

An aerial photograph of a wide, winding river flowing through a valley. The river is a deep blue color, contrasting with the brownish-green fields and sparse trees on either bank. In the distance, a range of mountains with patches of snow is visible under a clear blue sky. The overall scene is a vast, open landscape.

Gas/Condensate Well Drilling, Completion & Production Equipment

November 5, 2013 WDEQ-AQD/WRAP Presentation

Pinedale Anticline

Brian R Bohlmann, P.E.

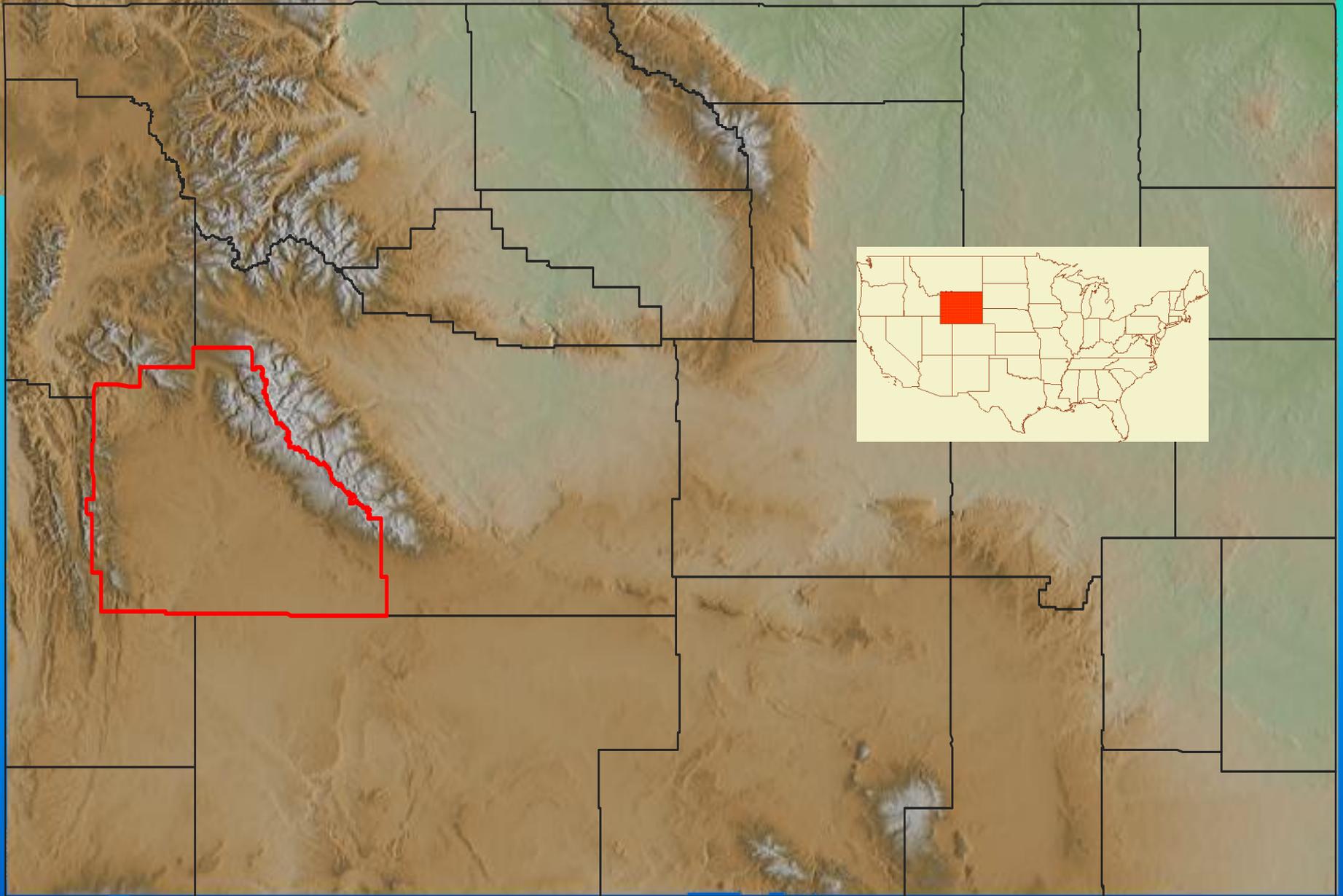
Emissions Inventory Supervisor

