SOUTH FLORIDA WATER MANAGEMENT DISTRICT

Five-Year Saltwater Intrusion Mapping Update

Lower West Coast Regional Groundwater Models

Surficial and Intermediate Aquifer System Model

Jon E. Shaw, P.G.
Principal Hydrogeologist, Water Supply Bureau

July 1, 2020

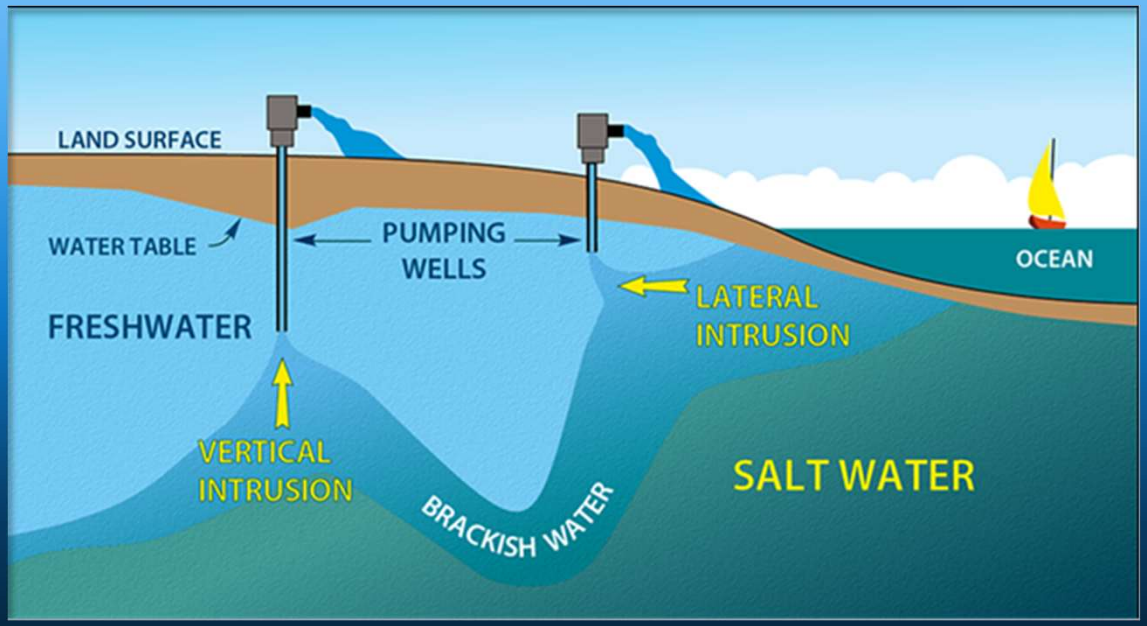
sfwmd.gov

Agenda

- Overview of saltwater intrusion and aquifers
- Importance to wellfields and infrastructure
- Project approach
- Results – Lower West Coast overview
- Conclusions
- Next steps
- Questions and discussion

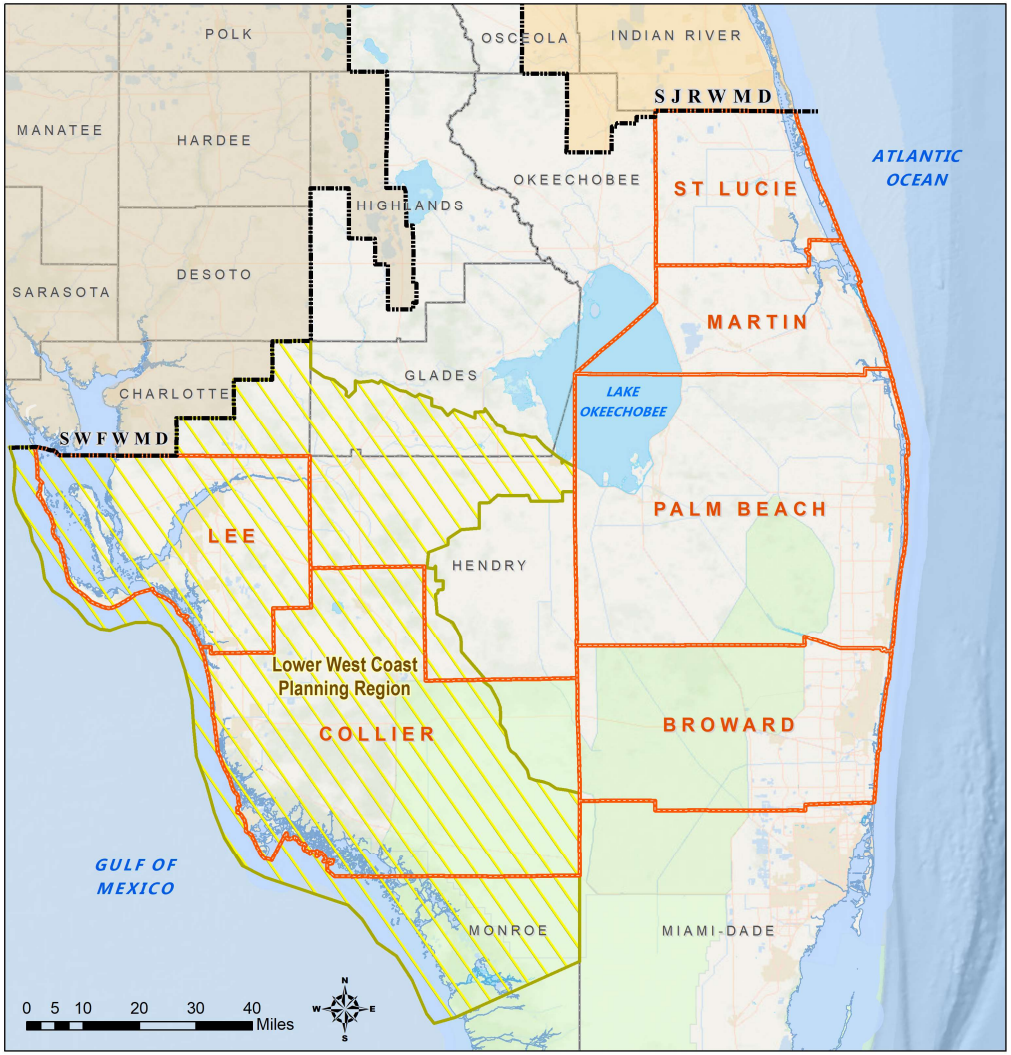
Common Sources of Saltwater Intrusion

- Lateral intrusion from the coast
- Vertical intrusion – upconing from saltwater below
- Surface infiltration – estuaries, boat basins, saltwater marshes, saltwater canals, etc.
- Ancient (relict) seawater trapped in low-permeability aquifers

