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Groundwater Contamination

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Groundwater supplies more than 54 percent of the population of Wyoming with domestic water. More than 90 percent of rural domestic water comes from groundwater as well. Because groundwater is such an important resource, it needs to be protected from the types and levels of contamination that could have detrimental effects on humans and the environment. Not all contaminants are bad, and they can be natural and/or human made. Once groundwater is contaminated, cleaning it up is a very difficult and expensive process.

Many people believe that the soil above groundwater aquifers will filter contaminants out of recharged water, but this is usually not true. The ability of soils to filter contaminants depends on many variables including the chemical properties of contaminants, soil, subsoil, and geological properties, site conditions, and climatic factors. These variables combined with the depth to the water table (the top of an aquifer) make groundwater contamination a very site-specific problem.

How Groundwater moves

Water is often referred to as the universal solvent. It will dissolve many natural and synthetic chemical compounds. Water flowing through the soil dissolves materials from soil and rock and chemicals from various land-use activities. How quickly a particular contaminant reaches a groundwater aquifer depends on the properties of the contaminant and the soil and on other site conditions.

Soil Properties that can influence soil's ability to filter out or retain contaminants include texture, permeability, and organic matter content. Texture refers to the relative proportion of sand, silt, and clay contained in the soil. Permeability is a measure of how fast water moves through the soil. Coarse-textured sandy soil allows rapid water movement and is less capable of filtering out some contaminants than fine-textured clay soils. These highly permeable soils will permit contaminants to leach more quickly than less-permeable soils. The leaching of a contaminant is the downward movement of a dissolved or suspended substance by water. The amount of organic matter also determines the capacity of soil to hold water and absorb chemicals. Generally, the greater the amount of organic matter in soil, the greater the capacity of the soil to absorb chemicals and reduce leaching.

Chemical Properties influencing a contaminant's ability to reach groundwater aquifers include solubility, adsorption, volatility, and degradation. Solubility is how readily a chemical dissolves in water. Water-soluble chemicals are easily leached. Adsorption is the ability of a chemical to be held on the surface of soil particles or organic matter. A chemical that is held tightly to soil

particles is less likely to be leached. Volatility is the ability of a chemical to be lost in the atmosphere. A highly volatile chemical may be lost to the atmosphere before being leached downward. Degradation is the breakdown or alteration of a substance in soil or water. A contaminant which degrades slowly is more likely to be susceptible to leaching.

Site Conditions such as depth to the groundwater are important with respect to contamination. Less distance between the soil surface and water table generally increases the chance for leached contaminants to reach an aquifer. There is less time for contaminant adsorption and degradation to occur. The slope on a site can affect the likelihood of contamination as well. A steep slope may create more runoff, which may transport a contaminant to a different location. Excessive rainfall increases percolation, leaching, and runoff. Cold soil temperatures slow the rate of degradation, allowing a chemical to be leached over a longer period of time.

Contaminants in an aquifer do not mix uniformly, remaining rather in a plume (or concentration). This plume then moves slowly through an aquifer along with groundwater movement. Contaminants position themselves differently according to their weight relative to water. Lighter materials such as gasoline will float at or near the top of an aquifer. Materials such as minerals will dissolve in water, and heavier, insoluble materials such as chlorinated hydrocarbons will settle to the bottom. Knowledge of these properties can be beneficial because some contaminants may remain localized, allowing for better detection and cleanup.

Causes of Groundwater Contamination

Virtually all of the uses of water degrade its quality. Quality is a relative term tied to a specific intended use. Land uses or activities on the surface can contribute to groundwater contamination. These uses or activities include landfills, underground storage tanks, sludge disposal, septic systems, agriculture, and industry. The type of contaminants released by these activities include bacteria, nitrates, volatile organics, hydrocarbons, pesticides, metals, and minerals. Groundwater contaminants may also be naturally occurring substances such as fluorides, selenium, and radionuclides. By identifying the types of activities, particularly those upgradient from a water supply, it may be possible to determine types of contaminants having the potential to reach groundwater supplies.

Landfills may contribute any of the above-named contaminants to groundwater. Evidence indicating contamination includes observed leachate runoff, seepage into nearby surface water, and high levels of the contaminants in well water or soil tests. Contaminants may be released if the cover or liner of landfill leaks, if there is leachate movement without adequate control, or if the landfill is on highly permeable soils.

Underground Storage Tanks, if leaking, can introduce contaminants into groundwater quite easily because the tanks are below the surface and contaminants are generally not subject to volatilization. Indications of leaking tanks include odors in water or nearby basements, tank inventory losses, and spills. Tanks can leak because of corrosion, poor installation or maintenance, lack of a backup containment, or the deterioration of abandoned tanks.

Sludge Disposal can introduce bacteria, nitrates, volatile organics, hydrocarbons, pesticides, metals, or minerals into groundwater. Groundwater can be contaminated by sludge disposal because of improper application methods, the nature of the sludge, the underlying soils and subsoils, or surface hydrologic features.

Septic Systems can introduce the same types of contaminants into groundwater as sludge disposal. Evidence of contamination includes waste water seeping above ground or high contaminant levels in water or deep soil tests. The causes of groundwater contamination by a septic system include faulty installation and/or maintenance, disposal of certain household chemicals into the system, overloading the capacity of a system, or septic tank cleaning additives.

Agricultural practices can introduce nitrates, petroleum products, and pesticides into groundwater. Water tests can detect these types of contamination in groundwater. Groundwater contamination from agriculture can be caused by the improper or ill-timed application of agricultural chemicals and spills.

Industry can introduce contaminants such as volatile organics, hydrocarbons, pesticides, metals, or minerals into groundwater. Groundwater contamination is detected by water tests. Some causes of contamination include leaks and improper storage and handling at industrial sites, spills from transport accidents, and broken pipelines.

Detection of Groundwater Contamination

The best method of detecting groundwater contamination is a water test for a particular contaminant. No single test can detect all of the contaminants discussed here. Water tests should be specific for the intended purpose of the water source. If people are supplied by a municipal water system, water testing is done for them in accordance with applicable state and federal laws. A private water source is different, however. It is a person's responsibility to protect himself or herself by knowing the quality of private well water.

Changes detected in water may indicate a contamination problem. To locate the source of the problem, use common sense. Look for clues to the source of the contamination and then have the water tested to determine the types and concentrations of contaminants. Contact a local public health department or a local University of Wyoming Cooperative Extension Service office for information on proper methods for collecting water samples, where to send them, what potential contaminants to test for, how to interpret the results, and what to do if there is a problem with the water.

Protecting Groundwater Quality

Prevention is the key to maintaining good quality groundwater. Individuals make the difference. There are some basics to practice to protect groundwater quality:

- Use, store, and dispose of household, shop, lawn and garden, and auto care products according to label instructions.
- Use, store, and dispose of agricultural chemicals according to recommendations and/or label instructions and use Integrated Pest Management (IPM) practices where appropriate.
- Test underground storage tanks and pipelines regularly to detect possible leaks.
- Follow regulations and guidelines for installing, plugging, and abandoning any type of well.
- Manage domestic septic tanks and disposal fields to prolong life and maximize their ability to remove contaminants.
- Contact federal, state, and local agencies for applicable rules, regulations, and guidance on groundwater protection.

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