

# Oil & Natural Gas Development in Michigan and the Role of the Office of Oil, Gas, and Minerals

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Geologist

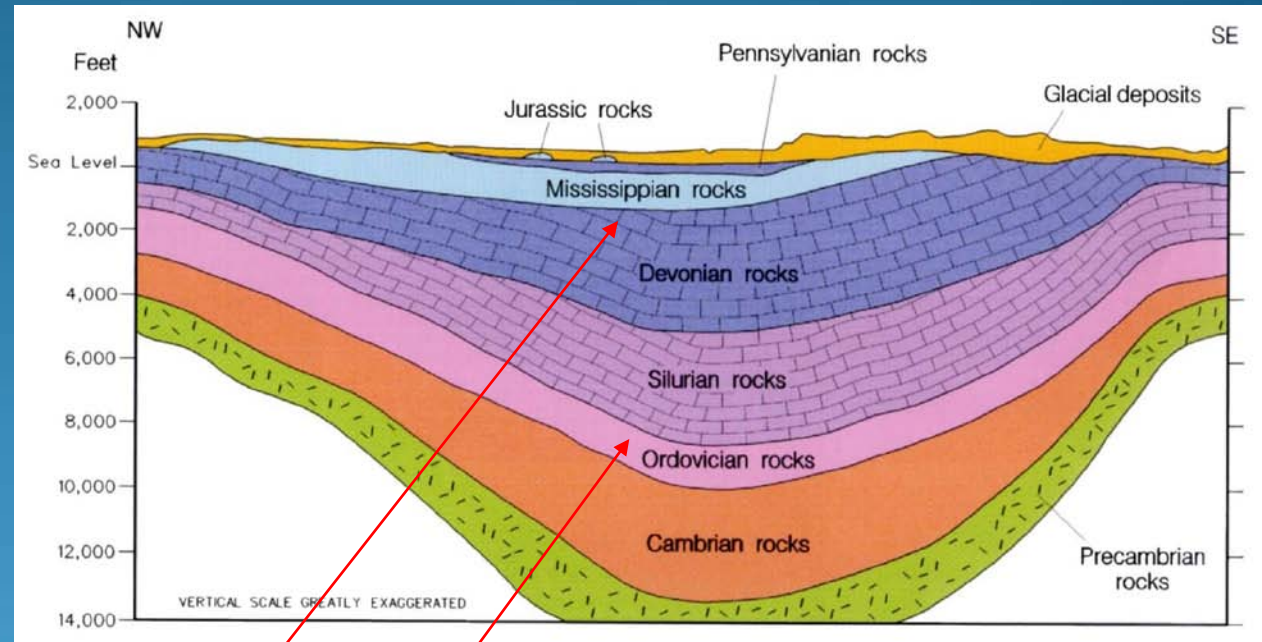
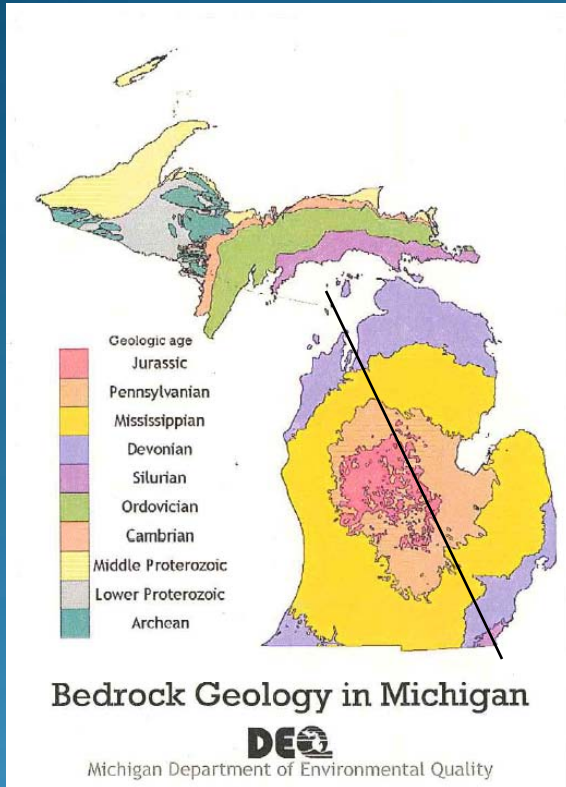
Michigan Department of Environmental Quality  
Resource Management Division  
Office of Oil, Gas, and Minerals



# DEQ Mission Statement

The Michigan Department of Environmental Quality promotes wise management of Michigan's air, land, and water resources to support a sustainable environment, healthy communities, and vibrant economy.