WY Department of Environmental Quality

Air Quality Division

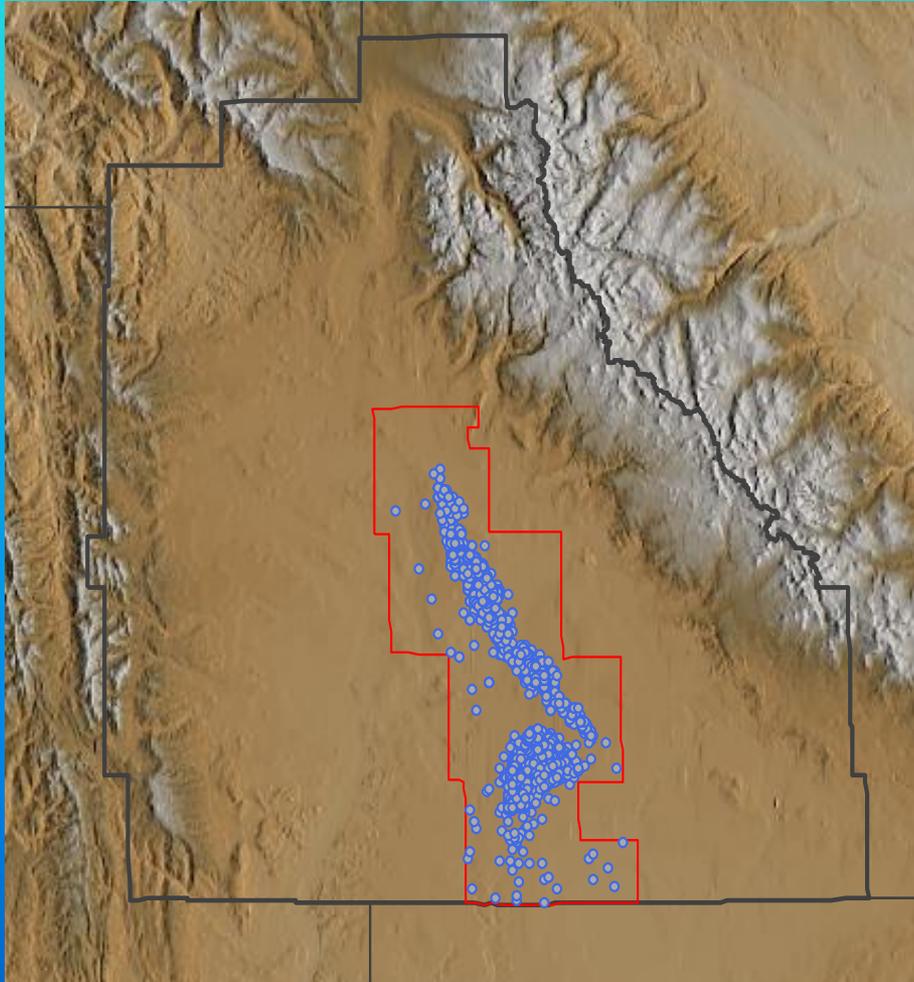
Photos Taken September 17, 2008

Oil and Gas Development



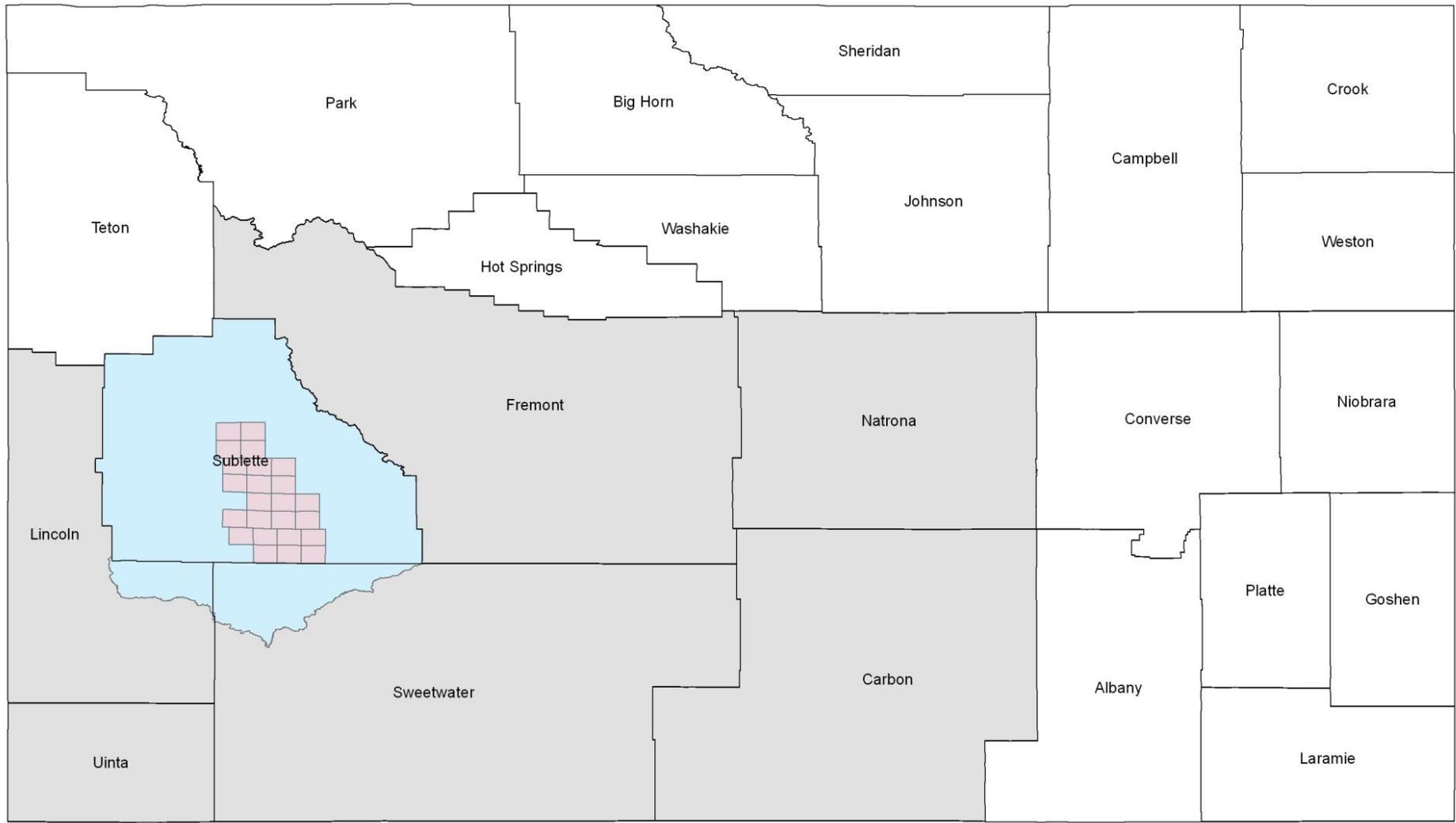
Oil and Gas Development

July, 2012



- Jonah Field and Pinedale Anticline Development (JPAD)

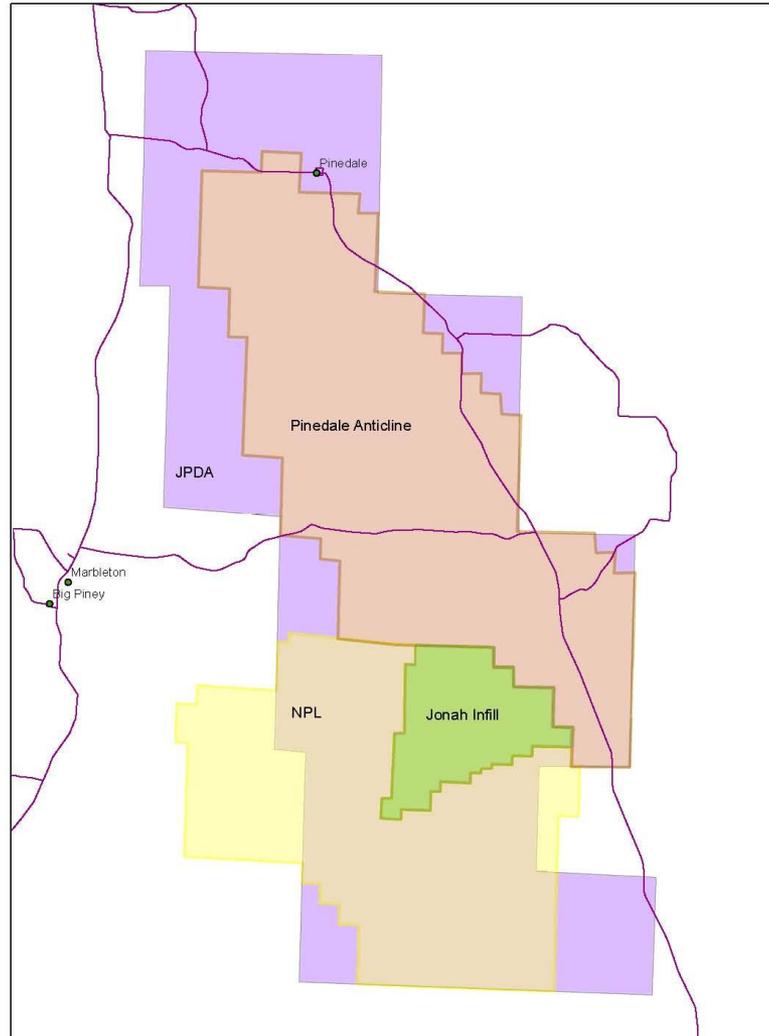
September, 2013 Permitting Guidance Update



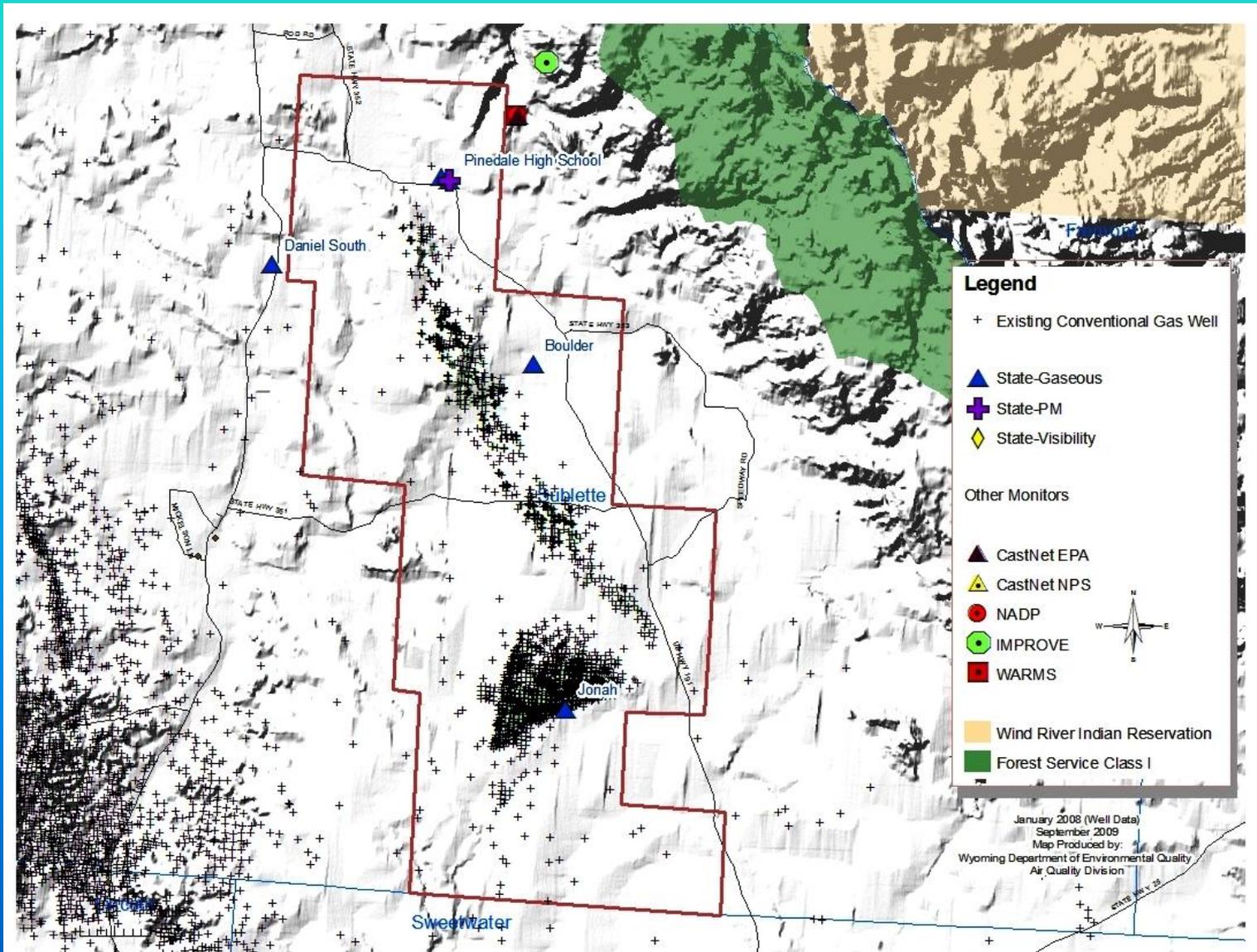
Legend



Jonah-Pinedale Anticline Development (JPAD) & Normally Pressured Lance (NPL) Area



