Biscayne/Surficial Aquifer Vulnerability Assessment Phase II
Palm Beach, Broward & Dade Counties

Michael Sole, Secretary

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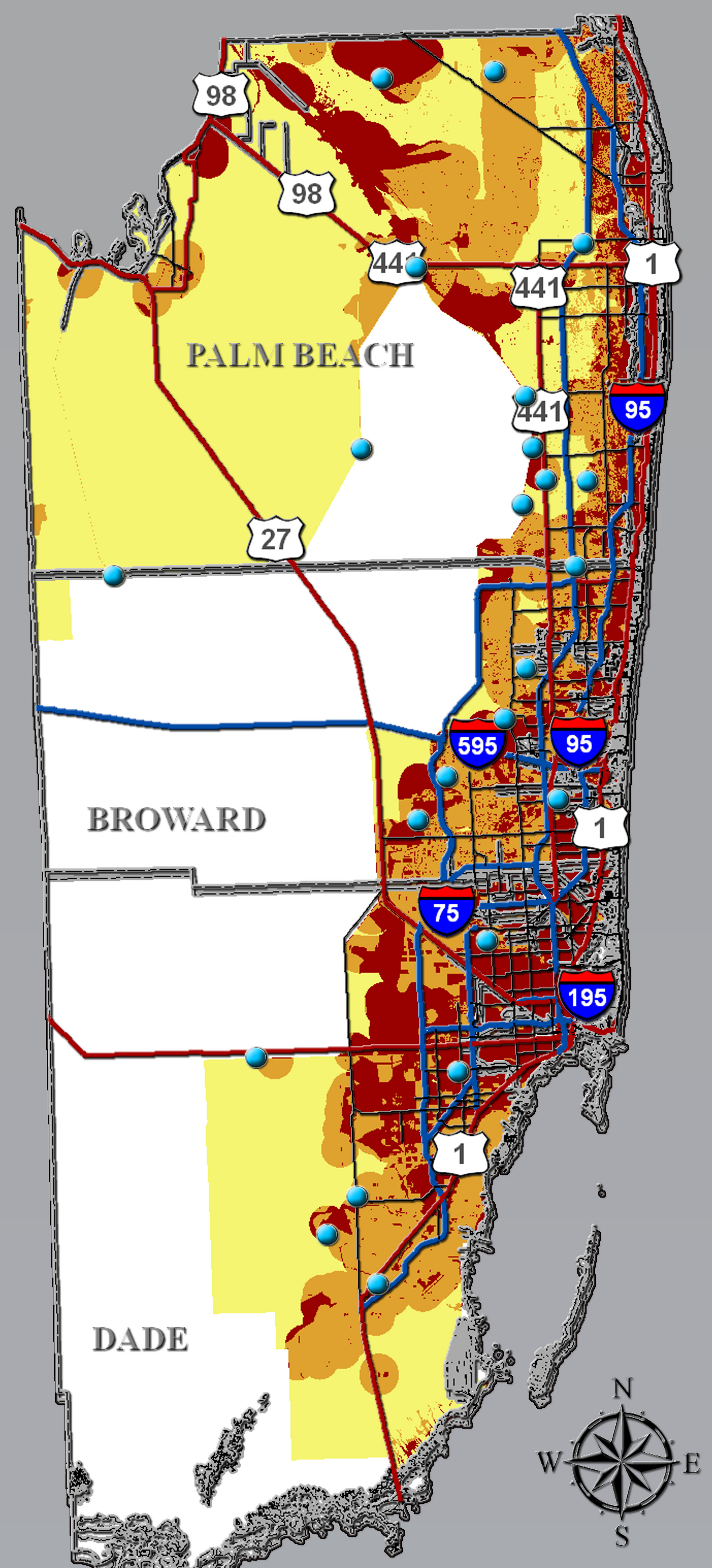

INTRODUCTION

The Counties of Miami-Dade, Broward and Palm Beach were used as the Biscayne/Surficial aquifer system model study area extent. This boundary extends slightly outside the range of the Biscayne aquifer but does represent a valuable surficial aquifer system source of potable water to the area and conforms to political boundaries. According to the United States Geological Survey (USGS) groundwater use from the three county area excluding the Floridan Aquifer system is estimated to be over 1 billion gallons of water per day for public supply, agriculture, and other uses. Not all of the County's combined 5.5 million residents (Bureau of Economic and Business Research, University of Florida, 2008) utilize water from the two aquifer systems. Approximately 25 % of this areas needs are met though the use of surface water.

