WRAC Meeting June 5th, 2008

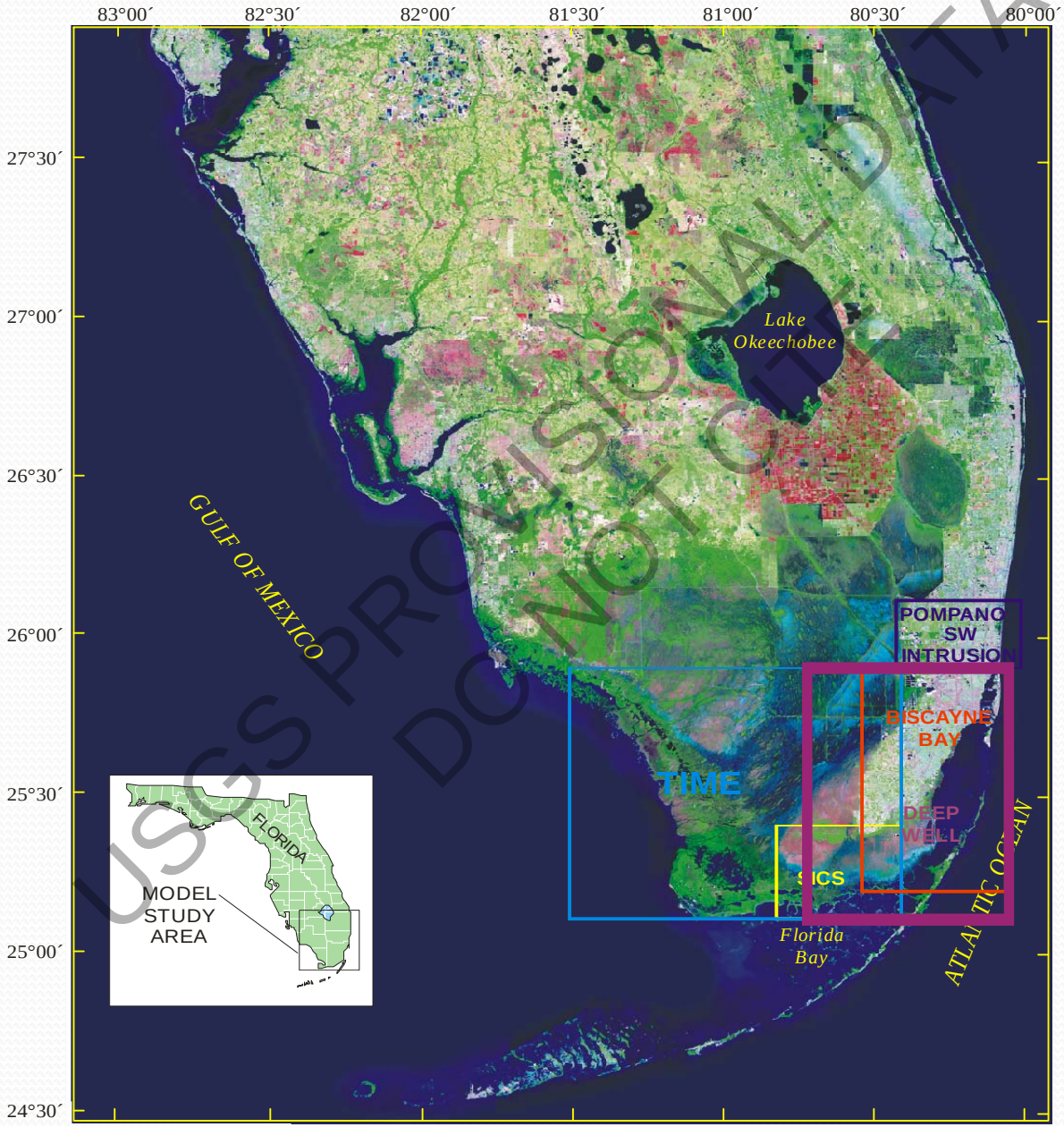
Long-Term Saltwater Intrusion: Quantifying Effects of Natural & Anthropogenic Stresses

USGS PROVISIONAL DATA
DO NOT CITE

Michael Zygnerski
Christian Langevin
United States Geological Survey
Fort Lauderdale, Florida USA

USGS
science for a changing world

USGS Modeling



USGS PROVISIONAL DATA
DO NOT CITE

USGS
science for a changing world

Pompano Project

Objectives

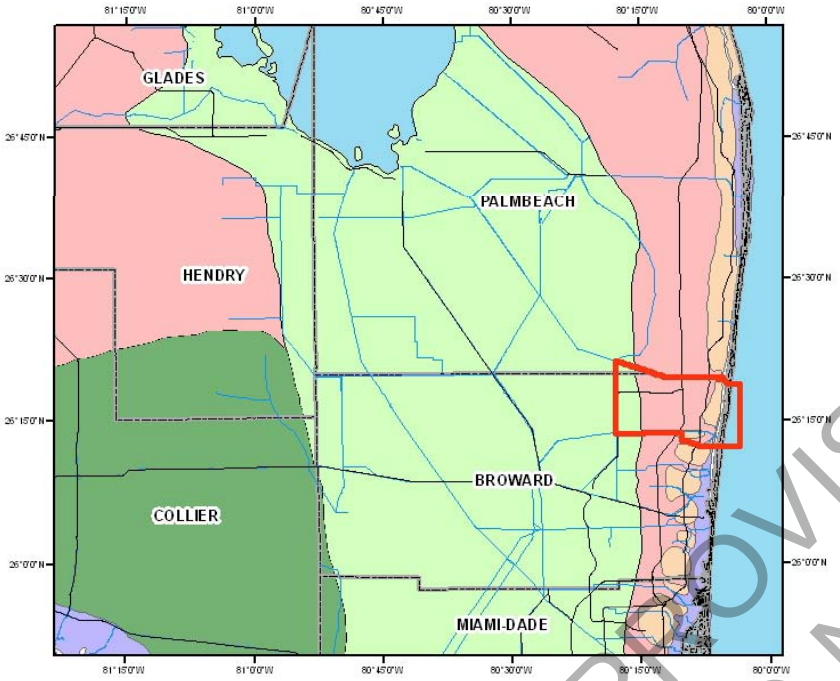
1. Simulate Historical Saltwater Intrusion
2. Quantify Effects of Stresses
3. Provide Useful Tool For Future Water Management

