CLERMONT CHAIN OF LAKES

ICWA

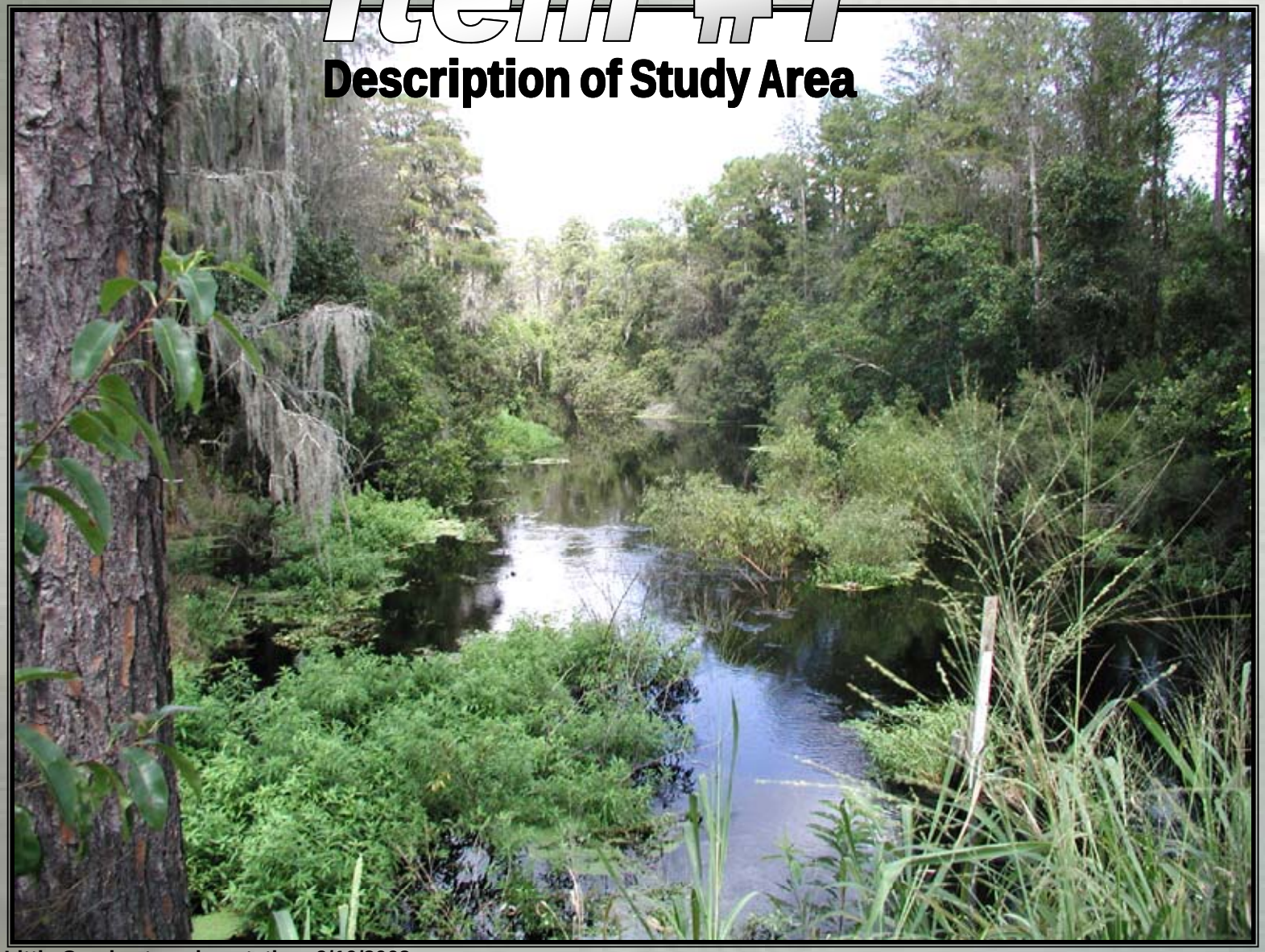
DEVO Engineering
CONSULTING GEOTECHNICAL ENGINEERS

PEC

CLERMONT CHAIN OF LAKES

Item #1

Description of Study Area

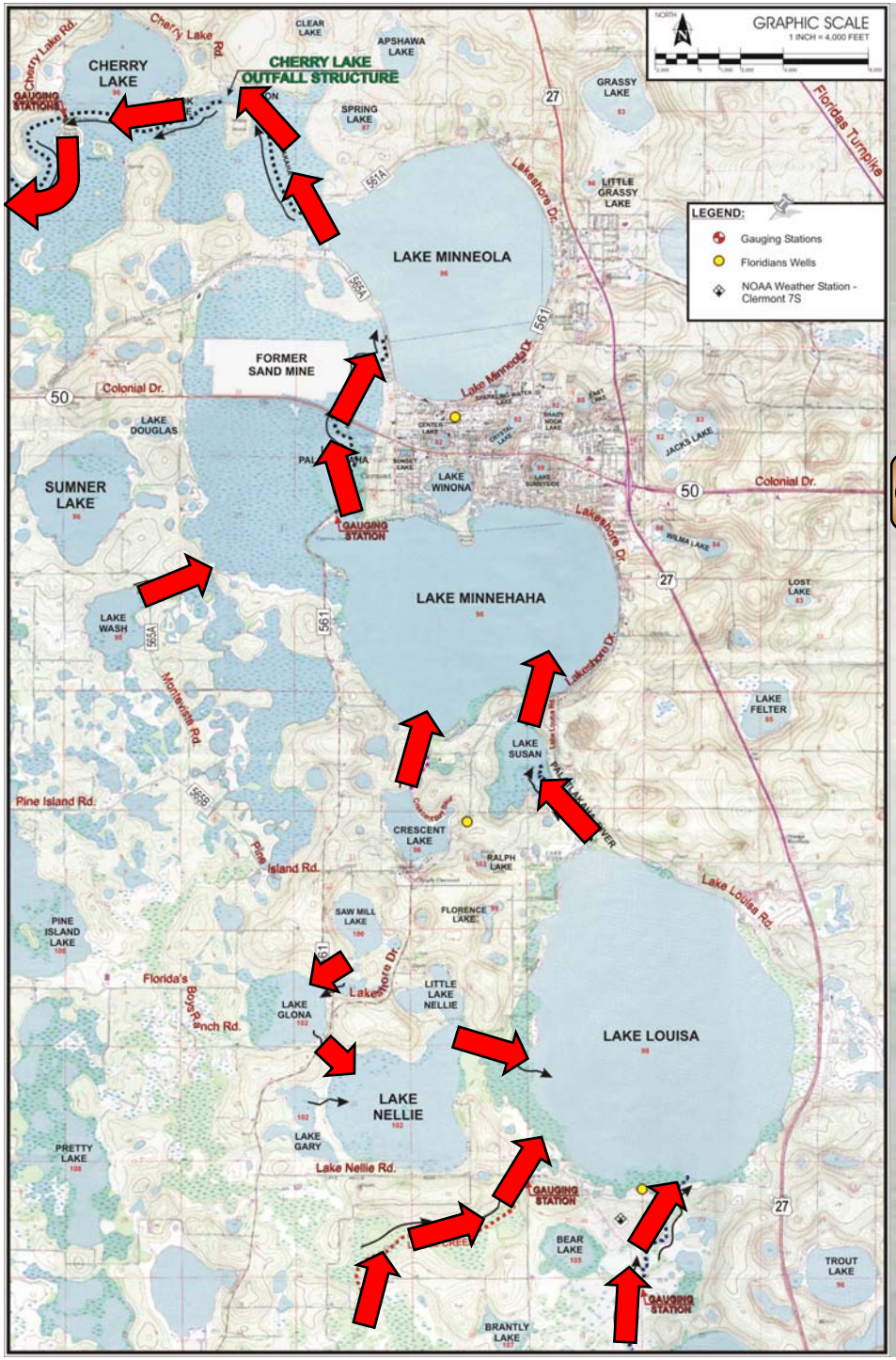


Little Creek, at gaging station, 9/10/2002

The Clermont Chain of Lakes

For the purpose of this study,
the Clermont Chain of Lakes consists of
the navigable lakes along the Palatlakaha River,
starting with Lake Louisa in the south,
and ending at Cherry Lake in the North.

This includes:
Lake Louisa, Lake Susan, Lake Minnehaha,
Crescent Lake, Lake Winona, Lake Palatlakaha,
Lake Hiawatha, Lake Minneola, Wilson Lake,
Cook Lake, and Cherry Lake



Clermont Chain of Lakes

Green Swamp (Big and Little Creeks)

↓

Lake Louisa

↓

Lake Susan

↓

Crescent Lake → Lake Minnehaha ← Lake Winona

↓

Lake Palatlakaha

↓

Lake Hiawatha

↓

Lake Minneola

↓

Wilson Lake

↓

Cook Lake

↓

Cherry Lake

Notable Events

- 1885, first steamboat navigates from Lake Harris to Lake Minneola
- 1889, first excavation of Monte Vista Canal, connecting Lake Crescent and Lake Minnehaha
- 1926, Yacht and Water Sports Club is organized
- 1938, Clermont-Minneola Waterways Club is Organized. They cleaned all the canals in 1939
- Clermont-Minneola Waterways Club becomes South Lake Waterways Club, leading an effort resulting in the "Engineering Report on Inland Waterways of Florida." This leads to...
- 1951, legislature creates Oklawaha Basin Recreation and Water Conservation and Control Authority, which later becomes the Lake County Water Authority
- 1956 Cherry Lake dam is completed
- April 6, 1960, water levels reach +99.04 ft in Lake Minnehaha
- 1963, dry years result in low water levels, +92.72 ft
- 1979, lakes reach flood stage of +97.66 ft, in September, 1979
- 1981, Lake Minnehaha reaches low stage of 92.47 ft, Dec 23, 1981
- 1998, wet El Nino year, flood stages of +98.11 seen
- 2000/2001, dry La Nina years, record low stages, +87.57ft. on May31, 2002

Source: Stanley Consultants, Inc.

Item #2

Problem Statement

Lake Minneola, north shore, 6/10/2002

Problem Statement

Record low lake levels affecting...


CR 561

Roadway Failure

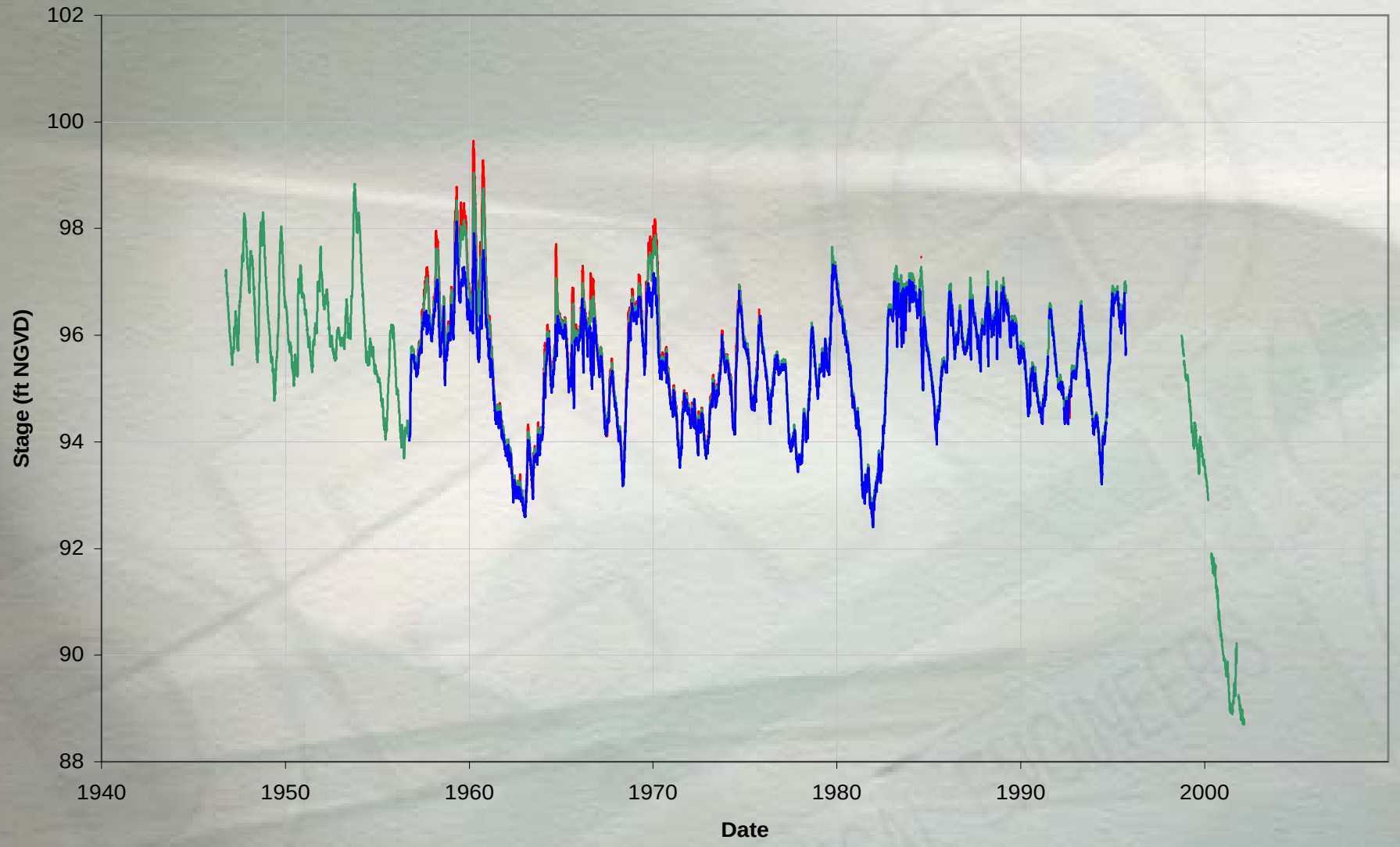

CR 565A Bridge

Navigability and Recreation


Lake Minneola

Aesthetics and Property Value

Historical Lake Levels (1946 – 2002)