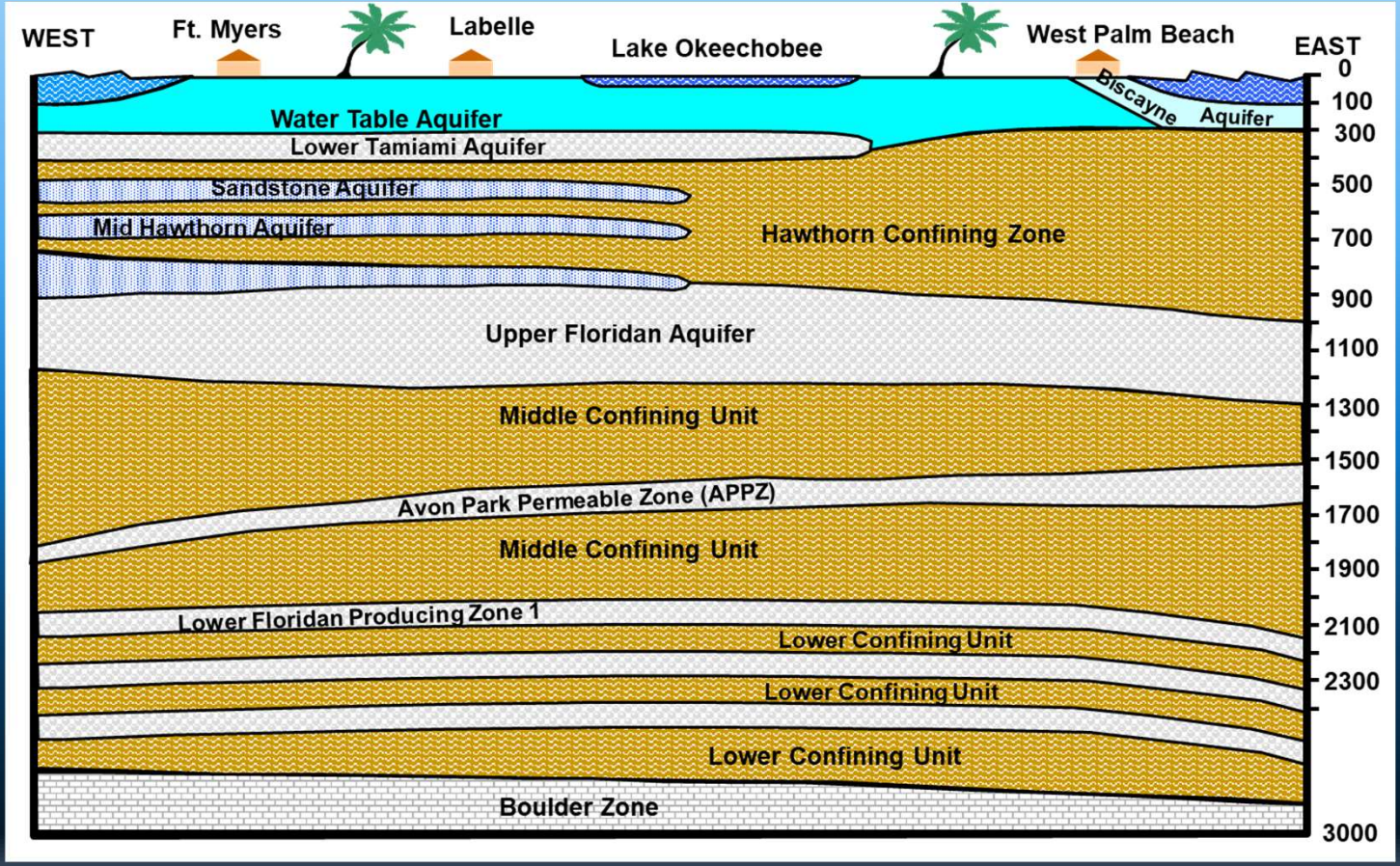


SFWMD Coastal Counties

Lower West Coast Planning Region

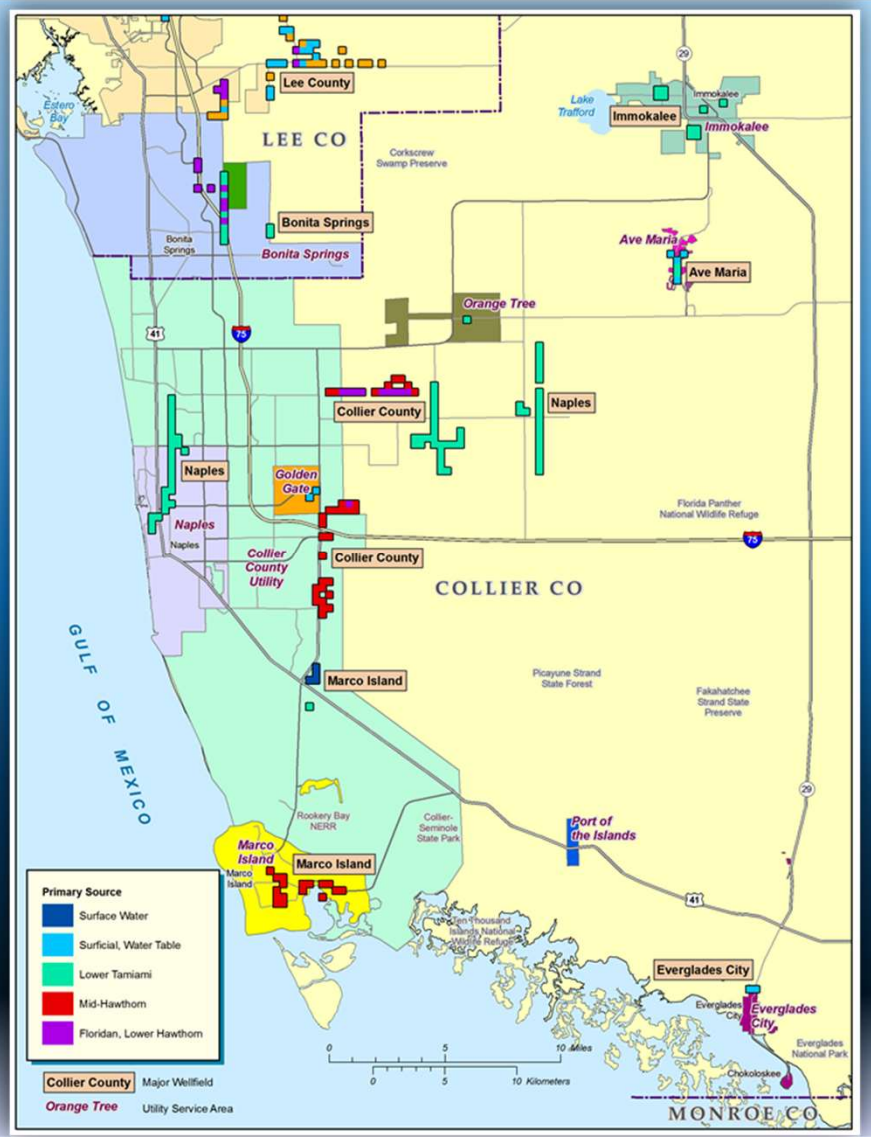


Generalized Hydrogeology of South Florida



Why is this Important?

- Wellfields are a major water supply source – protect investment
- Once saltwater enters wells, very difficult (if not impossible) to reverse
- Very expensive to relocate wellfields and associated infrastructure (e.g., pipelines, treatment plants and processes)
- Other sources of water are more expensive to treat (e.g., Floridan aquifer system requires reverse osmosis)

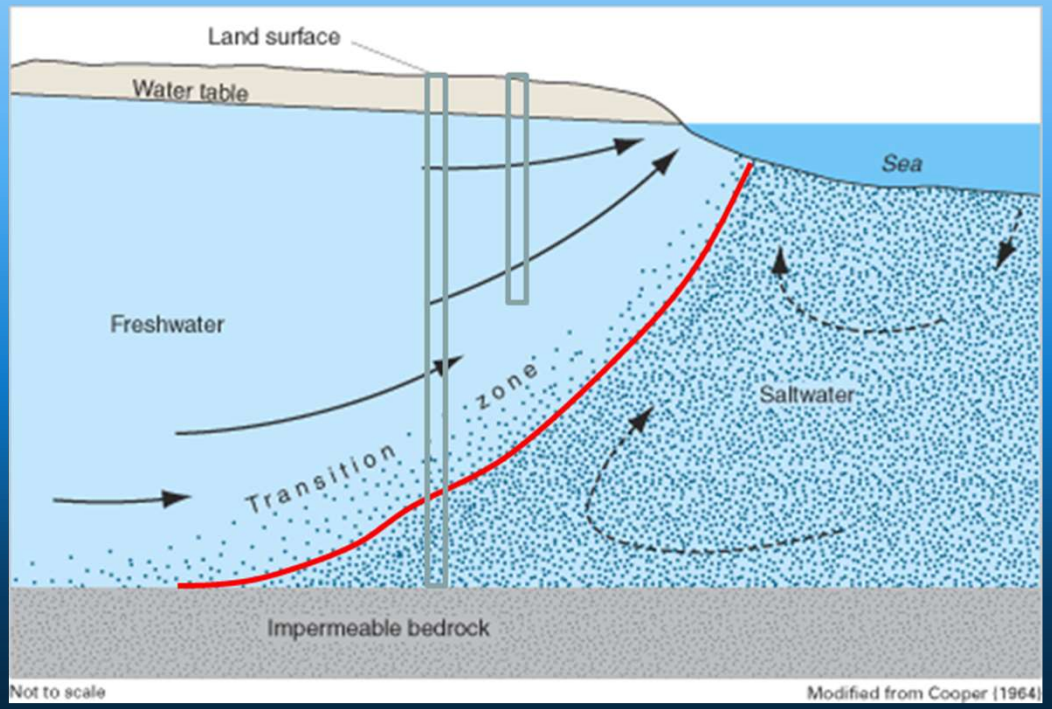


SFWMD Saltwater Interface Mapping Project

- Strategy: Compare interface positions over time (2009, 2014, 2019), note areas of concern, and adjust monitoring as necessary
- Update maps every 5 years
- Use all available data (USGS, SFWMD, counties, water use permittees)
- Farthest inland extent – dry season
- Maximum chloride value March/April/May 2019 (with some exceptions)
- 250 milligrams per liter (mg/L) chlorides – drinking water standard
- Coastal aquifers: Water Table (Biscayne), Lower Tamiami, Sandstone, and Mid-Hawthorn

Mapping Challenges

- Representing a 3D feature on a 2D map
- Representing a dynamic interface with fixed-time snapshots
- Representing a diffuse front with a single line
- Mapping from data that may represent one of several saltwater intrusion pathways
- Some wells used in 2009 and 2014 may not be available in 2019 (abandoned, destroyed, no longer monitored)
- New wells added to 2019 may alter interpretation of isochlor line
- Existing monitor well spacing, well depth, and construction



