SOURCES OF SALINITY IN IRRIGATION WATER AND STRATEGIES TO MINIMIZE

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FLORIDAN AQUIFER SYSTEM

- One of the most productive aquifers in the world
- The largest aquifer in Florida
- Mostly composed of porous carbonaceous rock
- Composed of upper and lower Floridan aquifer with varying degrees of confinement
- Recharge from surface is not equal across state
- Surrounded on three sides by salt water

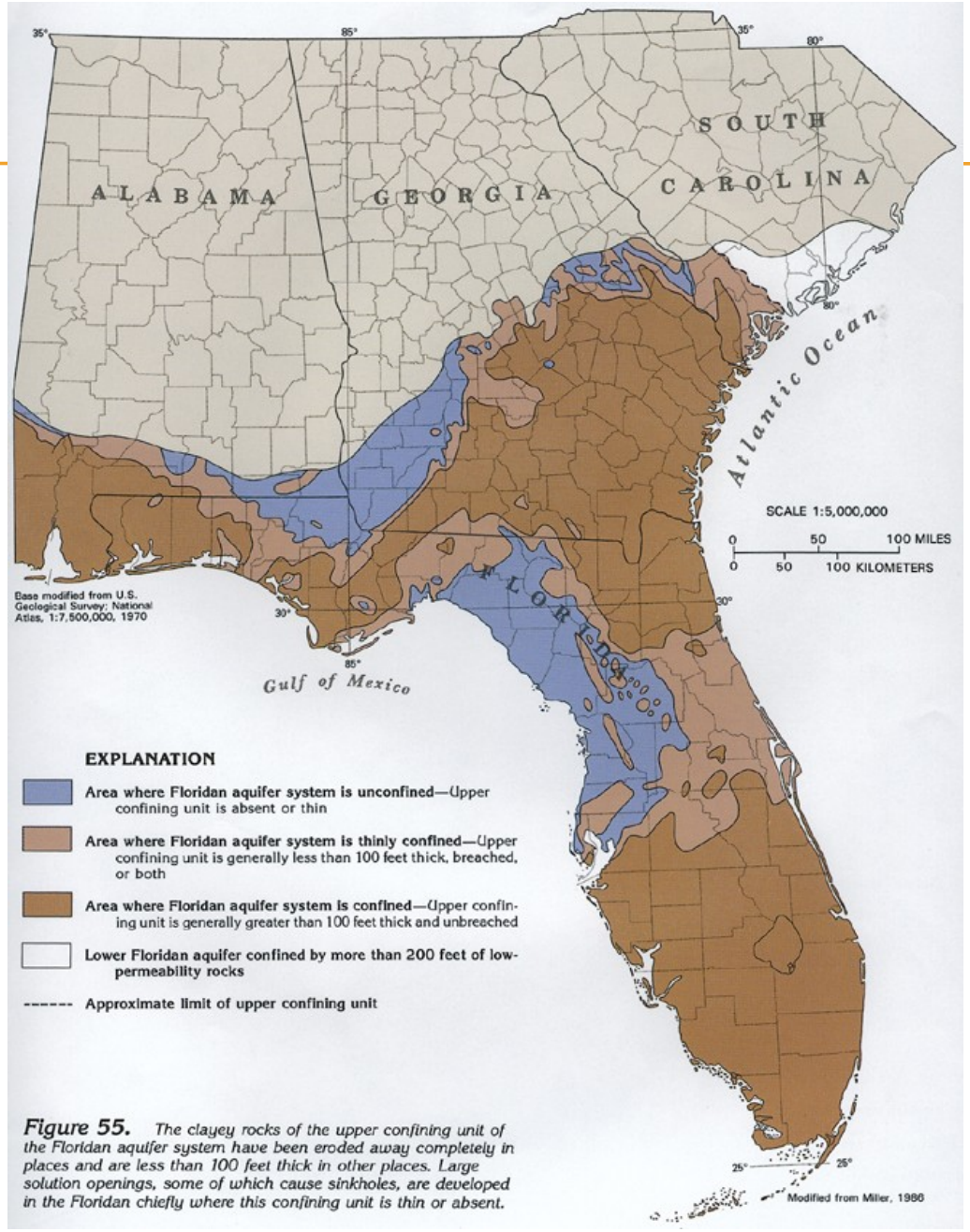


Figure 55. The clayey rocks of the upper confining unit of the Floridan aquifer system have been eroded away completely in places and are less than 100 feet thick in other places. Large solution openings, some of which cause sinkholes, are developed in the Floridan chiefly where this confining unit is thin or absent.

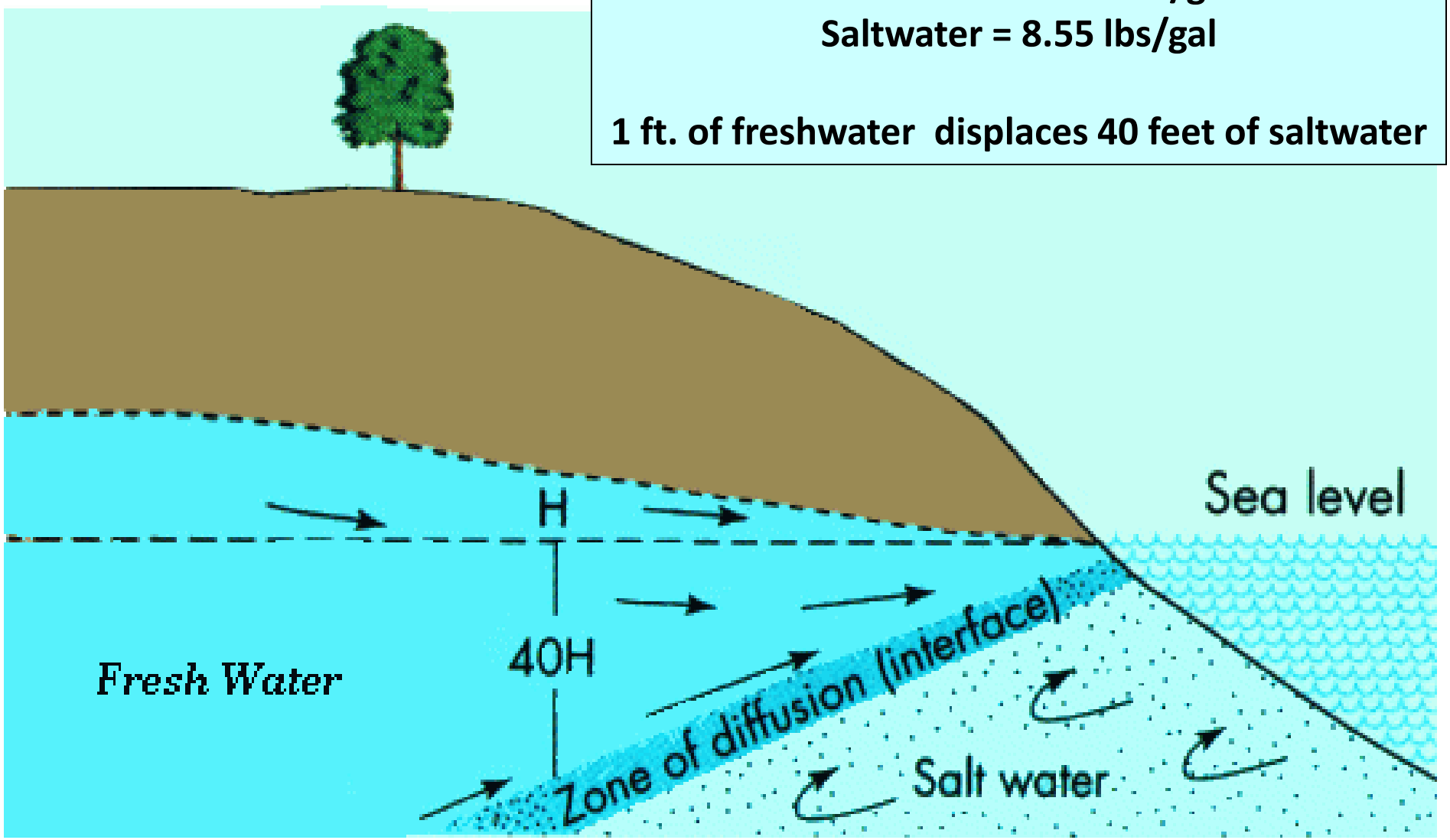
http://pubs.usgs.gov/ha/ha730/ch_g/G-Floridan5.html

