



2010 Marcellus Summit: Building a Sustainable Future

Penn State University, College Station, Pennsylvania

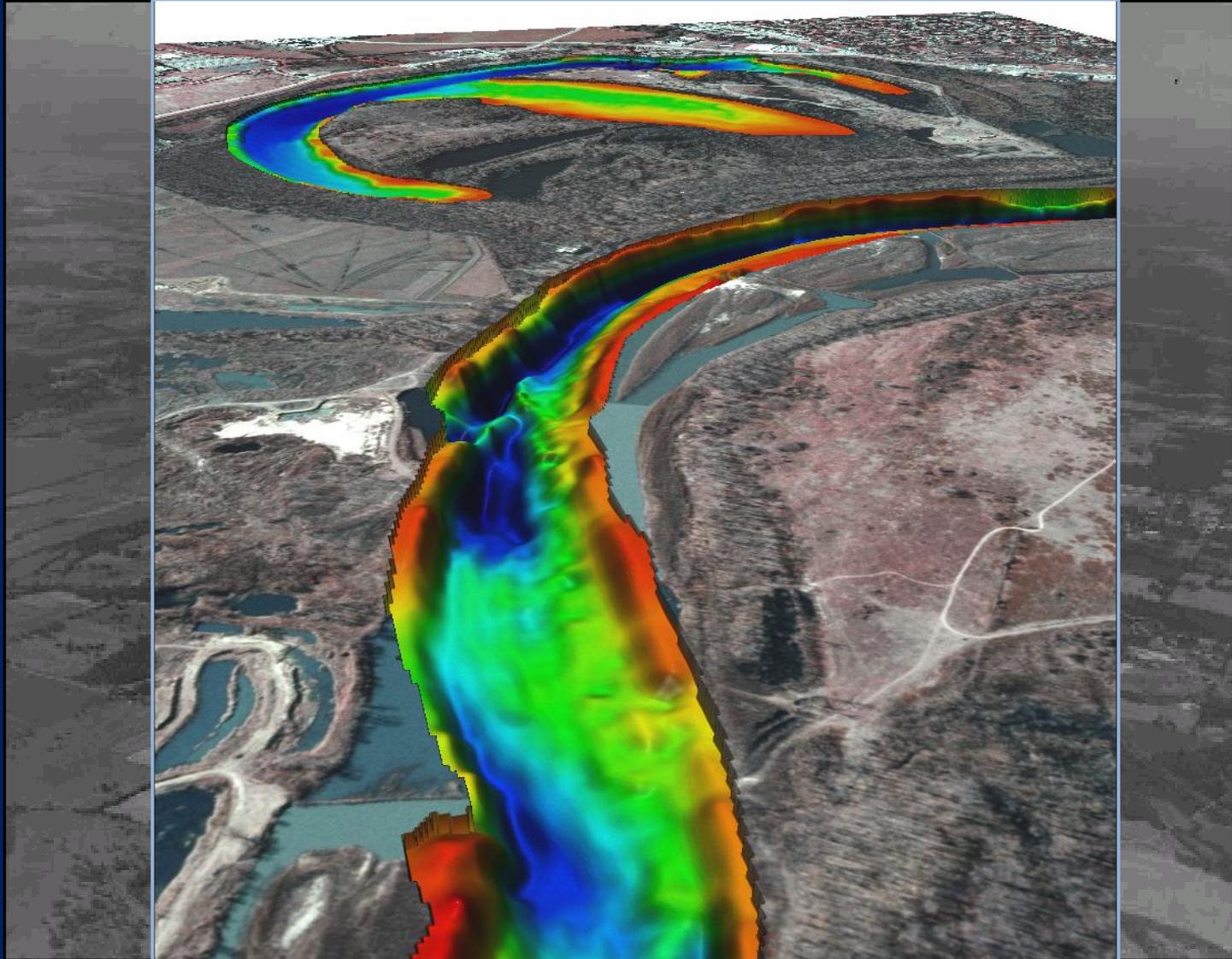
October 11, 2010

Creating Successful Community Partnerships — Carrizo-Wilcox Aquifer Collaboration in Louisiana: A Watershed Approach

**Red River Watershed Management
Institute - LSU Shreveport**

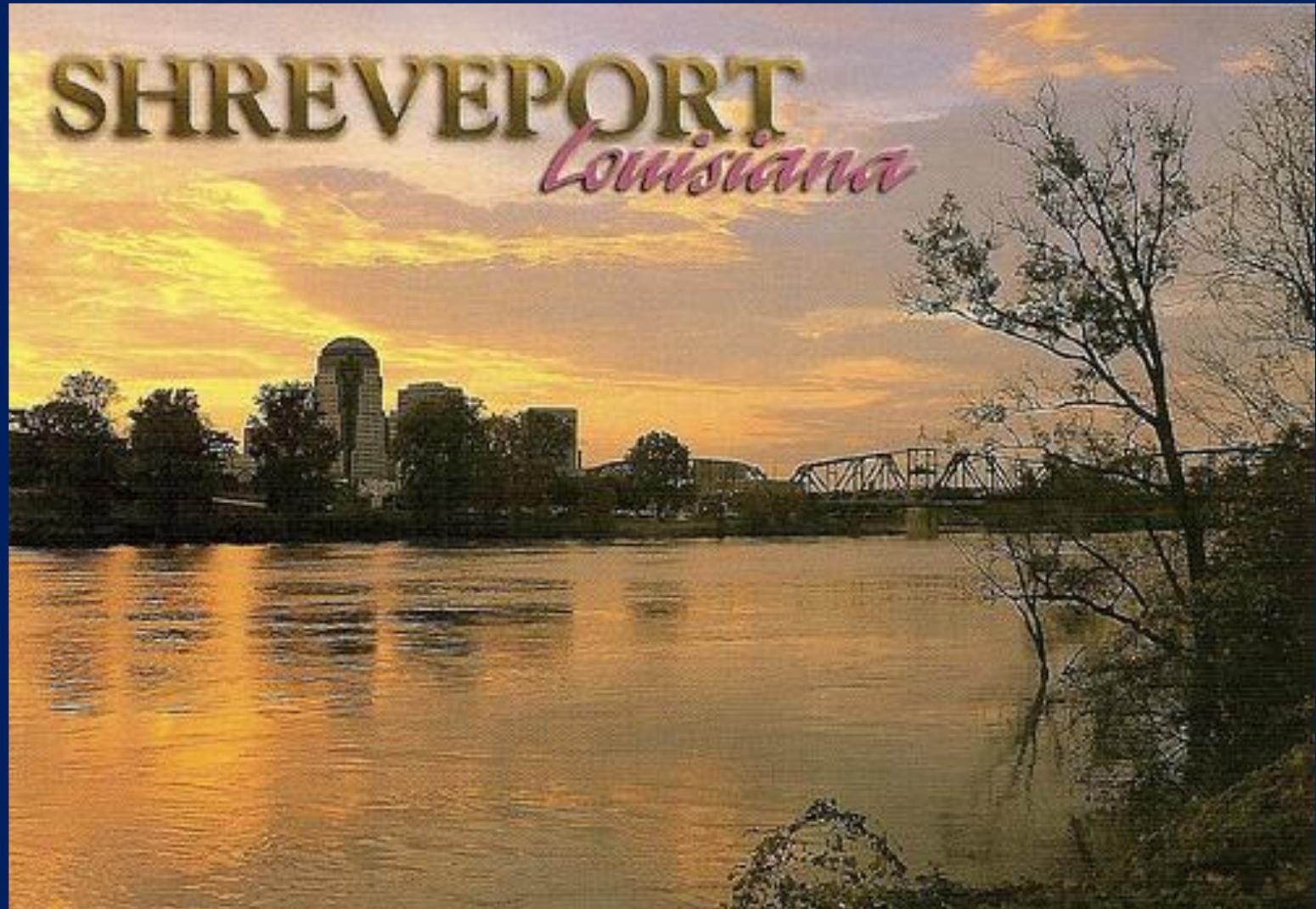
Gary Hanson, Director

A River



Multi-beam Sonar Survey conducted by the R/V Kharya (LSUS)
The Red River - Near Cloudsatta, Louisiana

A Community



A University

LSU system board approves new institute at LSUS

By Melody Brumble
The Times

LSU-Shreveport could become the leading expert in the Red River Basin because of a special program approved Friday by the LSU Board of Supervisors.

The Red River Watershed Management Institute will study water quality in the Red River Basin, which stretches from West Texas to the Mississippi River. Studies will involve LSUS faculty and students and could lead to new classes and majors.

Hands-on work will be conducted at C. Bickham Dickson Park, which LSUS manages for the City of Shreveport.

"We want this to be recognized as the primary resource for all Red River Basin studies," LSUS Chancellor Vince Marsala said.

The institute will be funded with grant money — \$1.1 million has been received so far

— and private donations. LSUS officials didn't ask the LSU System board for money.

Initial studies will focus on an oxbow lake in the park. The lake once was part of the Red River and still has channels leading to the river, institute director Gary Hanson said.



Marsala

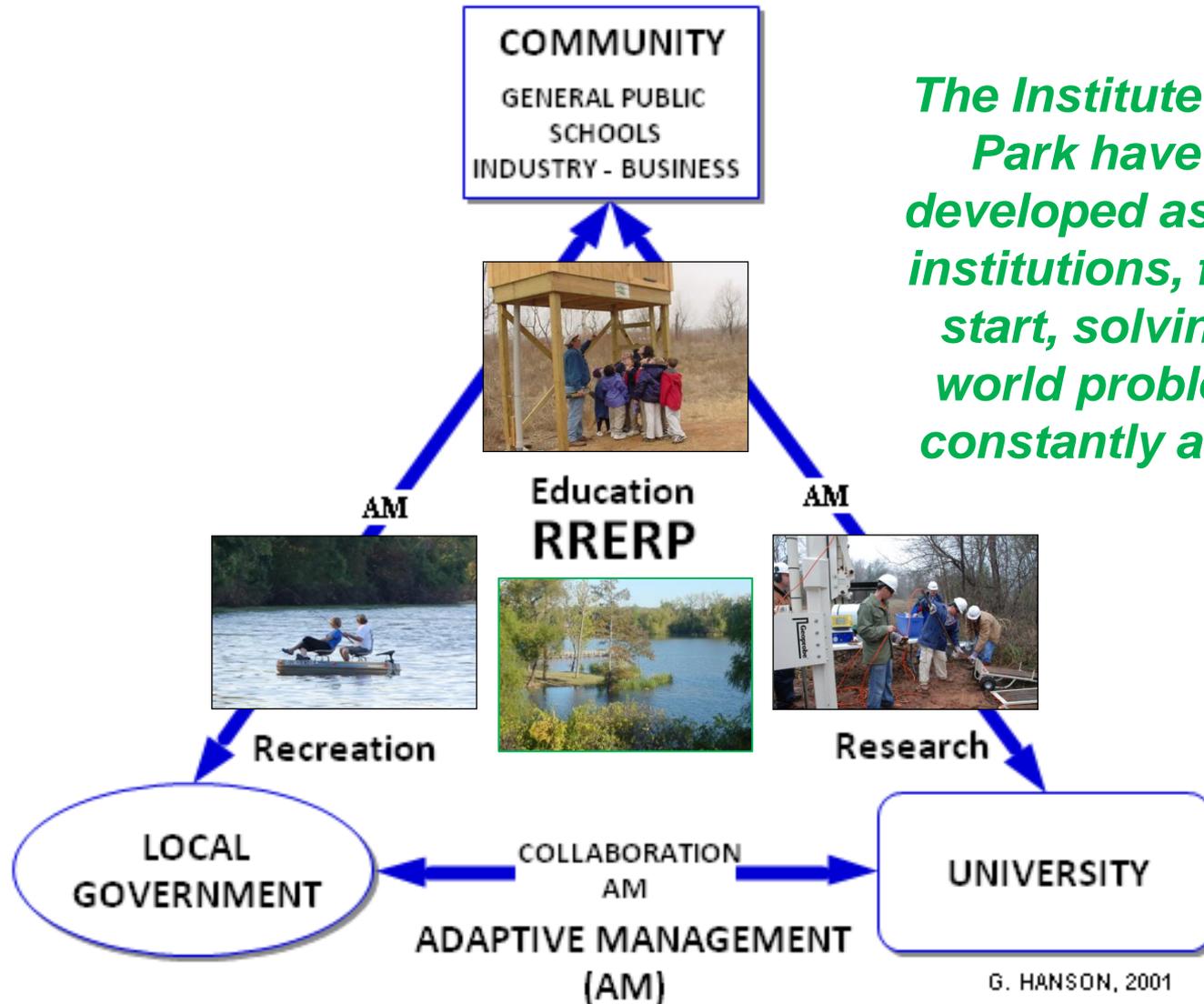
Eventually, people will be able to view a Web site containing data from the lake. Automatic monitoring equipment will update the information as people watch, Hanson said. The site also will provide hands-on experiences for students.