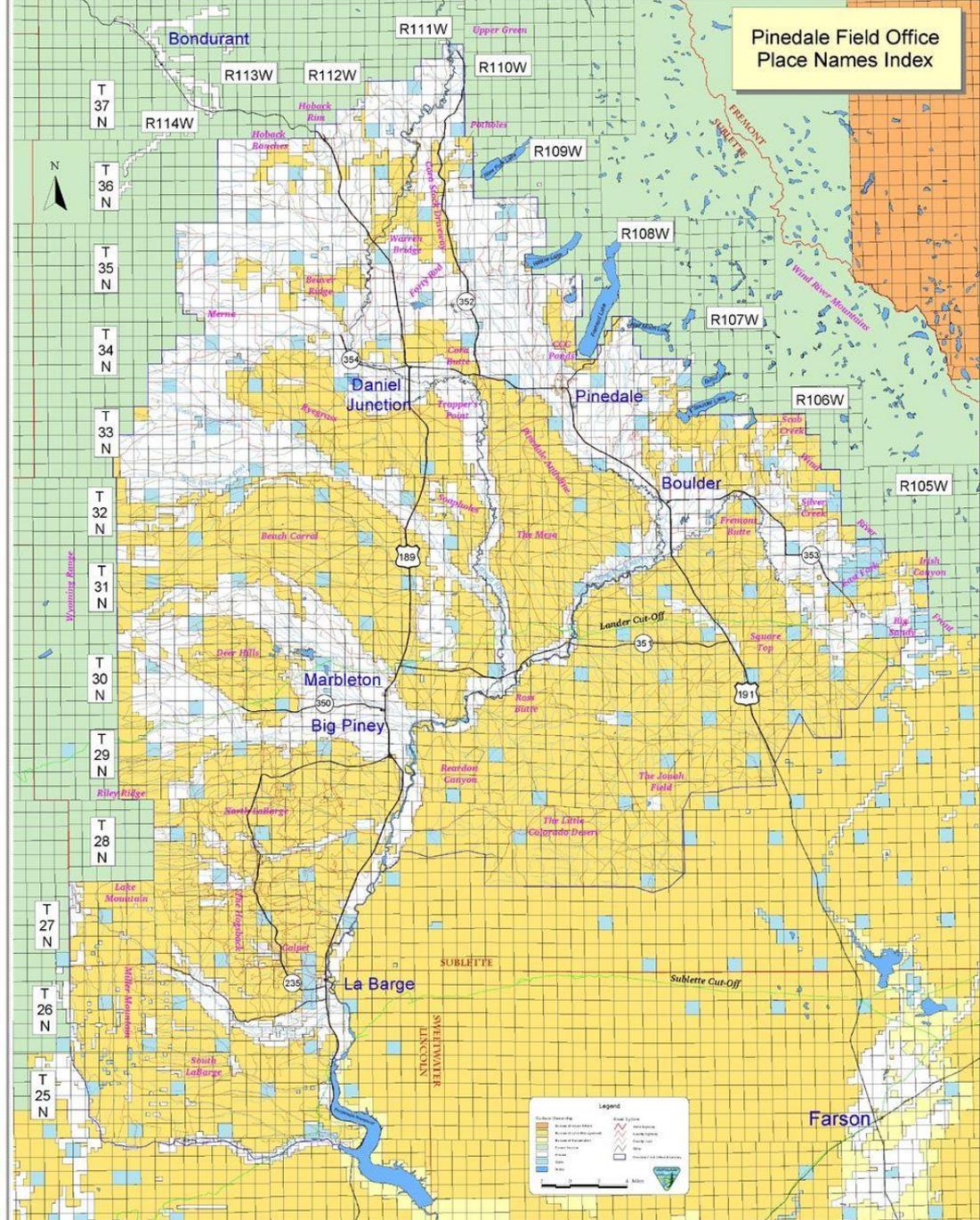
Jonah-Pinedale Anticline Development (JPAD) Area 2008 Well/Monitor Locations



Pinedale Anticline Development

- Pinedale Anticline Project Area (PAPA) Record of Decision (ROD) issued July 27, 2000
 - 700 wells mainly Federal minerals
- PAPA Supplemental Environmental Impact Statement (SEIS) ROD issued September 12, 2008
 - 4,400 wells on 600 pads and a liquids gathering system
 - average 7.3 wells per pad
 - 40 acre down-hole well spacing

**Pinedale Field Office
Place Names Index**



T 37 N
T 36 N
T 35 N
T 34 N
T 33 N
T 32 N
T 31 N
T 30 N
T 29 N
T 28 N
T 27 N
T 26 N
T 25 N

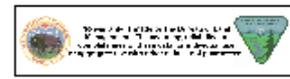
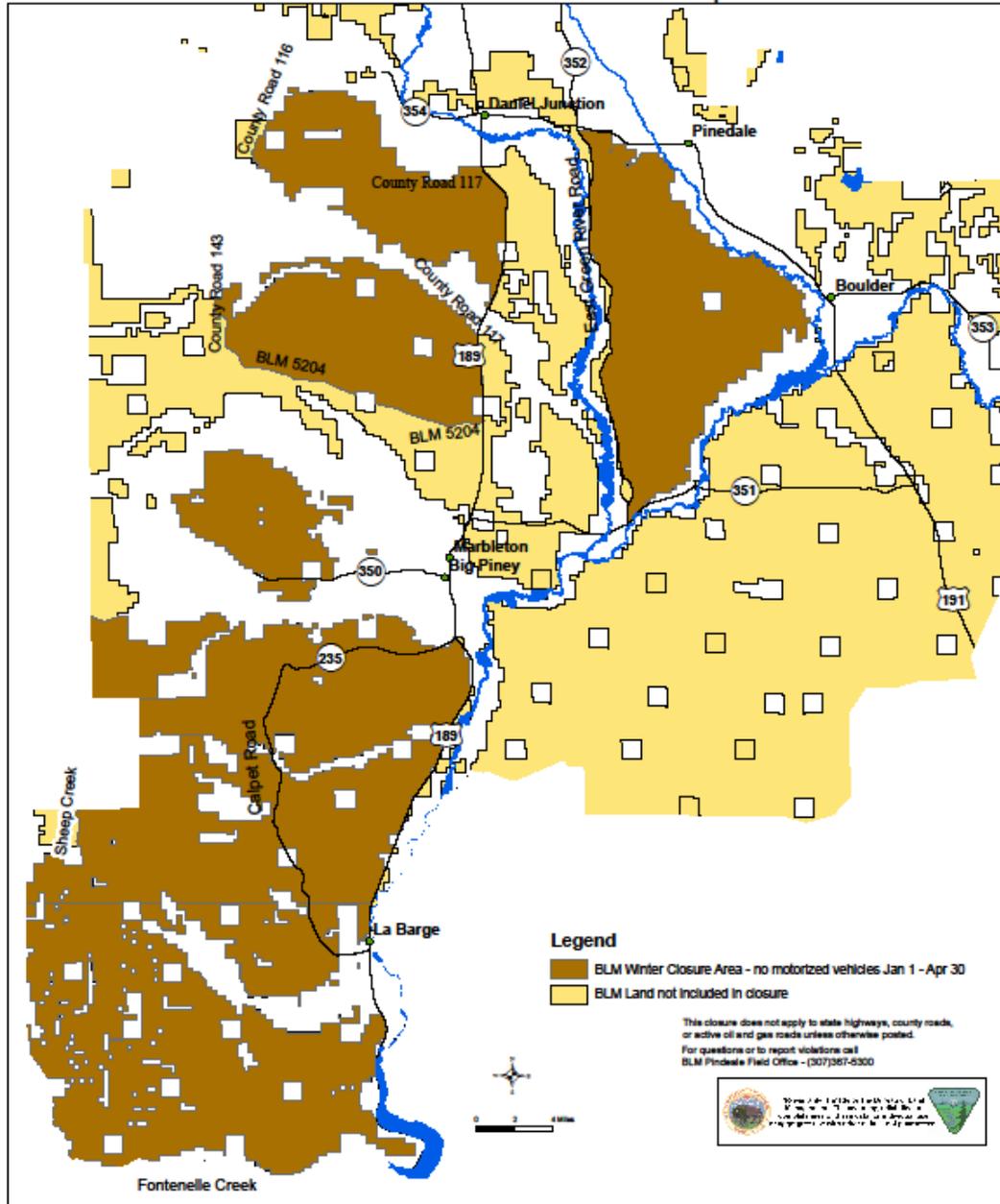
R 114 W
R 113 W
R 112 W
R 111 W
R 110 W
R 109 W
R 108 W
R 107 W
R 106 W
R 105 W

Legend

	Interstate Highway
	State Highway
	County Road
	Road
	Water
	Contour
	Spot Elevation
	Boundary
	Unimproved Road



