

Structure of Groundwater Flow in the Espanola Basin near Rio Grande and Buckman Wellfield

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Introduction



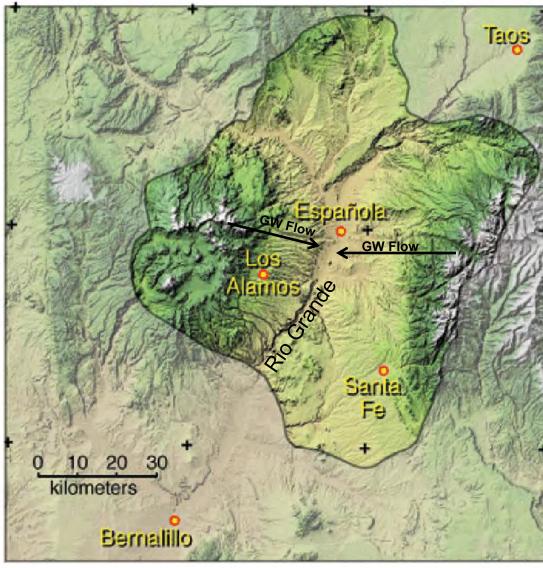
- Groundwater flow within Espanola Basin:
 - West of Rio Grande is generally eastward towards Rio Grande
 - East of Rio Grande is generally westward towards Rio Grande
- This suggests that the Rio Grande is likely a discharge area for the groundwater from either side of the basin
- However, this may not be exactly the case



107°W

36°30'N





35°15'N

105°30'W



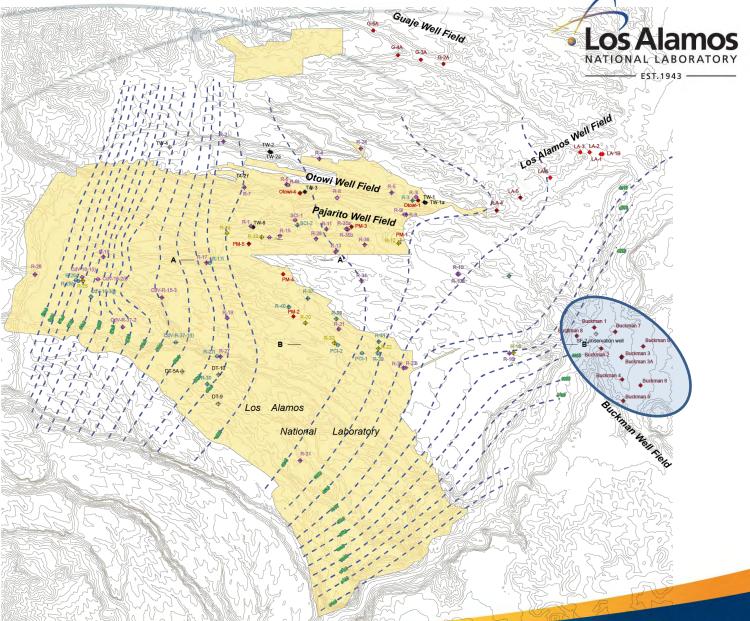
Conceptual Model - Lines of Evidence



Understanding of the hydraulic connection between the Rio Grande and the regional aquifer near the Buckman Wellfield can be deduced from existing information:

- Water-level data (pre- and post- development, pumping drawdowns; spring-discharge rates)
- Basin geology and hydrostratigraphy
- Ground-surface subsidence
- Isotope data





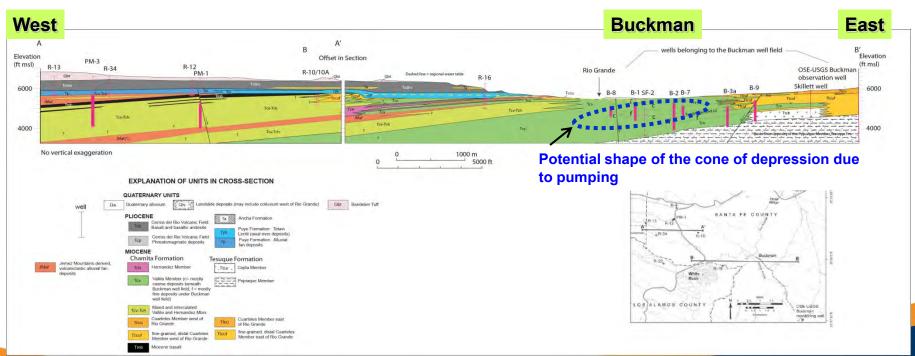
Setting



Regional Hydrostratigraphy



- Santa Fe Group sediments that make up the Buckman aquifer are highly stratified, and the layering is generally dipping to the west
- Hydrostratigraphy within aquifer is expected to affect the shape and orientation of the cone of depression caused by Buckman pumping

