Freshwater in the Coastal Plain: Exploring Solutions for 21st Century Challenges


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Introduction

“There are a lot of people growing a lot of food and using a moderate amount of water on a big wedge of sediment in a warming climate”

Dr. David Genereux, NCSU, Keynote Speaker

- 45% of land - 28% of people and only 19% of state’s water use.
- Annual P-ET = 17 billion gallons/d
- 13.7% P-ET is used in CP
- GW use is declining while SW use is rising (USGS 2010 data).

Common Themes - Wet, Flat, Salty, Stormy, Economic Challenges, Agriculture, Change, Upstream vs Downstream, Eutrophication, Denitrification

Hotspots, Low gradients, Old water, Lag times

Supply

(Jay Holley, GMA/ECU; Eban Bean, ECU; Tom Fransen, DEQ)

- JH- Supply challenges but the main issue is willingness to treat to meet demands?
  - Solutions may include unregulated aquifers, expanding RO plants, quarries, ASR
- EB- Ecological Flows- stream flow regime needed to maintain ecological integrity
  - Coastal Plain ecological flows are poorly understood, particular challenges for outer Coastal Plain due to lack of streamflow and salinity data.
- TF- To avoid supply problems (e.g those that arose during 1998-2002 and 2007-8 drought periods) need to prioritize regional planning and cooperation between local and state agencies and utilities.
Contaminants

(Detlef Knappe, NCSU; Dianne Reid, Dragonfly Resources; Stephen Harden, USGS)

- DK– emerging contaminants- Bromide, dioxane, perfluoroalkyl substances- monitoring/treating increasingly important as sw/shallower gw supplies increase.

- DR- large number of septic, package plant, and high-rate infiltration wastewater treatment systems in coastal watersheds but don’t have good data to assess the level of impact on surface water quality. Wastewater education is also needed.

- SH- agricultural drainage and animal waste management can cause increased nutrient loading to streams. Need to understand the nutrient processing in coastal plain watersheds to understand where excessive nutrient problems are likely.

Demand

(Ian McMillan, DEQ; Linwood Peele, DEQ; and Seth Robertson, DWI)

- IM- Cape Fear Water Supply evaluation & CCPCUA as surrogates for CP water management & use
  - Projected NC demand in 2035~3.5 Billion gpd, top uses- thermoelectric, livestock/aquaculture

- LP- No State-wide Water Use Permitting Program rather State-wide Water Use Registration Program
  - Potential Supplies in the Coastal Plain (from simplest to more challenging)
    - Maximize use of existing water system; interconnection / regional system (w/o IBT); groundwater sources; water storage/ quarries; additional surface water intake; allocation or reallocation of existing water storage in a reservoir; side stream reservoir; and mainstem reservoir

- SR- 20-year NC infrastructure needs based on surveys: Water - $10 Billion; Wastewater - $5.3 Billion
  - Particular challenge in Coastal Plain communities with< 20,000, less economic resources, ability to borrow constrained- more challenging for viable water and wastewater systems to exist.
Treatment
(David Pyne, ASR Systems; Mike Richardson/Ben Kearns, CFPUA; and Charlie Humphrey, ECU)

- DP~175 ASR wellfields in US- Legal, regulatory, and policy framework
  - Store pre-treated water in subsurface and recover during times of need.
  - ASR treatment processes call for integration, water treatment occurs during storage and systems need to be designed and managed around this.

- MR/BK- Advanced treatment includes: Ozonation, Enhanced coagulation, Biological filtration, UV Disinfection, Water Aeration, and elevated storage tank aeration
  - Process challenges: Water quality of source water, capital and maintenance costs, security concerns, and future regulated contaminants

- CH- Septic systems in coastal plain can contribute increased BOD, fecal coliform, TN & TP.
  - Coastal plain is sandier, can receive greater wastewater loads and systems don’t require as much space. Thus, septic system density increases as well as the contamination potential.
  - Problematic septic system options/Advanced septic treatment, increased reduction of N&P in vegetated buffers, reactive barriers, wetlands, and modified drainage ways

Impacts to Health, Economy, and the Environment
(Mike Piehler, UNC/CSI)

- Tourism draw to our coast is highly water-related. Visitors come to swim, fish, and drink.