Other Considerations

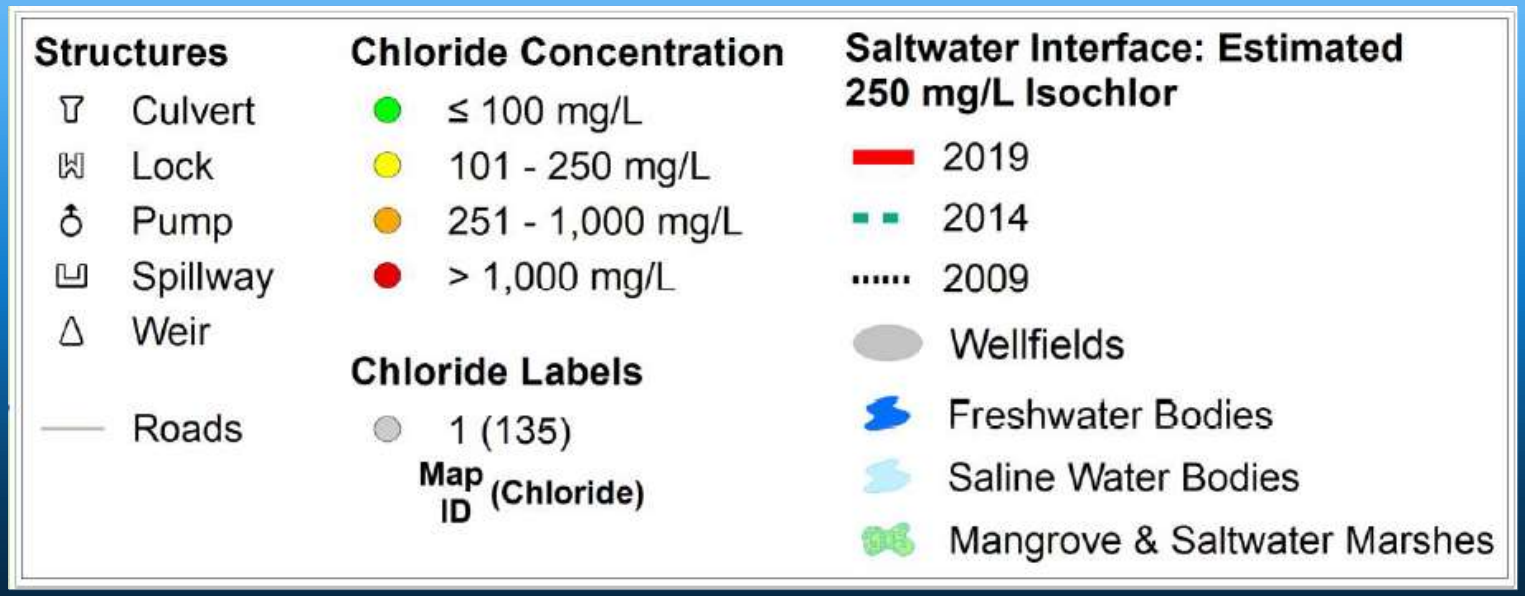
- Standardized well construction (e.g., short screen vs. long)
- Open interval position – base of aquifer
- Standardized sampling techniques
- Standardized parameters (chloride vs. conductivity)
- Sampling frequency
- Analytical methodology (field and laboratory)

Saltwater Intrusion Mapping

County	Aquifer	2009	2014	2019
Martin & St. Lucie	Surficial aquifer system	X	X	X
Palm Beach	Surficial aquifer system	X	X	X
Broward	Surficial aquifer system	X	X	X
Lee	Water Table	X	X	X
Lee	Mid-Hawthorn	X	X	-
Lee & Collier	Sandstone	X	X	X
Lee & Collier	Lower Tamiami	X	X	X
Collier	Water Table	X	X	X
Collier	Mid-Hawthorn	X	X	-
Lee & Collier	Mid-Hawthorn	-	-	X

Note: Miami-Dade County mapping performed by the USGS

Legend

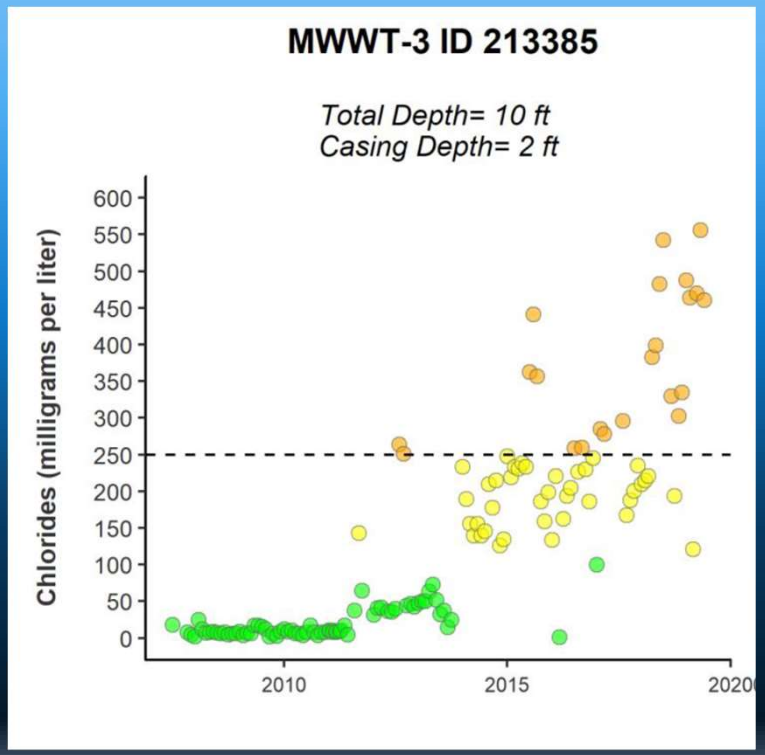

Structures
Culvert
Lock
Pump
Spillway
Weir
Roads
Chloride Concentration
≤ 100 mg/L
101 - 250 mg/L
251 - 1,000 mg/L
> 1,000 mg/L
Chloride Labels
1 (135)
Map ID (Chloride)
Saltwater Interface: Estimated 250 mg/L Isochlor
2019
2014
2009
Wellfields
Freshwater Bodies
Saline Water Bodies
Mangrove & Saltwater Marshes