# Michigan Basin Geology



Antrim Shale

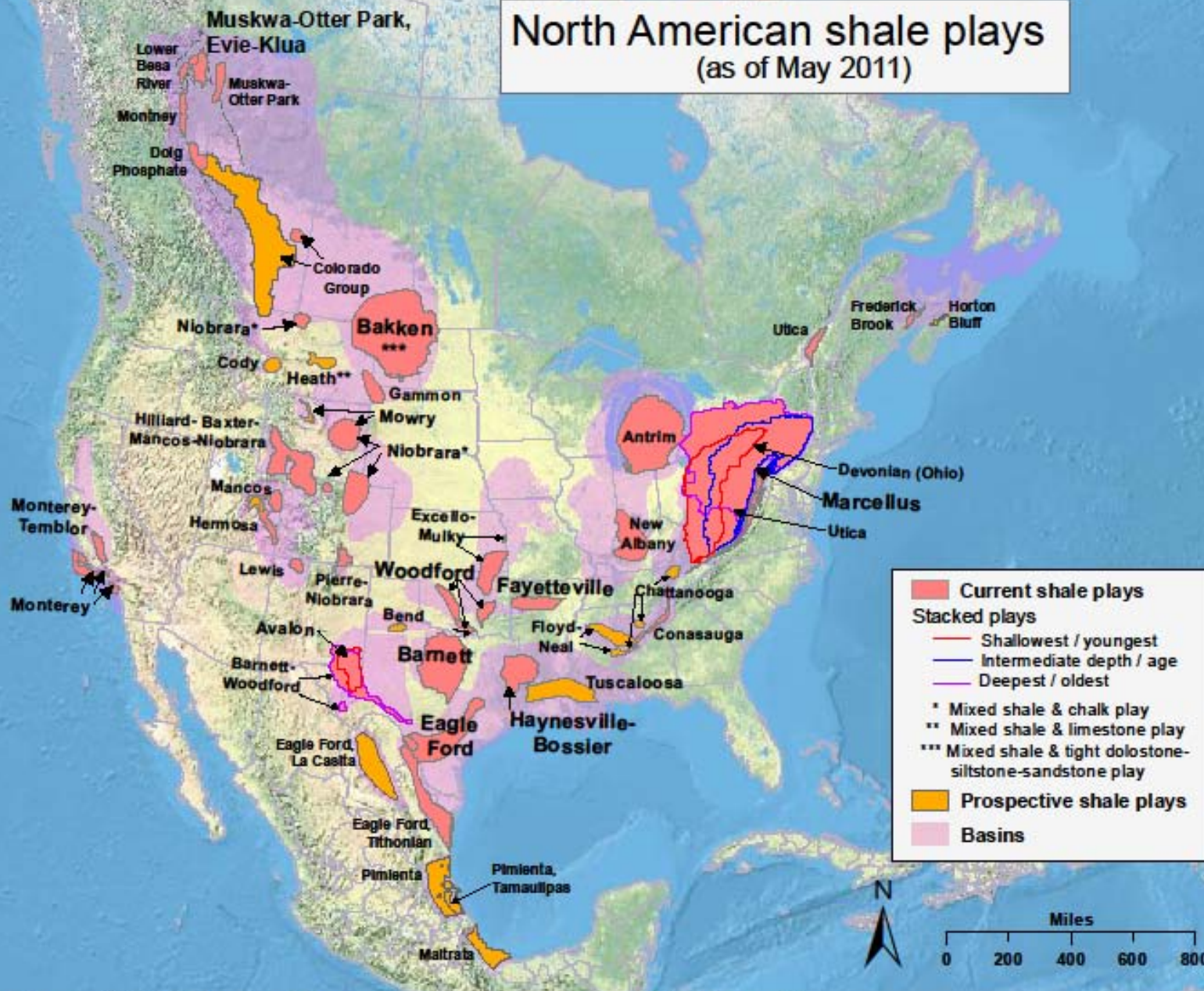
Utica-Collingwood

## OIL AND GAS WELLS





# North American shale plays (as of May 2011)

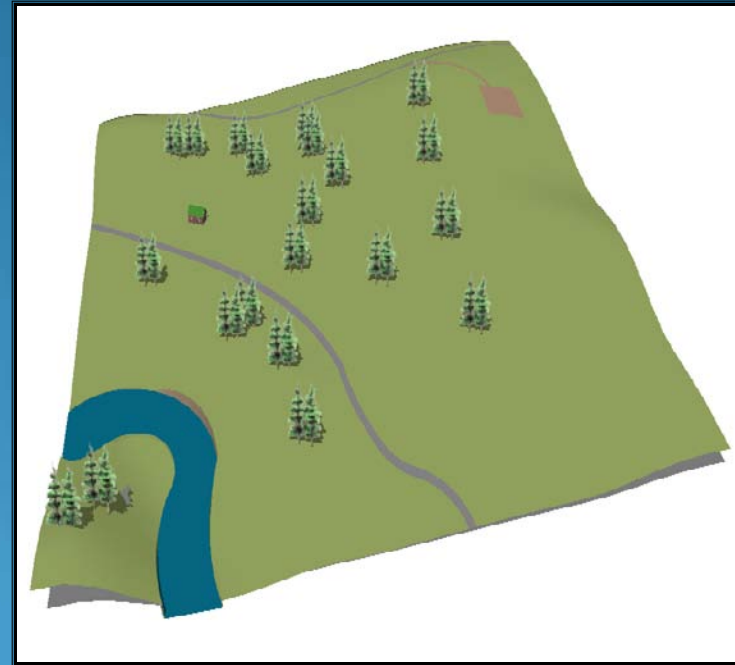


# OOGM's Role

- The DEQ, Office of Oil, Gas, and Minerals (OOGM) Regulates the Following:
  - Permitting (Well Site Selection, Isolation Distances, Soil Erosion and Control, Casing and Sealing Programs, Blowout Prevention, etc.)
  - Drilling & Completion (Casing and Sealing Programs, Blowout Prevention, Lined Reserve Pits, Hydraulic Fracturing, Water Management, Site Restoration, etc.)
  - Production (Approval of Secondary Containment Plans, Flowline Pressure Testing, Groundwater Monitoring, Response and Remediation of Spills)
  - Plugging and Final Site Restoration

