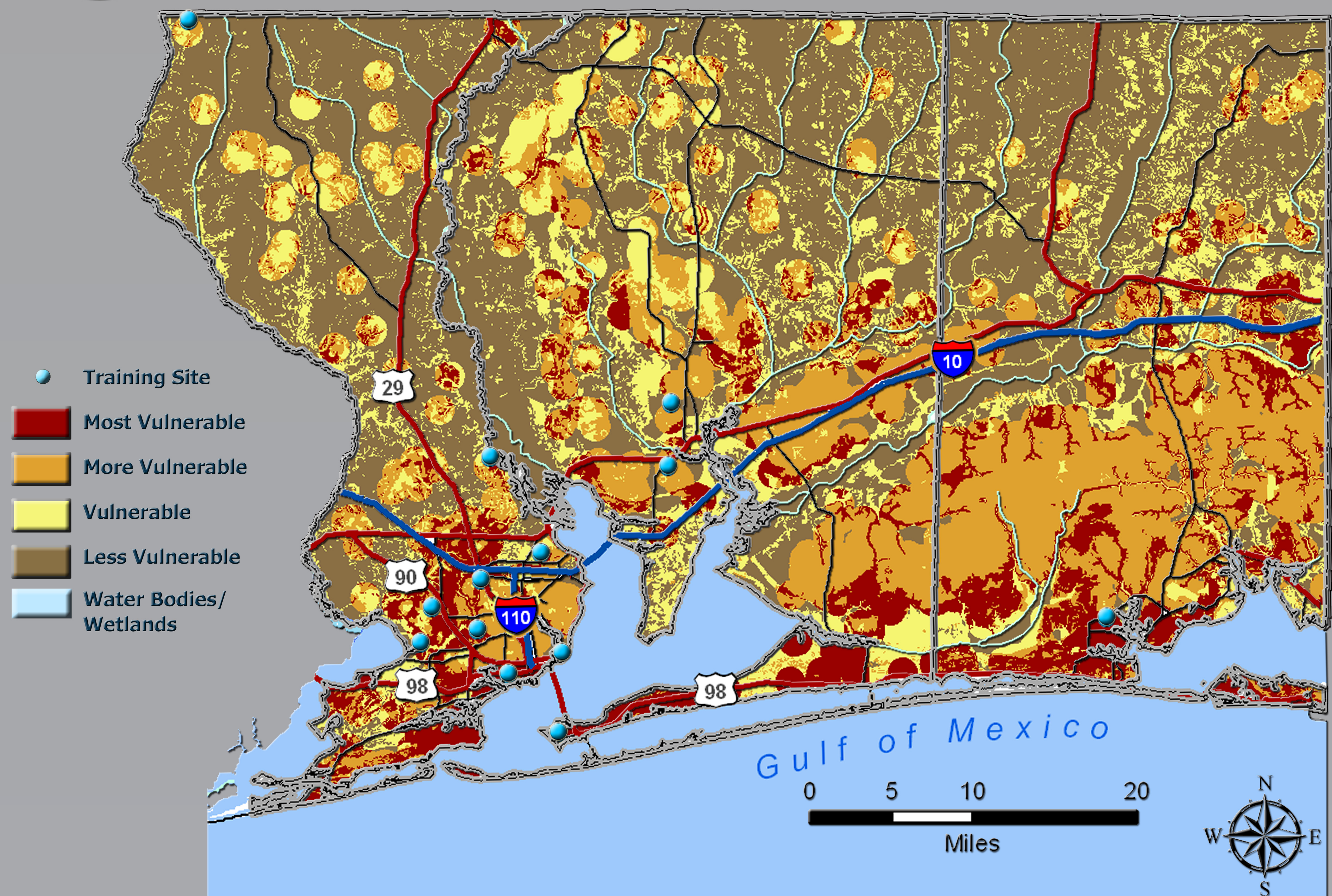
Sand-and-Gravel Aquifer Vulnerability Assessment Phase II
Escambia, Santa Rosa and Okaloosa Counties

Michael Sole, Secretary

Jonathan Arthur
State Geologist and Director



INTRODUCTION

The Counties of Escambia, Santa Rosa and Okaloosa were used as the sand-and-gravel aquifer system model study area extent. This boundary extends slightly outside the range of the published aquifer extent to include all of Okaloosa County. The sand-and-gravel aquifer does represent a valuable surficial aquifer system and in some areas of the model extent it is the only source of potable water. According to the United States Geological Survey (USGS) groundwater use from the sand-and-gravel aquifer over the three county area is estimated to be nearly 114 million gallons per day for public supply, agriculture, and other uses. Not all of the areas combined 655,000 residents (Bureau of Economic and Business Research, University of Florida, 2008) utilize water from the aquifer system. Approximately 25 % of this areas needs are met though withdrawals from the Floridan aquifer system.