Data for the period of 10/1/1946 through 3/2/2002

Summary of Water Levels in the Clermont Chain

YEAR	Condition	Lake Stage (ft)
1960	Flood	99.04
1963	Drought	92.72
1979	Flood	97.66
1981	Drought	92.47
1998	Flood	98.11
2002	Drought	87.57

Source: Stanley Consultants, Inc.

Item #3

Objectives

Lake Minneola, north shore, 6/10/2002

Objectives

Develop a subregional ground water / surface water model to quantify and distinguish the lake level influence of the following:

- natural weather patterns
- artificial ground water withdrawals

Item #4

Hydrologic Data Collection Effort

Cherry Lake Discharge Structure, 6/7/2002

Aerial Reconnaissance June 7, 2002, Fly-over

Lake Minnehaha, 6/7/2002

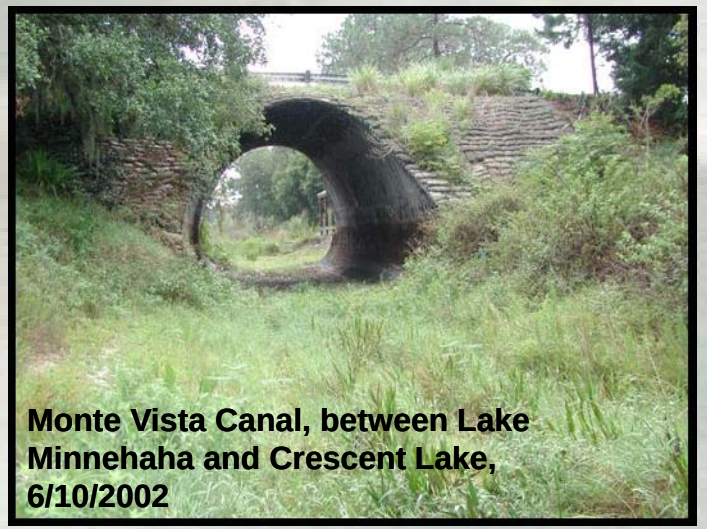
Lake Louisa, 6/7/2002

Cherry Lake Discharge Structure, 6/7/2002

Field Review

June 10, June 22, July 14, & September 10, 2002 Site Visits

Lake Minneola, 6/10/2002



Monte Vista Canal, between Lake Minnehaha and Crescent Lake, 6/10/2002

Cherry Lake, 6/22/2002

Lake Louisa State Park, 6/22/2002

Data Resources

Published Resources

- *USGS Water Resources Data, Volume 1A: Surface water, and Volume 1B: Ground Water, Water Year 2001* (et. al.)
- USGS Potentiometric Surface Maps of the Upper Floridan Aquifer
- USGS 7.5 Degree Quadrangle Maps
- *Hydrogeology and Simulation of the Effects of Reclaimed Water Application in West Orange and Southeast Lake Counties, Florida*, Andrew O'Reilly, 1998
- *Palatlakaha River Restoration Phase 1 Report – Appendix, Draft Technical Memorandum*, Stanley Consultants, Inc., April 2002
- *Clermont, Gem of the Hills*, Miriam Johnson and Rosemary Young, 1984

Online Resources

- Online data resources LCWA, SJRWMD, SFWMD, SFWMD, USGS

Transmitted data sources

- Data from LCWA, SJRWMD, USGS
- Southlake Utilities monitor well data

Item #5

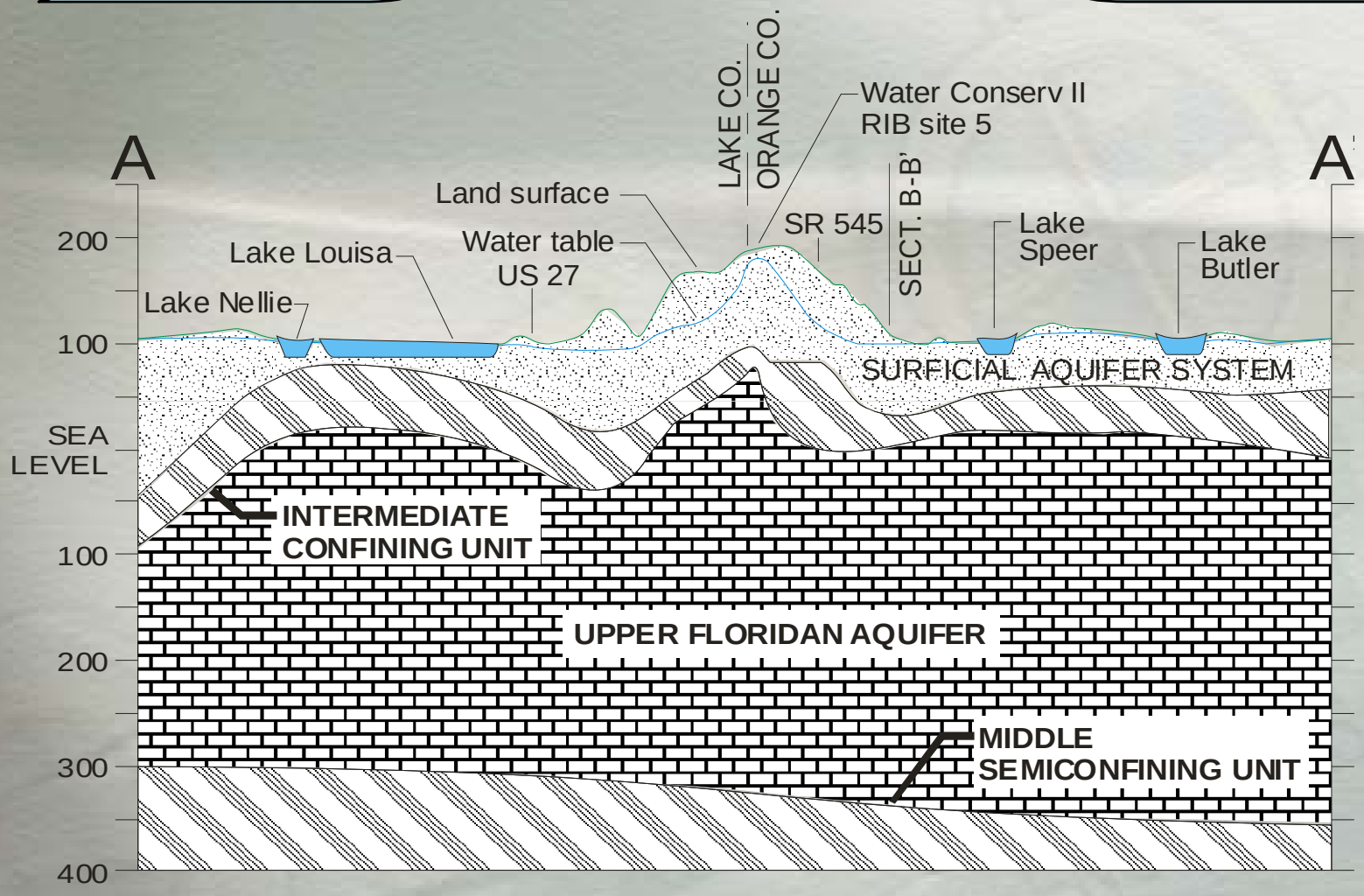
Hydrogeologic Setting

Cherry Lake, 6/7/2002

Geological Cross Sections

Location of geological cross sections presented in O'Reilly report

Cross Section A-A'

