The Importance of Ground Water In New Mexico

Approximately 90% of the total population of the State depends on ground water for drinking water. Eighty-one percent (81%) of the population are served by public systems with water derived from ground water sources. Approximately 150,000 people, or 10% of the State population, depend on private wells for drinking water.

Nearly half of the total water annually withdrawn for all uses in New Mexico is ground water, the only practicable source of water in many areas of the State.

About 4.4 billion acre-feet of recoverable fresh and slightly saline water are estimated to be present in underground storage in New Mexico.

Overall, the quality of these waters is assumed to be good, although there are significant pollution problems known to affect certain areas throughout the State. A comprehensive survey of the State's ground water quality has not been done, so a quantitative statement concerning ground water quality cannot be made.

Public Drinking Water Systems

The quality of water provided by public water supply systems in New Mexico is one measure of ground water quality. The primary contaminants in public water supply systems in New Mexico are nitrates, most often originating from septic tanks. However, as a result of expanded federal sampling requirements volatile organic contaminants (VOCs) are being discovered to be more widespread than previously recognized. Some wells have been shut down because of VOCs, while others have installed treatment systems. New Mexico also has naturally occurring elements including arsenic, fluorine, radium, radon, selenium, and uranium which adversely affect the quality of drinking water.

1996 reauthorization of the federal Safe Drinking Water Act (SDWA) mandates that EPA set new or revised standards for two constituents which are naturally occurring in New Mexico ground water: radon and arsenic.

EPA must promulgate a standard for radon by December 2000, with a proposal by August 1999. There is at present no drinking water standard for radon. Radon is an important issue for this state. Present sampling data suggest that radon could possibly be evident in 84% of New Mexico's water supply wells. Annual treatment costs to remove radon could be substantial, depending on the level at which EPA sets the standard. Under the 1996 amendments to the Safe Drinking Water Act, New Mexico may seek a waiver from this rule by:

- Seeking a risk assessment and risk reduction study from an independent scientific organization;
- Propose a standard based on that assessment;
- New Mexico may adopt a less stringent standard with multimedia mitigation.

EPA promulgation of a revised regulation for arsenic has been mandated for no later than January 1, 2001. The present standard for arsenic is 0.05 mg/l, and suggestions for a revised standard range from 0.002 mg/l upwards. In New Mexico, arsenic naturally occurs at or above 0.002 mg/l in more than fifty percent of the state's water supplies. Like radon, the costs to remove arsenic could be substantial depending on the level at which EPA sets the standard.

The State, in addressing these naturally occurring constituents, would like to approach these problems by a new approach:

- Assume a low vulnerability for most water systems and that the State should be allowed to set sampling frequencies based on vulnerability;
- Sample low vulnerability systems every five years which would reduce the frequency of sampling for most small systems;
- There would be more frequent monitoring for vulnerable systems thus focusing the resources based on the probable risk;
- Detection level (percent of Maximum Contaminant Level as set by USEPA) triggers more frequent sampling;
- Simplification of sampling requirements so that it is the same for all types and sizes of systems.

Since the 1920s, almost 200 public water supply wells in New Mexico have been adversely affected by pollutants caused by human activities. More than half of these wells have been taken out of use for human consumption. Some are still used for non-sensitive activities such as road watering, while others are being used for blending with water from other wells or treated to remove impurities. The details of these contamination incidents are described below.

Ground Water Contamination Inventories

Starting in the late 1970s, the New Mexico Environment Department (NMED) reviewed existing information on vulnerable aquifers and major known and potential contamination sources. Review of existing information by NMED has become an ongoing process as focus has shifted from identification of major potential sources of contamination to specific questions about known or suspected ground water problems. An initial inventory of known or suspected cases of ground water contamination resulting from surface impoundments and other facilities was concluded in 1980

(1). An update, expansion and computerization of this inventory of ground water contamination incidents of all types from all sources during the years 1927 through early 1996 is currently in progress.

