

Saltwater Intrusion: an expanding problem in coastal agriculture

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Objectives: 2014

- Use NCDA&CS well sample data
- Develop SAR vs EC chart
 - SAR: sodium adsorption ratio, or relative concentration of Na compared to Ca and Mg
 - EC: electrical conductivity
- Two issues:
 - Impacts on soils
 - Impacts on crops

Objectives: 2018

- Use recent NCDA&CS irrigation well data
- Install shallow GW wells in Hyde, Camden, and Pasquotank ag. fields that are having plant growth problems
- Perform EC studies of the ag. fields (O'Driscoll, Manda; ECU)
- Two issues:
 - Source of salinity: surface or ground?
 - Feasible steps: mitigate or adapt?

USDA Irrigation Water Classification Chart

30

AGRICULTURE HANDBOOK 60, U. S. DEPT. OF AGRICULTURE

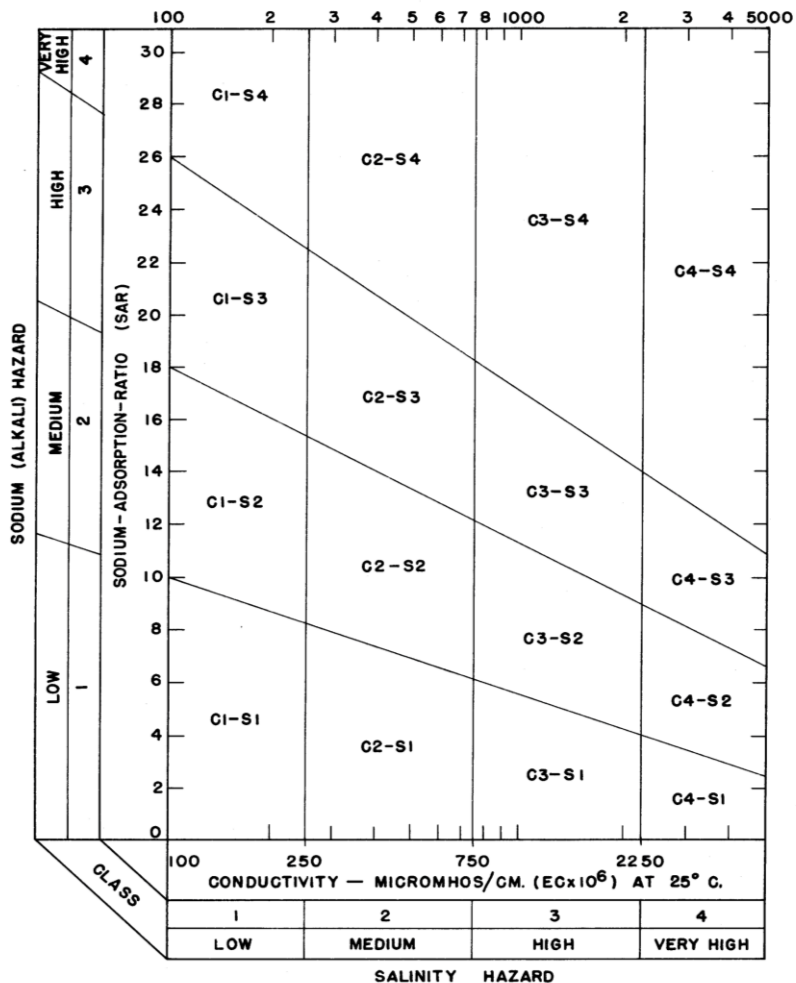


FIGURE 25.—Diagram for the classification of irrigation waters.

