Florida Water Resource Monitoring Council

Salinity Network Workgroup

November 9, 2016

1:00 – 3:00 PM

Chair: Rick Copeland (FDEP)

Agenda

- **Introduction**
- **GWL, PR Index for the UFA** (RC)
  - **Comments Regarding the GWL PR Index** (LB)
- **Coastal Salinity Monitoring Network Status** (RC)
- **Development of a South Florida Salinity Web page** (SP)
- **Protocols for Sampling Wells for purpose of monitoring the Fresh-water/Salt-water interface** (RC, SS, SP)
- **GWQ Index –** (RC)
- **Ideas for Future Direction of the SNW**

  - Discussion

RC: Rick Copeland (FDEP)

LB: Lucia Baldwin (SFWMD)

SP: Scott Prinos (USGS)

SS: Stephanie Sunderman-Barns (FDEP)

Four Current Objectives of SMW

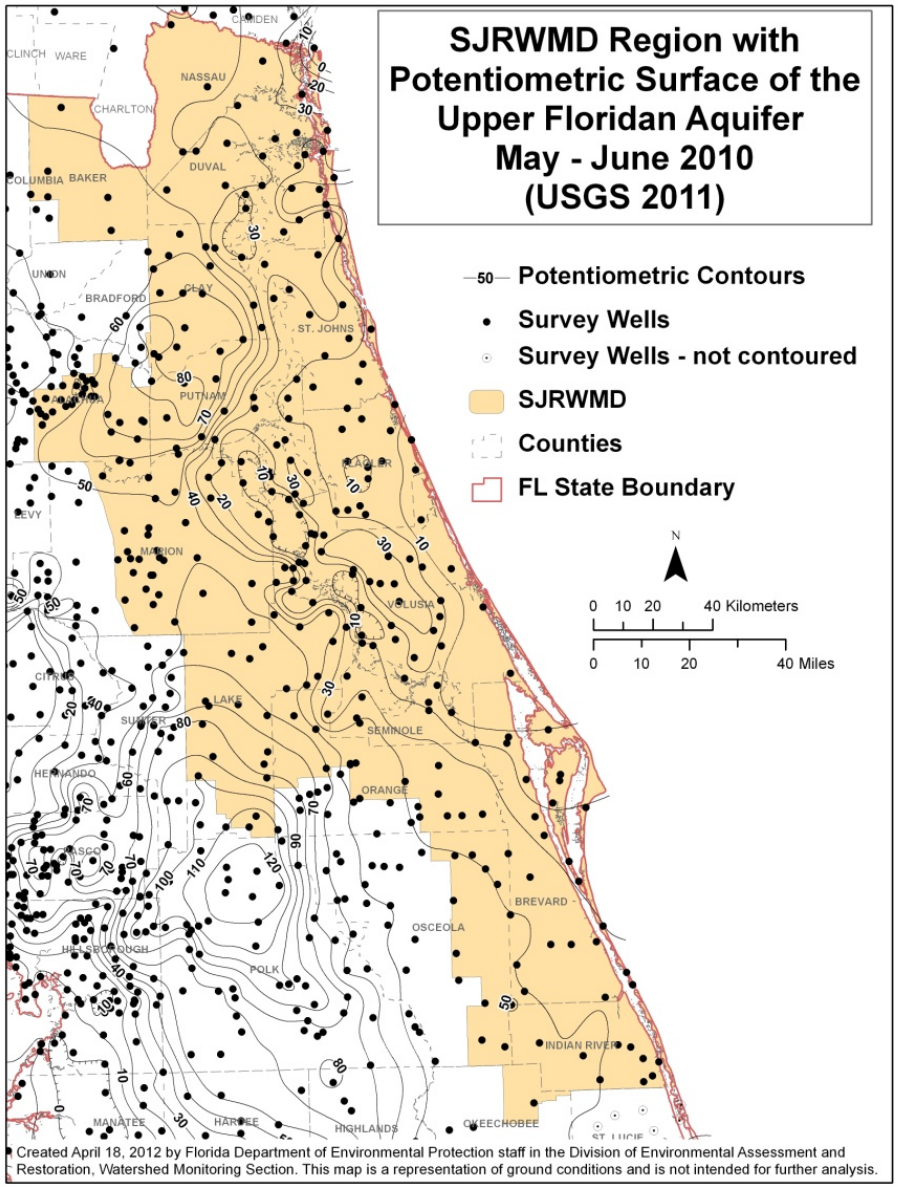
- **GWL, PR Index for the UFA**
- **Coastal Salinity Monitoring Network**
- **Protocols for Sampling in Wells for the purpose of monitoring the Fresh-water/Salt-water interface**
- **GWQ Index**

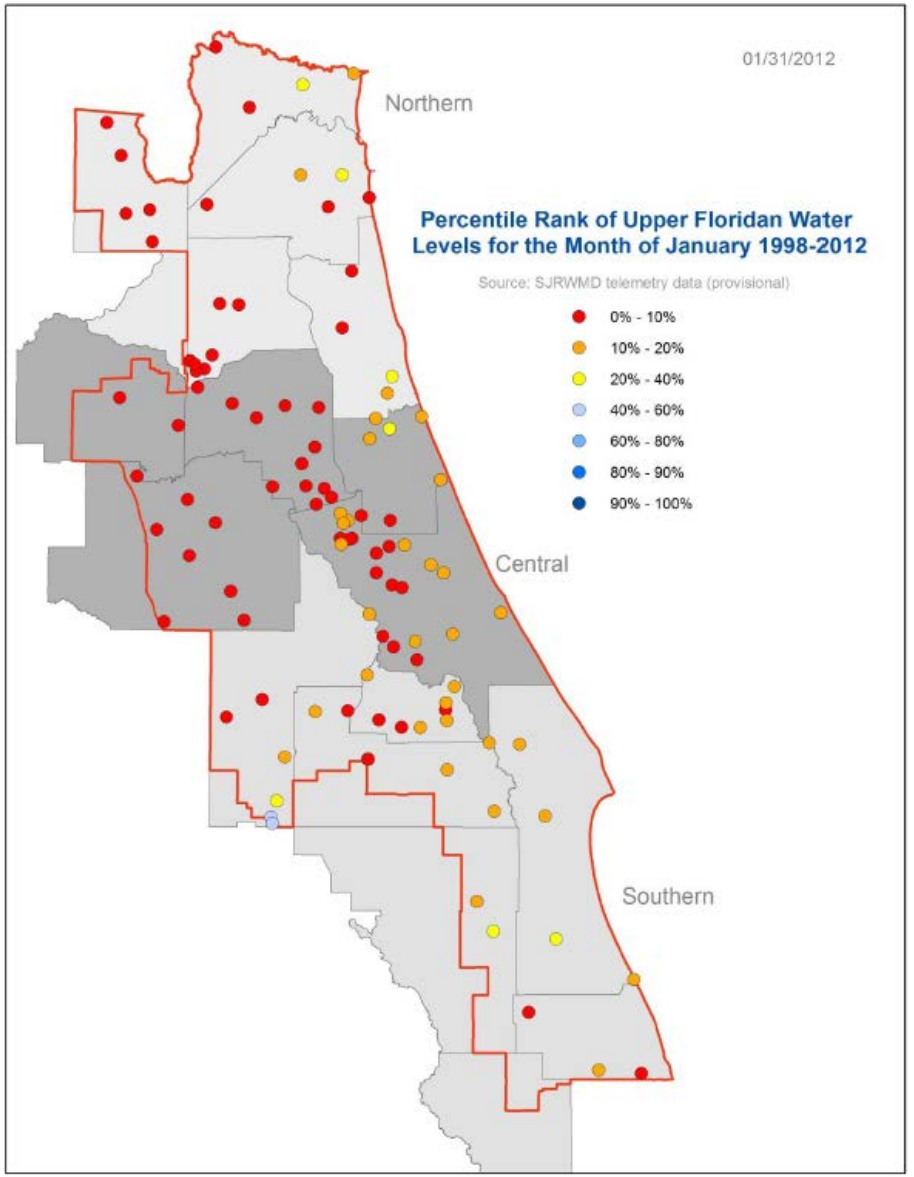
(1) GWL Percentile Ranking Index

- Periodically create a **composite** statewide PRI map, along with explanatory text

- Completed Pilot study (late 2014)
- Commence production twice/year; (2015)
  - May and September

  - May, 2015 Status
  - Sept, 2015 Status

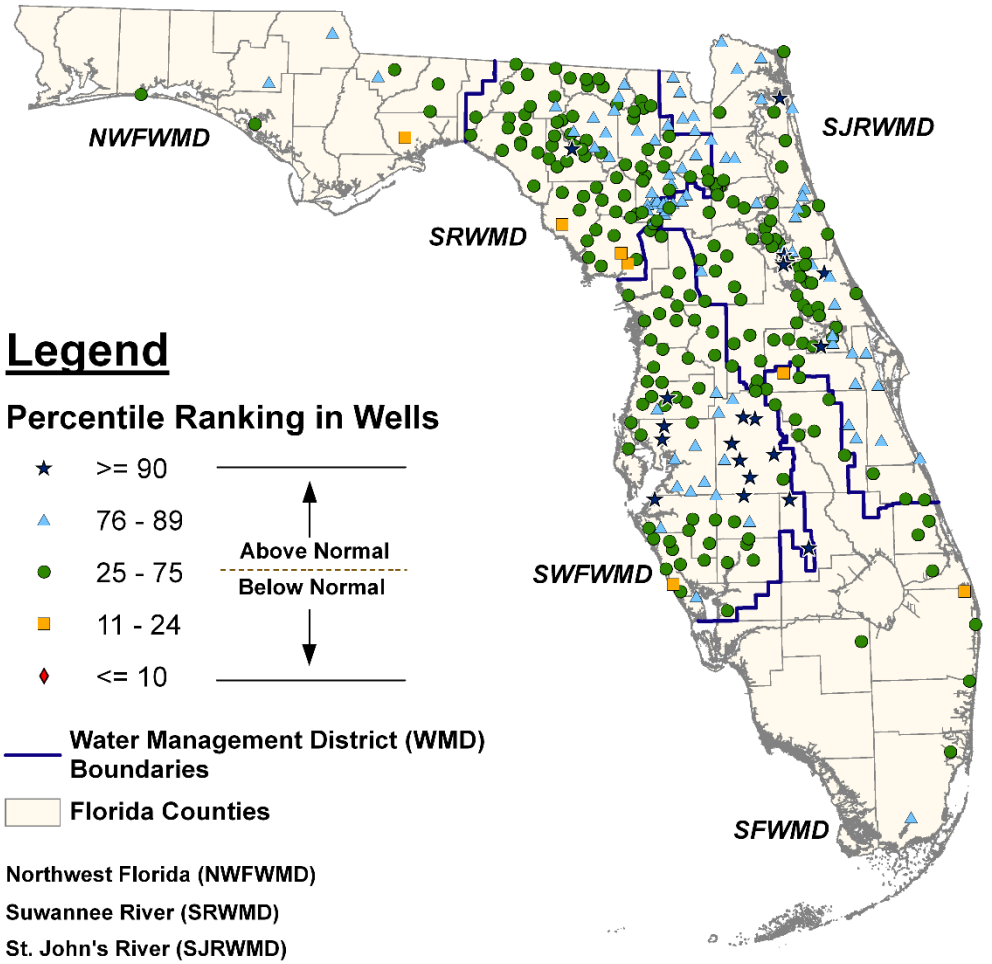

SJRWMD Region with Potentiometric Surface of the Upper Floridan Aquifer May - June 2010 (USGS 2011)
50 Potentiometric Contours
Survey Wells
Survey Wells - not contoured
SJRWMD
Counties
FL State Boundary
N
0 10 20 40 Kilometers
0 10 20 40 Miles
CLINCH
WARE
CAMDEN
NASSAU
CHARLTON
DUVAL
COLUMBIA
BAKER
UNION
BRADFORD
CLAY
ST. JOHNS
PUTNAM
FLAGLER
LEVY
MARION
VOLUSIA
CITRUS
LAKE
SUMTER
SEMINOLE
HERNANDO
ORANGE
PASCO
BREVARD
OSCEOLA
HILLSBOROUGH
POLK
INDIAN RIVER
MANATEE
HARDEE
HIGHLANDS
OKEECHOBEE
ST. LUCIE
Created April 18, 2012 by Florida Department of Environmental Protection staff in the Division of Environmental Assessment and Restoration, Watershed Monitoring Section. This map is a representation of ground conditions and is not intended for further analysis.