Map ID	SFWMD Facility ID	Project Name	Well Name	XCOORD	YCOORD	Cased Depth (feet lbs)	Total Depth (feet lbs)	Chloride (mg/L)
1	151658	HERONS GLEN	DV-1	353815	886551	6	16	105
2		USGS	L-2217	407800	886031	10	18	48
3	151660	HERONS GLEN	DV-3	353815	884739	5	15	57
4	151659	HERONS GLEN	DV-2	358805	884691	3	13	78
5	253993	COUNTY LINE DRAINAGE DISTRICT	PZ-1	463513	873122		15	36
6		USGS	L-1976	423498	872914	5	15	12
7		USGS	L-1976_G	423498	872914	5	15	10
8	213384	THE VERANDAH	MWWT-2	411150	861900	2	10	123
9	213382	THE VERANDAH	MWWT-1	411800	861580	2	10	45
10	213385	THE VERANDAH	MWWT-3	411500	861150	2	10	556
11		USGS	L-721_G	316766	860925		18	13
12	3242	R & D FARMS	W1	285686	855474	40	60	78
13	147722	GREENPLANET LANDSCAPE NURSERY	MW1	281559	853645	55	60	11200
14	12359	TWO PINES 40	1	283559	852104	45	60	157
15	141452	DEAN PROPERTY	MW2	281100	851654	40	50	1120
16	147707	TCCT - 101	SW1	289387	847785	55	55	43
17	147709	TCCT - 101	SW2	288640	847765	65	50	50
18	147101	OVERTON WELLS NUMBER 2 AND NUMBER 3	MW1	289262	845684	45	60	490
19	278542	GATEWAY WATER SERVICES DISTRICT	PZ-3	408610	827276	10	15	138
20	191301	PELICAN PRESERVE (LANDSCAPE)	WT-MW	399963	822360	2	10	34
21		USGS	L-1136	332884	822323	15	20	86
22	278541	GATEWAY WATER SERVICES DISTRICT	PZ-2	410329	818568	10	15	121
23	278540	GATEWAY WATER SERVICES DISTRICT	PZ-1	416058	815130	10	15	85
24	279553	CENTURYLINK SPORTS COMPLEX	MW-WT-1	379344	802463	5	15	73
25	279554	CENTURYLINK SPORTS COMPLEX	MW-WT-2	380273	800280	5	15	145
26	26903	LEGENDS GOLF AND COUNTRY CLUB	WT-1	390890	799810	15	35	154
27	224081	U-PICK FARMS	Monitor Well 1	362747	795111	5	10	95
28	31360	LEE COUNTY UTILITIES	GM-6A (wta)	426824	792479	18	40	22
29	31362	LEE COUNTY UTILITIES	GM-8A (wta)	432151	792457	20	42	26
30	31361	LEE COUNTY UTILITIES	GM-7A (wta)	429332	792454	18	36	22
31	31359	LEE COUNTY UTILITIES	GM-5A (wta)	424050	792436	20	24	34
32	31363	LEE COUNTY UTILITIES	GM-10A (wta)	437354	792430	18	42	19

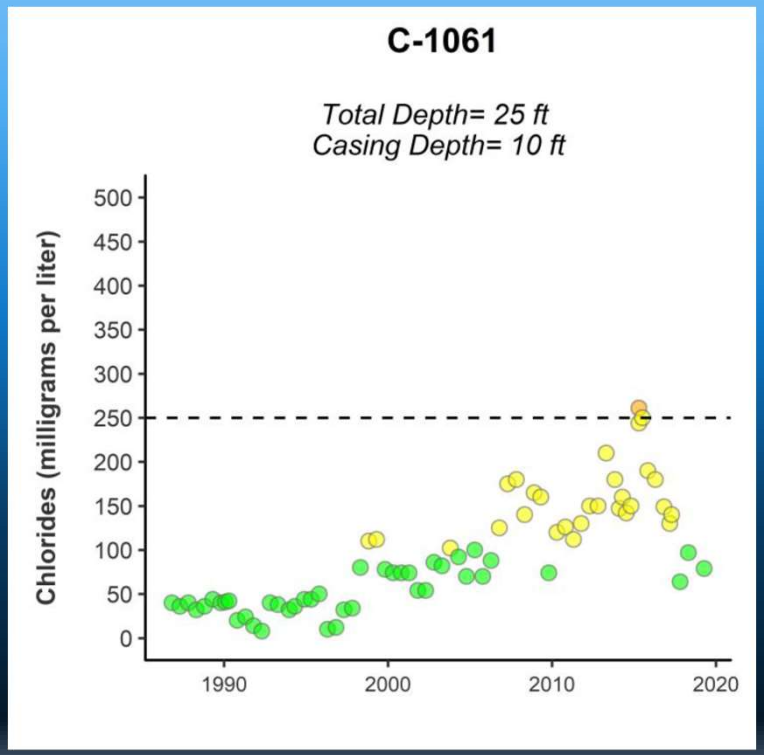
Chloride Time Series Plots

(Representing both sides of interface)