"I plan to take my students out to the site," Hanson said. "They will determine the extent of the lake, water quality, the flow of the river and its interchange with the lake."

A Public Park



Evolving Community-based Nature Education & Research Park Model (Red River Education & Research Park)



An adaptive model - Based on "Sense of Place" institution building

LSUS Red River Watershed Management Institute



An Partnership between the City of Shreveport and LSU Shreveport

LSU Shreveport and Red River Education & Research Park

Local Elementary School Children Visiting **SWAMP**



Surface Water Analysis & Monitoring Platform

LSUS 001 Monitoring Well Project - Wilcox/Alluvial Aquifer

LSUS Research Park



Halliburton Logging Well



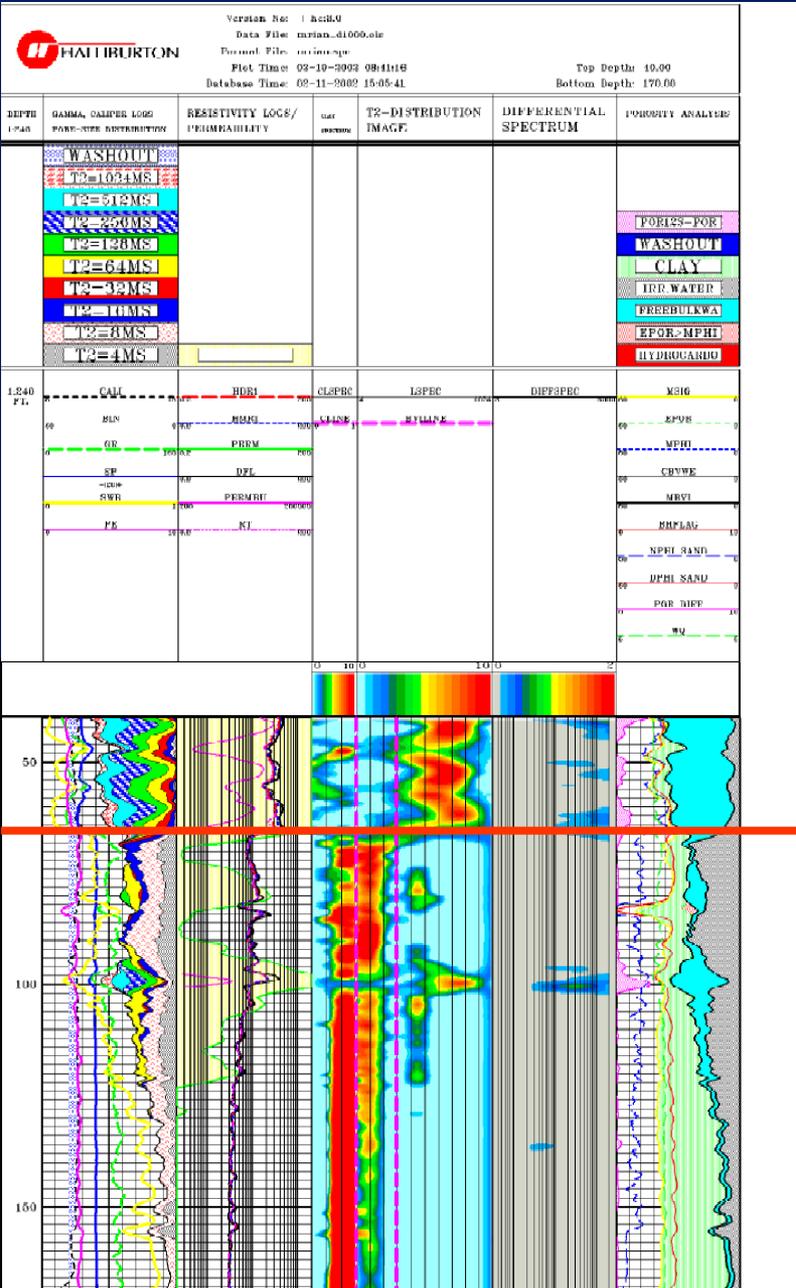
LSUS Red River Watershed Management Institute

Magnetic Resonance Imaging Log (MRIL)

Research

Red River Alluvial Aquifer

Wilcox Aquifer



Red River Education & Research Park



“Not scared of dirt,
willing to work”



Using a suite of borehole logs to
evaluate Red River Alluvial Aquifer
& Carrizo-Wilcox Aquifer

LSUS students using Geoprobe to
develop monitoring well in Red
River Alluvial Aquifer

Red River Education and Research Park A Public Park



LTEMP



- Long-term Surface Water Monitoring Equipment
- Ground Water Monitoring Well (Red River Alluvial)
- Ground Water Monitoring Well (Carrizo-Wilcox, Caddo Parish Coop. Project)
- Ground Water Monitoring Well (Carrizo-Wilcox)
- Floating Dock
- Surface Water Monitoring Site
- Acoustic Doppler Site
- Artificial Bat Habitat
- Field Station Building
- Test Plots (Agricultural and Natural Field)
- Research Barge
- Nutrient Analyzer