01/31/2012
Northern
Percentile Rank of Upper Floridan Water Levels for the Month of January 1998-2012
Source: SJRWMD telemetry data (provisional)
0% - 10%
10% - 20%
20% - 40%
40% - 60%
60% - 80%
80% - 90%
90% - 100%
Central
Southern

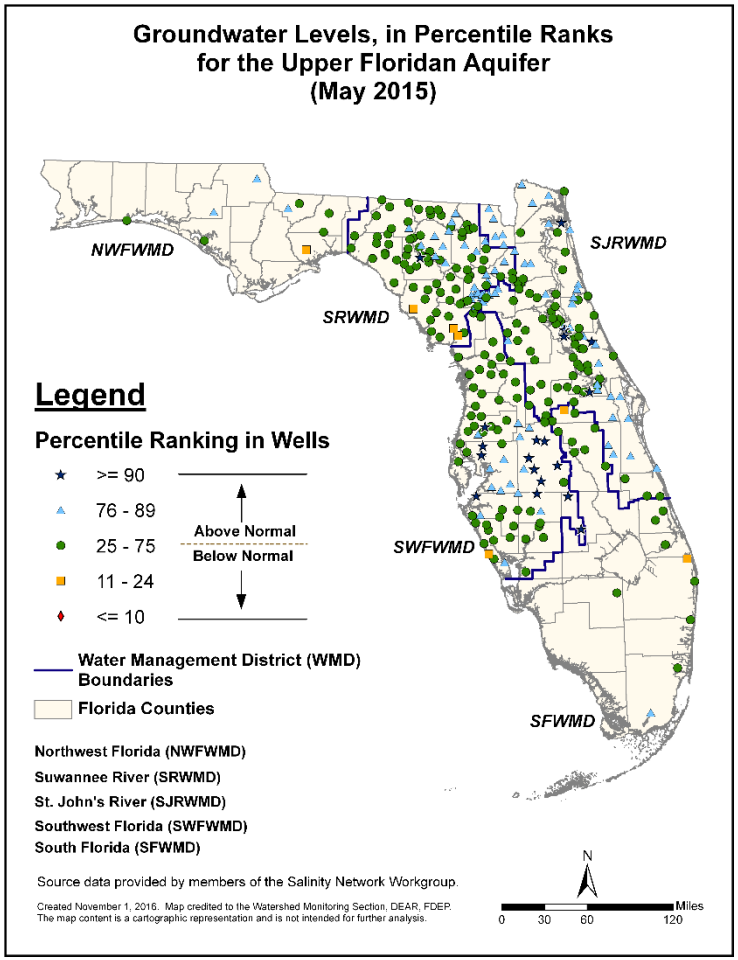
Map and Text

- Each map to be accompanied by an explanation page
- Lag time – Currently working on May and September, 2015 maps
- When complete, each map/text is uploaded to a link

Groundwater Levels, in Percentile Ranks for the Upper Floridan Aquifer (May 2015)



Issues to possibly address in the future



- PRI map is composite
  - Inconsistent POR
  - and methodologies
- For PR map
  - Decrease density of wells in SR, SJ, & SW?
  - Over time PORs may become more consistent
  - Over time, change to one standard meth?

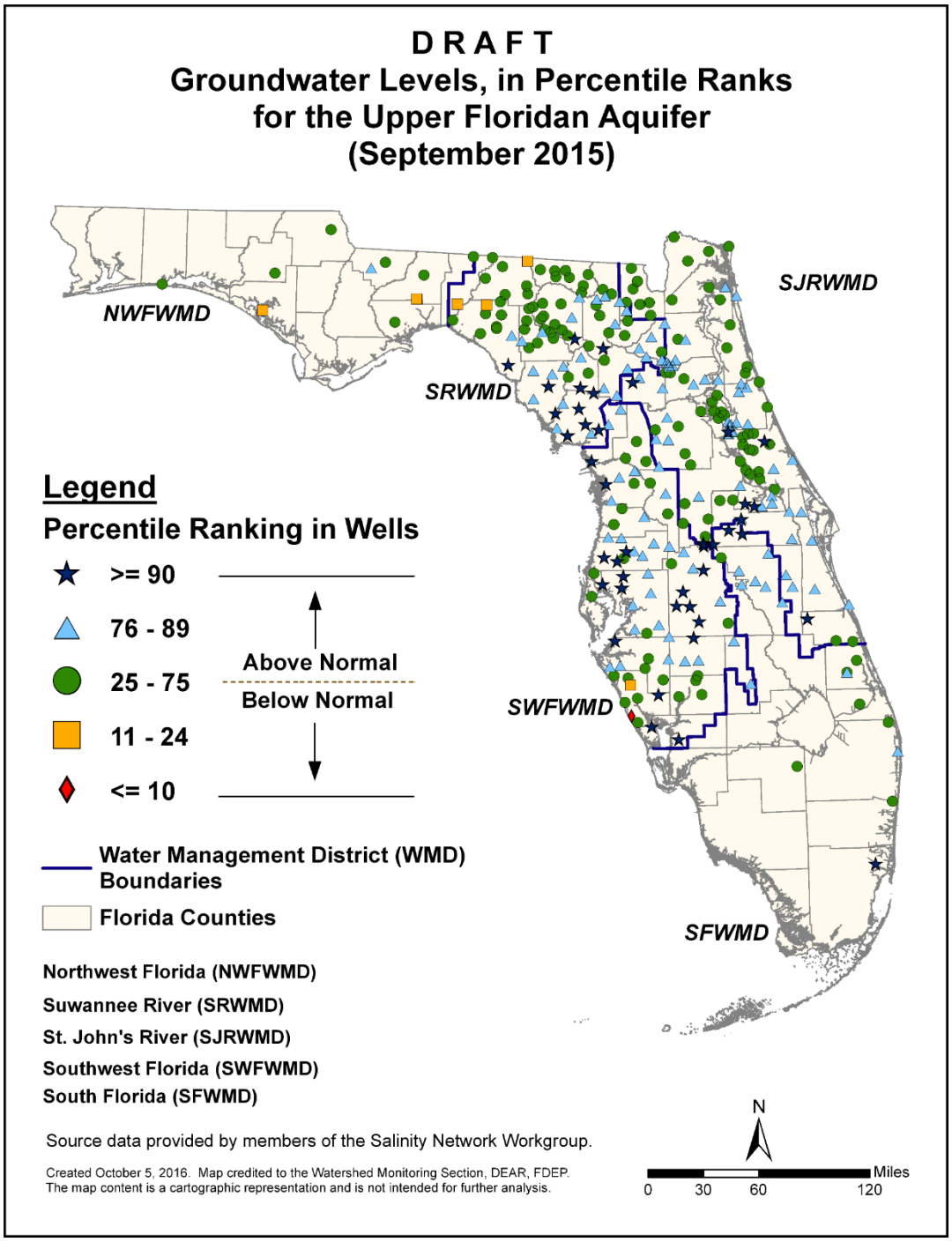
SR- SRWMD
SJ- SJRWMD
SW- SWFWMD

May 2015 Map - Status

- STATUS
  - RC – Needs to complete text
  - Send text out for review
  - Post final version on web site

September 2015 Map - Status

- STATUS
  - Map needs to be reviewed
  - RC – Needs to complete write text
  - Send text out for review
  - Post final version on web site


D R A F T
Groundwater Levels, in Percentile Ranks
for the Upper Floridan Aquifer
(September 2015)
NWFWMD
SRWMD
SJRWMD
SWFWMD
SFWMD
Legend
Percentile Ranking in Wells
>= 90
76 - 89
25 - 75
11 - 24
<= 10
Above Normal
Below Normal
Water Management District (WMD) Boundaries
Florida Counties
Northwest Florida (NWFWMD)
Suwannee River (SRWMD)
St. John's River (SJRWMD)
Southwest Florida (SWFWMD)
South Florida (SFWMD)
Source data provided by members of the Salinity Network Workgroup.
Created October 5, 2016. Map credited to the Watershed Monitoring Section, DEAR, FDEP.
The map content is a cartographic representation and is not intended for further analysis.
N
0 30 60 120
Miles

Pilot Study Final Report

"Groundwater Level Conditions for the Upper Floridan Aquifer Based on Percentile Ranks Pilot Study for May, 2010"

by Salinity Network Workgroup

Includes descriptions of PRI Methodologies

Needs several slight Modifications

Still – Issues to be resolved

- (1) May (Sept) PRI
  - (a) Is PRI based on May (Sept) monthly value compared to entire POR?

    or
  - (b) Is PRI based on May(Sept) monthly value compared to all other May (Sept) monthly values of POR? (a seasonal PRI)

Still - Issue to be resolved

Have methods in Appendices but

Need abbreviated verbiage within main text of the document that describes, for each participating entity, the PRI methodology used (seasonal or not), the equation used, and the POR

Still – Regarding Equation

- DEP Equation
  - PR(x) = [(# OBS < x)/(n-1)] x 100

Comments Regarding the Ground Water Level (GWL) Percentile Ranking Index

Lucia Baldwin - SFWMD

Comments Regarding the Ground Water Level (GWL) Percentile Ranking Index

Lucia Baldwin, PhD
Senior Scientist
Compliance & Reporting Section

FWRMC Salinity Network Workshop
November 9, 2016

Objectives

1. Discuss Percentile Rank functions in Excel

   PERCENTRANK (Array, x)

2. Discuss the arguments of Percentile Rank function
   - Array / Data Set
   - Value (x) we want to rank against the Array
3. To ensure consistency across reporting agencies

1. Percentile Rank Functions in Excel

Array
21
22
22
23
23
24
25
28
37
45
48
67

What percentage of the data has values under 23?

PERCENTRANK (array, 23) = 27%

PERCENTRANK.INC (array, 23) = 27%

PERCENTRANK.EXC (array, 23) = 31%

Excel 2007 Excel 2010, 2013, 2016, …..

