MOVEMENT OF CONTAMINATED GROUNDWATER AT ROCKY FLATS

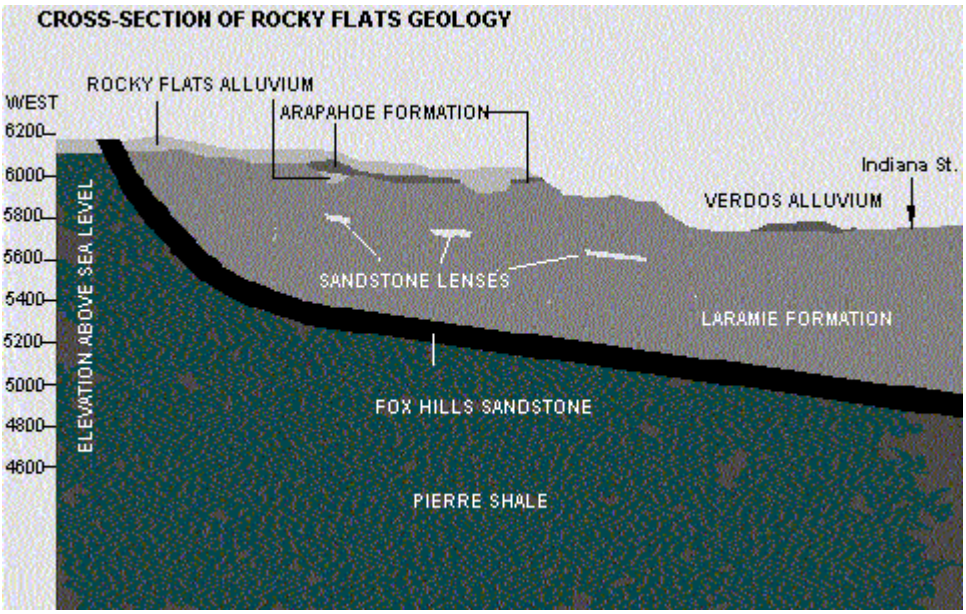


Figure 1

The Issue

Contaminants released from a nuclear or industrial facility move into the environment through pathways such as air, surface water or groundwater. Scientists conducting the State of Colorado's Historical Public Exposures Studies on Rocky Flats have researched pathways by which people could have been exposed to contaminant releases from the Rocky Flats Environmental Technology Site from 1952 to 1989.

The researchers found that the public was exposed to contaminants from Rocky Flats primarily through breathing the air. They determined that some contamination in surface water drainage and runoff from Rocky Flats flowed into creeks that entered drinking water reservoirs east of the site, but that this did not cause significant public exposure. The Rocky Flats Plant site has been found to contain areas of groundwater contamination, but researchers believe it has not migrated off the plant site, nor does it currently pose an off-site health threat.

What exactly is groundwater and how is it monitored?

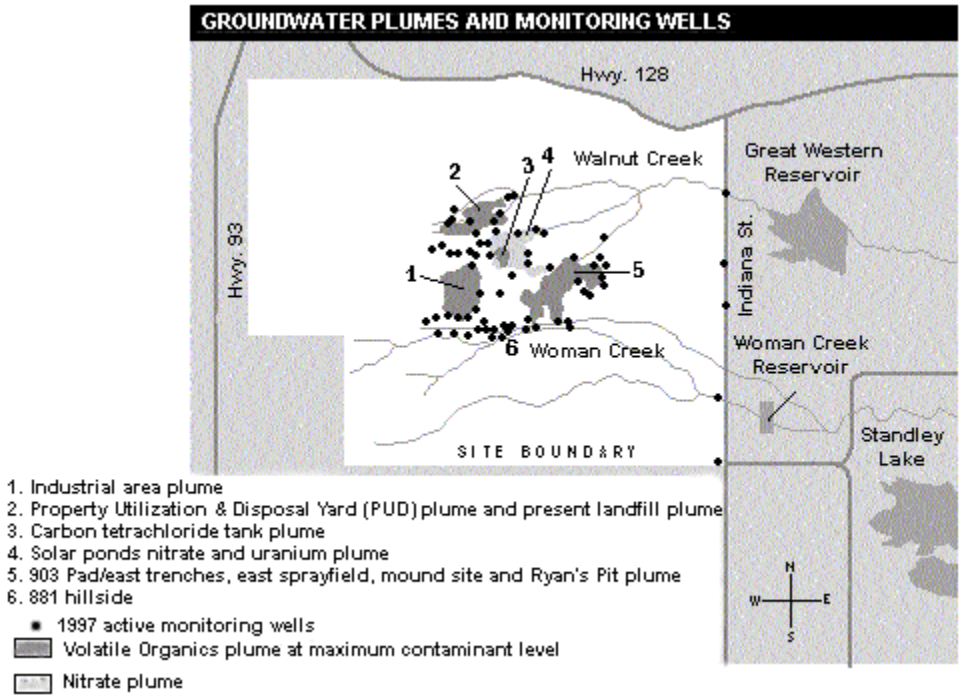
Groundwater is water found below the earth's surface in underground layers of rock, sand or gravel known as aquifers. Groundwater is monitored by drilling wells and analyzing samples from the wells for contaminants. Limited groundwater monitoring began at Rocky Flats in 1960. Additional wells were drilled in 1971 and in the mid-1980s. Monitoring data from on-site wells have shown that groundwater beneath the Rocky Flats Plant site is contaminated in certain areas.

