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.

Revisions to Original April 8, 2010 Version of This Report and Appendices

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

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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

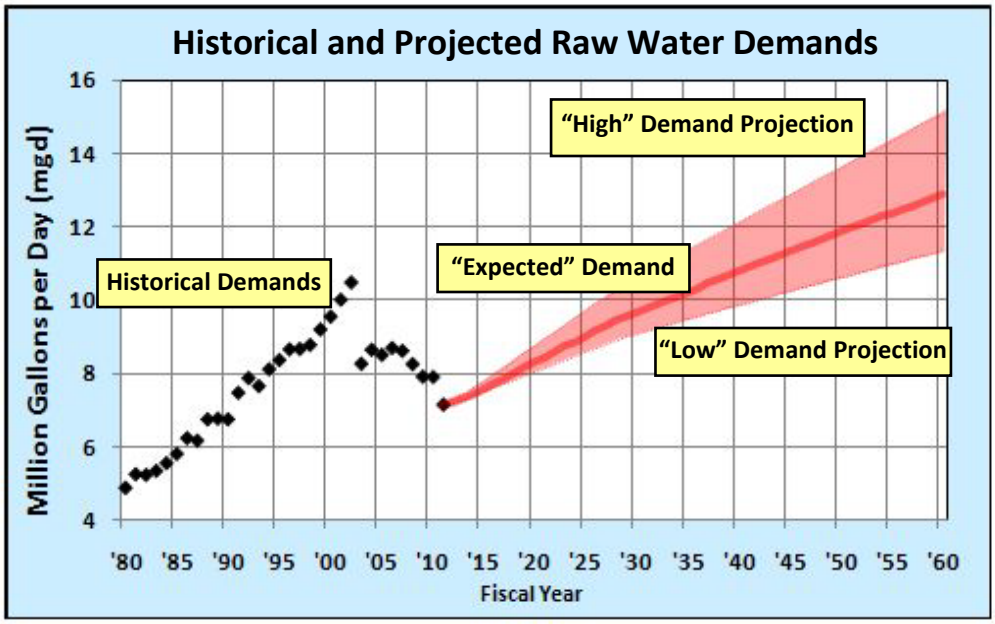
OWASA's Long-Range Water Supply Plan is not a static report, but will be periodically reviewed and updated to reflect changes to the assumptions, conditions, and information on which this 2010 edition is based.

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.

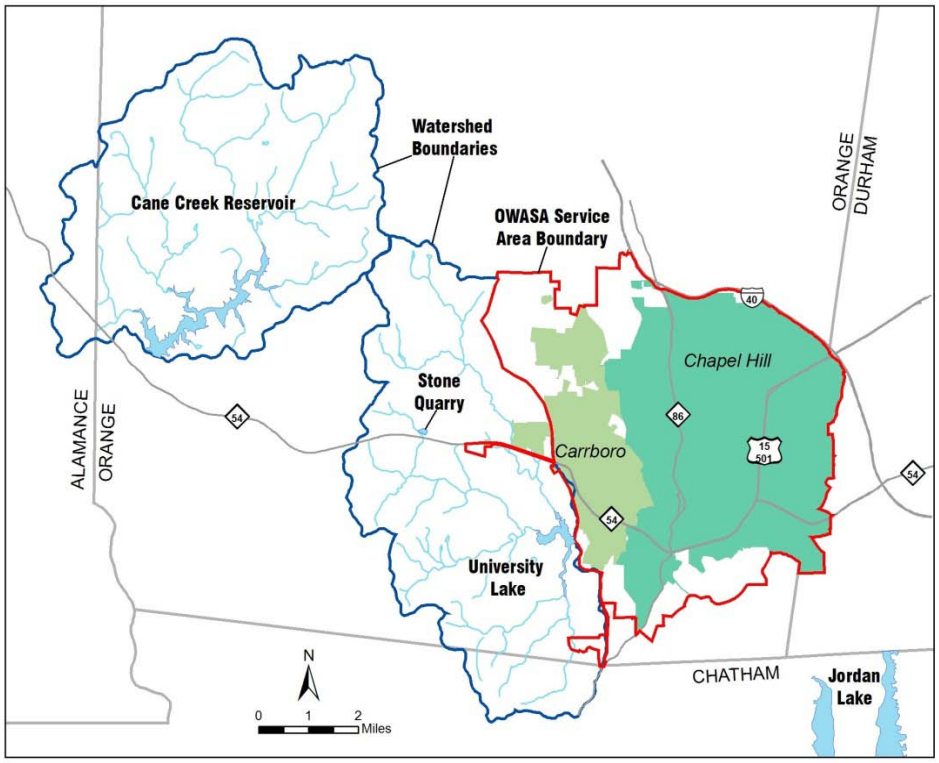
- Compare these data annually to demand projections of this report.

