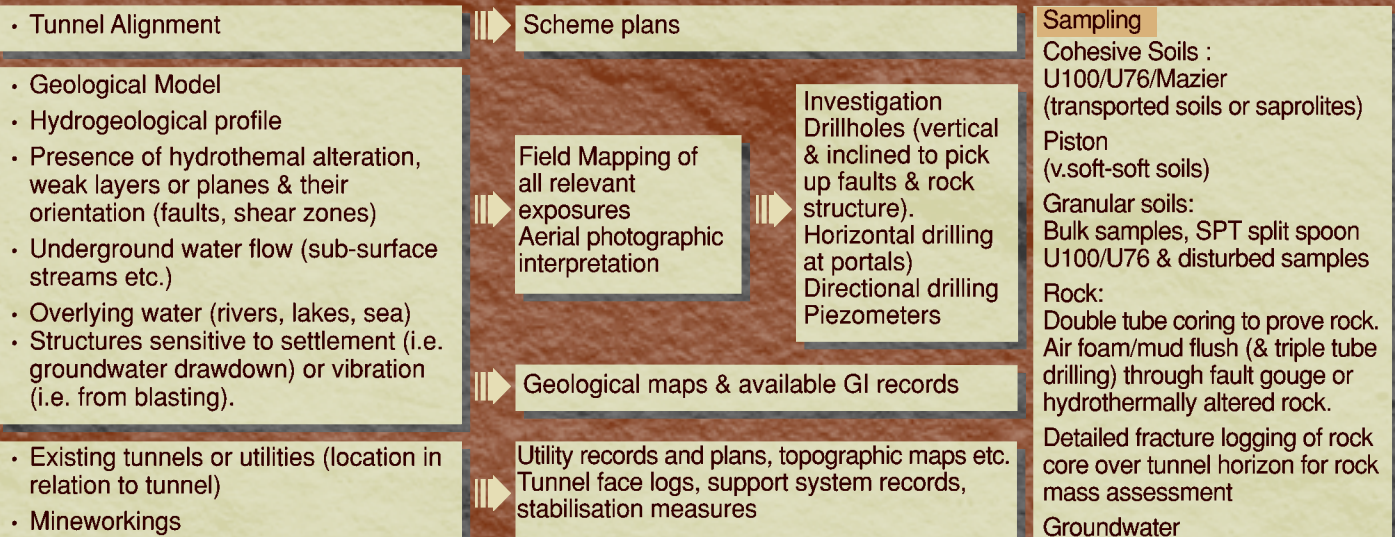


## GROUND INVESTIGATION GUIDELINES

### 04.4 - ROCK TUNNELS

#### What do we need to know?

##### General Information Needed



#### Typical Properties to be Determined

- Geological profile (rockhead level, rock type, overburden thickness & type)
- Rock mass characterisation (RMR, Q values, Hoek & Bray strength criteria, RQD and fracture index)
- Rock mass properties (Joints, microfracturing, faults & shear zones; fracture condition, orientation and infill, mineralisation, presence of hydrothermal alteration and weak layers.)
- Rock and discontinuity strength
- Rock abrasiveness & cuttability (for TBM design)
- Stability at Portals
- Rock mass and overburden permeability
- Water tables (perched, transient and artesian)
- Settlement characteristics of overburden due to groundwater drawdown
- Presence and type of gas

Groundwater chemistry:  
 SO<sub>3</sub>, pH, Cl

Instrumentation:  
 Inclinometers, Extensometers, settlement markers, crack tell tales

#### Typical Required Design Parameters

##### In situ tests:

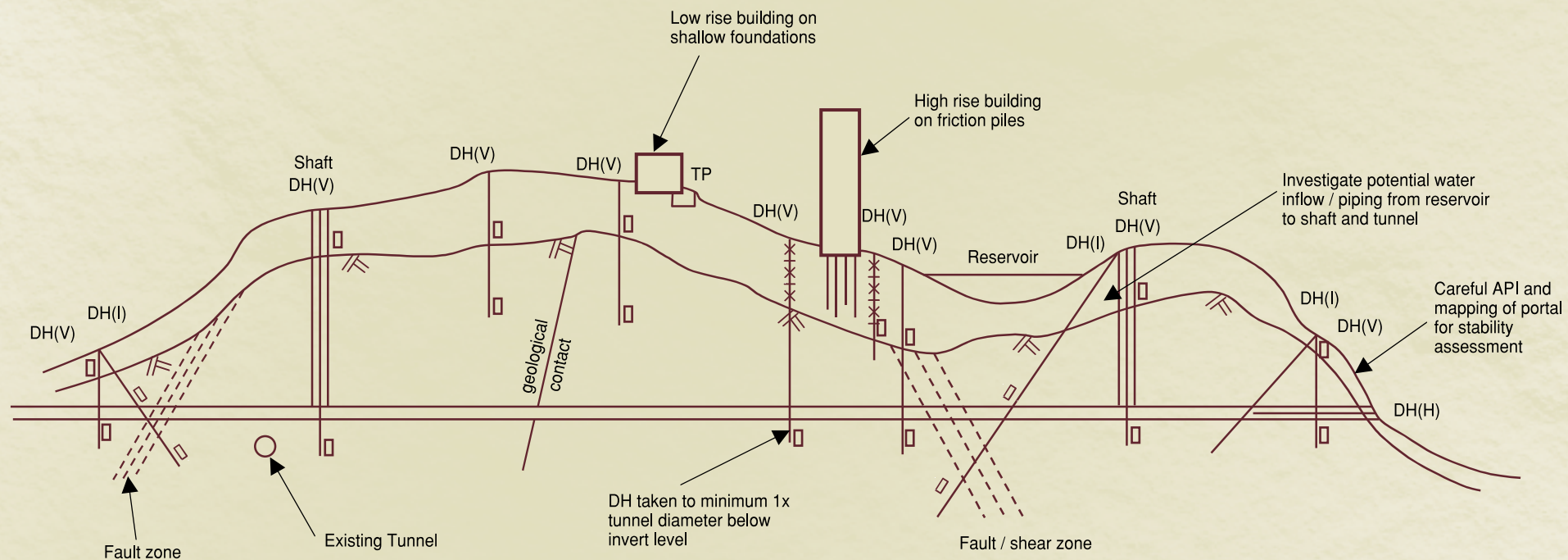
SPT, impression packer/BH televiewer, water absorption, packer tests, lugeon tests  
 Geophysical surveys (seismic, resistivity, micro-gravity, magnetic)  
 In situ modulus (High Pressure Dilatometer or Goodman Jack)  
 In situ stress tests (hydrofracture, pressuremeters) & high pressure dilatometer

##### Laboratory Tests:

Index tests, triaxial shear strength and oedometer for overburden.  
 Point load, UCS, Young's Modulus, Poissons Ratio, rock shear tests on joints and saw cuts for rock  
 TBM related test:  
 Thin section petrography, Punch test, Rock abrasivity test, Brazilian test, Machine Excavation Performance tests



## Tunnel Drawing



### Note

Movement monitoring required for all affected structures. Surface geophysics can be used to locate faults, shear zones geological contacts etc. Lugeon Tests to be done in all drillholes at, above and below tunnel level and throughout drillhole at shaft locations. Borehole televiwer and packer test for tunnel alignment and shaft location.

### Legend

	Rockhead	TP	Trial pit
DH(V)	Drillhole (Vertical)		Piezometer
DH(I)	Drillhole (Inclined)		Extensometer / Inclinator (In separate drillholes)
DH(H)	Drillhole (Horizontal)		