MAUNSELL CONSULTANTS ASIA LTD

TSUNG PAK LONG FLOOD PROTECTION SCHEME
PRELIMINARY ENVIRONMENTAL ASSESSMENT

Final Assessment Report

June 1995

CONSULTANTS IN
ENVIRONMENTAL
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1 BACKGROUND

1 BACKGROUND

1.1 Introduction

The villages of Tsung Pak Long and Tai Tau Leng near Sheung Shui, are subject to frequent flooding. This low lying area lies to the south of the Sutlej River and is drained by two tributaries of the Sutlej. Tidal conditions affecting water levels in the Sutlej cause drainage water under high flow conditions to back up in the tributaries and thus flood.

Maunsell Consultants Asia Limited (MCAL) were instructed by PM/NT North on 31 May 1994 (ref. (91) in NTN TPF 2/4/6) to carry out a preliminary Environmental Impact Assessment (EIA). An Initial Assessment Report (IAR) was produced by Consultants in Environmental Sciences (Asia) Limited (CES) as subconsultants to MCAL, and was submitted in draft in August 1994 and finalised in March 1995 (CES, 1995a).

The present document is the final Environmental Assessment which is based on the Initial Assessment. It includes additional work as suggested in the previous report and agreed by the client and also work which was suggested as necessary by Government.

1.2 Previous Studies

Drainage in this part of the New Territories has been examined by MCAL as part of the River Indus Study completed in 1989 and a flood protection scheme was proposed. More recently, an alternative scheme to alleviate flooding was proposed as part of the Teladflocoss 2 study (Binnie and Maunsell, 1993). This scheme (MCAL, 1994a) showed savings in terms of cost and land requirement and is the preferred scheme addressed in this report.

A supplementary review (MCAL, 1994b) was produced to determine design parameters, flood levels and embankment levels for discussion and agreement with Drainage Services Department (DSD). This document was reviewed as part of the current outline Environmental Assessment.

1.3 The Study Brief

The Brief for the Environmental Assessment was provided by EPD and is a copy of the Brief for a previous study, river training works in the North District. The present scheme is considerably smaller in scale and is located in an area which perhaps has different problems. Notwithstanding this, all relevant aspects of the Project Brief have been considered and the relevant and potentially more serious impacts were studied in greater detail.

1.4 The Environmental Assessment Report

This report is the result of a preliminary environmental impact assessment (EIA) of the proposed flood protection scheme for Tsung Pak Long and Tai Tau Leng. The study has been carried out at a relatively early stage of the design process with the intention of providing information to the engineers and others involved in the project to enable them to consider the environmental issues whilst developing their detailed plans for the site.

The existing environment is described in Section 2 of the EIA and the proposed flood protection scheme is described in Section 3. Potential impacts and other key environmental issues are identified in Section 4. Conclusions and recommendations for mitigation of adverse impacts based on these findings are presented in Section 5. This study deals with the potential impacts of the proposed scheme at all stages of construction and operation.

2 EXISTING ENVIRONMENT

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2.1 General Situation

The area around Tsung Pak Long and Tai Tau Leng is generally low lying and is marked on the catchment area plan as predominantly agricultural lowland. The area borders the southern edge of the Sutlej River and is bounded to the west by higher land (immediately adjacent to the western tributary). To the east the higher level Man Kam To road and to the south, the higher level New Territories Circular Road (NTCR) also form a topographical boundary.

The Sutlej River is subject to tidal influence and therefore drainage is impeded under certain conditions. At the site, the dry weather flows in the Sutlej are contained in a small concrete-lined drainage channel (approximately 1.2 m deep) which lies within a generally more open and overgrown channel. An embankment to the north protects the Sheung Shui temporary housing area, whereas the embankment to the south is currently at a much lower level which does not prevent overflow to the Tsung Pak Long area.

There are two main watercourses present in the area, as shown in Figure 3.1. The western watercourse serves a defined catchment of 84.7 ha and the eastern watercourse 60.4 ha. In addition, there is an area of local catchment which drains to both watercourses, of 20.2 ha. The western and eastern tributaries drain areas of the Fanling golf course and Kam Tsin village and join the River Sutlej close to Tsung Pak Long. They are both small streams and under normal conditions the eastern watercourse is used for irrigation of the agricultural areas. Both tributaries flow in culverts underneath the NTCR, before passing to the Tsung Pak Long area.

2.2 Ecology

The findings have been based on field observations carried out on on foot over the whole site between July 1994 and April 1995. This information has been supplemented by analysis of the aerial photographs for the area and liaison with other specialist wildlife experts, which has included particularly, liaison with Michael Lau, a specialist herpetologist and Dr. Mike Bascombe, a noted butterfly expert (see also data supplied in Annexes 1 and 2).

2.2.1 Habitats and Plants Present on the Site

A habitat map for the study area drawn up following field survey work is shown in Figure 2.1. The map indicates all the habitats represented on the site, namely woodland (including small groups of trees), watercourses/wetland, cultivated land and abandoned agriculture and wasteland. Only parts of the study area will be affected by the proposed scheme.

Woodland/Groups of Trees

All of the woodland present within the study area is either large groups of trees planted around the villages or young planted woodland. The dominant species is *Cinnamomum camphora* and there are several very large, mature trees present on or near the proposed works.

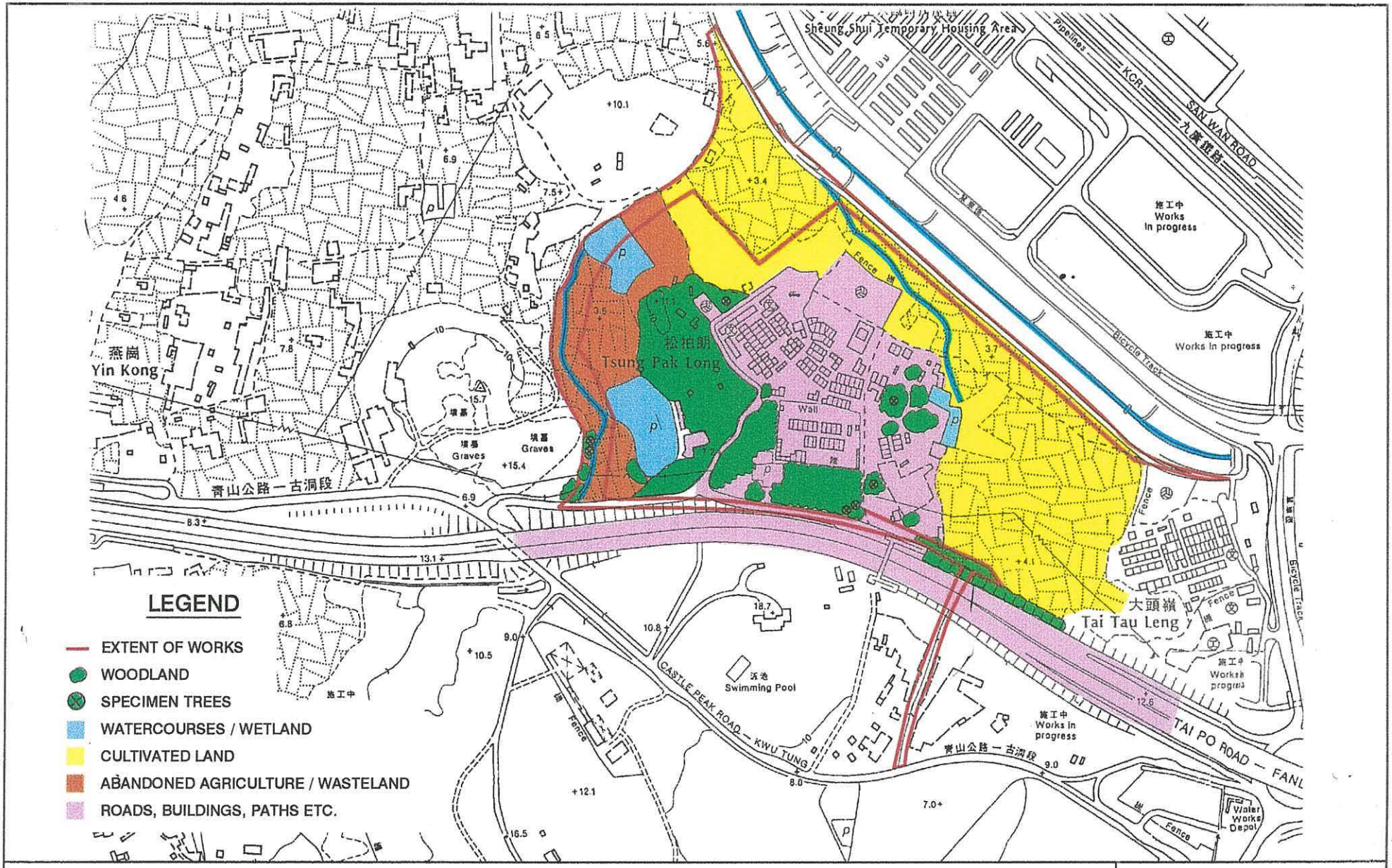

Figure 2.1 Habitat Map

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Tree and shrub species that were recorded from the more natural secondary woodland associated mainly with the water catchments include *Ardisia crenata, Microcos paniculata, Celtis sinensis, Sapium sebiferum, Sterculia lanceolata* and *Cinnamomum camphora*. The dominant tree in these areas is *Sapium sebiferum* with *Celtis sinensis* frequent.

Tree species planted for amenity purposes around and adjacent to the site, particularly along the roads include *Peltophorum pterocarpum, Acacia auriculiformis, Macaranga tanarius, Bombax malabaricum* and *Casuarina equisetifolia*.

Ornamental and fruit trees recorded on the site included *Litchi chinensis, Euphoria longana, Carica papaya, Citrus* spp., *Michelia alba* and *Psidium guajava*.

Wetlands and Watercourses

The western watercourse, which is polluted, contains no submergent vegetation. The flooded banksides are fairly unstable and generally covered in typical, common species such as *Alocasia odora; Alternanthera sessilis, Ammania baccifera, Colocasia esculenta, Commelina nudiflora, Eleusine indica, Hedychium coronarium, Kyllinga monocephala, Leersia hexandra, Paspalum distichum, Polygonum hydropiper* and *Juncus* spp.

One of the abandoned fish ponds has been colonised by water hyacinth *Eichhornia crassipes* which is the dominant species. Other species present include *Floscopa scandens, Polygonum hydropiper* and *Commelina nudiflora* in the old fish ponds

The existing main river channel of the Sutlej, which is normally dry except in storm conditions, is covered with grassy vegetation to the extent that it is regularly used for feeding water buffalo. Species recorded from this area included *Polygonum hydropiper, Rumex maritimus, Cyperus* spp., *Alopecurus aequalis,* and *Commelina nudiflora*.

Cultivated Land

Typical species recorded from the cultivated land include vegetables such as water spinach, *Ipomea reptans* and *Eleocharis dulcis*. There is a field of Indian Lotus, *Nelumbo nucifera* near to the proposed works area which is quite a rare occurrence in the New Territories now. The dominant vegetable growing in this area is the water spinach, which is harvested in small areas on a daily basis.

Extensive use of herbicide and pesticides was noted on the actively cultivated areas.

Abandoned Agriculture and Wasteground

Typical species recorded from the generally wet, abandoned cultivated land include *Mikania micrantha, Stellaria media, Bidens pilosa, Senecio scandens, Tithonia diversifolia, Mimosa pudica, Polygonum* spp., *Solanum nigrum, Ipomea* spp., *Cyperus* spp., *Imperata cylindrica, Miscanthus* spp., *Lespedeza formosa, Lantana camara, Setaria glauca, Eragrostis* (?) and *Aster ageratoides*. These species are all widespread throughout these kinds of areas in the New Territories and are common.

The area of embankments adjacent to the main Sutlej river channel and the concrete path near the village are covered in a variety of herb and grass species including *Mimosa pudica, Lantana camara, Wedelia trilobata, Hymenocallis americana, Aster ageratoides, Hypericum* spp., *Imperata cylindrica, Tradescantia fluminensis* and *Arundinella* spp. Parts of this area are sprayed heavily with herbicide presumably to keep the route of the path clear.

No rare or protected planted species were recorded within the study area. All the plants recorded are common and fairly widespread throughout the territory.

2.2.2 Animal Species Present on the Site

General information concerning the birds in the area was collected during the site visits. The area can be described as typical for birds. However, it is one of the few remaining isolated enclosed, undisturbed areas of abandoned cultivation surrounded by patchy areas of woodland and it is likely to support more species than many other areas in the vicinity. It is also, at present, prone to regular flooding which is likely to be attractive to water birds.

Common birds which were recorded on the site include the Chinese Pond Heron, cattle egret, common kingfisher, magpie, house swift, black-necked starling, crested mynah tree sparrow, magpie robin, black drongo, chinese bulbul and yellow bellied wren-warbler and other common woodland birds.

The Wild Animals Ordinance (Cap 170) 1980 provides total protection for all bird species in Hong Kong. Any disturbance to nests and eggs of birds will require the prior issue of a permit from the Director of the Agriculture and Fisheries Department.

The study area is not known to be of particular interest for reptiles and amphibians but appears from a site survey (see Annex 1) to support typical species associated with small areas of wet abandoned agricultural land surrounded by woodland and small buildings.

No specific survey has been undertaken for bats. However, bats generally require sheltered areas rich in insects or fruits for feeding and therefore well wooded areas and water bodies well protected by trees, such as those at and around this site, are likely to be attractive to bats generally. It is possible that a few common bats are using the area for foraging but given the scale of the works, this is not considered to be a key issue.

2.2.3 Butterfly Habitat

The fragmented, varied and damp nature of the habitats present, makes the site of particular note for butterflies. The small woodland/open areas adjacent to the Tsung Pak Long village access road and to the east of the concrete goldfish rearing ponds forms the stronghold of very rare butterflies including two *Horaga* species and other rare species. The location of this site in relation to the proposed flood protection works is shown on Figure 2.2.

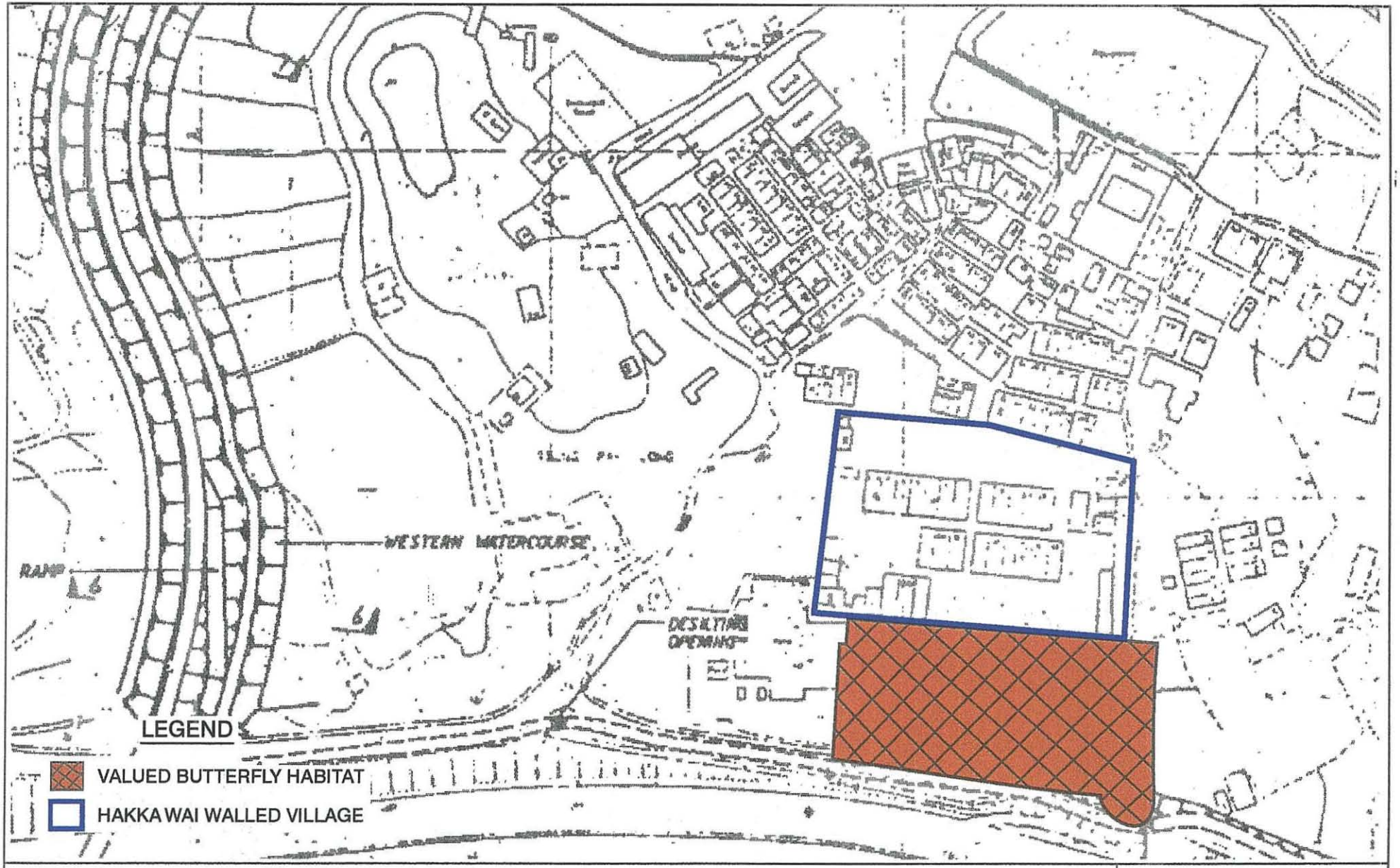

Figure 2.2 Location of Valued Butterfly Habitat and Hakka Wai Walled Village in relation to the Proposed Scheme

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Dr Bascombe, who has previously studied butterflies in this area, has confirmed that the Tsung Pak Long area has a good variety of foliage, including woodland, woodland clearing and bamboo. There are many nectar sources in the area or nearby. He has recorded 62 different species on his database for the whole of Tsung Pak Long, most of which have been found in the project area. Details of some of the butterfly species of note on this site are given in Annex 2.

2.3 Water Quality

The western watercourse, with a source near Kam Tsin, appears to be quite polluted with visual evidence of anoxic sediments observed on site visits. In addition, some odour was noted during low flow conditions. The eastern watercourse is used more extensively for irrigation of fields close to the Sutlej and appears to be of better quality.

It is understood that the need for future upgrading of culverts under existing roads has been examined as part of the hydraulic design process and has only been found to be necessary for the eastern watercourse culvert under the Castle Peak Road. The extent of the improvement work in this area will be investigated as part of the detailed design.

Samples of stream water and sediment were collected from the more polluted western watercourse and the results were summarised in detail in a key issue report (CES, 1995b). The location of water and sediment sampling points is shown in Figure 2.3 and the results of testing are shown in Table 2.1 and 2.2.

Some of the sediment in the surface 150mm showed high levels of contamination with certain metals when compared to the sediment classification criteria adopted for marine sediments in Hong Kong (EPD, 1992b) and also compared with Dutch Guidelines for classification of contaminated sediment (Min. of Housing, et al., 1994). The sediments from the western watercourse were also significantly elevated in organic pollutants, presumably from the animal waste discharged to the stream above the site.

Water quality in the western watercourse, as expected, showed a polluted state with very low dissolved oxygen and very high turbidity.

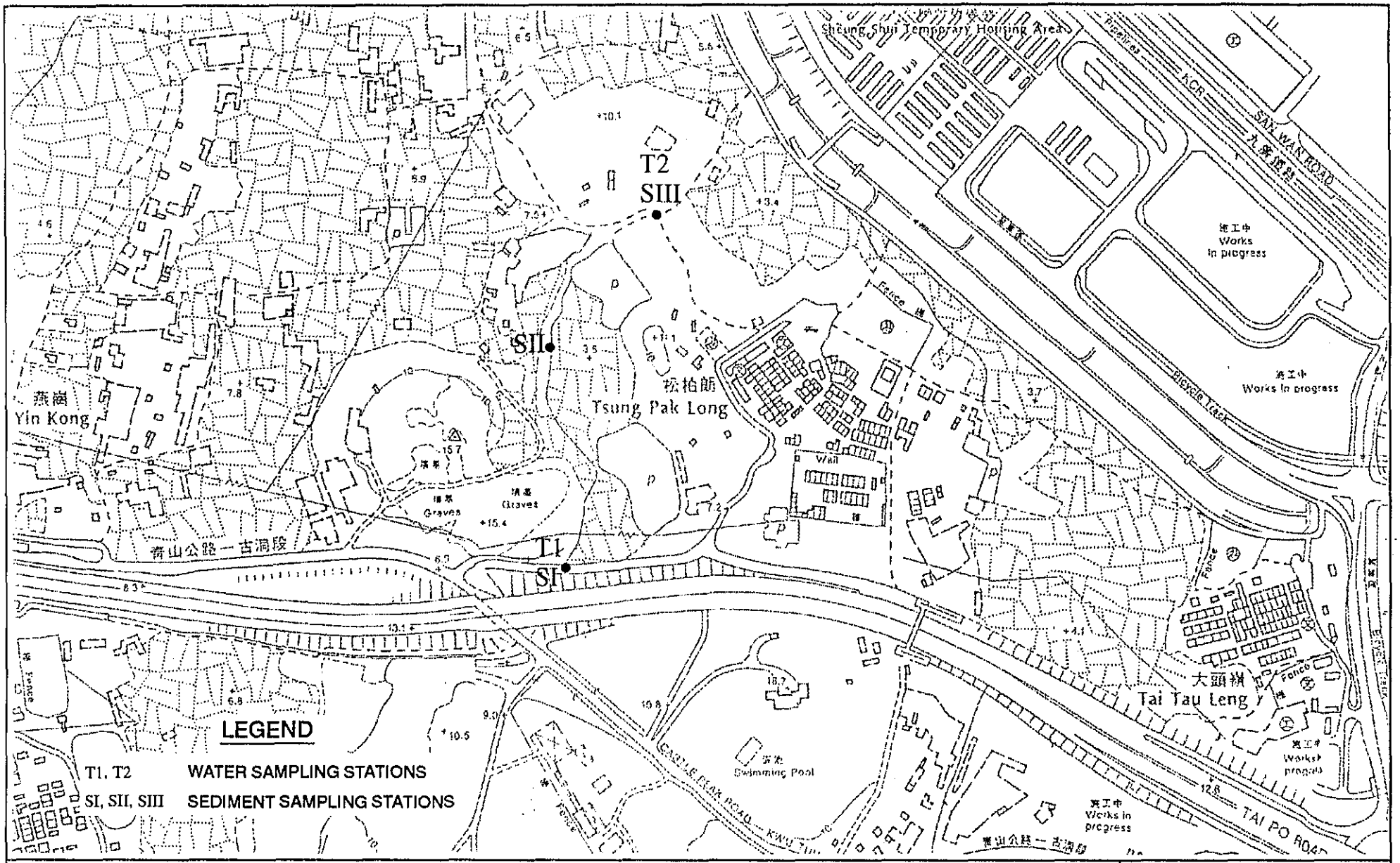

Figure 2.3 Location of Sediment and Water Sampling Stations

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Table 2.1 Results of Sediment Testing

Sample Identification	Cu	Cd	Cr	Pb	Ni	Zn	Hg	Moisture %	Chemical Oxygen Demand (COD) in mg Oxygen /kg	Total Organic Carbon % (TOC)
S1 - Surface	35	< 0.2	14	31	3.4	96	< 0.05	84.2	720000	0.9
S2 - Surface	120	0.95	10	36	4.2	300	0.05	25.0	20000	3.1
S2 - 150 mm	660	11	12	86	13	1300	< 0.05	-	-	-
S2 - 300 mm	49	0.36	9.7	22	2.0	140	0.07	-	-	-
S3 - Surface	1200	33	15	45	15	2400	0.38	36.1	46000	40
S3 - 150 mm	63	0.91	7.8	22	2.2	220	< 0.05	-	-	-
S3 - 300 mm	18	< 0.2	4.8	14	1.1	68	< 0.05	-	-	-

Remarks: All values in mg/kg dry weight.
Results are based on mass of sample dried at 103-105°C.
Values in shaded boxes are Class B. Bold values in shaded boxes are Class C.
For Moisture and COD, the analysis was performed on the sample "as received" and the result is reported on a "dry weight basis".

Table 2.2 Water Quality Monitoring Results

Date	Weather	Location	Sampling Time	Temperature °C	Dissolved Oxygen mg/l	Dissolved Oxygen % Saturation	Turbidity NTU	Suspended Solids mg/l	Observations
16/01/95	Sunny	T1	14:35	20.7	2.74	30.6	718	633	
		T2	15:00	20.2	0.69	7.5	689	446	
17/01/95	Sunny	T1	11:00	17	3.17	32.8	778	530	
		T2	11:25	15.1	0.17	1.7	236	239	
18/01/95	Cloudy	T1	10:14	17.9	0.53	5.5	>1000	9950	thick black sample
		T2	10:45	17.3	0.19	1.9	869	1574	
19/01/95	Sunny	T1	10:25	19.9	0.14	1.5	379	395	
		T2	10:43	19	0.27	3	>1000	29250	thick black sample
20/01/95	Cloudy	T1	10:50	20	0.31	2.7	>1000	1075	
		T2	11:20	20.2	0.36	3.6	498	575	

Note: All samples smelled strongly unpleasant

2.4 Noise

Tsung Pak Long village is characterised by low levels of community noise. Most of the village receivers are sufficiently remote from Tai Po Road, or are shielded by intervening structures, so that traffic noise levels are low or imperceptible. Only a small number of facades at the southern perimeter of the village are exposed to higher traffic noise levels. Within the village, traffic is limited to local vehicles accessing the parking area at the northern end of the village; noise from this very limited flow is not significant. There are no industrial activities taking place within the village. The fields surrounding the village are actively cultivated and do not accommodate noise-generating activities. At the time of the site visit on 14 July 1994, noise from construction activity at the industrial area adjacent to the Sheung Shui Temporary Housing Area (THA) was perceptible. Noise from the industrial areas north of San Wan Road was not distinguishable.

