Pit Pollution

— Backgrounder on the Issues, with a New Mexico Case Study —

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May, 2004

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1. Why Worry About Pits?

There are many fluids and wastes associated with oil and gas operations that can poison living organisms (e.g., cancer-causing substances such as benzene and other hydrocarbons; radioactive materials; heavy metals; and many others). When discharged into unlined pits the toxic substances in pits can leach directly into the soil and may contaminate groundwater. Lined pits can also lead to pollution via ruptures in liners or by overflowing the pit area. These events can result in soil and water contamination, which can have a negative effect on both human and ecosystem health. For example, the New Mexico Environmental Bureau, since its inception in the mid-1980s, has recorded more than 6,700 cases of oil and gas pits causing soil and water contamination in the state, with 557 of those cases resulting in groundwater contamination.[1]

Another issue related to pits concerns direct contamination of wildlife and livestock. In the arid western states, animals are drawn to pits that contain fluids. If pits are inadequately fenced and netted wildlife and livestock can access the pit contents. There have been many instances of bird, wildlife and livestock mortality resulting from drinking or simply coming in contact with the toxic fluids in pits.

The types of wastes stored in pits include: drilling wastes; produced water; and production fluids and wastes. At the present time, these wastes, known as exploration and production (E&P) wastes, are not technically considered hazardous by the federal government. This is because in the past Congress exempted E&P wastes from our nation's hazardous waste law, the *Resource Conservation and Recovery Act* (RCRA).[2] This exemption was granted despite the fact that toxic substances are contained in the wastes, and despite the countless examples of groundwater, surface water, air and soil contamination related to oil and gas activities.

1.1 How Pit Pollution Occurs

Pits are used to store a variety potentially toxic, as well as non-hazardous liquid and solid wastes associated with oil and gas development.

Solid wastes, if left on site, may contain toxic substances that can:
1) Leach out of the solids and contaminate groundwater.
2) Contaminate soils and vegetation.
3) Sterilize soils and prevent vegetative growth.

Liquid wastes may contain toxic substances that can:
1) Overflow the sides of the pit (e.g., during a rain event, or due to inadequate storage volume of the pit) and pollute soil and surface waters.
2) Leach directly into the ground (if stored in unlined pits) and contaminate soil and water.
3) Seep into the ground (even if the pits are lined) through tears in liners, allowing substances to leak through to the soil and groundwater. Even if pits are lined, the liners are often improperly installed, or are torn, and frequently leak.

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[1] Letter from Roger C. Anderson, Environmental Bureau Chief, New Mexico Energy, Minerals and Natural Resrouces Department, to Jennifer Goldman, OGAP. Oct. 23, 2003.
[2] U.S. Environmental Protection Agency. Oct. 2002. *Exemption of Oil and Gas Exploration and Production Wastes from Federal Hazardous Waste Regulations.*
www.epa.gov/epaoswer/other/**oil**/**oil-gas**.pdf

Photo of pit with a torn liner.

1.2 Soil and Water Contamination from Pits

As mentioned in the section on New Mexico Oil and Gas Pits, there are 6,700 documented cases of groundwater and soil pollution from oil and gas pits in the state.

The City of Lovington, New Mexico, has experienced soil pollution from oil spills and pits. In recognition of the contamination threats posed by oil and gas drilling wastes, and in an effort to protect its municipal water supply, Lovington recently banned the use of drilling pits on the city's water field. Information on Lovington situation can be found in Press Clips, in Appendix I.

Soil contamination from pit pollution can inhibit the health and growth of vegetation on-site, which may lead to soil instability and erosion. Also, vegetation may uptake the contaminants and cause health problems for animals that eat the contaminated plants. Similarly, if the contaminants enter surface or groundwater, organisms (humans, livestock, wildlife, aquatic life, micro-organisms) drinking or living in the water may experience negative health effects or death, depending on the level of contamination.

Between 1996 and 2002, the U.S. Environmental Protection Agency (EPA) in Wyoming, Utah, Colorado, Montana, South Dakota and North Dakota conducted 475 field inspections at sites having one or more production pits or commercial facilities using disposal pits. [3]

Problems were found at 290 (more than 60%) of the sites. Issues of concern included:

- Ongoing discharges to surface and groundwater were documented at 22 % of the sites inspected, and those discharges were unpermitted at 35 of those sites (34% of the sites with ongoing discharges observed).
- Leaks and spills were observed from equipment.
- Secondary containment for oil storage tanks was inadequate or non-existent at many sites.
- Pits were improperly designed, located, and operated (including exposed oil on pits)
- Half of the pits observed were either entirely or partially covered in oil. In EPA's view, the number of sites with exposed oil on pits and bird mortality was higher than expected given that advance notice of inspections was provided to site operators.
- There were a number of bird and wildlife deaths related to the pits (142 birds, 42 wildlife).
- There were ineffective or non-existent wildlife exclusion devices at the sites.

[3] United States Environmental Protection Agency, Region 8. January 2003. *Oil and Gas Environmental Assessment Effort – 1996 – 2002.* http://www.epa.gov/region8/land_waste/ogeafinalreport.pdf

One key finding of the EPA report was that almost every commercial facility evaluated had significant environmental issues. Commercial oilfield waste disposal facilities are facilities that receive produced water and other exploration and production wastes for treatment and disposal. Pits, also known as surface impoundments or ponds, are used to holds wastes so that the liquids will evaporate off of the solid waste materials.

1.3 Wildlife and Livestock Mortality Related to Pits

The U.S. Fish and Wildlife Service (FWS) has documented numerous problems related to contaminants in oil field waste pits. In Wyoming, the U.S. Fish and Wildlife Service has found deer, pronghorn, waterfowl, songbirds and rabbits in oil pits. Even if animals are not killed in the pits, the oil and chemicals in the pits may affect their health. For example, if animals absorb or ingest oil, they may become more susceptible to disease and predation.[4]

The U.S. FWS web site contains information on *Contaminant Issues - Oil Field Waste Pits.* [5] This web site lists numerous wildlife-related problems associated with oil and gas pits, such as:

- Skim ponds are a fatal attraction to migratory birds
- Birds, bats and other wildlife mistake pits for wetlands
- Birds landing on waste pits can get covered with oil
- Oil can weigh birds down and cause them to drown
- Many bird deaths go undetected because the carcasses sink to the bottom of the pits
- Oil destroys the feathers' ability to insulate the birds resulting in death from heat or cold stress
- Even a light sheen on the water surface can be deadly. Oil on the feathers of female birds can be transferred to their eggs back at the nest, killing the embryo. Small amounts of oil applied externally to an egg shell can be extremely toxic to embryos
- Some birds become victims of pits when they feed on insects trapped in oil covering the surface of the water
- Animals scavenging on dead birds at these pits often succumb to the toxic effects of oil

Examples of Wildlife and Livestock Deaths from Pit Pollution

> **Chris Velasquez, Rancher - Blanco, New Mexico** (Excerpt from *A High Price to Pay*)[6]
> "I have complained repeatedly to BLM [Bureau of Land Management] about a shallow pit filled with "black gunk" near a gas well operated by Williams. The pit was on my grazing lease and I found cattle tracks to the pit and feared animals might be drinking the oily water. I've found dead cows near oil pits before, and seen lots of dead birds and other wildlife floating in the oil pits so I was worried this cow would drink out of the pit and die too. I lose eight to ten cows each year because of the oil field activity."

[4] U.S. Fish and Wildlife Service. *Wildlife Mortality Risk in Oil Field Waste Pits.* http://mountain-prairie.fws.gov/contaminants/papers/pitrisk.pdf
[5] U.S. Fish and Wildlife Service. Region 6, Environmental Contaminants. *Contaminants Issues - Oil Field Waste Pits*. http://mountain-prairie.fws.gov/contaminants/oilpits.htm
[6] San Juan Citizens Alliance and New Mexico Wilderness Alliance. *A High Price to Pay: Consequences of oil and gas production.* "Chris Velasquez, Blanco Rancher." http://www.oteromesa.org/people_velasquez.htm

Eliminating Oil Field Hazards (Excerpt from U.S. Fish and Wildlife Service, *Division of Law Enforcement, Annual Report 2001*)[7]
"Service special agents continued to conduct oilfield task force operations throughout historic petroleum production areas in New Mexico, Oklahoma, and Texas. In New Mexico, special agents conducted ground inspections of oil pits in Sandoval, Rio Arriba, and San Juan Counties in April 2001. Netting violations detected at eight production sites were referred to the New Mexico Oil Conservation Division for State follow-up. In August, oil field inspections in the southeastern part of the State documented multiple hazards and recovered 17 oil-covered birds; seven operators paid $6,425 in fines for violating the *Migratory Bird Treaty Act*. Dead birds were also discovered at several sites on Bureau of Land Management property in the State; the companies holding the oil leases paid over $8,000 in fines."