West

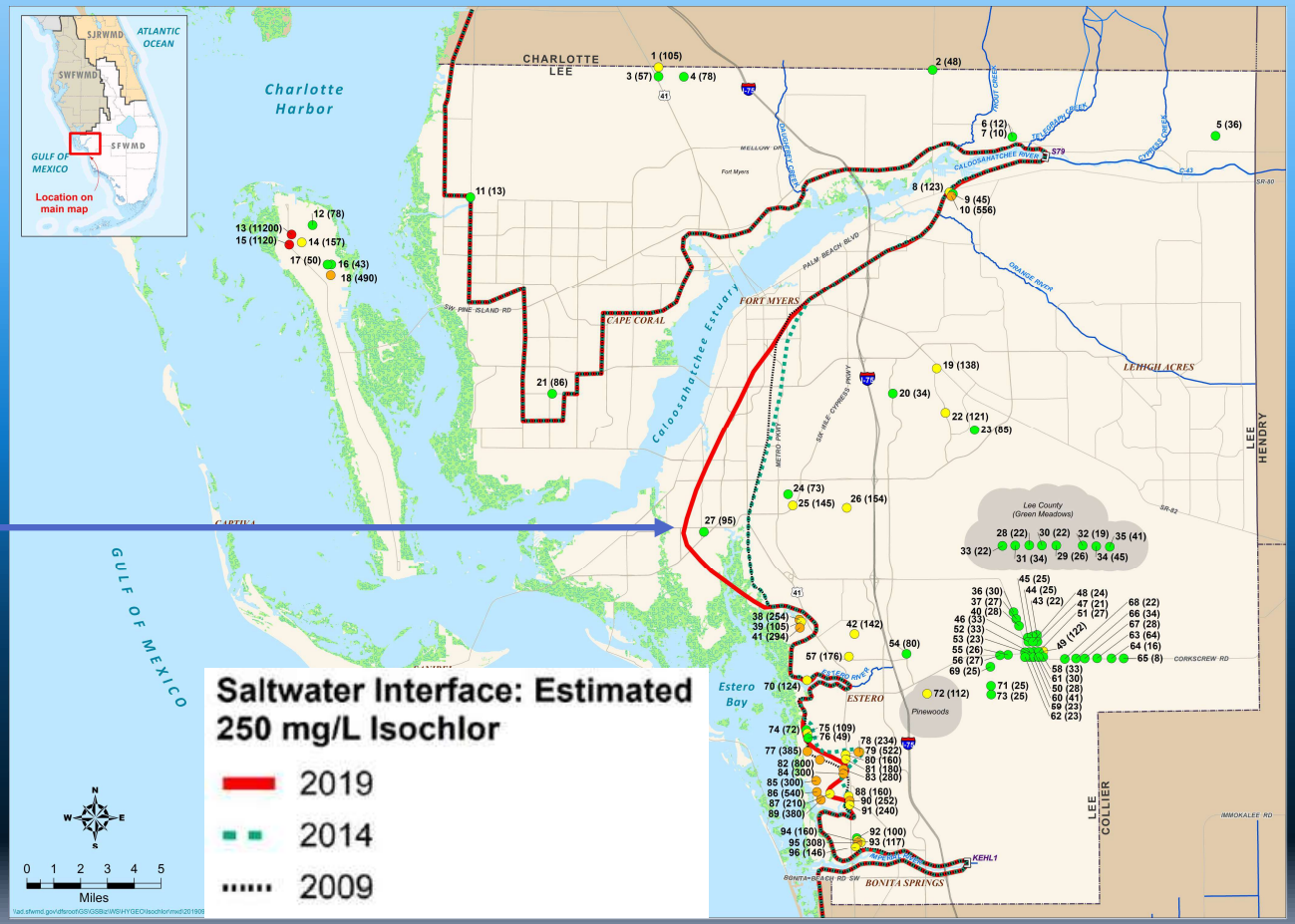


East

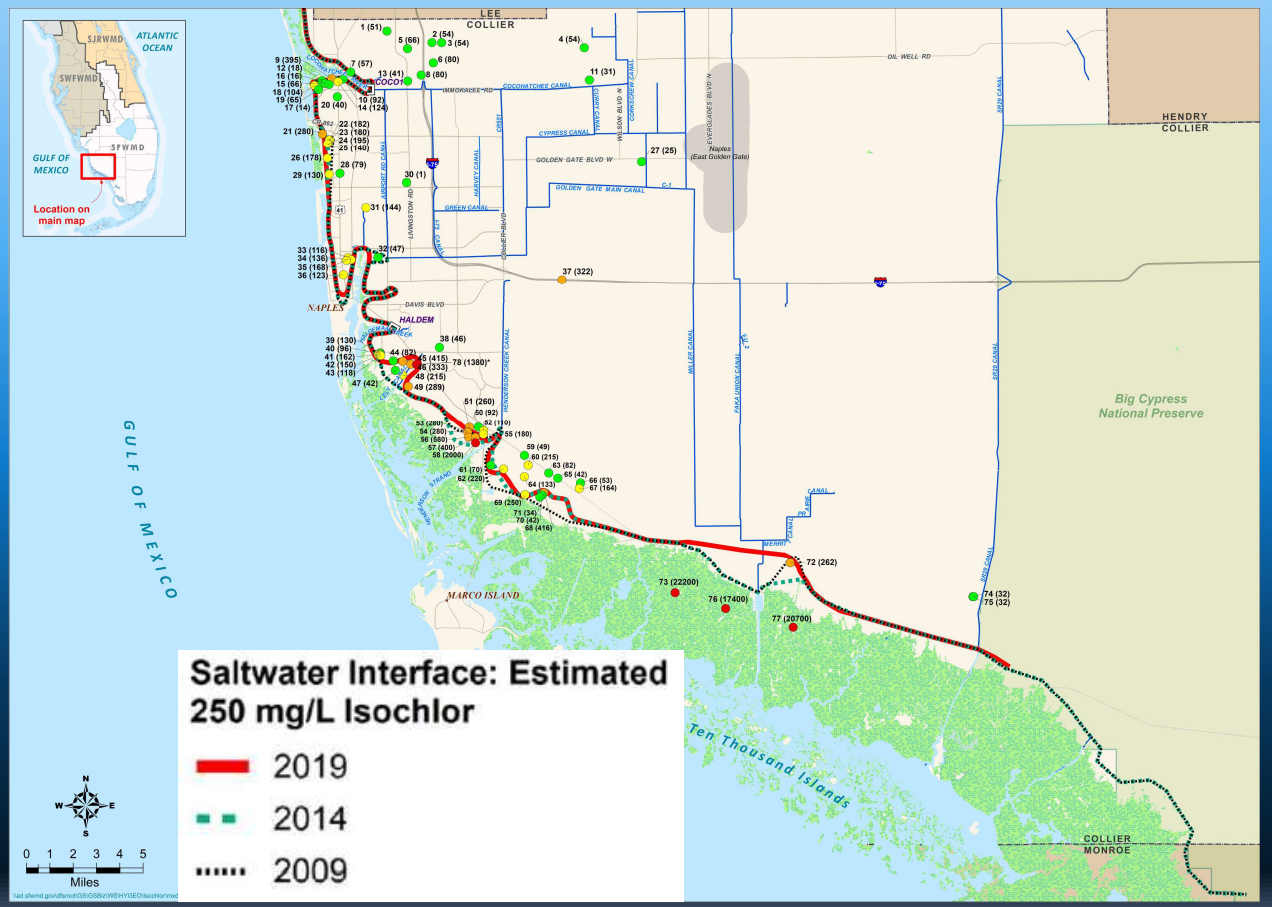


Lee County – Water Table Aquifer

- Relatively few changes
- Some improvements – new data points

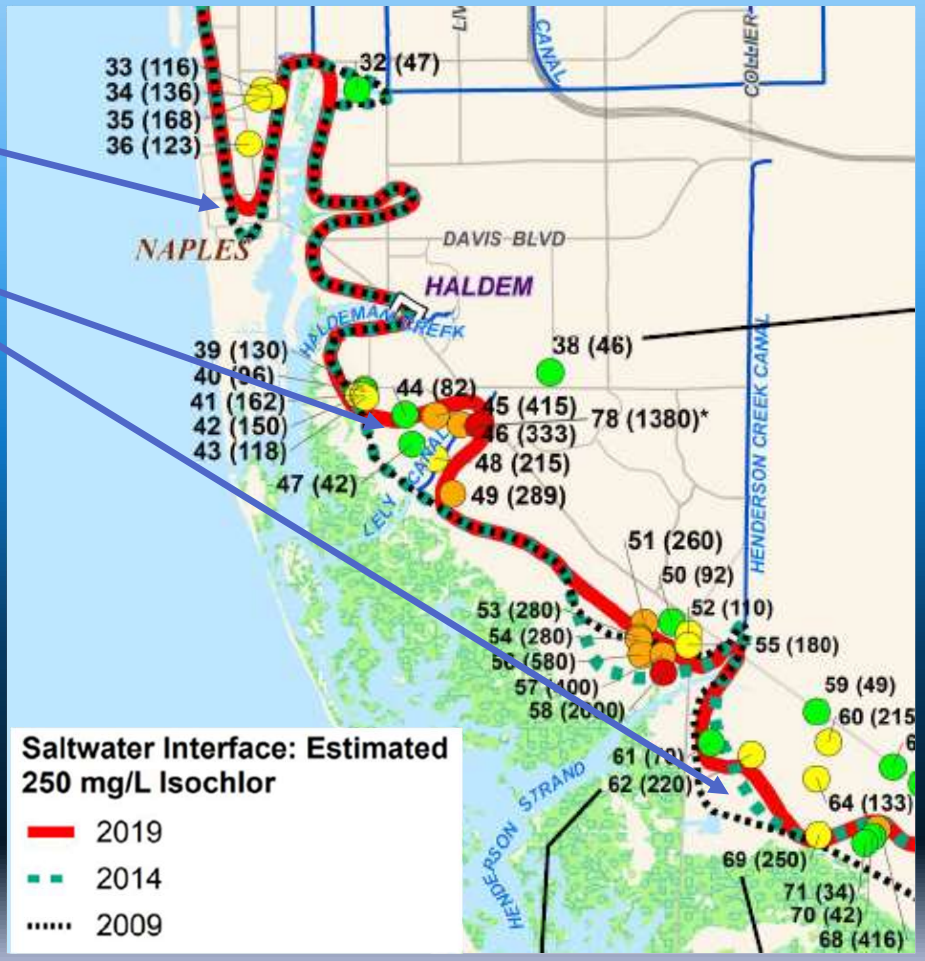


Collier County – Water Table Aquifer



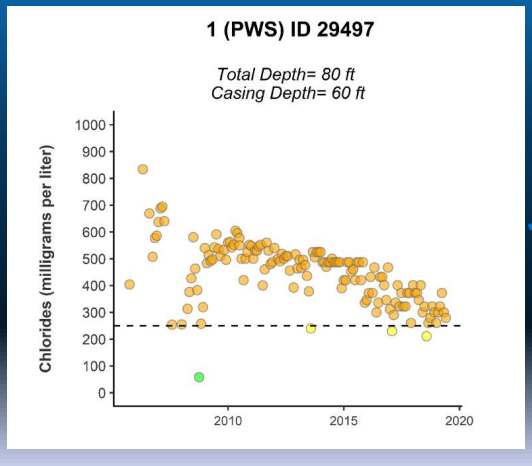