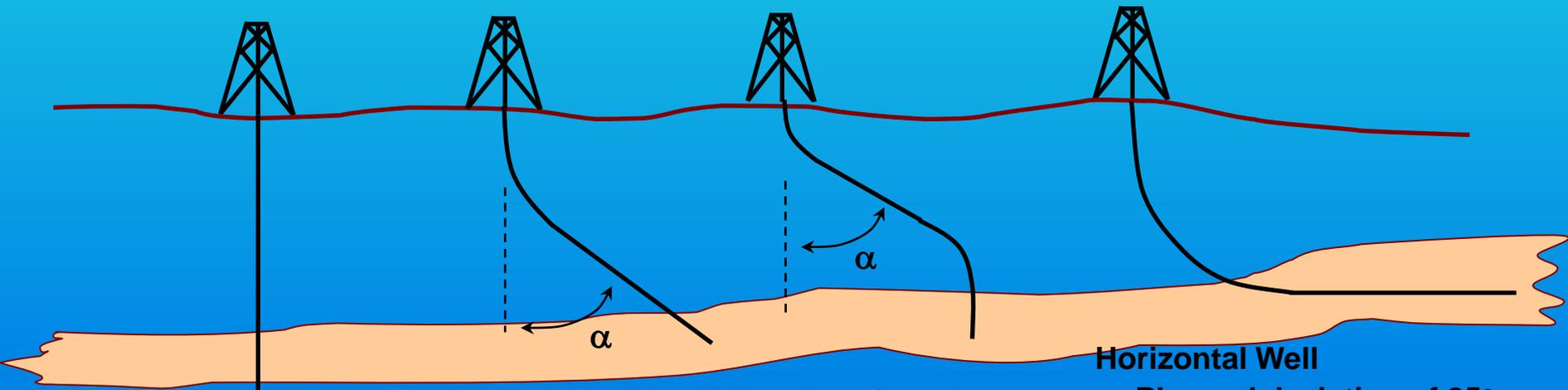
Big Game Winter Closure Pinedale BLM Field Office Closed to Motorized Vehicles Jan 1 - Apr 30



Directional Drilling

At the basic level:

- A deviated (or directional) well is a well that has been intentionally deviated from vertical. The deviation (or inclination) is measured from the vertical.
- A horizontal well is a deviated well with an inclination at or near 90°



Vertical Well

- Some unintentional deviation
- Typical inclination $< 3^\circ$

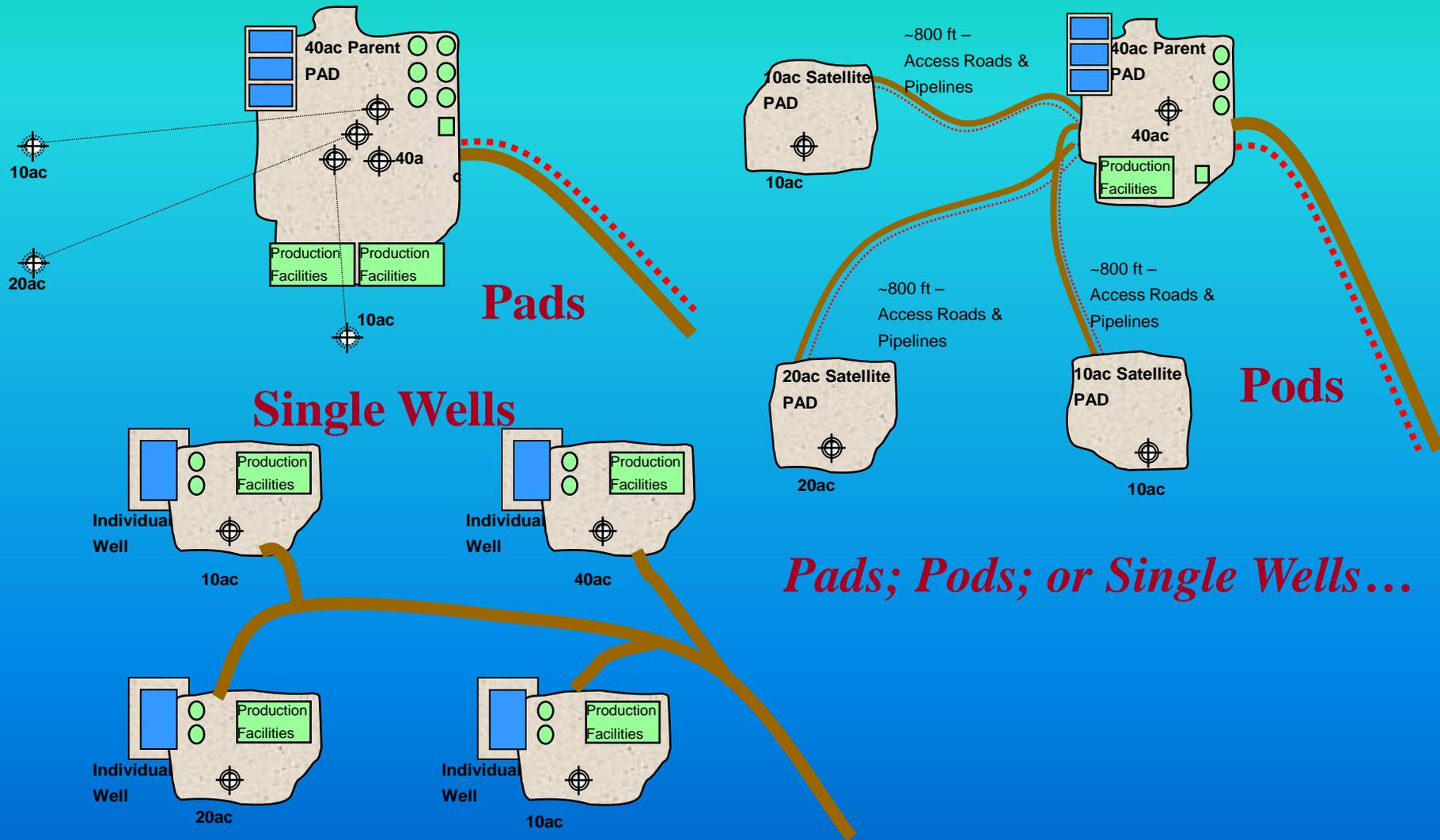
Deviated (directional) Well

- Planned deviation from vertical
- Planned direction (azimuth)
- Inclination up to 85°