- Coastal freshwater systems modulate human well-being through: hydration; nutrition; exposure to pollutants/toxicants; physical hazards; exposure to infectious diseases; and livelihoods.

- What is the impact of coastal plain watershed development on nutrient and sediment transport?

- At about 15% imperviousness, nitrate loading tends to increase, though large scale BMPs may be able to reduce this trend.

- Share data, share ideas: strive to manage at the intersection of environment and economy: as a functional natural system.
Talks available online at:

• https://wrri.ncsu.edu/wrri-events/coastal-plain/

Research, Data, and Resources in the Coastal Plain
(Feb. 16 Session)

• Kristen McSwain, US Geological Survey
  - USGS records streamflow data and stats, real-time groundwater monitoring, water quality, rain gauge, storm wave and tide hydrodynamic, historical/episodic data

• Cam McNutt and Amy Keyworth, NC Department of Environmental Quality, Division of Water Resources
  - Cam: Surface water monitoring data on approximately 30% of known surface waters. Coalition monitoring data is also available.
  - Amy: Focused on groundwater data. Special water studies, water level monitoring, water quality, CCPCUA
  - Most of their data is free for public on the DWR website. However, staff can provide data for decision making or the public upon request, not all data may be publicly available.

• Steven Berkowitz, NC Department of Health and Human Services, Division of Public Health-OSW Protection Branch
  - Subsurface septic and private drinking well data, County environmental health monthly activity reports, operator reports – large systems and smaller residential, shellfish sanitation (walking survey every 3 years).

• Rebecca Cumbie-Ward, NC State Climatology Office
  - Integrated water portal, water and weather data available, can download map and time series data.
  - Working to get data from further back in time.
**Data collection - challenges in the Coastal Plain**

- Elevation and lack of flow data, more issues with wind and lunar tides, backwater effects from major rivers may cause dual stormflow peaks along smaller tributaries.

- Difficulties delineating catchments with subtle elevation differences and extensive drainage alteration.

- Biggest septic system concentration are in coastal plain, thus higher potential for septic contamination.

- Sensors for water level and quality monitoring, salt water and salt in air/rain can corrode equipment.

- Storms and storm surge- can alter channel dimensions, rating curves, and monitoring equipment.

**Some identified data gaps**

- DEQ- 70% of known streams are not monitored, mapped streams < actual stream network. Watershed delineation challenges for flat, agriculturally-drained landscapes.

- USGS- streamflow data gaps in low lying areas- less gauging there due to challenges with rating curves and tidal/wind influence on flow. Less streamflow stations on lower-order rivers.

- DHHS- Data gaps include: number of septic systems, septic systems hooked into sewer, spatial location of systems, lack of central data depository of effluent quality, no central availability of operator and county reports, synthesis of private well data, and residential water use.

- State Climatology Office- don’t have a full historical account of data- New scripts are needed to fix these gaps (in progress).
Other feedback/observations

Overall, a common theme is that there is a gap between funding that is needed for monitoring programs, QA/QC, data sharing support, and funding that is available.

- For NC coastal watersheds (and others) there is not one place to find data encompassing the water cycle.
  - Surface water, groundwater, precipitation, evapotranspiration, and wastewater data tend to be in separate places. This may result in a limited capacity to connect the dots and understand how interconnected the various water fluxes are and how surface water quality and quantity are affected by groundwater and wastewater inputs.

- Older data may be in paper format and less available.

- Systems for collecting data from the public are not yet well-developed (e.g. septic systems, private well water use, etc.).

- Programs may have abundant data streams but lack the personnel or resources to systematically and thoroughly analyze the data.

- Privacy is a concern. Some people may not want full availability of data to prevent negative consequences. (e.g., septic systems affecting the sale/purchases of homes).

