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Sulfolane Contamination in North Pole, Alaska:
Can Government Fix the Problem?

Abstract:

In North Pole, Alaska, the chemical compound sulfolane has contaminated groundwater in a plume nearly 3.5 miles long, impacting homes using private well water systems. Sulfolane has also been detected in vegetables that were grown in contaminated soils in residents' gardens. The groundwater plume can be found above and below a layer of permafrost. Remediation of sulfolane can be accomplished by aerating water and soil; however, it is difficult and costly to reach the groundwater that lies beneath the permafrost, where sulfolane remains trapped in some areas. Private wells that are used by residents and businesses have been affected; currently, only buildings within the small boundaries of the city limits are on a public water utility system. Ultimately, the State of Alaska has the responsibility to correct the contamination and ensure clean water for residents. What is an acceptable limit for this contaminant in drinking water when there has been no precedent for such a spill? Evaluation and correction of the situation continues with assistance from the Environmental Protection Agency and the State of Alaska Department of Environmental Conservation. A pending study of health precautions will be released by EPA in 2019.

Keywords: North Pole, sulfolane, Flint Hills Refinery, EPA, Safe Drinking Water Act, Moose Creek, DWPP, Williams Alaska Petroleum, ADEC, TERA, National Toxicology Program, Source Water Protection Plan

Introduction

Sulfolane contamination in groundwater and soil has occurred in only a few areas in the United States and Canada. Scientists had little-to-no historical information to consult prior to the spill at the Flint Hills Refinery in North Pole, Alaska. Research on the effects of sulfolane

contamination and potential human health hazards did not exist. In the handful of previous cases, the affected areas were of small size and drinking water was not impacted. Sulfolane spills were such a rare occurrence that the Environmental Protection Agency did not have a maximum-allowable level established for drinking water. The actors in previous cases all settled on differing amounts in accordance with their state or provincial government, but these cases pertained to soil contamination, not groundwater.

This paper will examine how public policymakers developed a legal maximum limit of sulfolane in drinking water as a policy to protect public health. The framework for this study is the multiple-streams approach. In accordance with this theory, the focusing event is the North Pole sulfolane plume which has impacted over 600 homes. The problem centers on private water wells that became contaminated. Managing the event and solving the problem becomes the job of politics, when state legislators and agencies, the EPA, and municipal leaders all converge to render a specific public policy: what is an acceptable limit for this contaminant in drinking water when there has been no precedent for such a spill? A policy needed to be formulated to determine the extent of remediation measures and to protect public health.

The lack of a maximum-level allowed by law caused many difficulties in the Alaska situation. City of North Pole officials examined their municipal wells and discovered a sulfolane breach. The Alaska State Department of Environmental Conservation began testing of groundwater flow, and then testing of private household water wells. The current owner of the refinery, Flint Hills, offered to purchase and install water filtration systems for homes, but first they needed to determine if filtering could remove sulfolane and make the water safe to drink. In areas of high sulfolane concentration, Flint Hills paid for water delivery. Property owners and developers who wanted to construct new buildings or infrastructure had the potential to disrupt groundwater, and the city had to determine how that would be handled.

Throughout my research of the situation, I examined responses and efforts of the previous owner of the refinery, the current owner of the refinery property, the oil industry, the local university, state legislators, city officials, the state's Department of Environmental Conservation, the Governor, residents, and the federal Environmental Protection Agency. My major findings were that these entities sometimes worked together, and sometimes against each other, when offering potential solutions to the crisis. At some points, the interests of the oil industry and state

lawmakers were at odds with the entities overseeing public health, local government, and physical remediation. The contamination from the Flint Hills Refinery has brought up many legal issues, challenges, and questions. Flint Hills has made large efforts on its own accord to assist residents although it had no formal agreement to do so (prior to 2018). The oil industry was concerned with avoiding current and future liability and with the enormous cost of remediation. Two state lawmakers, one of whom represents North Pole in the Alaska State Legislature, supported the industry's recommendation for a relatively high level of sulfolane concentration in drinking water. The state's own DEC determined a much lower level should be acceptable, causing friction within state government.