SWAMP



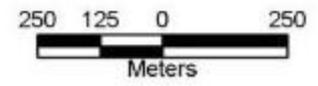
Field Station



Bat Cave



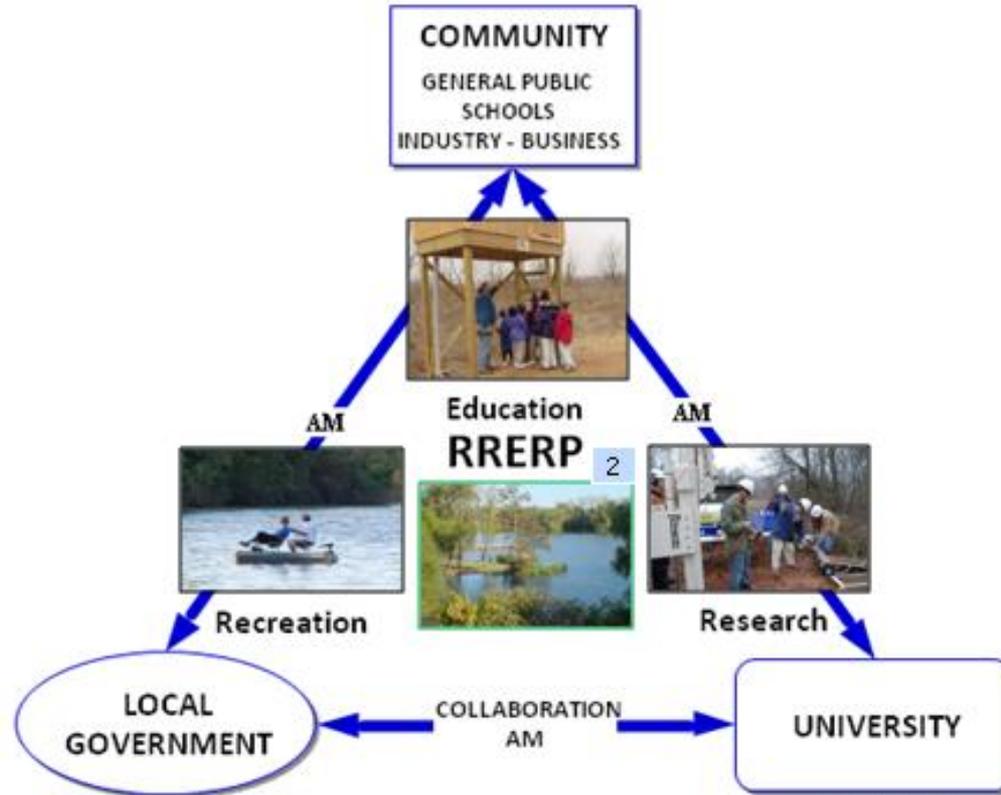
**RHAD1
ACOUSTIC
DOPPLER**





View from field station

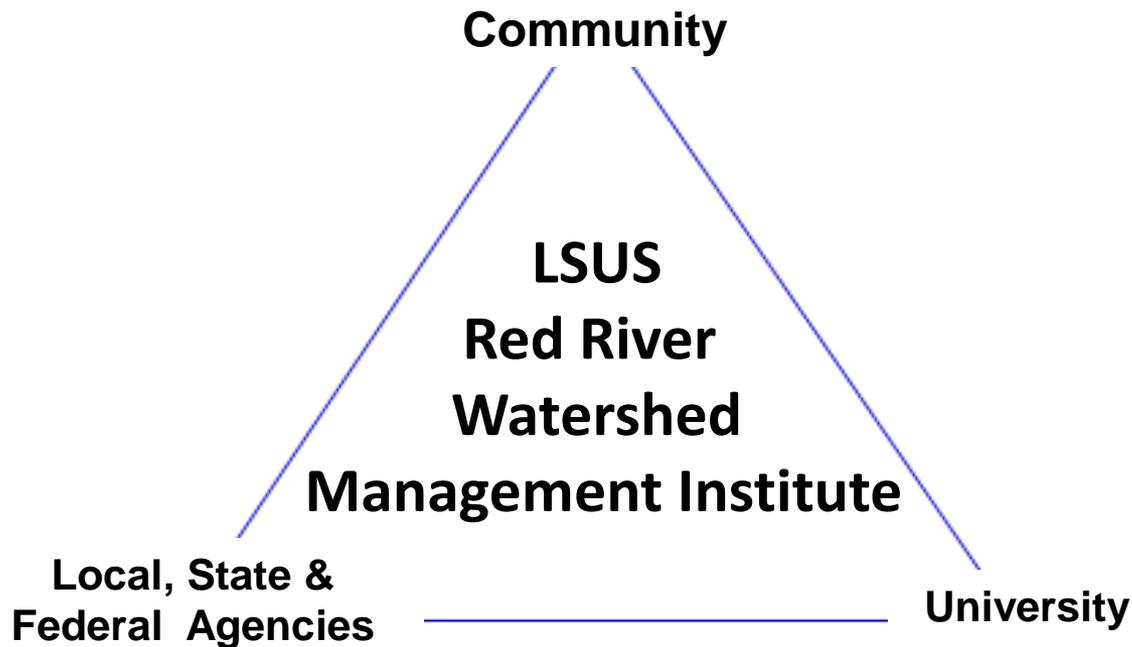
You Have Seen the Park Model



G. HANSON, 2001

Institute Model

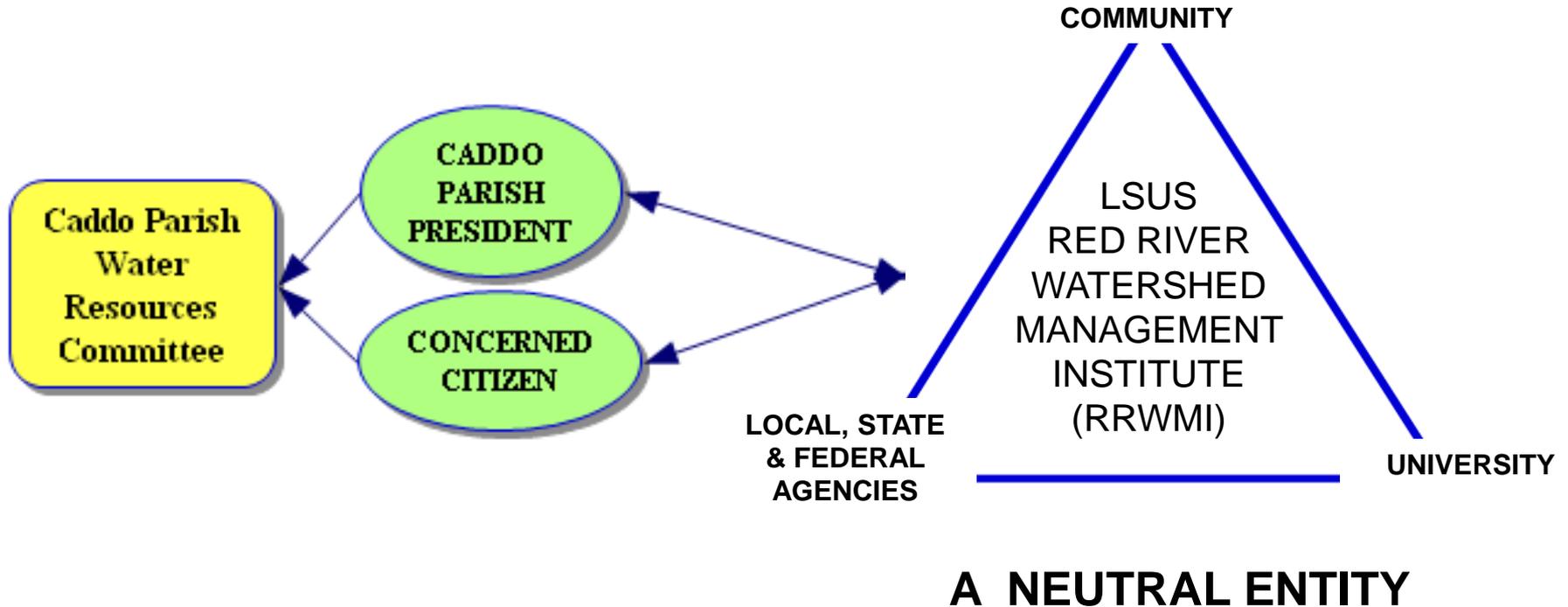
A Watershed Approach



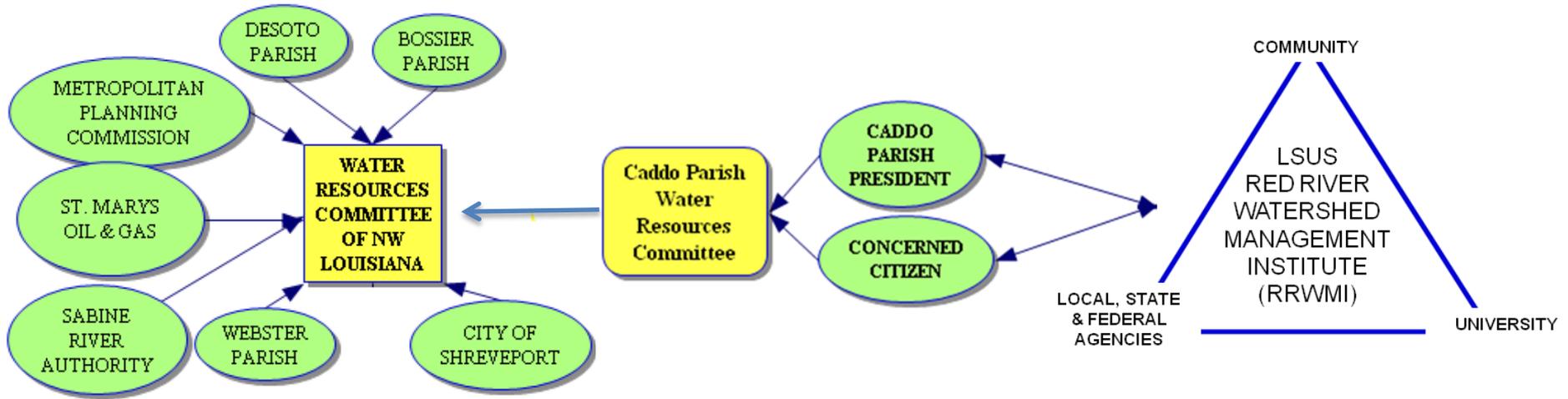
A NEUTRAL ENTITY

A Watershed Approach

A LOCAL WATER RESOURCES COMMITTEE



CADDO PARISH COMMITTEE EVOLVED INTO A REGIONAL “WATER RESOURCES COMMITTEE OF NW LOUISIANA”



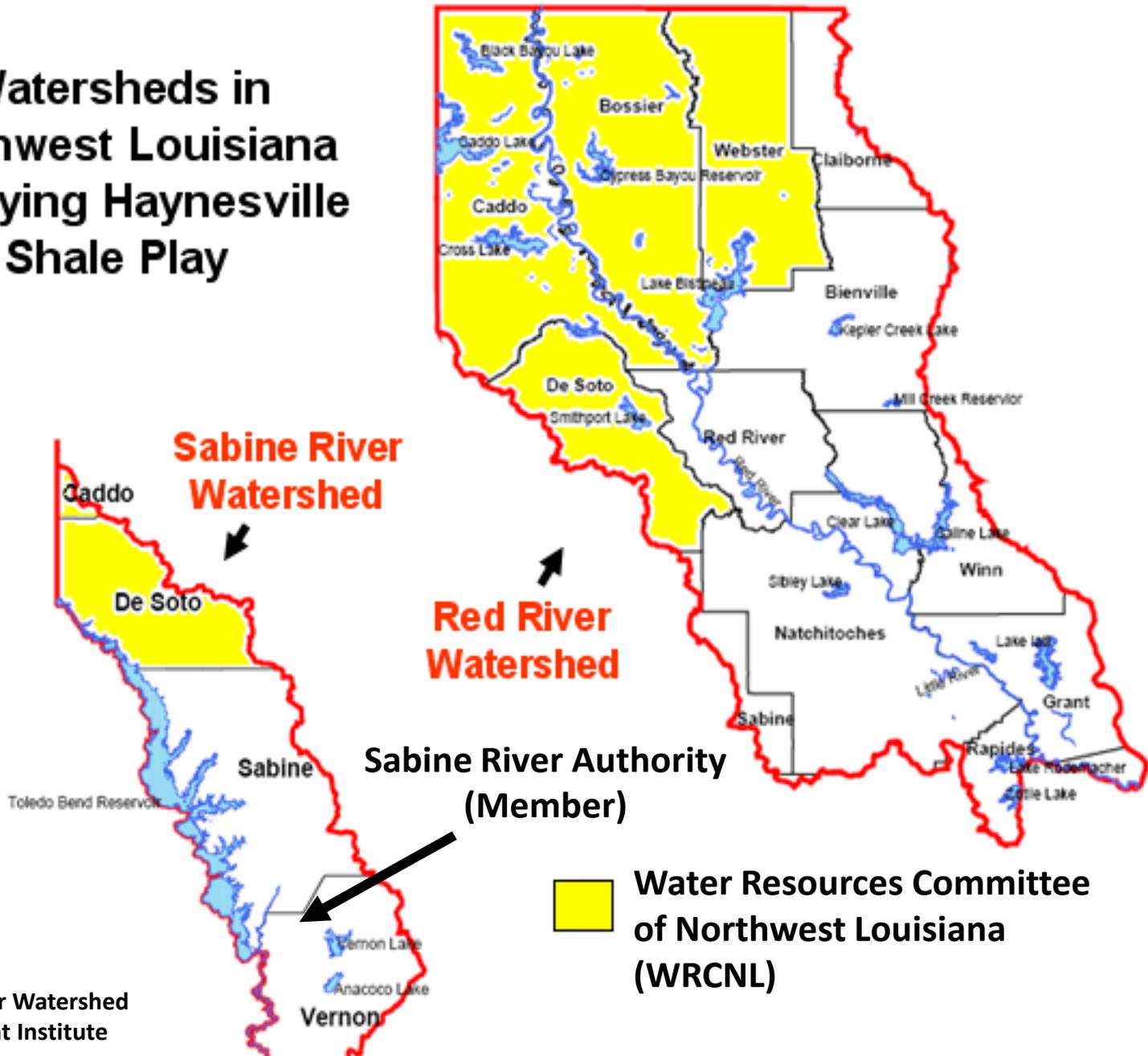
Water Resources Committee of Northwest Louisiana Watershed Based - Volunteer Committee



A Self-organizing Institution

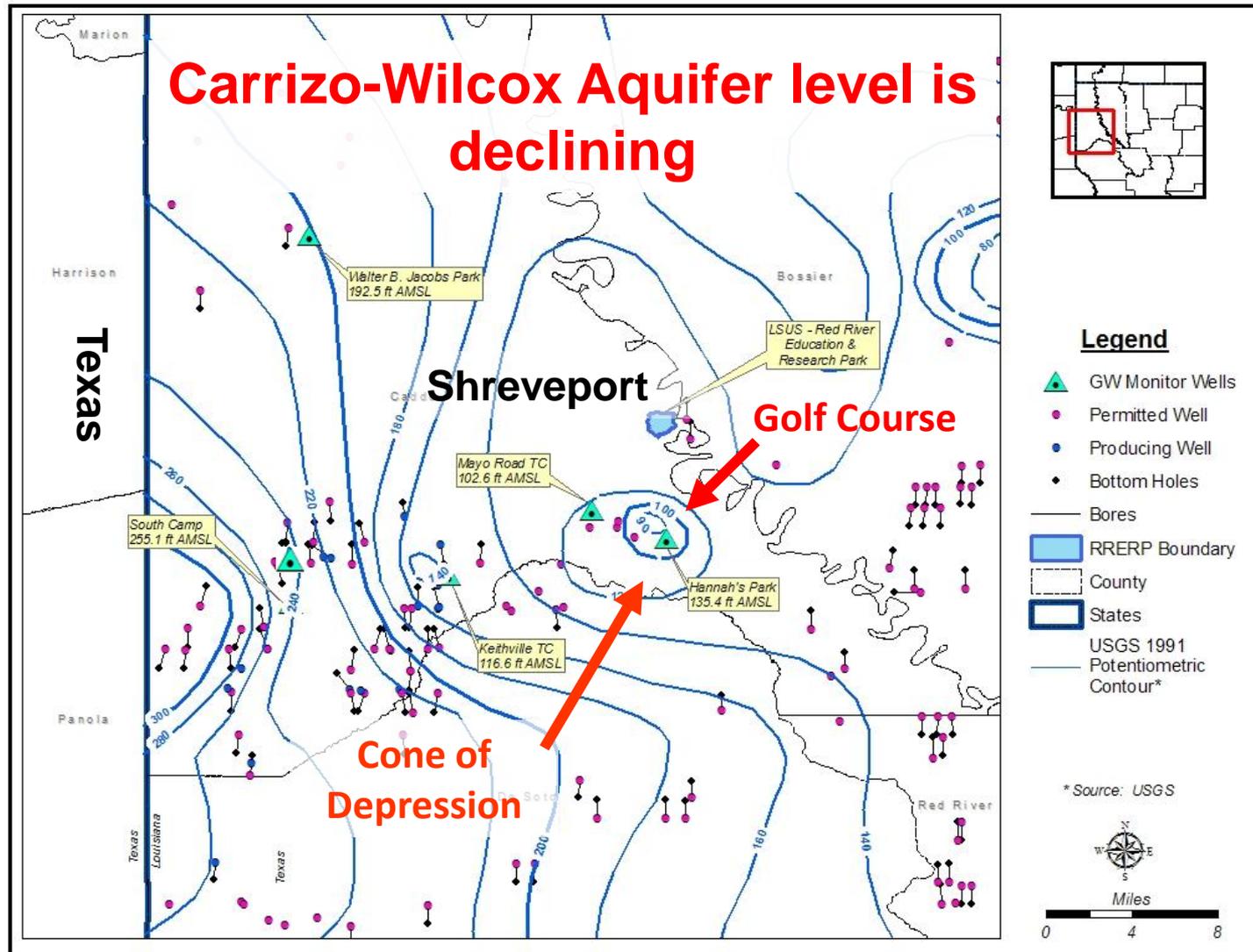
The Committee was formed by the Caddo Parish President, a concerned citizen & Director of the RRWMI. WRCNL evolved, more issues arose, & it became more flexible & adapted to solve new challenges.

