



Preserving Forests, Protecting Waterways



**Policies to protect Pennsylvania's natural heritage
from the threat of natural gas drilling**

**PennEnvironment Research & Policy Center
Winter 2009**

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from the threat of natural gas drilling**

**Erika Staaf
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Acknowledgments

PennEnvironment Research & Policy Center would like to thank all those who contributed information and perspectives to this report, including: John Baillie of Citizens for Pennsylvania's Future, Thomas Au of the Sierra Club Pennsylvania Chapter, Myron Arnowitz of Clean Water Action, John Rumpler of Environment America, Matthew Garrington of Environment Colorado, and Dana Dorman. Thanks also to Megan Parks and Tony Dutzik for their editorial assistance.

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Executive summary

When it comes to natural gas drilling, modern Pennsylvania has begun to mirror the coal rush of the 19th century. Pennsylvania sits upon the Marcellus Shale natural gas reserve, which is believed to be one of the largest natural gas reserves in the United States. Nearly 60 percent of this natural gas is found within Pennsylvania's state borders, deep under ground.

When natural gas companies come into a region of Pennsylvania to drill in the Marcellus Shale for natural gas, local residents are often left to fend for themselves against a powerful and well-funded industry. To make matters worse, the few laws that are on the books are often tilted to benefit the natural gas industry, not the general public.

As natural gas companies have developed new technologies for extracting gas from deep wells, they have begun to apply for record numbers of drilling permits on hundreds of thousands of acres of public and private lands, many of which the state has approved. Already, companies have drilled nearly 600 wells in the state.¹

Unfortunately, natural gas companies have caused new and widespread environmental problems throughout the Commonwealth as they use a new deep-well drilling process in the Marcellus Shale called hydraulic fracturing. The process consumes incredible volumes of water, often from nearby streams and rivers; releases toxic pollution into local waterways and drinking water supplies; harms local plant and animal species; and carves up our forests and public lands for short term payoff.

In order to ensure that Marcellus Shale drilling takes place in Pennsylvania in a way that protects our environment and public health, Penn-Environment supports:

- **Strengthening Pennsylvania's clean water laws** to ensure that natural gas drilling does not contaminate Pennsylvanians' drinking water or waterways used for recreation;
- **Declaring our wild places and public lands off-limits to drilling;**
- **Improving "Right to Know" laws for natural gas drilling** so that local communities and environmental officials have all of the necessary data to properly implement drilling proposals, enforce laws and make decisions;
- **Implementing a public input process for local communities on all decisions related to public and private lands;**
- **Improving tools for Pennsylvania's regulators**, allowing them more time and funding to ensure they can protect Pennsylvania from the harmful effects of drilling;
- **Ensuring that drilling companies pay for the pollution and environmental damage they create;**
- **Improving and enforcing federal laws and rules that protect Pennsylvania and other states from the effects of hydraulic fracturing.**

Only by implementing these core principles will we be able to ensure that Marcellus Shale natural gas drilling takes place in a manner that protects our environment and public health.



▲ Drilling in the Marcellus Shale will carve up our lands and threaten our waterways, as shown in this Washington County drilling site.

What is the Marcellus Shale?

The Marcellus Shale is a geologic formation that contains pockets of natural gas and runs through nearly the entire state of West Virginia and western Maryland, most of eastern Ohio, through the lower section of upstate New York near the Pennsylvania border, and across the western, central and north-eastern quadrants of Pennsylvania.

In fact, geologists believe that the largest part of the Marcellus Shale natural gas reserve is found under Pennsylvania, across nearly two-thirds of the state.² In total, the Marcellus Shale natural gas reserve covers approximately 54,000 square miles, which is equal in size to the state of Florida.³

This geological formation runs 5,000 to 8,000 feet below the surface, and the natural gas is found in the pores and pockets created by the Marcellus Shale.⁴

Geologists believe that there may be 50 to 350 trillion cubic feet of recoverable natural gas found in Marcellus Shale. With current rates of natural gas consumption at about 23 trillion cubic feet per year, Marcellus Shale natural gas could supply the country with natural gas for anywhere from two to 15 years.⁵

While geologists have known about the Marcellus Shale natural gas reserve for many years, only recently has deep-well drilling technology allowed natural gas companies—facing rising natural gas prices in the marketplace—to believe that tapping the Marcellus Shale is an economically beneficial endeavor.