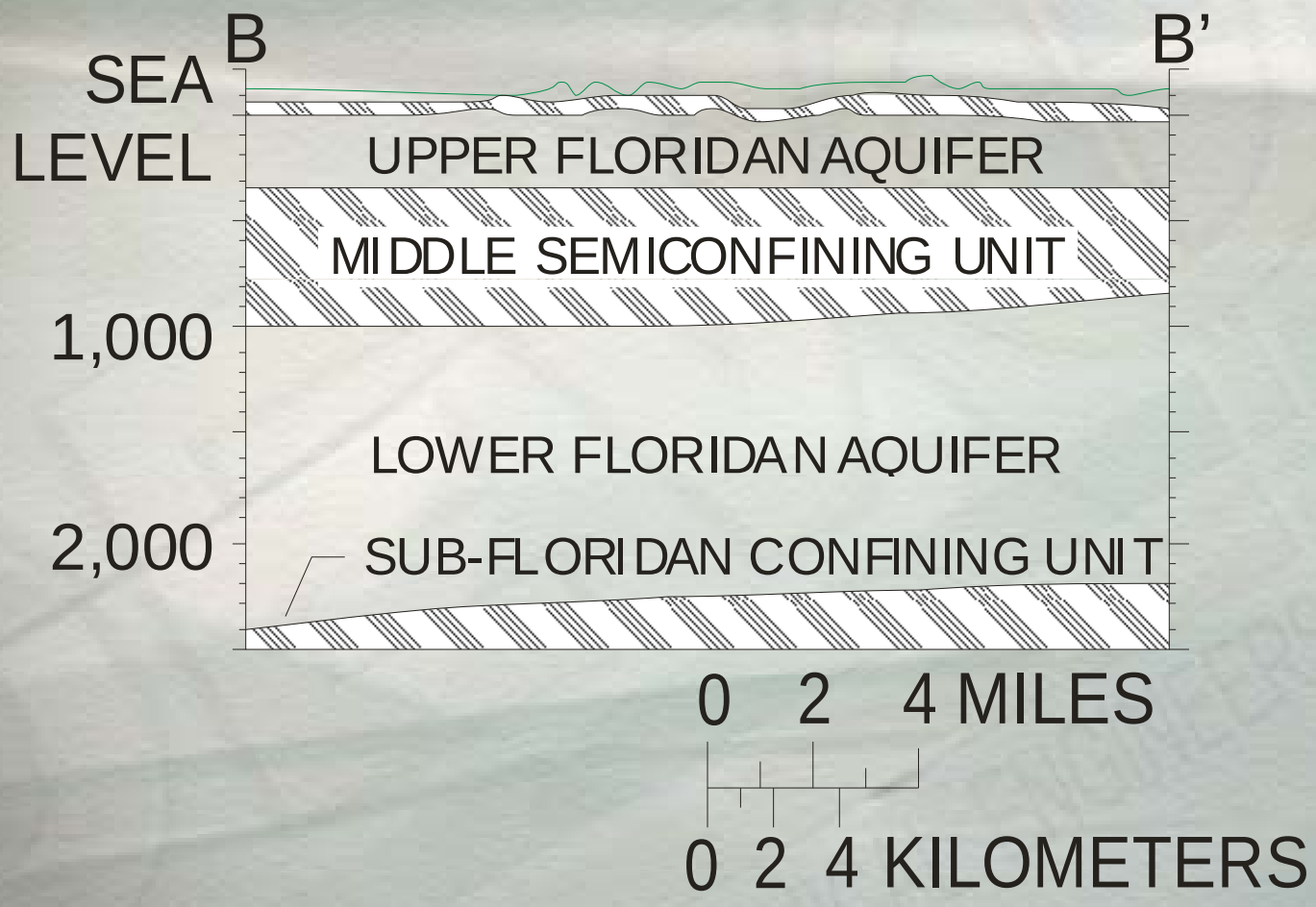


Source: O'Reilly

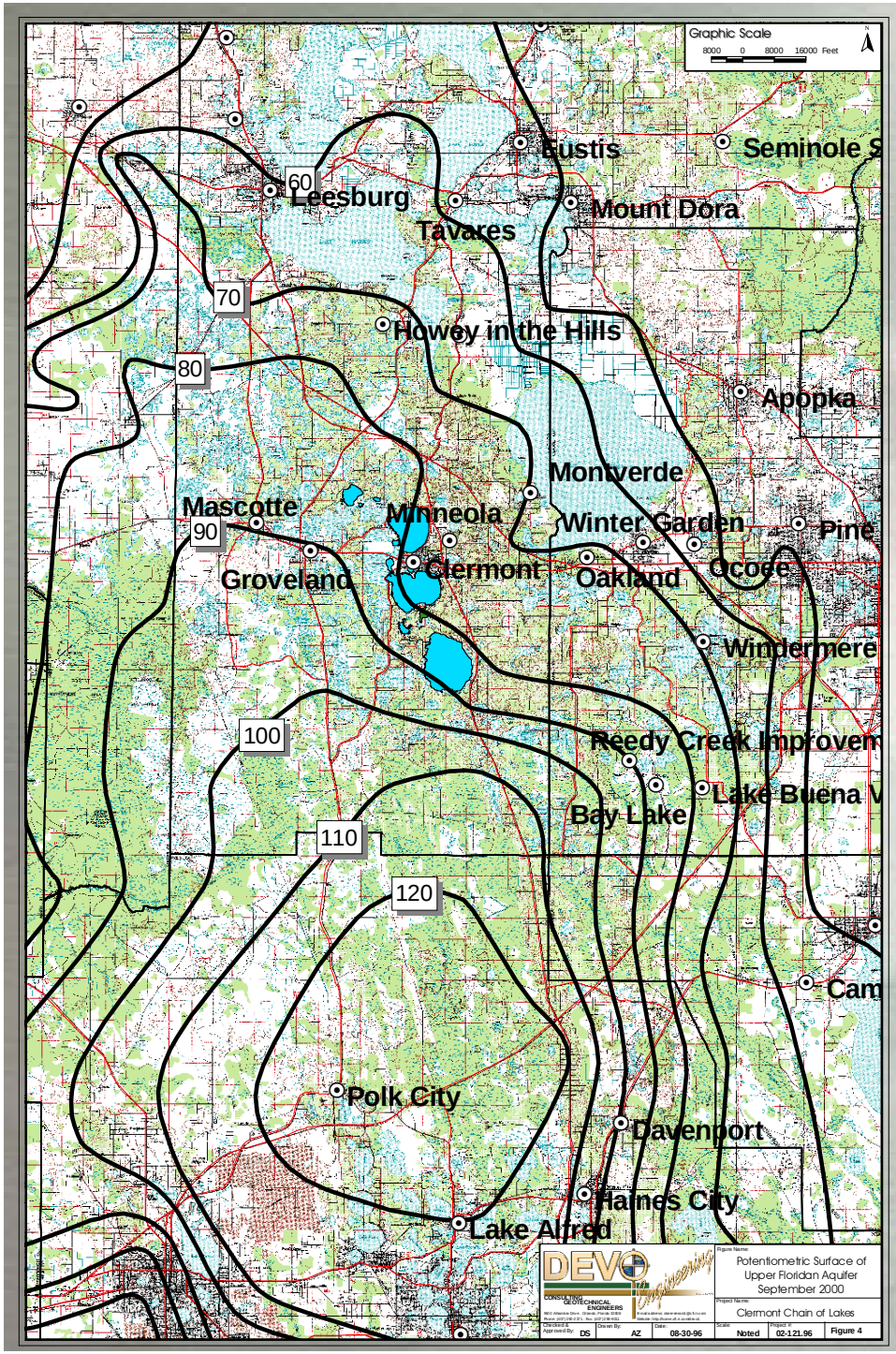
<u>Note:</u> thickness of intermediate confining unit in vicinity of Lake Louisa