PercentRank.INC vs. PercentRank.EXC

Array
21
22
22
23
23
24
25
28
37
45
48
67

Array
21
22
22
23
23
24
25
28
37
45
48
67

PERCENTRANK.INC (array, 67) = 100%

PERCENTRANK.EXC (array, 67) = 92%

PERCENTRANK.INC (array, 21) = 0%

PERCENTRANK.EXC (array, 21) = 8%

2. Value (x) we want to rank

x is a GWL value representative for May / September of each year:

– monthly median of max daily values – **SFWMD**
(wells with max daily data and wells with 15-min. data)

– value registered nearest 15th of the month – **NFWMD**
(wells with daily, monthly or quarterly frequency data)

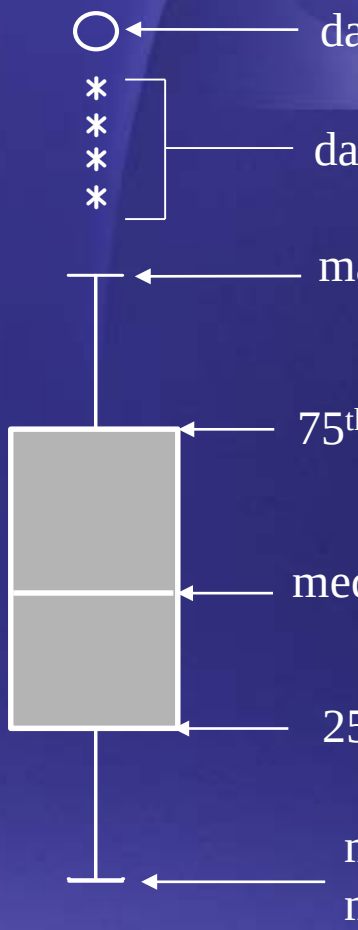
– daily mean on the 27th of the month – **Suwannee River WMD**
(wells with 15-min/ hourly data and manually-read well with a single values during first 2 weeks of the months)

Option for Choosing the Array / Data Set Against Which Value x Is Ranked

- All similar values registered for entire period of records

- Similar values registered during the same month (week or season)

Box Plot Description



data greater than 4 standard deviations above the median

data greater than 2 standard deviations above the median

maximum data value not outside +2 standard deviations above the median

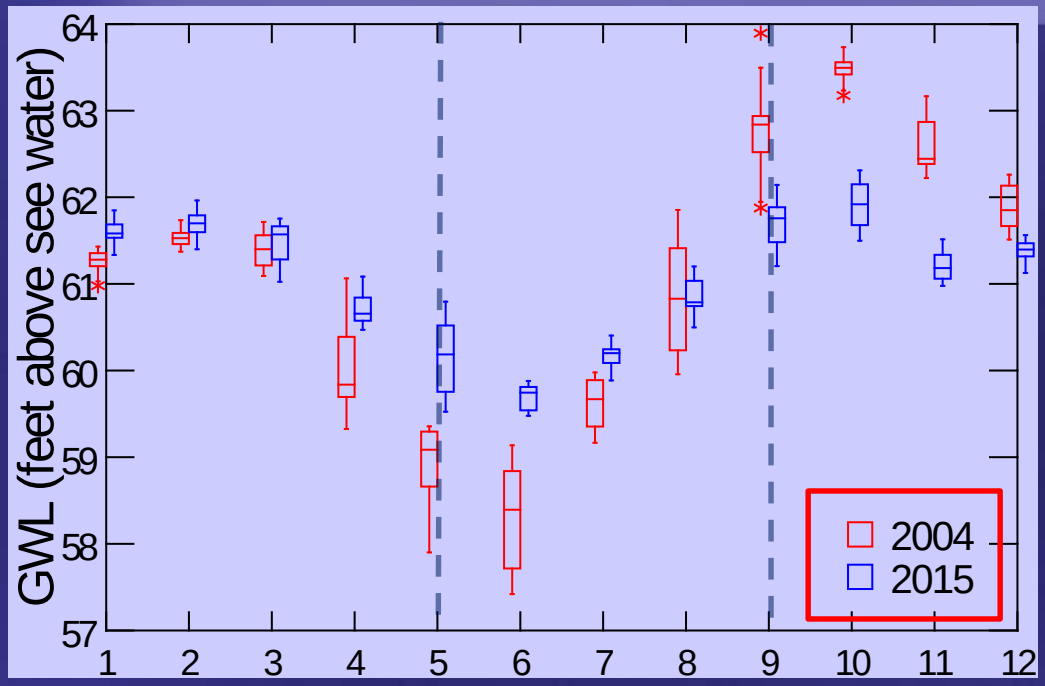
75th percentile (Q_{75})

median

25th percentile (Q_{25})

minimum data value not outside -2 standard deviations under median

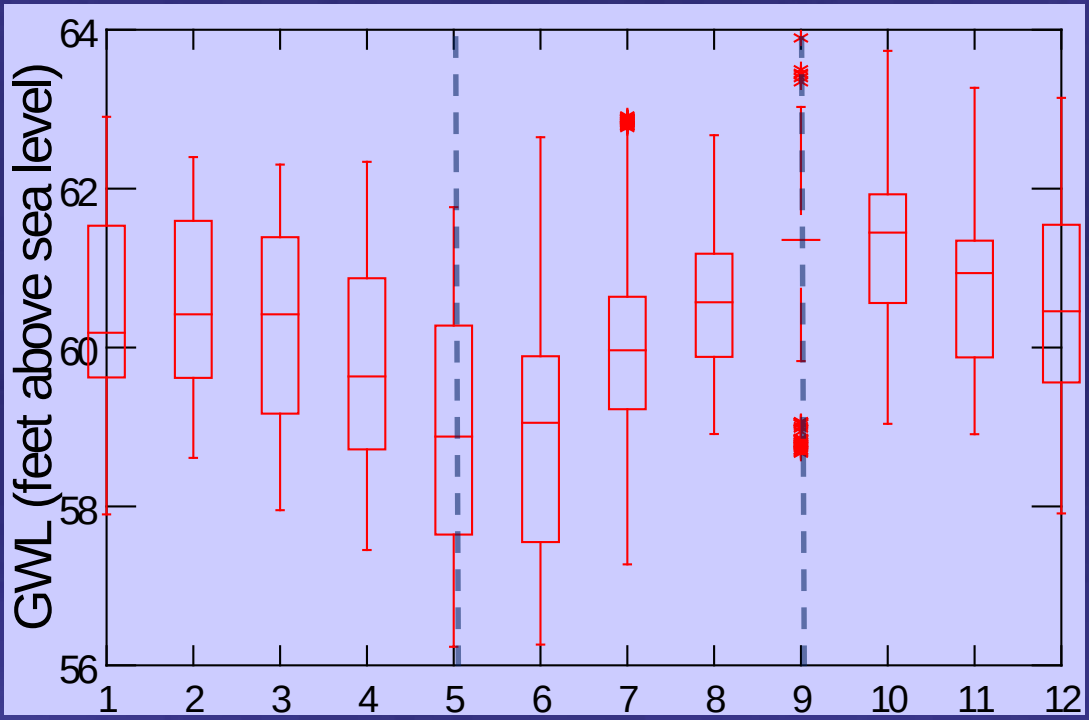
Daily Maximum GWL at Station POF-22 by Month



Note the seasonality of GWLs

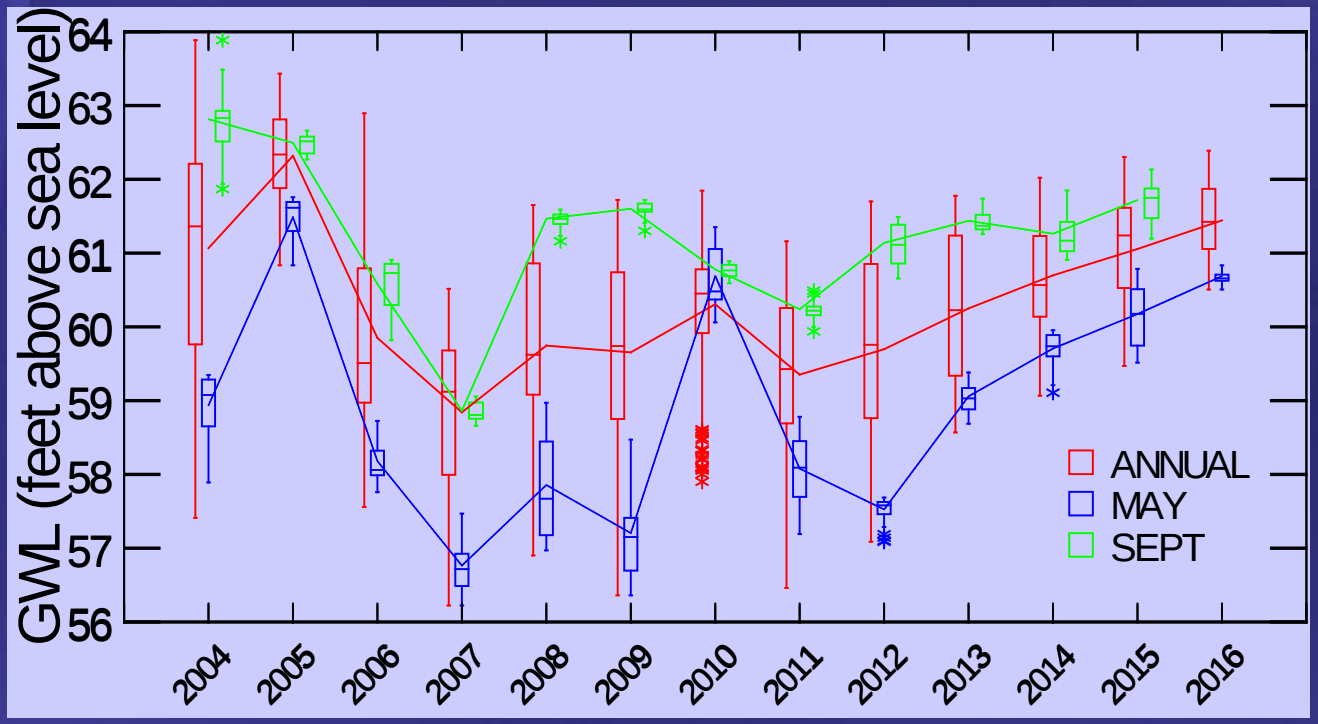
Low GWLs at the end /after dry season (May and June) High GWLs at the end /after wet season (September and Octo

GWL at Station POF-22 by Month for Interval 1/1/2004 to 5/31/2016



Seasonality is the same for the entire period of records

Seasonality of GWL in S. Florida at Station POF-22 (2004 – 2016)



May GWLs are, in most cases, lower are than annual GWLs
September GWLs are, in most cases, higher than annual GWL

Percentile Rank of Median GWL for May 2016

Station	vs . all GWL	vs. May GWL
BF-6	39.7	68.1
G-3061	79.2	92.4
L2-PW2	38.8	67.1
MF-52	36.7	66.9
ORF-19	66.1	82.3
ORF-32	35.7	72.5
OSF-102	60.9	86.5
OSF-22	45.5	77.0
OSF-62	48.0	78.8

Station	vs . all GWL	vs. May GWL
OSF-64	48.1	78.1
OSF-66	47.3	79.7
PB-747	2.9	14.9
PBF-2	76.5	93.5
POF-22	58.8	84.8
SKYLAKE	25.1	62.9
SLF-21	43.9	84.0
SLF-75	38.7	81.5
SLF-76	46.0	82.5

Comparing the x value with lower values data set yields higher percentile ranks.