In general, ground water contamination most frequently occurs in vulnerable aquifer areas where the water table is shallow although other factors including precipitation, soil type and preferential flow pathways also affect vulnerability. Vulnerability maps, based on aquifer depth, were prepared in 1989 for all counties in the State. These county maps are available for inspection at the appropriate NMED field offices and at the NMED Underground Storage Tank Bureau office in Santa Fe. The New Mexico Energy, Minerals and Natural Resources Department's Oil Conservation Division (OCD) developed vulnerability maps for the San Juan Basin in northwestern New Mexico in 1985 and 1992, which are available for inspection at their office in Santa Fe.

At least 1,233 ground water contamination plumes emanating from point sources, and numerous areas of widespread contamination from nonpoint sources, have been identified in the State from 1927 through October 1998 (Figure 7). This contamination has impacted 187 public and 1,719 private water-supply wells (Figures 6 and 8). To date, 622 cases have received or will soon receive some degree of remediation (Figure 9). For the purpose of this report, remediation is defined as either removal of polluted ground water for beneficial use or recycling, removal of floating hydrocarbons or purification of polluted ground water followed by reinjection or discharge to surface waters. Remedial actions include removal of floating non-aqueous-phase liquids, vapor ventilation, bioremediation, and a variety of pump-and-treat, pump-and-waste, or pump-and-use methods. The above remediation activities have occurred in the past, are occurring now or are expected to occur in the near future.

Ground water contamination is known to have occurred at approximately nine percent of facilities operating under a Ground Water Discharge Permit approved by NMED or OCD since the regulations became effective in 1977. Prevention of ground water contamination is clearly more cost effective and technically achievable than remediation.

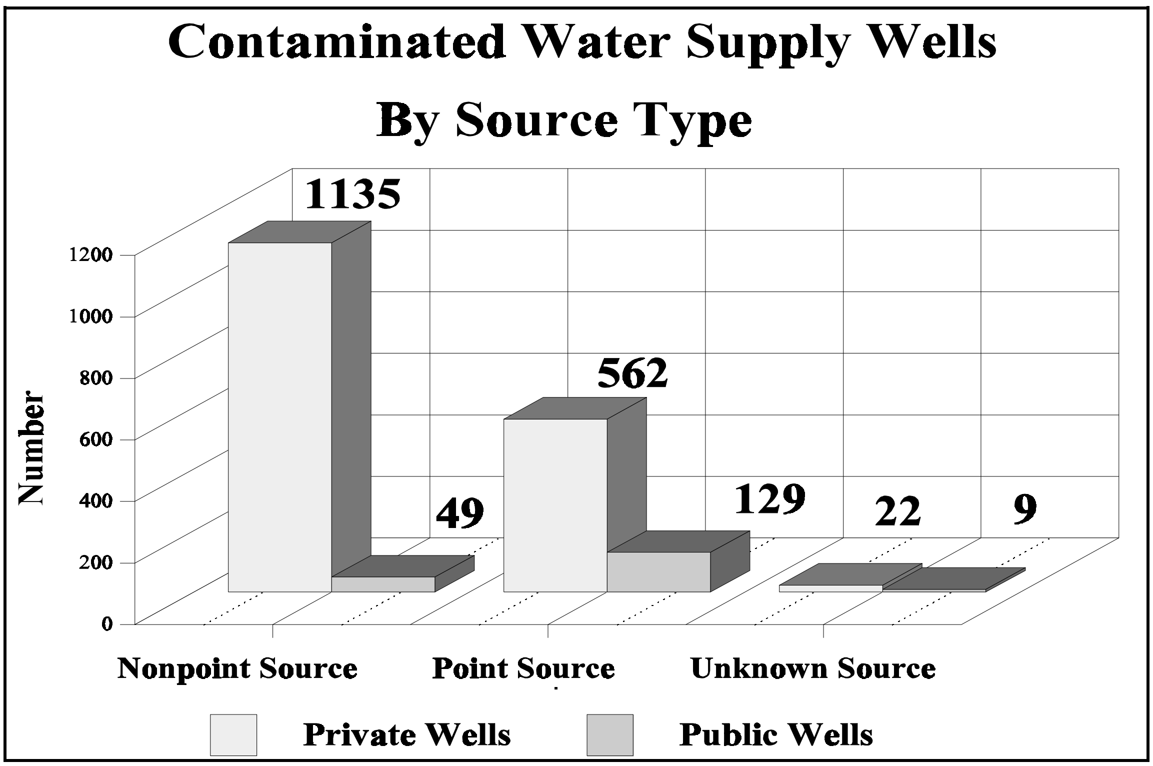


Figure 6. Contaminated Public and Private Water Supply Wells by Source Type in New Mexico.