The drilling process

The process to access the Marcellus Shale begins with deep-well drilling thousands of feet below the earth's surface and horizontal drilling along the surface of the shale.⁶

Hydraulic fracturing, or “fracking,” is used to force the natural gas from the pores of the shale. Fracking involves injecting millions of gallons of water, particles of sand or ceramic beads and chemicals into the well at extremely high pressures to fracture the shale and allow gas to flow to the surface. Some of these chemicals and other additives are known and suspected to cause numerous negative environmental and public health effects.

About 20 to 40 percent of this fracking fluid remains underground for a period of time following drilling. The other 60 to 80 percent of wastewater or “flow-back” water comes to the surface. Often this flowback water can pose a treatment and disposal challenge for the drilling company and local community.

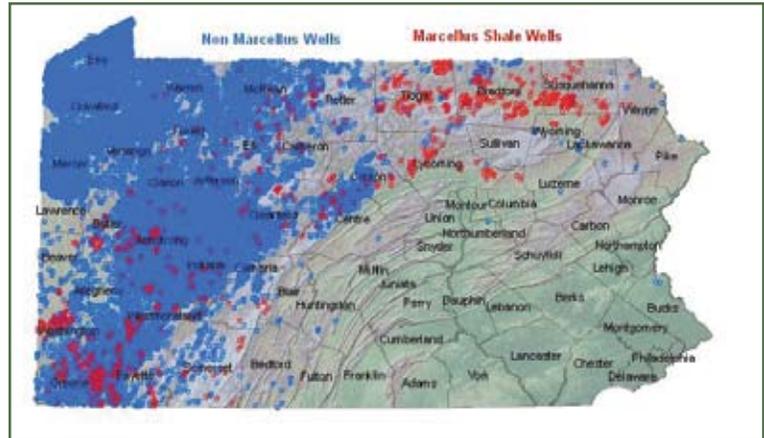


▲ The largest part of the Marcellus Shale natural gas reserve is found under Pennsylvania, across nearly two-thirds of the state (shown here in green).

When brought back to the surface, the wastewater is usually stored on site in lined, open-air treatment ponds before being trucked to a disposal facility to remove the chemicals and minerals and treat the water.⁷ Wells drilled in Marcellus Shale often require multiple hydraulic fracturing processes over the course of their lifetimes to keep the gas flowing.⁸

Currently, more than 60,000 natural gas well pads can be found in Pennsylvania.⁹ In 2008 alone, The Commonwealth approved over 7,500 natural gas drilling permits, more than any year on record.¹⁰

Companies have already drilled more than 600 Marcellus Shale wells in Pennsylvania,¹¹ and the rush to exploit the Marcellus Shale natural gas reserve guarantees that companies will continue to develop more well pads, drilling sites and pipelines in the Commonwealth.



Companies have already drilled nearly 600 Marcellus Shale wells in Pennsylvania.

Environmental threats posed by drilling

While deep-well gas drilling in the Marcellus Shale is just beginning in Pennsylvania, it has already led to severe environmental pollution and degradation. This includes excessive water pollution that has ended up in our rivers, streams and drinking water sources, and toxic pollution from the dozens of dangerous chemicals used in the natural gas extraction process.

Moreover, natural gas drilling has led to excessive water withdrawals from nearby rivers and streams. And natural gas drilling destroys much-needed habitat for Pennsylvania's native plant and animal species and areas used for recreational activities like hunting, fishing, hiking and camping.

Unfortunately, these negative effects have not only occurred in Pennsylvania where this form of drilling just began, but have become the legacy in other states that have experienced deep well drilling for years, such as Texas, Colorado, Arkansas and Wyoming.

Excessive water use

One of the greatest threats posed by natural gas drilling is the excessive use of water that is necessary for deep-well drilling. Each drilling site requires anywhere from 2 to 6 million gallons of water per wellhead for this process.¹² Natural gas companies often look to local rivers and streams to access these enormous volumes of water.¹³ To make matters worse, some drilling sites are near headwaters of streams with naturally low volume.

Many of Pennsylvania's waterways cannot handle these excessive withdrawals, which threaten to harm local plant and animal species. In the worst cases, so much water is removed that streams have dried up and disappeared.

