

appears to pose little risk due to rapid dilution, it is unlikely that seepage from ground water to the ocean would pose a significant risk.

E. What Are the Important Data Or Knowledge Gaps for Deep Well Injection?

In conducting the relative risk assessment, EPA found that there is a lack of definitive studies in South Florida that use a physical or chemical tracer or indicator to show whether stressors detected in aquifers come from treated wastewater managed by deep well injection, and if so, by what likely contaminant transport pathways (porous versus conduit flow). In addition, without more definitive tracer studies, it is difficult to assess the potential effects of local geochemical conditions on the fate and transport of injected treated wastewater.

While results from ground water monitoring around some Class I municipal wells in South Florida confirm that fluids have migrated out of the permitted injection zone, the full areal extent of USDW contamination is not known. This is not only because available monitoring data are limited, but also because the location and connectivity of natural conduits for fluid flow (fractures and solution cavities in the underground formations) are difficult to predict.

The fate and transport of pathogens in South Florida's aquifers are not completely understood. For example, the rates of microbial survival, inactivation, and transport are difficult to predict. Also uncertain are the rates of microbial straining or filtration by geological materials under different fluid flow scenarios, including porous media and conduit flow. Even with the most sophisticated modeling, or with expensive monitoring, this information is difficult to verify since the formations are thousands of feet underground. There is also insufficient data at present on the presence and viability of pathogens in injectate that has migrated out of the injection zone. However, the presence of coliform bacteria in injectate that has migrated, a long accepted indicator of the presence of sewage, indicates the likely presence of pathogenic microorganisms.

IV. Relevance of These Findings for the Final Rule for Class I Municipal Wells in South Florida

EPA requests comment on how the findings from the relative risk assessment, and identified data gaps, help inform the final regulatory action on the July 7, 2000, proposal. EPA

specifically requests comment on the three issues discussed below.

A. Additional Wastewater Treatment Prior to Injection

EPA believes the following findings from the relative risk assessment are relevant to the question of the extent to which additional treatment may be needed for Class I injectate that has a potential to reach USDWs.

1. Wastewater that does not undergo disinfection contains viruses and pathogenic bacteria and protozoa that have not been inactivated. Although the fate and transport of these pathogens in South Florida's subsurface is not well known, monitoring and modeling data suggest that, at some sites, fluid may migrate at rates that are sufficient to transport active and infective pathogens into USDWs. For example, using first order analytical modeling with conservative parameters and assuming flow is dominated by bulk flow through preferential flow paths, travel times to the base of the USDW of 170 days, 14 years, and 86 years have been estimated for Pinellas, Dade, and Brevard Counties respectively. There is significant uncertainty as to how long the viruses, protozoa, and bacteria will remain alive and to what extent they may affect existing and future sources of drinking water, although it is expected that significant attenuation and die-off would occur in the deep subsurface over long travel times. The limited data that are currently available show one-log (90%) inactivation rates in aquatic media ranging from 40 to 200 days for *Cryptosporidium*, 6 to 50 days for bacteria, and 1 to 30 days for viruses. This suggests that pathogen contamination would likely be a concern in areas where travel times are potentially short (e.g., Pinellas County). For such areas, additional treatment (e.g., primary treatment, coagulation, settling, filtration, and high-level disinfection) would likely be needed to inactivate, remove, or greatly reduce pathogens in order to increase the level of protection for current and future sources of drinking water. (As noted above, wastewater in Pinellas County is already treated to reclaimed water standards, which include both disinfection and filtration.) Additional treatment beyond secondary may also be appropriate to address pathogenic microorganisms in cases where injection of large volumes of wastewater increases the uncertainty regarding the areal extent of fluid movement and travel times for fluid to potentially reach USDWs.

2. Insufficient confinement is evident at some facilities and locations. At nine

facilities, there is either confirmed or suspected contamination of USDWs as a result of the movement of fluid from designated injection zones. This is a violation of Federal and State Class I UIC requirements, which prohibit any contaminants from entering USDWs. At nine other facilities, there is evidence of movement outside of the injection zone, though not yet into USDWs. Monitoring reports from some facilities suggest that fluid movement has resulted in fluctuations in total dissolved solids (TDS) concentrations and less pronounced changes in the concentrations of other potential stressors (e.g., fecal coliform, nitrate, ammonia, and total Kjeldahl nitrogen). Such fluid may have the potential to contaminate future sources of drinking water and place existing public and private water supplies at risk.

3. The full areal extent of fluid movement is not known. Nearly 500 million gallons per day (mgd) are disposed of through deep well injection at 42 sites in South Florida, with rates for individual wells ranging from less than 1 to more than 100 million gallons per day (mgd). While the dynamics of horizontal movement at any of these 42 sites of this quantity of water are not well understood, there is some evidence that water with the potential to reach USDWs (due to inadequate confinement) may not travel far. The first-order analytical modeling results presented in the relative risk assessment show horizontal travel distances at the surface ranging from 0.1 to 1.6 miles assuming rapid (bulk) vertical flow, and ranging from 1.2 to 16 miles assuming slow (porous media) flow. Note that a travel distance of 16 miles is modeled to occur only under a very long time horizon (1,188 years). Two members of EPA's External Peer Review Panel expressed concern, however, regarding the feasibility of using numerical models to assess the pattern of flow in and around the discharge zone (known as the Boulder zone), and to account for several trillion gallons of treated municipal wastewater that has been injected into the Boulder zone since the inception of Florida's Class I UIC program. These Panel members also pointed out that the risk could be significantly higher to USDWs than the modeling calculations that assumed porous media flow suggest, due to large uncertainties that were not accounted for in this modeling. In response to these concerns, EPA developed a second model assuming bulk flow through preferential flow paths, with travel times for injectate to reach USDWs and drinking water wells that were an order