Figure 7.

Point Sources of Ground Water Contamination in New Mexico.

1,233 Cases, Distributed County-by-County.

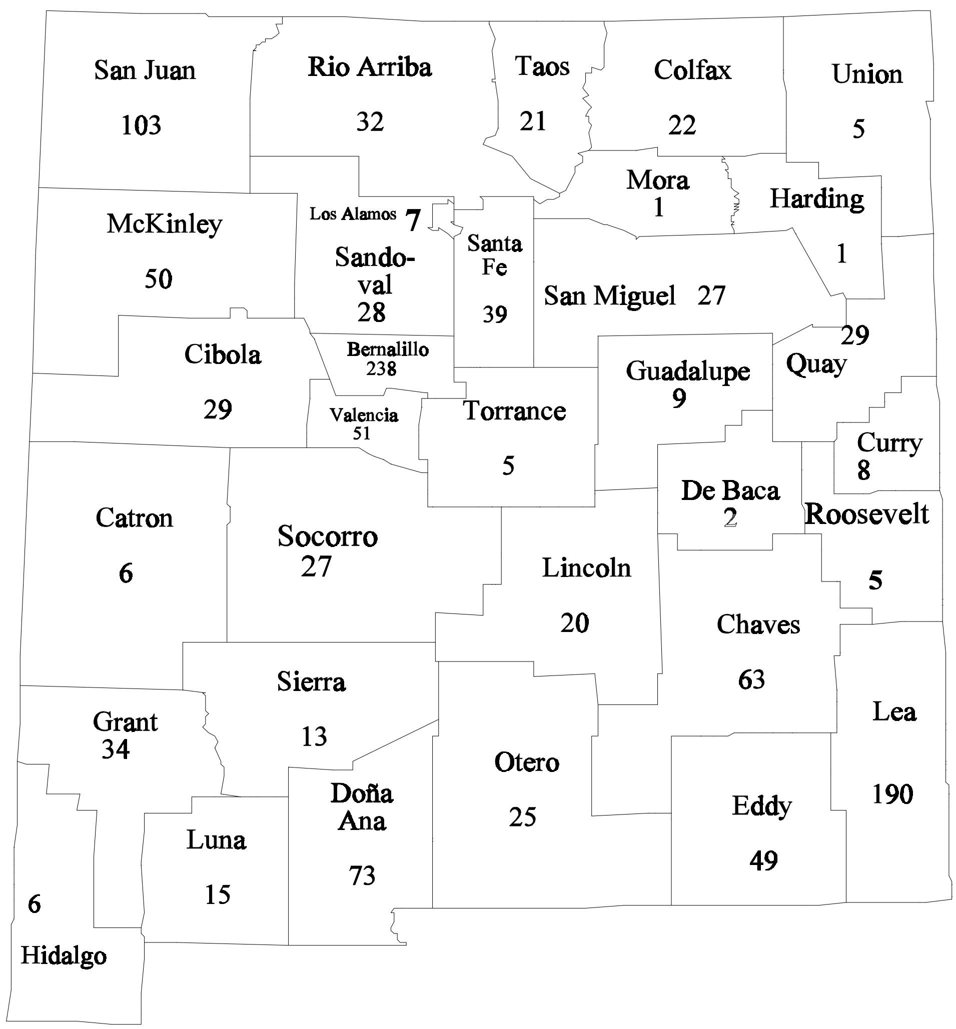


Figure 8.

Contaminated Water Supply Wells in New Mexico.

(Public and Private)

1,719 Sites, Distributed County-by-County.

