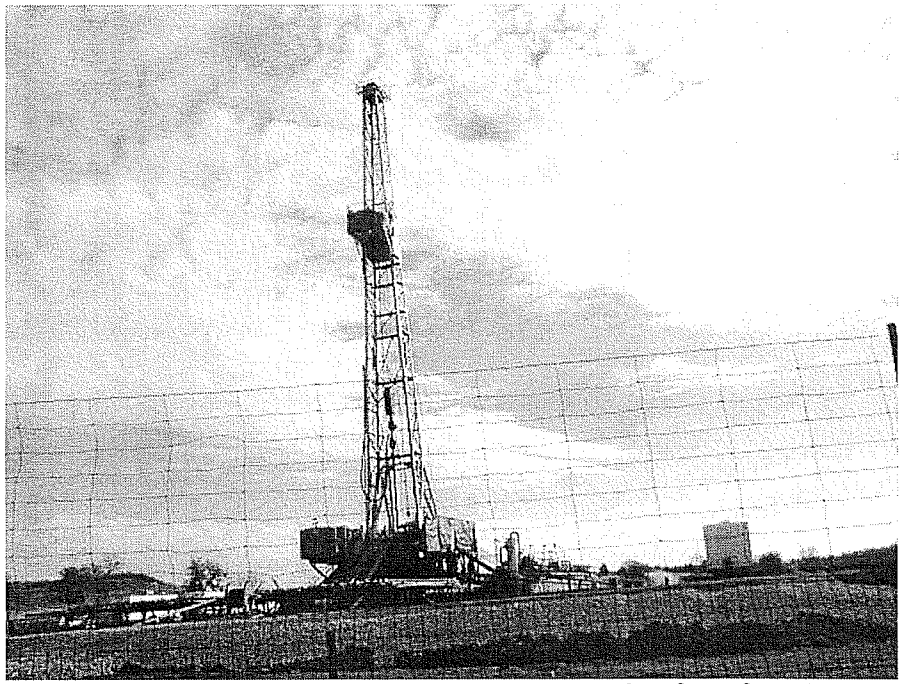
Advanced Membrane Technology Desalination of Oil Field Brine