The Biscayne aquifer is a relatively thin but highly permeable limestone aquifer which lies mainly beneath Dade and Broward Counties and continues into the southeastern part of Palm Beach County. The aquifer is unconfined or under water-table like conditions and highly vulnerable to contamination from land surface. Water levels fluctuate seasonally with precipitation and water use. The northern end of the study area transitions into the Surficial aquifer system. The Surficial aquifer is made up of unconsolidated sands and shelly sands and it too, like the Biscayne, is unconfined and highly susceptable to land use activities (Miller, 1990).

Identifying areas where the Biscayne/Surficial 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 in south Florida. 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 Biscayne/Surficial 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 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 to the left. The model output map indicates that the areas of highest vulnerability are associated with 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.

REFERENCES

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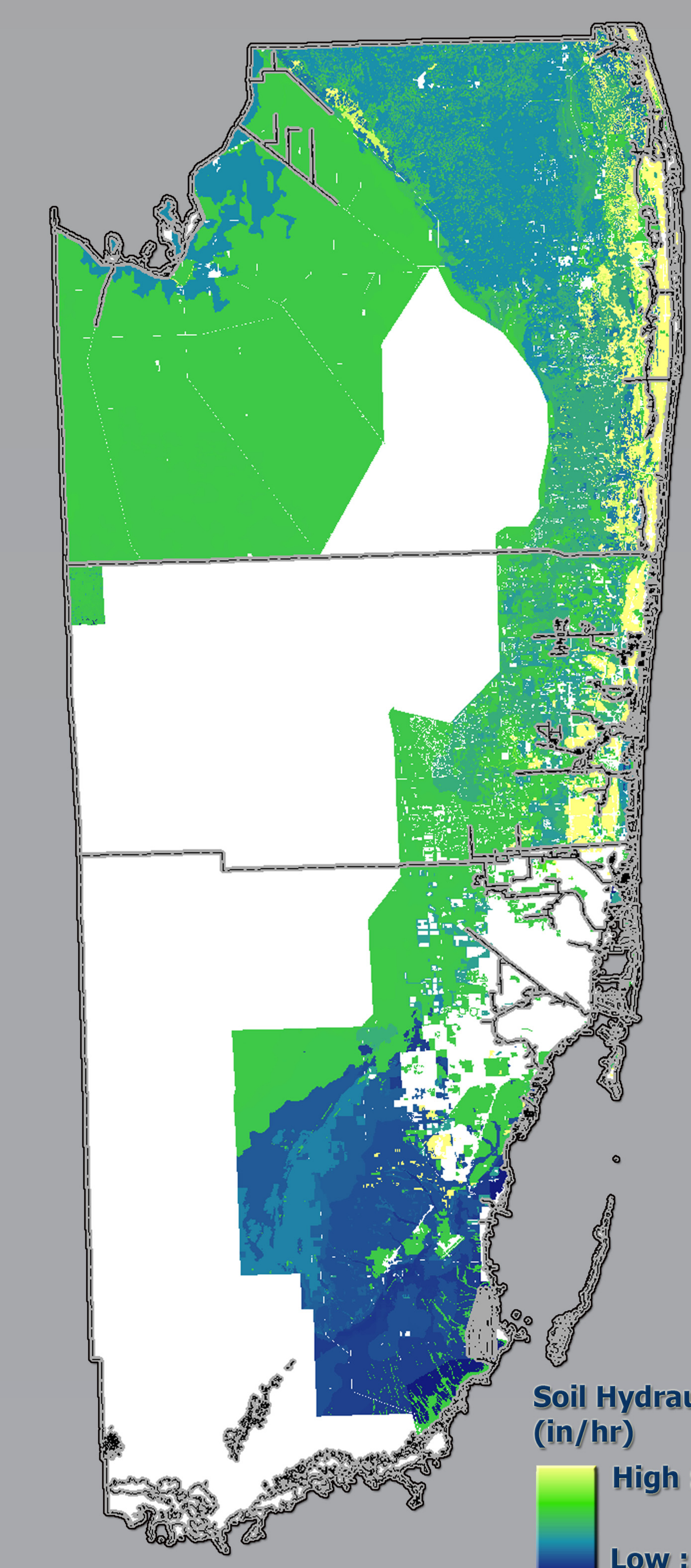
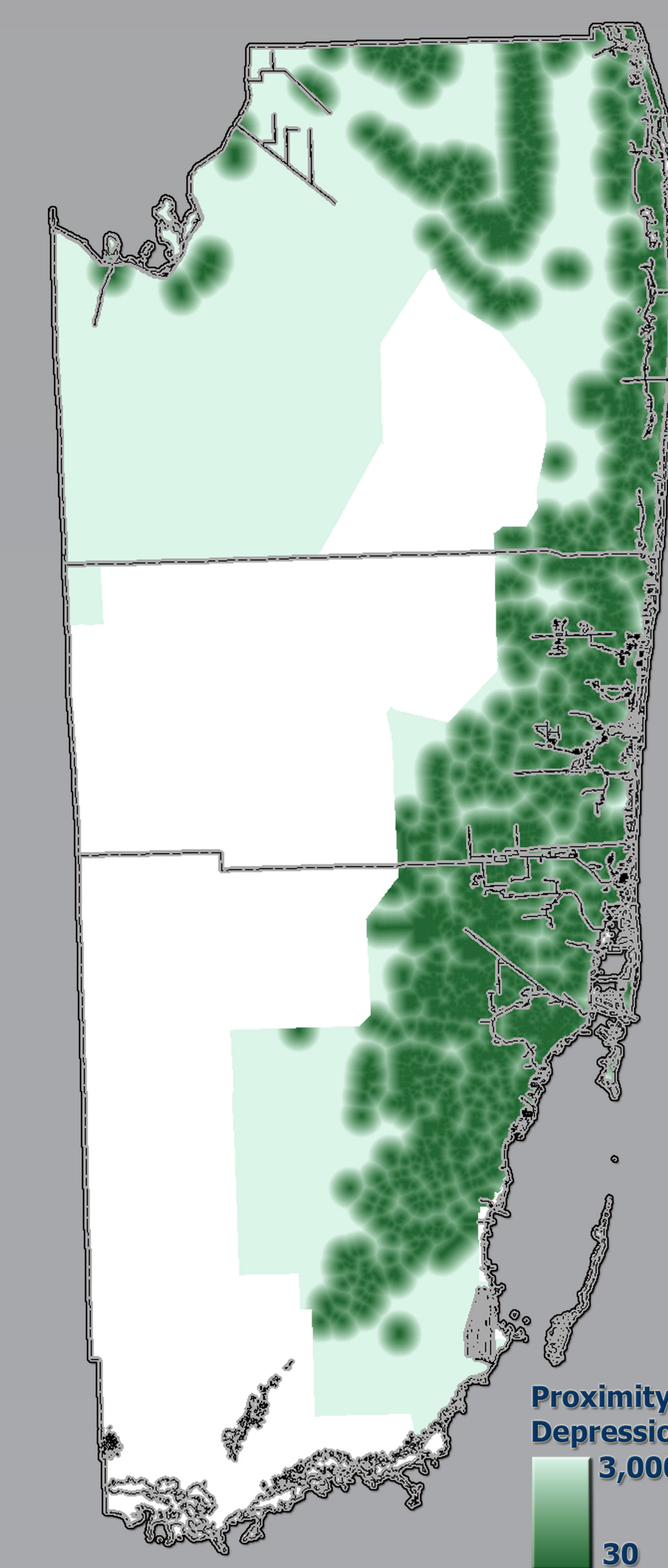
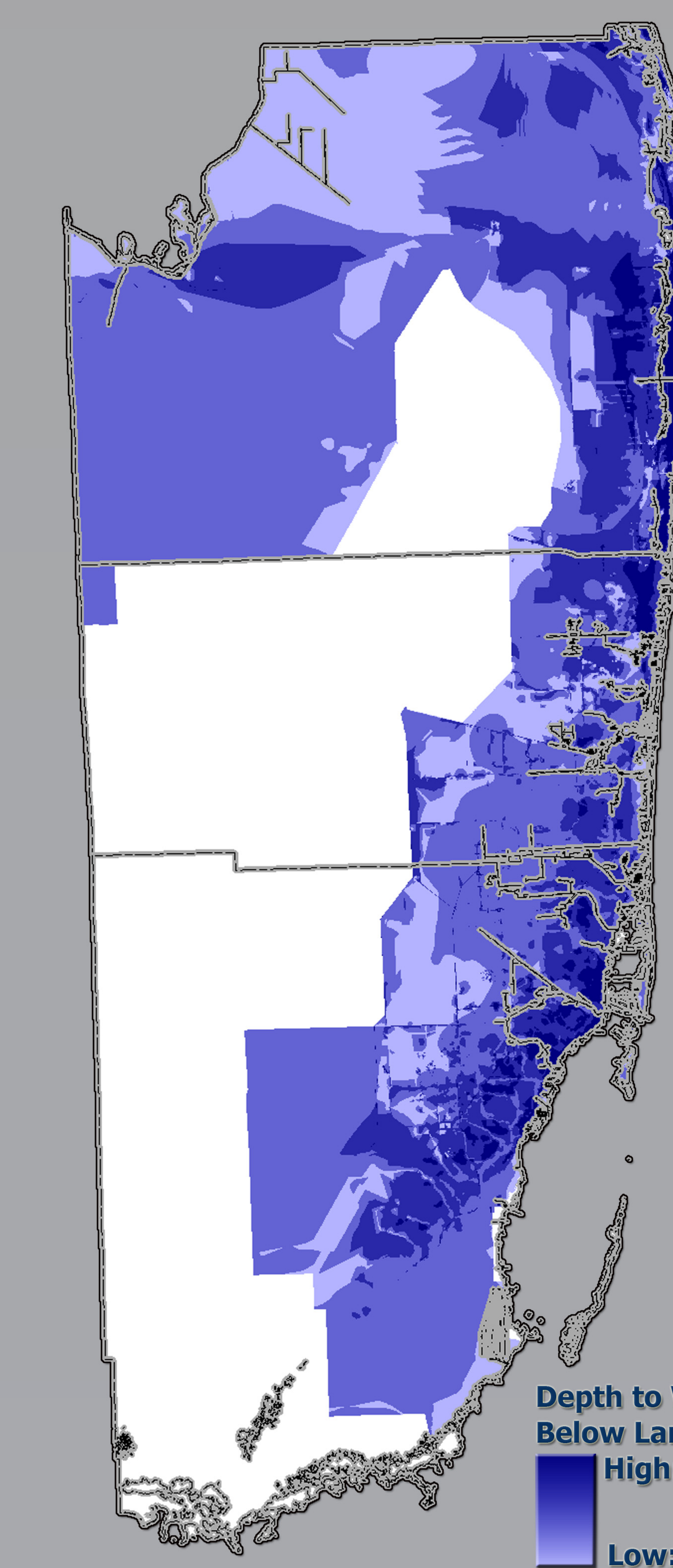






