DEVELOPMENT OF AN INTERIM STRATEGY FOR MANAGING SALT WATER INTRUSION IN THE UPPER FLORIDAN AQUIFER OF COASTAL GEORGIA

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Abstract: Salt water intrusion of the Floridan aquifer is present in Glynn County, Georgia and at the north end of Hilton Head Island, South Carolina. It is projected to move into Chatham County, Georgia. A history of this contamination problem and development of some recommended water management steps are outlined. In conjunction with stakeholders from throughout the area, the Georgia EPD proposes management steps to continue to deal with this contamination problem and prepare for the development of a final recommendation by the year 2005.

INTRODUCTION

The water supply for most of south Georgia, some portions of the low country of South Carolina, southern Alabama and significant portions of Florida comes from the Floridan aquifer. In most of these places it is the sole source of water for users. The Floridan aquifer within this area is one of the most prolific fresh water aquifers in the world. Industrial, municipal and agricultural development are all supported by using the naturally abundant ground water readily found in this aquifer.

While abundant, the water resources are unfortunately not unlimited. Heavy human usage has led to localized reductions of pressure in the aquifer. In some areas, this decline in pressure has enabled salt water to begin to move into the aquifer and contaminate the fresh water. The locations of known contamination include Port Royal Sound, near the north shore of Hilton Head Island, South Carolina, at Brunswick, Glynn County, Georgia and in and around Jacksonville, Florida. Significant cones of depression also exist at St Marys, Georgia - Fernandina Beach, Florida and at Jesup, Georgia, although at present they are not considered contamination sites.

The study of such potential contamination sources is of long standing, with a series of materials first published in the early 1960's and extending to the present day (Stewart, 1960; Counts and Donskey, 1963; McCollum and Counts, 1964; Wait, 1965; Gregg and Zimmerman, 1974, Bush, P.W. 1988, Jones, L.E. and Maslia, M.L., 1994).

HYDROGEOLOGY

Current potentiometric maps of the water levels in the Upper Floridan aquifer indicate a general reduction of potentiometric surface throughout the region. Heavy pumping in certain areas has reduced water pressure dramatically and created significant cones of depression (Clarke, Hacke, and Peck, 1990). The major coastal depression is centered on the City of Savannah, where water levels have decreased from an estimated 40 feet above sea level prior to development to approximately 150 feet below sea level in the center of the cone. Sites with water levels that previously were above sea level have been lowered below sea level in an area including eastern Liberty, eastern Bryan, southern Effingham and all of Chatham County in Georgia. Also included is southern Jasper and western Beaufort Counties in South Carolina. (Krause and Randolph, 1989). Such a decrease in pressure has resulted in the reversal of the potentiometric gradient. Where

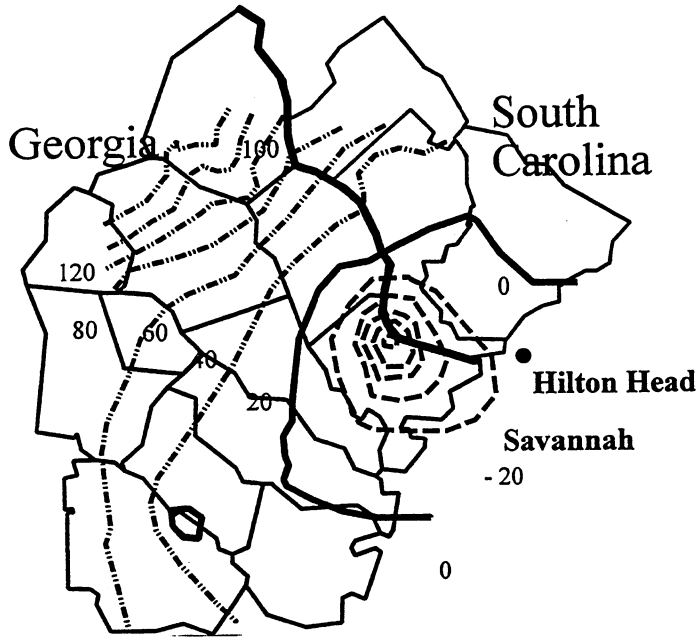

Figure 1. Potentiometric map of Upper Floridian aquifer (northern coast). Contour interval = 20 feet (mean sea level).

previously fresh water had flushed the aquifer clean, and flowed northeast into the bottom of Port Royal Sound, currently sea water is flowing into the aquifer at this site and moving slowly southwest (Randolph, Pernik and Garza, 1991; Smith, 1987, Smith, 1991). As it spreads, the salt water will reach Hilton Head Island wells and eventually the contamination will reach the Savannah area. Currently, Savannah is not considered to be experiencing any increased chlorides due to this problem.

