‘Creating’ More Water in the Catawba

CW-WMG – Catawba River Water Supply Master Plan

WRF & CW-WMG – Safe Yield Research Project

Catawba-Wateree Water Management Group

(19 Members with Intakes in the 11 Reservoirs and Main Stem of the Catawba)

- Belmont, NC
- Camden, SC
- Catawba River Water Supply Project
- Charlotte, NC
- Chester Metro, SC
- Duke Energy
- Gastonia, NC
- Granite Falls, NC
- Hickory, NC
- Lenoir, NC
- Lincoln County, NC
- Longview, NC
- Lugoff-Elgin Water Auth., SC
- Mooresville, NC
- Morganton, NC
- Mount Holly, NC
- Rock Hill, NC
- Statesville, NC
- Valdese, NC

CW-WMG is Leading Research & Planning Efforts to Ensure Sustainable Water Supply

- Safe Yield Research Project
- Sedimentation Study
- Conservation Study
- Catawba River Water Supply Master Plan
- States' Settlement Agreement
  - Water Supply Study Update
  - CHEOPS Modeling Update
  - Future Planning
  - Funding by CW-WMG, NC, and SC

SETTLEMENT AGREEMENT
DECEMBER 3, 2010

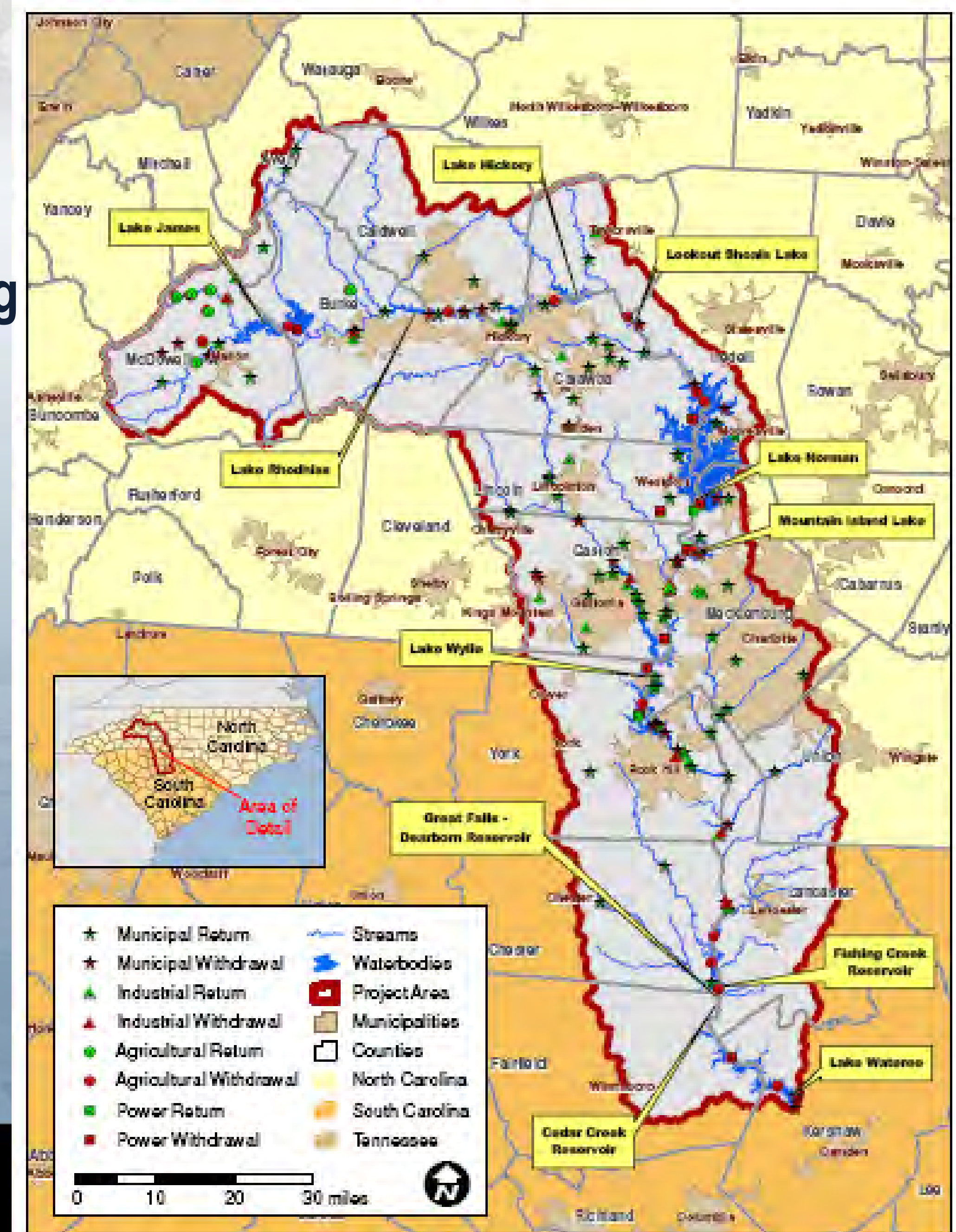
SOUTH CAROLINA V. NORTH CAROLINA, NO 138, ORIG.