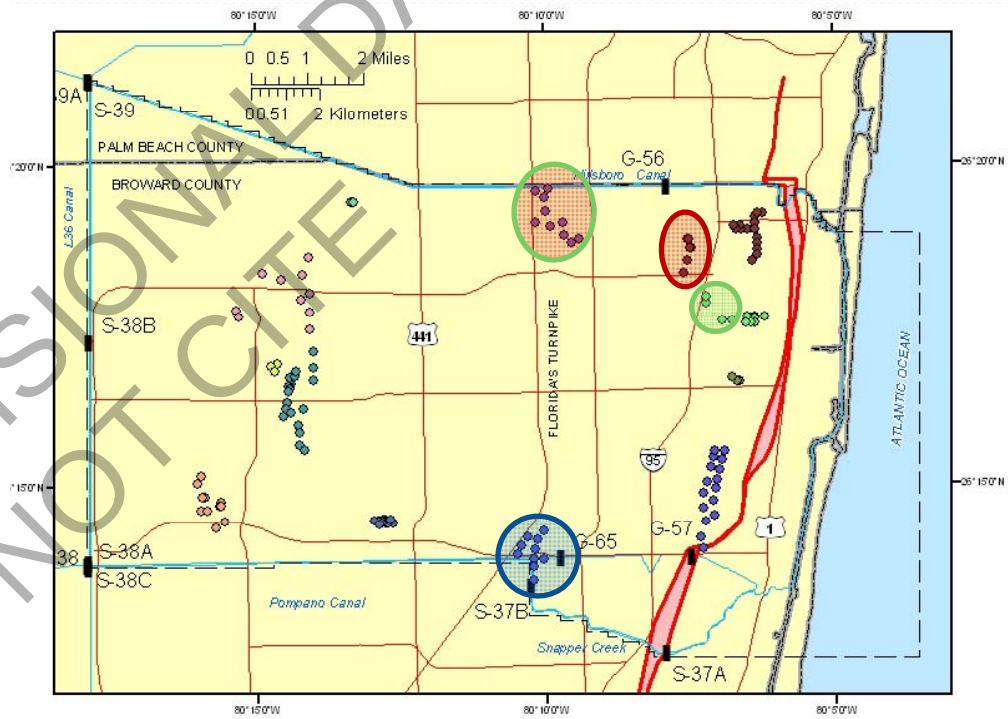
- Anthropogenic Stresses:
  - Everglades drainage
  - Agricultural/Urban development
  - Well field pumping
  - Canal water level management
- Natural Stresses:
  - Sea level rise
  - Rainfall variations

USGS PROVISIONAL DATA
DO NOT CITE

USGS
science for a changing world

Study Area/History





Explanation

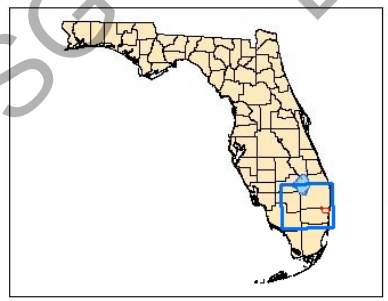
- Study Boundary
- Major Highways
- Major Canals
- County Boudaries

Physiographic Features

- ATLANTIC COASTAL RIDGE
- BIG CYPRESS SWAMP
- COASTAL MARSH & MANGROVE
- EVERGLADES
- LAKE OKEECHOBEE
- SANDY FLATWOODS

0 150 300 600 Kilometers

0 110 220 440 Miles



EXPLANATION

Municipal Wells

- BCNR
- BC2A
- CSID
- CRSP
- DEER

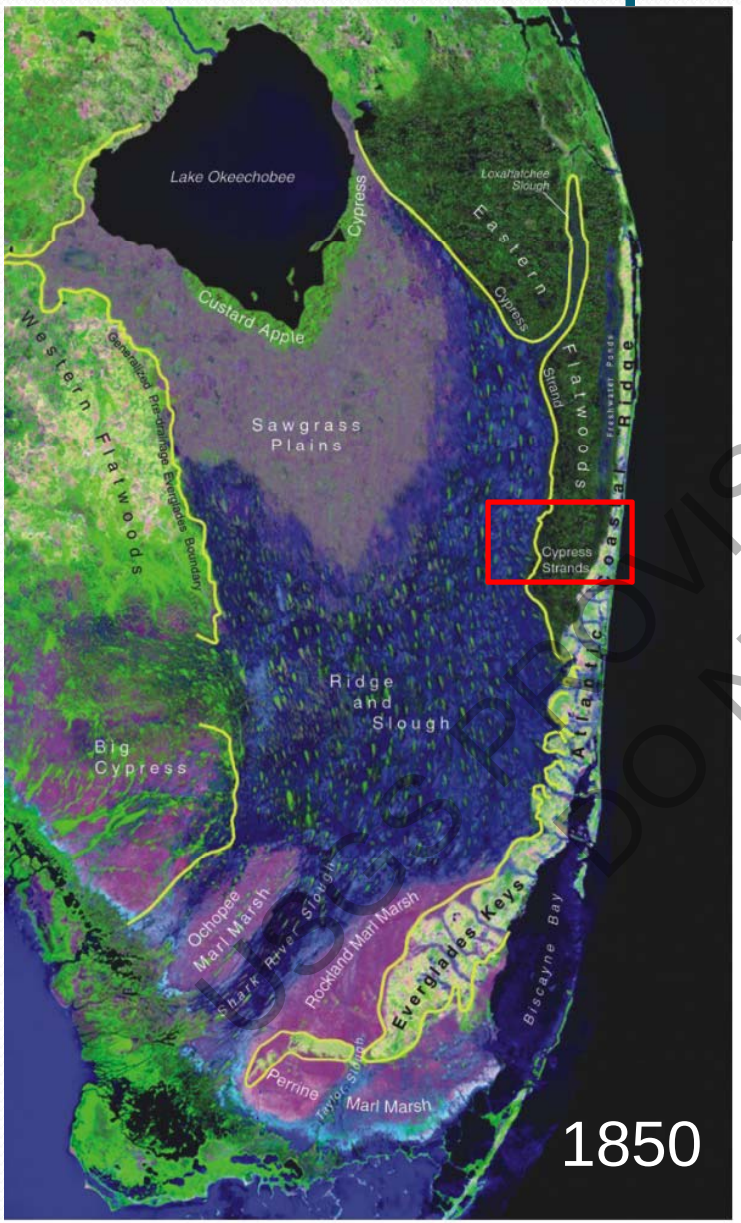
- HILL
- MARG
- NSID
- PARK
- POMP
- ROUC

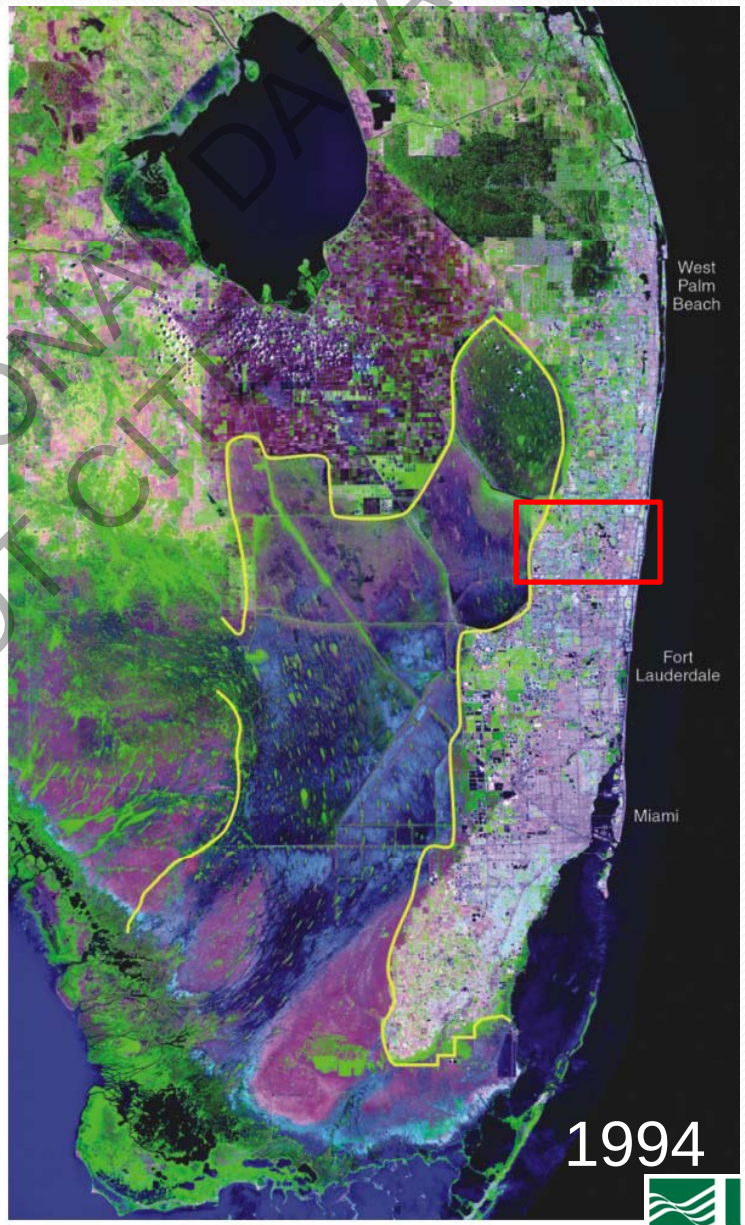
- CONTROL STRUCTURE
- Active Model Boundary
- MAJOR HIGHWAY
- MAJOR CANAL
- Approx. Position of Saltwater Interface (1994)
- COUNTY BOUNDARY