Tai Tau Leng village experiences a higher ambient noise level resulting from its closer proximity to Tai Po Road and Po Shek Wu Road. Facades facing the Sutlej River are oriented away from Tai Po Road, but noise from Po Shek Wu traffic is noticeable. The fields west of the village are actively cultivated. At the time of the site visit, noise from construction activity at the industrial area adjacent to the Sheung Shui THA was perceptible. Noise from the industrial areas north of San Wan Road was not distinguishable.

The area between the NTCR and Castle Peak Road accommodates mostly single-storey permanent and temporary houses clustered around a small stream, with scattered 2- and 3-storey residences further from the stream. Noise from the NTCR dominates the area. Toward the southern end of the area, noise from the smaller traffic flow on Castle Peak Road is more significant.

Baseline noise monitoring has not been conducted at the site, so background noise levels cannot be quantified. However, typical background noise levels are expected to be low and thus there is no need to quantify such levels in this case.

2.5 Air

The area around Tsung Pak Long and Tai Tau Leng is mainly agricultural. No industrial and construction activities were observed in the immediate proximity of the area (except at a distance in Sheung Shui industrial area). It is reasonable to believe that the background levels of air pollutants in the area would therefore be relatively low. No information on background levels of air pollutants in the area is available.

2.6 Historical and Cultural Heritage

The Antiquities and Monuments Office of the Recreation and Culture Branch do not list any historical or archaeological sites within the project boundary. A number of grave sites are present in the surrounding area. There is a Hakka Wai walled village in part of Tsung Pak Long, which is a listed historical structure (see Figure 2.2).

2.7 Visual Amenity

The area is largely rural, although it is in close proximity to new and on-going development at Sheung Shui and also lies adjacent to the NTCR. Tsung Pak Long is a traditional village area, and of particular interest is the walled part of the village. The majority of the low lying areas are abandoned or active agricultural areas and there are views to the upland areas of the border area. The visual context and the visual impact of the proposed development are provided in detail in section 4.6.

2.8 Community Infrastructure

The village of Tsung Pak Long has several local amenities including a school, village stores, playgrounds, and playing fields (football pitches and basketball courts). Apart from the agricultural employment, it is envisaged that residents are also employed in Sheung Shui and other nearby urban areas. Similarly, these urban areas would also provide shopping and recreational facilities for the village residents.

3 DESCRIPTION OF THE SCHEME

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The proposed flood protection scheme is illustrated in outline in Figure 3.1. The works consist of the following.

- Building a retaining wall along the southern edge of the River Sutlej which will retain floodwaters during storm conditions, preventing spill over onto the low lying ground surrounding the villages.
- Provision of embankments along the watercourse to the west of Tsung Pak Long which will extend from the River Sutlej to the access road to Tsung Pak Long.
- A box culvert which will divert the eastern watercourse, presently located between the villages of Tsung Pak Long and Tai Tau Leng, to the western watercourse at times of high flow. This culvert will be routed mostly along the alignment of the Tsung Pak Long access road.
- Channelisation of the eastern watercourse between the NTCR and Castle Peak Road. This would probably be a simple concrete lined channel.
- A storm water pumping station located near the confluence of the western watercourse and the River Sutlej, to deal with flows from the villages and other low lying areas when flood levels in the River Sutlej are too high to permit gravity discharge.
- An associated area for storage of water prior to higher-level discharge to the River Sutlej.
- A critical location for passing of flood waters from the adjacent catchment occurs at the point where the eastern watercourse crosses Castle Peak Road. At this point, the road level is 6.8 mPD. During the detail design the enlargement of the existing culvert under Castle Peak Road, and raising of the road level to 7.5 mPD will be considered.

During normal tidal and flow conditions, drainage from Tsung Pak Long, Tai Tau Leng and low lying areas will drain to the River Sutlej by gravity. During flood conditions, gravity connections to the river will be closed with an automatic penstock and flow will be diverted to the sump of the pumping station and pumping will commence. Only flows in excess of the pumping rate will be stored temporarily in the adjacent storage pond.

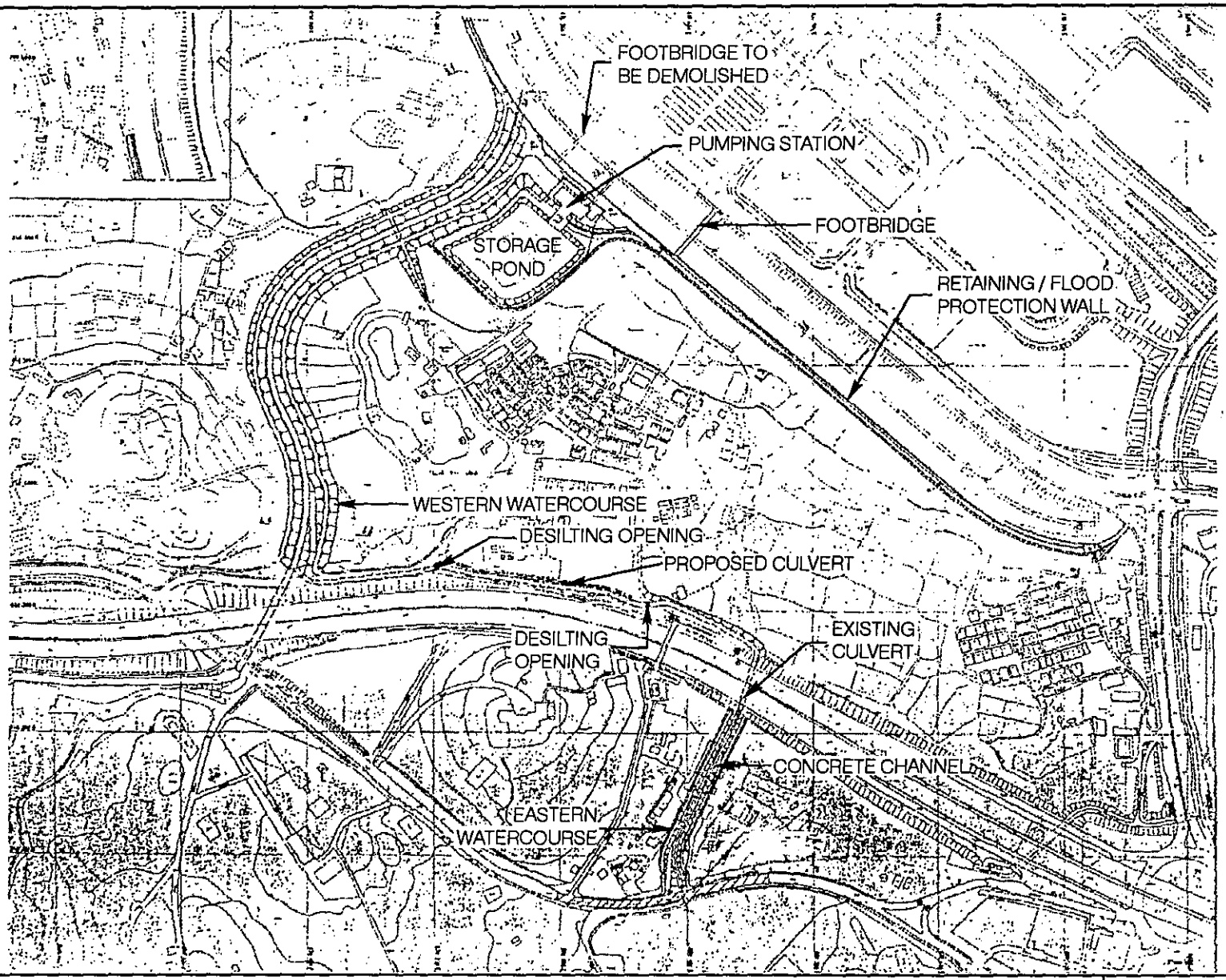

Figure 3.1 Proposed Flood Protection Scheme

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4 POTENTIAL IMPACTS

4 POTENTIAL IMPACTS

4.1 Ecology

The following ecological impacts are anticipated mainly as a result of construction activities:

- The construction works would involve the removal of some existing vegetation.

  It has been estimated that the following habitats would be lost as a direct result of the proposed scheme:

  2.5 ha of active agricultural land
  0.9 ha of abandoned agricultural land
  0.2 ha of overgrown ponds (parts of two)
  0.15 ha of young plantation
  350 meters of existing watercourse;
  scattered groups of trees

  The main areas that would be affected are either in active agricultural use or form part of the abandoned agricultural land. These specific areas are not generally considered to be of high ecological value. The proposed scheme would result in the destruction of a small area of wetland amounting to approximately 0.3 ha in total.

  A few scattered trees would need to be cut down to make way for the works but some of these are exotics including the young plantation species adjacent to the New Territories circular road where the culvert and associated embankment is proposed.

  In some areas, the proposals pass very close to and could affect groups of mature native trees. This is particularly the case on one part of the western watercourse (see Figure 2.1) and the new culvert which will connect the high flows from the eastern tributary to the western tributary running mainly along the existing Tsung Pak Long access road.

  There is one particularly notable, very large, mature *Cinnamomum camphora* tree one branch of which leans heavily over the road to the south of Tsung Pak Long village close to the subsidiary access road. There is to be a box culvert constructed near to this tree which could cause potential impacts. (It should be noted that since the IAR was carried out, the exact location of the culvert has been modified to reduce the impact on this tree and the butterfly habitat.)

- changing the existing pattern of water flow in the area,

  Channelizing the water held in the existing stream into a major new watercourse is specifically designed to protect the surrounding areas from flooding. This could, in turn, alter the species composition of the remaining habitats in the area and thus affect wildlife usage.

The water courses in the study site are grossly polluted thus reducing the value of the site to wildlife. Some of the abandoned fields become marshy during the rainy season. These seasonally inundated marshes may provide breeding habitats for selected species. However, these low-lying marshes receive polluted water from the flooded watercourses after heavy rain and are expected to support only limited number and diversity of species. The flood protection scheme would prevent the polluted water from flooding these areas.

- o disturbance during construction to existing species in particular invertebrates and birds.

  Depending on the nature of the work and the time of year of construction, disturbance could be caused to wildlife through noise, vibration, dust and habitat clearance. Also the storage of excavated materials and construction materials could impact on the vegetation.

- o engineering requirements for cut and fill, levels, importation of fill etc. altering the general topography, soil characteristics and structure. This could also include for the storage of excavated materials and construction materials which could impact on the local ecology.

4.2 Water Quality

4.2.1 Construction

Construction of these facilities may give rise to elevated suspended solids levels in the absence of mitigation measures. However, such construction impacts should be readily mitigated by carrying out work in the dry condition temporarily diverting residual stream flows around the active excavation area and minimising the exposed area of bare soil. Any contaminated material shall be excavated in one dry season.

During the construction phase, there will be no discharge of effluent because there will be no canteen facilities and if required, chemical toilet facilities would be provided. Temporary stockpiles of materials would not be allowed, or if permitted by agreement with EPD, would be provided with silt traps and drainage in order to reduce suspended solids in any effluent to standards specified in the Technical Memorandum (EPD, 1991) and therefore should not cause any significant impact.

4.2.2 Operation

Drainage schemes are normally designed to allow water to pass through the improved river section more quickly and therefore deliberately aim to steepen and shorten the flood hydrograph. This may be achieved by a variety of methods, including alteration of channel slopes, cross-sections, flow paths and surface. In this case lined channels and culverts are proposed in addition to embankments, a storage pond and a pumping station, as described in Section 3.

The scheme will not change the quantities of pollutants entering the watercourses. However, the faster runoff hydrograph will marginally increase the time the watercourses

are in the low flow condition. Since the low flow condition predominates anyway, this effect is not considered significant.

Lining and straightening the channels will reduce the amount of sediment scoured in floods, but it is likely that sediment accretion in times of low flow will be reduced and sediment mobility increased, due to higher channel velocities. Overall, however, the scheme is unlikely to have a major impact on sedimentation downstream.

Transfer of water from the eastern to the western watercourse is proposed as part of the scheme. However, this will only occur at high flows, when the capacity of the eastern watercourse is fully utilised. Given the existing poorer quality in the western watercourse, this aspect will not have any significant water quality impact.

Overall, the operational water quality impacts of this scheme are expected to be minimal.

4.2.3 Cumulative Impacts

The programme and extent of river improvement works upstream of Tsung Pak Long on the River Sutlej is presently unknown and therefore no cumulative assessment can be made at this stage. There is a requirement that during the construction stage the contaminated deposits in the western watercourse will be removed and the new channel will be lined. This will ensure easier maintenance and removal of any livestock waste that may accumulate and therefore should have a beneficial impact on water quality in the long term. Cumulative impacts will be addressed in the EIA study for the MDC of Fanling, Sheung Shui and Hinterland.

4.3 Noise

4.3.1 Environmental Standards and Guidelines

The noise generated by construction of the flood control works (exclusive of percussive piling) during the non-restricted hours (07.00 to 19.00) is assessed with reference to the criterion of 75 dB(A) (L_{eq} 30 mins). Works at the site are expected to cease before 1900 hours, so evening and night-time criteria stated in the Noise Control Ordinance (NCO) are not relevant.

Percussive piling requires a Construction Noise Permit, and is subject to noise control measures stipulated in the *Technical Memorandum on Noise from Percussive Piling*. Percussive piling is prohibited between 19.00 and 07.00 on normal weekdays and all day on public holidays (including Sunday). Permitted hours of piling depend on the noise levels as received at the worst-affected NSRs. The Acceptable Noise Levels (ANLs) for piling at these NSRs is 85 dB(A), based on the assumption that the NSRs have windows and no central air conditioning. The permitted hours of piling are shown in the following Table:

Table 4.1 Construction Noise: Permitted Hours of Operation for Piling

Amount by which noise from piling exceeds the ANL	Permitted hours of operation on any day not being a general holiday
More than 10 dB(A)	08.00 - 09.00 and 12.30 - 13.30 and 17.00 - 18.00
1 to 10 dB(A)	08.00 - 09.30 and 12.00 - 14.00 and 16.30 - 18.00
No exceedance	07.00 - 19.00

The noise generated by operation of the flood control works is assessed with reference to the *Technical Memorandum for the Assessment of Noise from Places other than Domestic Premises, Public Places or Construction Sites.* Sensitive facades facing the pumping station are characterised by an Area Sensitivity Rating "A", appropriate for rural areas unaffected by the noise from industrial premises or major roads. Thus, the Acceptable Noise Levels (ANL) are 60 dB(A) during the daytime (0700 to 1900 hours) and evening (1900 to 2300 hours), and 50 dB(A) during the night (2300 to 0700 hours). In addition, the Hong Kong Planning Standards and Guidelines (HKPSG) advises that fixed noise sources should be so located and designed that, when assessed in accordance with the *Technical Memorandum*, the level of the intruding noise at the facade of the nearest sensitive use should be at least 5 dB(A) below the appropriate ANL.

4.3.2 Methodology

The methodology outlined in the *Technical Memorandum on Noise from Construction Works other than Percussive Piling* and the *Technical Memorandum on Noise from Percussive Piling* has been used for the assessment of construction noise. The site is generally linear in shape, so the dominant portion of the site closest to a given representative Noise Sensitive Receiver (NSR) has been chosen as the notional source position. All items of powered mechanical equipment (PME) are assumed to be located at this notional source position. Equipment sound power levels have been taken from Table 3 of the *Technical Memorandum on Noise from Construction Works other than Percussive Piling* except where more detailed or complete information was available from *BS 5228: Part 1: 1984 (Noise control on construction and open sites).*

The *Technical Memorandum for the Assessment of Noise from Places other than Domestic Premises, Pubic Places or Construction Sites* has provided the basis for the assessment of operational noise. No corrections for tonality, intermittency, or impulsiveness have been made, but a +3 dB(A) facade correction has been applied. Barrier corrections indicated in Section 2.10 of the *Technical Memorandum* have been applied where appropriate. In accordance with the *Technical Memorandum*, 100% utilization of equipment is assumed over the 5 minute noise measurement period.

4.3.3 Sensitive Receivers

A set of representative NSRs has been selected and is shown in Figure 4.1. These NSRs are listed in Table 4.2.

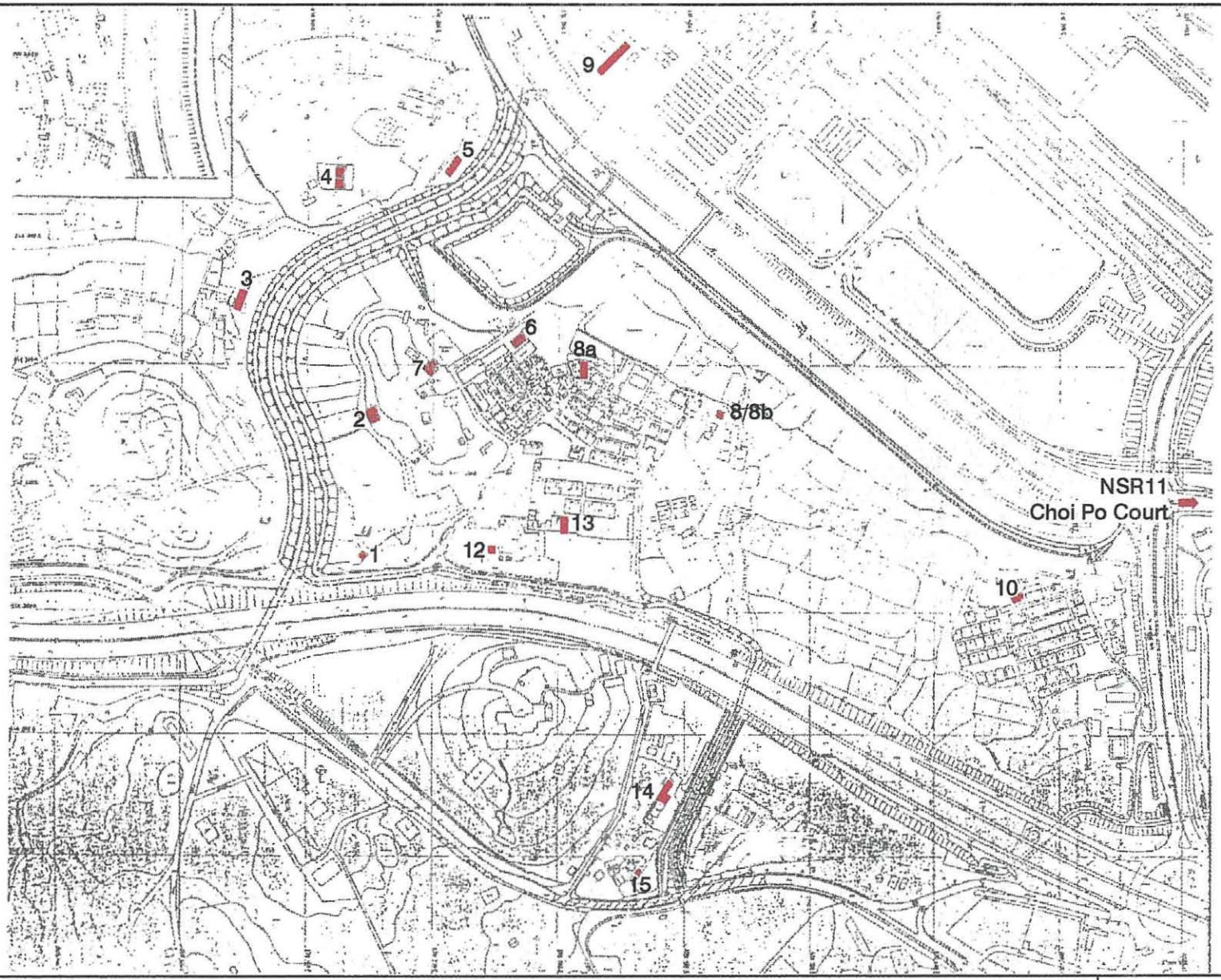

Figure 4.1 Representative Noise Sensitive Receivers (NSRs) & Air Quality Sensitive Receivers (ASRs)

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Table 4.2 Representative NSRs

NSR ID	Location	Remarks
NSR-1	West Tsung Pak Long	1-storey isolated temporary residence
NSR-2	West Tsung Pak Long	3-storey isolated new village residence
NSR-3	West Tsung Pak Long	1-storey mixed agricultural and residential temporary structures
NSR-4	West Tsung Pak Long	2-storey village residence
NSR-5	West Tsung Pak Long	1-storey isolated residence on stilts
NSR-6	Tsung Pak Long	1-storey school
NSR-7	Tsung Pak Long	1-storey school
NSR-8a	Tsung Pak Long	3-storey village residence
NSR-8b	East Tsung Pak Long	1-storey village residence
NSR-9	Sheung Shui THA	2-storey THA residence
NSR-10	Tai Tau Leng	3-storey village residence
NSR-11	Choi Po Court	28-storey residential tower
NSR-12	South Tsung Pak Long	2-storey village residence
NSR-13	South Tsung Pak Long	2-storey residence inside walled village
NSR-14	Cottage Area	1-storey permanent residence
NSR-15	Cottage Area	1-storey temporary residence

4.3.4 Construction Activities

The flood protection works are described in Section 3. Possible construction methods and equipment requirements are summarised below, and represent the basis of the construction noise impact assessment. It should be noted that the Contractor will implement his own construction schedule, with appropriate tasks and equipment lists which may differ from the assumptions stated below.

Western Watercourse

An embankment will be constructed along the small watercourse to the west of Tsung Pak Long village. A concrete-lined channel 4 m wide, flanked by embankments and drainage channels, will be built approximately along the alignment of the existing stream. Required works will include excavation of the existing stream bed and removal of excess material. The excavated surface will then be compacted prior to formation of the embankments and pouring of concrete. Concrete will be poured from lorry mixers, and compacted using vibratory pokers. Due to distances, the use of a concrete pump may be necessary.

Table 4.3 Construction Equipment: Western Watercourse

Task and Equipment	No.	SWL dB(A) per pc.	Source
Excavation and Compaction of Existing Stream Bed			
Bulldozer	1	115	CNP 030
Excavator/loader	1	112	CNP 081
20-t and 24-t dump truck	1	105	BS 5228
Vibratory compactor	1	105	CNP 050
Drainage pump	1	103	CNP 282
Concrete Operations			
Concrete lorry mixer	1	109	CNP 044
Vibratory poker	2	113	CNP 170
Concrete pump	1	109	CNP 047

Sutlej River

A retaining wall will be constructed along the southern edge of the Sutlej River. Required works will include ground excavation, the reinforcement and erection of concrete formwork and backfilling.

Table 4.4 Construction Equipment: Sutlej River

Task and Equipment	No.	SWL dB(A) per pc.	Source
Ground Excavation			
Excavator/loader	1	112	CNP 081
Dumptruck	1	117	CNP 067
Reinforcement			
Bar bender/cutter (electric)	1	90	CNP 021
Concreting			
Concrete mixer truck	1	109	CNP 044
Vibratory pokers	1	113	CNP 170
Erection of formwork			
Crane (mobile diesel)	1	112	CNP 048
Backfilling			
Dumptruck	1	117	CNP 067
Excavator/loader	1	112	CNP 081
Vibratory roller	1	108	CNP 186

Culvert along Tsung Pak Long access road

A culvert will be constructed, running parallel to and north of the NTCR. It will be routed along and at the side of the secondary access road, thus avoiding the mature trees and commercial fishponds to the north. The culvert, which will join the eastern and western watercourses, will be approximately 3.0 m wide and 2.5 m deep. Required works will include removal of existing access road surface, excavation of the culvert, and removal of excess material. The excavated surface will then be compacted prior to pouring of concrete. Concrete will be poured from lorry mixers, and compacted using vibratory pokers. The ditch in which the culvert is placed will then be backfilled and the surface reinstated.

Table 4.5 Construction Equipment: Culvert along Tsung Pak Long Access Road

Task and Equipment	No.	SWL dB(A) per pc.	Source
Excavation of Culvert			
Concrete breaker	1	117	CNP 023
Excavator/loader	1	112	CNP 081
20-t and 24-t dump truck	1	105	BS 5228
Vibratory compactor	1	105	CNP 050
Concrete Operations			
Concrete lorry mixer	1	109	CNP 044
Vibratory poker	2	113	CNP 170
Concrete pump	1	109	CNP 047
Reinstatement of Surface			
Excavator/loader	1	112	CNP 081
Vibratory compactor	1	105	CNP 050
Asphalt Paver	1	109	CNP 004

Eastern Watercourse

A concrete channel will be built along the line of the eastern watercourse between the NTCR and Castle Peak Road. Required works will include excavation of the existing stream bed and removal of excess material. The excavated surface will then be compacted prior to formation of embankments and pouring of concrete. Concrete will be poured from lorry mixers, and compacted using vibratory pokers. Due to distances, the use of a concrete pump is expected to be necessary.

Table 4.6 Construction Equipment: Eastern Watercourse

Task and Equipment	No.	SWL dB(A) per pc.	Source
Excavation and Compaction of Existing Stream Bed			
Excavator/loader	1	112	CNP 081
20-t and 24-t dump truck	1	105	BS 5228
Vibratory compactor	1	105	CNP 050
Concrete Operations			
Concrete lorry mixer	1	109	CNP 044
Vibratory poker	2	113	CNP 170
Concrete pump	1	109	CNP 047

Culvert under Castle Peak Road

A critical location for passing of flood waters from the adjacent catchment occurs at the point where the eastern watercourse crosses Castle Peak Road. At this point, the road level is 6.8 mPD. Consideration will be given, during detail design, to enlarging the existing culvert under Castle Peak Road, and to raising the road level to 7.2 mPD.