Horizontal Well

- Planned deviation of $85^\circ - 95^\circ$
- Planned azimuth

Development Options



Construction of a new well pad

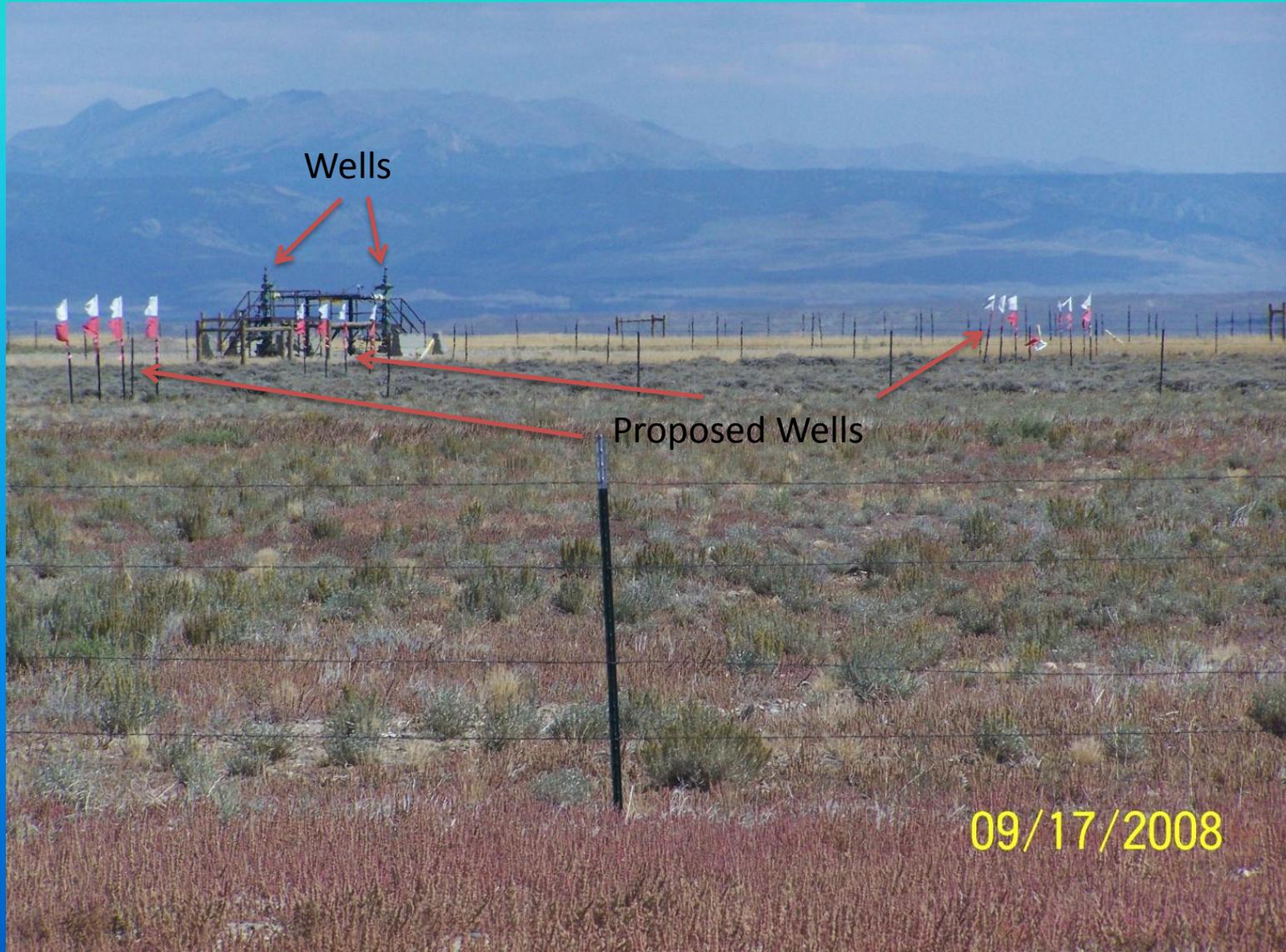


Construction of a new well pad

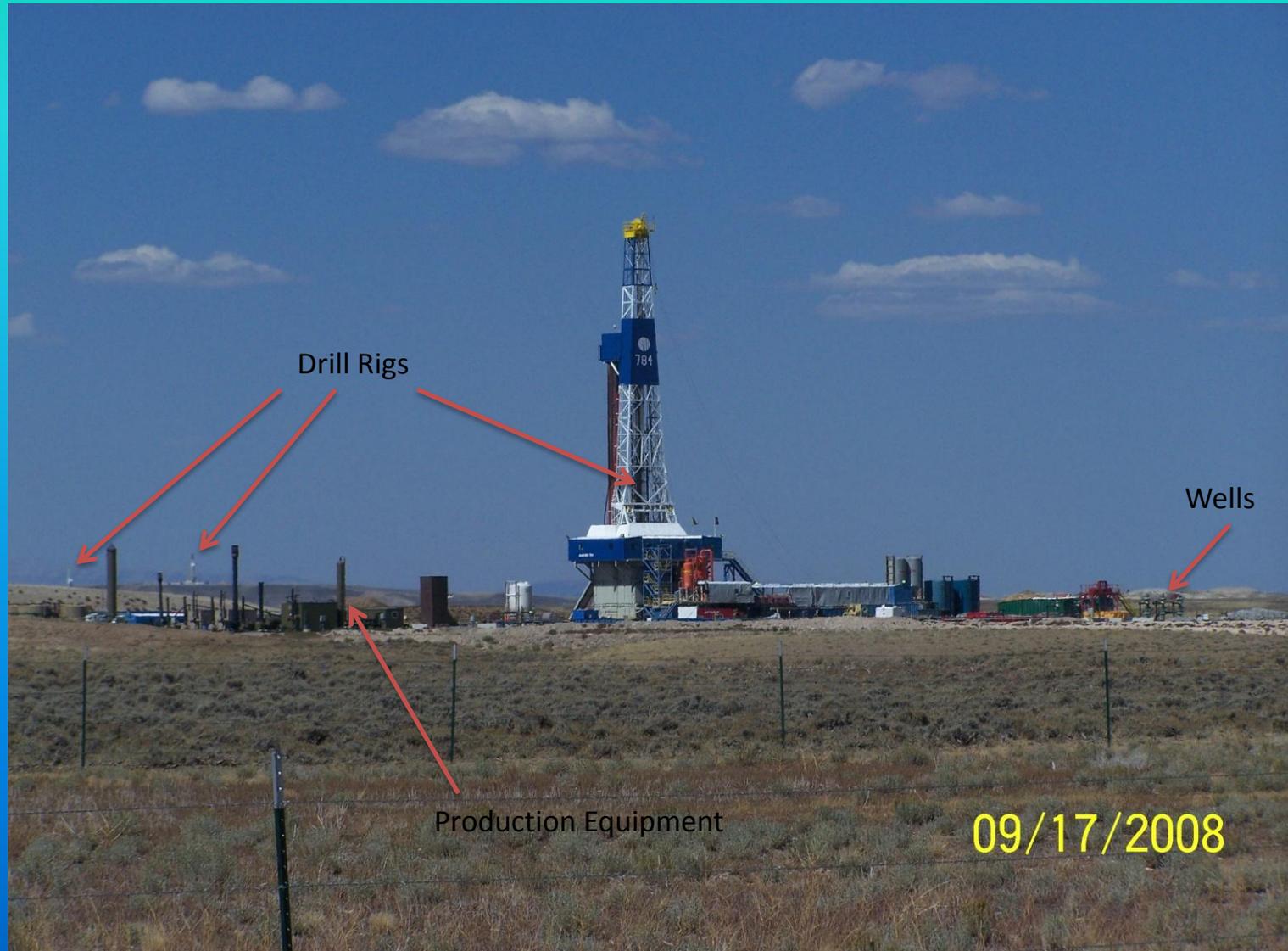


Proposed Well Locations

(Down-hole 40 acre well spacing in the Pinedale Anticline)



Shell's Nabors 784 Drill Rig



Drill Rigs

Wells

Production Equipment

09/17/2008

Shell's Nabors 784 Drill Rig

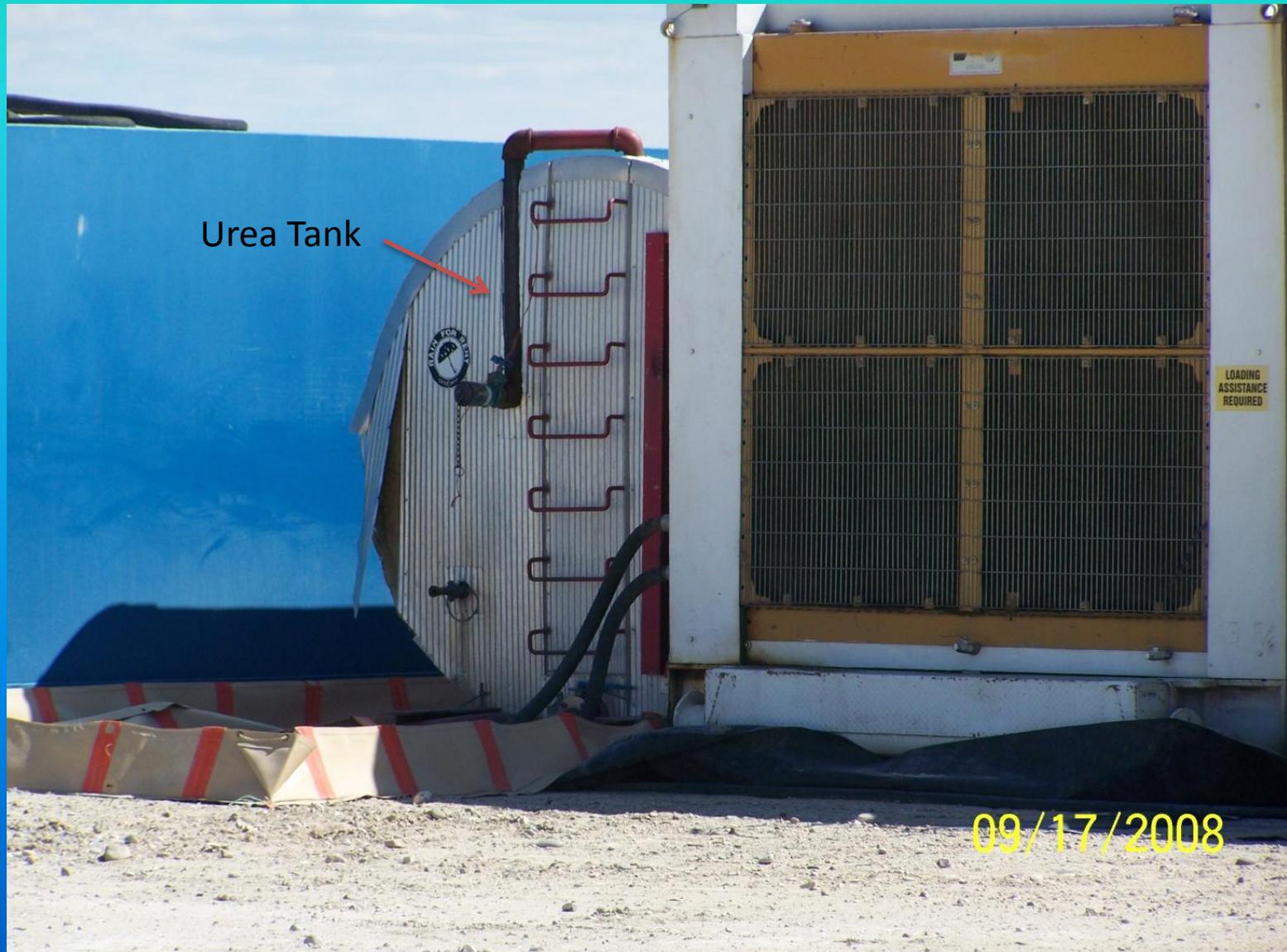


Cat 3512 (~1500 HP each) Diesel Generator Stacks w/SCR

Note: Typically all 3 generators operate only during the drilling of the first 2,500 feet of each well with 2 generators operating for the rest of the drilling.



Insulated Urea storage tank used w/SCR to control NOx emissions from the diesel generators.



