Alternative Water Supplies in the 24-County Coastal Area of Georgia

Facilitated Meeting on the Most Promising Methods of Alleviating Saltwater Intrusion

Katherine Zitsch - CDM

August 2005

Alternative Water Supply Study

- Conducted in 2000 and Early 2001
- Evaluated Four Different Sources
  - Wastewater Effluent Reuse
  - Impoundments on Small Rivers
  - Surface Water from Larger Rivers
  - Water Conservation

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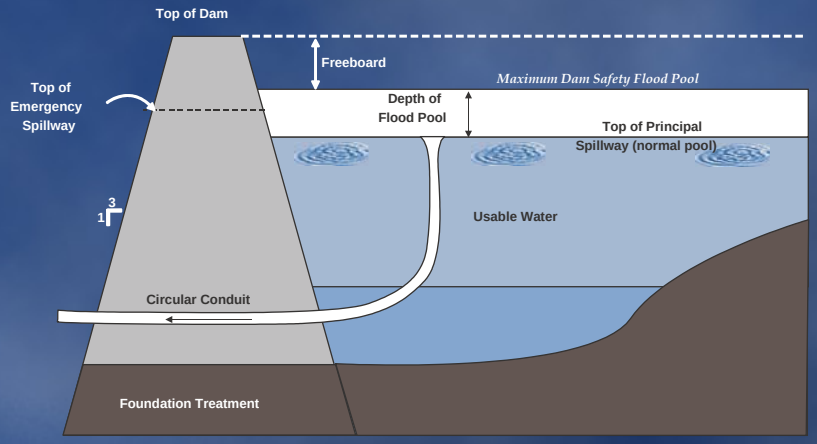
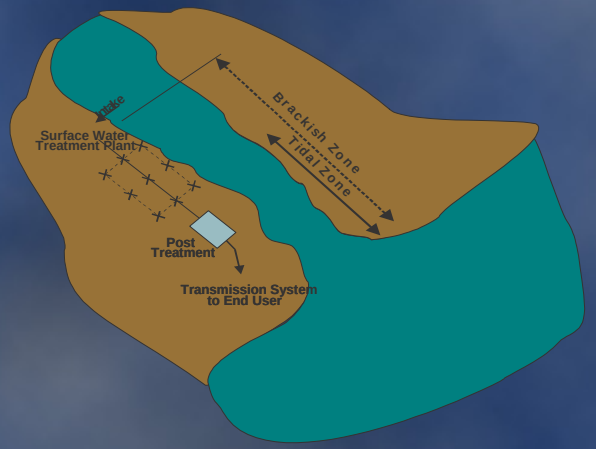
First Evaluation

- **Wastewater Effluent Reuse**
- **Off Main-Stem Impoundments**
- **Surface Water Supplies**
- **Water Conservation**





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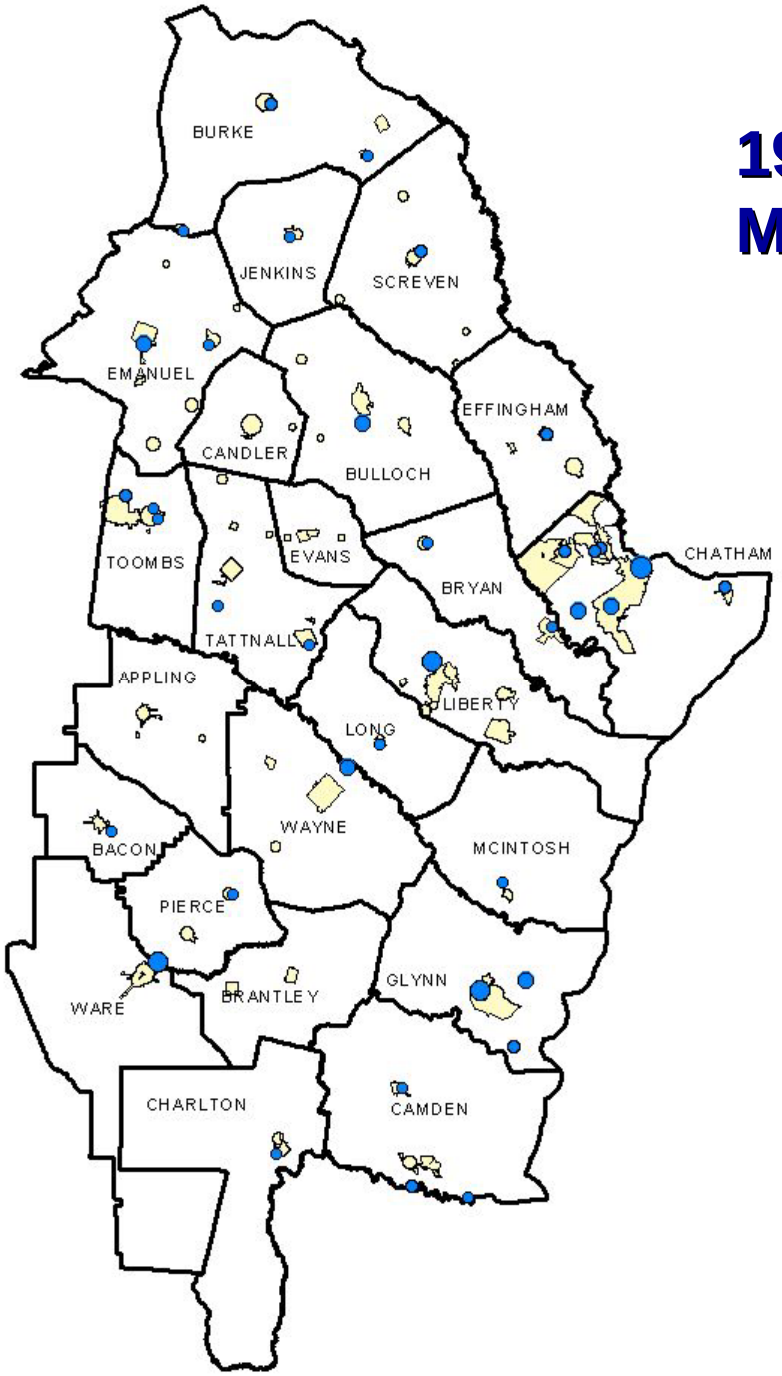
Golf Course Reuse Application Opportunities

- Scoring System to Evaluate
- Don’t Exceed Supply - 60% Rule

1998 24-County Area Municipal WPCP Flows



LEGEND

Municipal WPCP (Permitted MGD)
- 0.1 - 0.88
- 0.88 - 2.0
- 2.0 - 5.0
- 5.0 - 13.5
- 13.5 - 27.0

