

Marcellus Shale

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Marcellus Shale

Average Depth 6,750 feet

Bottom Hole Temperature 140 F

Bottom Hole Pressure 4,000 psi

Development of Marcellus Shale Gas play consist of Horizontal Drilling and Hydraulic Fracturing

Hydraulic Fracturing Fluids consist of:

Surfactants - Laurel sulfates, reduces interfacial tension in the formation

Friction Reducers - Polyacrylamide polymer, reduce surface tension between fluid and pipe surface

Biocides - Glutaraldehyde/quaternary ammonia blend, pasturize not sterilize

Scale Inhibitors - solvent based Ethylene Glycol

Corrosion Inhibitor - n,n-dimethyl formamide, gel -Hydroxyethyl Cellulose

Iron Control - 2-hydroxy-1,2,3-Propanetricarboxylic Acid

Propping Agents - Sand

Breaker - Sodium Chloride

Hydraulic Fracturing of Horizontal Wells requires large volumes of water - 3 to 8 million gallons

Sources of Water used for Hydraulic Fracturing

-Ground Water

-Surface Water

-Produced Water - Reused

Each million gallons of Hydraulic Fracturing Fluid contains @40,000 pounds of chemicals

Thus Horizontal Well fracturing could have 120,000 to 320,000 pounds of toxic chemical in the frac fluid (60 to 160 tons)

Flowback Water

20 to 30% of the Hydraulic Fracturing Flowback waste water remains underground

Flowback Water consist of the used Fracturing Fluids which could potentially be contaminated with NORM -Radium 226 - half life 1,620 years

Produced Water/Formation Water is generated as part of the

natural gas production process. The Produced Water is contaminated with:

Volatile Organic Chemicals - Benzene, Ethyl Benzene, Toluene, Xylene

Semivolatile Organic Chemicals - Phenol and Pyridien

Toxic Heavy Metals - Arsenic, Barium, Cadmium,

Chromium, Lead, Mercury and Vanadium

Sulfur containing compounds

NORM - Radioactive Radium 226, Radium 228 and Uranium 238

Salt Water Minerals

The Volatile Organic Chemicals and Toxic Heavy Metals are known and possible cancer causing agents and mutagens.

Naturally Occurring Radioactive Material (NORM)

The Marcellus Shale is very rich in Radium 226.

Radium 226 is a bone seeker and is a known carcinogen associated with lung and bone cancer.

The NORM becomes a problem when it is concentrated, precipitated due to changes in pressure and reacts with barium sulfate to produce scale.

The scale accumulates in production piping and in surface equipment such as tank bottoms, valves and connectors, pit sludges and gas-processing equipment.

Air Emissions

During the production of natural gas (methane), condensates are also produced. The condensates consist of extremely toxic volatile organic chemicals such as benzene (known human cancer causing agent), xylene, toluene, ethyl benzene and other probable and possible cancer causing agents and sulfur based compounds (sour gas). These chemicals are released into the air from the separation process and tank storage of condensates.

Emissions into the air from produced water tanks on the production site release methane, toxic volatile organic chemicals and sulfur compounds into the air.

Natural gas is frequently vented to the air when a well is completed.

Compressors and motors on the drilling and production sites release combustion products into the air. These combustion products combine with the volatile organic chemicals in the presence of heat and sunlight to produce ground level ozone.

Elevated ozone levels result in increased respiratory impacts for community members in the area.

The released methane gas contributes to global warming.

The air emissions could have the potential to cause health impacts to workers and community members living in close proximity to drilling and production sites

Acute Health Effects

Irritates Skin, Eyes, Nose, Throat and Lungs

Headaches
Dizziness, Light Headed
Nausea, Vomiting
Skin Rashes
Fatigue
Tense and Nervous
Personality Changes
Depression, Anxiety, Irritability
Confusion
Drowsiness
Weakness
Muscle Cramps
Irregular Heartbeat (arrhythmia)

Chronic Health Effects

Damage to Liver and Kidneys
Damage to Lungs
Damage to Developing Fetus
Causes Reproductive Damage
Damages Nerves Causing Weakness and Poor Coord.
Affects Nervous System
Affects the Brain
Leukemia
Aplastic Anemia
Changes in Blood Cells
Affects Blood Clotting Ability
Carcinogen
Mutagen
Teratogen - Developmental Malformation

Disposal Options for fracturing wastewater and production waste water consist of:

Injection into Disposal Wells - the water is wasted and no longer available for use

Wastewater Treatment Facilities that discharge the treated wastewater into surface water bodies - strict monitoring and compliance measures are needed to insure the protection of surface water bodies. The lack of adequate monitoring parameters to characterize fracturing waste water and production waste water chemical components can result in unknown impacts to surface water resources.

Emerging Technologies such as Thermal Evaporation and Brine Concentrator Technologies - air emissions from the Thermal Evaporation system is an area of concern.

Land spreading of wastewater

Road spreading of wastewater

Sources of Environmental Contamination

Ground water, surface water, soil, sediments and air are impacted by:

Fracturing which can create pathways that can allow migration into other non-target formations.

Leaks and spills which can occur from drilling and production wells, injection wells, flow lines, pipelines, pits, tanks, chemical storage

containers, drums and trucks.

Road spreading and land spreading can introduce contaminants into the environment.

Discharges into surface water resources of waste water not meeting permit limits.