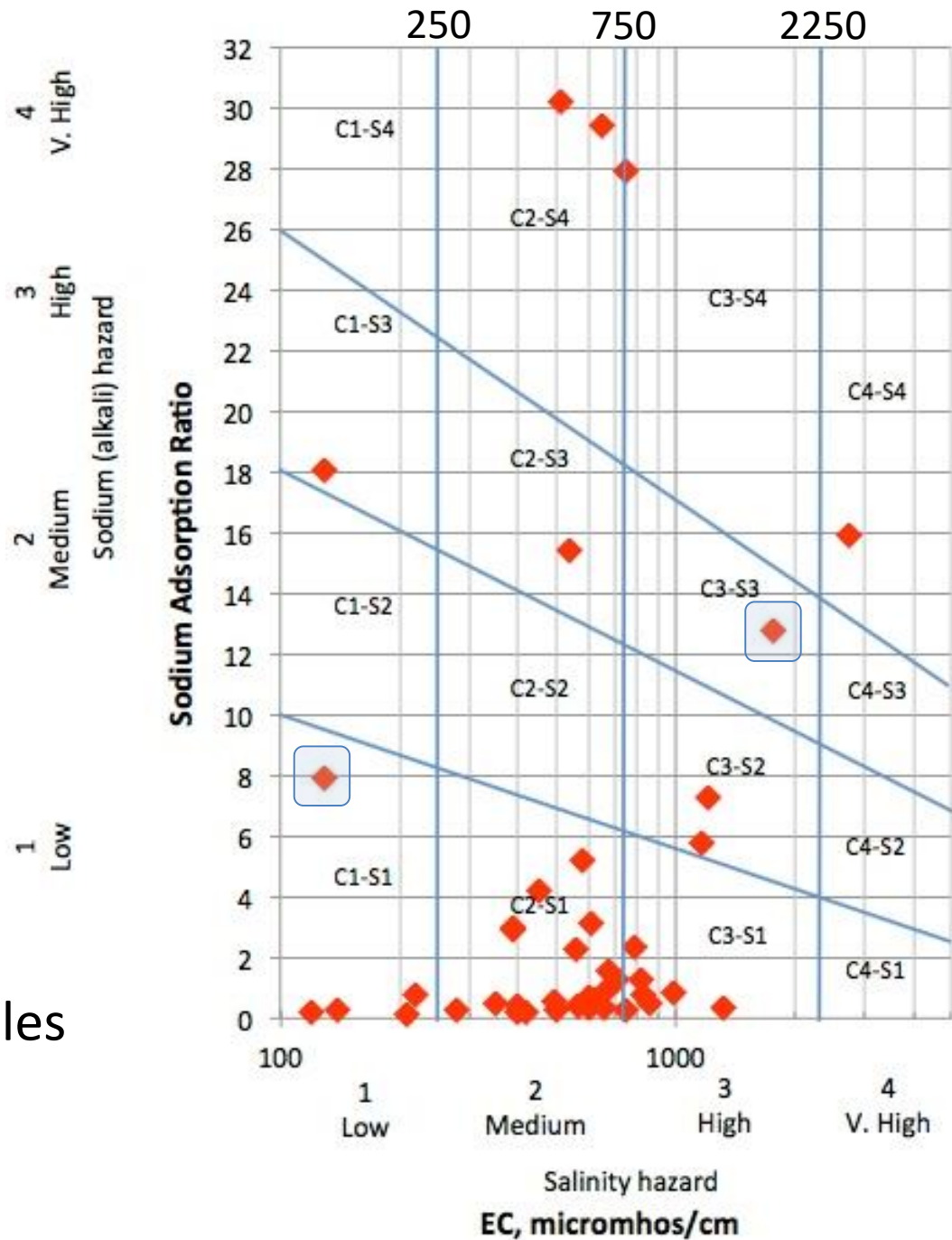
Classification and Use of Irrigation Waters (USDA, Circular 969, 1955):
https://www.ars.usda.gov/arsuserfiles/20360500/pdf_pubs/P0192.pdf

Caveats!

