Florida Water Resources Monitoring Council (FWRMC)
Public Meeting (Webinar) of Salinity Network Workgroup – December 14, 2011

Attendees:

Agency	Name
DEP	Rick Copeland
DEP	Gail Sloane
DEP	Stephanie Sunderman
DEP	Jay Silvanima
DEP	Tom Seal
DEP	Gary Maddox
DEP	Cindy Fischler
DEP	Paul Hansard
DEP	Rodney DeHan
DEP	Dan Phelps
DEP	Frank Rupert
DEP	Guy Means
DEP	Jan DeLaney
NWFWMD	Chris Richards
SRWMD	Megan Wetherington
SJRWMD	Don Boniol
SWFWMD	Dave DeWitt
SWFWMD	Granville Kinsman
SFWMD	Cindy Bevier
SFWMD	Pam Lehr
SFWMD	Lucia Baldwin
USGS	Scott Prinos
US Army Corps of Engineers	Susan Kemp
Alachua Co.	Jim Myles
Miami-Dade Co.	Susan Markley
Miami-Dade Co.	Virginia Walsh
Escambia Co.	Robert Turpin

Welcome / Introductions
Rick Copeland (RC) and Gail Sloane (GS) welcomed everyone to the second meeting of the Salinity Network Workgroup.

Review of October Meeting / Monitoring Sites
Rick Copeland (RC), FDEP, presented information on the background and logistics for the Salinity Network

- Reviewed meeting agenda
- Reasons for forming the Salinity Network
    - Since about 1998, groundwater (GW) levels and spring flows in FL have been declining, and specific conductance and concentrations of sodium and chloride have increased

  - These changes are due to decreases in rainfall and recharge, and possibly due to increases in GW withdrawals and sea level rise.
  - Scale is statewide and region (WMD) wide
- Draft goals for Salinity Network
  - Provide opportunity for GW programs to participate in FWRMC activities and work towards common goal
  - Provide GW data and information on a statewide to local scale
  - Define status and trends for salinity and GW levels
  - Integrate GW results with other water resource reports
  - Other issues as needed
- Draft model for Salinity Network
  - Use existing sampling stations at wells and springs
  - No new stations required (but can be added if needed)
  - Can include surface water (SW) if needed
- Draft management structure
  - Overall coordination through FWRMC guidance
  - Cooperative effort of all participating entities
  - Statewide efforts coordinated by FWRMC & DEP
  - Regional & local efforts coordinated by FWRMC, FWRMC Regional Councils (in development), & Regional Monitoring Entities (WMDs, etc.)
- Proposed analytes/indicators
  - Field: water level, spring flow, specific conductance, pH, temperature
  - Laboratory: sodium, chloride, total dissolved solids, sulfate, (calcium, magnesium if available)
  - Additional: rainfall, air temperature, GW withdrawal, evaporation and evapotranspiration
- Developing Indices
  - Use of percentiles for GW levels
  - Use specific conductance or chloride for salinity index (more groups have specific conductance data available).
- Summary of existing monitoring sites by WMD:
  - Abbreviations: Surficial Aquifer System (SAS) – included Sand & Gravel Aquifer (S&G) and Biscayne Aquifer (BA), Intermediate Aquifer System (IAS), Floridan Aquifer System (FAS) – includes Upper Floridan Aquifer (UAF) and Lower Floridan Aquifer (LFA)
  - NWFWMD
    - Water level data available at ~250 wells (many FAS, many S&G, some IAS); quarterly sampling frequency
    - Salinity data available at 12 wells along coast (FAS) and some springs; annual sampling frequency
  - SRWMD
    - Water level available at ~300 wells (mostly FAS) and springs (spring flow available); frequency is continuous, monthly, or quarterly; start date ~2000 (USGS has older data for many sites)
    - Salinity data available at 70-80 wells (FAS) and springs; sampling frequency is quarterly or annual; start date is ~2000
  - SJRWMD
    - Water level available at >700 wells (many in FAS, IAS, and SAS); spring flow available; frequency is continuous, monthly, or quarterly
    - Salinity data available at >300 wells (mostly FAS, some IAS and SAS); spring data available; frequency is once every six months
  - SWFWMD
    - Water level data available at ~1400 wells (many in FAS, IAS and SAS) and ~20 springs (spring flow available); frequency is continuous, monthly, or quarterly; start date for many is 1990
    - Salinity data available at ~400 wells (many UFA and IAS, few SAS) and ~70 springs; frequency is quarterly or annual; start date for many is 1990

