

# Water Use In the Eagle Ford Shale Play: A Systems Dynamics Approach

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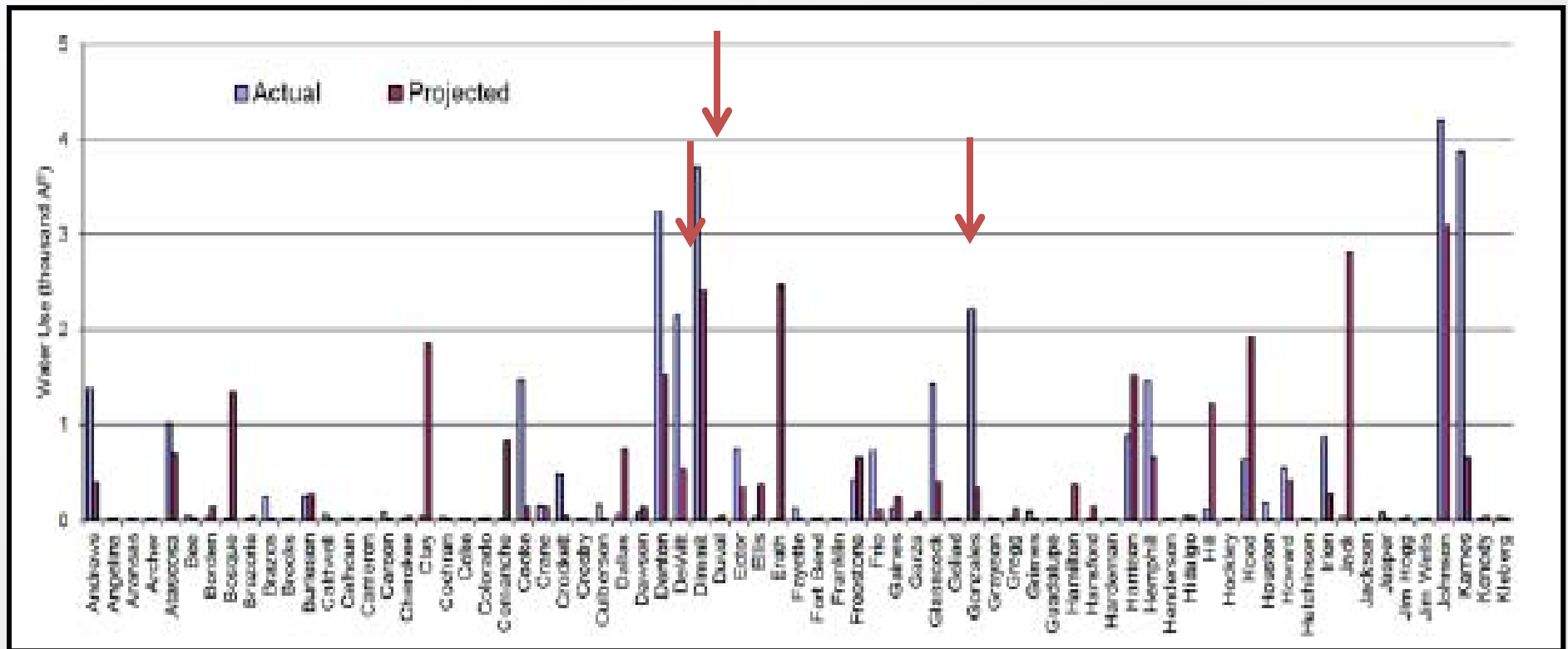
# Project Overview

- Objectives of Study:
  - Assess localized water use impacts from Eagle Ford shale play
  - Utilize a Systems Dynamics approach
    - Input from different stakeholders
    - Output: policy recommendations
- Accessing data only made publicly available
  - FracFocus
- Timeline of Study
  - Approximately 5 months

## Federal vs. State vs. more localized

- Federal Level
  - Different shale plays have different attributes that are not uniform across the nation
- State Level Water Usage (TWDB State Water Plan, 2012)
  - Mining (includes O&G development) uses approximately 1.6% of the water used in the state
  - Use from mining expected to decrease by 2060
  - Shale play development significantly different in each region of Texas
- Local Level

# Water Use Difficult to Track



# State of the Eagle Ford Area: GROWTH

- Tremendous growth since 2008
- Texas experiencing drought conditions through this extreme growth period