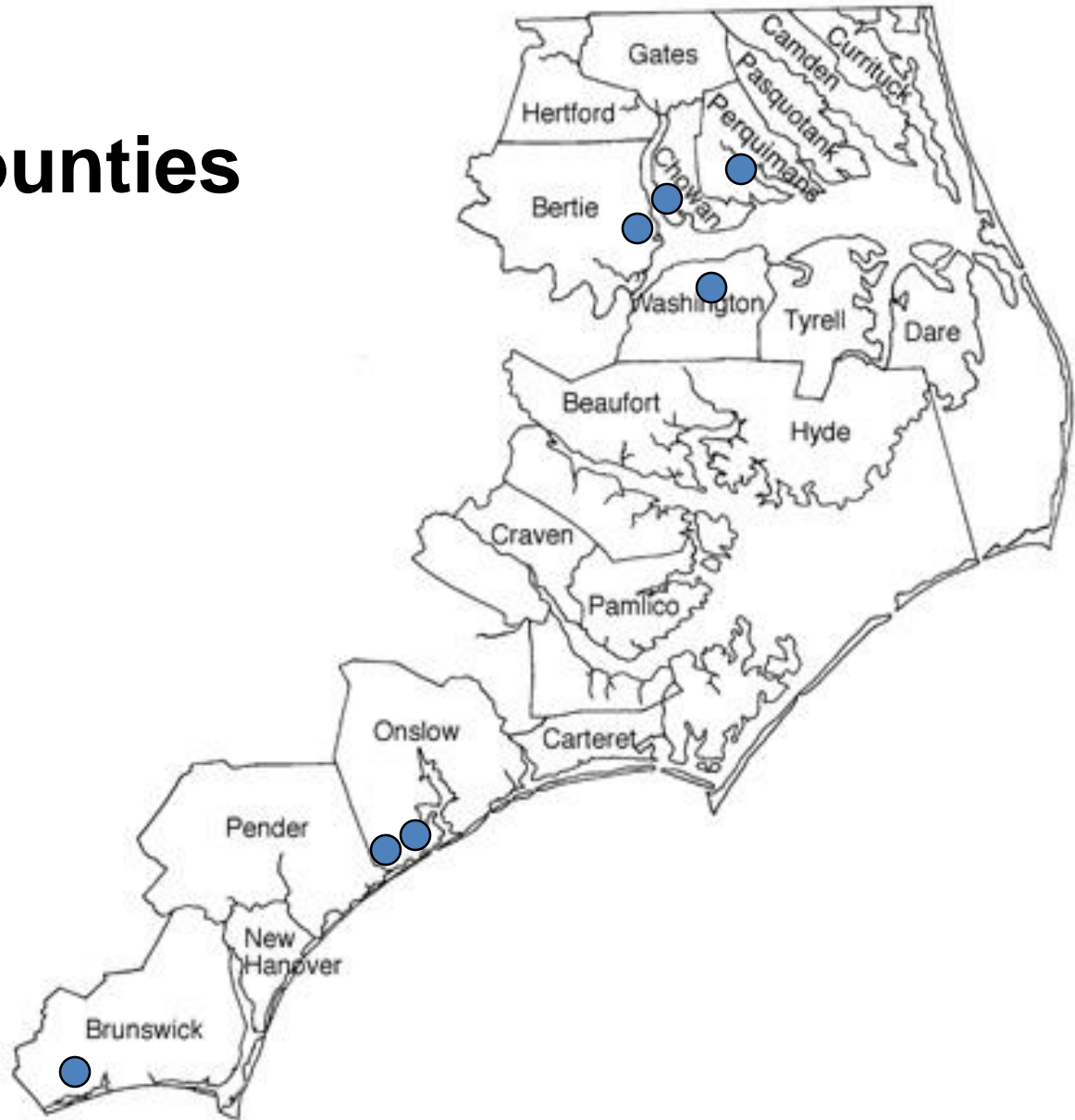
- The “classification of irrigation waters” was developed for arid regions.
- Recent research that focuses on wet regions seems to be in India, Bangladesh, and surrounding countries.
- Despite our rainfall, salts can build and problems occur if leaching below the root zone does not occur – *which is more likely an issue in low lying, high WT coastal fields where flushing is not achieved, and in greenhouses.*