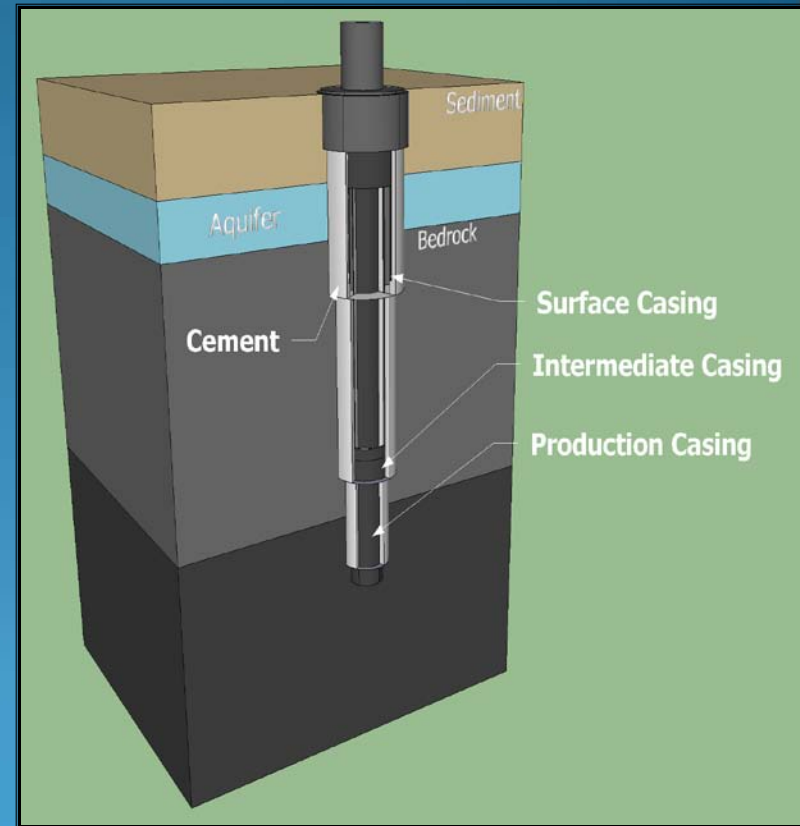
# Permitting – Surface Location

- Surface Ownership & Mineral Ownership
- Zoning and Spacing
- Site Location & Impacted areas
  - Drill Pad, Access, Flow lines
  - Land Use, Topography,
  - Soil Erosion & Sedimentation Control
- Isolation Distances
  - Structures, Water Wells, Utilities
  - Surface Water, Wetlands, Flood Plains
  - Threatened and Endangered Species
  - Historic Areas
  - Recreational Areas
  - Environmentally Sensitive Areas
- Reserve Pit
  - Location (if allowed)



# Permitting – Casing & Sealing / BOPs

- Casing
  - Surface Casing
    - Groundwater Protection
    - 100' Into Competent Bedrock and below lowest known fresh water zone
  - Intermediate Casing
    - Safety and Pressure Protection
    - Required when drilling below Detroit River Group
  - Contingency String Casing
  - Production Casing
  - All casing reviewed site specific
- Sealing
  - Types & Quantity of Cement
- Blow Out Preventer (BOP)
  - Meet Location Specific Criteria
  - Reviewed by Staff
    - Local Geologic Hazards
    - Expected Pressures