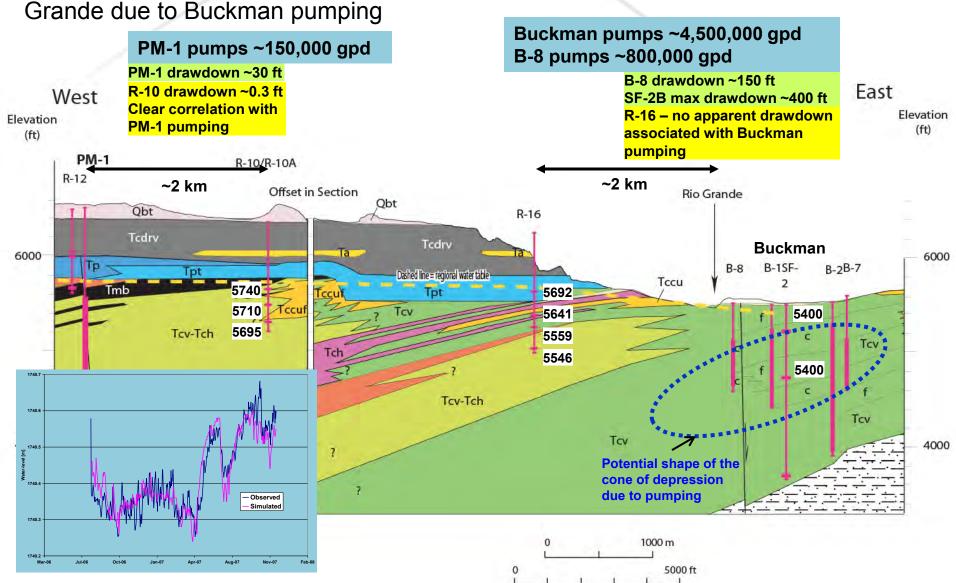




Pumping drawdowns

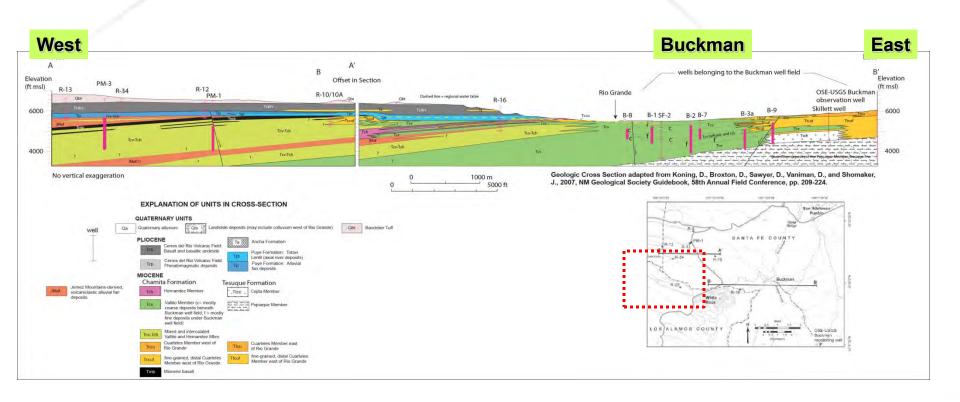


No apparent drawdown is observed in monitoring wells west of Rio

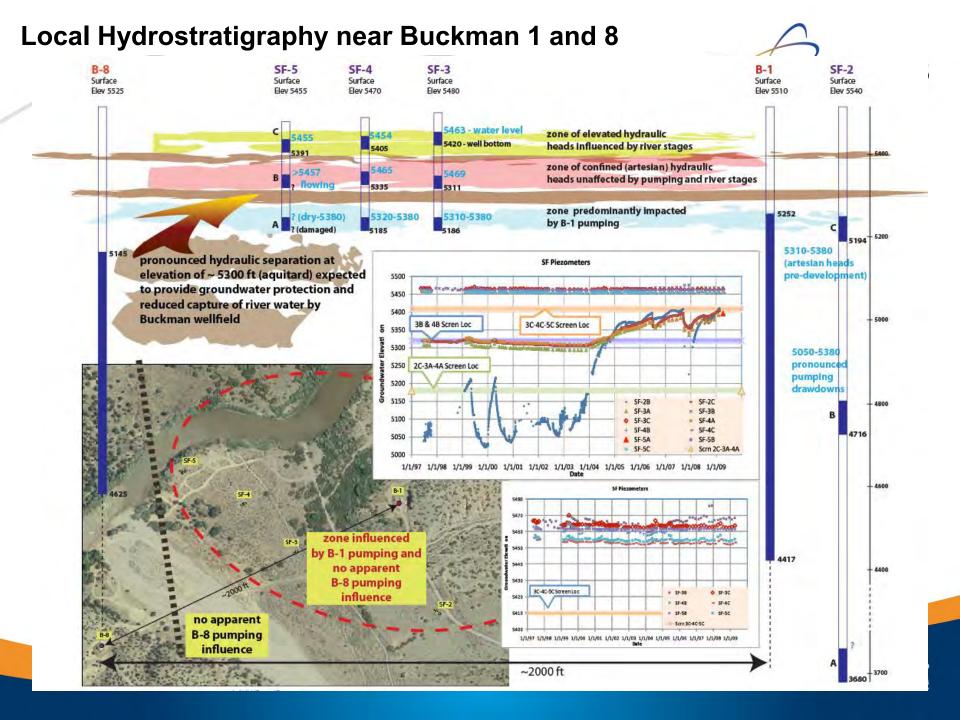


Regional Hydrostratigraphy