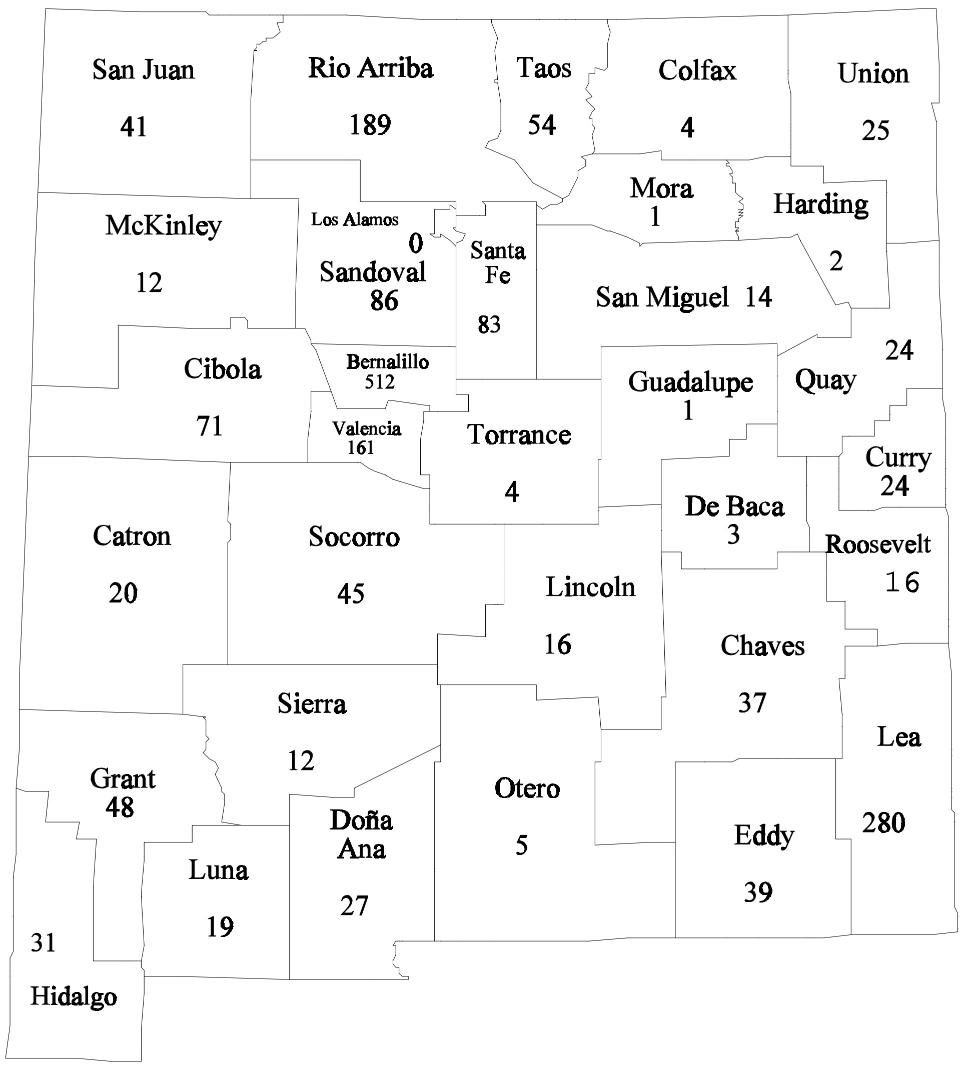
