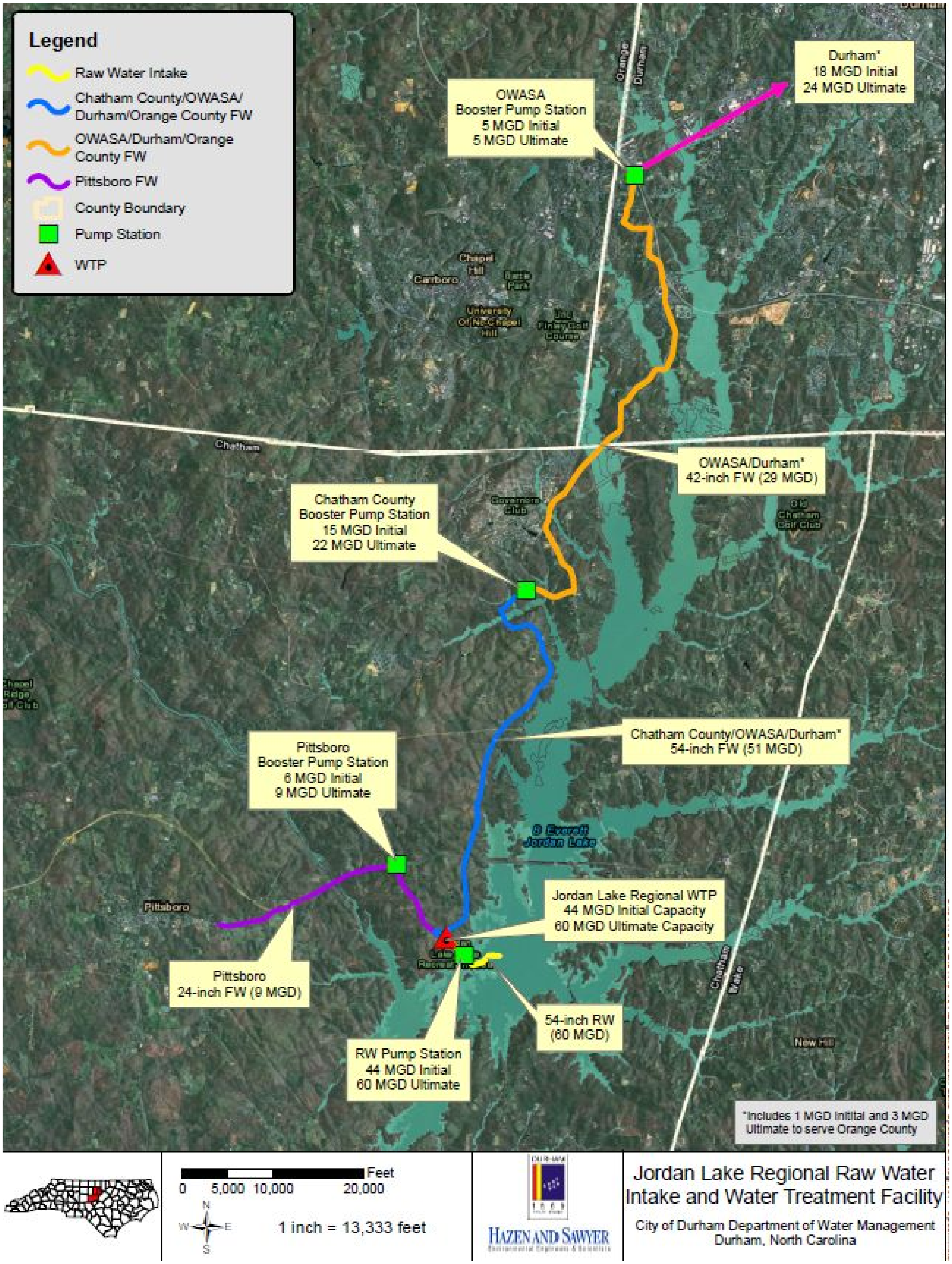


Figure V.3 – Potential Jordan Lake Regional Raw Water Intake and Treatment Facilities



Jordan Lake Allocation Request

Under this alternative, OWASA would maintain its current Level I allocation from Jordan Lake; no additional allocation is requested.

Available Supply

This alternative provides OWASA a 5 percent allocation of the water supply available in Jordan Lake, (which corresponds to 5 mgd in yield); and also includes development of the shallow Quarry Reservoir which provides an additional 2.1 mgd beginning in approximately 2035. The combination of using Jordan Lake and the expanded Quarry Reservoir meets OWASA's objective to have access to a water supply that has a reasonable refill time following drought.

Environmental Impacts

This alternative does not require the development of a new water supply source, and therefore represents none of the major environmental and social costs of a new reservoir, such as private land (and home) acquisition, road relocation, significant habitat destruction, and so forth. However, development of the proposed Jordan Lake regional facilities will have direct environmental impacts associated with the temporary and localized construction activities and permanent land clearing required for new raw water intake, pumping, treatment, and finished water transmission facilities. Virtually all of these will occur on property already owned by public entities or located within public rights of way.

No new infrastructure is required for the shallow Quarry Reservoir included as part of this alternative. In addition, OWASA must continue to meet downstream flow requirements for Cane Creek Reservoir, the source used to fill the Quarry Reservoir. Thus, downstream flow impacts from Cane Creek Reservoir should be minimal. The environmental impacts of the Quarry Reservoir portion of this alternative would be Less Than those for a Jordan Lake-only alternative.

This alternative (Jordan Lake and shallow Quarry Reservoir) will have environmental impacts that are the Same As using only a Jordan Lake allocation.

Water Quality Classification

Jordan Lake is classified as WS-IV, NSW, and the Quarry Reservoir is classified as WS-II, HQW, NSW. No reclassifications are required under this alternative; however, the existing critical area around the Quarry Reservoir may need to be expanded. That area is already owned by OWASA.

Timeliness

For the purposes of this analysis, capital funding for the initial facilities is assumed to occur in 2015, with construction completed in 2020, which meets OWASA's needs. In addition, our existing mutual aid agreements or other modified agreements would meet interim needs. The new intake facilities and all pipelines would be sized to meet ultimate maximum day demands. The WTP and shared pumping facilities are assumed to be constructed in two phases, with initial sizing to meet interim (2040) demands; all OWASA's demands would be met with the first phase of construction.

As noted above, OWASA and American Stone have an agreement that requires American Stone to cease rock quarrying at the end of 2030. OWASA expects to have the expanded Quarry Reservoir on-line around 2035.

Interbasin Transfer

Implementation of this alternative would not involve any interbasin transfers of water by OWASA.

Neither Chatham County, the City of Durham, Orange County, OWASA, nor the Town of Pittsboro currently transfer water out of the Haw River Basin (2-1). Implementation of the Jordan Lake regional alternative would eventually involve an interbasin transfer (IBT) of up to 1.5 mgd from the Haw to the Neuse River Basin (10-2) by Orange County, but no transfers would occur by any of the other four entities. Orange County would access its Jordan Lake allocation via a finished water interconnection between the City of Durham and Hillsborough systems, but would not require IBT certification because its transfer would not exceed the 2 mgd statutory threshold.

Water obtained and treated from the City of Durham's Jordan Lake allocation would be used only within the Cape Fear (Haw) portion of Durham's service area and therefore would not require IBT certification. Most notably, Jordan Lake would support a significant reduction in the City of Durham's current and future transfers out of the Neuse Basin by decreasing its reliance on Lake Michie and the Little River Reservoir to meet all of the City's water supply needs. Because Durham would begin using its full 16.5 MGD Jordan Lake allocation (10 MGD existing + 6.5 MGD requested) immediately upon completion of the new regional facilities, Durham's projected transfer of 20.4 MGD from the Neuse River Basin in 2020 would be reduced to 8.5 MGD. Similarly, the Jordan Lake option would enable Durham to reduce its projected 26.6 MGD transfer out of the Neuse Basin in 2045 to only 15.6 MGD. (Durham has a grandfathered capacity to transfer up to 45.4 MGD from the Neuse to the Haw River Basin.)

Regional Partnerships

This alternative was developed in coordination with the Jordan Lake Partnership, and is supported by other JLP members. In addition, OWASA will partner with others, such as the City of Durham, Chatham County, Orange County, and the Town of Pittsboro to pursue development of a new intake and treatment facility on the lake, if and when OWASA deems that the most appropriate method to access its allocation. Appendix B includes a scope of work that illustrates that these entities are working together to evaluate a western intake on Jordan Lake.

Technical Complexity

This alternative requires building a new treatment plant and intake structure, it is not technically complex. The distribution of water to the project partners will be the most technically challenging portion of this alternative, but that is fairly straight-forward. In addition, no new infrastructure is needed to expand the Quarry Reservoir. This alternative is rated as Complex.

Institutional Complexity

This alternative is rated Complex, as it requires the formal participation by multiple units of local government and must address issues of financing, ownership, governance, and operation and maintenance of new facilities. As noted above, agreements are not yet in place among these entities, but potential arrangements include single-entity ownership and operation; shared or joint ownership, such as the present Cary-Apex water treatment or Western Wake (Cary-Apex-Morrisville) wastewater partnerships; interlocal agreements; or the creation of a new entity, such as a Jordan Lake water supply authority. The eventual institutional arrangement will be determined by the governing boards of the participating utilities.

The regulatory challenges of this alternative are also of moderate complexity, and are associated primarily with permitting requirements. Each participating entity must be able to acquire and retain its own Jordan Lake water supply storage allocation from the NC Environmental Management Commission. Construction of new intake, pumping, treatment, and transmission facilities will require environmental review and permitting by local, State, and Federal (Corps of Engineers) agencies; but none of these represent new or unique regulatory challenges.

Political Complexity

Similar to the issues of institutional complexity noted above, this option represents a moderate degree of political complexity due to the involvement of multiple units of local government who must collaborate and reach agreement on issues of financing, governance, operation, maintenance, etc. of the new facilities. The existing Cary-Apex agreement regarding the construction, ownership, and operation of the Cary-Apex Water Treatment Facility; the Cary-Apex-Morrisville partnership in developing the new Western Wake Wastewater Facility; and the utility merger agreements among Raleigh and other Wake County municipalities have all demonstrated the economic and operational benefits to the individual partners of shared facilities. It is also believed that the successful and ongoing staff level collaboration demonstrated by the Jordan Lake Partnership and the recent focus of the Western Intake Partners provides a credible body of information and trust on which the respective local policy boards can base their formal agreements.

Prior to finalizing terms and conditions for participating in construction and ownership of regional water supply facilities at Jordan Lake, OWASA would seek the input and support from its member governments.

The Quarry Reservoir portion of this alternative is rated as Not Complex because all the required contractual and zoning approvals are in place to implement this alternative.

The overall rating of political complexity for this alternative is Complex.

Public Benefits

When compared to the traditional, largely independent approach to meeting water supply needs, this alternative offers many important advantages, including but limited to: (a) the anticipated economies and efficiencies of scale provided by regional facilities shared by multiple entities; (b) simplified and/or streamlined regulatory oversight of the facilities; (c) enhanced ability to respond to an evolving regulatory landscape; and (d) greater capacity to incorporate new and emerging technologies.

Also, as noted above, this alternative requires the development of no new water supply sources while ensuring a reliable and sustainable water supply for the participating entities, and reduces the volume of interbasin transfers out of the Neuse River Basin. This alternative would also provide redundancy to the region's water supply, as the construction of a second intake and water treatment plant on Jordan Lake would improve the region's ability to meet demands in case an emergency occurred at the Cary-Apex intake or water treatment plant.

As noted above, the Special Use Permit issued for the Quarry Reservoir offers benefits such as a No-Fault Well Repair Fund for surrounding property owners, but these would apply regardless of whether OWASA used the Quarry Reservoir as a water supply.

Consistency with local plans

This alternative is consistent with OWASA's Long-Range Water Supply Plan (2010 and Appendix C) and the JLP Triangle Regional Water Supply Plan (2014).

Total Cost ($ millions)

Cost spreadsheets were developed for each water supply option and are included in Appendix D. The total cost of the shallow Quarry Reservoir is $1.4 million as outlined below (note: total capital cost in all alternatives is rounded to nearest $100,000). It should be noted that the shallow Quarry Reservoir alternative does not include the potential need to replace the pump station by the mid-2030s when the expanded Quarry Reservoir would be placed in service. The cost details for the shallow Quarry Reservoir are not repeated in other alternatives that include it.

Capital Cost of Infrastructure:	$920,000
Contractor Mobilization/Profit	$138,000
Engineering Studies/Design	$138,000
Legal Fees/Permits	$ 53,000
Contingency	$125,000
Total Capital	*$1,400,000 (Rounded)*
Total Capital Cost per mgd	$667,000

Capital costs for this scenario include a new Jordan Lake raw water intake, raw water transmission facilities, a water treatment plant (WTP), plus shared as well as separate finished water pumping facilities and transmission lines. Where applicable, costs also include the purchase of land/easements, environmental mitigation, and water supply storage allocations. For the purposes of this analysis, capital funding for the initial facilities is assumed to occur in 2015, with construction completed in 2020. The new intake facilities and all pipelines would be sized to meet ultimate maximum day demands. For this conceptual financial analysis, each Partner's share of the capital costs of those facilities was calculated as the ratio of that Partner's ultimate demand to the total ultimate facility capacity. The WTP and shared pumping facilities are assumed to be constructed in two phases, with initial sizing to meet interim (2040) demands. Each Partner's share of the capital costs for those facilities was calculated as a direct ratio of that Partner's interim demand to the total interim capacity of the WTP and shared pumping facilities. Facility expansion is based on ultimate capacity in 2060. Financing for the expansion is assumed to occur in 2035 with construction completed in 2040. Each Partner's share of the capital cost for the expansion was calculated as a direct ratio of that Partner's incremental increase in demand (from 2040 to 2060) to the total increase in facility capacity. Initial and ultimate facility capacities of 44 and 60 mgd are based on projected maximum day demands in 2040 and 2060, respectively. A summary of ultimate estimated capital costs (in 2010 dollars) is presented below; however, it should be noted that the assumed cost allocations do not necessarily correspond to the Round 4 allocation requests for all of the Partners:

Conceptual-Level Capital Cost Estimates for Jordan Lake – West Regional Water Supply and Treatment Facilities			
Partner	Total Allocation Request (mgd)	Cost Share ($M 2010)	Cost Per MGD of Allocation ($M 2010)
Chatham County	18	$101.6	$5.6
City of Durham	16.5	$115.4	$7.2
OWASA	5	$30.3	$6.1
Orange County	2	$18.1	$9.0
Town of Pittsboro	6	$46.3	$7.7
Total	47.5	$311.7	$6.6

Unit Cost

The total estimated capital cost for the Jordan Lake portion of this alternative is $30.3 million, and the total capital cost for the shallow Quarry Reservoir is $1.4 million. OWASA's projected total unit cost of the Jordan Lake regional facilities – shallow Quarry Reservoir alternative is $4.46 million per mgd of supply.

Alternative 2 – Expand Quarry Reservoir in 2035 (Deep Option)

Jordan Lake Allocation Request

This alternative includes no permanent request for an allocation; OWASA would relinquish its existing allocation to Jordan Lake after the expanded Quarry Reservoir (2.2 BG) was filled in approximately 2035. In the interim, OWASA would maintain its existing Level I allocation of 5 percent of Jordan Lake's water supply pool.

Total Supply

This alternative would result in an additional 3.4 mgd of supply based on the minimum production rate included in OWASA's lease agreement with American Stone and estimated resulting storage. The additional supply would be available around the mid-2030s. OWASA would construct a 250-foot deep vertical shaft and multi-level pumping facilities to access the much deeper storage. As noted previously, the Quarry Reservoir has a drainage area of only 0.5 square miles and does not refill on its own, but must be refilled with water from Cane Creek Reservoir. Also as noted previously, Cane Creek Reservoir has a long refill time following drought; therefore, it could take several years to refill the Quarry Reservoir following drawdowns during extended droughts.

This alternative does not meet OWASA's objective to have access to a water supply that has shorter refill times following drought or other operational emergency. This alternative does not provide additional redundancy to the water supply system.

Environmental Impacts

Implementation of the deep Quarry Reservoir alternative would require construction of a 250-foot deep vertical shaft and a multi-level pumping gallery which would be located on OWASA property. There would not be any impact to wetlands, streams, or other important environmental features. OWASA would continue to meet downstream flow requirements for Cane Creek Reservoir, the source used to fill the Quarry Reservoir. Thus, downstream flow impacts from Cane Creek Reservoir should be minimal. Accessing the deep portion of the Quarry Reservoir would require greater energy use and associated carbon emissions than the Jordan Lake alternative. Additional land clearing would not be required. The overall environmental impacts of this alternative would be Less Than the Jordan Lake alternative.

Water Quality Classification

The Quarry Reservoir is classified as WS-II, HQW, NSW. No reclassifications are required under this alternative; however, the existing critical area around the Quarry Reservoir may need to be expanded. That area is already owned by OWASA.

Timeliness

OWASA and American Stone have an agreement that allows American Stone to mine through 2030. After mining ceases, it will take several years to complete the Quarry Reservoir expansion and refill; OWASA anticipates that the expanded Quarry Reservoir will be online in approximately 2035 but refill could be delayed if completion of the Quarry Reservoir coincided with a drought. If the Quarry Reservoir was online after 2040, OWASA would experience a supply shortfall under this scenario unless it maintained its current Level I allocation until the quarry was filled. OWASA's water supply is most vulnerable from approximately 2025 when the existing small Quarry Reservoir is drained, to the date the expanded Quarry Reservoir is operational (approximately 2035).

Interbasin Transfer

The Quarry Reservoir is located in the Haw River subbasin along with OWASA's entire service area. Thus no interbasin transfer is associated with this alternative.

Regional Partnerships

There is no opportunity for regional partnerships under this alternative.

Technical Complexity

This alternative involves construction of a 250-foot deep vertical shaft and multi-level pumping gallery. Thus, this alternative is considered Complex.

Institutional Complexity

No stream reclassifications are required for this alternative, but the existing critical area around the Quarry Reservoir may need to be expanded. This alternative is considered Not Complex.

Political Complexity

This alternative is rated as Not Complex because all contractual and zoning approvals required for the project have been received.

Public Benefits

The Special Use Permit issued for the Quarry Reservoir offers benefits such as a No-Fault Well Repair Fund for surrounding property owners, but these would apply regardless of whether OWASA used the Quarry Reservoir as a water supply.

Consistency with local plans

This option does not align with OWASA's Long-Range Water Supply Plan which recommends that OWASA maintain its Jordan Lake allocation and expand the Quarry Reservoir under the shallow option.

Total Cost ($ millions)

A planning level cost to develop the deep Quarry Reservoir option is summarized below. The costs do not include the reimbursement OWASA would receive from the State for relinquishing its Jordan Lake allocation, but this reimbursement would have minimal impact. Since these are planning level costs, the reimbursement has been omitted from all alternatives which include no permanent allocation from Jordan Lake.

Capital Cost of Infrastructure:	$34,810,000
Contractor Mobilization/Profit	$ 5,222,000
Engineering Studies/Design	$ 5,222,000
Legal Fees/Permits	$ 2,002,000
Contingency	$ 4,726,000
Total Capital	*$52,000,000 (Rounded)*
Total Capital Cost per mgd	$15,300,000

Unit Cost

The unit capital cost for this alternative is $15.3 million per mgd.

Alternative 3 – New Haw River Intake and Expand Quarry Reservoir in 2035 (Shallow Option)

This alternative includes building a new intake on the Haw River near the Orange County – Alamance County border, pumping the water through a new raw water transmission main to

Cane Creek Reservoir, expanding the Cane Creek Raw Water Pump Station, building a new pipeline from Cane Creek Reservoir to the Jones Ferry Road WTP and expanding the Quarry Reservoir (shallow option). This analysis assumes no low head dam would be required to provide adequate depth for the intake structure. If a dam was needed, the environmental impacts; institutional, political and technical complexity; and cost would all be higher then presented below. The shallow Quarry Reservoir portion of this alternative is described in Alternative 1 and is not included in the information provided below with the exception of the (1) total supply, and (2) cost analysis where only summary information is provided. Details can be found in the description for Alternative 1.

Jordan Lake Allocation Request

This alternative includes retaining OWASA's Level I allocation of 5 percent of Jordan Lake's water supply pool (approximately 5 mgd) until the expanded Quarry Reservoir or Haw River intake were online. OWASA would relinquish its existing Jordan Lake allocation once one of these alternatives was available.

Total Supply

This alternative would provide an additional 7.7 mgd of yield from the Haw River and 2.1 mgd from the expanded Quarry Reservoir. It would meet OWASA's demands and objective of increasing the water supply system's flexibility, reliability, and redundancy, and would include an option that does not have an extended refill time.

Environmental Impacts

Construction of a raw water intake, pumping station, and transmission main from the Haw River to Cane Creek Reservoir and from Cane Creek Reservoir to the WTP would have adverse environmental impacts. Withdrawals from the river would reduce downstream flows, thereby affecting habitat, recreational uses, and downstream water supply. There are stream crossings associated with both pipeline sections, but water quality impacts could be minimized through directional drilling. The water would need to be pumped from the Haw River to Cane Creek Reservoir, which would result in greater energy use and associated greenhouse gas emissions for pump operations. Environmental impacts are rated as the Same As the Jordan Lake alternative.