In southwestern Pennsylvania, Cross Creek in Hopewell Township and Sugarcamp Run in Independence Township—both found in Washington County—nearly ran dry as natural gas drilling operations pumped much of the water out of these streams to use in nearby natural gas drilling operations.¹⁴

With more than 40,000 drilling permit applications expected to be proposed in the Commonwealth over the next three years,¹⁵ more of Pennsylvania's rivers, streams and ecosystems will be vulnerable to these types of damaging water withdrawals.

Chemicals and wastewater leaks

As part of the hydraulic fracturing process, drilling companies use a cocktail of chemicals in order to help break up the shale and access the natural gas. Companies in Pennsylvania have been shown to use between 85 and 150 different chemicals in this process,¹⁶ including benzene, xylene, pesticides, and



▲ *Natural gas companies have proposed that state officials open up another 1 million acres of state forestland and 1.7 million acres of state game lands for further natural gas drilling.*

other chemicals. Many of these chemicals are suspected or known carcinogens that cause respiratory, hormonal, neurological, and other serious health problems.¹⁷ (See Appendix A).

This pollution can permeate our environment in a number of ways. Anywhere from 20 to 40 percent of the fracking fluid remains underground after drilling has ceased, leaving wastewater that could migrate to nearby aquifers. Wastewater that is pumped back to the surface of the well is often stored in open-air treatment ponds before being sent to treatment facilities.

However, some groups have voiced concern about the regulation of this practice. Even when the practice is followed correctly, open-air storage lagoons can still leak or overflow into the surrounding environment and nearby rivers and streams.¹⁸

Leaks and spills can occur at other phases of the wastewater treatment process as well. In a tributary along Cross Creek Lake in Washington County, for example, a nearby gas well reportedly polluted three-quarters of a mile due to a leaking wastewater pipe, killing aquatic and insect life in the area.¹⁹

What's worse, in 2005 Congress voted to exempt the oil and gas industry from complying with the Safe Drinking Water Act, a landmark environmental and public health protection statute. This makes it impossible for Pennsylvanians to know what is being released into our environment and potentially threatening our drinking water supplies and aquifers.

Threatening drinking water

A large volume of wastewater and industrial pollution is generated during the hydraulic fracturing process when chemicals, sand and water are forced underground at high pressures. Unfortunately, most sewage treatment facilities in Pennsylvania do not have the technology to deal with this type of industrial pollution coming in from Marcellus Shale drilling—or the system capacity to deal with the massive volume of water flowing into their treatment facilities.

This has led to under-treated or untreated wastewater being released into nearby rivers and streams, where they contaminate the local environment and can affect the quality and taste of drinking water. This was the case in Jersey Shore, in Lycoming County, Pennsylvania. In June 2009, state environmental officials ordered the Jersey Shore Borough's sewage treatment plant to stop accepting wastewater from oil and gas drilling after under-treated gas drilling wastewater was discharged into the Susquehanna River, which serves as a drinking water source for downstream communities.²⁰

More than just surface drinking water supplies are susceptible to contamination from natural gas drilling activities. In Susquehanna County, Cabot Oil & Gas reported that private water sources had been contaminated with methane after Cabot's natural gas drilling activities broke through nearby residents' underground well water supply.

Furthermore, if existing natural gas drilling operations in other states are



▲ Wastewater is often stored in open-air treatment ponds, like these in Washington County, which can leak or overflow.

a sign of what's to come, the future looks grim. At hundreds of drilling sites in New Mexico, Texas and Wyoming, groundwater sources have been contaminated as wastewater has leached into nearby aquifers, drinking water wells and streams.²¹

In Sublette County, Wyoming where some of the country's first and largest hydraulic fracturing operations have taken place, hydrologists discovered benzene—a known carcinogen—in well water at concentrations up to 1,500 times the level considered safe for public health.²²

In Weld County, Colorado, at least three residents recently discovered methane gas in their drinking water well, most likely caused by a nearby natural gas well. In one household, the tap water contained enough methane that they were actually able to light the water on fire as it came out of the faucet.²³



▲ Deep well drilling, considered to be exceptionally damaging to the surrounding environment, is beginning to take place on both private and public lands owned by the state's taxpayers.

Endangering public and private lands

Besides leaving a legacy of polluted waterways, contaminated drinking water supplies and toxic pollution, Marcellus Shale natural gas drilling is likely to cause irreversible damage to Pennsylvania's forests and open space. Deep well drilling is beginning to take place on public lands owned by the state's taxpayers and private property at an astronomical rate. Already, 660,000 acres of state forestlands have been leased out to drilling companies for natural gas exploration on our public lands.