The enlarged culvert runs beneath Castle Peak Road. Required works will include removal of existing road surface, excavation, and enlargement of the existing culvert. Concrete to form the enlarged culvert will be poured from lorry mixers, and compacted using vibratory pokers. The ditch in which the culvert is placed will then be backfilled and the surface reinstated.

Table 4.7 Construction Equipment: Culvert under Castle Peak Road

Task and Equipment	No.	SWL dB(A) per pc.	Source
Excavation of Culvert			
Concrete breaker	1	117	CNP 023
Excavator/loader	1	112	CNP 081
20-t and 24-t dump truck	1	105	BS 5228
Concrete Operations			
Concrete lorry mixer	1	109	CNP 044
Vibratory poker	2	113	CNP 170
Concrete pump	1	109	CNP 047
Reinstatement of Surface			
Excavator/loader	1	112	CNP 081
Vibratory compactor	1	105	CNP 050
Asphalt paver	1	109	CNP 004

Surface Water Pumping Station and Storage Pond

A storage pond will be formed to supplement the capacity of the pumping station and will store run-off from the low area surrounding the villages during storm conditions. The storage pond will drain to the pumping station located adjacent to the southern Sutlej River retaining wall, which will lift collected and stored water into the Sutlej River through a spillway. Outside of storm situations, the storage pond will be dry.

The works associated with the formation of the storage pond will be excavation of the pond and formation and compaction of the perimeter embankments. The pumping station will consist of a concrete structure to house the motors and switchgear together with an intake channel, screw pumps and exit spillway.

Table 4.8 Construction Equipment: Pumping Station and Storage Pond

Task and Equipment	No.	SWL dB(A) per pc.	Source
Pond Excavation and Formation of Embankments			
Bulldozer	1	115	CNP 030
20-t and 24-t dump truck	1	105	BS 5228
Vibratory compactor	1	105	CNP 050
Pumping Station			
Concrete lorry mixer	1	109	CNP 044
Vibratory poker	2	113	CNP 170

Pedestrian Footbridge

The existing pedestrian footbridge over the Sutlej River near the THA will be demolished, and a higher replacement bridge will be built.

Demolition of the existing bridge will be done by an excavator-mounted breaker positioned on the bank or in the bed of the existing river channel.

Table 4.9 Construction Equipment: Removal of Existing Footbridge

Task and Equipment	No.	SWL dB(A) per pc.	Source
Breaking bridge			
Air compressor Pneumatic breaker *or* Breaker (excavator-mounted, pneumatic or hydraulic)	1 1 *or* 1	100 110 *or* 122	CNP 002 CNP 024, 025, 026 *or* CNP 027, 028
Removal of broken bridge			
Dump-truck	1	105	BS 5228
Excavator/loader	1	112	CNP 081

The new footbridge will be supported on reinforced concrete pile caps founded on bored piles. Percussive piling may be necessary for temporary sheet piling.

Table 4.10 Construction Equipment: Piling for Footbridge

Task and Equipment	No.	SWL dB(A) per pc.	Source
Piling (percussive)			
Drop hammer driving sheet piles Single acting hammer driving steel pile	1 1	126 130	*Technical Memorandum on Noise from Percussive Piling*
Piling (bored)			
Reverse circulation drill	1	100	CNP 166
Concreting			
Concrete mixer truck	1	109	CNP 044
Concrete pump	1	109	CNP 047

The footbridge deck will be cast in-situ reinforced concrete. In-situ works require that formwork must first be built. Reinforcement will then be placed, and concrete will be delivered by mixer truck and placed using a concrete pump.

Table 4.11 Construction Equipment: Footbridge Superstructure

Task and Equipment	No.	SWL dB(A) per pc.	Source
Formwork and Reinforcement			
Crane (mobile diesel)	1	112	CNP 048
Bar bender/cutter (electric)	1	90	CNP 021
Compressor (silenced)	1	100	CNP 002
Concreting			
Concrete mixer truck	2	109	CNP 044
Concrete pump truck	1	109	CNP 047
Vibratory pokers	2	113	CNP 170

4.3.5 Construction Phase Impacts

Based on the foregoing assumptions, facade noise levels at representative NSRs have been calculated and are shown below in Tables 4.12 to 4.17. There are no other known projects near the area which will give rise to cumulative impacts on noise.

Table 4.12 Facade Noise Levels due to Construction: Sutlej River Retaining Wall

NSR ID	Location	Maximum Facade Noise Level (dB(A)) due to:				
		Excavation	Reinforcement	Concreting	Placement	Backfilling
NSR-3	West Tsung Pak Long	65	37	61	59	65
NSR-4	West Tsung Pak Long	70	42	66	64	70
NSR-5	West Tsung Pak Long	77	49	73	71	77
NSR-6	Tsung Pak Long	71	43	67	65	71
NSR-7	Tsung Pak Long	68	40	64	62	68
NSR-8a	Tsung Pak Long	72	44	68	66	72
NSR-8b	East Tsung Pak Long	76	48	72	70	76
NSR-9	Sheung Shui THA	76	48	73	70	76
NSR-10	Tai Tau Leng	80	51	76	73	80
NSR-11	Choi Po Court	73	45	70	67	73

Receivers within about 80 m of the construction site may be subject to daytime noise levels exceeding the 75 dB(A) assessment criterion. Near Tsung Pak Long, such NSRs are restricted to isolated dwellings beside agricultural plots (NSR-5 and NSR-8(b)). At Tai Tau Leng, the front row of village houses will be exposed to construction noise in excess of 75 dB(A). The need for construction noise mitigation measures is anticipated in order to reduce the impacts of noise resulting from these and other pieces of construction equipment.

Table 4.13 Facade Noise Levels due to Construction: Western Watercourse

NSR ID	Location	Facade Noise Level (dB(A)) due to:	
		Excavation and Compaction of Existing Stream Bed	Concrete Operations
NSR-1	West Tsung Pak Long	74	74
NSR-2	West Tsung Pak Long	77	77
NSR-3	West Tsung Pak Long	84	84
NSR-4	West Tsung Pak Long	81	81
NSR-5	West Tsung Pak Long	90	90
NSR-6	Tsung Pak Long	72	72
NSR-7	Tsung Pak Long	73	73
NSR-8a	Tsung Pak Long	68	68
NSR-9	Sheung Shui THA	69	69
NSR-12	South Tsung Pak Long	68	68

The western watercourse passes close to the scattered dwellings that lie outside the main settlement at Tsung Pak Long. As a result, the noise from construction operations along the watercourse is expected to exceed the assessment criterion of 75 dB(A). Within the main village area, construction noise levels are expected to be acceptable. The major contributors to noise are bulldozers (during construction of the embankments), excavator/ loader during excavation of the stream bed and concrete vibrators (during compaction of concrete). The need for construction noise mitigation measures is anticipated in order to reduce the impacts of noise resulting from these and other pieces of construction equipment.

Table 4.14 Facade Noise Levels due to Construction: Excavation of Culvert under NTCR

NSR ID	Location	Facade Noise Level (dB(A)) due to:		
		Excavation of Culvert	Concrete Operations	Reinstatement of Surface
NSR-1	West Tsung Pak Long	95	93	90
NSR-12	South Tsung Pak Long	89	87	84
NSR-13	South Tsung Pak Long	76	75	72

The excavated culvert passes close to the dwellings that lie on the southern perimeter of the main settlement at Tsung Pak Long. As a result, the noise from construction operations close to the culvert alignment is expected to greatly exceed the assessment criterion of 75 dB(A). Within the walled part of the village, construction noise levels are expected to be mostly acceptable due to the barrier effect of the surrounding wall. The major contributors to noise are concrete breakers (during removal of the access road surface), concrete vibrators (during compaction of concrete), and the loader (during backfilling). The need for construction noise mitigation measures is anticipated in order to reduce the impacts of noise resulting from these and other pieces of construction equipment.

Table 4.15 Facade Noise Levels due to Construction: Eastern Watercourse

NSR ID	Location	Facade Noise Level (dB(A)) due to:	
		Excavation and Compaction of Existing Stream Bed	Concrete Operations
NSR-14	Cottage Area	92	96
NSR-15	Cottage Area	84	87

Residential facades lie very close to the eastern watercourse. Construction operations along the stream course can be expected to result in very high noise levels, due to the close proximity of the facades to items of PME. The major contributors to construction noise are bulldozers (for forming embankments), excavators (for excavation of the existing stream bed) and vibratory pokers (for compaction of concrete). Though the duration of high construction noise levels will not be long, it is desirable to incorporate mitigation measures to reduce the impacts.

Table 4.16 Facade Noise Levels due to Construction: Pumping Station and Storage Pond

NSR ID	Location	Facade Noise Level (dB(A)) due to:	
		Pond Excavation and Formation of Embankments	Construction of Pumping Station
NSR-3	West Tsung Pak Long	65	64
NSR-4	West Tsung Pak Long	68	67
NSR-5	West Tsung Pak Long	74	73
NSR-6	Tsung Pak Long	78	72
NSR-7	Tsung Pak Long	71	68
NSR-8a	Tsung Pak Long	72	70
NSR-9	Sheung Shui THA	68	71

With the exception of the school in Tsung Pak Long (NSR-6), which is located close to the perimeter of the storage pond, receivers in the area are sufficiently far from the construction works that noise is not expected to exceed desirable limits. However, the exceedances expected at the school require that mitigation measures be considered.

Table 4.17 Facade Noise Levels due to Construction: Excavation of Culvert under Castle Peak Road

NSR ID	Location	Facade Noise Level (dB(A)) due to:		
		Excavation of Culvert	Concrete Operations	Reinstatement of Surface
NSR-14	Cottage Area	81	79	76
NSR-15	Cottage Area	94	93	89

The excavated culvert and roadworks pass close to the dwellings in the cottage area north of Castle Peak Road. As a result, the noise from construction operations is expected to greatly exceed the assessment criterion of 75 dB(A). The major contributors to noise are concrete breakers (during removal of the road surface), concrete vibrators (during compaction of concrete), and the loader (during backfilling). The need for construction noise mitigation measures is anticipated in order to reduce the impacts of noise resulting from these and other pieces of construction equipment.

Table 4.18 Facade Noise Levels due to Construction: Removal of Existing Footbridge

NSR ID	Location	Facade Noise Level (dB(A)) due to:		
		Breaking bridge		Removal of broken bridge
		Hand held equipment	Mounted equipment	
NSR-4	West Tsung Pak Long	60	72	62
NSR-5	West Tsung Pak Long	67	78	69
NSR-6	Tsung Pak Long	62	74	64
NSR-9	Sheung Shui THA	74	86	76

Excavator-mounted breakers have a high noise level compared with hand-held breakers, and thus can be expected to generate noise exceeding the daytime criterion at closer NSRs such as the Sheung Shui THA and NSR-5. Use of hand-held equipment is not expected to cause exceedances of the daytime noise criterion. The noise from removal of the bridge rubble is expected to exceed the assessment criterion of 75 dB(A) only at the nearby THA facades, due to the use of an excavator/loader. However, exceedance of the 75 dB(A) criterion is only marginal, and should occur only briefly when the excavator is operating at the extreme northern end of the footbridge. Facade noise levels at the THA are likely to be reduced to 75 dB(A) when the excavator/loader is operating at a distance of about 40 m from the THA facades.

Table 4.19 Facade Noise Levels due to Construction: Piling for Footbridge

NSR ID	Location	Facade Noise Level (dB(A)) due to:		
		Piling		Concreting
		Percussive[1]	Bored	
NSR-4	West Tsung Pak Long	75	49	61
NSR-5	West Tsung Pak Long	85	56	68
NSR-6	Tsung Pak Long	77	51	63
NSR-9	Sheung Shui THA	87	61	73

NOTE: [1] Based on drop hammer driving sheet steel piles. Add 4 dB(A) for use of single acting hammer driving steel sheet pile.

If required, percussive piling (using either a drop hammer or single acting hammer) is likely to be restricted to the hours of 08.00 to 09.30, 12.00 to 14.00, and 16.30 to 18.00, due to exceedance of the Acceptable Noise Level (ANL) at the nearest THA facades. Bored piling is likely to remain within acceptable noise levels, as is concreting.

Table 4.20 Facade Noise Levels due to Construction: Footbridge Deck Construction

NSR ID	Location	Facade Noise Level (dB(A)) due to:	
		Formwork and Reinforcement	Concreting
NSR-4	West Tsung Pak Long	62	68
NSR-5	West Tsung Pak Long	69	75
NSR-6	Tsung Pak Long	64	69
NSR-9	Sheung Shui THA	76	82

Noise levels at all nearby NSRs except those in the THA are expected to remain within the daytime criterion of 75 dB(A). At the THA, exceedance of the daytime noise level during deck construction may be expected.

4.3.6 Operation Phase Equipment

A description of the flood control scheme is provided above in Section 3. In general, the works are restricted to channels, culverts, and embankments designed to control and contain surface water during flood conditions. During normal tidal and flow conditions, drainage from Tsung Pak Long, Tai Tau Leng, and low-lying areas will drain to the Sutlej River by gravity. However, during flood conditions, gravity connections will close and the flow will be diverted to the pumping station to be pumped into the river. Flows in excess of the pumping rate will be temporarily stored in the adjacent storage pond.

Three screw pumps with a SWL of 85 dB(A) each have been assumed in the present assessment. It has been assumed that the pumps operate on a duty/standby basis, so two pumps are operational at a given time, although all three can operate simultaneously if required during a severe rainfall event. A generator will also be provided for emergency electricity supply.

4.3.7 Operation Phase Impacts

The following facade noise levels are expected at representative sensitive facades facing the pumping station and have been calculated on the basis of the continuous use of two ...s and the use of the emergency generator. In reality noise levels will be lower than ...ven below, since the generator will only be used at those times when the normal ...supply has failed.

Table 4.21 Facade Noise Levels due to Operation of Pumping Station

NSR ID	Location	Facade Noise Levels (dB(A))
NSR-3	West Tsung Pak Long	55
NSR-4	West Tsung Pak Long	58
NSR-5	West Tsung Pak Long	64
NSR-6	Tsung Pak Long	62
NSR-7	Tsung Pak Long	59
NSR-8a	Tsung Pak Long	61
NSR-9	Sheung Shui THA	62

During the periods of pump operation, the need for noise mitigation is not anticipated. However, in accordance with the methodology outlined in the *Technical Memorandum for the Assessment of Noise from Places other than Domestic Premises, Public Places or Construction Sites,* attempts should be made to minimise the tonal characteristics of the pump, particularly in the higher frequency ranges.

There are no other known projects near the area which will give rise to cumulative impacts on noise.

4.3.8 Environmental Monitoring during Construction

Daytime compliance monitoring should be undertaken at least three times per week, involving measurement over a 30-minute period of typical activity. Measurement should be carried out 1 m from the worst-affected external facades of designated NSRs. Noise measurements should not be made during periods of high background noise (such as during peak traffic hours), or in the presence of fog, rain, or excessive steady or gusty winds.

As part of the monitoring schedules, three levels have been devised to monitor compliance with environmental objectives and to provide early warning of potential problem areas. The definition of TAT levels and an action plan is given in Annex 3.

- *Trigger Level:* This level may be defined as receipt of one independent complaint (directed either to EPD or the site office).
- *Action Level:* This level may be defined as receipt of more than one independent complaint in a four-week period.
- *Target Level:* In the absence of statutory controls to limit daytime (07.00-19.00 hrs) construction noise, a limit of 75 dB(A) (L_{eq} 30 min) may be adopted as the Target Level. Exceedance of the Target Level is generally not permitted.

In addition to noise monitoring, the effectiveness of mitigation measures should be checked by ensuring that any silenced construction equipment is properly used and maintained, any noise barriers are properly positioned and maintained, and good site practice is maintained.

4.4 Air

4.4.1 Introduction

There exists a potential for air quality impact arising from construction of the flood protection scheme, resulting from dust generated mainly during the construction of the retaining wall along the southern edge of the Sutlej river and construction of the embankments along the western watercourse and eastern watercourse to the west and east of Tsung Pak Long. Construction of culverts and small concrete channels are likely to have confined and minimal dust impacts on nearby receivers.

Legislation and guidelines for the control of air quality that are relevant to this study are tabulated in Table 4.22 below.

Table 4.22 Hong Kong Air Quality Objectives

Air Pollutant	Concentration in microgram per cubic metre		
	Averaging Time		
	1-Hour	24-Hour*	Annual
TSP	500**	260	80

* Not to be exceeded more than once per year.

** In addition to the above established legislative controls, it is generally accepted that an hourly average total suspended particulate (TSP) concentration of 500 $\mu g\ m^{-3}$ should not be exceeded. Such a control limit is particularly relevant to construction work and has been imposed on a number of construction projects in Hong Kong in the form of contract clauses.

4.4.2 Sensitive Receivers

Ten representative air quality sensitive receivers were identified. They are existing buildings located around the site and are numbered 1 to 10 in Figure 4.1.

4.4.3 Assessment Methodology

The major pollutant emission of concern from construction activities is particulate matter. Vehicle and plant exhaust emissions from the site are not considered to constitute a significant source of air pollutants. Emission points for dust release from embankment construction activities include the following:

- End-tipping of construction material from trucks

- Bulldozing overburden material
- Grading of embankment material
- Truck travel on dusty roads
- Wind erosion of stockpiles and open site areas

It was assumed the embankment construction would be completed in 12 months with 10-hour working days. Haul trucks of 6m^3 capacity would be used for transporting the construction material from the borrow area to the site. There would not be concrete batching on the site due to the proximity to the nearby villages.

The estimation of dust emissions was based on typical values and emission factors from USEPA *AP-42*. Material silt content and moisture content were taken as 6.9 and 7.9 percent respectively; which are the geometric mean values for overburden of Western surface coal mining from USEPA *AP-42*. Unpaved site road surface material silt content was taken as 8.4 percent; which is the geometric mean value for haul road of Western surface coal mining from USEPA *AP-42*.

In this assessment, dust suppression measures and the estimated mitigation efficiencies have been incorporated into the dust emission calculations. The mean vehicle speed of the haulage trucks within the site area would be reduced to 15 km hr^{-1} by speed control. A 50 percent reduction of the dust generated from wind erosion, and vehicle movements on dusty surfaces would result from twice daily watering with complete coverage of all site roads and open site area as indicated in USEPA *AP-42*. Refer to Annex 4 for the emission factors calculation (Table TPLX590.XLS) and the input parameters of the model in an example of an FDM output file (T010590.OUT).

Air dispersion modelling was undertaken using the USEPA approved Fugitive Dust Model (FDM) to assess potential impacts from the construction activities. Wind-dependent emissions from fugitive dust sources and the advanced gradient-transfer deposition algorithm have been incorporated in the model. Modelling was undertaken to establish TSP concentrations at sensitive receivers for 1-hour, 24-hour and annual average time periods.

Wind speed and direction data for the year 1990 from Ta Kwu Ling meteorological station, which is the closest meteorological station to the study site, were combined with surface observations recorded at the Royal Observatory to obtain the best available data set.

No specific assessment was undertaken to calculate RSP concentrations. Dust generated from construction activities is composed mainly of larger particles. It is reasonable to assume RSP generation would be less than 50 percent of the TSP.

4.4.4 Impact on Receivers

There are no other known projects near the area which will give rise to cumulative impacts on air quality.

The predicted maximum 1-hour, maximum 24-hour and annual average TSP levels at the sensitive receivers during the period of embankment construction are tabulated in Table

4.23. Background dust information of the area is not available and no background dust concentration was incorporated in the calculations. All the predicted TSP levels are solely due to the activities of the embankment construction. The maximum 1-hour, maximum 24-hour and annual average TSP concentration contours for both the unmitigated and mitigated scenario are presented in Figures 4.2 to 4.7. All the plots are produced based on predicted TSP levels at sensitive receivers 1 to 10 only, TSP levels at other locations in the area should be viewed with care.

Modelling results indicate that there would not be exceedance of the 1-hour average TSP guideline level and the 24-hour and annual average TSP AQOs at any of the sensitive receivers except two exceedances and one exceedance of the 1-hour average TSP guideline level at receiver 3 and receiver 5 respectively. Based on the 1990 Ta Kwu Ling meteorological data, exceedances of the 1-hour average TSP guideline level at receivers 3 and 5 occurred during low wind speed conditions. By implementing the dust suppression measures in Section 5.4 and adopting more frequent watering of dusty site surfaces, especially those close to receivers 3 and 5, during low wind speed conditions, exceedance of the TSP guideline level and AQOs at the sensitive receivers is not expected.

Table 4.23 Predicted Maximum TSP Concentration at Sensitive Receivers During Period of Embankment Construction (μgm^{-3})

Receiver	1-hour Average	24-hour Average	Annual Average
1	311	48	10
2	227	35	12
3	541 (2)	76	26
4	470	46	11
5	530 (1)	70	29
6	127	23	8
7	156	28	10
8	138	18	8
9	365	31	6
10	184	29	7

Note: Predicted exceedances of Guideline level or HK AQO are highlighted.
( ) Number of exceedances based on 1990 Ta Kwu Ling meteorological data.

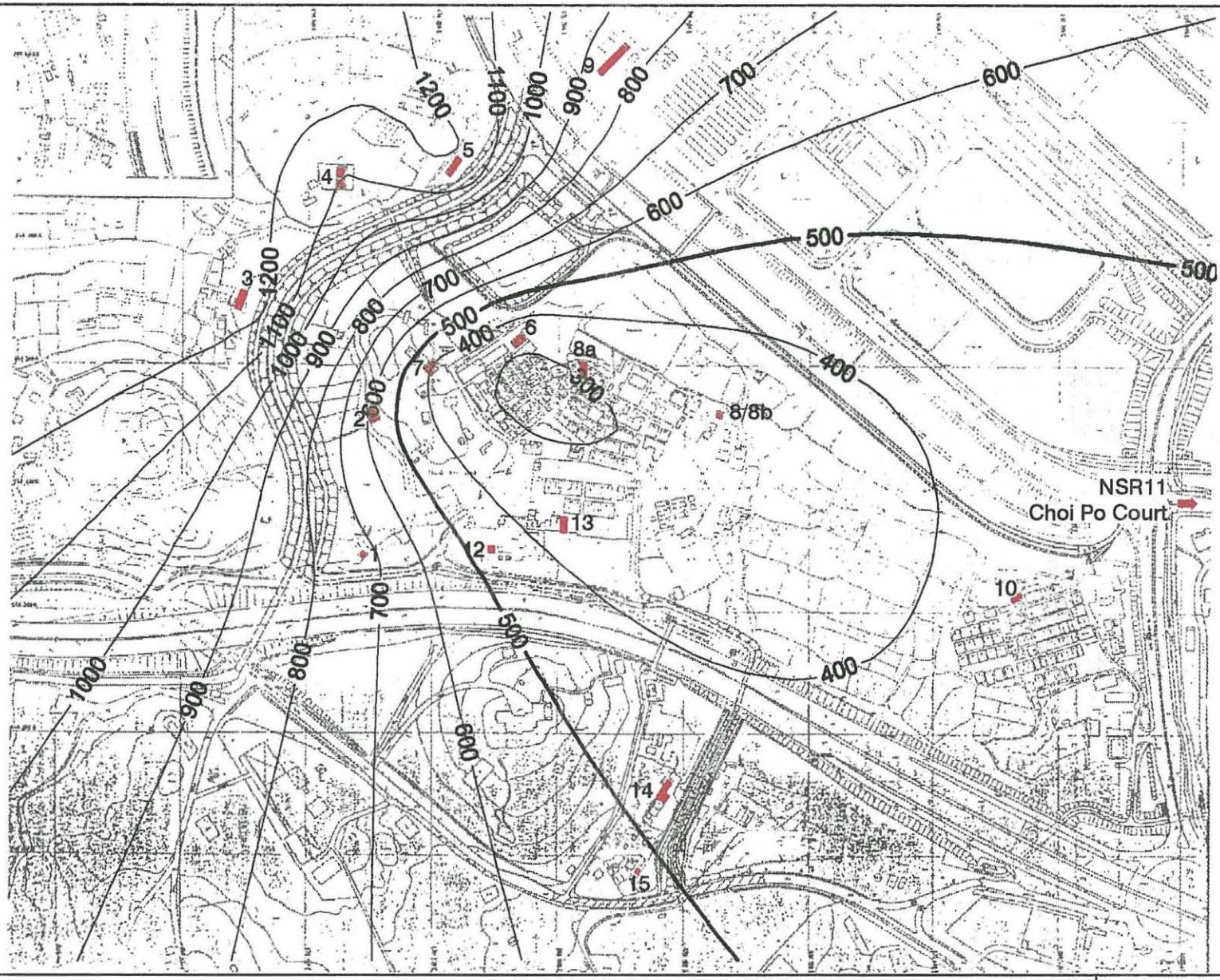

Figure 4.2 Predicted Maximum 1-Hour Average TSP Concentration Contours without Adoption of Dust Suppression Measures