Watersheds in Northwest Louisiana Overlying Haynesville Shale Play



Long Term Consequences of Excessive Groundwater Withdrawal

Potentiometric Surface of Carrizo-Wilcox Aquifer

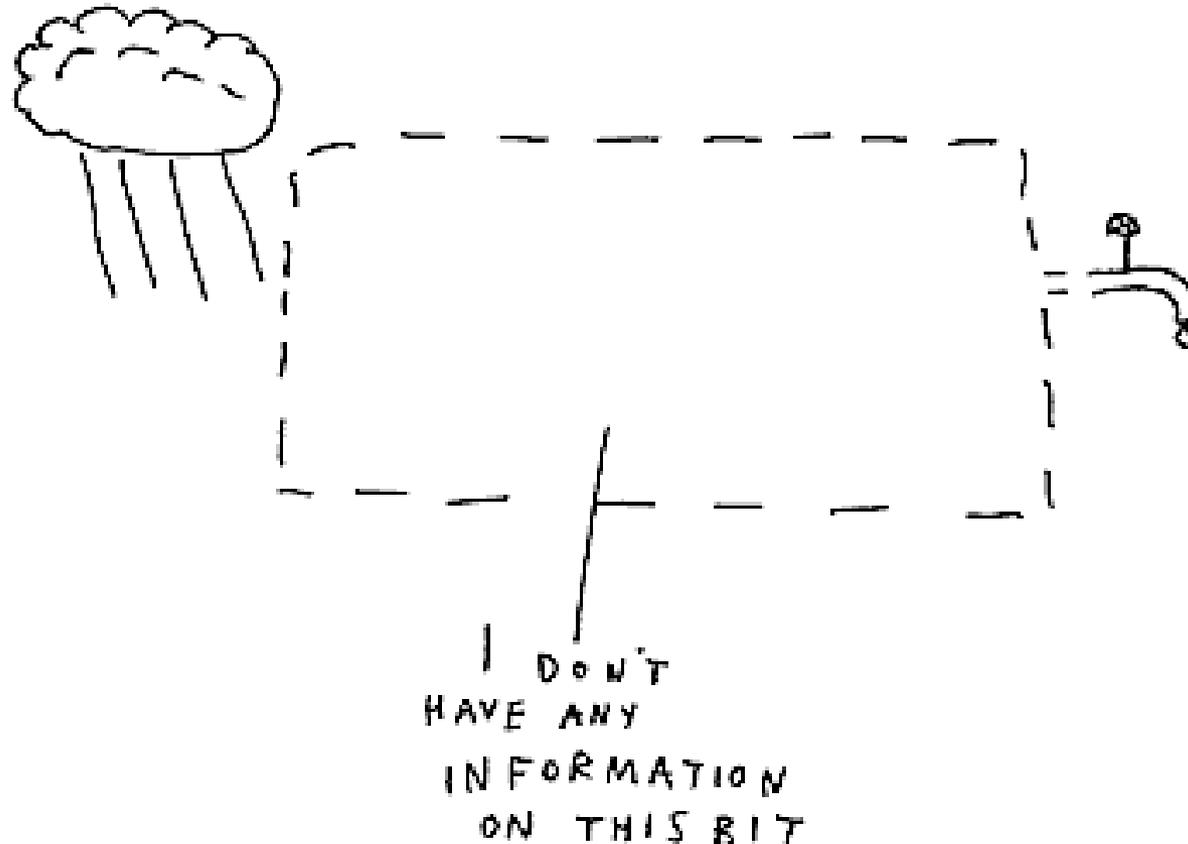


LSUS RRWMI, 2008 and USGS, 1993

Slow recharge rate!

To most folks... where THEIR water comes from may be a mystery...

HOW WE GET WATER IN OUR HOMES

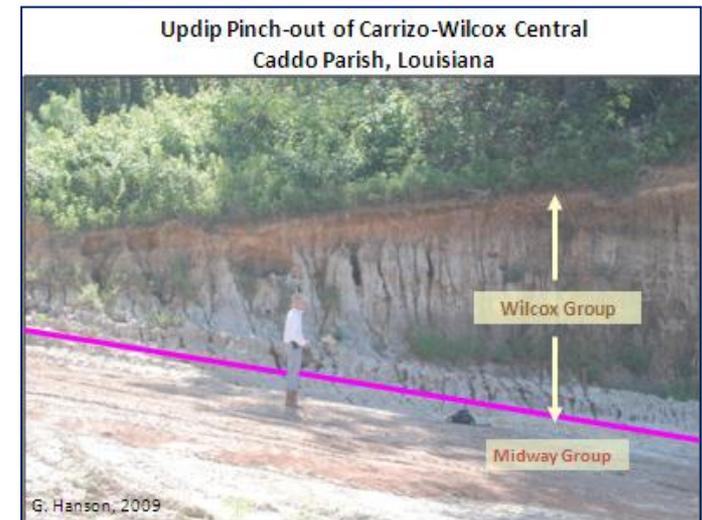
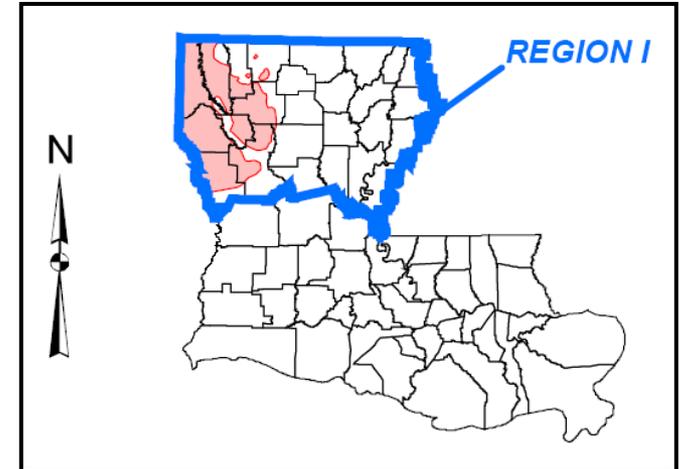
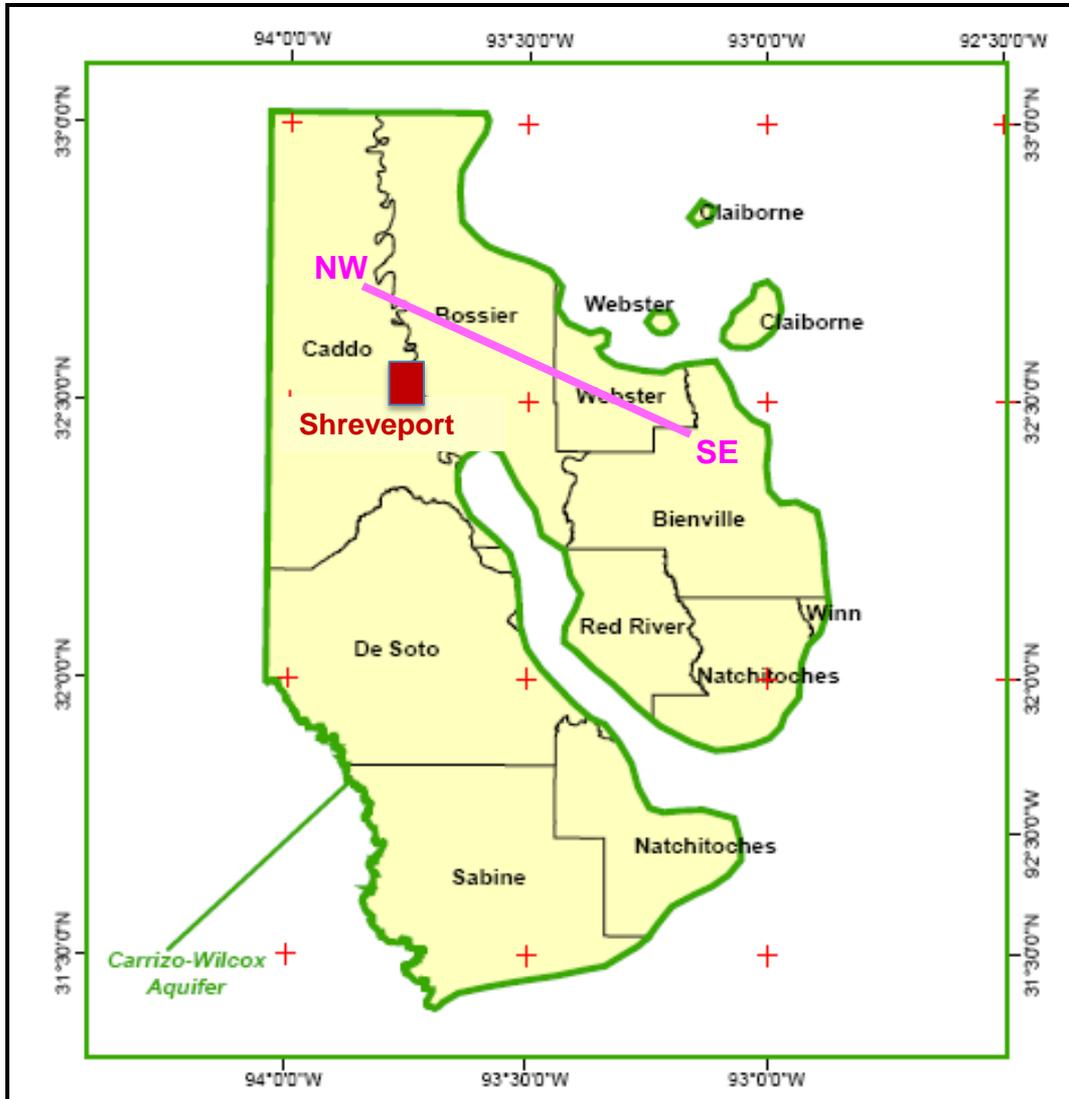


But...

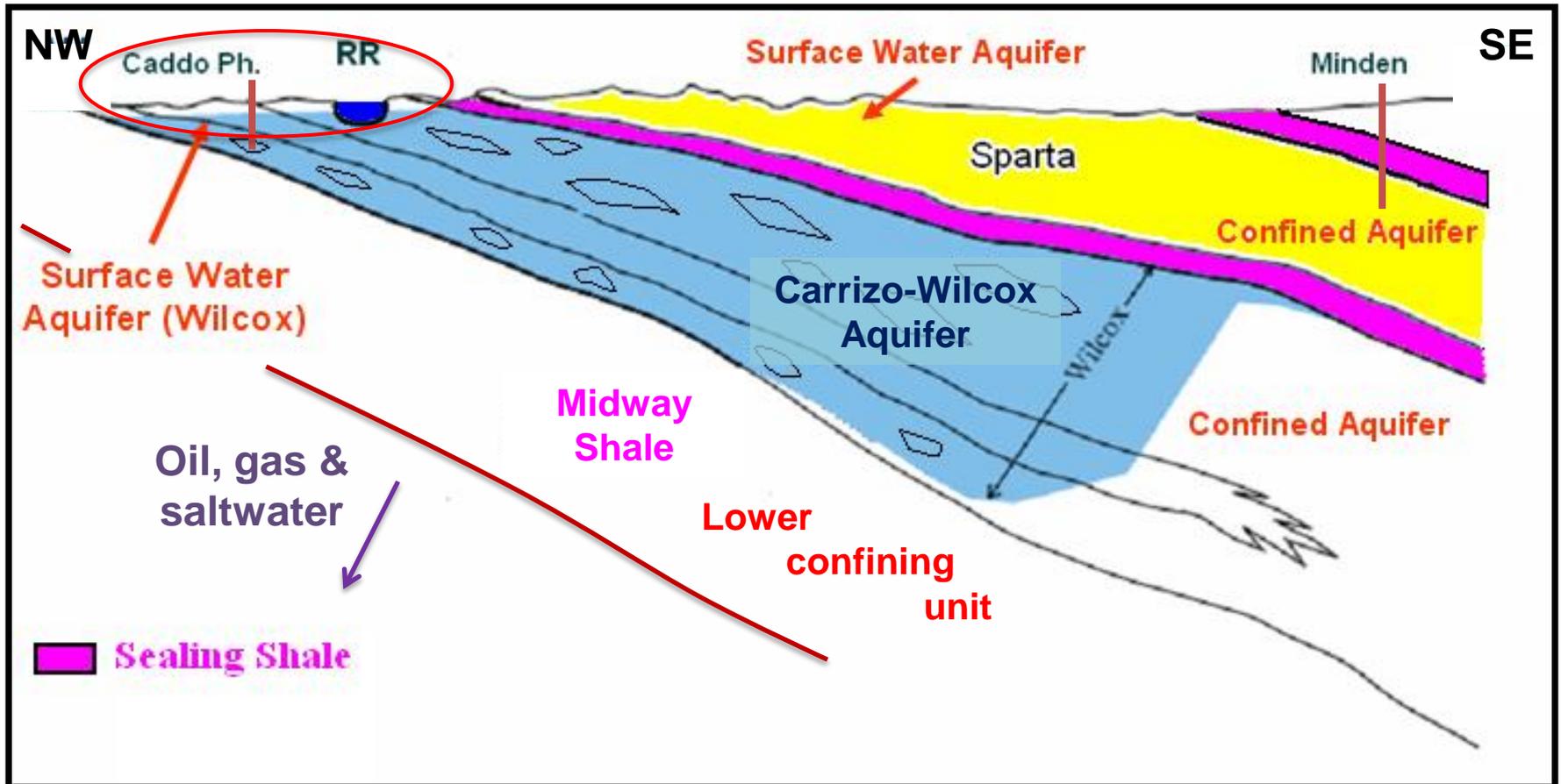
Water is a cultural issue - More than just a commodity