<u>OIL PRODUCTION</u>			<u>GAS PRODUCTION</u>		
Eagle Ford Shale - Annual Growth			Eagle Ford Shale - Annual Growth		
	B/D	Growth		MMCF/D	Growth
2008	358		2008	8	
2009	844	136%	2009	47	487%
2010	11,986	1,320%	2010	216	360%
2011	126,459	955%	2011	959	344%
2012	338,911	168%	2012	964	0.5%

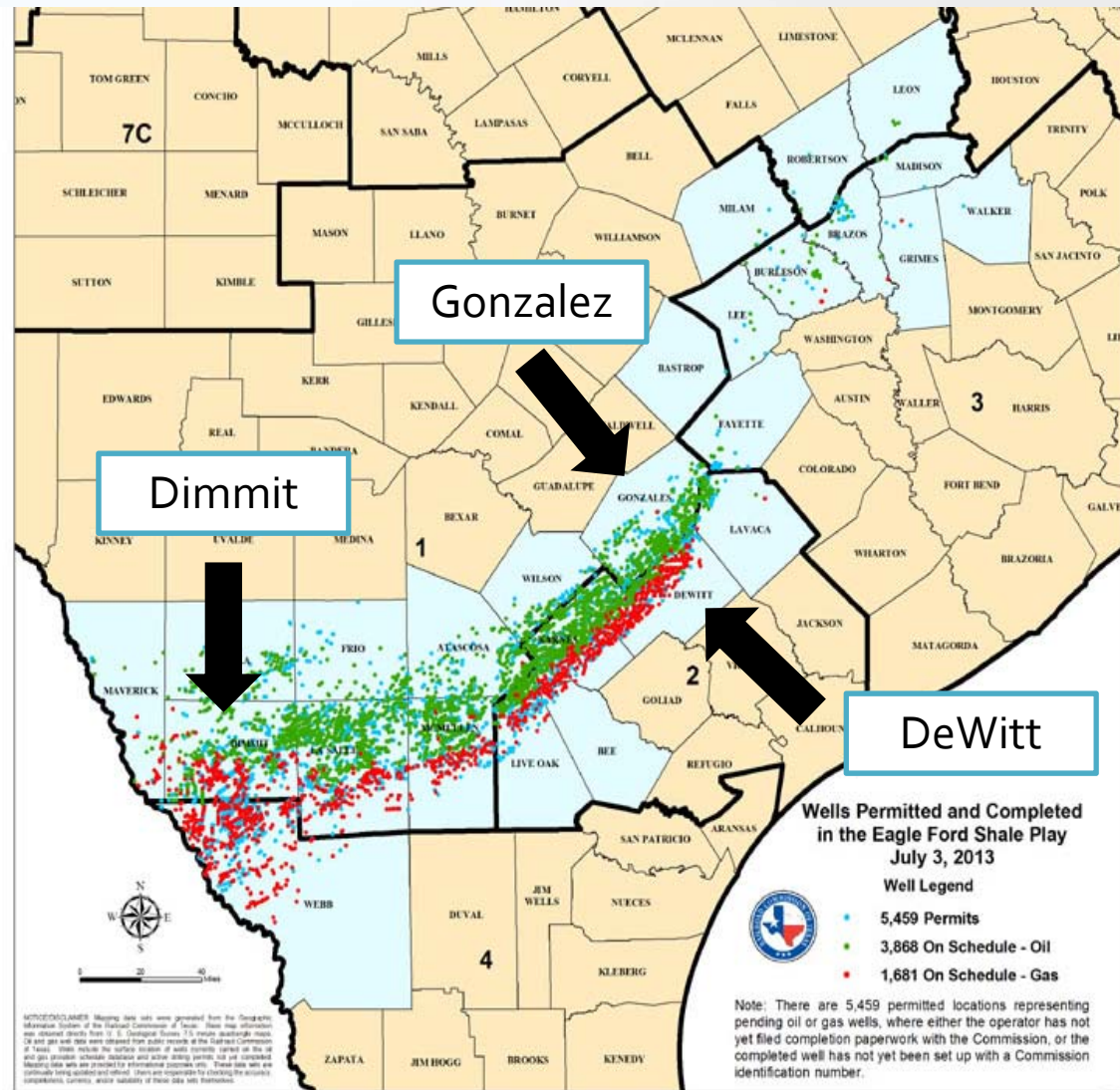
<u>CONDENSATE PRODUCTION</u>			<u>DRILLING PERMITS</u>		
Eagle Ford Shale - Annual Growth			Eagle Ford Shale - Annual Growth		
	B/D	Growth		Permits	Growth
2009	1,423		2008	26	
2010	13,708	863%	2009	94	261%
2011	70,934	417%	2010	1,010	974%
2012	72,126	1.6%	2011	2,826	180%
			2012	4,145	46%