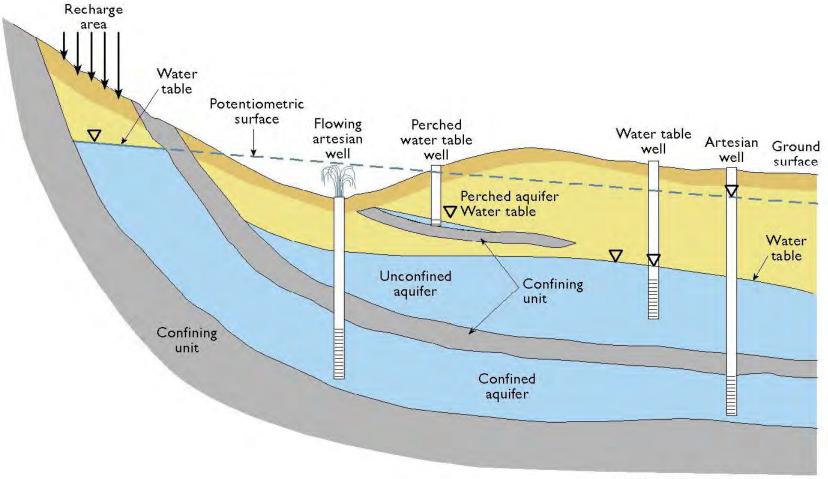






Simplified Depiction of Confined and Unconfined Aquifers





Modified after Harlan and others, 1989

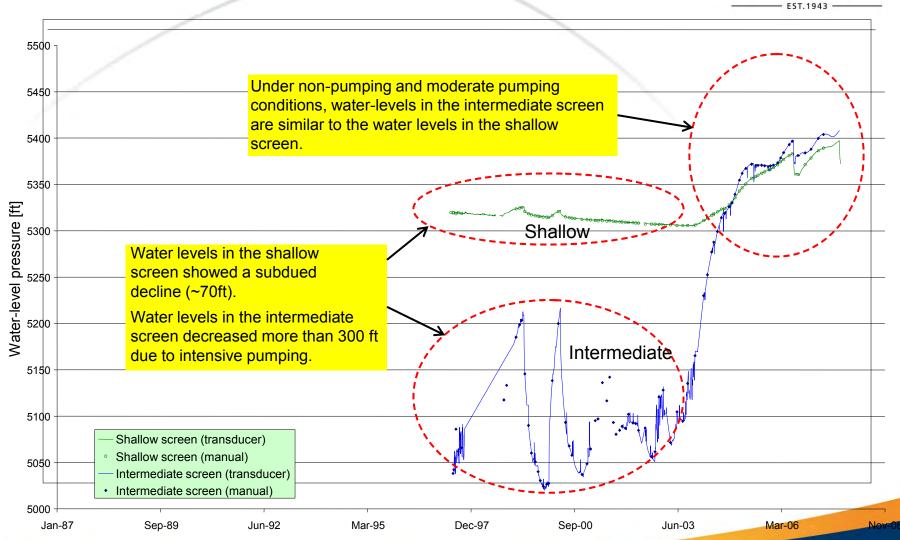


Water levels observed at the Buckman piezometer nest (3 screens)