Background Information

Catawba-Wateree River Basin

Basin Characteristics Impacting Available Water Yield

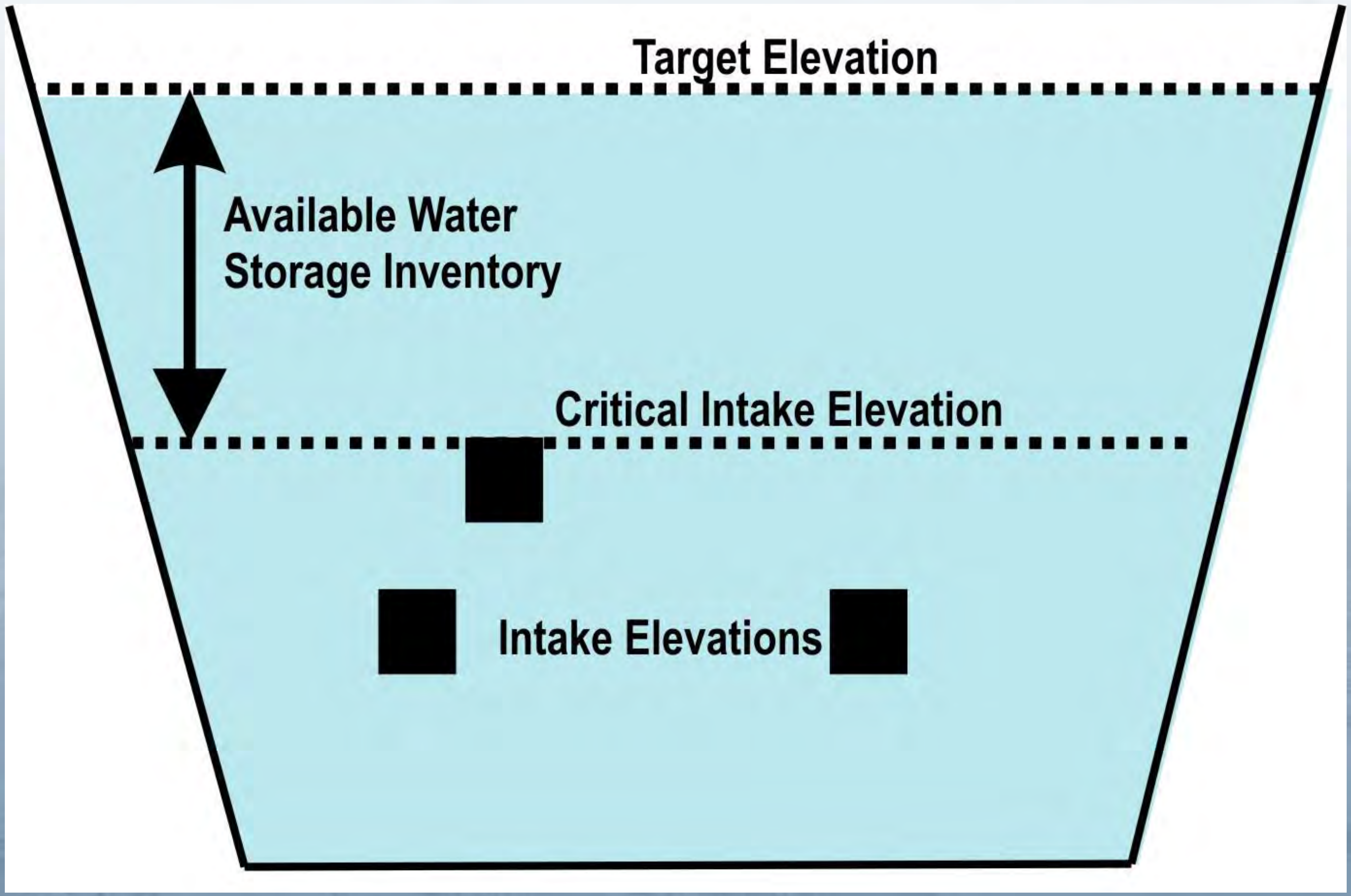
- Size, shape
- Multi-use, multi-reservoir
- Population location
- Reservoir storage
- Return flows
- NC-SC Border



