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POTENTIOMETRIC SURFACE OF THE UPPER FLORIDAN AQUIFER IN FLORIDA, MAY AND JUNE 1995

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INTRODUCTION

This report is the sixth in a series of map reports describing the potentiometric surface of the Floridan aquifer system in Florida (Healy, 1962, 1975, 1982; Barr, 1987, 1992) but specifically defines the potentiometric surface of the highly permeable Upper Floridan aquifer. Data used in this and previous map reports were collected as part of continuing programs of monitoring ground-water resources in Florida in cooperation with the Florida Department of Environmental Protection, the State water management districts, and local government agencies. Many of the general hydrologic conditions associated with water levels and flow in the Floridan aquifer system have been previously described by Cooper and others (1953), Stringfield (1966), Bush and Johnston (1988), and Miller (1990).

Illustrated and described in this report is the potentiometric surface of the Upper Floridan aquifer based on water levels from more than 1,725 wells measured in either May or June 1995. The potentiometric surface is an areal representation of the levels to which water would rise in tightly cased wells open to the Upper Floridan aquifer. The surface was developed from the altitude of water levels in the wells and is represented on maps by contours connecting points of equal altitude. To depict the dynamic condition of the aquifer, this report includes a map of changes in water levels between 1990 and 1995 (fig. 1) and hydrographs from five wells with long-term records (fig. 2).

UPPER FLORIDAN AQUIFER

The Floridan aquifer system is composed of a thick, hydraulically connected sequence of limestones and dolomites of Tertiary age that are present in the subsurface and at land surface throughout Florida and in parts of southern Alabama, southeastern Georgia, and southern South Carolina (Miller, 1986, 1990). Although the system varies laterally and vertically in permeability throughout the State, it is subdivided vertically into the Upper and Lower Floridan aquifers that are separated by the less-permeable middle confining and semiconfining units. Miller (1986) based the subdivision of the system on permeability contrasts between the units and reported the contact between adjacent units may or may not coincide with formation boundaries or time-stratigraphic breaks.

The Upper Floridan aquifer is confined or poorly confined beneath most of the State but is unconfined and crops out in an approximately 50-mile wide band from Hillsborough to Wakulla County and in an area south of the southeastern corner of Alabama in parts of Holmes, Jackson, and Washington Counties (from Miller, 1990, fig. 55). The altitude of the top of the Upper Floridan aquifer in northeastern Florida ranges from near sea level to more than 500 feet below sea level. In Escambia County in the extreme northwestern part of the State, the top of the Upper Floridan dips steeply from an altitude of 100 feet above sea level to more than 1,800 feet below sea level. The top of the Upper Floridan aquifer in an area along the gulf coast and in peninsular Florida between latitude 28°N and 30°N is at an altitude near or slightly above sea level. South of latitude 28°N, the top of the Upper Floridan dips southward, and the altitude decreases from near sea level to more than 1,100 feet below sea level.

Various environments of deposition, karst development, and other geologic processes have resulted in large variations in Upper Floridan aquifer thickness (Miller, 1986, pl. 28). Thickness of the aquifer in the panhandle ranges from less than 100 feet in northern Escambia County near the updip limit of the aquifer to greater than 2,300 feet in southern Wakulla County. In peninsular Florida, thickness is from less than 100 feet in eastern Collier and southeastern Hendry Counties to greater than 1,900 feet in northwestern Marion Counties. Other areas of relatively great thickness of the Upper Floridan aquifer include southern Manatee, northern Sarasota, and western Lee Counties, where thickness is greater than 1,400 feet. A detailed discussion of the Upper Floridan aquifer thickness and thickness variability can be found in Miller (1986).

POTENTIOMETRIC SURFACE

Data used to construct the May-June 1995 map of the potentiometric surface were obtained from published reports (Hardee and others, 1996; Knowles and others, 1995; Mahon and others, 1996; and Metz and Stelman, 1995). Potentiometric contours on the large map may differ slightly from the published reports referenced above due to additional data and differences in interpretation of data near water management district boundaries. In Escambia and northwestern Santa Rosa Counties and for the area generally south of latitude 27°N, no interpretation was made because of a lack of water-level data from wells open only to the Upper Floridan aquifer. Interpretations of the potentiometric surface in reports prior to this map series for the area south of latitude 27°N used water-level measurements that are now considered to represent composite heads of the Upper Floridan aquifer and overlying aquifer systems. Depressions in the potentiometric surface continue to exist in relatively large coastal areas from Santa Rosa to Gulf Counties and in parts of Hillsborough, Manatee, and Sarasota Counties. Depressions of relatively smaller area are readily discernible in numerous counties.