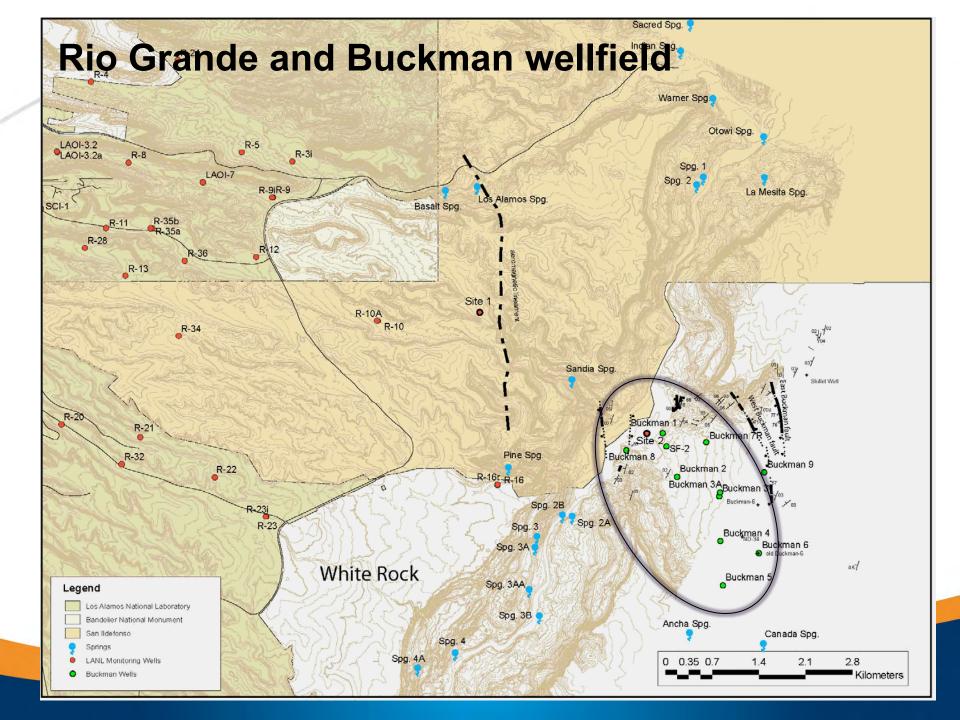
Water-levels observed at the Buckman Monitoring Nest (3 screens) 5920 5900 5880 Higher water levels deep in the aquifer compared to the water levels at shallower 5860 elevations demonstrate the confinement Water-level pressures [ft] of the regional aquifer near Buckman Deep wellfield 5840 5820 5800 Intermediate 5780 Deep screen 5760 **Shallow** Intermediate screen Shallow screen **5740** Oct-03 Mar-04 Sep-04 Mar-05 Sep-05 Apr-06 Sep-06 Apr-07

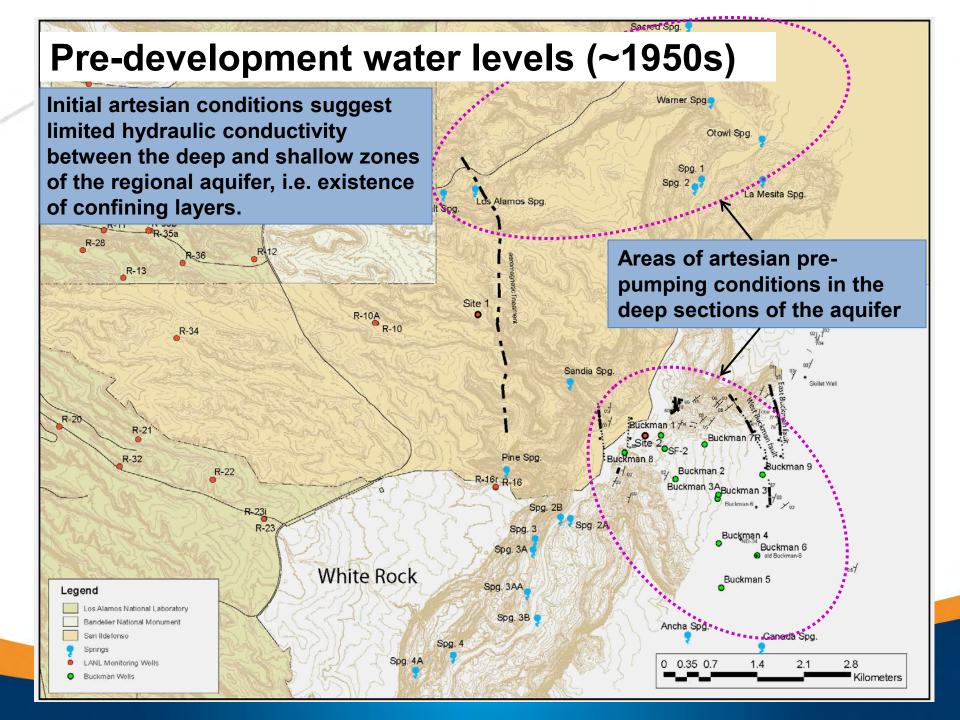
Water levels observed at monitoring nest SF-2 (2 screens)