Parishes Overlying Carrizo-Wilcox Aquifer



Generalized Geologic Cross-section Northwest Louisiana



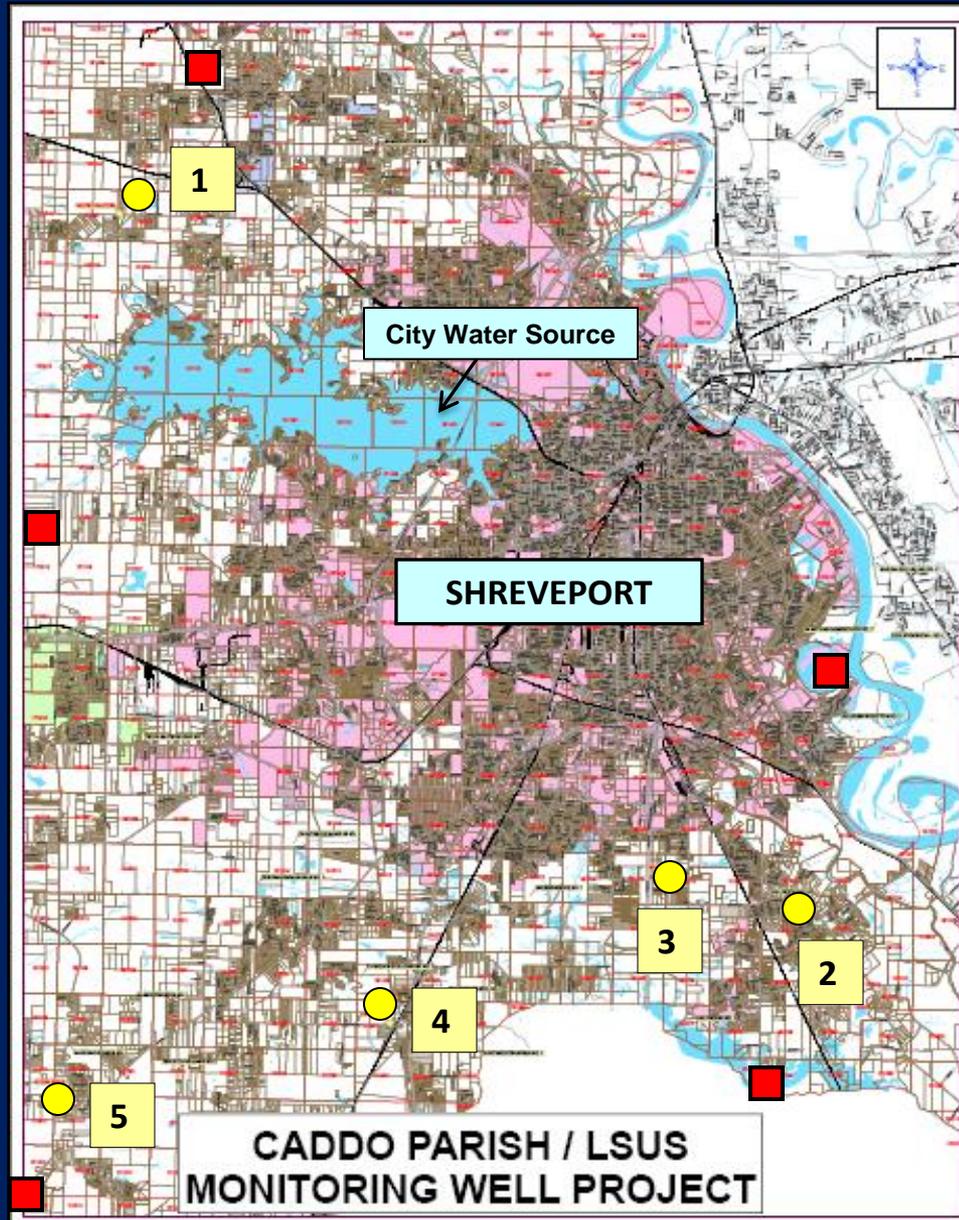
After Thorkildsen and Price, 1991

Caddo Parish/ LSUS Carrizo-Wilcox Monitoring Well Project

Monitoring Well Sites

- 1** Walter Jacobs Park
- 2** Hannah's Park
- 3** Mayo Road
- 4** Keithville
- 5** Springridge
- Phase II Wells drilled in 2010

Phase I wells were
collecting data prior to
the Haynesville Boom



LSUS/Caddo Parish Carrizo-Wilcox Monitoring Well Project



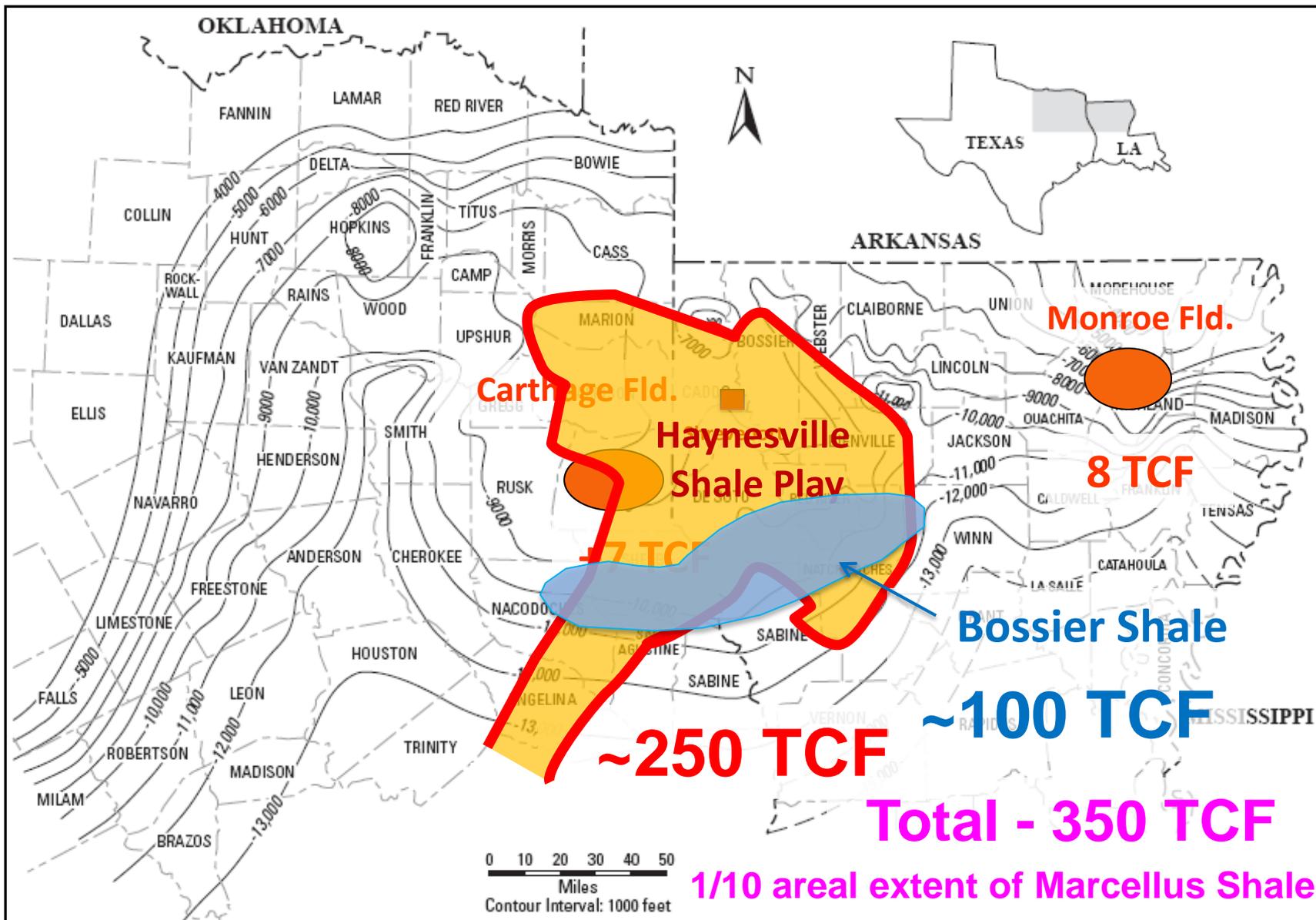
Walter B. Jacobs Memorial Park. LSUS students were involved in all phases of mapping, planning, drilling & development of the monitoring wells in the joint project.

Drilling of the project's first groundwater monitoring well at Walter B. Jacobs Memorial Park. LSUS students observe drilling operations.

