LegCo Panel on Environmental Affairs and LegCo Panel on Transport

Meeting 24 January 2002

Protection of Wetlands in Long Valley in Light of the Latest Development of the Spur Line Project

Comments from Association of Consulting Engineers of Hong Kong (ACEHK)

INTRODUCTION

The Association of Consulting Engineers of Hong Kong (ACEHK) has been invited to a meeting on 24th January of the joint LegCo Panels on Environmental Affairs and Transport to exchange views on the "protection of wetlands in Long Valley" Sheung Shui to Lok Ma Chau Spur Line. A summary of views of interested parties has been provided to the ACEHK in the invitation. From the variety of questions raised by interested parties one of the main engineering issues raised is the potential impacts of the tunnel on the hydrogeology of Long Valley.

As many members of ACEHK have been involved in the study, design and construction of numerous tunnels in Hong Kong (including the preparations for the proposed Spur Line Tunnel), and elsewhere in the world, the ACEHK is well placed to give an informed views on this subject.

The ACEHK wish to make clear in stating its view that this is not intended to be a detailed and comprehensive comment on all the issues associated with the tunnel, but that comment is confined to the specific engineering issue.

GENERAL

Over the past 30 years there have been major advances in the design of the equipment required for the construction of tunnels. Traditionally Hong Kong tunnels have been excavated through rock using drill and blast techniques. Road tunnels such as Tates Cairn and Route 3 and the recently completed railway tunnels on the Tseung Kwan O line have all been constructed using this method. Tunnel boring machines (TBMs) have traditionally been used in Hong Kong where the material to be tunnelled through is relatively soft such as weathered granites. However recently tunnels have adopted TBMs to excavate through rock. These machines have open or semi open faces and therefore there is no control on the stability of the face or control of groundwater seepage into the tunnel during construction.

TBMs have become more sophisticated over recent years with the potential for complete control of the construction process. This has allowed tunnels to be constructed safely in the most challenging of conditions. A major development over the past 20 years in Tunnel Boring Machines has been the introduction of Earth Pressure Balance (EPB) Technology. In such a machine the external earth pressures and the water pressures are balanced by the support pressure within the closed face at the front of the TBM. With such support there is prevention of ingress of groundwater and loss of ground at the face thus ensuring minimal dewatering and/or ground settlement.

One of the main concerns with regard to tunnelling under Long Valley is the potential for the tunnel to adversely affect the groundwater regime, with possible consequences on the ecology of the area. During construction of the tunnel beneath Long Valley, potential impacts on the hydrogeological regime could be minimised through the use of an Earth Pressure Balance Tunnel Boring Machine (EPB TBM). A diagram of such a machine is attached.

Earth Pressure Balance technology is relatively new to Hong Kong, but is well proven elsewhere in Asia and the rest of the world with some 16 major examples in the last 20 years. Notable recent large diameter EPB examples driven through geological profiles with similar characteristics to Long Valley are shown in the table below.

Examples of Earth Pressure Balance TBM Tunnel Projects World-wide

Year	Project	Diameter (m)	Geology
1990	Lyons, France	11.02	Alluvial & Gneiss
1991	Milan, Italy	8.03	Sands & Gravels
1996	Madrid Metro Spain	9.38	Sand, Clay & Alluvium
1996	Shanghai Metro, PRC	6.32	Silts & Clays
1998	DB320, Hong Kong	8.75	Alluvial Sands/Silt & Rock
1999	Groene Hart, Holland	14.87	Sand

Substantial lengths of the Channel Tunnel were driven using EPB technologies and most recently EPB machines are being used to bore a railway tunnel beneath the River Thames in UK for the Channel Tunnel Rail Link (CTRL) with little cover to the actual river bed. Similar closed face machines will be used in the next couple of years for the final tunnel sections of the CTRL into the heart of London.

It should be noted that the specific TBM proposed for the work has already successfully completed 1.78 kms of twin-tube tunnel on the West Rail Contract DB320 in very similar ground conditions with no detectable effect on the hydrogeology.

LONG VALLEY TUNNEL

It is not anticipated that the tunnelling under Long Valley will present a greater challenge than the DB320 tunnels and as the TBM has already been proven in Hong Kong, the risk of major failure is low. The possibility of significant adverse effects on groundwater and irrigation supplies is likely to be low if construction assessments have been carried out and appropriate mitigation and contingency planning is in place.

It is understood that the Spur Line tunnel uses the same design, tunnel boring machine and method of tunnel construction as adopted on DB320. The tunnels could be designed to be watertight and therefore no inflow is anticipated as demonstrated by the two tunnels on DB320. A further degree of confidence in the predicted watertightness of the completed Spur Line tunnel can be drawn from the vertical alignment of the tunnel which throughout Long Valley is located wholly within the completely decomposed rock. Here the permeability of the ground immediately outside the tunnel lining is much less than that in the alluvial phase above. The perceived risk of loss of groundwater within Long Valley resulting from a poorly performing tunnel lining, both during construction and operation, is considered to be remote.

EARTH PRESSURE BALANCE TUNNEL BORING MACHINE (EPB, TBM)