COMPOSITION OF FLORIDAN AQUIFER

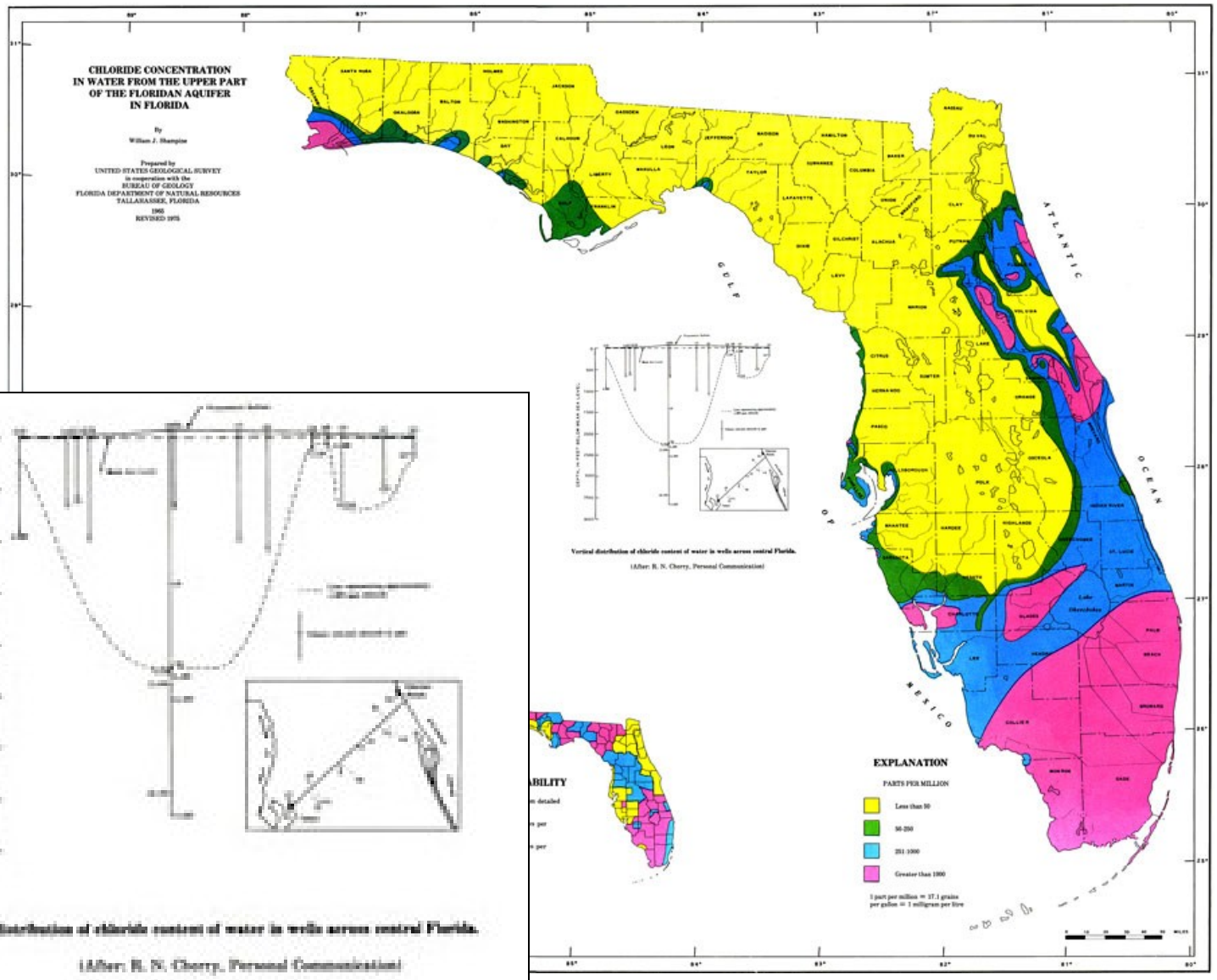
NORMAL BOUNDARY BETWEEN FRESHWATER AND SALTWATER

Freshwater = 8.34 lbs/gal
Saltwater = 8.55 lbs/gal

1 ft. of freshwater displaces 40 feet of saltwater



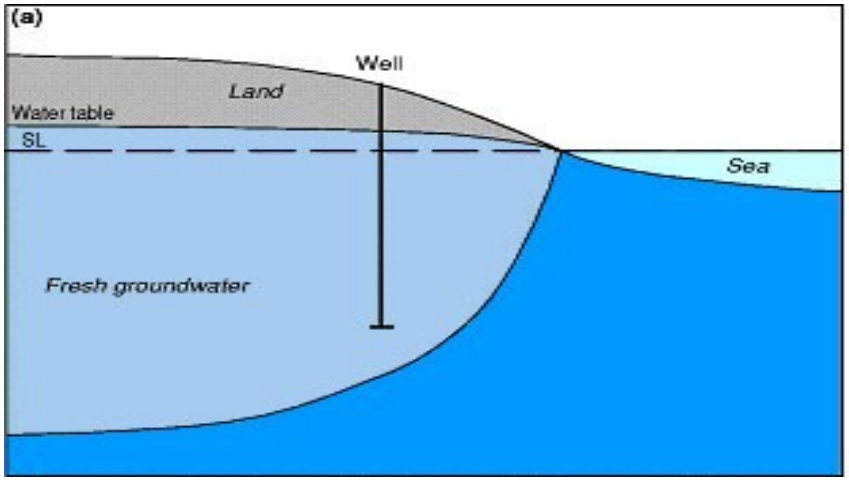
CHLORIDE CONCENTRATION IN UPPER FLORIDAN AQUIFER