<u>PRODUCING OIL WELLS</u>			<u>PRODUCING GAS WELLS</u>		
Eagle Ford Shale - Annual Growth			Eagle Ford Shale - Annual Growth		
	Wells	Growth		Wells	Growth
2009	40		2008	67	
2010	72	80%	2009	158	136%
2011	368	411%	2010	550	248%
2012	1,262	243%	2011	855	55%

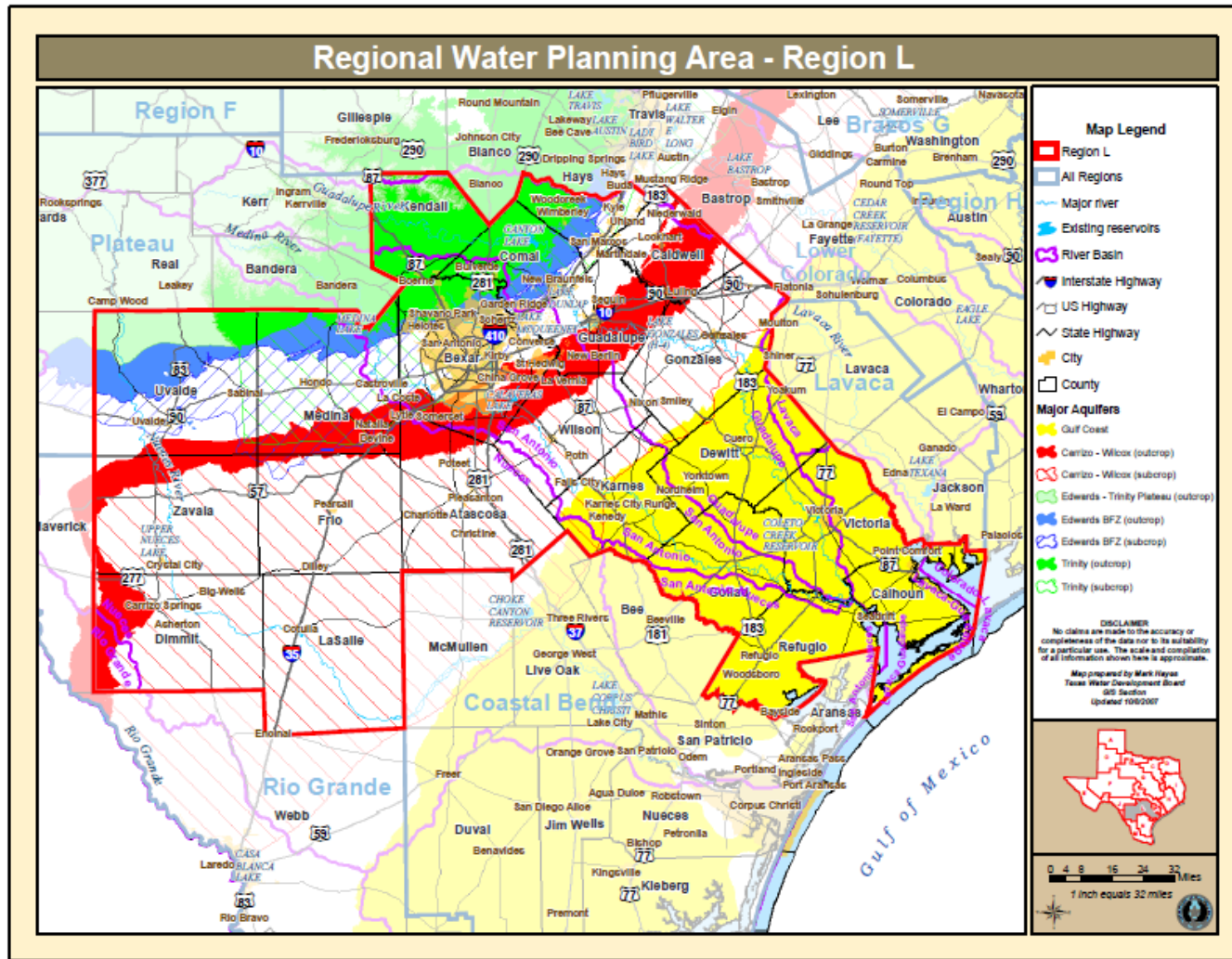