Data Handout

https://wrri.ncsu.edu/wrri-events/coastal-plain/
This Session

- To help address regional water challenges in coastal North Carolina:
  - Develop a better understanding of what data is available and accessible for coastal plain watersheds.
  - Identify where/when the data gaps are.
  - Document barriers that may exist to data collection, quality control, and synthesis.

Goals for this session

Goal of Small Group Discussions
- Discuss some of the big issues around each of the topics, including current issues and needs and considerations for the future. Based on this discussion, brainstorm with your group about some specific actions that could be taken to address these issues. In particular, we are looking for realistic, achievable actions, especially those that could be undertaken by students or interns as either class or service learning projects, honor's or master's theses or something similar.

Desired Outcome
- We would like to generate a list of these problems/solutions with brief descriptions and make them available to researchers, classes and students to consider when looking for projects that can benefit managers, the public, and others. Many of these could be achieved by professionals in various sectors but they often lack the time to invest in these solutions. WRRI and university researchers have the ability to facilitate and guide the implementation of some of these projects.
Discussion Topics

• **Data access, communication and sharing**
  - Issues include how to get access to data. Who has the data? Where does it live? How do you get it (person-to-person requests, online tools that give access, etc.)? What are the issues associated with sharing data – sharing in between agencies, between agencies and other researchers, sharing with the public, etc. Communicating data (including translating it into a form that can be applied and informative for decision making and other uses) is another challenge.

• **Data format, QA/QC issues**
  - Data from various programs and projects are stored in many formats – online databases with user interfaces, archived databases, paper files, excel spreadsheets, tables nested in research reports, etc. Sometimes metadata might be missing and there may be little information about how the data was quality assured and controlled in its original collection and in compiling old data into newly-accessible formats (e.g. manually typing old paper-based data into an electronic format).

• **Data gaps – spatial/temporal**
  - Many data gaps in spatial and temporal coverage exist throughout the coastal plain. These gaps have many implications the ability to draw conclusions about water issues that can inform management decisions, affect human health and well-being, etc.

Questions to consider for each topic

• **Bonus “points” for addressing rural areas and/or areas with significant spatial gaps in coverage and data.**

• Discuss the current issues and needs around this topic

• What future needs and considerations should we be thinking about?

• What are actionable, short-term items that can address some of these issues? Short-term can happen within 1 year from now, or require 6 months-1 year to complete but possibly wouldn’t start until later on.

• **Report Out/Deliverables**
  - At the end of the discussion, please plan about 5 minutes to share one of your ideas for how some of the issues you discussed can be addressed through a project-specific action item.
Potential Topics / Discussion starting points

- Who are stakeholders and what are their data needs? What are notable gaps in synthesis?

Data access, communication and sharing
- Making data more intuitive for other users beyond the science realm
- Gaps in synthesis
- Training: small water plants and water treatment
- Paper that $\rightarrow$ digital
- Privacy constraints

Data format, QA/QC, issues
- Format / QA/QC / Standardization
- Citizens science

Data gaps - spatial/temporal
- Rural water use and wastewater
  - Private groundwater wells and septic systems
  - Agricultural
    - Drainage districts and historical/drainage, drainage easements, tile drains
    - Irrigation
    - CAFOs
    - Fertilizer
- Urban water use and infrastructure
  - Bacterial water infrastructure, sewer and water leakage, land-use, untreated wastewater discharges
  - Runoff; disraces, urban stream burial
  - Leaking underground storage tanks and contaminated industrial sites
- Spatial and temporal data gaps
  - Groundwater quality in the surficial aquifer and connectivity between surficial and deeper aquifers (breaches in confining units)
  - Groundwater residence times
  - Surface water and groundwater quality and quantity
  - Precipitation
  - Wetlands
  - Water, nutrient, and carbon budgets for watersheds across a range of land uses
  - Dams and millponds
  - Land use change over time (e.g. TIA)
  - Accurate watershed maps (effects of artificial drainage and flat expansive drainage divides)
  - Drought resilience as we shift to more surface water supplies

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