The sand-and-gravel aquifer is a surficial aquifer consisting of a complex sequence of sand, gravel, silt and clay. A thick layer of clays and low permeability sediments lies at the base of the aquifer. The sand-and-gravel aquifer ranges from very thin to over 450 feet thick and is comprised of three zones; the surficial zone, the low permeability zone and the main producing zone (Pratt et-al, 1999). For the purposes of this project it was not appropriate to differentiate between the three zones and therefore the model focused on the aquifer system as a whole. The aquifer is unconfined or under water-table like conditions for the most part except where discontinous clay beds can act to form localized perched water table conditions. Because this aquifer is generally unconfined it is considered highly vulnerable to contamination from land surface (Miller, 1990).

Identifying areas where the sand-and-gravel aquifer system is more vulnerable to contamination from activities at land surface is a critical component of a comprehensive groundwater management program. Protection of the area's aquifer systems is an important measure to take in helping ensure viable, fresh water is available to the residents of the area from the region's aquifer systems for continued future use. Aquifer vulnerability modeling allows for a pro-active approach to protection of aquifer systems, which can save significant time and increase the value of protection efforts.

APPROACH

The primary purpose of the Sand-and-Gravel Aquifer Vulnerability Assessment, is to provide a science-based, water-resource management tool that can be used to help minimize adverse impacts on ground-water quality, including focused protection of sensitive areas such as springsheds and ground-water recharge areas. The modeling process used for the model project is "weights of evidence", and is based in a geographic information system (GIS). The approach used in the project is a modification of the technique used in Phase I of the Florida Aquifer Vulnerability Assessment project (Arthur et al., 2007). The main benefits of applying this technique is that it is data-driven, rather than expert-driven, and model output is dependent upon a training site datasets which produce self-validated model output. Training sites are ground-water wells with water quality indicative of a good connection between the aquifer and land surface, or simply, aquifer vulnerability.

Model generation is accomplished by associating the training site locations with data layers representing natural conditions which control aquifer vulnerability. Data layers used for the project are described in the adjacent sections and include proximity to closed depressions, depth to water and soil hydraulic conductivity. The model helps determine which areas of each data layer share a greater association with aquifer vulnerability based on the location of the training sites, and then combine them in a map as shown above. The model output map indicates that the areas of highest vulnerability are associated with the lowest depth to water values, close proximity to closed depressions and higher soil hydraulic conductivity. This modeling procedure is described in more detail in Arthur et al. (2007) and the Floirda Aquifer Vulnerability Assessment Phase II report.