LSUS Students Touring an EnCana Operated Haynesville Rig



Structure Map – Top of Cotton Valley Group

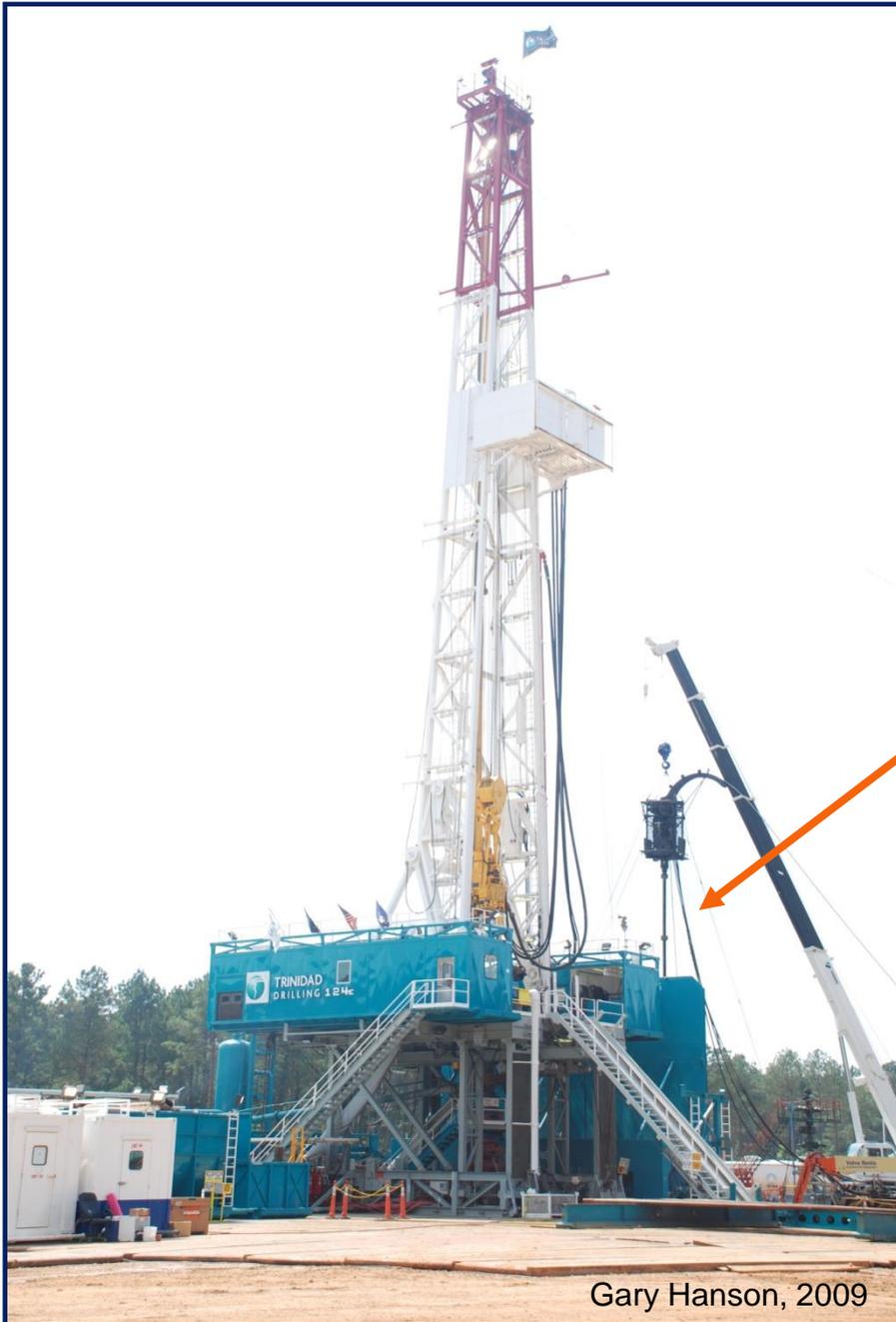


Generalized structure contours on top of Cotton Valley Group sandstone across northeastern Texas and northern Louisiana, modified from Finley (1984).

Haynesville Shale Gas Discovered in Northwest Louisiana - 2008

Haynesville Top Drive Rig
Drilling On Left & Adjacent
Well Undergoing Hydraulic
Fracture Stimulation (right)

Frac job underway



Water Sources for Haynesville Play

- **Groundwater**

- **Carrizo-Wilcox Aquifer**

- **Initially the main source for fracing**

At the start of Haynesville boom, many operators did not fully appreciate Louisiana's groundwater regulations

Drilling strains DeSoto water system



Vickie Webber/The Times



Vickie Webber/The Times

TOP: DeSoto Waterworks District No. 1 Administrator John Nelson watches as plant superintendent Fred Winchester pulls a sample of water from the treatment plant. **ABOVE:** Water samples are opened.

Water supply

The Carrizo-Wilcox Aquifer supplies underground water to eight parishes in northwest Louisiana. A 2004 study indicates 14.5 million gallons are pumped daily from the aquifer to supply water needs ranging from public water systems to industry to general irrigation. Caddo Parish is the heaviest user at 3.9 million gallons, followed by Bossier at 2.6 million gallons and DeSoto with 2.2 million gallons.



Withdrawals by Parish

Parish	Mgd/Day
Bienville	.80
Bossier	2.64
Caddo	3.90
DeSoto	2.20
Natchitoches	1.42
Red River	.59
Sabine	1.87
Webster	.93

Withdrawals, in million gallons per day

Public supply	6.78
Industry	.70
Power generation	.90
Rural domestic	4.40
Livestock	.47
Rice irrigation	.67
General irrigation	1.35
Aquaculture	.20
Total	14.58

*Approximate million gallons per day. Source: Louisiana Department of Transportation and Development and U.S. Geological Survey Water Resources Cooperative Program.

By Vickie Webber
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MANSFIELD — Natural gas drilling in DeSoto Parish could be slowed if the parishwide water system is unable to quickly upgrade its distribution system, the administrator said in a pitch

systems across the parish may not be able to fill the gap "because they" also are feeling the drain from drillers. At least one of the small water systems blames the increased draw from the underground aquifer for losing one of its wells high and dry.

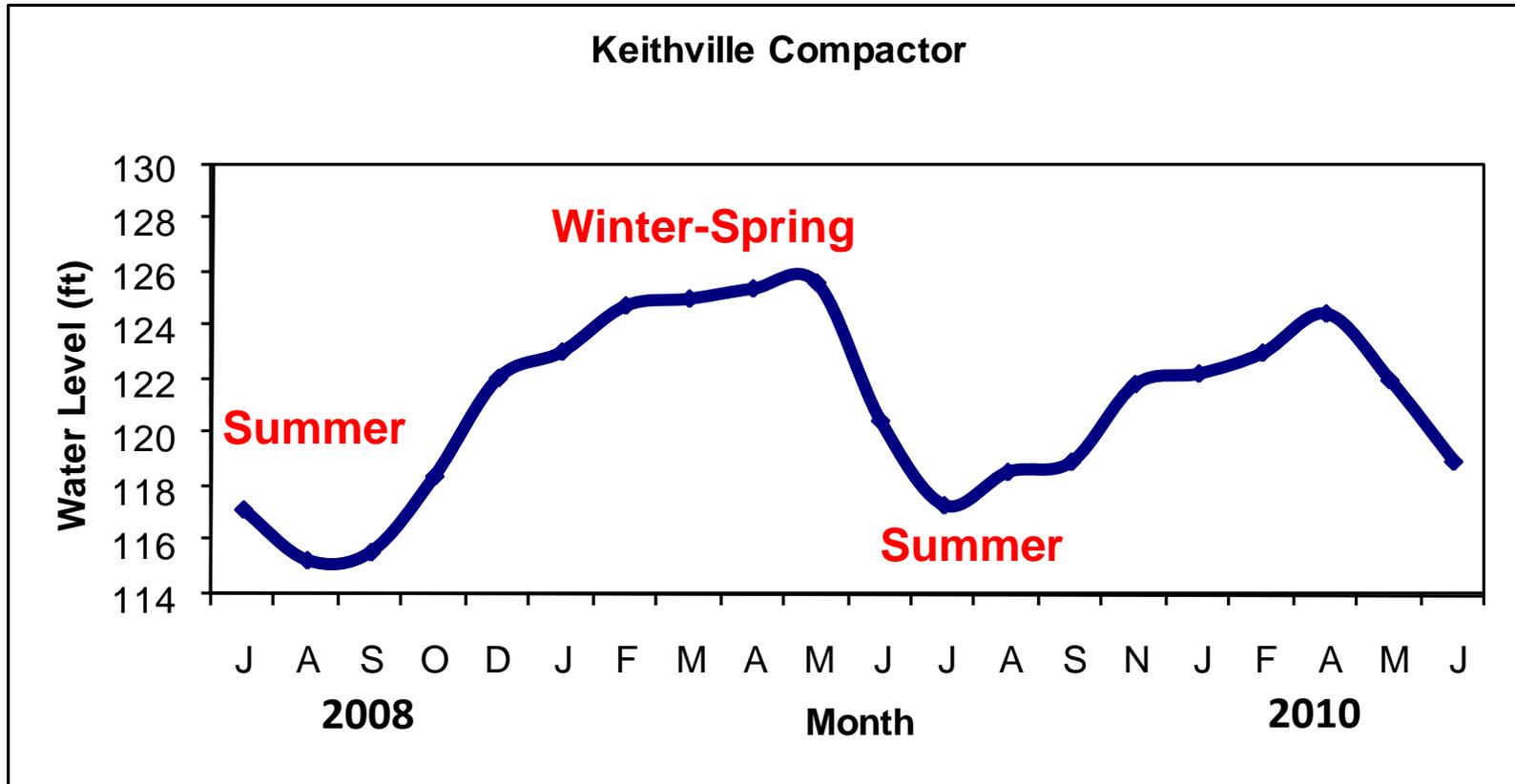
problem that could crop up in many northwest Louisiana parishes where Haynesville shale development is under way. Eight of 10 parishes in this corner of the state depend upon surface water from lakes or groundwater from aquifers for their drinking supplies.

"It's a serious situation that's got to be addressed," DeSoto Waterworks District No. 1 Administrator John Nelson said. "Water was denied several days last week to a well fracturing company "because we had no water to give them. ... A lack of water curtails drilling," Nelson said.

Local water supply problems developed

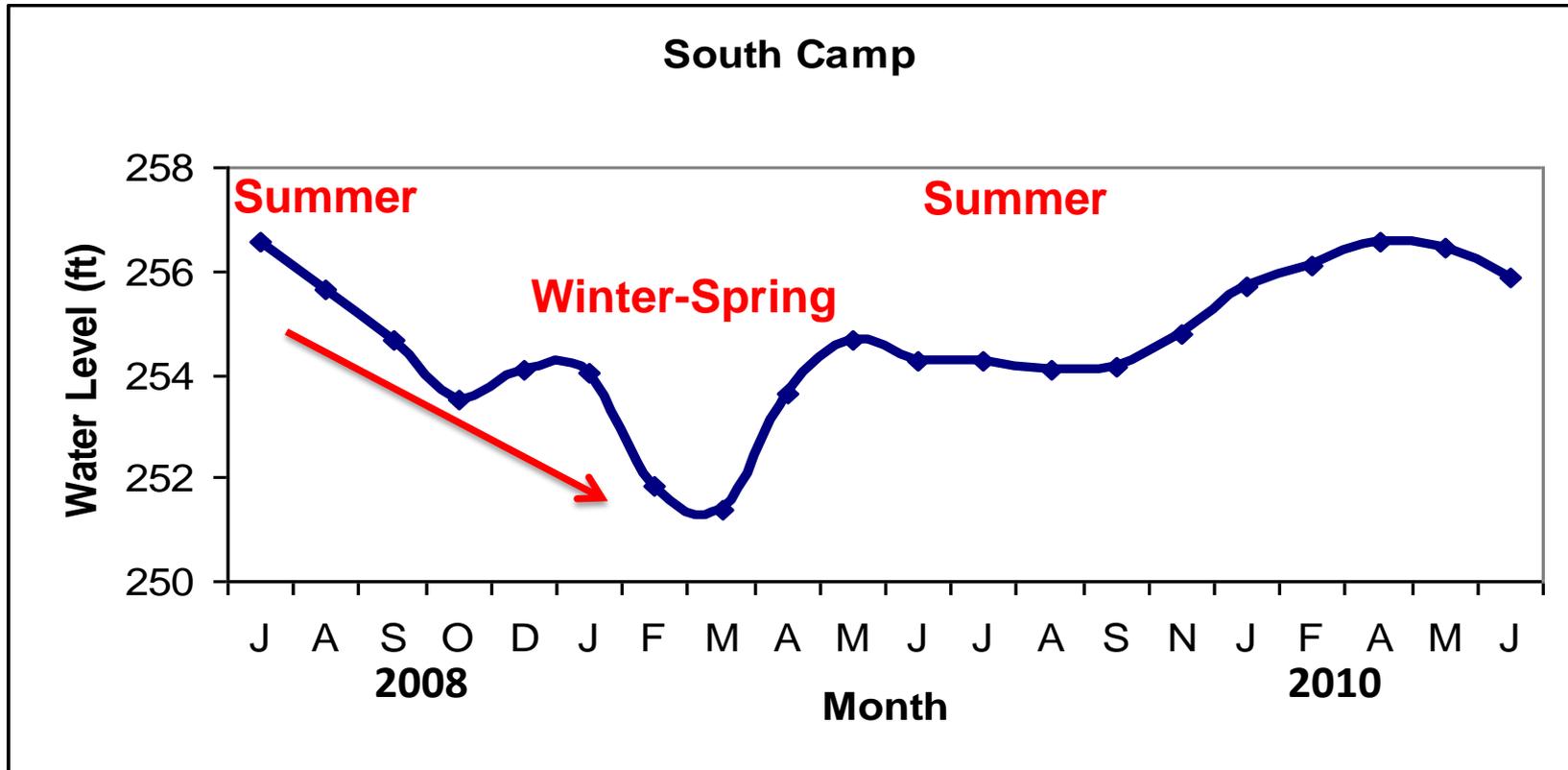
Professional waterworks administrators became convinced that the withdrawal of excessive amounts of groundwater by gas operators was depleting the aquifer.