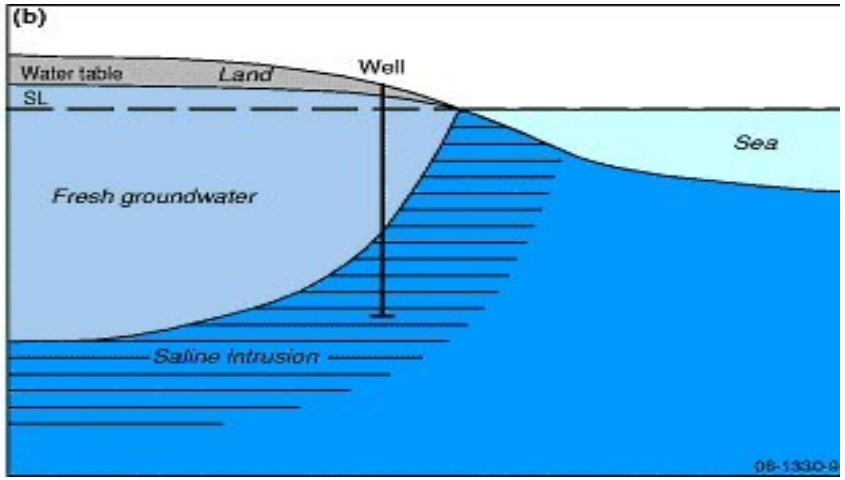


http://fcit.usf.edu/florida/maps/pages/8500/f8552/f8552.htm

FACTORS THAT CAN INCREASE GROUNDWATER SALTS CONCENTRATION – SALTWATER INTRUSION

- Lower rainfall
- Groundwater pumping
  - Regional
  - Localized cone of depression
- Sea-level rise

