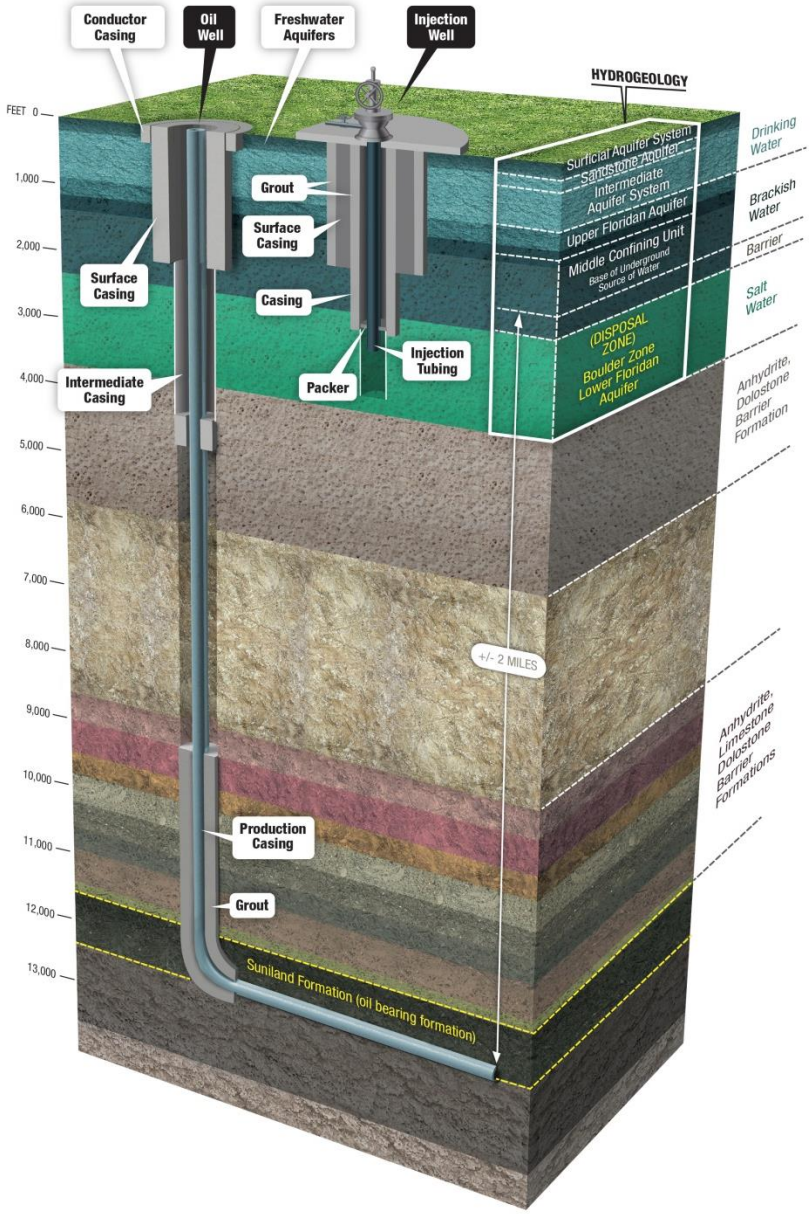
# Southwest Florida Injection Wells: Class I & Class II

In the State of Florida, there are three classes of injection wells – Class I wells, Class II wells and Class V wells. All three classes of wells are permitted by the Florida Department of Environmental Protection (DEP) and the U.S. Environmental Protection Agency (EPA). Class I wells are generally larger in diameter and have a higher injection rate than Class II wells. However, Class I and II injection wells do have some similarities; for example, they both have multiple protective casing pipes to protect freshwater aquifers and they both discharge into the subsurface stratum or sub-zone of the Lower Floridan aquifer, known as the Boulder Zone. Class V injection wells are typically permitted to discharge into the Surficial and Floridan aquifers, at more shallow depths, and these injection wells are not used for drilling fluids.