Regional Task Force Continues to Address Open Oil Field Pits and Tanks (Excerpt from *The Federal Wildlife Officer*, Spring 2002)[8]
"Service Special Agents throughout the region continued to investigate oil field pollution impacting migratory birds and other wildlife on historic oil fields in Oklahoma, Texas, and New Mexico. Three task force inspection operations were recently culminated following joint inspections of problematic well sites "Oil" and "G" initially documented by aerial surveillance. The Central Oklahoma operation resulted in the recovery of 32 oil covered migratory songbird and raptor carcasses from open pits or tanks operated by seven oil companies and the assessment of collateral fines totaling $11,900."

Is it possible to keep wildlife and livestock out of pits?

Measures to protect wildlife and livestock from toxic substances in pits include:
- systems to prevent oil from entering waste pits;
- immediately cleaning up any oil spills that find their way in open pits;
- adequate fencing around waste pits;
- netting to keep birds from entering pits.

Unfortunately, the devices used to keep out livestock and wildlife out of pits are often inadequate. For example, if netting is not installed properly or maintained well enough (e.g., if there are tears in the netting or if it sags into the waste pit, which is common after it snows), birds are still able to access the pits. Nets should be installed four or five feet above the pits to allow for sagging. Similarly, fencing can be used, but often, wildlife and livestock can still access pit areas.

1.4 Toxic Materials Stored and Disposed of in Pits

There are a variety of toxic substances utilized and created during the oil and gas extraction process. Yet "drilling fluids, produced water, and other wastes associated with the exploration,

[7] U.S. Fish and Wildlife Service. 2001. *Division of Law Enforcement, Annual Report 2001*. http://www.le.fws.gov/pdffiles/USFWS LAW92002.pdf
[8] The Federal Wildlife Officer Association Inc. 2002. "Regional Task Force Continues to Address Open Oil Field Pits and Tanks." *The Federal Wildlife Officer*. Volume 15, Number 1, Spring 2002. p. 2. http://www.fwoa.org/news/fwoanws27b.html

development, or production of crude oil or natural gas. . . " are not subject to federal hazardous waste law (*Resource Conservation and Recovery Act* (RCRA).

This exemption was granted despite the fact that toxic substances are contained in the wastes, and the fact that contamination of groundwater, surface water, air and soil have occurred and continue to occur from oil and gas activities. Even the U.S. Environmental Protection Agency acknowledges that although these oil and gas wastes are exempt from hazardous wastes regulations, the exemption does not mean these wastes could not present a hazard to human health and the environment if improperly managed.[9] Yet the exemption persists.

Potentially hazardous oil and gas wastes that may be found in pits.[10]

	Benzene (mg/l)	**Arsenic** (mg/l)	**Barium** (mg/l)	**Cadmium** (mg/l)	**Chromium** (mg/l)	**Lead** (mg/l)	**Selenium** (mg/l)
It should be considered a hazardous waste if it is above:	**0.5**	**5**	**100**	**1**	**5**	**5**	**1**
Production pit sludges	24					18.3	1.59
Production sands/solids	2,500	9.9			5.98		4.11
Workover/completion fluids	1,530	Heavy metals were not analyzed					
Produced formation – fresh water	1.3		646				
Produced formation – salt water	543		372	27.8	7.25	14.4	2.83
Oil-based drilling muds/cuttings	293	6.5	101	18.8		12.6	
Water-based drilling muds/cuttings	1,100	Heavy metals were not analyzed					

Drilling Fluids and Wastes

Drilling muds (also known as drilling fluids) are used to lubricate the drill bit and carry the rock cuttings back to the surface. Muds may be water-based, oil-based, or synthetic-based depending upon the drilling conditions encountered. Oil-based muds are the most toxic, followed by synthetic and then water-based muds.

Reserve pits are used to temporarily store the drilling muds during the drilling operations, and may be used to dispose of drilling wastes. When drilling is completed, reserve pits are usually closed, and:

- liquids in the pits may be evaporated, discharged to land or surface waters, reinjected in underground wells, or trucked off site for disposal.
- solids in the pits may be spread on land, buried on-site or trucked to an off-site disposal area.

Drilling wastes may contain an array of potential toxic substances.
A survey conducted by the U.S. Environmental Protection Agency and the American Petroleum Institute found that liquids in some drilling reserve pits contained: chromium, lead and pentachlorophenol at hazardous levels, and that oil-based fluids may contain benzene.[11] If improperly disposed of, these fluids can contaminate groundwater, surface waters and soil.

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[9] U.S. Environmental Protection Agency. Oct. 2002. *Exemption of Oil and Gas Exploration and Production Wastes from Federal Hazardous Waste Regulations.* www.epa.gov/epaoswer/other/**oil**/**oil-gas**.pdf

[10] Subra Company. 2003.

[11] U.S. Congress, Office of Technology Assessment. March, 1992. *Managing Industrial Solid Wastes from Manufacturing, Mining, Oil and Gas Production, and Utility Coal Combustion – Background Paper, OTA-BP-O-82.* (Washington, DC: U.S. Gov. Printing Office). p. 75

1) The drill cuttings that are brought to the surface (i.e., fragments of rock removed from the bore hole) contain varying amounts of hydrocarbons (oil, gas, volatile organic compounds such as benzene).

2) Drilling muds that circulate through the well and return to the surface may contain potentially hazardous substances including a variety of metals (cadmium, arsenic, chromium, lead, mercury, copper, etc.); diesel oil; grease; and various other hydrocarbons and organic compounds (e.g., methanol, chlorinated phenols, formaldehyde, benzene, toluene, ethyl benzene, xylene and acrylamide). Typically, if oil-based muds are used, there will be higher quantities of potentially toxic hydrocarbons such as benzenes and polycyclic aromatic hydrocarbons (PAHs), both of which are known to cause cancer in humans. But as seen in the table above, Subra Company found that both oil- and water-based drilling cuttings and muds can contain benzene at extremely high levels (see the table above).

3) Drilling muds often contain bentonite clay and other additives. Bentonite is a very expansive soil material. This may create a site with the potential for great soil volume change, and possibly damage to surface structures. The common practice for disposing of drilling muds is to either bury the mud reserve pit, or discharge the mud to the surface. For landowners who may want to build on what was previously a drill site, it is worth noting that in order to be eligible for FHA mortgage insurance, all unstable and toxic materials must be removed and the pit must be filled with compacted selected materials.[12]

4) Drilling mud reserve pits may also contain a mixture of other additives and chemicals that are used during the drilling process. These may include:
   - acids and caustics;
   - corrosion inhibitors (e.g., iron oxide, aluminum bisulfate, zinc carbonate, and zinc chromate)
   - bactericides and biocides (typically organic amines, chlorophenols, or formaldehydes)
   - surfactants, defoamers and emulsifiers (e.g., fatty acids and soaps)
   - filtrate reducers;
   - shale control inhibitors;
   - thinners and dispersants (e.g., iron lignosulfonates)
   - weighting materials (e.g., barium sulfate, barite or hematite);
   - lost-circulation materials
   - bentonite clay
   - flocculants (e.g., acrylic polymers such as acrylamide)

   Drilling additives often contain potentially toxic substances. For example, the EPA has classifed the flocculant acrylamide as a probable carcinogen.[13] Also, barite weighting agents may contain concentrations of heavy metals such as cadmium or mercury.[14] It is often difficult, however, to find detailed information on the exact chemical composition of drilling additives, as the mix of substances is considered *proprietary* information.

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[12] U.S. Department of Housing and Urban Development. Directive No. 4150.2. *Valuation Analysis for Single Family One- to Four- Unit Dwellings.*
[13] U.S. Environmental Protection Agency. Technology Transfer Air Toxics Web site. "Acrylamide" http://www.epa.gov/ttnatw01/hlthef/acrylami.html
[14] Railroad Commission of Texas. Oil and Gas Division. *Waste Minimization in Drilling Operations.* www.rrc.state.tx.us/divisions/og/key-programs/ogkwodoc.html

Consequently, companies are able to hide the potentially toxic ingredients from concerned citizens.