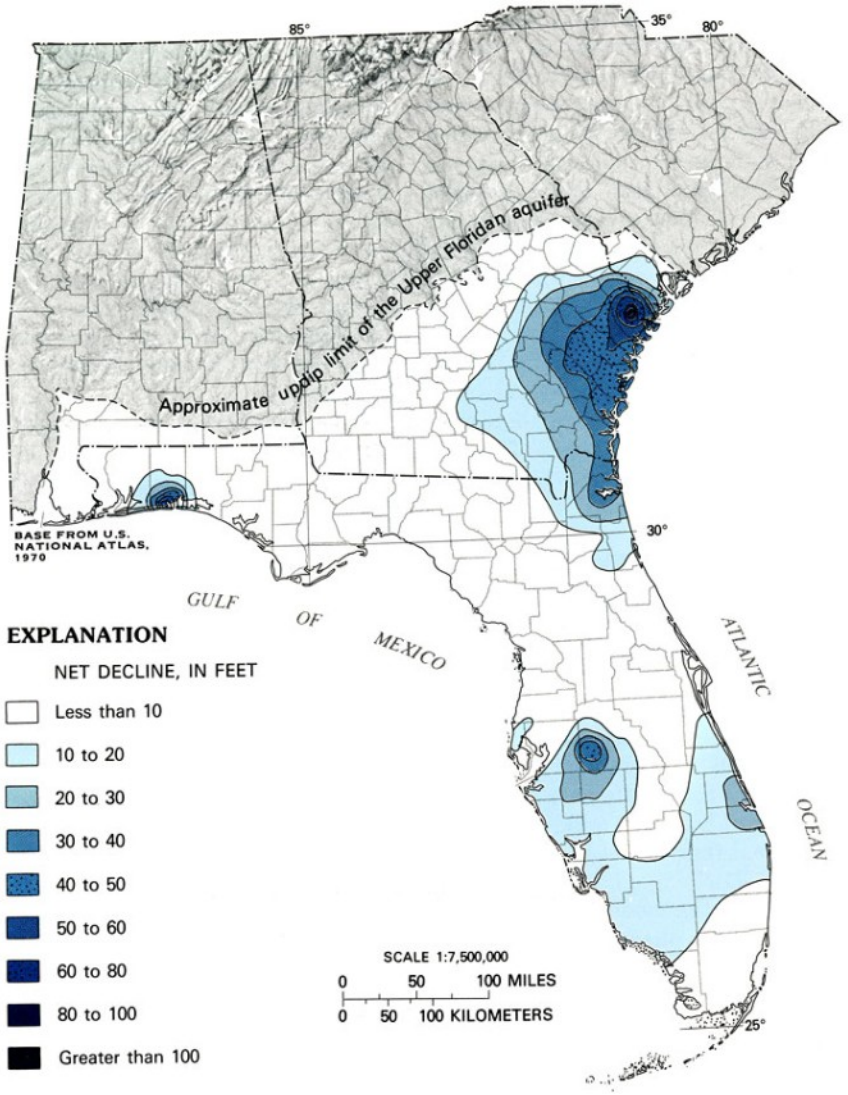




REGIONAL GROUNDWATER CHANGE

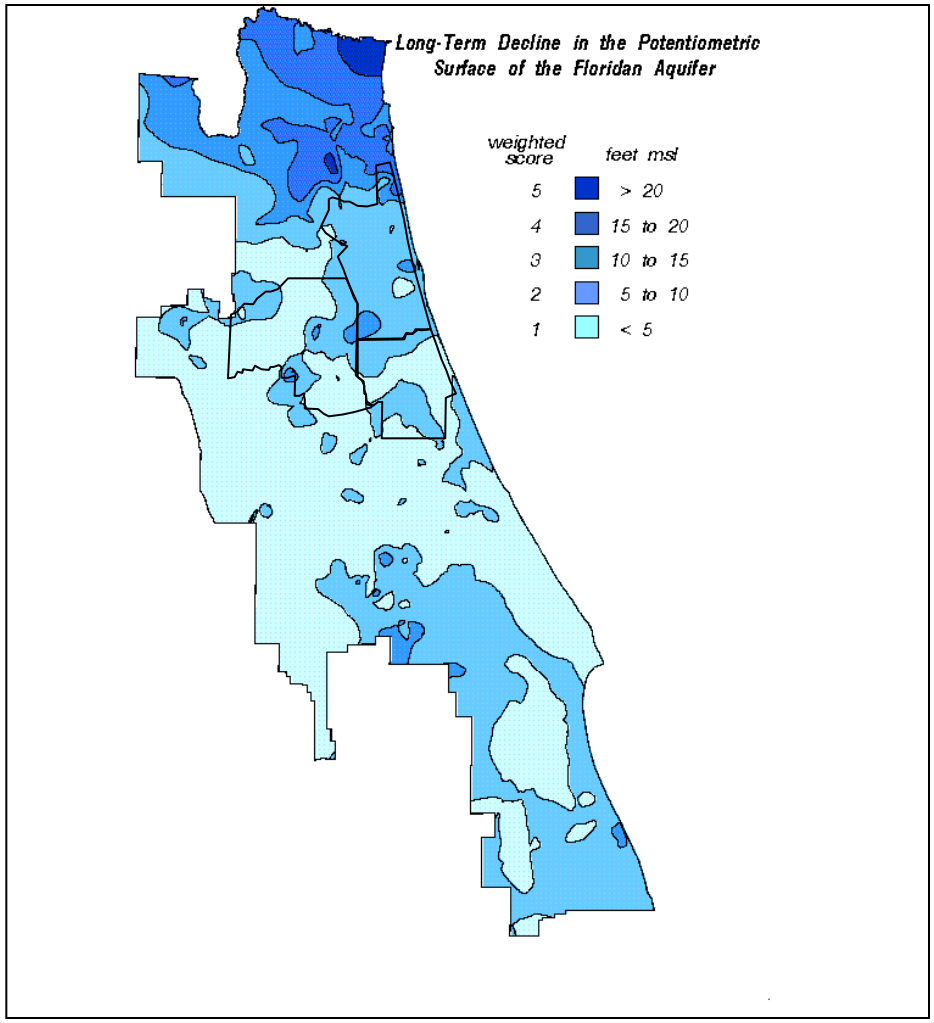
1950-1999 POTENTIAMETRIC SURFACE CHANGE

- Change in potentiometric head between 1950 and 1999

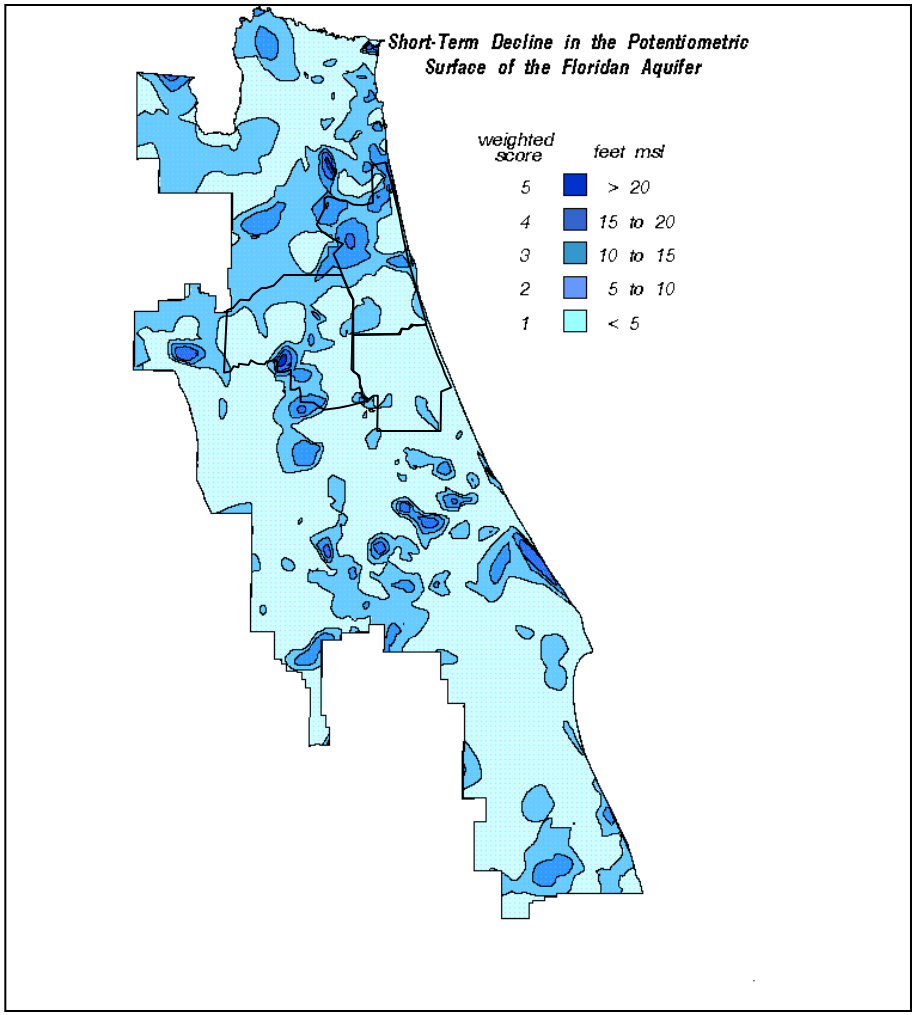


DECLINE IN POTENTIOMETRIC SURFACE OF FLOIRDAN AQUIFER - SJRWMD

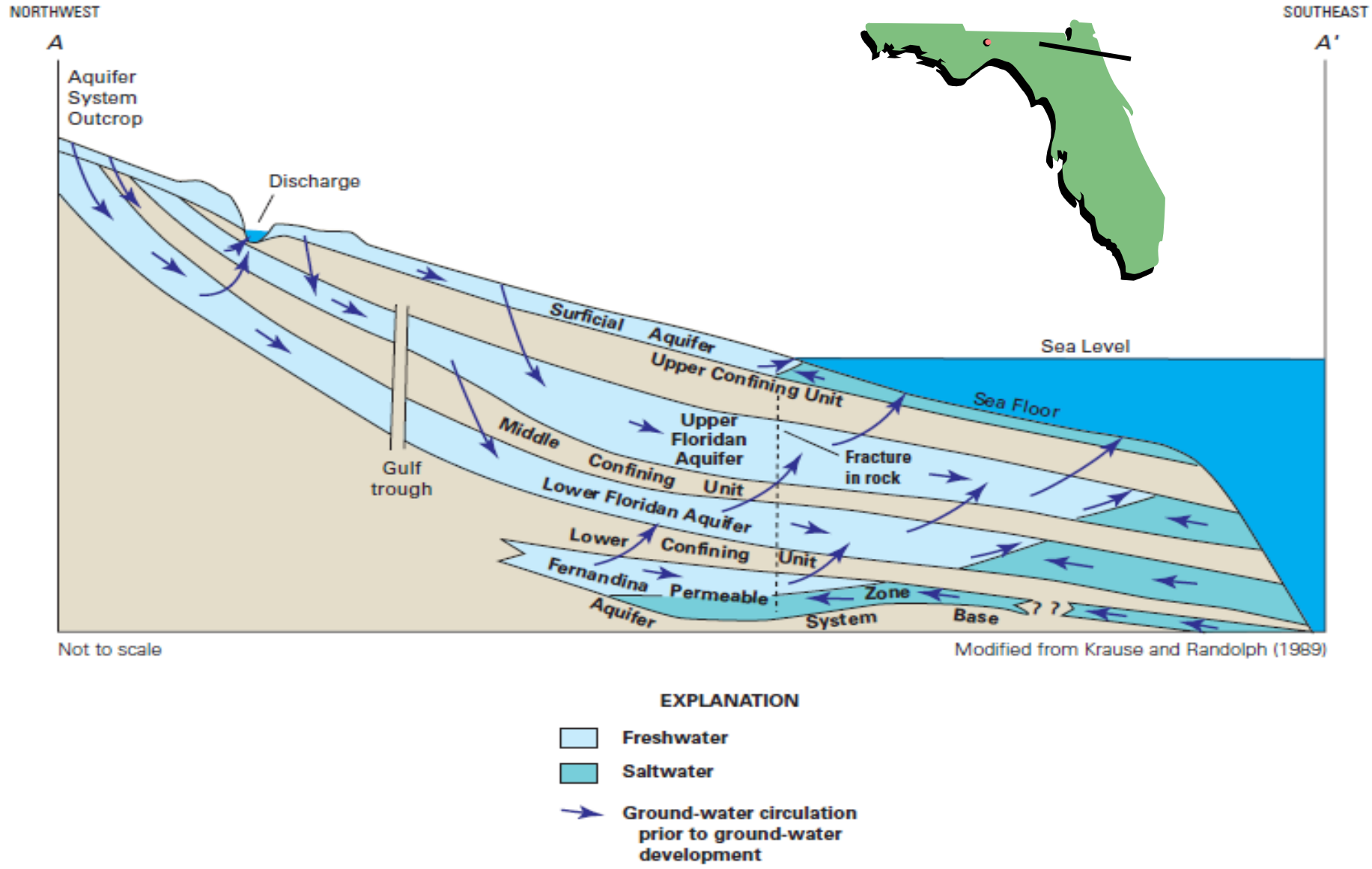
Long-term 1936-1990