SAR vs EC

- 2014 data
- 52 NCDA&CS well samples



Coastal Counties



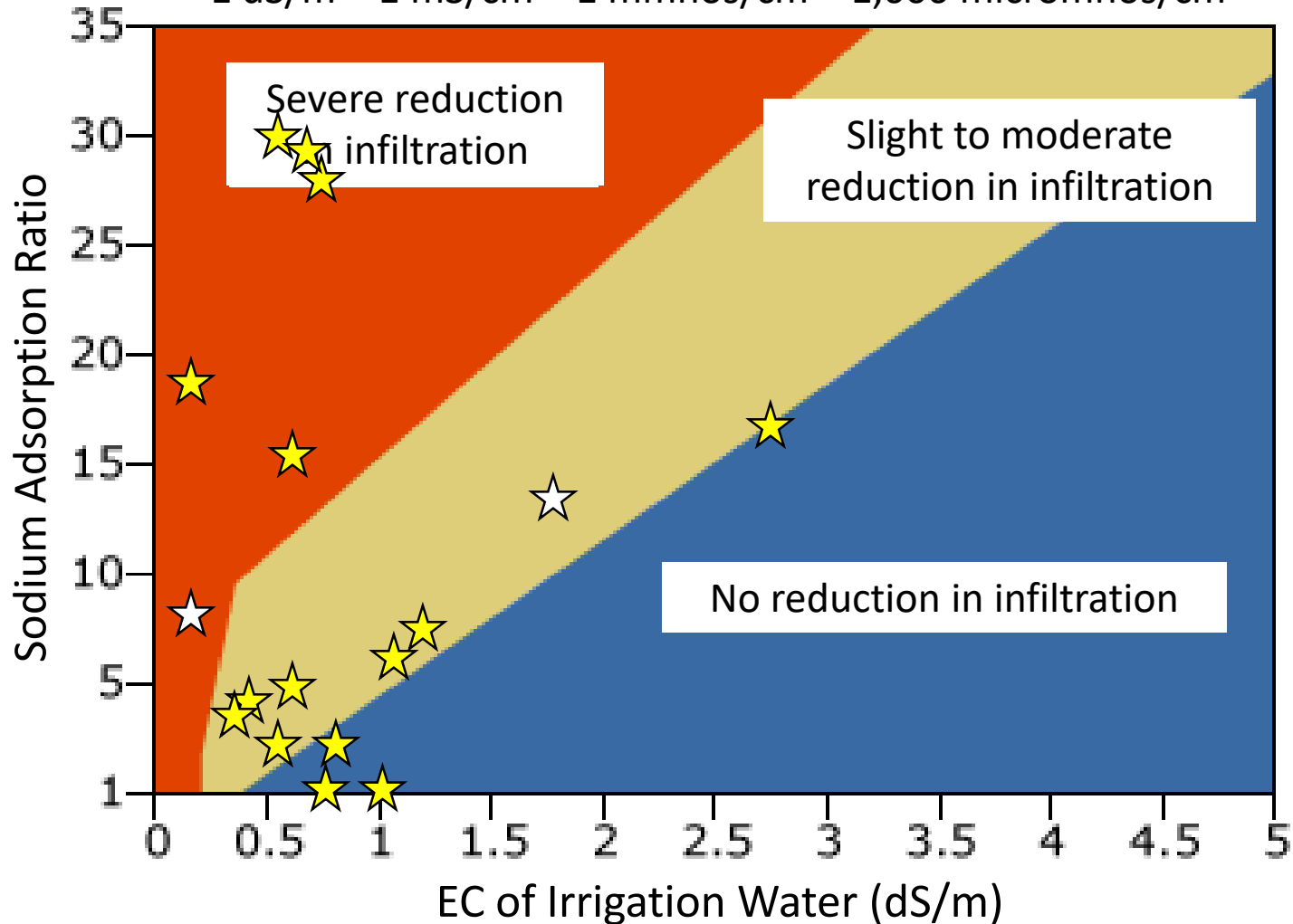
SAR Calculation

$$\text{SAR} = \frac{\text{Na}}{\sqrt{[(\text{Ca} + \text{Mg})/2]}}$$

- If Ca and Mg low, water is soft and SAR is larger
- As Ca and Mg increase, hardness increases, and SAR decreases