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



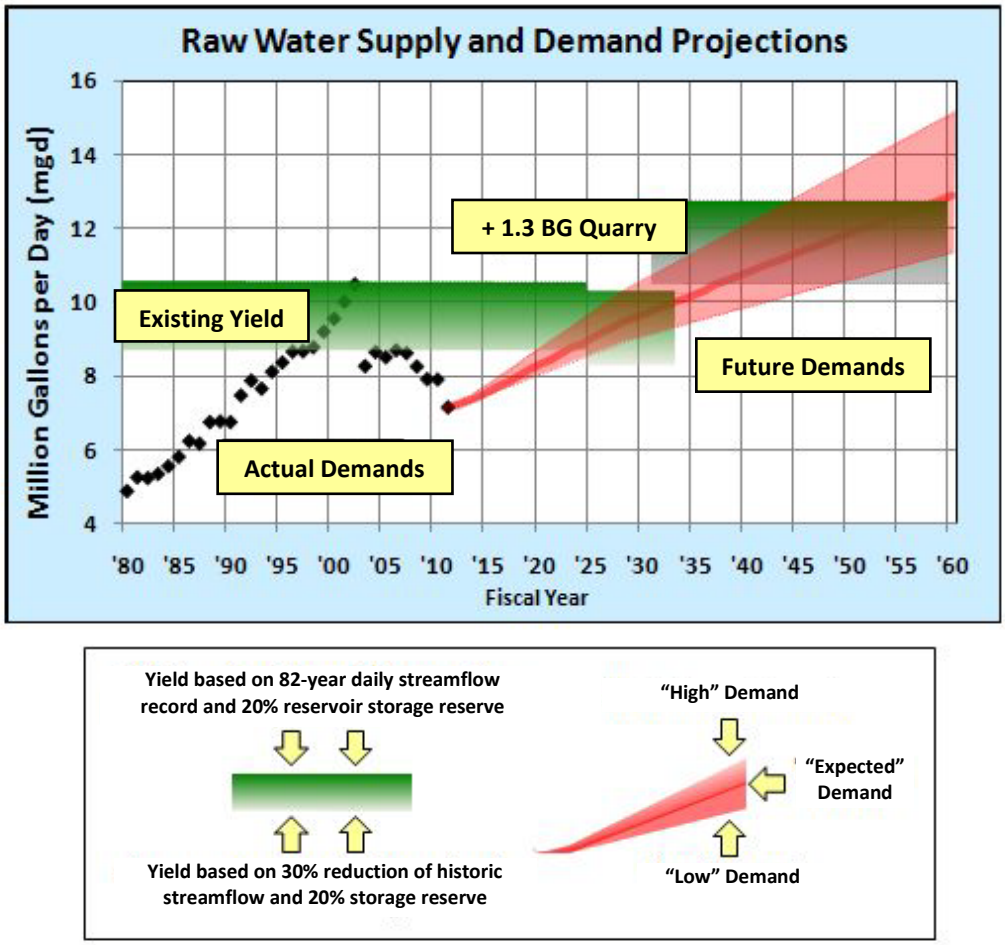
University Lake was created by UNC in 1932. It drains a 30-square mile watershed and has a usable storage capacity of 450 million gallons (MG). The lake and about 500 acres of adjacent lands are still owned by UNC, but OWASA controls all land within 100 feet of the shoreline and is entitled to use University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

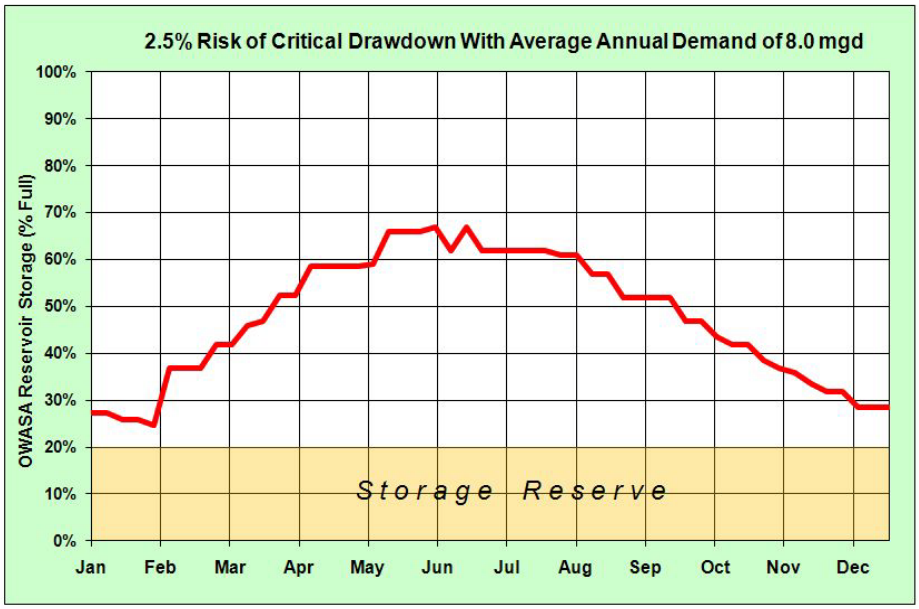
Figure 3 indicates that OWASA's current supply system can meet the community's water supply needs substantially further into the future than previously thought – even under hypothetical High Demand projections. This observation and the potential future benefits of an expanded Quarry Reservoir are discussed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