Water Quality Classification

The classification of the Haw River near the proposed intake is WS-V, NSW. Implementation of this alternative would require a reclassification to WS-IV, NSW. For this to happen, local governments with planning and zoning jurisdiction in the upstream watershed would need to agree to implement watershed regulations as required under State law.

Timeliness

The time required to implement this alternative is very uncertain, as it would depend on if and when local governments with planning and zoning control agreed to implement watershed regulations as required under State law. As described in the Institutional and Political Complexity sections below on this alternative, it is likely that some upstream local governments would not agree to adopt the required ordinances.

Interbasin Transfer

The proposed Haw River intake is located in the Haw River subbasin along with OWASA's entire service area. Thus, no interbasin transfer is associated with this alternative.

Regional Partnerships

No regional partnerships would be included in this alternative. Since this alternative would reduce downstream water availability on the Haw River, it would potentially impact the JLP recommended alternative that includes the Town of Pittsboro's planned expansion of its Haw River withdrawal.

Technical Complexity

The planning, design, and construction of this alternative is fairly straight-forward and thus is considered Not Complex.

Institutional Complexity

This alternative would require multiple Federal and State permits to build a new water supply intake on the Haw River. In addition, the Haw River would need to be reclassified to WS-IV. The NC Environmental Management Commission would require resolutions of support from the Orange and Alamance County Boards of Commissioners as they exercise planning and zoning jurisdiction in the area that would be designated as WS-IV protected area should this alternative be pursued. These local governments would be required to adopt land use regulations to comply with the NC Department of Environment and Natural Resources' water supply watershed protection regulations. In addition, this alternative would reduce downstream flows in the Haw River which could adversely impact the Town of Pittsboro's water supply.

Thus, this alternative is rated as Very Complex.

Political Complexity

In accord with State law, if this alternative is implemented, Orange and Alamance Counties would need to develop and adopt WS-IV watershed protection regulations for the applicable area above the intake on the Haw River. This would likely be extremely difficult to achieve. Furthermore, since this alternative would reduce downstream flows on the Haw River and potentially affect the Town of Pittsboro's water supply expansion plans, it is also likely to encounter opposition from several other public and private parties. In its 2014 assessment, American Rivers designated the Haw River as one of the ten most most endangered rivers in the country, bringing additional attention to the use and management of the river.

Thus, this alternative is considered Very Complex.

Public Benefits

Aside from addressing OWASA's future water needs, there would be no public benefits associated with this alternative. As noted above, negative public impacts would likely occur as a result of the impact on downstream flows on the Haw River.

Consistency with local plans

This alternative does not align with OWASA's Long-Range Water Supply Plan which recommended that the Haw River be used only on a temporary basis during a water supply emergency. The need for OWASA to temporarily use the Haw River during extended droughts has been reduced with the conversion of OWASA's Jordan Lake allocation to Level I in March 2013. As noted above, OWASA's use of the Haw River would be inconsistent with the JLP's preferred alternative in the Regional Water Supply Plan in which the Town of Pittsboro increases its withdrawal from the Haw River to meets its future water demands.

Total Cost ($ millions)

The total capital cost of this alternative is $29.3 million as outlined below:

Capital cost of infrastructure	$19,590,000
Contractor mobilization/profit	$ 2,939,000
Engineering	$ 2,939,000
Easement acquisition	$ 50,000
Legal fees/permits	$ 1,126,000
Contingency	$ 2,264,000
Total Capital Cost	$29,300,000 (rounded)
Total Capital Cost per mgd	$ 3,805,000

It should be noted that these costs and the environmental impacts described above assume that no dam would be required. If OWASA determines that a dam is needed to ensure there was adequate depth near the intake the capital cost, unit costs, environmental impacts, and permitting complexity would be greater than shown above.

Unit Cost

A new intake on the Haw River has an estimated unit capital cost of $3.8 million per mgd. For the Haw River and shallow Quarry Reservoir combined, the unit capital cost is $3.1 million per mgd.

Alternative 4 – Expand Reclaimed Water System and Quarry Reservoir in 2035 (Shallow Option)

OWASA would expand its reclaimed water system and the Quarry Reservoir (shallow option) under this alternative. OWASA currently provides reclaimed water to UNC and UNC Hospitals as described in Section II of this application. This alternative evaluates two other potential reclaimed water options: (1) extending the reclaimed water infrastructure to the area that includes NC 54 East, Meadowmont, and UNC's Friday Center along NC Highway 54, and (2) extending the reclaimed water system to UNC's cogeneration plant located west of UNC's main campus. These options are evaluated individually and together. The shallow Quarry Reservoir option portion of this alternative is described in Alternative 1 and is not included in the information provided below with the exception of the (1) total supply, and (2) cost analysis where only summary information is provided. Details can be found in the description for Alternative 1.

Jordan Lake Allocation Request

This alternative includes maintaining OWASA's Level I allocation of 5 percent of Jordan Lake's water supply pool (approximately 5 mgd) until the Quarry Reservoir is online; OWASA would relinquish that allocation after the expanded Quarry Reservoir is available.

Total Supply

The main water demands that could potentially use reclaimed water in the Highway 54 east area include:

- Irrigation of common areas
- Irrigation use at single family homes
- Cooling tower make-up at the Friday Center and commercial developments

These demands are currently estimated to be less than 0.05 mgd. For the future, it was assumed that additional reclaimed water could be used at golf courses, soccer fields, and landscaping within the transportation corridors. This potential demand for reclaimed water is difficult to estimate, but for purposes of planning, it has been estimated that reclaimed water use in this area through 2060 could reduce long-term demands by 0.25 mgd. This demand projection may be optimistic, and OWASA cannot force customers to connect to the system.

UNC's cogeneration facility cooling towers would use approximately 0.09 mgd of reclaimed water on an average basis, assuming no major expansion of that facility.

Together, the Highway 54 east area and cogeneration plant could use an estimated 0.34 mgd and the shallow Quarry Reservoir would provide 2.1 mgd for a total potential supply of 2.44 mgd which would meet OWASA's long-term supply requirements.

However, this alternative does not meet OWASA's objective to have access to a water supply that has shorter refill times following drought or other operational emergency. This alternative adds very limited redundancy to the water supply system making OWASA vulnerable to drought and other emergencies.

Furthermore, as noted in Section IV, OWASA faces certain operational and demand risks associated with increased use of reclaimed water in the future.

Environmental Impacts

To meet the reclaimed water needs in the vicinity of Meadowmont and the Friday Center, more than 21,000 feet of reclaimed water lines would need to be installed. While efforts would be made to locate and construct the lines in a manner that minimizes impacts to the environment, there would be some impacts. In addition, the reclaimed water pumping system would need to be expanded at the Mason Farm Wastewater Treatment Plant to provide water to the NC 54 east area. The additional pumping requirements would increase energy use for pumping and the associated greenhouse gas emissions.

To provide reclaimed water for use in the cogeneration facility cooling towers, approximately 4,300 feet of new reclaimed water lines would be required. These pipes would be installed in a densely developed area and construction activities would have a substantial but temporary disruptive impact on public and private transportation and the human environment. No new pumping equipment would be required for this portion of the alternative.

The environmental impacts of this alternative are rated as Less Than the Jordan Lake alternative.

Water Quality Classification

This criteria is not applicable to the reclaimed water option. No surface water reclassifications are required under this alternative. OWASA has a permit from the State to operate and maintain the reclaimed water system, and has consistently met the State's reclaimed water standards.

Timeliness

This project could be timed to meet OWASA's water demands, provided a sufficient number of end users agree to use the reclaimed water as an alternative to drinking water.

Interbasin Transfer

There is no interbasin transfer associated with this alternative.

Regional Partnerships

This alternative would further advance OWASA's and UNC's partnership to expand the use of reclaimed water as an alternative water supply source, but there would be no regional partnership.

Technical Complexity

This alternative involves building additional reclaimed water lines and expanding the reclaimed water system pumping capacity at the Mason Farm Wastewater Treatment Plant. Construction of the necessary reclaimed water lines would occur in a fairly developed part of the service area, and would temporarily disrupt traffic and other activities. The project could encounter some public opposition as a result. The average and peak flows for reclaimed water can vary by large amounts; pipes are sized to meet peak flows. However, if they are oversized, long residence times can occur and reclaimed water can deteriorate, thereby making it unsuitable for certain uses such as cooling tower make-up water. Thus, this alternative is considered Complex.

Institutional Complexity

A permit would be required from the North Carolina Division of Water Resources to expand the reclaimed water system, but based on OWASA's prior experience this permit process should be relatively straight-forward. Construction of the reclaimed water lines in and along State and local roadways will require approval by NC Department of Transportation and local governments. This could present some challenges, as these projects are both located in heavily traveled areas and would involve impacts to many residents and businesses. Some members of the public also have concerns about using reclaimed water for irrigating public areas. Thus, this alternative is considered Complex.

Political Complexity

Development of the reclaimed water system has been generally supported by the community; therefore, expansions of the system are not anticipated to be any more complex than other alternatives and this alternative is considered Not Complex.

Public Benefits

The public benefits by expanded use of reclaimed water because it reduces (a) drought risks, and (b) peak demands for drinking water, which can extend the capacity of OWASA's reservoirs, water treatment facilities, and distribution system. The use of reclaimed water also reduces the nutrient load discharged to Morgan Creek, a tributary of Jordan Lake which is impaired for aquatic life uses from nutrient enrichment.

Consistency with local plans

OWASA's Long-Range Water Supply Plan recommends that OWASA remain opportunistic to identify and pursue cost-effective opportunities to expand the use of reclaimed water. Prior analyses have shown that it is not cost-effective to expand reclaimed water service to the area of NC Highway 54 near the Friday Center and Meadowmont. Thus, this alternative is not consistent with the Long-Range Water Supply Plan.

Total Cost ($ millions)

The total cost for the Highway 54 portion of this alternative is $7.1 million as outlined below:

Capital cost of infrastructure	$ 4,730,000
Contractor mobilization/profit	$ 710,000
Engineering	$ 710,000
Legal fees/permits	$ 272,000
Contingency	$ 642,000
Total Capital Cost	$ 7,100,000 (Rounded)
Total Capital Cost per mgd	$ 28,400,000

The total cost for the Cogeneration portion of this alternative is $1.6 million as outlined below:

Capital cost of infrastructure	$ 1,040,000
Contractor mobilization/profit	$ 156,000
Engineering	$ 156,000
Legal fees/permits	$ 60,000
Contingency	$ 141,000
Total Capital Cost	$ 1,600,000 (Rounded)
Total Capital Cost per mgd	$ 17,778,000

The total cost for both options is $8.7 million.

Unit Cost

The unit cost for the Highway 54 portion of this alternative is $28.4 million per mgd. When the shallow Quarry Reservoir is included, the unit cost is $3.6 million per mgd.

The unit cost for the Cogeneration Plant portion of this alternative is $17.8 million per mgd. When the shallow Quarry Reservoir is included, the unit cost is $1.4 million per mgd.

The unit cost for including both options for reclaimed water is $25.6 million per mgd. When the shallow Quarry Reservoir is included, the unit cost is $4.1 million per mgd.

Selected Alternative

OWASA's preferred alternative is Alternative 1. OWASA can access its Jordan Lake allocation currently through its mutual aid agreements with the Town of Cary and City of Durham, and its existing water system interconnections with the City of Durham. In the future, OWASA would partner with other members of the JLP to secure access to Jordan Lake. This application assumes this would be through a new regional intake, transmission facilities, and treatment facility on the west side of Jordan Lake. OWASA will continue to evaluate options as it updates its Long-Range Water Supply Plan (see Section VI for more details). Between now and the time regional facilities would be available, OWASA would access its allocation through its mutual aid agreements or other agreements with the Town of Cary and City of Durham.

This alternative is included in, and entirely consistent with, the JLP's RWSP. This alternative represents a regional alternative for which allocation requests have been coordinated, and to the best knowledge of the partners, will not have a substantial negative impact on either the ability of Jordan Lake to meet all applicants' requests for water, or downstream users and the environment. Table V-2 summarizes each of the alternatives.

Table V.2 - Water Supply Alternatives Ratings

Classification	Alt 1: Jordan Lake Allocation and Shallow Quarry	Alt 2: Deep Quarry	Alt 3: Haw River and Shallow Quarry	Alt 4: Expand RCW and Shallow Quarry
Rd. 4 Allocation Request (% of storage)	5.0	5.0 (would relinquish after quarry online)	5.0 (would relinquish after Haw intake or shallow quarry online)	5.0 (would relinquish after shallow quarry online)
Supply (w/o quarry) (MGD)	5.0	N/A	7.7	0.3
Total Supply (MGD)	7.1	3.4	9.8	2.4
Environmental Impacts	The Same	Less Than	The Same	More Than
Water Quality Classification	WS-IV, NSW	WS-II, HQW, NSW	WS-V, NSW	WS-II, HQW, NSW
Timeliness	Acceptable w/Jordan	WS Vulnerable between 2025 and 2036 unless Jordan Lake allocation maintained	Acceptable if support by local governments	WS Vulnerable between 2025 and 2036 unless Jordan Lake allocation maintained
Interbasin Transfer (MGD)	0	0	0	0
Regional Partnerships	Yes - JLP	No	No	UNC only
Technical Complexity	Complex	Complex	Not Complex	Complex
Institutional Complexity	Complex	Not Complex	Very Complex	Complex
Political Complexity	Complex	Not Complex	Very Complex	Not Complex
Public Benefits	Many	None	None	Few
Consistency with local plans	Yes	No	No	No
Total Cost ($ millions)	30.3	52.0	29.3	8.7
Unit Cost (million $/mgd)	6.1	15.3	3.8	25.6
Total Cost w/quarry ($ millions)	31.7	52.0	30.7	10.1
Unit Cost w/quarry (million $/mgd)	4.5	15.3	3.1	4.1
Diversifies OWASA's Supply?	Yes	No	Yes	No
Selected Alternative	✓			

References

OWASA. 2010. Long-Range Water Supply Plan. April 8, 2010.

Triangle J Council of Governments. 2014. Triangle Regional Water Supply Plan, Volume II: Regional Water Supply Alternatives Analysis. Review Draft dated March 10, 2014.

SECTION VI. PLANS TO USE JORDAN LAKE

Based on the needs documented in Section IV, and the alternatives analysis presented in Section V, OWASA's preferred alternative is Alternative 1. Accordingly, this application includes a request for OWASA to maintain its current Level I Jordan Lake Water Supply Storage allocation in the amount of a **5 percent Level I Allocation**, which is assumed to correspond to a supply yield of approximately 5 mgd.

Implementation Plan and Timeline

In December 2012, OWASA requested the EMC to convert its Level II allocation to Level I, and this request was granted on March 14, 2013. OWASA can currently use this Level I allocation to access Jordan Lake water through the interconnected systems of the Town of Cary, City of Durham, and OWASA. The Town of Cary can provide the City of Durham over 9 mgd of drinking water, and Durham can in turn provide up to 7 mgd of finished water to OWASA. We currently have purchase and sale agreements in place with both entities in the form of mutual aid agreements. We have begun conversations with both entities to develop new or modified agreements to secure OWASA's ability to cost-effectively purchase water under appropriate conditions of supply and demand in order to avoid depleting University Lake/Cane Creek Reservoir/Quarry Reservoir storage during extended periods of drought or operational emergency.

OWASA is also partnering with the City of Durham, Chatham County, Town of Pittsboro, and Orange County to evaluate alternatives for sharing a new water intake structure on Jordan Lake and the associated infrastructure to provide each entity with Jordan Lake water. OWASA will further evaluate the options of partnering on new infrastructure and other methods to access its Jordan Lake allocation when updating its Long-Range Water Supply Plan. Under all alternatives, OWASA would continue to treat wastewater at its Mason Farm WWTP and use it as reclaimed water or recycle it to Morgan Creek, a tributary of Jordan Lake.

The information below summarizes OWASA's historic and planned strategies to access Jordan Lake:

History

1988	OWASA receives Round 1 Level II allocation of 10 percent of water supply pool (10 mgd) from EMC
1989	OWASA acquires 125 acres of land west of Jordan Lake and south of US Highway 64 for potential use as a future water supply and treatment facilities site
2000	OWASA submits Round 3 allocation application and requests 5 percent of water supply pool (Level II)
2002	EMC grants OWASA 5 percent (approximately 5 mgd) Level II allocation

2002, 2008	Two historic droughts hit region. OWASA realizes its vulnerability to severe, multi-year droughts and looks at options to increase reliability, redundancy, and diversity of its supply, and to manage demands
2002	OWASA implements State-approved process water recycling system at the WTP which decreases raw water demands by approximately 7 percent
2002	Seasonal rates implemented to encourage conservation by all customers
2003	OWASA adopts water conservation standards which include year-round water use restrictions. Revised water conservation ordinances adopted by Towns of Carrboro and Chapel Hill and Orange County to reflect OWASA's new standards (OWASA does not have statutory authority to adopt water conservation ordinance)
2007	OWASA implements increasing block rates to further encourage conservation by individually-metered residential customers; OWASA also implements system of Water Rate Drought Surcharges to further enhance conservation pricing message during declared shortage conditions
2009	OWASA and 12 other communities form and join Jordan Lake Partnership
2009	OWASA reclaimed water system begins operation in partnership with UNC
2009	OWASA revises water conservation standards to reflect lessons learned during 2007-2008 drought. Revised water conservation ordinances adopted by Towns of Carrboro and Chapel Hill and Orange County
2009	OWASA and Town of Cary enter into Mutual Aid Agreement in which OWASA can secure access to its Jordan Lake allocation
2010	OWASA and City of Durham enter into Mutual Aid Agreement in which OWASA can secure access to its Jordan Lake allocation
2012	OWASA submits request to EMC to change its Jordan Lake Level II 5 percent water storage allocation (approximately 5 mgd) to Level I; Town of Cary and City of Durham had informed OWASA that they would provide water supply assistance to OWASA, but could only provide capacity assurances if the water comes from OWASA's own Level I allocation
2012 – 2013	OWASA, Town of Cary, and City of Durham conduct coordinated, regional test of their interconnection capacities
2013	OWASA adopts Drought Response Operating Protocol
2013	EMC grants OWASA's request for conversion to a Level I allocation

2014 OWASA submits application to DWR to retain its Level I allocation for 5 percent of Jordan Lake's water supply pool

Planned Strategies

2014 OWASA participates in study funded by City of Durham to evaluate intake, treatment, and distribution options for shared Jordan Lake west water supply infrastructure with City of Durham, Chatham County, Town of Pittsboro, and OWASA

2014 – 2015 OWASA continues discussions with City of Durham and Town of Cary to modify existing Mutual Aid Agreements to guarantee access to Jordan Lake water when needed

2014 – 2015 JLP retains consultant to model capacities of the Triangle region's water system interconnections and recommend improvements to meet long-term needs

2015 OWASA maintains Level I allocation (approximately 5 mgd) through Round 4 Jordan Lake allocation process

2016 OWASA Board of Directors considers most up-to-date cost and technical information for water supply and demand management alternatives, including partnership arrangements for alternatives to secure access to Jordan Lake

2016 – 2018 OWASA selects alternative(s), finalizes update to Long-Range Water Supply Plan and pursues selected alternatives, including securing any necessary interlocal agreements

Mid-2020s OWASA begins to drain existing Quarry Reservoir to enable expansion when mining stops in December 2030; OWASA has higher vulnerability to drought until expanded Quarry Reservoir is filled and placed into service

Mid-2030s OWASA's expanded Quarry Reservoir is online

Raw and Finished Water Quality Monitoring Plan

As described in prior sections of this application, OWASA could access its allocation from Jordan Lake using existing mutual aid agreements with the City of Durham and Town of Cary. These agreements could be modified in the future to guarantee capacity in the Town of Cary's WTP. These agreements would be used until permanent access to Jordan Lake was obtained. Under these approaches, OWASA would receive treated water from the Town of Cary that was wheeled through our interconnection(s) with the City of Durham. The Town of Cary would monitor raw water under its existing program and all treated water leaving its plant to ensure compliance with all drinking water regulations.

OWASA would monitor the drinking water in its distribution system to ensure compliance with regulations established by EPA and the North Carolina Public Water Supply Section. Current regulations require OWASA to monitor a minimum of 80 sites in its distribution system, including sites with maximum residence time for disinfectant residuals and bacteriological contaminants every month. Water quality parameters (including pH, alkalinity, calcium hardness, ortho-phosphorus and conductivity) are monitored quarterly from seven distribution sites. Trihalomethanes and Haloacetic Acids are also monitored quarterly from 8 distribution sites. Additional quarterly sampling is required by the Unregulated Contaminant Monitoring Rule 3 for chromium, chromium-6, cobalt, molybdenum, strontium, vanadium, and chlorate. Lead and Copper testing is required once every three years for 30 homes with copper piping with lead solder in our service area. Asbestos is monitored once every nine years from one site in the distribution system.

Under the long-term alternative to access OWASA's Jordan Lake allocation presented in this application, OWASA would partner with the City of Durham, Chatham County, and Town of Pittsboro to build a new intake and treatment facility on Jordan Lake. While the institutional structure of this type of partnership is still unknown, OWASA would ensure that monitoring conducted as part of this partnership complied with all Federal and State requirements. For process control purposes OWASA monitors its current raw water supply sources on a weekly basis to measure dissolved oxygen, temperature, conductivity, pH, and chlorophyll-*a* at varying depths. Additionally, we enumerate and identify phytoplankton in the photic zone of each reservoir weekly. We use this data to determine which raw water sources to use, whether we need to change which intake we are withdrawing water through, and whether we need to modify chemical dosage at the plant. Water at various locations in the plant is monitored to ensure the treatment processes are working correctly.