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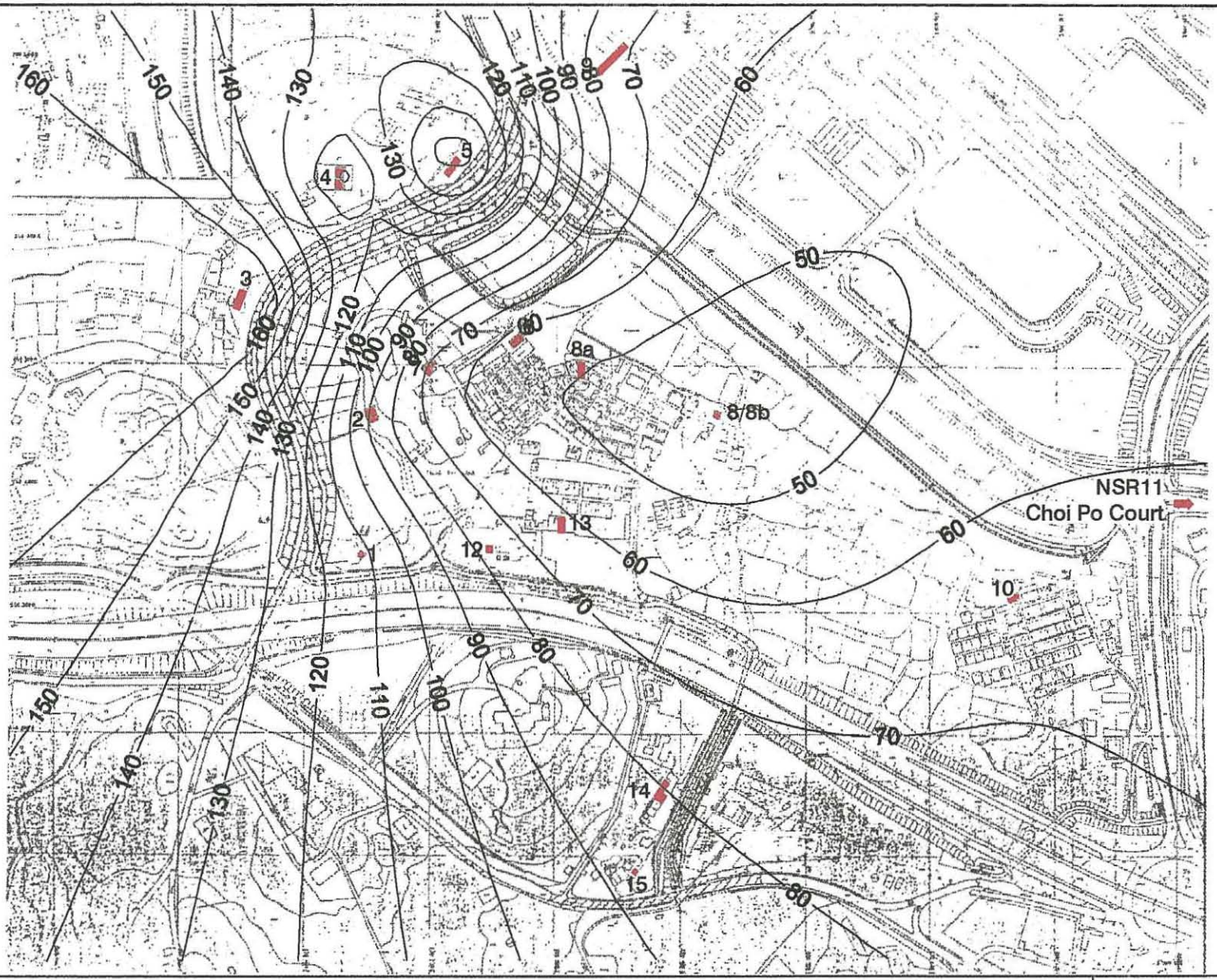

Figure 4.3 Predicted Maximum 24-Hour Average TSP Concentration Contours without Adoption of Dust Suppression Measures

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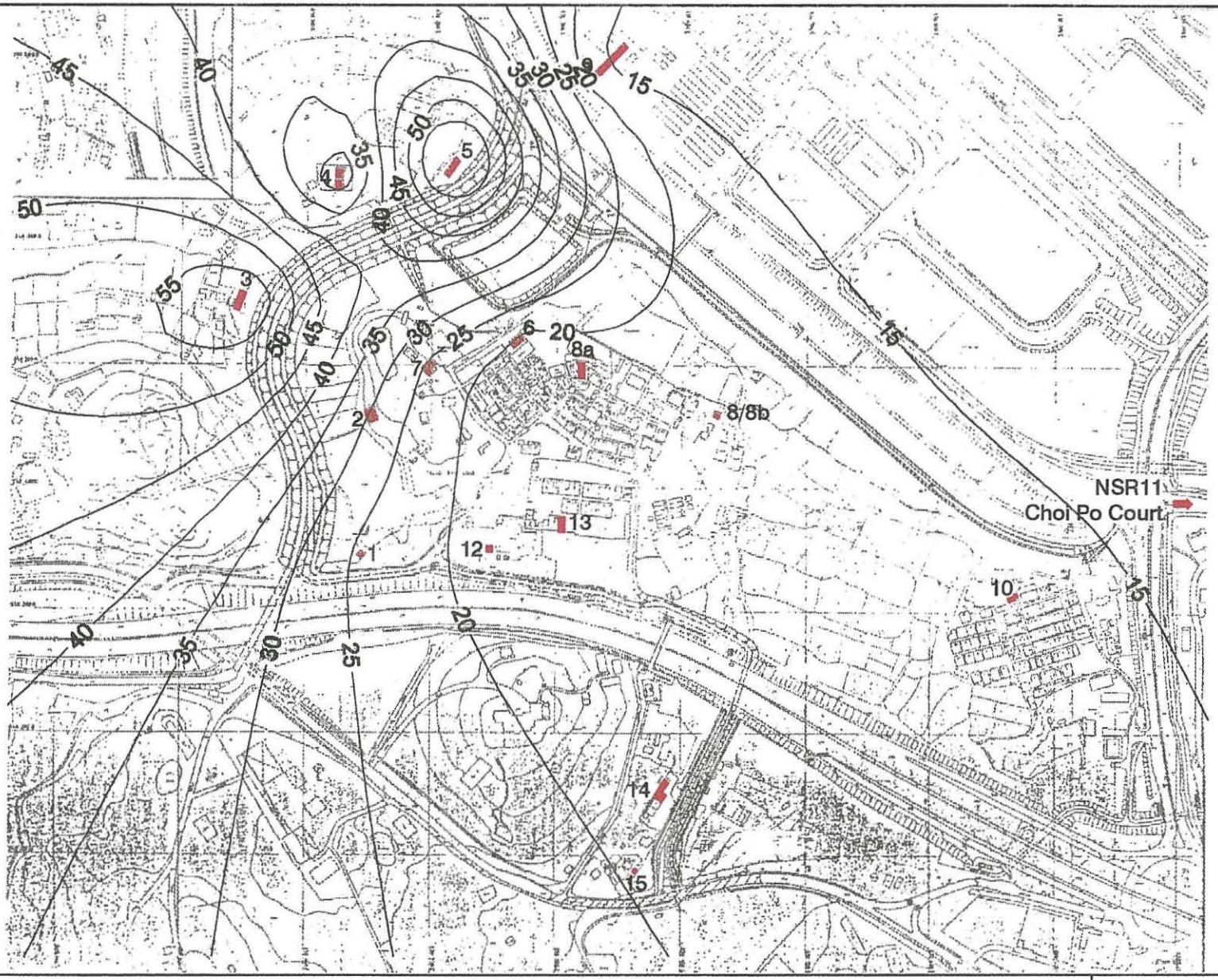

Figure 4.4 Predicted Annual Average TSP Concentration Contours without Adoption of Dust Suppression Measures

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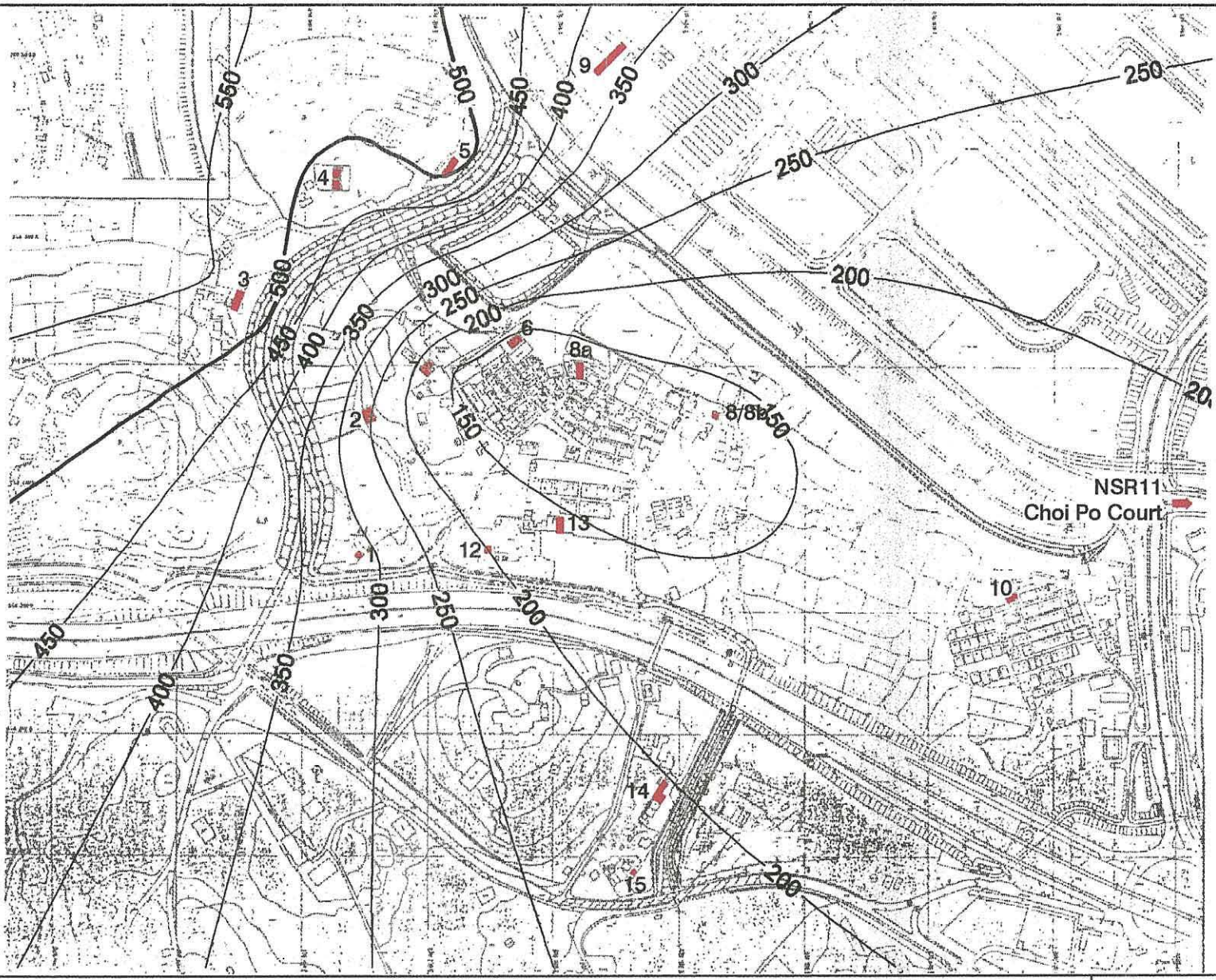

Figure 4.5 Predicted Maximum 1-Hour Average TSP Concentration Contours with Adoption of Dust Suppression Measures

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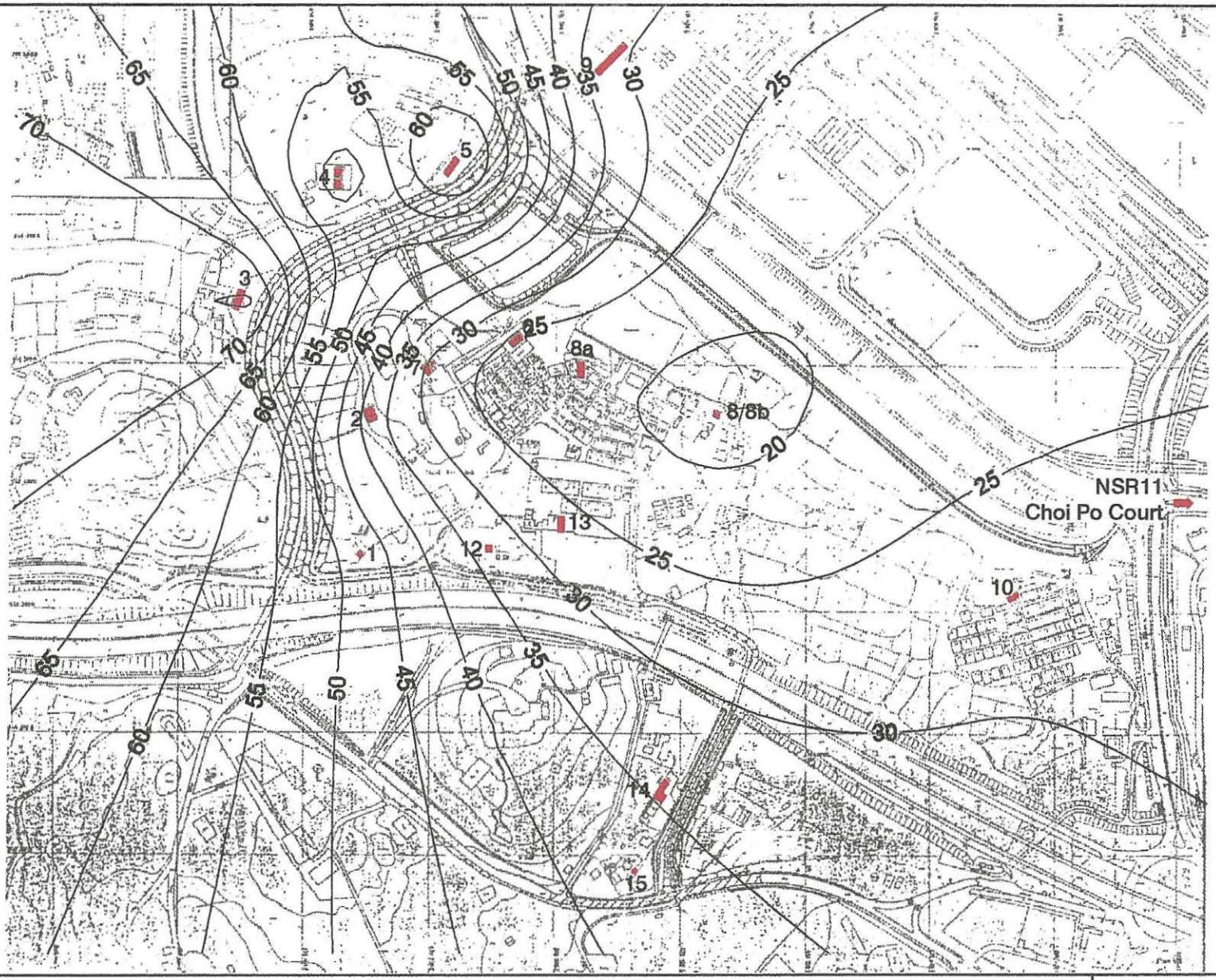

Figure 4.6 Predicted Maximum 24-Hour Average TSP Concentration Contours with Adoption of Dust Suppression Measures

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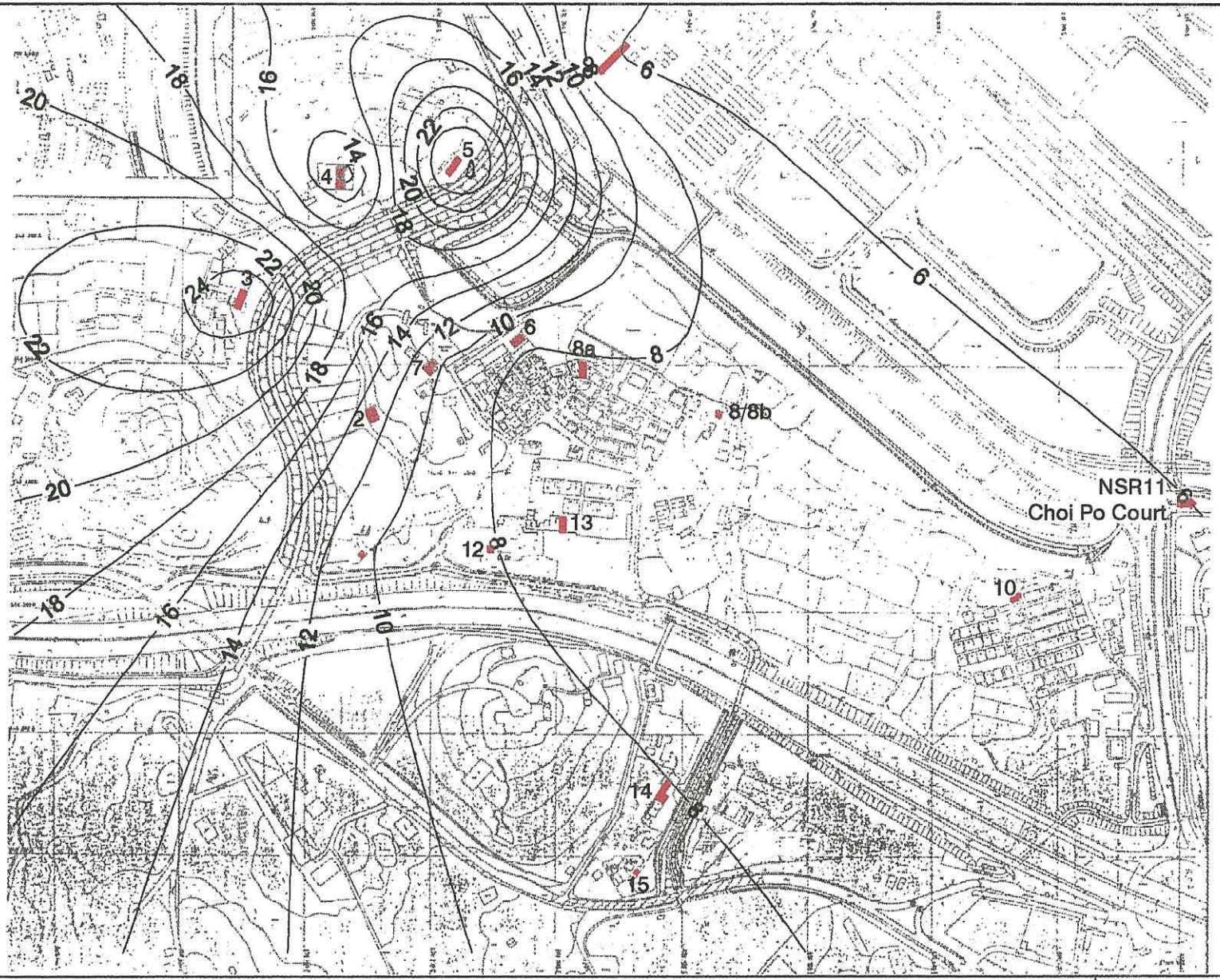

Figure 4.7 Predicted Annual Average TSP Concentration Contours with Adoption of Dust Suppression Measures

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4.4.5 Dust Monitoring and Audit

TSP monitoring should be carried out by the Engineer or Contractor throughout the construction period. Two high volume air samplers and associated equipment and shelters should be provided. Location of monitoring stations should be close to site boundary, free from local obstructions or shelters and one of them should be nearest to sensitive receiver 3 or 5. The exact locations should be reviewed in relation to practical site constraints.

Baseline monitoring should be carried out by the Engineer prior to the commencement of the construction work to determine the ambient dust (TSP) levels at specified monitoring stations. The baseline monitoring should be carried out for a period of at least two consecutive weeks (14 readings) prior to commissioning of the construction work - daily for 24-hour sampling, at least 3 times per day for 1-hour sampling while the highest dust impact is expected.

Impact monitoring during the course of the construction should be undertaken at a frequency not lower than one 24-hour measurement per six days and 1-hour monitoring should be carried out 3 times for every 6 days at the highest dust impact occasion. Should the monitoring results indicate a deteriorating situation, closer monitoring may be undertaken by the Engineer until the monitoring results indicate an improving and acceptable level of air quality. Meanwhile, the Engineer may direct the Contractor to take mitigation measures concerning potential dust sources and working procedures. Action plan for dust monitoring and audit should be carried out and this will be specified in the EM&A Manual.

4.5 Historical and Cultural Heritage

The Antiquities and Monuments Office of the Culture and Recreation Branch do not have any historical or archaeological sites listed in the area which would be affected by the development. There are a number of grave sites around the village area, which have been located on a map and on site. The current proposals do not impinge directly on any of the sites, which will be undisturbed. Special precautions will be required to avoid accidental damage by construction plant. This can be accomplished by prior notification of the limits of each site to the contractor. It is unlikely that the aspect from any of the sites will be affected indirectly by the scheme.

The Hakka Wai walled village at Tsung Pak Long, although close to the route of the proposed culvert, is unlikely to be directly or indirectly affected. This is a listed historical structure and therefore should also be notified to the contractor.

4.6 Visual Impacts and Landscaping

4.6.1 Introduction

This section determines and evaluates the visual impacts of the proposed Tsung Pak Long Flood Protection Scheme. The relevant environmental standards and guidelines are reviewed and a visual assessment methodology outlined. The existing visual context of the site is described in order to establish baseline visual conditions against which the

impact of the proposed Flood Protection Scheme can be assessed. Key viewpoints are identified and their visual sensitivity assessed. Based on the evaluation of visual impacts, the key concerns are identified and recommendations made to reduce and mitigate significant impacts.

Environmental Standards and Legislation

Currently in Hong Kong, there is no specific legislation governing visual impact or offering guidelines on visual assessment methodologies. The Government White Paper on "Pollution in Hong Kong - A Time to Act" (HK Govt., 1989) offers general policy objectives that are applicable to visual impacts, as well as specific environmental issues relating to, for example air and water quality. This white paper states that new environmental problems should be avoided by considering the environmental impacts in the early stages of the development process.

The "Environmental Guidelines for Planning in Hong Kong" (HK Govt., 1990) (containing extracts from the Hong Kong Planning Standards and Guidelines) make no specific reference to visual impacts in their "guidelines on environmental matters which should be considered in planning and development activities in Hong Kong".

The only directive from the Hong Kong Environmental Protection Department (EPD) is published in an advice note (EPD, 1992a) which offers guidelines on the environmental impact process for major private sector projects. This recognises visual impact as an issue of concern.

Clearly, these general statements offer little guidance on criteria for visual evaluation or methodologies for assessing visual impacts and acceptable standards. In the absence of formal guidelines, recognised visual assessment methodologies from overseas have been adapted to the particular Hong Kong conditions. These are methodologies currently in use in the USA and UK.

Visual Assessment Methodology

Visual evaluation and assessment is a subjective, and sometimes emotive, subject; it is based on a human response and opinion so the results can be as varied as the individuals involved. While the concept of human 'preference' has been researched for natural landscapes in Europe and the U.S., few studies have been undertaken in Asia or in developed urban settings, such as those found in Hong Kong.

In order to establish a more solid scientific base for visual evaluation, several assessment methodologies have been devised which attempt to quantify visual elements. Complex mathematical strategies for their ranking and evaluation have been proposed. As this type of approach is ultimately based on subjective judgments, the end result inevitably endorses an initial subjective response. The procedure (while of some value in comparing several visual impacts) is, in most cases, unnecessarily complex.

Some methodologies define a "visual envelope" indicating on a plan, an area affected by the proposed development. This approach is considered a useful visual assessment methodology where each location on a plan represents one viewpoint; for example in

rural areas. In the densely developed, urban areas of Hong Kong, this can be a misleading and over simplistic approach. For example, a high-rise residential building will have a range of views, from different floors and from different facades, within a building. On plan, such a building would fall within the visual envelope, however, it is likely that some flats would not be affected by the development in question. In addition, high-rise buildings in the foreground, can screen views of more distant view points from some floors and not others.

For the purpose of this study, visual evaluation and assessment is based on the following methodology which is considered most appropriate in this case. It is based on the methodology usually adopted for the assessment of other environmental impacts, such as noise and air quality.

Sensitive "receivers" are identified and the impacts assessed. Key viewpoints (receivers) to the development are identified. These viewpoints are considered to have varying degrees of "sensitivity" to changes in the view. Sensitivity is based on the land use at each viewpoint. The Environmental Guidelines (HK Govt., 1990) define sensitive users as "land uses which, by virtue of the nature of the activities thereon...., are susceptible to the influence of residual or physical changes generated by polluting uses". Visual impacts will not however, result in physical changes to the users in the area, as would damage to health from the effects of air pollution. Visual impact is therefore assessed in terms of the impacts on the "quality of life" of the users at the key view points.

Quality of life, like visual impact is a subjective term. For the purpose of this study, it is generally assumed that :

- Residential viewpoints are considered highly sensitive as the users (the residents) will be particularly aware of any visual changes. Residents are likely to care about the views from their homes as this is where they are likely to spend their leisure time. Visual impacts will have the most significant effect on the overall quality of life from a residential area. In addition, residents are likely to have a financial interest in the property (either ownership or rental) and a change in the visual quality of views or the surroundings could have significant financial implications due to changes in property values.

- Views from commercial developments, schools and public open spaces are considered moderately sensitive. In the case of schools and offices, while users may be at these viewpoints regularly, they are primarily there for another reason i.e. for study or work. In the case of open spaces, these are likely to be visited for shorter periods of time and there will be an element of control or choice in their use. A change in the view from these land uses will have a less significant effect on the overall quality of life of the user.

- View points from industrial areas and transport corridors are considered to have low sensitivity. In industrial areas, users expectations of visual quality are low and the users are there primarily for another reason i.e. to work. Users of transport corridors are subject to changes in a view for a relatively short period of time. A change in the view will therefore have an insignificant effect on the overall quality of life from such view points.

As stated, the "sensitivity" of each viewpoint is based on the land use at each location. In addition to this general classification of sensitivity, also of importance are :

- the distance between the viewpoint and the new development
- the number of people at each of the viewpoints
- the number of times people will look at the view while at this viewpoint
- what the viewer will be doing at the time (for example, morning exercises)
- light, air and general weather conditions will affect the view (hazy conditions, which prevail in Hong Kong during the summer months, reduce contrasts within the visual environment)
- the size of the development in relation to the overall view (the impact will be less significant if part of a wide or panoramic view)
- the overall quality of the existing view; this will be influenced by the extent and type of existing man-made development.

