

Title: Assessment of Groundwater Flow Paths and Discharge to the Coastal Region of Baldwin County, Alabama to Understand Contaminant Transport using a Cross-Sectional Groundwater Flow and Transport Model

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Identification and Statement of the major regional water problem:

Groundwater and surface water resources in southern Baldwin County, Alabama are vital to support the rapidly growing population of the area, support a growing economy within the region, and to ensure that environmentally-sensitive ecosystems such as coastal estuaries and wetlands are preserved in the region. Growing population, tourism, and industry is dependent upon the quality and quantity of the water resources and health of the ecosystem within the region. Degradation of the water resources and coastal transition zones (i.e. coastal estuaries and wetlands) potentially threaten the regional economy. Groundwater is the only viable source of freshwater in the region and is utilized by municipalities, private homes, businesses, industry and large-scale agriculture. The health of the coastal surface water bodies (estuaries and wetlands) and the regional ecosystem is critical to the success of local industries (i.e. fish and shrimp industries and manufacturing), tourism, and recreation. In recent years, Baldwin County has experienced some of the most rapid growth in public and private sectors, ranking third among all counties within the state of Alabama. As a result, observed decreasing quality of groundwater and surface water due to increased agricultural landuse, and urban and residential expansion has become an increasing concern for the region. Agricultural and urban uses of fertilizers and septic systems are primary sources that contribute to nutrient contamination of groundwater and surface water in the region. Nitrate contamination has been observed to be a problem in some of the aquifers of Baldwin County (Murgulet and Tick, 2008). Nitrate levels in wells have been observed to exceed regulatory drinking water standards (10 mg/L NO_3^-). Not only is this a concern for human health but groundwater discharge and surface-runoff of elevated nitrate levels to coastal surface waters may adversely affect the ecological health of coastal wetlands, embayments, and estuaries. Therefore, it is imperative to construct an accurate conceptual model for contaminant transport in the region. The development of a twodimensional cross-sectional groundwater flow and transport numerical model will help to identify potential groundwater recharge and discharge zones, flow pathways, and delineate areas most prone to contaminant discharge, and predict contaminant transport to the coastal zones in Baldwin County, Alabama and the Gulf of Mexico.

The proposed research herein is critical for evaluating regional and local transport pathways within the groundwater system, to coastal surface waters, and to the Gulf of Mexico. Recent data published on groundwater nitrate levels and chloride concentrations (Murgulet and Tick, 2008; Murgulet and Tick, 2007) for the region will be used to test the groundwater transport model to help predict and determine flow pathways, and potential discharge zones for the region. This research will help in the construction and development of a conceptual model for evolution and transport of contaminants within the aquifer system of Baldwin County, Alabama and other regions similar to this groundwater/coastal boundary system. In addition, the groundwater flow and transport model will help evaluate and characterize mass fluxes through the aquifer system allow for the testing of different scenarios (i.e. contaminant mass and distribution, recharge rates, etc.) and resulting impacts on the groundwater system. This tool will be critical for developing cost-effective aquifer management plans to ensure sustainable freshwater supplies and preserve the health of the regional ecosystem along the coast of Alabama and the Gulf of Mexico.