An example of how companies can withhold information comes from a report written on offshore oilfield drilling wastes and disposal techniques.[15] The report documents how one company legally dumped 896 tonnes of drilling muds off the coast of Great Britain. When questioned about the constituents in the drilling mud, both the company and the government body overseeing the industry would provide only the trade names of the chemicals. The company described one drilling additive, SOLTEX® (trade name for a shale control inhibitor used in water-, oil- or synthetic-based muds, in both on-shore and offshore drilling operations[16]), as lignite (non-asphaltic), and further described it as "cellulose-based," with no reference to the fact that it contains potentially toxic heavy metals.[17]

In 1995 Greenpeace published the following typical analysis for heavy metal content of SOLTEX®, which they obtained from "a confidential source".[18]

Components of SOLTEX®	**Concentration (mg/kg)**
Antimony	6.0
Arsenic	0.4
Barium	16.0
Cadmium	0.6
Chromium (total)	1.2
Cobalt	2.0
Copper	1.3
Fluoride	200.0
Lead	3.0
Mercury	0.2
Nickel	11.0
Vanadium	16.0
Zinc	2.1

Whether or not drilling additives cause harm in the environment depends on the amount of additive used, the concentrations of potentially harmful constituents, and how quickly (if at all) the toxic substances break down once they enter the environment.

Without full disclosure of chemical constituents, however, the public has no way of gauging the potential hazards posed by drilling muds and additives.

[15] Jonathan Wills, M.A., Ph.D. May 2000. *Muddied Waters. A Survey of Offshore Oilfield Drilling Wastes and Disposal Techniques to Reduce the Ecological Impact of Sea Dumping.* http://www.offshore-environment.com/additives.html
[16] http://www.cpchem.com/drillingspecialties/products/soltex.asp
[17] Reddy, S., et al. 1995. cited in *Muddied Waters.*
[18] Jonathan Wills, M.A., Ph.D. May 2000. *Muddied Waters. A Survey of Offshore Oilfield Drilling Wastes and Disposal Techniques to Reduce the Ecological Impact of Sea Dumping.* http://www.offshore-environment.com/additives.html

Less toxic alternatives exist

Substitutions of some drilling-related chemicals can minimize the toxicity of drilling wastes and reduce the risks and costs associated with drilling fluid disposal. According to the U.S. Environmental Protection Agency, there are less toxic alternatives to some of the more toxic compounds. Unfortunately, many companies continue to use the more toxic substances.

Less toxic alternatives include:[19]

- **Dispersants:** use of chrome-free lignosulfonates and polysaccharide polymers instead of chrome lignosulfonate.
- **Biocides:** use of amines instead of pentachlorophenols and paraformaldehyde.
- **Drilling fluid lubricants:** use mineral oil and lubra-beads instead of diesel oil.

Produced Water

When drilling takes place, water is often encountered in along with the oil and gas. This water is pumped out with the oil and gas, and is separated from it using equipment at the surface. In coalbed methane (CBM) operations, huge volumes of produced water are generated because removal of the water is what allows the gas to flow out of the coal.

Produced water may be stored on the surface in open pits, which are also referred to as evaporation pits or disposal pits.

Most contaminants found in produced water are naturally occurring, and so they will vary based on what is present in the subsurface at a particular location. In some locations, the water removed is extremely salty. If the produced water contains large quantities of salts, it is typically referred to as brine or salt water. Other constituents often found in produced water include:

- volatile organic compounds (VOCs) – e.g., benzene, toluene, ethyl benzene, xylene
- polycyclic aromatic hydrocarbons (PAHs) – e.g., naphthalene
- other hydrocarbons, such as crude oil
- heavy metals – e.g., arsenic, barium, cadmium, chromium, lead, mercury, selenium, vanadium, zinc
- Naturally Occurring Radioactive Materials (NORM) – Radium 226 or 228

There are a number of problems that can arise if produced water contaminates soil or groundwater, or if produced water is stored in a manner that allows it to be accessible to livestock, wildlife and birds. Potential problems include:

- Excess salts can effectively sterilize soils for years
- Some metals and NORM can be taken up by vegetation, and pose a health threat to animals that consume the plants; and these substances can be toxic to wildlife that drink the produced water
- Hydrocarbons, benzene and PAHs can contaminate soil and water. Health effects associated with hydrocarbons include: respiratory ailments, effects on neurologic, cardiac and gastrointestinal systems, and skin disorders. Some hydrocarbons are known to cause cancer (e.g., PAHs and benzene). The amount of exposure and how the exposure occurs (e.g., skin contact, ingestion, inhalation) influence which bodily systems are affected the extent of damage to the systems.

[19] U.S. Environmental Protection Agency (U.S. EPA). October 2000. *Profile of the Oil and Gas Extraction Industry.* EPA Office of Compliance Sector Notebook Project. EPA/310-R-99-006. p. 70.

Production Fluids and Wastes

Numerous pits may be used to store or dispose of fluids produced during the production stage of oil and gas operations.

Oil/hydrocarbon production pits: In many oil and gas extraction operations, water, oil and various natural gases are simultaneously extracted. Separators are used to separate the oil from the natural gases, and a "heater treater" separates the water from the oil. According to the U.S. Fish and Wildlife Service, this process is often ineffective.[20] As a result, oil and other hydrocarbons are mixed in with the waste water; and this oily water may be sent to disposal pits. Oil- or hydrocarbon-laden produced water, if stored in open pits, presents a hazard to birds, livestock and wildlife.

Dehydrator waste production pits: natural gas from conventional natural gas wells and coalbed methane wells often contains water, which must be removed before the methane gas can be sold. Much of the waste water is released as vapor, but a significant amount of vapor condenses back into water, which is stored or disposed of in tanks or open pits, sometimes referred to as "drip pits."

There are several processes that can be used to remove water from the gas. These include: glycol dehydration; solid desiccant dehydration; and calcium chloride dehydration.

According to a report by the U.S. EPA, [21] the waste water from dehydration processes may contain:

- Dissolved hydrocarbons, including BTEX (benzene, toluene, ethylbenzene and xylene). Benzene is a known human carcingen.
- metals such as arsenic, barium, cadmium, chromium and lead.

Workover fluids: during well workover operations, which are the major maintenance and equipment repairs done on wells, chemicals, some of which are toxic, are used. These chemicals usually appear in the produced water when production resumes,[22] or in the case of cleaning fluids, may be spilled from equipment at the surface.

Examples of potentially toxic workover fluids include:[23]

- Scale removal requires strong acids, such as hydrochloric or hydrofluoric acids. Scale itself is primarily comprised of sodium, calcium, chloride and carbonate; but trace contaminants such as barium, strontium, and radium may be present.
- Corrosion inhibitors are flushed through the well. Corrosion-resistant compounds of concern include zinc carbonate and aluminum bisulfate.
- In addition, painting- and cleaning-related wastes, such as solvents containing suspended oil and grease, may be generated during workovers.

Stimulation/Completion fluids: Stimulation fluids may also be known as completion fluids. These fluids are injected into a well to encourage the flow of oil and gas to the surface. One common stimulation practice, known as hydraulic fracturing or "fracing," involves injecting a highly

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[20] U.S. Fish and Wildlife Service. Region 6, Environmental Contaminants. *Contaminants Issues - Oil Field Waste Pits*. http://mountain-prairie.fws.gov/contaminants/oilpits.htm

[21] U.S. Environmental Protection Agency. January, 2000. *Associated Waste Report: Dehydration and Sweetening Wastes.* p. 18 http://www.epa.gov/epaoswer/other/oil/execrep.htm

[22] U.S. Environmental Protection Agency. January, 2000. *Associated Waste Report: Completion and Workover Wastes*. p. 38. http://www.epa.gov/epaoswer/other/oil/execrep.htm

[23] U.S. Environmental Protection Agency (U.S. EPA). October 2000. *Profile of the Oil and Gas Extraction Industry.* EPA Office of Compliance Sector Notebook Project. EPA/310-R-99-006. p. 41.

pressurized solution of solvents and gelling agents, mixed with sand and water, into the underground geologic formation to create and hold open fractures. A single oil or gas well can require several “frac-jobs” or other stimulation efforts to compete its total production, and will utilize up to five pits to manage its wastes during its total lifecycle.

Another stimulating technique is acidizing, which involves pumping acid (usually hydrochloric acid), into the formation. The acid dissolves some of the rock material so that the rock pores open and fluid flows more quickly into the well. Fracing and acidizing are sometimes performed simultaneously, in an acid fracture treatment.