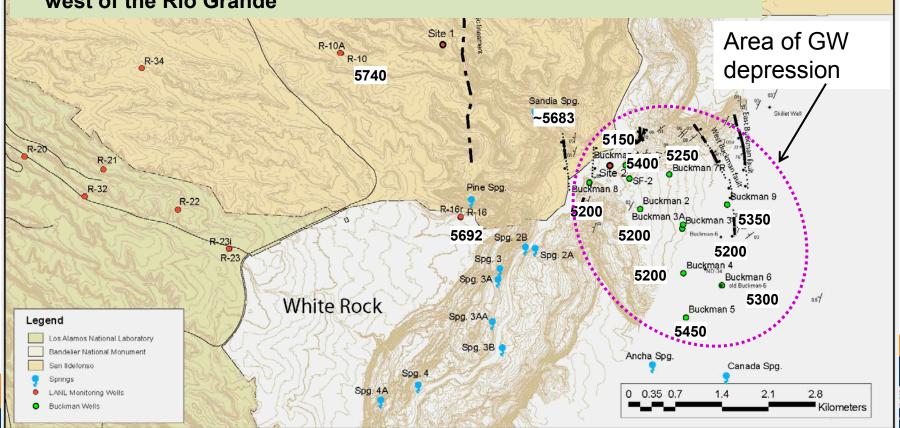


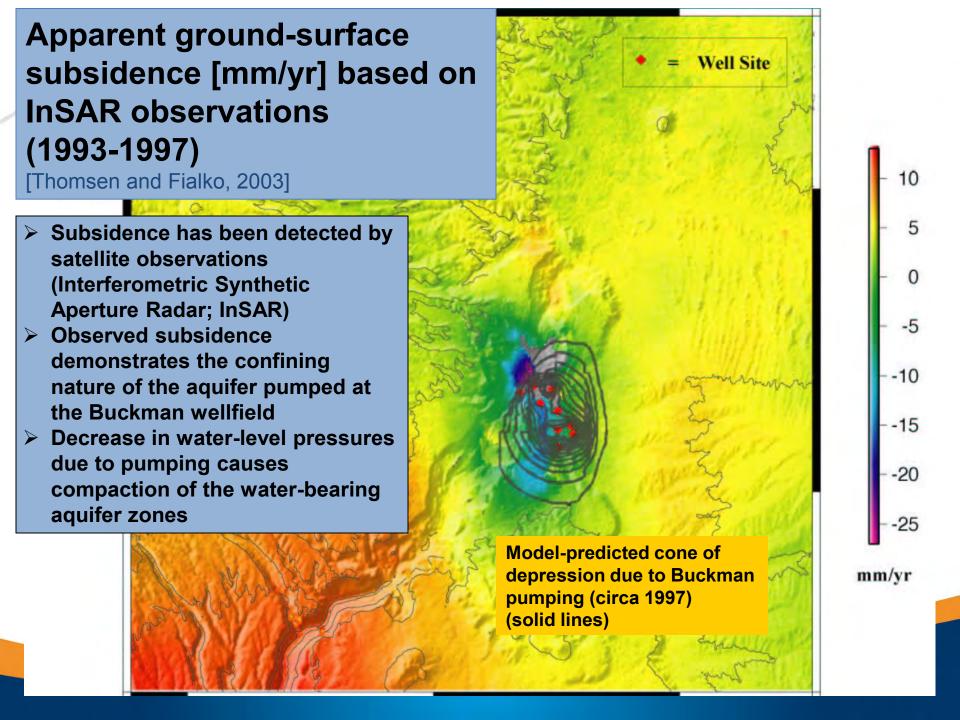




Post-development water levels (~2010)

