Water Recycling
Hydraulic Fracturing, Remote Surface Locations

Tyler Bittner
Stimulation (aka: Hydraulic Fracturing or Frac’ing)

Required for commercial gas production

Creates flow path through concrete-like rock

“Large” volumes of water and sand pumped down the wellbore into the formation at depth

Sand props fractures open

Water flowed back to surface and reused

Natural gas is piped to gas plant
Traditional Stage Fracturing Operations

- 60-100 tanks with manifolds
- Cleaning out tank bottoms
- Transportation, filling, delivery and pick up of tanks
- Large foot print and reclamation
- Multiple visits and extended completion time
Water Management Approach

PROBLEM:
(2007) 30,000 BWPD
► would require 300 truck loads per day; 109,500 truck loads per year
Cost of water management
Thousands of wells to drill
Public pressure
Dynamic regulations

SOLUTION:
• Multi Well Pad Drilling
• SIMOPS
• Remote Fracturing
• Water Recycling Pits
• HDPE and FlexSteel Lines
• Comprehensive team approach
  ► Drilling, Completions, Production, 3rd parties and Water Management Group
  ► Flexibility
• New Technology
• Community interaction
  • Less impact
Remote Frac’ing from Water Recycling Pit, More Efficient, and Keeps Trucks Off Roads
Hayes Gulch Hydraulic Fracturing, Remote Surface Operations – Statistics

- Accessed 14 drilling pads
- 87 new wells drilled

- Pumped 495 frac stages
  - 74,000,000 lbs of proppant (370 railcars)
  - 145,000,000 gal of fluid handled/recycled (220 Olympic swimming pools)

- Eliminated 12,000+ water truck trips to locations.

Additional benefits
- Smaller size drilling pads
- Less traffic resulting in less dust, emissions, road maintenance, accidents
- More fracs per day
- Get in and get out sooner!
WPX Piceance – Remote Hydraulic Fracturing

Produced Water

Subsurface Disposal

Flowback

Water Recycling

Resources

Hydraulic Fracturing

New Well Completion
The Science of Remote Surface Water Recycling Pits

- Permitted and documented with regulatory agencies (COGCC, CDPHE for Air, CDPHE for Storm water, compliance with 40 CFR 112 for SPCC, Migratory Bird Treaty Act)
- Voluntarily built beyond higher “E&P Waste Facility” Standards
- Professionally engineered and constructed
- Ongoing maintenance and odor control
- Continuous operation and water flow
- Oil/condensate removal within 24 hours

- Seam testing
- Soil compaction and geosynthetic base
- Double lined with leak detection system
- Netting / fencing protects wildlife
- Monitoring Wells
- Operational SOPs
- Daily inspections
- Hydro-testing
- 2’ freeboard
Lining and Leak Detection Systems

**Liner & Leak Detection System Details**

- **Pit Liner System**
  - 60 mil Electrically conductive HDPE Liner
  - 200 mil Hypernet Geonet Drain Mat
  - 40 mil HDPE Liner
  - GCL Geosynthetic Bentonite Liner

- Place pipe 2" above bottom of collection drain. Slope pipe toward deep end of pit.

- 6" Perforated PVC meeting ASTM D 3034 & D 2720.
- 3/4" - 1.5" rounded drain rock.
- Wrap collection drain rock in Mirafi Woven Fabric 160N or equal.

- Monitoring Stand Pipe with 6" PVC. Removeable Cap to be located at deep end of pit. Place steel fence posts for protection.

- Install Pocket Vents per manufacturer’s recommendations every 50 liner feet along perimeter at top of liner. Vent to perforate both HDPE liners.

- 6" PVC meeting ASTM D 3034 & D 2729.
- 3/4" - 1.5" round drain rock. (No crushed gravel allowed.)

- * 60 mil Electrically conductive HDPE Liner
  - 200 mil Hypernet Geonet Drain Mat
  - Mirafi NK150 Fabric Wrap

- Sloped Bottom at 0.5% to 1.0%

- * Mirafi 160N Fabric Wrap
  - 40 mil HDPE Liner
  - GCL Geosynthetic Bentonite Liner
  - Prepared subgrade

- 6" Perforated PVC meeting ASTM D 3034 & D 2729.

* Install HDPE / Bentonite Liners: Hypernet and Vent Pockets per manufacturer’s instructions.

Fox Engineering Solutions, Inc.
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Additional Location Mitigation and Best Management Practices

**Best management practices**

- Spill Prevention Countermeasures and Control Plan (SPCC)
- Secondary spill containment
- Storm water control
- Reclamation/Weed Management
- Sensitive Area Determination
  - Hydrologic analysis of location
  - Surface and ground water

**Pre-frac inspection list**

- Road base condition
- Berms in place
- Equipment placement
- Tank placement/condition
- Truck access, flow

**Spill reporting, remediation**

- COGCC, CDPHE, BLM, DOT
- Rules even more stringent
Used nearly 11,000 times since 2006
Miles away – remote locations
Reduces truck traffic by up to 90%
Roads & community (maintenance noise, odor, dust, traffic hazards)
Eliminated nearly 600,000 heavy truck trips on public roads

Reduces pad footprint by 30%
Reduces time required to drill and complete by up to 75%
Recognized awards with COGCC and BLM
Recycle, Reduce and Improve

2014 Trucking Reduction YTD Ryan Gulch

Reduced Truck Loads

- Production: 1,580,576
- To Frac Ops: 814,083
- Frac Flowback: 393,190
- Injection: 1,178,861
- Total: 3,966,710

Pumped Water (bbls) vs. Reduced Truck Loads

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Summary - Benefits of Hydraulic Fracturing, Remote Surface Locations

- Reduced truck traffic
- Reduced surface footprint
- Less dust / emissions
- Minimal impact to local wildlife and threatened and endangered plants
- Reduced impact on road infrastructure
- Reduced risk of accidental release
  Less connections and manifold on tanks
- Regulatory support
  COGCC, CPW and BLM
- Regulatory Compliance
  COGCC, CDPHE, CPW, BLM
- Community Support
- Buffer for activity
- Predictable delivery
  Efficient operations
  Flexibility with market unpredictability
- Cost Control