WATER TABLE REPRESENTS AVERAGE 1995 CONDITIONS

Upper and Lower Floridan Aquifers



Source: O'Reilly

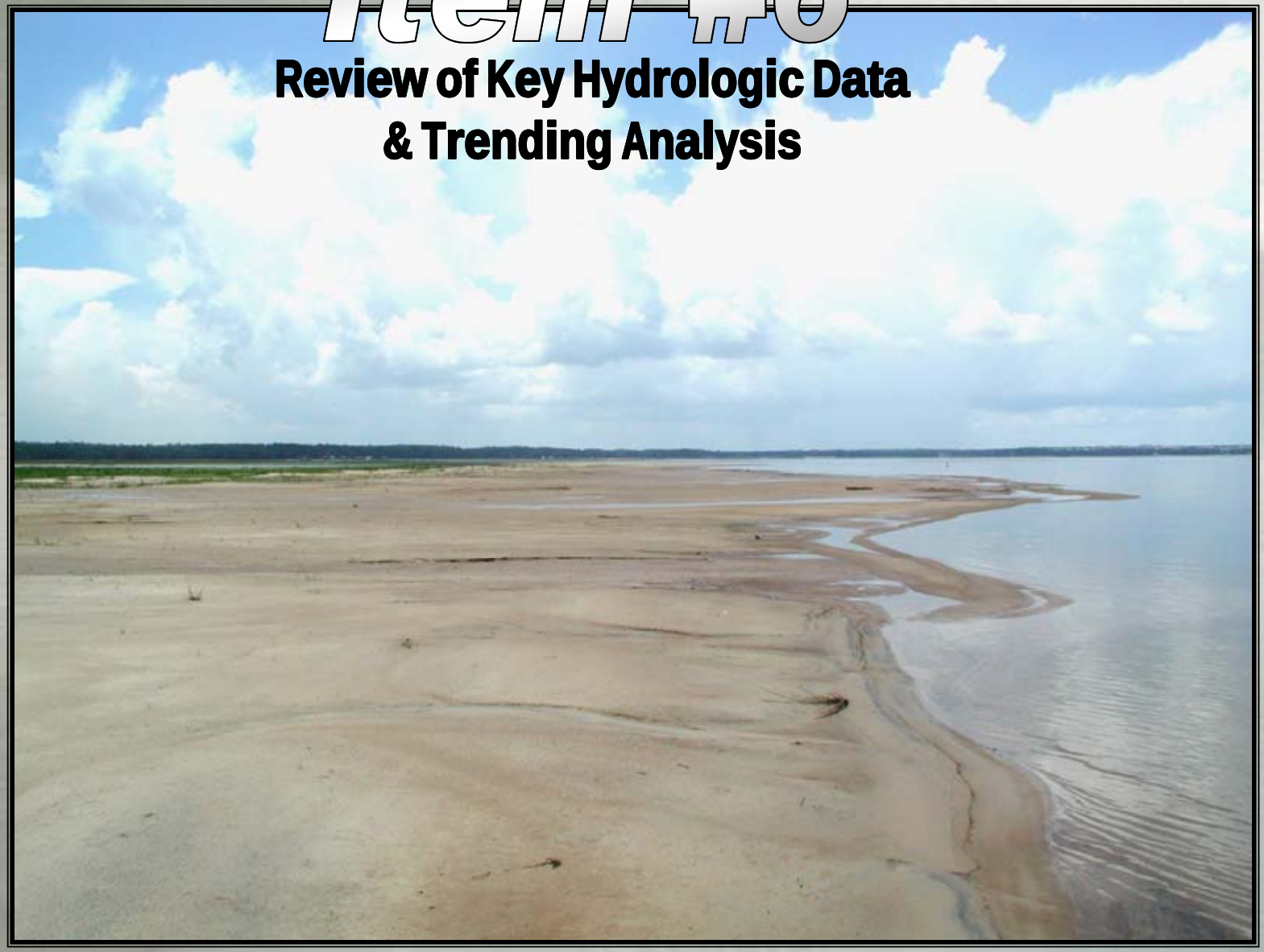


Potentiometric Surface of the Upper Floridan Aquifer

September 2000

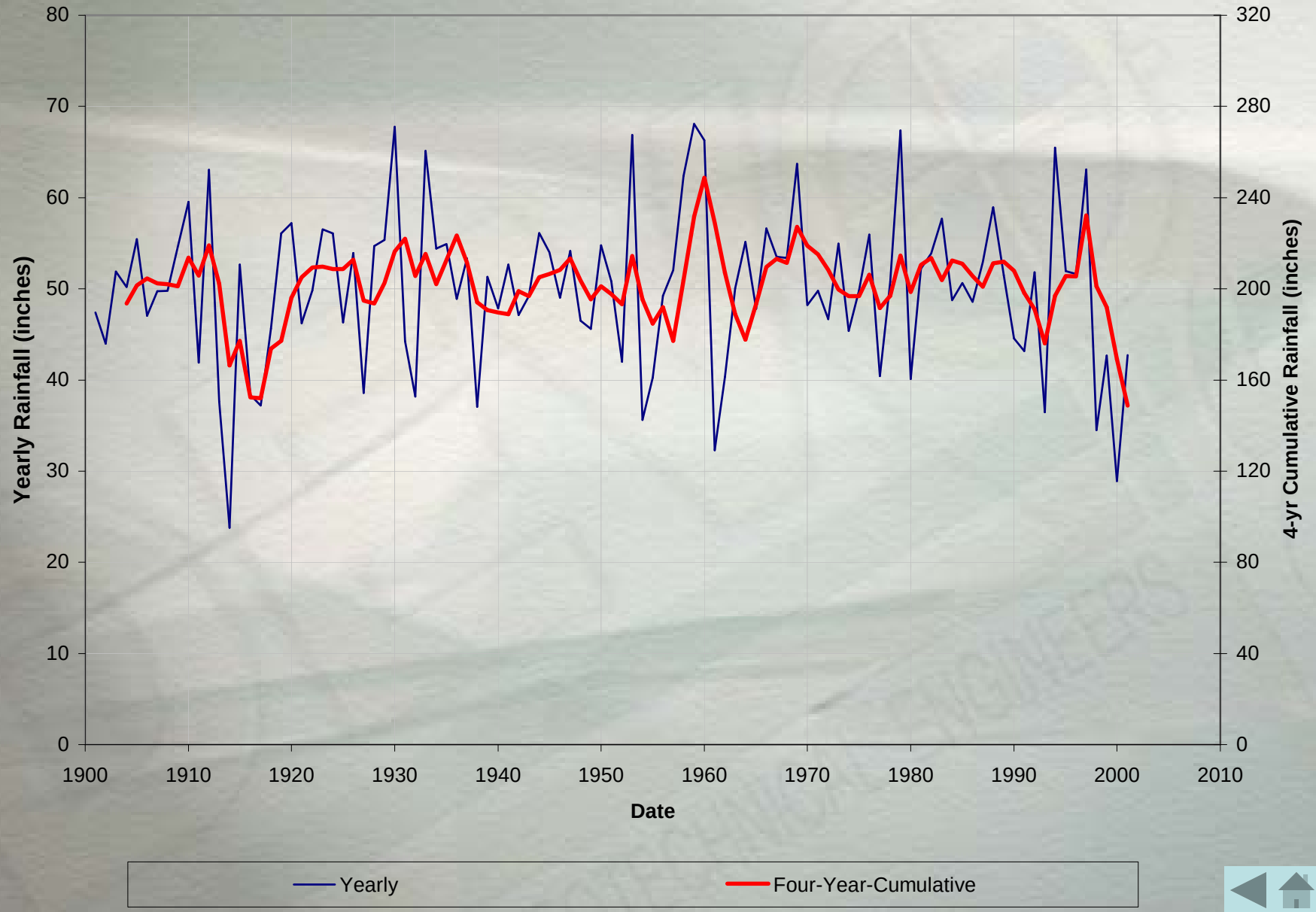
Item #6

Review of Key Hydrologic Data & Trending Analysis

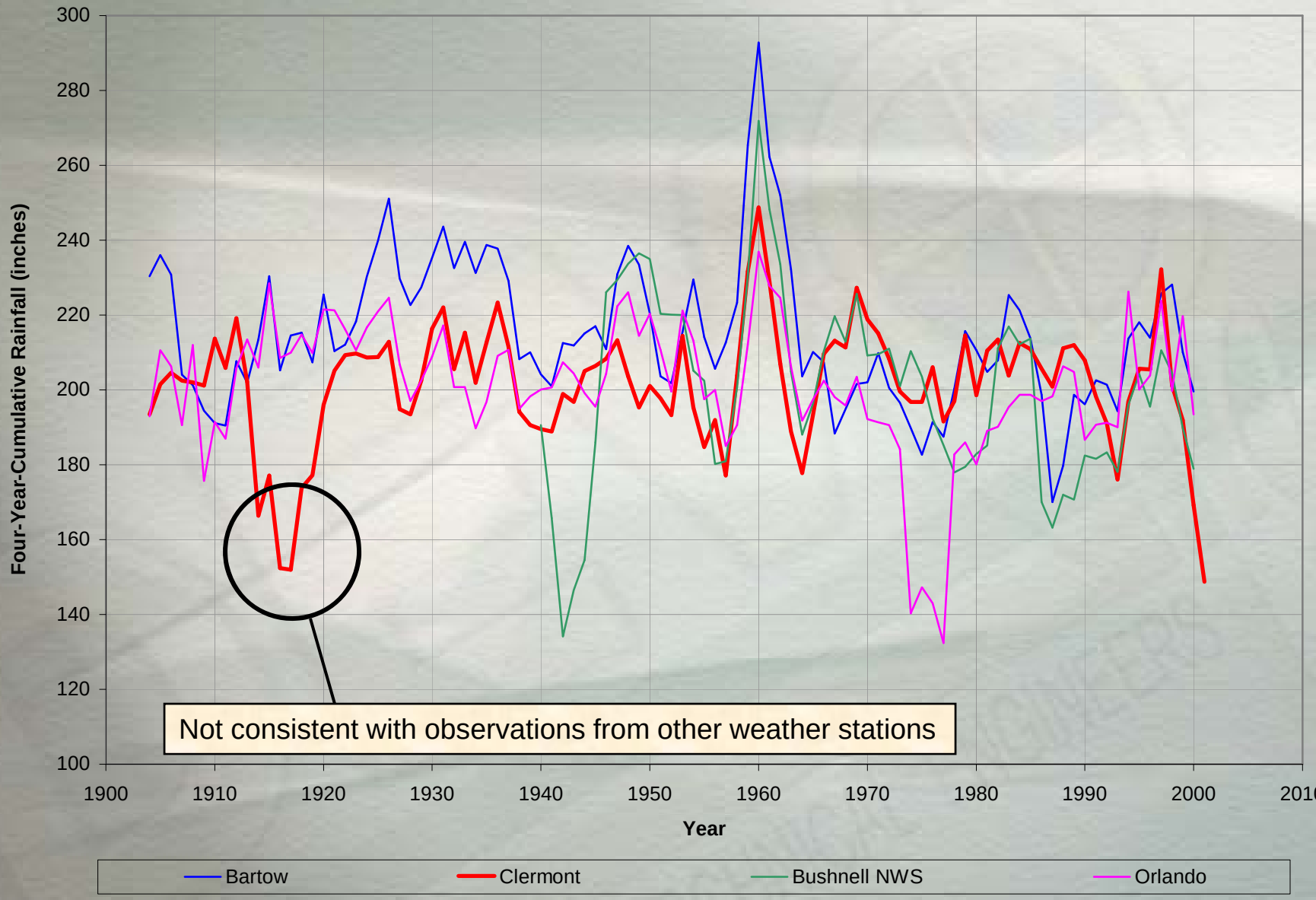


Lake Louisa, 6/10/2002

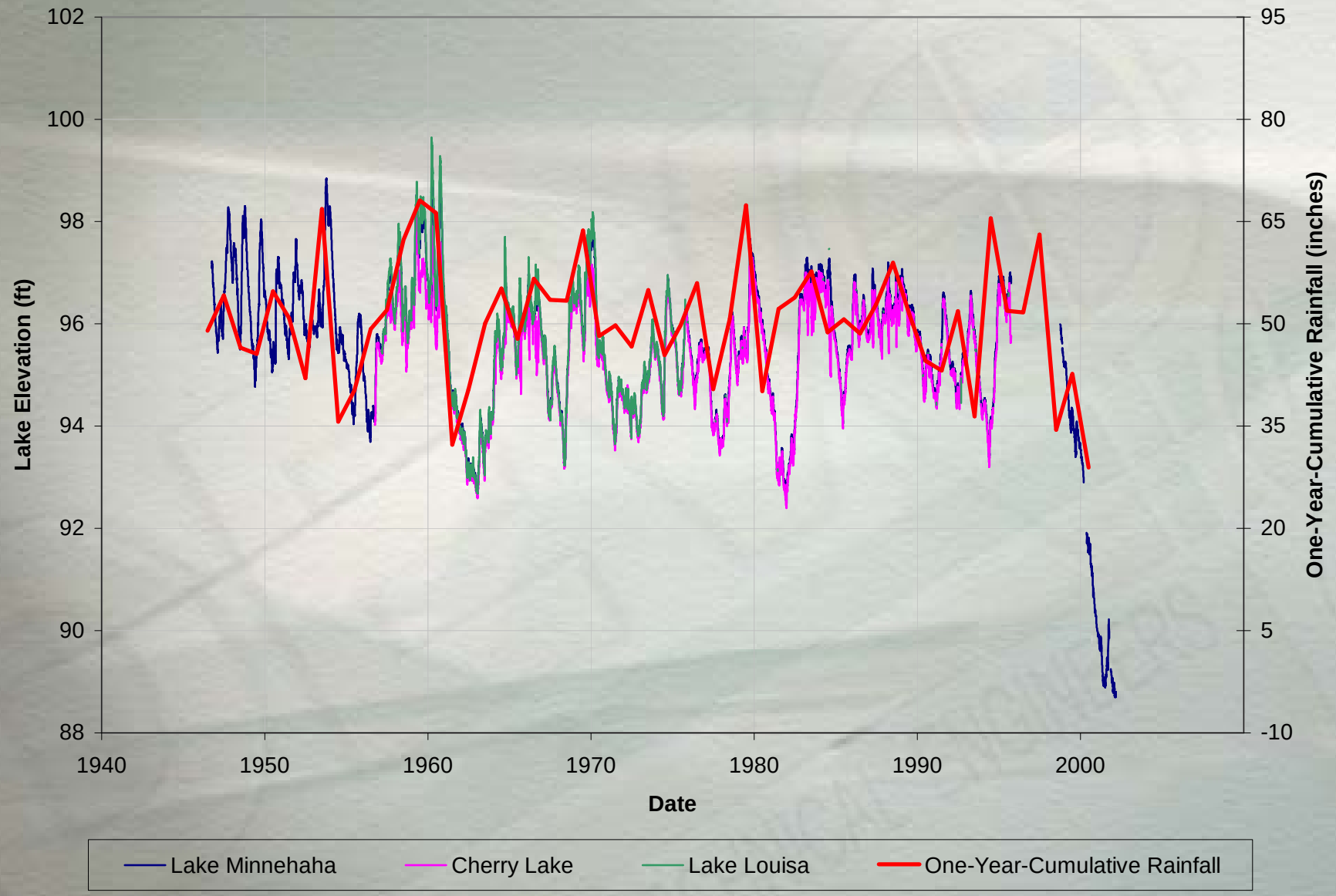
100 Years of Rainfall Data at Clermont Weather Station



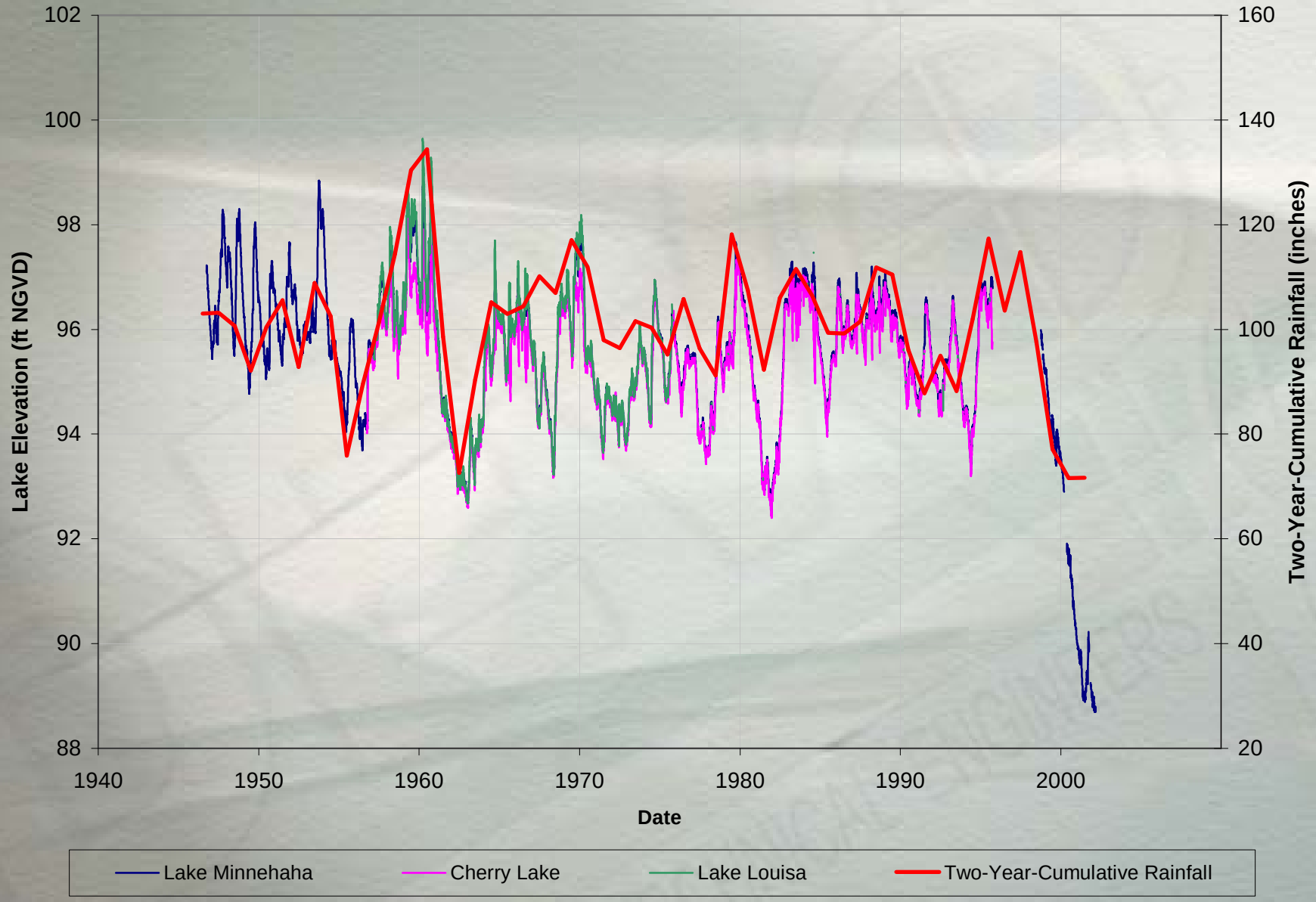
Rainfall Data for Selected Central Florida Weather Stations