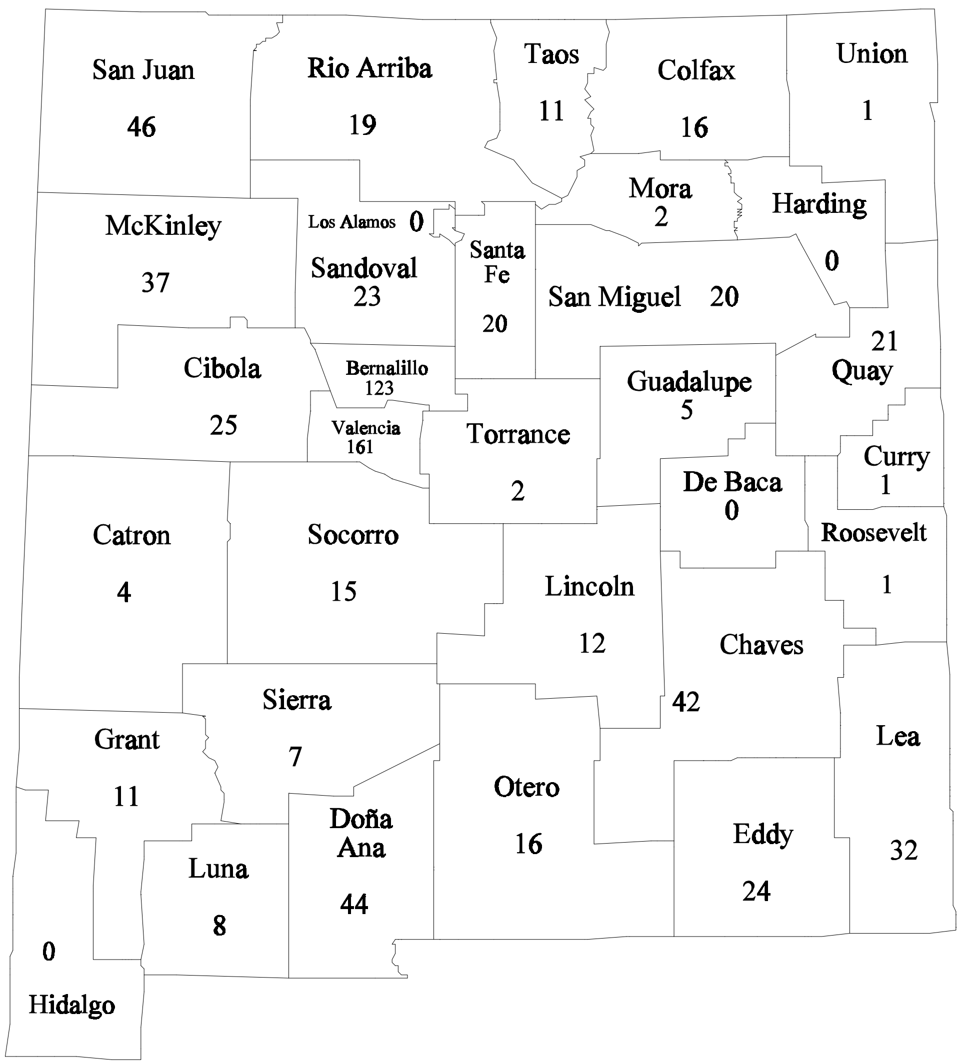