Having established the sensitivity of the viewpoints to the new development (a factual exercise), the overall visual impact can be assessed. This is based on objective professional experience, with consideration of the following:

- Visual obstruction; the extent to which the development will block a view.
- Visual intrusion; the incompatibility of the development within the existing view. This is created by the introduction of contrasting and incongruous forms, textures and colours.
- Visual quality; a judgment of the effect of the development on the existing visual quality of the area.

4.6.2 Background Information

Chapter 2 of this report gives a general description of the study area. This section will examine the existing visual context and identify key viewpoints to the Tsung Pak Long Flood Protection Scheme.

Existing Visual Context

The study area encompasses the two settlements of Tsung Pak Long and Tai Tau Leng. The villages are set within low lying agricultural land that provides an open green setting, contrasting with the tight streets and limited view corridors between the buildings.

The existing bed of the River Sutlej is open and overgrown. Combined with the agricultural land, this creates a belt of green that acts as a visual break between the villages of Tsung Pak Long, Tai Tau Leng, and the embankment of Man Kam To Road,

along which are situated the Sheung Shui temporary housing area and two new high rise office developments.

Views from the village settlements across the agricultural land are restricted to the west by higher land that is densely vegetated.

The land to the south of both villages is of a lower visual quality, comprising roads, factories and scrap yards. Here views are limited by dense vegetation.

To the south the project area crosses Castle Peak Road and includes the Fanling golf course.

4.6.3 Identification of Key Viewpoints

Key viewpoints to the project area are identified and their sensitivity assessed. These are described below and are located on the plan. (Figure 4.8)

- Tsung Pak Long Village is situated on low lying agricultural land that is bordered on two sides by the Sutlej River and its western tributary. In plan the village would appear to have open views over the project area on its western and northern sides, however only 30% of the buildings located along these village edges are residential and classed as highly sensitive receivers. The other buildings along these edges are public, community buildings: schools, temple buildings and the Tse Tong (village ancestral building). The sports courts and car park situated along the western and northern edges of Tsung Pak Long create an intermediate zone that interrupts the views over the agricultural lowlands. The tight street network prevents any views outwards from within the residential core of the village. Villagers use the paths crossing the agricultural land and along the Sutlej River as their main pedestrian access routes.

- Tai Tau Leng Village is situated at the eastern most end of the project area. The village has high quality views over agricultural lowland to the west. To the north, views are dominated by the embankment of Man Kam To Road and its new office developments. The fence surrounding the football field located on the northern edge of the village acts as a partial visual buffer. The surroundings of Tai Tau Leng will generally remain unchanged.

- Several residences and squatter houses are located on the higher ground along the western watercourse. From these sensitive viewpoints there are long views over most of the project area. These views will in places be partially screened by the dense vegetation.

- The two high rise office developments situated on Man Kam To Road are nearing completion. These developments are situated on the fringe of Sheung Shui's Business District and consequently should be of a reasonably high property value. As these buildings are situated on higher ground they have uninterrupted views over the project area. Although places of work are not considered as highly sensitive receivers, consideration must be given to the effects of any development on property value.

- The Sheung Shui Temporary Housing area bordering the project area, is programmed for clearance beginning in the financial year 1995/96. As construction of the Tsung Pak Long Flood Protection Scheme is planned to begin in early 1996, the temporary housing area is not considered to be a sensitive receiver in the long term.

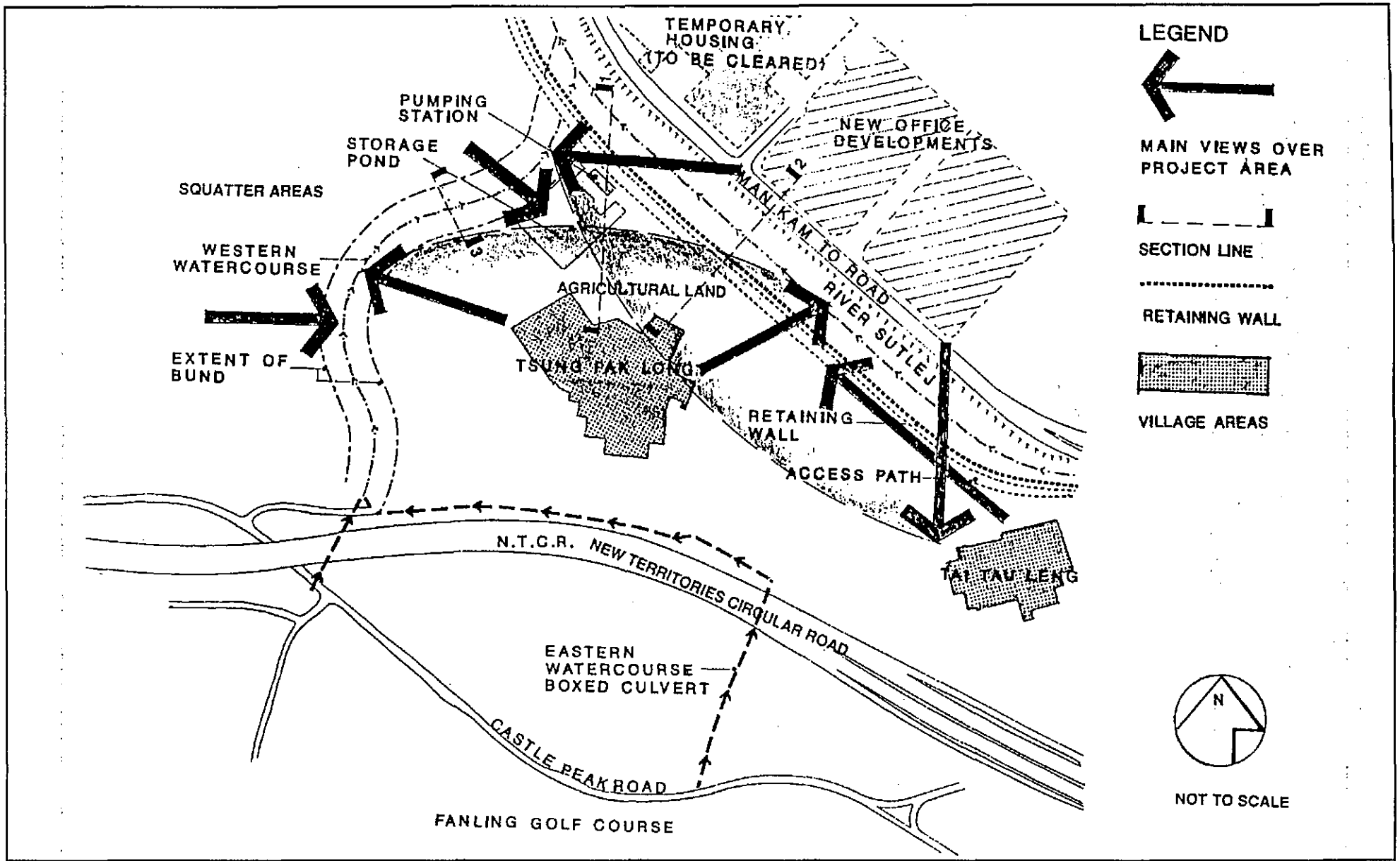

Figure 4.8 Plan Showing Main Views Over Project Area

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4.6.4 Visual Characteristics of the Project

The main visual impacts related to this project will result from the containment of the River Sutlej within a retaining wall approximately 3 to 4 metres in height. An access path and verge will be provided on the south side of the wall. The western watercourse joining the Sutlej River will be contained within bunds again up to 3 to 4 metres high. The eastern watercourse will be contained within bunds between Castle Peak Road and the NTCR from which point it will join the existing boxed culvert below the NTCR. From there flows will be through the new box culvert below the Tsung Pak Long access road until they discharge to the western watercourse.

A pumping station will also be required. This will be situated next to the River Sutlej on the area of low lying agricultural land. The pumping station will be built 4 meters above the surrounding agricultural land and the building will be 5 meters high and 25 meters long. A storage pond will be built in association with the building, this will take up most of the adjacent agricultural land.

A new pedestrian footbridge will be provided across the Sutlej River.

4.6.5 Impact of Construction Activities

The anticipated construction period of the flood protection scheme is 2.5 years. During this time the following visual impacts are anticipated :

- The works area located to the north of Tsung Pak Long will turn the agricultural land bordering the sensitive receivers of Tsung Pak Long and the residences to the west, into a construction site; significantly altering the visual character of this area.
- Removal of existing vegetation as well as disruption of existing roads to allow for excavation associated with the provision of the box culvert for diversion of the eastern watercourse, will heighten the visibility of the project area from viewpoints at present screened by vegetation.
- Excavation and construction of the retaining wall along the Sutlej River and the pedestrian footbridge will disrupt the river bed area affecting all the identified sensitive receivers.
- Construction of the pumping station will be highly visible due to the height of the building in relation to the surrounding.
- Storage of excavated materials and construction materials for all of the above.
- Traffic activity generated by construction vehicles will turn a small scale agricultural landscape into a construction site.

4.6.6 Impact Following Completion

The most imposing element associated with the Tsung Pak Long Flood Protection Scheme will be the pumping station. The maximum height of the pumping station will be 9 meters above the surrounding low lying land and will be highly visible to the sensitive receivers of Tsung Pak Long, Tai Tau Leng, the squatter residences to the west and the office blocks.

The River Sutlej will be contained on the Tsung Pak Long side, by a retaining wall whose maximum height will be approximately 4 metres. Located adjacent low lying land, this will be a highly visible element. The detailed design of the wall and choice of materials used will be important. The visual impact of the wall will be greatest from the offices on Man Kam To Road as they have an open view of the whole wall from above. From Tsung Pak Long the retaining wall will be viewed against the backdrop of the steep bank on the northern side of the Sutlej River and the office buildings, making its impact less significant. Although the wall interrupts the existing open views across the river bed, it will be a built element that would strengthen the visual boundary of the village and assist in screening the high rise office development. Viewed from Tai Tau Leng, the retaining wall would blend into the existing built environment bordering the village to the north. From the higher ground to the west, the wall will be viewed within a longer vista across the low lying land. The perceived visual impact of the wall from this viewpoint will therefore be reduced. The greatest impact on this viewpoint will be created by the removal of the agricultural land in the foreground.

A pedestrian footbridge will be constructed to replace the small existing bridge. This will be a concrete structure with stepped and ramped access at both ends.

The western watercourse will be contained within bunds. For most of the year the water level will be low, leaving the inside walls of the watercourse exposed. The design of the watercourse lining will therefore require careful consideration. This part of the flood protection works will be most visible from Tsung Pak Long however the buildings along the western side of the village overlooking this watercourse are public buildings, not classed as being highly sensitive. The sensitive receivers situated to the west of this watercourse will not be significantly affected by the proposed works as the higher land in this area allows uninterrupted views out over the top of the new water channel.

The eastern watercourse will be contained within bunds between Castle Peak Road and the NTCR from which point it will be housed within a boxed culvert below ground level. Following the completion of works on this watercourse the main visual impact will result from the clearance of the existing vegetation in the affected area and the addition of the bunds into the landscape.

From the New Territories Circular Road (NTCR) views over the project area are generally screened by dense tree planting. The scale of the proposed structures would be insignificant from this distance when taken in the context of the overall view from the road, especially when experienced at high speed.

4.7 Community Issues

The village areas of Tsung Pak Long and Tai Tau Leng are served by an access road off Castle Peak Road and, in addition, are connected by footpaths to the Man Kam To road and Sheung Shui. Tsung Pak Long has several amenities including a school.

There will be some disruption to the vehicular access due to construction of the culvert along the access road, but an alignment has been selected which will make it possible to maintain a one-way flow at all times. Properties and a grave site which would have been affected by a previous planned route for the culvert are no longer affected due to re-alignment of the route.

Similarly, footpath connections will be temporarily severed during construction of embankments. Along the southern edge of the Sutlej River, access to the Man Kam To road and to areas west of Tsung Pak Long will be disrupted. It should be possible, however, to maintain alternative access at all times. Although less desirable, residents could alternatively use the road access. The farms and residences on the western bank of the western tributary also have a footpath connection with Tsung Pak Long which will be disrupted during construction. It should be possible to maintain an alternative access at all times.

The access arrangements following construction will be unaltered along the vehicular access road to the villages. All footpaths and river crossings will be reinstated and reprovisioned where necessary. Access will therefore not be affected by the scheme and no community severance will result.

The playing field and amenity area at Tai Tau Leng and at Tsung Pak Long will remain unaffected except for a minor adjustment of the fence line at Tai Tau Leng.

5 RECOMMENDEDMITIGATION MEASURES

5 RECOMMENDED MITIGATION MEASURES

5.1 Ecology

The construction stage of the Tsung Pak Long Flood Protection Scheme would cause ecological impacts. It is recommended, therefore, that the following measures are carried out in order to help mitigate these impacts:

- retention of existing habitats of nature conservation importance for example some of the woodland, individual trees and the vegetation associated with the stream courses wherever possible. This may require minor alterations to the works area or layout when it is determined on site.

- avoidance of construction works on the culvert in the sensitive area when the butterfly larvae are feeding (during and after adult flight times) as the biggest problem is dust covering the foliage and flowers. The preferred time of year to avoid any works in the vicinity of the butterfly habitat at Tsung Pak Long is March to November. The critical time to avoid during this period is June - September. Thus the desired months to carry out the work on the culvert in this area are therefore December, January or February. As there is only a small area involved, it is the dry season and it involves only the construction of a box culvert, this is not considered to be an unreasonable request for any Contractor to comply with.

- the use of native species local to the area for replanting; it is important to choose species that are likely to establish successfully. A proposed planting list of species of value to wildlife which could be considered for replanting in this scheme is given in Annex 5.

  Particular emphasis has been placed on species native to the area or species that are of particular value as larval food plants or adult food for butterflies.

  Areas that could be considered for replanting include both the bunds and banks of the western watercourse, the areas around the storage pond and the verge adjacent to the River Sutlej.

- avoiding the use of fertilisers, herbicides and pesticides in the future management of the flood control embankments. The recommendation is to encourage natural habitats to form on the restored works areas and embankments to provide additional wildlife habitat.

The provision of off-site conservation measures, such as habitat creation of wetlands to compensate for the areas lost, was considered but it is understood that the restrictive land allocation does not allow for this to be pursued. Also, improving the nature conservation value of the storage pond as a means of compensating for wetland loss was suggested in the Amphibian and Reptile Report (Annex 1). However, it is understood not to be possible to grow vegetation on the bottom and banks of the pond or to create a small depression to retain water in the base of the storage pond because of engineering requirements, safety problems and mosquito nuisances.

With the use of native species for planting, sensitive treatment of adjacent water features such as the ponds and watercourses, the general retention of some of the existing habitats and sensitive treatment of the animal species requirements, it is considered that the construction impacts of the proposed scheme could be reduced.

Contractors methods of working and requirements should be designed specifically to reduce disturbance to wildlife and damage to existing habitats. For example, contract documents should ensure that the *Cinnamomum camphora* tree (close to the proposed new culvert and overhanging the road) trunk, roots and branches are protected during the construction period. As the clearance between the road and the branch is only about 4 metres, this may mean that in this vicinity, the contractor would probably have to utilise smaller machinery in order to ensure the protection of this tree.

5.2 Water Quality

The anticipated water quality construction impacts should be readily mitigated by carrying out work in the dry season, temporarily diverting residual stream flows around the active excavation area and minimising the exposed area of bare soil. Therefore, the following requirements must be adhered to and added to the contract specification:

(a) excavation of the channel is only allowed in dry conditions, and
(b) excavation of contaminated material must be removed from the site within one dry season and before the main excavation commences.

In addition, it is recommended that a performance related approach (outlined in Section 4.2.1) is taken. To ensure that the performance standard adequately reflects the existing situation, a background survey of the current water quality in the watercourses has been carried out. Survey locations were just downstream of the culvert under the NTCR and just upstream of the junction with the Sutlej. Survey parameters were dissolved oxygen, temperature, turbidity and suspended solids. The results were reported and assessed in a Key Issue Report (CES, 1995b). In addition, a pre-construction baseline study is also recommended, although given the variability inherent in such a small stream the limitations of the data should be recognised.

If fuel is stored on site, a bunded area should be provided and oil separation facilities installed for the drainage water. This should be specified in the contract. Appropriate toilet facilities need to be provided for construction workers to comply with the standards given in the Technical Memorandum on Effluent Standards. If a canteen is to be placed on-site, a suitable effluent treatment system will be needed. These aspects will need to be specified in the contract.

Finally, disposal of excavated mud could cause environmental impacts such as deterioration of water quality or other parameters. A survey of three points evenly spaced along the western watercourse was carried out and reported in detail in a Key Issue report (CES, 1995b). The upper layers of the stream bed were found to be contaminated as a result of discharge of livestock waste. As sediment is contaminated it should be left in-situ where not affected by construction works. However, for contaminated material which has to be excavated, approval has been given by EPD to dispose of it to an approved landfill site providing the moisture content does not exceed

70% by weight. Where the moisture content is exceeded the material will need to be stored and dried off-site at facilities with suitable leachate control mechanisms. A suitable area has been identified at Sha Ling borrow area where the facilities used for Contract TPF 30/86 are still in place. This includes leachate pipes connected to a leachate storage tank with road access for emptying and a lined storage area with surrounding containing bunds. Following careful removal of the existing material within the bunds to landfill, the facilities can be used for storing and drying the contaminated material arising from the works. Figure 5.1 gives details of the facility.

To check on the effectiveness of mitigation measures, it is recommended that monitoring and audit is carried out. Daily monitoring during construction using a turbidity meter (HACH 2100P or similar) upstream and downstream of the works should be sufficient. Monitoring at two locations should also allow some of the natural variability of the stream to be accounted for. As the turbidity of the western watercourse is usually very high (see Table 2.2) the potential impacts on this watercourse and downstream are expected to be minimal.

In addition to specifying mitigation measures in the contract, it is suggested that the contractor should be required to meet a water quality performance standard. Results from the monitoring could be compared to Trigger, Action and Target (TAT) levels derived from baseline readings taken daily for four weeks prior to construction commencing. It is recommended that the Target level be set at the 95%ile of the baseline monitoring and 30% greater than the upstream control value, and the Trigger level at the 95%ile and 10% greater than upstream. The Action level could be set mid-way between the Trigger and Target values. The formal definitions of the TAT levels are given in Annex 3.

Such a performance standard in terms of turbidity levels could indicate incidence of water quality deterioration and at the same time avoiding false alarm as the natural variation of the system has been taken into account. It is the responsibility of the site staff acting for the client (the Engineer) to enforce the contract and warn the contractor of the need to meet the standard by provision of appropriate mitigation measures.

5.3 Noise

The most effective mitigation measure is to control noise at its source. In the case of powered mechanical equipment, this involves either selecting silenced equipment, or reducing the transmission of noise using mufflers, silencers, or acoustic enclosures.

5.3.1 General Construction Noise Reduction Measures

(a) Noisy equipment and activities should be sited by the Contractor as far from sensitive receivers as is practical.

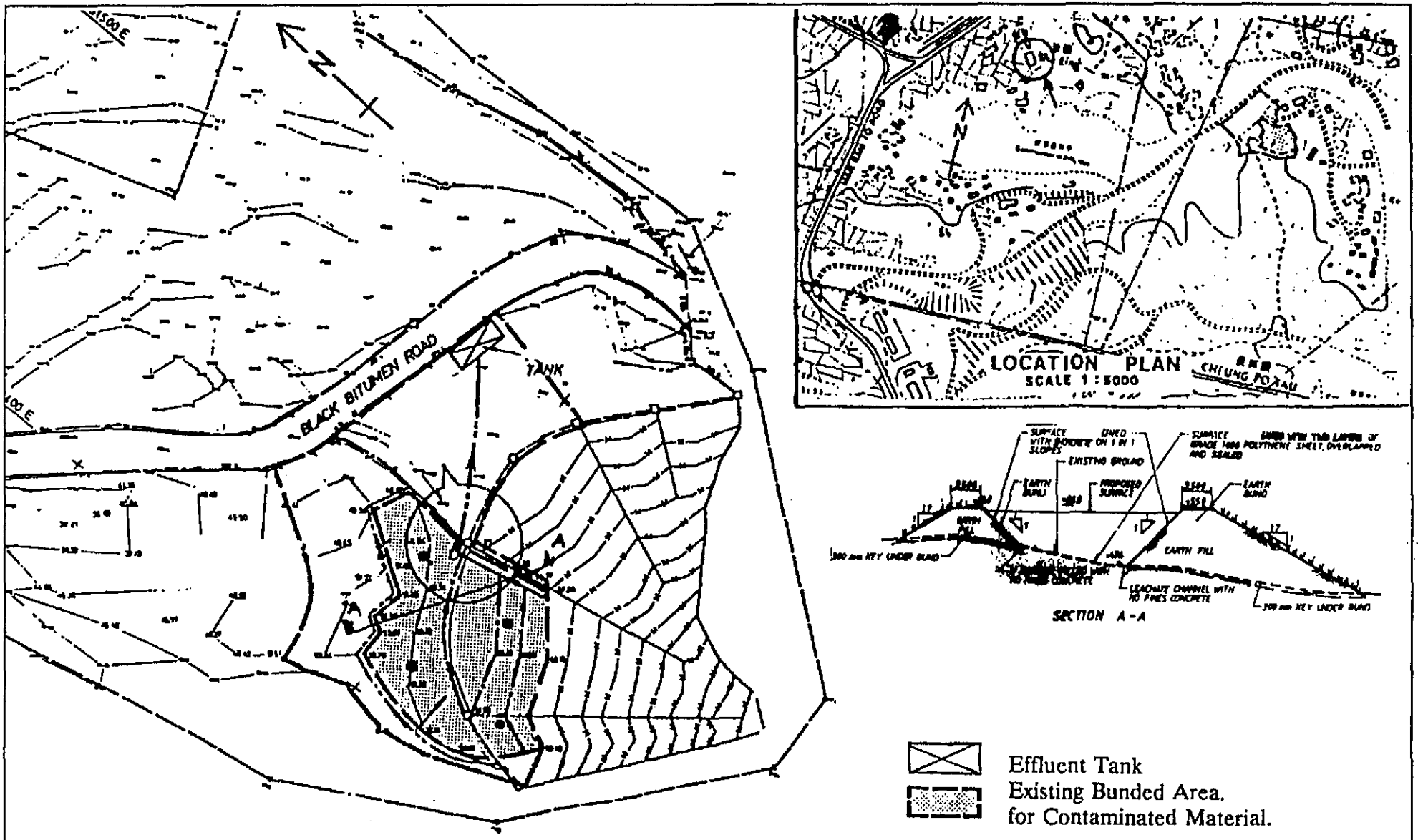

Figure 5.1 Existing Facilities at Sha Ling Borrow Area for Drying Contaminated Material

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(b) Noisy plant or processes should be replaced by quieter alternatives where possible. For example, pneumatic concrete breakers can be silenced with mufflers and bit dampers, or can be replaced with electric hydraulic breakers. If appropriate, a concrete cruncher (hydraulically-powered jaws) may be used; the cruncher emits a sound power level about 20 dB(A) lower than that of an electric breaker. Silenced diesel and gasoline generators and power units, as well as silenced and super-silenced air compressors, can be readily obtained. Manual operations are generally quietest, but may require long periods of time.

(c) Noisy activities can be scheduled to minimise exposure of nearby NSRs to high levels of construction noise. For example, noisy activities can be scheduled for midday, or at times coinciding with periods of high background noise (such as during peak traffic hours). As far as possible, noisy operations during teaching hours should be avoided near the schools at Tsung Pak Long. Prolonged operation of noisy equipment close to dwellings should be avoided.

(d) Idle equipment should be turned off or throttled down. Noisy equipment should be properly maintained and used no more often than is necessary.

(e) The power units of non-electric stationary plant and earth-moving plant can be quietened by vibration isolation and partial or full acoustic enclosures for individual noise-generating components.

(f) Construction activities can be planned so that parallel operation of several sets of equipment close to a given receiver is avoided.

(g) If possible, reduce the numbers of operating items of powered mechanical equipment.

(i) Construction plant should be properly maintained and operated. Construction equipment often has silencing measures built in or added on, e.g., bulldozer silencers, compressor panels, and mufflers. Silencing measures should be properly maintained and utilised.

(j) Limited hours of use for powered mechanical equipment are recommended; a ten-hour period from 8.00 a.m. to 6.00 p.m. is suggested. Hours of use could be further restricted by the Resident Engineer if sufficient and justifiable complaints from affected villagers are received.

While it is not feasible to dictate the methods of construction to be employed by the contractor, noise control requirements can be incorporated in the tender/contract documents, specifying the noise standards to be met and requirements for noise monitoring on the site.

5.3.2 Use of Temporary Noise Barriers during Construction

Temporary noise barriers or earth embankment may be used to screen specific receivers. Free-standing acoustic panels can be positioned to screen sensitive facades. The panels should be absorptive, having a noise reduction capability of up to 10 dB(A). Barrier

material should have a mass per unit surface area in excess of 7 kg m^{-2}; alternatively, sandbags may be used to form a temporary screen. It should be noted that some sound will pass around the ends of a short barrier. In order to minimise this occurrence, the length of the barrier should be about five times its height, or the barrier should be curved around the noise source. The minimum height of the barrier should be such that no part of the noise source is visible from the NSR.

In siting the barrier, care should be taken to avoid reflecting noise to NSR positions behind the barrier. The barrier should be as close as possible to the noise source, and there should be no gaps or openings in it.