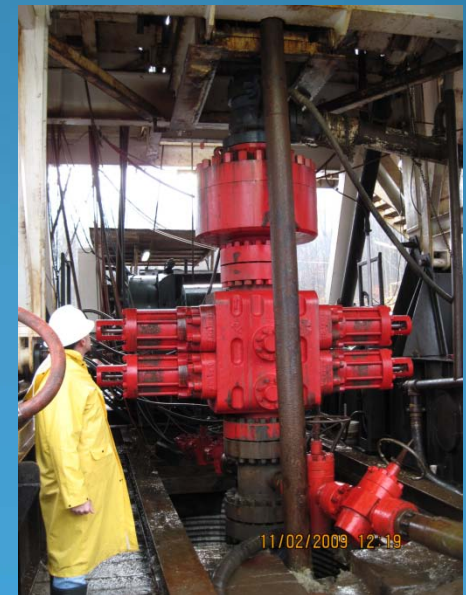


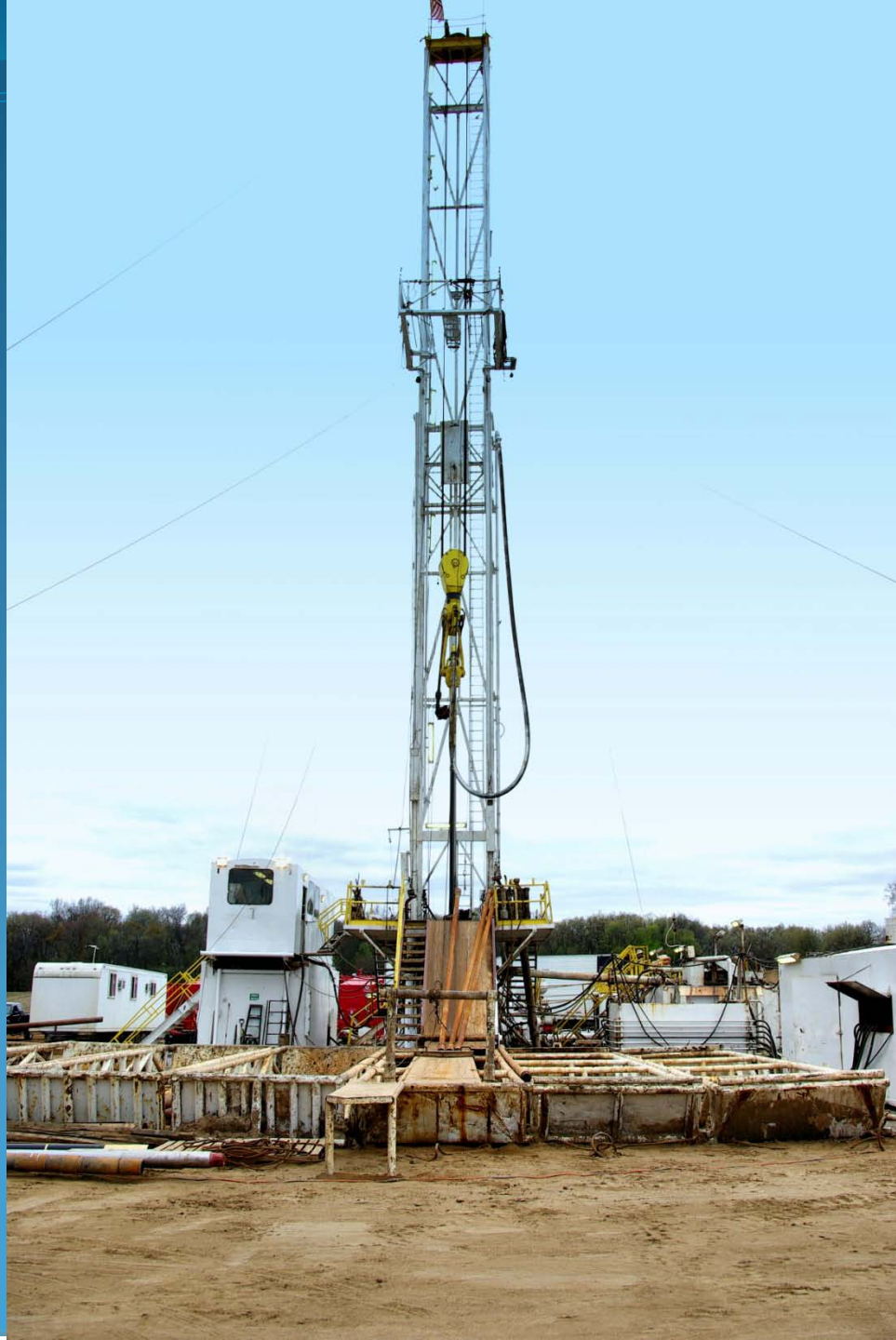
# Drilling & Completion



## ➤ Field Staff Onsite & Records Review

- Casing and Sealing Programs
- Blowout Prevention
- Reserve Pits
- HydroFrac Water Management
- Site Restoration, etc.





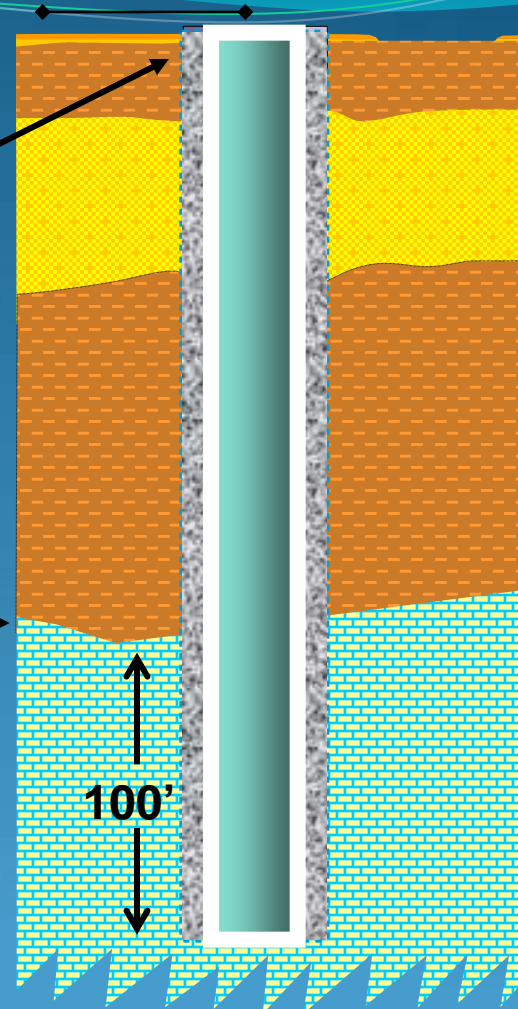


# Surface Casing

Conductor Pipe

Base of fresh water  
Top of bedrock

At least 100 feet into  
bedrock and at least 100  
feet below all freshwater  
zones

