Ensuring an Adequate Water Supply for the Future:
Learning From the Drought

Orange Water and Sewer Authority

March 9, 2008
Objectives

Provide Information on:

- Current status of supplies and demand
- Long-term supply and demand outlook
- Emerging strategies – changing approaches
- A brief word about water quality

Receive Your Questions, Comments and Suggestions!
Drought Headlines

- Water storage at ~53% full – *unprecedented for our lakes to be so low at this time of year*
- Conditions have improved; however, our local “water supply” drought has not ended
- Below normal rainfall expected throughout the spring
- Stage Three Water Shortage declared March 1, 2008
- Stage Three Water Rate Surcharges in effect March 17
- Conservation needed to ensure adequate supply through rest of the year
Cane Creek Reservoir (12’5” below full)
University Lake (~5’ below on 3/3; now full)
Quarry Reservoir (was 7’ down; now full)

October 2007

Route 54

Bethel Hickory Grove Church Road
OWASA Reservoir Storage

OWASA Reservoir Storage and Inflow, Jan 1, 1996 - Mar 7, 2008

Total Reservoir Inflow (30-day median) as percent of 18-year daily median

Percent of Total Reservoir Storage
Daily Water Demands

Daily Customer Demand December 16, 2007 - March 6, 2008

- Pre-Drought Projections for December - March
- Actual Monthly Average
- Conservation Goals
OWASA Water Demands

Monthly Average Customer Demand, Jan 1, 1996 - Mar 6, 2008

- Peak Day Demand for Year
- Average Day Demand for Year
Use By Major Customer Classes

- Single-Family Residential: 36%
- UNC and UNC Hospitals: 29%
- Multi-Family Residential: 18%
- Commercial/Other: 17%
2008 Minimum Reservoir Storage Projections At Average Demands of 7 and 9 mgd Under Worst Historic Drought Conditions

Beginning with Reservoirs 40% Full on March 1, 2008

7 mgd Demand = Upper edge of each color band
9 mgd Demand = Lower edge of each color band
2008 Minimum Reservoir Storage Projections At Average Demands of 7 and 9 mgd Under Worst Historic Drought Conditions

Beginning with Reservoirs 40% Full on March 1, 2008

Total Water in Storage (100% = 3.558 BG)

- 7 mgd Demand = Upper edge of each color band
- 9 mgd Demand = Lower edge of each color band

Legend:
- 1941 Drought
- Doomsday Drought No Further Streamflow

X-axis: March to February
Y-axis: Water in Storage (%)
2008 Minimum Reservoir Storage Projections At Average Demands of 7 and 9 mgd Under Worst Historic Drought Conditions

Beginning with Reservoirs 40% Full on March 1, 2008

Total Water in Storage (100% = 3.558 BG)

- 1941 Drought
- 2002 Drought
- Doomsday Drought (No Further Streamflow)

7 mgd Demand = Upper edge of each color band
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2008 Minimum Reservoir Storage Projections At Average Demands of 7 and 9 mgd Under Worst Historic Drought Conditions

Beginning with Reservoirs 40% Full on March 1, 2008

7 mgd Demand = Upper edge of each color band
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2008 Minimum Reservoir Storage Projections At Average Demands of 7 and 9 mgd Under Worst Historic Drought Conditions

*Actual Streamflow Records Reduced by 40%*

Assumes that total storage begins at 39% on February 1, 2008

7 mgd Demand = Upper edge of each color band  
9 mgd Demand = Lower edge of each color band
Raw Water Supply, Demand, and Potential Deficits

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<th>Year</th>
<th>Pre-CCR</th>
<th>Existing System (with 2007 quarry pump improvements)</th>
<th>Expanded Quarry</th>
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Million Gallons Per Day

With Reuse

Lesser PC & Less Reuse

Greater PC & More Reuse

2001 Master Plan

"Expected Growth"

30-Yr Safe Yield

2001-02 Drought

Without Reuse
Increasing Uncertainty…

- Two droughts of record in last 6 years?
- Local effects of global climate change?
  - More frequent and severe droughts
  - More intense precipitation events
  - Effects on facilities, quantity and quality
- Security risks
- Operational risks (greater dependence on RCW)
- Other…
Shifting Emphasis...