5.3.3 Evaluation of Effectiveness of Noise Reduction Measures

Evaluation of the exact effectiveness of these measures at a given receiver requires a knowledge of the planned construction schedule, which is not available at this stage. Estimates of the noise reductions capable are provided below:

Stationary and Earth-moving Plant: These pieces of equipment include concrete pumps, excavators, bulldozers, and dump trucks. Noise reduction can be achieved through proper maintenance of the exhaust system, and through exhaust silencers. Additionally, engine noise is amenable to reduction through isolation of vibrating engine components, installation of partial or full acoustic enclosures of noise-generating components, and damping of vibrating panels. U.S. tests have shown that partial or full enclosures can achieve noise reductions of 10 and 25 dB(A) respectively; in the following assessments for mitigated noise levels, a reduction of 10 dB(A) for concrete pumps, excavators, bulldozers, and dump trucks has been assumed.

Barrier: A purpose-built mobile noise barrier, located close to the noise source, can be fabricated to protect sensitive receivers. Effective barriers are typically lined on the noise-generating side with a noise-absorbing material. Assuming that the barrier has no gaps, and that it blocks the line of sight between noise generator and noise receiver, reductions of 5 to 10 dB(A) can be achieved. In the following assessments for mitigated noise levels, the use of barriers capable of reducing noise by 5 dB(A) has been assumed where the use of quietened equipment alone is not sufficient to bring construction noise levels below 75 dB(A).

Assuming these measures are incorporated, the construction noise levels can be reduced, as discussed in the following paragraphs.

5.3.4 Construction of Sutlej River Retaining Wall

Table 5.1 Mitigated Facade Noise Levels due to Construction: Sutlej River Retaining Wall (Quiet Equipment)

NSR ID	Location	Maximum Facade Noise Level[1] (dB(A)) due to: Construction of Retaining Wall
NSR-5	West Tsung Pak Long	72
NSR-8b	East Tsung Pak Long	71
NSR-9	Sheung Shui THA	71
NSR-10	Tai Tau Leng	74

NOTE: 1. Assumes the use of quietened equipment.

The use of quietened stationary and mobile equipment reduces facade noise levels at the nearest NSRs in Tsung Pak Long and Tau Tai Leng sufficiently to bring them beneath 75 dB(A) at all exposed receivers. Thus, the need for additional noise-reducing measures during embankment construction is not expected to be necessary.

5.3.5 Construction of Western Watercourse

Table 5.2 Mitigated Facade Noise Levels due to Construction: Western Watercourse (Quiet Equipment)

NSR ID	Location	Facade Noise Level[1] (dB(A)) due to:	
		Excavation and Compaction of Existing Stream Bed	Concrete Operations
NSR-2	West Tsung Pak Long	70	76
NSR-3	West Tsung Pak Long	77	84
NSR-4	West Tsung Pak Long	73	80
NSR-5	West Tsung Pak Long	83	90

NOTE: 1. Assumes the use of quietened equipment.

Due to the very close proximity of these representative NSRs to the western watercourse, and the predominance of non-quietened items of PME, the use of quietened PME is not sufficient to bring facade noise levels within acceptable limits at all nearby facades. Additional measures will be necessary.

Programming of construction so that the concurrent use of two vibratory pokers is not necessary will bring facade noise levels at NSR-2 during concreting to 75 dB(A). Sensitive scheduling of excavation works, in combination with the use of quietened equipment, is expected to be sufficient to reduce noise levels at closer NSRs such as NSR-3 to below 75 dB(A) as well. For example, use of a quietened bulldozer alone would result in a facade noise level at NSR-3 of 69 dB(A); concurrent use of the remaining assumed excavation/compaction equipment results in a facade noise level of 75 dB(A).

At the very close receivers such as NSRs 3 and 5 (respectively 25 m and 13 m from the notional source positions), no practical mitigation measures are capable of reducing concreting noise to below 75 dB(A). It is recommended that all practicable measures be implemented, including use of quiet equipment, sensitive scheduling of activities, and use of temporary noise barriers to reduce noise levels as far as possible. The duration of the construction activity at such close proximity is not expected to be long. Concurrent use of barriers and quiet equipment could result in the following noise levels:

Table 5.3 Mitigated Facade Noise Levels due to Construction: Western Watercourse (Quiet Equipment and Barriers)

NSR ID	Location	Facade Noise Level[1] (dB(A)) due to:	
		Excavation and Compaction of Existing Stream Bed	Concrete Operations
NSR-2	West Tsung Pak Long	65	71
NSR-3	West Tsung Pak Long	72	79
NSR-4	West Tsung Pak Long	68	75
NSR-5	West Tsung Pak Long	78	85

NOTE: 1. Assumes the concurrent use of quietened equipment and temporary noise barriers.

5.3.6 Excavation of Culvert under Tsung Pak Long Access Road

Table 5.4 **Mitigated Facade Noise Levels due to Construction: Excavation of Culvert under Tsung Pak Long Access Road (Quietened Equipment)**

NSR ID	Location	Facade Noise Level[1] (dB(A)) due to:		
		Excavation of Culvert	Concrete Operations	Reinstatement of Surface
NSR-1	West Tsung Pak Long	88	92	87
NSR-12	South Tsung Pak Long	82	86	81
NSR-13	South Tsung Pak Long	69	74	72

NOTE: 1. Assumes the use of quietened equipment.

Due to the very close proximity of these representative NSRs to the culvert's alignment, the use of quietened PME is not sufficient to bring facade noise levels within acceptable limits at all nearby facades. Additional measures will be necessary.

Sensitive programming of reinstatement works, in combination with the use of quietened equipment, is expected to be sufficient to reduce noise levels to below 75 dB(A). For example, operation of a quietened excavator alone would result in facade noise levels of about 75 dB(A) at NSR-1 and 69 dB(A) at NSR-12. By introducing temporary barriers, further reductions are possible; for example, the use of quiet concrete breakers separately from the rest of the assumed excavation equipment results in a facade noise level at NSR-12 of 72 dB(A).

At the very close receivers such as NSR 1 (9 m from the notional source position), no practical mitigation measures are capable of reducing the noise from concrete breakers and concrete vibrators to below 75 dB(A). It is recommended that all practicable measures be implemented, including use of quiet equipment, sensitive scheduling of activities, and use of temporary noise barriers to reduce noise levels as far as possible. The duration of the construction activity at such close proximity is not expected to be long. Concurrent use of barriers and all assumed quiet equipment could result in the following noise levels:

Table 5.5 Mitigated Facade Noise Levels due to Construction: Excavation of Culvert under Tsung Pak Long Access Road (Quietened Equipment and Barriers)

NSR ID	Location	Facade Noise Level[1] (dB(A)) due to:		
		Excavation of Culvert	Concrete Operations	Reinstatement of Surface
NSR-1	West Tsung Pak Long	83	88	82

NOTE: 1. Assumes the concurrent use of quietened equipment and temporary noise barriers.

5.3.7 Eastern Watercourse

Table 5.6 Mitigated Facade Noise Levels due to Construction: Eastern Watercourse (Quiet Equipment)

NSR ID	Location	Facade Noise Level[1] (dB(A)) due to:	
		Excavation and Compaction of Existing Stream Bed	Concrete Operations
NSR-14	Cottage Area	87	95
NSR-15	Cottage Area	78	87

NOTE: 1. Assumes the use of quietened equipment.

Due to the very close proximity of these representative NSRs to the eastern waterway, the use of quietened PME is not sufficient to bring facade noise levels within acceptable limits at all nearby facades. Additional measures will be necessary.

Sensitive scheduling of excavation works, in combination with the use of quietened equipment, is expected to be sufficient to reduce noise levels at all but the closest NSRs to below 75 dB(A). For example, the use of a quietened excavator alone results in a facade noise level of 69 dB(A) at NSR-15, and 77 dB(A) at NSR-16.

At very close receivers such as NSR 14 and 15 (respectively 7 m and 18 m from the notional source positions), no practical mitigation measures are capable of reducing the noise from concrete vibrators to below 75 dB(A). It is recommended that all practicable measures be implemented, including use of quiet equipment, sensitive scheduling of activities, and use of temporary noise barriers to reduce noise levels as far as possible. The duration of the construction activity at such close proximity is not expected to be long.

5.3.8 Pumping Station and Storage Pond

Table 5.7 Mitigated Facade Noise Levels due to Construction: Pumping Station and Storage Pond

NSR ID	Location	Facade Noise Level[1] (dB(A)) due to Pond Excavation and Formation of Embankments
NSR-6	Tsung Pak Long	70

NOTE: 1. Assumes the use of quietened equipment.

Noise at the school can be reduced to acceptable levels with the use of quiet equipment. However, liaison with the school authorities should still be pursued to ensure that construction noise is reduced as far as possible during examination periods.

5.3.9 Culvert under Castle Peak Road

Table 5.8 Mitigated Facade Noise Levels due to Construction: Excavation of Culvert under Castle Peak Road (Quiet Equipment)

NSR ID	Location	Facade Noise Level[1] (dB(A)) due to:		
		Excavation of Culvert	Concrete Operations	Reinstatement of Surface
NSR-14	Cottage Area	74	79	73
NSR-15	Cottage Area	87	92	86

NOTE: 1. Assumes the use of quietened equipment.

Due to the very close proximity of these representative NSRs to Castle Peak Road, the use of quietened PME is not sufficient to bring facade noise levels within acceptable limits at all nearby facades. Additional measures will be necessary.

The use of temporary noise barriers to screen sensitive facades from items of PME can further reduce noise to the levels shown below:

Table 5.9 Mitigated Facade Noise Levels due to Construction: Excavation of Culvert under Castle Peak Road (Quiet Equipment and Barriers)

NSR ID	Location	Facade Noise Level[1] (dB(A)) due to:		
		Excavation of Culvert	Concrete Operations	Reinstatement of Surface
NSR-14	Cottage Area	69	74	68
NSR-15	Cottage Area	82	87	81

NOTE: 1. Assumes the concurrent use of quietened equipment and temporary noise barriers.

It would be possible to further reduce the noise at NSR-15 from surface reinstatement to 74 dB(A) by sensitive scheduling of construction to ensure that the excavator/loader does not operate concurrently with other items of PME. However, at very close receivers such as NSR 15 (10 m from the notional source position), no practical mitigation measures are capable of reducing the noise from concrete breakers and concrete vibrators to below 75 dB(A). It is recommended that all practicable measures be implemented, including use of quiet equipment, sensitive scheduling of activities, and use of temporary noise barriers to reduce noise levels as far as possible. The duration of the construction activity at such close proximity is not expected to be long.

5.3.10 Construction of Footbridge Deck

Temporary screening of the crane would be sufficient to reduce the marginal exceedance during erection of formwork to 75 dB(A). This could be accomplished by placing the crane in the river bed so that the river bank forms a shield between the crane and the THA. During concreting, greater exceedance of the daytime criterion is expected, calling for greater mitigation measures. If equipment numbers were reduced to one each of mixer trucks, pump, and pokers, and if temporary barriers were used to shield the noise from the mixer truck and pump, then facade noise levels at the nearest THA facade would be reduced to about 77 dB(A). As the works progressed southward across the bridge, this noise level would be reduced to 75 dB(A) when the poker was at a distance of about 40 m from the nearest THA facade.

5.3.11 Measures other than Noise Reduction (Liaison and Good Community Relations)

The establishment of good community relations can be of great assistance to both the contractors and affected receivers. Residents of Tsung Pak Long and Tai Tau Leng, particularly those located very near the planned works, should be notified in advance of planned operations, and informed of progress. If necessary, a liaison body can be established to bring together representatives of the affected communities, the government, and the contractors. In addition, residents may be provided with a telephone number for the Resident Engineer's office, where they may register complaints concerning excessive noise. If justified, the Resident Engineer may authorise noisy operations to cease or to be conducted at more restricted hours.

5.4 Air

Computer modelling shows that the embankment construction and filling activities are likely to cause elevated dust levels at the closest sensitive receivers and mitigation should therefore be adopted by the contractor to minimise dust generation.

A commitment by the contractor to adopt good operational practices for dust minimisation should reduce the dust nuisance to a minimum. A number of practical measures are listed below:

- Use of regular watering to reduce dust emissions from exposed site surfaces and unpaved roads, at least twice daily with complete coverage, particularly during dry weather.
- Use of frequent watering for particularly dusty static construction areas and areas close to sensitive receivers 3 and 5 where construction operations are taking place.
- Side enclosure and covering of any aggregate or dusty material storage piles to reduce emissions. Where this is not practicable owing to frequent usage, watering should be employed to aggregate fines.
- Open stockpiles should be avoided or covered. Where possible, prevent placing dusty material storage piles near sensitive receivers 3 and 5.
- Provision of barriers, which may be the temporary noise barrier, between the site and nearby sensitive receivers to act as dust barriers.
- Tarpaulin covering of all dusty vehicle loads transported to, from and between site locations.
- Establishment and use of vehicle wheel and body washing facilities at the exit points of the site, combined with cleaning of public roads where necessary.
- Provision of wind shield and dust extractor at the loading points and use of water sprinklers at the loading area.
- Imposition of speed controls for vehicles on unpaved site roads. 15 km hr^{-1} is the recommended limit.
- Where feasible, routing of vehicles and positioning of construction plant at maximum possible separation distance from sensitive receivers especially sensitive receivers 3 and 5.
- Instigation of a control program to monitor the construction process in order to enforce controls and modify methods of work if dusty conditions arise.

By implementing dust suppression measures given above and adopting more frequent watering of dusty site surfaces, in particular those close to receivers 3 and 5, during low wind speed conditions, dust impact at the sensitive receivers can be further reduced.

5.5 Historical and Cultural Heritage

Contractors must be given prior notice of the location and extent of all grave sites and listed structures (the walled village) so that works do not encroach on these areas. As the scale of the works is small, no other mitigation measures will be necessary.

5.6 Visual Impacts and Landscaping

The construction stage of the Tsung Pak Long Flood Protection Scheme will cause significant visual impacts to the sensitive receivers identified within the project area. It is recommended that careful landscape treatment is carried out in order to mitigate these impacts.

5.6.1 Temporary Mitigation Measures (Construction Phase)

- Construction working areas should be limited to the minimum practicable size.
- Working areas adjacent to sensitive receivers should be enclosed with hoardings to screen construction activities.
- Heights of storage materials and stock piles should be maintained at low levels.
- Night-time working and lighting should be minimised.
- Alignment of the works so that where possible existing trees can be retained.
- Planting to screen the permanent works should be undertaken during the construction stage to assist in mitigating construction impacts.

5.6.2 Permanent Mitigation Measures

- Careful attention should be paid to the design of the pumping station, including its height and the materials used. The form of the building should reflect the small unit size of the rural style buildings. Light coloured materials should be used so that the building is less obtrusive when viewed against the skyline.
- The footbridge across the River Sutlej should be finished in light coloured materials to reduce its impact when viewed against the sky. Lighting of the bridge should be concealed within the structure. The structure itself should not be flood lit.
- Screen planting should be carried out between Tsung Pak Long and the storage pond to screen the pumping station as effectively as possible (Figure 5.2).
- The retaining wall along the River Sutlej should be granite faced on both sides to improve its appearance from all sensitive viewpoints. Granite is a natural material and more appropriate in a rural setting. It is also less visually intrusive than concrete and tends to be less reflective.

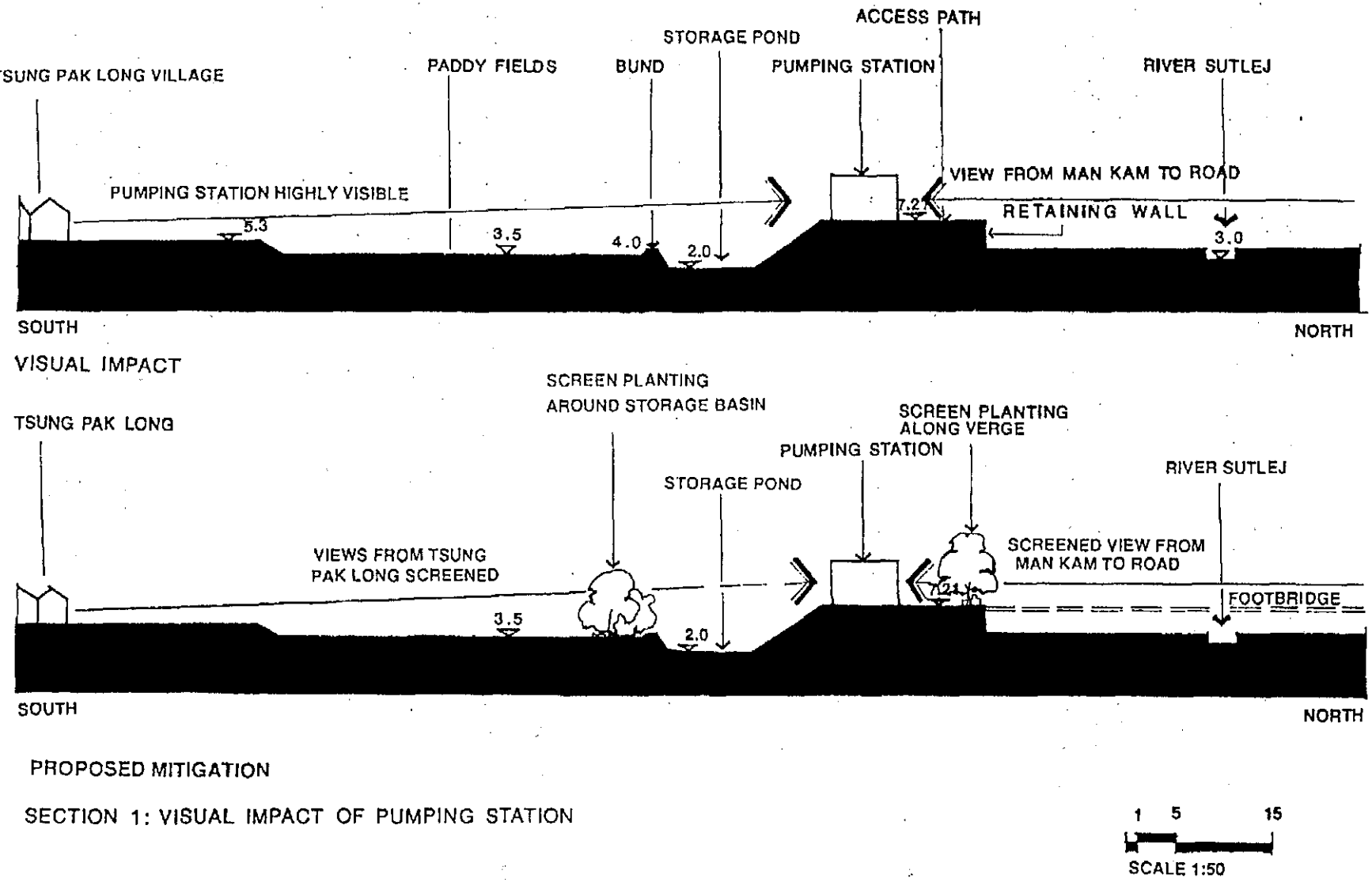

Figure 5.2 Section 1: Visual Impact of Pumping Station and Proposed Mitigation

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- Trees, shrubs and climbers should be planted within the verge along the Sutlej River retaining wall. This will help to screen the wall while also creating an attractive visual boundary to the Tsung Pak Long and Tai Tau Leng Village areas (Figure 5.3).

- Tree planting and shrub planting should be carried out in the 2 metre flat zone at the top of the embankment to the north of the Sutlej River. This should help to screen the project area from Man Kam To Road and the new office developments along it (Figure 5.3).

- It is an engineering requirement that the bottom and lower walls of the inside of the water channel for the western watercourse be concrete lined. It is proposed that the top section of the inside of the water channel should have a grass-crete finish to achieve a green appearance. The outside edges of the bunds will remain soft so that screen planting can be included. Screen planting should incorporate trees that will not only screen the bunding but will also screen the pumping station from sensitive viewpoints to the west on the higher ground (Figure. 5.4).

- Reinstatement planting should be carried out in areas disturbed by works on the eastern watercourse. Planting could be incorporated on the outside edge of the bunds to screen the open section of the watercourse.

- All temporary and permanent planting should be designed to incorporate species that will attract butterflies (refer to ecological assessment).

5.7 Community Issues

The major concerns for the local community will be disturbance from the construction works. Mitigation measures relating to noise and air impacts are described in sections 5.3 and 5.4. Access by road and pedestrian path is important for Tsung Pak Long because of its relatively isolated location and therefore access should be maintained throughout the construction period. This is of particular importance for school children who require safe access from the surrounding areas to the school at Tsung Pak Long.

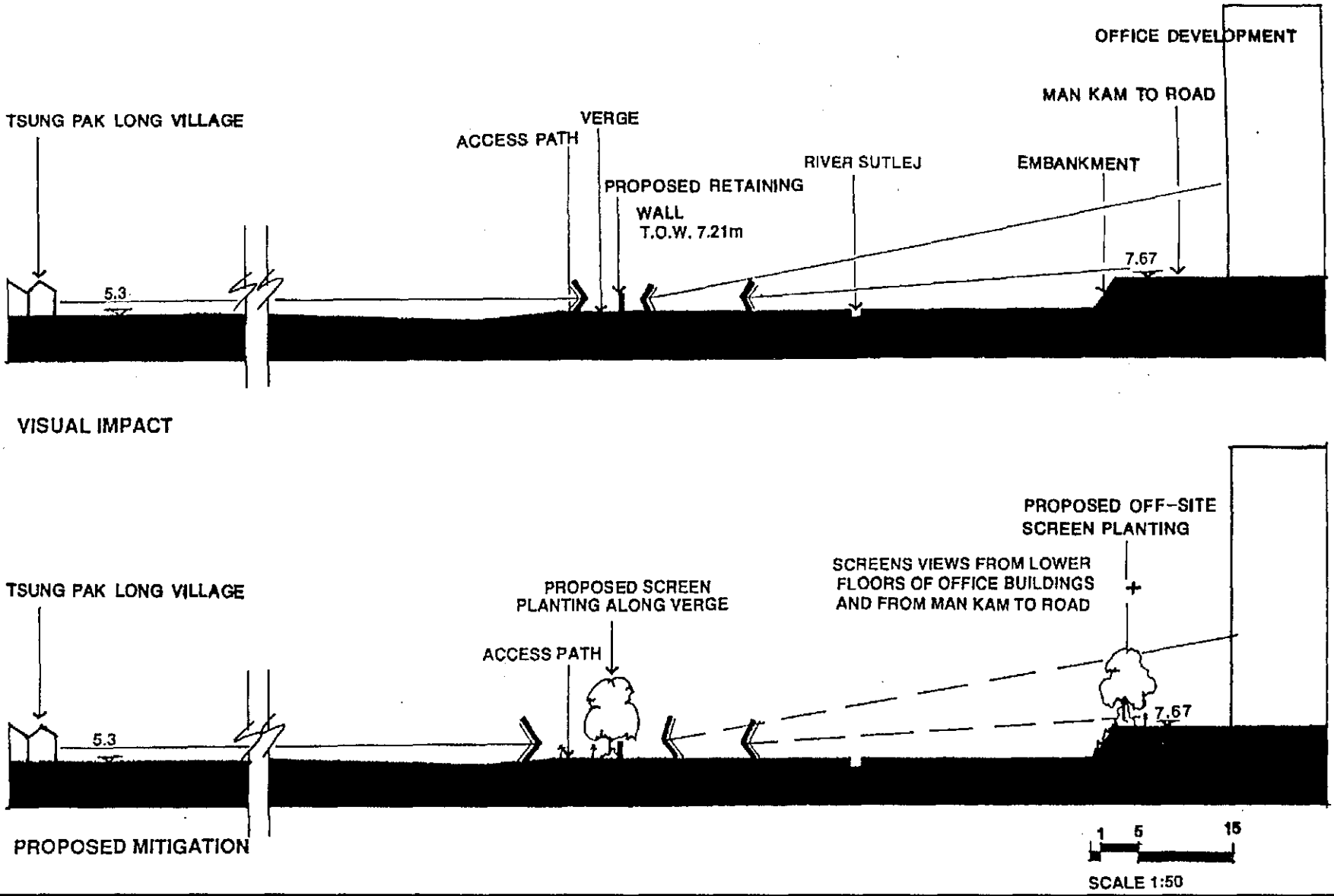

Figure 5.3 Section 2: Visual Impact of Retaining Wall and Proposed Mitigation

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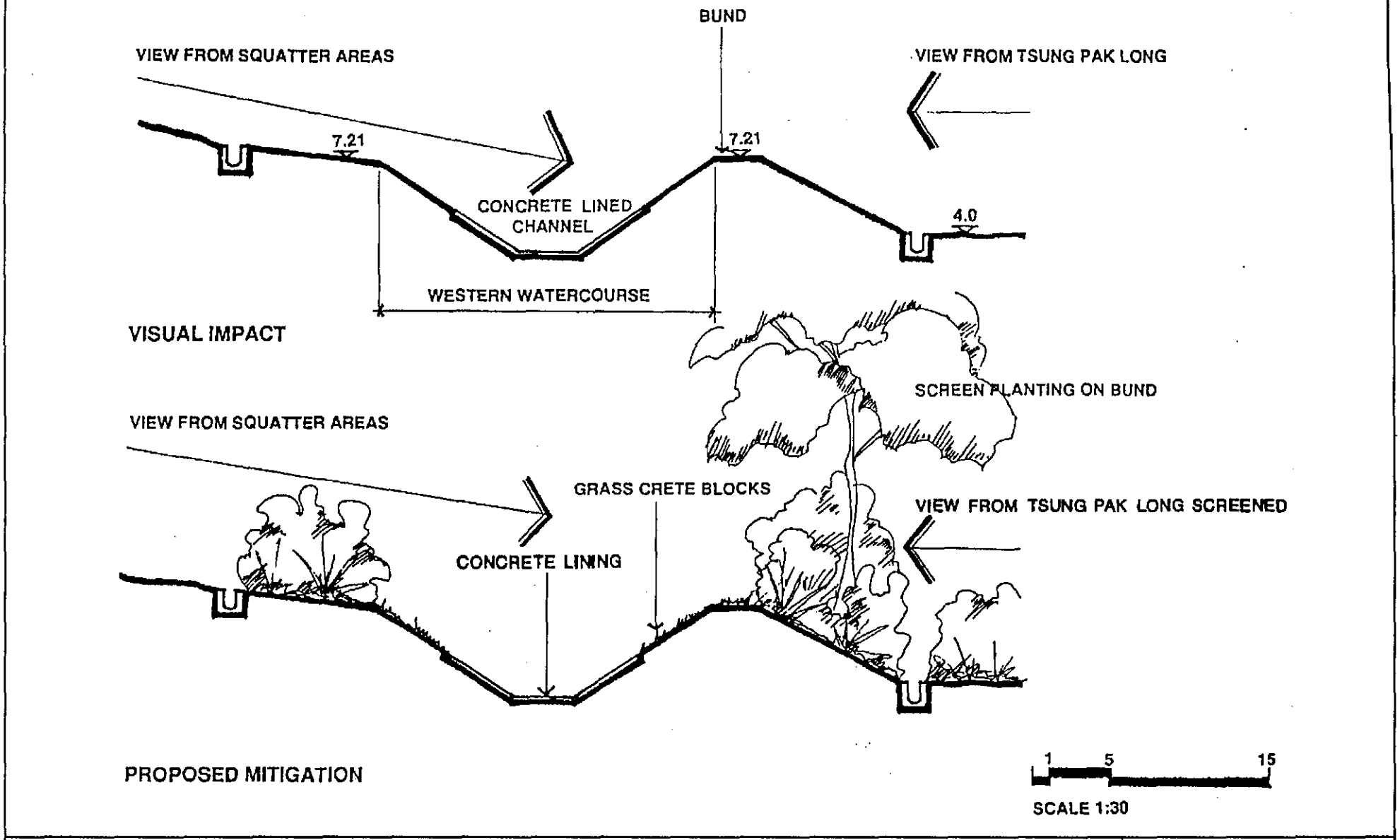

Figure 5.4 Visual Impact of Section 3: Western Watercourse and Proposed Mitigation

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6 CONCLUSIONS AND RECOMMENDATIONS

6 CONCLUSIONS AND RECOMMENDATIONS

6.1 Ecology

In conclusion, the main ecological constraints for the proposed flood protection works are the proximity to existing habitats and species of interest on the site, including butterfly habitats, the abandoned fish ponds and groups of mature, native trees.