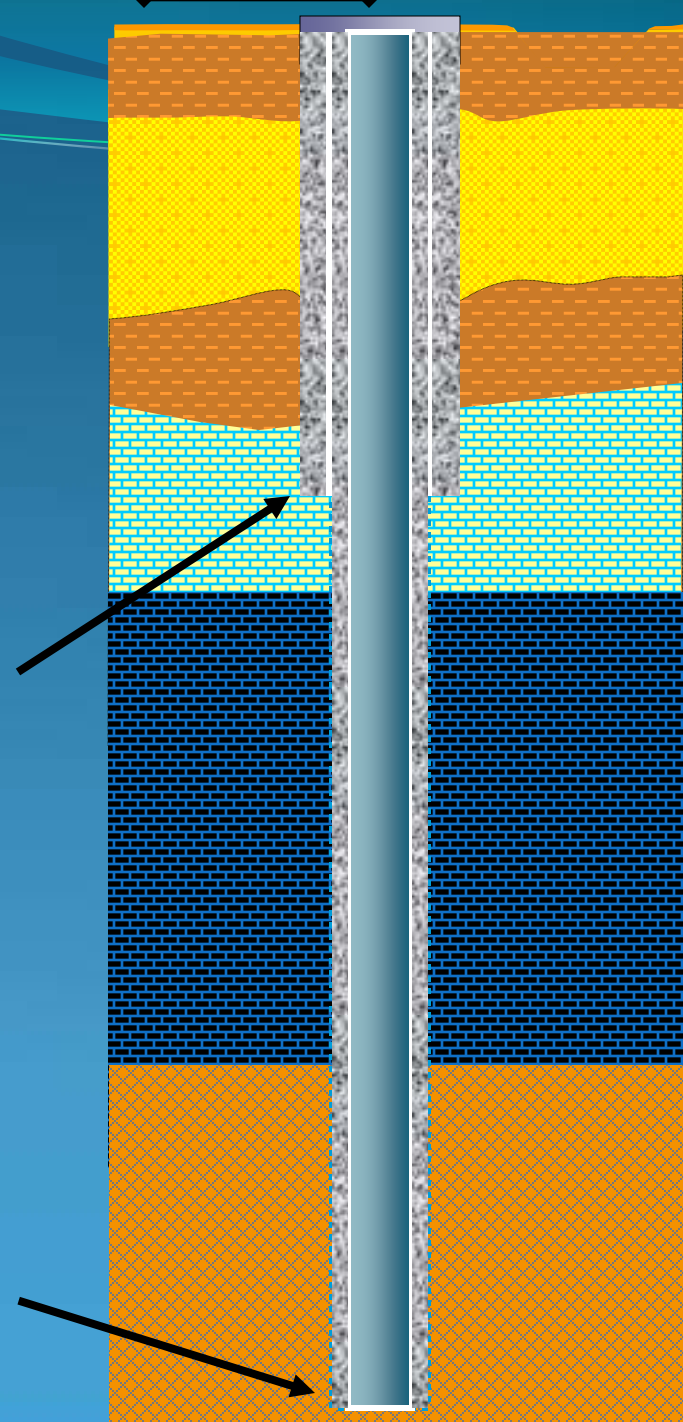




# Intermediate Casing

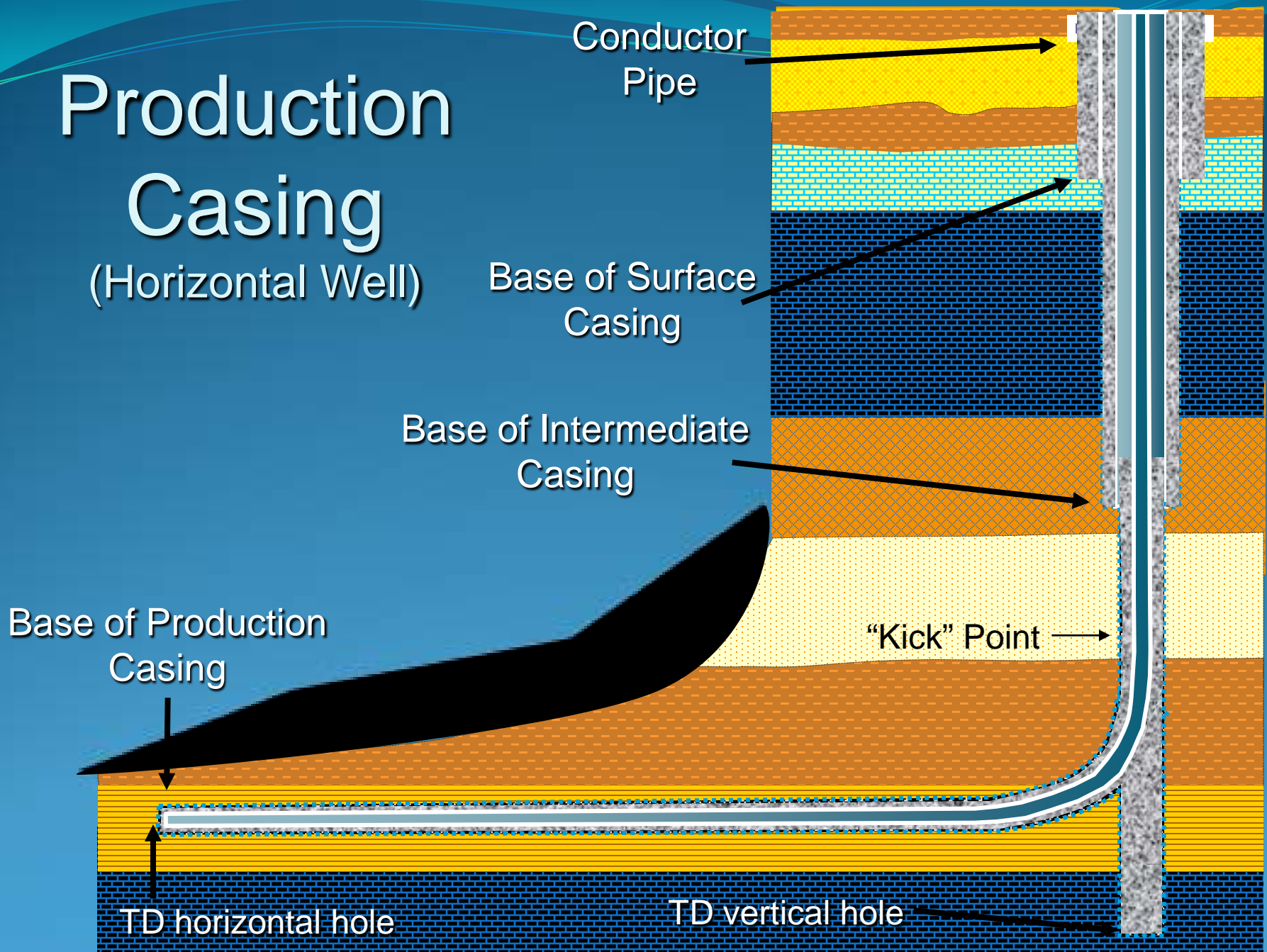
## Base of Surface Casing

## Base of Intermediate Casing



# Production Casing

(Horizontal Well)



# Production

## ➤ Field Staff Activities

- Approval of Secondary Containment Plans
- Flow Line Pressure Testing & Groundwater Monitoring
- Response & Remediation of Spills
  - Cleanup to Part 201 Criteria
- Routine Inspections
  - Part 615 Compliance
  - Spills & Releases
  - Ensuring Monitoring & Production
  - Soil Erosion Sedimentation Control