Stimulation fluids may contain toxic, hazardous and carcinogenic materials including: benzene, polycyclic aromatic hydrocarbons, ethylbenzene, toluene, xylene, naphthalene, methanol, sodium hydrozide, and methyl tertiary-butyl ether (MTBE),[24] as well as a variety of metals (e.g., antimony, barium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, sliver, thallium, vanadium and zinc).[25] Very small quantities of chemicals such as benzene are capable of contaminating millions of gallons of water. And only 28 tablespoons of MTBE could contaminate hundreds of thousands of gallons of groundwater, making that water unfit for human consumption.[26]

In 1992, the U.S. EPA conducted a sampling program to characterize the potentially hazardous compounds in workover and completion wastes.[27] They collected seven workover and completion samples from oil and gas sites in New Mexico, Oklahoma and Texas. Several of the samples were taken after fracturing and acidizing had occurred. The other samples were taken during swabbing of a pipeline, and after completion of an injection well. More than 70 elements and chemicals were found in the samples, although there was a wide range in concentrations in the samples. Six of the seven samples exhibited hazardous characteristics of toxicity for benzene. Toluene and lead also appeared at toxic levels in some of the samples.

2. Alternatives to Pits

2.1 Alternative to Unlined Pits

If pits are used, they should have, at minimum, two layers of liners, with a leak detection system between the layers. Furthermore, pits should have fences tall and strong enough to keep out wildlife, and nets or other devices installed to prevent birds from coming in contact with the wastes.

But there are alternatives to using lined or unlined pits. Steel tanks, ideally with secondary containment and leak detectors, can be used to store many oil and gas wastes during operations. The wastes can then be transported off site for permanent disposal.

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[24] U.S. Environmental Protection Agency. August, 2002. *DRAFT Evaluation of Impacts to Underground Sources of Drinking Water by Hydraulic Fracturing of Coalbed Methane Reservoirs*. EPA 816-D-02-006. Chapter 6. Water Quality Incidents. http://www.epa.gov/safewater/uic/cbmstudy/docs.html

[25] U.S. Environmental Protection Agency. January, 2000. *Associated Waste Report: Completion and Workover Wastes*. pp. 56-57. http://www.epa.gov/epaoswer/other/oil/execrep.htm

[26] Johnson, R., et al., “MTBE: To What Extent Will Past Releases Contaminate Community Water Supply Wells?,” Environ. Sci. Technol. 2000, 34 (9), 210 A-217 A. Cited in Natural Resources Defense Council. January, 2002. “Hydraulic Fracturing: A threat to drinking water.”

[27] U.S. Environmental Protection Agency. January, 2000. *Associated Waste Report: Completion and Workover Wastes*. pp. 66-73. http://www.epa.gov/epaoswer/other/oil/execrep.htm

During drilling operations, “closed-loop” drilling fluid systems (sometimes referred to as closed mud systems) can greatly reduce or eliminate the discharge of toxic drilling wastes on site. These systems negate the need for drilling reserve pits. Not only is it possible to have “pitless” drilling operations, it can also be an economic advantage to companies to used closed-loop drilling systems.

Many companies are using closed loop drilling systems in Texas, Louisiana, Oklahoma, Alaska and other states. Examples of companies who are using closed-loop technologies include: Shell, El Paso, Chevron-Texaco, Exxon, and many others.

2.2 Closed Containment Systems

Oil and gas operators can use closed containment systems (e.g., tanks that are not open on top) in place of various production pits. It is important that tanks be enclosed by fences and nets. Otherwise, birds, wildlife and livestock may still be attracted to the liquid in the tanks.[28]

Photo of a closed containment system in New Mexico.

This tank has a steel-mesh lid to keep out wildlife and birds. The secondary containment pit has prevented the fluids from flowing all over the well site, but it is clear that the waste fluids have seeped into the surrounding soil. It is not clear whether or not contamination of groundwater has occurred. These wastes, which may contain toxic chemicals, are now accessible to wildlife.

Tanks do have a tendency to corrode with time and develop leaks. And they may overflow if their capacity is not adequate to hold the wastes (and any precipitation if the tanks are not enclosed).

The New Mexico Oil and Conservation Division’s document ***Pollution Prevention Best Management Practices for the New Mexico Oil and Gas Industry*** suggests the following measures to prevent contamination from tanks.[29]

- All above ground tanks that contain fluids other than fresh water must be contained in an impermeable bermed enclosure to contain a volume of one-third more than the total volume of the largest tank or of all interconnected tanks.
- All below grade tanks. . . must have secondary containment and leak detection.

[28] http://mountain-prairie.fws.gov/contaminants/contaminants1c.html
[29] **Pollution Prevention Best Management Practices for the New Mexico Oil and Gas Industry**, Volume I, Section 6, pp. 49, 50. http://www.emnrd.state.nm.us/ocd/

Benefits of closed containment systems

- Tanks require little or no maintenance
- Tanks may be reused (moved to a new site) when the well stops producing.
- Tanks isolate waste products from the environment; if enclosed tanks are installed, there is no need to install fences or netting to keep out wildlife and livestock
- These systems greatly reduce or eliminate soil contamination, thereby reducing remediation costs.

Examples of closed containment systems

- In 2003, the Farmington, New Mexico City Council approved five gas wells on the condition that the company agreed to store condensate wastes in buried tanks; and install double walled condensate tanks as a means of leak protection.[30]
- Many well sites in New Mexico used tanks, rather than pits, to hold production wastes. What's missing from many of the tanks in New Mexico are leak detection devices and adequate secondary containment systems.

2.3 Closed-loop or "Pitless" Drilling Systems

What's the difference between conventional drilling systems and closed-loop drilling systems?
At a typical oil or gas drilling site, drilling fluids (mud, water, additives) are circulated through the wellbore, then the fluids and drill cuttings (rock fragments created by the drilling process) are deposited in a reserve pit dug near well. This pit is used to hold used drilling fluids and wastes.

A reserve pit can be the source of considerable costs at a drilling site. The pit itself must be constructed at the beginning of drilling, which requires the use of heavy earthmoving equipment. The pit may have to be lined, which is an added expense. And when the drilling project is over, the pit, including all of the waste fluids and solids, must be properly remediated. Remediation could include activities such as: the removal and offsite disposal of the waste materials and liner; the burial of the wastes and liner; backfilling of the pit with soil; and revegetation of the disturbed pit area.

In a closed-loop drilling fluid system, the reserve pit is replaced with a series of storage tanks that separate liquids and solids. Equipment to separate out solids (e.g., screen shakers, hydrocyclones, centrifuges) and collection equipment (e.g., vacuum trucks, shale barges) minimize the amount of drilling waste muds and cuttings that require disposal, and maximize the amount of drilling fluid recycled and reused in the drilling process. The wastes created are typically transferred off-site for disposal at injection wells or oilfield waste disposal facilities.

Increased Utilization of Closed-Loop Drilling

According to a paper delivered at an American Association of Drilling Engineers Conference in 2002, "environmental concerns and regulatory authorities are forcing the offshore drilling industry to modify or eliminate dumping of drilling wastes overboard. On land rigs, the practice of constructing earthen reserve pits is also declining in favor of "zero-discharge" closed-loop systems. Therefore the effective containment and transportation of drilling wastes is becoming

[30] Laura Banish. February 12, 2003. "Farmington council approves five new gas wells," *Daily Times* Farmington, New Mexico).

ever more important. The environmental benefits of a well designed waste collection and transportation system can be observed directly in many cases."[31]
The New Mexico Oil Conservation Division identifies closed-loop drilling as a "best management practice" in their Pollution Prevention Best Management Practices for the New Mexico Oil and Gas Industry. New Mexico OCD is not alone in identifying closed-loop drilling systems as a "best practice." In almost any pollution prevention or "Best Management Practices" document for the oil and gas industry, closed-loop drilling systems are mentioned as the most environmentally safe method for reducing the potential impact that drilling operations can have on the environment.[32]

Increasingly, closed loop systems are being used all over the United States, Canada, and the world. In personal conversations with closed-loop drilling system companies, OGAP has heard that one company has performed approximately 900 closed-loop drilling operations in the past 8 years (in CO, WY, ND, NM and other western states). A representative from another company operating out of Texas, Louisiana and Oklahoma remarked that most of the major companies in the region are using closed-loop drilling systems at the majority of their operations, because they understand the potential future liabilities that may follow them if they use conventional drilling systems that use reserve pits.