- Greater conservation and demand management will be essential to everything we do!
  - Cost-effective compared to new reservoirs
  - Reduces energy and water & sewer costs
  - Complements GHG and climate change efforts
- Use of reclaimed water
- Full cost pricing
- More options to ensure reliability and reduce risk to droughts, & other emergencies
Conservation

- **Water use efficiency requirements** as a condition of receiving OWASA service
  - New development as efficient as possible
- **Conservation pricing**
- **Expanded education and outreach**
  - Targeted water use audits
  - More workshops
  - Financial incentives (loans, rebates, credits, etc.)
- Strong **partnerships** will be essential
Reclaimed Water (RCW)

- Highly treated water normally discharged into Morgan Creek; suitable for non-drinking water uses
- New RCW system serving main campus
  - Now under construction; start-up March ‘09
  - Initially save 0.6 mgd; perhaps 2 mgd in 20 years
  - UNC paying all the costs
  - Expandable to serve other customers
- Bulk fill RCW at Mason Farm WWTP
  - Now distributing RCW at no charge
  - Haulers must first receive training
General Schematic for OWASA’s Reclaimed Water System
Reclaimed Water

- Carolina North
  - Working closely with UNC
  - Would probably build new RCW facility
  - Dual distribution system from very outset
  - Expandable to serve nearby areas
Water Supply Alternatives

- Buy drinking water from others
- Wells
- Jordan Lake
- Haw River
Short-Term Next Steps

- Continue to closely monitor supply and demand
- Continue worst case scenario planning – be prepared to act; running out of water is not an option
- Continue local and regional emergency response planning
- Joint staff work with Carrboro, Chapel Hill and Orange County to develop additional conservation measures nearing completion
Next Steps

- Consider what risk tolerance will be acceptable to our customers and determine what actions will be required to get us to 2030s when the expanded Quarry Reservoir comes on line

- Update long-term demand projections and Water Supply Plan
  - Conservation remains a key component; now and in the future
  - Potential expanding role for reclaimed water
  - Participate in discussions to determine potential costs and benefits of regional access to Jordan Lake (even if needed only as an emergency backup supply)
Implement Plan

- Implement water supply and demand management plan
  - Conservation and demand management strategies
  - Expanded use of reclaimed water
  - Supply-side strategies
A Few Words About Water Quality

- Essential for protection of public health
  - Conventional parameters of concern
  - Emerging contaminants of concern
- Important from taste and odor perspective
- Quality affects design and cost of treatment
- Effects of climate change on water quality?
  - Watershed vegetation and hydrology
  - Quality of precipitation
Impacting the Hydrologic Cycle

**Natural Ground Cover**
- 40% evapotranspiration
- 10% runoff
- 25% shallow infiltration
- 25% deep infiltration

**10%-20% Impervious Surface**
- 38% evapotranspiration
- 20% runoff
- 21% shallow infiltration
- 21% deep infiltration

**35%-50% Impervious Surface**
- 35% evapotranspiration
- 30% runoff
- 20% shallow infiltration
- 15% deep infiltration

**75%-100% Impervious Surface**
- 30% evapotranspiration
- 55% runoff
- 10% shallow infiltration
- 5% deep infiltration
Imperviousness and Stream Health

The graph illustrates the relationship between the percentage of watershed impervious area and stream impact. It shows three levels of impact:

- **Low Impact**: Impervious areas below 10% of the watershed area, with a corresponding low stream impact.
- **Moderate Impact**: Impervious areas between 10% and 30% of the watershed area, resulting in a moderate stream impact.
- **High Impact**: Impervious areas above 30% of the watershed area, leading to a high stream impact.

The graph suggests a linear increase in stream health as the percentage of impervious area decreases, indicating that maintaining lower percentages of impervious areas is crucial for protecting stream health.
Quality is Good, Not Pristine

- Nutrient enrichment
- Total Organic Carbon
- Algal Growth
- Dissolved Oxygen depletion in bottom
- Taste and Odor Challenges
Management Studies

- Watershed and Water Quality Modeling
- Evaluation of Alternative Scenarios
- Water Quality Goals
- Management Options
- Participation by landowners, local govts, etc.
Protection Strategies

- Large-Lot (5-ac/2-ac) re-zoning
- Limited non-residential development
- No public water and sewer extensions
- Acquire 1,265 acres of additional land
  - Fee simple acquisition and conservation easements
  - State and County funding support
- Cost-share assistance for Ag BMPs
- Restricted in-lake recreational activities
There’s much more to tell!

And we have a lot to do...
We seek and appreciate your feedback!

We appreciate your efficient use and protection of our water resources!

Your leadership and support will be essential to the success of our efforts!
Buy drinking water from others

- We have existing emergency interconnections with the City of Durham (recently expanded), Town of Hillsborough, and Chatham County.