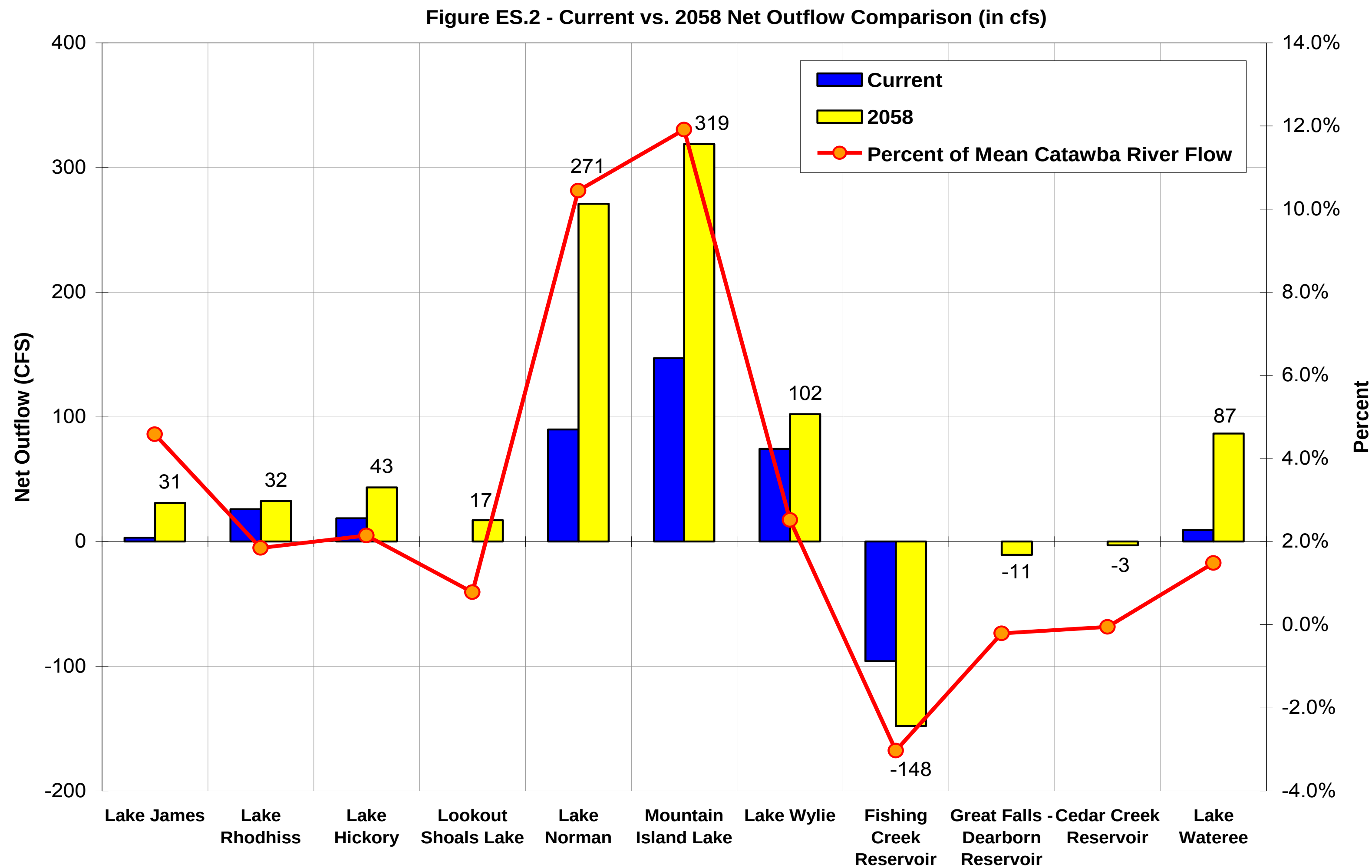
Water Yield is Constrained by Intake Levels

