Technical Fact Sheet SJ2016-FS1

Recharge to the Upper Floridan Aquifer in the St. Johns River Water Management District, Florida

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This technical fact sheet provides information on the different aquifer systems in the St. Johns River Water Management District (SJRWMD) and on the factors that influence recharge to and discharge from the Upper Floridan aquifer (UFA). As part of its ongoing work, SJRWMD periodically prepares the following information as a regional water supply planning aid and for groundwater resource management.

Recharge to the UFA is the replenishment of water in aquifer storage by the downward infiltration of water from precipitation or from surface water bodies. The regional geologic structure and the lithologic and hydraulic characteristics of the surficial aquifer (SA), the intermediate confining unit (ICU), and the UFA determine the areas and rates of recharge to the UFA in the SJRWMD.

A large percentage of precipitation is returned to the atmosphere by evapotranspiration. Some of the remaining water either flows directly into surface water bodies as overland runoff or indirectly as base flow where water infiltrates downward into the SA and then moves laterally until it discharges to a surface water body or wetland.

A significant amount of water from precipitation is available for UFA recharge as water moves downward through permeable soils and the unsaturated zone into the saturated zone, where it becomes groundwater. The movement of groundwater is in the direction of decreasing hydraulic head. Recharge to the UFA occurs in areas where the SA water table elevation is higher than the UFA potentiometric elevation, resulting in downward hydraulic pressure gradients to move water from the SA, through the ICU, and to the UFA. Relative rates of recharge are dependent on the magnitude of the hydraulic pressure differences, and on the ICU thickness and its hydraulic conductivity. Recharge also occurs directly from infiltrating rainfall where the UFA limestones are exposed at land surface or where the limestones are covered by only a thin mantle of

siliciclastic sediments. Direct local recharge can also occur where sinkholes and other karst features have breached the ICU.

The ICU is composed of the low permeability clay and silt sediments that lie between and that collectively retard the movement of water between the overlying SA and the underlying UFA. The thickness and integrity of the ICU is a significant factor affecting recharge to the UFA. The ICU thickness varies due to geologic structure, depositional history, erosion, and karst development. The fine-grained sediments provide an effective aquitard above the UFA in northern and southern areas of SJRWMD where the ICU is greater than 100 feet thick, resulting in low to very low UFA recharge rates of 1 to 5 inches per year (in/yr) in these areas.

The highest rates of recharge to the UFA (greater than 15 in/yr) occur in west-central SJRWMD where the ICU is absent and the UFA limestones are either exposed at land surface or, more commonly, are covered by a thin layer of sandy or clayey sediments. The UFA is unconfined in these areas, resulting in direct hydraulic connection between the UFA and surface drainage.

High to moderate UFA recharge occurs in areas of central SJRWMD where the UFA is thinly confined (ICU thickness of 20 to 50 feet) or semi-confined (ICU thickness of 50 to 100 feet). Relatively higher recharge rates occur where the integrity of the ICU has been compromised by sinkholes and solution pipes and in the higher topographic elevations of the upland ridges that typically have higher hydraulic pressure gradients. The moderate and high recharge areas have recharge rates of 5 to 10 and greater than 10 in/yr, respectively.

The UFA limestones are typically not exposed at land surface in the high and moderate recharge areas in central SJRWMD, but their near surface presence is indicated by karst terrain that results as the overlying siliciclastic sediments settle into the irregular and highly soluble limestone rocks. The dissolution of the UFA limestones and the occurrence of closed surface drainage basins with internal drainage result in the development of closed depressions, sinkholes, caves, and other karst features. Closed depressions and sinkholes capture rainfall and surface water drainage and funnel it underground, providing a more direct pathway for UFA recharge.

The solution porosity that develops as a result of dissolution of the UFA limestones allows large volumes of water to move rapidly through the aquifer. Transmissivity is the capacity of the rocks to transmit recharge water into the regional groundwater flow system. Areas in SJRWMD that have high to moderate UFA transmissivity generally correspond to areas where the ICU is thin or breached by karst features. The capacity to move water away from recharge areas is an important part of the recharge process .