- SFWMD
  - Water level data available at >500 wells (many in FAS, IAS, and SAS); frequency is continuous or monthly; start date for many is 1990s
  - Salinity data available at 42 wells (UFA); frequency is annual
  - Salinity data also available at ~2400 wells associated with consumptive use permits; frequency is quarterly
- USGS
  - Many FL wells with water level and salinity data included in WMD summaries
  - Water level data available for ~100 wells in GA (mostly FAS); frequency is continuous or quarterly

- GW Level Summary (statewide)
  - >3500 wells (good distribution in FAS, weak distribution in IAS, good distribution in NW and SE in SAS)
  - Frequency is mostly continuous, monthly, or quarterly
  - Start date for most is at least 2000, but many have start date since ~1990
- Salinity Summary (statewide)
  - Hundreds of wells (good distribution in FAS, weak distribution in IAS, good distribution in SE in SAS)
  - Frequency is quarterly, once every six months, or annual
  - Variable start date

<u>Questions / Discussion:</u>

- GS commented that compiling the monitoring site information is tremendous progress. This has been one of the first efforts that the FWRMC is aware of that is attempting to determine how many wells are being monitored statewide. Hopefully this information can eventually become part of a statewide catalog of water resource monitoring efforts that the FWRMC will be compiling.

SWFWMD Coastal Monitoring Network

<u>Dave DeWitt (DD), SWFWMD, presented information from the 2011 Coastal Groundwater Quality Monitoring Network / Water Use Permit Network Volume VI Report</u>

- Summary of most recent edition of the SWFWMD Coastal GW monitoring report (volume 6) (available at http://www15.swfwmd.state.fl.us/LibraryImages/TD_370_S618_V.6.pdf)
  - These monitoring efforts began in the early 1990s (period of record presented is ~16 years)
  - USGS and DEP have aided in evolution of the monitoring network
  - Data organized by aquifers/zones in temporal groupings for statistical comparisons of chloride and sulfate trends
  - Spatial presentation of sites (District-wide map) with percent increasing/decreasing (or no change) in salinity parameters (primarily chloride and sulfate)
  - Spatial presentation of chemical character of GW at monitored sites using hydrochemical facies analysis
  - Period of record plots of chloride and sulfate concentrations for each well with LOWESS trend line fitted to data
  - GW-quality resource monitoring and reporting, 2006 Recovery Strategy, Southern Water Use Caution Areas (SWUCA)
- WUCAs encompass about 2/3 of SWFWMD area
  - Southern WUCA enacted in 1992
  - Northern Tampa Bay WUCA and Dover/Plant City WUCA enacted more recently
  - SWUCA originally divided into Lake Wales Ridge/Highlands Ridge WUCA and East Tampa Bay WUCA (East Tampa Bay is most impacted area – increasing chloride trends evident)
- SWFWMD Coastal GW Quality / Water-Use Permit Monitoring Network
  - 215 wells in Coastal Groundwater Water Quality Monitoring Network (CGWQMN)
  - 152 wells in Water Use Permit Network (WUPNet), in SWUCA
  - Wells in UFA (249 wells – divided into Tampa/Suwannee and Ocala/Avon Park producing zones) and IAS (106 wells)