Caddo Parish/LSUS GW Monitoring



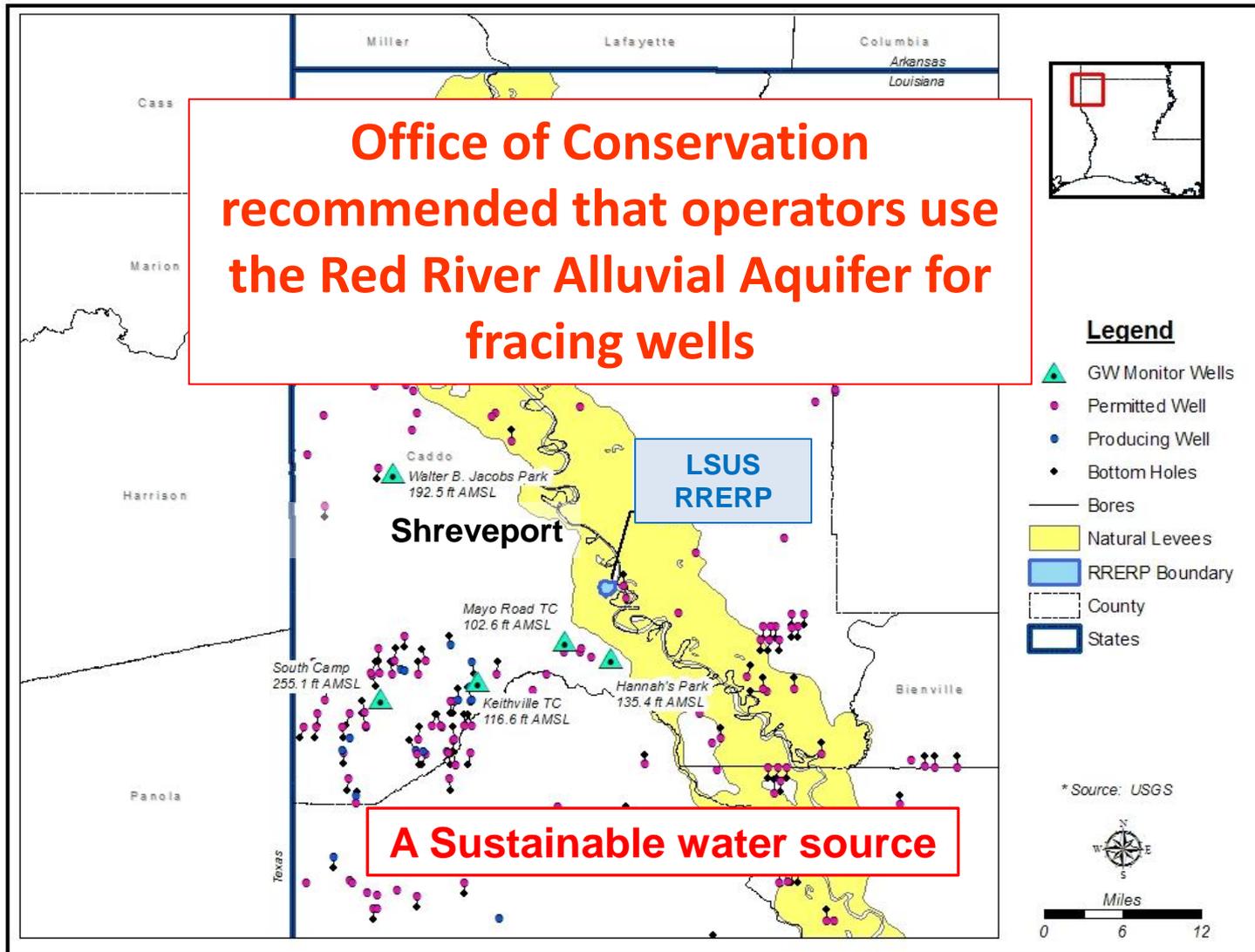
Typical Carrizo-Wilcox seasonally influenced water level curve

Caddo Parish/LSUS GW Monitoring



Water level appeared to be dropping rapidly in this area of heavy drilling & hydraulic fracturing

Alternative Water Sources - Red River Alluvial Aquifer



USGS, 1995 LSUS RRWMI, 2008

Non-Potable - Yields up to 1600 gallons/minute

Alternative Water Sources – South Caddo, Desoto

Surface Water

Smithport Lake



Red River



Toledo Bend Reservoir



Sabine River



Alternate Water Sources for Frac Water - Ponds

Landowners hope ponds suck in drilling dollars



Greg Pappas/The Times

Dennis Bell, a land owner and dirt contractor who lives east of Mansfield, has built several ponds on his property and is also building ponds for others to be used for water supply for the oil and gas exploration business.

By Vickie Welborn
vwelborn@gannett.com

MANSFIELD — It's not often that a dirt contractor says he's glad it's raining. But Dennis Bell was among the few who didn't mind last week's rain.

Because every drop that might have kept him from a job was serving another purpose: filling up the many ponds that Bell has constructed for himself and others. One at his home on state Highway 522 east of Mansfield was practically dry before the deluge. After a few days, it was beginning



Greg Pappas/The Times

Five miles of fast lines transport water from Dennis Bell's ponds at his home east of Mansfield.

interests. The Public Jury for months has been attempting to get a clear opinion from the state attorney general's office on water ownership rights of the sister lakes.

Absent that, Assistant District Attorney Gary Evans last month issued his own opinion, stating that the lake water was owned by the state of Louisiana. But since a mechanism is not in place to handle water sales, Evans suggested the Public Jury, as a political subdivision of the state, set a price for the water and set up

Get Rich Quick? -
Don't sale the farm,
just sell the pond
water...



Industry built ponds

Water Wars - Ponds started to dry up



Shifting the gas industry from groundwater to surface water

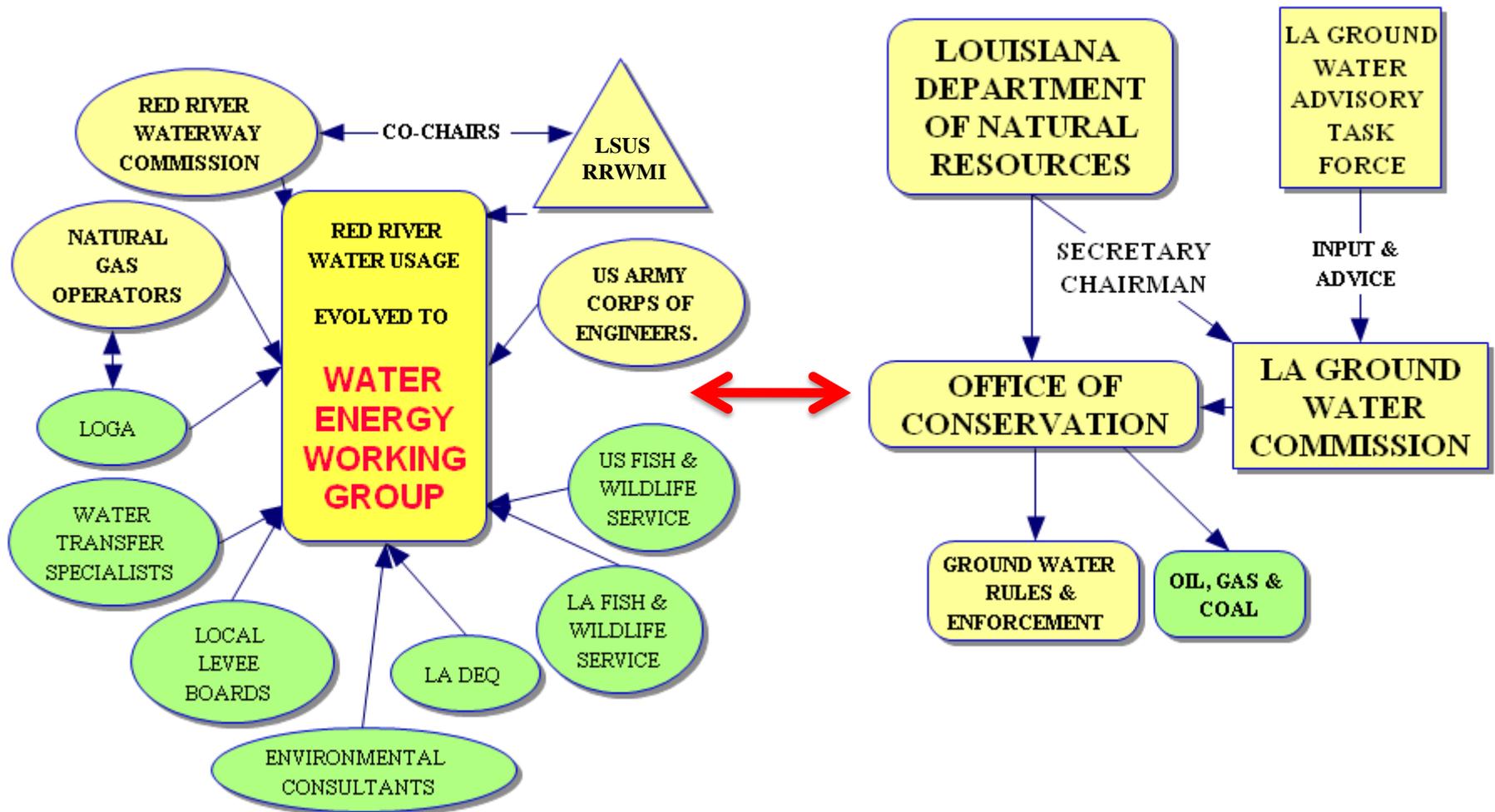
First attempts to acquire permission to set up withdrawal sites on the Red River were met with long delays and apparent inaction by the US Corps of Engineers.

Eventually, the Red River Watershed Management Institute joined with the Red River Waterway Commission and organized a meeting between the Corps and some of the natural gas operators at LSUS.



The Ad Hoc Committee that was set up to help the gas operators transition from groundwater to surface water (Red River) as a frac water source, evolved into the **Water Energy Working Group**

CLOSE COORDINATION BETWEEN WATER ENERGY WORKING GROUP & OFFICE OF CONSERVATION HAS BEEN CRITICAL FOR SUCCESS



Water Energy Working Group – Meeting at LSU Shreveport

WG became more flexible & adapted to issues before or as they arose

Participants:

US Army Corps of Engineers Vicksburg (USACE)
Red River Waterway Commission, LAF&WS, LADEQ
Red River Watershed Management Institute (LSUS)
Red River Valley Assoc., Sabine River Authority, Caddo
Levee District, Bossier Levee District, La DOTD, U.S. Fish
& Wildlife Service, Chesapeake, Questar, EnCana,
Petrohawk, Camterra, J&W, Exco, Shell, El Paso,
Louisiana Oil and Gas Association, Red River Pump,
Impact Energy Services, Water Resources Committee of
Northwest Louisiana, International Paper Company

Early on & on a voluntary basis,
most Haynesville operators reduced
their use of groundwater

Co-chairs: Directors of Red River Watershed Management
Institute & Red River Waterway Commission

From Groundwater to Surface Water Learning to Deal with the Haynesville Boom

Self-Organizing

- The **Working Group** was formed to assist operators gain access to the **Red River** as a **frac water source in lieu of stressed groundwater aquifer**.
- **Like other regulatory entities** experiencing the **incredibly rapid development of the Haynesville**, **USACE** was suddenly **confronted with unique water related issues (sent 8 managers!)**
- In order to gain **access to river sites** for water withdrawal, **USACE** determined that a **Section 10 permit was required** (does not give permission to take water).
- Although **Louisiana** had previously **enacted groundwater legislation**, at the time there was **no surface water legislation**.

From Groundwater to Surface - Results

A **second meeting** was called about a month later to provide the Corps with **estimated future withdrawal rates/volumes** and to **finalize a protocol for permit submission**. Just prior to the meeting, **Chesapeake was issued the first permit**. After this meeting **20 more permits** were issued to several other operators.