Figure 9.

Ground Water Cleanups in New Mexico.

622 Sites, Distributed County-by-County.



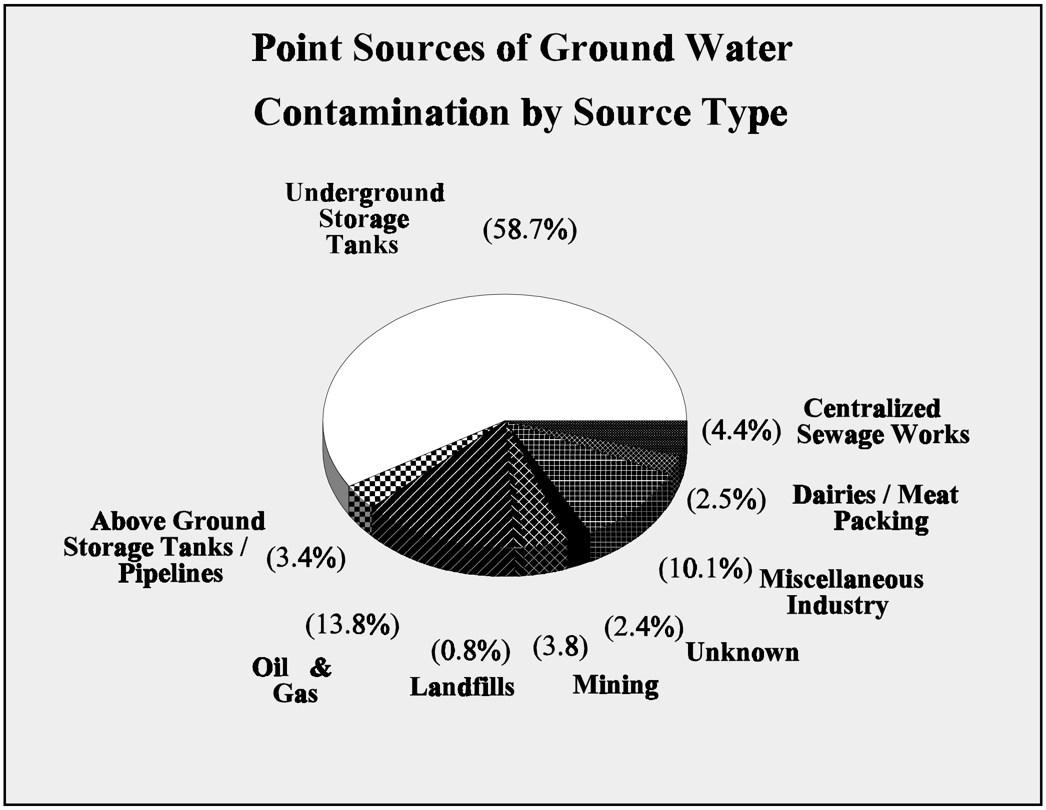


Figure 10. Point Sources of Ground Water Contamination in New Mexico by Source Type.

More than half of all cases of ground water contamination in the State have been caused by nonpoint sources, predominantly household septic tanks or cesspools. Nonpoint source contamination may be caused by diffuse sources such as large numbers of small septic tanks spread over a subdivision, residual minerals from evapotranspiration, confined-animal feedlot operations, areas disturbed by mineral exploration and/or storage of waste products, urban runoff or application of agricultural chemicals.

Point source categories are shown in Figure 10. These sources are include publicly and privately owned sewage treatment plants with flows over 2,000 gallons a day, dairies, mines, food processing operations, industrial discharges, landfills and accidental spills or leaks.

Nonpoint Sources of Contamination

Household Septic Tanks and Cesspools

It is estimated that there are over 175,000 household septic tanks or cesspools in the State discharging roughly 35 million gallons per day of wastewater to the subsurface. In shallow water table areas, the effluent percolates rapidly to underlying aquifers. These systems can pollute ground water with the following contaminants:

- total dissolved solids (TDS);
- iron, manganese and sulfides (anoxic contamination);
- nitrate;
- potentially toxic organic chemicals; and
- bacteria, viruses and parasites (microbiological contamination).

TDS contamination occurs largely from 'mineral pickup,' the increase of minerals during domestic use.

Anoxic contamination is a chemical condition in which the water is deficient in oxygen. It can be caused by septic tank discharges or by naturally occurring geologic deposits such as humus and peat. Iron, manganese and hydrogen sulfide, typical anoxic contaminants, can cause severe taste and odor problems and can stain laundry and porcelain, but are not known to be hazardous to human health. Nitrate contamination, on the other hand, typically lacks such aesthetic problems, but can cause methemoglobinemia, a rare but potentially serious and sometimes fatal disease affecting infants. Questions have also been raised as to whether nitrates can cause cancer in healthy adults. Ground water nitrate levels resulting from household septic tank contamination have been monitored at concentrations as high as thirty milligrams per liter as nitrogen (thirty mg/L as N), three times the health standard.

Conditions of severe anoxic and nitrate contamination are mutually exclusive due to differences in the oxidation-reduction potentials of the ground water involved. Organic chemicals and disease-causing microbes, however, can occur in conditions of both anoxic and nitrate contamination. Many household products, especially cleaners, contain organic chemicals. Trichloroethylene, in particular, is a well-known ground water contaminant released by septic tank discharges.

Household septic tanks and cesspools constitute the single largest known source of ground water contamination in the State. Widespread nitrate contamination and/or anoxic conditions have been documented in Chamita, Española, Pojoaque, Tesuque, Santa Fe, Bernalillo, Corrales, Albuquerque and its South Valley, Carnuel, Bosque Farms, Los Lunas, Belen, Carlsbad, Nara Visa, Lovington and Hobbs.

Agriculture

Evapotranspiration (ET) is a process in which water enters the atmosphere either by direct evaporation or by transpiration from living plants. Minerals left behind in the soil following ET water losses can increase the TDS of shallow ground water and form alkali deposits. In the Rio Grande Valley, for example, irrigation canals have diverted river water for hundreds of years. Percolating irrigation water has caused the shallow water table in many valley areas to rise and be more vulnerable to ET. This problem can be remedied by the construction of drains to lower the water table, as was done in Albuquerque in the 1930s.