Monitoring needed for process control would be set up at any new plant that would treat Jordan Lake water.

Estimate of Costs

Jordan Lake Costs

Jordan Lake was financed and constructed by the federal government through the US Army Corps of Engineers. Storage space for municipal and industrial water supply was included at the request of State and local officials with the understanding that the costs associated with this water supply storage would be paid for by the actual users. The result of that arrangement is that the management plan for Jordan Lake dedicates 33 percent of the conservation pool, or 45,800 acre feet, for water supply storage.

North Carolina General Statute 143-215.38 authorized the State, acting through the Environmental Management Commission, to assume repayment responsibilities for the costs associated with providing water supply storage in Jordan Lake. These costs fall into three basic categories: capital costs including interest, operating costs, and administrative costs. The total cost for each percent of water supply allocated from Jordan Lake varies with a number of parameters, the key ones being when the allocation is granted and when water is expected to be withdrawn. OWASA's estimated capital, operating and administrative costs associated with a

Level I allocation of 5 percent of Jordan Lake's water supply pool (approximately 5 mgd) are outlined below.

Capital and Interest Costs

Capital costs are based on the Jordan Lake construction costs of approximately $89 million, excluding funds budgeted specifically for recreational lands and facilities. Since the project's cost is shared among several project purposes, the Corps estimated that 4.6 percent of the construction cost is attributable to water supply. Including interest accrued during project construction, $4.388 million represents the original investment cost for the water supply provided by the reservoir. Based on this figure, the initial capital cost is $43,880 for each one percent of supply storage. OWASA paid $219,400 in capital costs in early 2013 when the State approved converting OWASA's allocation to Level I. Since OWASA has had an allocation since 1988, it has paid interest on its allocation; thus no invoice for additional interest was received from DWR when the conversion to Level I was approved.

Operating, Replacement, and Rehabilitation Costs

In addition to the costs incurred to construct the project, there are continuing expenses for operation and maintenance (O&M), and periodic expenses for replacement and rehabilitation of facilities at Jordan Lake. Current and future allocation holders are required to pay a proportional share of these operating expenses. Allocation holders must also reimburse the State for payments made to cover operating expenses since the Corps started charging for these operating expenses in 1992.

The proportional share of replacement costs attributed to water supply is estimated by the Corps to be 2.8 percent of the total expense. These costs are more difficult to budget because they are not incurred on a regular basis. The Corps estimated an annual equivalent project replacement expense of approximately $66,000. The proportion of these annual replacement costs charged against water supply amounts to approximately $1,800 total, or $18 per percent of storage. Until the Corps starts incurring replacement costs and passing these costs on to the State, allocation holders will not have any additional reimbursement costs associated with replacement costs.

The proportional share of major rehabilitation costs attributed to water supply is also estimated by the Corps to be 2.8 percent of the total expense. Annual rehabilitation costs can be estimated at about $30,090 based on costs incurred in 1995 and 1996. At this rate the proportion of these annual rehabilitation costs charged against water supply amounts to approximately $843 or $8.43 per percent of storage. Future allocation holders must reimburse the State for the actual rehabilitation payments made on their allocations since 1992. The Corps has not billed the State for any rehabilitation expenses since 1996. When rehabilitation expenses are incurred in the future they will be distributed proportionally to allocation holders.

OWASA has budgeted approximately $5,000 annually in O&M costs; when replacement and rehabilitation payments are also required, the payment will be approximately $11,000 annually for its Level I allocation.

Cost Summary

Based on the information provided above, and actual invoices received from DWR in January 2013 (Level II allocation) and March 2013 (modification to Level I allocation), the following summarizes OWASA's projected costs to maintain its Level I allocation.

Table VI.1 - Jordan Lake Costs

Estimates for Year	2013 Conversion fo Level I 2013	Subsequent Years
Capital Cost[1]	$219,400	
Accrued Interest on Capital[2]	$0	
Total Capital Cost[3]	$219,400	
Interest Portion of Capital Payments[4]	$7,076	$7,076
Annual O&M Cost [5]	$3,202	$3,887
Accrued O&M Cost [6]	$0	
Annual Rehab Cost[7]	$0	$42
Accrued Rehab Cost[8]	$0	
Replacement Cost[9]	$0	$90
Total Cost (5% allocation)	$449,078	$11,095
Additional Fixed Cost	$250	$250

Notes:

1. *$4,388,000 for 45,800 acre-feet of storage. This represents amount incurred by OWASA to convert its Level II allocation to Level I in 2013*
2. *3.225% interest paid annually on the original capital cost for the years 1992-2014, compounded annually. OWASA has been paying interest annually so none accrued.*
3. *Total Capital Cost = Capital Cost + Accrued Interest on Capital.*
4. *The interest on $43,880 at 3.225% interest rate; OWASA invoiced $7,076 in 2013.*
5. *The estimated annual O&M (operation and maintenance) cost, based on an average of actual O&M costs for the years 2007-2011. 2013 amount is based on actual invoice received.*
6. *The total of actual O&M costs for the years 1992-2011 and estimates for 2012, 2013 and 2014. Since OWASA has had Level II allocation since 1988, no accrued O&M costs.*
7. *The estimated annual rehabilitation cost, based on an average of actual rehabilitation costs for the years 1995-1996. None invoiced in 2013.*
8. *The total of actual rehabilitation costs for the years 1992-1999. Payback assumes either a lump sum, or 20 equal annual payments at a 3.225% interest rate.*
9. *Replacement cost is based on the Corps estimate of the average annual replacement cost. Note that there is no accrued replacement cost, as the State has not been billed for such as of year 2011.*
10. *Total Cost per percent of storage = (Total Capital Cost or Interest Portion of Capital Payments) + Annual O&M Cost + Accrued O&M Cost + Annual Rehabilitation Cost + Accrued Rehabilitation Costs + Replacement Cost.*
11. *An additional administrative charge of $250 is added to each allocation holder's bill.*

Other Capital Costs

Other capital costs to implement the Jordan Lake alternative are summarized in Section V which evaluates financial and non-financial aspects of the various alternatives considered by OWASA.

Operating Costs

If OWASA uses its current water purchase agreements, it would purchase finished water from the Town of Cary. The rate outlined in that agreement is the lowest tier applied to residential uses (currently $3.60 per 1,000 gallons or $3,600 per million gallons) (Town of Cary, 2013). However, the existing mutual aid agreement with the Town of Cary does not guarantee that OWASA will be able to receive water when and in the amounts needed. Based on discussion with the Town of Cary staff, if OWASA desires a greater level of receiving an assured supply of water from Cary the Town of Cary will modify the rate charged to OWASA.

Hazen and Sawyer has estimated the operating and maintenance costs for a shared intake, WTP and distribution facilities on the west side of Jordan Lake. Based on this analysis, OWASA's proportionate share of life cycle costs (through 2060) are $17 million assuming OWASA's capacity share of such regional facilities is 5 mgd.

Replacement and Rehabilitation Costs

Hazen and Sawyer's estimates of operating costs summarized above include the 2010 estimated cost through 2060, which includes replacement and rehabilitation costs.

Cost Summary

Hazen and Sawyer's estimates of operating costs also included an annual payment to maintain the Jordan Lake allocation, so total costs are addressed in their analysis for the western intake. This option to access Jordan Lake would provide OWASA long-term assurance in accessing its full allocation. The costs summarized below are those provided by Hazen and Sawyer for partnering on a western intake, pump station, transmission mains, and WTP.

Construction Cost	$20,180,000
Contractor Mobilization	$ 3,027,000
Engineering	$ 3,027,000
Land/Easements	$ 168,000
Legal/Permits	$ 1,160,000
Contingency	$ 2,756,000
Total Capital	$30,318,000
Present Worth of Life Cycle Costs	$47,322,000

Summary

To ensure that it has an adequate water supply to meet the full range of supply and demand conditions throughout the planning period, OWASA seeks to maintain its existing Level I allocation of 5 percent of the water supply storage in Jordan Lake (which corresponds to about 5 mgd). Jordan Lake would serve as a water supply insurance policy which OWASA can access when needed during drought or other operational emergency. The extreme droughts of 2001-2002 and 2007-2008 highlighted the limitations and vulnerability of OWASA's drinking water supplies, and the need for us to maintain a Jordan Lake water supply allocation to provide additional reliability and resiliency.

References

Town of Cary. 2013. Town of Cary website accessed December 30, 2013. http://budget.townofcary.org/budget/fy2014proposed/017-bundle.pdf

APPENDIX A: DENR JORDAN LAKE WATER SUPPLY WORKBOOK

Use Sector	Use Sub-sector	Description
Residential	Single Family Residential	Single Family Homes
	Multi-Family Residential	Townhomes, condominiums, apartments - may be separately metered or master metered
Commercial	Commercial	Offices and Retail
Industrial		
Institutional	UNC	UNC and UNC Hospital
	Other Institutional	Churches, Schools, Government Facilities
Unique		
Non-Revenue	WTP Process	Water used by the WTP in the production of finished water that is discharged and never enters the distribution system
	Other Non-Revenue	Water used for maintenance of distribution system including flushing, fire flow testing, installing new connections; all onter non-revenue water, which is primarily leakage, theft, unnmetered use, meter error.

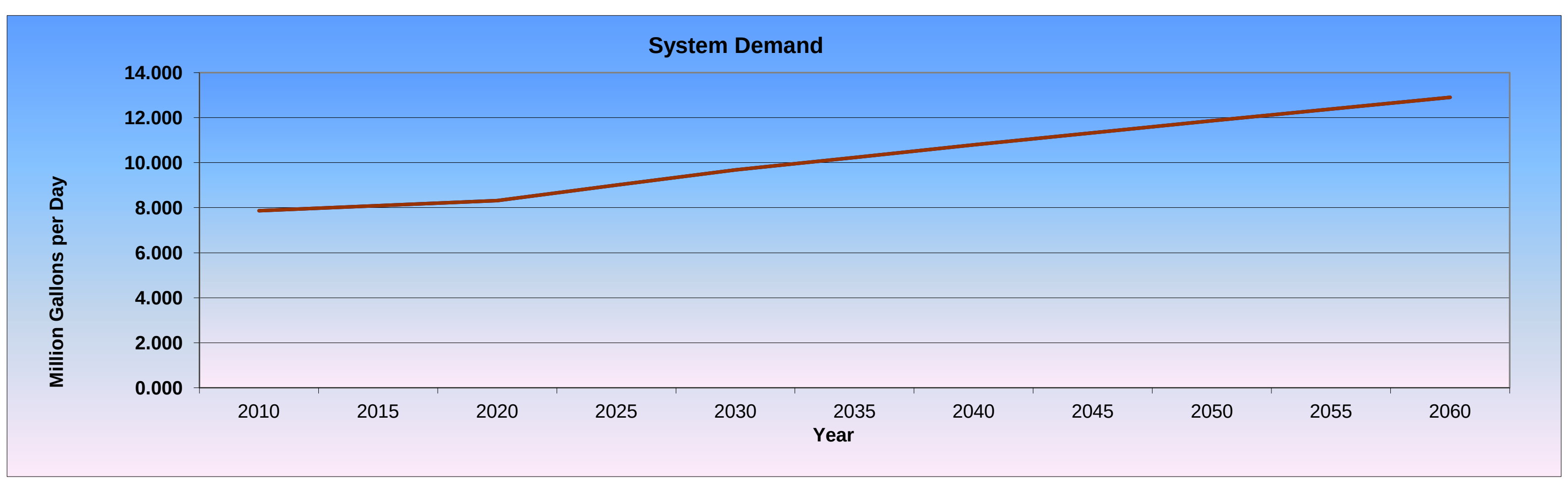
Local Water Supply Plan supplemental information for Jordan Lake Allocation Application

Applicant OWASA

Date 28-Oct-14

Projections

Type of Population to be Served												
		2010	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**	**2055**	**2060**
Year-round population		79400	86850	92700	101450	107000	115700	121200	129950	135500	144200	149700
Seasonal Population (if applicable)												
Indicate months of seasonal use												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**June**	**Jul**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**
Type of Use (Average Daily Service Area Demand in Million Gallons per Day (MGD) Do not include sales to other systems)												
		2010	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**	**2055**	**2060**
(1) Residential		4	4.115	4.23	4.58	4.93	5.21	5.49	5.76	6.03	6.3	6.57
Metered Irrigation												
(2) Commercial		1.17	1.205	1.24	1.34	1.44	1.525	1.61	1.69	1.77	1.845	1.92
Metered Irrigation												
(3) Industrial		0	0	0	0	0	0	0	0	0	0	0
Metered Irrigation												
(4) Institutional		1.9	1.955	2.01	2.175	2.34	2.475	2.61	2.74	2.87	2.995	3.12
Metered Irrigation												
Sub-total		7.070	7.275	7.480	8.095	8.710	9.210	9.710	10.190	10.670	11.140	11.610
(5) System Processes % as Decimal	0.01	0.090	0.095	0.100	0.105	0.110	0.115	0.120	0.130	0.140	0.145	0.150
(6) Non-Revenue Water % as Decimal	0.10	0.700	0.720	0.740	0.800	0.860	0.910	0.960	1.005	1.050	1.100	1.150
(7) Total Service Area Demand		7.860	8.090	8.320	9.000	9.680	10.235	10.790	11.325	11.860	12.385	12.910
Sales Commitments		**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**	**2055**	**2060**
Existing Sales Contracts (list buyer and years covered by contract)												
Emergency Sales Only												
Existing commitments for additional Future Sales (list buyer)												
Total Sales Contracts		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total System Demand		7.860	8.090	8.320	9.000	9.680	10.235	10.790	11.325	11.860	12.385	12.910
		2010	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**	**2055**	**2060**



Future Sales Contracts that have already been agreed to.						
Water Supplied to:		Contract Amount and Duration			Pipe Size	Regular or
System Name	PWSID	MGD	Year Begin	Year End	(inches)	Emergency
Chatham County - North	03-19-126	0			16	Emergency
City of Durham	03-32-010	0		2029	16	Emergency
Town of Cary	03-92-020	0		2029		Emergency
Town of Hillsborough	03-68-015	0			16	Emergency

Future Supplies List all new supplies or facilities which were under development as of July 1, 2012							
Source or Facility Name	PWSID	SW or GW	Sub-Basin	Wat Qual Classification	Expected Supply	Development Time	Year Online

Demand - Supply Comparison (Show all quantities in Million Gallons per Day)											
Available Supply , MGD	2010	2015	2020	2025	2030	2035	2040	2045	2050	2055	2060
(1) Existing Surface Water Supply	10.500	15.500	15.500	15.500	15.500	15.500	15.500	15.500	15.500	15.500	15.500
(2) Existing Ground Water Supply											
(3) Existing Purchase Contracts											
(4) Future Supplies											
(5) Total Available Supply	10.500	15.500	15.500	15.500	15.500	15.500	15.500	15.500	15.500	15.500	15.500
(6) Service Area Demand	7.860	8.090	8.320	9.000	9.680	10.235	10.790	11.325	11.860	12.385	12.910
(7) Existing Sales Contracts											
(8) Contracts for Future Sales											
(9) Total Average Daily Demand		8.090	8.320	9.000	9.680	10.235	10.790	11.325	11.860	12.385	12.910
(10) Demand as Percent of Supply		52%	54%	58%	62%	66%	70%	73%	77%	80%	83%
Additional Information for J.L. Allocation											
(12) Sales Under Existing Contracts											
(13) Expected Sales Under Future Contracts											
(14) Demand in Each Planning Period	7.860	8.090	8.320	9.000	9.680	10.235	10.790	11.325	11.860	12.385	12.910
(15) Supply Deficit (Demand minus Supply)	(2.640)	(7.410)	(7.180)	(6.500)	(5.820)	(5.265)	(4.710)	(4.175)	(3.640)	(3.115)	(2.590)

OWASA	Applicant
28-Oct-14	Date

Future Supply Alternative 1

List the Components of each alternative scenario including the expected period when each component will come online. Show all water volumes in millions of gallons per day

	(label the alternative presented in this table) 2010	2015	2020	2025	2030	2035	2040	2045	2050	2055	2060
(1) Line (15) From Demand - Supply Comparison Table	-2.64	-7.41	-7.18	-6.5	-5.82	-5.265	-4.71	-4.175	-3.64	-3.115	-2.59
(2) Available supply from project 1		0	0	0	0	0	0	0	0	0	0
Available supply from project 2						2.1	2.1	2.1	2.1	2.1	2.1
Available supply from project 3											
(3) Supply Available for future needs	**2.64**	**7.41**	**7.18**	**6.5**	**5.82**	**7.365**	**6.81**	**6.275**	**5.74**	**5.215**	**4.69**
(4) Total discharge to Source Basin											
(5) Consumptive Use in Source Basin											
(6) Total discharge to Receiving Basin											
(7) Consumptive Use in Receiving Basin											
(8) Amount NOT returned to Source Basin	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

List details of the future supply options included in this alternative scenario

Future Source	PWSID	SW or GW	GS 143-215.22G Basin	Wat. Qual Classification	Additional Supply mgd	Development Time (years)	Year Online
Jordan Lake		SW	Haw (2-1)	WS-IV, NSW	0	0*	2013
Expand quarry storage - shallow option		SW	Haw (2-1)	WS-II, HQW, NSW	2.1	7	2035

* Could access Jordan Lake now through mutual aid agreements so included in existing supp

* W. Intake would not be available until 2020

OWASA	Applicant
28-Oct-14	Date

Future Supply Alternative 2

List the Components of each alternative scenario including the expected period when each component will come online. Show all water volumes in millions of gallons per day

(label the alternative presented in this table)	2010	2015	2020	2025	2030	2035	2040	2045	2050	2055	2060
(1) Line (15) From Demand - Supply Comparison Table	-2.64	-7.41	-7.18	-6.5	-5.82	-5.265	-4.71	-4.175	-3.64	-3.115	-2.59
(2) Available supply from project 1						3.4	3.4	3.4	3.4	3.4	3.4
Available supply from project 2						-5	-5	-5	-5	-5	-5
Available supply from project 3											
(3) Supply Available for future needs	**2.64**	**7.41**	**7.18**	**6.5**	**5.82**	**3.665**	**3.11**	**2.575**	**2.04**	**1.515**	**0.99**
(4) Total discharge to Source Basin											
(5) Consumptive Use in Source Basin											
(6) Total discharge to Receiving Basin											
(7) Consumptive Use in Receiving Basin											
(8) Amount NOT returned to Source Basin	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

List details of the future supply options included in this alternative scenario

Future Source	PWSID	SW or GW	GS 143-215.22G Basin	Wat. Qual Classification	Additional Supply mgd	Development Time (years)	Year Online
Expand Quarry - deep option		SW	Haw (2-1)	WS-II, HQW, NSW	3.4	7	2035
Relinquish Jordan Lake allocation after quarry online		SW	Haw (2-1)	WS-IV, NSW	-5	N/A	2035

OWASA	Applicant
28-Oct-14	Date

Future Supply Alternative 3

List the Components of each alternative scenario including the expected period when each component will come online. Show all water volumes in millions of gallons per day

	(label the alternative presented in this table)										
	2010	2015	2020	2025	2030	2035	2040	2045	2050	2055	2060
(1) Line (15) From Demand - Supply Comparison Table	-2.64	-7.41	-7.18	-6.5	-5.82	-5.265	-4.71	-4.175	-3.64	-3.115	-2.59
(2) Available supply from project 1					7.7	7.7	7.7	7.7	7.7	7.7	7.7
Available supply from project 2						2.1	2.1	2.1	2.1	2.1	2.1
Available supply from project 3					-5	-5	-5	-5	-5	-5	-5
(3) Supply Available for future needs	**2.64**	**7.41**	**7.18**	**6.5**	**8.52**	**10.065**	**9.51**	**8.975**	**8.44**	**7.915**	**7.39**
(4) Total discharge to Source Basin											
(5) Consumptive Use in Source Basin											
(6) Total discharge to Receiving Basin											
(7) Consumptive Use in Receiving Basin											
(8) Amount NOT returned to Source Basin	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

List details of the future supply options included in this alternative scenario

Future Source	PWSID	SW or GW	GS 143-215.22G Basin	Wat. Qual Classification	Additional Supply mgd	Development Time (years)	Year Online
Haw River		SW	Haw (2-1)	WS-V, NSW	7.7	10	2030
Expand Quarry - shallow option		SW	Haw (2-1)	WS-II, HQW, NSW	2.1	7	2035
Jordan Lake - relinquish allocation		SW	Haw (2-1)	WS-IV, NSW	-5	N/A	2030

OWASA	Applicant
28-Oct-14	Date

Future Supply Alternative 4

List the Components of each alternative scenario including the expected period when each component will come online. Show all water volumes in millions of gallons per day

	(label the alternative presented in this table)										
	2010	2015	2020	2025	2030	2035	2040	2045	2050	2055	2060
(1) Line (15) From Demand - Supply Comparison Table	-2.64	-7.41	-7.18	-6.5	-5.82	-5.265	-4.71	-4.175	-3.64	-3.115	-2.59
(2) Available supply from project 1				0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34
Available supply from project 2						2.1	2.1	2.1	2.1	2.1	2.1
Available supply from project 3						-5	-5	-5	-5	-5	-5
(3) Supply Available for future needs	**2.64**	**7.41**	**7.18**	**6.84**	**6.16**	**2.705**	**2.15**	**1.615**	**1.08**	**0.555**	**0.03**
(4) Total discharge to Source Basin											
(5) Consumptive Use in Source Basin											
(6) Total discharge to Receiving Basin											
(7) Consumptive Use in Receiving Basin											
(8) Amount NOT returned to Source Basin	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

List details of the future supply options included in this alternative scenario

Future Source	PWSID	SW or GW	GS 143-215.22G Basin	Wat. Qual Classification	Additional Supply mgd	Development Time (years)	Year Online
Reclaimed Water			N/A	N/A	0.34*	10	2025
Expand Quarry - shallow option		SW	Haw (2-1)	WS-II, HQW, NSW	2.1	7	2035
Relinquish Jordan Lake allocation		SW	Haw (2-1)	WS-IV, NSW	-5	N/A	2035

*0.09 - 0.34 mgd depending on where lines go and number of customer requests for reclaimed water

Applicant	OWASA
Date	30-Apr-14

Alternatives	**Summary Description**
Alternative 1	Jordan Lake/Shallow Quarry - OWASA maintains its 5 mgd Level 1 allocation from Jordan Lake and expands quarry (shallow option)
Alternative 2	Deep Quarry - OWASA would expand its quarry reservoir and access the lower depths of the quarry and relinquish its Level 1 allocation after quarry online)
Alternative 3	Haw River/Expand Quarry (Shallow) - OWASA constructs a permanent intake on the Haw River and a pipeline from the Haw River to Cane Creek Reservoir; OWASA would also expand its quarry reservoir (shallow option). OWASA relinquishes its Jordan Lake allocation after one of the new supplies is online.
Alternative 4	Expand Reclaimed Water System/Expand Quarry (Shallow) - OWASA extends reclaimed water to Highway 54 area and cogeneraiton plant and expands the quarry (shallow option). After quarry online, OWASA relinquishes its Jordan Lake allocation.

