The Hydraulic Profiling Tool (HPT) is designed to evaluate the subsurface hydraulic properties of a site. While the probe is advanced into the underground, water is injected at a constant rate $Q$ (up to 5000 ml/min) through a screen on the side of the probe.

An inline pressure transducer measures the pressure response $p$ (kPa) of the soil/groundwater system against water injection. The water flows into the layers depending on the hydraulic properties of the soil. A low pressure response would indicate a large grain size, and the ability to easily transmit water. A high pressure response, however, would indicate a small grain size and the inability to transmit water. Pressure and flow rate are both logged versus depth. In order to discard the potential effects of the flow rate variability, the interpretation of the recorded profile is preliminary assessed in terms of $Q/p$ as relative hydraulic conductivity or index.

The HPT tool can be used to identify potential contaminant migration pathways. Similarly, it can help to identify target horizons for remedial reagent injection or provide qualitative guidance on how difficult injection may be in different zones of the formation. The HPT system can be also used to collect profiles of static water pressure data, which can be used to calculate static water levels and detect potential vertical hydraulic gradients. By means of several slug tests, the site specific hydraulic behaviour can be validated and, under favourable conditions, be translated into absolute values of hydraulic conductivity (conversion of the relative HPT signals into absolute $K$-values).
CONE PENETRATION TESTING

Cone Penetration Testing (CPT) is a world-renowned geotechnical investigation method able to provide soil and groundwater characteristics. Fugro has developed a variety of penetrometers, probes and samplers, which are hydraulically pushed into the subsurface soil to obtain physical and chemical data. Lightweight detachable CPT units are offered for difficult access sites. Large trucks and all-terrain vehicles are also available, with weights in the range of 15 to 30 tonnes providing the required penetration reaction.

For environmental data collection, the CPT cone is basically used as an adapter to the screening sensors. Subsurface lithologic characteristics are identified through tip resistance and sleeve friction logs.

Through a standardised interpretation of tip resistance and friction ratio (Robertson, 1990), CPT data gives detailed information about the subsurface lithology.

ELECTRICAL CONDUCTIVITY

The HPT-CPT probe records electrical conductivity (EC), slope and, as an option, dynamic porewater pressure.

A special feature is the combined processing of electrical conductivity data with data of the CPT measurements. Fugro has developed an algorithm that allows the groundwater electrical conductivity to be estimated as part of the detected bulk electrical conductivity. This information can be provided continuously and depth oriented with a resolution of 2 cm.

DIRECT PUSH SYSTEMS

HPT-CPT probings can be realised with a number of direct-push systems, for example CPT crawlers and mini-crawlers, standard CPT and track trucks, and stand-alone devices. The choice of direct push system is typically based on access, terrain and available space. For direct push work over water, probing systems can be mounted onto boats or pontoons in various combinations.

BENEFITS OF THE HPT-CPT PROBE

- Minimal invasive investigation of the subsurface
- Efficient and economical acquisition of various datasets in a single push
- Identification of potential contaminant pathways
- Assessment of mass flux distributions, with respect to mass discharge
- Delivery of key parameters for estimating natural attenuation efficiency/ratios
- Survey of dam bodies for chasing hydraulic/stability weak zones
- Support in civil engineering projects (dewatering, water management, groundwater modelling, etc.)