Eagle Ford Task Force Report, 2013

# Wells and County Locations



RRC, (2013)

# Region L



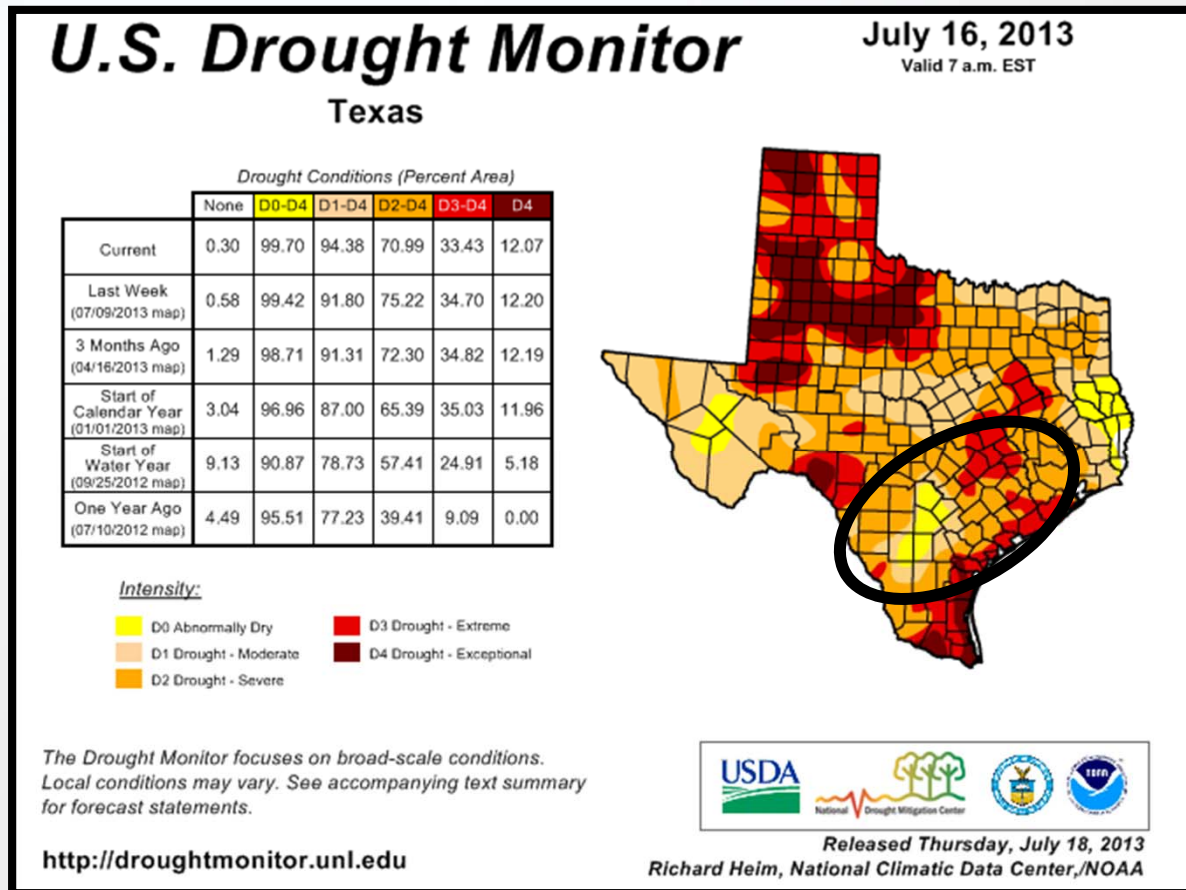
Map updated by Mark Hayes, Texas Water Development Board, Planning Division, GIS Section (10/07) L:\projects\RIO\ITS\carhuleta\Maps\_ArcGIS\MXD\Regional Water Planning Area Maps