## ➤ Lansing

- Production Records Review





# Typical Tank Battery for oil storage







Full Facility View  
servicing production of  
3 separate wells

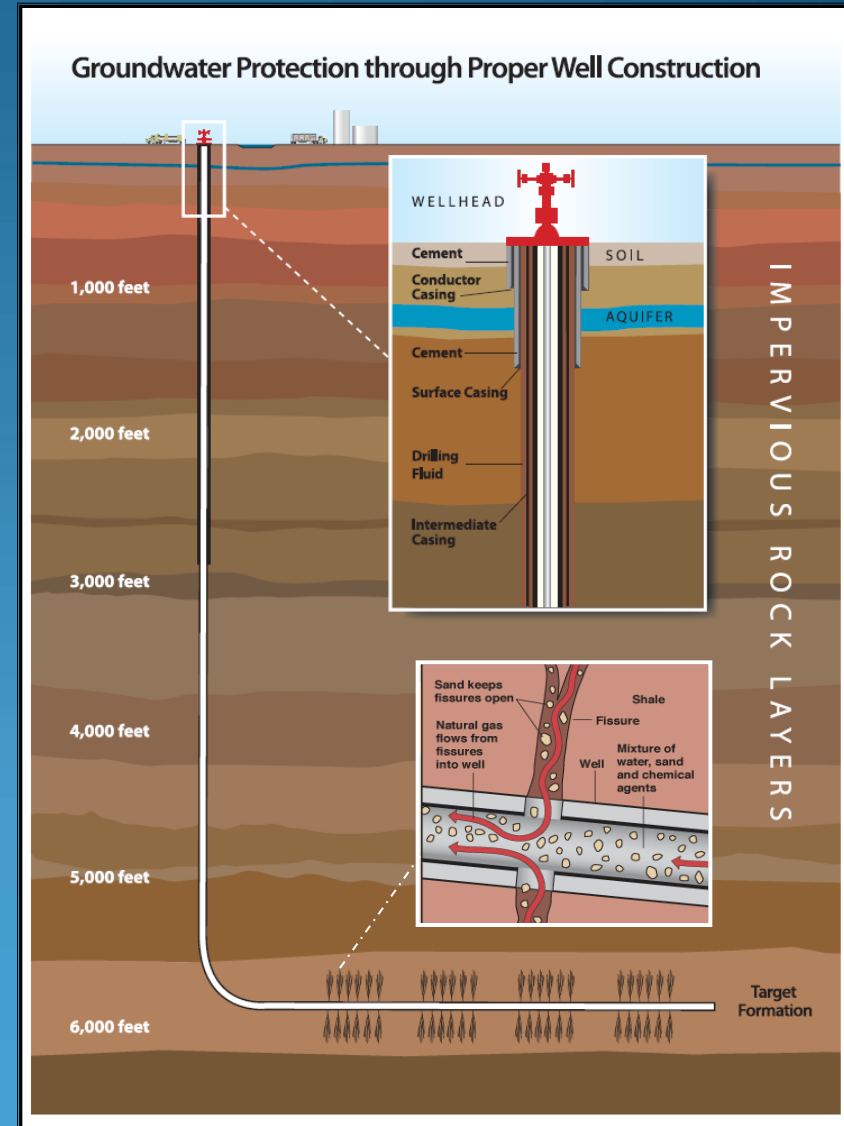
# Plugging and Final Site Restoration

- OOGM Issues Plugging Instructions
  - Ensure that all oil, gas, brine, and fresh water is confined to the strata in which the oil, gas, brine, and fresh water occur by using cement and/or mechanical plugs
  - Plugged under static hole conditions
  - Inspections during plugging and record review after



# What is Hydraulic Fracturing?

- A procedure used to complete some oil or natural gas wells
- Pump water at high pressure to create fractures in rock that allow oil or natural gas to flow more freely to the well bore
- Proppants, usually silica sand, are added to the water to hold the fractures open once they are created



# Hydraulic Fracturing

## The Five Most Common Issues

- Migration of gas or fracture fluids
  - Site specific review of casing and sealing programs
- Identification of chemical additives
  - MSDS – post online ASAP –improve chemical disclosure
- Management of “flow back” water
  - No fluid to pits – deep well disposal - reporting
- Surface spills
  - Secondary containment & tanks instead of pits
- Water use
  - SOW Instruction 1-2011 – Use of WWAT – Monitor wells – reporting – MSDS sheets – website