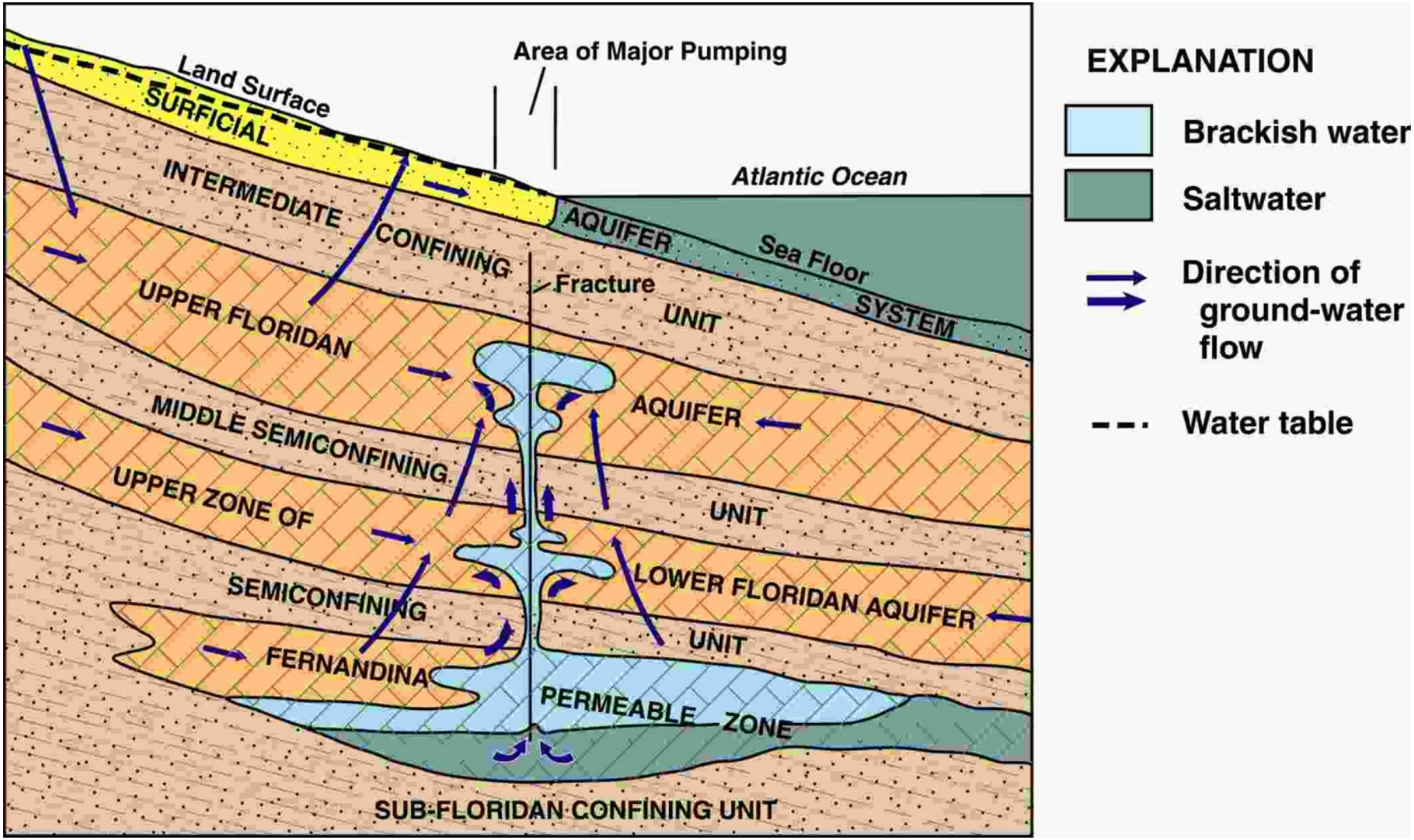
Short-term (1980-1990)



MIXING OF LOWER AND UPPER FLORIDA AQUIFERS: SEMI-CONFINEMENT BETWEEN LAYERS



GEOLOGICAL FRACTURES



LOCALIZED IMPACTS - CONE OF DEPRESSION AND CORRESPONDING CONE OF ASCENSION

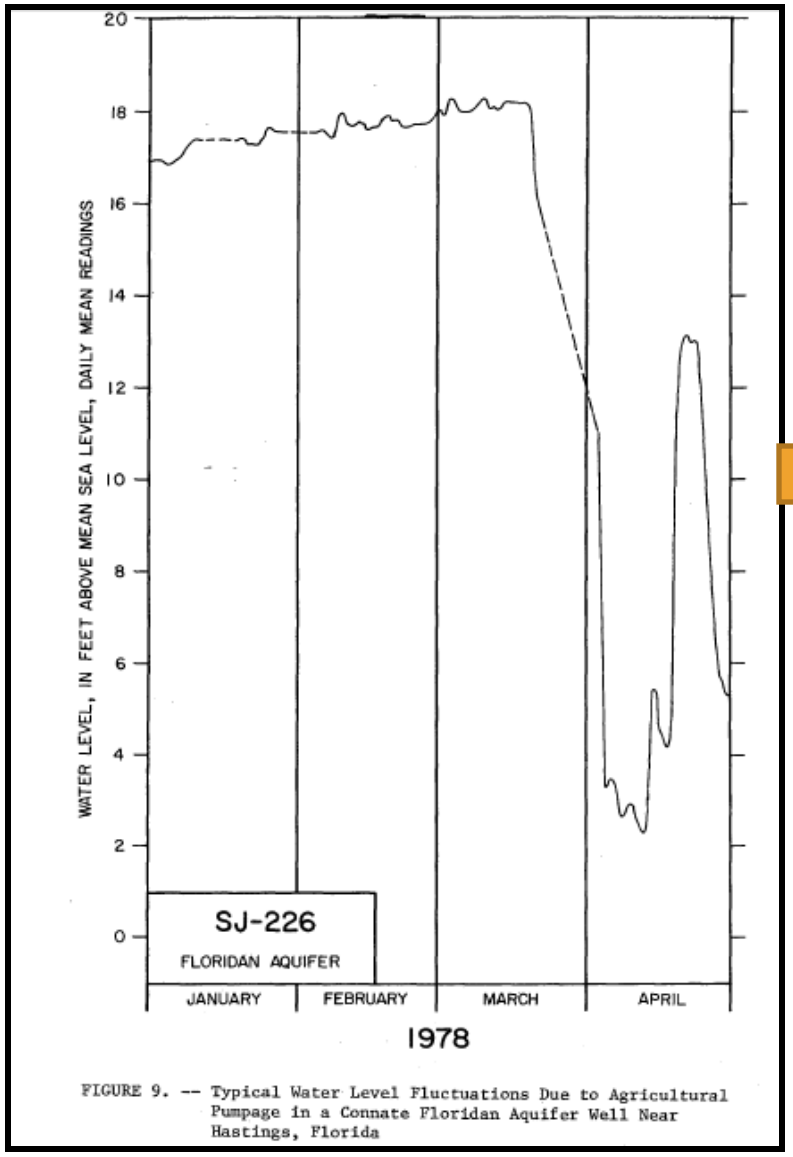
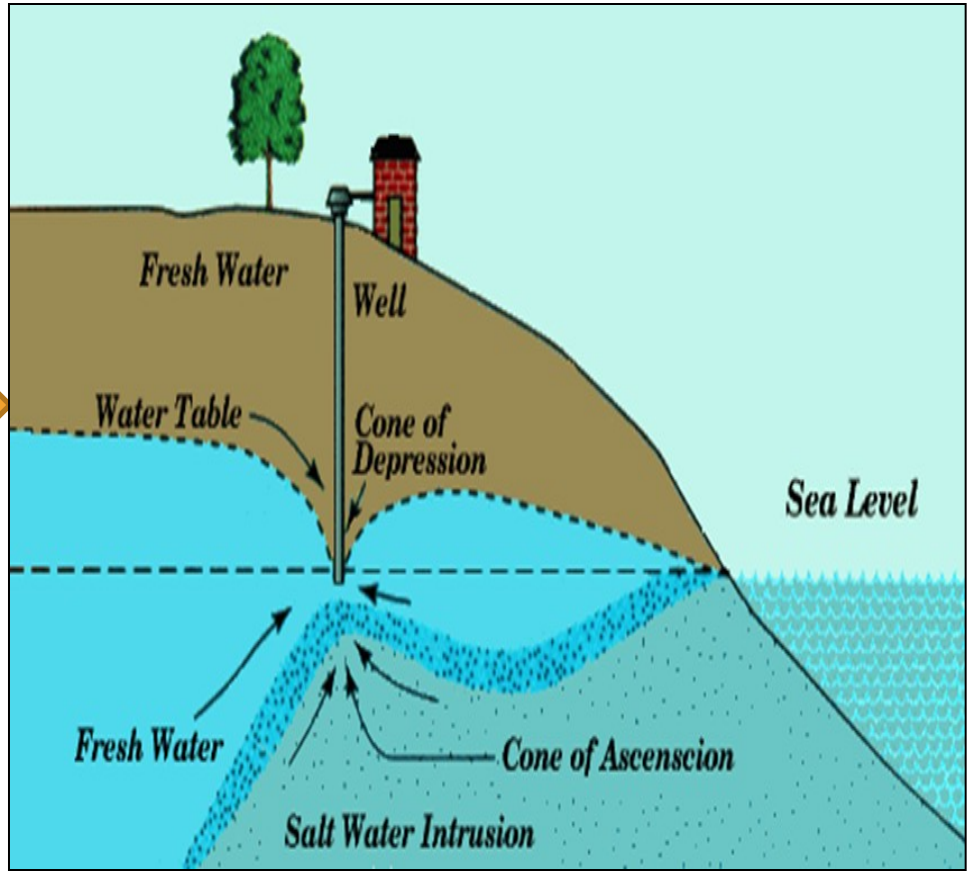
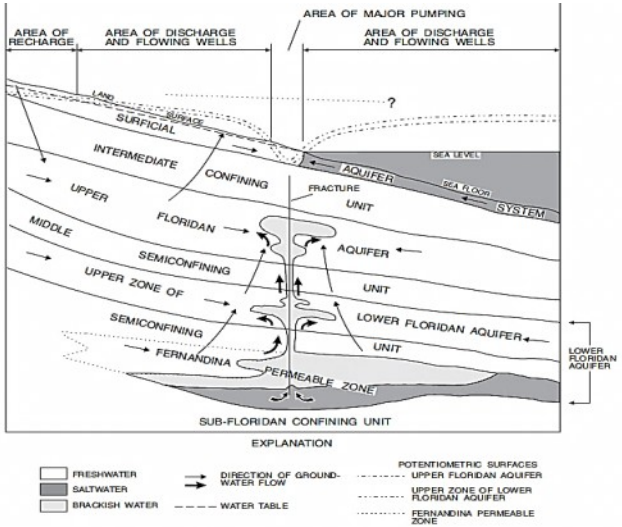


