



Managing Water Supply in Turbulent Times

Dave Zimmer, P.E., BCEE

Presented at:

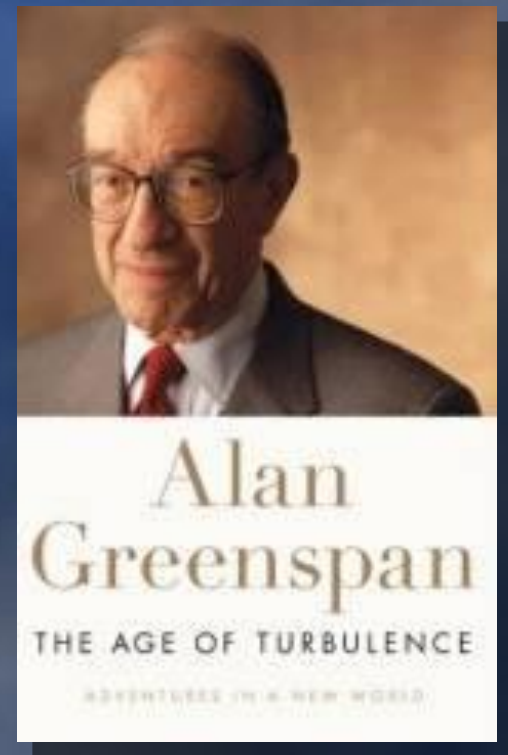
South Carolina Water Resources Conference

October 15, 2008

The Age of Turbulence

“We are living in a new world...that presents us with **enormous new possibilities** but also **enormous challenges**.”

The Age of Turbulence is my attempt to understand the nature of this new world; **how we got here, what we’re living through, and what lies on the horizon....”**



Presentation Topics

- ◆ **“How We Got Here”**
 - **Evolution of Urban Water Management**
- ◆ **“What We’re Living Through”**
 - **Water Industry Challenges in the Southeast**
- ◆ **“What Lies on the Horizon”**
 - **Potential Solutions to our Water Challenges**
- ◆ **Closing Comments**
 - **The Value of Water**

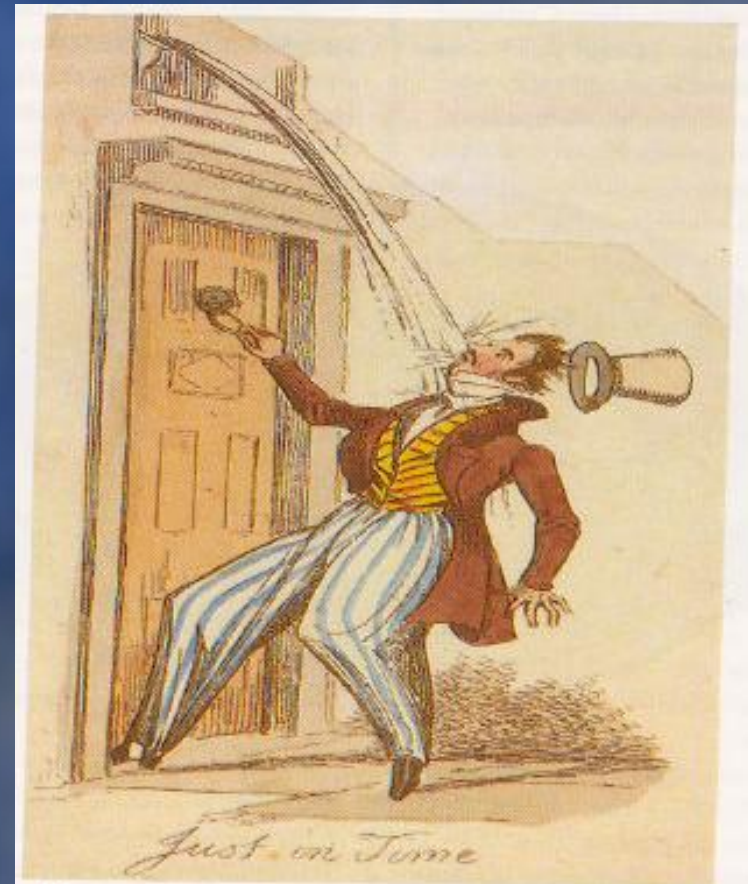
“How We Got Here”

– Evolution of Water Infrastructure

- ◆ **Cities of the Future: Towards Integrated Sustainable Water and Landscape Management (Novotny & Brown 2007)**
- ◆ **Condenses several 1,000s of water infrastructure history into four distinct stages – or paradigms**

Stage 1 – Opportunistic Use of Readily Available Water

- ◆ Water supply from easily accessed surface and ground waters
- ◆ “Toss it out of the house” sanitation system
- ◆ Early Roman Law - fines for throwing “missiles of mirth” out a window and hitting someone (Note: Law only applied during daylight hours and does not cover soiled clothes.)



MANY OF THE STREETS, NEVERTHELESS, WENT ON BEING RECEIPTACLES AND RESERVOIRS FOR THE CONTENTS OF THE CHAMBER-POT AND THE SLOP PAIL...

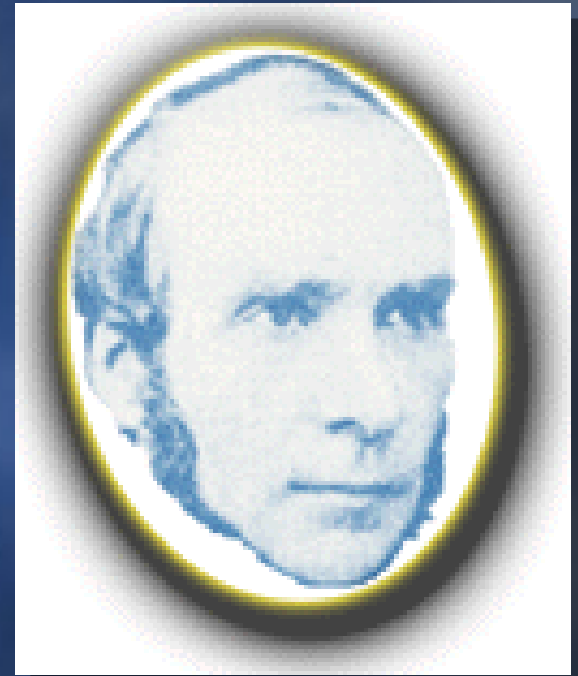
Stage 2 – Engineered Storage and Conveyance

- ◆ Water conveyance techniques well-developed in Roman Times
- ◆ 1840-1870s new sewer system is “Pride of Paris”
- ◆ Objective is to move water rapidly from where it is to where it’s needed, and from where it’s not wanted to someplace else



Stage 3 – Addition of Water Treatment Technologies

- ◆ Deteriorating sanitation conditions in Dark and Middle Ages results
- ◆ 1854 Dr. John Snow solves cholera epidemic, leading to water chlorination
- ◆ 1972 Clean Water Act goal of fishable and swimmable waters



Stage 4 – Non-Point Source Pollution Control

- ◆ Efforts to reduce pollution from stormwater runoff (no longer just point source control)
- ◆ Still in progress



“What We’re Living Through” – Southeast Water Industry Challenges

- ◆ **Population and water demand growth**
- ◆ **Droughts and water supply limitations**
- ◆ **Water supply competition**
- ◆ **Aging infrastructure**
- ◆ **Emerging contaminants**
- ◆ **Economic crisis**
- ◆ **Revenue shortfalls and funding challenges**

U.S. Drought Monitor

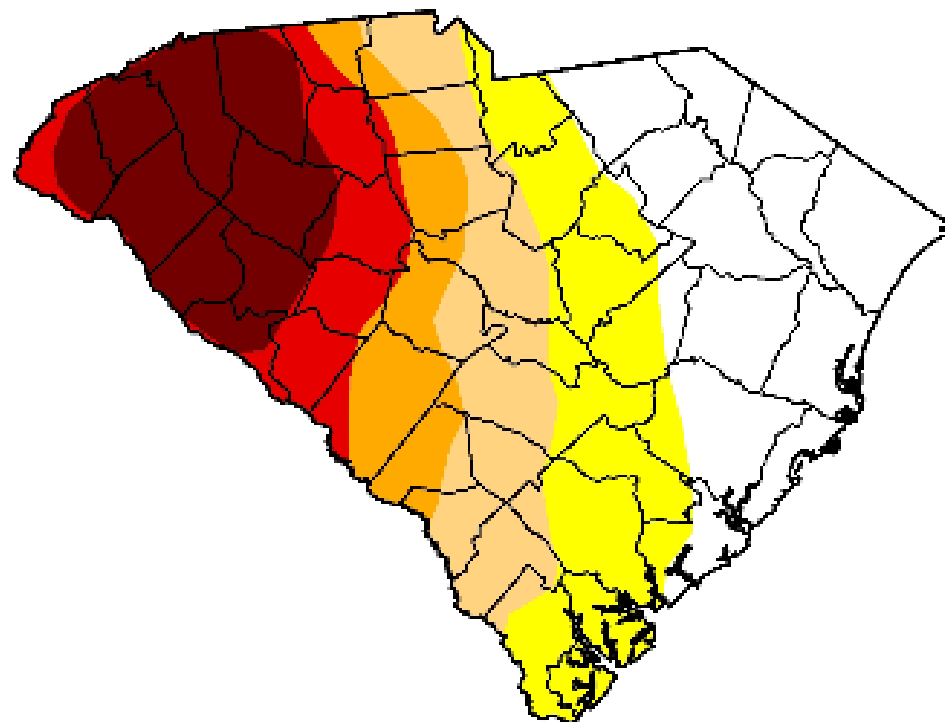
South Carolina

October 7, 2008

Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	27.9	72.1	51.3	36.4	26.7	17.2
Last Week (09/30/2008 map)	27.9	72.1	51.3	36.4	26.7	17.2
3 Months Ago (07/15/2008 map)	9.6	90.4	73.6	51.6	37.9	15.7
Start of Calendar Year (01/01/2008 map)	1.0	99.0	95.3	76.5	41.9	19.5
Start of Water Year (10/07/2008 map)	27.9	72.1	51.3	36.4	26.7	17.2
One Year Ago (10/09/2007 map)	4.1	95.9	89.9	80.0	59.6	23.2