Percentile Rank of Median GWL for September 2015

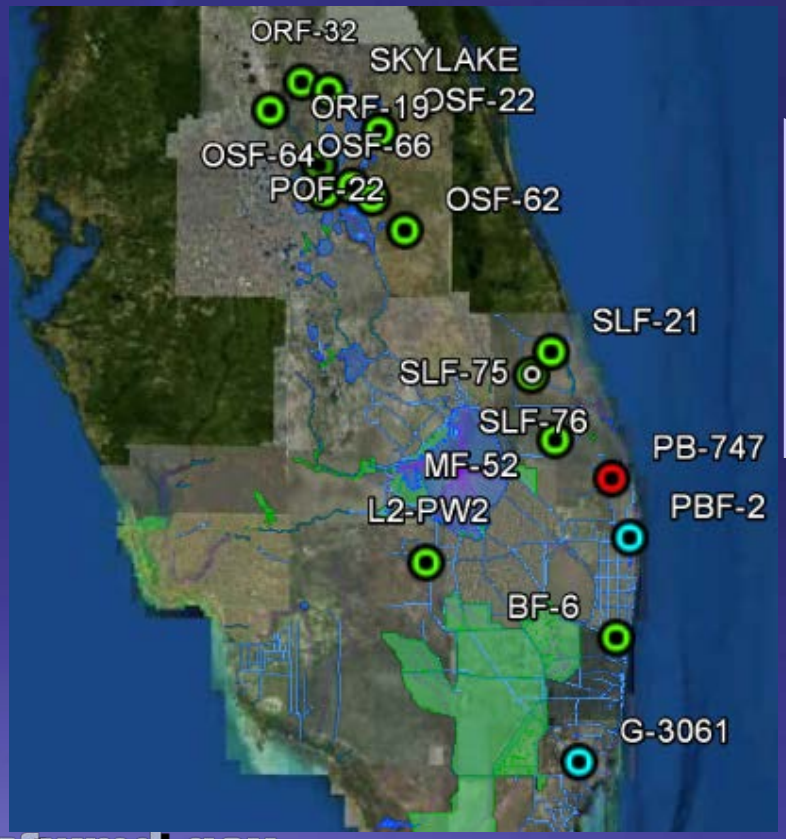
Station	vs. all GWL	vs. Sep. GWL
BF-6	69.6	38.6
G-3061	93.1	69.4
L2-PW2	75.6	34.4
MF-52	74.9	36.0
ORF-19	98.1	88.4
ORF-32	92.6	83.4
OSF-102	88.8	79.2
OSF-22	84.8	61.8
OSF-62	82.3	59.7

Station	vs. all GWL	vs. Sep. GWL
OSF-64	84.1	62.5
OSF-66	85.4	61.5
PB-747	37.9	6.0
PBF-2	89.3	80.5
POF-22	87.8	78.6
SKYLAKE	94.0	80.6
SLF-21	77.0	49.9
SLF-75	75.2	49.3
SLF-76	81.0	57.5

Comparing the x value with higher values data set yields lower percentile ranks.

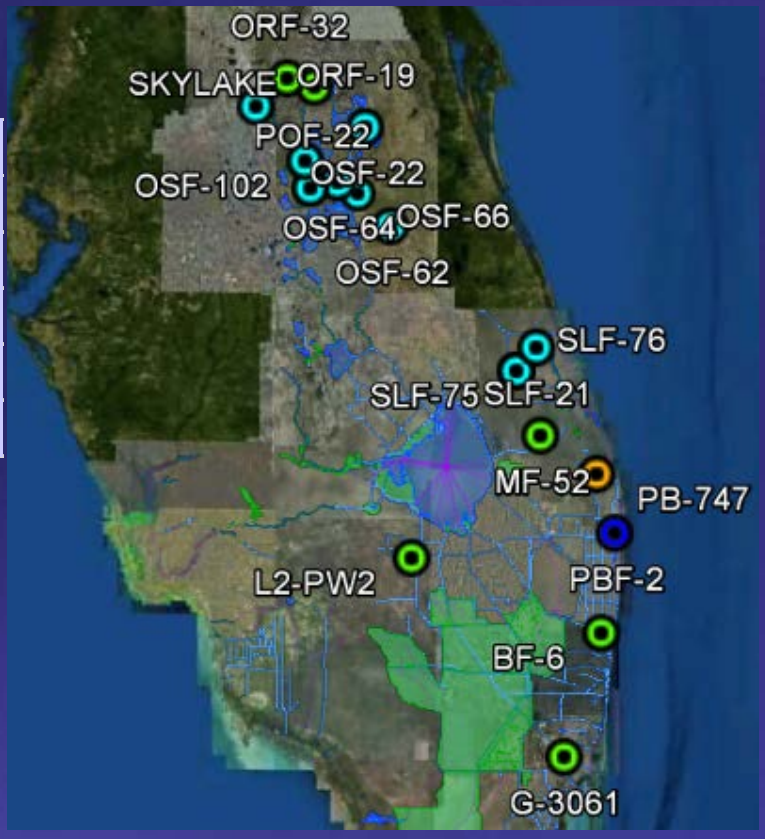
Mapped GWL Percentile Ranks of SFWMD Stations

PRs of May 2016 Median vs. All Daily Values



Legend	
	> = 90 %
	76 - 89 %
	25 - 75 %
	11 - 24 %
	< = 10%

PRs of May 2016 Median vs. May Daily Values



Reason to Use All GWL Data Set

- Missing values should be 5% or less of entire data set, but the percentage of missing value might be bigger for seasonal / restricted data sets.

- Seasonality might be different for different latitudes along Florida. S. Florida, **May** GWLs are among the lowest of the year and September GWLs are among the highest of the year.

Conclusion: Use <u>all</u> GWL data set not a seasonal subset

Questions and Comments

GWL PRI Equations

- Suggestions
  - Each participating entity send the PRI equation that they use to RC
  - Report be modified to clarify the differences
    - POR, Equation, and Seasonal or Non-Seasonal PRI

(2) Development of the Coastal Salinity Monitoring Network

- Not only the Salinity Network, but also a Coastal Salinity Monitoring Network (CSMN)- "Rind around the state"
  - Networks-of-existing networks
    - **No new $**
  - Add wells and surface water sites in future

- **Governor's Office Supports CSN**

Why Have a CSMN?

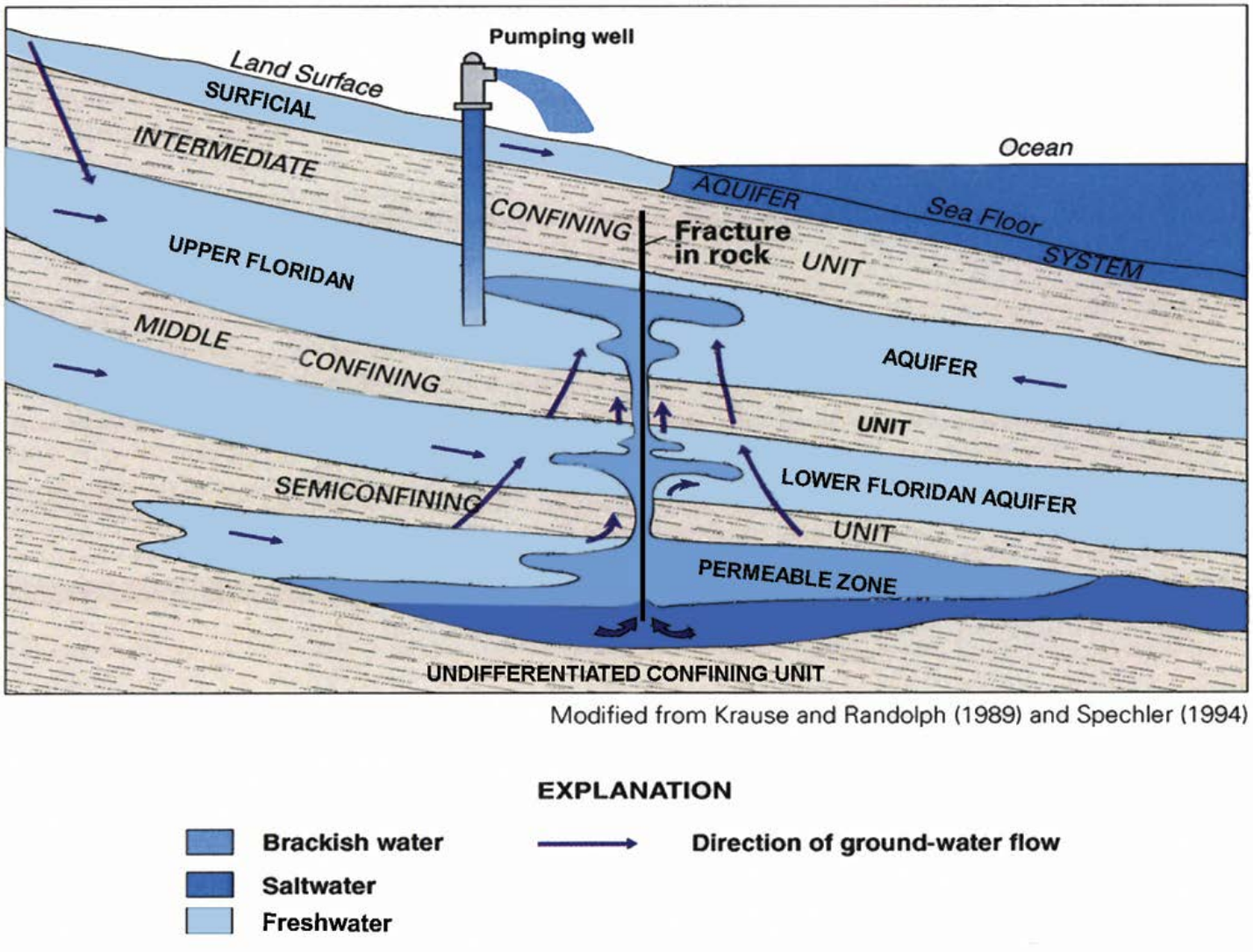
Several Causes of intrusion

Two of particular interest are:

1. Intrusion issues along coast

2. Potential upwelling of saline GW from base of Floridan aquifer system (FAS)

Potential Upwelling

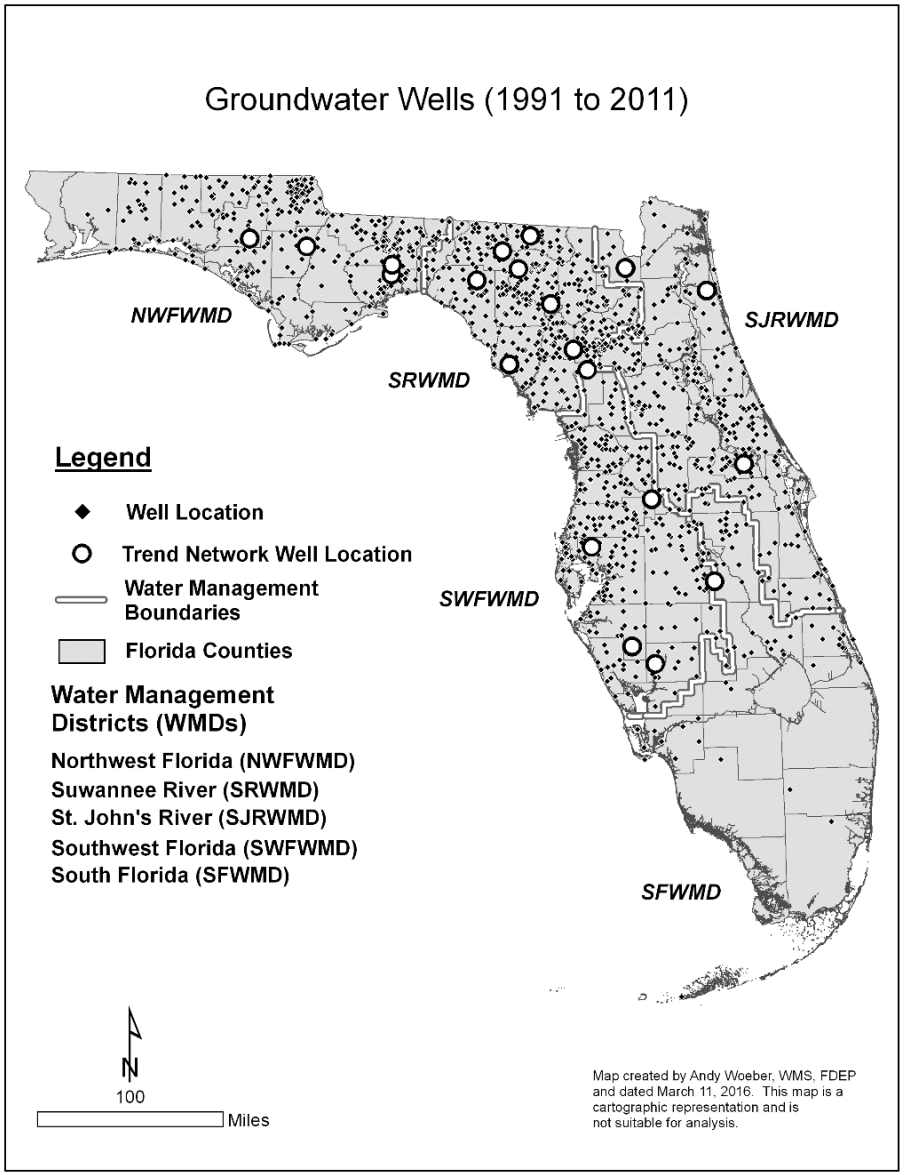


>1300 FAS Monitoring Wells

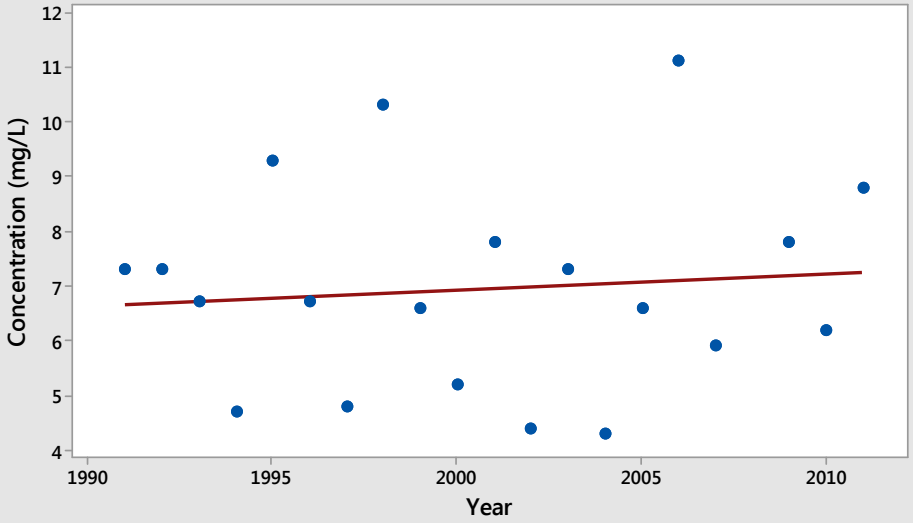
- Part of DEP's Status Network (SN) and old Background Network (BN)
  BN: 1991-1999; SN: 2000-2016
- BN/SN: 60-366 samples/year, across FL
- E.G. - Obtained annual medians
  - Na and Cl
- Plotted medians per year
  - Rate of Increase mg/L per Decade

- DEP's Status Mon Net can monitor this type of intrusion

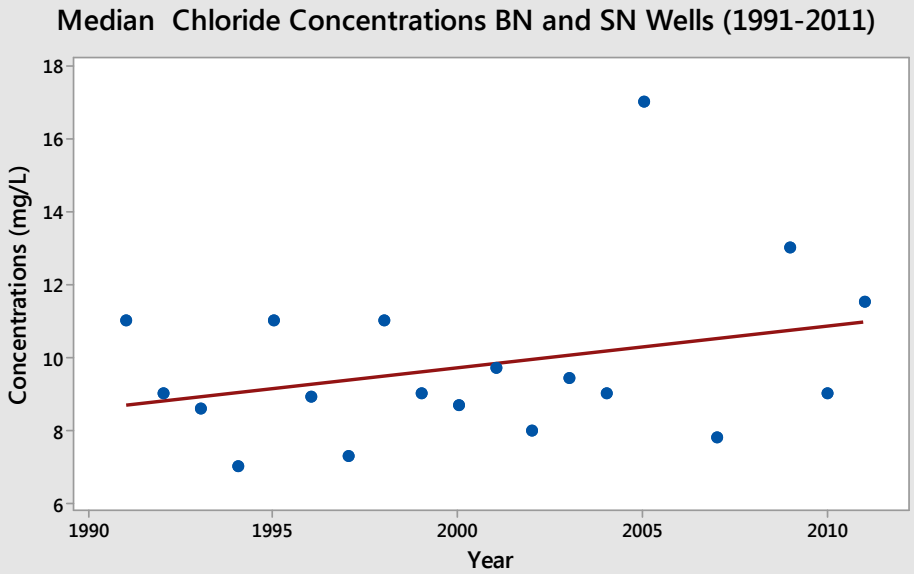
FAS wells with Na and Cl data



Annual Medians

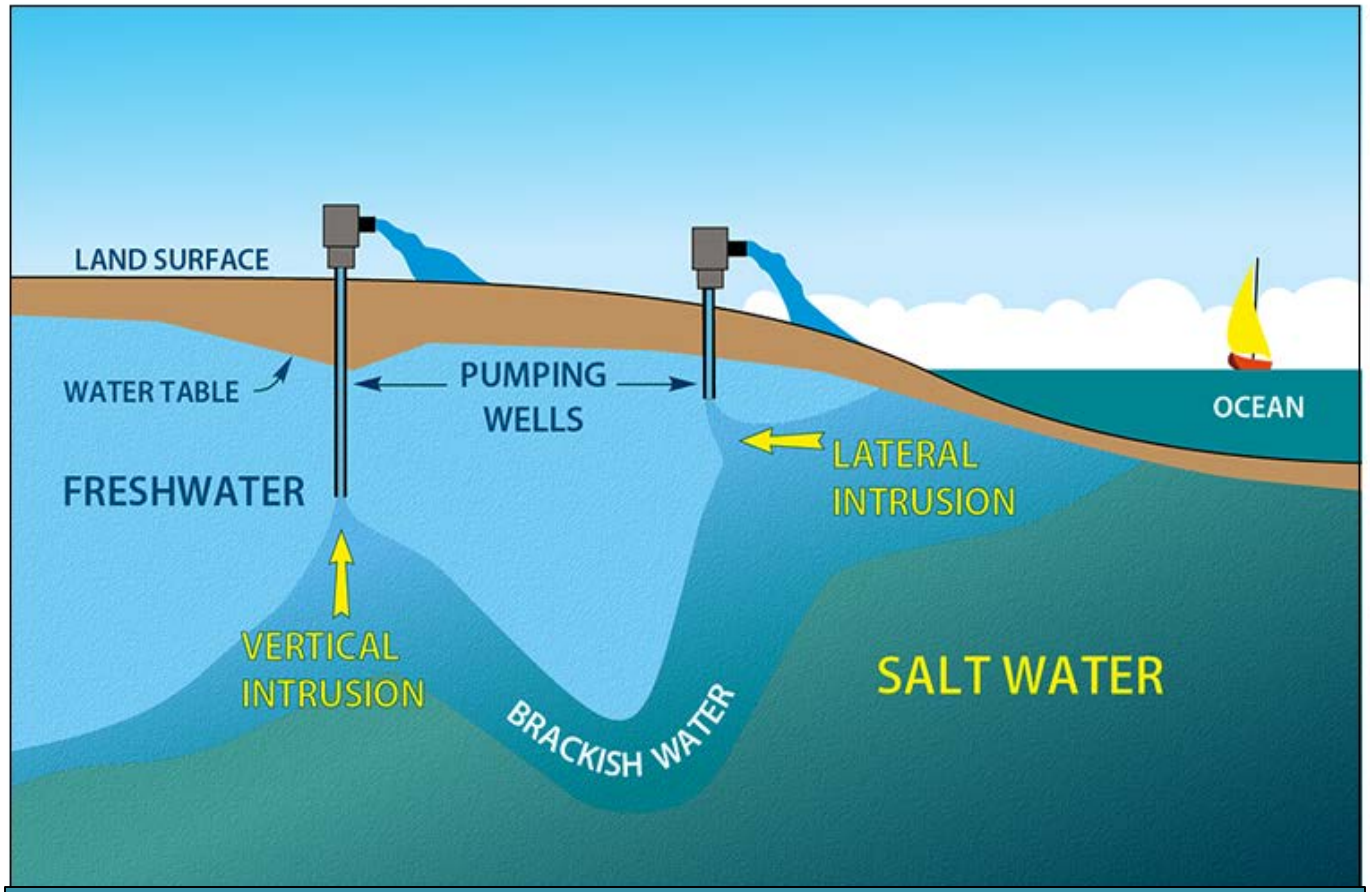


Outlier (2008) was removed for visual reasons.



Outliers (2006 and 2008). There were removed for visual reasonsi

Intrusion along Coast



Saint Johns River Water Management District (Date Unknown)

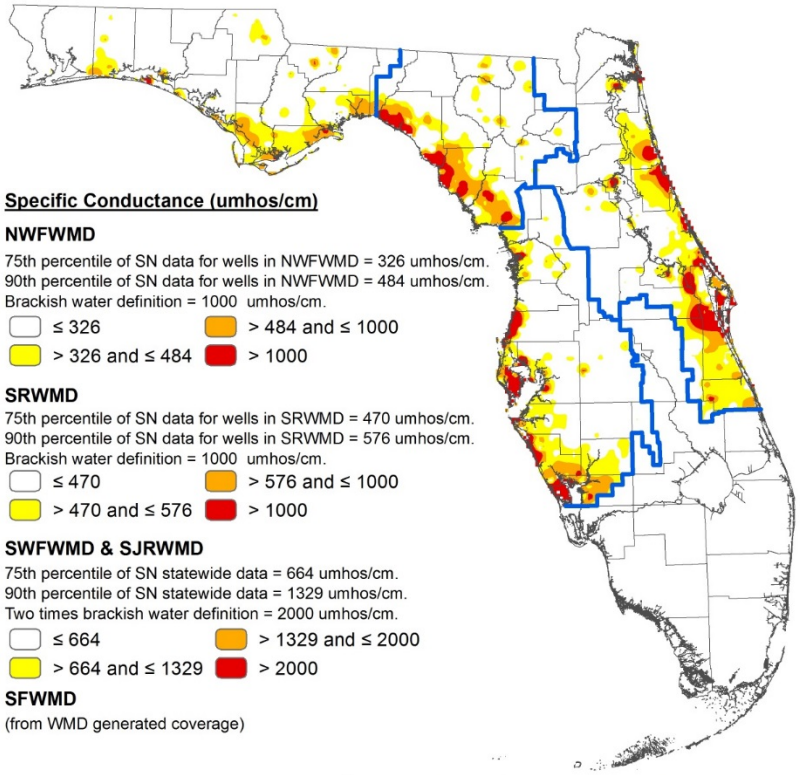
Establishment of CSMN

- “Let data suggest were to build Coastal SalNet”

Identify Potential CSMN Wells

- Generated greatest concentration maps (“Rind”)
- Then used WMD wells as candidate wells
- WMDs to determine:
  - Which wells (and aquifers)
  - Additional areas (if needed)

Specific Conductance in Status Network (SN) Wells (All Aquifers) Modeled Using Inverse Distance Weighting



Specific Conductance (umhos/cm)

NWFWMD

75th percentile of SN data for wells in NWFWMD = 326 umhos/cm.
90th percentile of SN data for wells in NWFWMD = 484 umhos/cm.
Brackish water definition = 1000 umhos/cm.

- ≤ 326
- > 326 and ≤ 484
- > 484 and ≤ 1000
- > 1000

SRWMD

75th percentile of SN data for wells in SRWMD = 470 umhos/cm.
90th percentile of SN data for wells in SRWMD = 576 umhos/cm.
Brackish water definition = 1000 umhos/cm.