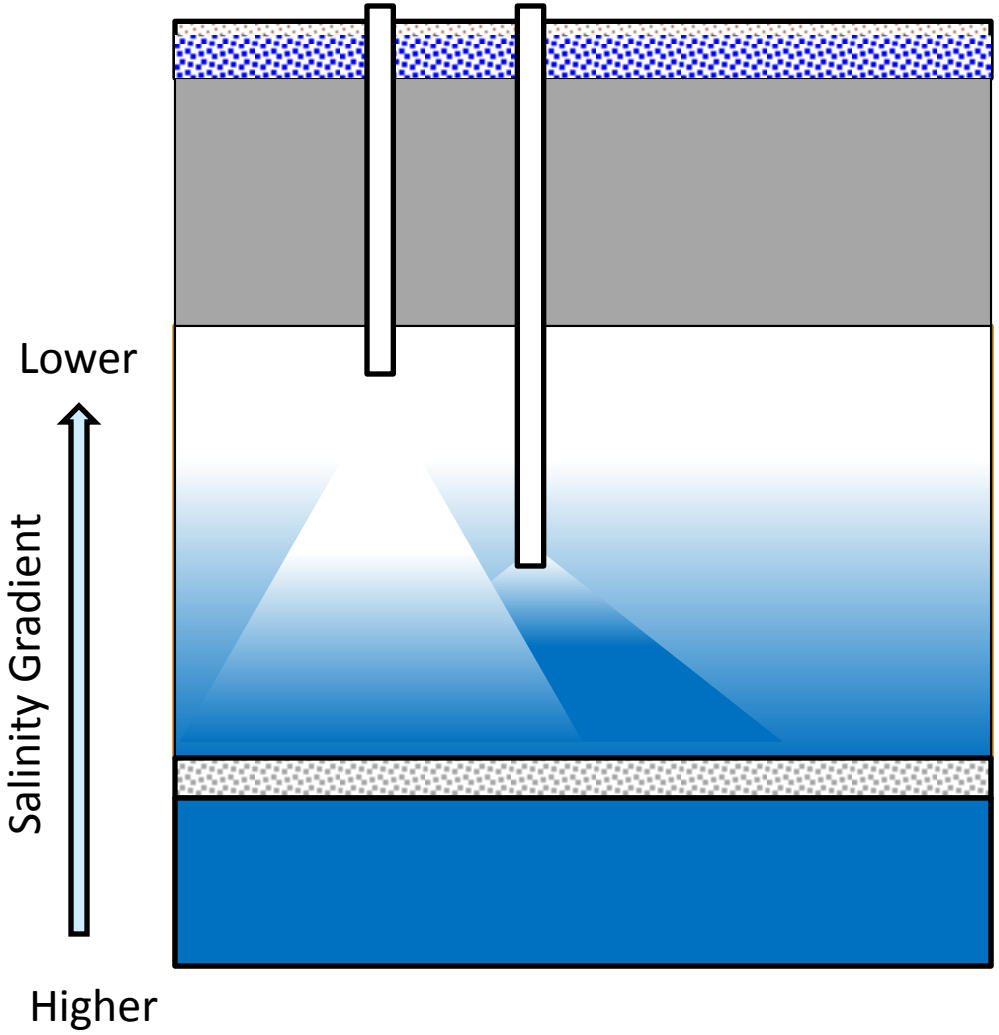
FIGURE 9. -- Typical Water Level Fluctuations Due to Agricultural Pumpage in a Connate Floridan Aquifer Well Near Hastings, Florida