Burlington Resources Rig in Barnett Shale Development

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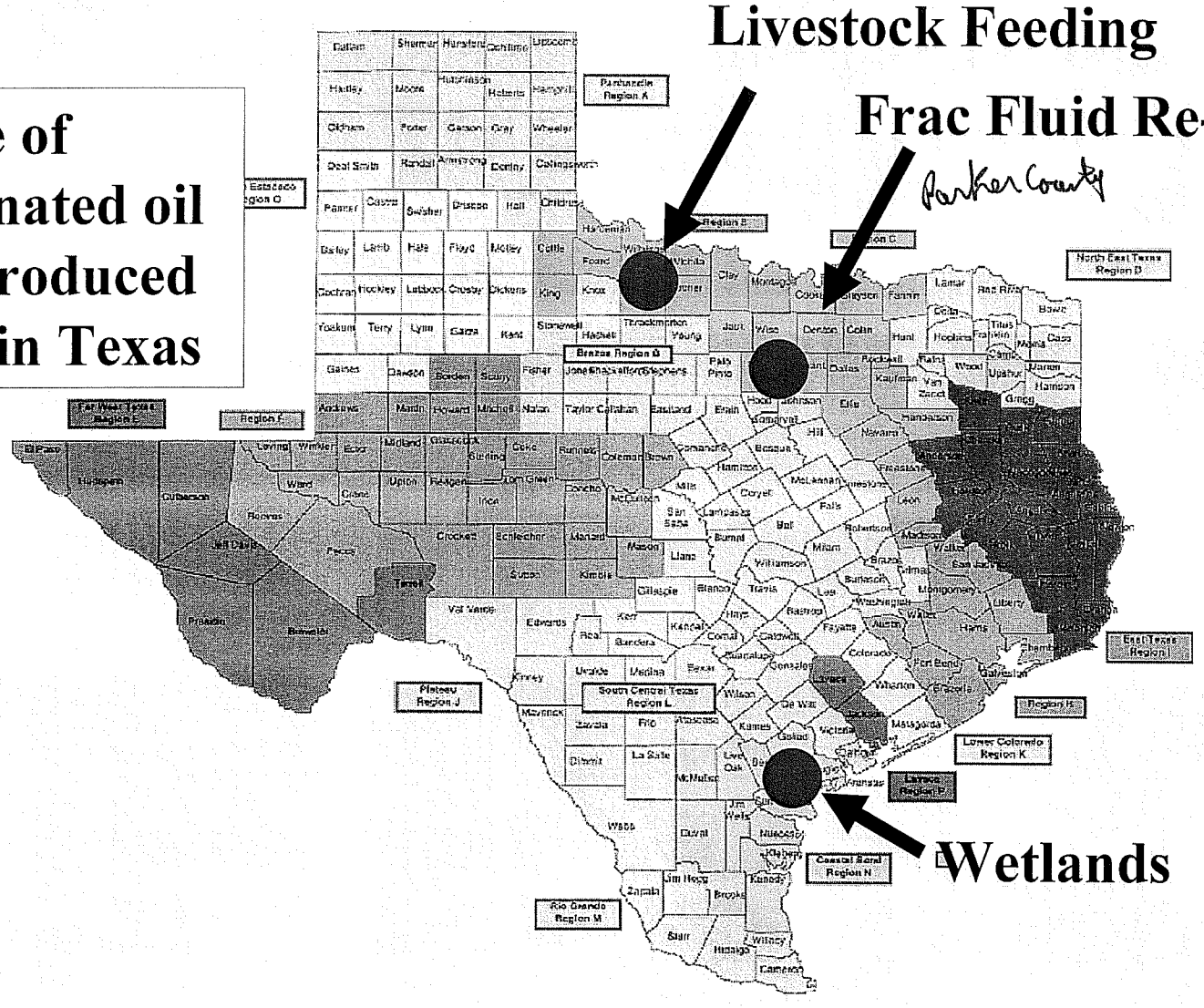
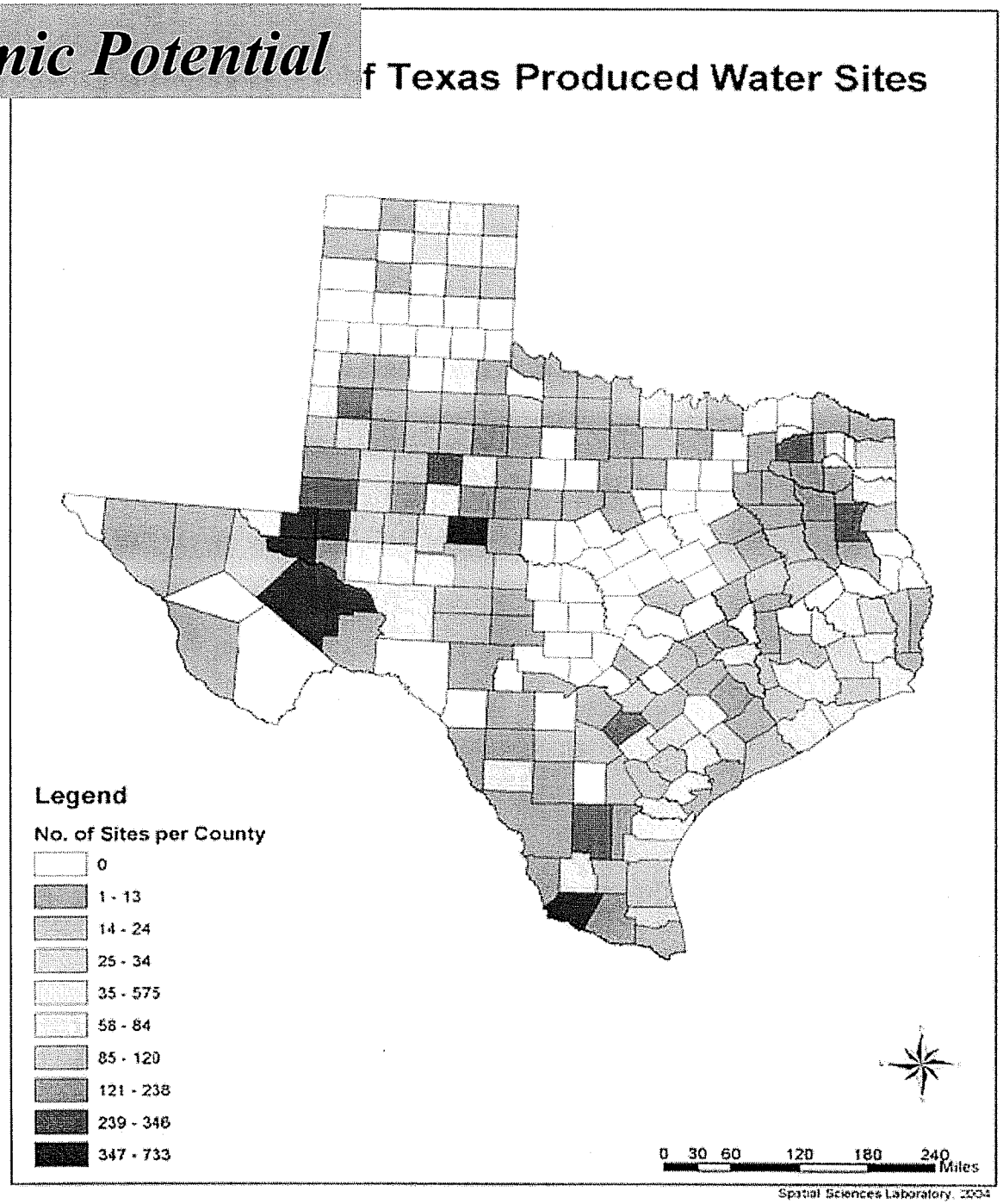
Re-use of Desalinated oil field produced water in Texas