By far the most important constraint is the presence of the two rare Southeast Asian butterflies of the *Horaga* species and other rare butterfly species (see Annex 2).

Selective retention of important areas of natural habitat has been recommended where possible, most particularly the woodland and wetland around the stream courses for the associated fauna. This will be especially important for the *Horaga* species given their rare status. Mitigation measures have been put forward which will serve to limit the ecological impact of the scheme. However, given the engineering requirements for the works and the limited scope for both on and off site mitigation measures, some residual impacts will occur.

With regard to the recommendations set out in the Initial Assessment Report, following a site visit with the engineering team to discuss mitigation measures, the location of the culvert near the known rare butterfly habitat has been modified to run down the southern part of the road. This should avoid the potential impacts listed in the IAR. Working areas and methods would be controlled so that impacts on the butterfly site are unlikely to be significant.

It is understood that the detailed tree survey recommended in the Initial Assessment Report will shortly be undertaken to determine the exact location of the trees in relation to the proposals; the purpose of this is to avoid important mature trees where possible as scheme design gets increasingly committed.

The Initial Assessment Report also recommended that a landscape architect/ecologist should be employed to draw up a detailed planting scheme for the restoration of the area, in particular the treatment and planting of the embankments. This is shortly to be commissioned as part of the landscape works for the scheme.

It is still recommended that when it comes to pegging out the site, that there is an input from the landscape architect/ecologist to ensure that important mature trees and habitats are avoided on the ground where possible.

Also it is recommended that the contract documents are drafted to ensure the maximum protection for wildlife habitats. This could involve an input to the contract by a specialist ecologist/landscape professional to ensure that the methods of working, works areas, storage areas, access routes, use of chemicals, protection from fire etc. are all incorporated into the contract and become an obligation on the contractor.

It would be highly desirable to set up an initial meeting with the contractor and the resident engineer for this project to ensure they are fully briefed on all the environmental and ecological issues associated with this project. Training could be given to supervisory staff of both the Resident Engineer's team and the contractor.

6.2 Water Quality

Water quality impacts during construction could result, unless mitigation measures are adequately implemented by the contractor. Monitoring of the construction works is recommended both upstream and downstream and should be carried out by the supervision team of the Project Engineer. These matters are described in detail in the Monitoring and Audit Manual.

The contract should also require the contractor to submit working methods, including proposed mitigation measures, to the supervision team in advance for provisional approval.

6.3 Noise

Most NSRs in Tsung Pak Long village are sufficiently remote from Tai Po Road, or shielded by intervening structures, that traffic noise levels are low or imperceptible. There is little traffic and no industrial activity within the village. Tai Tau Leng village experiences a higher ambient noise level resulting from its closer proximity to the NTCR and Po Shek Wu Road. The fields surrounding these villages are actively cultivated. The area between the NTCR and Castle Peak Road, which accommodates mostly single-storey houses clustered around the small stream, is dominated by noise from the NTCR.

The noise generated by construction of the flood control works during the non-restricted daytime hours (07.00 to 19.00) has been assessed with reference to the criterion of 75 dB(A) (L_{eq} 30 mins). Works at the site are expected to cease before 1900 hours, so evening and night-time NCO criteria are not relevant. Construction noise at a set of 15 selected representative NSRs, both residential and school, has been assessed, based on an assumed construction methodology, schedule, and list of equipment.

The noise generated by operation of the flood control works is assessed with reference to the *Technical Memorandum for the Assessment of Noise from Places other than Domestic Premises, Public Places or Construction Sites*. The Acceptable Noise Levels (ANL) are 60 dB(A) during the daytime and evening, and 50 dB(A) during the night. In addition, the Hong Kong Planning Standards and Guidelines (HKPSG) advises that fixed noise sources should be so located and designed that, when assessed in accordance with the *Technical Memorandum*, the level of the intruding noise at the facade of the nearest sensitive use should be at least 5 dB(A) below the appropriate ANL.

Construction works will require the use of powered mechanical equipment for channel and embankment formation, concreting, and surface finishing/reinstatement. Percussive piling is not anticipated. The construction noise assessment found that exceedances of the assessment criterion could be expected at NSRs that were close to the works. In certain areas, such as along the eastern and western watercourses, these near NSRs are so close to the construction works that unmitigated construction noise levels are expected to exceed 75 dB(A) by almost 20 dB(A).

The most effective mitigation measure is to control noise at its source. In the case of powered mechanical equipment, this involves either selecting silenced equipment, or reducing the transmission of noise using mufflers, silencers, or acoustic enclosures.

An assessment based on the use of quiet equipment and temporary noise barriers found that one or both of these measures could reduce noise to acceptable levels at all but the very-closest NSRs. The nature of this flood control project requires that items of PME be deployed very close to a small number of sensitive residential facades. In particular, the improvement of the eastern and western watercourses, and improvements to culverts under Castle Peak Road and the Tsung Pak Long access road, will necessarily require that very noisy equipment (e.g., bulldozers and concrete breakers) and equipment that cannot be quietened (e.g., concrete vibrators) will be used for a short duration near a small number of dwellings.

During normal tidal and flow conditions, surface waters at Tsung Pak Long, Tai Tau Leng, and low-lying areas will drain to the Sutlej River by gravity. However, during flood conditions, gravity connections will close and the flow will be diverted to the pumping station to be pumped into the river. The impact of pump operation has been assessed, and is found to remain within acceptable limits.

Given the social and economic benefits to be derived from flood control in this low-lying area, it is recommended that all practicable noise control measures be implemented, including the use of quiet equipment, sensitive scheduling of activities, and the use of temporary noise barriers to reduce noise levels as far as possible. Further, residents of Tsung Pak Long and Tai Tau Leng, particularly those located very near the planned works, should be notified in advance of planned operations, and informed of progress.

6.4 Air

During the construction phase of the flood protection work, due to the proximity of the flood protection work to the sensitive receivers, dust impacts at some sensitive receivers will occasionally be high, even with the adoption of all reasonable dust mitigation measures.

Nevertheless, the dust impacts would only occur sporadically during periods of worst case meteorological conditions coincident with maximum construction activities. Modelling results indicate that there would not be exceedance of the 1-hour average TSP guideline level and the 24-hour and annual average TSP AQOs at any of the sensitive receivers except two exceedances and one exceedance of the 1-hour average TSP guideline level at receivers 3 and 5 respectively. Based on the 1990 Ta Kwu Ling meteorological data, exceedances of the 1-hour average TSP guideline level at receivers 3 and 5 occurred during low wind speed conditions. By implementing the dust suppression measures in Section 5.4 and adopting more frequent watering of dusty site surfaces, especially those close to receivers 3 and 5, during low wind speed conditions, exceedance of the TSP guideline level and AQOs at the sensitive receivers is not expected.

It is suggested that a commitment to adopt good operational practices for dust minimisation by the contractor should reduce the dust nuisance to a minimum. Particular attention should be given to suppression of dust generating activities near sensitive receivers. Dust monitoring and audit should be carried out and this will be specified in the EM&A Manual.

6.5 Historical and Cultural Heritage

There are no residual impacts predicted, provided that works areas are carefully planned to be separated from the designated Hakka Wai walled village area and the areas of Fung Shui trees and grave sites.

6.6 Visual Impacts and Landscaping

A visual impact assessment has been carried out and proposals for landscaping have been recommended. Detailed landscape design, including a suitable planting list and survey of existing trees will be undertaken prior to award of contract.

6.7 Community Issues

There will be no significant severance impacts on the community, providing that access routes are maintained at all times or alternatives provided which are acceptable to local residents.

6.8 Other Recommended Action

The proposed works, as described in this report, are likely to have some impact and there will be a need to minimise and control the extent of these impacts. This can be achieved by appropriate specification of monitoring and audit requirements. Some items for further work are therefore recommended as follows:

- summary in an EM&A Manual, of monitoring and audit requirements, including environmental team organisation and reporting responsibility
- define areas and activities where temporary working limits (for instance, for noise) may be necessary
- finalise contract clauses for the implementation of general pollution control provisions

7 REFERENCES

7 REFERENCES

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ANNEX 1
AMPHIBIAN AND REPTILE SURVEY

Amphibian and Reptile Survey of the Proposed Tsung Pak Long Flood Protection Project

By Michael Lau
11 December

Introduction

This report covers the findings of the amphibian and reptile survey of the proposed Tsung Pak Long Flood Protection Scheme in northeastern New Territories. The aims of this survey are: to assess the value of the study site to the herpetofauna; and to recommend appropriate mitigation measures.

The survey was carried out during the afternoon and early evening of 6 December 1994 in order to record both diurnal and nocturnal species. The study area was covered on foot and all the major habitats, namely the woodland, watercourses, cultivation and abandoned field were visited. Reptiles and amphibians were recorded by direct sighting and active searching in potential hiding places. Dip net was also used to sample aquatic species.

Results

A total of five species were found in this survey and they are listed below:

Habitat	Species	Occurence
Watercourse	*Rana guentheri* Gunther's Frog	1 adult
Abandoned field	*Bufo melanostictus* Asiatic Common Toad	1 adult
	Polypedates megacephalus Brown Tree Frog	1 adult
Cultivation	*Rana limnocharis* Paddy Frog	1 adult
Woodland	*Hemidactylus bowringii* Common House Gecko	1 adult
Village	*Hemidactylus bowringii* Common House Gecko	5 adults & 3 juveniles

All the species found are common and widespread species typical to agricultural areas in this region.

Discussion and Recommendation

Rather few reptiles and amphibians were found in this survey because these 'cold-blooded' animals become less active in the cold season. Moreover, the wet season is over, making the seasonal marshes in the abandoned field dry up and become unsuitable for amphibians. Due to their secretive nature and the timing of this survey, it is highly likely that some other species inhabiting in the study site were not recorded during the survey.

Species that have been recorded from the neighbouring area and may occur in the study site include: *Kaloula pulchra* (Asiatic Painted Frog), *Microhyla ornata* (ornate Pigmy Frog), *Scincella reevesi* (Reeves' Smooth Skink), *Eumeces chinensis* (Chinese Skink), *Calotes versicolor* (Changeable Lizard), *Takydromus sexlineatus* (Grass Lizard), *Enhydris chinensis* (Chinese Water Snake), *Xenochrophis piscator* (Checkered Keelback), *Ptyas mucosus* (Common Rat Snake) and *Naja naja* (Chinese Cobra). All the species mentioned above are common with the exception of Grass Lizard which is uncommon but widespread in Hong Kong. Common Rat Snake and Chinese Cobra are included in Animals and Plants (Protection of Endangered Species) Ordinance but they are not threatened locally.

The watercourses in the study site are grossly polluted, thus reducing the value of the site to amphibians. The cultivated land are also of limited value to amphibians due to the 'extensive use of herbicide and pesticide' as stateded in the Initial Assessment Report. Some of the abandoned fields will become marshes during the rainy season. These seasonally inundated marshes may provide breeding habitats for a number of amphibian species. However, these lowlying marshes will receive polluted water from the flooded watercourses after heavy rain and are expected to support only limited number and diversity of amphibians.

Some of the woodlands within the study site are quite well established. However, they are small in size and are unlikely to support unusual forest-specialised reptiles and amphibians.

In short, the study site is unlikely to have populations of rare reptiles nor amphibians. However, it has quite a diverse herpetofauna consisting of common species.

The proposed development will not have a major impact on the reptiles and amphibians living in the area. One aspect that needs to be considered is the rather wide concrete channel (4m.) so formed from this scheme may become 'pitfall trap' to certain small terrestrial vertebrates which are not capable of climbing vertical or steep concrete embankments. It may prevent movement of certain reptiles and amphibians and cause habitat fragmentation. Therefore it is recommended that the banks of the channel should not be too steep (say not more than 45°) and the concrete should be roughened.

The proposed scheme will result in the destruction of some wetlands. If properly designed, the storage pond in the scheme can, to a certain extent, compensate the loss of wetlands. Vegetation should be allowed to grow at the bottom and the banks of the pond to provide food and/or cover for wildlife. If feasible, a small depression away from the pump should be incorporated in the bottom of the pond so that it will retain some water when the storage pond is drained. This body of water may become a breeding habitat for the amphibians in the area.

ANNEX 2
BUTTERFLY DATA

ANNEX 2

BUTTERFLY DATA (Information kindly supplied by Dr. Mike Bascombe on 22/7/94)

Total number of species recorded is 62. Some species of note include the following:

Horaga onyx

Habitat:	Secondary growth, woodland clearings
Status:	Found singly throughout Hong Kong. The area marked on Figure 2.2 is the only site where it is reasonably common, appearing consistently in June and September
Phenology:	Singly in most months. Most common (only at Tsung Pak Long)June and September
Adult Food:	Nectar from *Lantana camara* etc. ?overripe Lychees still on tree
Larval food plants:	Not known, possibly same as *Horaga albimacula*

Horaga albimacula

Habitat:	Woodland clearings where there is much secondary growth
Status:	Rare and localised throughout its range. Four small colonies known in Hong Kong, the largest in the wooded area
Phenology:	June to September; also December
Adult Food:	*Psychotria rubra* (nectar) *Ampelopsis brevipedunculata* (honeydew)
Larval food plant:	*Actinodaphne chinensis* (male flowers only)

Castalius morsimon

Habitat:	Secondary growth, agricultural land, rural roadsides
Status:	Never common. Scattered colonies in Hong Kong, one at Tsung Pak Long (Figure 2.2).
Phenology	Every month; most common September to November
Adult food:	Nectar from a variety of plants, damp patches
Larval food plant:	*Paliurus ramosissimus*

Neope muirheadis

Habitat:	Shady woodland and secondary growth in vicinity of bamboo
Status:	A recent recolonizer (first Hong Kong record 1957). Now reasonably common and widespread. A colony at Tsung Pak Long (Figure 2.2).

Phenology:	February to September. Most common in March.
Adult food:	Moist stream beds, exuding sap, animal dung
Larval food plants:	Bamboos (*Aruninaria, Bambusa, Phyllostrachys*)

Charaxes bernardus

Habitat:	Mainly woodland
Status:	Reasonably common. Consistently found in Tsung Pak Long area.
Phenology:	All months, most commonly May
Adult food:	Citrus sap, hanging or fallen fruits
Larval food plants:	*Acronychia pedunculata* *Cinnamomum camphora* *Litsea glutinosa*

Horaga albimacula and *Horaga onyx* are the most noteworthy species, but of course the number of species is an indication of the value of the area.

ANNEX 3
DEFINITION OF TRIGGER, ACTION AND TARGET LEVELS

ANNEX 3

DEFINITION OF TRIGGER, ACTION AND TARGET LEVELS

It has become common practice to apply a range of environmental limits termed trigger, action and target (TAT) levels to provide a framework for the interpretation of monitoring results. These levels are defined as follows:

- *Trigger Level:* This level acts as an "early warning" of deterioration, so that closer monitoring may be initiated, possible sources of impact may be identified, and early mitigation measures enacted to prevent further deterioration.

- *Action Level:* Achievement of this level indicates that degree of impact has increased from the Trigger Level, and that corrective action is required before conditions further deteriorate and relevant standards are not met.

- *Target Level:* This is the upper limit, or maximum permissible level that will still comply with the appropriate regulation or guideline. Exceedance of the Target Level is generally not permitted.

Generalized Event/Action Plan in Event of a Noise Nuisance

Event	Action	
	Environmental Supervisor/Engineer's Representative	Contractor
When a complaint is received	• Notify contractor • Conduct measurement • Investigate noisy operations	--
When more than one complaints are received within 2 weeks time	• Notify Contractor • Analyze investigation • Require Contractor to propose measures for the analyzed noise problem • Increase monitoring frequency to check mitigation effectiveness	• Submit noise mitigation proposals to Environmental Supervisor/Engineer's Representative • Implement noise mitigation proposals
75* dB(A) exceeded between 0700-1900 hrs on normal weekdays	• Notify contractor • Notify EPD*** • Require Contractor to implement mitigation measures • Increase monitoring frequency to check mitigation effectiveness	• Implement mitigation measures • Prove to Environmental Supervisor/Engineer's Representative effectiveness of measures applied

* reduce to 70 dB(A) for schools and 65 dB(A) during school examination periods.
** to be selected based on Area Sensitivity Rating.
*** only applicable to projects of significant scale.

Remark:

(1) It would be preferable to have an Environmental Supervisor who is independent from the Engineer and employed by the project proponent to execute the duties of monitoring and audit.

ANNEX 4
TSUNG PAK LONG FLOOD PROTECTION WORKS. DATA FOR AIR QUALITY MODELLING

	TSUNG PAK LONG FLOOD PROTECTION WORKS		
	Total retaining wall length along southern edge of the River Sutlej (m)	681	(width=10m)
	Total embankment length along western watercourse (m)	448	(width=38m)
	Total embankment length along eastern watercourse (m)	156	(width=18m)
Item	Description	TSP	Remarks
	Retaining Wall along southern edge of the River Sutlej		
1	Tipping from haul truck		
	particle size multiplier	0.73	*from AP-42*
	material silt content (%)	6.9	*geometric mean from AP-42, Western surface coal mining, overburden*
	mean wind speed (m/s)	3.53	*from Ta Kwu Ling 1990 met data*
	drop height (m)	3	*estimated*
	material moisture content (%)	7.9	*geometric mean from AP-42, Western surface coal mining, overburden*
	truck capacity (cu.m)	6	*from Engineer*
	E (kg/Mg)	1.7083E-04	*calculated as in AP-42*
	construction rate (Mg/day)	67	*from Engineer*
	E (kg/day)	0.01	*calculated*
2	Bulldozing overburden		
	number of dozer	1	*estimated*
	material silt content (%)	6.9	*geometric mean from AP-42, Western surface coal mining, overburden*
	material moisture content (%)	7.9	*geometric mean from AP-42, Western surface coal mining, overburden*
	mitigation efficiency (%)	50	*estimated mitigation efficiency of watering*
	E(kg/hr)	0.90	*calculated as in AP-42*
	working hour per day	10	*from Engineer*
	percentage of time bulldozing (%)	40	*estimated*
	E(kg/day)	3.60	*calculated*
3	Grading		
	number of grader	1	*estimated*
	mean vehicle speed (km/hr)	8	*estimated*
	mitigation efficiency (%)	50	*estimated mitigation efficiency of watering*
	E (kg/VKT)	0.31	*calculated as in AP-42*
	working hour per day	10	*from Engineer*
	percentage of time grading (%)	40	*estimated*
	distance travelled (km/day)	32	*calculated*
	E (kg/day)	9.85	*calculated*
4	Haul truck on unpaved site road		
	particle size multiplier	0.8	*from AP-42*
	silt content of road surface material (%)	8.4	*geometric mean from AP-42, Western surface coal mining*
	mean vehicle speed (km/hr)	15	*assumed*
	mean vehicle weight (Mg)	20	*estimated*
	mean number of wheel	10	*assumed*
	number of days with >= 0.254 mm rainfall	151	*from RO 1990 weather statistics*
	mitigation efficiency (%)	50	*estimated mitigation efficiency of watering*
	E (kg/VKT)	0.56	*calculated as in AP-42*
	average trip distance - to and fro (km)	0.68	*estimated*
	number of vehicle trip per day	7	*calculated from construction rate*
	E (kg/day)	2.61	*calculated*
5	Site erosion		
	silt content (%)	6.9	*geometric mean from AP-42, Western surface coal mining*
	number of days with >= 0.254 mm rainfall	151	*from RO 1990 weather statistics*
	time with > 5.4 m/s wind speed (%)	14.52	*from Ta Kwu Ling 1990 met data*
	E (kg/day/hectare)	7.70	*calculated as in AP-42*
	total site area (sq.m)	6814	*estimated*
	percentage active operating area (%)	50	*estimated*
	mitigation efficiency (%)	50	*estimated mitigation efficiency of watering*
	E (kg/day)	1.31	*calculated*
	Total E (wind dependancy=0) (g/m/s)	6.5451E-04	*calculated line source strength*
	Total E (wind dependancy=1) (g/m/s)	1.3151E-07	*calculated line source strength*
	Total E (wind dependancy=3) (g/m/s)	5.0680E-07	*calculated line source strength*

	Embankment along western watercourse		
6	Tipping from haul truck		
	particle size multipler	0.73	*from AP-42*
	material silt content (%)	6.9	*geometric mean from AP-42, Western surface coal mining, overburden*
	mean wind speed (m/s)	3.53	*from Ta Kwu Ling 1990 met data*
	drop height (m)	3	*estimated*
	material moisture content (%)	7.9	*geometric mean from AP-42, Western surface coal mining, overburden*
	truck capacity (cu.m)	6	*from Engineer*
	E (kg/Mg)	1.7083E-04	*calculated as in AP-42*
	construction rate (Mg/day)	440	*from Engineer*
	E (kg/day)	0.08	*calculated*
7	Bulldozing overburden		
	number of dozer	2	*estimated*
	material silt content (%)	6.9	*geometric mean from AP-42, Western surface coal mining, overburden*
	material moisture content (%)	7.9	*geometric mean from AP-42, Western surface coal mining, overburden*
	mitigation efficiency (%)	50	*estimated mitigation efficiency of watering*
	E(kg/hr)	0.90	*calculated as in AP-42*
	working hour per day	10	*from Engineer*
	percentage of time bulldozing (%)	40	*estimated*
	E(kg/day)	7.19	*calculated*
8	Grading		
	number of grader	1	*estimated*
	mean vehicle speed (km/hr)	8	*estimated*
	mitigation efficiency (%)	50	*estimated mitigation efficiency of watering*
	E (kg/VKT)	0.31	*calculated as in AP-42*
	working hour per day	10	*from Engineer*
	percentage of time grading (%)	40	*estimated*
	distance travelled (km/day)	32	*calculated*
	E (kg/day)	9.85	*calculated*
9	Haul truck on unpaved site road		
	particle size multipler	0.8	*from AP-42*
	silt content of road surface material (%)	8.4	*geometric mean from AP-42, Western surface coal mining*
	mean vehicle speed (km/hr)	15	*assumed*
	mean vehicle weight (Mg)	20	*estimated*
	mean number of wheel	10	*assumed*
	number of days with >= 0.254 mm rainfall	151	*from RO 1990 weather statistics*
	mitigation efficiency (%)	50	*estimated mitigation efficiency of watering*
	E (kg/VKT)	0.56	*calculated as in AP-42*
	average trip distance - to and fro (km)	0.45	*estimated*
	number of vehicle trip per day	28	*calculated from construction rate*
	E (kg/day)	6.98	*calculated*
10	Site erosion		
	silt content (%)	6.9	*geometric mean from AP-42, Western surface coal mining*
	number of days with >= 0.254 mm rainfall	151	*from RO 1990 weather statistics*
	time with > 5.4 m/s wind speed (%)	14.52	*from Ta Kwu Ling 1990 met data*
	E (kg/day/hectare)	7.70	*calculated as in AP-42*
	total site area (sq.m)	17027	*estimated*
	percentage active operating area (%)	50	*estimated*
	mitigation efficiency (%)	50	*estimated mitigation efficiency of watering*
	E (kg/day)	3.28	*calculated*
	Total E (wind dependancy=0) (g/m/s)	1.4889E-03	*calculated line source strength*
	Total E (wind dependancy=1) (g/m/s)	1.3207E-06	*calculated line source strength*
	Total E (wind dependancy=3) (g/m/s)	1.9258E-06	*calculated line source strength*