Collier County – Water Table Aquifer

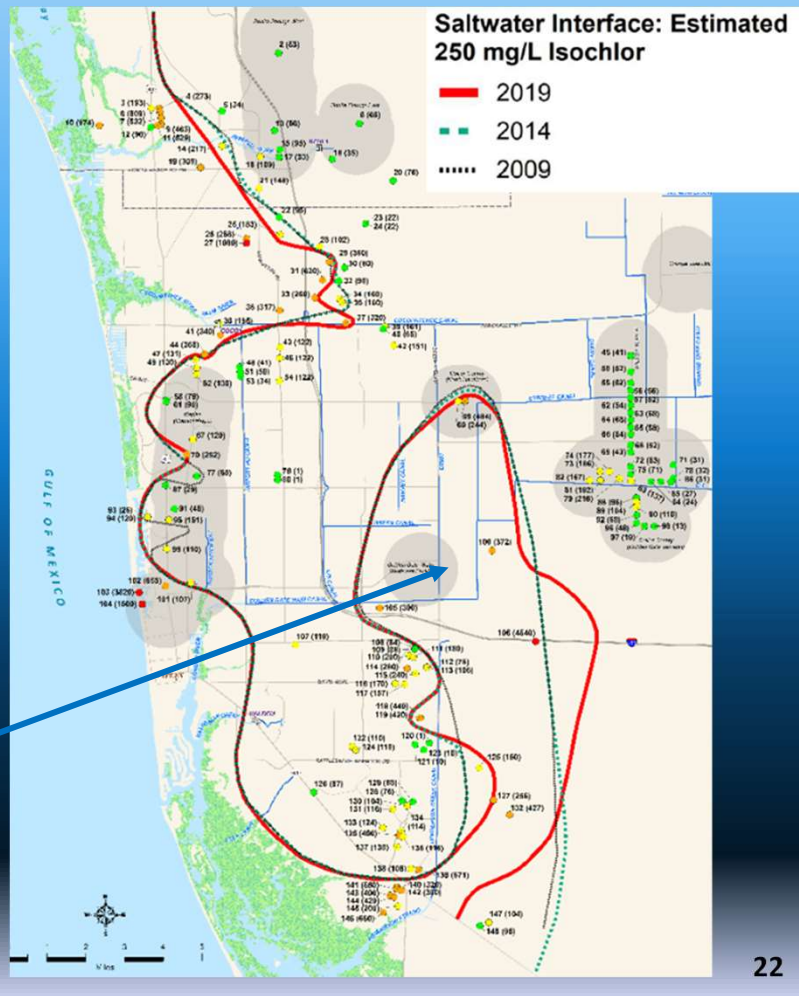
- Relatively stable in the Naples area
- Inland movement near Lely Canal and Henderson Creek
- New development near the coast. Surface water is tidal and ranges from fresh to saline. Permittees monitor for chloride concentration in groundwater