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Qualifications:
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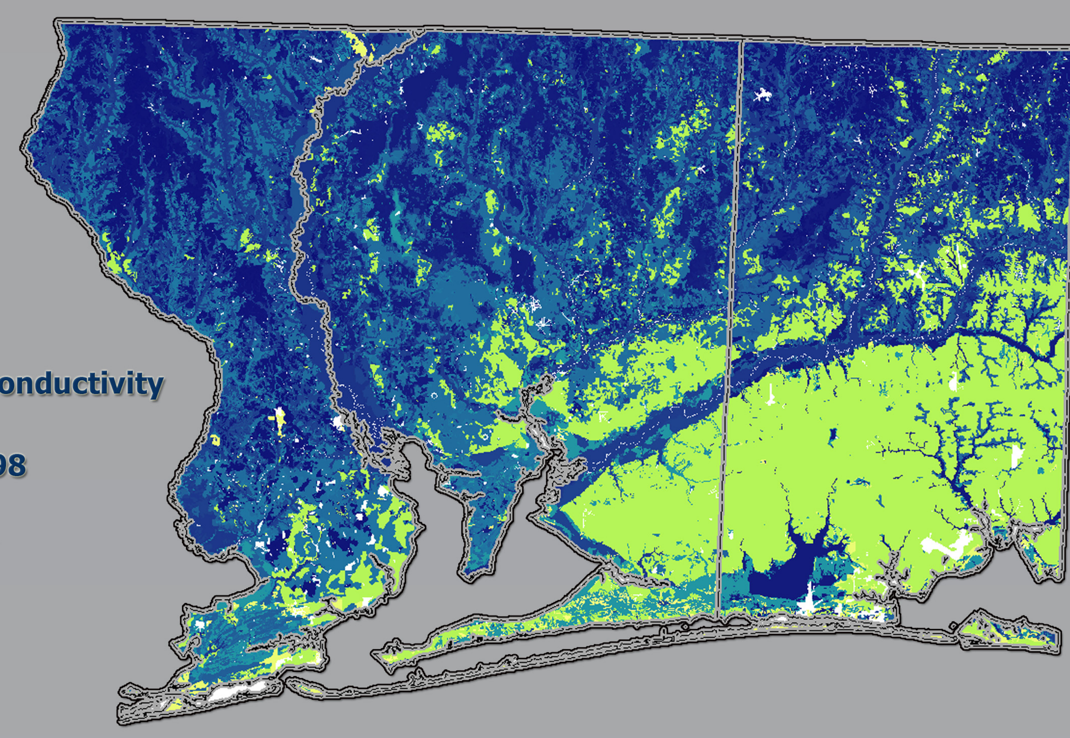
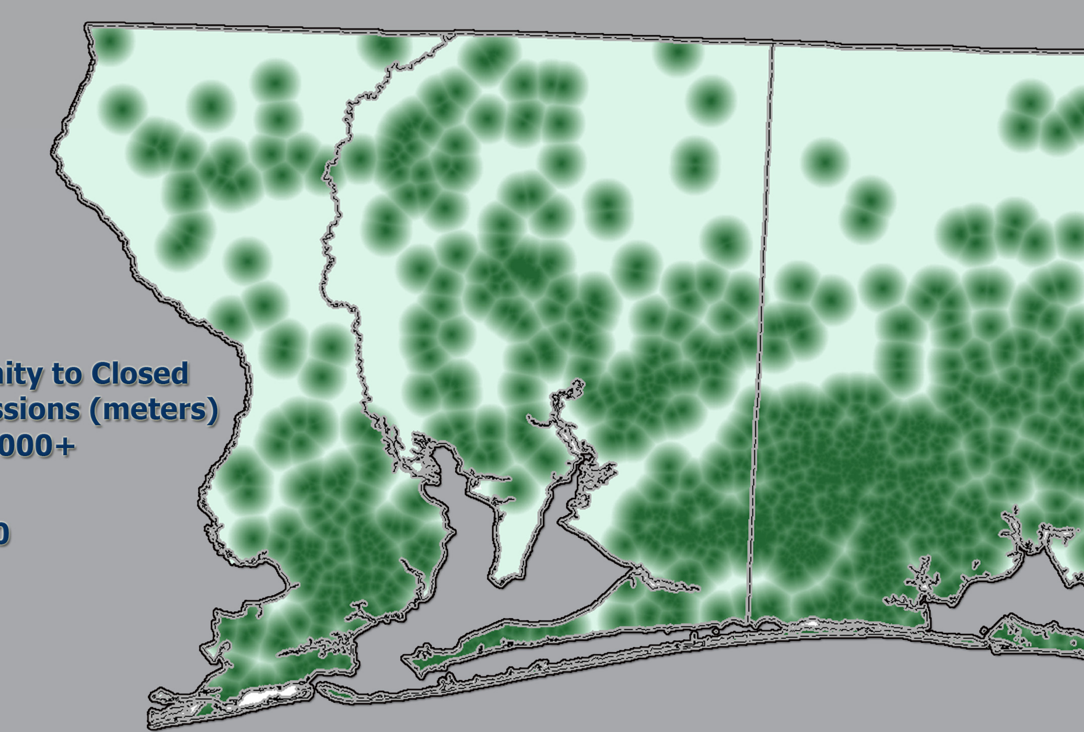