- ≤ 470
- > 470 and ≤ 576
- > 576 and ≤ 1000
- > 1000

SWFWMD & SJRWMD

75th percentile of SN statewide data = 664 umhos/cm.
90th percentile of SN statewide data = 1329 umhos/cm.
Two times brackish water definition = 2000 umhos/cm.

- ≤ 664
- > 664 and ≤ 1329
- > 1329 and ≤ 2000
- > 2000

SFWMD

(from WMD generated coverage)

Water Management Districts

Florida Counties

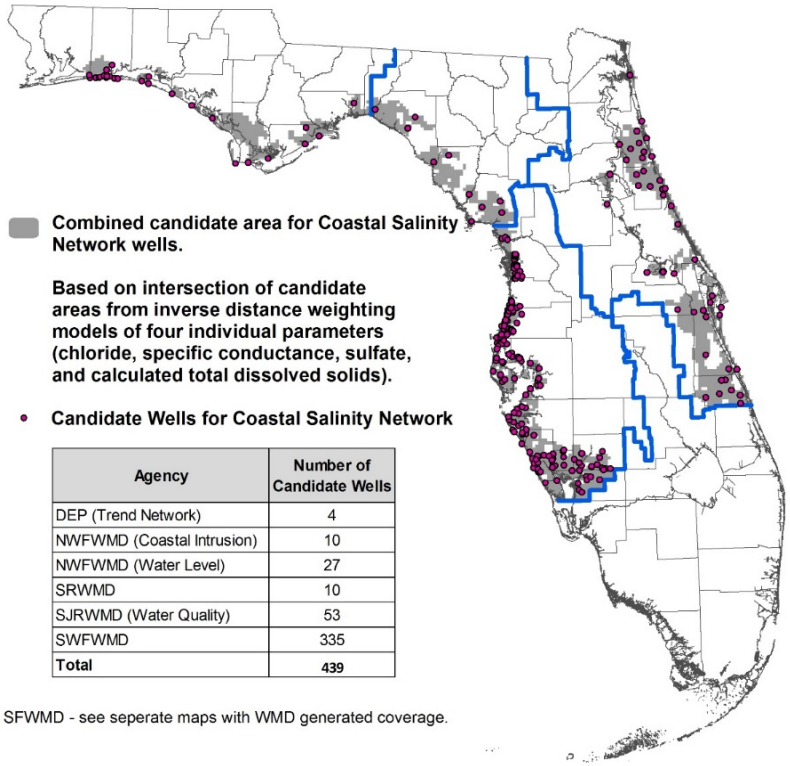
N

0 50 100 200 Kilometers

0 50 100 200 Miles

Created November 3, 2015 by Florida Department of Envionmental Protection staff in the Division of Environmental Assessment and Restoration. This map is a cartographic representation and is not intended for further analysis.

Candidate Coastal Salinity Network Wells
Based on Combined Modeled Data
(Chloride, Specific Conductance, Sulfate, Calculated TDS)



Combined candidate area for Coastal Salinity Network wells.

Based on intersection of candidate areas from inverse distance weighting models of four individual parameters (chloride, specific conductance, sulfate, and calculated total dissolved solids).

Candidate Wells for Coastal Salinity Network

Agency	Number of Candidate Wells
DEP (Trend Network)	4
NWFWMD (Coastal Intrusion)	10
NWFWMD (Water Level)	27
SRWMD	10
SJRWMD (Water Quality)	53
SWFWMD	335
Total	**439**

SFWMD - see seperate maps with WMD generated coverage.

Water Management Districts

Florida Counties

N

0 50 100 200 Kilometers

0 50 100 200 Miles

Created November 3, 2015 by Florida Department of Enviornmental Protection staff in the Division of Environmental Assessment and Restoration. This map is a cartographic representation and is not intended for further analysis.

CSMN

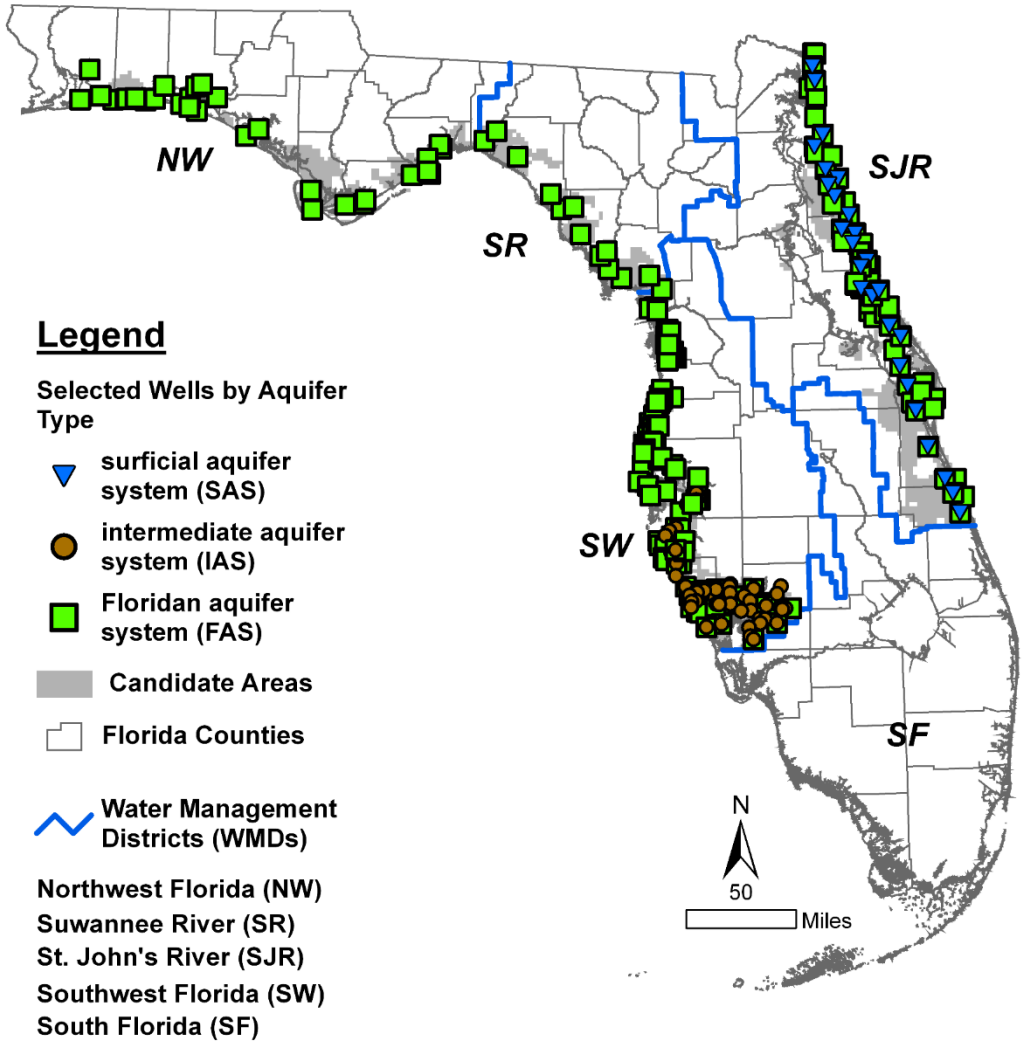
- WMDs finalize:
  - Areas, aquifers, and wells for CSMN
  - Forward pertinent information to DEP

- No WQ data to be sent to DEP at this time
- Once Water Information System (WIN) Database system is operational, data can be obtained by all entities

Selection of Wells

- Almost Complete
- SRWMD
  - 10 sites will be selected from 13 possibilities
- NWFWMD
  - 4 sites proposed to be added in future
- SFWMD – Special Situation

Final Selection
Coastal Salinity Network Wells
Chloride, Specific Conductance, Sulfate, Calculated TDS



Created October 12, 2016 by Andy Woeber, DEAR, DEP.
The map is a cartographic representation and is not intended for further analysis.

CSMN Monitoring Sites

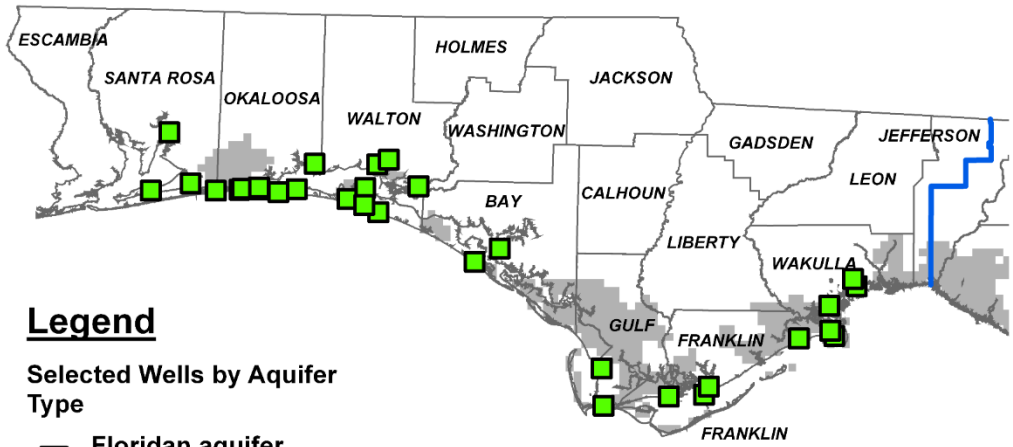
WMD	Aquifer System	No. Sites
NWFWMD	FAS	28
SRWMD	FAS	10
SJRWMD	FAS	70
	IAS	3
	SAS	29
SWFWMD	FAS	152
	IAS	63
	Total =	355

10 of 13 potential sites to be selected

4 additional sites proposed in NWFWMD

Sites to be sampled for salinity indicators such as Na, Cl, SO4, TDS, SC

Final Selection
Coastal Salinity Network Wells
Northwest Florida Water Management District
(Chloride, Specific Conductance, Sulfate, Calculated TDS)