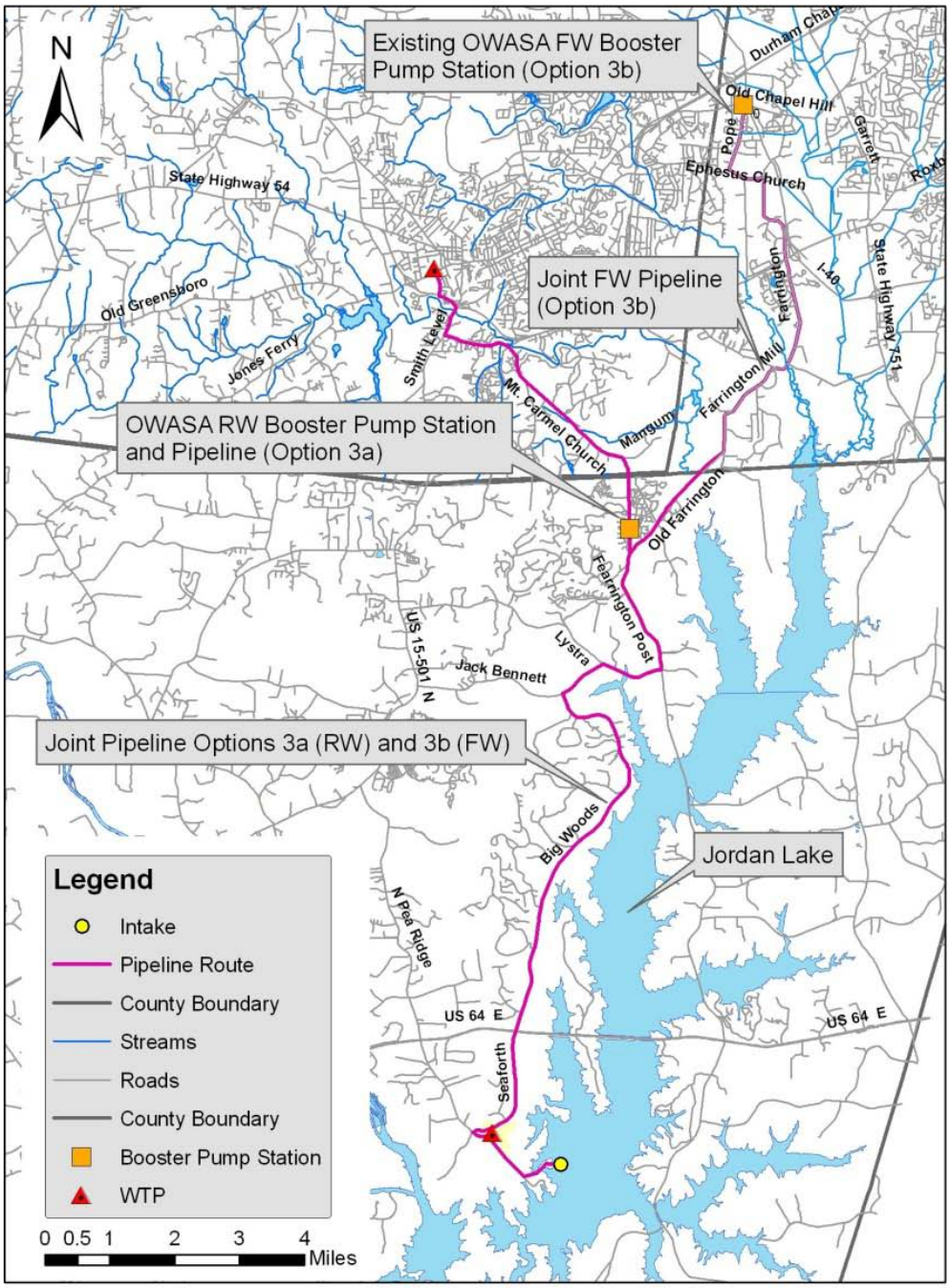
OWASA holds a Level II ("future use") allocation of 5% of Jordan Lake's water supply storage capacity, and owns 125 acres of land adjacent to US Army Corps of Engineers property on the west side of Jordan Lake in Chatham County. The storage allocation corresponds to an estimated yield of 5 mgd on an 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