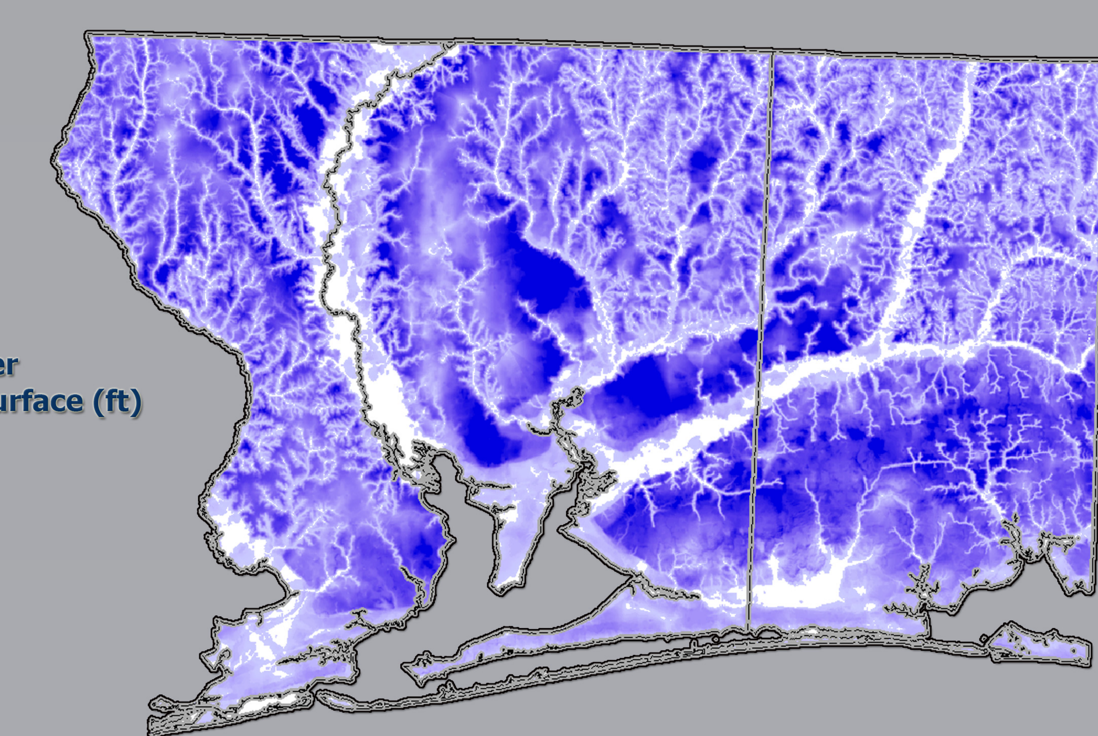
Soil Hydraulic Conductivity Theme

The rate that water moves through soil is a critical component of any aquifer vulnerability analysis, as soil is an aquifer system's first line of defense against potential contamination. Soil hydraulic conductivity is the "amount of water that would move vertically through a unit area of saturated soil in unit time under unit hydraulic gradient" (U.S. Department of Agriculture, 2005). In 2006, the County soils data were redesigned for the study area by the Natural Resources Conservation Service. As a result, more detailed information was made available for this analysis in the sand-and-gravel model area than during previous projects.

Closed Topographic Depression Theme

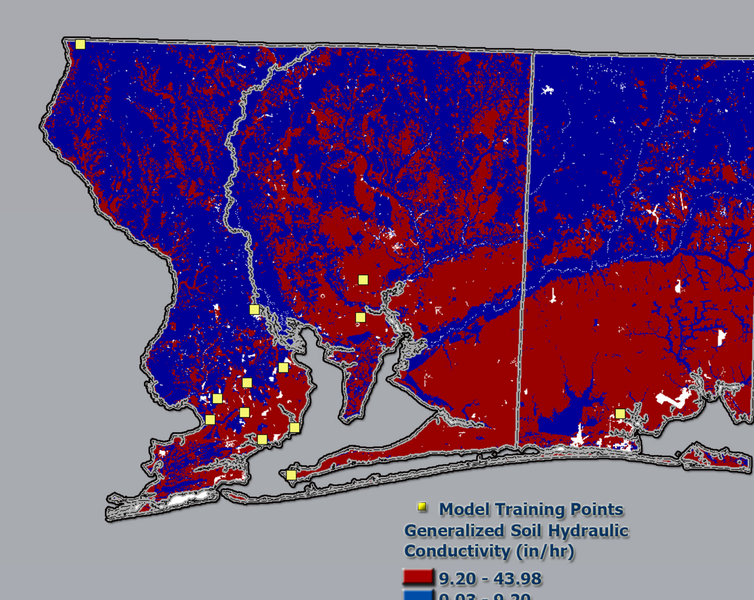
Karst features, or sinkholes and closed topographic depressions, can provide preferential pathways for movement of ground water into the underlying aquifer systems and increase an area's aquifer vulnerability where present. The closer an area is to a closed depression, the more vulnerable it may be considered. Closed depressions are identified on the topographic maps as hatchured lines and their shapes can range from circular to elongated polygons. These resulting closed depression features can be buffered into 30-m zones out to a distace of 3,000 m to allow for a proximity analysis.