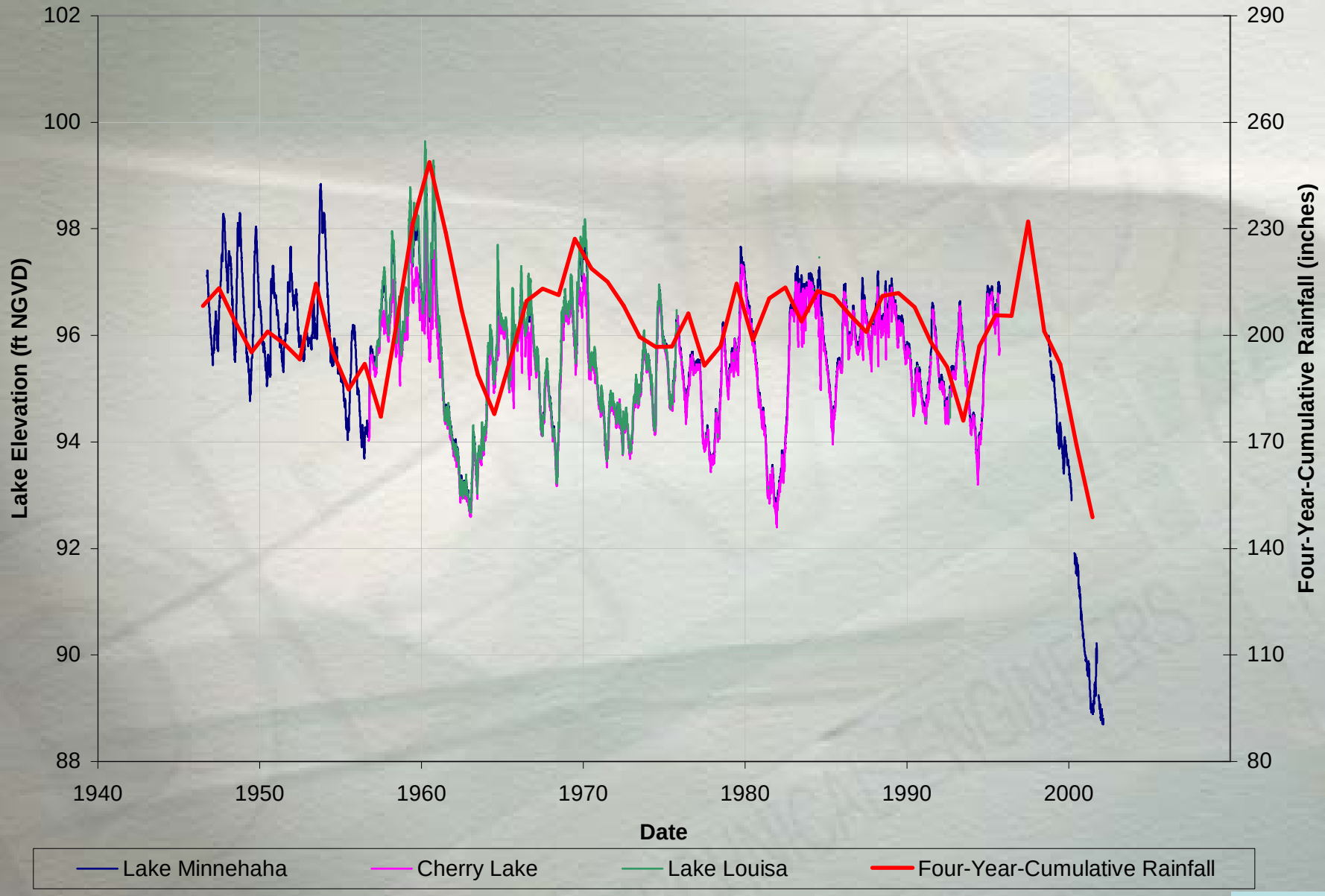
Historical Lake Levels and One-Year-Cumulative Rainfall

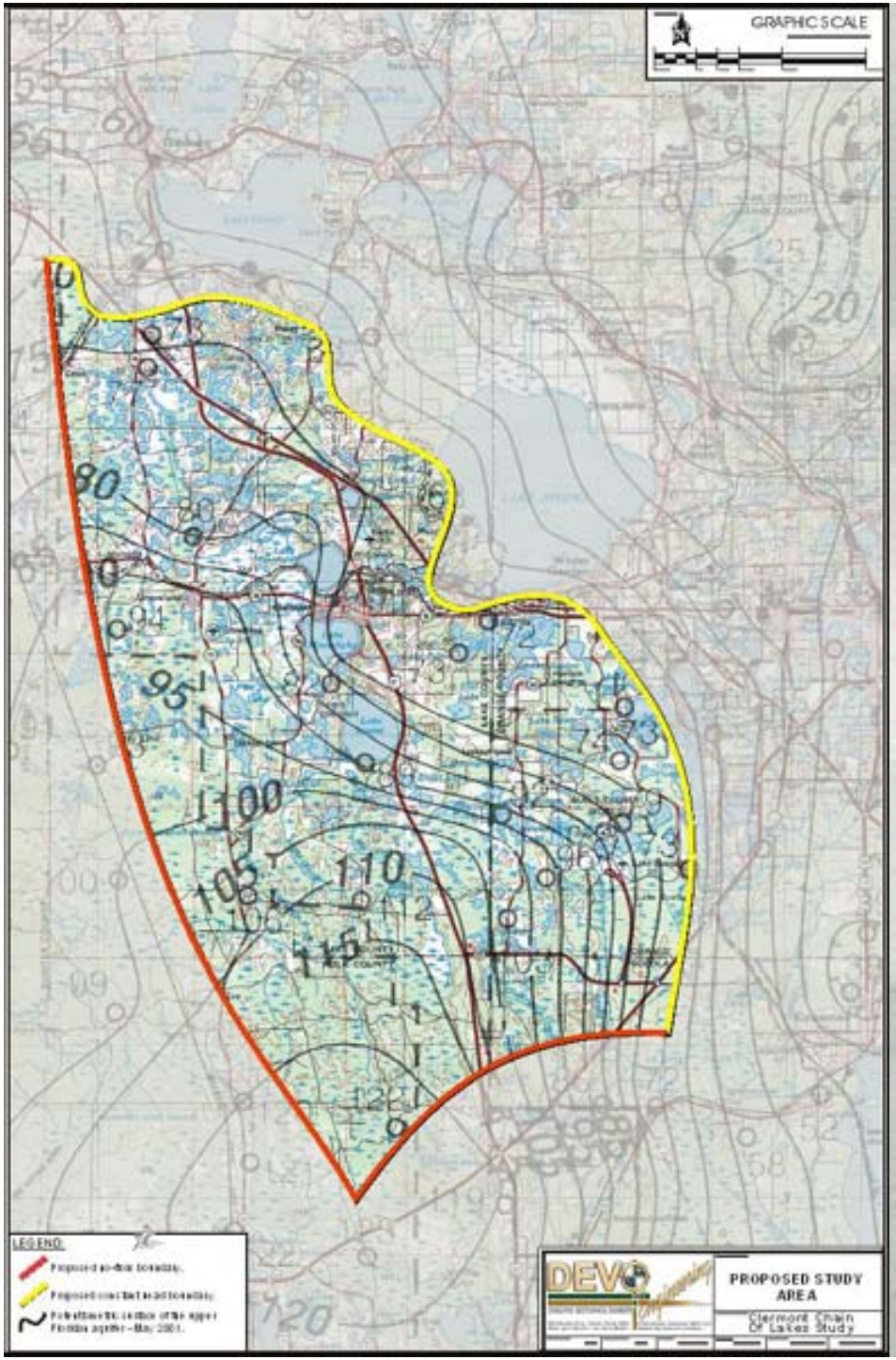


Historical Lake Levels and Two-Year-Cumulative Rainfall



Historical Lake Levels and Four-Year-Cumulative Rainfall

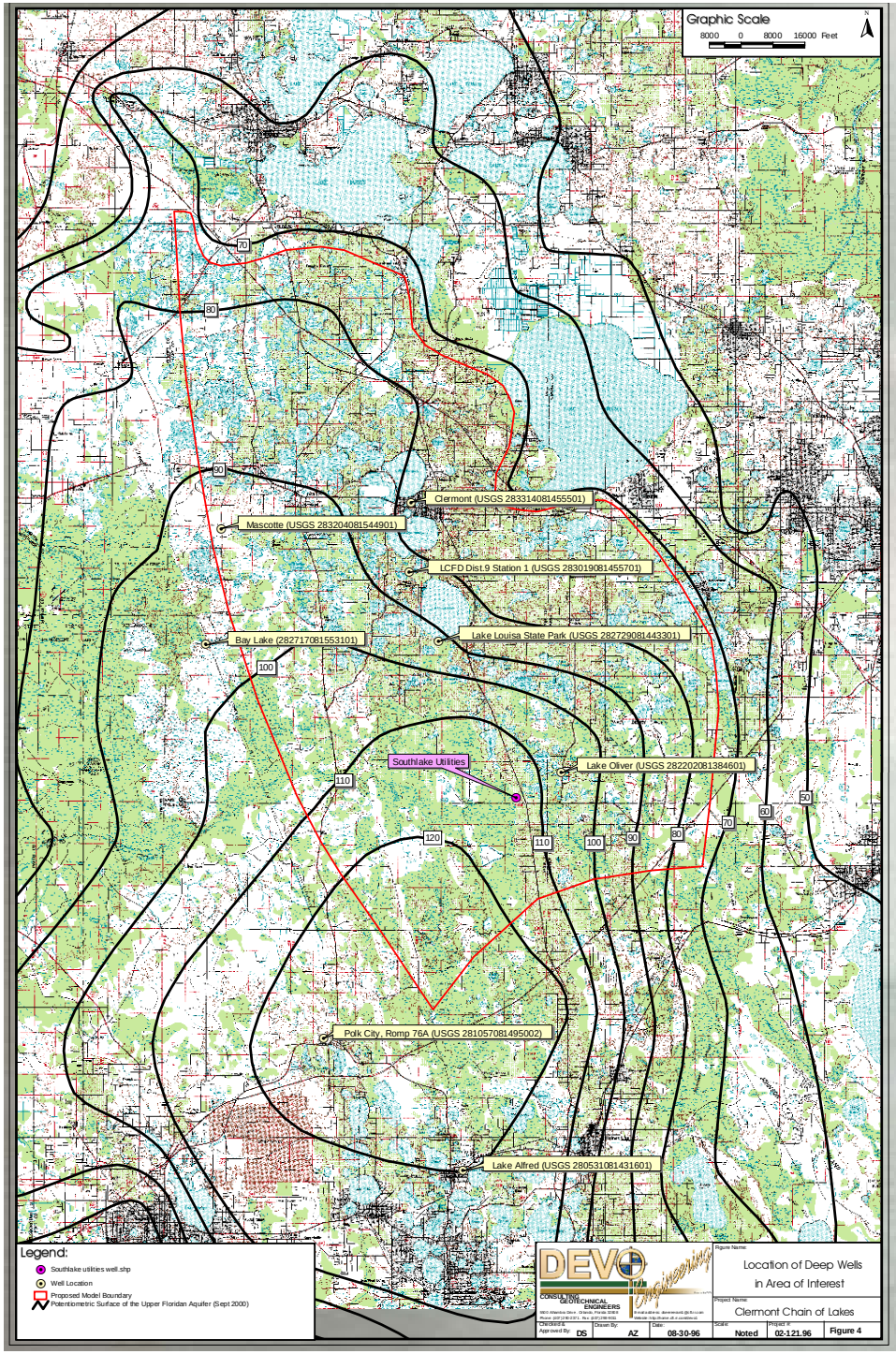




Floridan Aquifer Watershed for Area of Interest

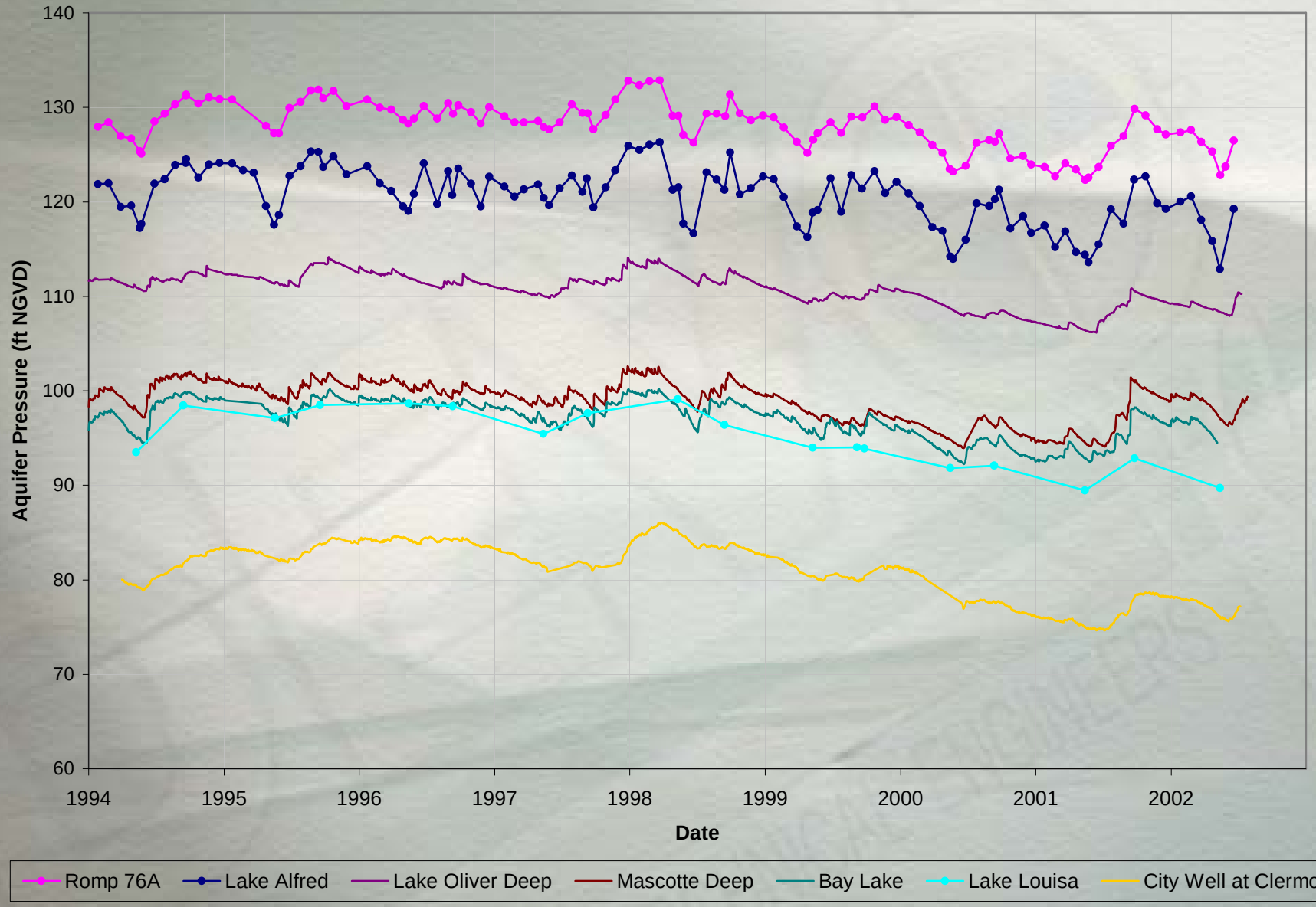
- Model boundary was selected to take advantage in naturally features in the Upper Floridan aquifer
- A boundary perpendicular to potentiometric lines represents a no-flow boundary. No flow crosses this boundary
- A boundary parallel to a pontentiometric line represents a constant head boundary.