This information was corroborated by the Texas Railroad Commission, which stated that "Even though it is not always cost effective, some companies have elected to use only closed loop drilling fluid systems in their operations. . .whenever a closed-loop system is used, the operator reduced his potential liability associated with a conventional earthen pit and waste management and site closure costs." [33]

According to the U.S. Congress, Office of Technology Assessment, these systems are increasingly being used (e.g., in California) because of the reduction in overall drilling costs and in the volume of wastes needing disposal.[34]

Benefits of Closed-Loop Drilling

Efficient use and re-use of materials
The tanks represent an additional cost, but there is no longer a need to construct the reserve pit. The tanks can be re-used, and there is a reduction the risk of environmental contamination. Additionally, there is a more efficient use of drilling fluid, and the technology can save the operator money when conditions allow its use.[35]

According to the Railroad Commission of Texas' Oil and Gas Division:

[31] Richards, M.J. and Love, W.W. 2002. "Bulk Transportation of Drilling Waste," a paper presented at the American Association of Drilling Engineers 2002 Technology Conference, April 2002, in Houston, TX. Paper AADE-O2-DFWM-HO-18.
[32] E.g., The Illinois Environmental Protection Agency's "Best Management Practices for Oil Exploration and Extraction." (http://www.epa.state.il.us/p2/fact-sheets/bmp-oil-exploration.html). And the Railroad Commission of Texas' "Waste Minimization in Drilling Operations." www.rrc.state.tx.us/divisions/og/key-programs/ogkwodoc.html
[33] Railroad Commission of Texas. Oil and Gas Division. Waste Minimization in Drilling Operations. www.rrc.state.tx.us/divisions/og/key-programs/ogkwodoc.html
[34] U.S. Congress, Office of Technology Assessment. March, 1992. *Managing Industrial Solid Wastes from Manufacturing, Mining, Oil and Gas Production, and Utility Coal Combustion – Background Paper, OTA-BP-O-82.* (Washington, DC: U.S. Gov. Printing Office). p. 75
[35] U.S. Environmental Protection Agency (U.S. EPA). October 2000. *Profile of the Oil and Gas Extraction Industry.* EPA Office of Compliance Sector Notebook Project. EPA/310-R-99-006. p. 69.

Closed-loop drilling fluids systems use a series of steel tanks that contain drilling fluids and equipment used to remove cuttings. These systems enhance the operator's ability to monitor fluid levels and characteristics. The result is more efficient use of the drilling fluid and less drilling waste remaining at the end of the operation. Also, the operator may more easily recycle the waste drilling fluid.[36]

Closed-loop systems reduce company liability
Pits may or may not be lined (depending on the oil and gas regulations); and pits are open to the atmosphere. Because of this, the pit may leak liquids into surface or groundwater and release high levels of volatile organic compounds, which in turn create health, environmental, and financial risks. If improperly fenced, livestock may enter the pit area. If the livestock is poisoned by the pit materials, companies may be liable for the deaths, and be required to compensate the livestock owner.

According to the Railroad Commission of Texas, even though closed-loop drilling is not always the least expensive option, some companies in Texas have elected to use only closed-loop drilling fluids systems in their operations. Why? Because whenever a closed-loop system is used, the operator reduces the potential future liability associated with a conventional earthen pit, and reduces the waste management and site closure costs. It's also good for the company image and public relations.[37]

Closed-loop or pitless drilling also:

- eliminates unsightly and hazardous pits
- reduces the time, energy and expense of building, fencing and netting, and reclaiming reserve pits
- decreases the need for cuts in sensitive and hilly areas
- total surface disturbance associated with a well pad is reduced
- eliminates risk of waterfowl and wildlife mortality related to pits
- eliminates risk of damaging underground pipelines and utilities
- allows drilling in areas with a high ground water table (e.g., floodplains)
- greatly reduces drilling wastes (even drill cuttings may be put to beneficial use, e.g., if not contaminated they may provide a source of finely-ground clay for berm construction around tank batteries or other uses)
- rigs use less water per well—it can reduce water consumption by as much as 80%
- the US Environmental Protection Agency (EPA) has estimated that "closed loop systems" can reduce the volume of drilling fluids by as much as 90%[38]
- eliminates soil segregation, which reduces wind erosion problems and costs associated with soil moving
- reduces truck traffic associated with transporting drilling wastes by as much as 75%
- may improve relationship with surface owners
- greatly reduces waste tracking and need for land farming operations

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[36] Railroad Commission of Texas. Oil and Gas Division. Waste Minimization in Drilling Operations. www.rrc.state.tx.us/divisions/og/key-programs/ogkwodoc.html
[37] Railroad Commission of Texas. Oil and Gas Division. Waste Minimization in Drilling Operations. www.rrc.state.tx.us/divisions/og/key-programs/ogkwodoc.html
[38] U.S. Congress, Office of Technology Assessment. March, 1992. *Managing Industrial Solid Wastes from Manufacturing, Mining, Oil and Gas Production, and Utility Coal Combustion – Background Paper, OTA-BP-O-82.* (Washington, DC: U.S. Gov. Printing Office). p. 75

Closed-Loop Drilling Case Studies

CASE 1: Prima Energy's Cost-Benefit Analysis[39]

Prima Energy Corp. has drilled more than 68 wells in Colorado[40] using a highly automated closed-loop system, which the company started developing along with Nabors Drilling USA, Inc. in 1993. The company found that the economics of drilling these wells in Colorado were best if drilling required less than 12 days. The following table outlines the cost benefit of closed-loop drilling systems.

	Conventional rotary drilling with reserve pit		**Closed-loop drilling with mud motors and diamond bits (50 wells)**	
	Amount	Cost	Amount	Cost
Water	6,400 barrels	$ 4,720	1,200 barrels	$ 1,350
Location	300 x 300 feet	$ 3,000	200 x 150 feet	$ 900
Mud		$ 2,000		$ 1,700
Surface Damages		$ 3,500		$ 2,500
Berm		$ 1,000		0
Mud Haul		$ 2,800		$ 900
Dewatering Unit *		0		$ 8,250
Total		**$17,020**		**$15,600**

* Dewatering cost includes rental of unit, labor, extra fuel, polymer and acid, linear motion shaker, centrifuge, trucking, end loader and miscellaneous costs.

Prima Energy's Calculated benefits of closed-loop drilling:

- cost savings of $1,320 per well
- water savings of 5,200 barrels (closed-loop drilling used 80% less water)

CASE 2: Comparing closed loop drilling to a conventional system: A tale of two wells[41]

Closed-loop systems employ a suite of solids control equipment to minimize drilling fluid dilution and provide the economic handling of the drilling wastes. For one company, a typical closed-loop system includes a series of linear-motion shakers, mud cleaners and centrifuges followed by a dewatering system. The combination of equipment typically results in a "dry" location where a reserve pit is not required, used fluids are recycled, and solid wastes can be landfarmed, hauled off or injected downhole.

Two wells, drilled only 200 ft apart in Matagorda County, TX, provided a unique opportunity to compare the cost savings difference between conventional solids-control equipment and the company's closed-loop system. Both wells drilled through the same formations, using the same rig crew, mud company and bit program.

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[39] Longwell, John and Hertzler, Glenn. (Prima Energy Corp. and Nabors Drilling USA, Inc., respectively). 1997. "Closed-loop system as a cost effective alternative to reserve pits," presented at the *Advances in Drilling Technologies for the North American Rockies Conference* (April 28, 1997, Denver, CO)

[40] Interstate Oil and Gas Conservation Commission. 1999 Chairman's Stewardship Award report. www.iogcc.state.ok.us

[41] www.miswaco.com/More_Info/About_Us/98131.pdf

The closed loop system with improved solids control resulted in some significant savings:

- 43% savings in drilling fluid costs
- 23% fewer rotating hours
- 33$ fewer days to drill to a comparable depth
- 37% reduction in the number of bits used
- up to 39% improvement in the rate of penetration

CASE 3: Reducing waste volume and costs using closed-loop systems[42]

Challenge— Challenges associated with conventional reserve pits include volume of drilling wastes; drill site installation and restoration costs; pollution of land and/or surface water due to failure of pits and/or containment system and associated cleanup costs; and potential for subsurface pollution due to downward migration from pits and/or surface soil permeability.

Solution— Use closed-drilling pit system to reduce volume of drilling waste. The drilling contractor maintained "safe pit levels" and recycled drilling fluid to minimize pit volumes and disposal requirements. Waste management costs due to procedures other than those specified were also the responsibility of the drilling contractor. Cost savings provided the incentive to implement and maintain proper procedures to minimize waste generation in the closed-loop system.