USGS PROVISIONAL DATA
DO NOT CITE

USGS
science for a changing world

Land Use & Population Growth





Chris McVoy, SFWMD

USGS PROVISIONAL DATA DO NOT CITE

USGS science for a changing world

Land Use & Population Growth

Broward County Historical Commission

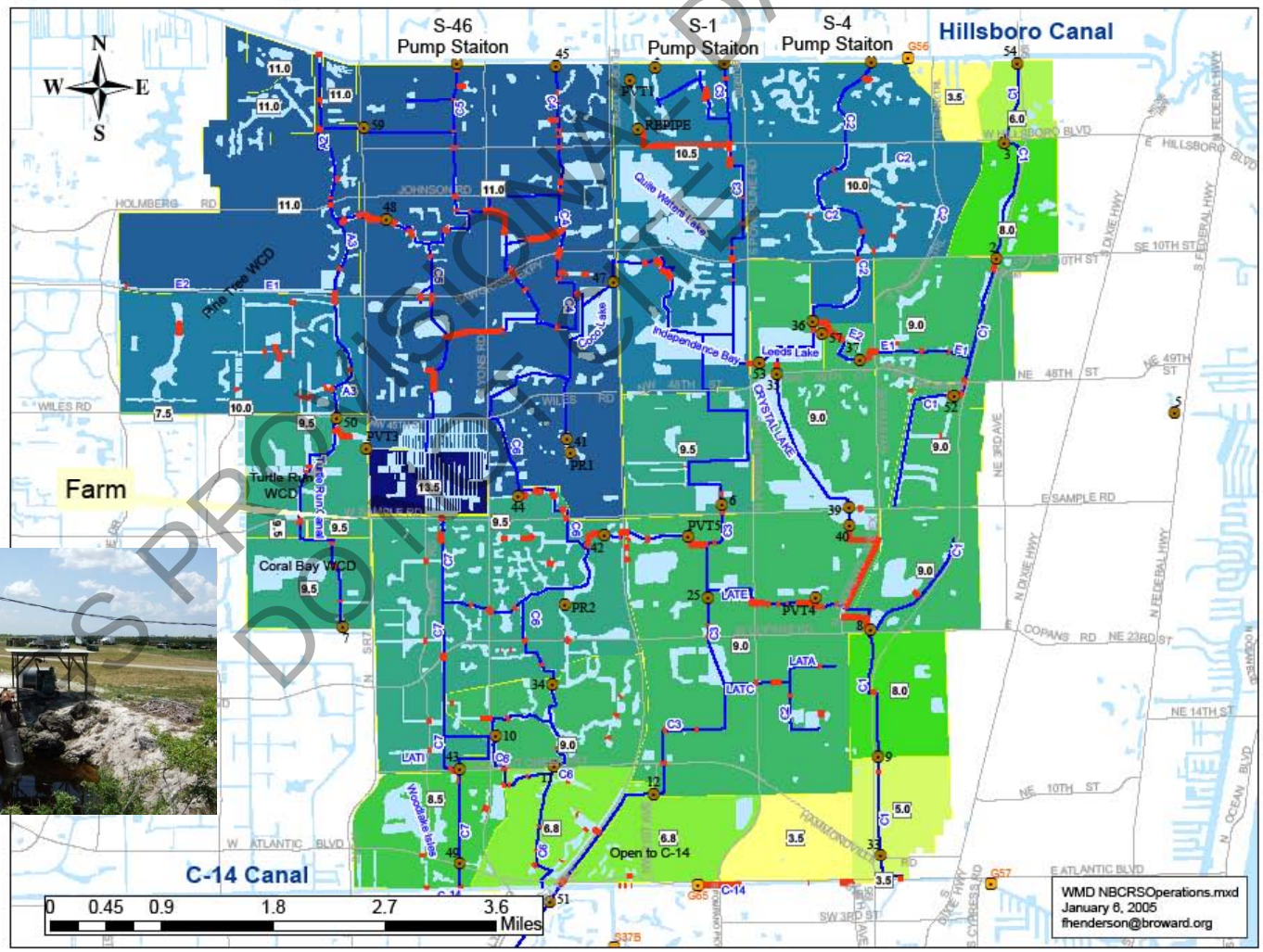
SFWMD

USGS PROVISIONAL DATA
DO NOT QUOTE

USGS
science for a changing world

Water Management

NBCRS Operations - Target Water Levels and Location of Control Structures



Legend

- Broward County Control Structure
- SFWMD Control Structure
- Culvert
- Major Roads
- Flow Path
- Surface Water
- NBCRS Boundary

Target Water Levels (FT)