Defining Failure

Existing municipal and industrial intakes located at relatively shallow depths in the reservoirs



Net Water Withdrawals Projected to More Than Double in Next 50 Years (Current vs. 2058, cfs)



Water Demand Projected to Exceed Available Yield by 2048 (2002 Drought …2007 Drought)

Table ES-3. Safe Yield Evaluation - Summary

Reservoir	Safe Yield Projection Year [Associated Withdrawal Projection (mgd)]			
	Baseline Critical Intake [1]	Mutual Gains Critical Intake	Mutual Gains Boat Access	Mutual Gains Full Reservoir Access
James	2048 (34)	2048 (32)	2008 (12)	> 2078 (> 44)
Rhodhiss	2048 (40)	2048 (40)	> 2078 (> 52)	> 2078 (> 52)
Hickory	2048 (37)	2048 (37)	2008 (17)	> 2078 (> 54)
Lookout Shoals	2048 (12)	2048 (12)	> 2078 (> 15)	> 2078 (> 15)
Norman	2038 (133)	2048 (169)	2068 (202)	> 2078 (> 223)
Mountain Island	2038 (192)	2048 (207)	2008 (131)	> 2078 (> 272)
Wylie	2068 (171)	2048 (141)	2008 (95)	> 2078 (> 189)
Fishing Creek	> 2078 (> 225)	> 2078 (> 238)	> 2078 (> 238)	> 2078 (> 238)
Great Falls-Dearborn	2058 (2)	> 2078 (> 3)	> 2078 (> 3) [2]	> 2078 (> 3)
Cedar Creek	2058 (1)	> 2078 (> 1)	2008 (1)	> 2078 (> 1)
Wateree	> 2078 (> 74)	> 2078 (> 74)	> 2078 (> 74)	> 2078 (> 74)

Notes: 1. Withdrawal flows associated with years given may not match exactly with flows outlined in Section 3 and Appendix C. Baseline safe yie [redacted] projections.
2. No critical boat acce [redacted]

LIP – Formalizes Regional Drought Response

Stage	Triggers	Action Summary
0	Storage Index (SI) below Target Storage Index (TSI), but greater than 90% of TSI; or US Drought Monitor ≥ 0; or USGS Stream Gauges ≤ 85% of long term average (must have two)	***Licensee*** - Activate Catawba-Wateree Drought Management Advisory Group (CW-DMAG).
1	SI at or below 90%TSI, but greater than 75% of TSI...and US Drought Monitor ≥ 1; or USGS Stream Gauges ≤ 78% of long term average	***Licensee*** - Reduce downstream, bypass, recreation flows and Normal Minimum Elevations. ***Public Water Suppliers (PWS)*** – Voluntary water use restrictions, 2 day/wk irrigation, reduce vehicle washing; water reduction goal of 3-5%. ***Other Large Water Intake (LWI) Owners*** – Notify employees and customers and request voluntary cutbacks.
2	SI at or below 75%TSI, but greater than 57% of TSI...and US Drought Monitor ≥ 2; or USGS Stream Gauges ≤ 65% of long term average	***Licensee*** – Further reduce flows and Normal Minimum Elevations. Eliminate recreation flows. ***PWS*** – Mandatory water use restrictions, **2 day/wk irrigation**, eliminate vehicle washing; water reduction goal of 5-10%. ***Other LWI Owners*** – Notify employees and customers and request voluntary cutbacks.
3	SI at or below 57%TSI, but greater than 42% of TSI...and US Drought Monitor ≥ 3; or USGS Stream Gauges ≤ 55% of long term average	***Licensee*** - Reduce downstream and bypass flows to critical flows, and further reduce Normal Minimum Elevations. ***PWS*** – Mandatory water use restrictions, **1 day/wk irrigation**, limit other outdoor water uses; water reduction goal of 10-20%. ***Other LWI Owners*** – Notify employees and customers and request voluntary cutbacks.
4	SI at or below 42%TSI...and US Drought Monitor = 4; or USGS Stream Gauges ≤ 40% of long term average	***Licensee*** – Maintain downstream and bypass flows to critical flows, and reduce Normal Minimum Elevations to critical elevations. ***PWS*** – Restrict all outdoor water use, implement emergency restrictions; water reduction goal of 20-30%. ***Other LWI Owners*** – Notify employees and customers and request voluntary cutbacks.