Potentiometric-surface maps of the Upper Floridan aquifer for May 1990 and May-June 1995 were compared to determine net changes in head throughout the State. Net water-level rises in wells are chiefly the result of increased precipitation between 1990 and 1995 but may also be from a decrease or cessation of pumping. Declines in water levels result from either decreased precipitation or increased pumping during the 5-year period. Changes in head between the maps were determined by computer techniques to determine head differences at well locations and at the intersection of drawn potentiometric-surface contour lines. Although small to moderate changes (rises and declines of less than 10 feet) may have occurred in most of the State, there are 2 relatively large areas shown in figure 1 that reflect more than 10 feet of change between 1990 and 1995. There are additional areas where greater than 10 feet of change occurred, but which are not presented on the map. These areas were identified during a comparison of only the potentiometric contours, but were omitted from the map because of: 1) uncertainties resulting from interpolations made during construction of the potentiometric-surface maps, 2) gaps in the well network on one or both of the maps, and 3) inconsistency of wells selected for measurement and map construction.

The large depression in the potentiometric surface centered in coastal Okaloosa County extends into Santa Rosa and Walton Counties. Heads declined more than 20 feet as shown in figure 1, largely as a result of withdrawals for municipal supply. Heads are depressed below natural conditions in coastal Bay and Nassau Counties and in Alachua County where withdrawals for municipal supply also occur; however, in those areas the change in head between 1990 and 1995 could only be quantified by subtracting intersecting contours, and the areas were not highlighted on the change map. Net rises greater than 20 feet have occurred in relatively large parts of Hillsborough and Polk Counties as shown in figures 1 and 2E; an area with net rises of water levels of greater than 10 feet extends southward into Hardee County. This area of rise is largely because of reduced pumping for mining activities that had occurred there for many years (Marella, 1995) but is also attributable to greater rainfall early in 1995 compared to that in 1990.

Hydrographs for five wells in areas where regional ground-water withdrawals have had appreciable effects on water levels are shown in figure 2. Hydrographs were constructed using available data from the U.S. Geological Survey WATSTORE (WATer Data STOrage and REtrieval System) data base. Water-level data were collected and plotted as either daily values, monthly means, or miscellaneous measurements made in the wet or dry seasons, typically in May and September. The hydrographs (fig. 2) show net water-level declines since record keeping began in all wells except at the ROMP 60 well located in southwestern Polk County. In this well water levels have been rising since the mid-1970's. This rise is largely because of the decline in pumping for phosphate mining in central and west-central Florida.

SELECTED REFERENCES

Barr, G.L., 1987, Potentiometric surface of the Upper Floridan aquifer in Florida, May 1985: Florida Geological Survey Map Series 119, 1 sheet.

----- 1992, Potentiometric surface of the Upper Floridan aquifer in Florida, May 1990: Florida Geological Survey Map Series 138, 1 sheet.

Bush, P.W., and Johnston, R.H., 1988, Ground-water hydraulics, regional flow, and ground-water development of the Floridan aquifer system in Florida and parts of Georgia, South Carolina, and Alabama: U.S. Geological Survey Professional Paper 1403-C, 80 p.

Cooper, H.H., Kenner, W.E., and Brown, Eugene, 1953, Ground water in central and northern Florida: Florida Geological Survey Report of Investigations no. 10, 37 p.

Hardee, J.W., and others, 1996, Potentiometric surface of the Floridan aquifer system in northwest Florida, June / July 1995: Northwest Florida Water Management District Map Series 96-1, 1 sheet.

Healy, H.G., 1962, Piezometric surface and areas of artesian flow of the Floridan aquifer in Florida, July 6-17, 1961: Florida Bureau of Geology Map Series 4.

----- 1975, Potentiometric surface and areas of artesian flow of the Floridan aquifer in Florida, May 1974: Florida Bureau of Geology Map Series 73.

----- 1982, Potentiometric surface of the Floridan aquifer in Florida, May 1980: Florida Bureau of Geology Map Series 104.