The Boulder Zone is a deeply buried stratum of geologic stratigraphy in Florida. This zone of cavernous permeability, located in fractured dolomite found in the lower Floridan aquifer, underlies a 13-county area, including Collier County. Since it is not a single or flat horizon of caves, the Boulder Zone is characterized by varying elevation contours; i.e., the top of the zone is irregular and lies as shallow as roughly 2,000 feet below sea level and as deep as about 3,400 feet below sea level.




Additionally, because of its cavernous nature, the Boulder Zone's permeability is extremely high. The highly fractured nature of the dolomite that makes up the Boulder Zone is thought to represent caverns developed at several different layers and connected by vertical "pipes," or solution tubes, similar to a modern cave system. This type of system is referred to as karst topography. Karst is a geologic landscape formed from the dissolution of soluble rocks, such as limestone, dolomite, and gypsum.

The karst topography of the Boulder

Zone formed about 55 million years ago. At this point of geologic time, present-day Florida only existed as a carbonate bank with a shallow sea covering it, including most of Southwest Florida. Because Southwest Florida was underwater, the seawater was able to actively dissolve some of the exposed rocks and create a karst landscape.

Over millions of years, as sea level rose and fell globally, more and more carbonates were deposited on top of the Florida platform and built up in layers we observe as geologic strata today. The karst that makes up the Boulder Zone was buried deeply beneath the surface where it lies presently.

Currently, the Boulder Zone is overlain by 500 to 1,000 feet of low-permeability limestone, dolomite, and anhydrite/gypsum of the Lower Floridan aquifer, in addition to the regional middle confining unit. These solid layers act as multiple barriers, responsible for protecting the shallow fresh water from the upward movement of salt water naturally present in the Boulder Zone and any fluids injected into the Boulder Zone. That is, the same mechanisms that have provided a barrier protecting the overlying freshwater from the salty water in the Boulder Zone over geologic time, currently prevent injected fluids from reaching the shallower parts of the Floridan aquifer system. Simply put, these layers keep the shallow water fresh despite the underlying salty water.

Further, vertical movement of injected waters from the Boulder Zone is driven by buoyancy. In the case of oilfield injection wells, the injected water has high levels of salinity; and thus, is denser than the saltwater of the Boulder Zone, as well as denser than groundwater in the overlying confining strata. Therefore, although the injected fluids are rapidly diluted to the extent they could not easily be detected, at least initially, the injected oilfield fluids tend to sink rather than migrate upwards. As the Boulder Zone already lies deeper than the aquifers from which our drinking water is drawn, the sinking injected fluids (even before they are diluted) pose no threat to drinking water supplies. Considering the hundreds of millions of gallons of effluent (unrelated to oil drilling operations) injected daily into the Boulder Zone, the volumes injected by oil drilling operations are insignificant and rapidly diluted.

The Boulder Zone also has a very high transmissivity, which is related to the rate that groundwater flows through an aquifer. High transmissivity allows for minimal increases in pressure during injection processes. A typical Class I injection well injecting into the Boulder Zone has an injection wellhead pressure of 30 pounds per square inch (psi) at a rate of 2,000 gallons per minute (gpm). A typical Class II well has an injection rate of less than 175 gallons per minute. A gas-powered pressure washing unit for use around the typical home operates within a range of 1,800-4,000 psi of pressure, which makes the 30 psi pressure of an injection well nearly negligible in comparison.
Unlike the low-permeability layers overlying it, the karst system of the Boulder Zone and its large solution tubes give the zone a high permeability, allowing the salty groundwater it contains to move primarily horizontally while restricting vertical flow. This high permeability prevents pressure buildup in injection wells, and, coupled with the fact that the Boulder Zone already naturally contains saltwater, it provides an ideal zone for receiving injected wastes. Based on an injection test on a high rate, 4,400 gallons per minute, a Class I well at the North Collier Regional Treatment Plant only increased the bottom hole pressure during injection by less than 3 psi. As such, for years, the Boulder Zone has been used as a receiving formation for billions of gallons of treated sewage and brine injected safely into it by utilities in Dade, Broward Palm Beach, Martin, Lee, and Collier Counties, thereby protecting our precious surficial groundwater and surface water.