County Boundaries
GADOT City Boundaries

5 0 5 10 Miles

Sources:
NPDES Locations, EPD, 1996
Georgia Extension Service, UGA, 1998

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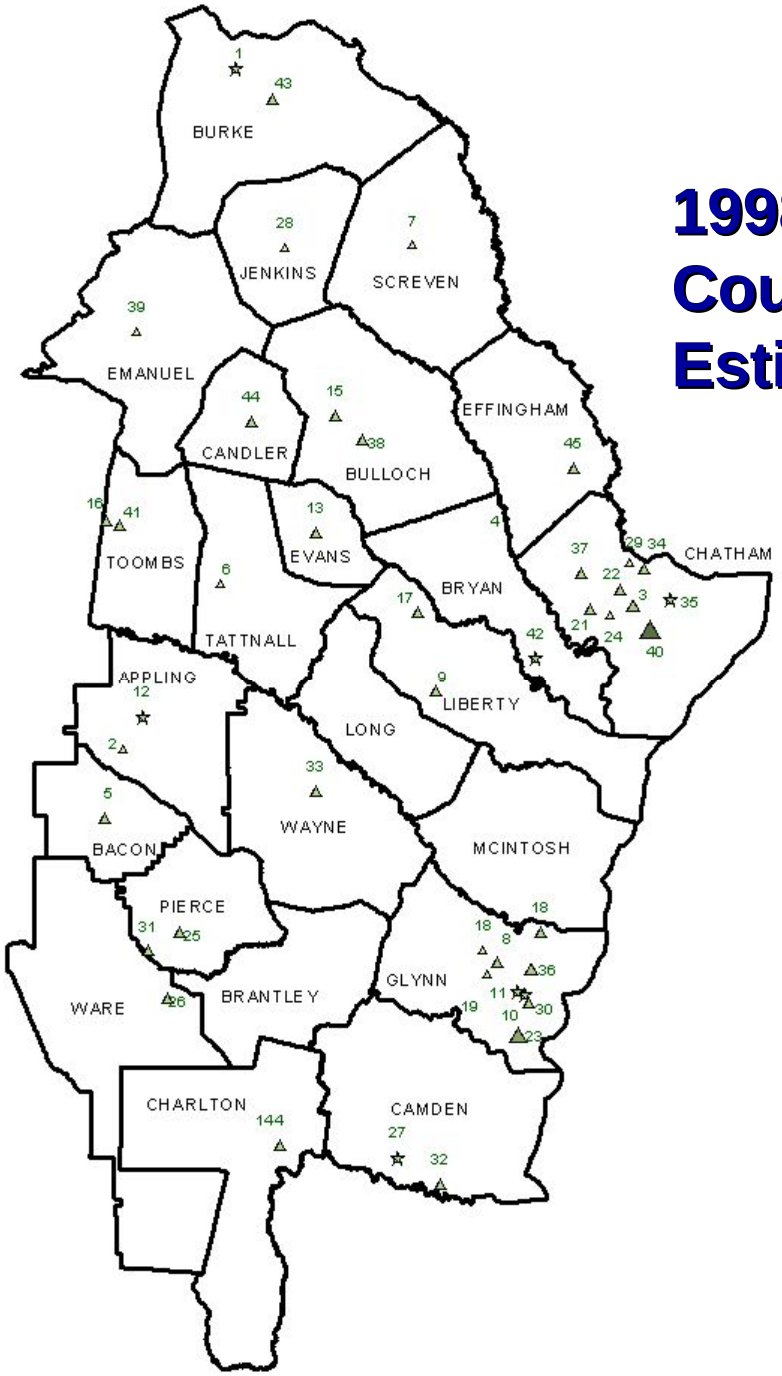
Location of Municipal NPDES

1998 24-County Area Golf Course Irrigation Estimated Water Use



LEGEND

Estimated GC Water Use

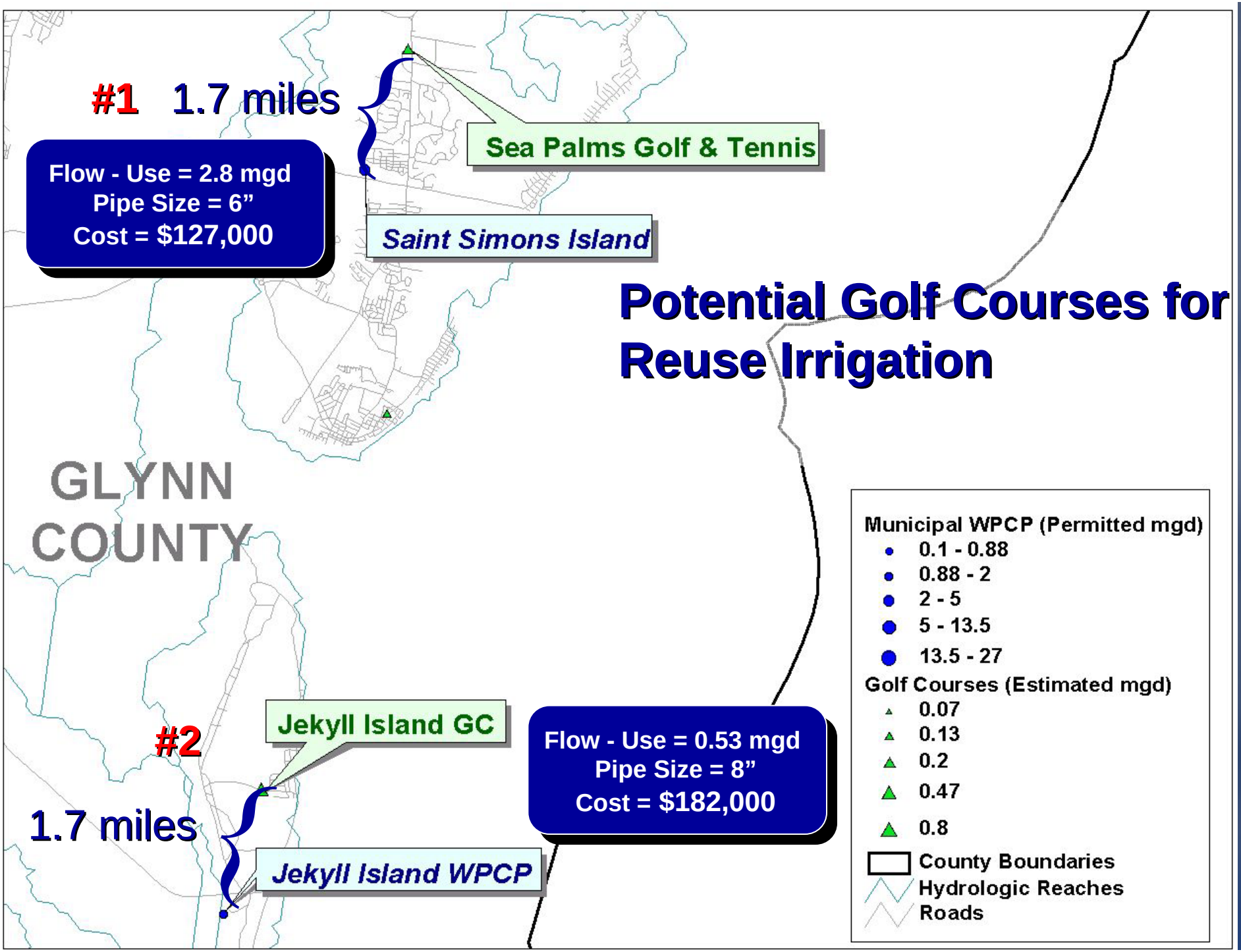
- 0.07 mgd
- 0.13 mgd
- 0.2 mgd
- 0.47 mgd
- 0.8 mgd
- No Data
- County Boundaries

