Well and Spring Vulnerability to Contamination
Mountains and Inner Piedmont of South Carolina
A Tritium Survey Testing Local Recharging

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OVERVIEW

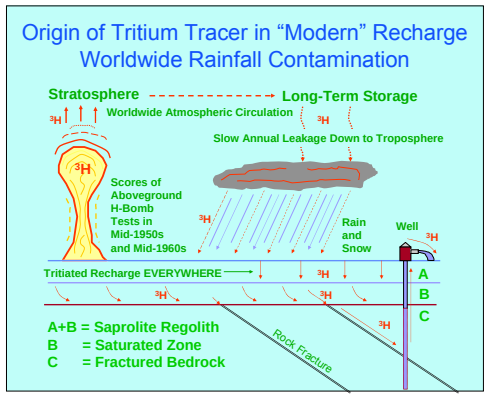
The Appalachian mountains and broad Piedmont geologic provinces are underlain by hard crystalline rocks capped by an often thick (10-20 m) earthy regolith. The mountains and its bordering transition to the innermost Piedmont (basically foothills) have special ground-water hydrologic conditions compared to the rest of the state, and even with the remainder of the Piedmont by having greater relief. Furthermore, the mountains and foothills are now subject to considerable development for various purposes, from lower intensity residential or recreational to denser suburbs. Thus simultaneously the local ground-water resource is now more important, by its greater use, while potential threats to water quality have increased markedly by the different uses of the land. Presently public-system and private-home wells supply many residences, schools, and businesses. Several springs in the mountains and Piedmont are used for special-interest drinking water and several others are used for bottling water, with growing interest in the latter use. In summary, in this area of different hydrologic conditions the ground-water resource is important, becoming more so, and potential threats to its quality are multiplying.

Circumstantial evidence from known geologic conditions and hydrogeologic principles, plus extrapolation of findings from the broader Piedmont, suggest that ground water in the mountains and innermost Piedmont should be very vulnerable to rapid contamination by any chemical contaminants applied or leaked at the surface at nearby locations. This would be true for both wells and springs. This conceptual assessment is based mainly on the absence of a thick areally extensive layer of tight clay in the regolith to confine or isolate the ground water in the fractured rock below it. The nature of saprolite controls this. Water can thus recharge readily through the regolith near wells. Secondly, vulnerability is interpreted as higher because of the minimal volume of saturated regolith, which holds the water that eventually recharges into fractures at the top of the bedrock. With sometimes only a few meters of saturated thickness, there are not many years of infiltrated rainwater "stacked up" above the recharging fractures to delay entry of contaminants to the rock aquifer. After recharge reaches the fractures, their small volume but relatively open nature allow rapid water velocities, especially under pumped conditions or other imposition of high hydraulic gradient. Finally, relatively high natural (unpumped) hydraulic gradients are predicted by the great local relief in the mountains and foothills. Recharging and subsequent ground-water flow is predicted to be rapid.

A brief initial survey used a convenient selection of sites to test this interpretation of high vulnerability. For wells, the mountains and foothills are emphasized. Springs included those farther into the piedmont. Tritium already emplaced by natural rainfall was used as a tracer or indicator of recent recharge water.

Nearly all wells and springs tested in this brief survey had confidently detected tritium (>8 ±8 Tritium Units, being a concentration). This is similar to the findings elsewhere in the lower-relief Piedmont in South Carolina and in various settings in Georgia. Even high-water-table wells in valley bottoms and springs in lower parts of broad lower areas showed this indication of high vulnerability, those settings being plausibly of longer flowlines and longer flow times from more distant upland recharge areas, and thus possibly of lower vulnerability. They too mostly showed the recent recharge tritium. We assume that in the case of the valley-bottom wells, at least, the high relief on the nearby mountain slopes with attendant high hydraulic gradients caused the more rapid ground-water flow to explain this.

We conclude that wells and springs in this region are mostly highly vulnerable to contamination. Those that are used for such critical purposes as public supply (formal or informal), home drinking water, sensitive manufacturing or agriculture, or in the case of some springs, supporting endangered species, all deserve special attention to the land-use practices surrounding them and especially upslope of them.



RATIONALE: An In-Place On-Going Tracer Test

Contaminant tritium (^3H) has been applied everywhere by natural precipitation as part of water molecule and thereafter flows with the water through the unsaturated zone and in ground water.

This tritium marks all recharge from shortly after WWII, the era of widespread ground-water contamination (e.g., chlorinated solvents, petroleum from underground tanks, synthetic pesticides, etc.).

More importantly, the contaminant tritium shows where any dissolved contaminant might reach in the period of less than four of five decades.

"High vulnerability" is defined here as able to be contaminated from the surface within ca. 50 years.

Tritium Presence in Public-Supply Wells in Mountains and Foothills

Site / Well	Tritium Concentration (TU Tritium Units)
Cliffs at Glassy Mountain	
Well 4	14 ± 8 11 ± 8 (dup)
Well 8	10 ± 8
Well 11 *Possibly low vulnerability	<6 ± 8*
Caesars Head	
Well 1	11 ± 8
Well 2	14 ± 8
Table Rock State Park	
White Oak well	12 ± 8
Devils Fork State Park	
Laural Ridge well	9 ± 8 15 ± 8 (dup)
Oconee State Park	
Campground well	16 ± 8

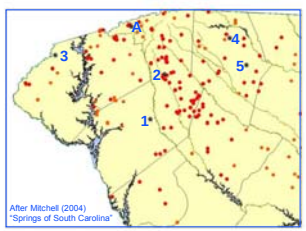
M = mountains P = piedmont

Tritium Presence in Springs in Mountains and Inner Piedmont

Spring		Tritium Concentration (TU Tritium Units)
Moody (routine public use)	M	19 ± 8
Williamston (substantial public use) *possibly low vulnerability	P	<6 ± 8* 6 ± 8* (dup)
Boiling (Spartanburg Co.)	P	27 ± 8
Waddy Thompson	P	33 ± 8
Cedar	P	21 ± 8 23 ± 8 (dup)
Unnamed (Greenville Co.) (endangered species site)	P	16 ± 8

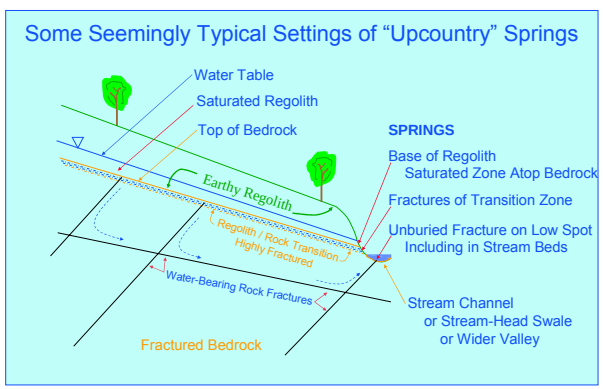
M = mountains P = piedmont

Conclusions: Wells and Springs and Therefore Ground Water in General in the Mountains and Inner Piedmont Are Vulnerable to Rapid and Easy Contamination From the Surface Environment Due to Rapid Recharging. Water Supplies Here Deserve Special Attention to Protection.



Spring Locations
1. Mineral Spring
2. Waddy Thompson Spring
3. Moody Spring
4. Boiling Springs
5. Cedar Spring

A. Shown in bottom photo



Even Very Small Springs Can Be Surprisingly Important to People

Moody Springs Oconee County

Spring in Mountains