A high resolution P-wave seismic reflection survey was performed at the P Reactor Area, Savannah River Site, South Carolina in order to delineate and predict migration pathways of a large contaminant plume including trichloroethylene that originates from the northwest section of the reactor facility located within the Upper Atlantic Coastal Plain. These data were collected with 40 Hz geophones, a 16 lb. sled-hammer source and a 1 m receiver spacing with near and far offsets of 15 and 60 m, respectively. In such areas with near-surface contaminants, a detailed subsurface characterization of the vadose zone hydraulic parameters is very important. An inexpensive method of deriving such parameters by use of seismic reflection surveying is beneficial, and our approach uses the relationship between seismic velocity and hydraulic parameters together with empirical observations relating porosity to permeability and hydraulic conductivity. Shear wave velocity profiles were estimated from surface wave dispersion analysis of the seismic reflection data and were subsequently used to derive hydraulic parameters such as hydraulic conductivity and porosity. Even though the survey design parameters were not optimal for surface wave analysis, the results demonstrate the usefulness of this approach for the upper ±15 of unconsolidated sediments.