5 0 5 10 15 Miles

Source:
Golf Courses, Golf Magazine 'Drive", 1998
Georgia Extension Service, UGA, 1998

CDM Camp Dresser & McKee

Location of Golf Courses


#1 1.7 miles
Flow - Use = 2.8 mgd
Pipe Size = 6”
Cost = $127,000
Sea Palms Golf & Tennis
Saint Simons Island
Potential Golf Courses for Reuse Irrigation
GLYNN COUNTY
#2
Jekyll Island GC
1.7 miles
Jekyll Island WPCP
Flow - Use = 0.53 mgd
Pipe Size = 8”
Cost = $182,000
Municipal WPCP (Permitted mgd)
0.1 - 0.88
0.88 - 2
2 - 5
5 - 13.5
13.5 - 27
Golf Courses (Estimated mgd)
0.07
0.13
0.2
0.47
0.8
County Boundaries
Hydrologic Reaches
Roads

Results

- Implement Wherever Possible
- Golf Course Irrigation
  - Many Moving to Miocene Wells
  - 0.07 to 0.47 mgd
- Other Uses
  - Agricultural Irrigation
  - Industrial Uses
  - Dual-Pipe Distribution System

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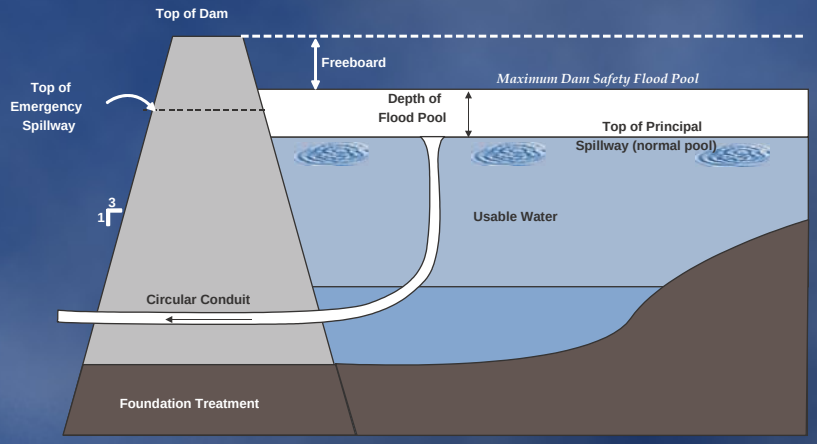
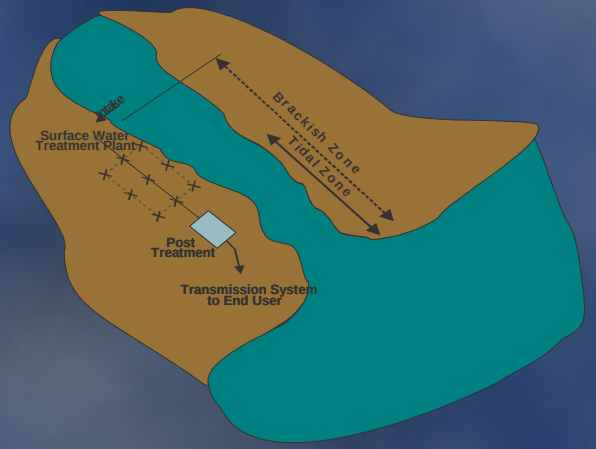
Second Evaluation

- Wastewater Effluent Reuse
- Off Main-Stem Impoundments
- Surface Water Supplies
- Water Conservation





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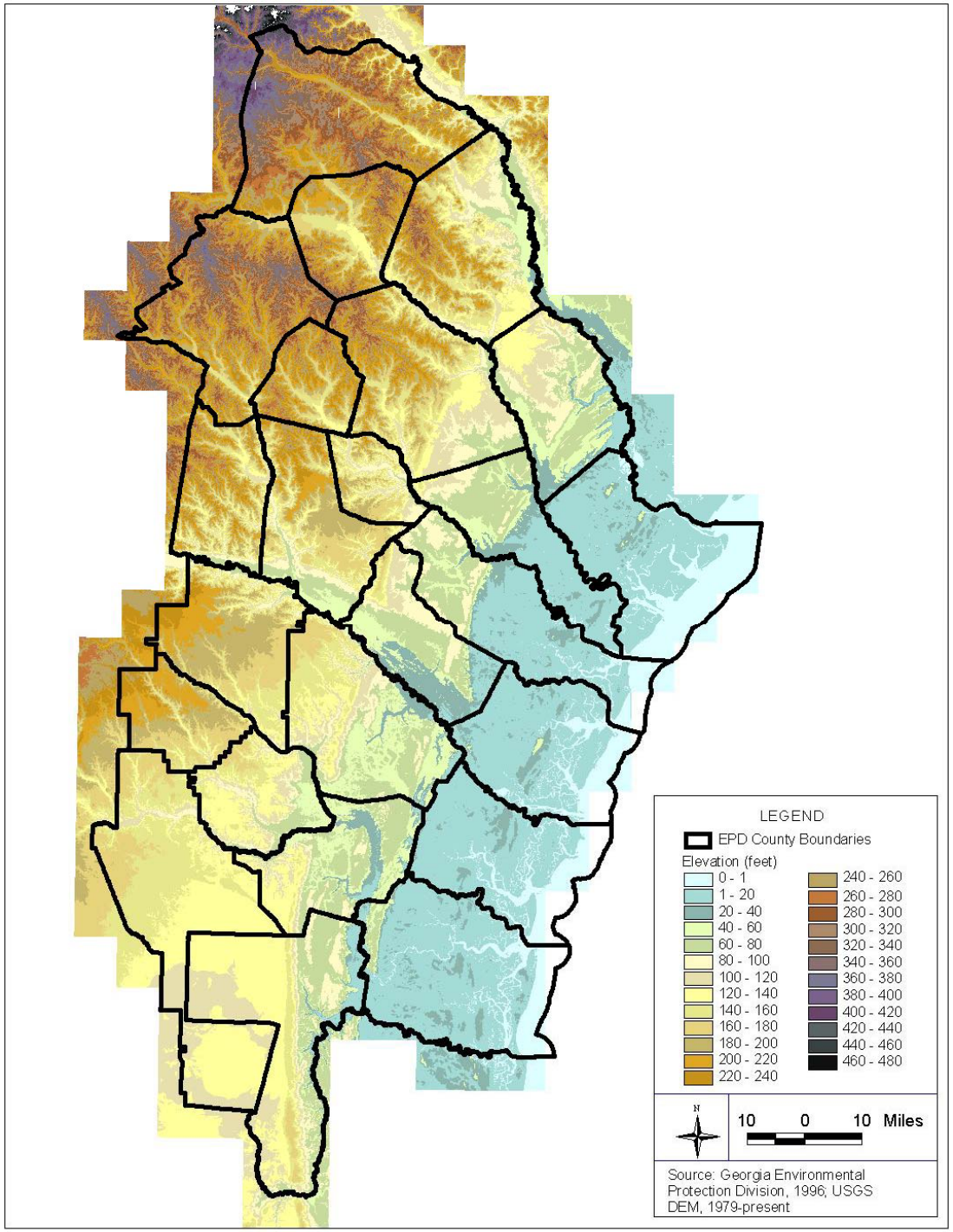
Digital Elevation Model