3. Economic Potential



Desalination to produced fresh water for Agri-industry and Community Use

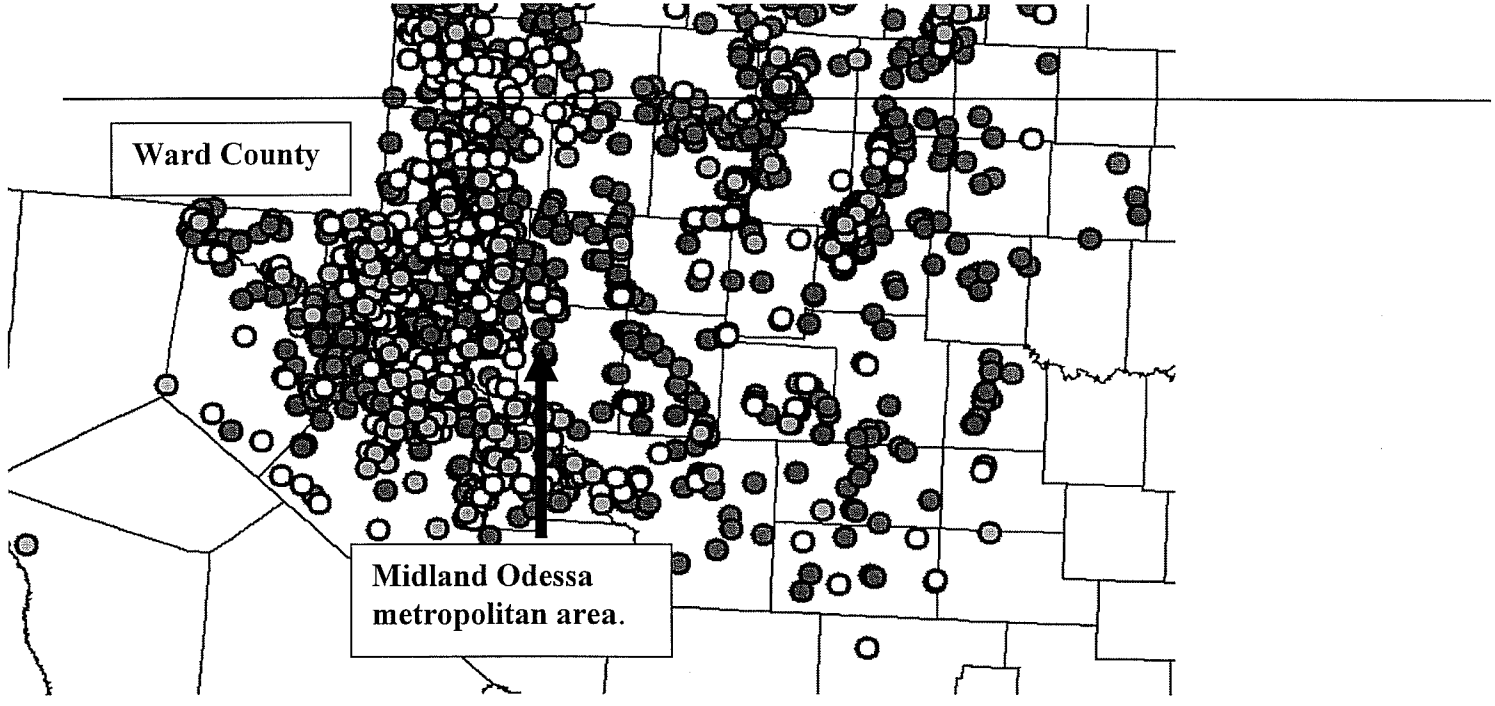
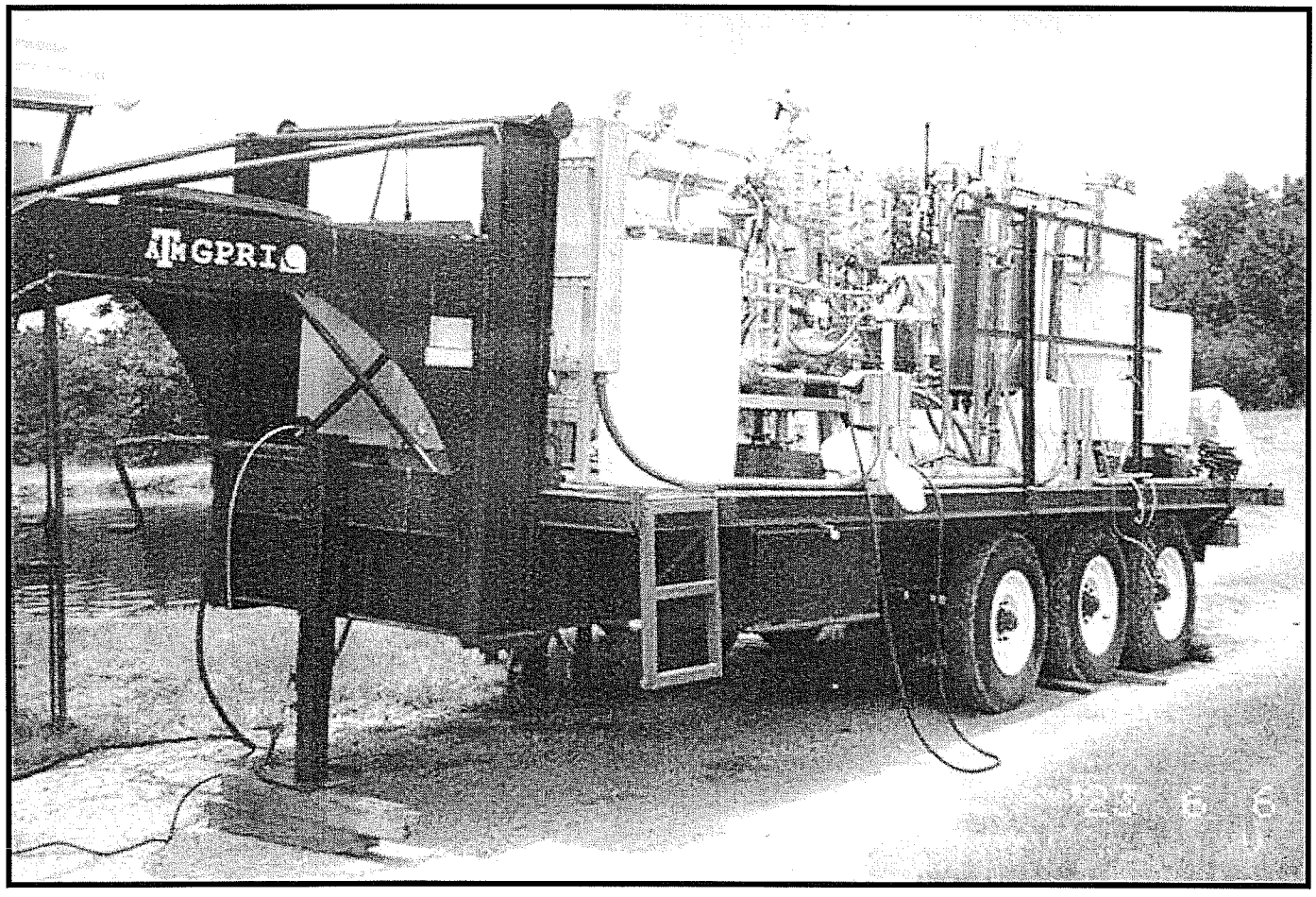


