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

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 POTENTIOMETRIC 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

EXPLANATION
- Freshwater
- Saltwater
- Ground-water circulation prior to ground-water development

Modified from Krause and Randolph (1989)
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
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.