What is Fracking?

• Hydraulic fracturing is a process in which pressurized fluid is pumped into underground formations to create tiny fractures or spaces that allow crude oil and natural gas to flow from the reservoir into the well so it can be brought to the surface. The wellbore is encased with protective steel and cement, called surface casing, to protect groundwater.
## Hydraulic Fluid Composition

- Recovery
- Disposal

### A Fluid Situation: Typical Solution Used in Hydraulic Fracturing

**0.49% Additives**

<table>
<thead>
<tr>
<th>Compound</th>
<th>Purpose</th>
<th>Common application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acids</td>
<td>Helps dissolve resinates and organic foreign in rock (pre-fracture)</td>
<td>Swimming pool cleaner</td>
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<tr>
<td>Gutacondlyse</td>
<td>Eliminates bacteria in the water</td>
<td>Disinfectant; Sterilizer for medical and dental equipment</td>
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<tr>
<td>Sodium Chloride</td>
<td>Allows a delayed break down of the gel polymer chains</td>
<td>Table Salt</td>
</tr>
<tr>
<td>Ni, Diisethylenimine</td>
<td>Prevents the corrosion of the pipe</td>
<td>Used in pharmaceuticals, acrylic fields and plastics</td>
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<tr>
<td>Borate salts</td>
<td>Maintains fluid viscosity at temperature increase</td>
<td>Used in laundry detergents, hand soaps and cosmetics</td>
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<tr>
<td>Polyacrylamide</td>
<td>Maintains fluid viscosity between fluid and pipe</td>
<td>Water treatment and soil conditioner</td>
</tr>
<tr>
<td>Petroleum distillates</td>
<td>&quot;Slips&quot; the water to minimize friction</td>
<td>Make-up removers, lubricants, and emulsifying agents</td>
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<tr>
<td>Guar gum</td>
<td>Thickens the water to suspend the sand grains and prevent slippage</td>
<td>Thickener used in cosmetics, foods, drinks, toothpastes, soaps, and other industries</td>
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<tr>
<td>Citric Acid</td>
<td>Prevents precipitation of metal oxides</td>
<td>Food additives, food and beverage, lemonade</td>
</tr>
<tr>
<td>Potassium chloride</td>
<td>Constrains and creates fluid</td>
<td>Low sodium table salt substitute</td>
</tr>
<tr>
<td>Ammonium bi(hydri)</td>
<td>Removes oxygen from the water to protect the pipe from corrosion</td>
<td>Cosmetics, food and beverage processing, water treatment</td>
</tr>
<tr>
<td>Sodium or potassium carbonate</td>
<td>Maintains the effectiveness of other components, such as fracturing fluids</td>
<td>Washing soda, detergents, soap, water softeners, glass and ceramics</td>
</tr>
<tr>
<td>Proppant</td>
<td>Allows the fractures to remain open so the gas can escape</td>
<td>Drilling water filtration, proppant</td>
</tr>
<tr>
<td>Ethylene glycol</td>
<td>Prevents scale deposits in the pipe</td>
<td>Automotive anticorrosion, household cleaners, detergents, and lubricants</td>
</tr>
<tr>
<td>Isopropanol</td>
<td>Used to increase the viscosity of the fracture fluid</td>
<td>Glass cleaners, metal polish, and hair color</td>
</tr>
</tbody>
</table>

On average, 99.5% of fracturing fluids are comprised of freshwater and compounds are injected into deep shale gas formations and are typically confined by many thousands of feet or rock layers.

EOG Resources
South Texas Eagle Ford Oil

- San Antonio
- 120 Miles
- Oil Window
- Wet Gas Window
- Dry Gas Window
- Corpus Christi
- Laredo
The average depth of a deep shale gas well is about 7,500 feet, which is:

- 1 ½ miles below the Earth’s surface
- More than six Empire State Buildings stacked end to end
- 1 ½ times deeper than the deepest part of the Grand Canyon
- More than 25 football fields laid out goal post to goal post.
Regulatory Requirements

- Railroad Commission of Texas (RRC) requirements
  - SPCC Plans – Spill Prevention Containment and Countermeasure Plans (also submitted to TCEQ)
  - Emergency Protection Plans
- Corps of Engineers
  - SWPP Plan – Storm Water Protection Prevention Plans for roads, vegetation, construction
  - Wetlands Permit – 404 Permit
- TCEQ for surface water requirements
- San Antonio River Authority
  - River, Stream, & Creek Crossings (SARA)
- County/Community – Floodplain permits
Floodplain Management

• Permit Applications
  – Communities need to have Floodplain Management Plan
  – Require detailed set of plans
  – Require specifications
  – Require Emergency Action Plans
  – Ensure all other permits have been obtained

• FEMA Recommendations
  – Special Flood Hazard Area (SFHA)
  – Zone A
  – Zone AE

• SARA Recommended BMP’s
  – Hollistic Watershed Masterplan
  – Ordinance Handbook
Floodplain Management Plan

- Guidance on land use, transportation, zoning, subdivisions, capital improvements, parks, health, welfare and safety
- Requires community to evaluate and prioritize flood hazards
- Identify resources and capabilities
- Develop and implement mitigation measures
- Adopt special provisions for oil and gas activities
- Consider whether current flood management plan meets needs or should be updated or enhanced
Preconstruction Permit Needs

• Need to establish Base Flood Elevation (BFE) for floodplain being encroached upon
• Establish Pad Site Elevation
• Determine and Illustrate Egress and ingress from the County Road / State Highway to the well site on the site plan
• Submit Engineering study / Drawings for review
• Submit Emergency Plan of Action if site is in a floodplain area
• Preparing of any LOMAs or LOMR-Fs as required
Post Construction Permit Needs