# Water Usage

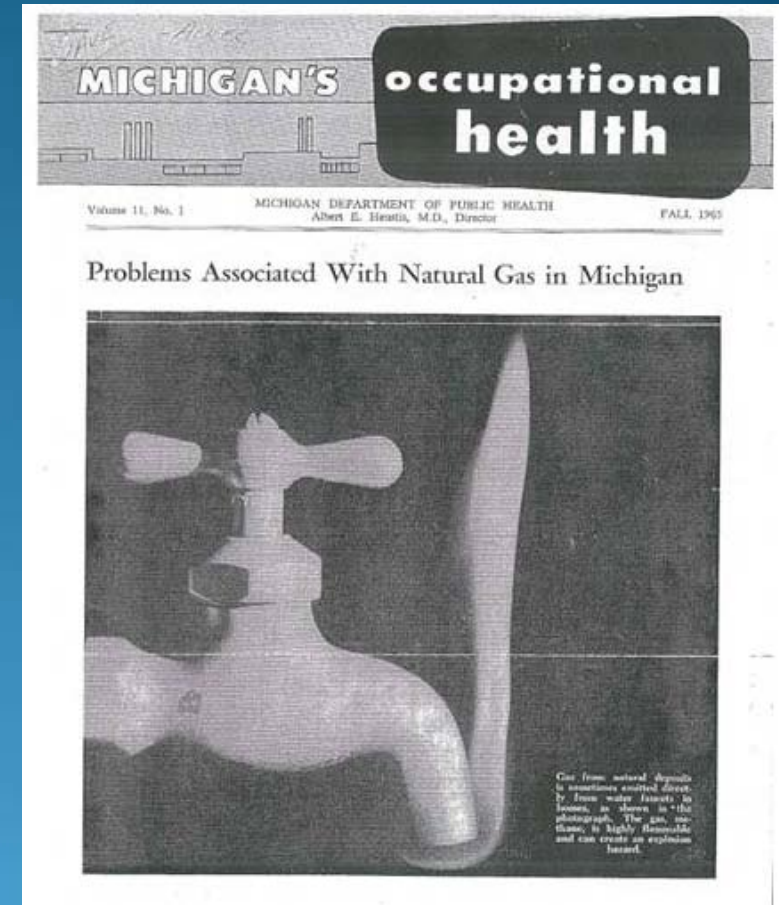
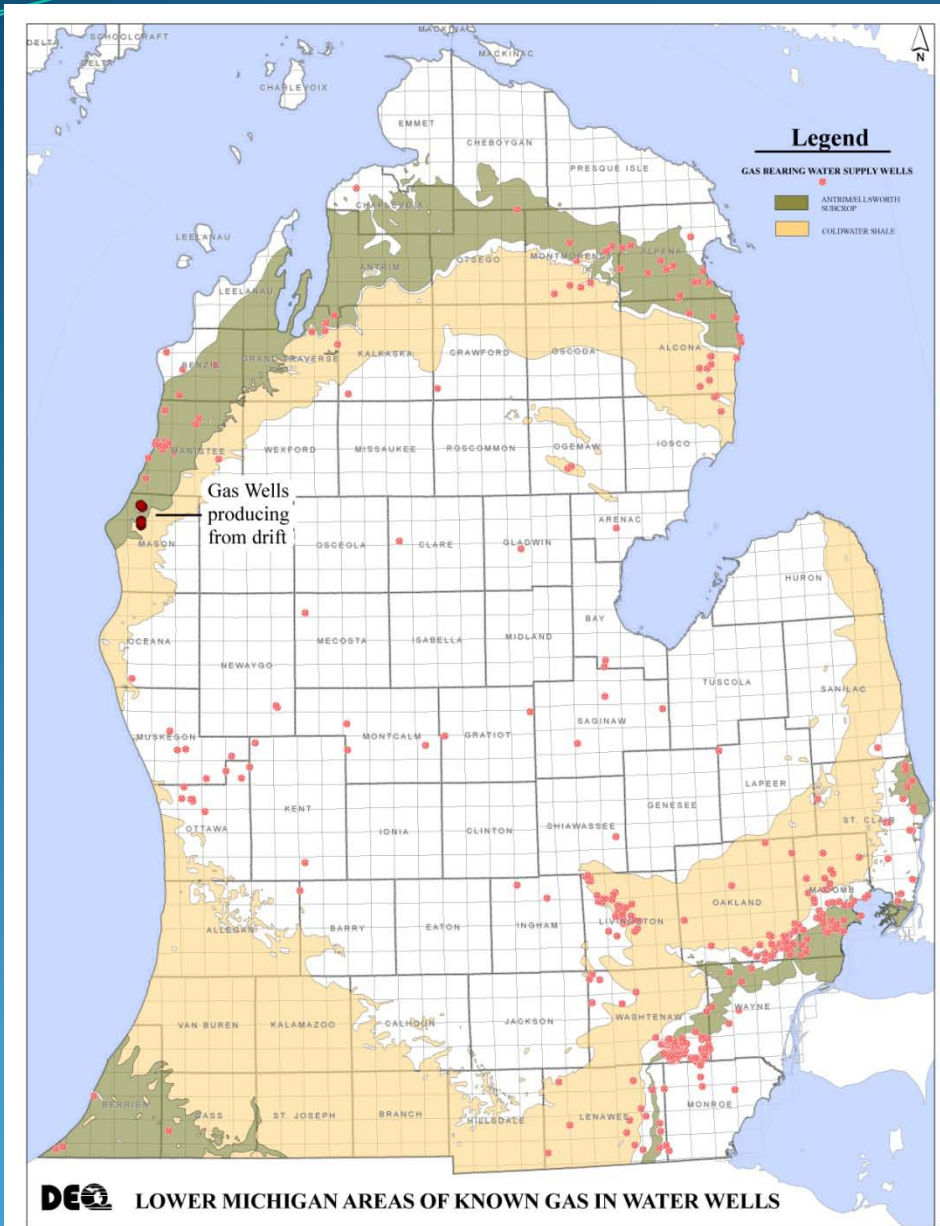
- Use of Groundwater
  - Temporary Water Well
  - Transport Water to Site
  - Use of Groundwater
- Fresh Water is stored on site in lined pits or tanks
- Water with chemical additives has to be stored in steel tanks



# Hydraulic Fracturing



# Naturally Occurring Gas in Water Wells



Has been reported in Michigan for a while (Article from 1965). Can occur when the aquifer is in connection with gas bearing shales or buried organics