	Alternative 1 (Jordan Lake Allocation)	**Alternative 2**	**Alternative 3**	**Alternative 4**	**Notes**
Allocation Request (% of storage)	5	5.0 (would relinquish after quarry online)	5.0 (would relinquish after Haw intake or shallow quarry online)	5.0 (would relinquish after shallow quarry online)	
Total Supply from Alternative (MGD)	7.1*	3.4	9.8	2.4	Totals do not include temporary allocation from Jordan Lake for alternatives 2, 3, and 4
Environmental Impacts	The Same	Less Than	The Same	More Than	
Water Quality Classification	WS-IV, NSW	WS-II, HQW, NSW	WS-V, NSW	WS-II, HQW, NSW	
Interbasin Transfer (MGD)	0	0	0	0	
Regional Partnerships	Yes - JLP	No	No	UNC only	
Technical Complexity	Complex	Complex	Not Complex	Complex	
Institutional Complexity	Complex	Not Complex	Very Complex	Complex	
Political Complexity	Complex	Not Complex	Very Complex	Not Complex	
Public Benefits	Many	None	None	Few	
Consistency with local plans	Yes	No	No	No	
Total Cost ($ millions)	$30.3	$52.0	$29.3	$8.7	These totals do not include shallow quarry cost
Unit Cost ($/1000 gallons)	$6.1	$15.3	$3.8	$25.6	These totals do not include shallow quarry cost
Total Cost w/quarry ($ millions)	$31.7	$52.0	$30.7	$10.1	
Unit Cost w/quarry (million $/mgd)	$4.5	$15.3	$3.1	$4.1	

APPENDIX B: WESTERN INTAKE SCOPE OF WORK

HAZEN AND SAWYER
Environmental Engineers & Scientists

DRAFT ENGINEERING SERVICES PROPOSAL FOR THE CITY OF DURHAM, NC UPDATE LIFE-CYCLE COSTS ESTIMATES FOR TWO WATER SUPPLY OPTIONS: OWASA-DURHAM JORDAN LAKE JOINT DEVELOPMENT, AND EXPAND LAKE MICHIE

December 16, 2013

Project Understanding and Scope

The City of Durham is currently preparing an application for the Jordan Lake Water Supply Storage Allocation – Round 4 which is due in early 2014. As part of this application the applicant is required to calculate costs for their proposed Jordan Lake allocation as well as proposed water supply alternatives. As part of the Jordan Lake Partnership (JLP), the City of Durham is working with the Orange Water and Sewer Authority (OWASA), Chatham County, and the Town of Pittsboro (referred to hereinafter as the Western Intake Partners) to expand use of the Jordan Lake water supply pool by constructing a regional intake on the western shore of the lake. As a part of this planning effort, and to provide the cost estimates required by the Jordan Lake Application – Round 4, the City wishes to update the following two water supply feasibility investigations:

1. Technical Memorandum (TM) 3-Develop Jordan Lake in Partnership with Others, Option 3b: Jordan Lake plus a new water treatment plant at OWASA's Bells Landing property; construct a new jointly-owned pipeline to convey finished water to the OWASA-Durham interconnection located in the vicinity of Old Chapel Hill Road and Pope Road; and increase booster pumping capacity to provide 10 mgd of finished water to OWASA's 642-feet pressure gradient. This TM was prepared for OWASA by Hazen and Sawyer, P.C, in June 18, 2009 (final version issued by OWASA in January 15, 2010) in support of the 2010 OWASA Long-Range Water Supply Plan Update.

2. Expand Lake Michie from its present Water Surface Elevation (WSE) of 341 feet to Intermediate WSE 365 or Ultimate WSE 380. A preliminary engineering evaluation of these two options was completed for the City of Durham as a part of the *Evaluation of Alternative Reservoirs on the Flat River and Little River*, Hazen and Sawyer, October 1988.

The City's primary interest is to update the capital and life-cycle cost estimates of these investigations to a common year 2010 basis in support of its Jordan Lake Round 4 Water Supply Storage Allocation request. To reflect the full JLP membership in the TM 3b investigation, the City wishes to add conceptual design and life-cycle costs for finished water interconnections with Chatham County and the Town of Pittsboro in addition to the included OWASA-Durham interconnection. Sizing of the Jordan Lake Regional Water Treatment Plant (JLRWTP) and related infrastructure may also be updated accordingly.

In the second investigation, the City recognizes that calculations of reservoir yield the conceptual design concepts for expanding Lake Michie are dated. For example, the design concept for the new Lake

Michie Dam assumed a conventional earthfill embankment, whereas modern roller-compacted concrete construction techniques would probably be cost competitive and also attractive in terms of a shorter time to construct the new dam and lower operation and maintenance costs. Furthermore, the safe yield evaluations were based on pre-1988 streamflow records and bathymetrical and topographical data that have since been updated. Nevertheless, in this case, a simple updating of most of the capital and lifecycle costs contained in the referenced 1988 report is all that is required for present purposes.

Land acquisition and environmental mitigation are exceptions. In the 1988 report, costs for environmental mitigation assumed impacts of the expanded reservoir would be mitigated through the purchase and placement under the management of the Carolina Wildlife Resources Commission (WRC) an amount of land equal to the acreage located between the existing and proposed reservoir WSE's. It was further assumed that the City would purchase all additional lands located above the normal WSE that would be inundated during passage of the estimated maximum reservoir flood level, and that these "flood" lands would qualify as mitigation property and would thus offset the net acreage to be purchased for environmental mitigation. These assumptions will be reviewed and mitigation requirements will be updated to reflect current experience in environmental mitigation for similar projects. In addition, the estimate of required land acquisition will be adjusted to reflect current City ownership of lands surrounding Lake Michie.

<u>Tasks and Deliverables</u>

The following is a summary of the professional engineering services to be performed by Hazen and Sawyer for this project:

Task 1: Meetings with the City of Durham and Western Intake Partners

In addition to usual communications by phone and email, Hazen and Sawyer will attend two meetings with the City as follows:

1. Kickoff meeting with the Western Intake Partner's (or conference call) to confirm the project scope, details, and objectives.
2. Presentation of costs for each alternative and supporting information/assumptions. After forwarding a draft cost estimate to the City of Durham, Hazen and Sawyer will attend a meeting to present and review the costs and assumptions and receive the City's comments.

Task 2: Update Water Supply Feasibility Investigations

Hazen and Sawyer will update the two referenced feasibility investigations as discussed above under Project Understanding and Scope and as follows:

1. TM 3-Develop Jordan Lake in Partnership with Others, Option 3b - The following subtasks will be completed to update this alternative consistent with the level of engineering accuracy and detail reflected in the original TM:
    a. Update sizing of the JLRWTP, intake, and related infrastructure based on revised capacity, pumping rates, and related information provided by the City of Durham and the WIPs.

b. Based on design capacity information and input on pipeline routes furnished by the WIPs, develop a conceptual design for finished water transmission pipelines from the new JLRWTP to serve Chatham County and the Town of Pittsboro.

c. Update the capital and life-cycle cost spreadsheet used to prepare TM 3 to include/adjust for the foregoing subtasks. Update the cost spreadsheet to the current Engineering News Record Construction Cost Index (ENR CCI). Based on cost sharing information provided by the City, develop estimates of capital and lifecycle costs as required by the Jordan Lake Water Supply Storage Application guidelines for each WIP.

2. Lake Michie Expansion - The following subtasks will be completed to update this alternative. The level of effort will be generally consistent with that discussed above for TM 3:

a. Input project data from the 1988 report for the two Lake Michie Expansion options to the cost template spreadsheet used to prepare TM 3.

b. Based on current experience in environmental mitigation for similar reservoir development projects, update environmental mitigation costs to reflect property acquisition and other mitigation requirements that will likely be imposed during the Section 401/404 permitting process for the reservoir expansion. Note that for the purposes of this update, wetlands impacts will be estimated from the existing National Wetlands Inventory maps, and impacts on streams will be based on a similar desktop survey. No field investigations will be performed. Wetland mitigation costs will be based on the EEP published mitigation costs for wetlands and streams.

c. Based on real estate information provided by the City, update the estimate of lands within the reservoir acquisition area that are already owned by the City and also update the estimate of costs for additional property to be acquired.

d. Update the capital and life-cycle cost spreadsheet for this alternative to include/adjust for the foregoing subtasks. Also update the cost spreadsheet to the current Engineering News Record Construction Cost Index (ENR CCI).

3. Cost Estimate Summary and Supporting Assumptions: For each of the two water supply alternatives we will prepare a brief project description and cost estimate for use in the Jordan Lake Water Supply Storage – Round 4 Application, to include the assumptions and data used to prepare the cost estimate. summary of the assumptions used to prepare/update the cost

- Brief Project Description and Scope
- Bullet list of the Conceptual Design Assumptions, including
    - Design Capacity
    - List of Facilities involved (and capacity)
    - Pipelines / Interconnections for each of the WIPs (TM 3b update only)
    - Permitting and regulatory cost assumptions

- Cost Table (total cost, and cost for each WIP)
- Attachments, including supporting engineering calculations and cost spreadsheets

Schedule

We anticipate that we will complete and forward the Cost Estimates and Supporting Data to the City within four calendar weeks after receipt of the City of Durham's authorization to proceed. This schedule assumes that we will receive timely input from the City for the items discussed hereinbefore and that there are no delays for these or other items not within our control. Following receipt of the City's comments on the cost estimates, we will prepare and forward to the City final cost estimates within one week.

Fee

Hazen and Sawyer will complete all of the services described above for a lump sum fee of $##,###.

APPENDIX C: LONG-RANGE WATER SUPPLY PLAN

LONG-RANGE WATER SUPPLY PLAN

FINAL REPORT

APRIL 8, 2010

Revised: 02/04/2011
08/30/2011
04/20/2012
01/25/2013

Orange Water and Sewer Authority
Carrboro, North Carolina

Cane Creek Reservoir

ORANGE WATER AND SEWER AUTHORITY

A public, non-profit agency providing water, sewer and reclaimed water services to the Carrboro-Chapel Hill community.

<u>Revisions to Original April 8, 2010 Version of This Report and Appendices</u>

Revision Date	**Description**	**Pages**
2/4/2011	Technical correction and clarification regarding capacity and cost of Expanded Quarry Reservoir options (no impact on other portions of this Report or on the Findings and Conclusions).	12
8/30/2011	Updated 50-year demand projections per revised UNC estimates and other modified assumptions (no impact on other portions of this Report or on the Findings and Conclusions).	4-6, 8 and Appendix II
4/20/2012	Revised economic analysis of Option 5C (Temporary Water Shortage Restrictions). Previous versions considered (unbudgeted) revenue losses resulting from additional water shortage restrictions to be a significant "cost" of Option 5C. Unbudgeted revenue losses are no longer included in the cost calculations for this option.	2-3, 17, 18, 24 (Table 3), 25 and Appendix XI
	Revised text reflects the OWASA Board's 10/20/2011 policy resolution, which stated that: *"OWASA shall only purchase water from other communities or obtain water from its Jordan Lake storage allocation during periods of increased drought risk after it has declared a Stage 1 Water Supply Shortage per OWASA's State-approved Water Shortage Response Plan and OWASA's Water Conservation Standards as incorporated therein."* This revision, along with the revised economic analysis of Option 5C (Temporary Water Shortage Restrictions), is reflected in changes to Key Recommendation 4 and Additional Recommendation A of the Report.	17-18 and 28
	Other corrections and minor text adjustments to ensure editorial consistency within the Report and with current OWASA policy.	
1/25/2013	Revised text reflects the OWASA Board's 1/10/2013 adoption of a Drought Response Operating Protocol (DROP), which stated that: *"The OWASA Board may authorize purchases from other utilities and/or obtain water through its Jordan Lake allocation only when total water storage in University Lake, Cane Creek Reservoir, and the Quarry Reservoir is below the Mandatory Stage 1 Shortage trigger, but no sooner."*	17-18 and 28

ORANGE WATER AND SEWER AUTHORITY

A public, non-profit agency providing water, sewer and reclaimed water services to the Carrboro-Chapel Hill community.

FINAL REPORT
LONG-RANGE WATER SUPPLY PLAN

Table of Contents

ORANGE WATER AND SEWER AUTHORITY

A public, non-profit agency providing water, sewer and reclaimed water services to the Carrboro-Chapel Hill community.

Long-Range Water Supply Plan
Executive Summary

The threat of water shortages during the historic droughts of 2001-02 and 2007-08 confronted OWASA with challenging questions. Do we have enough water to meet our community's present and future needs? What are the most reliable, cost-effective, and sustainable supply and demand methods for meeting those needs? How will our options be affected by future climate and land use changes? This report answers those questions with a very positive outlook for our water supply future.

Thanks largely to the 25 percent reduction in water use achieved by all OWASA customers since 2002, our locally protected Cane Creek, University Lake, and Quarry Reservoir supplies can meet our expected needs for the next 50 years under most circumstances; *but, it is essential that the recent gains in water efficiency be sustained in the future for this Plan to be fully realized.* To that end, OWASA will continue to promote water conservation and efficiency through customer awareness and education, targeted technical assistance, conservation pricing, and support for increased water efficiency standards in new and renovated buildings.

Expanding the Quarry Reservoir continues to offer the most effective supply supplement for the least investment and will provide full local control of a substantial amount of high quality water; however, that supply source will not be available until 2035. Between now and the time that the expanded Quarry Reservoir is in service, we will need the additional "insurance policy" of Jordan Lake in the event of severe drought, critical facility failure, or other unforeseen/ emergency situation. The only economically feasible access to our Jordan Lake water supply storage allocation will be through partnership arrangements with area utilities; that is, by securing the permanent ability to obtain water under appropriate conditions of supply and demand – either through purchases or other arrangements. OWASA's continued participation in the Jordan Lake Partnership offers important opportunities to develop such agreements. It is essential that we retain our water supply allocation and acquire cost-effective access to it.

Investing OWASA funds to expand the reclaimed water system or to establish financial incentive programs, such as plumbing fixture rebates, to promote additional water conservation is not recommended at this time, because these options are less cost-effective than others evaluated. Nevertheless, we will continue to examine such opportunities on a case-by-case basis.

This report presents a positive water supply future for OWASA and the conservation-minded community we serve. The continued and proactive practice of this conservation ethic will enable future generations to enjoy a reliable and more sustainable supply of high quality drinking water with far less capital investment than anticipated in previous reports.

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SECTION 1
BACKGROUND AND PURPOSE

The purpose of OWASA's Long-Range Water Supply Plan is to determine the optimum mix of strategies that will ensure a reliable, cost-effective, and sustainable water supply to meet the needs of Carrboro, Chapel Hill, and the University of North Carolina at Chapel Hill (UNC) through 2060. During the 10 years since OWASA's 50-year water supply plan was last revised, two historic droughts have occurred; OWASA's rate structure has been significantly modified; permanent process water recycling has been implemented at the Jones Ferry Road Water Treatment Plant (WTP); a major reclaimed water (RCW) system has begun operating; non-potable water sources and advanced water use efficiency technologies are now increasingly being incorporated into new commercial and residential development; and customer consumption patterns have changed markedly.

This update recognizes the need to revisit underlying assumptions – especially in view of such substantially changed conditions – and the relative benefits and costs of supplemental supply and demand management options that were evaluated previously, as well as others that have not been considered. This report focuses on untreated (raw) water. It does not address other important aspects of OWASA's drinking water system, such as treatment, storage, and distribution, that also determine the overall reliability of our system.

Guiding Principles

Consistent with OWASA's Mission Statement and longstanding support of proactive resource planning, source water protection, and water conservation, this report has been guided by the following principles:

- *Making the highest and best use of our local water resources: University Lake, Cane Creek Reservoir, and the Quarry Reservoir.*
- *Cost-effectiveness for OWASA and its customers, with consideration for economic, environmental, and social costs and benefits.*
- *Reliability, redundancy, and flexibility to maintain a full range of water supply options for future generations.*

Assumptions

The technical and economic methods on which the major findings and recommendations of this report were based are described below. Key assumptions that underlie the entire report include:

- *OWASA's utility service area, as defined by the urban services boundaries of Carrboro, Chapel Hill, and Orange County, will remain unchanged through 2060.*
- *Water demand projections do not anticipate any retail or wholesale water, wastewater, or RCW sales outside of the existing service area.*
- *Future State and Federal regulations will allow OWASA to continue recycling water treatment plant process water and operating its RCW program.*

Report Preparation

OWASA retained the engineering firm of Hazen and Sawyer, P.C. to conduct the underlying technical and economic analyses for this report. That work is presented in a series of Technical Memoranda (TMs) in the Appendices. Additionally, Hazen and Sawyer developed specialized spreadsheet tools for analyzing the financial costs and benefits of each supplemental supply and demand reduction option under a range of variables. OWASA staff then applied these tools to generate the cost information presented in this report. Some of the TMs are followed by two versions of the cost analyses: (1) the original Hazen and Sawyer spreadsheets as reflected in the text and tables of the corresponding TMs (these did not evaluate the costs of meeting the water demand projections subsequently developed by OWASA); and (2) OWASA staff's application of the spreadsheets as reflected in the text and tables in the body of this report.

Fifty-year water demand projections were developed by OWASA in consultation with planning and economic development staffs of Carrboro, Chapel Hill, Orange County, UNC, and UNC Hospitals.

This report was compiled and written by OWASA staff and reviewed by Hazen and Sawyer for technical accuracy.

Engineering and Cost Estimates

A goal of the planning level economic estimates and financial evaluations was to apply uniform methods and assumptions that would provide valid relative comparisons among the individual water supply and demand reduction options. All costs in the individual TMs represent order-of-magnitude estimates to be used for comparing the options and for long-range planning purposes. These estimates were developed to a sufficient level of detail that incorporates the major components of each alternative for planning-level purposes. Estimates were not based on the more detailed levels of engineering and cost analyses customarily applied to preliminary and final stages of project design work. Additional descriptions of the approach and methods are presented in **Appendix I.**

Financial Cost/Benefit Analysis

All financial evaluations incorporate the net present life-cycle costs (NPC) of each supply or demand reduction option. These include capital costs, periodic rehabilitation/replacement, and fixed and variable operating and maintenance costs. Capital improvements are assumed to have a useful life of 50 years, with salvage value (useful remaining life of the facilities in 2060) credited toward life-cycle costs.

Capital costs are assumed to be debt-financed for 25 years at a uniform annual interest rate of 5%. All costs are discounted back to the present at an assumed annual rate of 5%. Net present costs (in 2009 dollars) are generally presented in two ways for each identified option: (1) as the capital cost per million gallons per day (mgd) of additional yield (or demand reduction), and (2) as the total life-cycle cost per 1,000 gallons supplied to meet any deficits projected during the 50-year planning period.