- Sampled annually (full network) or three times per year (sub-network)
- Analysis evaluates trends in GW quality with respect to salinity (chloride, sulfate, and chloride:sulfate ratio) using Wilcoxon Rank-Sum test on temporal groupings of data and scatter plots with LOWESS smooths
  - Period of record is 1991-2007 (WUPNet 2000-2007)
  - Data partitioned into four 2-year groups and two 7-year groups
  - Results indicate percent of wells in each aquifer zone with increasing trends and decreasing trends
  - Spatial presentation shows increasing or decreasing trends and percent change for chloride or sulfate in individual wells within temporal groups in the various aquifer zones
  - Scatter plots show trends in chloride and sulfate in various aquifer zones
    - Example 1: Shallow coastal well has significant increasing trends in chloride and sulfate. Deeper UFA well does not have significant trend in chloride and sulfate.
    - Example 2: In most impacted area of SWUCA, some wells have significant decreasing trends in chloride and sulfate.
    - Example 3: In Avon Park UFA, some wells have no significant trends in chloride and sulfate, but others have significant increasing trends.
- Report Conclusions
  - Wells in UFA along Gulf coastal margin and SWUCA are showing long-term increasing trends in salinity - increasing chloride for temporal groups 1993-2000 vs. 2000-2007 in 40% of wells in Ocala/Avon Park zone and 26% of wells in Tampa/Suwannee zone.
  - Analysis of IAS wells for temporal groups 1993-2000 vs. 2000-2007 showed equal numbers (~25%) for both increasing and decreasing chloride trends.
  - Ocala/Avon Park zone of UFA had the highest percentage of increasing trends across all temporal groups.
  - Sulfate trends across temporal groups indicated both increasing and decreasing trends in the IAS and UFA
  - Trends in chloride-sulfate ratios indicate an increase in chloride over sulfate, as evidence of continued salt water intrusion in the SWUCA

Questions / Discussion:

- RC invited DD to present additional information on LFA wells and use of production well at the next Salinity Network meeting.

Ground Water Watch

Scott Prinos (SP), USGS, presented information on Water Level and Saltwater Encroachment Monitoring, and Data Analysis

- USGS monitoring data available relevant to Salinity Network goals
  - Water level monitoring (real-time continuous, instantaneous measurements)
  - Water quality monitoring (continuous, instantaneous measurements)
  - Surface and borehole geophysical data
- Water level monitoring
  - Real-time, automated, continuous measurements (http://www.sflorida.er.usgs.gov/ddn_data/index.html)
  - Manual water level monitoring
  - Analyses (many done through Ground Water Watch Website, http://groundwaterwatch.usgs.gov/): frequency analysis, trend analysis, graphical examinations, geographical evaluations
  - Data and analyses available for thousands of stations across the US
- USGS also has a Surface Water Watch with SW data and analyses available (http://waterwatch.usgs.gov/new/)
- Water quality monitoring (http://www.envirobase.usgs.gov/FLIMS/SaltFront/viewer.htm)
  - Salinity (chloride, total dissolved solids, salinity, conductivity) sampling
  - Real-time, continuous conductivity
  - Major and trace ion sampling

  - Stable and unstable isotope samples
  - Dissolved gases sampling
  - Analyses: geographic analysis of salinity (map shows station location, salinity trends and current / historic salt water fronts), trend analyses, ion ratios and mixing, age dating
  - 103 water quality monitoring wells in SAS in east coast of FL, 24 in southwest FL, 18 in central FL
  - Trace ion chemistry
    - Ca : (HCO_3+SO_4) > 1, indicating that saltwater intrusion has arrived
    - Compare results to saltwater-freshwater mixing line data. As saltwater encroaches values are offset from mixing line, but as the front passes, values become closer to mixing line.
- Geophysical data
  - Collection
    - Time-domain electromagnetic (TEM) soundings
    - Helicopter electromagnetic (HEM) surveys
    - Continuous resistivity profiling (CRP)
    - DC resistivity
    - Sub bottom profiling / seismic surveys
    - Induction logging
    - Distributed temperature sensing (DTS)
    - Capacitively coupled resistivity (CCR) surveys
  - Analysis
    - Develop time series electromagnetic induction log (TSEMIL) data sets
    - Compare TSEMIL data sets to chloride measurements
    - Model TEM, HEM, CRP, and DC resistivity surveys
    - Compare TEM soundings to induction logs and aquifer depths
    - Compare HEM surveys to induction logs and TEM soundings
  - Optimum design of wells for induction logging – new well design penetrates beyond the base of the aquifer and uses sand or pea gravel to fill voids so that logging tool can sense changes occurring in various depth intervals.
- USGS reports available at http://pubs.er.usgs.gov/

Questions / Discussion:

- Rodney DeHan (RD) asked if there has been any effort to integrate Ground Water Watch and Surface Water Watch programs. SP responded that there is not any nationwide effort to create correlations. The information from the programs resides on two separate websites. However, local efforts use information available for developing local scale studies that can address correlations, where appropriate.