OPT_LEV

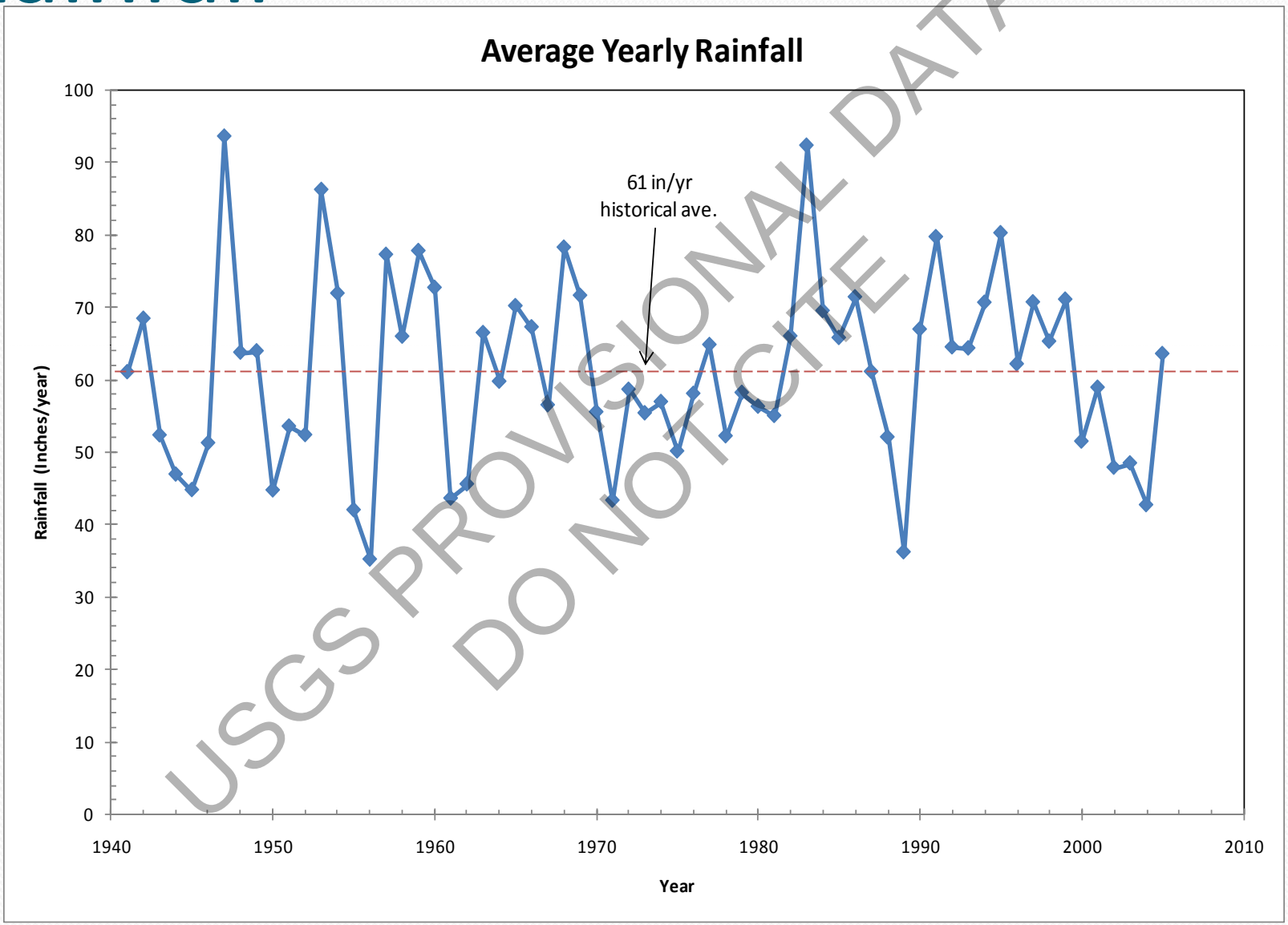
- 3.5
- 5.0
- 6.0
- 6.8
- 7.5
- 8.0
- 8.5
- 9.0
- 9.5
- 10.0
- 10.5
- 11.0
- 12.0
- 13.0
- 13.5