Safe Yield Research Project

(co-funded by WRF and CW-WMG)

Research Team Delivers Global Experts to Catawba Water Supply Challenges

- **Water Research Foundation**
  - Jennifer Warner, PM
- **Research Team – HDR Engineering**
  - Kevin Mosteller, Mike Benchich, Mary Knosby, Chris Ey, Joel Bilodeau
- **Project Advisory Committee (PAC)**
  - Alison Adams (Tampa Bay Water, FL)
  - Mark Woodbury (Riverside Technology, Fort Collins, CO)
  - David Yates (National Center for Atmospheric Research, CO)
- **Technical Advisory Committee (TAP)**
  - Bill Holman (Nicholas Institute, Duke University)
  - Neil Grigg (Colorado State University)
  - Peter Sutherland (GHD- Australia)
  - Ken Choffel (HDR- Texas)
- **Other participants**
  - Catawba-Wateree Water Management Group (18 municipalities and Duke Energy)

Research Outcomes

- Best practice guidance for defining water supply water yields in multi-use, multi-reservoir systems
- Defined approach for integrating the impacts of climate change on future water yield estimates
- Strategies for increasing safe yield from similar reservoir systems
- Quantitative and qualitative review of the financial, environmental, and public impacts of selected strategies

Candidate River Systems Evaluated

Candidate River Systems Evaluated

Findings from Comparison System Review

1. Water yield analysis – function of stress level
2. Yield typically evaluated with computer models
3. Assumptions, data, and elements used in models vary due to differing characteristics of water supply
4. Shared supplies require excellent communication, coordination, and organization
5. Demand-side management is focus of extending available water supply
6. Yield analysis for Catawba-Wateree among the best

Yield Strategies Simulated
(High/Medium Priority Ranking)

Strategy	Description	Anticipated Result Compared to Baseline
BL – 01	Baseline For Comparison to Yield Scenarios	-
CC – 01	Low Impact of Climate Change on Water Supply	Lower yield
CC - 02	High Impact of Climate Change on Water Supply	Lower yield
YS – 01	Lower Existing Intakes in the Upper Catawba Basin	Greater yield for areas of greatest vulnerability
YS – 02	Lower Existing Intakes in Middle Catawba Basin	Greater yield
YS – 03	Re-route Existing Effluent (i.e. Return) Flows Upstream	Greater yield for areas of greatest vulnerability
YS – 04	Reduce Per Capita Water Demands for Public Water Supplies	Delay in reaching yield
YS – 05	Increase Off-Stream Storage in middle Catawba Basin	Greater yield for areas of greatest vulnerability
YS – 06	Raise target operating levels in reservoirs	Greater yield
YS – 07	Utilize inter-basin transfer during drought	Greater yield
YS – 08	Reduced impact of sedimentation in reservoirs	Greater yield

Yield Strategies Not Evaluated
(Low Priority Ranking)