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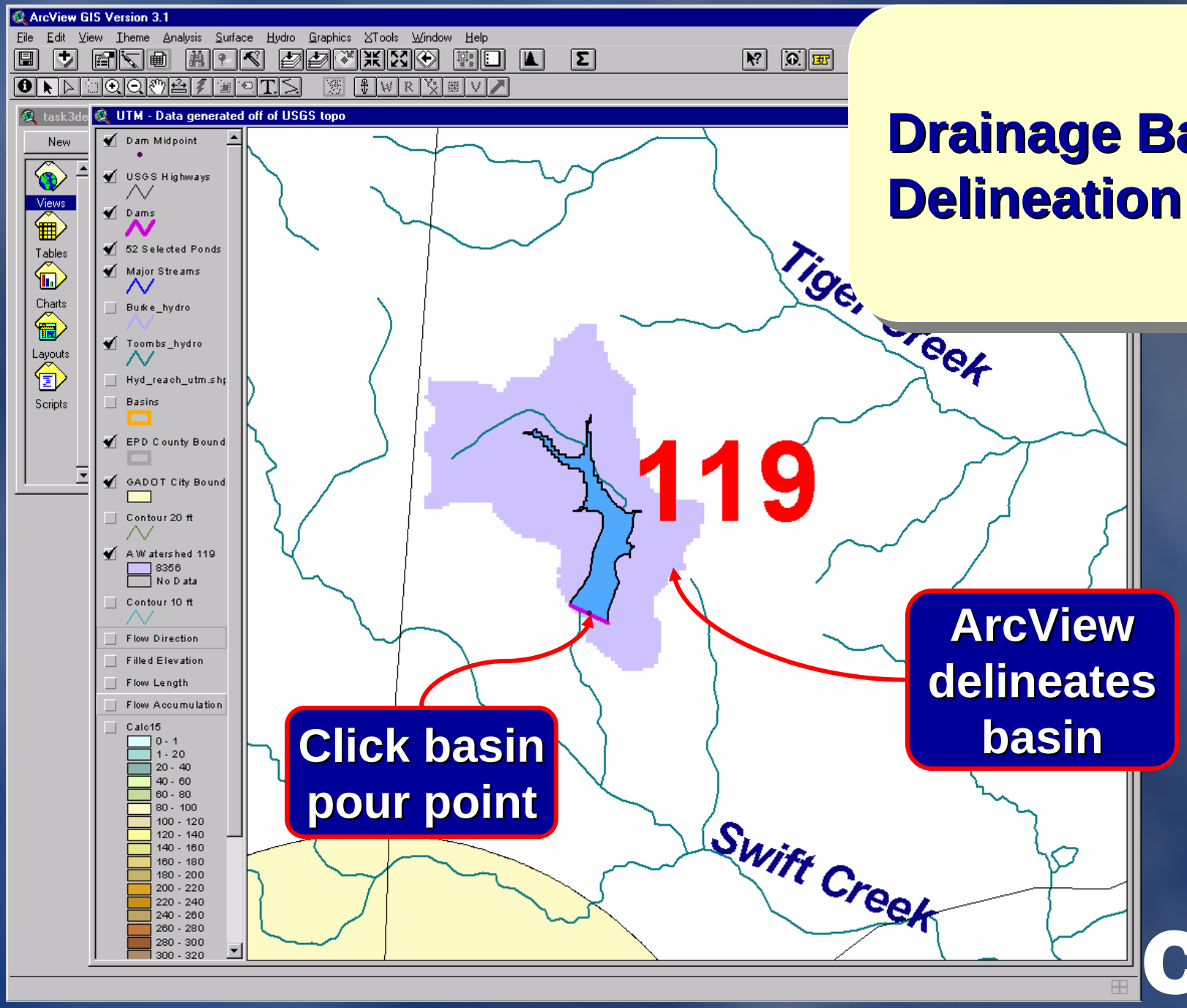
Drainage Basin Delineation