Intensity:

- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements

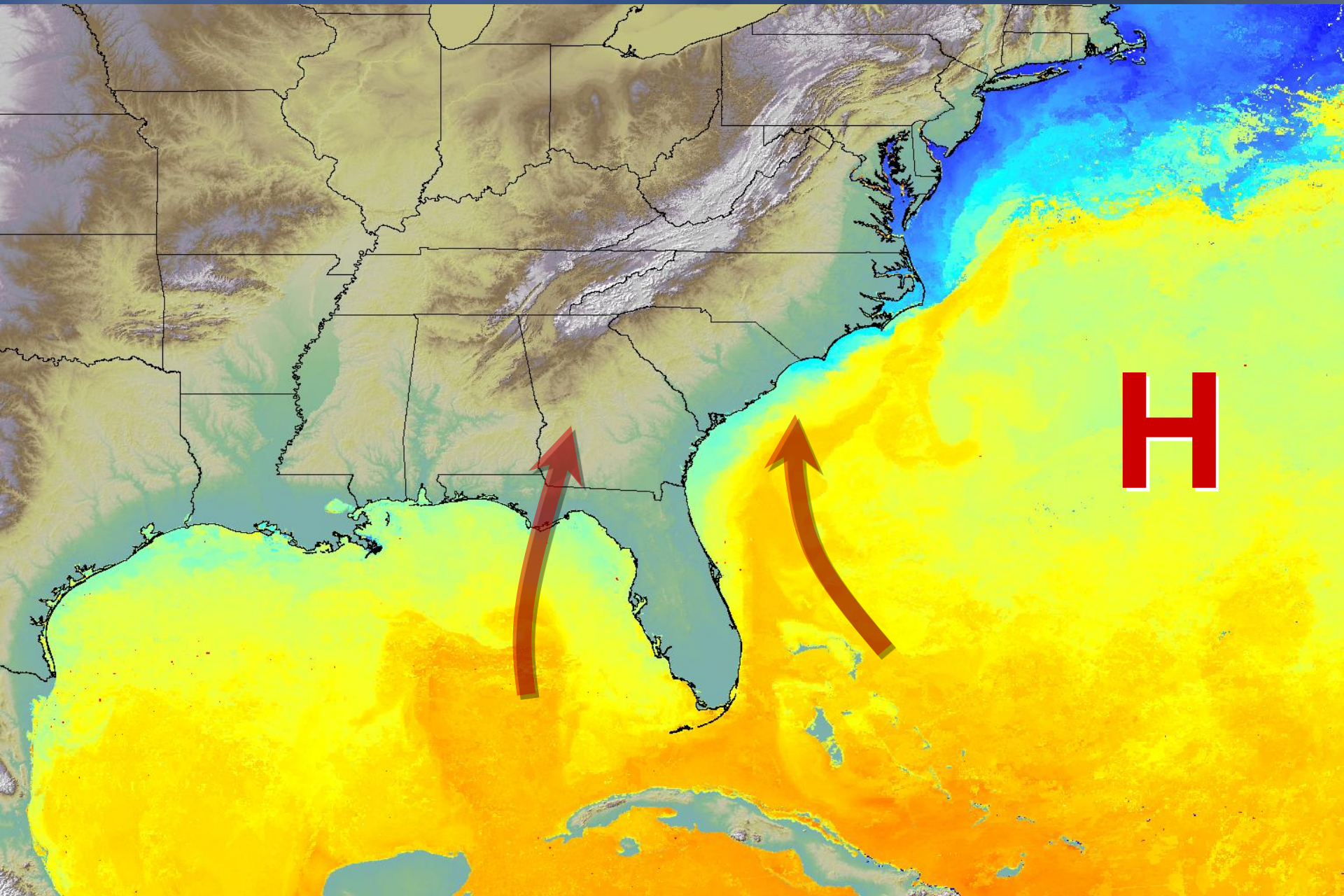


Released Thursday, October 9, 2008

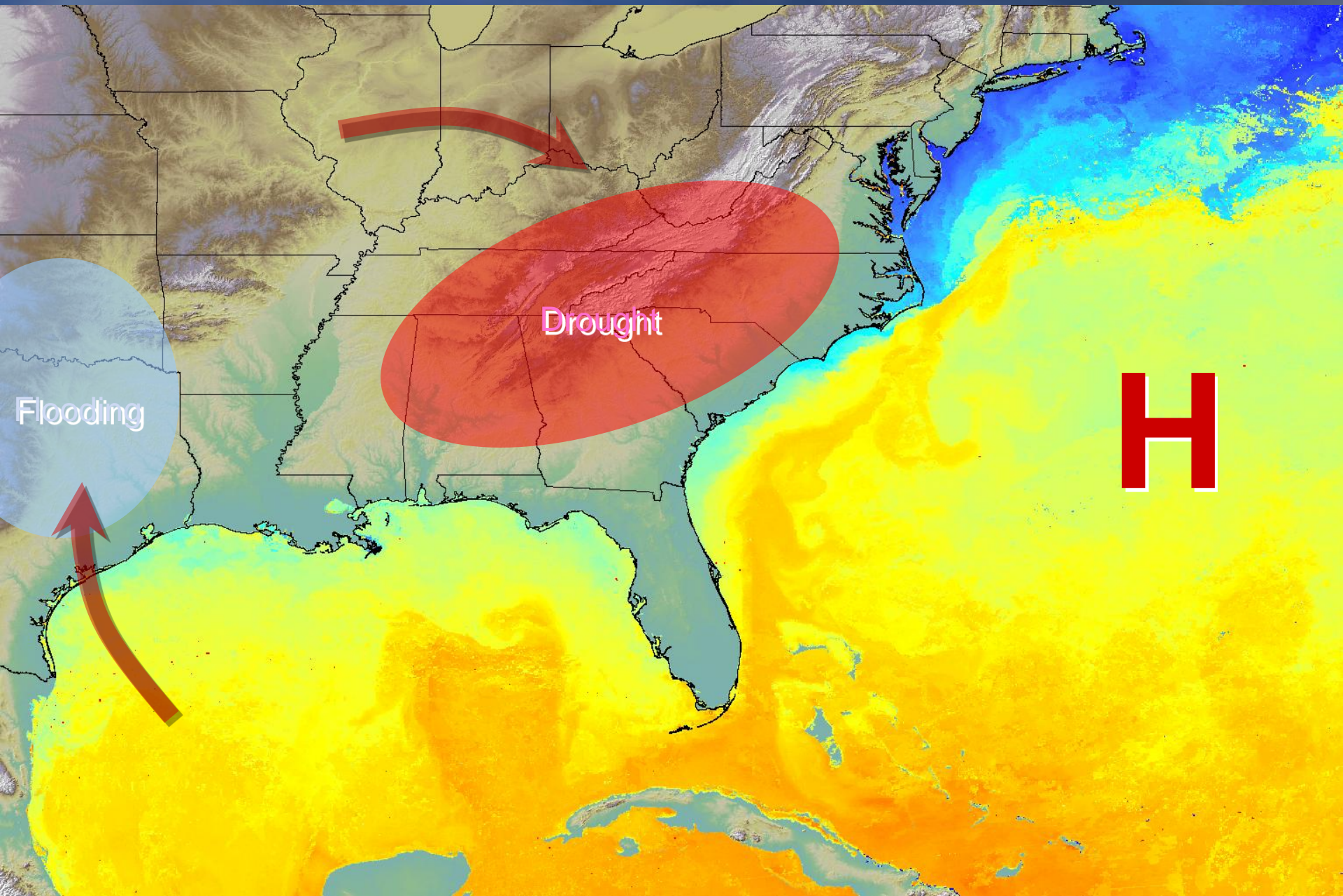
Author: Laura Edwards, WRCC

<http://drought.unl.edu/dm>

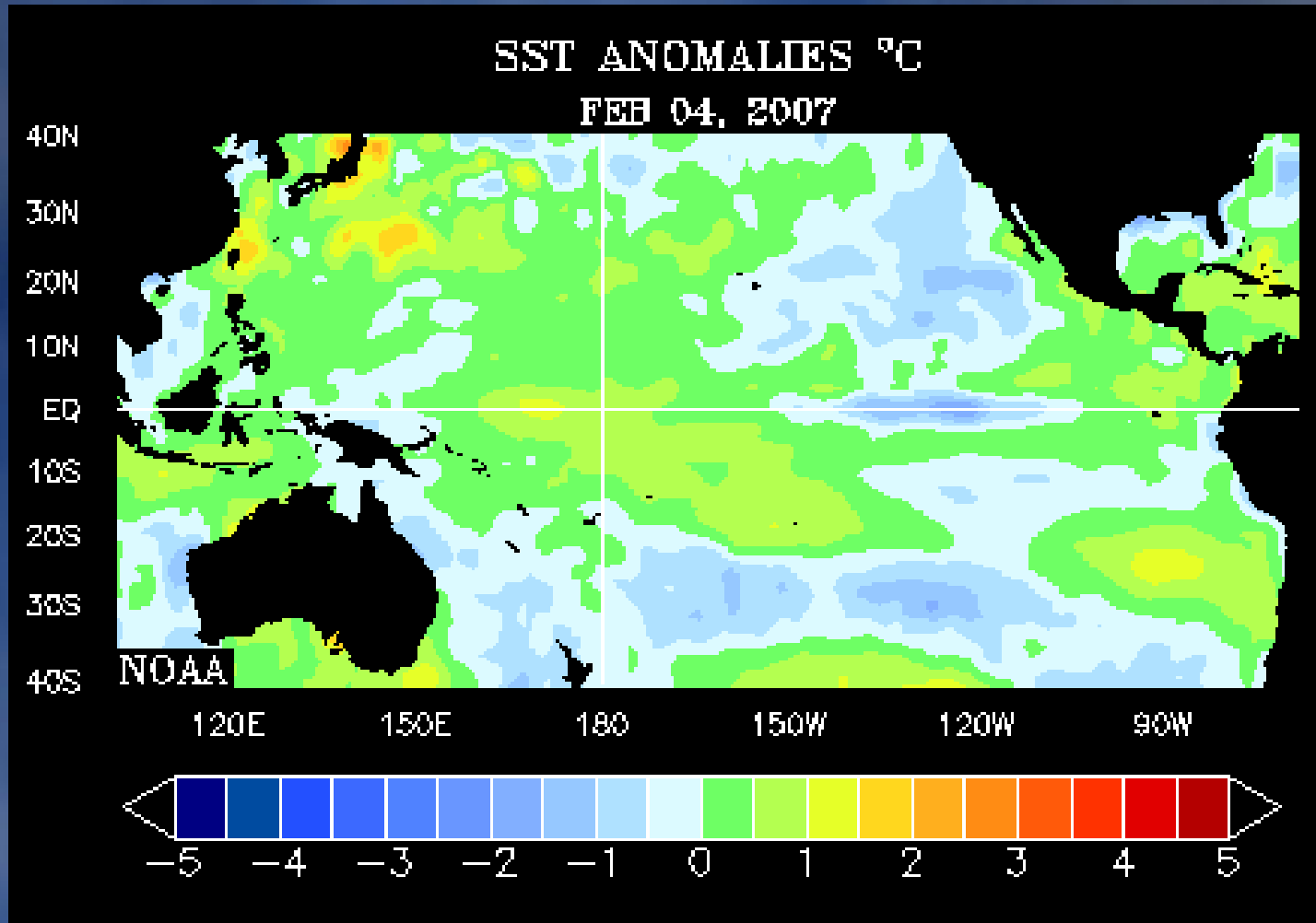
Typical Summer Conditions



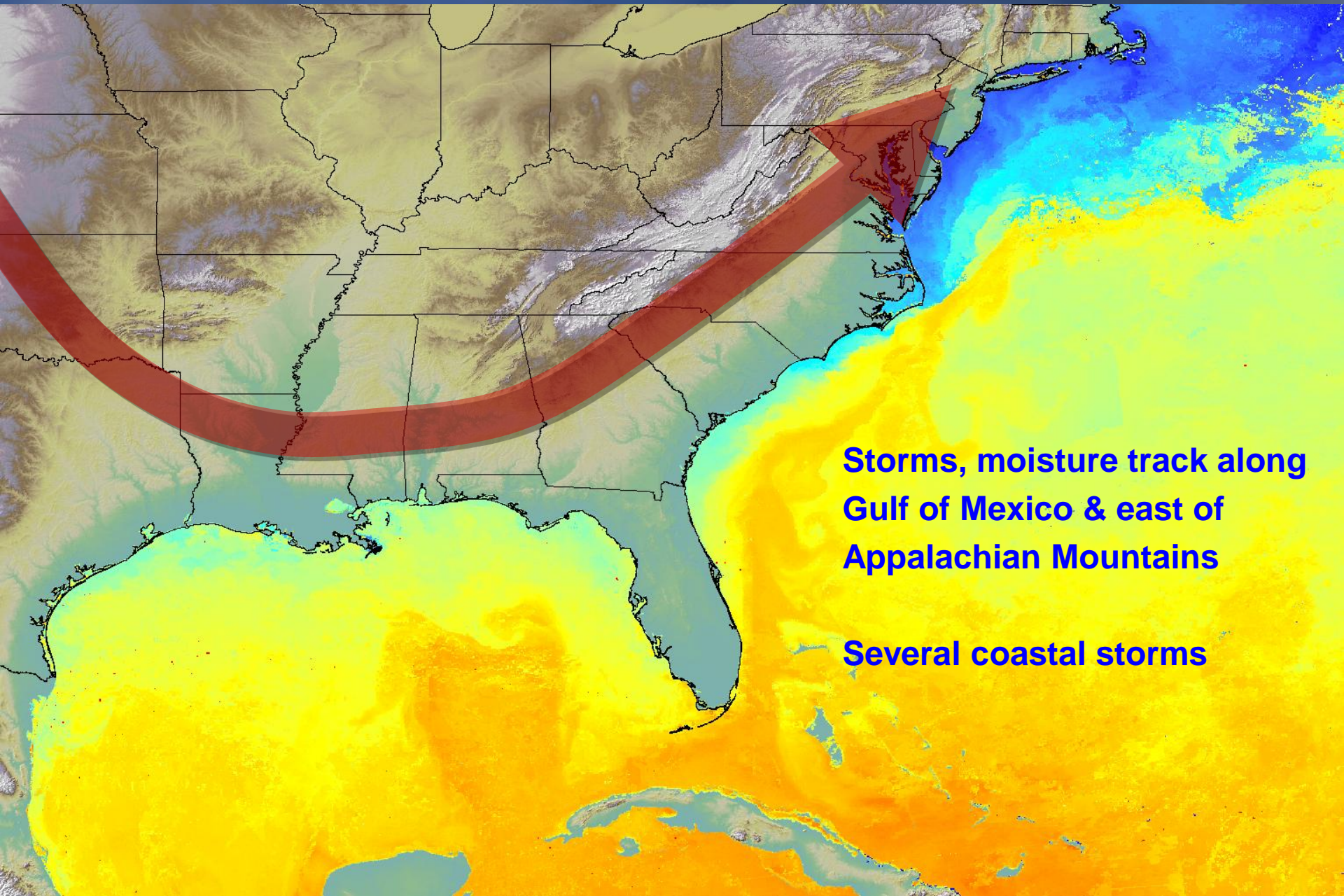