	Conventional reserve pit	**Closed-loop drilling fluid system**
Surface disturbance	reserve pit (235' x 77' x 5') cuttings pit (20' x 10' x 5') water pit (40' x 10' x 5')	No reserve pit necessary.
Total drilling mud and wastes in pits	16,625 barrels	1,100 barrels
	Total reduction in drilling mud and wastes in pits using closed-loop drilling	**15,625 barrels**

Benefits— The following benefits were realized:

1. Total estimated cost savings (considering reduced costs for drill site installation, fluid hauling and disposal, dirt work, and surface damage payment): $11,000.00
2. Reduced surface disturbance by 18,000 square feet (0.4 acres).
3. Reduced drilling mud and wastes in pits by 15,625 barrels.
4. Reduced potential for environmental impact to surface and groundwater.

CASE 4: Closed Loop Drilling Fluid System[43]

Problem— A small independent operator was concerned about the volume of drilling waste in conventional reserve pits at his drilling locations. Waste management costs were a concern, as well as the costs associated with impact on adjacent land due to pit failures. The operator was concerned about the potential for surface water or ground water contamination and the associated potential liabilities.

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[42] New Mexico Oil Conservation Division. *Pollution Prevention Best Management Practices for the New Mexico Oil and Gas Industry.* http://www.emnrd.state.nm.us/ocd/

[43] Railroad Commission of Texas. *Waste Minimization - Case Histories - Drilling Operations.* http://www.rrc.state.tx.us/divisions/og/key-programs/ogkwchdo.html

Solution— The operator was drilling relatively shallow wells in normally pressured strata. Because the drilling plan was relatively simple, the operator investigated the feasibility of using a closed-loop drilling fluid system for these wells. The use of a closed-loop system eliminated the need for a conventional reserve pit. The operator negotiated with drilling contractors to obtain a turn-key contract that required the drilling company to use a closed-loop system and take responsibility for recycling the waste drilling fluid.

Benefits— The turn-key contract was incrementally more expensive. However, because of reduced drill site construction and closure costs; reduced waste management costs; and reduced surface damage payments, the operator realized a savings of about $10,000 per well. Also, the operator reduced the potential for environmental impact and associated potential liability concerns.

CASE 5: Closed-loop system helps reduce drilling waste[44]

A large oil and gas production company used a number of pollution prevention techniques, including closed loop drilling, to drill an exploratory well adjacent to the Tishomingo Wildlife Refuge in Johnston County, OK. The well was drilled on land owned by the U.S. Army Corps of Engineers. Some of the measures taken in drilling the well included:

- Using a closed-loop mud system that allowed for reuse of drilling fluids and use of smaller quantities of water for dilution of the mud to control viscosity and density
- Use of compressed air as the drilling fluid where possible, which allowed for the use of smaller quantities of water and drilling fluid
- Using a smaller casing, which allowed for the use of a 25% smaller hole. This generated a smaller volume of drill cuttings and required less drilling fluid

Savings and Benefits— The hole-size reduction, use of air drilling and closed-loop system reduced wastes by close to 1.5 million pounds. A material and disposal cost savings of $12,700 was achieved.

3. Case Study: The Pit Situation in New Mexico

Numerous types of pits may be constructed to contain liquid and solid wastes created during oil and gas exploration and production. Generally, the pits are shallow, uncovered, and may or may not be lined. Typically, when pits are no longer needed, the fluids are allowed to evaporate, and the leftover sludge is bulldozed over or backfilled. If there is a liner, it is common practice in New Mexico to rip the liner, allow the fluids to seep into the soil, remove the liner (or leave it in place) and then bulldoze over the site.

3.1 Regulation of New Mexico oil and gas pits

In December 2003, the New Mexico Oil Conservation Commission passed a rule regulating pits and below-grade tanks that are associated with oil and gas development. This rule required that an inventory of oil and gas pits occur by establishing a “pit permit” system; and the rule fine-tuned the state’s regulation of pit construction, operational standards, and reclamation. For a number of reaons, the 2003 rule is inadequate:

[44] Oklahoma Department of Environmental Quality. *Pollution Prevention Case Studies.* http://www.deq.state.ok.us/CSDnew/P2/Casestudy/oxyusa%7E1.htm

- does not require closed systems for drilling fluids and cuttings to protect fresh water supplies and soil contamination;
- while generally "prohibiting unlined pits," it allows for exemptions from this "prohibition" in the eight major oil and gas producing counties;
- it allows for on-site disposal of drill fluids, chemicals and salts;
- it fails to require the OCD to characterize and record pit waste; and
- it widely enables the OCD to grant routine and broad exemptions to the rule.

3.2 Contamination from New Mexico pits

How many pits are there?

As mentioned above, in December of 2003, the New Mexico Oil and Conservation Division (OCD) began requiring companies to receive permits for pits. Up until that time permits for pits were not required, so the OCD did not have reliable records of how many pits existed in the state. Consequently, at the present time the best data available on the number of pits in the state comes from a request made by the OCD to oil and gas operators in 1997, asking for information on lined and unlined pits.

Based upon the responses received by the OCD (only 251 operators responded, out of more than 750 operators in the state[45]), there are at least 13,200 pits in New Mexico – 5,600 lined and 7,600 unlined.[46]

With only one-third of operators responding, it is highly likely that there are significantly more than 13,200 pits in the state. Using rough calculations based on the number of wells in the state, it is likely that there are tens of thousands of pits located throughout the state.

- As of October, 2003, there were 39,874 producing wells in New Mexico.[47]
- If every one of these operations used just one pit, there would be close to 40,000 pits in the state.
- It is probable that most operations use more than one pit. Oil and gas operations may use numerous pits during the drilling stage, well completion stage, production stage, as well as emergency pits to contain spills. So the number of pits in the state may well exceed 40,000.

What wastes are going into oil and gas pits in New Mexico?

- In 1999, it was estimated by the New Mexico Oil Conservation Division (OCD) that more than 90% of all drilling muds and cuttings were disposed of in pits. The volume of drilling wastes

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[45] New Mexico Energy, Minerals and Natural Resources Department. *Factsheet: Well Operators in New Mexico* (http://www.emnrd.state.nm.us/ocd/)
[46] Letter from Roger C. Anderson, Environmental Bureau Chief, New Mexico Energy, Minerals and Natural Resources Department, to Jennifer Goldman, OGAP. Oct. 23, 2003.
[47] New Mexico Energy, Minerals and Natural Resources Department *Factsheet: New Mexico Well Statistics* (http://www.emnrd.state.nm.us/ocd/)

disposed of in pits was approximately 89,000 yd^3 (almost 18 million gallons) of drill cuttings and 1,134,400 barrels (about 47 million gallons) of drilling fluids.[48]

- OCD also estimates that about half of all "associated wastes" are disposed in pits. No estimates are available for volume of associated wastes produced in New Mexico.[49] Associated wastes are exploration and production wastes other than produced water and drilling muds and cuttings. These wastes would include: hydraulic fracturing fluids; and wastes from field processing facilities such as glycol dehydrators and separators.

- About 59 million barrels (about 2.5 billion gallons) of produced water were disposed in on-site pits and in commercial and centralized surface impoundments in New Mexico.[50]

Pit Contamination in New Mexico

The Oil Conservation Division (OCD) does not know how many of the 13,200 documented pits are currently causing contamination of soil or groundwater.

Between the mid 1980s and 2003, however, the New Mexico Environmental Bureau recorded more than 6,700 cases of pits causing soil and water contamination, with at least 557 of those cases resulting in groundwater contamination. More than 360 of those 557 groundwater contamination sites investigated by the New Mexico Environmental Bureau are not yet fully cleaned up.[51]

Since 2001, the OCD has investigated 734 cases of soil or groundwater contamination; 444 of the investigations were conducted at field production locations (e.g., well sites as opposed to major processing facilities).[52]

Examples of Contamination:

Duncan Oil Field[53]

Contamination of groundwater and nearby soils with hydrocarbons from an unlined pit was documented in the Duncan Oil Field west of Farmington, New Mexico. Waste pits containing produced water were found to contain large amounts of polycyclic aromatic hydrocarbons, which are phototoxic to fish, and may cause cancer, organ damage and reproductive effects in humans. Volatile hydrocarbons including benzene (a carcinogen),

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[48] New Mexico Energy, Minerals and Natural Resources Department, Oil Conservation Division.. August, 2001. *State Review of Oil and Natural Gas Environmental Regulations, Inc. Follow-up and Supplemental Review.* (www.strongerinc.org/pdf/NMfinal.pdf)
[49] New Mexico Energy, Minerals and Natural Resources Department, Oil Conservation Division.. August, 2001. *State Review of Oil and Natural Gas Environmental Regulations, Inc. Follow-up and Supplemental Review.*
[50] New Mexico Energy, Minerals and Natural Resources Department, Oil Conservation Division.. August, 2001. *State Review of Oil and Natural Gas Environmental Regulations, Inc. Follow-up and Supplemental Review.* www.strongerinc.org/pdf/NMfinal.pdf
[51] Letter from Roger C. Anderson, Environmental Bureau Chief, New Mexico Energy, Minerals and Natural Resrouces Department, to Jennifer Goldman, OGAP. Oct. 23, 2003.