Soil SAR – EC relationship

1 dS/m = 1 mS/cm = 1 mmhos/cm = 1,000 micromhos/cm

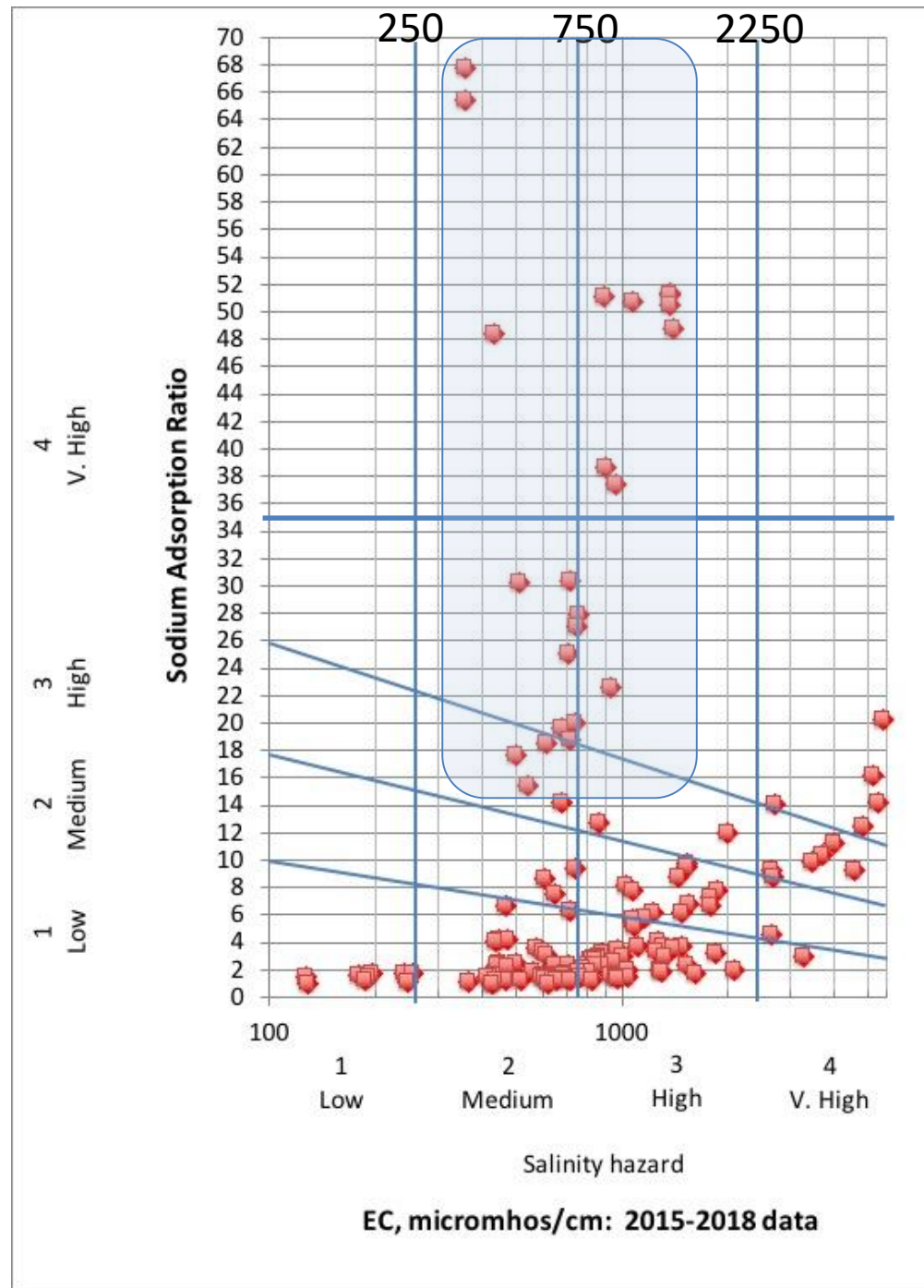


2015-2018 Update

- Spring 2018 - several agents reported crop producers with soil problems
 - Soil samples came back high SS-I and/or ESP
 - Led to current project and monitoring wells
- November 2018 - an area agent reported greenhouse grower with elevated sodium irrigation water that is impacting his plants
 - Did update of NCDA irrigation well samples