2007 Summer Conditions



La Niña - Ocean Anomalies



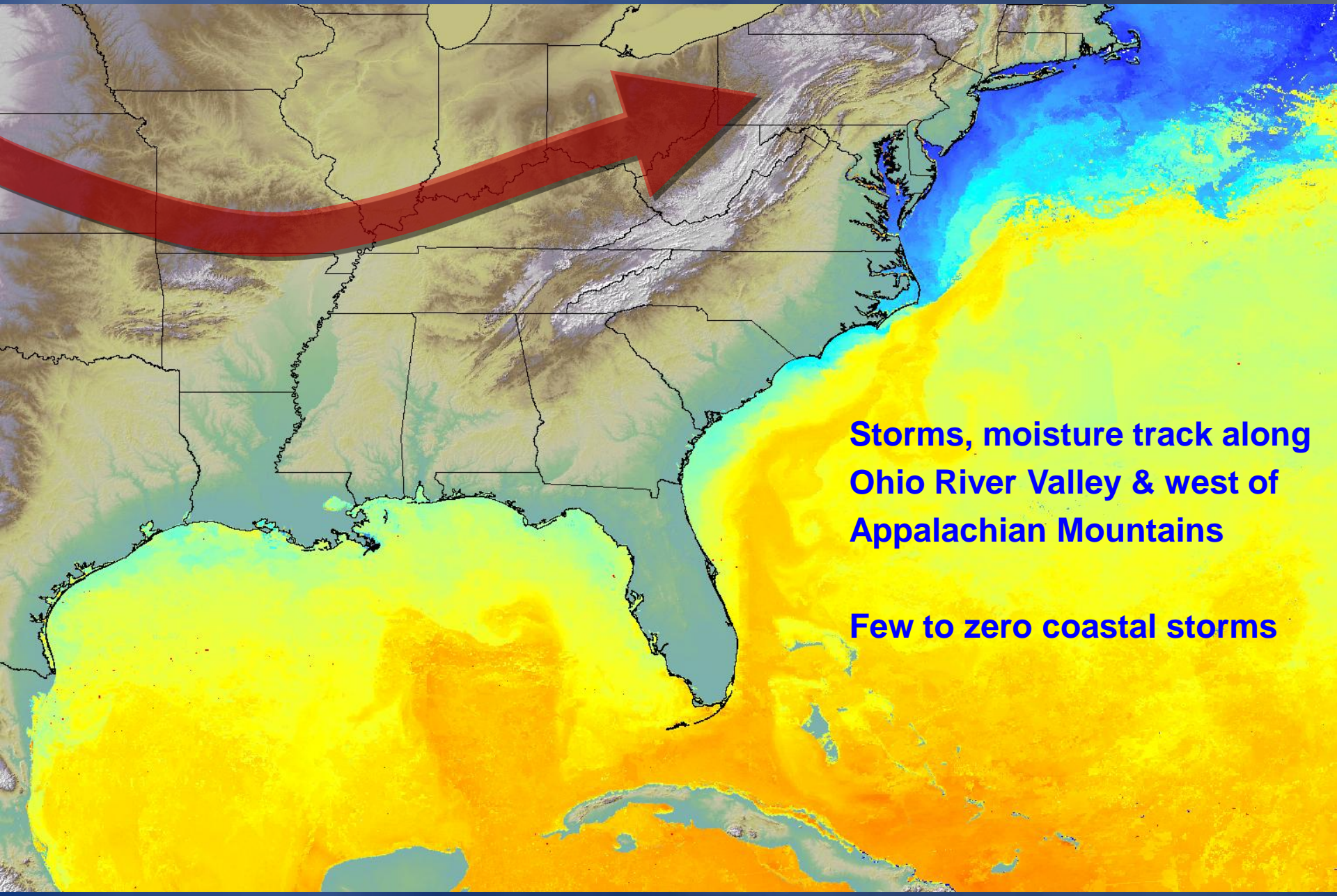
Typical Winter Jet Stream



**Storms, moisture track along
Gulf of Mexico & east of
Appalachian Mountains**

Several coastal storms

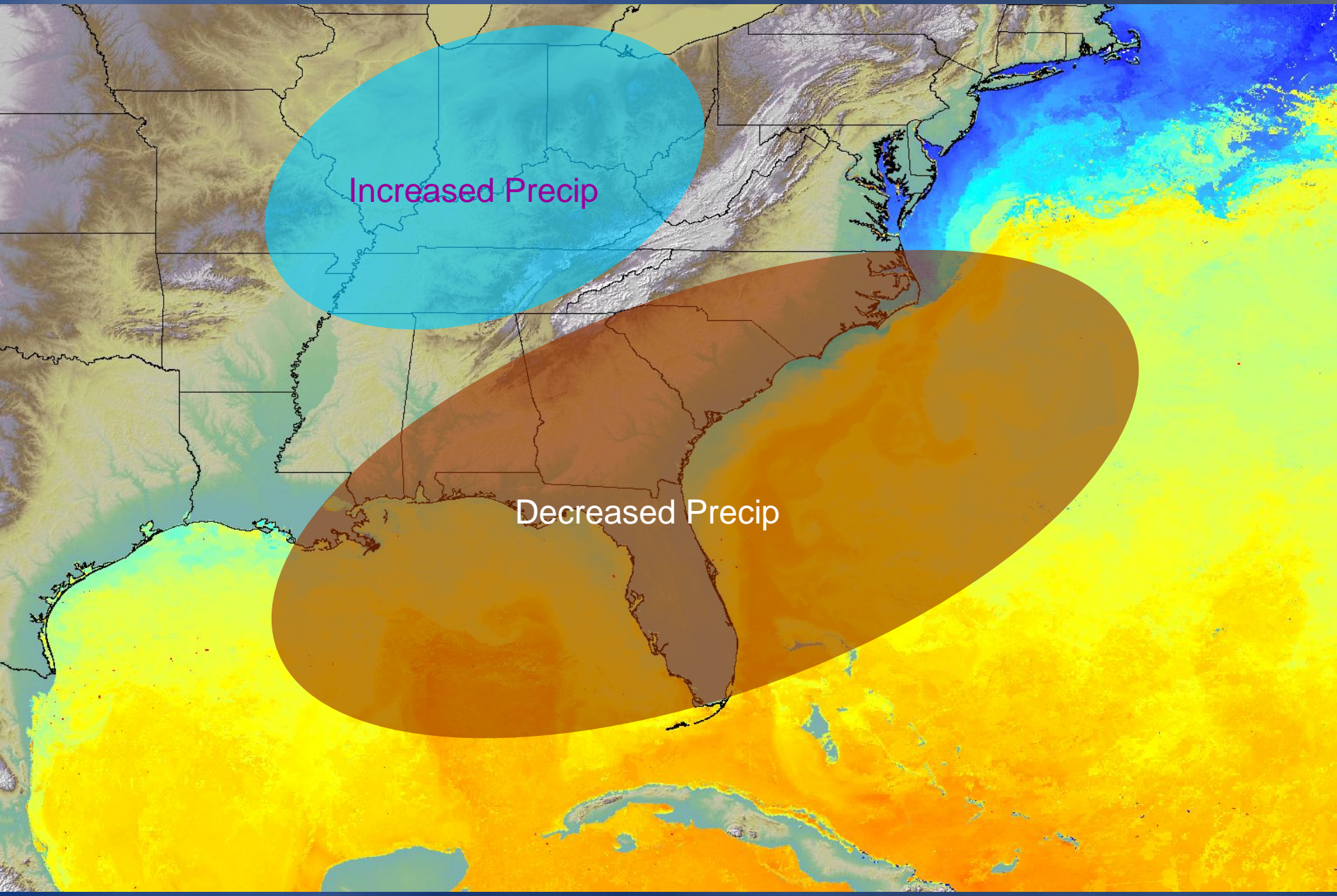
La Niña Winter Jet Stream



**Storms, moisture track along
Ohio River Valley & west of
Appalachian Mountains**