Floridan Wells in Area of Interest

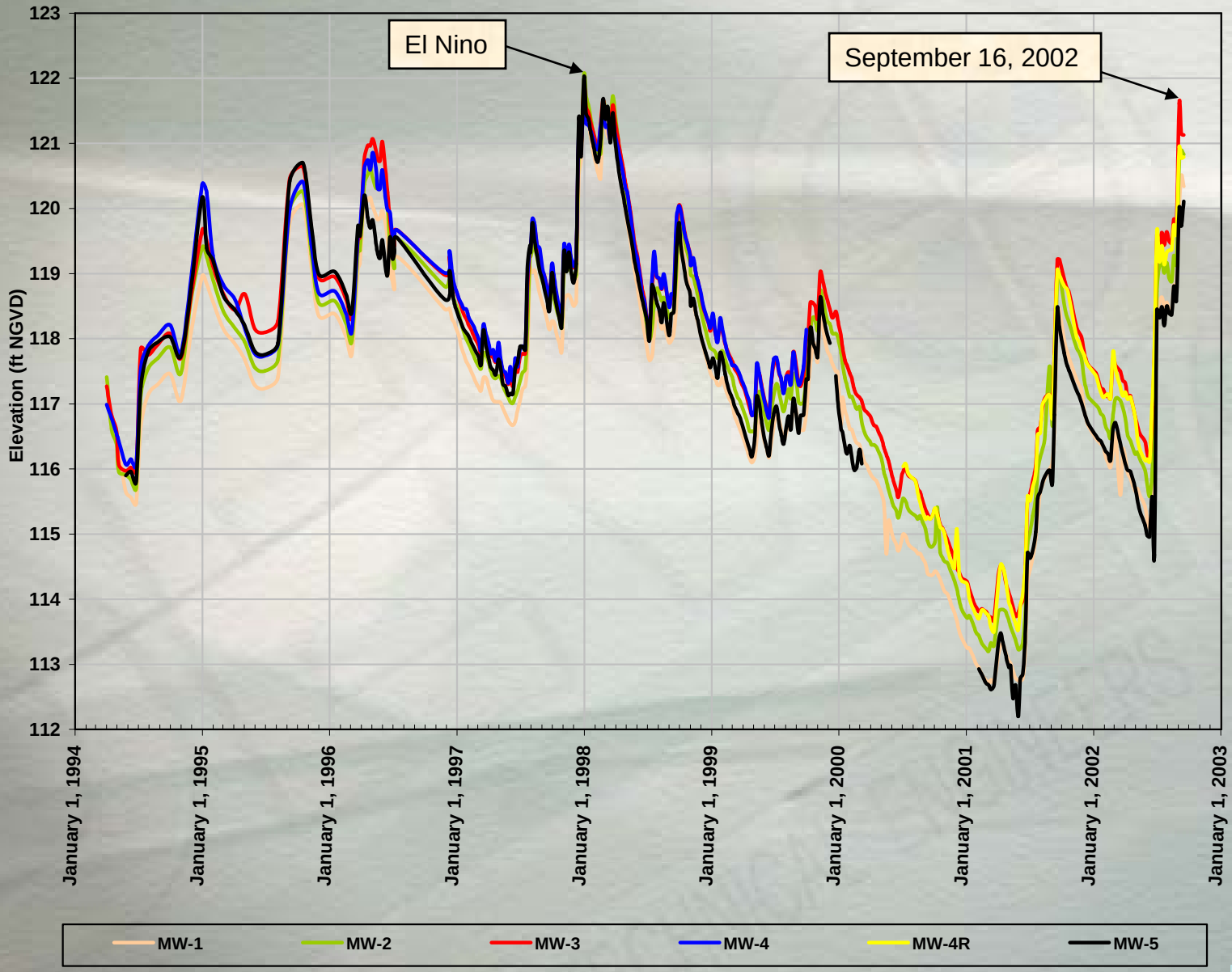


- Location of selected monitored wells in and near the defined study area, from USGS database survey and online sources.

