Rapid Recharge to Perched-Intermediate Groundwater Zones, Pajarito Plateau, Los Alamos, New Mexico

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INTRODUCTION

The Los Alamos National Laboratory continuously measures groundwater levels and surface-water discharge at over 150 locations on the Pajarito Plateau as part of a monitoring network to protect groundwater resources. The resulting data are analyzed to help identify locations where surface water and shallow alluvial groundwater recharge deeper perched-intermediate groundwater zones.

The Pajarito Plateau consists of a series of east sloping finger like mesas separated by deep canyons containing ephemeral and intermittent streams. The vadose zone ranges in thickness from 600–1300 ft above the regional aquifer. Annual precipitation includes 33-50 cm of rain (35-40% of total precipitation) and up to 130 cm of snow.

BACKGROUND

Groundwater occurs in three distinct zones beneath the plateau.

(1) Shallow alluvial groundwater in the canyon bottom sediments is recharged by short reaches of perennial flow maintained by natural spring input or anthropogenic discharges and by seasonal flow associated with storm runoff and snowmelt.

(2) Perched intermediate groundwater occurs in subsurface bedrock above layers of low permeability or due to capillary barriers (Robinson et al., 2005). Intermediate groundwater zones are highly variable in vertical (1ft - 400 ft thick) and lateral extent (up to 3.7 mi). Monitoring of these zones provides early warning for contamination moving towards the regional groundwater system.

(3) Deep regional groundwater is the source for drinking water for the town of Los Alamos and is found at depths of over 1200 ft on the western side of the plateau to approximately 600 ft on the eastern edge of the plateau.

Typical estimated annual infiltration rates vary spatially from <1mm/yr to over 1000 mm/yr. However, localized rapid recharge can sometimes yield transient infiltration events that are detected 200 ft below ground surface within a few days.

There are inferred connections between alluvial and intermediate aquifers because contaminants (e.g. high explosives, nitrate, perchlorate, and tritium) are present in both alluvial and intermediate groundwater.

PURPOSE

(1) Document the geologic and hydrologic conditions which are conducive to rapid recharge

(2) Use the knowledge as a predictive tool to identify other locations where rapid recharge could occur.

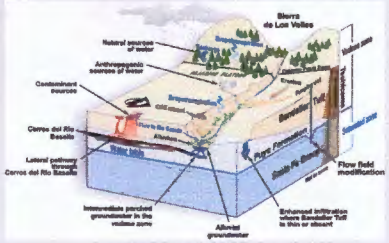
RESULTS

- ~ 2 month lag between alluvial recharge and intermediate recharge for western side (600 ft depth).
- ~ 2-4 week lag between alluvial recharge and intermediate recharge for eastern side (400 ft depth).

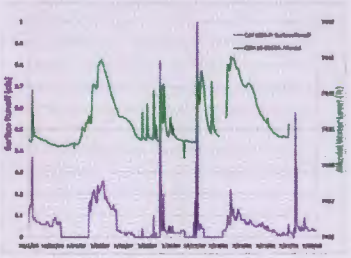
- Densely welded fractured tuff
- Perennial stream flow near mountain front.
- Longer distance to intermediate zone ~600ft

- Fractured basalt
- Seasonal surface flow during snowmelt and summer rainstorms.
- Shorter distance to intermediate zone ~400ft

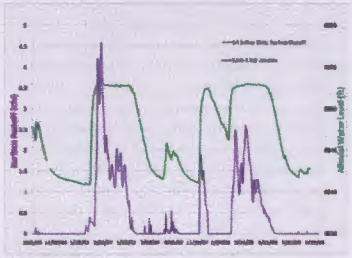
Pajarito Plateau Watersheds and Monitoring Well Locations



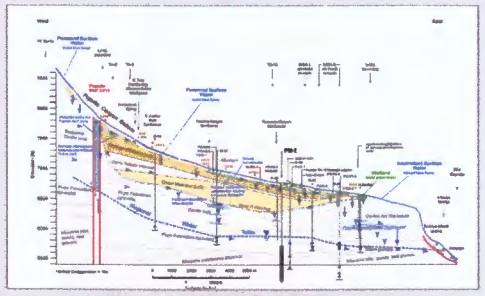
Conceptual Block Diagram



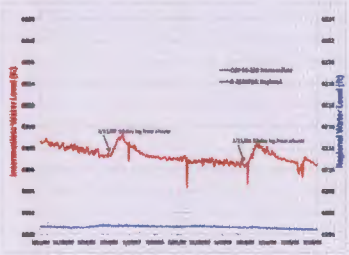
Cañon de Valle Surface Runoff and Alluvial Water Level



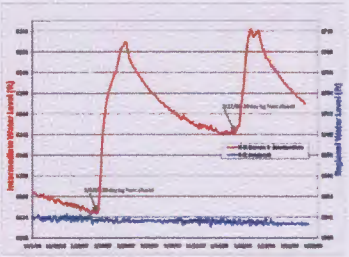
Los Alamos Canyon Surface Runoff and Alluvial Water Level



Cross Section of Pajarito Canyon



Cañon de Valle Intermediate and Regional Water Level



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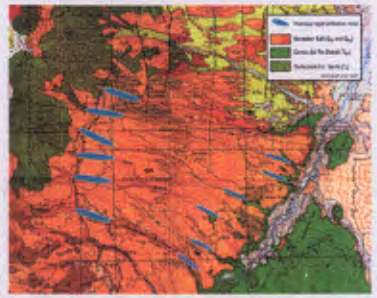

Geology of Pajarito Plateau

CONCLUSIONS

- Observe rapid recharge to intermediate aquifer on both eastern and western side of plateau- two contrasting hydrogeologic settings.
- Fractures and/or faults primary fast pathways

➢ **Key Feature: Persistent overland flow and brittle bedrock near surface.**

- In contrast, do not observe rapid recharge in central portion of plateau:
- Thick alluvium overlying nonwelded to moderately welded tuff
- Saturated alluvium in direct contact with permeable tuff -matrix flow.

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