Few to zero coastal storms

La Niña Winter Precipitation



“What Lies on the Horizon?”

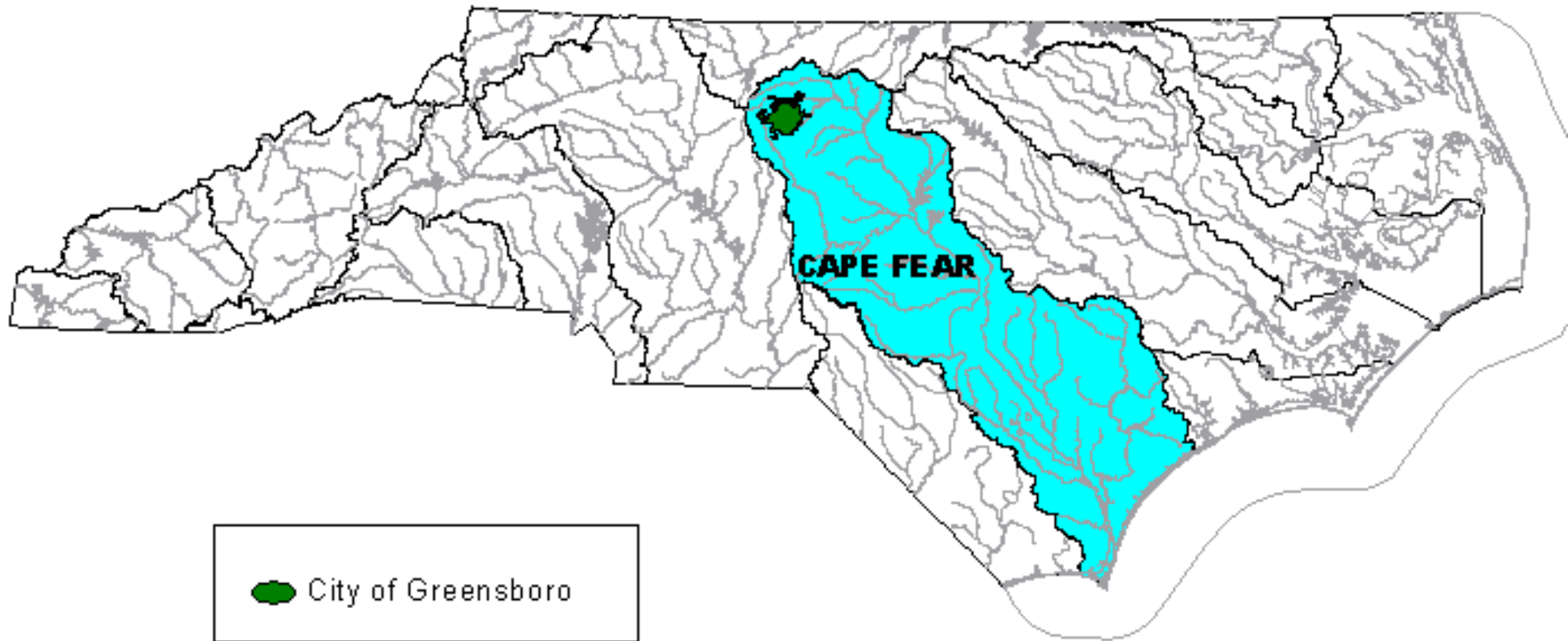
- ◆ More People
- ◆ More Water Demand
- ◆ More Droughts
- ◆ More Supply Limitations
- ◆ More Supply Competition
- ◆ More Regulations
- ◆ More Funding Needed



Potential Solutions to Southeast Water Challenges (Case Studies)