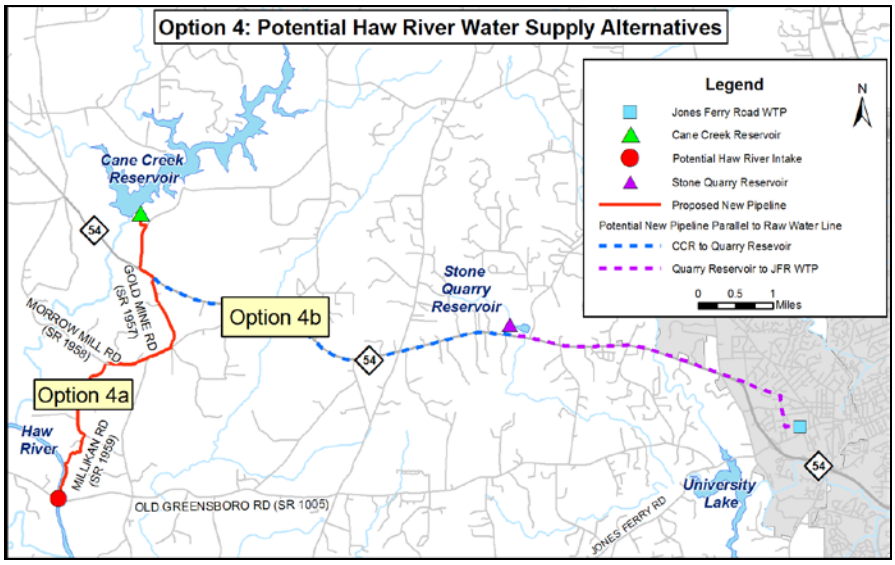
The Jordan Lake Regional Water Supply Partnership was created in 2009 by local jurisdictions and water systems in the Triangle area to jointly plan for the expanded use of the Jordan Lake water supply. OWASA is participating in the Partnership in order to obtain access to its 5 mgd water supply storage 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.

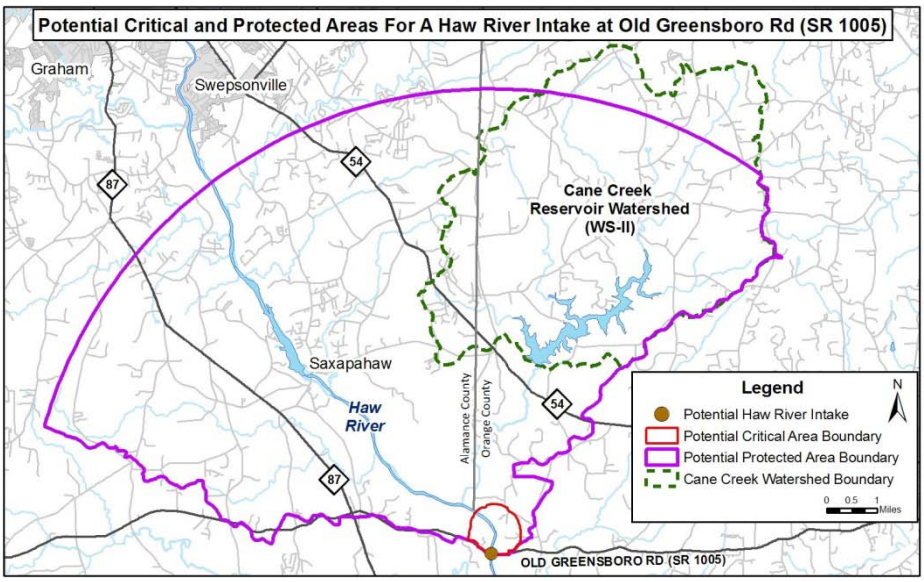
This option would involve the construction of a permanent intake on the Haw River in the vicinity of Old Greensboro Road in Orange County; installation of approximately 5 miles of pipeline to the Cane Creek Reservoir; improvements to the Cane Creek pumping station; and approximately 11 miles of new pipeline 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			**Addi-tional 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.