# Water Use in Select Counties

<b>De Witt County</b>	<b>2010</b>		<b>2011</b>		<b>Growth</b>
Municipal	998,407,464	59.38%	1,328,494,527	42.04%	↓ -17.34%
Manufacturing	59,956,584	3.57%	78,855,942	2.50%	→ -1.07%
Mining	20,854,464	1.24%	709,377,627	22.45%	↑ <b>21.21%</b>
Livestock	550,362,339	32.73%	847,212,600	26.81%	→ -5.92%
Irrigation	51,810,309	3.08%	195,836,451	6.20%	→ 3.12%
<i>De Witt County Total</i>	<i>1,681,391,160</i>		<i>3,159,777,147</i>		
<b>Dimmit County</b>					
Municipal	834,504,411	17.39%	782,042,400	19.68%	→ 2.29%
Mining	326,828,553	6.81%	1,208,255,508	30.41%	↑ <b>23.60%</b>
Livestock	179,869,752	3.75%	151,520,715	3.81%	→ 0.06%
Irrigation	3,457,604,961	72.05%	1,831,934,322	46.10%	↓ -25.95%
<i>Dimmit County Total</i>	<i>4,798,807,677</i>		<i>3,973,752,945</i>		
<b>Gonzales County</b>					
Municipal	1,338,595,908	30.90%	1,574,837,883	23.66%	→ -7.25%
Manufacturing	782,042,400	18.05%	691,781,673	10.39%	→ -7.66%
Mining	9,123,828	0.21%	732,187,197	11.00%	↑ <b>10.79%</b>
Livestock	1,776,865,503	41.02%	1,438,306,314	21.61%	↓ -19.42%
Irrigation	424,909,704	9.81%	2,219,697,012	33.34%	↑ 23.54%
<i>Gonzales County Total</i>	<i>4,331,537,343</i>		<i>6,656,810,079</i>		
(Source: TWDB, 2013)					

# Region L: Water Stresses

- Drought
- Unmet irrigation needs
- Increasing needs for more water through 2060 projections
- Increasing population
- County Level Water Usage
  - Reliance on GMA's & GCD's to implement some regulation on GW usage in region
    - Evergreen GCD
    - Wintergarden GCD





# Major Studies Recap

- **Eagle Ford Task Force Report (RRC, 2013)**

- Trend to gel fracs
- 850 gallons of water/ft of fracture
- ~ 5 million gallons of water/well
- Carrizo-Wilcox Aquifer = 80% of EF
  - Likely able to handle load
- “Water Market” created in EF
- Produced water - future source

- **UT study (Nicot, 2012)**

- Data set for EF less certain
- ~ 90% of water initially injected in EF is GW
- ~ 20% brackish water
- ~ 0% recycling/reuse water
- Future trend: Freshwater use decrease; Brackish water use increase