The refinery shut down operations in 2014, mostly due to the expense of remediation and legal costs. Insurance paid for part of the clean-up, but the insurance ran out in 2014. The proposed solution to this environmental crisis is an expansion of the North Pole Municipal water system, which will be extended well beyond its current city boundaries. The expansion to affected areas is estimated to cost nearly \$100 million, 80 percent of which will be paid-for by Flint Hills, and the remaining 20 percent by the State of Alaska. Finally, after more than nine years of discussion, studies and planning, construction of water lines began in January 2018.

Background

Existence of the sulfolane plume in North Pole was announced in 2009. The Alaska Department of Environmental Conservation (ADEC) believes that the spill happened before 2000, when the chemical was first detected in groundwater monitoring wells within the refinery's property boundaries.

Sulfolane was leaking from the refinery when the facility was controlled by its original owner, Williams Alaska Petroleum Inc. The company maintains that their liability ended when they sold the refinery. Flint Hills Resources purchased the oil refinery in North Pole in 2004. Flint Hills is a subsidiary of Koch Industries, one of the enterprises controlled by the billionaire brothers Charles and David Koch. The State of Alaska owned the land until shortly before the sale to Flint Hills, so the state may face some liability for the cleanup. Flint Hills knew when it purchased the refinery that sulfolane had leaked, but the company assumed that sulfolane only existed within the refinery's boundaries (a 240-acre site). Sulfolane was unregulated at that time,

but it came to ADEC's attention immediately after the sale. Flint Hills began testing by drilling off-site wells in 2008 (Buxton, 2016). The company was sued around the same time by a neighboring homeowner whose well-water was tainted. It was also discovered that sulfolane had breached one of the municipal public wells in the City of North Pole (Barr, 2012). The City began weekly testing to check for the contaminant.

The State of Alaska estimated that 300 gallons of sulfolane spilled, but the chemical also leaked during other parts of the refining process (ADEC, 2018). The ADEC believes sulfolane leached into groundwater over a period of many years, due in part to storage in wastewater lagoons. These lagoons were lined with plastic, but there were numerous holes in the liners. The wastewater could have had sulfolane concentrations of 35,000 parts per million. The groundwater flow in the area is north-northwest in the spring and shifts north in the summer and fall (Paturi, 2016) so the contaminant spread in two directions away from the refinery's property (Barr, 2012).

Flint Hills has made large efforts on its own accord to assist residents, such as purchasing and installing filtration systems in individual homes or has had water delivered to affected residents, although Flint Hills had no formal agreement to do so. Flint Hills attempted to sue Williams Petroleum for clean-up costs, but the Alaska Superior Court ruled that time limits between the Flint Hills purchase of the property and the filing of the lawsuit exceeded state law.

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The Case

Prior to the North Pole spill, little research or testing had been done regarding sulfolane contamination of drinking water supplies, or on health hazards to animals and humans. Laboratory testing began after the breach outside the refinery, but not enough time has passed yet to conclude a long-term study of what exposure may do to human subjects. In 2012, the State of Alaska nominated sulfolane for inclusion in the National Toxicology Program (NTP) for study,

and it was accepted (ADEC, 2017). This program is managed by the National Institutes of Health (NIH), the Center for Disease Control and Prevention (CDC), and the Food and Drug Administration (FDA). NTP began short and long- term studies on the effects of ingesting sulfolane, primarily on pregnancy, development, and the immune system. Published studies (as of 2018) have not been concluded on humans; only testing on lab rodents has been performed. Short-term six-month studies on animals have shown effects on the central nervous system, such as hypothermia, convulsions, and hyperactivity. Longer studies have shown effects on the liver, spleen, and kidneys, and possible growth and developmental problems (TERA, 2014 and 2018, and EPA, 2017). There is no evidence yet of cancerous results.

It has been shown (ADEC, 2017) that sulfolane will present in edible plants that have been irrigated with sulfolane-contaminated water. ADEC claims that bathing, washing dishes and laundry, rinsing food, cooking food where water is discarded, washing cars, watering lawns, and small-scale digging will not cause significant exposure to sulfolane. Sulfolane dissipates when exposed to air; however, airborne water droplets can still be inhaled by humans, especially when showering. ADEC advises that livestock should not be given sulfolane-contaminated water if the animals will be eaten or milked, or to chickens who produce eggs for human consumption.

Large-scale excavation (such as building or road construction) will require dewatering first (pumping out groundwater) to minimize exposure to property and workers. Dewatering requires a special permit. After dewatering, soil to be removed must be aerated to release moisture or water content. Sulfolane does not adhere to soil or objects.