Future Updates

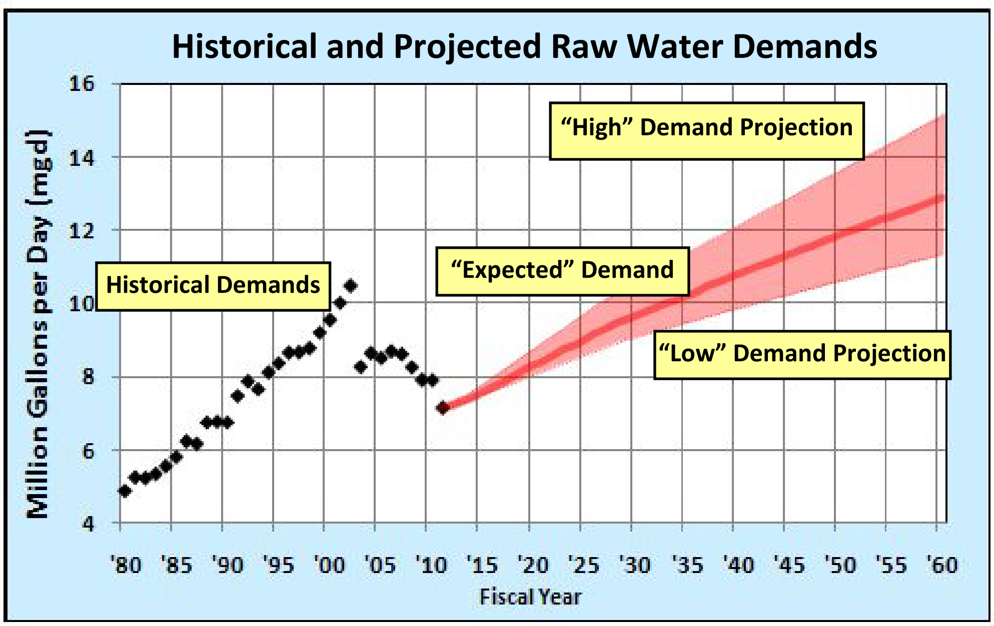
OWASA's Long-Range Water Supply Plan is not a static report, but will be periodically reviewed and updated to reflect changes to the assumptions, conditions, and information on which this 2010 edition is based.

SECTION 2
50-YEAR WATER DEMAND PROJECTIONS
(Revised 8/30/11)

Demand projections were developed from historical and recent OWASA consumption data by major user groups (single family detached, condominium/townhouse, multifamily, UNC Central Campus, UNC Hospitals, "other" non-residential users); historical, recent, and anticipated development trends as documented by local building permit and certificate of occupancy data, published planning documents of Carrboro, Chapel Hill, and UNC; and consultation with planning and economic development staff of Carrboro, Chapel Hill, Orange County, UNC, and UNC Hospitals. The demand projections incorporated the most current information available about development plans for Carolina North.

Historical and projected demands are presented in Figure 1. Black diamond symbols indicate average annual water withdrawals from OWASA's reservoirs from Fiscal Years 1980 through 2011, and the red bands represent High, Low, and Expected demand projections through 2060. Principal assumptions for those scenarios are listed below the graph. Additional details are provided in **Appendix II.**

Figure 1. 50-Year Raw Water Demand Projections



"Expected Demand" Assumptions:

- The pace of local development activity will return to the 1980-2000 average of approximately 560 new meter equivalents (MEs) per year within several years and will continue at this linear rate through 2060. (One ME represents the water demand exerted by a typical single family residential customer. A non-residential or institutional customer with greater needs requires a larger meter, and therefore represents multiple MEs.) Although this may be considered to be an unrealistically high forecast of future growth, it is consistent with the Town of Chapel Hill's *Residential Market Study, December 2010*, prepared by Development Concepts, Inc., which projects an average annual housing demand of 392 new units per year through 2020 for Chapel Hill. None of the long-range planning documents of Carrboro, Chapel Hill, or Orange County provide development projections beyond 2035.

- The future profile of OWASA's service area will follow recent trends with respect to the overall mix of single versus multi-family residential, commercial, and other uses.

- UNC Central Campus and UNC Hospitals projections are based on an average areal consumption rate of 0.144 gpd/GSF applied to 4.6 million of additional GSF *(3/26/2006 UNC Campus Master Plan Update)* with buildout occurring in 2028. It is assumed that reclaimed and/or other non-potable water will meet 27% of total Main Campus/Hospitals demands by 2028.

- Carolina North projections are based on McKim & Creed's *Technical Memorandum: Carolina North Campus Utility Infrastructure Planning to Support US Army Corps of Engineers Permitting Submittal, March 26, 2010, Exhibits 1-2 and 1-3.* It is assumed that non-potable sources (harvested rainwater) will ultimately replace 8.7% of the 1.39 mgd total demand projected for Carolina North.

- Initial (2010) consumption rates for major user groups are based on actual OWASA averages observed from FY 2004-2007, a period when annual demand remained stable, no drought conditions occurred, and no changes were made to OWASA's rate structure. "Expected" projections assume that additional passive conservation will further reduce demand from existing (pre-2010) units by 15% by 2060, and by 10% from all new development by 2060.

"Lower Demand" Scenario – Same assumptions as for "Expected Demands," except for the following:

- 15% less residential and non-residential (non-UNC) development through 2060.

- Reclaimed and/or other non-potable water will replace 50% of potable demand at Carolina North.

- By 2060, additional conservation will reduce existing (pre-2010) UNC Central Campus/Hospitals demand by 7.5% and Carolina North Demand by 5%.

"Higher Demand" Scenario – Same assumptions as for "Expected Demands," except for the following:

- One new high density mixed use development project – similar in scale to Chapel Hill's "East 54" – with water demands equivalent to approximately 150 new single family homes added each year through 2060.

- New non-residential (non-UNC) development through 2060 is 25% greater than expected.

- UNC Central Campus and UNC Hospitals growth through 2028 is 25% greater than expected.

- Carolina North water demand is 25% higher than expected and no reclaimed or other non-potable water use occurs.

50-YEAR WATER DEMAND PROJECTIONS

Key Findings

Demand projections through 2060 are substantially less than OWASA's 2001 *Comprehensive Water and Sewer Master Plan* projections for 2050 due to three main factors:

1. Increased water use efficiency of 20 – 25% among all sectors of OWASA's customer base during recent years: These changes appear to be permanent and should be considered to represent "new normal" consumption patterns for OWASA's customers.

2. OWASA/UNC RCW system: Began operating in April 2009 and projected to replace nearly 1 mgd of potable water demand.

3. Development activity: The installation rate of new OWASA service connections has declined steadily since 2004, reflecting the lower pace of development in Carrboro and Chapel Hill. Community growth is expected to continue at this reduced pace through the current economic recession before returning to previous activity levels.

The combined effects of these trends are reflected in the net decline and lower rate of raw water demand growth as shown in Figure 1, and in the 2060 demands that are lower than previously forecast for 2050.

Key Actions

- Continue monitoring critical indicators of community growth (certificates of occupancy, new OWASA meter installations, etc.).

- Continue monitoring monthly water use patterns among and within major customer groups.

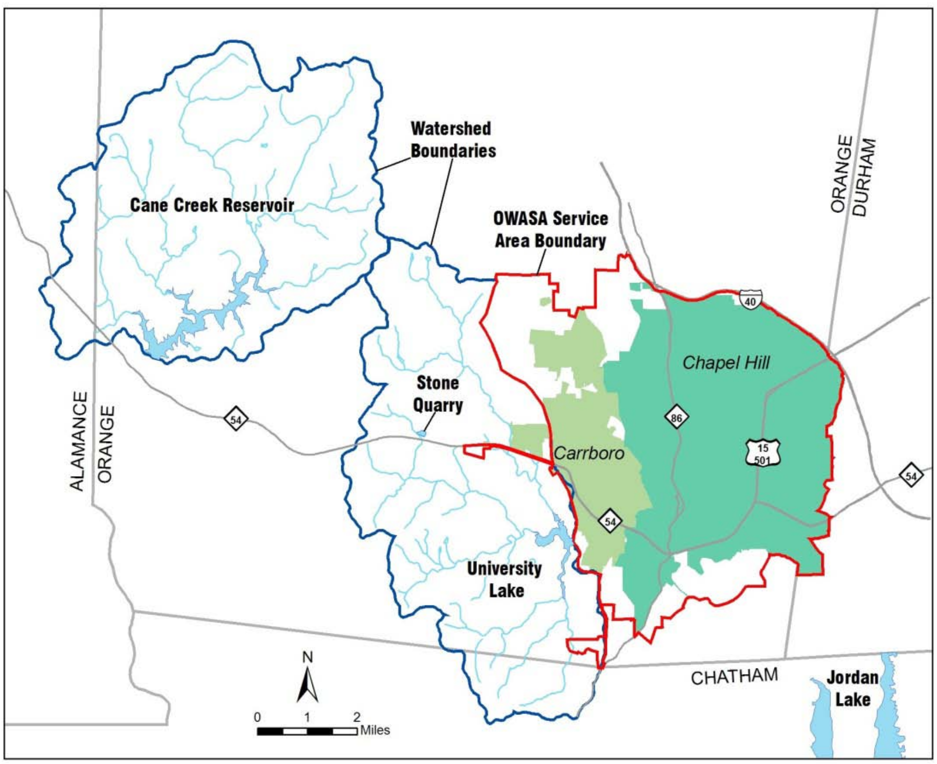
- Compare these data annually to demand projections of this report.

SECTION 3
CAPACITY OF EXISTING SYSTEM

OWASA's existing supply sources include University Lake, Cane Creek Reservoir, and the Quarry Reservoir, as shown in Figure 2.

Raw water from University Lake is pumped to the Jones Ferry Road Water Treatment Plant (WTP) in Carrboro. Cane Creek water can be pumped directly to the WTP; into Phil's Creek near the existing Quarry Reservoir, where it flows downstream to University Lake for re-pumping to the treatment plant; or, into the existing Quarry Reservoir and stored for later use. Water from the Quarry Reservoir can be pumped directly to the Jones Ferry Road WTP or to University Lake via Phil's Creek.

Figure 2. OWASA Water Supply Sources, Watersheds, and Service Area Boundary



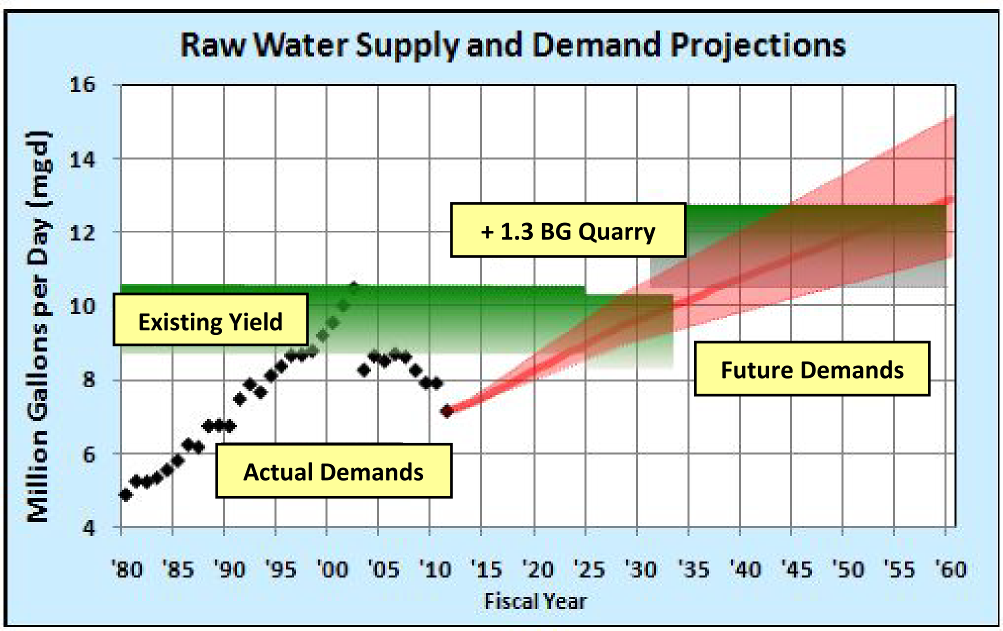
University Lake was created by UNC in 1932. It drains a 30-square mile watershed and has a usable storage capacity of 450 million gallons (MG). The lake and about 500 acres of adjacent lands are still owned by UNC, but OWASA controls all land within 100 feet of the shoreline and is entitled to use University Lake as a water supply source through a contractual agreement with UNC.

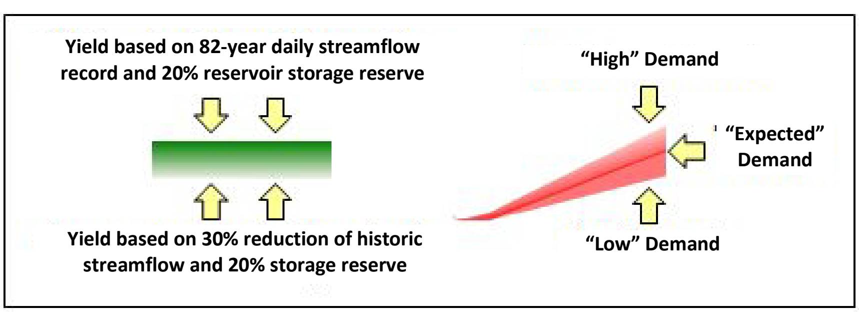
Cane Creek Reservoir was created by OWASA and filled in 1989. It can store approximately 3 billion gallons (BG) of water from its 32-square mile drainage area. More than 2,000 acres of surrounding watershed land is either owned by OWASA or protected through permanent conservation easements held by OWASA.

The existing Quarry Reservoir, located about 3 miles west of Carrboro in the University Lake watershed, was acquired in 1979 to supplement OWASA's water supply during severe droughts or emergencies. It has a usable storage volume of 200 MG. Pumping capacity improvements completed in 2007 provide additional operational flexibility. Approvals were obtained in 2001 to expand the nearby active quarry, which is operated (on OWASA-owned property) by the American Stone Company, in the direction of the existing Quarry Reservoir. Per OWASA's agreement with American Stone and per stipulations of the Orange County Special Use Permit that authorized the quarry's expansion, mining operations will cease by 2030, and the large quarry pit will be available for use as a supplementary water source. OWASA owns the entire 190 acres on which the Quarry Reservoir and active pit are located. American Stone Company operates the quarry under a lease agreement with OWASA.

Hydrological modeling conducted for this study determined that the existing system can provide 10.5 million gallons per day (mgd) while still maintaining a 20% storage reserve during a recurrence of the 2001–02 drought of record (see also **Appendix V-A**). Previous yield estimates of 11.7 mgd calculated for the same drought conditions were based on complete reservoir drawdown; i.e., with no water left in reserve. Figure 3 illustrates yield (supply) in relation to the demands depicted earlier in Figure 1.

Figure 3. Supply and Demand Projections through 2060





The green bar extending from the left represents the yield of OWASA's existing University Lake/Cane Creek/Quarry Reservoir system. The right hand bar extending from 2035 to 2060 represents additional yield that would be available with 1.3 BG of expanded Quarry Reservoir storage (see Option 1: Expanded Quarry Reservoir on page 11 for further details). The upper margin of each bar represents total system yield based on 82 years of historic streamflow data. The lower margins are calculated on the basis of a hypothetical 30% reduction of actual streamflow in order to approximate future conditions that might result from major changes in weather patterns (climate change) and/or changes in watershed land use that might affect streamflow.

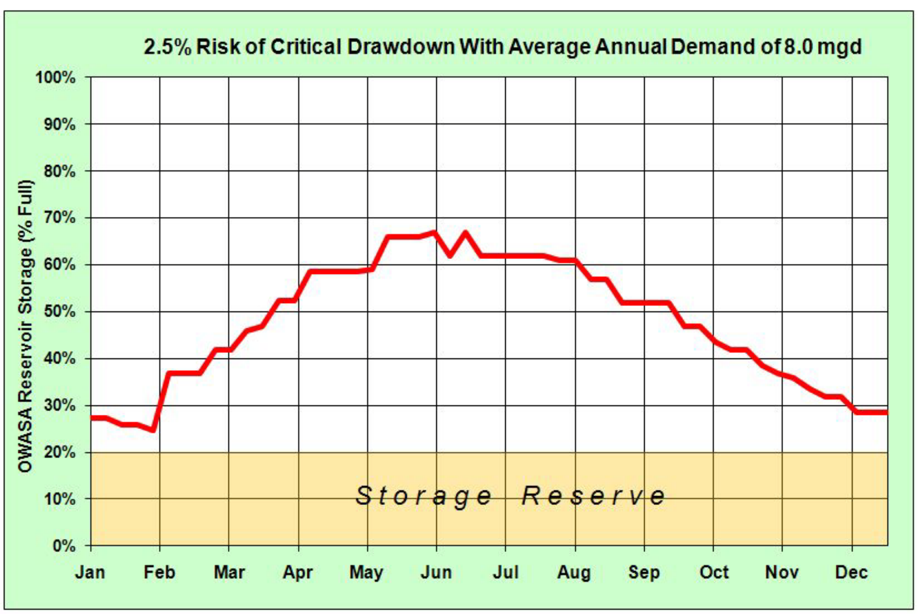
Figure 3 indicates that OWASA's current supply system can meet the community's water supply needs substantially further into the future than previously thought – even under hypothetical High Demand projections. This observation and the potential future benefits of an expanded Quarry Reservoir are discussed later.

For planning purposes, it is recommended that OWASA adopt the 10.5 mgd yield, which includes a 20% storage reserve (700 million gallons) that is believed to provide adequate time to implement emergency supply measures during an extreme drought.

For operational purposes, it is recommended that OWASA maintain sufficient water in storage so that the risk of depletion ("critical drawdown") to 20% or less during any succeeding 12-month period does not exceed 2.5%. This is consistent with the Stage 1 Water Shortage trigger adopted in OWASA's 2009 Water Conservation Standards.

The red line in Figure 4 indicates reservoir storage levels that correspond to a 2.5% probability (risk) that drawdowns to 20% or less of total storage will occur during the following 12 months, assuming an average demand of 8.0 mgd.

Figure 4. 2.5% Risk of Reservoir Drawdown to 20% or Less of Total System Storage



The graph was derived from a statistical analysis of 82 years of streamflow (1926–2007), which indicated that drawdowns to 20% or less would have occurred in 2 of those 82 years (i.e., 2.5%). For the OWASA system, those would have been during the drought years of 2002 and 2007. **Appendix III** includes additional risk graphs for withdrawal rates of up to 12 mgd.

What Does This Mean?

These graphs provide decision-making guidance regarding drought vulnerability. For example, Figure 4 represents a year (such as 2008) with an average demand of 8.0 mgd. The risk of critical drawdown (i.e., to 20% or less of total storage within 12 months of any point on the graph) will be less than 2.5% as long as reservoir levels remain above the red line; i.e., during a year with average demands of 8.0 mgd, OWASA would not declare a Stage I Water Supply Shortage as long as storage levels remained above the red line.

Reservoirs are designed to accumulate and store water during periods of normal and high streamflow so that it can be available when flows decrease or decline to zero during a drought. It is apparent from these analyses that the existing system can reliably meet OWASA's water supply needs when streamflow and reservoir levels are significantly lower than what has traditionally been considered to be "normal."

CAPACITY OF EXISTING SYSTEM

Key Findings

- OWASA's existing system can provide 10.5 million gallons of water per day (mgd) while still maintaining a 20% storage reserve during a recurrence of the 2001–02 drought of record and can reliably meet OWASA's water supply needs when streamflow and reservoir levels are significantly lower than "normal."

- Because this plan includes lower demand projections than previously forecasted by OWASA, the current system can meet the community's water supply needs substantially further into the future than previously thought – even under hypothetical High Demand projections.

Key Actions

- Continue to follow a risk-based approach when considering drought management decisions during periods of low streamflow and declining reservoir levels. Use the critical drawdown graphs to support important decisions, such as water purchases or Water Supply Shortage declarations.

SECTION 4
SUPPLEMENTAL SUPPLY AND DEMAND REDUCTION OPTIONS

As discussed in the previous section, under most conditions – even a recurrence of the 2001-02 drought of record – OWASA's existing system can meet virtually all of our expected needs for the next 25 years, provided that the 25 percent reduction in water use achieved since 2002 is sustained in the future. Additional water will be needed after 2035, but the amount and timing of those longer-term needs will depend on actual demands at that time.

The following section includes a brief description of 11 supply and demand-side options for meeting long-term future needs and a summary of their respective benefits and costs. Overall findings are summarized in Tables 2 and 3, which follow the descriptions. It is assumed that the alternative supply sources meet all regulatory standards for water quality and can be appropriately treated at OWASA's WTP without requiring additional process water. **Appendix IV** contains more information about the quality of OWASA's existing sources. *Making the highest and best use of our local water resources* is a guiding principle of these evaluations and subsequent recommendations.

Option 1: Expanded Quarry Reservoir

American Stone Company's ongoing operation at OWASA's Quarry Reservoir (Figure 5) is expected to produce a total storage capacity of 2.2 – 3.0 BG when mining is completed in 2030. The final volume will depend on actual production through 2030, but American Stone is contractually committed to a rate of rock extraction that will result in a final volume of at least 2.2 BG. Between 1.3 and 1.9 BG of this new storage capacity will be readily accessible with existing OWASA pumping facilities, which can withdraw water from a maximum depth of 100 feet. Withdrawals from greater depths would require additional facilities. Modeling results

Figure 5. Existing Quarry Reservoir and Active Quarry Expansion

Existing reservoir is on the left. Active quarry pit is advancing from the right.

indicate that this "shallow version" of Quarry Reservoir expansion will provide between 2.1 and 2.9 mgd of additional yield for an estimated capital investment of less than $2 million (2009), or about $500,000 – $700,000 per mgd of additional yield (see also **Appendix V-A**).