SAR vs EC: 2015-2018 NCDA data

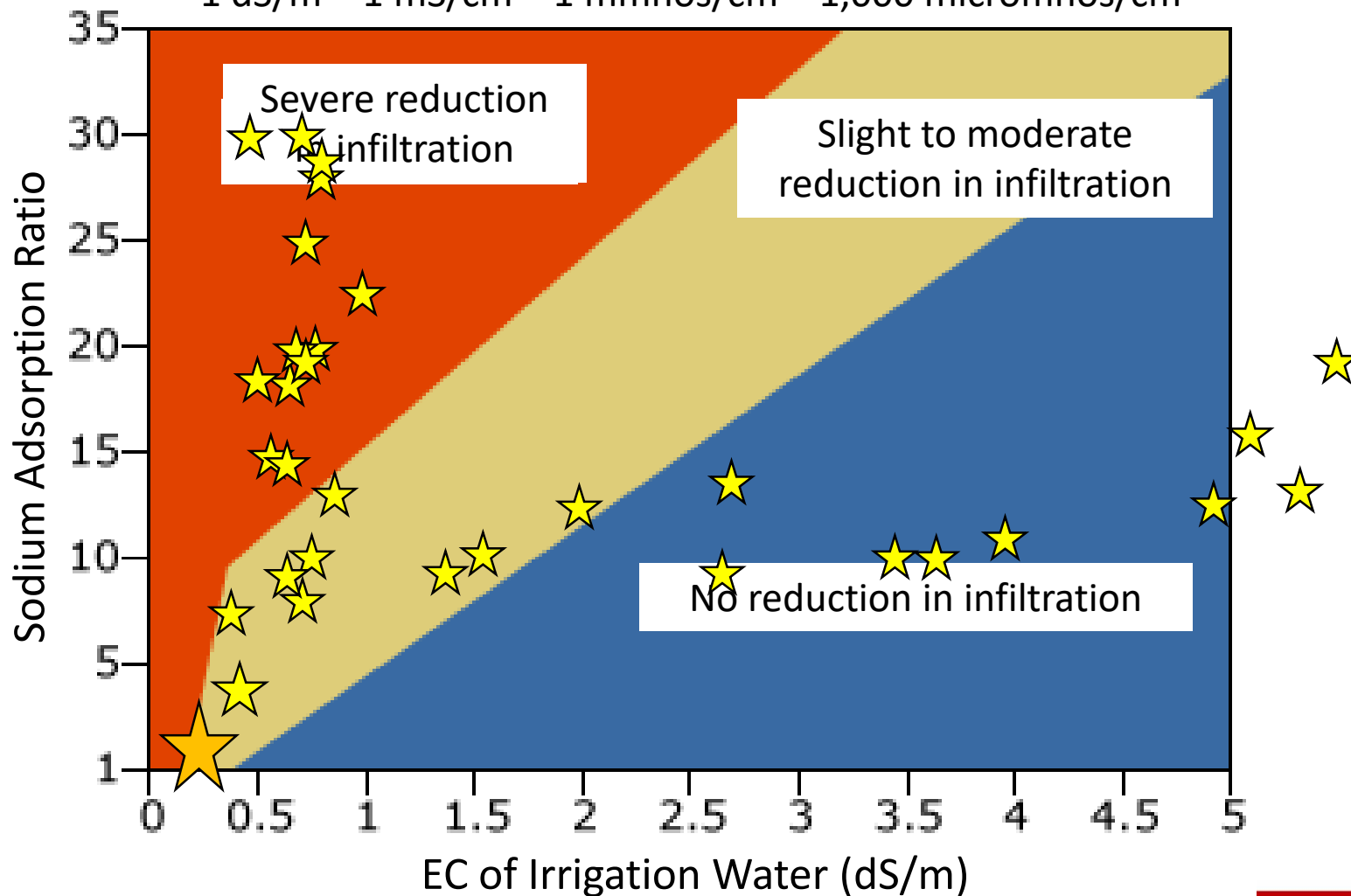
- N = 157
- SAR > 32 counties:
 - Pender (4)
 - Onslow (2)
 - Carteret (2)
 - Craven (1)
 - Gates (1)