EFFECT OF WELL DEPTH

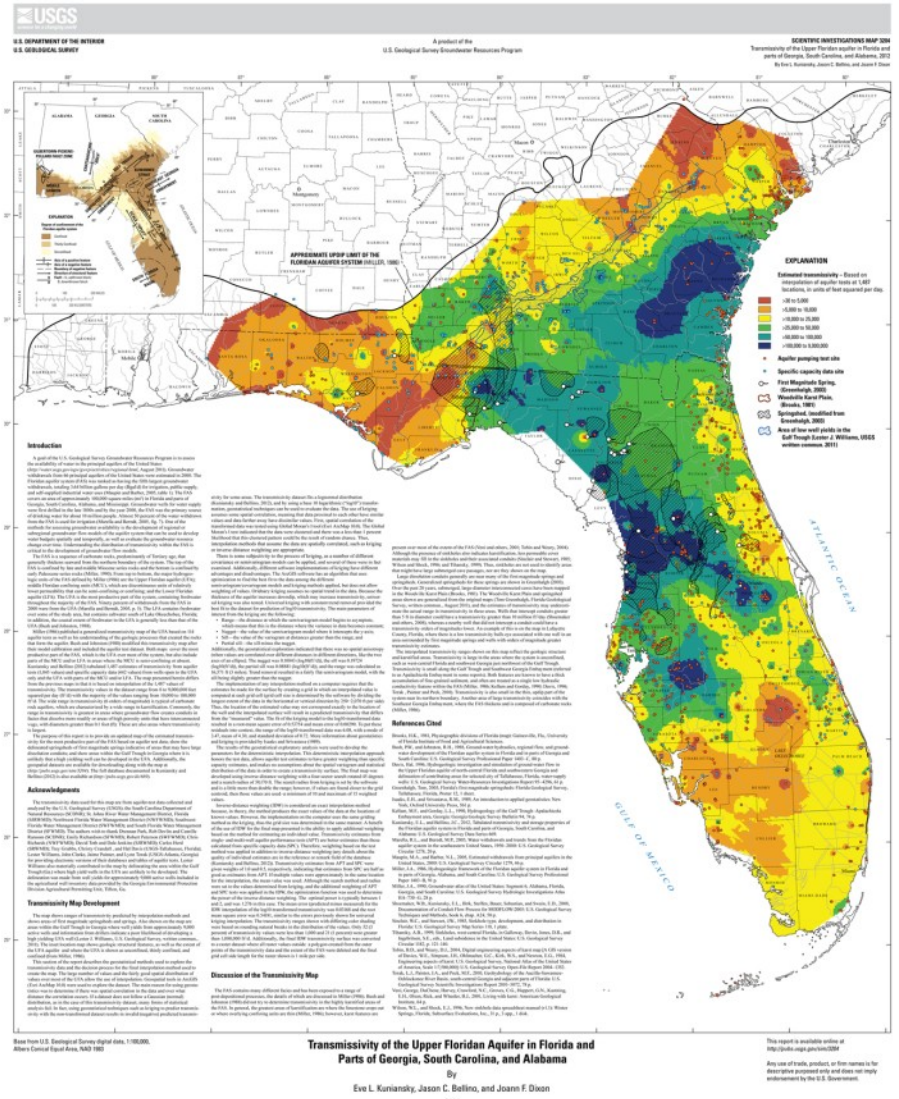
- The deeper the well within the aquifer the greater the probability of saltwater entrainment





EFFECT OF PUMP VOLUME

- Depending on aquifer transitivity and surface recharge, volume of groundwater pumping will also increase saltwater entrainment.