Access to another 1.3 – 1.7 mgd of yield (in addition to the 2.1 – 2.9 mgd) from a "deep version" of the Quarry Reservoir would require the construction of a 250-foot vertical shaft and a multi-level pumping gallery for a capital cost of approximately $34 million (2009), or $7.4 to $10 million per mgd of the deep quarry's 3.4 – 4.6 mgd total yield. A "hybrid" option could include construction of the deep vertical shaft – without installation of the pumps and accessory equipment – before the shallow quarry is filled with water and placed in service in order to preserve the deep quarry as a future option. All versions of Quarry Reservoir expansion would provide additional yield, but would not add substantial redundancy to the overall system if another major supply source or transmission component were out of service for maintenance, equipment failure, or other emergency conditions.

All anticipated configurations could be refilled from the Cane Creek Reservoir through existing pumping and conveyance facilities. Previous studies had proposed refilling the expanded Quarry from University Lake, but this would require major capital improvements to existing infrastructure with little or no increase in operational yield. Increasing the existing pumping and transmission capacity from the Cane Creek Reservoir would reduce the time needed to refill the expanded quarry after a prolonged drought, but would offer no additional yield.

The Expanded Quarry (shallow version) offers the greatest water supply benefit for the lowest economic and environmental costs of all the options, and represents the least challenging regulatory/political hurdles.

Options 2 and 3: Jordan Lake Water Supply Development

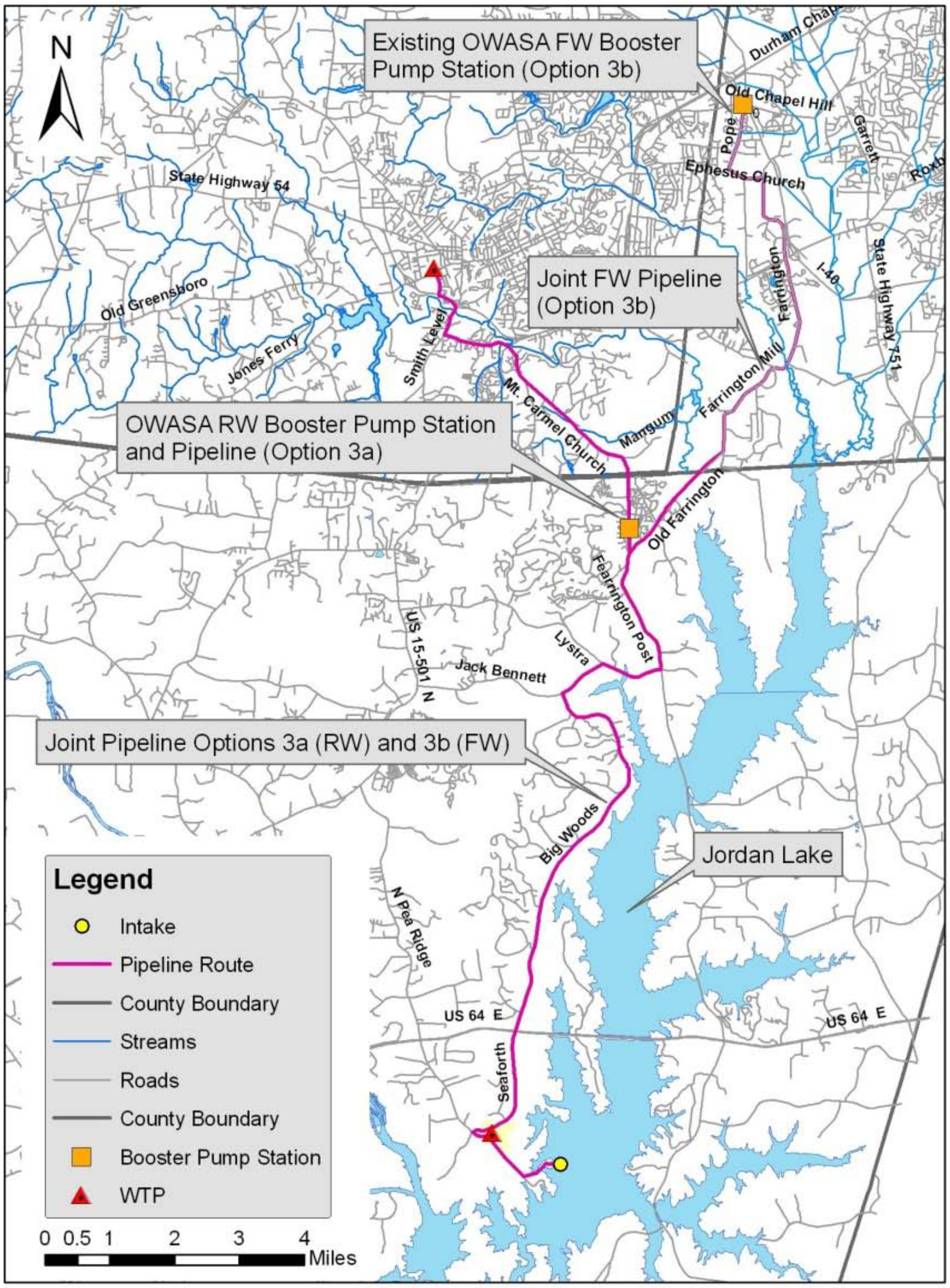
OWASA holds a Level II ("future use") allocation of 5% of Jordan Lake's water supply storage capacity, and owns 125 acres of land adjacent to US Army Corps of Engineers property on the west side of Jordan Lake in Chatham County. The storage allocation corresponds to an estimated yield of 5 mgd on an annual basis. With allowable peak day withdrawals of 10 mgd, analyses conducted for this project determined that OWASA's allocation could actually provide up to 6.2 mgd of additional yield, due to the optimization benefits of our multiple reservoir system.

One set of cost analyses evaluated raw water (RW) intake/pumping/transmission facilities only; a second set considered the additional construction of a new Jordan Lake water treatment plant (WTP). Two hypothetical scenarios were examined: (Option 2) independent OWASA-only facilities **(Appendix VI)**, and (Option 3) shared facilities developed in partnership with other entities **(Appendix VII)**.

Figure 6 shows potential routes of jointly developed raw and finished water pipelines from Jordan Lake to the OWASA and Durham systems. Option 3A would provide raw water intake/pumping/transmission facilities, which could be the initial phase of an Option 3B project that ultimately included a WTP (in which case the RW pipeline would be converted for finished water (FW) transmission to the existing point of interconnection between OWASA and Durham). Option 3A (RW facilities only) would involve the construction of approximately 13 miles of jointly owned (OWASA + partners) pipeline plus an additional 6-mile spur that would only serve OWASA. For the purposes of this study, it was assumed that OWASA would retain a

10 mgd share of jointly owned facilities developed with a total peak day capacity of 65 mgd. OWASA's share of capital costs under this scenario would be approximately $40 million, compared to the estimated $54 million for an independently developed OWASA-only RW line from Jordan Lake to the Jones Ferry Road WTP. Corresponding unit costs would be $6.4 and $8.8 million per mgd. Based on these planning level estimates and assumptions, the jointly developed project would provide economy of scale savings to OWASA of 25%.

Figure 6. Potential Raw and Finished Water Pipeline Routes from Jordan Lake to the OWASA System



It is unlikely that State/Federal regulatory authorities would approve an OWASA-only project or any other project by a single entity acting on its own. While a joint development project with cooperating entities would provide economies of scale, OWASA would derive little or no economic benefit from sharing the equivalent portion of an Option 3B project (new regional WTP), due to the additional fixed costs of an additional treatment plant and the excess capacity that will remain for decades to come at OWASA's existing Jones Ferry Road WTP. Such a facility would, however, further enhance our water system reliability.

Raw water intake, pumping, and transmission facilities developed in partnership with others appears to represent OWASA's least expensive capital option for obtaining Jordan Lake water in the future, but this could be precluded if the other utilities decide to build a regional WTP and pump FW, rather than RW, to their respective service areas. Nevertheless, the addition of Jordan Lake to OWASA's water supply "portfolio" – as a source of either raw or finished water – would provide significant flexibility and redundancy to the overall system. It is essential for OWASA to retain its Jordan Lake storage allocation in order to ensure such future flexibility and reliability.

The eventual form or institutional structure of such a joint arrangement is neither known nor proposed at this time. Possibilities might include the creation of a new regional Jordan Lake development entity; an equity partnership similar to the existing Cary-Apex WTP; or a set of multi-lateral water purchase and sales agreements among individual agencies.

The Jordan Lake Partnership

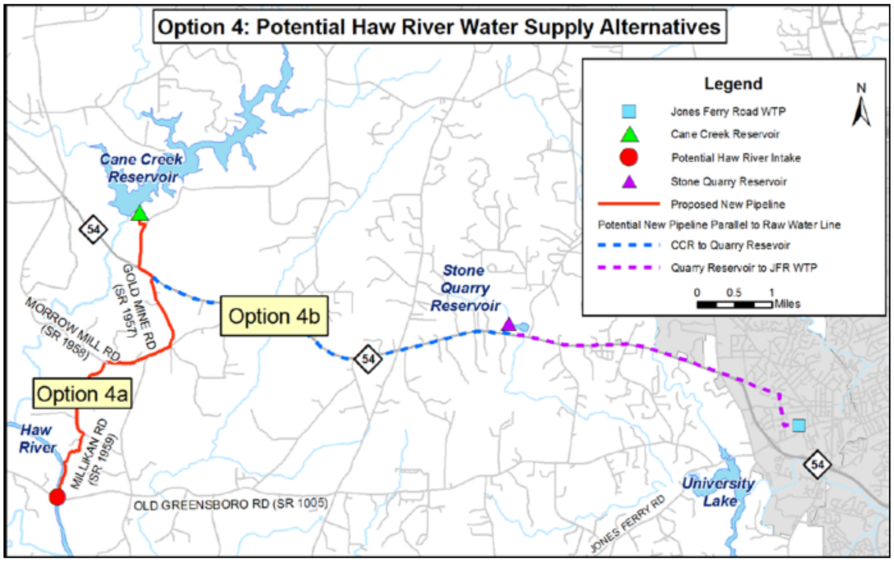
The Jordan Lake Regional Water Supply Partnership was created in 2009 by local jurisdictions and water systems in the Triangle area to jointly plan for the expanded use of the Jordan Lake water supply. OWASA is participating in the Partnership in order to obtain access to its 5 mgd water supply storage allocation, which will only be feasible through a joint arrangement with other local utilities. The Partnership's efforts are currently focused on gathering, reviewing, and refining relevant water supply and demand information of its members to support a new round of Jordan Lake allocation requests and a potential *Jordan Lake Western Intake Preliminary Planning Project.*

Option 4: Permanent Haw River Intake and Pipeline

Permanent facilities to supplement the Cane Creek Reservoir with Haw River water would provide 7.7 mgd of additional yield and add significant system flexibility and redundancy.

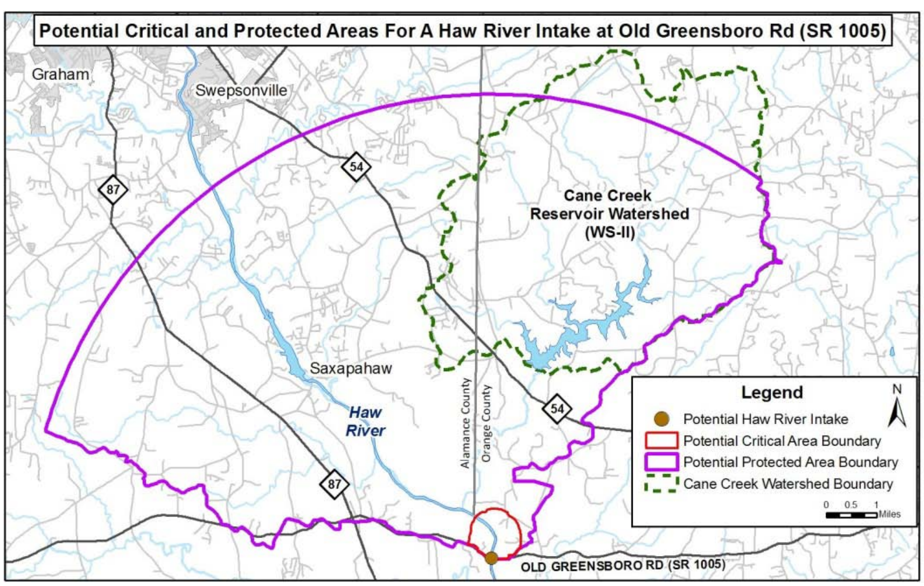
This option would involve the construction of a permanent intake on the Haw River in the vicinity of Old Greensboro Road in Orange County; installation of approximately 5 miles of pipeline to the Cane Creek Reservoir; improvements to the Cane Creek pumping station; and approximately 11 miles of new pipeline parallel to the existing RW transmission main from Cane Creek to the Jones Ferry Road WTP (Figure 7). **Appendix VIII** provides additional detail.

Figure 7. Potential Haw River Intake and Pipeline



Capital and unit costs ($60 million, or $7.7 million per mgd) would be in the same range as those of the Option 3 Jordan Lake joint development scenario, but a permanent supply from the Haw River would likely face significant regulatory and public acceptance challenges, including Section 401/404 review and the need to reclassify a 10-mile portion of the Haw River from Class V ("protected as a water supply which is generally upstream and draining to Class WS-IV waters") to WS-IV ("suitable as a drinking water source"). Prior to considering such a reclassification, the NC Environmental Management Commission would require resolutions of support from the Orange and Alamance County Boards of Commissioners, who exercise planning and zoning jurisdiction in the potential WS-IV Watershed Protected Area, and who would be required to adopt additional State-mandated land use regulations (Figure 8). We believe it is unlikely that such local governmental support could be gained.

Figure 8. Potential Critical and Protected Area Delineations for a Haw River Intake Near Old Greensboro Road



Rather than pursuing a permanent supply source, it is recommended that OWASA retain this option as a worst-case contingency plan for emergency conditions; i.e., for the temporary installation of Haw River withdrawal, pumping, and above ground pipeline facilities to the Cane Creek Reservoir if storage in our existing reservoir/quarry system declined to 20 percent or less and no other emergency supply options were available.

The need for this or any other emergency supply alternative will be less critical if OWASA is able to secure permanent access to Jordan Lake water.

Option 5A: Expand OWASA's Reclaimed Water (RCW) System

RCW use can increase our available water supply to the extent that it replaces existing or future potable water use. To investigate the potential benefits and costs of expanding RCW treatment and distribution capacity, OWASA staff evaluated the hypothetical extension of RCW service to an area in the vicinity of Highway 54 East, Meadowmont, and the Friday Center. Based on existing and anticipated development for this area, we estimated that RCW would reduce long-term potable water use by approximately 0.25 mgd. This would require a substantial capital investment ($7.7 million, or $30 million per mgd of water savings) to expand RCW treatment and pumping facilities at the Mason Farm Wastewater Plant and to install new underground infrastructure in an already developed area. The economic viability of extending the RCW system would be enhanced if the improvements were funded by third party (non-OWASA) sources, but it is unlikely that this alternative will be economically feasible even with such support. Additional details are available in **Appendix IX**.

Financial and budgetary plans for this and other demand reduction projects with associated capital and operating costs, such as Option 5B below, must recognize the likelihood of water and sewer revenue reductions if previous budget and longer term projections have been based on higher (pre-reduction) demand forecasts.

It is recommended that OWASA remain "opportunistic" on a case-by-case basis with respect to additional non-UNC customers, such as the St. Thomas More School located next to the RCW transmission main, who find it cost-effective to extend or connect to the system.

Option 5B: Additional Water Conservation Investments

To evaluate the potential benefits and costs of OWASA-funded conservation incentives, we analyzed the hypothetical replacement of older large volume toilets with high efficiency units. Water savings of 0.5 mgd would require the replacement of approximately 28,000 toilets. With an assumed OWASA cost of $200 per unit ($150 rebate + $50 administrative), the capital costs of this program would be approximately $5.6 million, or $11.2 million per mgd of water savings. For rebates of $75, rather than $150 per unit replaced, total costs would be $3.5 million, or $7.0 million per mgd of water savings.

As discussed under 50-Year Demand Projections, substantial increases in water efficiency have occurred in recent years among all OWASA customers. These are expected to continue in response to State and local regulatory requirements, construction trends, conservation pricing, etc. without further device give-aways or OWASA financial incentives.

It is recommended that OWASA continue to promote water conservation through customer education, conservation pricing, and limited technical assistance, but without any direct financial incentives (subsidies).

Option 5C: Temporary Water Shortage Restrictions

OWASA successfully reduced water demands during the droughts of 2001-02 and 2007-08 through the temporary imposition of mandatory use restrictions and potable water rate surcharges (2007-08); but the degree to which such actions will have similar effects during future droughts is not known at this time due to fundamental changes in water use that have occurred among all OWASA customer classes. Actual reductions will depend on a range of changing conditions, especially the amount of "demand hardening" (permanent water use reduction) that occurs between now and the next drought, as well as the time of year when restrictions are imposed.

Although this approach effectively lowers consumption, it has the disadvantage of customer inconvenience and hardship, especially when drought rate surcharges are imposed. Another important consideration is the potential unplanned and unbudgeted revenue shortfalls that may accompany water use reductions due to mandatory restrictions. OWASA's Rate/Revenue Stabilization Reserve Fund can be used to offset such unanticipated losses and help avoid permanent rate increases. The drought rate surcharges, whose primary purpose is to encourage conservation during declared Water Shortages, also help offset unplanned revenue shortfalls.

Per the October 20, 2011 policy resolution and January 10, 2013 Drought Response Operating Protocol adopted by the OWASA Board of Directors, a Water Shortage Advisory followed by Stage 1 Water Shortage restrictions will be the first responses to future extended drought conditions. Because Stage 1 restrictions by themselves may not prevent critical reservoir drawdowns during extended periods of severe drought, especially as service area demands increase in the future, they may need to be augmented with purchases of treated water and/or by obtaining water from OWASA's Jordan Lake water supply allocation; however, per the January 10, 2013 DROP, "the OWASA Board may authorize purchases from other utilities and/or obtain water through its Jordan Lake allocation only when total water storage in University Lake, Cane Creek Reservoir, and the Quarry Reservoir is below the Mandatory Stage 1 Shortage trigger, but no sooner."

Option 6: Purchase Water from Neighboring Suppliers

OWASA's existing interconnections provide the capacity to receive a total of about 10 mgd of treated water from Durham, Hillsborough, and Chatham County (Table 1).

Table 1. Interconnection Capacities Among Neighboring Utilities

OWASA to Durham	5 mgd
Durham to OWASA	7 mgd
OWASA to Hillsborough	2 mgd
Hillsborough to OWASA	2 mgd
Chatham County to OWASA	1 mgd
OWASA to Chatham County	0
Durham to Chatham County	3 mgd
Durham to Hillsborough	1 mgd
Durham to Cary	7 mgd
Cary to Durham	10 mgd

At an assumed cost of $3.00 per thousand gallons (2009), temporary purchases (e.g., from Cary via Durham) offer a cost-effective option compared to the capital-intensive development of a new supply source. This is especially true for the infrequent and limited amounts of water that OWASA is expected to need during the next 25 or more years. Purchases offer an additional degree of fiscal control by enabling the supplemental source to be effectively turned on or off as needed, in contrast to temporary restrictions, whose residual effects on OWASA customer behavior (and on water/sewer revenues) persisted substantially longer than the temporary need to reduce consumption.

Per the October 20, 2011 policy resolution and January 10, 2013 DROP adopted by the OWASA Board of Directors, OWASA will purchase water only after first declaring a Stage 1 Water Supply Shortage and only when total water storage in University Lake, Cane Creek Reservoir, and the Quarry Reservoir is below the Mandatory Stage 1 Shortage trigger. The goal of such purchases will be to avoid critical reservoir drawdowns during extended periods of severe drought and to lessen the inconvenience and potential hardship of more severe (Stage 2 and greater) use restrictions and rate surcharges on OWASA customers.

The OWASA Board of Directors would keep the community fully informed of critical water supply issues and will continue to notify customers and local elected boards in advance of any impending need to purchase water when indicated by reservoir storage and demand conditions. It is expected that such notice would provide additional customer motivation to reduce water use and reinforce efforts to avoid more severe Water Supply Shortage use restrictions and rate surcharges.

In addition to drought conditions, the ability to receive or send water to other local utilities provides important mutual support during maintenance or failure of critical facilities, extreme weather, or other unforeseen/emergency circumstances. The reliable availability of supplemental water from neighboring utilities requires the development of secure and permanent purchase/sale/conveyance agreements. Additional information about purchases is available in **Appendix XII**.

OWASA is a party to the 2001 *Water and Sewer Management, Planning and Boundary Agreement* adopted by the Towns of Carrboro, Chapel Hill, Hillsborough, and Orange County. In its present form, the Agreement constrains the purchase and sale of water across jurisdictional boundaries and could impede the timely access to OWASA's Jordan Lake water supply allocation, which represents an important "insurance policy" for times of special need. We will work with the signatories to make any modifications to the Agreement that may be needed to resolve unnecessary constraints on our access to Jordan Lake.

It is recommended that OWASA engage in discussions with neighboring utilities about agreements that will secure the permanent ability to purchase water under appropriate conditions of supply and demand. Continued participation in the Jordan Lake Partnership will offer valuable opportunities to explore such arrangements.

It is further recommended that OWASA continue to keep the Carrboro, Chapel Hill, and Orange County elected boards up to date about these efforts and to work cooperatively in amending the 2001 Water and Sewer Management, Planning, and Boundary Agreement as may be needed to ensure a reliable and sustainable future water supply.