- ◆ Demand Management
- ◆ Indirect Potable Reuse Water Reuse
- ◆ Integrated Water Resources Planning

Demand Management Case Study - Greensboro



1998 Snapshot - “Ample Supply and Cheap Water”

- ◆ Declining block water rate structure
- ◆ Public views water as abundant, daily irrigation, lush lawns
- ◆ No discussion of water supply vulnerability to City leaders or public
- ◆ Minimal capital investment in water system

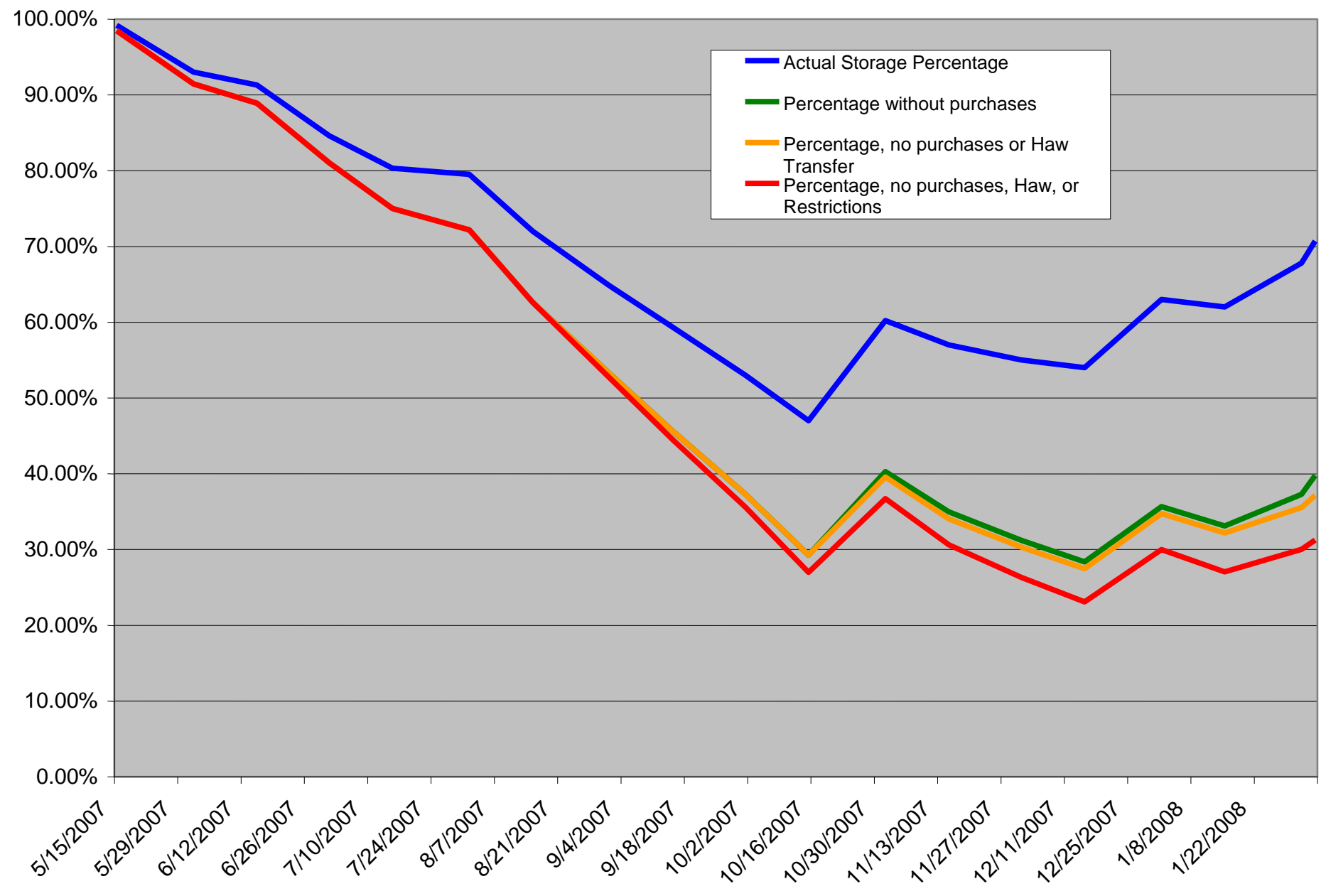
2001-2002 Drought is a Reality Check



Greensboro's Director Implements Multiple Supply and Demand Management Measures

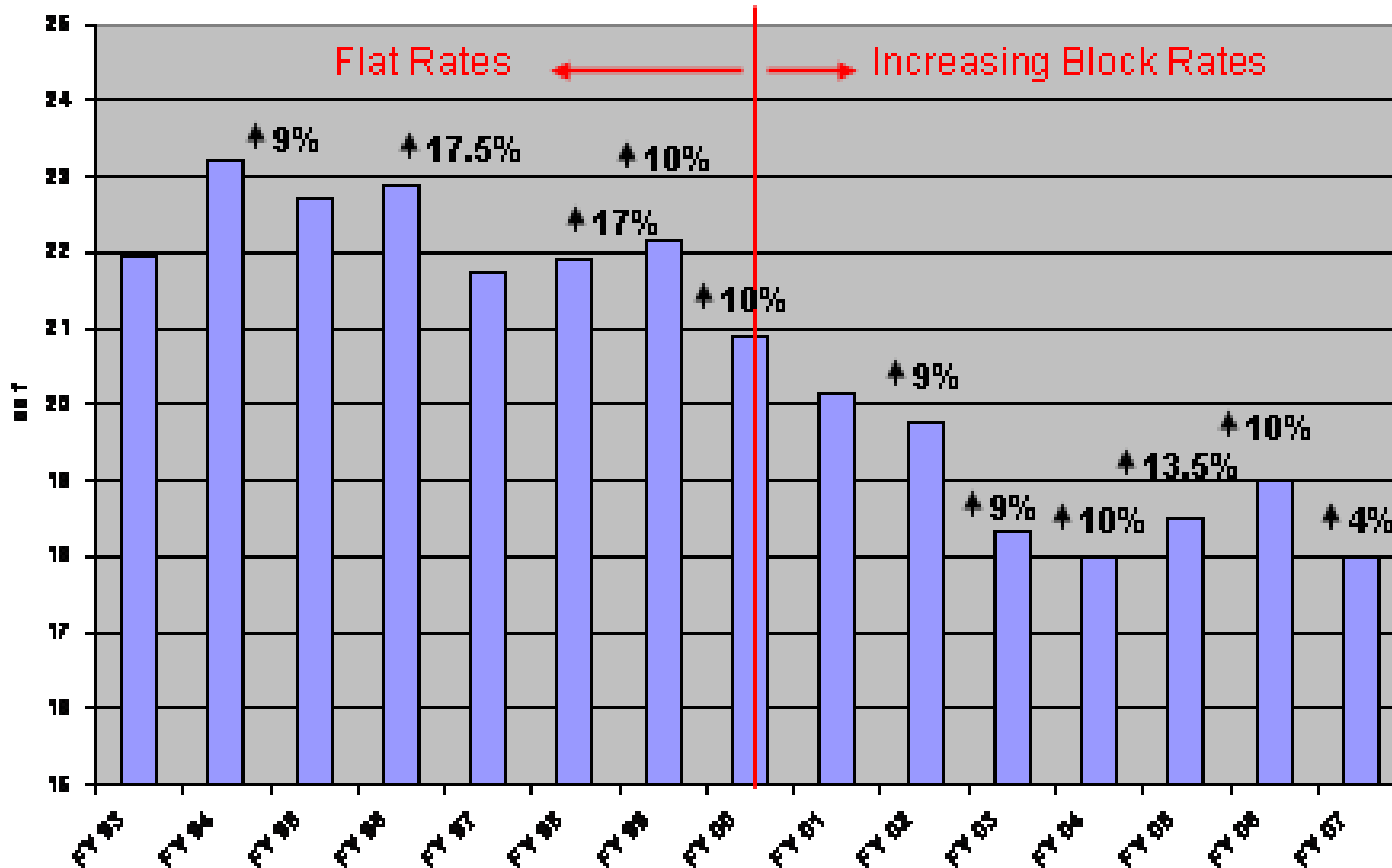
- ◆ **Two water system interconnects (Reidsville and Burlington)**
- ◆ **New emergency supply source (Haw River)**
- ◆ **Mandatory water restrictions**
- ◆ **New increasing block, tiered water rate structure**