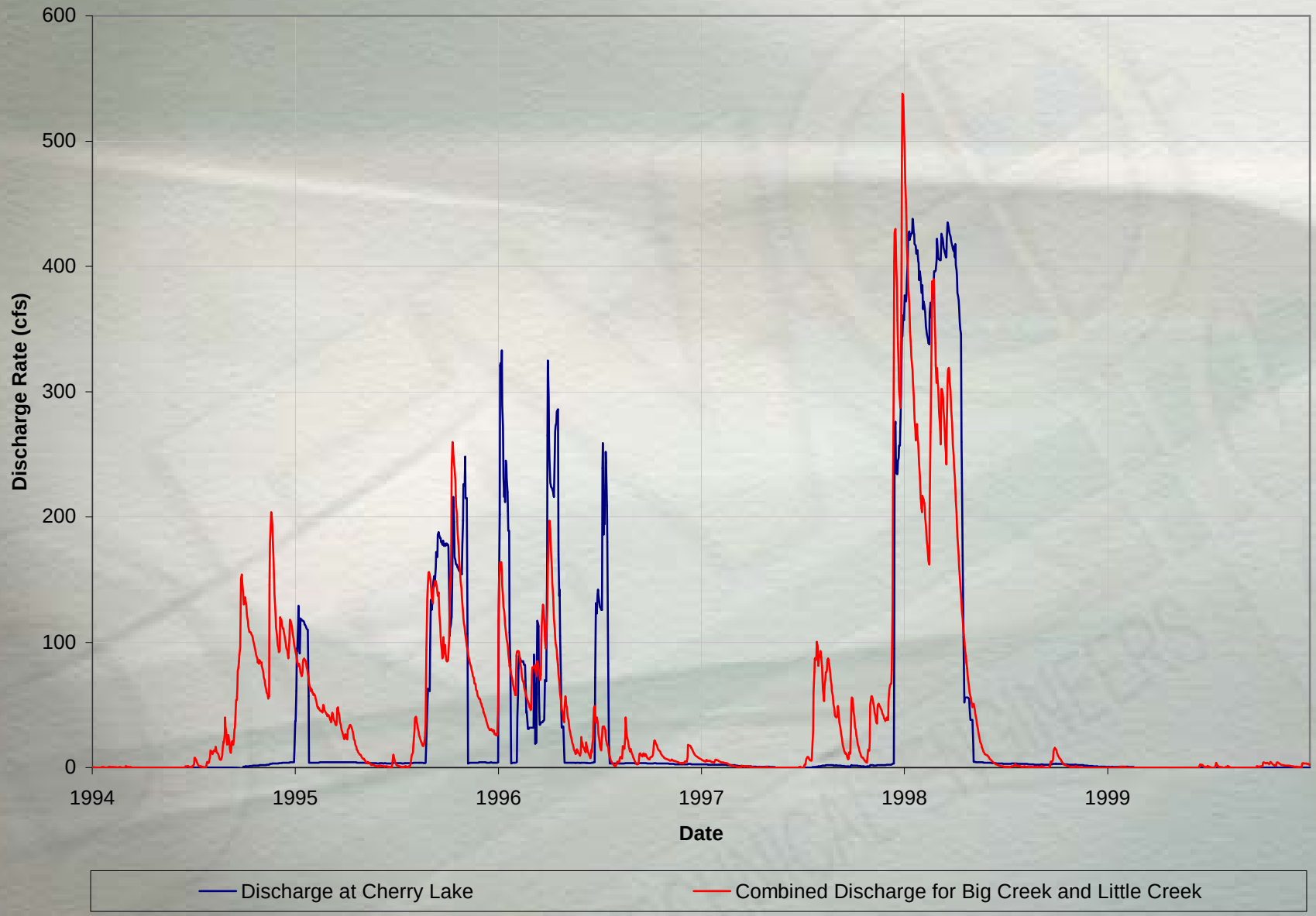
Potentiometric Surface Trends



Southlake Utilities Monitor Wells

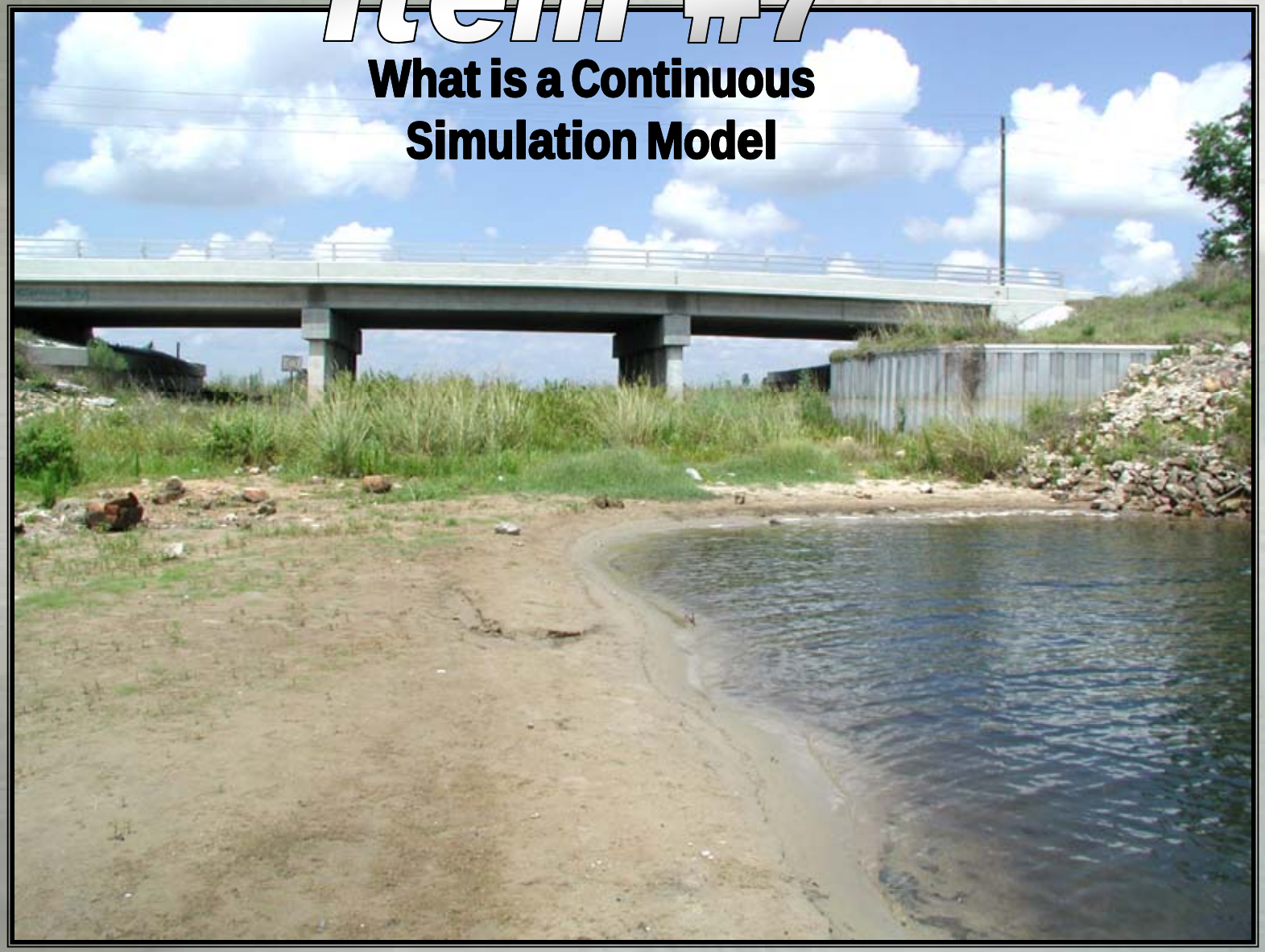


Discharge for Big and Little Creeks and Cherry Lake



Item #7

What is a Continuous Simulation Model



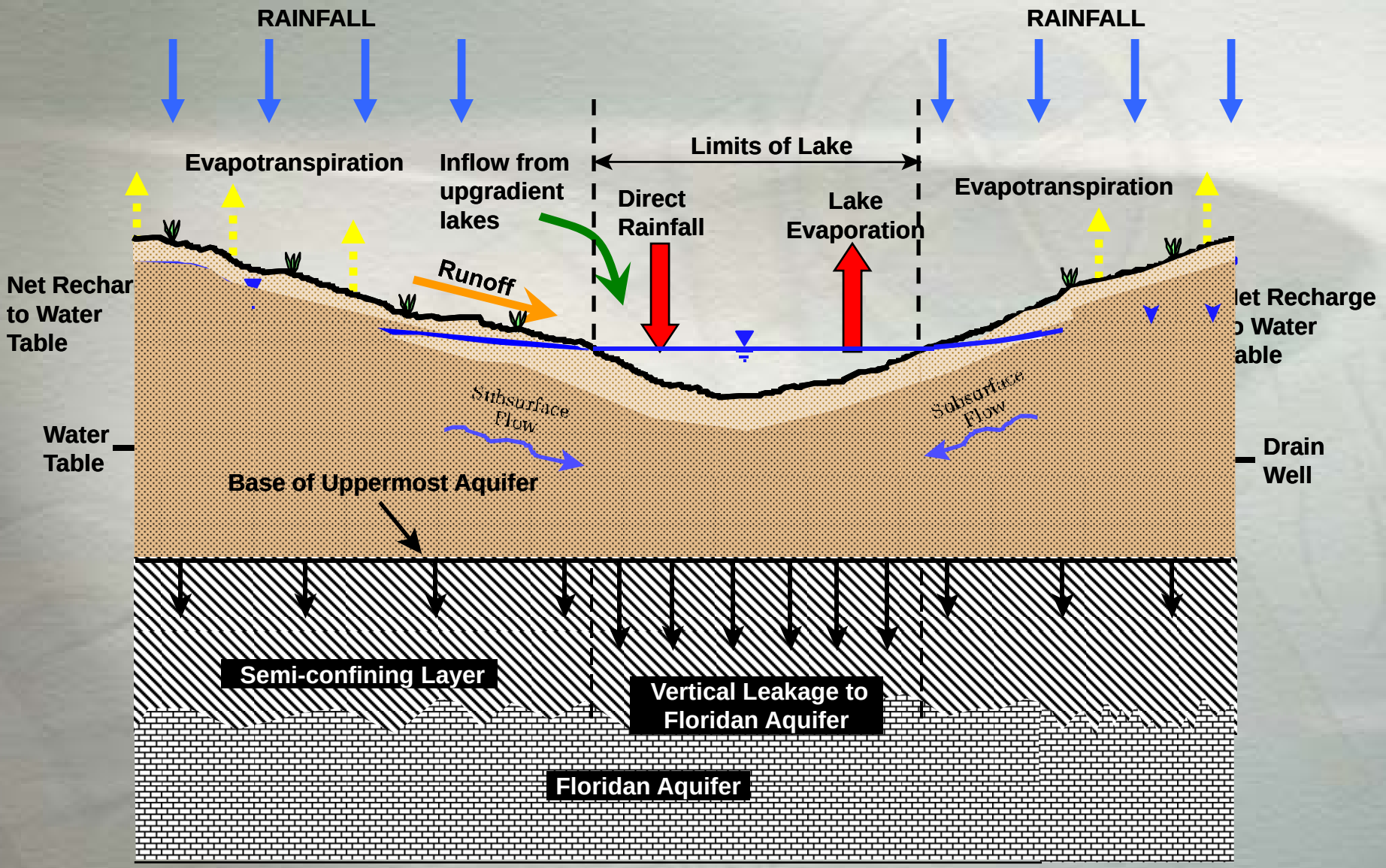
Lake Minneola, CR 565A Bridge, 6/10/2002

What is long-term, continuous simulation modeling?

- A model which analyzes the day to day hydrology of the system over a long period of time (say 3 to 100 years), taking into account all components of the system's water budget.

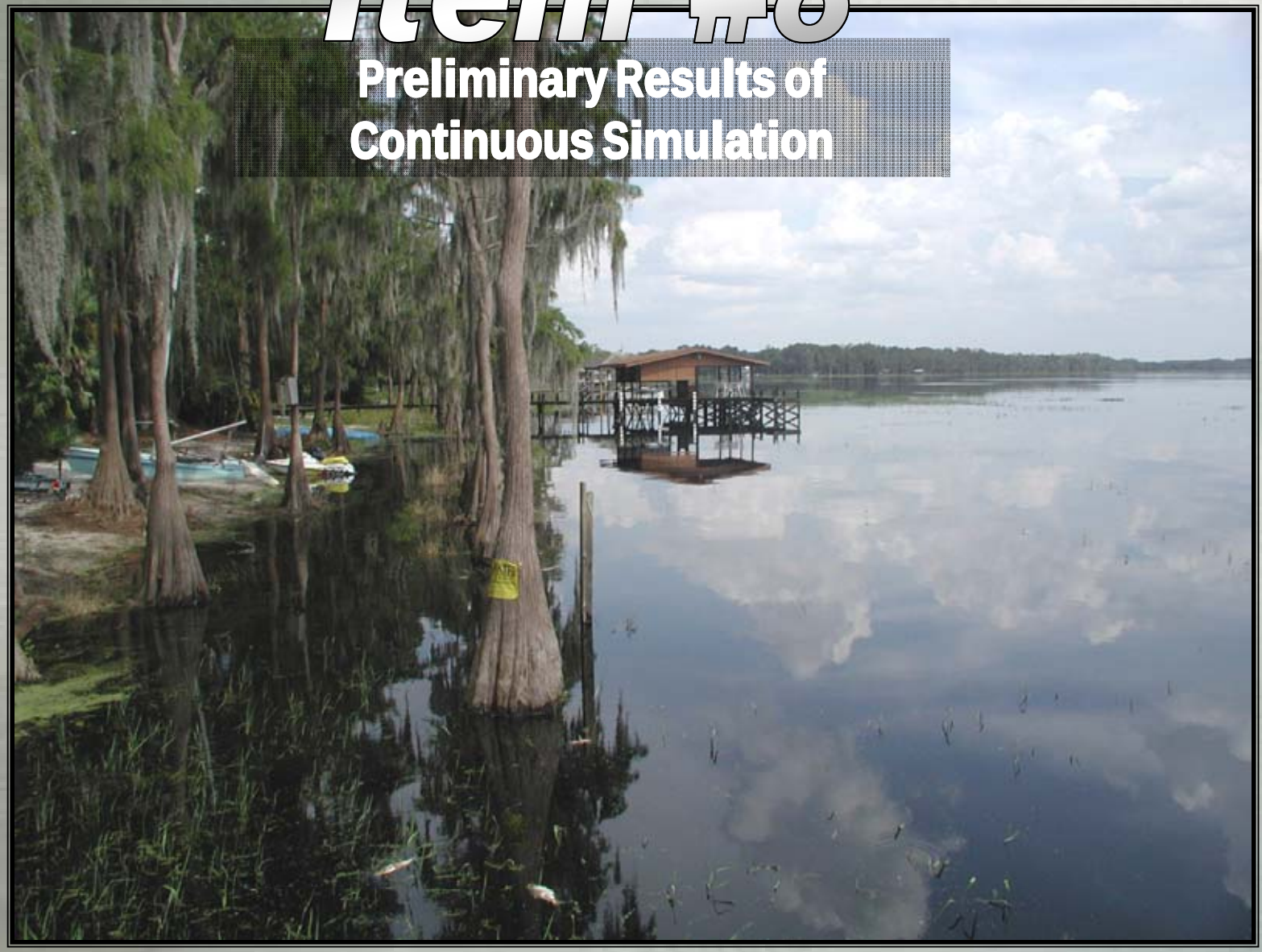
- Such a model can predict, on a daily basis, stages, inflows, and discharge rates and volumes (both ground water & surface water).

Conceptual Model for Closed Basin Modeling in Central Florida



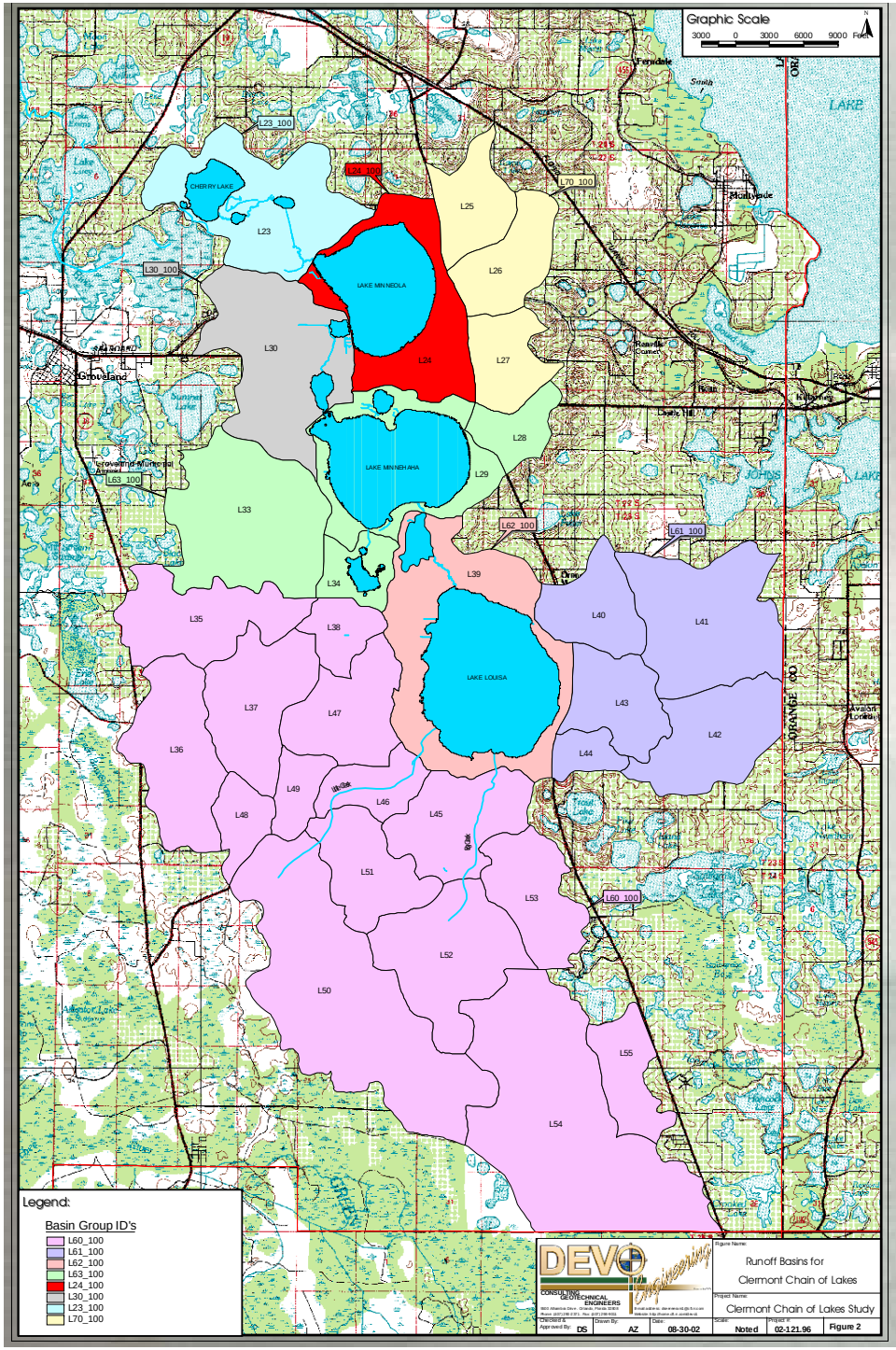
Item #8

Preliminary Results of Continuous Simulation



Lake Louisa, 9/10/2002

Surface Water Watersheds Contributing to Clermont Chain of Lakes



Measured and Predicted Lake Levels

Model Period: January 1, 1994 through November 30, 2001.