- **Ceres Study (Freyman, 2013)**

- 51% of TX wells = high water stress areas

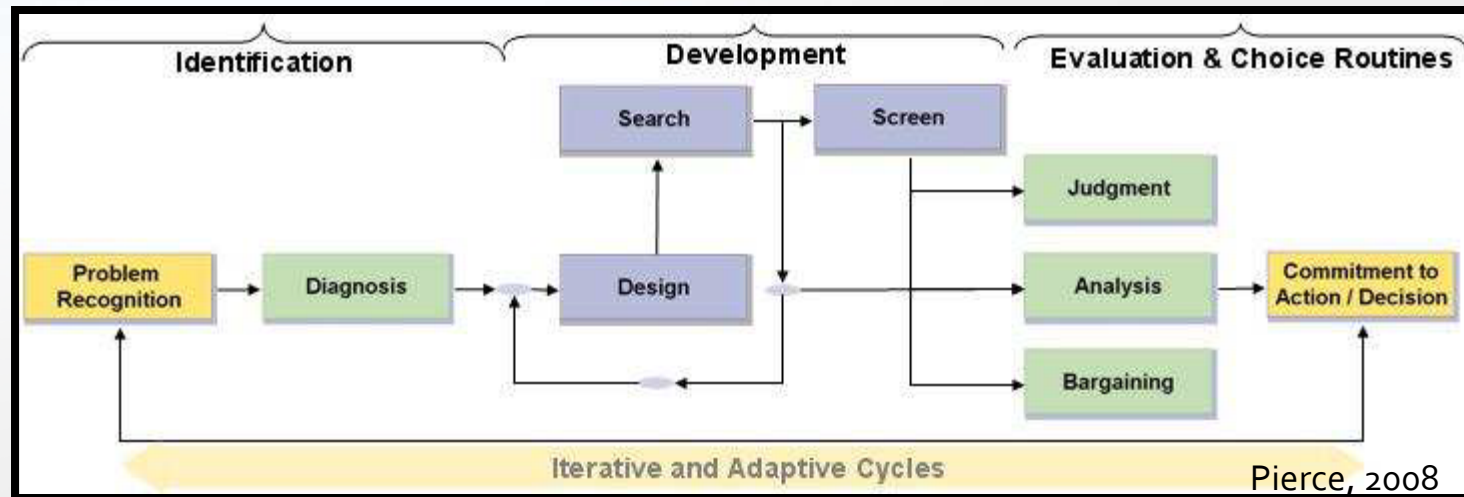
- **Texas House Natural Resources Committee Interim Report (2013)**

- Projected O&G water demand in EF ~ 5.5 – 6.7% of total water demand in that region
- ~ 1500 wells drilled using ~6.1 million gal/well
- Over next 20 yrs. ~25,000 new wells will be drilled in EF
- Difficult to predict and manage GW availability
- Wintergarden GCD – impact to water supply should be assessed by local scale
  - 1/3 of avg. annual recharge in Carrizo-Wilcox Aquifer required to develop EF
  - Recharge rates slower than pumping rates in historical past of aquifer

# Major Assumptions for this Study

- Most water use quantities reported on FracFocus are for entire life cycle of well
  - Hydraulic fracturing makes a large component of that amount
- Water is consumed, not just withdrawn
- Most wells in region are horizontal, not vertical

# Methods: Systems Dynamics Approach



## Stakeholder Input:

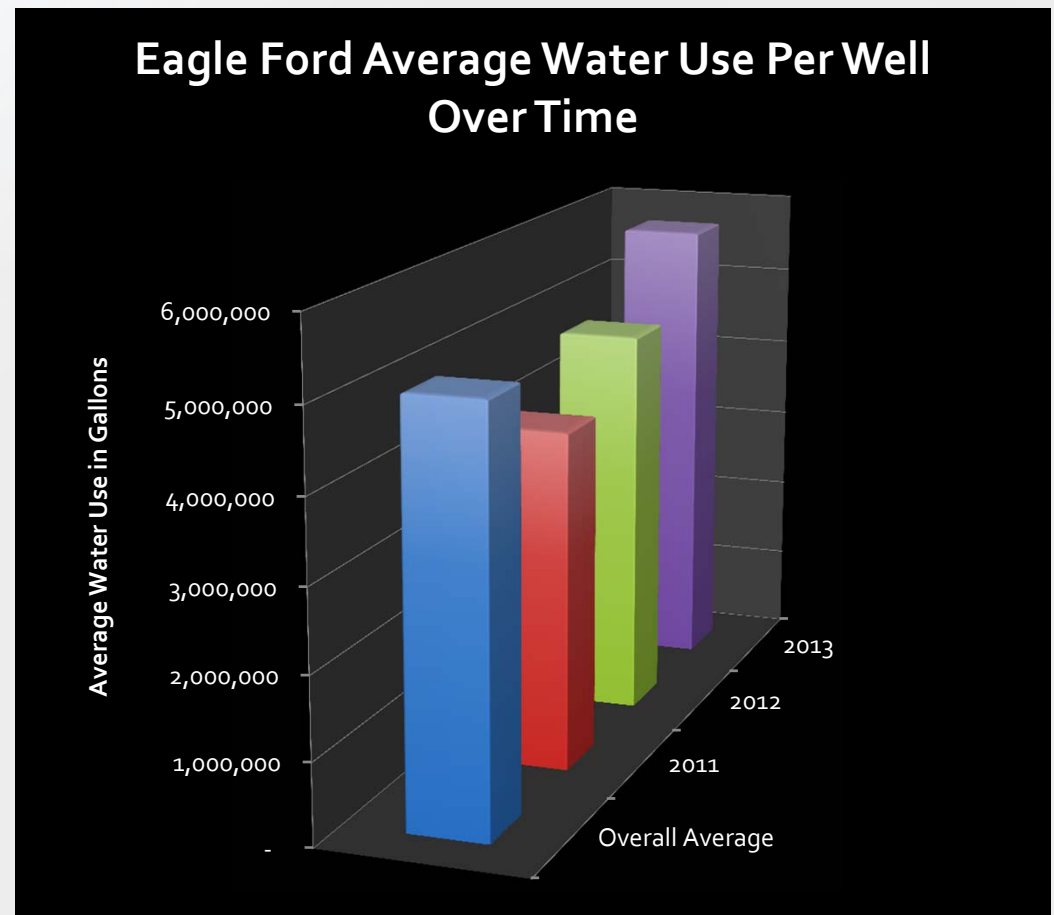
- Oil and Gas Industry
- Policymakers and advisors (both state and federal)
- Local and other public representatives
- Water users, planners, and regulators
- Academia
- Environmental Entities
- Landowners