- There is a cone of water-level depression near Buckman due to pumping
- ➤ Water-level elevations are ~400 ft higher west of Rio Grande
- Buckman pumping does not affect water levels and spring discharge west of Rio Grande
- These observations suggest hydraulic separation between the aquifer zones pumped at Buckman and the aquifer zones monitored by LANL west of the Rio Grande

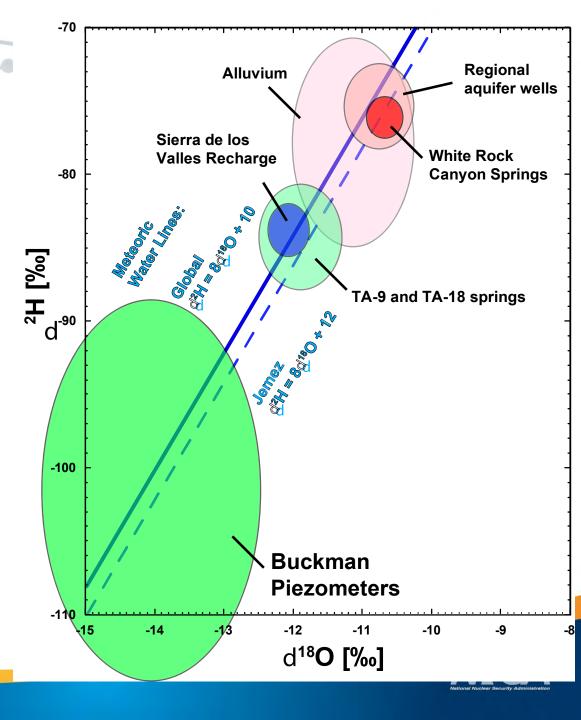




Isotope $\delta^{18}O/\delta^2H$ ratios

Substantially different isotope signatures are observed between Buckman wells and Pajarito Plateau springs and wells (regional, intermediate, and alluvial)

These data suggest different groundwater origins and little or no contribution of Pajarito Plateau groundwater at Buckman



White Rock Canyon Springs



Water origin and discharge rates

- White Rock Canyon springs are almost entirely located west of Rio Grande
- The groundwater discharged by the springs west of Rio Grande shows geochemical signature similar to water infiltrated along the Pajarito Plateau
- Most of the springs are discharging the regional aquifer (the rest are discharging perched horizons fed by local infiltration)
- Annually-averaged recharge occurring along the Pajarito Plateau is about 67 kg/s [Kwicklis, et al., 2005]
- Annually-averaged discharge at the springs is about 60 kg/s [*Purtymun, 1995*].
- Intensive water-supply pumping of the <u>deep aquifer zones</u> beneath the Pajarito
 Plateau and the Buckman wellfield appear to have no impact on the discharge rate
 of springs located West of Rio Grande.



Buckman Wellfield – Water-Quality Monitoring



The Laboratory coordinates with City of SF to supplement groundwater monitoring within well field

City of Santa Fe Buckman Water-Supply Wells 2014–2015 Sampling and Analysis Plan

	Analytical Suites										
	Metals (filtered, unfiltered)		Organics (unfiltered)				Radionuclides (unfiltered)		Inorganics (filtered, unfiltered)		
Location	Metals _a	Chromium	VOCs	SVOCs	PCBs	HEXP	Radionuclides _b	Low-Level Tritium	General	Nitrate+nitrite	Perchlorate
Buckman No. 1	1, 3	—d	1, 3	1, 3	1, 3	1, 3	1, 3	1, 2, 3, 4	1, 3	_	1, 3
Buckman No. 6	1, 3	_	1, 3	1, 3	1, 3	1, 3	1, 3	1, 2, 3, 4	1, 3	_	1, 3
Buckman No. 8	1, 3	_	1, 3	1, 3	1, 3	1, 3	1, 3	1, 2, 3, 4	1, 3	_	1, 3
SF-3A	_	4	_	_	_	_	_	4	_	4	4
SF-4A	_	4	_	_	_	_	_	4	_	4	4







- Multiple lines of evidence support a conceptual model of limited hydraulic connection between the deep (pumped) and shallow section of the regional aquifer in the area of Buckman wellfield
- Vertical upward gradients within the Buckman wellfield under predevelopment conditions indicate an inherent protection of the Buckman water resources from local contamination sources