Access to Red River!

From Groundwater to Surface Water Water Energy Working Group

Third Meeting - Resilience

- The **third meeting was called** because, operators were told **permits were being held up** by **US Fish and Wildlife Service**.
- The **USF&WS** was contacted & a **high-level manager** attended our third meeting. He informed the operators that they had to take measures to **protect three threatened or endangered species** in or along the Red River.
- In response, **operators** developed **survey protocols** for **Earth Fruit**, the **Interior Least Tern** & developed **slotted water intake manifolds** for the **Pallid Sturgeon**.

Alternative surface water frac sources

EXCO is building an 8 mile pipeline in order to use treated wastewater from International Paper Co. at Mansfield, La.

HAYNESVILLE SHALE

Drilling's environmental



IMPACT

By Vickie Welborn
vwelborn@gannett.com

IP, EXCO test water source union

NEAR MANSFIELD — International Paper Company's Mansfield Mill is testing a partnership with the region's burgeoning natural gas business through an environmentally friendly move that could have a long-range positive impact on both industries.

IP and EXCO Resources Inc. are in a trial to reuse the papermaker's treated processed water to aid EXCO in its hydraulic fracturing process. The trial run, which has been approved by the Louisiana Department of Environmental Quality, will go through Sept. 30, allowing EXCO to complete two Haynesville Shale natural gas wells.

The end result is that millions of gallons of treated processed water that normally would be discharged into the Red River will be diverted through pipelines to EXCO's drilling loca-

Jim Hudelson/The Times

Birds fly near a collection pond containing treated water that is being pumped through a pipe for use at a nearby natural gas-drilling well site. International Paper's Mansfield Mill is in the background.

12 million gallons/day

The Times, 2010

This gives DNR a tool for tracking water use

It was during this timeframe, DNR was becoming more flexible & proactive. The Secretary held numerous, lengthy public meetings throughout the State

TO:

FROM:

SUBJECT: Reporting Requirements for Water Use in E&P Operations

To promote regulation

After completing an oil or gas well, all operators have to fill out an Office of Conservation Well History and Work Resume Report Form (WH-1). Now operators also have show their water use on Page 3 of the WH-1.

GWR 12-0015	RED RIVER	100,000	1,000,000	2,000,000
TOTAL GROUND WATER VOLUME USED (gal)		1,100,000		

Groundwater supply well

Total Groundwater Used

Total Surface Water Used

From Groundwater to Surface Water

DNR-Office of Mineral Resources has worked diligently to develop a surface water use plan

Who owns the surface water?

- Surface water “**opinions**” were rendered by **Attorney General** stating that the **state owns** all “**naturally running water.**”
- The **AG opinions** were used as the basis for **enacting surface water use legislation. Act 955** calls for the establishment of **cooperative endeavor agreements (CEA)** in order to **withdraw water from streams or lakes fed by streams.**

Haynesville Frac Job - Shreveport

**Reducing the use of
groundwater:**

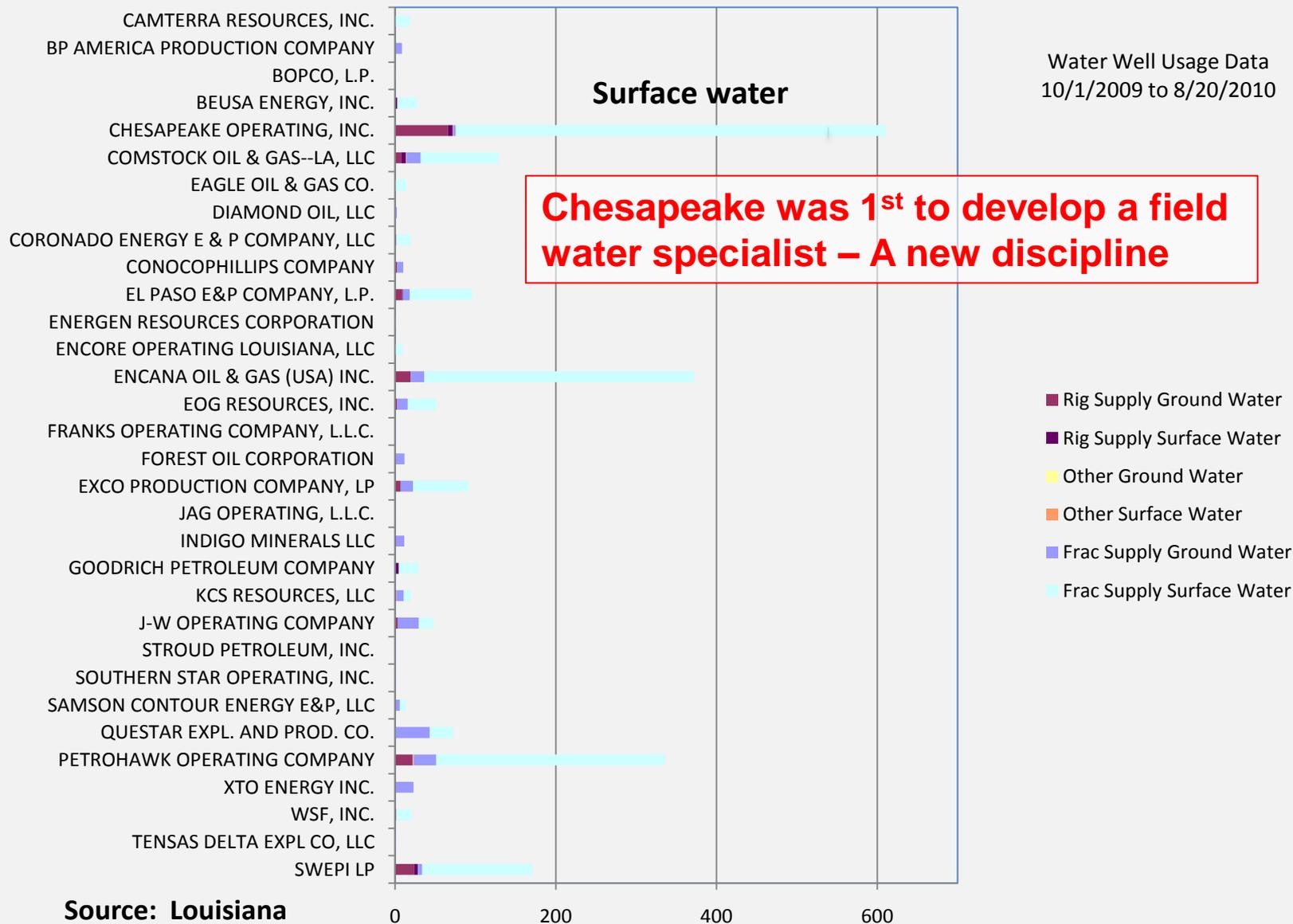
**How is the voluntary
approach working?**

Results?

Source: EnCana, 2010

Haynesville WH-1 Water Volumes by Company

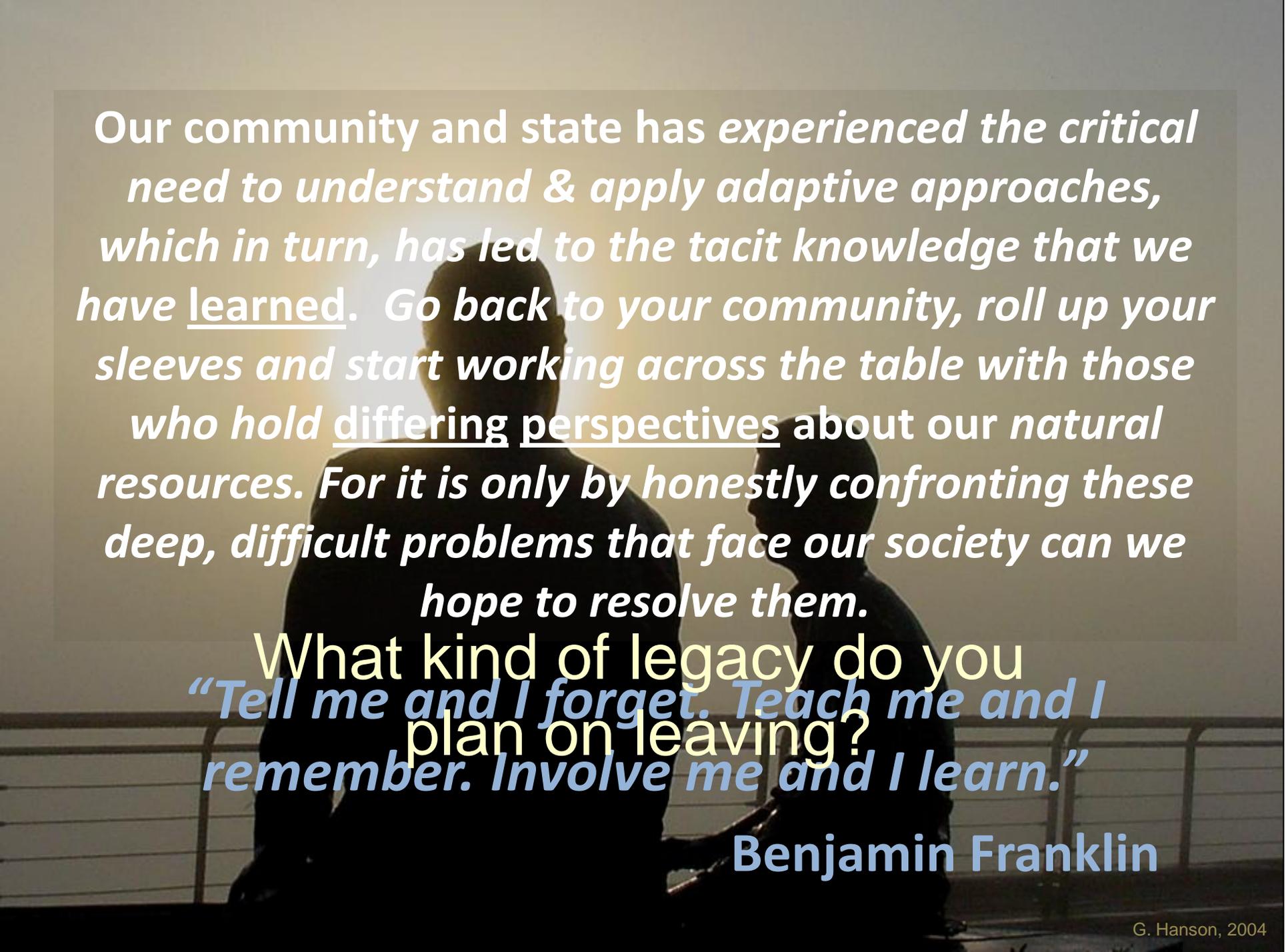
Water Well Usage Data
10/1/2009 to 8/20/2010



Source: Louisiana
Department of Natural
Resources, 2010

Millions of Gallons

Since Oct. 2009

The background of the slide features a silhouette of two people standing on a balcony or walkway, looking out at the ocean. The sun is low on the horizon, creating a bright, hazy glow behind them. The person on the left is seen from the back, while the person on the right is in profile, facing the other. A metal railing is visible in the foreground.

Our community and state has *experienced the critical need to understand & apply adaptive approaches, which in turn, has led to the tacit knowledge that we have learned. Go back to your community, roll up your sleeves and start working across the table with those who hold differing perspectives about our natural resources. For it is only by honestly confronting these deep, difficult problems that face our society can we hope to resolve them.*

What kind of legacy do you
“Tell me and I forget. Teach me and I
plan on leaving?
remember. Involve me and I learn.”

Benjamin Franklin

Acknowledgements:

Sponsors of the Marcellus Summit
Interstate Oil & Gas Compact Commission

US EPA Region 6

City of Shreveport

AEP SWEPCO

LSU Shreveport & LSU System

Halliburton

Anderson Oil & Gas

Louisiana Dept. of Natural Resources & Office
of Conservation

The Parishes of Caddo, DeSoto, Bossier &
Webster, Sabine River Authority & Red River
Waterway Commission

Members of the Water Energy Working Group

Thank you!