Have contaminants been found in groundwater at Rocky Flats?

Yes. Liquid contaminants spilled on the ground and certain substances that dissolve in water can easily move down through the soil and contaminate the shallow groundwater. Data from on-site monitoring wells at Rocky Flats show areas of groundwater contaminated with elevated radioactivity, nitrates and volatile organic compounds at different locations (see Figure 2). Summaries of historic Rocky Flats groundwater monitoring data done previously by two researchers show localized areas of elevated radioactivity in groundwater at or near past Rocky Flats disposal sites, near the solar evaporation ponds and the 903 Pad. Elevated nitrate concentrations are found in groundwater near the solar ponds and the spray fields. Volatile organic compound plumes have been identified in the 881 Area, the present landfill, the 903 Pad,

around a former carbon tetrachloride tank, the former mound burial area and under the industrial area of the plant.

GROUNDWATER PLUMES AND MONITORING WELLS
Figure 2



How can researchers study groundwater movement?

To evaluate the potential for groundwater to transport contaminants, researchers first study the area geology and hydrogeology. Geology is the study of the earth, the rocks which make up the earth and the forces that act on it. Hydrogeology is the study of groundwater movement. Each layer of material beneath the earth's surface has a different capacity for holding groundwater and transporting contaminants.

How fast does groundwater move?

Groundwater movement is generally very slow compared to movement of surface water. Groundwater at Rocky Flats moves only a few feet to 100 feet a year. Because groundwater moves slowly, contaminants do not mix or spread quickly. Instead they remain concentrated in slow moving plumes that may persist for many years.

What is the geology at Rocky Flats?

Rocky Flats is situated on a plain at the foot of the Rocky Mountains, sloping slightly downward toward the east (see Figure 1). Groundwater is located at different depths beneath the Rocky Flats site. The most shallow groundwater is found in three geologic formations which vary in thickness: the alluvium (sands and gravels), the Arapahoe formation (sandstone and claystone) and the Laramie formation (mostly claystone with a few sandstone "lenses"). Below the shallow groundwater is several hundred feet of claystone composed of tightly fitting clay particles which serve as a natural barrier. Water can move downward through claystone at the rate of only inches per year. Below the claystone is a deeper layer of groundwater found in the bedrock Laramie Fox Hills formation.

How can groundwater become surface water?

Groundwater flowing horizontally on top of the claystone layer can emerge downslope as springs during some periods of the year at the edges of valleys created by Walnut Creek and Woman Creek, which flow through the plant site. Thus, the contaminated groundwater can become surface water, but it is captured in detention ponds built on the two creeks in 1979 to prevent most of the uncontrolled flows of storm water off the plant site. These ponds are sampled regularly.

Walnut Creek, which drains about half of the Rocky Flats site, used to flow eastward into Great Western Reservoir, a former drinking water supply for the City of Broomfield. In 1989, Broomfield officials diverted Walnut Creek from flowing into the reservoir, and in 1997, secured a new drinking water supply. The city no longer uses Great Western as a drinking water source.

Until recently, Woman Creek, which drains the southeastern portion of Rocky Flats, flowed directly east into Standley Lake, a drinking water supply for the Cities of Westminster, Northglenn and Thornton and some residents of Federal Heights. With U.S. Department of Energy funding, a reservoir was constructed on Woman Creek east of the Rocky Flats boundary in 1996 to keep the Rocky Flats drainage from flowing into Standley Lake.

Monitoring of these surface water bodies (see Figure 2) is done to ensure that public water supplies are safe. According to the monitoring data, the Rocky Flats groundwater contamination has not affected these surface water bodies.

Has the contaminated groundwater plume moved off-site past the eastern boundary?

The scientists conducting the Historical Public Exposures Studies on Rocky Flats considered whether a contaminated groundwater plume could have moved off-site east of the Rocky Flats Plant boundary at Indiana Street. To be conservative, they typically overestimate the rate of groundwater movement for their analyses. They estimated that contaminated groundwater from Rocky Flats would take from 30 to 300 years to travel through various geologic pathways eastward to Indiana Street.

The data from all Rocky Flats groundwater monitoring wells including six wells along the plant's eastern boundary at Indiana Street are regularly checked and are routinely reported to the public.

From 1992-1994, scientists detected plutonium levels exceeding the state standard for groundwater in samples from one shallow groundwater well next to Walnut Creek at Indiana Street near the northeast corner of the site. When sediment in the well was cleaned out in 1994, the levels of plutonium dropped below the standard and have remained so to date. Scientists believe that heavy rains caused the contaminated sediment to enter the well.

Summary

Scientists concluded that it is unlikely that groundwater contaminants released from the plant in the past could have reached any wells used by the public today. Sampling of plant-wide wells has confirmed these conclusions.

Monitoring data available to date indicate that contaminated groundwater from the Rocky Flats Site has not migrated to the plant's eastern boundary. Nor have groundwater contaminants released from the plant in the past reached any private or municipal wells east of the site.

Scientists conducting the state's Rocky Flats Historical Public Exposures Studies have concluded that at this point in time, areas of groundwater contamination remain within the plant boundary and that further evaluation of groundwater as a potential exposure pathway for off-site populations during the period of interest (1952-1989) is not appropriate. However, monitoring of the groundwater at Rocky Flats will continue, and the data will be available to the public. The researchers have found that the primary pathway by which the public could have been exposed to past Rocky Flats releases is through breathing the air.