Pennsylvania's current system makes it difficult for local authorities to dictate where deep well natural gas drilling does or does not take place. Under Pennsylvania's Municipalities Planning Code, the Commonwealth's cornerstone land use law, local communities and residents may, in some cases, be unable to take action or have binding input into natural gas drilling in their communities. To make matters worse, landowner rights and mineral rights are separate under Pennsylvania law, and with a few exceptions, mineral rights often trump land use laws.

This lack of local landowner input has proved to be problematic in recent years. In 2003, under pressure from concerned citizens, Pennsylvania's Department of Conservation and Natural Resources (DCNR) issued a moratorium on deep-well oil and gas drilling on public lands. Yet in 2008, under pressure from industry lobbyists and their allies in the Pennsylvania Legislature, state environmental officials lifted the five-year moratorium, opening up 75,000 acres of public lands for natural gas drilling in three state forests.²⁴

As 2009 commenced, natural gas companies proposed that state officials open up another 1 million acres of state forestland and 1.7 million acres of state game lands for further natural gas drilling, a proposal that is still pending before the Pennsylvania Legislature.

Policy recommendations

Any natural gas drilling that takes place in the Marcellus Shale must protect the public's health, our environment and Pennsylvania's natural heritage. To ensure that this standard is achieved, PennEnvironment recommends the following actions:

Strengthen clean water laws

Given the severe threats posed by deep well natural gas drilling to our streams, rivers and drinking water sources, Pennsylvania must improve its clean water laws to ensure that its waterways—both above ground and below—are fully protected from toxic pollution and excessive water use.

The Department of Environmental Protection (DEP) has stated that increased natural gas drilling increases the likelihood of pollution in our waterways.²⁵ This is counter to the goal of the federal Clean Water Act, one of our cornerstone environmental laws, which stated that all of our waterways should be fishable and swimmable by 1983, and that we should have zero discharges to our rivers, lakes and streams by 1985. This is a goal that will never be met when states like Pennsylvania allow polluters to keep contaminating our water resources. However, if drilling is to be a part of Pennsylvania's future, the Commonwealth's laws and practices must favor clean water protections first and foremost.

PennEnvironment supports:

- **Setting water withdrawal limits and reporting requirements on discharges and wastewater disposal to DEP as part of the National Pollutant Discharge**

Elimination System (NPDES) process for natural gas drilling.

- **Expanding the existing protective buffer zone around streams to protect water ways from natural gas drilling pollution.**
- **Requiring DEP to account for cumulative impacts of natural gas exploration from multiple drilling sites when permitting new drilling.**

Place pristine places off limits

Given the potential dangers of natural gas drilling to our forests and waterways, as well as DEP's lack of capacity necessary for oversight and enforcement, it is troubling that much of Pennsylvania's new drilling exploration is occurring in our state parks and forests, near clean streams and rivers, and near sensitive biological areas. It is critical that the most pristine parts of Pennsylvania's natural heritage are protected.

PennEnvironment supports:

- **Designating the following places off limits for natural gas drilling: important habitat for threatened or endangered species; areas that supply drinking water to downstream communities; and sensitive or threatened ecosystems such as wetlands. Designating a safe distance between drilling activities and these areas.**
- **Restricting all new natural gas drilling leases in public lands until natural gas companies can prove that their activities will not cause damage to our environment—a milestone that the industry has not yet been able to meet with the ongoing pollution problems and environmental degradation their activities are causing across the state.**



▲ PennEnvironment recommends designating sensitive or threatened ecosystems off limits for natural gas drilling.

Improve public right to know

Pennsylvanians have a right to know about the chemicals that are used in the fracking process, as well as which companies are releasing pollution into our environment and redirecting to wastewater treatment plants.

Many of the chemicals used in the fracking process are known or suspected to cause cancer, birth defects, and other negative health effects. Unfortunately, most natural gas companies refuse to let the public know precisely what chemicals they are using in their drilling processes and in what amounts. Companies are not even required to report their natural gas withdrawals to state officials for many years following drilling—a policy that is unique to Pennsylvania. Only by having access to all of the pertinent information related to natural gas drilling of the Marcellus Shale can the general public, elected officials and environmental regulators take the proper steps to protect our environment and public health.