Soil Hydraulic Conductivity Theme

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 Biscayne/Surficial model area than during previous projects.

Closed Topographic Depressions 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 distacne of 3,000 m to allow for a proximity analysis.

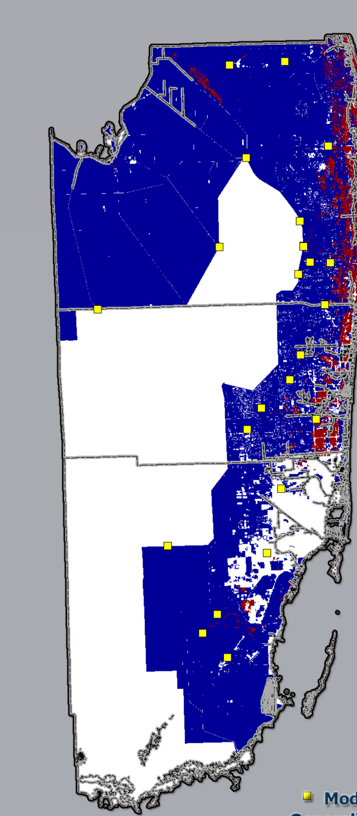
Depth to Water

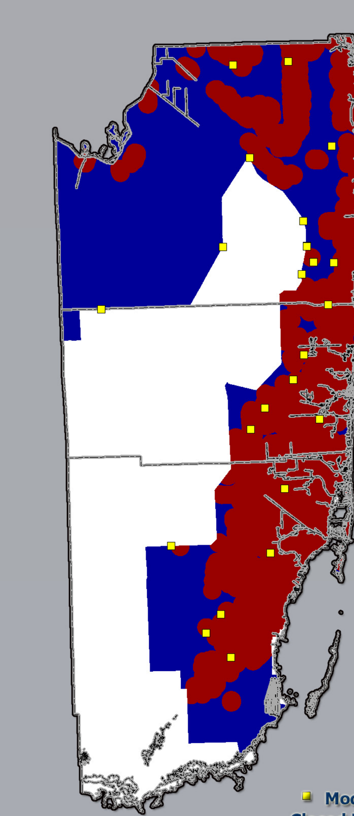
Depth to water is the thickness in feet of the space between land surface and the water table. The surface is created by subtracting a water table surface from the digital elevation model. A water table surface is created for the aquifer using water level measurements obtained from the South Florida Water Managment District (SFWMD) databases and utilizes kriging to create a surface.

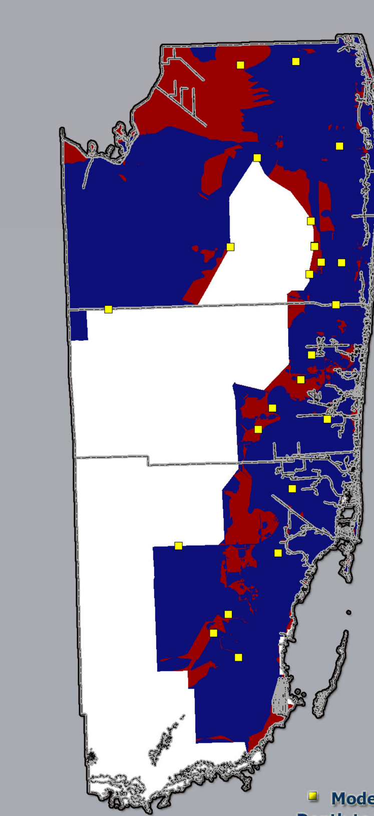
Generalization of Input Data

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 Biscayne/Surficial 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 0.47 to 43.98 inches per hour (in/hr) across the study area. Modeling indicated that areas underlain by 13.02 to 43.98 in/hr were more associated with higher aquifer vulnerability. The depth to water ranges from 1 to just 10 feet thick across the study area, and the analysis revealed that areas with less than 1 feet of depth to water were more associated with higher aquifer vulnerability. Finally, the analysis indicated that areas within 2,430 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.







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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.