3-D Basins

Rodney DeHan (RD), DEP, presented information on "Why should karst Watersheds be Monitored and Modeled as three-Dimensional Systems?"

- Focus is on karst topography and three-dimensional watersheds
- Interaction between watershed components (in soil, on surface, in sediments, in atmospheric deposition, and in aquifers) is maximized in karstic setting, so one must develop a water budget for the system when designing monitoring and modeling studies.
- Recommended for further information: USGS Circular 1139, Ground Water and Surface Water: A single Resource. Additional recommended references can be found at the end of the presentation slides for this talk, found in the 2011 meeting archives (http://www.dep.state.fl.us/water/monitoring/council/archive11.htm).
- Ground water can be a major contributor to base flow in karst regions (FL and other parts of the US)
- The Woodville Karst Plain is the location of FGS's watershed characterization and modeling studies (ongoing since 2003). Data confirm the need for monitoring karstic watersheds as 3-D systems.

- Hydrology, microbiology, and chemistry interplay to determine water quality in karstic watersheds.
    - For example: Microbiological processes release carbon dioxide, which changes carbonate equilibrium and SW-GW interaction. The dissolution of lime stone and dolomite permits further interaction between SW & GW by changing water quantity in various watershed components and changing water quality through mixing.
- Spring Creek example – visible interaction between SW & GW demonstrated by reversal of spring flow between discharging and siphoning. These aquifers follow a multi-porosity flow. The direction of flow influences water quality.
- Significant changes in water flow and quality are seen in gaining and losing streams.
- When designing a monitoring plan, one must account for the location of all points of interaction between SW and GW when calculating the watershed's water budget. Specifically designed methods, such as dye or natural isotope tracing, can be employed to aid in accurate characterization of karstic watersheds. An accurate water budget is critical for determining the hydrogeological characterization of the watershed and developing predictive numerical models. Predictive numeric models are valuable, scientifically-based tools that can help in making water and land use decisions and policies at all levels of government.
- Recommendations to the Florida Monitoring Council:
    - The Florida Council should make the effort to present information to the National Monitoring Council about the unique nature of karstic watersheds and the specific approaches, methodologies and policies that must be implemented in order to monitor, characterize, model, conserve, sustain, protect and manage such watersheds.
    - The Florida Council should seek to form a "karstic regions consortium" (KRC) with other states with similar hydrogeological settings (KY, TX, etc) in order to have a one voice in affecting real changes at the federal level.
    - One suggested approach is to draft a joint resolution or "white paper" in collaboration with these states and present it to these states' Congressional delegations and to the EPA, USGS, NOAA, Corp of Engineers and other federal agencies that have a role in water resource conservation and environmental protection.
    - Enclose with the resolution a list of research topics, surveys, maps and other scientific data needed to underpin any suggested changes by the KRC. The KRC should then seek funding from these agencies for proposals and projects designed to realize and meet these needs.

<u>Questions / Discussion:</u>

- Tom Seal commented that the Santa Fe River, referenced in RD's presentation, receives water from the New River. The New River is high in salinity because of discharge from a nearby prison. This is a good example of how upstream SW influences water quality in a losing stream system.
- Because of time, RC had to cut off last part of RD's presentation. After the meeting RC contacted RD and invited him to complete the presentation at the next Salinity Network meeting.