PennEnvironment supports:

- **Requiring natural gas companies to report the types and amounts of the chemicals they're using, as well as where they are being used. This type of information must be available to the general public, environmental officials, their employees who may be in contact with these chemicals, and emergency response personnel and physicians.**
- **Requiring companies to report withdrawals from Pennsylvania's waterways, including how much water they have removed as well as where they are directing their wastewater and how much wastewater they're producing.**
- **Requiring companies to regularly report the amount of natural gas withdrawn from each well in Pennsylvania to state officials, environmental regulators and the public.**
- **Implementing an electronic reporting system whereby the public can easily access information about Marcellus Shale hydraulic fracturing activities outlined above.**

Increase public participation

Currently, most decisions made about Pennsylvania's public lands, such as state parks and forests, or private lands in residents' communities or backyards, do not require a public comment period or input from the surrounding community. If and when state officials do solicit public comments and feedback, the input is not binding and they are not required to implement the will of the people. The public should be given ample time and opportunity to voice their opinion regarding oil and gas exploration—on both public and private lands in their community.

PennEnvironment supports:

- **Requiring a comprehensive and binding public comment process for decisions being made about large tracts of state land, or related to oil or gas drilling activities that impact Pennsylvania's waters.**



▲ Pennsylvanians have a right to know about pollution being released into the forests and waterways that provide irreplaceable recreational opportunities and wildlife habitat.

- **Improving Pennsylvania's property rights and land use laws to provide property owners and local officials an opportunity for input into local natural gas drilling proposals.**
- **Amending the sections of the Municipalities Planning Code to allow local officials and residents to determine best practices for land use within their community.**

Improve tools for Pennsylvania's regulators

When Pennsylvanians are faced with the environmental and public health threats posed by natural gas drilling, our environmental regulators at the Pennsylvania Department of Environmental Protection (DEP) are our first—and often last—line of defense. Unfortunately, the current system undercuts the department's power and leads to both fewer and lower penalties for polluting companies. DEP does not currently have the funding, the staff, or the time to properly review all of the proposed natural gas drilling permits or to ensure that companies are using the best available technologies and practices. Most importantly, DEP needs the resources to ensure the protection of Pennsylvania's environment and public health.

PennEnvironment supports:

- **Increasing funding for DEP's permitting department in order to tackle the growing number of proposals for natural gas exploration in the state.**
- **Increasing DEP's time period for reviewing permits in order to guarantee that the public's health and the environment are protected, and to allow**

- for full public disclosure and input.**
- **Increasing the capacity and funding for DEP's enforcement staff to monitor and control drilling companies' water withdrawals and discharges.**
- **Allowing state health and environment officials to review and provide input on applications for operations that could affect public health or wildlife habitat.**

Ensure that polluting industries pay for damages

Natural gas drilling has been shown to cause severe damage to our environment and threaten public health—while reaping huge financial benefits for the companies that are extracting this natural resource from underneath the Commonwealth's lands. Companies should pay for the pollution and environmental degradation that they create and the necessary environmental regulatory costs that are needed to oversee this industry.

PennEnvironment supports:

- **Levying fees on natural gas companies for the valuable resources that they remove from underneath Pennsylvania's lands. Pennsylvania is the only state in the nation with significant extraction activities that does not charge extraction fees for natural gas taken from under its lands.²⁶ As private drilling companies generate billions of dollars in profit, we must ensure that Pennsylvania receives its fair share of revenue for turning over natural gas rights to these industries.**
- **Requiring drilling companies to pay for air pollution, water pollution, lost habitat, and other environmental and public health threats they create. Companies, not taxpayers, should foot**



▲ PennEnvironment supports requiring companies that profit from polluting to pay the costs of clean up.

the bill for these negative byproducts of natural resource exploitation.

- **Requiring natural gas companies to pay the entire cost of plugging their wells when drilling is complete, instead of leaving Pennsylvania's taxpayers to pay.**
- **Implementing mandatory minimum penalties for violating federal and state environmental laws or environmental regulations related to natural gas drilling. These mandatory minimum penalties must be significant enough to deter companies from violating environmental laws.**
- **Requiring air emission controls—including diesel particulate filters—on all natural gas operations within a quarter of a mile of schools and homes in Pennsylvania.**

Federal action

Deep-well natural gas drilling and hydraulic fracturing are not unique to Pennsylvania. In fact, hydraulic fracturing has been taking place in Colorado, Wyoming, Montana, New Mexico, Texas, Alabama and other states for years, and is likely to increase in the Marcellus Shale states in the near future.