Figure 2 shows Texas produced water sites near the Pecos River, south of the New Mexico border. Produced water is classified into three categories. The green sites (~1/3) are brackish water (less than 10,000 ppm) and could be used for beneficial purposes after treatment. One-third of the sites has salinity (TDS) from 10,000 to 50,000 ppm, and is the focus of this project.
A state-wide map in color can be found at http://www.gpri.org/produced

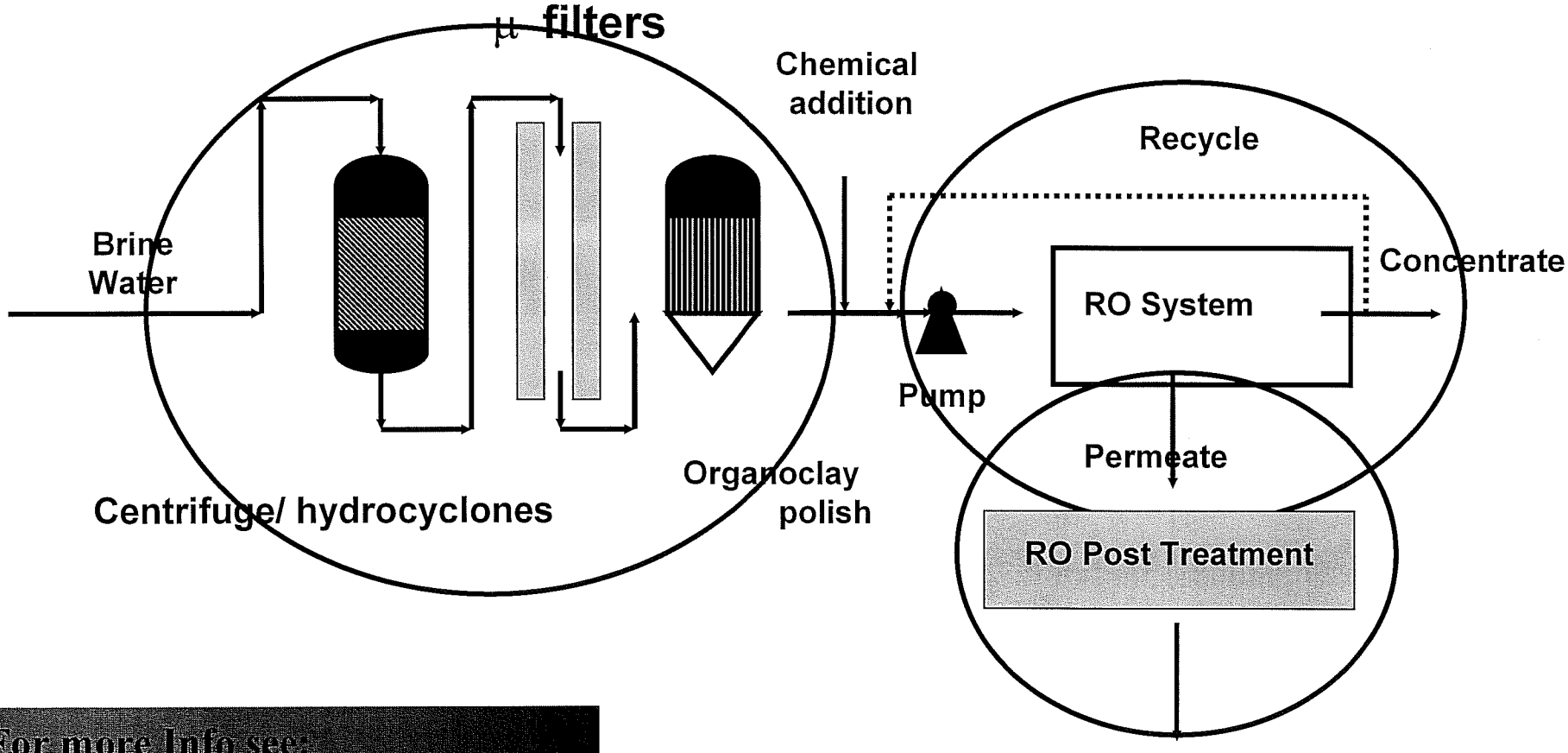
2. Description of the Technology

A&M Pilot Desalination Unit



2. Description of the Technology

BGW Desalination Process



For more Info see:

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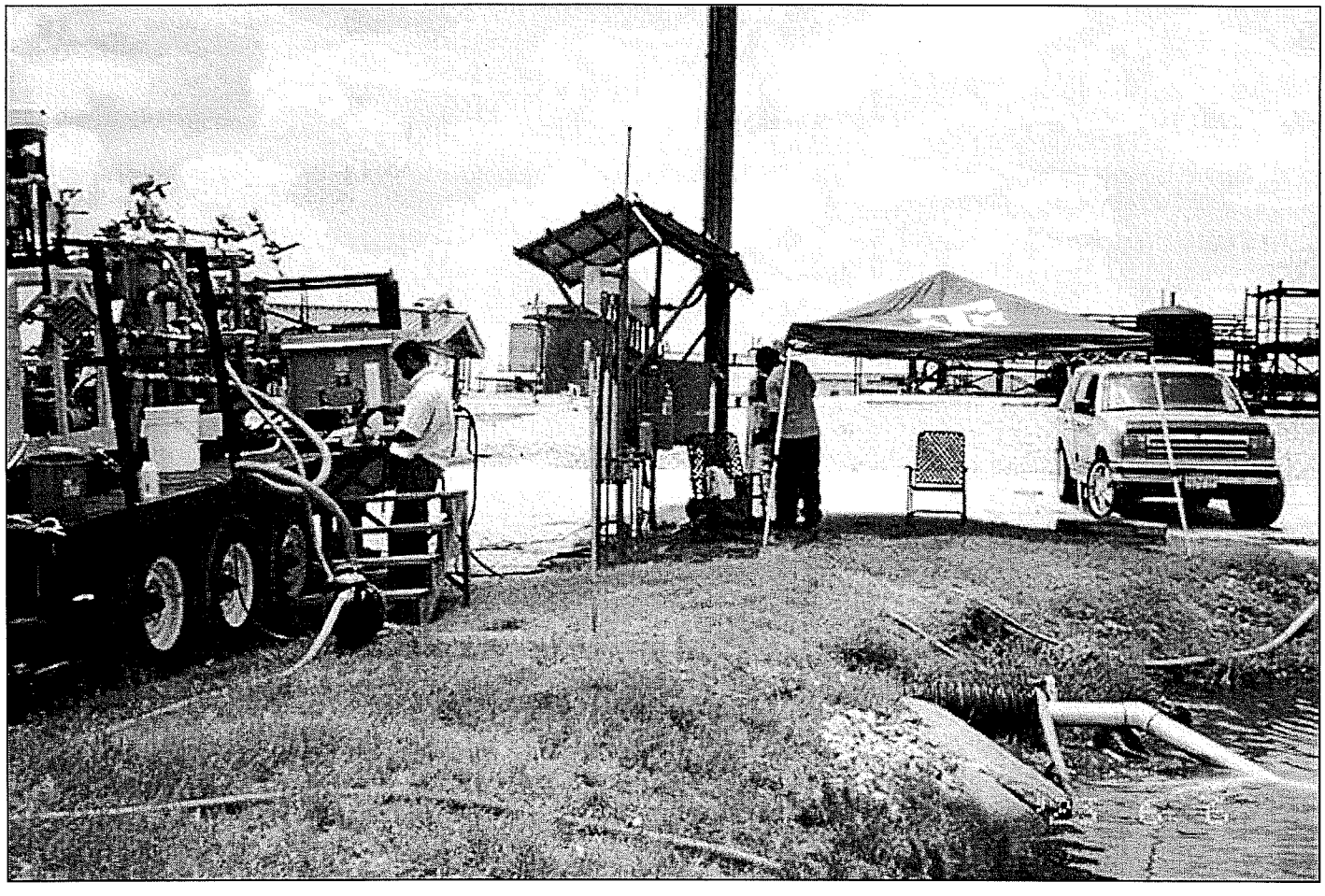
2. Description of the Technology

