Two New York operators used fuel oil for roof padding in the early and middle 1970's. Currently, the only fluid injected into solution mining caverns in New York for roof padding is food-grade mineral oil. A proposal for diesel oil injection at a facility where caverns are to be created for natural gas storage has been approved. Figure 6 is a schematic representation of oil-padding in a single-well cavern. Modern facilities maintain close control of the location and extent of solutioning, so that roof padding does not contribute to the type of problems associated with Tully Valley.

"Wild brining."--Pullen (1973) used the term "wild brining" to refer to withdrawal of brine created via solutioning of subsurface salt by naturally circulating groundwater, without the use of injection. The industry soon recognized that this practice could cause uncontrolled solutioning to occur remote from the withdrawal wells, ultimately resulting in subsidence problems. Because of this hazard, most operators discontinued their use of this method by 1921 (Solvay Process Company [Brussels] 1921).

The early New York practice of allowing aquifer water to flow down brine well annuli can be viewed as man-induced "wild brining," because brine was withdrawn without injection of fresh water. However, early "wild brining" at single-well caverns in Wyoming and Livingston Counties in New York is not known to have caused significant ground subsidence. Reasons probably include low production rates combined with relatively short well life, with most of the early facilities having been drilled between 1880 and 1893 and abandoned by the turn of the century. In addition, at single-well caverns aquifer water entered and brine was withdrawn through the same wellbore, so the location of solutioning was limited to beneath that well.

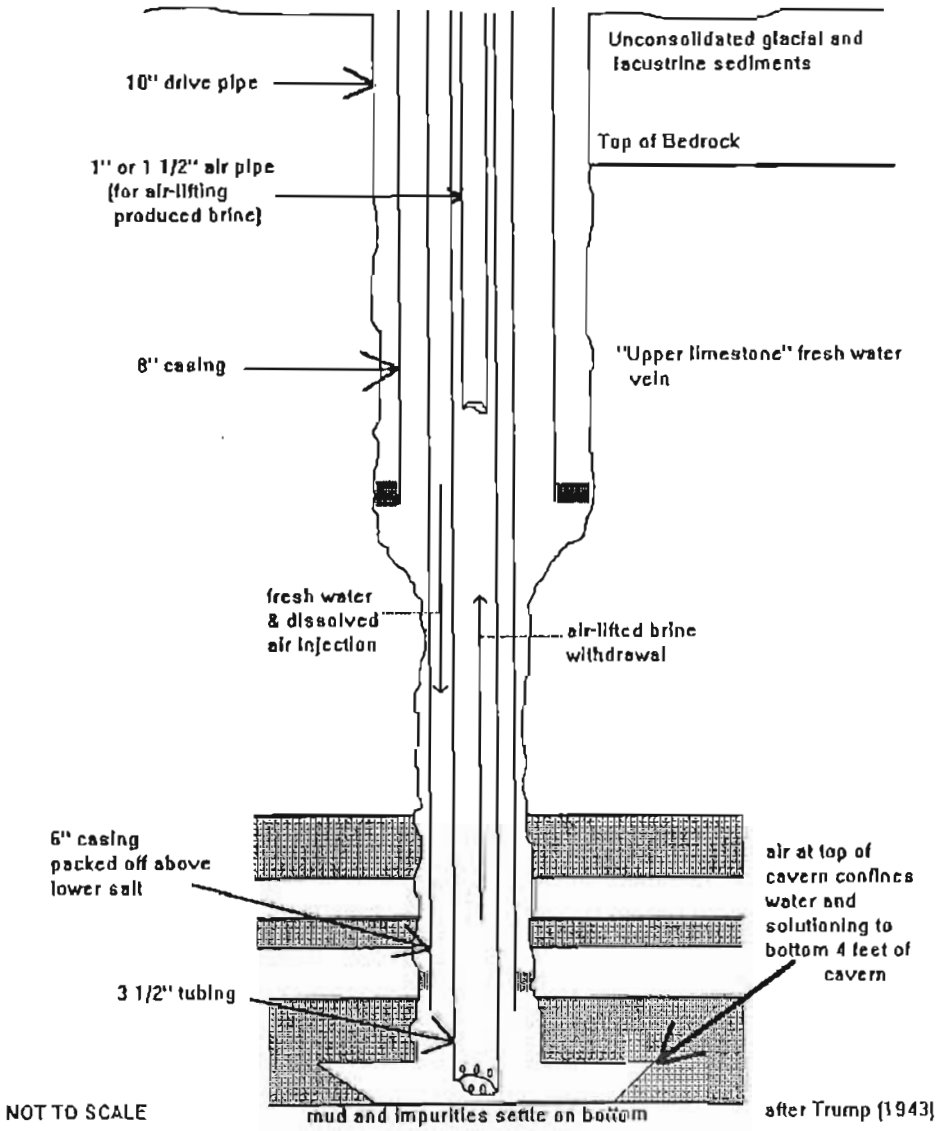

Figure 5. Tully Valley air-padding technology, 1929.

The only long-term "wild brining" to take place in New York occurred in Tully Valley and did contribute to significant subsidence and sinkhole formation. Starting in about 1930, casings were removed from closely spaced wells, allowing aquifer water to flow down wellbores and dissolve salt. Brine withdrawal from multi-well connected caverns led to large unsupported roof spans. Caverns collapsed, resulting in fracturing of overlying strata. Through this process, groundwater recharge to the deep salt strata was increased to the extent that by the late 1950's fresh water injection was no longer necessary for sufficient solutioning to occur (Tully 1985). A true "wild brining" scenario, as illustrated in figure 7, was thus created, whereby circulating groundwater rather than injected fresh water was the cause of solutioning. The point of fresh water entry to the salt cavern, which is the location of most solutioning, was unknown. Large volumes of brine were withdrawn without maintaining control of the location or extent of solutioning. Sinkholes and significant general ground subsidence were the ultimate result.

The practice of "wild brining" in Tully Valley, and therefore in New York State, ceased when the field was abandoned in 1988.