As Pennsylvania begins to address gas drilling through legislative and administrative action, parallel federal legislative and administrative actions are needed to protect Pennsylvania and other states from the harmful effects of oil and gas drilling, hydraulic fracturing and extraction.

PennEnvironment supports:

- **Reinstating the portion of the Safe Drinking Water Act that directs the Environmental Protection Agency (EPA) to regulate the oil and gas industry's activities, specifically the injection of fracturing fluids underground.**
- **Establishing more stringent effluent limitation guidelines to restrict the most harmful waste disposal practices of the oil and gas industry, specifically:**
 - **Banning wastewater discharge to publicly owned treatment works.**
 - **Requiring recycling and reuse of all flowback wastewater.**
 - **Regulating centralized waste treatment plants that receive drilling wastewater.**
 - **Setting zero discharge limits and using advanced pollution control technologies to limit or eliminate pollution in water discharged from centralized wastewater treatment plants.**
 - **Requiring complete disclosure from drilling companies of all chemicals used in hydraulic fracturing and publishing the results.**
 - **Creating enforceable Best Management Practices to regulate wastewater prior to transfer and treatment.**



▲ PennEnvironment supports action here in Pennsylvania, as well as at the federal level, to address Marcellus Shale gas drilling.

Notes

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Appendix A

Frac Water Chemicals Chemical Components (From MSDS)

This list is the basis for the "River Reporter" article analyzing the health effects of fracturing ingredients to be found at this link: www.riverreporter.com/issues/08-12-04/fracking.pdf. Information from the Pennsylvania Department of Environmental Protection (DEP), December 2008.

2,2-Dibromo-3-Nitrilopropionamide
2-butoxyethanol
2-methyl-4-isothiazolin-3-one
5-chloro-2-methyl-4-isothiazotin-3-one
Acetic Acid
Acetic Anhydride
Aliphatic Acid
Aliphatic Alcohol Polyglycol Ether
Ammonia Persulfate
Aromatic Hydrocarbon
Aromatic Ketones
Boric Acid
Boric Oxide
Butan-1-01
Citric Acid
Crystalline Silica: Cristobalite
Crystalline Silica: Quartz
Dazomet
Diatomaceous Earth
Diesel (use discontinued)
Ethane-1,2-diol
Ethoxylated Alcohol
Ethoxylated Alcohol
Ethoxylated Octylphenol
Ethylene Glycol
Ethylhexanol
Ferrous Sulfate Heptahydrate
Formaldehyde
Glutaraldehyde
Glycol Ethers
Guar gum
Hemicellulase Enzyme
Hydrochloric Acid
Hydrotreated light distillate
Hydrotreated Light Distilled

Isopropanol
Isopropyl Alcohol
Magnesium Nitrate
Mesh Sand (Crystalline Silica)
Methanol
Mineral Spirits
Monoethanolamine
Petroleum Distillate Blend
Petroleum Distillates
Polyethoxylated Alkanol (1)
Polyethoxylated Alkanol (2)
Polyethylene Glycol Mixture
Polysaccharide
Potassium Carbonate
Potassium Hydroxide
Prop-2-yn-1-01
Propan-2-01
Propargyl Alcohol
Propylene
Sodium Bicarbonate
Sodium Chloride
Sodium Hydroxide
Sucrose
Tetramethylammonium Chloride

Frac Stage #1

Hydrochloric Acid
Propargyl Alcohol
Methanol
Acetic Acid
Acetic Anhydride

Frac Stage #2

Methanol
Boric Oxide

Petroleum Distillate Blend
Polysaccharide
Potassium Carbonate
Sodium Chloride
Potassium Hydroxide
Ethylene Glycol
Boric Acid
Sodium Bicarbonate
Monoethanolamine

Frac Stage #3

Hydrotreated light distillate
Ethoxylated Alcohol
Glutaraldehyde
Dazomet
Sodium Hydroxide
Methanol
Diesel (use discontinued)
2,2-Dibromo-3-Nitrilopropionamide Poly-ethylene Glycol Mixture
Mesh Sand (Crystalline Silica)



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