A second concern with agriculture is the finding that approximately 70 pesticides or pesticide decomposition by-products have been detected in the nation's ground water **(2, 3)**. The National Survey of Pesticides in Drinking Water Wells **(4)** alone found 13 of 127 analytes above their minimum reporting limits. Overall nationally, the survey found 16 different pesticides or pesticide degradates in drinking water wells. In contrast, in New Mexico, one well was found to have a degradate level above the detection limit but below any health standard.

Fumigant pesticides, halogenated methanes, ethanes and propanes, are common ground water contaminants in other states, but have not been extensively used in New Mexico. Carbamate pesticides such as aldicarb, carbaryl, and methomyl have caused ground water contamination in other states and are used in New Mexico; and aldicarb have been used heavily in certain areas. NMED, in cooperation with the New Mexico Department of Agriculture, has been collecting reconnaissance samples for pesticides in ground water through a multi-phase Agricultural Chemical Sampling Project. To date, out of a total of 41 locations, nine wells have displayed measurable pesticides. However, these results have consistently been less than the EPA's maximum contaminant levels for drinking water.

Point Sources of Contamination

Oil Field Sources

The most common cause of oil field contamination is the past practice of disposal of produced water to unlined pits. Other causes include leaks of crude petroleum and/or produced water from pipelines and well casings.

Produced waters, often brines, tend to gravitate to the lowest part of a freshwater aquifer and migrate along a hydraulic gradient different from that of the water. In addition to inorganic contaminants, such as chloride, most produced waters contain aromatic hydrocarbons that also can contaminate ground water. At the present time, ninety percent of the approximately 454 million barrels of water produced annually in the State is injected into deep wells for the purposes of secondary recovery, pressure maintenance or disposal.

Crude oil and natural gas condensate, if discharged in the liquid phase by upsets or spills, will float atop the water table and their water soluble constituents will dissolve into the ground water.

An August 1989 OCD survey of reported spills found that nearly half were due to corrosion of tanks, valves or pipelines.

Oil field contamination of ground waters has been a more serious problem in southeastern production areas of the State than in those in the northwest part of New Mexico. This is due to the larger quantity and generally poorer quality of water produced in the southeast, as well as the relative vulnerability of southeastern sole-source aquifers (e.g. the Ogallala). Cases of documented ground water contamination as a result of oil and gas exploration and production, however, are increasing in northwestern New Mexico. A priority OCD study of unlined pits in northwestern New Mexico funded by EPA under a Clean Water Act grant documented ground water contamination resulting from produced water disposal to unlined pits **(9)**.

Refined Petroleum Product Sources

The most common cause of petroleum product contamination in the State is leaking underground storage tanks (LUSTs). It is estimated that between 5 and 15% of the approximately 4,252 underground storage tanks in the State are leaking. Causes of leaks include overfill, and faulty installation, as well as tank and line corrosion. In addition to ground water contamination, LUSTs can cause explosive hazards when product vapors migrate to basements and utility corridors.

Other sources of refined petroleum product contamination include leaks and tank-bottom water discharges from above-ground storage tanks, leaks and hydrostatic test water discharges from pipelines, transportation accidents and waste oil disposal.

Nitrate Sources

Point sources of nitrate contamination include sewage treatment plants, food processing facilities, dairies, slaughterhouses, fertilizers, mining facilities, other industrial facilities and septic tanks serving restaurants, mobile home parks, or other commercial operations. Nitrate contamination, such as from mining, can result in considerably higher concentrations (e.g. 500 mg/L as N) than those resulting from household septic tanks, which seldom exceed 30 mg/L as N (the health standard is 10 mg/L). Dairies, which are common in New Mexico, can cause nitrate contamination up to 200 mg/L as N.

Solvents Sources

Halogenated or aromatic solvents are used by many different industries such as machine shops and electronics firms, and also occur in a variety of household products. The most common solvents being detected in the State's ground water are benzenes and chlorinated methanes, ethanes, ethylenes and propanes.

Metals/Minerals Sources

Contamination by metals and/or minerals may be caused by mining and milling or other industrial activity. Common contaminants include sulfate, pH, total dissolved solids, heavy metals, radionuclides and other trace elements.