Since 2012, Flint Hills has offered resources such as bottled water, a complaint office, bulk water delivery, and the installation of water filtration systems in private homes for over 1500 affected residents, (Arcadis, 2013) The company has spent millions of dollars in this effort. Flint Hills also dug a new municipal well for the City of North Pole. The ADEC has conducted door-to-door testing in many neighborhoods that lie within the sulfolane plume, an area of about 7 square miles. ADEC, with assistance from Flint Hills, has also hosted public meetings and public comment periods on the crisis to keep residents informed and to ensure that they know resources are available to help them.

In mid-2016, the Alaska Supreme Court reversed the earlier decision by the Superior Court, and determined that incorrect laws were applied (Buxton, 2016). It said Williams was at least

partially responsible for the contamination problem, and was partially liable for clean-up costs, up to the limits of the sale contract. The court also said that state law holds Williams responsible for the sulfolane that migrated from the refinery's property.

Flint Hills closed the refinery in 2014, citing lower oil prices and the high costs of sulfolane cleanup as their main reasons for ending operations. Limited functions continue as a fuel storage site. The Koch brothers attempted to sell the property, but there were no buyers. In December of 2016, Flint Hills began demolishing the refinery (Bohman, 2016). Removing the structures results in lower maintenance and liability issues, and lower property tax values and payments. The facility will continue to provide fuel storage as it is co-located with the Trans-Alaska oil pipeline and the Alaska Railroad.

The City of North Pole began a lawsuit against Williams Petroleum in 2014, to sue for damages and for the costs of remediation. The present-Governor, Bill Walker, announced a partial settlement by the state in February of 2017. The Williams lawsuit is still ongoing, but the State of Alaska and Flint Hills Resources agreed to pay for an extension of the North Pole Municipal Water System. This extension would provide piped water service to all properties that are impacted by sulfolane contamination. Flint Hills will continue to provide drinking water until construction is completed. The City of North Pole will continue to own, operate and maintain the system. The agreement to install piped water to all affected properties resolves all claims currently pending in Fairbanks court between the City of North Pole, the State of Alaska, and Flint Hills.

Case Analysis

For several years, Flint Hills sought ways to decrease their costs and liability for the clean-up. They were required by ADEC and the EPA to clean the groundwater at the refinery site. The groundwater was filtered to remove sulfolane, and then reinjected back into the ground (Barr, 2012). In 2014, the company pushed the State of Alaska to lower the standards for removal of sulfolane from groundwater. The state standard was 15ppb (parts per billion). Over 300 private water wells tested at or above that level of contamination. Flint Hills requested that the standard be raised to 362ppb, claiming that experts from the University of Alaska Fairbanks deemed this figure to be a safe level. Only 3 wells tested at 362ppb. Remediation at the 15ppb level was costing the refinery a great deal of money. The state stood fast and waited for a federal study to

be released that examined what drinking low levels of the chemical would do to animals (TERA, 2014). An official at the Environmental Protection Agency countered that the 362ppb measurement was pertinent only to refinery property, and not to household drinking wells (Bross, 2015).

There was also political pressure from the state legislature against the state's own department, the Alaska Department of Environmental Conservation. The State of Alaska relies heavily on oil revenues for its funding. Rep. Tammie Wilson (R-North Pole) and then-Rep. Pete Higgins (R-Fairbanks) claimed that ADEC caused the refinery shutdown due to onerous clean-up standards. They claimed ADEC was too stringent, and that Flint Hills had proposed an acceptable level of pollution at 362ppb. In a press release, Wilson said ADEC had "unrealistic expectations" that played a major role in the refinery's closure. In the same press release, Higgins declared that ADEC actions "forced" the shutdown (Cole, 2014). The representatives cited the loss in economic opportunity, job layoffs, and reduced revenue from property taxes and royalty oil taxes as economic burdens for the company, the state, and the City of North Pole. State employees at ADEC felt this was push-back from the legislature. However, then-Governor Sean Parnell, a Republican with previous ties to the oil industry (he was an attorney for Conoco Phillips in the past), disagreed with his legislators. Parnell maintained that public health was the first and foremost concern of the state, and the state would continue to pursue remediation efforts and best practices.