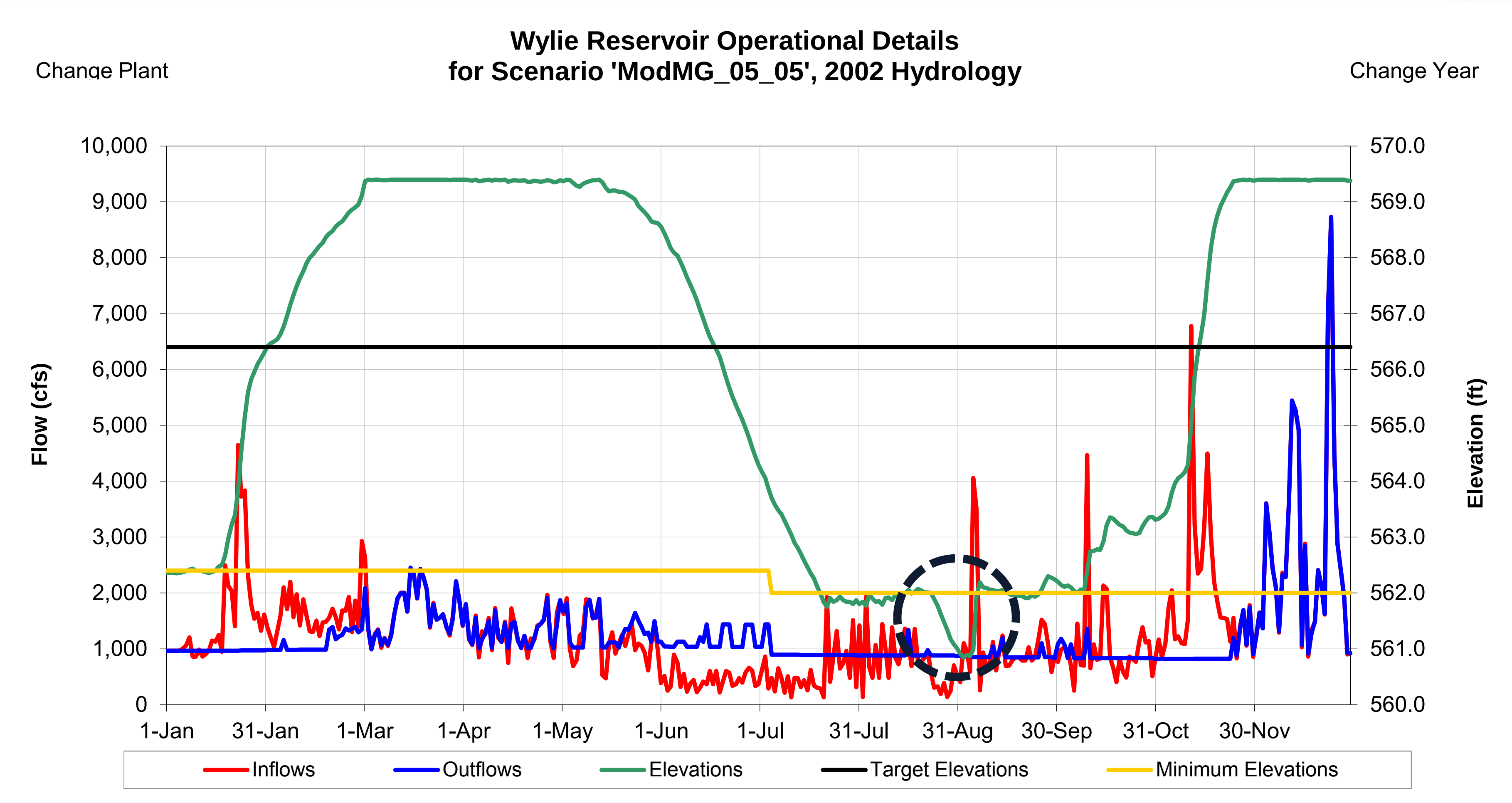
Priority	Description	Rationale for Ranking
Low	Develop demand-side interconnections for at-risk systems	Prior analysis did not indicate significant opportunity
Low	Increase return flows to surface waters (e.g. stormwater)	Impractical from environmental, financial perspective
Low	Evaluate cloud seeding (i.e. increased precipitation)	Impractical from environmental, financial perspective, and not advantageous given basin configuration
Low	Reduce critical flows from Lake Wyle (i.e. Duke licensed flows)	Critical flows determined through extensive negotiation during recent relicensing effort
Low	Cover select reservoirs to reduce evaporation	Impractical from environmental, financial, and public acceptance perspective
Low	Use groundwater supply to supplement during drought	Not advantageous due to basin hydro geologic conditions

BL-01 Preliminary Simulation Results

Reservoir	Projected Range of Safe Yield Values (mgd)	Associated Year Withdrawal is Projected to be Reached
James	15 – 32	2038 – 2048
Rhodhiss	36 – 40	2038 – 2048
Hickory	30 – 37	2038 – 2048
Lookout Shoals	10 – 12	2038 – 2048
Norman	133 – 169	2038 – 2048
Mountain Island	192 – 207	2038 – 2048
Wylie	130 – 141	2038 – 2048
Fishing Creek	>238	>2078
Great Falls – Dearborn	[illegible]	>2078
Rocky Creek – Cedar Creek	[illegible]	>2078
Wateree	>74	>2078

592 MGD

BL-01 Preliminary Simulation Results



Yield Strategies - Preliminary Results

Strategy	Description	Total Basin Change in Water Yield (mgd)	
BL – 01	Baseline For Comparison to Yield Scenarios	-	
CC – 01	Low Impact of Climate Change on Water Supply	74	
CC - 02	High Impact of Climate Change on Water Supply	0	
YS – 01	Lower Existing Intakes in the Upper Catawba Basin	159	√
YS – 02	Lower Existing Intakes in Middle Catawba Basin	0	X
YS – 03	Re-route Existing Effluent Flows Upstream	251+	√
YS – 04	Reduce Per Capita Water Demands for Public Water Supplies	*~20 year extension of sustainable demand*	√
YS – 05	Increase Off-Stream Storage in middle Catawba Basin	0	?
YS – 06	Raise target operating levels in reservoirs	137	√
YS – 07	Utilize inter-basin transfer during drought	0	?
YS – 08	Reduced impact of sedimentation in reservoirs	0	X