Lee & Collier Counties – Lower Tamiami Aquifer

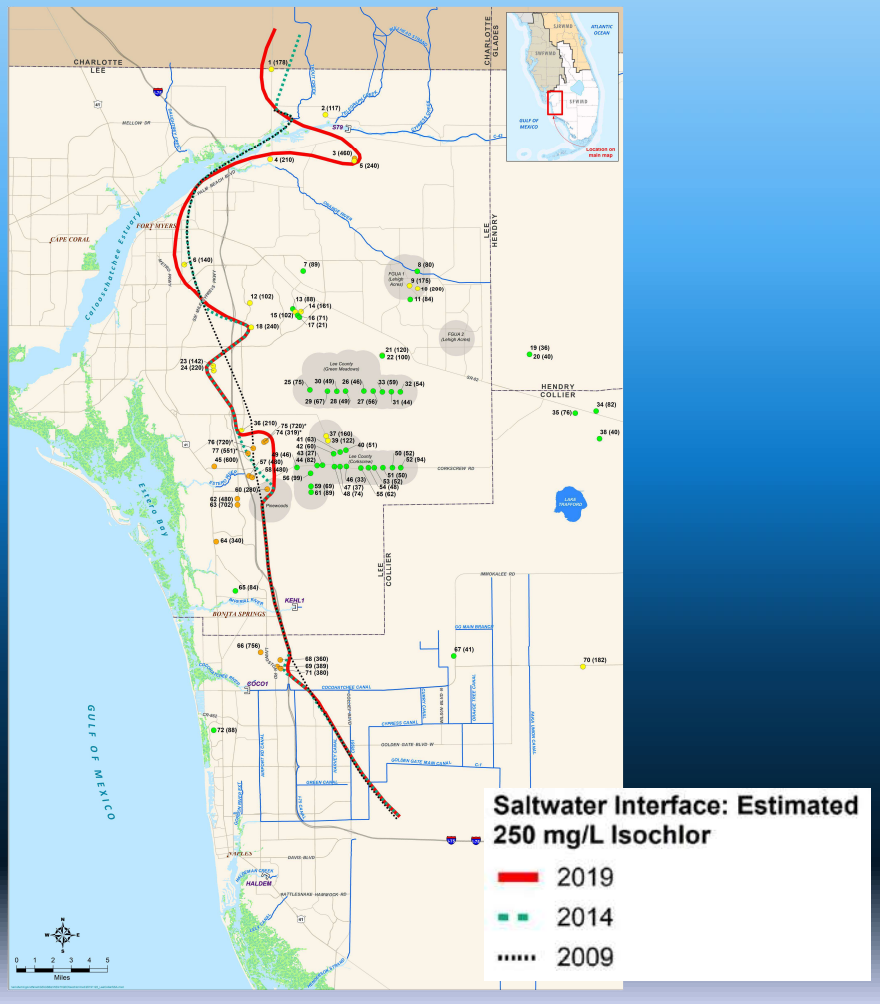
- Relative stable near Naples Coastal Ridge wellfield
- Interface retreated in Bonita Springs and northern Collier County
- Movement in southern Collier County
- Example of relict seawater





Lee & Collier Counties – Sandstone Aquifer

- Two new monitor wells in confined aquifer. Chloride concentrations are monitored and fluctuate, with high concentration at the end of the dry season.
- Results in apparent landward movement in the Buckingham/ Lehigh Acres area and near FGCU



Lee & Collier Counties – Mid-Hawthorn Aquifer

- One new monitor well in confined aquifer. Chloride concentrations are monitored and fluctuate, with high concentration at the end of the dry season.

Conclusions

- Water Table aquifer – Noticeable inland movement around Lely Canal and Henderson Creek
- Lower Tamiami aquifer – Interface retreated in northern Lee and southern Collier counties; advanced in southern Collier County
- Interface is dynamic – advanced and retreated depending on wellfield pumpage, reclaimed water use, tides, sea level rise, and other factors
- Saltwater intrusion is occurring, emphasizing the importance of continued monitoring (laterally and vertically) and wellfield management
- Additional, localized monitoring may be required at select projects and wellfields by permittees to protect water supplies

Next Steps

- Work with local governments, the USGS, permittees, and others to:
  - Identify other existing wells to increase mapping accuracy for future maps
  - Consider sampling frequency
  - Identify funding to facilitate well replacement, as needed
  - Evaluate needs and identify funding for new wells where there are data gaps and in areas of concern

Resources

- 2009, 2014, and 2019 maps available at: https://www.sfwmd.gov/documents-by-tag/saltwaterinterface
- Merged isochlor 2019: https://geo-sfwmd.hub.arcgis.com/datasets/merged-isochlor-2019
- Chloride data 2019: https://geo-sfwmd.hub.arcgis.com/datasets/chloride-data-2019

- Jon Shaw, jshaw@sfwmd.gov, (561) 682-6849

Questions and Discussion

Thank You