Desalination Unit at Site



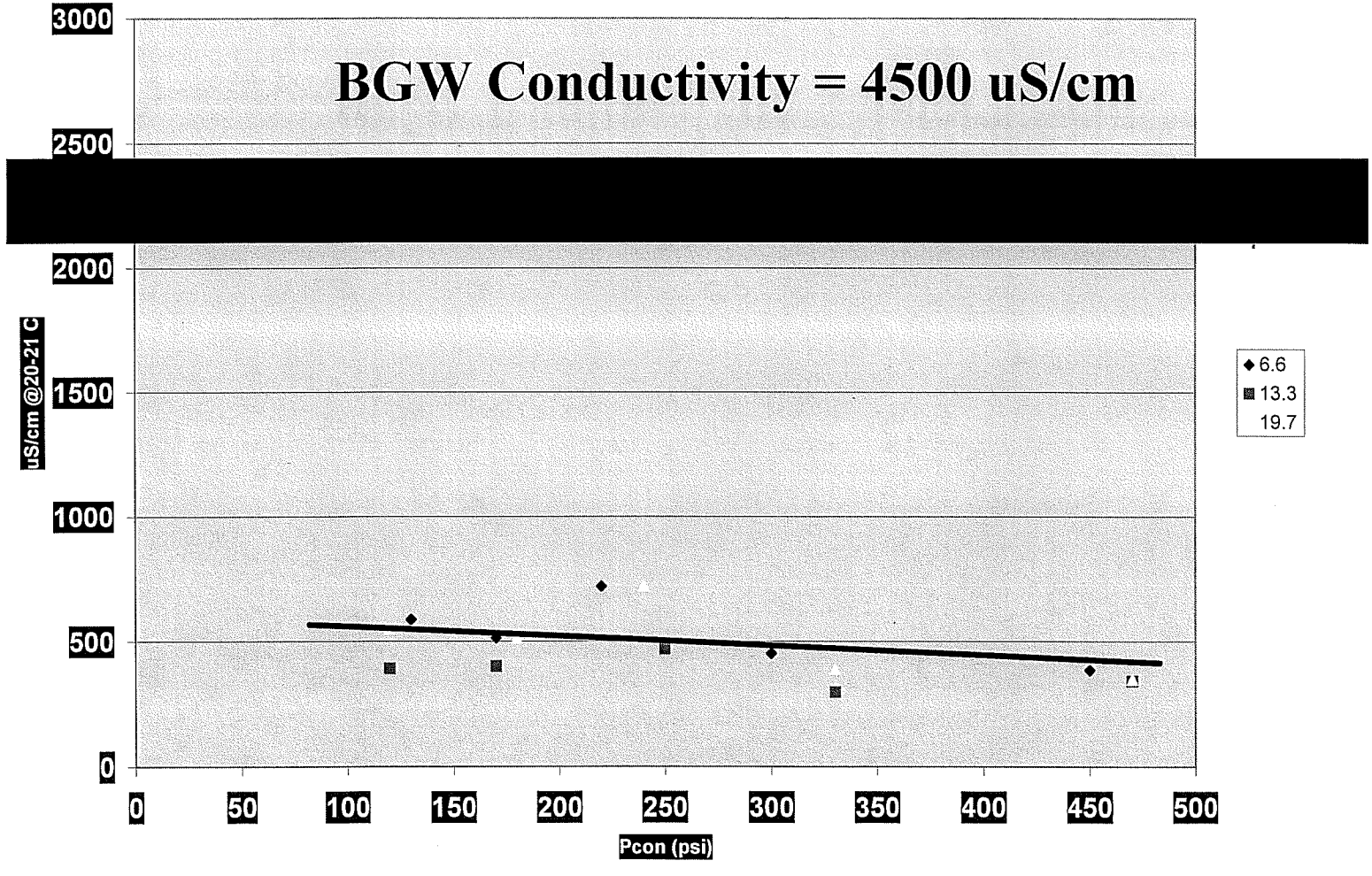
Accomplishments of Previous DOE Projects