Preliminary Findings/Results (Provocative Results)

- Low Inflow Protocol (LIP) implementation is extremely influential in determining water yield
- Reservoir elevation minimums (intermediate and critical – based on LIP) and their relationship to intake levels are limiting
- Reservoir operations and water use patterns tend to naturally divide the Basin into two sections
- Climate Change impacts can be mitigated

Catawba-Wateree Water Supply Master Plan

(co-funded by CW-WMG and Others)

Catawba-Wateree Water Supply Plan

- Project Scope
  - Secure funding assistance
  - Manage stakeholder process
  - Refine future water demand projections
  - Develop future modeling scenarios
  - Review/Revise LIP drought management plan
  - Identify water demand/water conservation opportunities
  - Identify water supply regionalization opportunities
  - Other (public education, regulatory, public ed.)
  - Water Supply Master Plan development

Key Issues for Successful Master Plan

- Funding
- Schedule
- Maintaining Momentum in ‘Normal’ Years
- Defining Modeling Scenarios
- Stakeholder Input
- Regional Consensus Support of Recommendations

Master Plan – Collaborate to Close the Gap

Strategy	Description	Total Basin Change in Water Yield (mgd)
BL – 01	Baseline For Comparison to Yield Scenarios	-
CC – 01	Low Impact of Climate Change on Water Supply	74
CC - 02	High Impact of Climate Change on Water Supply	0
YS – 01	Lower Existing Intakes in the Upper Catawba Basin	159
YS – 02	Lower Existing Intakes in Middle Catawba Basin	0
YS – 03	Re-route Existing Effluent Flows Upstream	251+
YS – 04	Reduce Per Capita Water Demands for Public Water Supplies	*~20 year extension of sustainable demand*
YS – 05	Increase Off-Stream Storage in middle Catawba Basin	0
YS – 06	Raise target operating levels in reservoirs	137
YS – 07	Utilize inter-basin transfer during drought	0
YS – 08	Reduced impact of sedimentation in reservoirs	0

CW-WMG is working very effectively as a regional water supply planning organization, building a comprehensive long-range water supply plan from the foundation established in relicensing, and looks forward to partnering with the States and Commission to complete and implement the Plan