USGS PRECISIONAL DATA DO NOT CITE

BROWARD COUNTY FLORIDA

USGS science for a changing world

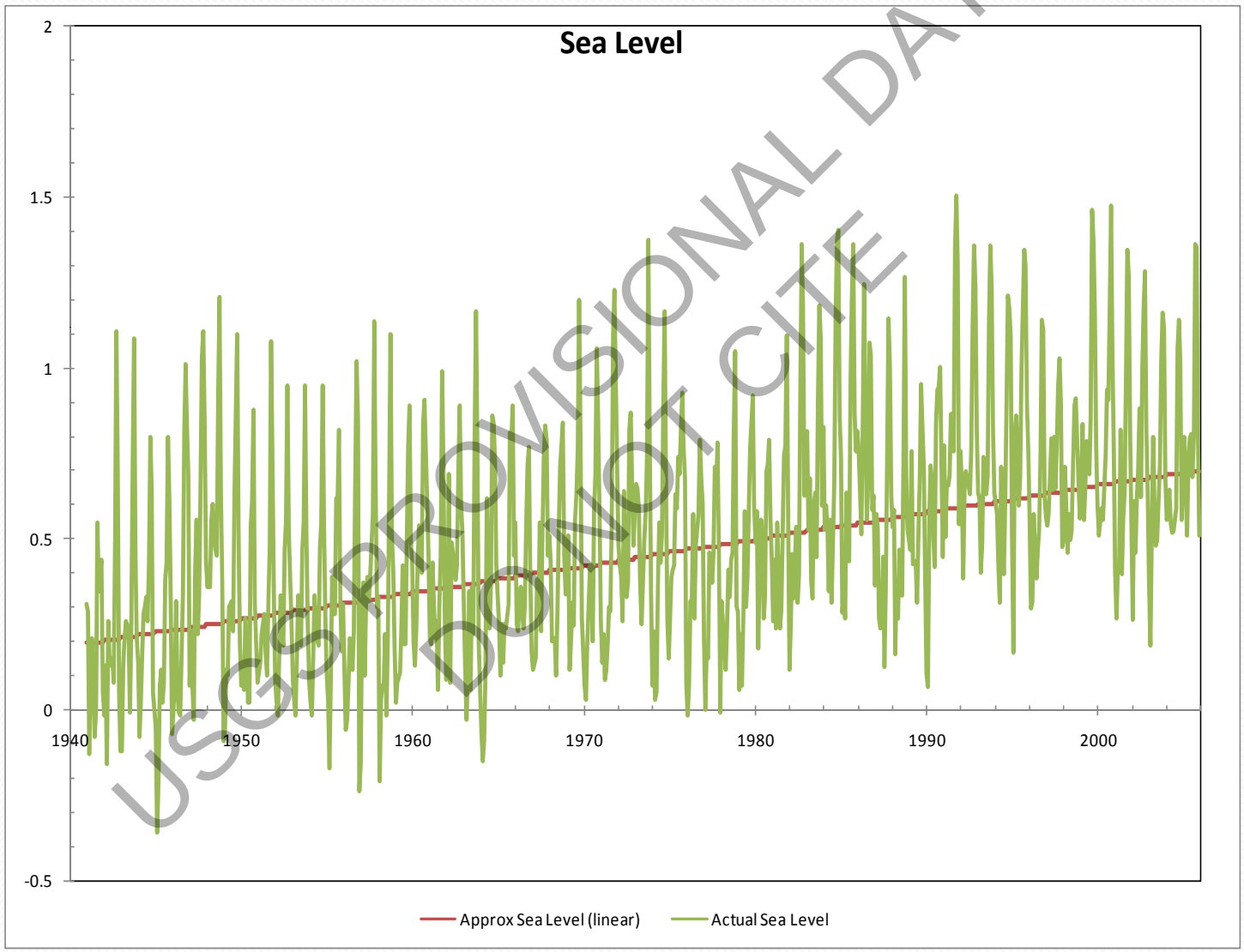
Rainfall



USGS PROVISIONAL DATA
DO NOT CITE

USGS
science for a changing world

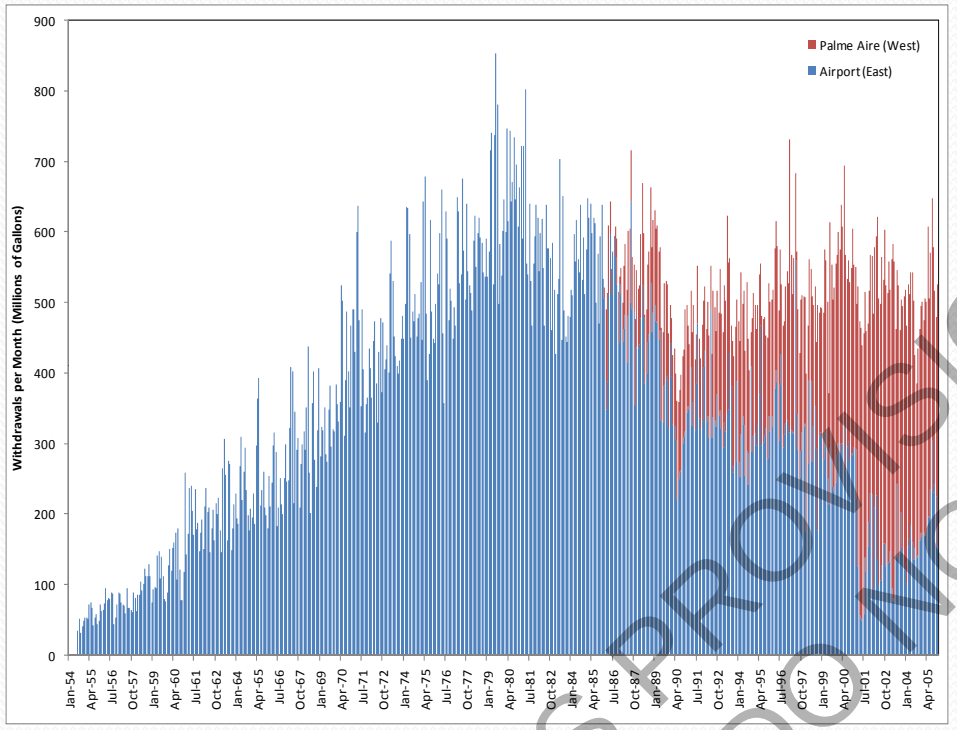
Sea Level Rise

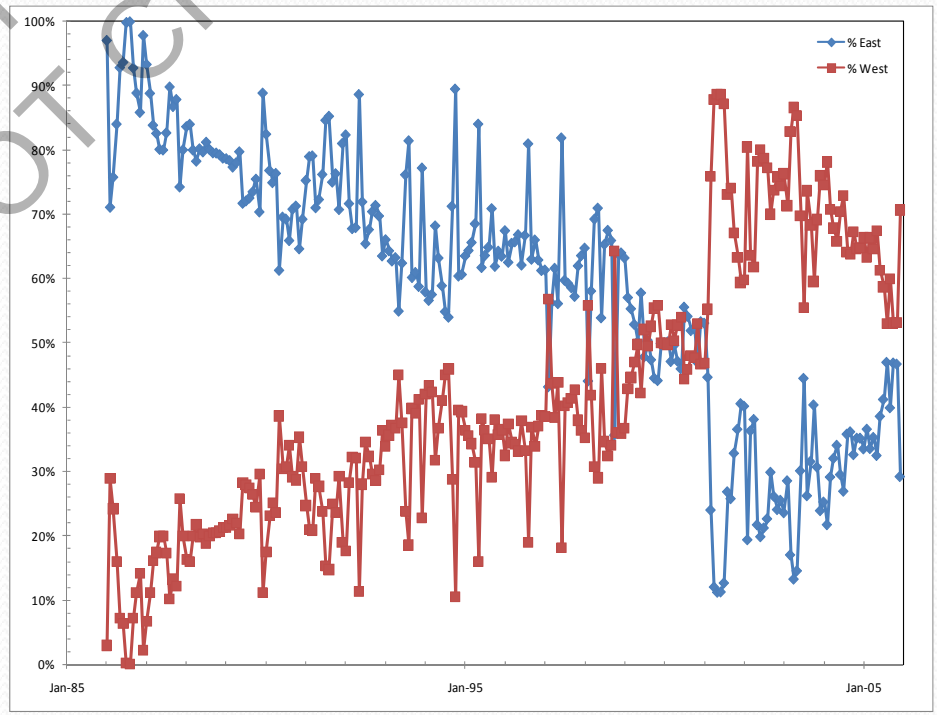


USGS PROVISIONAL DATA
DO NOT CITE