- “As Built” survey / site plan to Verify Pad Elevation
- Means of Protection of Well Head if the pad is below BFE
- Means of Disconnection of Well Head in Case of Emergency if the pad and or the approach is constructed below the BFE
- All electrical connections need to be above the BFE
- List of any chemicals stored on site and their classification code
- Strapping mechanisms for on site equipment stored below BFE
- All roads that cross through a flood plain will need to be constructed as a permanent structure with the appropriate headwalls, culvert pipes, and flood stage markers
- The appropriate vegetation installed on the pad edges to abate erosion possibilities
SFHA

• Floodways:
  – Drilling sites in floodways need to demonstrate no increase in flood stages during 100-year flood.

• Fuel or Storage Tanks
  – Elevated above BFE or floodproofed (water tight)

• Buildings
  – Floodproofed & signed off by Registered Engineer or Architect

• Mechanical & Utility Equipment
  – Elevated above BFE, water tight, & anchored

• Electrical Equipment
  – Elevated or floodproofed to BFE or moveable from site

• Hazardous & Explosive Materials
  – Should be protected to at least 500-year flood
Well Site Development and Maintenance

- Select location pads in areas with lowest potential for impact to water quality
- Avoid construction and operations within floodplains and sensitive riparian, wetlands, & springs
- Surround location with constructed berms
- Select size of the well site that minimizes amount of disturbed area
- Utilize level areas, avoid narrow ridges, steep slopes, culturally significant, or environmentally or ecologically sensitive areas
- Select location that minimizes cut and fill slopes and avoids drainage swales
- Segregate, stockpile, and conserve all topsoil
- Compact all fill slopes
- Use clustered development spacing
- Keep water up-stream of well site from entering site.
- Temporary erosion control measures must be used during construction.
- Utilize tanks to collect sanitary waste
Stormwater Pollution Prevention Plan

- Develop and implement SWPPP:
- Erosion and Sediment Structural Controls including but not limited to:
- Erosion and Sediment Non-Structural Controls / Soil Stabilizers
- Description of construction operations implementing provisions of SWPPP
- Show design, locations, and appropriate storm water devices that take water from well pads or other facilities to minimize storm water runoff impacts
- Description of proper BMP maintenance throughout life of entire operation
Interim Well Site Reclamation

- Restoration of well site and access road
- Properly close all pits
- Regrade site to compliment surrounding contours
- Respread stockpiled topsoil
- Stabilize all disturbed areas along access corridor, well site and pipelines
- Utilize suitable temporary erosion control measures until permanent controls can be established
Final Well Site Restoration

• After well is plugged, site should be closed and restored as follows:
  – Remove all equipment from site, restore natural drainage patterns and remove sedimentation ponds, or other control facilities
  – Round or shape all disturbed areas to conform site to adjacent terrain
  – All unstabilized areas should be scarified, limed, fertilized, seeded and mulched
  – Line any channels or ponds remaining as part of site restoration with an erosion resistant lining
Access Road Construction/Maintenance

- Roads should be constructed above floodplains
- Roads should not be located in perennial or intermittent stream channels
- Roads should not be located where they will cause additional downstream flooding or sediment deposition
- Adequate storm water management during road construction
- Roads upslope of a stream should allow for adequate filter strips
- Embankments should be sloped and stabilized to minimize erosion
- Access roads should be maintained and periodically
- A stone loading and unloading pad is recommended
Access Road Reclamation

• Roads should be restored as follows:
  – Road should be closed to vehicular traffic and natural drainage patterns should be restored
  – All bridges and culverts should be removed
  – Cross-drains, dikes and waterbars should be constructed to minimize erosion
  – Road surfaces are to be scarified, limed, fertilized, seeded and mulched.
Pipeline Construction and Maintenance

• Techniques, measures, and procedures should be utilized for adequate planning and construction of pipelines:
  – Keep pipeline right-of-way widths to a minimum
  – Test pipelines and flowlines for leaks before backfilling trenches
  – Compact pipeline trenches during backfill
  – Re-grade and reclaim fill slopes to conform to adjacent terrain
  – Prevent blockage of dams or streams, or relocation or changing the natural course of any stream
  – bury pipelines below the stream scouring depth
  – Identify, map, and attempt to avoid areas where ground movement potential exists and/or monitor long term ground movement
• Locate pipelines and flowlines in existing road corridors
• Establish permanent vegetation to minimize erosion
Waste Management

• Landfarming - water base fluids spread on the soil
  – Fluids must be below 3,000 ppm chloride
  – PH must be between 6 – 10
  – Electrical Conductivity
  – Total Petroleum Hydrocarbons < 1 %
  – Levees must be erected around proposed site
  – Storm water discharge is prohibited
  – Unloading may not be conducted during episodes of heavy rains
  – Fluid is not to be applied thicker than 3 inches
  – Area must be disked within 30 days of application of drilling fluids
  – Area must be generally flat; Wooded areas are prohibited

• Disposal Wells - dispose of waste by deep injection
  – Containment measures; require spill response plan
  – Utilize BMP’s near streams
  – Test integrity of casing and document geologic separation between injection zone
River Authority Actions

• Working with Oil & Gas Companies on issues affecting the basin
• Visiting well sites as needed
• Responding to public inquiries
• Working with regulatory agencies as needed
• Hosting workshops with local communities
• Fracking study with USGS to set baseline of contaminants in surface waters
Questions???

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