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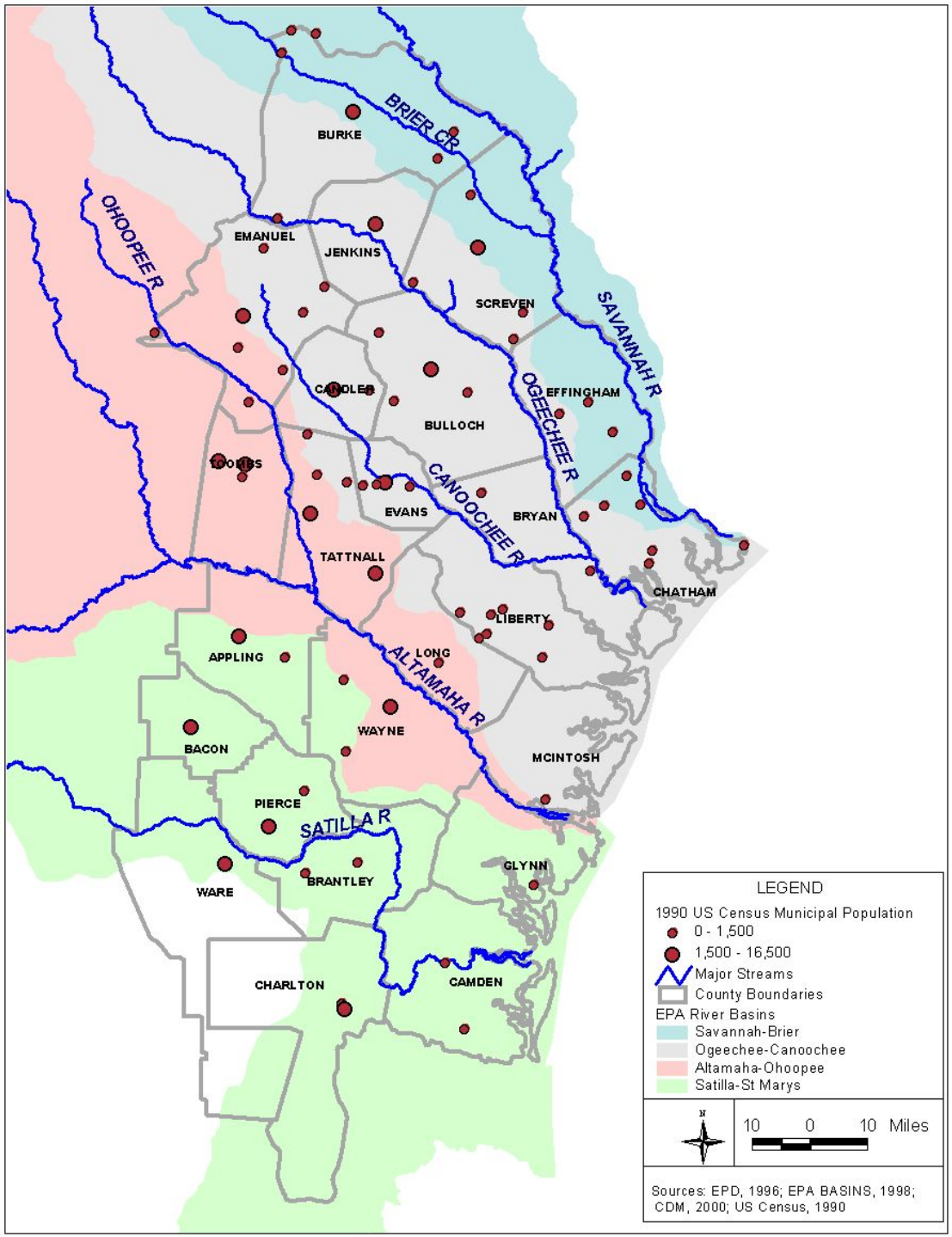

1990 US Census Municipal Populations

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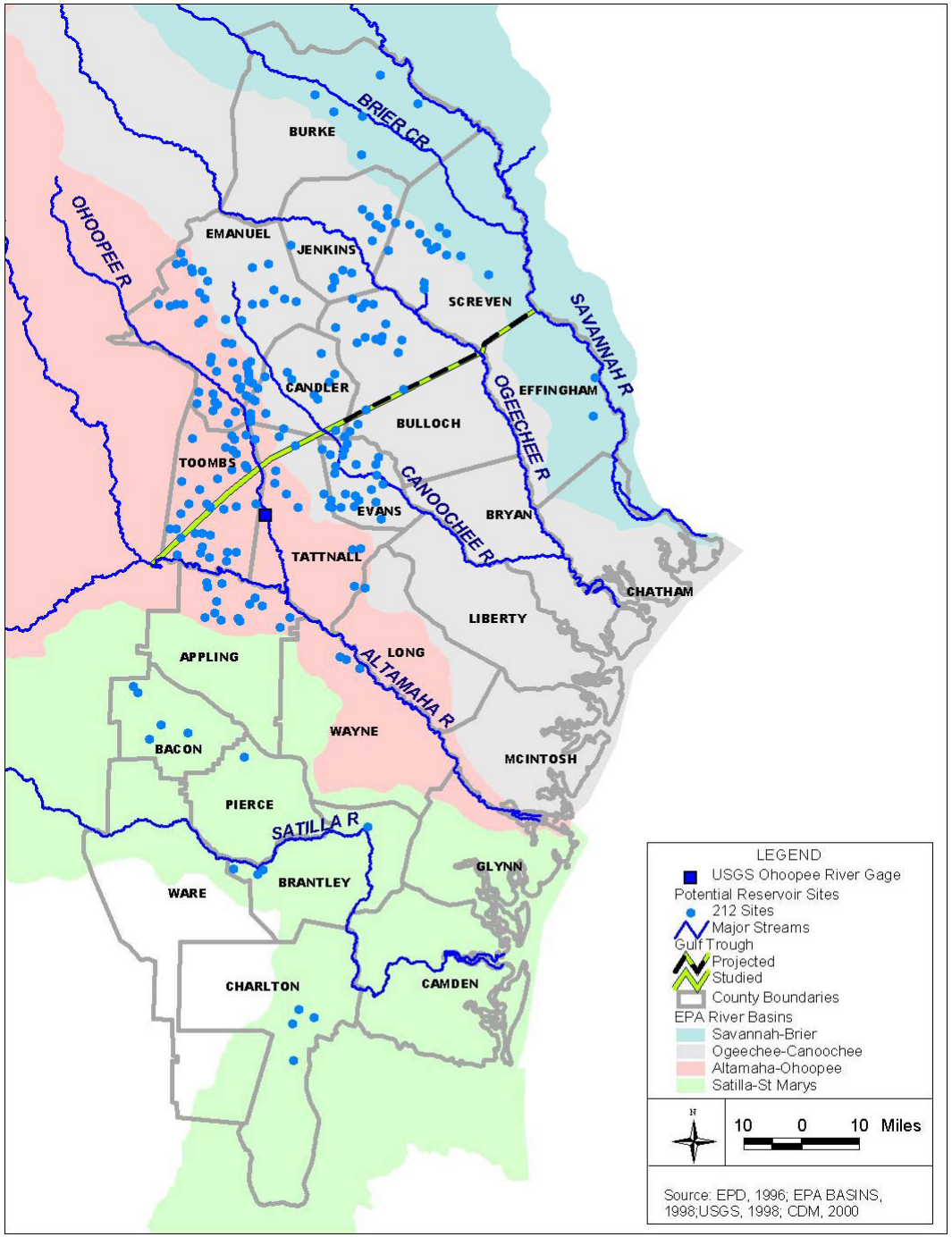

212 Potential Sites

- Evaluated
  - Yield
  - Cost
  - Wetland Impacts
  - Existing Reservoirs Nearby
  - Water Quality Concerns
  - No Significant Demand
  - Infrastructure Impacts