Shed housing the Drill Mud Pumps



Drill Mud Tanks



Chemical Tanks



Drill Mud Return Pipe



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Drill Cuttings Solids/Liquids Separation



Drill Cuttings Shaker



Drill Cuttings



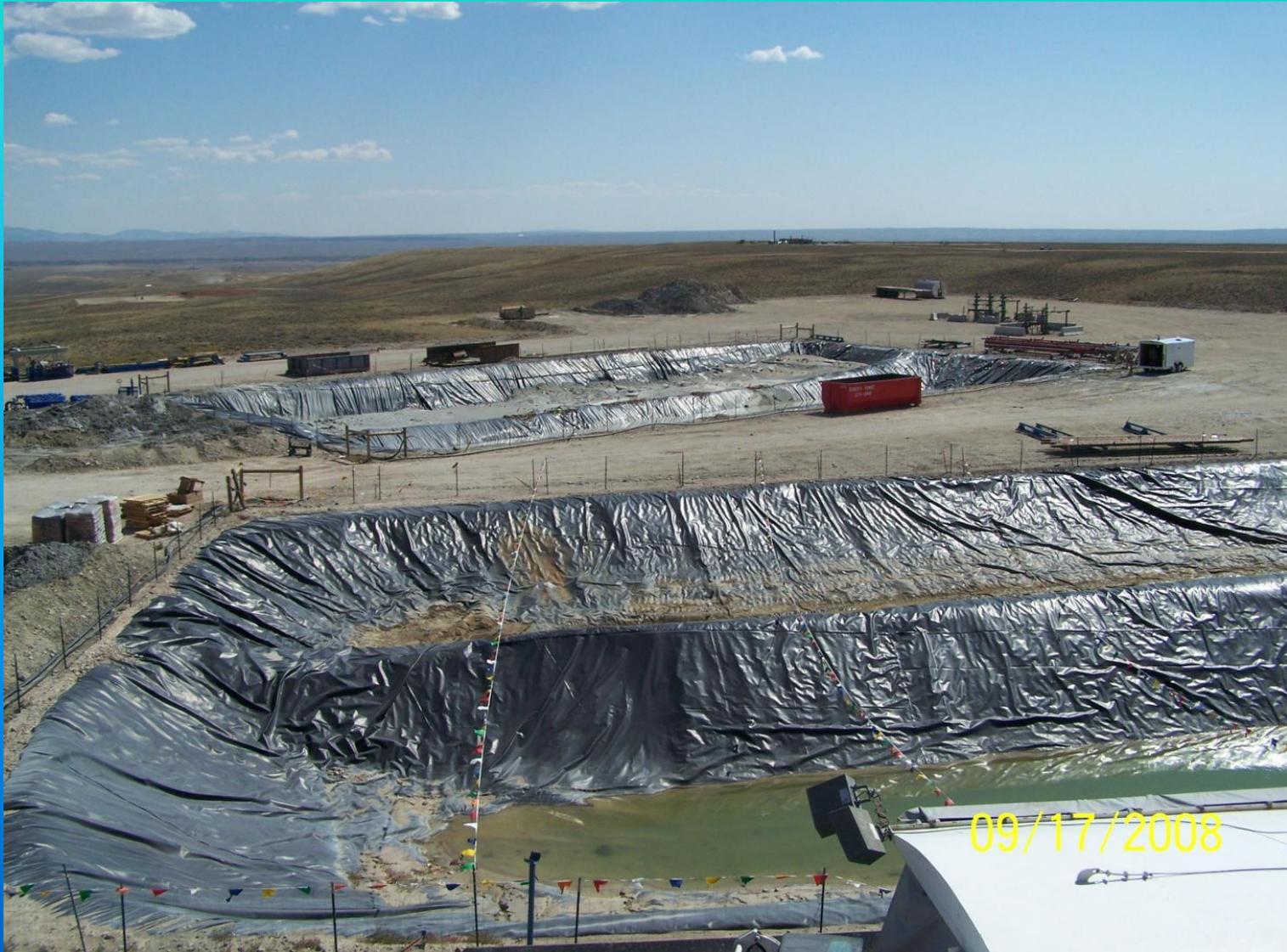
Drill Cuttings



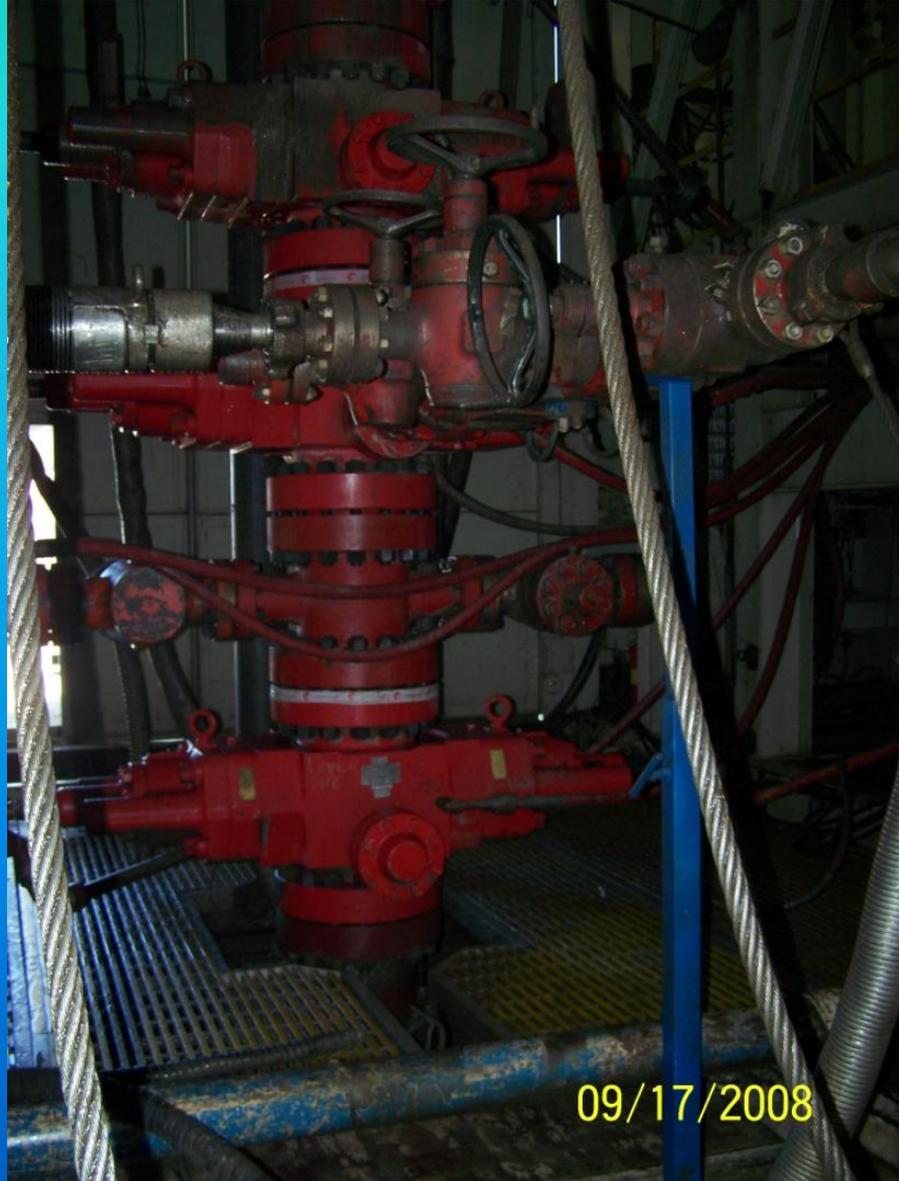
Drill Cuttings from different wells



Temporary Water Storage Ponds



Well Blow-Out Preventer



Drilling Flare Box w/Spark Ignition



Well Casing (45 foot lengths)



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Drill Rigs



Drill Rigs



09/17/2008

Drill Rigs



Warbonnet Area

09/17/2008

Portable 4-Phase Green Completion Equipment

(JPAD operators began using green completions in 2005)
{Green Completions required on all wells in the CDA as of 8/1/10}



Well Fracing Equipment



Well Fracing Equipment



Mesa 7-27 Well (Single Well Site)