Discussion/ Questions

Climate Change Impacts in the Catawba

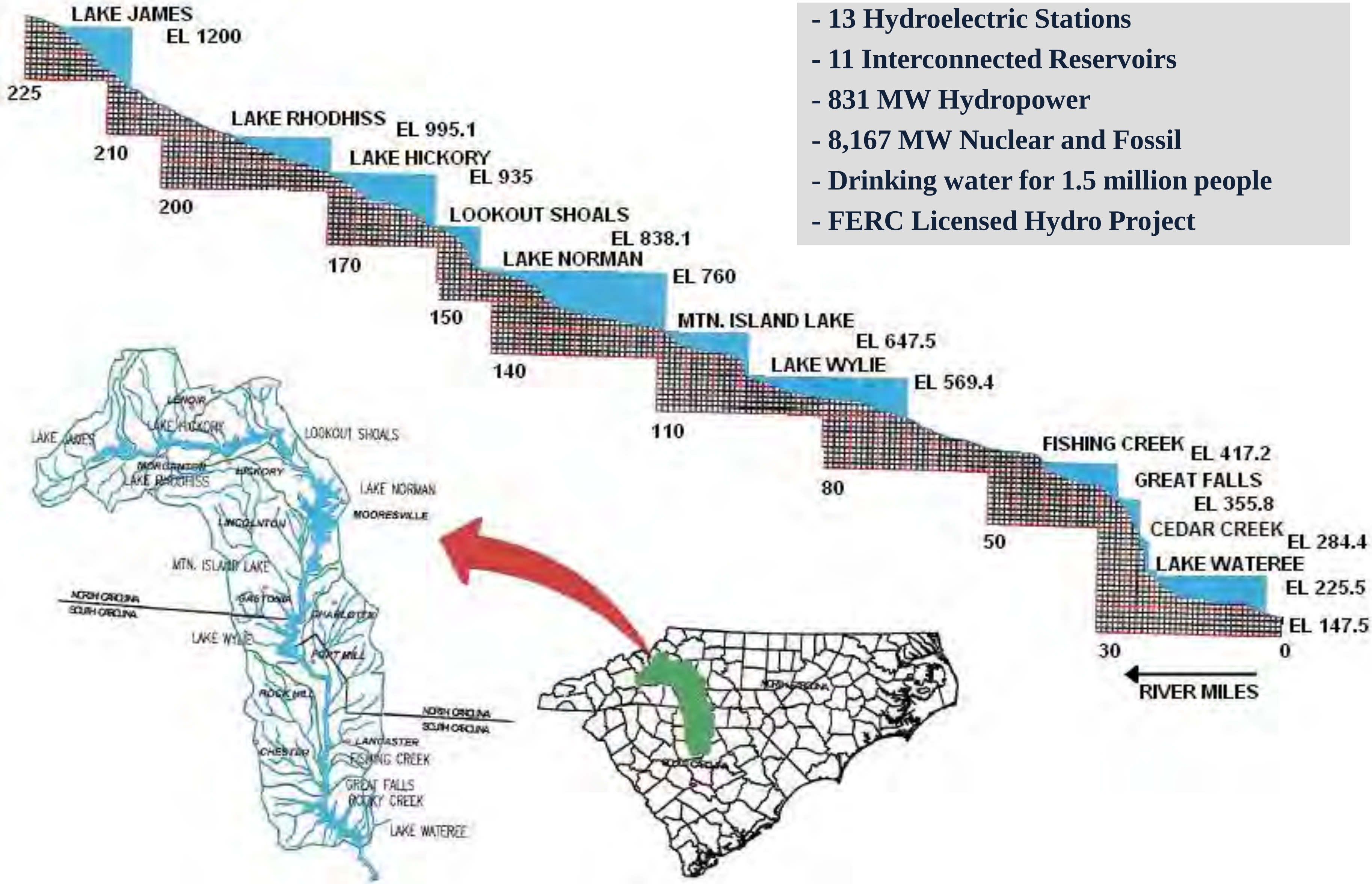
- Changes in precipitation
  - Amounts, intensity
  - Streamflow, inflow dataset
  - Temporal effects
- Increased evaporation
  - Temperature
  - Wind
  - Transpiration
- Changes in demand

CC-01: Climate Change – Low Impact

- Assume moderate increase in temperature of 5 ^{o}F to 2078, corresponding to 3.33% increase in reservoir evaporation rate per ^{o}F.
- Temperature increase applied gradually.
- No changes to inflow or water use
- Expected to <u>decrease water yield</u>

Multi-Use, Multi-Reservoir System

- 13 Hydroelectric Stations
- 11 Interconnected Reservoirs
- 831 MW Hydropower
- 8,167 MW Nuclear and Fossil
- Drinking water for 1.5 million people
- FERC Licensed Hydro Project



CC-02: Climate Change – High Impact

- Assume aggressive increase in temperature of 9 ^{o}F to 2078, corresponding to 3.33% increase in reservoir evaporation rate per ^{o}F.
- Inflow decrease by 1% per decade to 2078 for higher evapo-transpiration rates outside of reservoirs
- Temperature, inflow changes applied gradually.
- No changes to water use
- Expected to decrease water yield

Drought Management Advisory Group Works Collaboratively to Extend Water Supply

Resource Agencies

- NCDENR
- NCWRC
- SCDNR
- SCDHEC
- USGS

Public Water Suppliers

City of Marion
City of Morganton
Town of Granite Falls
City of Lenoir
Town of Valdese
City of Hickory
Town of Long View
Charlotte-Mecklenburg Utilities
Lincoln County
City of Newton
City of Gastonia
City of Mount Holly
City of Belmont
Bessemer City
City of Cherryville
Town of Dallas
City of Lincolnton
City of Rock Hill
Catawba River Water Supply Project
Chester Metropolitan District
City of Camden
Lugoff-Elgin Water Authority
City of Statesville
Town of Mooresville

Industries

Siemens Westinghouse
American & Efird
Bowater
SCANA
International Paper
The Greens of Rock Hill
Clariant Corporation
Invista

Duke Energy