In Glynn County, the reduction in pressure has been sufficient to allow higher pressure brines resident in an underlying unit called the Fernandina Permeable Zone to move upwards through faults, fractures and possibly improperly abandoned wells, into the fresh water of the Upper Floridan aquifer. This zone of increased chlorides has recently remained relatively stable in size, near the Brunswick peninsula. Some locations in the area have continued to experience variably increasing chloride concentrations.

HISTORY

Actions to deal with the aquifer water problem have also occurred over a long period of time. As early as 1940 Savannah was studying the feasibility of additional water sources other than the Floridan aquifer and by 1947 they had built and begun operation of a Savannah River surface water treatment plant, the Savannah I&D facility. This plant has been expanded through the years. In the early 1980's attempts were made by a variety of parties to study the Savannah area and make further recommendations (Garza and Krause, 1992). By the late 1980's Chatham county was under a firm cap on any additional groundwater usage, limiting the increase in Floridan aquifer growth to a fixed amount for municipal users, and requiring any new industrial users within the county to obtain their water from the Savannah I&D facility (Chatham-Savannah MPC, 1995). In Glynn County, industrial users, prodded into action by the known contamination, began to implement enhanced water use efficiency technologies at their plants, thereby reducing their Floridan aquifer water needs.

Actions were also being taken by South Carolina DHEC, in conjunction with users on Hilton Head Island, SC. Water usage from the Floridan aquifer was capped, use of alternate sources of water was required and a proposal for necesary reductions in Floridan usage has been implemented. These costly steps are anticipated to result in a significant reduction of aquifer usage by Hilton Head by the year 1999.

Current levels of water withdrawals have resulted in the problems noted above. Looking to the future, we expect that population growth will accelerate throughout the coastal region and that agricultural water usage will continue to expand. This means that as time goes on, even more water will be withdrawn from the Floridan aquifer. It was time for action.

INITIAL INTERIM STRATEGY

In the early 1990's Georgia began to investigate possible recommendations for a policy for coastal Georgia's Floridan aquifer users. Informational discussions were held with many organizations in Georgia and with the appropriate regulatory bodies of both South Carolina and Florida. South Carolina was particularly interested in the proposals from Georgia, since South Carolina had already implemented significant restrictions on Hilton Head. (There are indications that if South Carolina is not satisfied with the scope of the recommendations coming from Georgia, they may initiate an interstate lawsuit asking for the protection of their ground water source.) In conjunction with these groups, it was decided that an interim groundwater strategy, dealing with short term developments over the next ~10 years of usage should be written. Any final strategy, for the continued long term management of the aquifer, would be developed in the next few years and be implemented in the year 2005.

Using the existing statutory authority, the Georgia Environmental Protection Division first recommended an Interim Strategy encompassing a 24 county area of Georgia and submitted it to our stakeholders in early 1996 (Georgia EPD, February 1996). The initial Strategy was a "reduced use" option. The following features were recommended:

- Implement mandatory industrial and municipal water use efficiency standards.
- Implement mandatory permit reductions on Georgia's industrial and municipal users, resulting in a minimum of a 12 million gallon a day cut in usage, using Chatham County equivalents (CCE). The CCE is a measure of the relative impact and proximity of a withdrawal within coastal Georgia on the potentiometric surface at Savannah. Users far from Savannah have a much smaller impact on water levels in Savannah, while users in Chatham County significantly and directly impact local water levels. The CCE was developed as a measure of this relative impact.
- Require collective water supply efforts in the 24 counties, and by all users within those counties.
- Establish a water market for the exchange of water withdrawals. New users would be required to seek such offsets from decreases elsewhere.
- Encourage continued cooperation with our neighboring states of Florida and South Carolina.
- Divide, using geologic evidence, the 24 counties into three distinct geologic regions, called the northern, central, and southern sub-areas. While all three areas had required actions recommended, within the central sub-area (those counties closest to Savannah and Brunswick) even more serious restrictions were proposed.
- Restrict usage of the Floridan aquifer by any new and some existing users. New agricultural users would not be allowed into the Floridan. New golf courses were to seek

alternate water sources, either other aquifers or re-use of effluent waste water. Existing courses needed to leave the Floridan altogether over some time period. Non-contact cooling water was to be re-injected.

Many public meetings were held with a broad variety of groups for discussion of the strategy. Comments were actively sought from all parties impacted by the recommendation, including industry, municipalities, agricultural groups, environmental organizations and other interested parties. Continued stakeholder involvement is essential for the development of the plan. Eventually over 400 comments were received and analyzed. The comments indicated that many did not fully support the recommendations and that modifications were required prior to any full acceptance of the recommended plan. Concerns ran the gamut from economic issues, fairness concerns, reduction and re-allocation problems, and others. A key concern was the continued necessity to incorporate "sound science" in the new proposals.