Well Separator



Separator Heater

Separator Heater



Dehydrator Contact Tower

Glycol Pump

09/17/2008

Dehydrator Kimray Glycol Pump



Dehydrator Reboiler Heater



Line Heater for Heat Tracing



Pneumatic Pumps 09/17/2008

Controlled Pneumatic Glycol Heat Trace Pump



Dehydrator & Pneumatic Pump Control Device



Uncontrolled Condensate & Produced Water Storage Tanks



Condensate Tank Thief Hatch



Truck Loadout Hook-ups for Storage Tanks



09/17/2008

Facility Data Logger & Control Station



Gas Sales Custody Transfer Point



Multiple Well Facility



Dehydration Unit Contact Towers and Control Devices



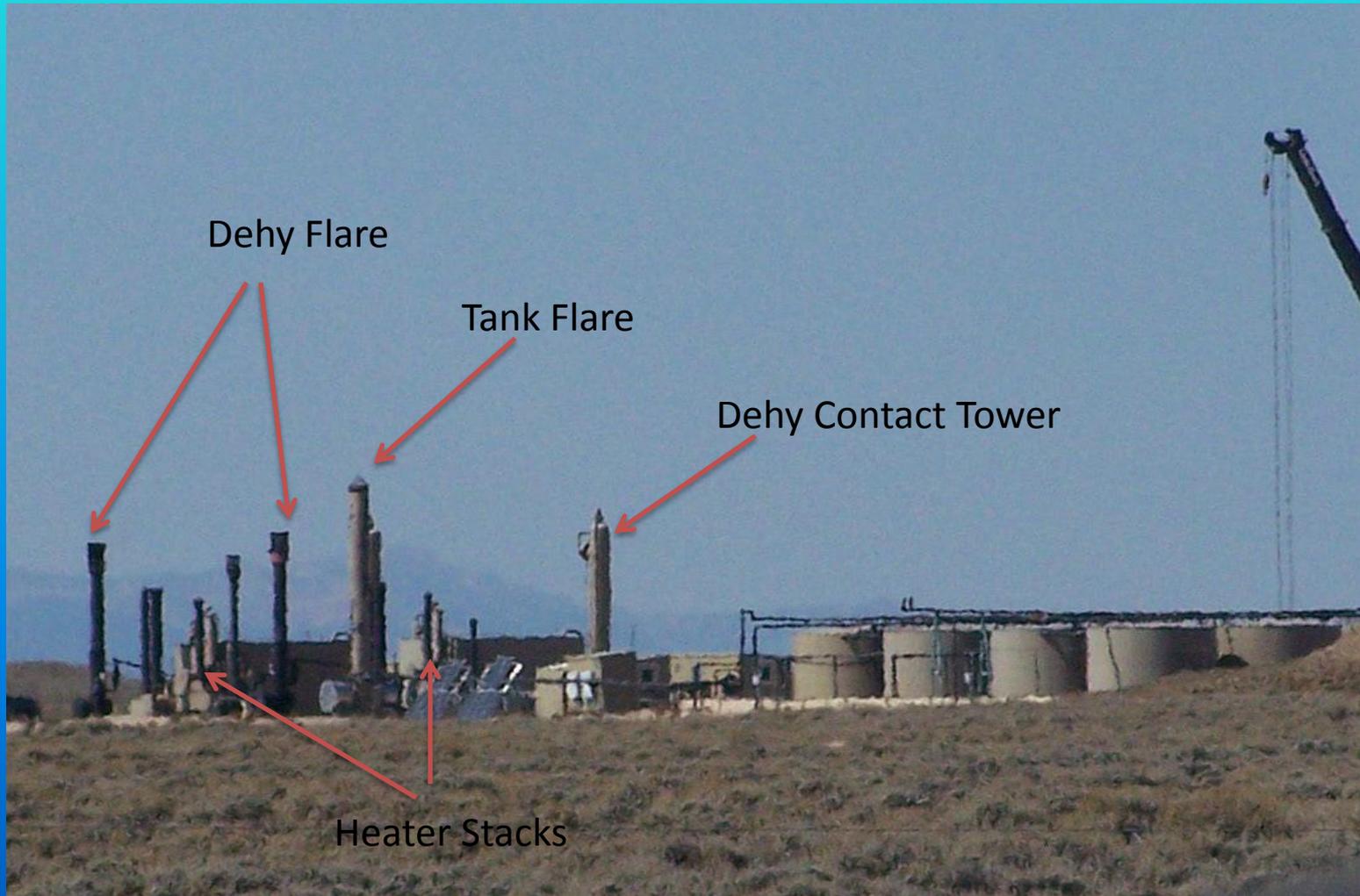
Dehydrator & Pneumatic Pump Control Device

Note: Storage tanks have a separate control device for VOCs



Multiple Well Facility

(As of July 28, 2004, for all multiple well or Pad facilities, all emissions from existing and new tanks and dehydration units must be controlled upon the first date of production.)



Line Heater w/3 Pneumatic Pumps



Pneumatic Pumps

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Controlled Pneumatic Glycol Heat Trace Pump



Solar Powered Control Station



Controlled Condensate & Produced Water Storage Tanks



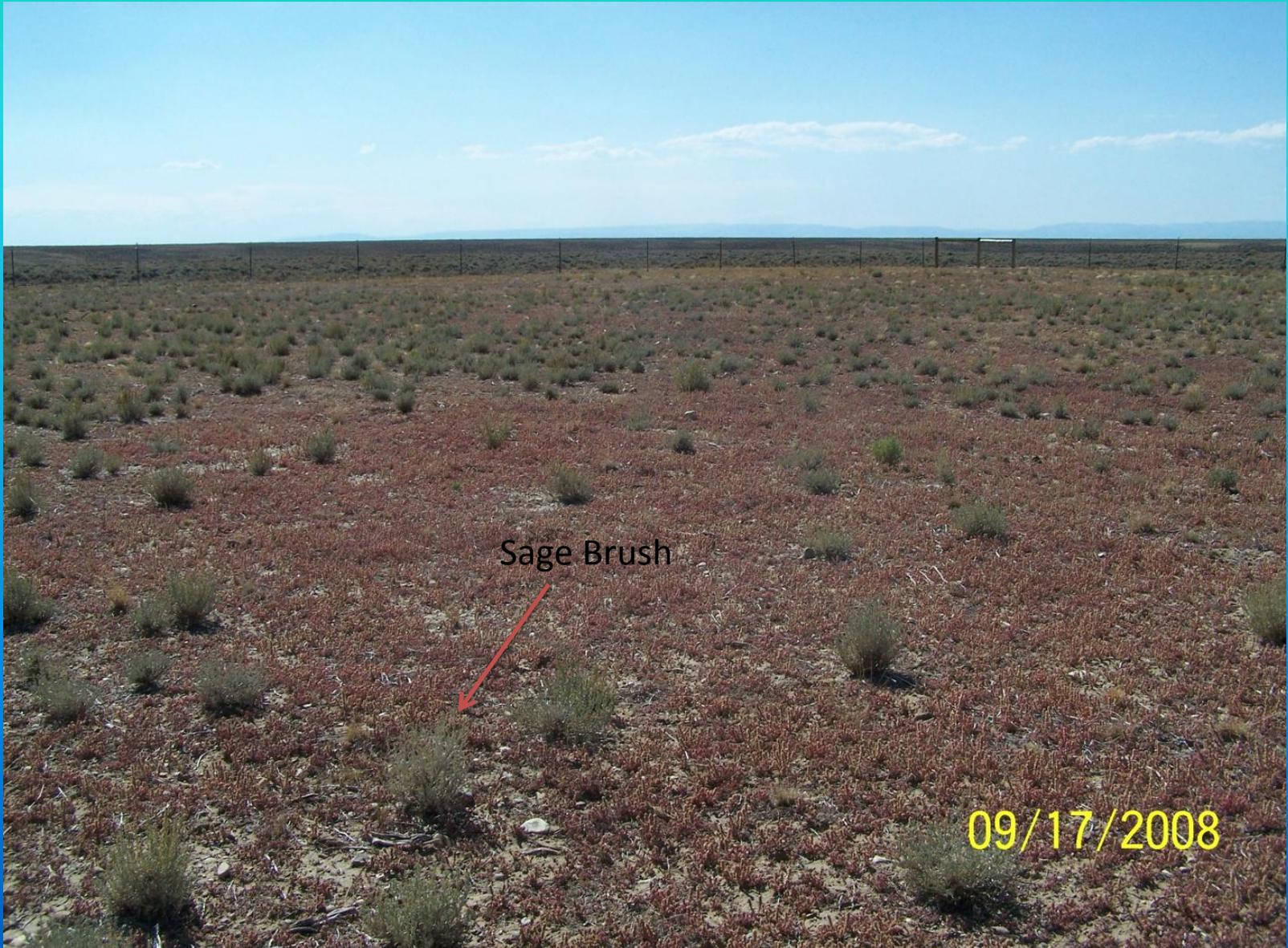
300 bbl storage tanks

09/17/2008

Methanol Tank



Reclaimed Well Pad



Reclaimed Well Pad



09/17/2008

Camouflaged Storage Tanks near the Lander Cut-Off Trail



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Questar Gas Management's (now QEPE) Liquids Gathering Facility

(processes nearly 160 million mcf of gas and 1.4 million bbls of condensate in 2012)



Enterprise Jonah Gas Gathering's Paradise Compressor Station

{consists of 8 Cat G3612LE (3,668 Hp), 2 Cat G3516LE (1,800 Hp), and 1 Cat G3408CLE (425 Hp) compressor engines: Total of **33,369 Hp** at one compressor station}



Anticline Water Disposal

Photo taken from the Boulder Monitoring Station Location
(Processed 5.9 million barrels of water and 41,236 bbls of condensate in 2012)



Shell's Warbonnet Water Handling Facility (Phase I) Temporary Storage Tanks



Shell's Warbonnet Water Handling Facility (Phase I) Truck Unloading Produced Water