There was limited data available on what an acceptable level of sulfolane in drinking water should be, since sulfolane contamination has been quite rare and was largely unstudied before the North Pole incident. In Texas, a cleanup level of 320 parts per billion was accepted, but that situation did not involve drinking water. In Canada, a level of 90 parts per billion was approved (CCME, 2006 and Warnica, 2014)). Delaware is the most stringent at 1.6ppb, and Indiana more moderate at 16ppb. In the end, EPA adjusted the measurement standard to 16ppb (Cole, 2014 and TERA, 2014), with the EPA director himself speaking about the North Pole incident in a formal announcement.

ADEC has been monitoring the site cleanup on refinery property. An underground filtration system was installed, and soil was excavated, aerated, and disposed of as necessary. It is believed that no more sulfolane is leaking from the property (ADEC, 2017).

Conclusion

As the city and state deals with the aftermath, what are our lessons learned? How can we prepare for a similar situation in the future? North Pole is preparing for that eventuality. Its City Council asked a local engineering firm to develop a Source Water Protection Plan in the hope of preventing future contamination problems. The plan would be a tool that the city can use to regulate land uses that are in proximity to any municipal water wells. The ordinance would address issues such as: private wells in the vicinity, septic systems, runoff potential, and fuel storage tanks. Limits may be imposed on the type of development that could occur on a parcel of land within the area. The plan is being developed in conjunction with Alaska Department of Environmental Conservation researchers and will receive funding from the EPA.

The model for this type of assessment originated with amendments that were added to the Safe Drinking Water Act in 1986 and 1996, which required all states to develop programs to protect the quality of public drinking water systems. In Alaska, it is known as the Drinking Water Protection Program (DWPP). A water source (such as groundwater) is identified and mapped, and any potential uses within the mapped area that may pose a risk to water quality are examined. Non-regulatory measures can include: public education, a spill-prevention plan, household hazardous waste collection, and conservation easements. Regulatory actions could entail: prohibiting the use of certain chemicals, zoning ordinances, subdivision ordinances, and operating systems for industrial or other activities (ADEC, 2017).

To add to the city's woes, more (unrelated) contaminated wells have recently been uncovered near North Pole. Perfluorinated compounds have been discovered in the Moose Creek neighborhood (Friedman, 2017), related to firefighting foam chemicals used at nearby Eielson Air Force Base. Similar to the Flint Hills situation, the US Air Force conducted several town hall meetings and took public comment from residents. It also developed a feasibility study with seven plans to remediate the problem. The Air Force has also come forward to pay for water delivery and granular-activated carbon filters for the affected homes (261 properties with a total of 750 people) until a more permanent solution is completed. The City of North Pole has suggested that it could (again) extend its municipal water system to help Moose Creek residents

(Friedman, 2017). This plan, which the City Council supports and which the Air Force recommends as the best scenario, would entail laying over five and a half miles of pipe, and the Air Force will cover the cost. Bryce Ward, Mayor of the City of North Pole, said that the city has learned quite a bit about the water treatment process in dealing with the sulfolane issue, and adding the second expansion to Moose Creek would enable the city to take advantage of the economies of scale that would result from both projects (Ellis, 2017).

The State of Alaska and the City of North Pole accomplished the arduous task of creating a public policy regarding sulfolane contamination levels. This pioneering effort may assist researchers and communities in the future. Scientists now have a major case study to examine, and lawmakers have a precedent for policy and procedures. Unfortunately, potential health risks are still largely undetermined and unknown. The possibility of long-term consequences to human health remains.

North Pole residents are still waiting for completion of the new municipal water system. Land clearing for rights-of-way has already started this year (City of North Pole, 2018), and construction of the piping system will continue for the next two years. This will result in connections to the North Pole Municipal Water System for 650 new customers. In addition, Flint Hills dug two new municipal wells for the City of North Pole to supply the expansion. While this seems like a good solution, unanswered questions remain: how will property values be affected by tainted groundwater? What are the health consequences for people who have used and consumed sulfolane-contaminated water amounting to years' worth of exposure? The EPA has a pending health study set for release in the Summer of 2019, so affected residents must still wait for definitive answers regarding potential health risks. The study will examine laboratory animals who drank sulfolane-contaminated water for two years, and then focus on effects on the reproductive and immune systems, and the possibility of carcinogenic effects. The EPA has mandated that testing of water wells must continue, even though it expects the sulfolane plume to dissipate over time.

The court-battle with Williams Petroleum, regarding any payment for damages, is still ongoing as of this writing.

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