- *"Environmental and Regulatory Issues Relating to the Utilization of Produced Water from Oil & Gas Operations"*
  - Working relationship established with agencies and regulatory practices that are encountered when developing produced water reuse program
- *Establishing Programs to Reimburse Operators for Produced Water Desalination*
  - Promoted the beneficial re-use of produced water resources from oil and gas operations

Waste Water Pre-Treatment Costs

Type of Pre-treatment	Kw Used	Fresh Water Produced	Power per 1,000 gal	Cost* per 1,000 gal
oil + biofilm removal	2.80	199.4	14.04	$0.98
oil removal	0.94	99.4	9.46	$0.66
* = Power cost @ $.07 per Kwh				

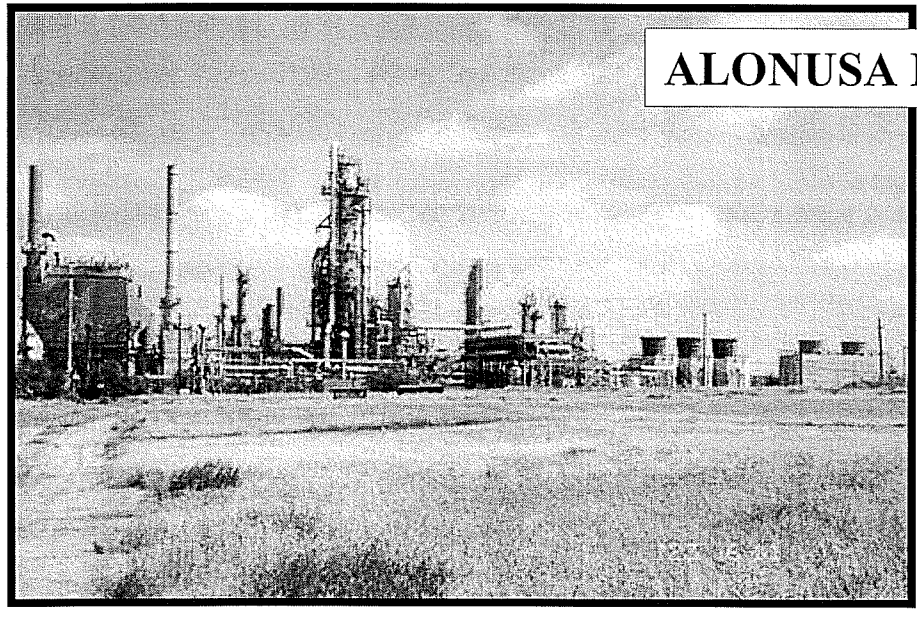
Progress on Desalination of Produced Brine



Beneficial Re-use of Produced Water

- *Desalination to produced fresh water for agri-industry*
- *"Conditioning" saline water for oil field re-use (fracturing fluids, weighting brines)*
- *Make-up brine for waterflooding operations*

Use of Treated Waste Water from Oil Refinery, Big Spring, Texas



ALONUSA Big Spring Refinery

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Devon Fracturing Operations-Current Practices

Step No.	Description	Volume		Cost of the step	subtotal cost
		bbls	gallons	$/bbls	
1	Water Transport to Well	10,000	420,000	$ 0.25	$2,500.00
2	Frac Water Treatment on site	-	-	$ 0.01	$0.00
3	Water to Well 2	-	-	$ 0.10	$0.00
4	Water to Disposal Well	10,000	420,000	$ 0.80	$8,000.00
5	Disposal costs	10,000	420,000	$ 0.30	$3,000.00
				Total costs	$13,500.