Soil SAR – EC relationship

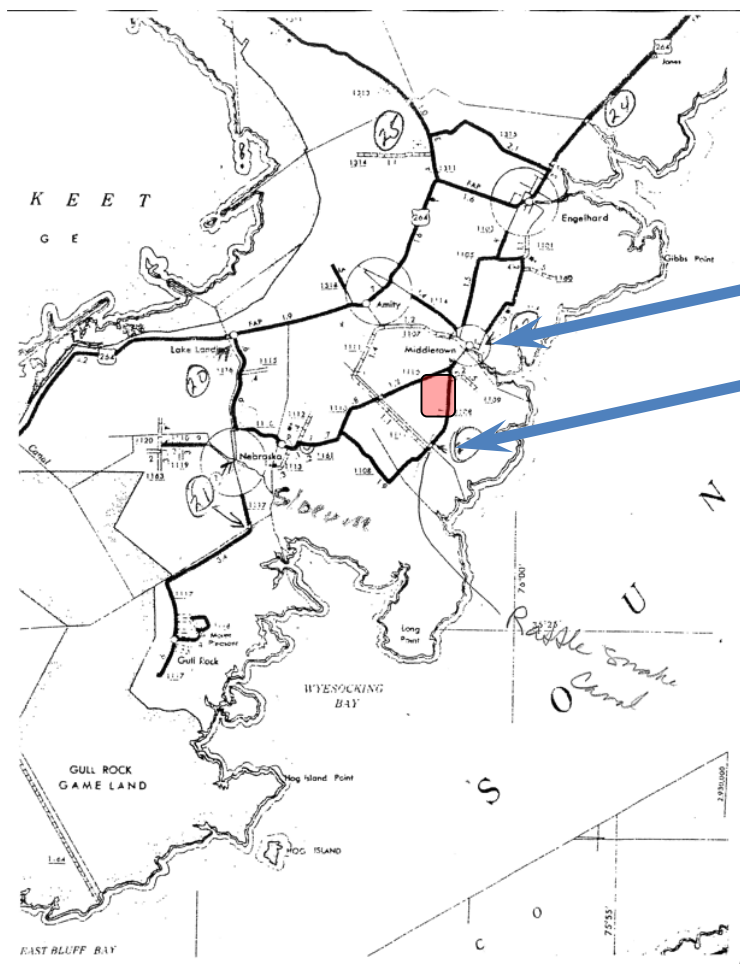
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Current Ag Situation – Hyde Co. site