Strategy works Brilliantly in 2007 Drought

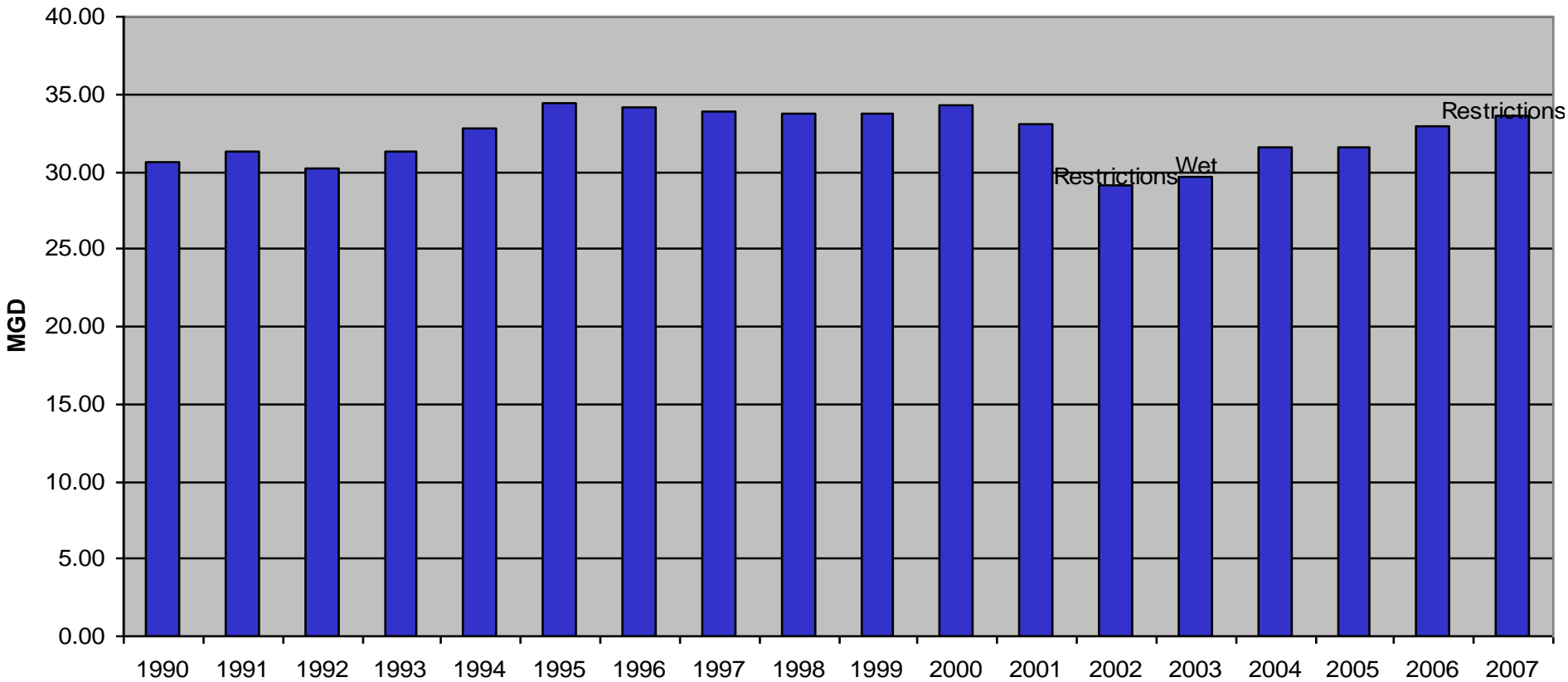


Increasing Block Rates and Water Restrictions Dramatically Drop Average Consumption

Consumption per Residential Account

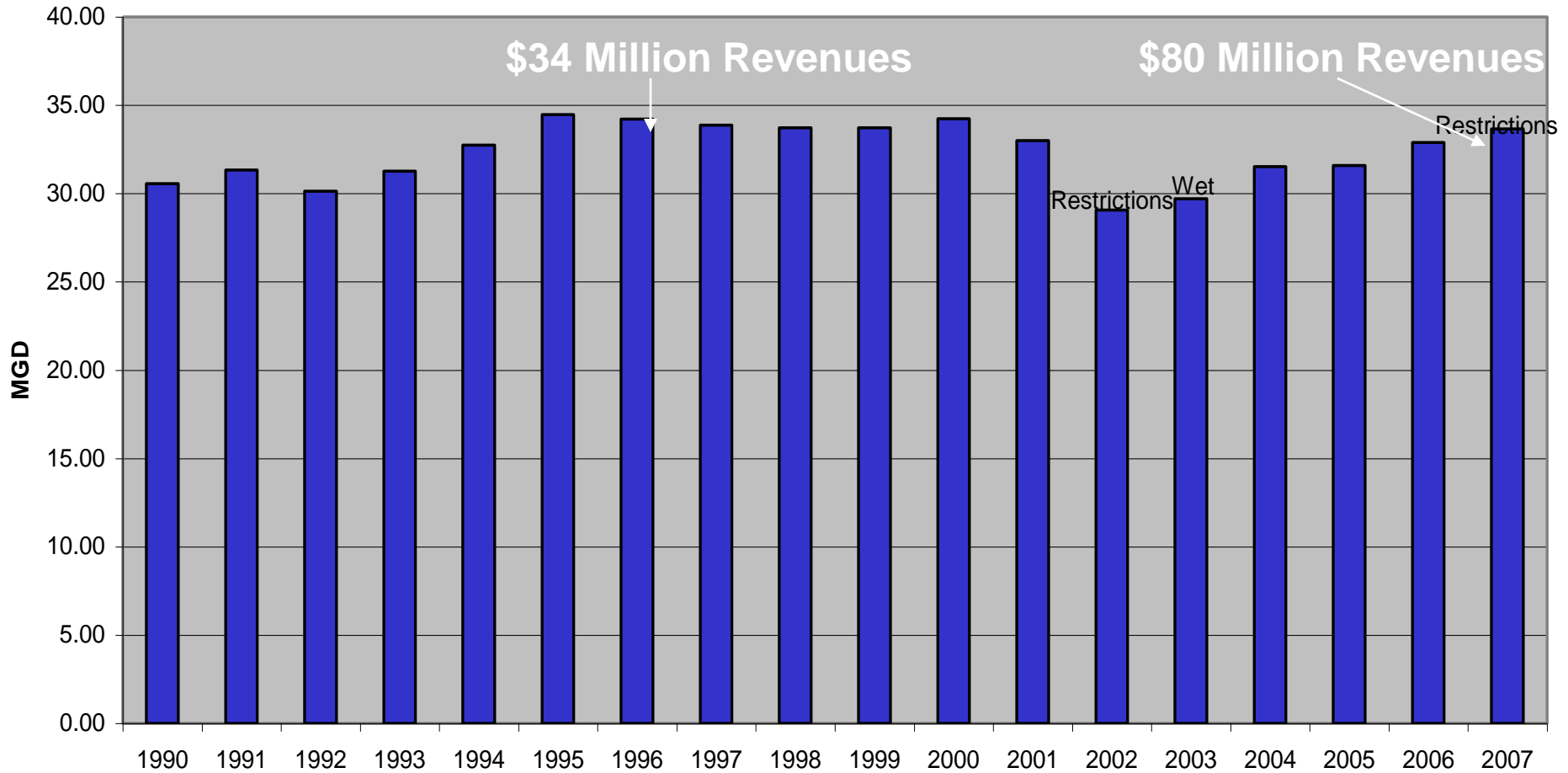


Average Water Production has been held Flat...

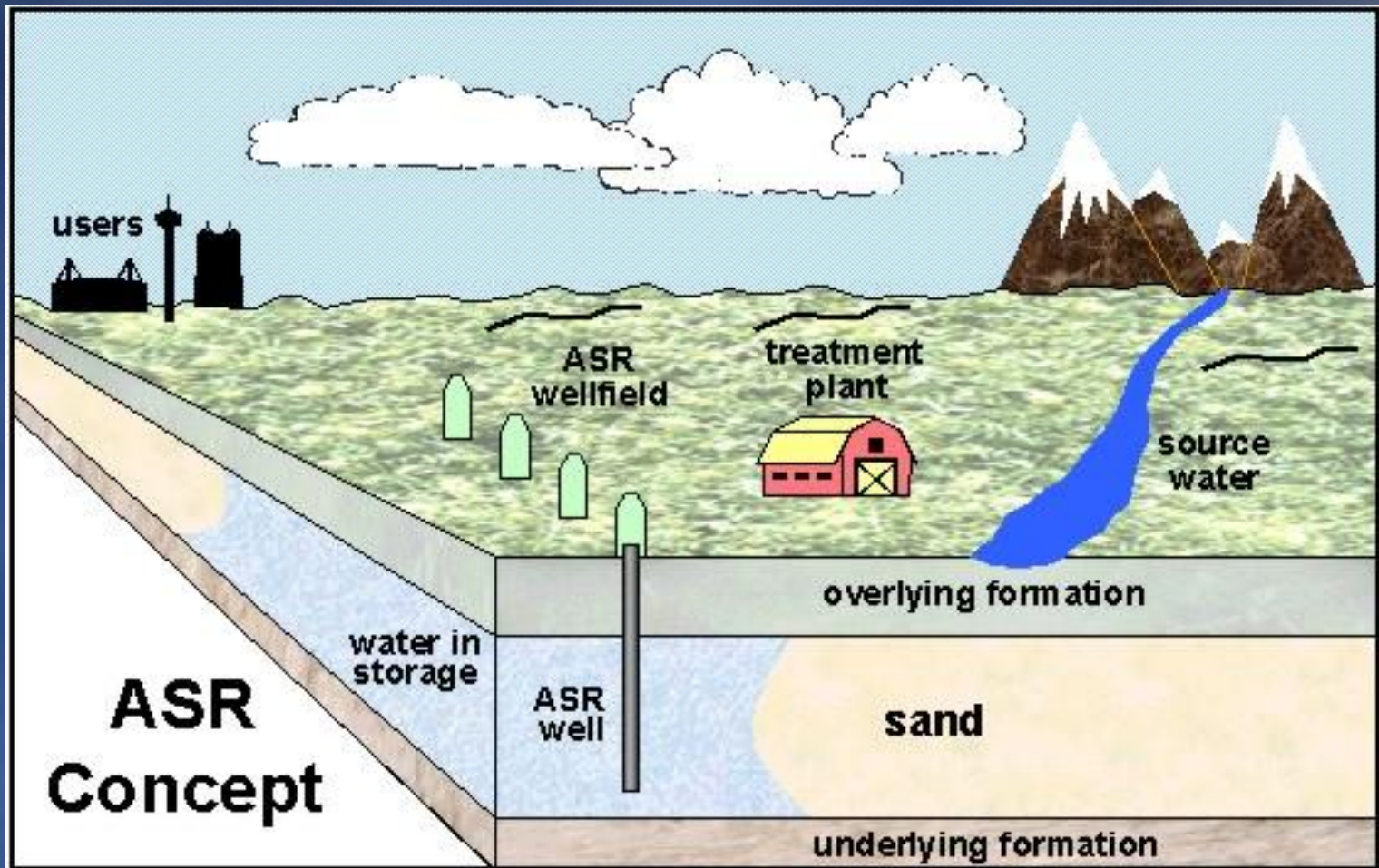


While Water Revenues have More than Doubled!!