Devon Energy Cost Savings Potential

Spraberry Trend in West Texas

- Spraberry reservoirs originally contained 10 billion bbls of oil in place (more than 400 billion gallons) producing from more than 10,000 wells
- Trend found in Borden, Dawson, Glasscock, Martin, Midland, Reagan, Sterling, Tom Green, and Upton counties
- More than 230,000 people live in this area

Desalination of Produced Brine: U.S. Reserves

Barnett Shale Development

Devon Energy $$ indicate cost savings per year = 2.5 New Wells

Each Permian Basin Independent Operator (1,000 bbl/day) has potential to save the equivalent of 2 new wells per year.

PROJECT FACT SHEET

CONTRACT TITLE: Advanced Membrane Filtration Technology for Cost Effective Recovery of Fresh Water from Oil & Gas Produced Brine - BBA Round 2

ID NUMBER: DE-FC26-03NT15427
PRODUCT LINE: Gas/Oil - Environmental

PERFORMER: Texas Engineering Experiment Station
STREET: 332 Wisenbaker Engineering Research

CONTRACT PERFORMANCE PERIOD:
9/30/2003 to 9/29/2006

P.O. BOX:
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GOAL:
To develop improved RO (reverse osmosis) membrane filtration technology for treating waste water produced during oil and gas production operations.

OBJECTIVE:
The objectives include evaluation of a new pre-treatment technology using combinations of liquid-liquid centrifuges, organoclay absorbents, microfiltration, and the evaluation and modification of different oil resistant membrane materials and membrane types. We will also develop a dynamic model using variable feed flow, trans-membrane pressures, and recycling ratios to permit optimization of a process design. We plan to experimentally validate models and the equipment process trains.

TOTAL PROJECT COSTS:
DOE: $350,000
COST SHARE: $109,000
TOTAL: $459,000

PROJECT DESCRIPTION:

Background:

Before oil field brine can be used for any beneficial purpose, it must be processed to remove residual petroleum hydrocarbon material. An effective way of removing petroleum from produced water is the use of membrane filters to separate oily waste from the brine. Experience from both the municipal and commercial water treatment industry and the petroleum industry has shown that filter fouling is a major reason for the high cost of water desalination and wastewater treatment in general. Thus the goal of this project is to improve the lifetime and operating efficiency of these filters used for wastewater treatment (including desalination).

Scope of Work:

For three years, researchers at Texas A&M University have been working on desalination processes to treat oil field produced brine to make it suitable for beneficial use. Results indicate that the brine treatment is feasible and can be done simply and economically. Now new technology has been developed having the potential to reduce the cost of desalination to a value comparable with disposal by re-injection into dispoal wells.
Desalination of oil field brines requires a series of steps to remove contaminatnts and decrease salinity. A key to cost effective desalination by RO is pre-treatment. The core tasks of this proposal focus on two new pre-tratment technologies for oil removal combined with modificaiton of different membrance materials and membrane types.

PROJECT STATUS:

Accomplishments:

Oil Program Technology Booklet 6/23/2004

Barrufet's process design model has been developed and used to model the prototype water desalination system. Burnett has constructed a filtration portable unit to be used for long term testing.

Dr. Barrufet Visited French research facility 8/6/2004

Dr. Barrufet visited the scientists at the research facility of Total Oil and Gas in Paris France in July to discuss A&M's process design model. Total (formerly TotalFinaElf) has both oil and gas production world wide and, like other operators, faces increasing costs to manage produced water. In Texas, Total has a lease in Star County that is in the proximity to Key Energy's salt water disposal facility. (Key Energy is also a sponsor of the A&M GPRI project.

First Field Trial Completed 8/6/2004

Burnett and his colleagues have completed the first "field trial" of the desalination unit on the A&M campus at the water treatment plant located at the Brayton Firefighter Training Center. Figure 1 shows the mobile desalination unit on site during preliminary testing. This unit has a capacity to deliver from 2,000 gpd to 5,000 gpd depending upon the salinity of the water to be treated.

Results of Trial Run 8/25/2004

Preliminary tests showed promise. Oil content (residual diesel and combustion products) was reduced more than 90%. Data from the meters indicated that the electrical power required to perform the water conditioning (pre-treatment steps) was less than ($.02 per barrel of fresh water ($0.50 per 1,000 gallons).