## Methods: Trends

- “Trend” method – 5% off the top and the bottom of the data to create an average without outliers
- FracFocus
  - DeWitt, Dimmit, and Gonzales county analyses
- SkyTruth
  - 27 county analysis of average water trends for Eagle Ford
- Sky Truth vs. FracFocus
  - Difference between these two on a large scale not significant when assessing just average water use trends from the FracFocus header data
  - *Note: More in-depth analysis will be needed to if assessing beyond average trends*

# Eagle Ford Region Findings

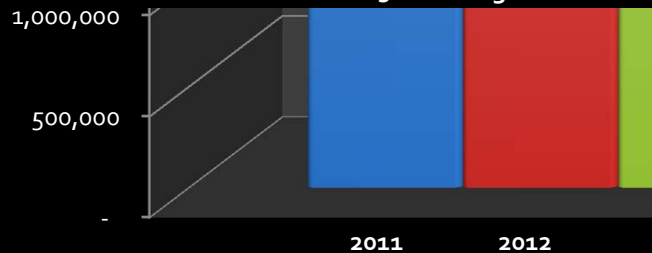
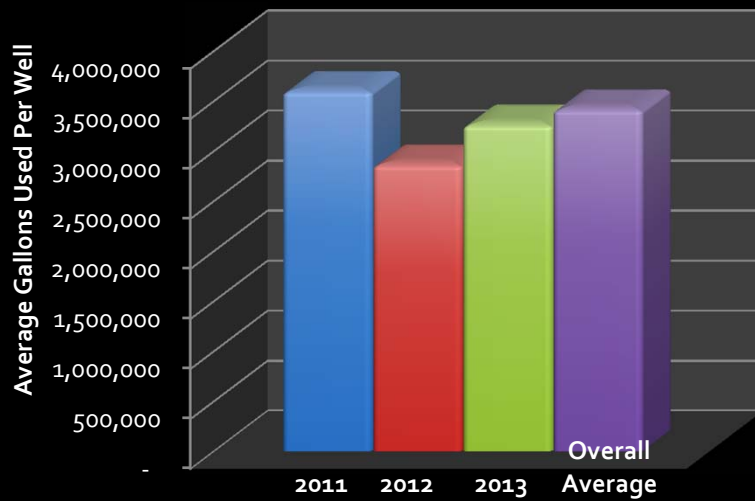
- Approximately 5 million gallons of water used per a well in region
- Although increasing average trend of water use can be seen, this is most likely due to large growth in region
- Major companies in region have variable average water use trends