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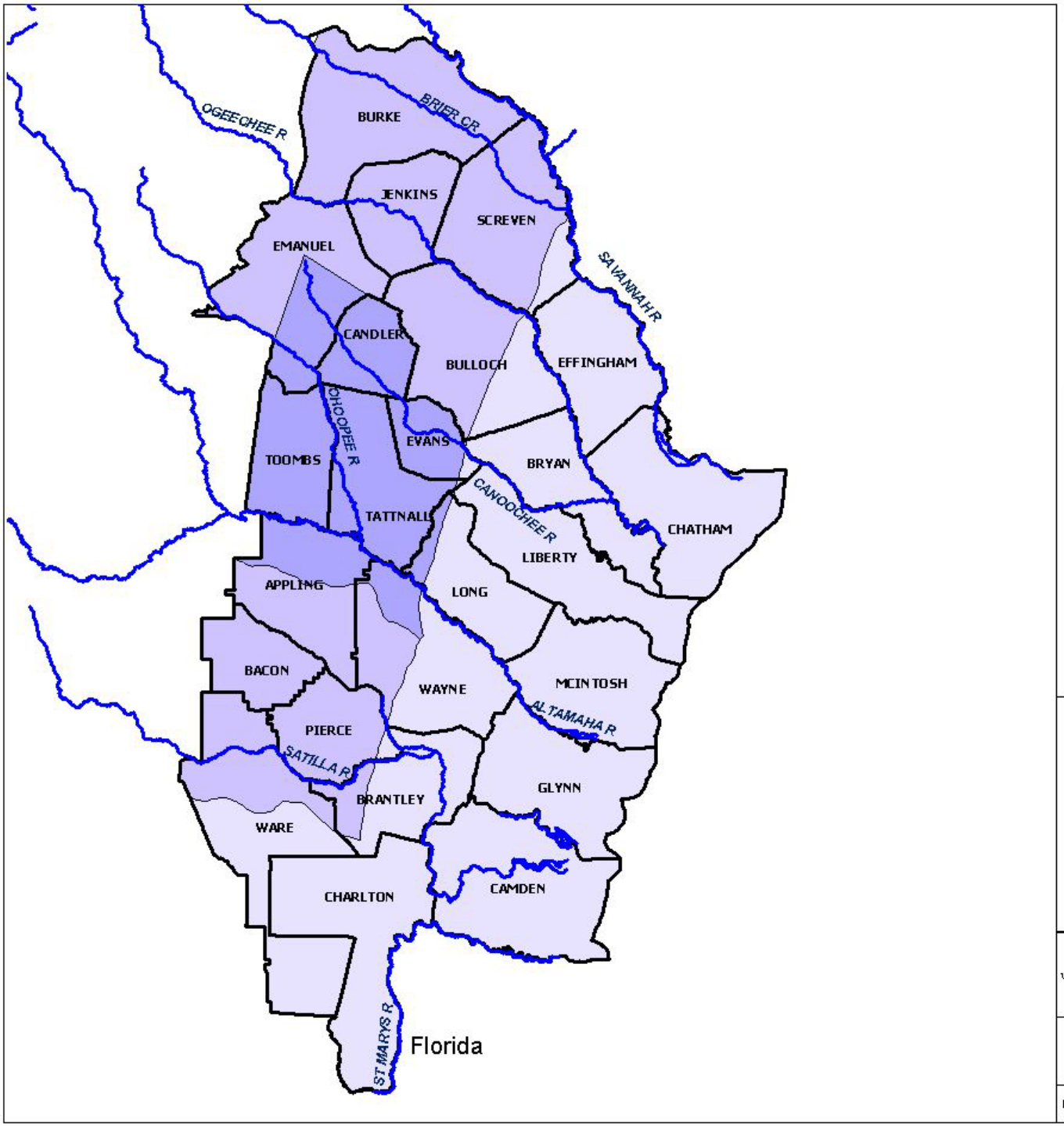

Preferential Regions for Reservoirs

LEGEND

- Major Streams
- EPD County Boundaries

Dam Siting Preference Regions

- Most Favorable
- Average Favorable
- Less Than Average Favorable

N W E S

10 0 10 Miles

Sources:
Georgia Environmental Protection Division, 1996;
CDM, 2000

CDM Camp Dresser & McKee Inc.

Cost Summary
Final 14 Reservoirs

- **Cost per Gallon of Yield**
  - **Range $3.00 to $6.16**
  - **Average $5.03**

If construction funded using revenue bonds

- **Least expensive reservoir**
  $0.59 / 1,000 gal / month
- **Most expensive reservoir**
  $1.21 / 1,000 gal / month

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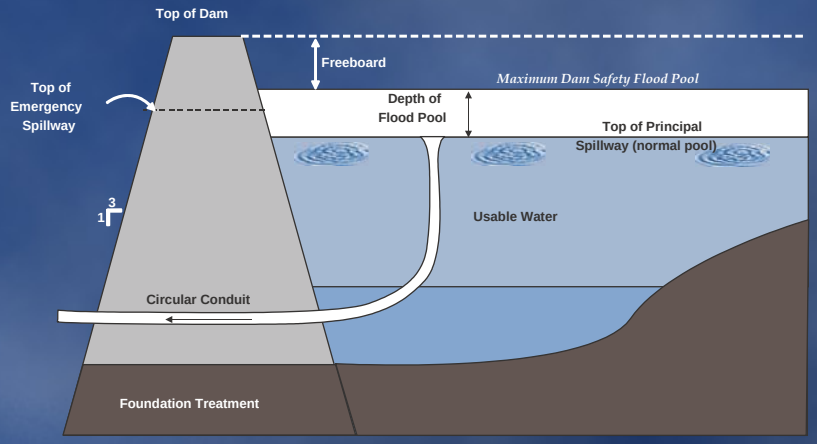
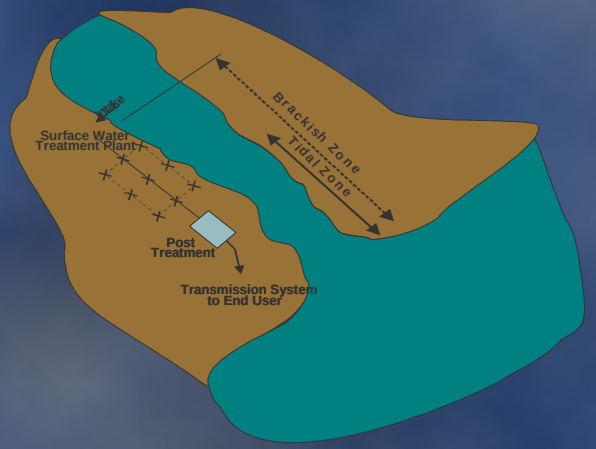
Third Evaluation

- Wastewater Effluent Reuse
- Off Main-Stem Impoundments
- **Surface Water Supplies**
- Water Conservation