Knowles, Leel, Jr., O'Reilly, A.M., Phelps, G.G., and Bradner, L.A., 1995, Potentiometric surface of the Upper Floridan aquifer in the St. Johns River Water Management District and vicinity, Florida, May 1995: U.S. Geological Survey Open-File Report 95-461, 1 sheet.

Mahon, G.L., Sepulveda, A.A., and Choquette, A.F., 1996, Potentiometric surface of the Upper Floridan aquifer in the Suwannee River Water Management District, May and June, 1995: U.S. Geological Survey Open-File Report 96-617, 1 sheet.

Marella, R.L., 1995, Water-use data by category, and water management district in Florida, 1950-90: U.S. Geological Survey Open-File Report 94-521, 114 p.

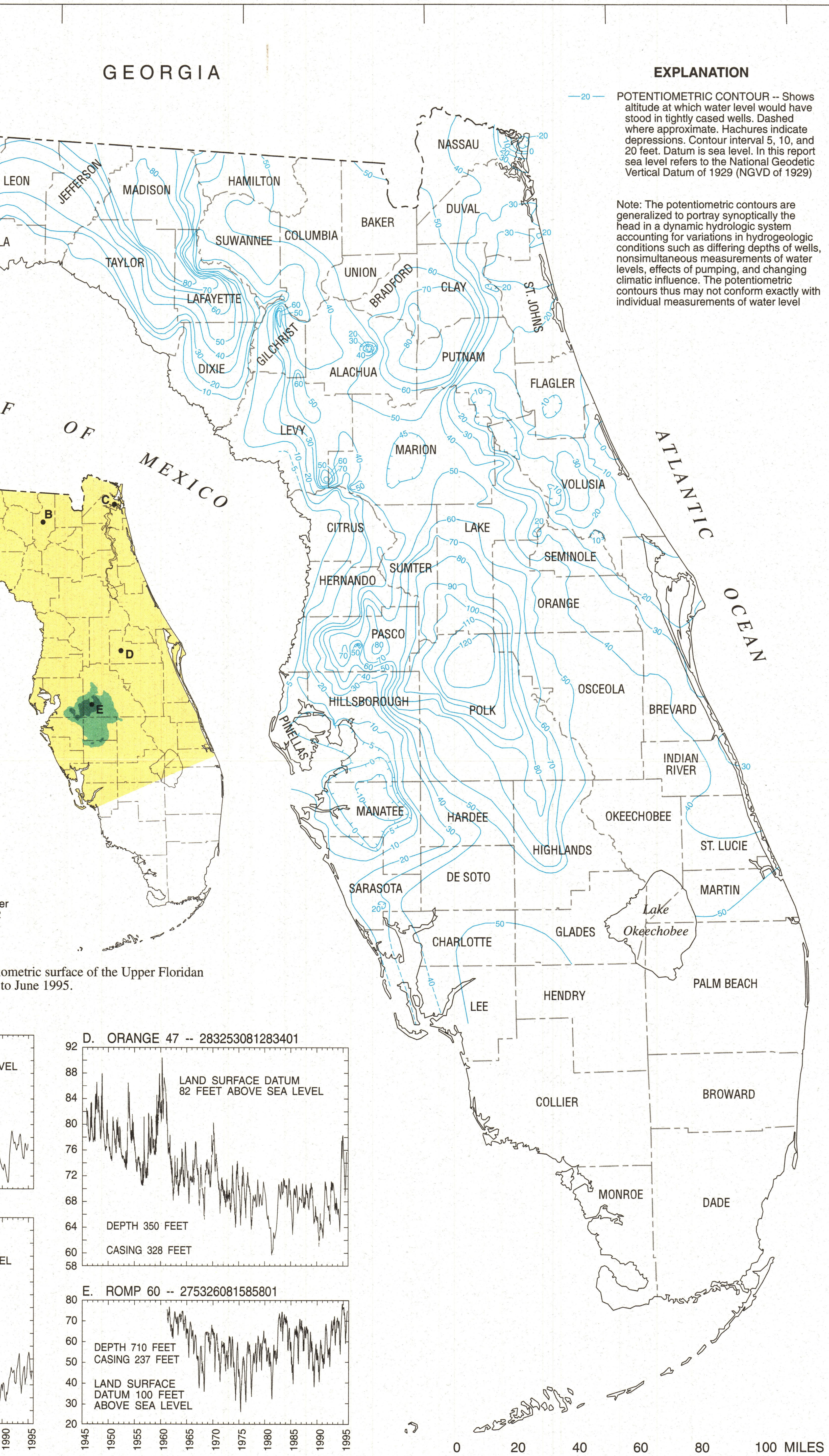
Metz, P.A., and Stelman, K.A., 1995, Potentiometric surface of the Upper Floridan aquifer, west-central Florida, May 1995: U.S. Geological Survey Open-File Report 95-704, 1 sheet.

