

Shallow Water FLUTE systems

Difference from Standard Water FLUTE systems?

The Shallow Water FLUTE (SWF) is the least expensive Water FLUTE system, and, possibly the least expensive multi-level system available. The system consists of a continuous borehole liner, spacers defining the sampling intervals, and tubing directly to the surface from each sampling interval (see the drawing). The SWF depends on the ability to pump the water sample to the surface using a peristaltic pump, so the maximum water table depth at any sampling interval is < 25 ft. The SWF is shipped on a small plastic reel and hence the shipping and installation is similar to a blank FLUTE liner.

The SWF is capable of up to 10-20 ports per borehole depending on the hole diameter from 4 inches to greater. There is no need for an exterior seal with grout, sand or bentonite. The liner seals the entire hole and the water is drawn directly from the formation. The installation can be done by most customers. The water table depth at each port can be measured with a FLUTE vacuum water level meter system. A particular advantage is that the air couple transducer (ACT) system for monitoring water table levels can be used with a simple surface connection to a pressure transducer. The transducers are then located in the surface casing for easy access for reuse, replacement or repair.

A positive displacement sampling design of the same system is available at modest additional cost, but only half as many ports are available, and no ACT option.

The drawing shows an advantage of the Water FLUTE design that is also well suited for the SWF. The sampling ports can be either water sampling intervals or vadose pore gas sampling intervals. ACT pressure transducers for the vadose sampling intervals allow the monitoring of pore gas pressures.

The SWF system is fully removable for other use of the borehole or easy abandonment by grouting the borehole. The system can be used for artesian situations with a heavy mud fill. Whereas the system can be used for a variety of borehole depths, the Standard Water FLUTE system is better suited for boreholes more than 200 ft deep or for deeper water tables.

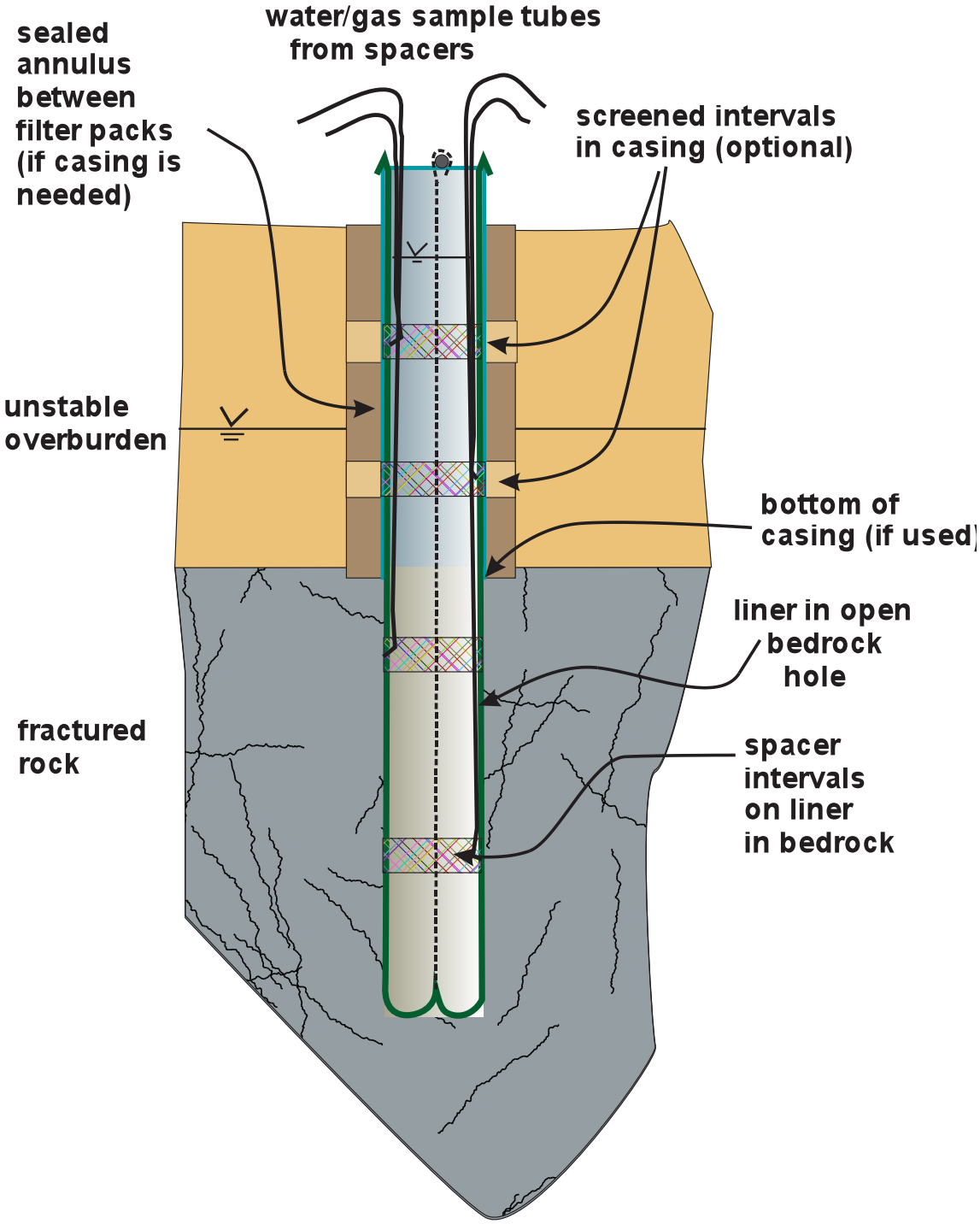
The SWF is well suited for detection of tracer arrivals in that the purge volumes are minimal and the sample is drawn directly from the formation. Because there is not an interior tubing bundle, a transparent liner version allows one to watch for the arrival of strongly dyed injections, such as potassium permanganate, using a borehole camera. That option requires a special polyester liner instead of the standard nylon liner.

A FLUTE method called a *precise gradient measurement* is available in order to measure vertical gradients within ~ 1mm between any two ports in the liner.

Because there is no field assembly and no annular sealing materials needed, and the system is fully removable by inversion from the borehole, the overall cost of the Shallow Water FLUTE system is often the least expensive multi-level sampling and head measurement option of the multi-level monitoring systems. Furthermore, there is no concern about the seal of granular materials in a slender annulus.

The ability to continuously monitor water table variations with standard pressure transducers at 10-20 elevations is an exceptional high resolution capability for cross-hole conductivity assessments. Once the cross-borehole measurement is finished, the transducers can be moved to another borehole for reuse.

Shallow Water FLUTE system



(only 4 sampling intervals are shown for clarity)