USGS
science for a changing world

Withdrawals





USGS PROVISIONAL DATA
DO NOT CITE

USGS
science for a changing world

Traditional Saltwater Wedge

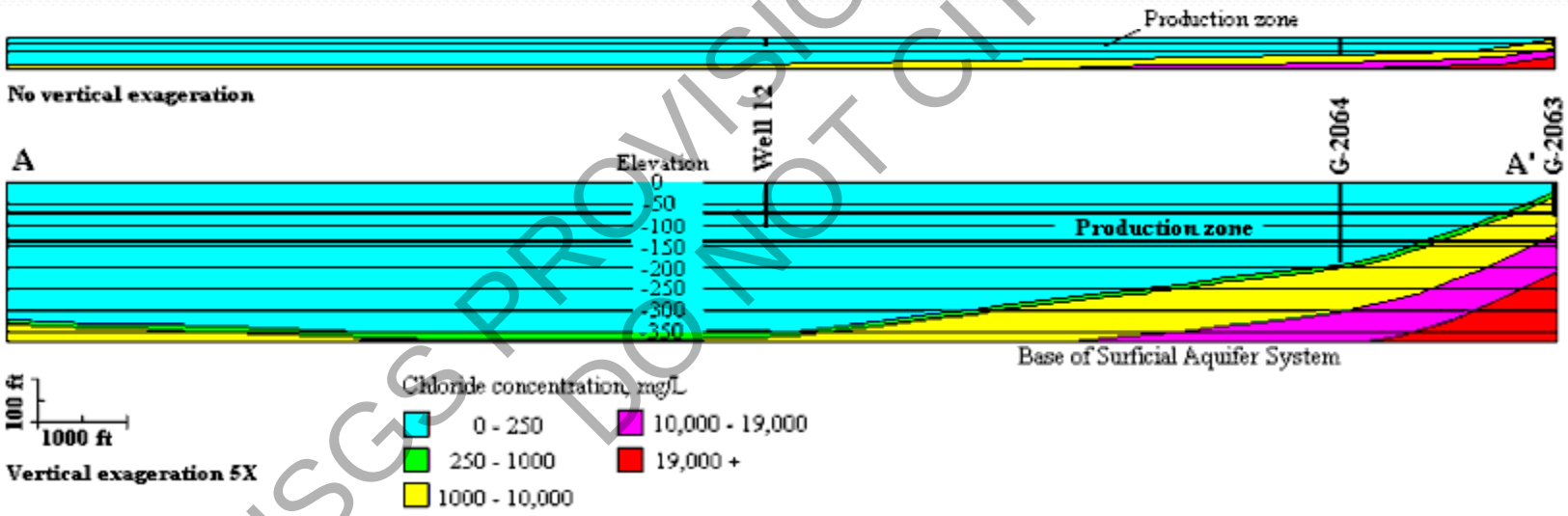


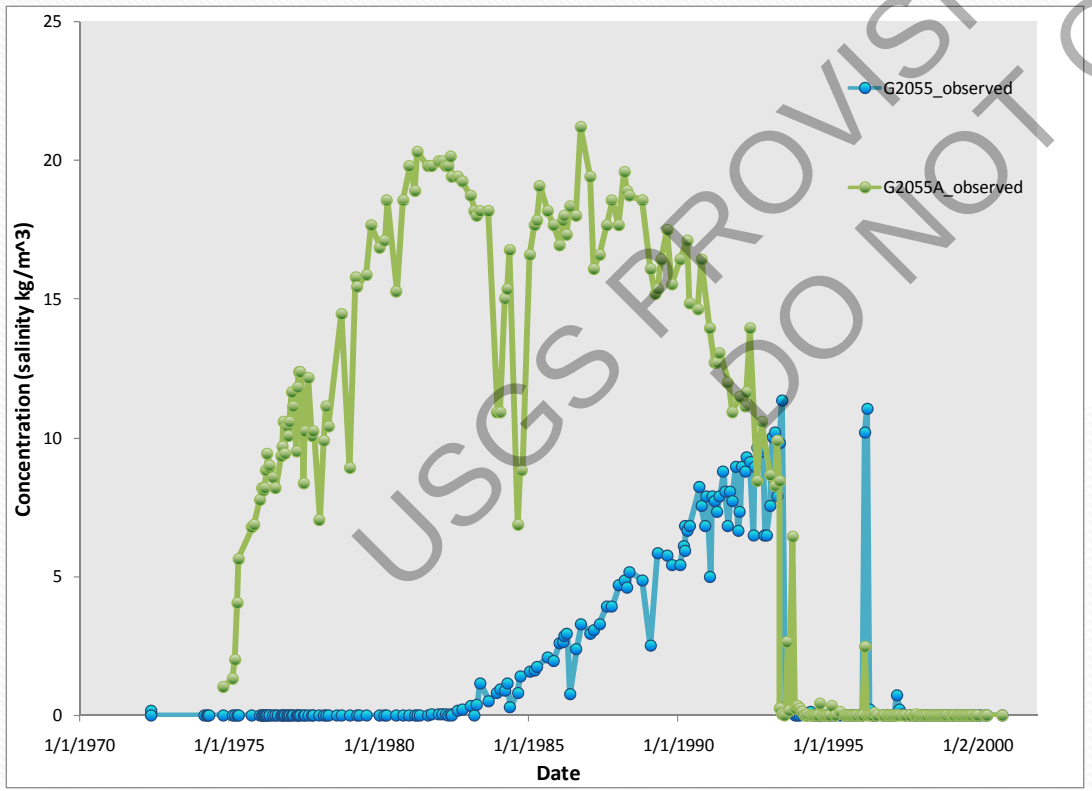
Figure 7. Vertical section A - A' showing estimated chloride concentration in the Surficial Aquifer System, 1972.