Legend

Selected Wells by Aquifer Type

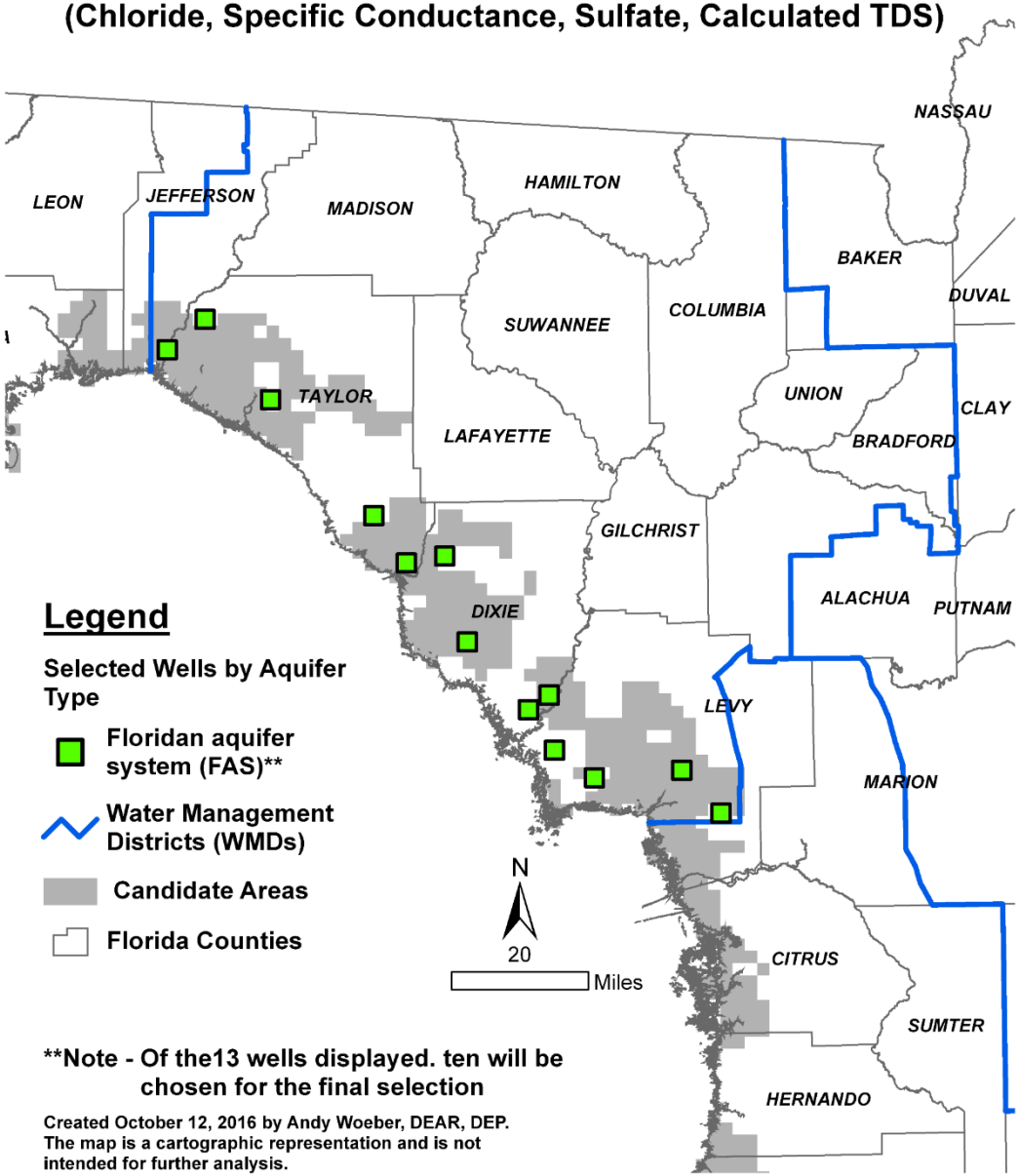
- **Floridan aquifer system (FAS)**
- **Water Management Districts (WMDs)**
- **Candidate Areas**
- **Florida Counties**

N

20 Miles

Created October 12, 2016 by Andy Woeber, DEAR, DEP.
The map is a cartographic representation and is not intended for further analysis.

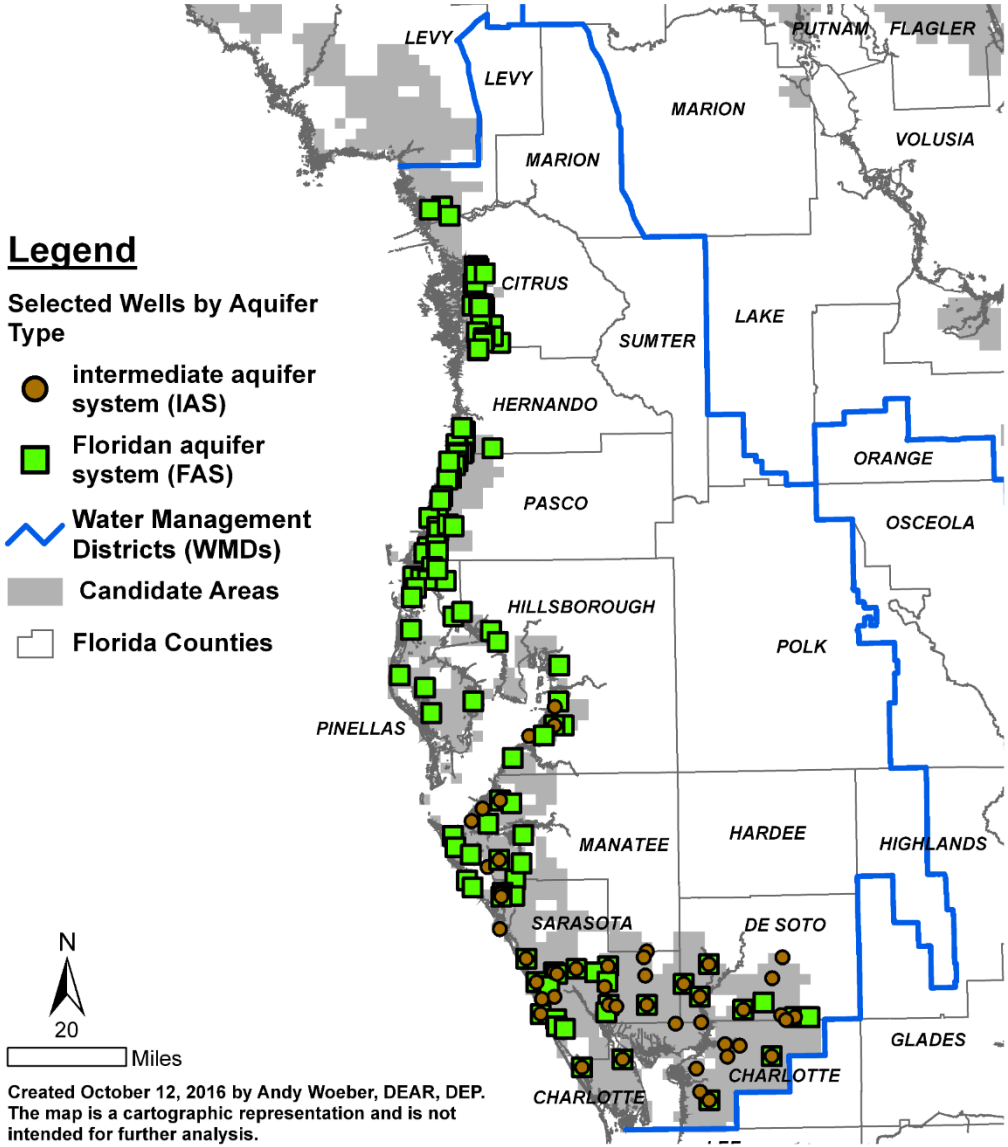
Final Selection
Coastal Salinity Network Wells
Suwannee River Water Management District
(Chloride, Specific Conductance, Sulfate, Calculated TDS)

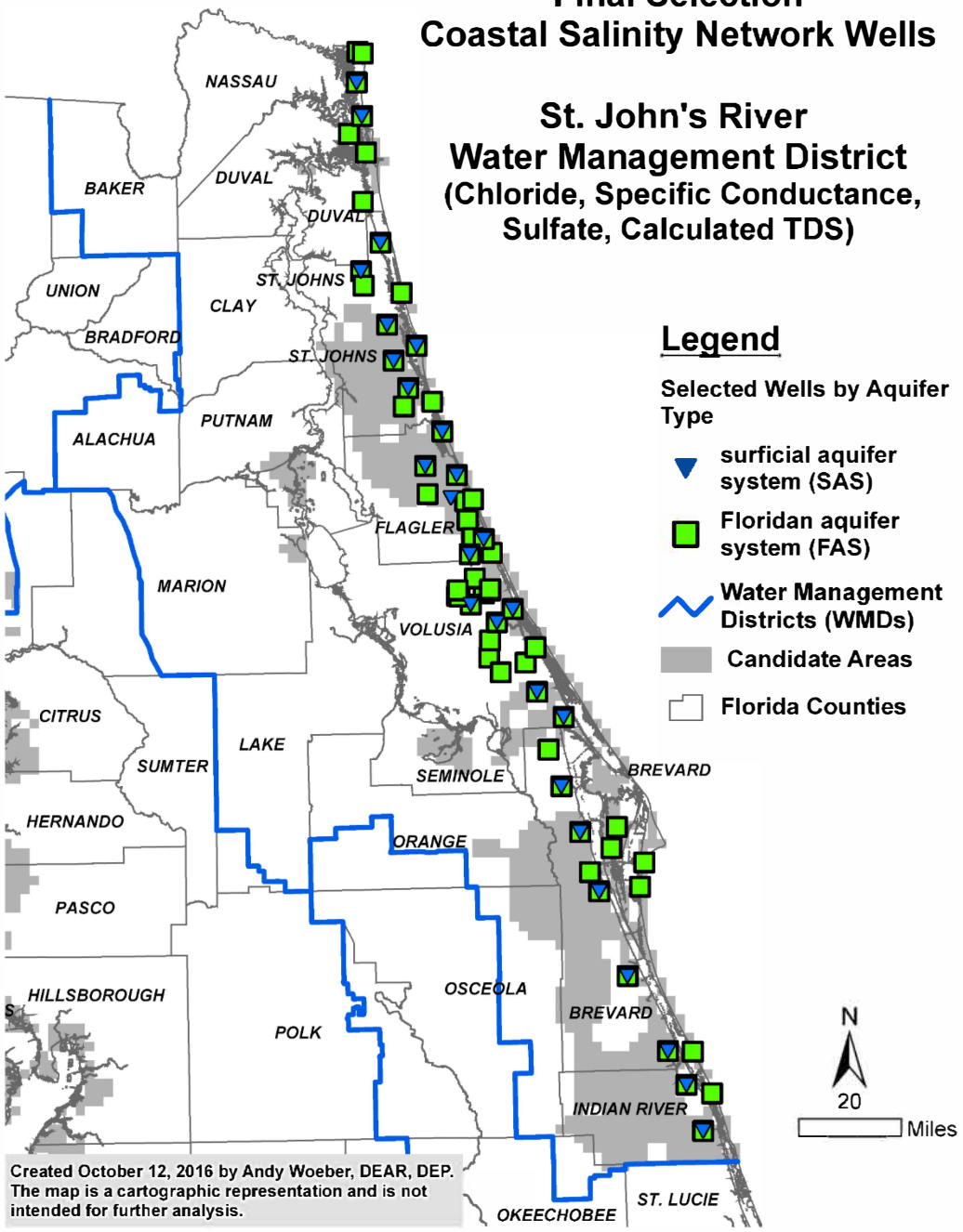


**Note - Of the13 wells displayed. ten will be chosen for the final selection

Created October 12, 2016 by Andy Woeber, DEAR, DEP.
The map is a cartographic representation and is not intended for further analysis.

