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INVESTIGATION REPORT ON FLOODING IN THE NEW TERRITORIES AND TSUEN WAN IN JUNE 2001

Statement by Independent Reviewer

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1. Introduction

I have studied the final investigation report (the "Report") of the Drainage Services Department (DSD) on the causes of flooding in the New Territories and Tsuen Wan in June 2001. My statement is based on site visits to the key flooding spots on August 20 and 21 (schedule attached), interviews and meetings of DSD representatives on August 28, 29, and September 4, 2001, and an examination of the modelling/investigative methodology as well as detailed supporting material and supplementary calculations provided at my request. I have also considered the additional comments on the Report provided by the Water Supplies Department, the Territory Development Department, and the Director of Civil Engineering together with the responses of DSD.

Although the report has dealt with the flooding of many places in the New Territories, my comments will focus on the following locations where significant flooding was reported last summer:

- River Indus/Tin Ping Shan
- Ngau Tam Mei, Yuen Long
- Belvedere Garden, Tsuen Wan
- Kau Lung Hang/Yuen Leng/Tsat Sing Kong/Ping Kong/Pok Wai

2. **Overall Comments**

The Report is a comprehensive document which covers the facts relating to the flood events, and an objective assessment of what happened based on:

- Measurements of rainfall, tidal and flood levels;
- Assessment of site conditions, aerial photos, observations during the flooding events, video-records, and interviews with villagers;
- Analysis of return periods, catchment runoff, and flow capacity of stream courses and hydraulic structures;
- Application of a well-established mathematical model to study flood propagation; and
- Engineering judgement.

In general the methodology and main findings of the Report are scientifically-based and credible. The unsteady flow numerical model (MIKE 11) used for determination of flood levels in the rural catchment is an internationally accepted, industry-standard computer code that has been calibrated against local flood data. Both the model assumptions and the way it has been applied (e.g. hydrological input parameters; river roughness coefficient; tidal boundary condition; sensitivity tests) are reasonable and consistent with previous Drainage Master Plan (DMP) studies. The approach adopted to interpret the causes of flooding, in particular the impact of construction works, is sensible and the conclusions are acceptable. The Report has offered a useful picture of the general flooding problem in the New Territories, and also the causes of the specific major flooding events in June 2001. Some lessons on possible future flood alleviation can also be learned.

3. **Summary Views**

My views on the major flooding events can be summarized as follows:

River Indus/Tin Ping Shan

The relatively narrow and shallow upstream reaches of River Indus are known to have limited flow capacity (generally speaking the river can cope only with a rainstorm of around two-year return period). The low-lying areas adjacent to the river are hence flood prone. On June 9, an intense rainstorm (about 1 in 10 year return period) coincided with a high tide downstream, which raised

the water level upstream. The Tin Ping Shan flood plain was submerged under water to a maximum depth of 2.6 m. The trained river sections downstream do not contribute significantly to flood relief, as the flow constrictions at the KCRC Bridge (No.36) near Fu Tei Au, and at the Man Kam To Bridge, have remained.

For the Tin Ping Shan flooding incident, the issue is whether the river training works have contributed significantly to the flooding. In general I agree with the approach of using the predicted flood levels in the absence of any river training works (i.e. the pre-existing river) **as a reference** or **baseline scenario** to assess the impact of the construction works. This is a reasonable and practical approach. The alternative would have been to model the configuration of the complex temporary works, river diversions, and bypass channels. This can hardly be done with any confidence using the one-dimensional open channel flow model within the time frame. Nevertheless, the model has been used to study the causes of flooding for schematized scenarios; useful insights have been gained.

Based on the model computations and recorded data, the following findings seem to be reasonable and acceptable:

- Some trained river sections (e.g. widened river diversion and bypass channels) help to alleviate the flooding, while some construction works (temporary structures and scaffolding, stockpiles) have contributed to worsen the flooding. On balance, the effect of the engineering works on the recent flooding is not significant.

- The flooding in Tin Ping Shan area is chiefly related to the insufficient flow capacity of the existing river, and the bottlenecks at the downstream bridges. In particular the water mains beneath the Man Kam To bridge presents a significant flow blockage with raised upstream levels.

- Model calculations suggest that the stockpile collapse into the existing river in the Tin Ping Shan area does not have any impact on flooding (owing to the presence of the by-pass channel).

Ngau Tam Mei, Yuen Long

During the flood of June 9, the spatial distribution of the rainfall was quite non-uniform. The northern part of the upstream catchment was subject to a rainstorm of up to 30-year return period, while the rainfall in the downstream flooded areas of Wai Tsai Tsuen and Yau Tam Mei Tsuen corresponded only to a storm of 1-5 year return period.

The same approach as in River Indus has been used to evaluate the impact of the river training works (temporary bridge, temporary pipe crossings, stock-piles, haul roads, raised embankments, reduced flood plain cross-sections). The model has been satisfactorily calibrated and tested for two flood events in 1999 and 2000. In this case, however, the model suggests that observed flood levels are 0.5-0.75 m higher than that predicted for the baseline scenario (without river improvement works). This conclusion is consistent with the observed substantial change in flood plain topography in the vincinity and downstream of the Wai Tsai Tsuen area. It is likely the observed flooding has been aggravated by the construction works.

Belvedere Garden, Tsuen Wan

The evidence (data and analysis) supports the conclusion that the significant flooding that occurred on the four occasions (June 9, 11, 12, 23) is related to abnormally large overflows from the Tai Lam Chung catchwater channel down Stream 'A' leading to the catchpit on Fat Yip Lane. This overflow of around 15 m^3/s caused serious erosion of the river channel beneath the Tuen Mun Highway. The sediment and stone debris brought down by the torrential flood blocked the catchpit that led to the drainage system of Castle Peak Road. It is clear the overflow far exceeded the stream channel capacity, which resulted in significant overbank flow, and consequent flooding of the Tsuen Wan Government Primary School, Fat Yip Lane, Castle Peak Road, and downstream roads (Lai Chi Road, Hoi On Road).

The exceptionally large runoff is derived from the overflow from two side weirs located along the Tai Lam Chung catchwater channel, as well as over-topping of the embankment. The high overflow occurred even though the rainstorm in the area corresponded to one of only 3-4 year return period. This event can be traced to an over-bank water level in the catchwater channel. It

appears that the unexpectedly high level (300 mm above embankment level) may be related to engineering works for a landslip prevention project. During the flooding there was temporary steel decking and over 100 supporting struts placed along 530 m of the channel immediately downstream of the region of overtopping. The flow confinement (due to the decking) and the added flow resistance (due to decking and struts) could have led to higher head losses which would result in a higher water level in the catchwater channel. While the Report does not explicitly address the possible reasons for the high water level, the backwater effect is demonstrated by a calculation of the head loss of the struts. This analysis illustrates the nature of the problem, and gives a qualitative indication of the effect of the construction works. Head loss may also be enhanced by the decking and any trapped erosion debris in the covered channel. Although the exact cause of this abnormally high water level remains elusive, the analysis of the observations suggests that this event is possibly related to the engineering works.

Kau Lau Hang/Yuen Leng/Ping Kong/Tsat Sing Kong/Pok Wai

The flooding events at these locations are all related to insufficient channel capacity. The observed flooding level is consistent with the predicted maximum stormwater flows corresponding to the rainfall storms. The analysis for Pok Wai shows the flooding of the village (polder scheme under construction) is due to inflow from the adjacent river as a result of insufficient provision of temporary flood protection by the contractor.