However, there may be limited potential to purchase water from others during current drought.
Wells (groundwater)

- Available supply is highly uncertain
- Groundwater supply is also impacted by the drought
- Use of groundwater could affect others and also affect streamflow
- Not recommended
Jordan Lake

- OWASA currently has a Level II storage allocation equivalent to ~5.0 MGD; but no existing infrastructure or contractual arrangements with others to access this supply.

- So far, the Jordan Lake water supply pool has performed very well during the current drought.

- Important for OWASA and our region to work together to efficiently access this resource in the future, even if only needed by OWASA during shortage conditions.
Haw River

- Potential Worst Case Drought Response Scenario – pump Haw River water to the Cane Creek Reservoir
- Supply appears to be available – extensive regulatory approvals required
- Feasible, but very expensive
- Appears to be most viable Worst Case Drought Response option
Financial Implications

- Potential revenue shortfall this Fiscal Year (FY) year projected at $1.0 – $2.5 million

- Work to reduce O&M spending by $1.3 million this FY

- Depending on the duration and severity of the drought – higher than anticipated rate increases may be required (and potentially additional reductions in O&M and/or Capital Project expenditures)
Stage Three Restrictions

- No irrigation except with hand-held hose or watering can; limited to 3 days per week with ½ inch limit; no watering of turf (grass)

- No outdoor use except for public health and safety

- No car washes; no filling or topping off swimming pools

- No flushing or pressure testing of new lines unless the water is captured and recycled

- 20% or more demand reduction goal; less than 35 gallons per person per day recommended
# Stage Three Surcharges
(for single-family residential customers)

<table>
<thead>
<tr>
<th>Monthly Usage</th>
<th>Without Surcharges</th>
<th>Stage 2 Surcharges</th>
<th>Stage 3 Surcharges</th>
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<td>2,000 gallons</td>
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<td>20,000 gallons</td>
<td>$159.34</td>
<td>$340.97</td>
<td>$460.87</td>
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Effective Dates:
- November 1, 2007
- March 17, 2008
## Stage Three Surcharges
(for non-residential customers)

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<tr>
<th>Monthly Usage</th>
<th>April (Non-peak) No Surcharges</th>
<th>May (Peak) No Surcharges</th>
<th>April or May (Non-peak or Peak) With Stage 3 Surcharges</th>
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<td>5,000 gallons</td>
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<td>$51.51</td>
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<td>10,000 gallons</td>
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<td>100,000 gallons</td>
<td>$330.26</td>
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Effective March 17, 2008
Figure 1. Single Family Residential Housing Starts in Carrboro and Chapel Hill, CY 1996-2006
Figure 7.

Household Water Use
SF Detached Homes, CY 1992-2006

Gallons per Day (gpd)


11 Percent Reduction in Avg Household Use
Figure 8. Household Water Use
Multifamily Individually Metered, CY 1992-2006

Gallons per Day (gpd)


17 Percent Reduction in Avg Household Use
RCW to University Lake
Jones Ferry Road Water Treatment Plant

20 million gallons per day (mgd) peak treatment capacity
Reservoir Drawdown Frequency and Guidelines for Conservation Triggers, Average Demand = 9.15 mgd

Number of times (or percent of years) during 77 years of daily streamflow records in which reservoir storage would have declined to 20% or less during the following 18 months.

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Water Resembling Percent of Full in University Lake, Case Creek, and Quarry Reservoirs

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</tbody>
</table>

Conservation Stages and Risk Levels

Each cell of the table contains an integer and a percentage, which represent the probability that reservoir levels will decline to 30 percent or less of full capacity during the following 18 months. These were calculated from spreadsheet model runs of 77 years of daily streamflow data, updated through January 2003, and driven by monthly water demand and reservoir storage at the beginning of each month. Calculations were based on an average annual raw water demand of 9.15 mgd, adjusted by observed monthly ratios, which are reflected in monthly demands shown at the top of the table.

Each column of the table corresponds to a month, and each row corresponds to reservoir storage, as percent full, at the beginning of that month. Colors indicate the corresponding conservation and risk levels proposed for each condition. Cells highlighted in orange or blue represent actual reservoir storage conditions at the beginning of that month during 2007 (orange) or the current year (blue).