Miller, J.A., 1986, Hydrogeologic framework of the Floridan aquifer system in Florida and in parts of Georgia, Alabama, and South Carolina: U.S. Geological Survey Professional Paper 1403-B, 91 p, 28 pls.

----- 1990, Ground water atlas of the United States, Segment 6, Alabama, Florida, Georgia, and South Carolina: U.S. Geological Survey Hydrologic Investigations Atlas 730-G, 28 p.

National Oceanic and Atmospheric Administration, 1993-95, Climatological data annual summary, Florida, 1990-95: published annually.

Stringfield, V.T., 1966, Artesian water in the Tertiary limestone in the southeastern states: U.S. Geological Survey Professional Paper 517, 226 p.



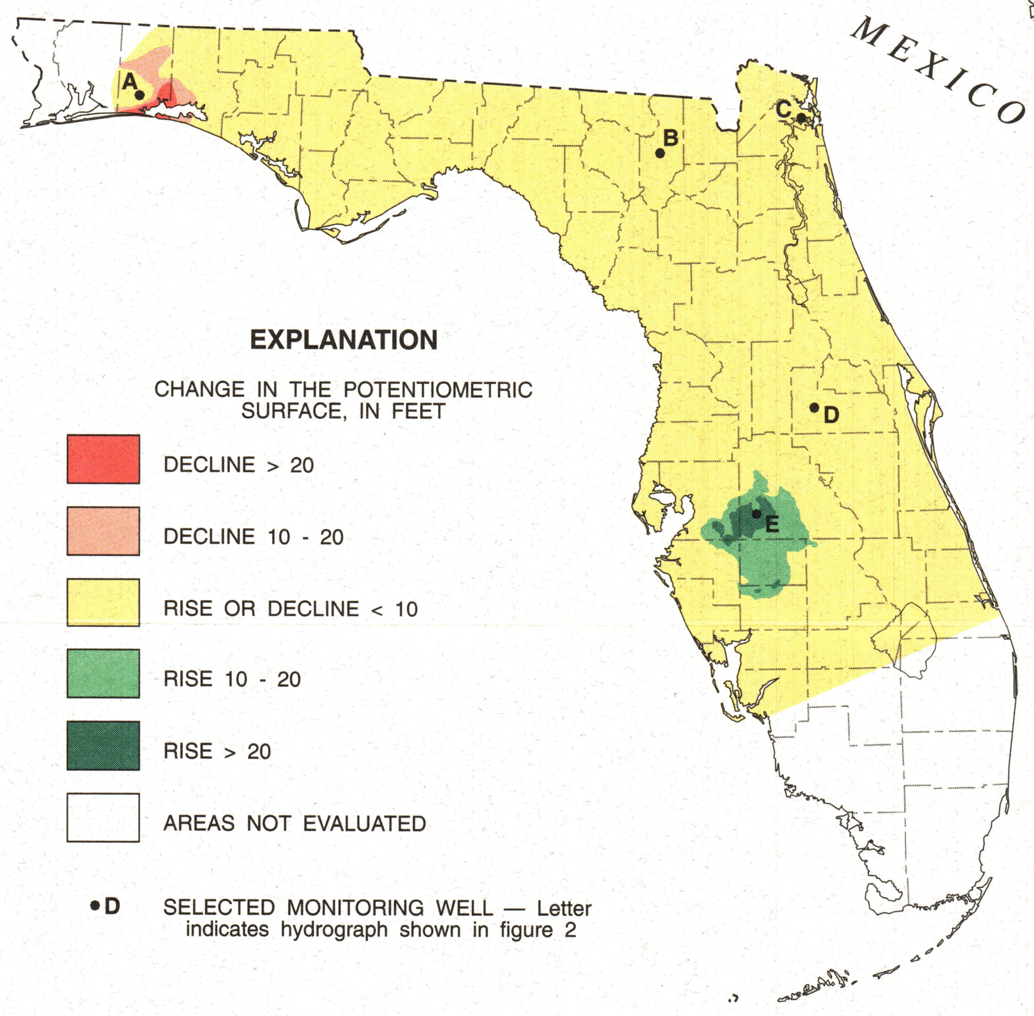


Figure 1 — Generalized net change in the potentiometric surface of the Upper Floridan aquifer between May 1990 and May to June 1995.