Option 7: Expand Cane Creek Reservoir by Constructing a New Dam

This option would provide 5 mgd of additional yield by raising the Cane Creek Reservoir's existing water level by 20 feet, thereby doubling its usable storage from 3 BG to 6 BG. The project would require expanding the capacity of the Cane Creek pumping station and constructing approximately 11 miles of new pipeline parallel to the existing RW line from Cane Creek to the Jones Ferry Road WTP. OWASA's 2001 *Comprehensive Water and Sewer Master Plan* considered accomplishing this with modifications to the existing Cane Creek dam and spillway, but Hazen and Sawyer's recent review determined that "it is unlikely that the existing dam and gated spillway could be modified to increase its structural height by the required amount" **(Appendix XIII)**.

This option would therefore require the construction of a new dam directly downstream of the existing Cane Creek dam and would cost nearly $130 million, or $25 million per mgd. It would involve formidable regulatory, environmental, and political obstacles, including the acquisition of approximately 450 acres of privately owned land, relocation of at least one public road, preparation of an EIS, and NC Environmental Management Commission approval of the right to condemn private property for water supply purposes. This proposal would likely face vigorous public opposition similar to or greater than what was encountered for the original Cane Creek Reservoir project.

No new evidence has been found to improve the low preferential ranking that this option received in OWASA's 2001 Comprehensive Water and Sewer Master Plan. It is recommended that the expansion of the Cane Creek Reservoir not be considered in any future reviews of OWASA water supply options.

Option 8: Expand University Lake by Constructing a New Dam

Existing University Lake and Dam

This option would provide 4.7 mgd of additional yield by increasing University Lake's usable storage from its current capacity of 0.45 BG to 3 BG with a new dam constructed about 400 feet downstream of the existing dam. This would raise University Lake's water level by 22 feet and would require the construction of new intake and pumping facilities to replace existing facilities, which would be inundated upon project completion.

Although it would provide additional yield, expanding University Lake would not add substantial flexibility or redundancy to the overall system if another major supply source or transmission component were out of service. As with the Option 7 (expansion of the Cane Creek Reservoir), implementation would involve formidable regulatory, environmental, and political obstacles, including:

- Permission by UNC and the NC Council of State;
- Permanent inundation of approximately 260 additional acres of land;
- Acquisition of at least 270 additional acres of land, including all or portions of 60 private lots, at least 5 residential buildings, and the UNC Francis Owen animal research facility;
- Five road relocations;
- Relocation of all existing OWASA recreational facilities;
- Impacts to wetlands and other environmentally sensitive lands; and
- Preparation of a detailed Environmental Impact Statement (EIS) as required by the National Environmental Policy Act (NEPA).

Estimated capital costs would exceed $100 million, or $23 million per mgd and are among the highest of the options evaluated. Additional information is available in **Appendix XIV.**

No new evidence has been found to improve the low preferential ranking that this option received in OWASA's 2001 Comprehensive Water and Sewer Master Plan. It is recommended that the expansion of University Lake not be considered in any future reviews of OWASA water supply options.

Option 9: Dredge Sediment from University Lake

This option would involve the removal, stockpiling, dewatering, and relocation of approximately 700,000 cubic yards of accumulated sediment (equivalent to ~125 MG of storage capacity) from University Lake. This would provide an additional yield of only 0.2 mgd and would cost an estimated $37 million, or $180 million per mgd of additional yield. Site constraints and the overall scale of this project would likely require phasing over a period of two or more years and would involve heavy and sustained vehicular traffic for the relocation of sediment removed from the lake. Additional details are available in **Appendix XV**.

Due to the negligible water supply benefits and extremely high financial and environmental costs, it is recommended that dredging accumulated sediment from University Lake not be considered in any future reviews of OWASA water supply options.

Option 10: Construct A Dam and Reservoir on Sevenmile Creek

A reservoir on Sevenmile Creek south of I-85 and west of Hillsborough could provide 4 mgd of additional yield to OWASA, but the financial, legal, regulatory, and political hurdles of this option render it unsuitable for further consideration.

Capital costs would likely exceed $115 million, or $29 million per mgd, including substantial costs for responding to regulatory and legal challenges. A large portion of the 1,000+ acres of land needed for this project is currently owned by Orange County and has been designated for eventual use as a nature preserve. In addition to strenuous public opposition, this project would face a major regulatory hurdle in obtaining interbasin transfer certification from the NC Environmental Management Commission due to the transfer of water from the Neuse to the Cape Fear River Basin. Additional details are available in **Appendix XVI**.

The creation of an OWASA reservoir on Sevenmile Creek is not feasible and should not be considered in any future review of potential water supply options.

Summary of Options

Table 2 presents a qualitative overview of the options, including the benefits and costs over the 50-year planning period as follows:

Adequate Yield: Does the option, by itself, provide enough water to meet customer needs during hypothetical drought conditions under the "Expected" or "High Demand" projections?

Flexibility, Redundancy: Does the option add significant flexibility or reliability to OWASA's overall supply system if another major supply source or transmission component were temporarily out of service?

Financial Cost: Net present cost per thousand gallons needed to satisfy projected water supply deficits during drought conditions. High, Medium, and Low indicate relative values among the options. Estimated dollar values are presented in Table 3, as derived in the OWASA staff spreadsheets included in corresponding Appendices.

Environmental and Regulatory/Political Challenges: The High, Medium, and Low indicators reflect the relative overall challenges described in the preceding narrative summaries.

Table 2. Summary of Options, Benefits, and Costs

Option		Adequate Yield?		More Flexibility, Redundancy?	Costs and Challenges		
		Expected Demand	High Demand		Financial	Environ-mental	Regulatory /Political
1A	Expanded Quarry Reservoir (Shallow)	Yes	No	No	Low	Low	Low
1B	Expanded Quarry Reservoir (Deep)	Yes	Yes	No	Medium	Low	Low
2	Jordan Lake (OWASA only)	Yes	Yes	Yes	High	Medium	High
3	Jordan Lake (Partnership)	Yes	Yes	Yes	Medium	Medium	High
4	Haw River to Cane Creek Reservoir	Yes	Yes	Yes	Medium	Medium	High
5A	Expand RCW System	No	No	No	Medium	Medium	Low
5B	Additional Conservation Investments	No	No	No	Medium	Low	Low
5C	Temporary Water Shortage Restrictions	No	No	No	Low	Low	Low
6	Purchase Water from Neighboring Suppliers	Yes	Yes	Yes	Low	Low	Medium
7	Expand Cane Creek Reservoir	Yes	Yes	No	High	High	High
8	Expand University Lake	Yes	Yes	No	High	High	High
9	Dredge University Lake	No	No	No	High	High	High
10	Sevenmile Creek, New Dam and Reservoir	Yes	Yes	Yes	High	High	High

Table 3 on the next page summarizes the net present life-cycle costs of each option over the 50-year planning period assuming the High Demand projections. Additional information is provided in **Appendix I**, with more technical and financial detail in **Appendices V** through **XVI**.

The net present cost of each option is based on the total volume of water needed to meet projected water supply deficits during the 50-year planning period. Costs are expressed as 2009 dollars per 1,000 gallons supplied during the planning period. Water supply deficits were calculated by applying the following assumptions to the "High" future water demand scenarios:

- Existing supply system in place through 2035,
  Yield = 9.8 mgd, with 30% storage reserve
- Expanded quarry (shallow version) in service in 2036
  Yield = 11.8 mgd, with 30% storage reserve
- 2001-02 drought of record recurs 9 times (at 5-year intervals) from 2015-2055
- Customer demands through 2060 follow the High projection scenario
- Deficits represent the difference between projected demands and the system's total operational yield in a given time period

These extremely conservative assumptions represent a precautionary approach for assessing OWASA's long-range water supply options. If the high demands, extreme drought conditions, and associated deficits assumed for this analysis do not occur, then the need for future water supply supplements can be further deferred.

Table 3. Net Present Cost Comparisons (for High Demand and Extreme Drought Scenarios)

Cost Comparison of Supplemental Water Supply Options During Three Projected Phases of System Development	*For "High" Demand Projections*
Supply & Demand Scenario:	Existing System Operational Yield = 9.8 mgd with a 30% storage reserve. Supply scenarios assume extreme conditions in which the 2001-02 drought recurs 9 times from 2015-2055. Deficits occur in 2030 (0.62 mgd), 2035 (0.92 mgd), 2045 (0.65 mgd), 2050 (1.5 mgd), and 2055 (2.4 mgd), when average annual demands ("High" projection scenario) exceed either the 9.8 mgd operational yield of the Existing System or the 11.8 mgd yield with the Expanded Quarry (shallow version) in service.

	Supplemental Supply or Demand Reduction Option		Additional Yield (mgd)	PHASE I 2009 - 2035	PHASE II 2036 - 2045	PHASE III 2046 - 2060
				Range of Estimated Annual Deficits:		
				0.06 to 0.92 MGD	0 to 0.65 MGD	1.5 to 2.4 MGD
				Cumulative Need:		
				360 MG	236 MG	1,420 MG
				Net Present Cost per 1,000 gallons supplied (2009) [A] (Costs highlighted in red indicate that the supply option by itself cannot fully meet the estimated maximum annual deficit.)		
1A	Expanded Stone Quarry (Shallow)	1.5 BG (tot vol)	2.1	*QUARRY OPTIONS NOT AVAILABLE UNTIL 2036*	$4	*1.5 BG SHALLOW QUARRY IN SERVICE*
		2.1 BG (tot vol)	2.9		$5	
1B	Expanded Stone Quarry (Deep)	2.2 BG (tot vol)	3.4		$90	$15
		2.6 BG (tot vol)	4.0		$90	$15
		3.0 BG (tot vol)	4.6		$90	$15
2	Jordan Lake, OWASA Only (10 mgd design capacity)	RW to JFR WTP	6.2	$107	$105	$9
		FW to Dist Syst		$299	$325	$26
3	Jordan Lake, Joint Venture (OWASA share: 10 mgd of 65 mgd total design capacity)	RW to JFR WTP	6.2	$78	$76	$7
		FW to Dist Syst		$154	$155	$14
4	Haw River to Cane Creek Reservoir		7.7	$116	$114	$10
5A	Expand Reclaimed Water System 0.25 mgd permanent demand reduction		2.2	$73	$35	$16
5B	Additional Conservation Investments ($75 and $150 fixture rebates) 0.50 mgd permanent demand reduction		0.5	$17 (w/$75 rebate)	$25	$15
				$28 (w/$150 rebate)	$37	$19
5C	Temporary Water Shortage Restrictions		(Temporary restrictions provide no additional yield and represent no direct economic cost to OWASA)			
6	Purchase Water from Neighboring Systems		N/A	$5	$6	$7
7	Expand Cane Creek Reservoir to 6 BG		5.0	$236	$241	$22
8	Expand University Lake to 3 BG		4.7	$200	$204	$18
9	Dredge Sediment from University Lake		0.20	$248	$221	$60
10	New Dam and Reservoir on Sevenmile Creek		4.0	$222	$221	$20

[A] Includes all life-cycle costs (capital, operating, maintenance, replacement, salvage value, etc.) through 2060 per 1,000 gallons pumped if each option were operated to satisfy specified demand conditions.

SUPPLEMENTAL SUPPLY AND DEMAND REDUCTION OPTIONS

Key Findings

- The significant gains in conservation and water efficiency achieved by OWASA customers since 2002 are equivalent to a 20 to 25 percent "addition" to the community's available water supply. A fundamental assumption of this Plan is that those gains will be sustained in the future.

- Between 1.3 and 1.9 BG of expanded Quarry Reservoir storage will be available by 2035. This will provide between 2.1 and 2.9 mgd of additional yield for an estimated capital investment of less than $2 million, because it will be accessible with existing OWASA pumping facilities. This "shallow quarry" configuration is the most cost-effective of the supplemental supply or demand reductions options evaluated. All anticipated configurations of the expanded Quarry Reservoir could be refilled from the Cane Creek Reservoir through existing pumping and conveyance facilities.

- It is essential that OWASA retain its Jordan Lake allocation, especially until the expanded Quarry Reservoir comes on line around 2035. With allowable peak day withdrawals of 10 mgd, our 5 percent storage allocation could provide up to 6.2 mgd of additional yield, due to the optimization benefits of our multiple reservoir system. Access to Jordan Lake as a source of either raw or finished water would add significant flexibility and redundancy to OWASA's overall system if another major supply source or transmission component were out of service.

- Temporary purchases of treated water from neighboring utilities offer the most cost-effective way to supplement the benefits of mandatory water shortage restrictions during infrequent periods of severe drought, equipment failure, natural or manmade disaster, or other unforeseen circumstance.

- Permanent facilities to supplement the Cane Creek Reservoir from the Haw River would provide 7.7 mgd of additional yield, but would face daunting regulatory/political, and public acceptance challenges. Rather than a permanent supply source, the Haw River provides a worst-case contingency option; i.e., for the temporary installation of withdrawal, pumping, and above-ground pipeline facilities to the Cane Creek Reservoir if storage in OWASA's existing reservoir/quarry system declined to 20 percent or less during extreme conditions and no other emergency options were available.

- Investing in an expansion of OWASA's RCW system or establishing financial incentive programs, such as plumbing fixture rebates, to promote additional water conservation is less cost-effective than certain other options with additional benefits, and is not recommended at this time.

- The following supply options were found to be unsuitable or non-feasible and should not be considered in future reviews of OWASA's Long-Range Water Supply Plan: dredging sediment from University Lake; expanding either University Lake or Cane Creek

Reservoir by building higher dams; and constructing a dam and reservoir on Sevenmile Creek.

Key Actions

- Continue to promote water conservation and efficiency through customer awareness and education, targeted technical assistance, conservation pricing, and support for increased water efficiency standards in new and renovated buildings. The reliability of our local water supply sources assumes that recent gains in water use efficiency will be sustained during the next 50 years.

- Pursue with the University any opportunities for expanding the reclaimed water system that are determined to be cost-effective and beneficial.

- Develop a detailed plan of work for implementing the Expanded Quarry Reservoir option.

- Continue to participate in the Jordan Lake Partnership in order to retain OWASA's water supply storage allocation and ensure cost-effective access to that allocation through secure and permanent agreements with nearby utilities.

- Develop agreements with neighboring utilities to secure the permanent ability to purchase water under appropriate conditions of supply and demand. The Jordan Lake Partnership provides an important opportunity for achieving this. Provide periodic updates to the elected boards of Carrboro, Chapel Hill, and Orange County regarding these activities.

- Work cooperatively with the elected boards of Carrboro, Chapel Hill, and Orange County to modify as necessary the 2001 *Water and Sewer Management, Planning, and Boundary Agreement* to better reflect the important role that water purchases may play in ensuring the long-term reliability and sustainability of our water supply.

SECTION 5
SUMMARY AND RECOMMENDATIONS

This report presents a very positive long-range outlook for OWASA's water supply. Future generations living and working in our community will be able to enjoy a reliable supply of high quality drinking water with far less capital investment than predicted 10 years ago. This report indicates that OWASA has essentially achieved its Water Conservation Goal adopted in 2005:

> *To develop, fund, and implement a cost-effective water conservation and demand management program that will meet our community's long-term water supply needs (through 2050) by making the highest and best use of our local water resources and eliminating the need for costly new water supply sources and facilities.*

This has been accomplished through the combined efforts of OWASA, its customers, and the elected, business, and UNC leadership of the community. Supply and demand management milestones during the past nine years have included:

- Approval of the Quarry Reservoir expansion project
- Year-round conservation standards
- Seasonal and tiered customer water rates and the establishment of water rate surcharges applicable during declared water shortages
- Water Treatment Plant process water recycling
- OWASA/UNC reclaimed water system
- Increasing use of non-potable and advanced water use efficiency technologies in new development
- Proactive customer education

Primary Recommendations:

1. Continue to promote water conservation and efficiency through customer awareness and education, targeted technical assistance, conservation pricing, and support for increased water efficiency standards in new and renovated buildings. The reliability of our local water supply sources assumes that recent gains in water use efficiency will be sustained during the next 50 years.
2. Continue to pursue the Quarry Reservoir expansion (shallow version) as the most cost-effective, long-term option for a supplemental supply source. This will ensure full local control of a substantial increment of supply with minimal additional capital investment.
3. Continue to participate in the Jordan Lake Partnership in order to retain OWASA's water supply storage allocation and to ensure cost-effective access to Jordan Lake through secure and permanent agreements with nearby utilities. It is essential that OWASA retain and acquire access to its allocation.
4. Develop water purchase/sale agreements with neighboring utilities that will secure the permanent ability to cost-effectively purchase water under appropriate conditions of supply and demand consistent with the long-term performance objectives of (1) avoiding critical reservoir drawdowns during extended periods of severe drought, (2) reducing the

need for more severe Water Shortage restrictions and drought rate surcharges, and (3) providing additional flexibility and redundancy in the event of critical facility failure, extreme weather, or other unforeseen/ emergency circumstances. Per the OWASA Board's policy resolution of October 20, 2011, *OWASA shall only purchase water from other communities or obtain water from its Jordan lake storage allocation during periods of increased drought risk after it has declared a Stage 1 Water Supply Shortage per OWASA's State-approved Water Shortage Response Plan and OWASA's Water Conservation Standards as incorporated therein; and, per the Drought Response Operating Protocol (DROP) adopted by the OWASA Board on January 10, 2013, only when total water storage in University Lake, Cane Creek Reservoir, and the Quarry Reservoir is below the Mandatory Stage 1 Shortage trigger.*

5. Work cooperatively with the elected boards of Carrboro, Chapel Hill, and Orange County to amend the 2001 *Water and Sewer Management, Planning, and Boundary Agreement* – only as needed – to resolve any unnecessary constraints on access to OWASA's Jordan Lake allocation and to ensure a reliable and sustainable water supply for the future.

Additional Recommendations:

A. Decisions to purchase water and/or declare Water Supply Shortage restrictions should be based on clearly defined trigger conditions, such as those established in OWASA's State-approved Water Shortage Response Plan (November, 2010). *OWASA will notify its customers and local elected boards in advance of an impending need to purchase water if reservoir storage and demand conditions do not improve in the near future.*

B. Recognize that OWASA's reservoirs were intended to be drawn down during periods of low inflow. Continue to follow a risk-based approach to drought management and use the "critical drawdown" graphs to develop more detailed triggers for drought management decisions, such as when to purchase water, when to declare a Water Supply Shortage, etc.

C. Retain the option of supplementing OWASA'S local supply sources with water pumped from the Haw River as a worst-case (temporary) contingency plan for emergency drought conditions, rather than as a permanent supply source.

D. Conduct no further evaluations of the following options, which are not considered to be viable: (a) expansion of University Lake or Cane Creek Reservoir; (b) sediment removal from University Lake; and (c) new dam and reservoir on Sevenmile Creek.

E. Recognize and pursue opportunities for expanding the reclaimed water system that are determined to be cost-effective and beneficial. Evaluate future requests for RCW service on a case-by-case basis, and require that extensions of the RCW system be paid for by benefiting parties in accordance with OWASA's contractual obligations to UNC.

F. Continue to monitor long-term trends in customer demand patterns, reservoir inflows, annual production rates of the active stone quarry, and other information needed to refine demand projections and water supply yield estimates. Demand projections should be systematically reviewed and adjusted to reflect actual observed trends at intervals of approximately every five years.

G. Continue to keep OWASA customers and local elected boards informed of any changes to the assumptions, conditions, or information on which this Water Supply Plan is based.