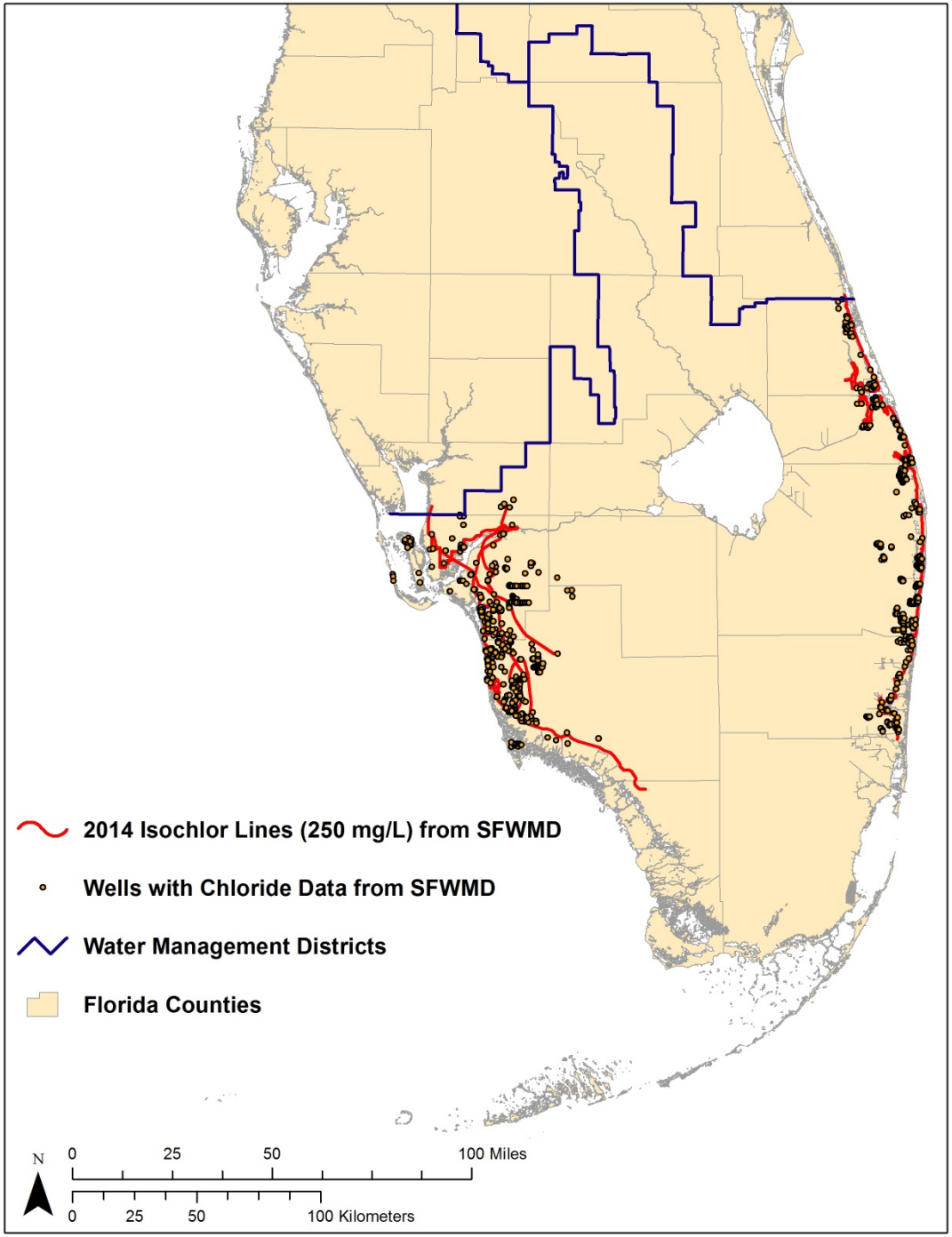
Final Selection
Coastal Salinity Network Wells
Southwest Florida Water Management District
(Chloride, Specific Conductance, Sulfate, Calculated TDS)




Final Selection
Coastal Salinity Network Wells
St. John's River
Water Management District
(Chloride, Specific Conductance,
Sulfate, Calculated TDS)
Legend
Selected Wells by Aquifer Type
surficial aquifer system (SAS)
Floridan aquifer system (FAS)
Water Management Districts (WMDs)
Candidate Areas
Florida Counties
NASSAU
BAKER
DUVAL
DUVAL
UNION
ST. JOHNS
CLAY
BRADFORD
ST. JOHNS
PUTNAM
ALACHUA
FLAGLER
MARION
VOLUSIA
CITRUS
LAKE
SUMTER
SEMINOLE
BREVARD
HERNANDO
ORANGE
PASCO
OSCEOLA
HILLSBOROUGH
BREVARD
POLK
INDIAN RIVER
ST. LUCIE
OKEECHOBEE
N
20
Miles
Created October 12, 2016 by Andy Woeber, DEAR, DEP.
The map is a cartographic representation and is not intended for further analysis.

SFWMD area

Example of 250 mg/L isochlor maps for various aquifers in south Florida



Example of 250 mg/L isochlor map, and more, of Biscayne aquifer in Miami-Dade County, FL

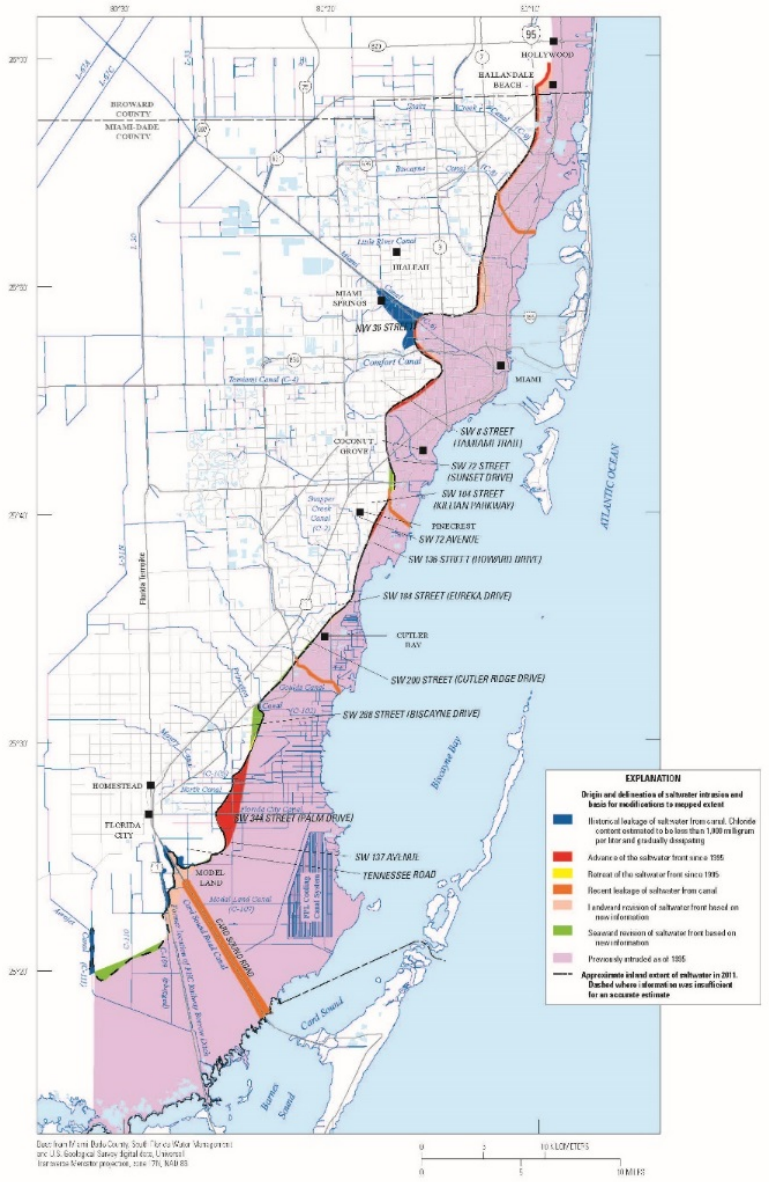


Figure 17. Map showing the origin and delineation of saltwater intrusion in the Biscayne aquifer and the basis for modifications to its mapped extent.

Development of a South Florida Salinity Web page

Scott Prinos - USGS

For more information on this presentation, please contact:
Rick Copeland at
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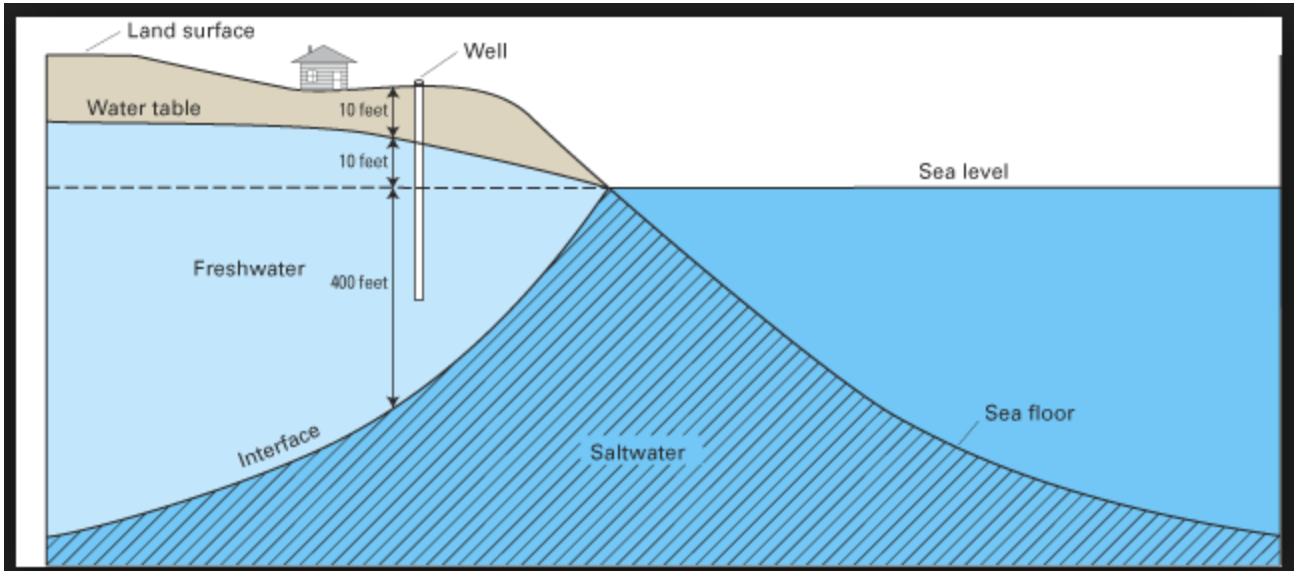
3. Proposed Methods for sampling saltwater/freshwater interface

- Revisions to FDEP Standard operating Procedures for Sample Collection


Land surface
Well
Water table
10 feet
10 feet
Sea level
Freshwater
400 feet
Interface
Saltwater
Sea floor

Project purpose **is monitoring the FW/SW Interface** in wells completed close to the interface

- Wells without in place plumbing and > 10 ft open hole

- Current SOPs
  - Place purging pump at top of water column or at top of open hole
  - Problem – salinity at bottom of open interval (or screen) is often greater then near the top of the interval

  - Want sample of maximum salinity
  - Purging may move FW/SW interface position

Current SOPs

- If well has in-place plumbing
  - Use current SOPs
- If well has ≤ 10 ft of screen or open hole
  - Use current SOPs

Proposed changes to SOPs (1)

- **If well has >10 ft of screen (or open hole) and no in-place plumbing**

- 1. Micro-purging (low-flow purging)
  - Conduct Sp Cond (SC) profile down well
  - Place pump at point of max SC or
    - Within 5 ft of bottom of wells screen (or open hole)
  - Purge < 500 mL/min for a minimum of 1 equip volume
  - Commence stabilization/sampling procedures
  - Use same pump for purging and sampling

Proposed changes to SOPs (2)

- 2. No purging: Use non-isokineic thief sampler, such as double check-vale bailer, or Kemmerer sampler
  - Conduct SC profile down well
  - Afterwards, lower devise
    (≤ 2 cm/sec to target depth)
  - Trigger the device to close, according to manufacturer's instructions
  - Retrieve sample (≤ 2 cm/sec to surface)
    Note sampler may shut at incorrect depth
    - Check SC from a small portion of sample
    - If it is anomalous from previous data, obtain another sample

Next Steps

- Review Proposed SOP Revisions for wells used to monitoring FW/SW interface
- Send comments to RC by 11/22/2016
- SS/RC will synthesis and forward to Aquatic Ecology and Quality Assurance (AEQA) Section of DEP by 11/30/2016
- AEQA Section proceeds to possible rule revision

(4) Saline GWQ Index

Currently this objective is <u>on hold</u>

Questions?

(5) Future Direction Ideas

Next SNW Meeting

Wednesday, May 10, 2017 1:00-3:00

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