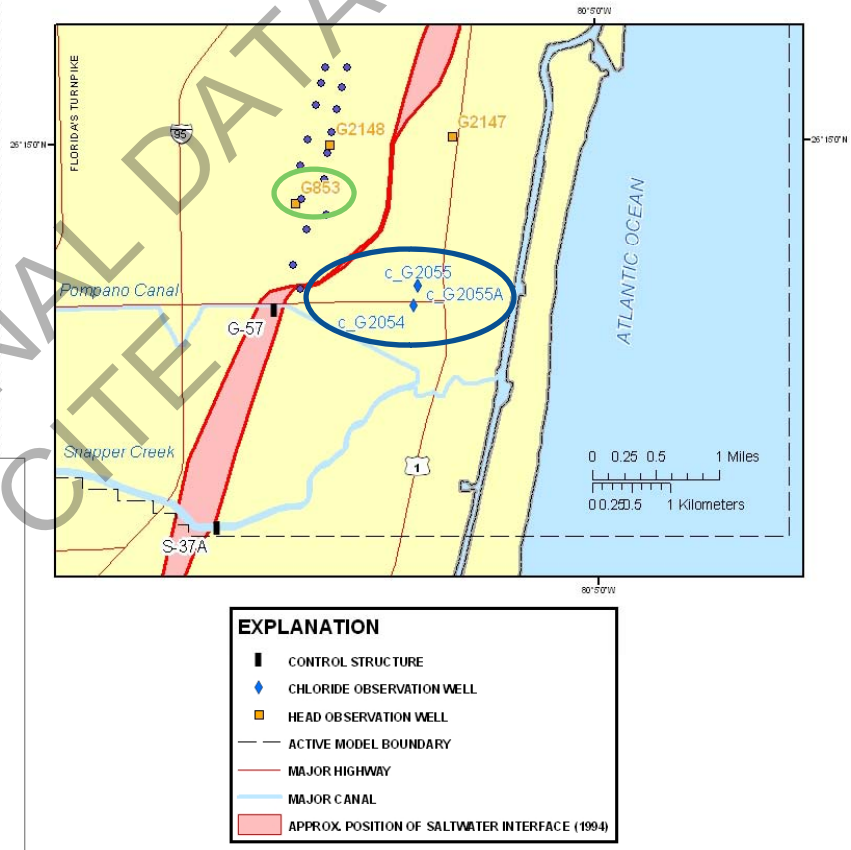
USGS PROVISIONAL DATA
DO NOT CITE

Dunn, 2001

USGS
science for a changing world

Unique Situation





USGS PROVISIONAL DATA
DO NOT CITE

USGS
science for a changing world

Perched Wedge

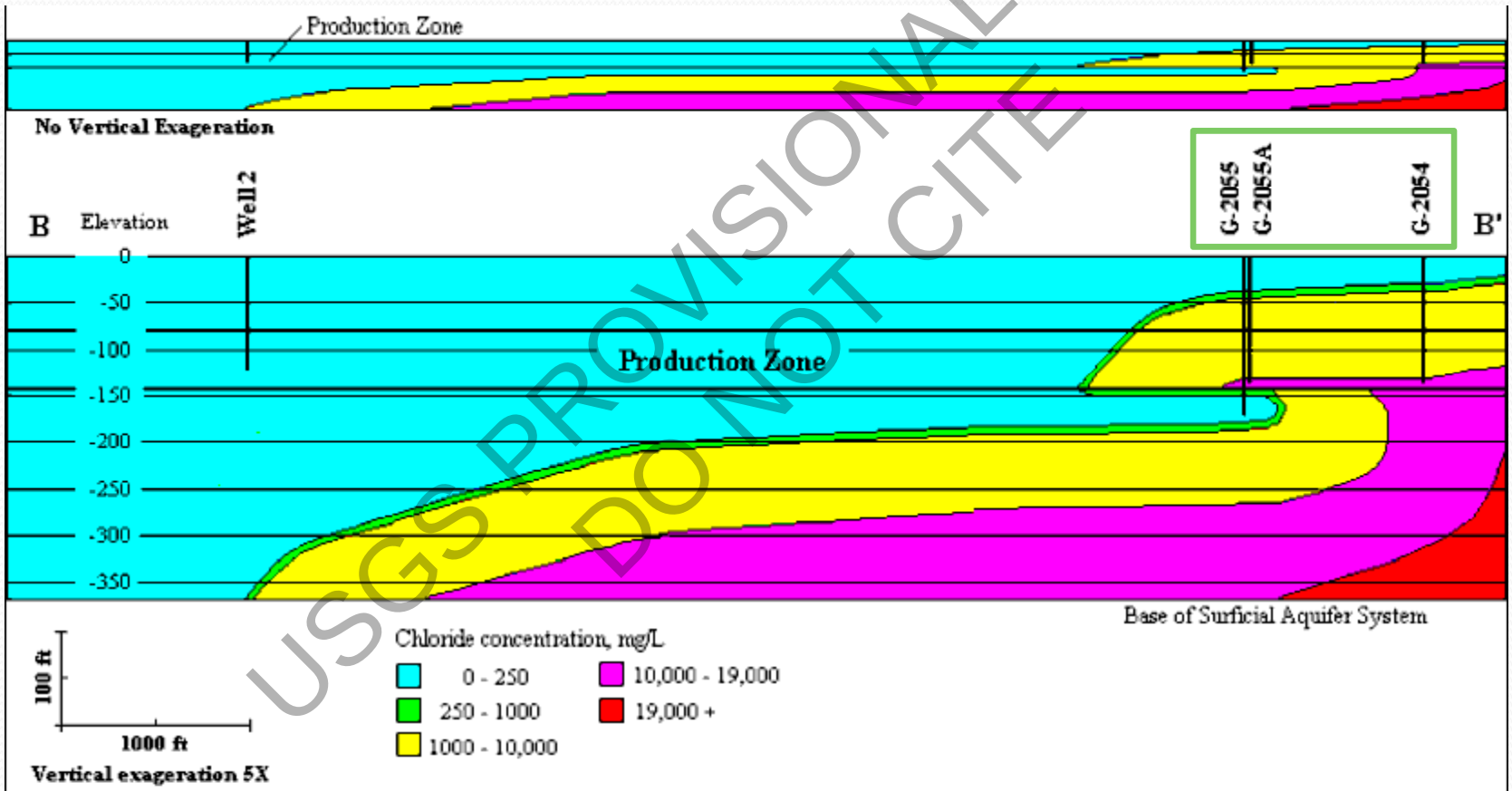


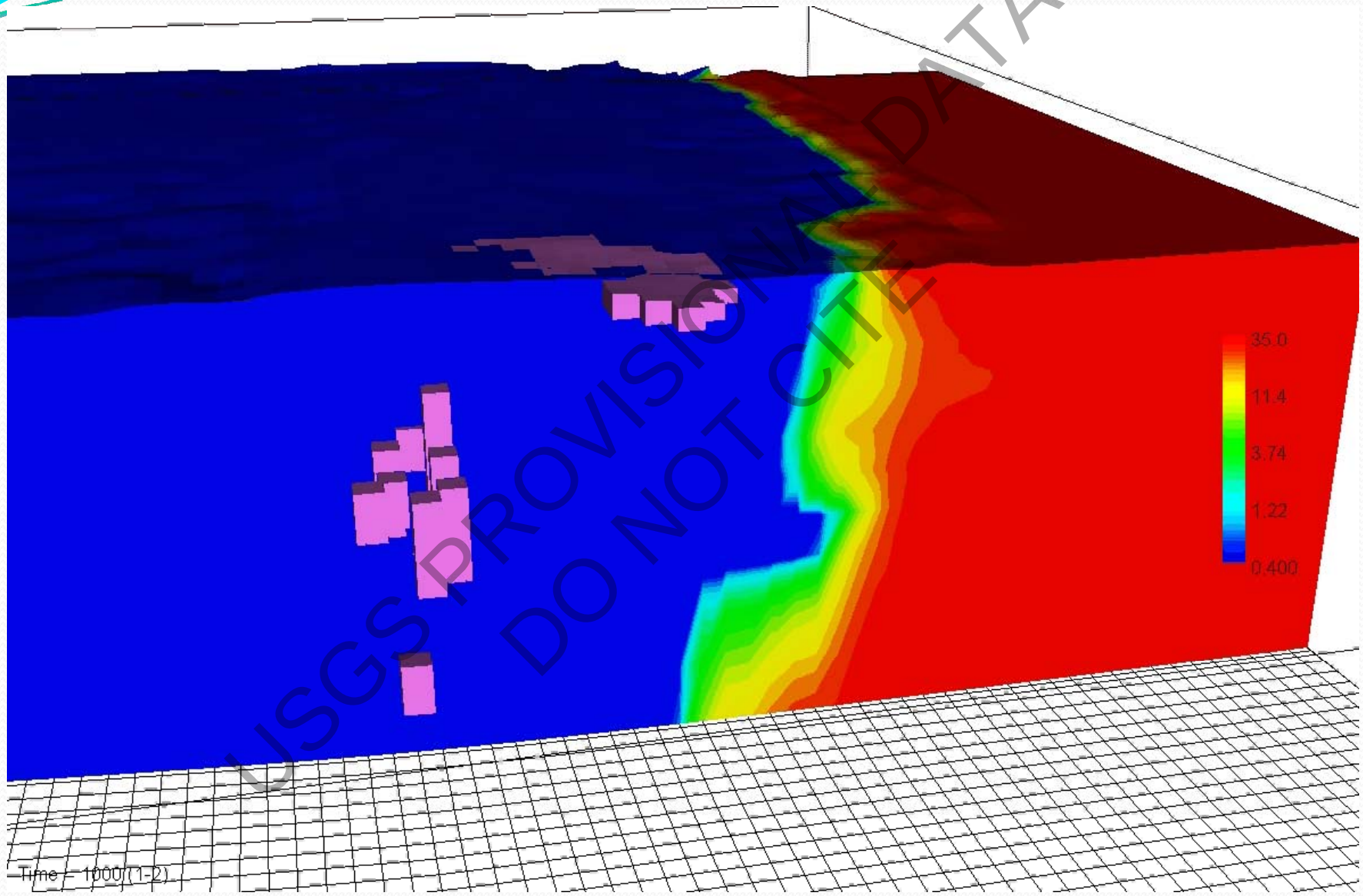
Figure 12. Vertical section B - B' showing estimated chloride concentration in the Surficial Aquifer System, 1979.