# Internet Resources

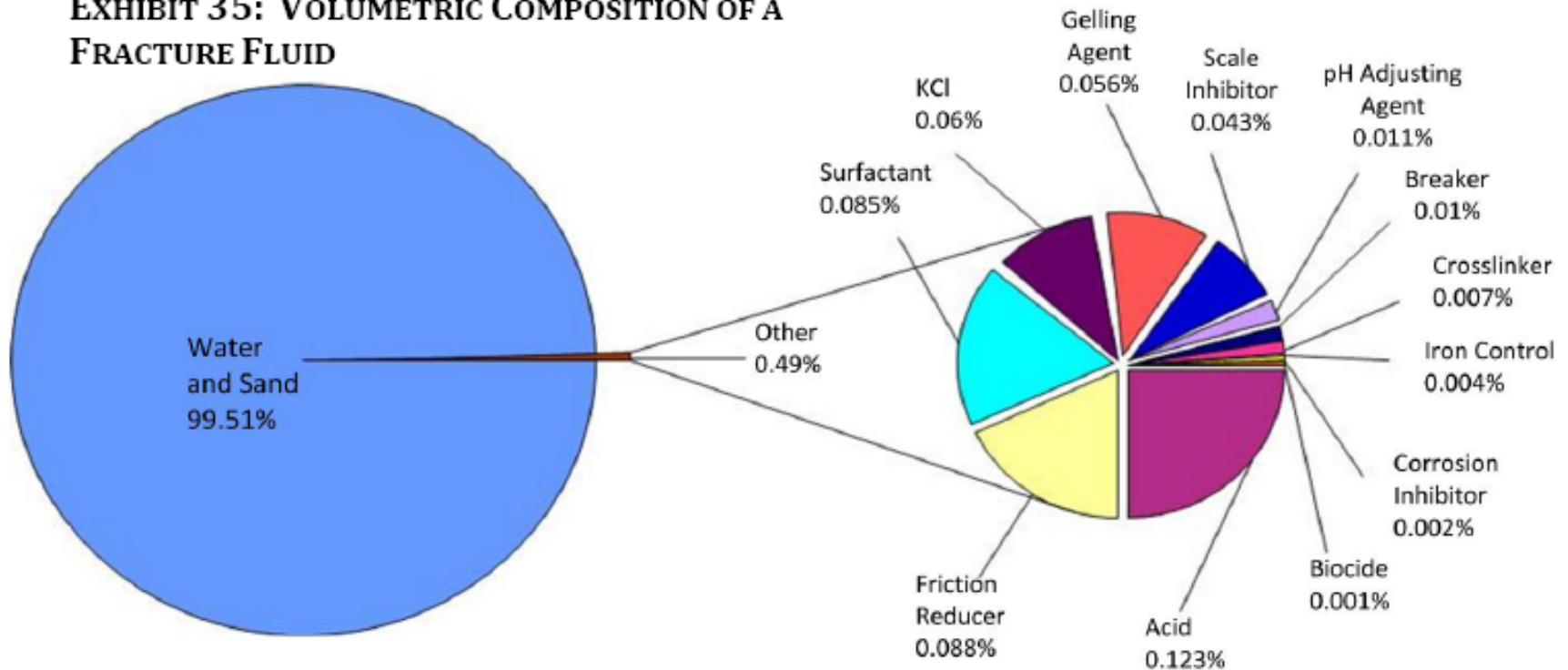
- [www.Michigan.gov](http://www.Michigan.gov)
  - Type “Office of oil, gas and minerals” in the search bar in the top right of the web page.
- Google, Yahoo, Bing, etc.
  - Search for: *Michigan State University Extension Oil and Gas Portal*
- Geology.com
  - <http://geology.com/oil-and-gas/>
- United States Environmental Protection Agency
  - <http://www.epa.gov/hydraulicfracture/>
- FracFocus.org



# What's in Frac Fluid?

## MODERN SHALE GAS DEVELOPMENT IN THE UNITED STATES: A PRIMER

**EXHIBIT 35: VOLUMETRIC COMPOSITION OF A FRACTURE FLUID**



Source: ALL Consulting based on data from a fracture operation in the Fayetteville Shale, 2008

MSDS sheets for chemicals: <http://www.michigan.gov/ogs>



## FRACTURING FLUID ADDITIVES, MAIN COMPOUNDS AND COMMON USES

Additive Type	Main Compound	Purpose	Common Use of Main Compound
Acid	Hydrochloric acid or muriatic acid	Helps dissolve minerals and initiate cracks in the rock	Swimming pool chemical and cleaner
Antibacterial agent	Glutaraldehyde	Eliminates bacteria in the water that produce corrosive by-products	Disinfectant; sterilizer for medical and dental equipment
Breaker	Ammonium persulfate	Allows a delayed break down of the gel	Used in hair coloring, as a disinfectant, and in the manufacture of common household plastics
Corrosion inhibitor	Formamide	Prevents the corrosion of the well casing	Used in pharmaceuticals, acrylic fibers and plastics
Crosslinker	Borate salts	Maintains fluid viscosity as temperature increases	Used in laundry detergents, hand soaps and cosmetics
Friction reducer	Petroleum distillate	"Slicks" the water to minimize friction	Used in cosmetics including hair, make-up, nail and skin products
Gel	Guar gum or hydroxyethyl cellulose	Thickens the water in order to suspend the sand	Thickener used in cosmetics, baked goods, ice cream, toothpaste, sauces and salad dressings
Iron control	Citric acid	Prevents precipitation of metal oxides	Food additive; food and beverages; lemon juice ~7% citric acid
Clay stabilizer	Potassium chloride	Creates a brine carrier fluid that prohibits fluid interaction with formation clays	Used in low-sodium table salt substitute, medicines and IV fluids
pH adjusting agent	Sodium or potassium carbonate	Maintains the effectiveness of other components, such as crosslinkers	Used in laundry detergents, soap, water softener and dishwasher detergents
Proppant	Silica, quartz sand	Allows the fractures to remain open so the gas can escape	Drinking water filtration, play sand, concrete and brick mortar
Scale inhibitor	Ethylene glycol	Prevents scale deposits in the pipe	Used in household cleansers, de-icer, paints and caulk
Surfactant	Isopropanol	Used to reduce the surface tension of the fracturing fluids to improve liquid recovery from the well after the frac	Used in glass cleaner, multi-surface cleansers, antiperspirant, deodorants and hair color
Water	Water	Used to expand fracture and deliver proppant (sand)	Landscaping, manufacturing

# Recent Legislations Regarding Large Scale Water Withdrawals

- 2006 and 2008
  - Defines “Adverse Resource Impact”: “Stream’s ability to support characteristic fish populations is functionally impaired”
  - Defines Large Quantity Withdrawal (>100,000 gpd)
  - Provides for Registration of Water Withdrawals
  - Provides for an Internet Based Screening Tool – **“Water Withdrawal Assessment Tool”**
  - Water Withdrawal Regulations Part 327- Oil and Gas Development under Part 615 is exempt

# The Water Withdrawal Assessment Process



- Three models interact within the impact assessment model
  - Withdrawal Model - How much water is in the aquifer, is being withdrawn, and from where and how it will affect stream flow
  - Stream Flow Model - How much water is flowing in the stream during summer low flow periods
  - Fish Impact Model - What fish are in the stream and what is the likely effect of removing water on those groups of fish