Ore refining mills produce large quantities of tailings, the raffinate of which typically contains elevated levels of metals/minerals. Due to engineering convenience and economic advantages, tailing impoundments have often been located in alluvial valleys close to the mill. This frequently causes ground water contamination, which persists long after removal or amelioration of the sources of contamination.

Public Landfills

Concern about the potential for landfills to contaminate ground water has grown in recent years. Very little is known about the composition of wastes buried in landfills in the State. Constituents known to occur in landfill leachate include chlorides, nitrogen species, solvents and a large number of other organic contaminants.

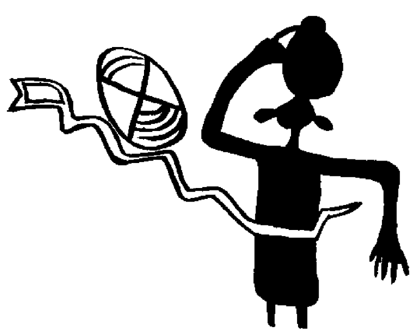
Household wastes alone contain a large number of leachable constituents. In Oklahoma, for example, more than forty organic compounds, including phthalates and alkybenzenes, were detected in ground water contaminated by a landfill that did not receive appreciable amounts of industrial wastes **(5)**. In an Albuquerque survey of household hazardous waste, more than 50% of the wastes identified were disposed of in area landfills, including more than 53,000 gallons of used motor oil per year **(6)**.

Large quantities of septage (solids and liquids pumped from septic tanks periodically) have in the past been discharged to unlined pits at several landfills in the State, a practice no longer allowed. The septage in several cases has been commingled with industrial wastes such as produced water, waste petroleum products and chlorinated solvents.

NMED has conducted a limited study of ground water quality impacts of landfills in the State. Ground water contamination has been documented at eight landfills **(7, 8)**. The United States Bureau of Land Management is conducting studies at several of its landfills, particularly in Doña Ana and San Juan Counties.

Septage Disposal

Vacuum truck operators provide a vital service to septic tank owners by periodically removing accumulated solids. In some areas of the State, however, operators do not dispose of septage using legally or environmentally sound mechanisms. Several septage disposal sites have been found to contain petroleum products, metals, minerals and solvents. To help correct the situation, NMED is in the process of developing septage tracking regulations and is working with local governments and private operators to permit environmentally sound and legal septage disposal facilities around the state.



REFERENCES: GROUND WATER QUALITY

New Mexico Environmental Improvement Division

1) 1980 Boyer, David G., Dennis McQuillan and Maxine S. Goad. New Mexico Surface Impoundment Assessment, February 1980. Santa Fe. 98 pages plus appendices.

United States Environmental Protection Agency

2) 1986 Pesticides in Ground Water: Background Document. Office of Ground Water Protection (WH-550G). 72 pages.

3) 1986 State Program Briefs, Pesticides in Ground Water. Office of Ground Water Protection (WH-550G). 93 pages.

4) 1990 National Survey of Pesticides in Drinking Water Wells, Phase I Report (EPA 570/9-90-015). 98 pages.

5) 1974 Robertson, J.M., C.R. Toussaint and M.A. Jorque. Organic Compounds Entering Ground Water From a Landfill. EPA-660/2-74-077. 47 pages.

Albuquerque Environmental Health and Energy Department

6) 1983 Salas, A., L.J. Gordon and R. Anglada. City of Albuquerque Residential Hazardous/Toxic Waste Survey. Albuquerque. 32 pages.

New Mexico Environmental Improvement Division

7) 1986 McQuillan, Dennis and Patrick Longmire. Water Quality Investigations at Lee Acres Landfill and Vicinity, San Juan County, New Mexico. Santa Fe. 47 pages.

8) 1988 Baker, David L. and Dennis McQuillan. Los Angeles Landfill Site Summary, City of Albuquerque, New Mexico. New Mexico Environmental Improvement Division. Santa Fe. 53 pages.

New Mexico Oil Conservation Division

9) 1989 Olson, William C. Volatile Organic Contamination of Ground Water Around Unlined Produced Water Pits. Open File Report H89-9, Hydrology Program, New Mexico Institute of Mining and Technology. 69 pages.