09/17/2008

Shell's Warbonnet Water Handling Facility (Phase I) Storage Tanks



Shell's Warbonnet Water Handling Facility (Phase I) Temporary Generators for Electrical Needs



Construction of Shell's Liquid Gathering System



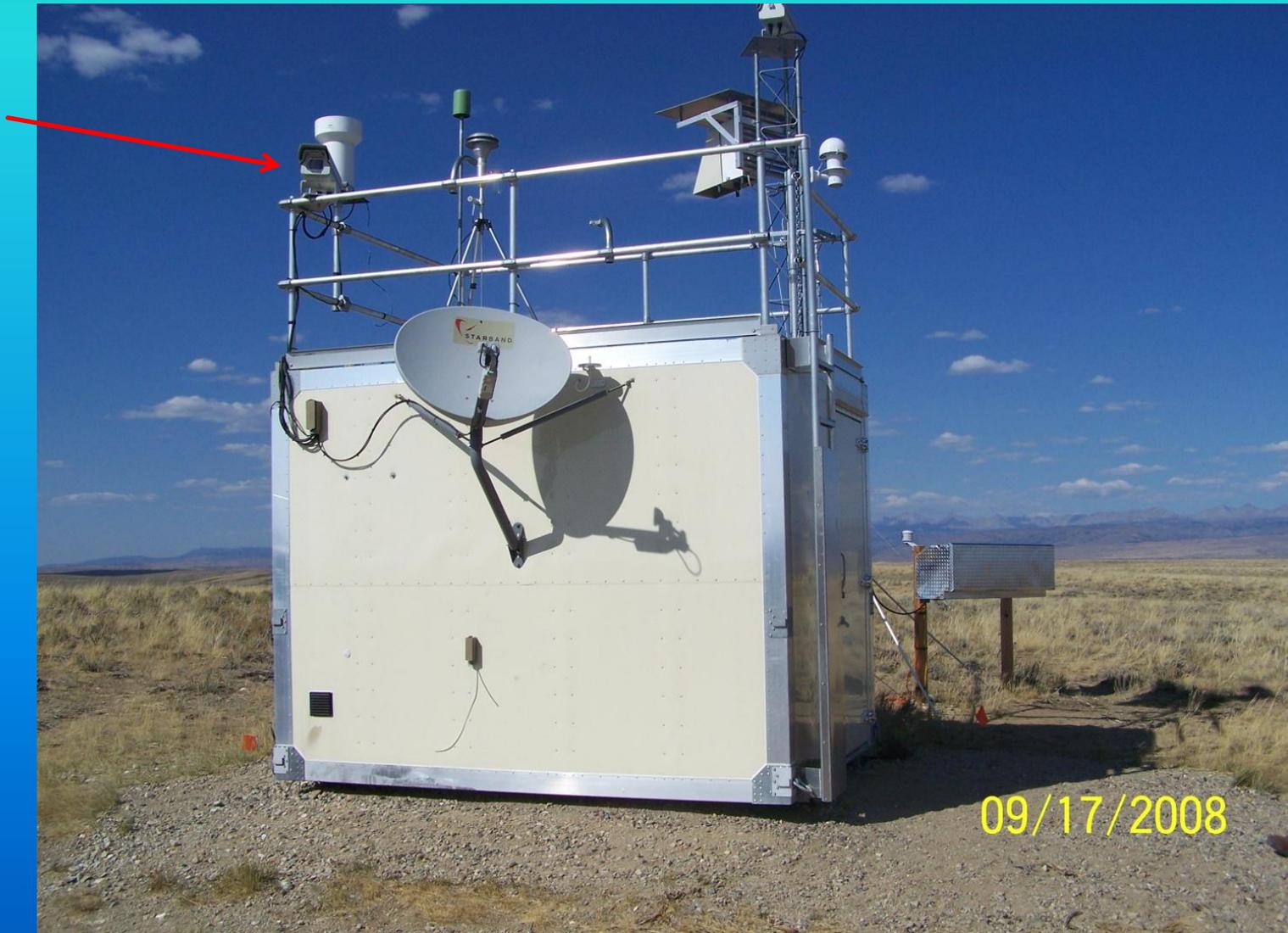
Construction of Shell's Liquid Gathering System



Boulder Monitoring Station

<http://www.wyvisnet.com/>

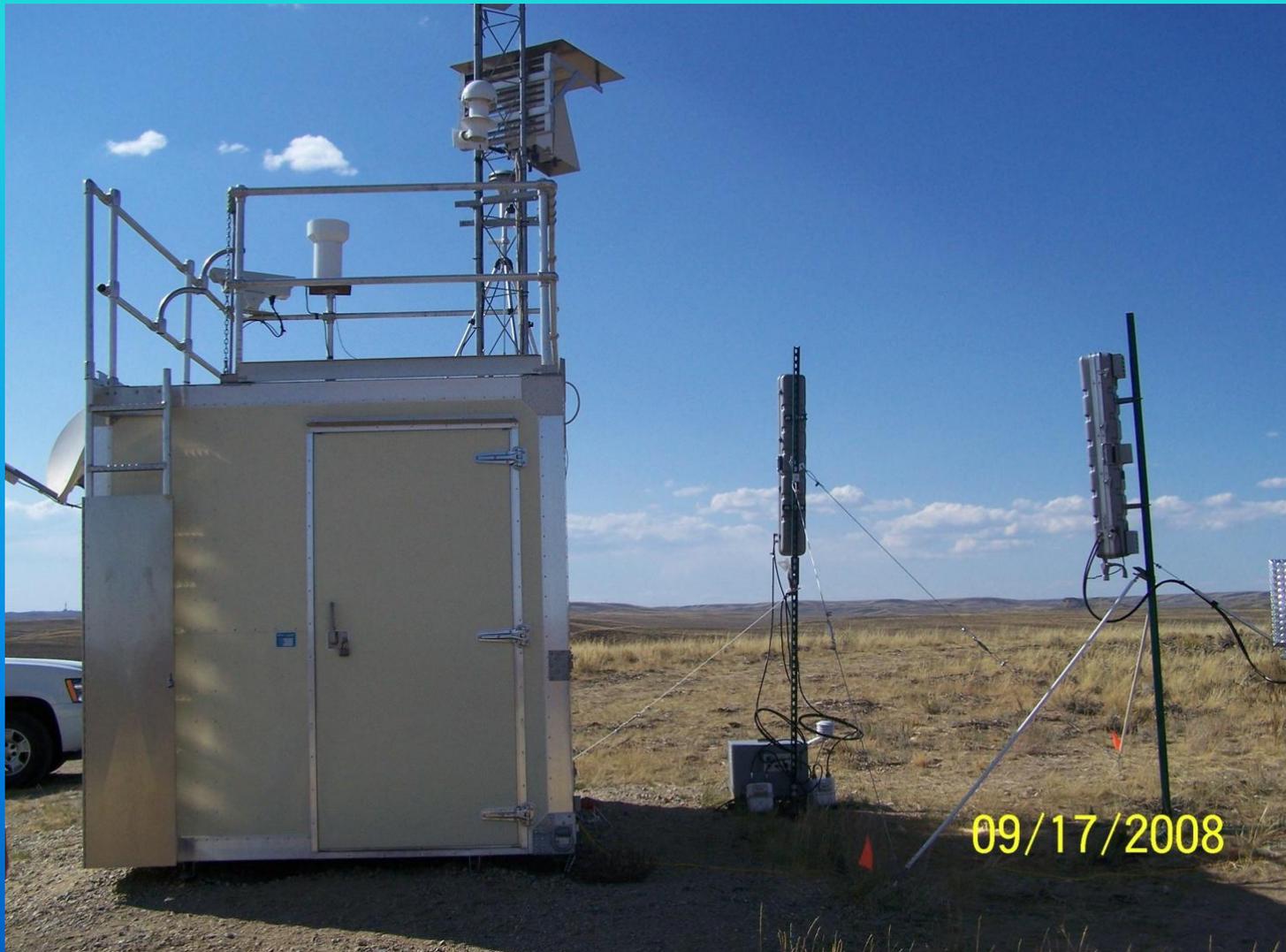
Camera



09/17/2008

Boulder Monitoring Station

(measured 8-hour ozone level of 122 ppb in February, 2008)



Websites/Links

- Inventory Web Page: <http://deq.state.wy.us/aqd/ei.asp>
- UGRB Ozone Non-Attainment Area Inventory Forms Web page:
<http://deq.state.wy.us/aqd/Annual%20and%20Winter%20Upper%20Green%20River%20Basin%20Emission%20Inventories.asp>
- Actual Emissions Web Page:
<http://deq.state.wy.us/aqd/Actual%20Emissions.asp>
- Oil & Gas forms & Guidance Documents Web page:
<http://deq.state.wy.us/aqd/oilgas.asp>
- Oil & Gas Production Facilities Guidance Document:
http://deq.state.wy.us/aqd/Oil%20and%20Gas/September%202013%20FINAL_Oil%20and%20Gas%20Revision_UGRB.pdf

Questions?

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<http://deq.state.wy.us/aqd/ei.asp>

<http://deq.state.wy.us/aqd/oilgas.asp>