**2007 Reservoir Levels**

**2008 Reservoir Levels**
Figure 3. Monthly Combined Water and Sewer Charges for Typical In-District Residential Customers as of January 2007 (assuming 6,000 gallons per month usage)
<table>
<thead>
<tr>
<th>Class</th>
<th>Description</th>
<th>Dec-Jan 07/08 as Percent of Dec-Jan 06/07</th>
<th>Percent of Total Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 00</td>
<td>Townhomes</td>
<td>90%</td>
<td>0.5%</td>
</tr>
<tr>
<td>Class 01</td>
<td>Single Family Residential</td>
<td>85%</td>
<td>31.6%</td>
</tr>
<tr>
<td>Class 02</td>
<td>Ind. Metered Multi-Family</td>
<td>90%</td>
<td>5.2%</td>
</tr>
<tr>
<td>Class 03</td>
<td>Master Metered Multi-Family</td>
<td>95%</td>
<td>21.8%</td>
</tr>
<tr>
<td>Class 04</td>
<td>Private Non-UNC Dorms/Group Homes</td>
<td>107%</td>
<td>1.4%</td>
</tr>
<tr>
<td>Class 05</td>
<td>Nursing Homes</td>
<td>60%</td>
<td>0.7%</td>
</tr>
<tr>
<td>Class 06</td>
<td>Hotel/Motel/Guest Quarters</td>
<td>91%</td>
<td>1.3%</td>
</tr>
<tr>
<td>Class 07</td>
<td>Non-UNC Medical/Health Care</td>
<td>94%</td>
<td>1.3%</td>
</tr>
<tr>
<td>Class 08</td>
<td>Non-UNC Schools and Churches</td>
<td>86%</td>
<td>1.4%</td>
</tr>
<tr>
<td>Class 09</td>
<td>Office/Retail/Commercial/Banks</td>
<td>95%</td>
<td>5.3%</td>
</tr>
<tr>
<td>Class 10</td>
<td>Service Stations/Auto Repair</td>
<td>88%</td>
<td>0.2%</td>
</tr>
<tr>
<td>Class 11</td>
<td>Car Washes</td>
<td>32%</td>
<td>0.1%</td>
</tr>
<tr>
<td>Class 12</td>
<td>Laundromats</td>
<td>111%</td>
<td>0.4%</td>
</tr>
<tr>
<td>Class 20</td>
<td>Non-UNC Irrigation</td>
<td>58%</td>
<td>0.3%</td>
</tr>
<tr>
<td>Class 21</td>
<td>Non-UNC Recreational Facilities</td>
<td>76%</td>
<td>0.5%</td>
</tr>
<tr>
<td>Class 22</td>
<td>Municipalities/Government Operations</td>
<td>75%</td>
<td>0.3%</td>
</tr>
<tr>
<td>Class 25</td>
<td>Restaurants/Food Preparation</td>
<td>81%</td>
<td>1.6%</td>
</tr>
<tr>
<td>Class 26</td>
<td>UNC Classroom/Faculty Offices</td>
<td>91%</td>
<td>3.3%</td>
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<tr>
<td>Class 27</td>
<td>UNC Laboratory/Research Facilities</td>
<td>93%</td>
<td>3.4%</td>
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<tr>
<td>Class 28</td>
<td>UNC Office/Administration</td>
<td>90%</td>
<td>0.2%</td>
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<tr>
<td>Class 29</td>
<td>UNC Student Housing</td>
<td>103%</td>
<td>3.8%</td>
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<td>Class 30</td>
<td>UNC Hospitals/Patient Care</td>
<td>92%</td>
<td>4.1%</td>
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<td>Class 31</td>
<td>UNC Heating and Cooling</td>
<td>91%</td>
<td>9.2%</td>
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<tr>
<td>Class 32</td>
<td>UNC- Other</td>
<td>114%</td>
<td>2.2%</td>
</tr>
</tbody>
</table>

| Total   |                                           | 90.9%                                    | 100.0%               |
OWASA Reservoir Storage

Total Reservoir Inflow (30-day median) as percent of 18-year daily median

Percent of Total Reservoir Storage
Since the drought of 2001-02

- Implemented conservation rates in 2002. *Increasing block rate structure for individually metered residential customers took effect on October 1, 2007.*

- New Water Conservation Ordinances approved by Carrboro, Chapel Hill & Orange County in 2003 mandating year round conservation measures.

- Process water recycling approved for Jones Ferry Road Water Treatment Plant in February 2005 (reduces reservoir withdrawal 6-8%).

- Construction underway for the reclaimed water system serving the University (operational by 2009).

- Adopted Goal and Objectives for long-term water conservation in 2005 (“...highest and best use of local water resources”).
Very positive results

- Since 2001, per-household residential water consumption has decreased about 12%; and summer peak demand has been lowered by about 20%.
- Conservation will play an increasingly important role in our future…

OWASA’s Build Your Own Rain Barrel Work Shop