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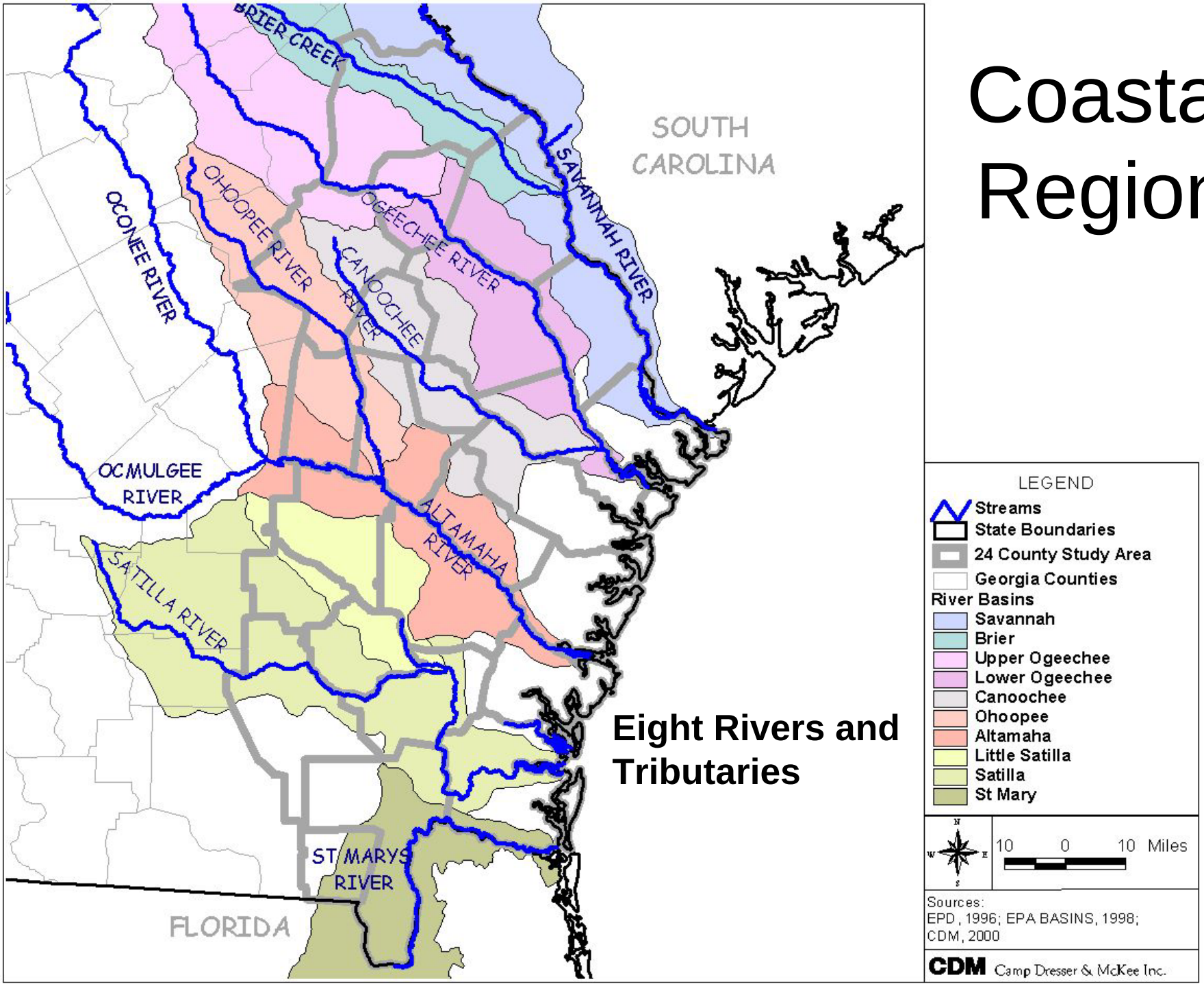
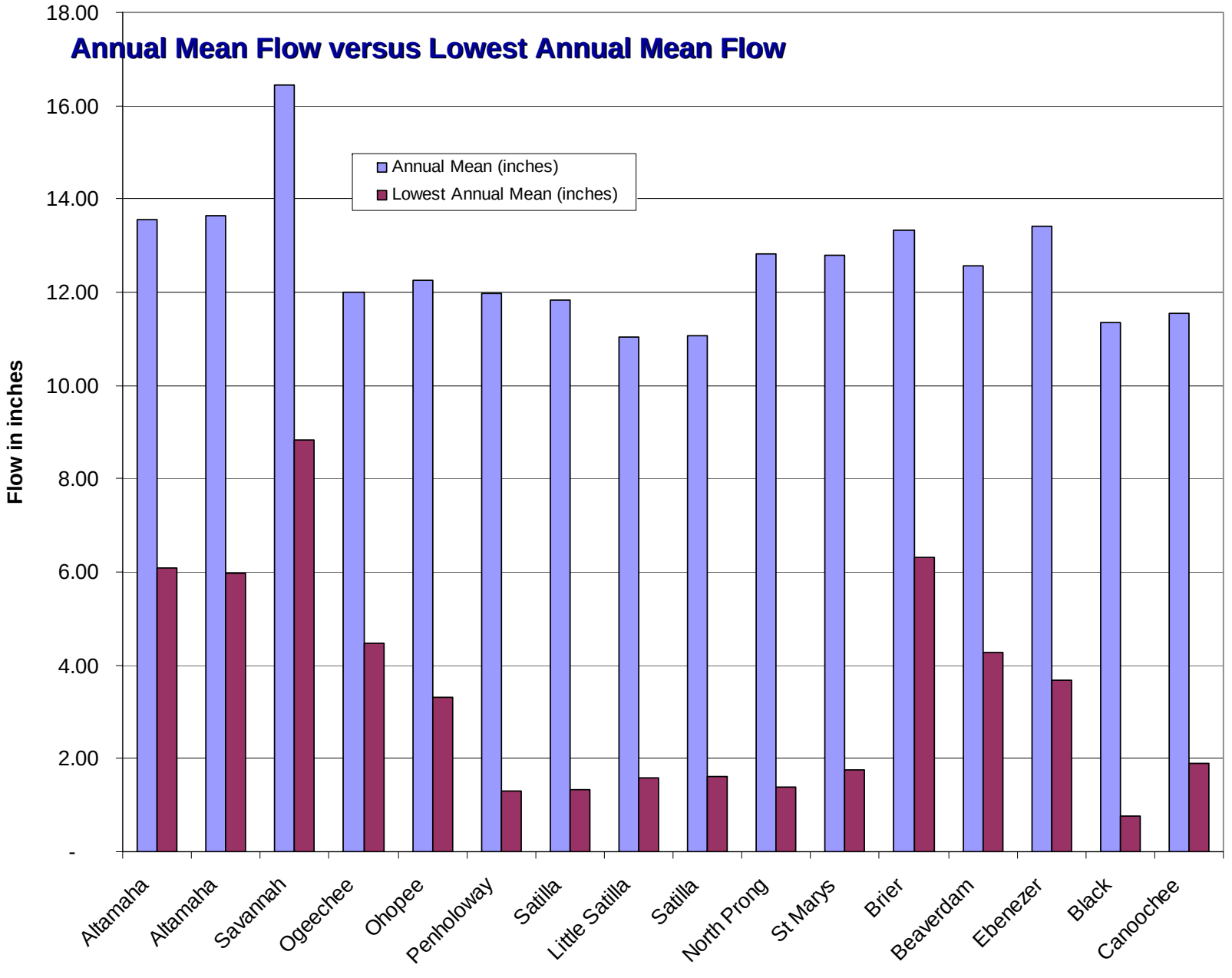
Coastal Region