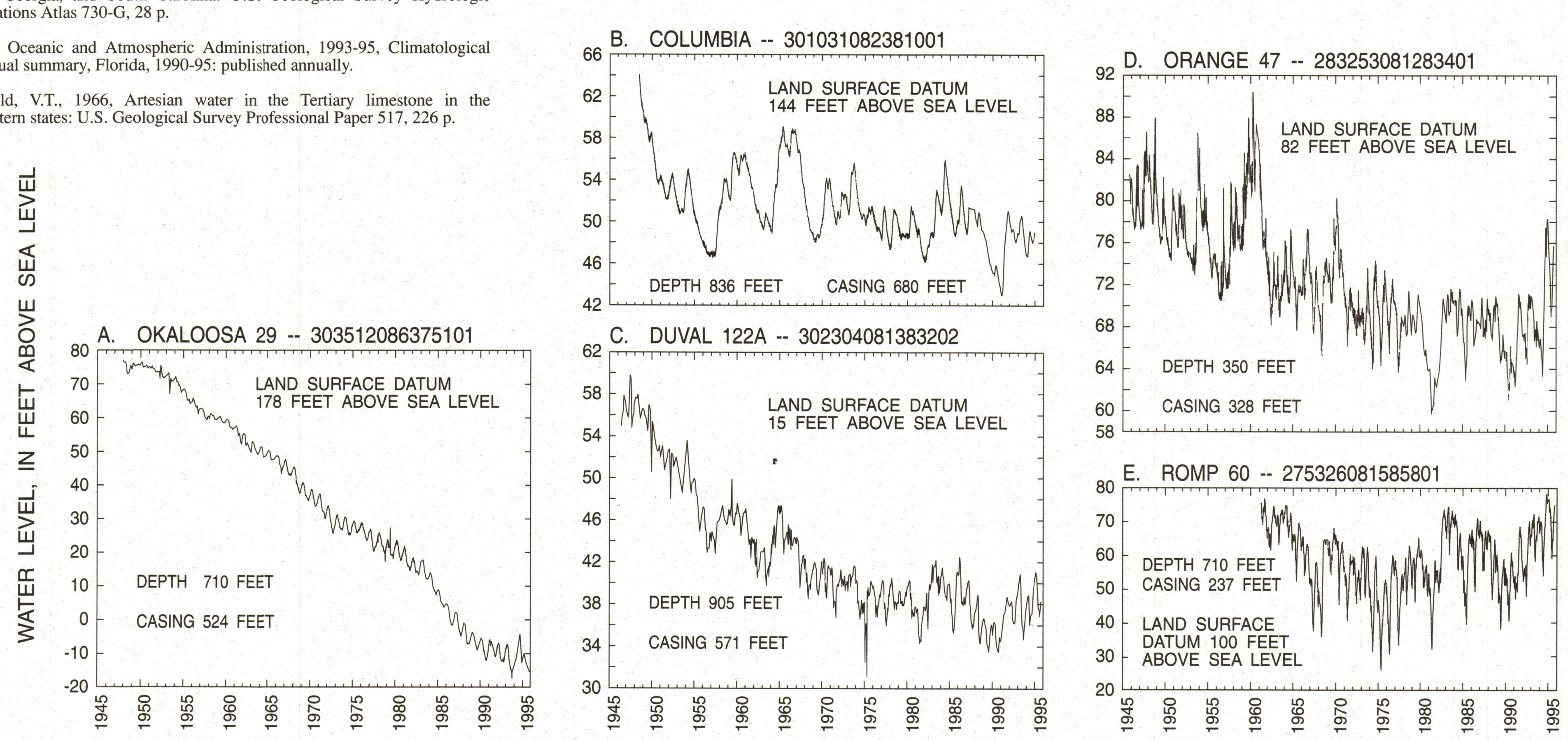


Figure 2 — Fluctuations of ground-water levels in selected wells in the Upper Floridan aquifer.