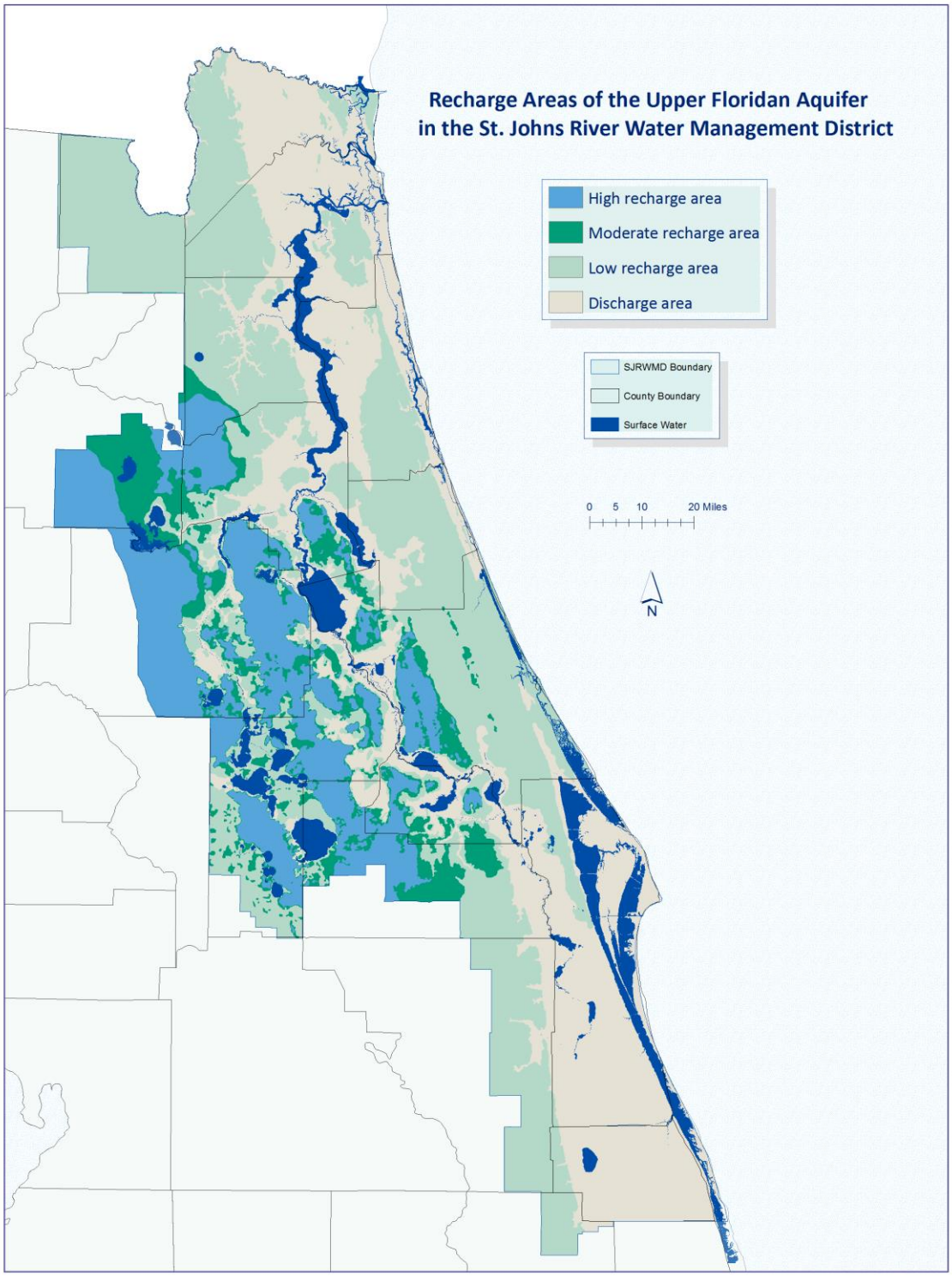
Seasonal and long-term rainfall patterns result in varying recharge input to aquifer storage. Recharge increases the amount of water in UFA storage and increases hydraulic heads in the aquifer. The higher heads force the water to move through the rock matrix, fractures, and solution conduits that form the underground drainage system as water moves down gradient to discharge areas and to springs.

Discharge from the UFA is the reduction in groundwater storage by diffuse upward leakage, spring flow, and groundwater withdrawals. Discharge from the UFA occurs in areas where the elevation of the UFA potentiometric surface is higher than the elevation of the water table. In these areas, water moves from the UFA in an upward direction through the ICU to the SA. Where the elevation of the potentiometric surface is higher than land surface, springs and free-flowing artesian wells can occur. UFA discharge typically occurs in topographically low areas, such as along and near the St. Johns, Wekiva, and Ocklawaha rivers and their tributaries, and along the Atlantic coast.

The high, moderate, and low recharge areas of the UFA in SJRWMD were mapped using a geographic information system (GIS) to analyze the geologic and hydrologic factors described above that determine recharge to and discharge from the UFA. The analysis integrated data for the ICU thickness and for the hydraulic pressure gradients between the SA and UFA, using 2012 mean water level data. GIS spatial data for closed surface water basins, closed topographic depressions, and reported sinkhole incidents were also evaluated.

Approximately 62% of SJRWMD’s area contributes recharge to the UFA. Discharge from the UFA occurs in the remaining 38%. Of the areas that contribute recharge, 24% are high recharge areas (greater than 10 in/yr), 13% are moderate recharge areas (5 to 10 in/yr), and 63% are areas with low recharge (1 to 5 in/yr) to the UFA.

The map that follows is a regional representation of recharge and discharge areas of the UFA and is intended to be used as a regional planning aid for groundwater resource management. The map is not intended for site-specific assessments. This map updates and replaces all previous versions of SJRWMD UFA recharge maps. The UFA recharge map and other geospatial data can be downloaded from *floridaswater.com* (under the "Online tools, GIS, data" tab).


Recharge Areas of the Upper Floridan Aquifer
in the St. Johns River Water Management District
High recharge area
Moderate recharge area
Low recharge area
Discharge area
SJRWMD Boundary
County Boundary
Surface Water
0 5 10 20 Miles
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