The beginning if the modeling period was chosen such that the long term behavior of the model could be assessed. The end of the modeling period corresponds to the most recent data obtained for Clermont 7 S weather station.

Summary of Water Budget Components

Inflows				
	Rainfall (gallons)	Stream Inflow (gallons)	Runoff (gallons)	Infiltration ** (gallons)
1994	14,121,372,489	7,886,138,353	2,658,758	351,030,149
1995	11,197,032,065	12,792,878,867	296,945,264	616,339,729
1996	11,136,647,455	9,486,250,811	33,261,350	742,483,346
1997	13,608,103,300	9,365,008,235	185,982,871	343,969,177
1998	7,433,776,874	20,404,248,542	62,384,518	700,522,983
1999	9,200,026,732	161,146,178	295,111,387	90,279,185
2000	6,236,867,630	35,870,585	97,398,038	-177,543,230
2001*	9,212,966,291	0	35,124,682	-11,254,580
Total	82,146,792,834	60,131,541,571	1,008,866,868	2,655,826,758

Outflows			
	Evaporation (gallons)	Leakage (gallons)	Discharge (gallons)
1994	-10,977,059,555	-1,401,785,601	-1,487,115,734
1995	-10,977,059,555	-1,401,785,601	-15,415,858,007
1996	-10,977,059,555	-1,401,785,601	-10,147,245,663
1997	-10,977,059,555	-1,401,785,601	-6,835,361,428
1998	-10,977,059,555	-1,401,785,601	-22,709,473,349
1999	-10,977,059,555	-1,401,785,601	0
2000	-10,977,059,555	-1,401,785,601	0
2001*	-10,502,609,044	-1,282,729,838	0
Total	-87,342,025,932	-11,095,229,048	-56,595,054,181

* Year 2001, data for January 1 through November 30, 2001

** Positive infiltration represents flow into lakes. Negative infiltration represents flow out of lakes.

Inflow & Outflow Totals

	Yearly Inflows (gallons)	Yearly Losses (gallons)	Yearly Net (gallons)
1994	22,361,199,750	-13,865,960,890	8,495,238,860
1995	24,903,195,926	-27,794,703,164	-2,891,507,238
1996	21,398,642,961	-22,526,090,820	-1,127,447,858
1997	23,503,063,581	-19,214,206,585	4,288,856,996
1998	28,600,932,916	-35,088,318,506	-6,487,385,589
1999	9,746,563,481	-12,378,845,157	-2,632,281,676
2000	6,192,593,022	-12,378,845,157	-6,186,252,135
2001*	9,236,836,393	-11,785,338,882	-2,548,502,489
Total	145,943,028,032	-155,032,309,161	**-9,089,281,129**

Note:

Total net loss represents a drop in lake levels from +94 ft at beginning of simulation to +89.12ft. at and of simulation.

Implications of Model Results

- Leakage rate between surficial aquifer and Upper Floridan aquifer is on the order of 5 to 6.5 inches/year
- Lakes in the Clermont Chain do not appear to be well connected to the upper Floridan aquifer
- Big Creek and Little Creek are the main sources of surface water inflow
- The recent drop in lake levels appear to be caused by the recent severe deficit in rainfall, and subsequent lack of stream inflow from Big Creek and Little Creek

Item #9

The Next Step-Where We Focus Our Attention Next

Lake Minneola, 6/10/2002

What's Next

- Big Creek and Little Creek. What factors affect the discharge rate/volume from these creeks. Is the increase in deep Floridan pumpage expected to impact these discharge rates.
- How does the Green Swamp behave. Is it a perched lake?

Item #10

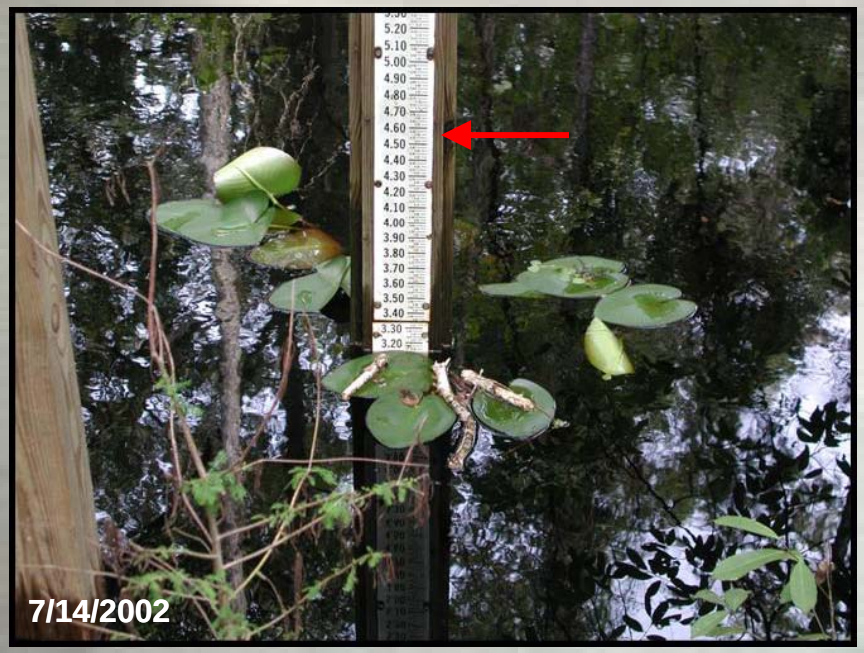
Before and After Assorted Photos

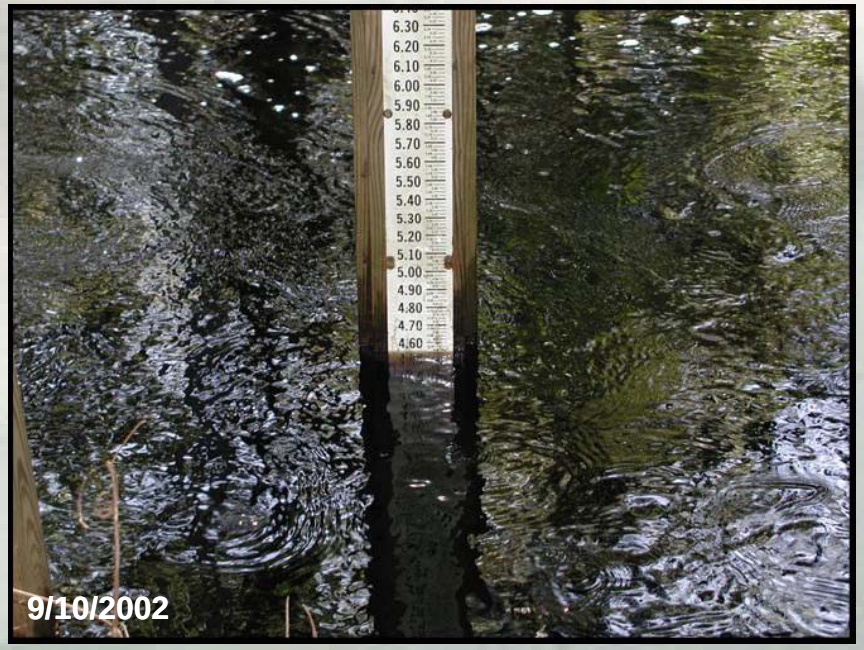
Trout Lake

Big Creek Gaging Station

Big Creek has spread out, so the difference in perspective reflects inability to get close to bridge due to rising water.

Big Creek Gaging Station





Gage up from about 3.15 to 4.55

Big Creek Gaging Station

Foot bridge over Big Creek. (No “before” picture available)

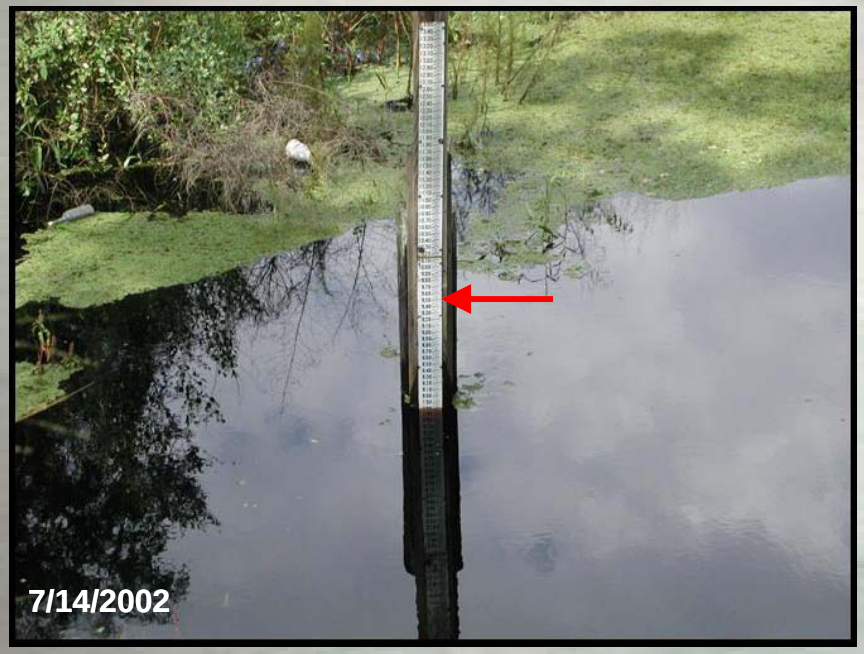
Little Creek Gaging Station

Looking downstream from Lake Nellie Road

Little Creek Gaging Station

Looking upstream from Lake Nellie Road

Little Creek Gaging Station



Gage up from 7.8 to 8.75

Lake Louisa State Park

Approximate location of shoreline on 9/10/2002

Orange pole, denoting safe bathing area (presumably)

Lake Louisa State Park

Lake Louisa State Park

Lake Louisa State Park

Note: **Can't identify a common feature. These pictures are looking in the same direction but may not have been taken at exactly the same spot**

Lake Louisa State Park

Note: **Can't identify a common feature. These pictures are looking in the same direction but may not have been taken at exactly the same spot**

Lake Louisa State Park

Note: **Can't identify a common feature. These pictures are looking in the same direction but may not have been taken at exactly the same spot**

North Shore of Lake Louisa

Note: **Both pictures taken on same date. Not “before-and-after”**

North Shore of Lake Louisa

Fish kill

Note: Both pictures taken on same date. Not “before-and-after”

Crooked River Preserve
on Lake Louisa Rd

Looking upstream on the Palatlakaha River between Lake Louisa and Lake Susan

Common Feature: tree line

Crooked River Preserve

Looking downstream on the Palatlakaha River between Lake Louisa and Lake Susan

Common feature: cypress tree

Lake Susan Lodge

Lake Susan Lodge

Monte Vista Canal between Lake Minnehaha and Crescent Lake

Looking toward Crescent Lake from Bronson Road

Monte Vista Canal between Lake Minnehaha and Crescent Lake

Looking towards Crescent Lake, back to Lake Minnehaha

Lake Minnehaha near Monte Vista Canal

Boat dock near mouth of Monte Vista Canal on Lake Minnehaha

North Shore of Lake Minnehaha

Note: **both pictures taken on same date. Not “before-and-after”**

CR 561 Bridge over channel between Lake Minnehaha and Lake Palatlakaha

6/10/2002

9/10/2002

Note: on 9/10/2002 water was flowing from Lake Palatlakaha to Lake Minnehaha

CR 561 Bridge over channel between Lake Minnehaha and Lake Palatlakaha

CR 561A Bridge over channel between Lake Minneola and Wilson Lake

Looking towards Lake Minnehaha

CR 561A Bridge over channel between Lake Minneola and Wilson Lake

Looking towards Wilson Lake

North Shore of Lake Minneola

North Shore of Lake Minneola

Cherry Lake Discharge Structure
Downstream Face

Note: **Downstream lake level was higher than upstream lake level on September 10, 2002. A foot to a foot-and-a-half of water was being retained above the base of the structure on the downstream side.**

Cherry Lake Discharge Structure
Upstream Face