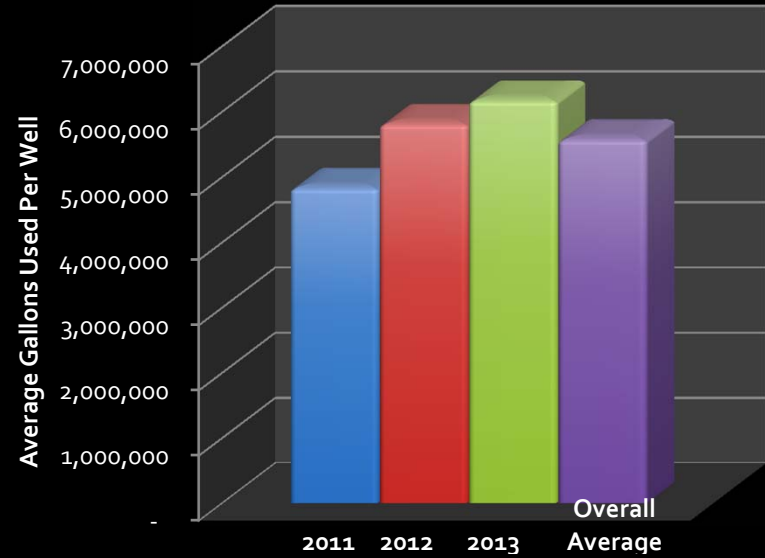
# County Findings

## De Witt County Per Well

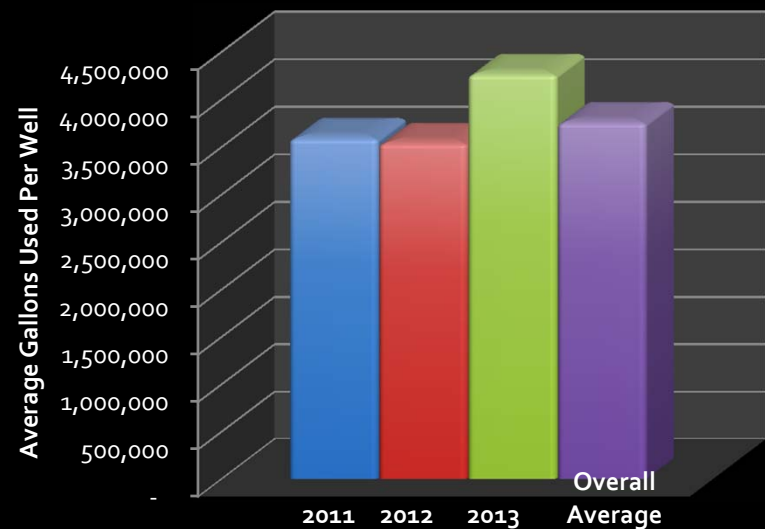
### De Witt County Per Well Averages



## Dimmit County Per Well Averages



## Gonzales County Per Well Averages



# Challenges to Research

- Talking to industry – variable input
- Collaboration
- Accessing information
  - Quality control of data & data validation
- FracFocus database:
  - Prior to June 2013, database validity checks not as strong as current version implements
  - Voluntary input in 2011, 2012, and part of 2013 within Texas
- Data consistency lacking due to structural database changes, voluntary submission, and ease of database maneuverability to gather research in a timely manner

# Visible Trends & Other Considerations

- Most operators source the water themselves (not the service companies)
  - Usually means groundwater wells
- Disconnect between what water planners are planning for and actual mining use
  - Need to further assess
- A relatively slow industry trend towards brackish water use in area
  - Brackish water use highly variable by company
- Other things to consider in further analysis:
  - Population growth from EF eco. development
  - Changing water use demands of O&G because of recycling/reuse, market fluxes, and other factors (scenarios)
  - Other water stresses and competition (i.e. irrigation in region and GW recharge )



# Policy Recommendations

- Promote tracking of sources of water used for O&G operations
- Promote transparency and ease of access to information
- Promote water plans that:
  - Account for O&G operations during drought planning, especially for water stressed localities
  - Considered scenarios of changes of water demand by O&G industry over projection time periods
  - Although mining is a small portion on a large scale, localized affects should be assessed in water stressed regions
- Promote O&G industry to have effective water management plans for every well site
  - Plans that include an assessment of water use in that area
- Promote policymakers and regulators to have more inclusive definitions in regulations and laws

# Questions?

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# Texas Overview

- State & Local Regulators:
  - Texas Railroad Commission
  - Texas Commission on Environmental Quality
  - Groundwater Management Areas
  - Groundwater Conservation Districts
- Recent regulations:
  - RRC: Hydraulic Fracturing Disclosure Rule - O&G required to submit to [Fracfocus.org](http://Fracfocus.org) (since Feb. 2013)
  - RRC: Amendment to recycling/reuse rules to make these technologies easier to utilize