GSU "EXPANDED USE" PROPOSAL

An additional suggestion (Cummings, Terrebonne, and Garza, 1996) came in from Georgia State University in Atlanta. Since ground water modeling indicated that an almost complete cessation of aquifer usage would be required to halt the flow of salt water into the aquifer, GSU noted that any recommended reduction in usage only delayed the onset of contamination. If the contamination would eventually enter Chatham County under whatever strategy proposal or recommended limitations on aquifer usage was implemented, GSU proposed that the use of the aquifer continue or expand until it could not be used because of the salinity. In the mean time, a user fee would be established, requiring all current users to pay. This would go into a dedicated fund and only be withdrawn when a treatment plant was needed to provide water to contamination-impacted users. In this way current users would begin to pay for the eventual cost of future surface water treatment. GSU first presented this proposal to the stakeholders as a thought experiment in October 1996. It was not well received. The main complaint was that it indicated that the aquifer in Savannah must become contaminated, and stakeholders were not able to agree on that idea.

In additional work since that time, the policy of "Sustainable Use" has been broadly defined. Sustainable Use requires finding an appropriate level of withdrawals from the aquifer which would assure continued use of the aquifer at that level, with no further movement of the salt water. In modeling efforts, it was found that such a level of withdrawals would result in Chatham County reducing their usage by over 75%, while Glynn County could not use Floridan water at all! Sustainable Use remains a theoretically possible solution, but does not seem to be a realistic solution to the current problem. For some people, somewhat unpalatable compromise positions may be the only policy left to approve.

GROUNDWATER MODELING

Extensive additional modeling results using the Coastal model simulation and the MODFLOW program through USGS (McLemore, 1995) enabled EPD to determine that under a variety of withdrawal rates and withdrawal locations, the travel time of salt water from the known contamination location at the north end of Hilton Head to Savannah is on the order of 250 to 350 years. Of course if potential sources of salt water exist closer to Savannah, this travel time would need to be adjusted down. But in any case, and whatever the policy action chosen, there is still considerable time before the salt water wedge is in the Savannah area. Modeling of the Brunswick area indicates that the area of the salt expands and contracts with varying usage, but will always be present.

REVISED INTERIM STRATEGY

Taking these facts into account, in concurrence with some of the public comments previously received, and also using additional information developed since the previous release, modifications were made to the Initial Strategy. This new document was released in December, 1996 (Georgia EPD, December 1996). Three public meetings to discuss this proposal were held in January, 1997 and the additional comments from stakeholders are currently being considered.

It is important that the policy for coastal groundwater management allow for continued economic development throughout coastal Georgia, treat all users equitably and minimize impacts on those existing users that have a minimal impact on salt water intrusion. Users have asked for the continued application of scientifically sound techniques and for enhanced scientific data gathering. As such, the following policy recommendations were made.

It is important to realize this is an ongoing determination and the material presented below is the recommendation as of January 30, 1997. It has not yet been approved nor has implementation begun.

The Revised Interim Strategy at this point contains the following recommendations for general policy:

- Encourage continued water conservation efforts from all users. We recommend that Chatham County imple-ment the MPC water supply plan (Chatham-Savannah MPC, 1995). We recommend that the Pulp and Paper industry implement the recommendations of their industry group (Woitkovich and Bryant, 1996).
- Establish a dedicated user fee to pay for the continued development of a sound scientific approach. This may be in conjunction with stakeholder groups and EPD jointly determining the necessary scientific studies and monitoring efforts. This will address the concerns and

questions about the aquifer and impacts of withdrawals. The agenda of this scientific program should determine at what level the user fees would be set. EPD cannot do this on its own, since this fundamental change would require legislative action.

- Require water supply planning for all counties within the 24 county area.
- Place a yet to be defined cap on groundwater use on Chatham, Glynn and portions of southern Effingham and southeastern Bryan counties.
- Allow controlled growth of aquifer use in other areas of coastal Georgia.
- Initiate the gathering of withdrawal information from agricultural users within the 24 county area.
- Other recommendations as well.

Final modification of this Revised Interim Strategy is pending, though the time frame for approval and implementation of the final recommendation has yet to be determined.

CONCLUSIONS

Salt water is moving into and contaminating the fresh water in certain locales within coastal Georgia, southern South Carolina, and Florida. Working with stakeholders from throughout the region, and in discussion with our neighboring states, a Revised Interim Coastal Groundwater Strategy has been developed and proposed for implementation over the next few years. This interim recommendation should closely control aquifer withdrawals in the most seriously impacted areas, while allowing for moderate groundwater withdrawal growth in areas of smaller impact. Additional scientific work will be completed over that time frame, and by the year 2005, we expect to complete the development of a comprehensive, long-term proposal to deal with the salt water contamination issue in the Upper Floridan aquifer.

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