2001. *State Review of Oil and Natural Gas Environmental Regulations, Inc. Follow-up and Supplemental Review.* www.strongerinc.org/pdf/NMfinal.pdf
[53] Eiceman, Gary Alan. 1986. *Hazardous Organic Wastes from Natural Gas Production, Processing And Distribution: Environmental Fates.* New Mexico Water Resources Research Institute. http://wrri.nmsu.edu/publish/techrpt/abstracts/abs227.html

toluene, and xylenes were found in water, and polycyclic aromatic hydrocarbons were found in the soil downgradient from earthen pit at distances up to 164 feet away.

Hampton Well (Natural Gas) Site[54]

For more than 12 years the Public Service Company of New Mexico (PNM) discharged liquids removed from natural gas (using dehydration equipment) into an unlined disposal pit, located at the northern-most portion of the Hampton Well Site in San Juan County, New Mexico. The dehydration liquids included liquid hydrocarbons. In 1996, PNM discovered potential hydrocarbon contamination from the pit and began closing the site. In January, 1997, PNM notified the New Mexico Oil Conservation Division's Environmental Bureau that groundwater beneath the former pit was indeed contaminated by hydrocarbons.

Also in 1997, Burlington Resources Oil and Gas Company (Burlington), which was operating well equipment located in the southern-most portion of the Hampton Well site, discovered a hydrocarbon seep along the northwestern edge of their well site. This seep was also coming from a former pit.

As of November, 1998, neither PNM nor Burlington had completed remediation activities at the Hampton Well site. Groundwater contamination was still a problem, and a plume of contamination extended approximately 1000 feet downgradient from the site. As of 2000, according to the New Mexico Oil Conservation Commission, contamination at the Hampton Well site remained a threat to public health and safety and the environment.

Banning Pits to Protect Water Supplies

In an effort to protect municipal water supplies, the city of Lovington, NM recently passed an ordinance that prohibits companies that operate on the city's water-field from permanently disposing of drilling wastes in pits on site. See Appendix II for news articles on this issue.

[54] State of New Mexico Energy, Minerals And Natural Resources Department Oil Conservation Commission. March 24, 2000. Hearing Called By The Oil Conservation Commission For The Purpose Of Considering: Application Of Public Service Company Of New Mexico For Review Of Oil Conservation Division Directive Dated March 13, 1998, Directing Applicant To Perform Additional Remediation For Hydrocarbon Contamination, San Juan County, New Mexico. Case No. 12033 Order No. R-11134-A http://www.emnrd.state.nm.us/ocd/Orders/Hearing/2000/12033-A.pdf

Appendix I

Web links to closed-loop drilling service companies

There are many companies that provide closed-loop drilling services. While OGAP does not endorse any of these companies, we are providing some links so that readers can do more research on these systems.

These companies all claim to use closed-loop drilling fluid or “zero discharge” drilling systems. Zero discharge means different things to different companies. For some, it means zero discharge of fluids, while others stress the zero discharge of wastes into earthen pits. Be sure to read the fine print, and contact the companies to discuss what they can and can’t accomplish with their systems.

* Brandt (a Varco Company) http://www.brandtvarco.com/
* M-I-SWACO http://www.miswaco.com/
* Soli-Con http://www.soliconequipment.com/
* Kem-Tron http://www.kemtron.com/
* Tri-Flo International Inc. http://www.triflo.com/
* Fluid Systems Inc. http://www.fluidsystems.us/
* Flottweg http://www.flottweg.com/index_en.html
* Lakefront Enterprises, Inc. http://www.enviro-bond.com/

Appendix II

Press Clips

The Lovington Daily LEADER

City Worries About Safety Of Its Water Supply

By GINGER GRANATH
Tuesday, September 16, 2003

City employees brought in 20 more chairs to an already packed house to accommodate the huge crowd at the city commission meeting last night. Over 50 oil and gas producers, service company owners, lawyers and bureaucrats packed the commission chambers at City Hall, the majority in protest to Ordinance 449 -- the city's proposed ordinance to require more stringent compliance for oil and gas activity in the city's water field, five miles south of Lovington.

The City of Lovington draws 100 percent of its water from 17 wells on approximately 1,900 acres south of town -- and allows rights-of-way in the field to 22 different oil and gas companies.

But there are problems out there, says City Manager Pat Wise, and while the city's drinking water has not been contaminated yet, it very easily could be.

"It is my thought that we must do everything we can to protect our municipal water supply," Wise told the audience and commissioners. "That's the lifeline of this community, and if we lose it, we lose the community."

In his 18 months as city manager, Wise explained that he has seen several problems in the water field. "On the east side [of the water field], there were four oil pipeline leaks. None were reported, three were one company.

On the west side, there was the rupture of a pipeline that knocked down two city employees, four more pipeline leaks, and none were reported to us, we did find them ourselves. On one, we found a pipeline worker attempting to remediate the site before they notified the city -- it's still leaking as we speak."

Wise said because several calls to the companies that own the facilities, and the state OCD (Oil Conservation District), the state's regulatory agency, have been unfruitful, he asked the city's legal counsel to draw up an ordinance which requires all spills to be reported to the city, and gives the city more power to regulate the oil and gas activity on the 1,900 acre water field. In effect, the 18-page ordinance gives power to the city that would otherwise be in the hands of the OCD -- and that is what drew the crowd of concerned oil and gas producers and others.

Mike Feldewert of the New Mexico Oil and Gas Association spoke on behalf of the membership: "We're not here in opposition to your goals and objections," he told the commissioners, "what we're disputing here today is the means the city has set forth to accomplish these goals. We would suggest this ordinance is not necessary."

While it wasn't stated, Feldewert and others who took a turn at the podium to voice their opposition, implied that the commission would be inviting litigation if it passed the ordinance. "Let's face it, we all live in a legalistic world now," said David Purdy of Devon Energy. "If you would be willing to focus your power as a governing body to the people in the state agencies who have the responsibility, and don't back off, you'll do everybody a favor, and in the end solve the problem you have here."

Further, Purdy argued, the city shouldn't punish the prudent operators for the actions of a few non-compliant oil companies. "For a company that has opted to not follow the rules, 25 more rules will not get the bad apple out of the cart."

The oil and gas producers seemed concerned that if Lovington could pass such a strict ordinance, establishing another layer of permits and reporting, then other municipalities could follow suit, and soon there would be too many layers of red tape for operators to do business.

"If [the ordinance] moves forward, this is a serious issue for the industry.
We're going to have a municipal layer, state layer, federal layer; that creates confusion," said Feldewert. "It's unnecessary and in the end we really don't know whose in charge ... and there may be some problems there as far as enforcement."

Currently, the oil and gas industry is required to report leaks, spills and other problems to the OCD. But Wise's complaint is that the OCD is completely ineffective in enforcing the state statutes. "If we rely on the
layers of bureaucracy that are in place, there's been one problem out there ... since 1992. That's how responsive the OCD has been to the city," complained Wise.

"I'd just ask that consider what you're doing," said Harry Teague, county commissioner and owner of Eunice Well Service. "You can see how that becomes burdensome for the companies. There is going to be a lot of money spent, but it’s not going to be spent clarifying the water problem. Think real strongly about it before you give up on OCD, your elected officials, your state representatives, your state senators, your governor. I'd ask you to spend some money that way before you start spending money on litigation. When we start doing these things we're going to have an effect on a lot of people's way of life."

The city commissioners listened intently to six different speakers, and then decided to hold off on passing the ordinance until they could gather more input from the oil and gas industry. "I'm kind of like some of those [speakers]," said Mayor Pro-Tem Bill Shipp after the presentations were made and the room cleared out. "Where do you stop adding regulations on regulations. ... I know there's a middle of the road here, let's don't hastily do something. This is a good start, we've got their interest."