Annual Mean Flow versus Lowest Annual Mean Flow
Flow in inches
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
-
Annual Mean (inches)
Lowest Annual Mean (inches)
Altamaha
Altamaha
Savannah
Ogeechee
Ohopee
Penholoway
Satilla
Little Satilla
Satilla
North Prong
St Marys
Brier
Beaverdam
Ebenezer
Black
Canoochee

Conjunctive Use

- Respect Minimum Flows
- Use Groundwater as Supplement
  - Needs Modeling
  - What Flows can Aquifer Support
  - For What Period of Time

Treatment Plant Needs

- Proven treatment record by the City of Savannah's I&D Plant
- Operated since 1940s
- If Conjunctive Use, Groundwater Treated After Filters (Post-Treatment Only)
  - Chlorination
  - Fluoridation
  - Corrosion Inhibitors

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Cost Comparison

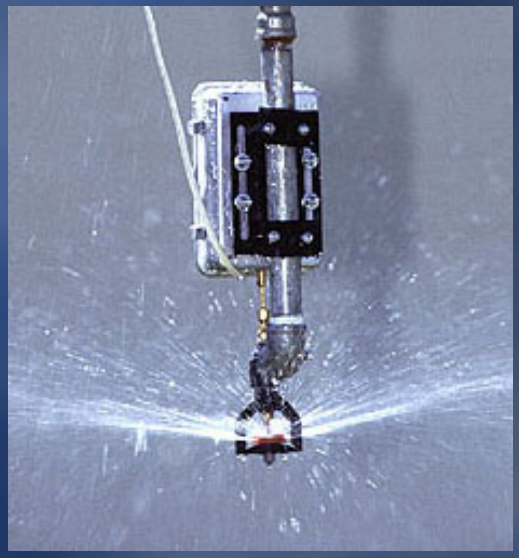
- Construction Costs Much Higher for Surface Water Treatment Plants
- Operating Costs Approximately 70% Higher
- If Financed through Revenue Bonds, Cost of Surface Water Approximately 5x Higher per Thousand Gallons

Results

- Regional Surface Water Plants
- Cost Increases
- Viable Solution

Fourth Evaluation

- Wastewater Effluent Reuse
- Off Main-Stem Impoundments
- Surface Water Supplies
- **Water Conservation**



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Conservation Measures Evaluated

- Unaccounted for Water (UAW)
- Conservation Pricing
- Agronomic Irrigation
- Public Education, Information, and Participation
- Technology
  - Low-flow Fixtures
  - Water-efficient Appliances
  - Recycled Water Cooling
  - Low-spray Irrigation Devices
  - Soil Moisture Meters

Findings
2050 Water Demand & Conservation

- **Domestic / Commercial Use**
  - **Only 11% of Water Demand**
  - **Up to 69 mgd Potential Water Savings for Region**
- **Agricultural / Industrial**
  - **Savings on Individual Basis**

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Recommendations
Regional Conservation Efforts

- ✓ Encourage Agricultural Site Water Audits
- ✓ Characterize County & Regional Agricultural Water Use and Conservation Savings
- ✓ Regional Implementation of Conservation Strategies to Reduce Redundant Costs
- ✓ Public Access to Information and Tools for Reducing Water Use and Water Loss

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Recommendations
County & Local Efforts

- ✓ Reduce UAW Wherever Possible
- ✓ Conservation Pricing Where per Capita Consumption is High
- ✓ Public Education Should be a Supplemental Effort
- ✓ Monitoring and Program Assessment to Review Effectiveness of Strategies

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August 2005

Facilitated Meeting

- Held September 18 and 19, 2001
- Seven Expert Panelists
- Panelists from US and Europe

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Alternative Evaluation Criteria

- Technical / Construction Feasibility
- Public & Political Acceptance
- Socio-Economic Impacts
- Environmental Impacts
- Anticipated Costs
- Regulatory and Institutional Feasibility/ Complexity
- System Reliability
- Near Field Effectiveness
- Regional Effectiveness

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Alternatives Evaluated

- Physical Barrier
  - Slurry Walls
  - Sheet Piles

Not Practical to Implement Along Georgia Coast

"Unfavorable"

Alternatives Evaluated

- Surface Water Impoundments
- Scavenger Wells
  - Specially Designed Well Systems
  - Extract Freshwater While Preventing Upconing of Saline Water
- Intrusion with Treatment
  - Allow Intrusion
  - Treat Brackish Groundwater with RO

Also deemed relatively

"Unfavorable"

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Alternatives Evaluation

Also deemed relatively

"Unfavorable"

- **Injection Barrier**
  - Hydraulic Barrier by Injecting Water
  - Creates zone in which Freshwater Gradient towards Sea
  - Prevents Intrusion of Seawater
- **Extraction Barrier**
  - Hydraulic Barrier by Extracting Saline Water
  - Lowers Heads and Protects Wells Further Inland

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Moderately Ranked Alternatives

- Non-potable Water Reuse
- Well Relocation
- Pumping Caps
- Modified Pumping Scheme
  - Schedule
  - Rate
- Controlled Intrusion
- Aquifer Storage and Recovery
- Desalinization

"Caution"

Alternatives Evaluated

- Demand Management
  - Water Conservation
- Rainwater Harvesting
- Retrofit Existing Wells
  - Reduce Capacity
- New Well Standards
  - Reduce Cross-Connection Between Aquifers
  - Regulate Pumping Capacity, Screen Depth
- Plug Abandoned Wells
  - Reduce Leakage Between Aquifers

Implement, but not Individually Sufficient to Solve Problem.

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Highest Ranked Alternatives

- Surface Water Supply
  - Direct Withdrawal
  - Conjunctive Use
- Alternative Aquifers

"Favorable"

Further Feasibility Studies

- Working Group
  - March 1 – 3, 2004
  - Further refined mitigation approaches for Savannah, GA, Hilton Head Island, SC, and Brunswick, GA
- Developed Scope of Work
  - Feasibililty Studies of Mitigation Approaches
  - To be used by EPD for Development of a Bid Package for Engineering Consulting Firms

Options Selected for Feasibility Evaluation
[options considered worthy of evaluation/study]

Table 2. Summary of mitigation strategies by focus area			
Option	**Northern capped area**	**Hilton Head Island**	**Glynn County**
Direct surface water withdrawal			
Savannah River	Yes	Yes	No
Altamaha River	No	No	Yes
Ogeechee River	Yes	No	No
Alternative aquifers			
Brunswick and surficial aquifer systems	No	No	Yes
Lower Floridan aquifer	Yes	No	No
Cretaceous aquifer	No	Yes	No
Water conservation	Yes	Yes	Yes
Non-potable water use	Yes	Yes	Yes
Well relocation	Yes	Yes	Yes
ASR			
Savannah River	No	Yes	No
Ogeechee River	Yes	No	No
Intrusion with treatment	Yes	Yes	Yes

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Questions?