Middle Creek & Rattlesnake Canal

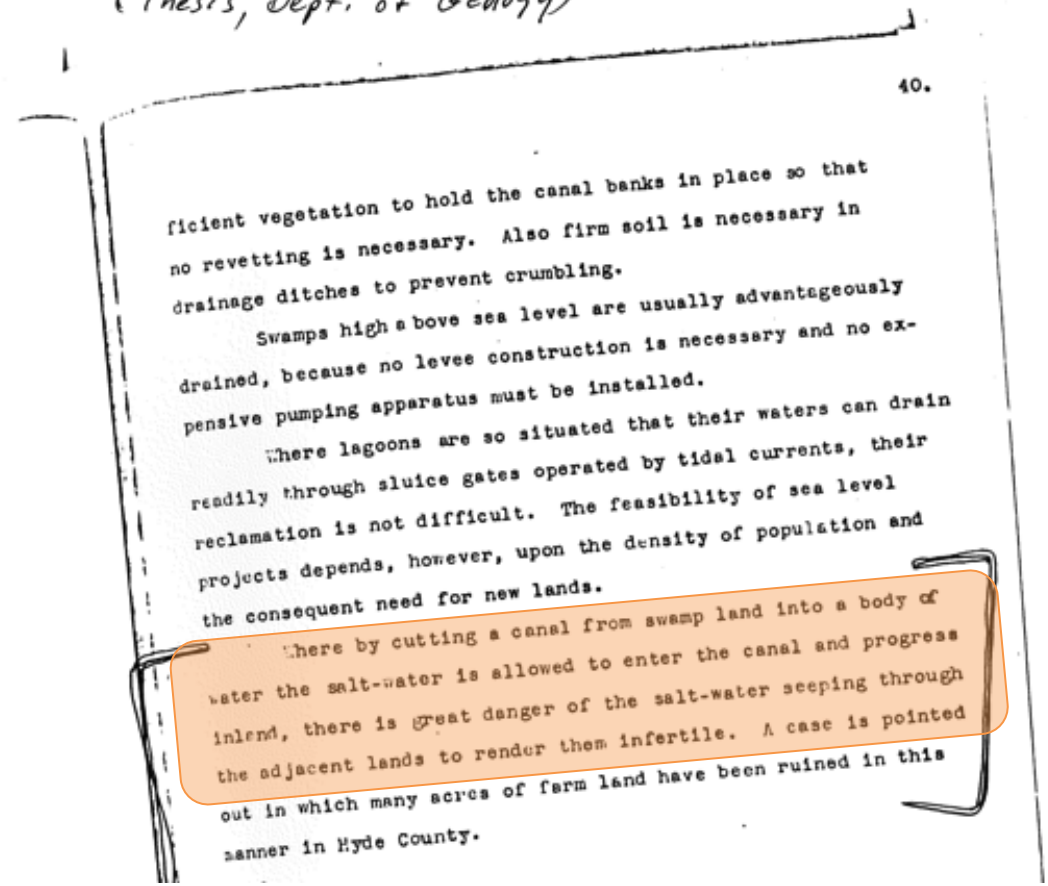


- Salinity data from 3/1984-3/1985 (n=12):
 - Middle Crk
 - Rattlesnake Canal
 - Both ~8 ppt
- Recent sampling (n=10):
 - Middle Crk: ~ 15 ppt
 - Rattlesnake Canal: ~14 ppt
- Project site drains to Middle Crk.; has tide gates

Not new!

"Where by cutting a canal from swamp land into a body of water the salt-water is allowed to enter the canal and progress inland, there is great danger of the salt-water seeping through the adjacent lands to render them infertile."

"A Study of the Physiographic History of Swamp Lands in Relation to The Problem of their Drainage"
by - Henry Travis Thompson
Chapel Hill - 1928
(Thesis, Dept. of Geology)



Options?

- Salt tolerant versions of current crops
 - Already tried at sites and didn't perform well
- Apply gypsum – but need drainage below roots!
- Alternative crops
 - Asparagus
 - Seashore mallow (*Kosteletzkya pentacarpos*)
 - Sugar beets
 - Barley
 - Sorghum, etc.

References

- SAR-EC graph reference:
 - http://www.salinitymanagement.org/Salinity%20Management%20Guide/dw/dw_3.html
 - http://www.salinitymanagement.org/Salinity%20Management%20Guide/dw/dw_3a.html
 - Classification and Use of Irrigation Waters (USDA, Circular 969, 1955):
https://www.ars.usda.gov/arsuserfiles/20360500/pdf_pubs/P0192.pdf

References

- Soil salinity basics (Ullman agent training):
 - <https://hos.ifas.ufl.edu/media/hosifasufledu/documents/IST30688---7.pdf>
- Crop salt tolerance data (compiled article with references):
 - <http://www.fao.org/docrep/005/y4263e/y4263e0e.htm>
- SAR calculator:
 - <http://turf.okstate.edu/water-quality/sar-calculator/>

References

- *Strategies to Mitigate the Impacts of Sea Level Rise and Salt Water Intrusion on Agricultural Lands* (NRCS webinar):
 - <http://www.conservationwebinars.net/webinars/strategies-to-mitigate-the-impacts-of-sea-level-rise-and-salt-water-intrusion-on-cropland/>

References

- *Determining the Suitability of Salt-affected Water and Soil for Tree and Shrub Plantings (USDA):*
 - https://prod.nrcs.usda.gov/Internet/FSE_DOCUMENT/S/nrcs144p2_050264.pdf

Questions?