http://pubs.usgs.gov/sim/3204/

CUMULATIVE EFFECT - WATER QUALITY WELL MONITORING ARRAY

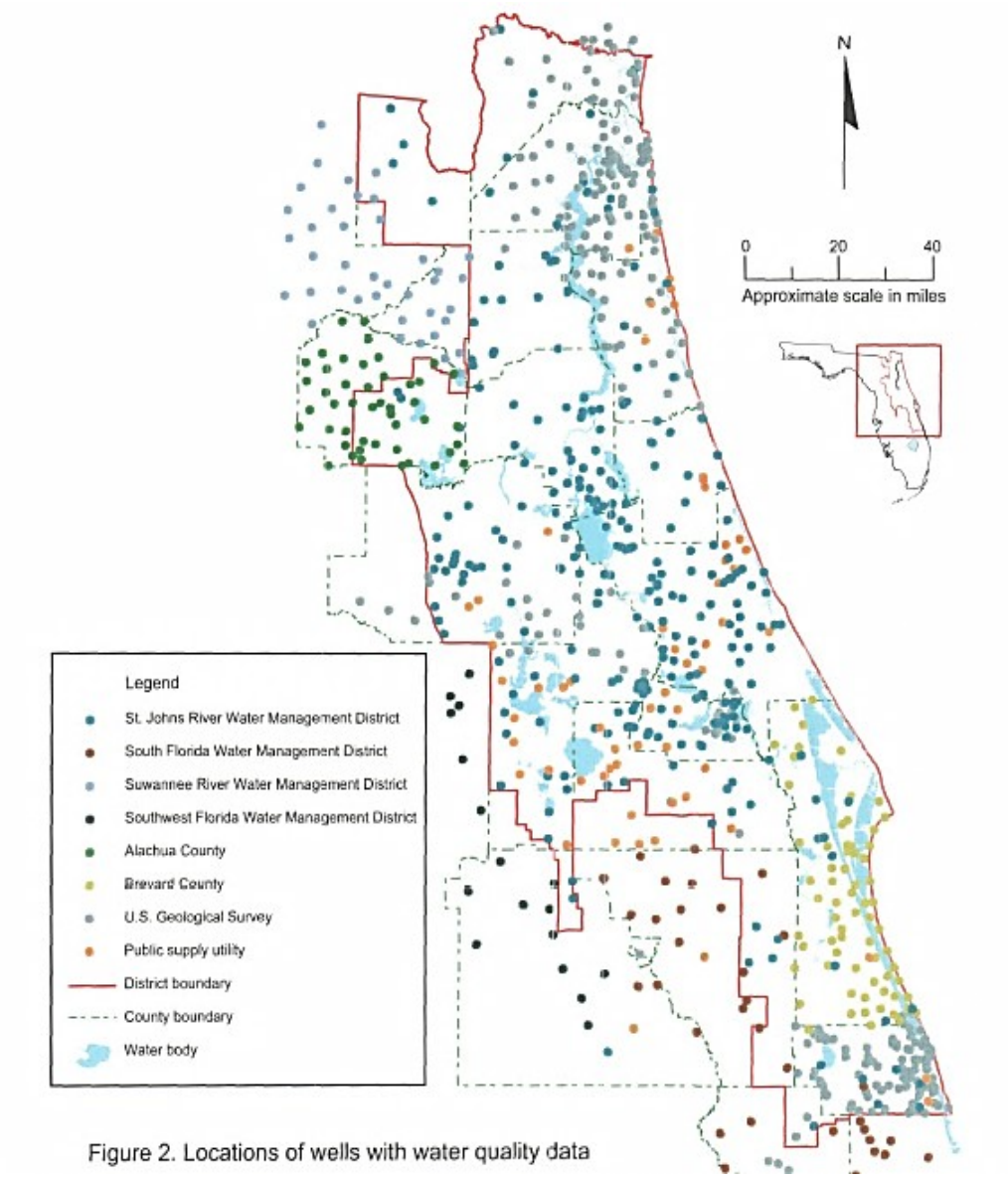


Figure 2. Locations of wells with water quality data

CHLORIDE IN UPPER FLORIDAN AQUIFER

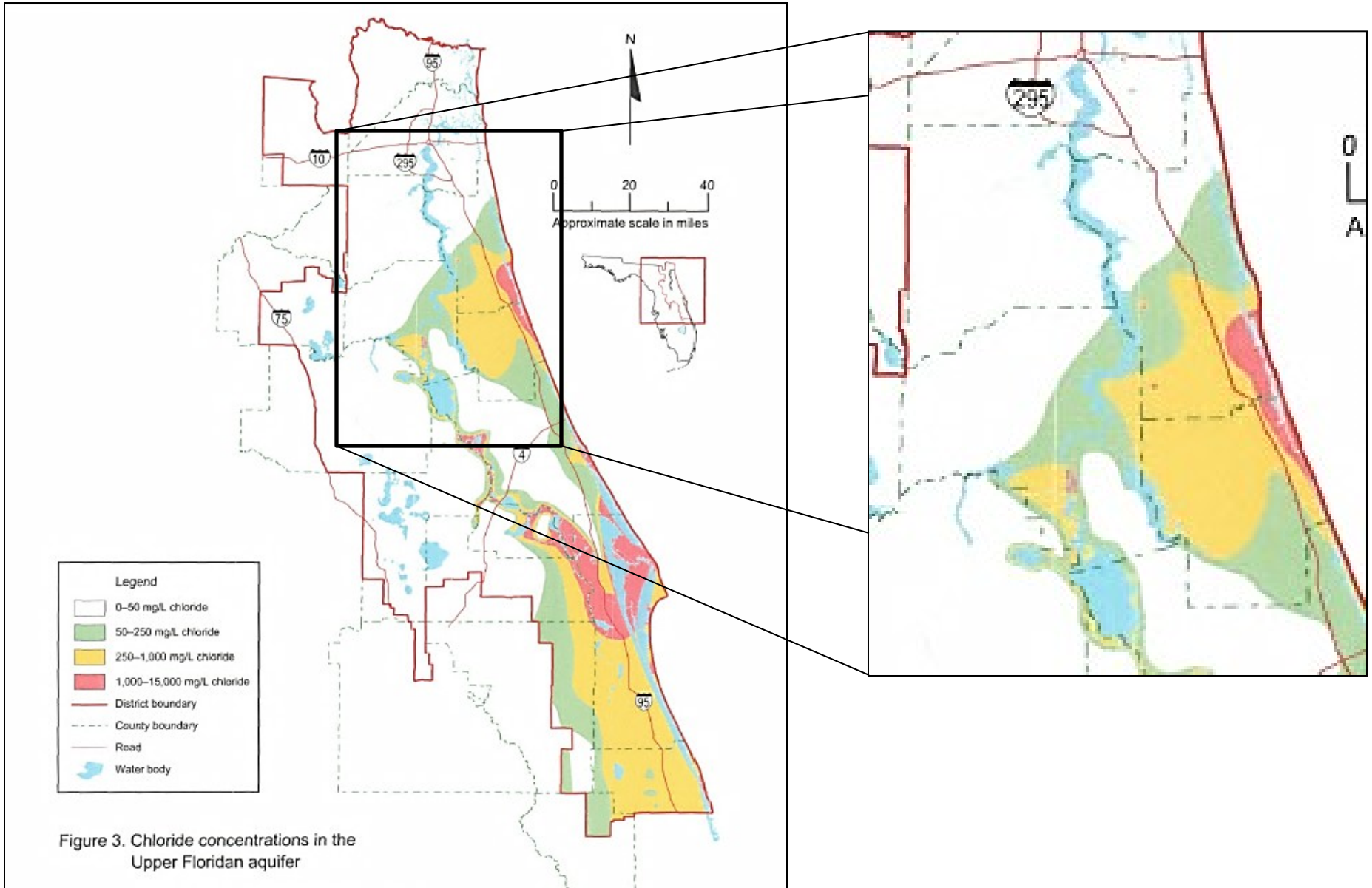


Figure 3. Chloride concentrations in the Upper Floridan aquifer

TRENDS IN CHLORIDE CONCENTRATION

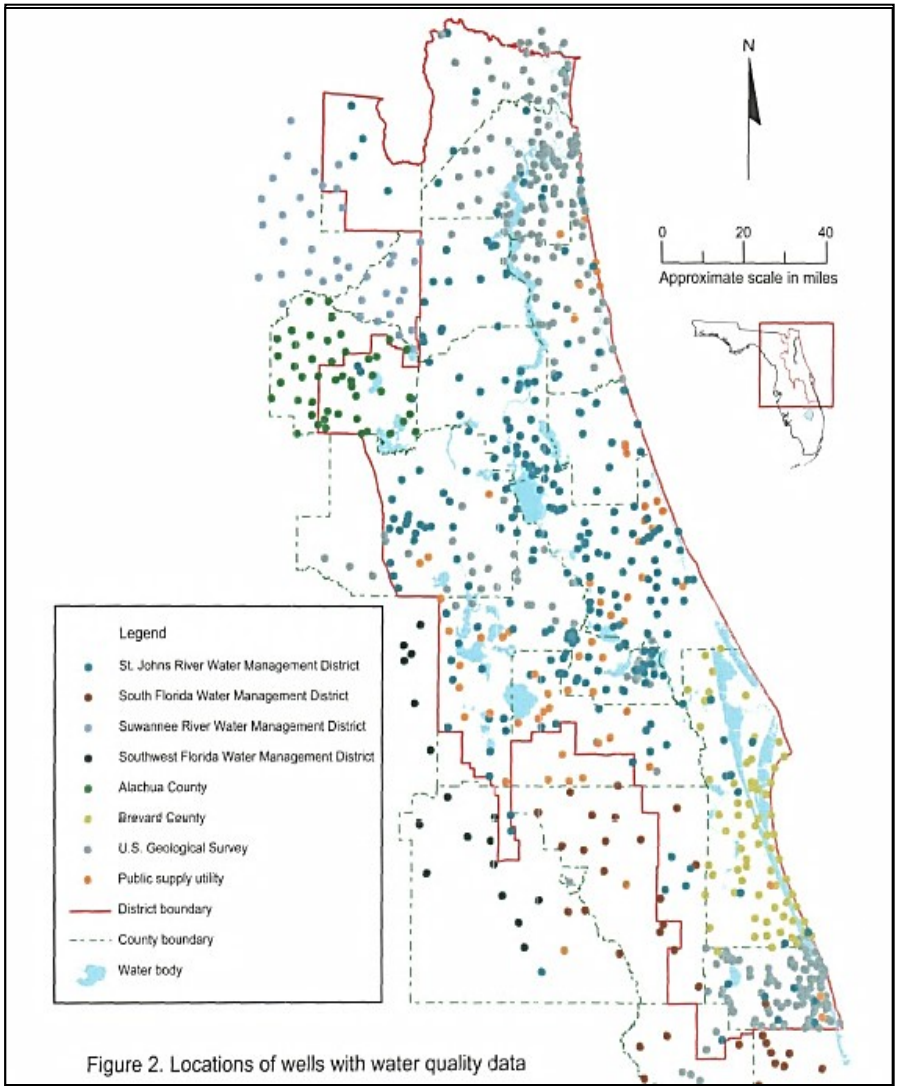


Figure 2. Locations of wells with water quality data

WHAT ACTIONS CAN BE TAKEN?

- Backfill well to make shallower
  - Will likely result in lower yield
- Drill new wells to spread out area of withdrawal
- Reduce water demand through conservation and alternative irrigation practices
- Evaluate possible use of surface water supply
- Possible mixing with surficial aquifer or surface water
- No known mechanical approach other than reverse osmosis

SUMMARY

- The heavier weight of saltwater allows it to move under freshwater and is regulated by the freshwater head and geological confining layers.
- Changes in freshwater head due to natural (lower rainfall) or human (groundwater pumping) or sea-level rise will cause the freshwater:saltwater boundary to change.
- Up-coning of saltwater can cause a localized increase in salinity.
- Depth of well, and pumping volume can influence the degree of saltwater entrainment.
- Backfilling to shallow wells and reduced pumping rates will help to reduce salinity resulting from up-coning as well as local water withdrawals.