APPENDIX D: COST SPREADSHEETS

OWASA Alternative 1: Jordan Lake - Shared Intake

HAZEN AND SAWYER
Environmental Engineers & Scientists

Jordan Lake Joint Development – Western Intake, WTP and Related Facilities
Conceptual-Level Estimate of Water Facilities Project Capital and Life-Cycle Costs
for
OWASA

April 24, 2014

Summary of Water Facilities Capacity & Cost Sharing					
Description	Existing	Initial (2020)	Interim (2040)	Ultimate (2060)	WTP Land Cost Sharing
Water Supply Storage Allocation (mgd):	5	5	5	5	--
OWASA Capacity (equal to maximum day demand, mgd):	--	0.0	5.0	5.0	--
Average Water Use:	--	0.0	5.0	5.0	--
WTP Design Capacity (mgd):	--	44	60	60	--
WTP Expansion Increment (mgd):	--	--	16	--	--
OWASA Share of WTP Capacity (mgd):	--	5.0	0.0 inc.	5.0	0.0
% Total Capacity & Fixed Operating Cost Share:	--	11.4%	0.0%	8.3%	0.0%
% Avg. Plant Production & Variable Operating Cost Share:	--	0.0%	13.0%	10.5%	--
% Share of Common Finished Water Main, Section 1:	--	--	--	9.8%	--
% Share of Common Finished Water Main, Section 2:	--	--	--	17.2%	--
Friction Head Applied to Variable Operating Costs (ft):	--	60.4	104.6	125.4	--
Raw and Finished Water Pump TDH applied to Variable Op. Costs (ft):	--	386	431	451	--
OWASA Pressure Zone (ft):		**642**			

	CAPITAL COSTS (2010 Dollars)							Allocated to OWASA	
								Costs Subtotals	
No.	Description	Pipe Diam.	Quantity	Unit	Unit Cost	Total Cost	% of Total	Initial Const. (2015-2020)	Expansion (2035-2040)
1	**Raw Water Intake Structure (Shared)**								
	Steel Frame Tower w/ Multiple Level Screens (designed for 60 mgd total)		1	LS	$10,700,000	$10,700,000	8.3%	$892,000	
2	**Intake Piping (Shared)**								
	Dual Microtunneled Intake Lines (sized for 60 mgd total)	48 in	2,000	LF	$2,900	$5,800,000	8.3%	$483,000	
	Pipeline to New Raw Water Pump Station	54 in	1,000	LF	$473	$473,000	8.3%	$39,000	
3	**Raw Water Pump Station (Shared)**								
	Interim Capacity 44 mgd		1	LS	$10,582,000	$10,582,000	11.4%	$1,203,000	
	Ultimate Capacity 60 mgd		1	LS	$3,024,000	$3,024,000	0.0%		$0
4	**Jordan Lake Regional WTP (Shared, includes High Service PS, TDH = 100 ft)**								
	Interim Capacity 44 mgd		1	LS	$84,883,000	$84,883,000	11.4%	$9,646,000	
	Ultimate Capacity 60 mgd		1	LS	$27,130,000	$27,130,000	0.0%		$0
5	**Shared Finished Water Transmission Pipeline**								
	22 MGD Capacity - Northern Segment No. 1	54 in	48,800	LF	$473	$23,082,400	9.8%	$2,263,000	
	22 MGD Capacity - Northern Segment No. 2	42 in	62,905	LF	$368	$23,149,040	17.2%	$3,991,000	
6	**Finished Water Booster Station (Durham/OWASA/Orange Co./Hillsborough Shared)**								
	Interim Capacity 5.0 mgd		1	LS	$1,660,000	$1,660,000	100.0%	$1,660,000	
	Ultimate Capacity 0.0 mgd		2	LS	$0	$0	100.0%		$0
7	**CONSTRUCTION COST SUBTOTAL**							**$20,180,000**	**$0**
	<u>CAPITAL COST ALLOWANCES</u>								
8	**Contractor Mobilization, Overhead & Profit (@ 15% x Line 7)**						15%	$3,027,000	$0
9	**TOTAL CONSTRUCTION COST**							**$23,207,000**	**$0**
10	**Engineering Studies, Design, and Construction Services (@ 15% x Line 7)**						15%	$3,027,000	$0
11	**Subtotal**							**$26,234,000**	**$0**
12	**Land Acquisition and Easements** – OWASA WTP Site		0	Acre	$10,000	$0	0.0%	$0	
13	USACE Jordan Lake Easement		1	LS	$200,000	$200,000	8.3%	$17,000	
14	Allowance for Additional Land/Easement		1	LS	$100,000	$100,000	100.0%	$100,000	
15	Mitigation Costs for Stream Impacts		555	LF	$374	$207,570	14.0%	$29,000	
16	Mitigation Costs for Wetlands Impacts		2.26	Acre	$68,502	$154,815	14.0%	$22,000	
17	**Subtotal**							**$26,402,000**	**$0**
18	**Legal Fees, Permits and Approvals (@ 5% x Line 9)**						5%	$1,160,000	$0
19	**Subtotal**							**$27,562,000**	**$0**
20	**Contingency (@ 10% x Line 19)**						10%	$2,756,000	$0
21	**ESTIMATED PROJECT CAPITAL COST:**							**$30,318,000**	**$0**
22								**$30,318,000**	
			Quantity	**Unit**	**Unit Cost**	**Total Cost**	% Total		
23	Round 4 Level 1 Allocation Purchase Cost (+ $250 fee)	2020	0	mgd	$91,041	$0	100.0%	$0	
24	Annual Allocation O&M cost (included in life-cycle analysis)		Varies	mgd	$2,219				
25	Additional Fixed Administration Cost (annual)		1	LS	$250				
26	**Subtotal Allocation Capital Costs:**							**$0.00**	**$0.00**
27	**ESTIMATED PROJECT CAPITAL COST INCLUDING ALLOCATION PURCHASES:**							**$30,300,000**	**$0**
28								**$30,300,000**	
29	**ESTIMATED PRESENT WORTH OF LIFE-CYCLE COSTS:**							**$47,322,000**	
30	**ESTIMATED UNIT LIFE-CYCLE COSTS PER 1,000 GALLONS CONSUMED:**							**$3.99**	
31	**ESTIMATED UNIT LIFE-CYCLE COSTS PER 1,000 GALLONS OF LEVEL 1 ALLOCATION PURCHASED:**							**$0.63**	

April 24, 2014

CALCULATION OF O&M & LIFE-CYCLE COSTS for OWASA

Discount Rate:	1.295%
Capital Recovery Interest Rate:	3.225%
% Construction Cost Applied to O&M:	66%

Year and Water Usage					Actual (Inflated) Dollars						2010 Dollars		
			Water Quantity (mgd)			Other Capital / Fixed Costs		O&M Costs			Total Annual Costs		
												Running Present	
Year	# Yrs from 2010	WTP Capacity	Jordan Lake Allocation	Avg. Usage	Construction Capital Financing	Replace-ment & Salvage	Jordan Lake Allocation	Fixed	Variable	Total Annual	Net Present Worth	Per 1,000 gal's Allocation	Per 1,000 gal's Pumped
2010	0												
2011	1												
2012	2												
2013	3												
2014	4												
2015	5				$1,904,000					$1,904,000	$1,785,000		
2016	6				$1,904,000					$1,904,000	$1,763,000		
2017	7				$1,904,000					$1,904,000	$1,740,000		
2018	8				$1,904,000					$1,904,000	$1,718,000		
2019	9				$1,904,000					$1,904,000	$1,696,000		
2020	10	44	5	0.0	$1,904,000		$13,000	$182,000	$0	$2,099,000	$1,846,000	$5.78	
2021	11	44	5		$1,904,000		$13,000	$185,000	$0	$2,102,000	$1,825,000	$3.39	
2022	12	44	5		$1,904,000		$13,000	$187,000	$0	$2,104,000	$1,803,000	$2.59	
2023	13	44	5		$1,904,000		$13,000	$189,000	$0	$2,106,000	$1,782,000	$2.19	
2024	14	44	5		$1,904,000		$14,000	$192,000	$0	$2,110,000	$1,762,000	$1.94	
2025	15	44	5	1.3	$1,904,000		$14,000	$194,000	$106,000	$2,218,000	$1,829,000	$1.79	$42.85
2026	16	44	5		$1,904,000		$14,000	$197,000	$0	$2,115,000	$1,721,000	$1.66	$46.62
2027	17	44	5		$1,904,000		$14,000	$199,000	$0	$2,117,000	$1,701,000	$1.57	$50.35
2028	18	44	5		$1,904,000		$14,000	$202,000	$0	$2,120,000	$1,682,000	$1.50	$54.03
2029	19	44	5		$1,904,000		$14,000	$205,000	$0	$2,123,000	$1,663,000	$1.44	$57.68
2030	20	44	5	2.5	$1,904,000		$15,000	$207,000	$226,000	$2,352,000	$1,818,000	$1.40	$20.55
2031	21	44	5		$1,904,000		$15,000	$210,000	$0	$2,129,000	$1,625,000	$1.36	$21.74
2032	22	44	5		$1,904,000		$15,000	$213,000	$0	$2,132,000	$1,606,000	$1.32	$22.92
2033	23	44	5		$1,904,000		$15,000	$215,000	$0	$2,134,000	$1,587,000	$1.29	$24.07
2034	24	44	5		$1,904,000		$15,000	$218,000	$0	$2,137,000	$1,569,000	$1.26	$25.22
2035	25	44	5	3.8	$1,904,000		$16,000	$221,000	$361,000	$2,502,000	$1,814,000	$1.24	$13.27
2036	26	44	5		$1,904,000		$16,000	$224,000	$0	$2,144,000	$1,534,000	$1.22	$13.83
2037	27	44	5		$1,904,000		$16,000	$227,000	$0	$2,147,000	$1,517,000	$1.20	$14.39
2038	28	44	5		$1,904,000		$16,000	$230,000	$0	$2,150,000	$1,500,000	$1.18	$14.94
2039	29	44	5		$1,904,000		$16,000	$233,000	$0	$2,153,000	$1,482,000	$1.16	$15.48
2040	30	60	5	5.0		$1,338,000	$17,000	$173,000	$688,000	$2,216,000	$1,506,000	$1.14	$9.62
2041	31	60	5			$1,355,000	$17,000	$175,000	$0	$1,547,000	$1,038,000	$1.12	$9.84
2042	32	60	5			$1,373,000	$17,000	$177,000	$0	$1,567,000	$1,038,000	$1.09	$10.07
2043	33	60	5			$1,391,000	$17,000	$180,000	$0	$1,588,000	$1,039,000	$1.07	$10.30
2044	34	60	5			$1,409,000	$17,000	$182,000	$0	$1,608,000	$1,038,000	$1.05	$10.53
2045	35	60	5	5.0			$18,000	$184,000	$734,000	$936,000	$597,000	$1.02	$7.61
2046	36	60	5				$18,000	$187,000	$0	$205,000	$129,000	$0.99	$7.63
2047	37	60	5				$18,000	$189,000	$0	$207,000	$129,000	$0.96	$7.65
2048	38	60	5				$18,000	$192,000	$0	$210,000	$129,000	$0.93	$7.67
2049	39	60	5				$19,000	$194,000	$0	$213,000	$129,000	$0.90	$7.69
2050	40	60	5	5.0			$19,000	$197,000	$782,000	$998,000	$596,000	$0.88	$6.06
2051	41	60	5				$19,000	$199,000	$0	$218,000	$129,000	$0.85	$6.07
2052	42	60	5				$19,000	$202,000	$0	$221,000	$129,000	$0.83	$6.09
2053	43	60	5				$20,000	$204,000	$0	$224,000	$129,000	$0.81	$6.10
2054	44	60	5				$20,000	$207,000	$0	$227,000	$129,000	$0.79	$6.12
2055	45	60	5	5.0			$20,000	$210,000	$834,000	$1,064,000	$596,000	$0.77	$5.07
2056	46	60	5				$20,000	$212,000	$0	$232,000	$128,000	$0.75	$5.08
2057	47	60	5				$21,000	$215,000	$0	$236,000	$129,000	$0.74	$5.09
2058	48	60	5				$21,000	$218,000	$0	$239,000	$129,000	$0.72	$5.10
2059	49	60	5				$21,000	$221,000	$0	$242,000	$129,000	$0.70	$5.12
2060	50	60	5	5.0		-$8,831,804	$21,000	$224,000	$897,000	-$7,690,000	-$4,041,000	$0.63	$3.99
Totals:	**--**	**--**	**--**	**32.5**	**$47,600,000**	**-$1,965,804**	**$688,000**	**$8,272,000**	**$4,628,000**	**$59,222,000**	**$47,322,000**	**$0.63**	**$3.99**

OWASA Option: Shallow Quarry

OWASA Jordan Lake Round 4 Application: Alternatives 1, 3, and 4
Conceptual-Level Project Cost Estimate

							2010 DOLLARS
No.	**Description**	**Pipe Diam.**	**Allocated Fraction**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
1	**CAPITAL COST**						
2	**Emergency Generators**						
	Raw Water Pump Station		**100%**	1	LS	$920,000	$920,000
3	**CONSTRUCTION COST SUBTOTAL**						**$920,000**
4	**CAPITAL COST ALLOWANCES**						
5	**Contractor Mobilization, Overhead & Profit (@ 15% x Line 3)**					15%	$138,000
6	**TOTAL CONSTRUCTION COST**						**$1,058,000**
7	**Engineering Studies, Design, and Construction Services (@ 15% x Line 3)**					15%	$138,000
8	**Subtotal**						**$1,196,000**
9	**Property & Easement Acquisition (Estimate)**					N/A	
10	**Subtotal**						**$1,196,000**
11	**Legal Fees, Permits and Approvals (@ 5% x Line 6)**					5%	$53,000
12	**Subtotal**						**$1,249,000**
13	**Contingency (@ 10% x Line 12)**					10%	$125,000
14	**ESTIMATED PROJECT CAPITAL COST**						**$1,400,000**
15	**INCREASE IN OPERATIONAL YIELD, MGD:**						**2.1**
16	**Capital Cost per MGD:**						**$667,000**

OWASA Option: Deep Quarry

OWASA Jordan Lake Round 4 Application: Alternative 2
Conceptual-Level Project Cost Estimate

2010 DOLLARS

No.	Description	Pipe Diam. (in)	Allocated Fraction	Quantity	Unit	Unit Cost	Total Cost
1	**CAPITAL COST**						
2	**Raw Water Intake Structure**						
	Raw Water Intake Shaft (20 ft finished diameter)			275	VF	$30,000	$8,250,000
3	**Intake Piping**						
	Microtunneling (minimum 30")	######		600	LF	$2,100	$1,260,000
	Pipeline to new RWPS (Vertical)	######		275	VF	$200	$55,000
4	**Raw Water Pump Station**						
	#REF!		100%	1	LS	$6,660,000	$6,660,000
5	**Raw Water Transmission**						
	Parallel Raw Water Trans. Main from Quarry to JFR WTP	######		27,800	LF	$200	$5,560,000
6	**Raw Water Outlet Structure**						
	Energy Dissipation valve/structure			1	LS	$220,000	$220,000
7	**Cane Creek Refill Supply Incremental Costs**						
	10 mgd Raw Water Pumping Station		100%	1	LS	$2,380,000	$2,380,000
	Parallel Raw Water Trans. Main from Cane Creek to Quarry	######	100%	33,000	LF	$260	$8,580,000
8	**Emergency Generators**						
	Raw Water Pump Station		100%	1	LS	$1,840,000	$1,840,000
9	**CONSTRUCTION COST SUBTOTAL**						**$34,810,000**
10	**CAPITAL COST ALLOWANCES**						
11	**Contractor Mobilization, Overhead & Profit (@ 15% x Line 9)**					15%	$5,222,000
12	**TOTAL CONSTRUCTION COST**						**$40,032,000**
13	**Engineering Studies, Design, and Construction Services (@ 15% x Line 9)**					15%	$5,222,000
14	**Subtotal**						**$45,254,000**
15	**Property & Easement Acquisition (Estimate)**					N/A	
16	**Subtotal**						**$45,254,000**
17	**Legal Fees, Permits and Approvals (@ 5% x Line 12)**					5%	$2,002,000
18	**Subtotal**						**$47,256,000**
19	**Contingency (@ 10% x Line 18)**					10%	$4,726,000
20	**ESTIMATED PROJECT CAPITAL COST**						**$52,000,000**
21	**INCREASE IN OPERATIONAL YIELD, MGD:**						**3.4**
22	**Capital Cost per MGD:**						**$15,294,000**

OWASA Option: Haw River

OWASA Jordan Lake Round 4 Application: Alternative 3

Conceptual-Level Project Cost Estimate

2010 DOLLARS

No.	Description	Pipe Diam.	Allocated Fraction	Quantity	Unit	Unit Cost	Total Cost
1	**CAPITAL COST**						
2	**Raw Water Intake Structure**						
	Johnson Screen-Type Intake			1	LS	$1,029,600	$1,029,600
3	**Intake Piping**						
	Directional Bore (minimum 30")	30 in		200	LF	$2,100	$420,000
	Pipeline to new RWPS	24 in		200	LF	$200	$40,000
4	**Raw Water Pump Station**						
	8.3 mgd capacity			1	LS	$2,750,000	$2,750,000
5	**Raw Water Transmission**						
	Raw Water Trans. Main to from Haw River to Cane Creek R.	24 in		26,000	LF	$200	$5,200,000
6	**Raw Water Booster Station**			N/A			
7	**Raw Water Outlet Structure**						
	Energy Dissipation valve/structure			1	LS	$220,000	$220,000
8	**Cane Creek Transmission Incremental Costs**						
	Cane Creek 10 mgd Raw Water Pump Station Expansion		100%	1	LS	$2,380,000	$2,380,000
	Parallel Trans. Main (Cane Creek to Stone Quarry)	24 in	100%	33,000	LF	$200	$6,600,000
9	**Emergency Generators**						
	Raw Water Pump Station			1	LS	$950,000	$950,000
10	**CONSTRUCTION COST SUBTOTAL**						**$19,590,000**
11	**CAPITAL COST ALLOWANCES**						
12	**Contractor Mobilization, Overhead & Profit (@ 15% x Line 10)**					15%	$2,939,000
13	**TOTAL CONSTRUCTION COST**						**$22,529,000**
14	**Engineering Studies, Design, and Construction Services (@ 15% x Line 10)**					15%	$2,939,000
15	**Subtotal**						**$25,468,000**
16	**Property & Easement Acquisition (Estimate)**					$50,000	$50,000
17	**Subtotal**						**$25,518,000**
18	**Legal Fees, Permits and Approvals (@ 5% x Line 13)**					5%	$1,126,000
19	**Subtotal**						**$26,644,000**
20	**Contingency (@ 10% x Line 19)**					10%	$2,664,000
21	**ESTIMATED PROJECT CAPITAL COST**						**$29,300,000**
22	**INCREASE IN OPERATIONAL YIELD, MGD:**						**7.7**
23	**Capital Cost per MGD:**						**$3,805,000**

OWASA Analysis: Expand Reclaimed Water along Highway 54

OWASA Jordan Lake Round 4 Application: Alternative 4
Conceptual-Level Project Cost Estimate
Expansion of Existing Reclaimed Water System along Hwy 54

No.	Description		Quantity	Unit	Unit Cost	Total Cost
					2010 DOLLARS	
1	**CAPITAL COST**					
2	**RCW Pump Station Expansion**					
	RCW Transfer Pump, VFD, Valves and Electrical		1	LS	$181,000	$181,000
	RCW Distribution Pump, VFD, Valves and Electrical		1	LS	$488,000	$488,000
	PLC Controllers		1	LS	$44,000	$44,000
3	**Chemical Feed System Expansion**					
	Building and Improvements for New 15,000 Gallon Sulfuric Acid Tank		1	LS	$1,140,000	$1,140,000
	Chemical Feed System		1	LS	$68,000	$68,000
4	**RCW Distribution Piping Improvements**					
	15/501 ByPass Extension from St. Thomas More	Diam: 8 in	2,700	LF	$100	$270,000
	WWTP to NC 54 East along Finley Golf Course Road	Diam: 12 in	5,700	LF	$140	$798,000
	NC 54 East - W. Barbee Chapel Road	Diam: 12 in	3,600	LF	$140	$504,000
	W. Barbee Chapel Road to CH Country Club	Diam: 12 in	4,900	LF	$140	$686,000
	to Friday Center area	Diam: 8 in	3,300	LF	$100	$330,000
	Spur into Townhouse Section Common Space	Diam: 8 in	1,000	LF	$100	$100,000
	Bores Under 15/501 and NC 54	2	200	LF	$300	$120,000
		Total Length:	**21,200**	**LF**		
5	**CONSTRUCTION COST SUBTOTAL**					**$4,730,000**
6	**CAPITAL COST ALLOWANCES**					
7	**Contractor Mobilization, Overhead & Profit (@ 15% x Line 5)**				15%	$710,000
8	**TOTAL CONSTRUCTION COST**					**$5,440,000**
9	**Engineering Studies, Design, and Construction Services (@ 15% x Line 5)**				15%	$710,000
10	**Subtotal**					**$6,150,000**
11	**Property & Easement Acquisition (Estimate)**				N/A	
12	**Subtotal**					**$6,150,000**
13	**Legal Fees, Permits and Approvals (@ 5% x Line 8)**				5%	$272,000
14	**Subtotal**					**$6,422,000**
15	**Contingency (@ 10% x Line 14)**				10%	$642,000
16	**ESTIMATED PROJECT CAPITAL COST**					**$7,100,000**
17	**INCREASE IN OPERATIONAL YIELD, MGD:**					**0.25**
18	**Capital Cost per MGD:**					**$28,400,000**

OWASA Analysis: Expand Reclaimed Water to Cogeneration Plant

OWASA Jordan Lake Round 4 Application: Alternative 4

Conceptual-Level Project Cost Estimate

Expansion of Existing Reclaimed Water System to Cogeneration Plant

No.	Description		Quantity	Unit	Unit Cost	Total Cost (2010 DOLLARS)
1	**CAPITAL COST**					
2	**RCW Distribution Piping Improvements**					
	Line from Belltower to Cogeneration Facility	Diam: 8 in	4,300	LF	$240	$1,032,000
3	**CONSTRUCTION COST SUBTOTAL**					**$1,040,000**
4	**CAPITAL COST ALLOWANCES**					
5	**Contractor Mobilization, Overhead & Profit (@ 15% x Line 3)**				15%	$156,000
6	**TOTAL CONSTRUCTION COST**					**$1,196,000**
7	**Engineering Studies, Design, and Construction Services (@ 15% x Line 3)**				15%	$156,000
8	**Subtotal**					**$1,352,000**
9	**Property & Easement Acquisition (Estimate)**				N/A	
10	**Subtotal**					**$1,352,000**
11	**Legal Fees, Permits and Approvals (@ 5% x Line 6)**				5%	$60,000
12	**Subtotal**					**$1,412,000**
13	**Contingency (@ 10% x Line 12)**				10%	$141,000
14	**ESTIMATED PROJECT CAPITAL COST**					**$1,600,000**
15	**INCREASE IN OPERATIONAL YIELD, MGD:**					**0.09**
16	**Capital Cost per MGD:**					**$17,778,000**