USGS PROVISIONAL DATA
DO NOT CITE

Dunn, 2001

USGS
science for a changing world

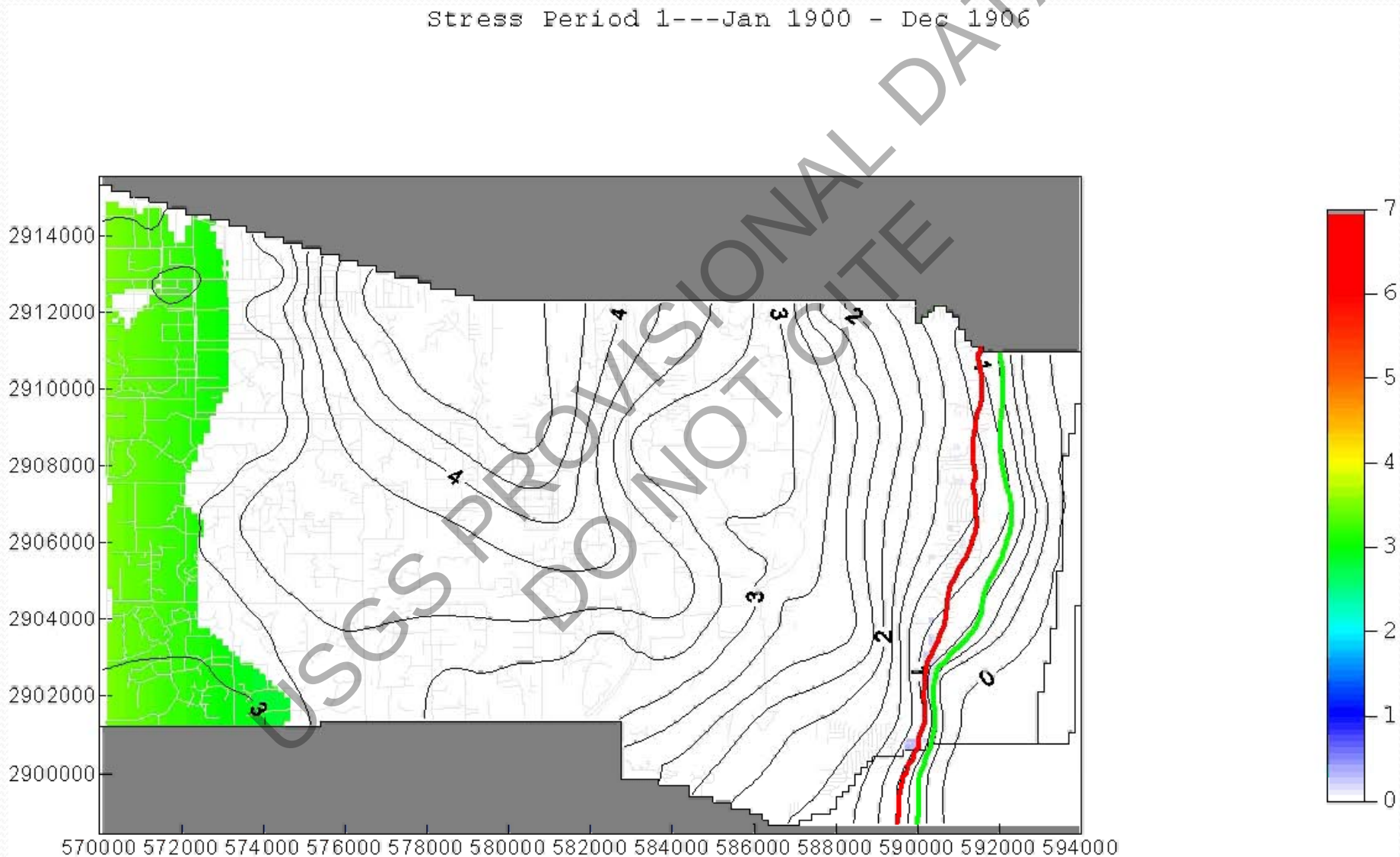
Results: Cross-Section



USGS PROVISIONAL DATA
DO NOT CITE

USGS
science for a changing world

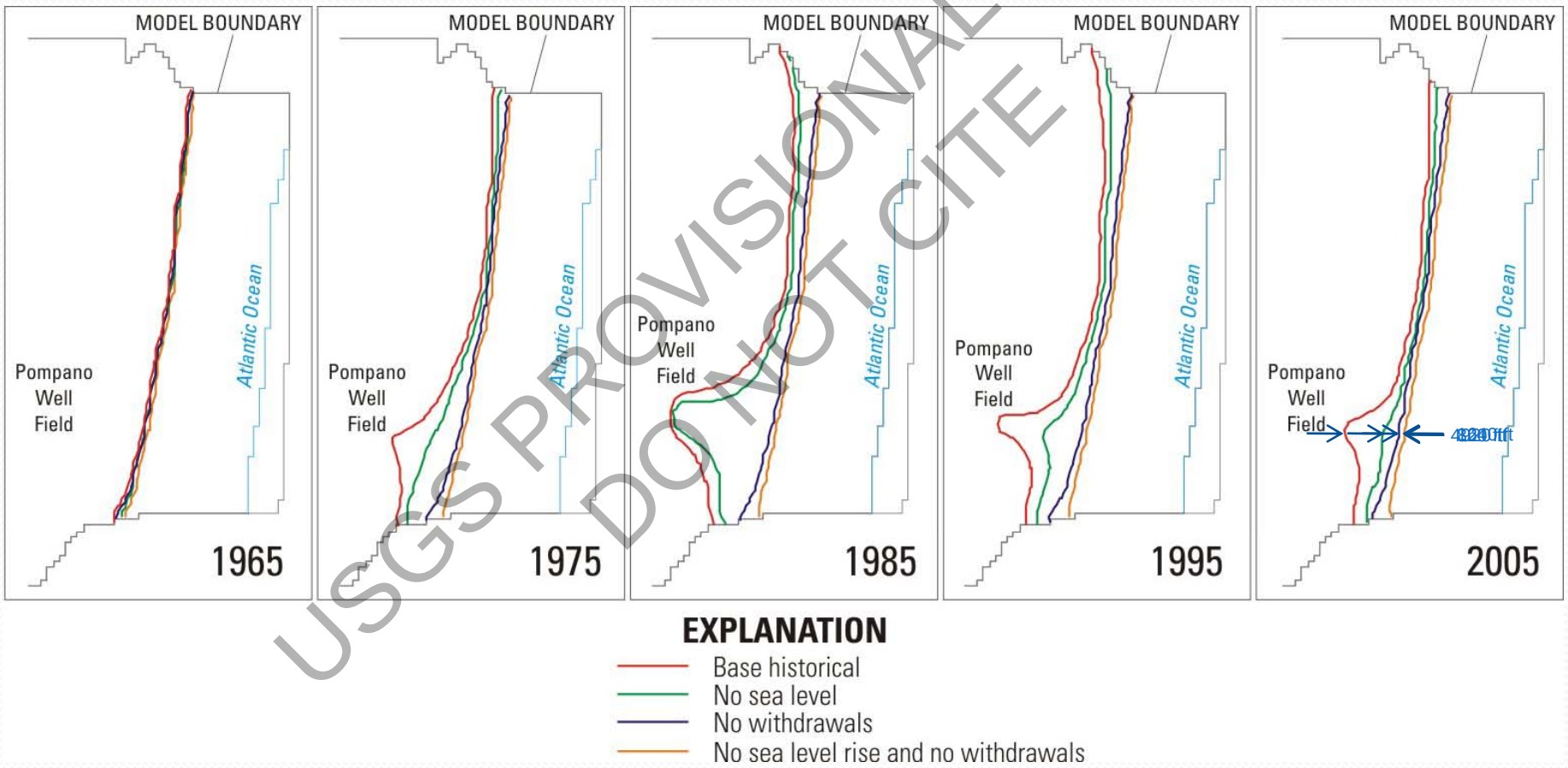
Results: Plan View



USGS PROVISIONAL DATA
DO NOT CITE

USGS
science for a changing world

Results & Conclusions



USGS PROVISIONAL DATA
DO NOT CITE

Key Points

- Possible to simulate the complex process of saltwater intrusion
- Saltwater intrusion caused by: well field withdrawals, sea level rise, drought
- Shift of withdrawals to inland well fields is an effective strategy for preventing saltwater intrusion

USGS PROVISIONAL DATA
DO NOT CITE

USGS
science for a changing world

Questions??

Acknowledgements

- Broward County
  - Darrel Dunn
  - Jennifer Jurado
  - Katie Lelis
  - Fran Henderson
  - Dave Markward
  - Joe Heilman
  - Guy Bartolotta
- Pompano Beach Utilities
- SFWMD
  - Krista Guerra
  - Winnie Said
- PEST Support
  - John Doherty
- Broward County Historical Commission

USGS PROVISIONAL DATA
DO NOT CITE

For further information contact:

Michael Zygnerski

mzygners@usgs.gov

USGS
science for a changing world