Total Greensboro Annual Average Water Consumption



Case Study No. 2 – Indirect Potable Water Reuse in Orange County, CA



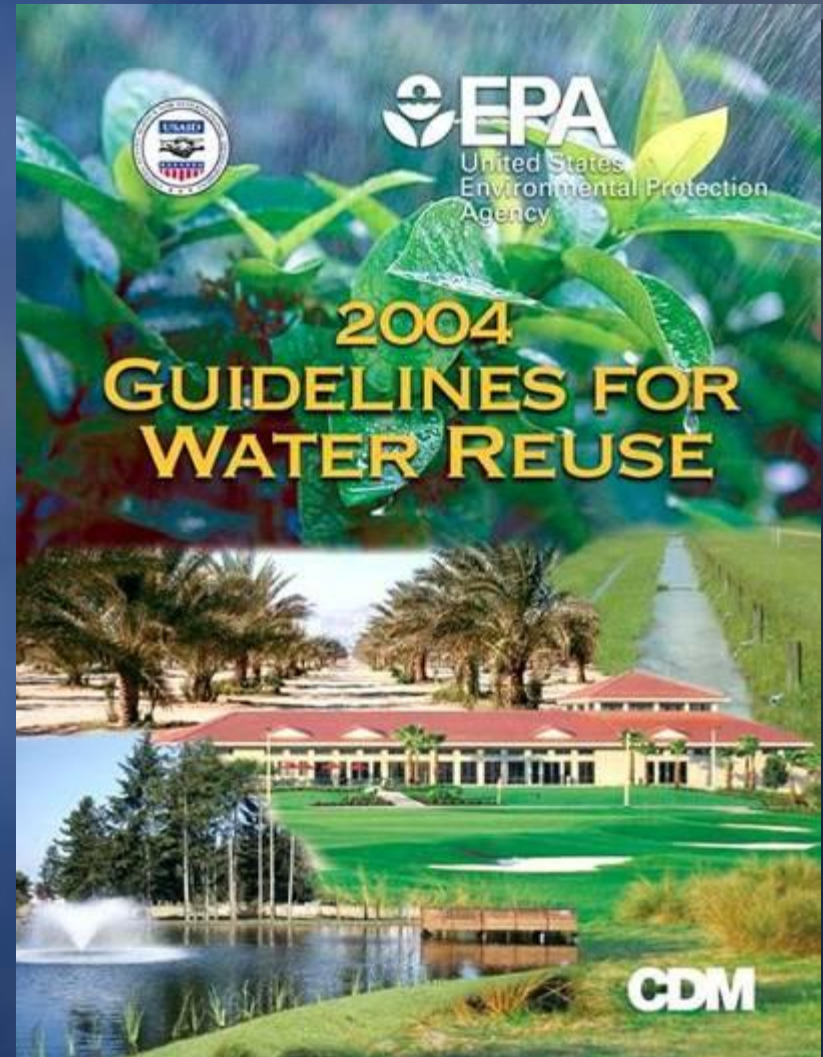
Wide Range of Reuse Applications

- ◆ Urban
- ◆ Industrial
- ◆ Agricultural
 - Food Crops
 - Non-Food Crops
- ◆ Environmental
- ◆ Groundwater Recharge
- ◆ Indirect Potable Supply and ASR



2004 Guidelines for Water Reuse is an Excellent Reference Source

- ◆ Treatment requirements
- ◆ Groundwater recharge
- ◆ Emerging Contaminants
- ◆ Updated Inventory of State Regulations
- ◆ Public participation
- ◆ Potable reuse issues

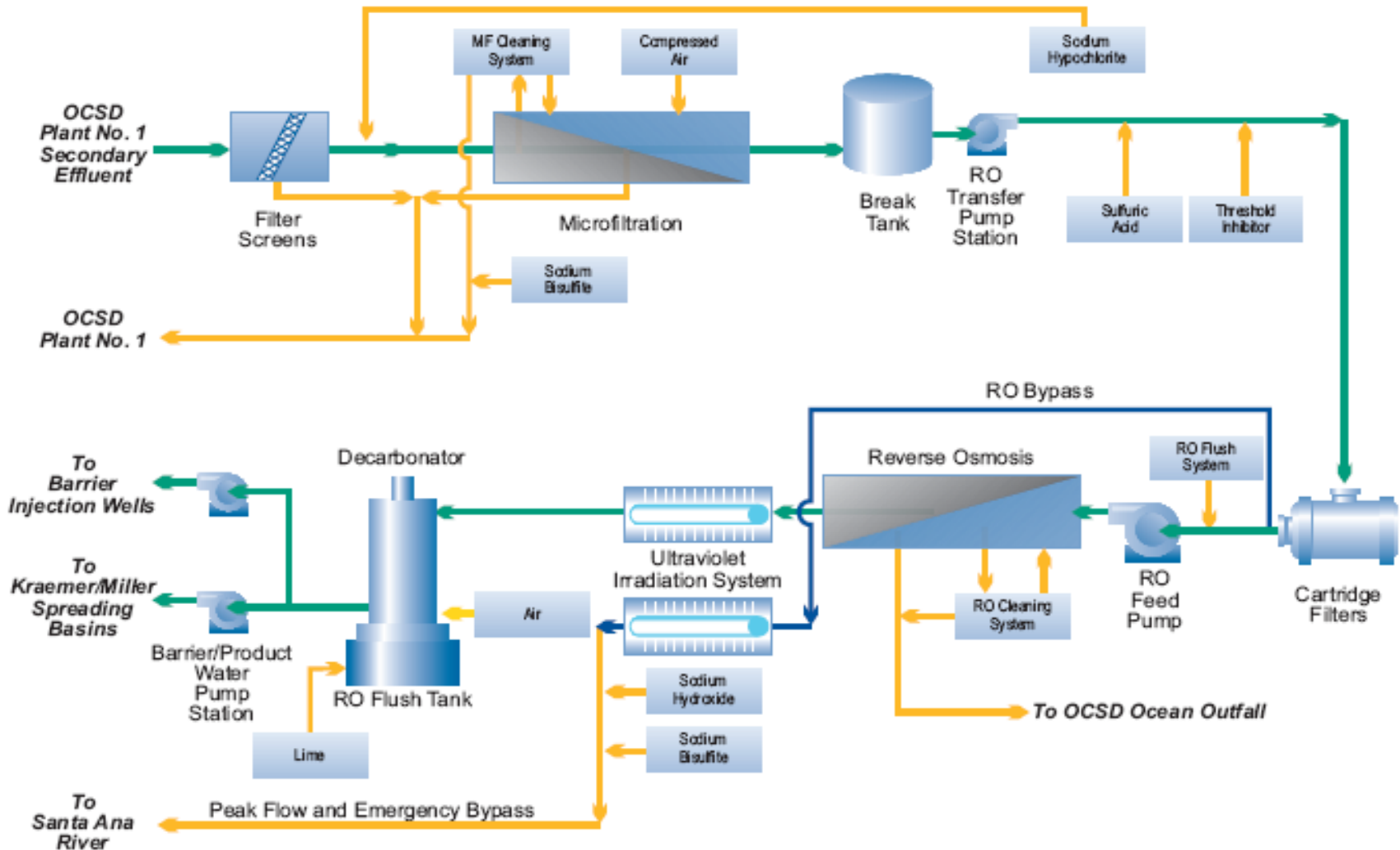


Orange County Water District (OCWD) Groundwater Replenishment System Project

- ◆ 70-mgd system, expandable to 130-mgd
- ◆ Largest reclamation project of its kind
- ◆ Potable and reclaimed supply
- ◆ Provides salt water intrusion barrier
- ◆ Eliminated new ocean outfall



Multi-Barrier Treatment Process includes Microfiltration, Carbon Adsorption, RO, and UV Disinfection



Case Study No. 3 - Integrated Regional Water Management Plan in Los Angeles



Integrated Regional Water Management Planning Goals

- ◆ **Integrate water supply, stormwater, and wastewater management**
- ◆ **Regional watershed approach**
- ◆ **Local agencies and interest groups working together across jurisdictional boundaries**
- ◆ **Precursor of Stage 5 – Integrated and Sustainable Urban Water Management?**