"I am a little bit leery of just throwing this [ordinance] out there and making it more difficult for some oil companies that are doing what they're supposed to do," agreed Commissioner Dixie Drummond, who then asked if the non-compliant companies' rights-of-way could be revoked.

Patrick McMahon, the city's legal counsel, said that he and Wise were researching the rights-of-way, and that some of the documents are "pretty old." "We're not sure all the companies out there have the proper right-of-way to have property out there," said Wise.

The names of the companies dragging their feet on reporting and cleanup in the city's water field (five companies responsible for seven recent incidents) weren't disclosed at the commission meeting, but Wise said "none of those that spoke were the guilty parties."

"It's got their attention," Harris said of the proposed ordinance. "I agree, we don't need another layer of regulations, ... we need to put pressure on them."

Wise got the permission of the commission to address another letter to the OCD and see if some of the problems with the non-compliant companies in the water field would be addressed. In the meantime, the commissioners requested more input from the oil and gas industry, with the hopes that if an ordinance was required, it would be satisfactory for all involved parties.

HOBBS News-Sun

Lovington City Commission Meets

By: Michelle A. Fox
October, 28, 2003

The problem of oil companies contaminating soil and other resources in Lovington took center stage Monday night, but found that the city's concerns were not a problem unless officials with the state were apprised of it.

The Lovington City Commission had invited Chris Williams of the Oil Conservation Division of the New Mexico Energy, Minerals and Natural Resources Department to Monday's meeting to address the problem of soil reclamation due to oil and gas-related contamination occurring in the city's 1,800-acre water field.

"I do not know what the solution is," said Williams. "We have two environmental agents for three counties. We do not know about a problem unless someone tells us about it."

City manager Pat Wise talked of an oil company that spilled 1,800 barrels of oil, failed to notify anyone and simply covered the spill with dirt.

"There is drinking water 50 feet under that spill," Wise said. "That scares the hell out of me. I have had oil companies tell me they do not think about the environmental concerns."

Citing notification as a main problem and the cost of removing equipment left by defunct companies as another, Williams talked about budget issues.

"We have talked about raising the reclamation fund, but we are afraid if it gets too high it will become a target for spending other than reclamation," Williams said.

According to Williams, it is costing the state $101,000 to take soil samples from Lovington's Araho site -- which has 4 feet of oil and sludge sitting in a pit there since 1992.

After it is decided how far down the site will need to be excavated, it could cost up to another $50,000 to finish the project. It is unknown how far down the contamination goes.

The pit at the site could cost $120,000 to clean up.

Lovington mayor Troy Harris was not moved by the personnel and budget issues of the division.

"We have a water field we need to protect," Harris said. "Through the years, your agency has not done its job. We have reported problems and they have not been addressed. If they have been, it was months or years later."

Harris told Williams that if the division was not going to take care of the problems, the city would do what it could to take care of them.

Representatives from the OCD along with Bob Gallagher of the New Mexico Oil and Gas Association will be in Lovington on Nov. 7 for a tour of the water field.

In other business the commission:

* Accepted the resignation of members of the entire Lodgers' Tax Board.
* Approved variance zoning to Randall and Joyce Gandy.
* Awarded the bid for the 17th Street Project to Armstrong Construction.
* Awarded the bid for engineering on the Senior Center Therapy Pool to The Larkin Group of Albuquerque.
* Accepted the city manager recommendations for board appointments. ■

The Lovington Daily LEADER

State Officials Get Close Look at Contamination Threat

By: Ginger Granath
November 11, 2003

It seems City Manager Pat Wise may having finally gotten the attention of the New Mexico Oil Conservation District (OCD). Friday, Wise arranged a bus tour into the city's 1,800 acre water field south of town to show everyone the oil spills plaguing the land. Four OCD representatives attended, including Director Lori Wrotenbery.

Bob Gallagher, director of New Mexico Oil and Gas Association; Steve Daly with the Bureau of Land Management; Mayor Troy Harris; Mayor Pro-Tem Bill Shipp; Charles Kelley, assistant city manager; Patrick McMahon and Mike Newell, the city's legal counsel; and Jennifer Goldman of the New Mexico Oil and Gas Accountability Project rounded out the group.

Loaded up in a yellow school bus, Wise showed the group five problem areas and pointed out the city's 17 water wells.

At each stop, Wayne Price, Gary Wink, and Bill Olson of OCD walked each site, listed the irresponsible operators, and made field notes.

"Yeah, it's pretty obvious there's something that's there because of the hydrocarbon smell," said Price after examining blackened soil near a poorly repaired pipeline. It appeared someone tried to cover the spill with sand; it wasn't immediately clear to the OCD staff or city officials who the responsible party was for the spill.

The dark soil encompassed a large area that was just up stream from one of the city's water wells. "The gradient is headed right toward that municipal well," Wise said pointing to the well just southeast of the spill.

What isn't known is whether or not any of these surface problems have reached the fresh water aquifer 50 to 55 below the surface. The City of Lovington draws 100 percent of its water from 17 wells on 1,800 acres south of town -- and allows rights-of-way in the field to 22 different oil and gas companies. Water in the well field is not currently contaminated, but in the past one of the city's wells was shut-in after contamination was found.

"What you have is leak upon leak upon leak upon leak," said McMahon pointing to a hardpan area where black soil snaked around two leaky tank batteries, "and what should happen is they should come out here and drill down to the ground water and see how far this stuff goes. It's possible it goes ten feet down and stops, but in their experience I bet they're going to tell you there's a good probability the ground water is going to be impacted."

"Until we check into it further, we really can't comment on the seriousness of it," said Wrotenbery after viewing the first two sites. "What we do plan to do is take a look at this whole area and put together a report for the city on what we find, document what has happened in the past, and what work has been done."

One site, the Araho site, was abandoned over 11 years ago with tank batteries and a lined pit full of black sludge left behind. At Wise's persistence, the OCD has begun cleaning up that site, removing the corroded tanks. The pit is still there, and Olson said his staff has drilled monitor wells around it. "Monitor wells were drilled, bore wells were drilled and this liner so far is intact and is holding," he explained to the group, "and we do have good clean water under this pit, so we're real fortunate of that." According to Wise, the surety bond on the site was released from the state back to the oil company years ago, leaving the cleanup cost, which will run hundreds-of-thousands of dollars, in the hands of the OCD.

The first step when a person sees an apparent leak is to notify the operator, who is supposed to have the company name and contact number clearly marked. A person can also contact OCD to report the leak. Olson explained the district's role: "The first thing we do is try to find a responsible party" when there is a problem. "It's their responsibility for environmental cleanups, unless the site is truly abandoned." In those instances, OCD often has to foot the bill: "We try to work with monies we have to clean up sites."

It's not always that easy, though, said Olson pointing to an apparently abandoned facility with a Penrock sign in front. "Penrock is still a viable company, the sign says Penrock, [but] sometimes they're sold and the signs aren't changed."

This past year, when numerous calls to operators and the OCD failed to produce results, Wise became worried. He asked the city's legal counsel to draft ordinance 449, a city ordinance which would regulate oil and gas operations in the city's 1,800 acre water field. There is a New Mexico state statute that allows a city to pass ordinances to protect its municipal water, which is the legal portal for the city's ordinance.

Prior to introducing the ordinance at the September 15 city commission meeting, several representatives of the oil and gas industry got wind of it, and showed up en masse to voice strong opposition. Some industry representatives suggested that by passing the ordinance, the city would subject itself to costly litigation. Since then, two organizations, the New Mexico Cattle Growers Association and the Oil and Gas Accountability Project, along with several farmers and ranchers have publicly supported the ordinance. (The city commission has not adopted the ordinance yet, which is in its second draft.)

"We need a lot better enforcement," said Goldman, who joined Friday's tour from the OGAP's office north of Taos, "although a lot of the problems are the regulations." According to its mission statement, OGAP was created in 1999 to "advocate for greater corporate and governmental accountability, responsibility, and respect for people and places in the course of oil and gas development."

Goldman took a great deal of interest in the apparent damage on the surface of the land, snapping pictures and taking notes, while conversely, Gallagher, the director of NMOGA, the largest organization of New Mexico producers, referred to the tour as a "media circus" and did not leave the bus to view the final three sites.

The tour concluded after about an hour-and-a-half. Wrotenbery and her staff stayed around at City Hall to discuss issues with Wise, McMahon, Harris and Shipp.

Last night, Wise briefed the city commission on the day, saying he was pleased with the progress. "I thought it went wonderfully," he said. "We took them to five different sites, existing batteries, abandoned batteries, pipeline blowouts. ... I think they understand our pain now, I certainly hope so."