Incorporation of Salinity Monitoring in Surface Water

<u>Susan Markley (SM), Miami-Dade County, presented information on Salinity in Everglades System Estuaries and Restoration Issues</u>

- Focus is to discuss concepts associated with salinity issues in surface water in south FL
- Comprehensive Everglades Restoration Plan (CERP) group helps to compile and assess restoration goals, and is a major collaborative partner for projects associated with these issues
    - CERP includes Northern estuaries (St. Lucie, Caloosahatchee, Indian River Lagoon, Lake Worth) and Southern estuaries (Biscayne Bay, Florida Bay, southwest shelf)
- Issues / Restoration Objectives:
    - Northern estuaries experience disruptive, rapid changes due to release from Lake Okeechobee (salinity patterns can differ greatly from natural conditions, and salinity can swing rapidly from near marine conditions to virtually fresh conditions)
    - Southern estuaries experience unstable salinity patterns and timing, but also suffer from hypersalinity

  - In both northern and southern systems, discharges of freshwater also carry high nutrient concentrations. (Salinity patterns and nutrient patterns are linked in most cases.) Southern estuaries are P-limited and highly oligotrophic
  - Restoration goals focus on more natural quantity, quality, timing, and delivery of freshwater to achieve more stable mesohaline zones.
- Example 1: In St. Lucie estuary, salinity patterns are unstable, fluctuate rapidly, and can be damaging to the system.
- Example 2: Biscayne Bay salinity is typically near marine, but following large discharge (after hurricane) it can become nearly fresh, and will take several weeks to recover due to slow flushing.
- Example 3: Southern estuaries (Florida Bay & Biscayne Bay) can experience hypersalinity during dry/drought conditions. Hypersalinity can be stressful for natural communities, including seagrasses. Conveyance of warm, fresh water through everglades restoration is intended to restore natural patterns of reduced hypersalinity and frequency of hypersaline event occurrence.
- Example 4: Florida Bay (Whipray Basin station), 2001-2006 – in drought years the measured salinity conditions are much higher than the target ranges for restoring natural conditions
- Additional recommended references and contact information can be found at the end of the presentation slides for this talk, found in the 2011 meeting archives (http://www.dep.state.fl.us/water/monitoring/council/archive11.htm).

<u>Questions / Discussion:</u>

- In response to RD's previous comments, SM commented that the GW-SW interaction is being considered in south Florida efforts.
- Virginia Walsh and Susan Kemp added that one of the current projects involves developing an integrated SW-GW model. Studies have tied salinity in southern FL estuaries to data at GW staging stations upstream. Many system-wide hydrologic models at local scales (especially in south FL) incorporate GW-SW interaction.

Salinity Network Logistics

<u>Rick Copeland (RC), FDEP, presented additional information on logistics for the Salinity Network</u>

- One of the next steps to formalizing the Salinity Network will be to draft a ***framework document.***
- ***RC will create the first draft***, using the EPA's recommended 10 elements for monitoring programs (http://water.epa.gov/type/watersheds/monitoring/repguid.cfm).
  - Program Strategy
  - Monitoring Objectives
  - Monitoring Design
  - Indicators
  - Quality Assurance
  - Data Management
  - Data Analysis and Assessment
  - Reporting
  - Programmatic Evaluation
  - General Support & Infrastructure Planning
- Need to explore index development
  - Index should use uniform methodology
  - Index should be able to be used at a variety of scales (statewide, county, site specific)
  - Index can be used for each aquifer / aquifer system
  - Index will be recognized and used as a tool by public, policy makers, and scientists
  - Explore use of percentiles for water levels, specific conductance, and/or chloride
  - ***Could form a subgroup to focus on developing a proposed index. (Please contact RC with feedback or interest in joining the subgroup.)***
- Potential to develop a GW level index (bases on existing data)
  - FAS has data available
  - IAS does not have much data available
  - SAS in SJRWMD, SWFWMD, and SFWMD has data available

    - S&G in NWFWMD has data available
- Potential to develop a salinity index (based on existing data)
    - FAS has data available (NWFWMD data is only coastal)
    - IAS does not have much data available
    - SAS has data available in southeast FL
- Future effort required from participating agencies will mostly be attending meetings, sharing information about existing monitoring programs, and reviewing documents / reports
- Next meeting will be scheduled after the winter holidays – potential speakers will be Granville Kinsman (SWFWMD) and Dave DeWitt (SWFWMD)

<u>Questions / Discussion:</u>

- GS noted that the next FWRMC Statewide Council is tentatively scheduled for February 21-22, 2012. GS asked RC to provide an update on the Salinity Network Workgroup activities at the Statewide Council meeting.