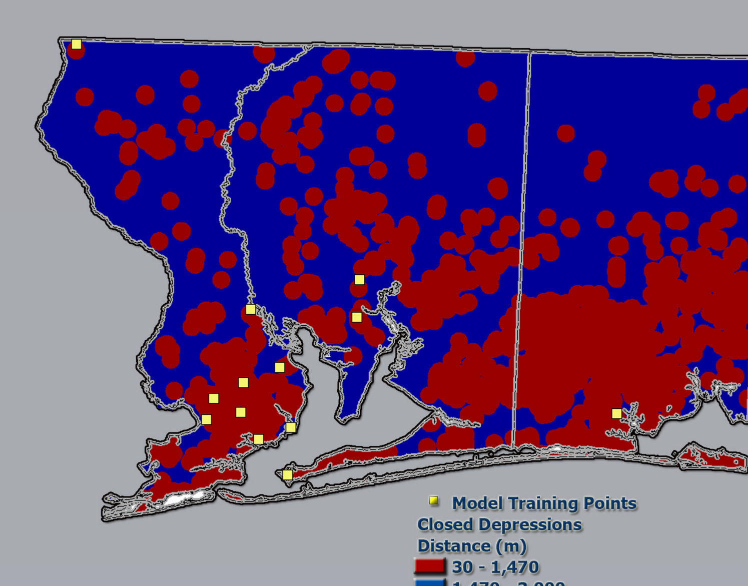


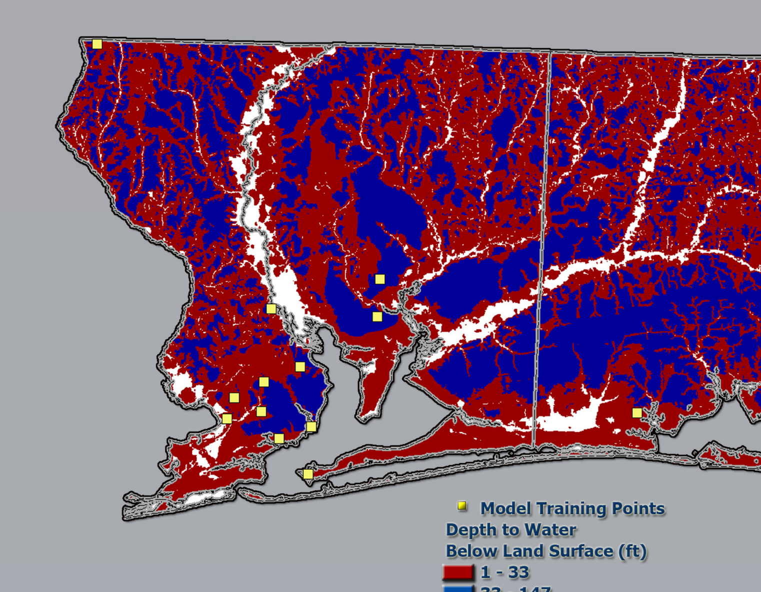


Depth to Water

Depth to water is the thickness in feet of the space between land surface and the water table. The surface is created by subtracting a water table surface from the digital elevation model. A water table surface is created for the aquifer using water level measurements obtained from the Northwest Florida Water Managment District (NWFMD) databases and the linear regression method developed by Sepulveda (2002) to create a surface.







Generalization of Input Data

The modeling process involves generalizing input layers to evaluate which areas of each data layer share a greater association with locations of training sites, or, simply, aquifer vulnerability. Essentially, this process helps to determine the threshold or thresholds that maximize the spatial association between the patterns in the input data layers and the training sites pattern. For the sand-and-gravel model, a binary break was typically defined by the modeling analysis for each data layer which creates two spatial categories: one with stronger association with the training points and one with weaker association.

Soil hydraulic conductivity ranges from 0.03 to 43.98 inches per hour (in/hr) across the study area. Modeling indicated that areas underlain by 9.20 to 43.98 in/hr were more associated with higher aquifer vulnerability. The depth to water ranges from 1 to just 147 feet thick across the study area, and the analysis revealed that areas with less than 33 feet of depth to water were more associated with higher aquifer vulnerability. Finally, the analysis indicated that areas within 1,470 meters of a closed topographic depressions were more associated with higher aquifer vulnerability. These generalized themes are used to generate the final model output as shown to the left.

This poster is developed as part of Florida Aquifer Vulnerability Assessment (FAVA) Phase II for the Florida Department of Environmental Protection/Florida Geological Survey per FDEP/FGS Contract No. RM059. Version 1.0: August 31, 2009. The vulnerability map accompanies "The Florida Aquifer Vulnerability Assessment Report (FAVA) Phase II" prepared by Alan E. Baker, P.G. 2324, and James R. Cichon of Advanced GeoSpatial Inc.; FAVA Phase II project managers are Allan Stodghill, P.G. (FDEP), Division of Water Resource Mangement and Rick Copeland, Ph.D., P.G., FDEP/FGS.