Closing Comments - The Value of Water

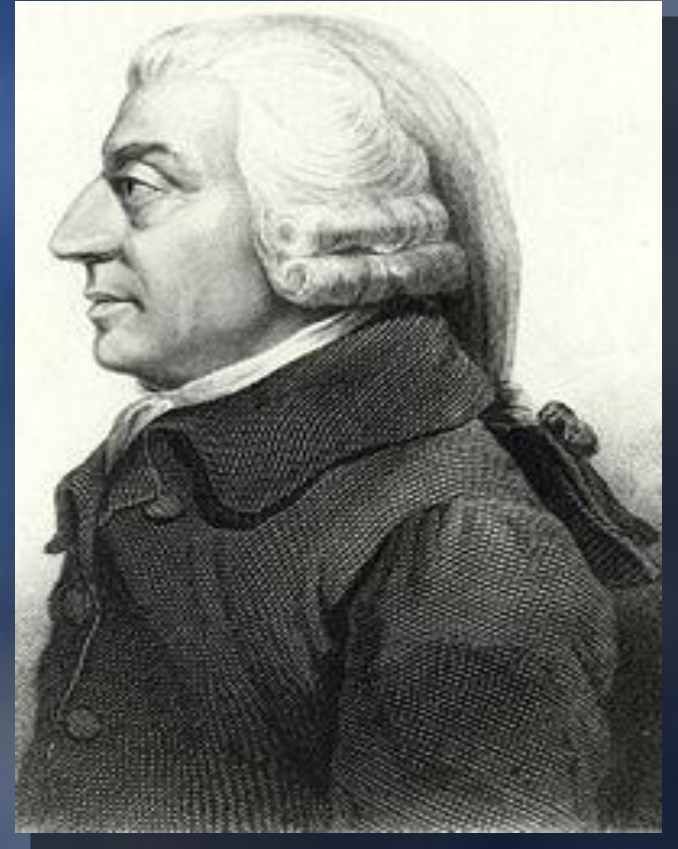
“Water is, of course, absolutely essential to life – not only human life but all life, both animal and vegetable. Yet man’s assessment of the value of water is very low until he finds himself without it.”

- Dr. Thomas R. Camp, 1963

The Paradox of Value

Although water is on more useful, in terms of survival, than diamonds, diamonds command a higher price in the market.

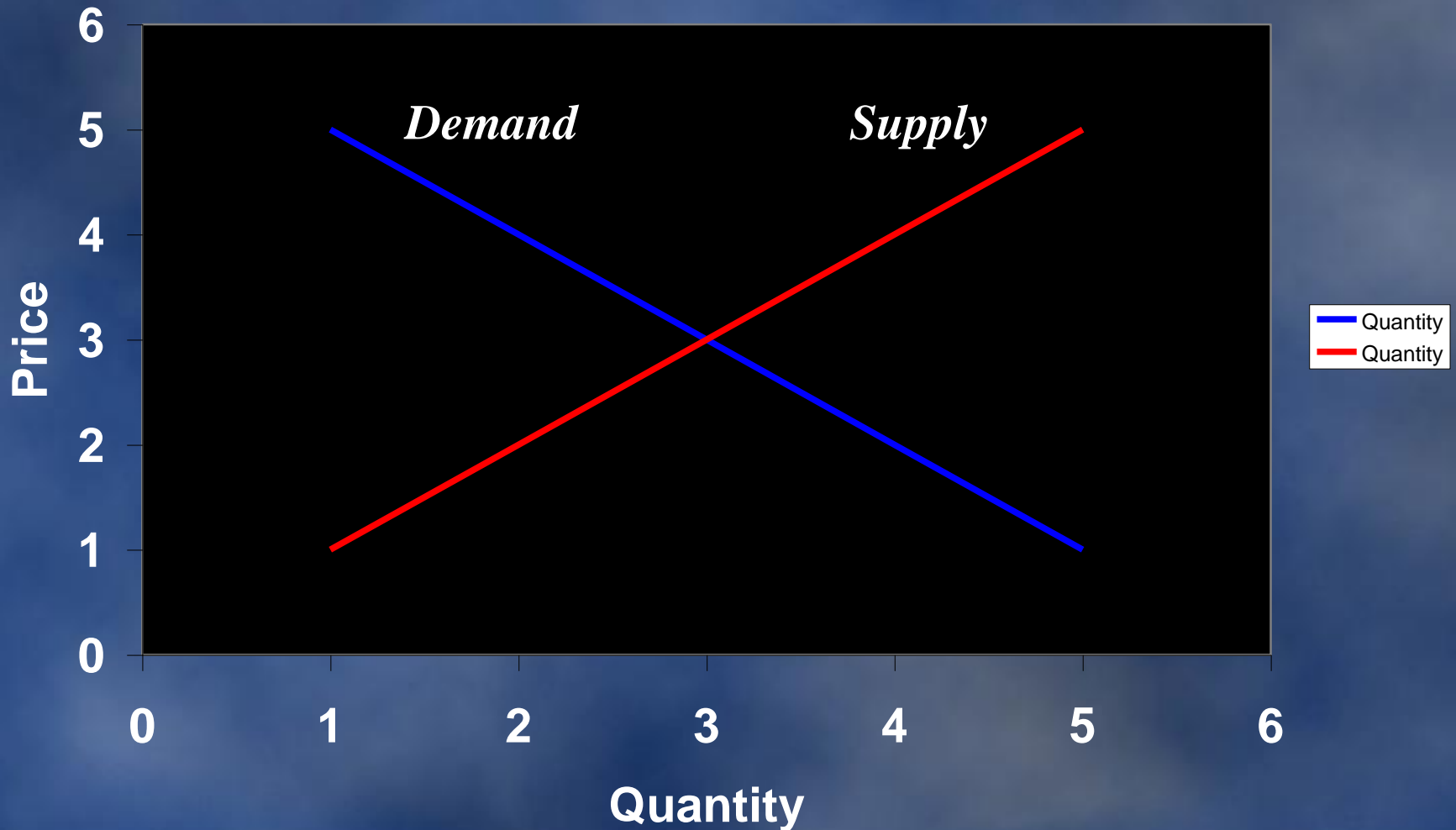
Mr. Smith explained that because of its abundance, water has a relatively low price. Diamonds, on the other hand, command high prices due to their relative scarcity.



*Adam Smith, Philosopher
and Economic Pioneer*

Economics of Supply and Demand

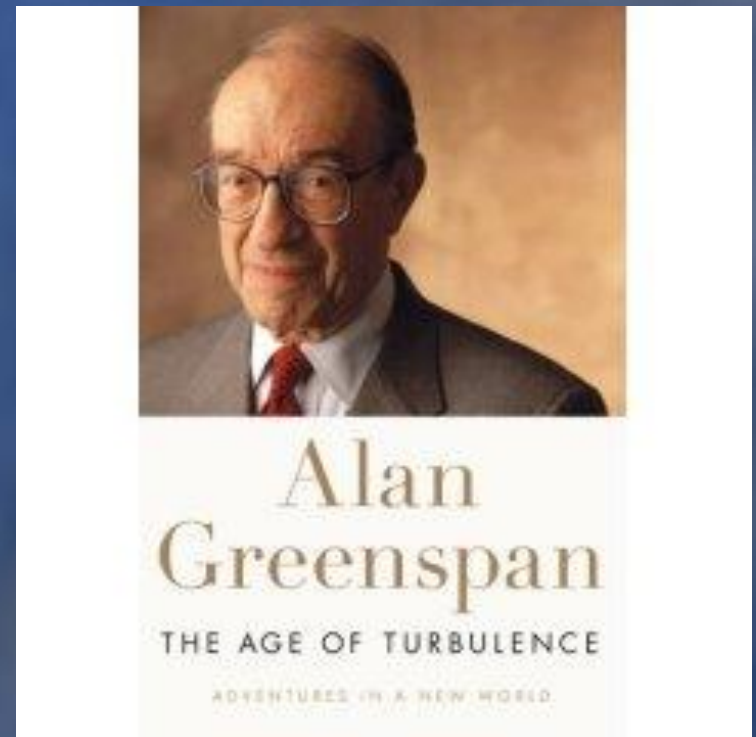
Support Increased Pricing



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Continuing South Carolina's Leadership Tradition, We Will Solve Our Water Challenges on the Horizon

- ◆ **Educate** the public and elected officials on the *Value of Water*
- ◆ **Effectively price** water to raise needed revenue and to encourage conservation
- ◆ **Leverage technology** and alternative water supply approaches
- ◆ **Think Long Term**



South Carolina
Leadership

THE AGE OF TURBULENCE

ADVENTURES IN A NEW WORLD



Questions?

Indirect Potable Reuse and Aquifer Storage Recovery

- ◆ Current treatment technologies can treat wastewater to drinking water quality
- ◆ Public perception still an issue
- ◆ Injected water can cause subsequent quality concerns – arsenic dissolution and bacteria seeding

Treatment	Advanced with filtration & high level disinfection
BOD ₅	20 mg/L
TSS	5 mg/L
Total Coliform	Below Detection
Total Nitrogen	10 mg/L
TOC	3mg/L Avg 5mg/L Max
Primary & Secondary Standards	Compliance with Most