A4-2

	Embankment along eastern watercourse		
11	Tipping from haul truck		
	particle size multiplier	0.73	*from AP-42*
	material silt content (%)	6.9	*geometric mean from AP-42, Western surface coal mining, overburden*
	mean wind speed (m/s)	3.53	*from Ta Kwu Ling 1990 met data*
	drop height (m)	3	*estimated*
	material moisture content (%)	7.9	*geometric mean from AP-42, Western surface coal mining, overburden*
	truck capacity (cu.m)	6	*from Engineer*
	E (kg/Mg)	1.7083E-04	*calculated as in AP-42*
	construction rate (Mg/day)	31	*from Engineer*
	E (kg/day)	0.01	*calculated*
12	Bulldozing overburden		
	number of dozer	1	*estimated*
	material silt content (%)	6.9	*geometric mean from AP-42, Western surface coal mining, overburden*
	material moisture content (%)	7.9	*geometric mean from AP-42, Western surface coal mining, overburden*
	mitigation efficiency (%)	50	*estimated mitigation efficiency of watering*
	E(kg/hr)	0.90	*calculated as in AP-42*
	working hour per day	10	*from Engineer*
	percentage of time bulldozing (%)	40	*estimated*
	E(kg/day)	3.60	*calculated*
13	Grading		
	number of grader	1	*estimated*
	mean vehicle speed (km/hr)	8	*estimated*
	mitigation efficiency (%)	50	*estimated mitigation efficiency of watering*
	E (kg/VKT)	0.31	*calculated as in AP-42*
	working hour per day	10	*from Engineer*
	percentage of time grading (%)	40	*estimated*
	distance travelled (km/day)	32	*calculated*
	E (kg/day)	9.85	*calculated*
14	Haul truck on unpaved site road		
	particle size multiplier	0.8	*from AP-42*
	silt content of road surface material (%)	8.4	*geometric mean from AP-42, Western surface coal mining*
	mean vehicle speed (km/hr)	15	*assumed*
	mean vehicle weight (Mg)	20	*estimated*
	mean number of wheel	10	*assumed*
	number of days with >= 0.254 mm rainfall	151	*from RO 1990 weather statistics*
	mitigation efficiency (%)	50	*estimated mitigation efficiency of watering*
	E (kg/VKT)	0.56	*calculated as in AP-42*
	average trip distance - to and fro (km)	0.16	*estimated*
	number of vehicle trip per day	2	*calculated from construction rate*
	E (kg/day)	0.17	*calculated*
15	Site erosion		
	silt content (%)	6.9	*geometric mean from AP-42, Western surface coal mining*
	number of days with >= 0.254 mm rainfall	151	*from RO 1990 weather statistics*
	time with > 5.4 m/s wind speed (%)	14.52	*from Ta Kwu Ling 1990 met data*
	E (kg/day/hectare)	7.70	*calculated as in AP-42*
	total site area (sq.m)	2811	*estimated*
	percentage active operating area (%)	50	*estimated*
	mitigation efficiency (%)	50	*estimated mitigation efficiency of watering*
	E (kg/day)	0.54	*calculated*
	Total E (wind dependancy=0) (g/m/s)	2.4218E-03	*calculated line source strength*
	Total E (wind dependancy=1) (g/m/s)	2.6302E-07	*calculated line source strength*
	Total E (wind dependancy=3) (g/m/s)	9.1224E-07	*calculated line source strength*

FUGITIVE DUST MODEL (FDM)
VERSION 90121
MAY, 1990

RUN TITLE:
Tsung Pak Long, 1990 TKL Met Data, line sources, receiver 1

INPUT FILE NAME: t010590.IN
OUTPUT FILE NAME: t010590.OUT
MET DATA READ FROM FILE NAME: t010590.MET
PLOT OUTPUT WRITTEN TO FILE NAME: t010590.DAT

CONVERGENCE OPTION 1=OFF, 2=ON	1
MET OPTION SWITCH, 1=CARDS, 2=PREPROCESSED	2
PLOT FILE OUTPUT, 1=NO, 2=YES	2
MET DATA PRINT SWITCH, 1=NO, 2=YES	1
POST-PROCESSOR OUTPUT, 1=NO, 2=YES	1
DEP. VEL./GRAV. SETL. VEL., 1=DEFAULT, 2=USER	1
PRINT 1-HOUR AVERAGE CONCEN, 1=NO, 2=YES	2
PRINT 3-HOUR AVERAGE CONCEN, 1=NO, 2=YES	1
PRINT 8-HOUR AVERAGE CONCEN, 1=NO, 2=YES	1
PRINT 24-HOUR AVERAGE CONCEN, 1=NO, 2=YES	1
PRINT LONG-TERM AVERAGE CONCEN, 1=NO, 2=YES	1
NUMBER OF SOURCES PROCESSED	66
NUMBER OF RECEPTORS PROCESSED	1
NUMBER OF PARTICLE SIZE CLASSES	5
NUMBER OF HOURS OF MET DATA PROCESSED	8712
LENGTH IN MINUTES OF 1-HOUR OF MET DATA	60.
ROUGHNESS LENGTH IN CM	10.00
SCALING FACTOR FOR SOURCE AND RECPTORS	1.0000
PARTICLE DENSITY IN G/CM**3	2.65

PREPROCESSED METEOROLOGICAL DATA SELECTION SWITCHES
1111111111111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111111111111111111111111111111111111111111111011111111111111111111111111111
1111111011111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111111111111111111111111111111111111111111111111111111111111111111111111111

11111111111111111111111111111111111111111110

GENERAL PARTICLE SIZE CLASS INFORMATION

PARTICLE SIZE CLASS	CHAR. DIA. (UM)	GRAV. SETTLING VELOCITY (M/SEC)	DEPOSITION VELOCITY (M/SEC)	FRACTION IN EACH SIZE CLASS
1	1.2500000	**	**	0.0262
2	3.7500000	**	**	0.0678
3	7.5000000	**	**	0.1704
4	12.5000000	**	**	0.1536
5	20.0000000	**	**	0.5820

** COMPUTED BY FDM

1

RECEPTOR COORDINATES (X,Y,Z)

(830145., 840345., 2.) (

1

SOURCE INFORMATION

TYPE	ENTERED EMIS. RATE (G/SEC, G/SEC/M OR G/SEC/M**2)	TOTAL EMISSION RATE (G/SEC)	WIND SPEED FAC.	X1 (M)	Y1 (M)	X2 (M)	Y2 (M)	HEIGHT (M)	WIDTH (M)
2	0.000654510	0.01713	0.000	830716.	840350.	830690.	840353.	0.50	10.00
2	0.000654510	0.02444	0.000	830690.	840353.	830655.	840366.	0.50	10.00
2	0.000654510	0.03540	0.000	830655.	840366.	830610.	840396.	0.50	10.00
2	0.000654510	0.11231	0.000	830610.	840396.	830480.	840508.	0.50	10.00
2	0.000654510	0.10819	0.000	830480.	840508.	830354.	840615.	0.50	10.00
2	0.000654510	0.04458	0.000	830354.	840615.	830302.	840659.	0.50	10.00
2	0.000654510	0.02985	0.000	830302.	840659.	830274.	840695.	0.50	10.00
2	0.000654510	0.04066	0.000	830274.	840695.	830240.	840747.	0.50	10.00
2	0.000654510	0.03343	0.000	830240.	840747.	830220.	840794.	0.50	10.00
2	0.001488900	0.05128	0.000	830258.	840678.	830243.	840647.	0.50	38.00

2	0.001488900	0.06883	0.000	830243.	840647.	830207.	840618.	0.50	38.00
2	0.001488900	0.08475	0.000	830207.	840618.	830153.	840600.	0.50	38.00
2	0.001488900	0.06593	0.000	830153.	840600.	830113.	840581.	0.50	38.00
2	0.001488900	0.07721	0.000	830113.	840581.	830080.	840541.	0.50	38.00
2	0.001488900	0.07367	0.000	830080.	840541.	830068.	840493.	0.50	38.00
2	0.001488900	0.07332	0.000	830068.	840493.	830079.	840445.	0.50	38.00
2	0.001488900	0.05595	0.000	830079.	840445.	830095.	840411.	0.50	38.00
2	0.001488900	0.05517	0.000	830095.	840411.	830097.	840374.	0.50	38.00
2	0.001488900	0.06104	0.000	830097.	840374.	830088.	840334.	0.50	38.00
2	0.002421800	0.05377	0.000	830391.	840070.	830388.	840092.	0.50	18.00
2	0.002421800	0.04702	0.000	830388.	840092.	830392.	840111.	0.50	18.00
2	0.002421800	0.27740	0.000	830392.	840111.	830440.	840215.	0.50	18.00
2	0.000000132	0.00000	1.000	830716.	840350.	830690.	840353.	0.50	10.00
2	0.000000132	0.00000	1.000	830690.	840353.	830655.	840366.	0.50	10.00
2	0.000000132	0.00001	1.000	830655.	840366.	830610.	840396.	0.50	10.00
2	0.000000132	0.00002	1.000	830610.	840396.	830480.	840508.	0.50	10.00
2	0.000000132	0.00002	1.000	830480.	840508.	830354.	840615.	0.50	10.00
2	0.000000132	0.00001	1.000	830354.	840615.	830302.	840659.	0.50	10.00
2	0.000000132	0.00001	1.000	830302.	840659.	830274.	840695.	0.50	10.00
2	0.000000132	0.00001	1.000	830274.	840695.	830240.	840747.	0.50	10.00
2	0.000000132	0.00001	1.000	830240.	840747.	830220.	840794.	0.50	10.00
2	0.000001321	0.00005	1.000	830258.	840678.	830243.	840647.	0.50	38.00
2	0.000001321	0.00006	1.000	830243.	840647.	830207.	840618.	0.50	38.00
2	0.000001321	0.00008	1.000	830207.	840618.	830153.	840600.	0.50	38.00
2	0.000001321	0.00006	1.000	830153.	840600.	830113.	840581.	0.50	38.00
2	0.000001321	0.00007	1.000	830113.	840581.	830080.	840541.	0.50	38.00
2	0.000001321	0.00007	1.000	830080.	840541.	830068.	840493.	0.50	38.00
2	0.000001321	0.00007	1.000	830068.	840493.	830079.	840445.	0.50	38.00
2	0.000001321	0.00005	1.000	830079.	840445.	830095.	840411.	0.50	38.00
2	0.000001321	0.00005	1.000	830095.	840411.	830097.	840374.	0.50	38.00
2	0.000001321	0.00005	1.000	830097.	840374.	830088.	840334.	0.50	38.00
2	0.000000263	0.00001	1.000	830391.	840070.	830388.	840092.	0.50	18.00
2	0.000000263	0.00001	1.000	830388.	840092.	830392.	840111.	0.50	18.00
2	0.000000263	0.00003	1.000	830392.	840111.	830440.	840215.	0.50	18.00
2	0.000000507	0.00001	3.000	830716.	840350.	830690.	840353.	0.50	10.00
2	0.000000507	0.00002	3.000	830690.	840353.	830655.	840366.	0.50	10.00
2	0.000000507	0.00003	3.000	830655.	840366.	830610.	840396.	0.50	10.00
2	0.000000507	0.00009	3.000	830610.	840396.	830480.	840508.	0.50	10.00
2	0.000000507	0.00008	3.000	830480.	840508.	830354.	840615.	0.50	10.00
2	0.000000507	0.00003	3.000	830354.	840615.	830302.	840659.	0.50	10.00
2	0.000000507	0.00002	3.000	830302.	840659.	830274.	840695.	0.50	10.00

```
          2     0.000000507    0.00003  3.000 830274.  840695. 830240.  840747.    0.50   10.00
          2     0.000000507    0.00003  3.000 830240.  840747. 830220.  840794.    0.50   10.00
          2     0.000001926    0.00007  3.000 830258.  840678. 830243.  840647.    0.50   38.00
          2     0.000001926    0.00009  3.000 830243.  840647. 830207.  840618.    0.50   38.00
          2     0.000001926    0.00011  3.000 830207.  840618. 830153.  840600.    0.50   38.00
          2     0.000001926    0.00009  3.000 830153.  840600. 830113.  840581.    0.50   38.00
          2     0.000001926    0.00010  3.000 830113.  840581. 830080.  840541.    0.50   38.00
          2     0.000001926    0.00010  3.000 830080.  840541. 830068.  840493.    0.50   38.00
          2     0.000001926    0.00009  3.000 830068.  840493. 830079.  840445.    0.50   38.00
          2     0.000001926    0.00007  3.000 830079.  840445. 830095.  840411.    0.50   38.00
          2     0.000001926    0.00007  3.000 830095.  840411. 830097.  840374.    0.50   38.00
          2     0.000001926    0.00008  3.000 830097.  840374. 830088.  840334.    0.50   38.00
          2     0.000000912    0.00002  3.000 830391.  840070. 830388.  840092.    0.50   18.00
          2     0.000000912    0.00002  3.000 830388.  840092. 830392.  840111.    0.50   18.00
          2     0.000000912    0.00010  3.000 830392.  840111. 830440.  840215.    0.50   18.00
                               ==========
        TOTAL EMISSIONS          1.49341
        NOTE:  SOME SOURCE EMISSION RATES ARE A FUNCTION OF WIND SPEED AND TOTAL IS NOT CORRECT
1
            1 HOUR AVERAGE FOR HOUR ENDING     1
                 CONCENTRATIONS IN MICROGRAMS/M**3

 (830145., 840345.,    43.906)  (
1
            1 HOUR AVERAGE FOR HOUR ENDING     1
                 DEPOSITION RATE IN MICROGRAMS/M**2/SEC

 (830145., 840345.,**********)  (
 ****** NOTE: FOR RECEPTORS WITH Z UNEQUAL 0, DEPOSITION IS SET TO 999999.999
1
            1 HOUR AVERAGE FOR HOUR ENDING     2
                 CONCENTRATIONS IN MICROGRAMS/M**3

 (830145., 840345.,    13.971)  (
1
            1 HOUR AVERAGE FOR HOUR ENDING     2
                 DEPOSITION RATE IN MICROGRAMS/M**2/SEC

 (830145., 840345.,**********)  (
 ****** NOTE: FOR RECEPTORS WITH Z UNEQUAL 0, DEPOSITION IS SET TO 999999.999
1
```

ANNEX 5
TREE AND SHRUB SPECIES WHICH ARE ATTRACTIVE TO WILDLIFE AND WHICH COULD BE CONSIDERED FOR PLANTING AT TSUNG PAK LONG

ANNEX 5

TREE AND SHRUB SPECIES WHICH ARE ATTRACTIVE TO WILDLIFE (birds, butterflies and other insects etc.) WHICH COULD BE CONSIDERED FOR PLANTING AT TSUNG PAK LONG

Most but not all of the species listed are native plants local to the area. The ones listed that are non-native are specific species which are attractive to butterflies or birds.

TREES

Abarema clypearia
Acronychia pedunculata
Alangium chinense
Antidesma bunius
Aporusa chinensis
Ardisia chinensis
Ardisia crenata
Aquilaria sinensis
Bischofia trifoliata
Bridelia monoica
Carallia brachiata
Casearia glomerata
Castanopsis fabri
Castanopsis fissa
Castanopsis tribloides
Celtis sinensis
Choerospondias axillaris
Cinnamomum camphora
Cinnamomum parthenoxylon
Citrus spp.
Crateva religiosa
Cratoxylon ligustrinum
Cunninghamia lanceolata
Diospyros morrisiana
Diospyros eriantha
Elaeocarpus sylvestris
Endospermum chinense
Evodia spp.
Ficus microcarpa
Ficus subulata
Ficus variegata
Gardinia oblongifolia
Gordonia axillaris
Hibiscus tilaceus
Ilex cinerea
Itea chinensis
Liquidamber formosana
Lithocarpus corneus
Lithocarpus glaber
Litsea cubeba
Litsea glutinosa

Litsea monopetala
Litsea rotundifolia
Litchi chinensis
Machilus breviflora
Machilus oreophila
Machilus thunbergii
Machilus velutina
Microcos paniculata
Mallotus paniculatus
Morus alba
Myrica rubra
Ormosia spp.
Pentaphylax euryoides
Prunus phaeosticta
Quercus glauca
Quercus myrsinaefolia
Quercus championi
Quercus bambusaefolia
Quercus edithae
Reevesia thyrsoidea
Rhodoleia championi
Salix babylonica
Sapium discolor
Sapium sebiferum
Schefflera octophylla
Schima spuerba
Sterculia lanceolata
Symplocos glauca
Symplocos lanceolata
Symplocos laurina
Symplocos crassifolia
Symplocos glauca
Symplocos paniculata
Syzygium buxifolium
Syzygium hancei
Syzygium levinei
Syzygium jambos
Viburnum odoratissimum
Viburnum sempervirens

SHRUBS

Ampelopsis chinensis
Arundinaria spp.
Bambusa multiplex
Bambusa spp.
Callicarpa pedunculata
Camellia oleifera
Citrus spp.
Clerodendrum spp
Cratoxylus ligustrinum
Enkianthus quinqueflorus
Eurya chinensis
Eurya japonica

Gardenia jasminoides
Gordonia axillaris
Ilex asprella
Ilex pubescens
Ilex rotunda
Itea chinensis
Ixora chinensis
Lantana camara
Lasianthus chinensis
Ligustrum sinense
Melastoma candidum
Melastoma sanginium
Microcos paniculata
Mussaeanda pubescens
Nerium indicum
Paliurus ramosissimus
Phyllostrachys nidularia
Psychotria rubra
Rapanea neriifolia
Raphiolepis indica
Rhamnus chinensis
Rhododendron simsii
Rhodomyrtus tomentosa
Strophanthus divaricatus
Vitex negundo
Wickstroemia indica
Wickstroemia nutans

CLIMBERS and HERBS

Crotalaria mucronata
Lonicera confusa
Milletia spp.
Rosa laevigata
Smilax china
Smilax lanceaefolia

GRASSES

Alopecurus aequalis
Apluda mutica
Carex spp.
Cyperus spp.
Eragrostis atrovirens
Ichaemum cilare
Miscanthus sinensis
Paspalus conjugatus
Pennisetum alopecuroides
Setaria pamifolia

ANNEX 6
COMMENTS AND RESPONSES ON THE DRAFT FINAL ASSESSMENT REPORT, THE KEY ISSUES REPORT (SEDIMENT & WATER QUALITY) AND THE DRAFT INITIAL ASSESSMENT REPORT (RECEIVED AFTER FINALISATION OF THE IAR)

EIA Study for Tsung Pak Long Flood Protection Scheme
Draft Initial Assessment Report
Response to Comments attached to EPD letter dated 23.11.94
(Ref: (45) in EP2/N7/14

1. Environmental Protection Department

1.1 Water Quality Issues

i) *Major Comments: Para. 4.2.1, 4.2.3, 5 & 8 of the EIA Study Brief have not been complied with*

The assessment is as detailed as is required given the location and scale of the works and construction methods to be employed. The detail is sufficient for the Initial Environmental Assessment Stage, as discussed at our recent meeting.

ii) *Section 1.3 : The Study Brief. The scale of works of the EIA requirements have been clearly defined in the brief and should not be scaled down.*

Noted. Response as in (i) above.

iii) *Section 2 : Existing Environment. The baseline (existing) environment conditions for siltation, erosion pattern and characteristics of soil and sediment have not been addressed in the report.*

Noted. As agreed the consultants will recommend further study on baseline environmental conditions. Text amended.

iv) *Section 4 : Potential Impacts. The potential adverse environmental impacts arising from the dredging and disposal of contaminated mud have not been predicted/evaluated, and mitigation measures to alleviate the impacts have not been proposed.*

Noted. As agreed the consultants will recommend further study on the issue of classification of potentially contaminated mud and waste disposal. Text amended.

v) *Section 4.2.1: Water Quality - Construction. Evaluation of the potential impacts identified arising from the construction activities have not been provided. With the landbased plants proposed in tables 4.2 to 4.7, the environmental impacts are expected to be excessive.*

Potential impacts have been assessed to be potentially excessive in the absence of mitigation measures. However, potential mitigation measures are given in Section 5.2. To make the effect of the mitigation measures and performance standard more explicit, text has been added to Sections 4.2.1 and 5.2.

vi) *Section 5 : Recommended Mitigation Measures. Concrete/effective mitigation measures have not been recommended to rectify the construction impacts.*

Please see response v) above and the amended Section 5.2.

vii) *Section 6.8 : Other Recommended Action. Water quality and mud problems arising from construction and operational activities should be fully reviewed in the Key Issue Reports as required by the study brief.*

Please see responses iii) and iv) above and the amended parts of Chapter 6.

1.2 Noise issues

i) *Section 4.3.4: According to the Technical Memorandum on Noise from Construction Work other than Percussive Piling, the sound power level of "dumptruck" should be 117 dB(A) instead of the value quoted in Tables 4.2 to 4.7.*

As stated in Section 4.3.2 of the IAR, equipment sound power levels for the report were taken from the *Technical Memorandum* except where more detailed or complete information was available from *BS 5228: Part 1: 1984 (Noise control on construction and open sites).* In the present assessment, dumptrucks of 20-t and 24-t capacity are expected on the site. The British Standard was preferred as a source for dumptruck SWLs since it specifies noise levels for 20-t, 24-t, 35-t, and 50-t dumptrucks. The SWL of 105 dB(A) used in the Tsung Pak Long assessment corresponds to the average SWL of six monitored 20-t and 24-t dumptrucks. In contrast, the *Technical Memorandum* does not specify the size of dumptruck associated with its 117 dB(A) SWL. This SWL is consistent with the loudest 35-t and 50-t dumptrucks monitored, and thus does not appear to apply to the type of equipment expected at the Tsung Pak Long site.

ii) *Section 4.3.8: The Table 4.3 in Annex 2 with the generalized action plan should be replaced by the one below [provided].*

Noted. Text amended.

iii) *Section 5.3.3: The noise mitigation measures suggested in this section will not substantially reduce noise emission from mobile plants. Therefore, the assumption of 10 dB(A) noise reduction for bulldozers and dump trucks is on the high side.*

The assumption of 10 dB(A) noise reduction was based on measures applicable to mobile plant, including exhaust system maintenance, exhaust silencers, isolation of vibrating engine components, installation of partial or full acoustic enclosures of noise-generating components, and damping of vibrating panels. While this is a sizeable reduction to achieve, it is in keeping with the requirement stated in the next Comment that quieter PME should be considered to alleviate the situation as far as possible.

iv) *Sections 5.3.4 to 5.3.9: Even though with noise mitigation measures, some of the identified NSRs will still suffer from construction noise vastly exceeding the 75 dB(A) limit. Under these circumstances, the consultant is obliged to explore other quieter/innovative construction methods and PMEs to alleviate the situation as far as possible. For example, hydraulic earth breaking tools should be used instead of the conventional pneumatic breakers and diesel air compressors.*

In the IAR, the consultant has considered the mitigation measures outlined in EPD's *Practical Guide for the Reduction of Noise from Construction Works.* Thus, sensitive works scheduling, use of quiet equipment, and the use of temporary noise barriers have all been suggested in the IAR. However, these measures, either alone or in combination, fail to reduce noise levels to below 75 dB(A). Primarily, the problem lies with the very short source-receiver distances -- as small as 5 m -- that prevail at the site. Given these short distances, the use of even a single item of PME generates noise levels exceeding the 75 dB(A) criterion.

The effectiveness of quietened or innovative construction methods is limited. For example, concrete and other hard surfaces may be broken by means of hydraulic or electric crusher jaws which crack or bend the material to break it. However, the jaws

are mounted on an excavator, which has a SWL of 112 dB(A) (*Technical Memorandum*); thus, the overall noise reduction may not be great. Alternatively, non-explosive demolition agents may be used to crack concrete surfaces prior to their removal. This method uses an expanding chemical agent that is inserted into holes drilled in the concrete. The method has two drawbacks. The use of this expanding agent at Tsung Pak Long has the potential to affect water quality through contamination. More significantly, the use of expanding agents requires the use of rock drills to form the holes which will receive the demolition agent, and an excavator to remove the cracked concrete. Rock drills have a SWL similar to that of an unquietened concrete breaker, while excavators have a SWL greater than that of a breaker. Thus, as above, the overall noise reduction may not be great.

Given the practical limitations on reducing noise to below 75 dB(A), it is recommended that the measures outlined in the IAR - sensitive works scheduling, use of quiet equipment, and the use of temporary noise barriers - be vigorously pursued to reduce construction noise as far as possible.

1.3 Air Quality Issues

i) *Section 4.4: a) Details of assessment methodology such as emission factors should be provided. A sample set of input and output files should also be included for us to review whether the assessment is in order.*

Noted. Emission factors of the construction activities were calculated according to USEPA AP-42 and the parameters used in the calculations have been adopted and accepted in previous studies. The parameters and calculated emission factors are tabulated in the attached table TPL0490.XLS. A sample output file for receiver 10 is also attached for your reference.

Section 4.4: b) I cannot agree with the view expressed in the last two sentences of 2nd paragraph of S4.4.4, p. 30.

As stated in S4.4.1, p. 28, the construction works involved are likely confined and with minimal dust impact. The 1-hour average TSP guideline for the two worst-case receivers is just exceeded marginally.

Confined and minimal dust impacts only refer to construction of culverts and small concrete channels as stated in section 4.4.1. It is considered that major impacts in this assessment will be due to the construction of embankments along the southern edge of the River Sutlej and along the western watercourse. Emissions from construction of the embankment were considered in the assessment.

You should see whether measures such as more frequent watering during construction, increasing height and width of dust barriers in vicinity of air sensitive receivers 3 and 5 could further reduce dust impact to below the 1-hour average TSP guideline level.

Indeed, the results are based on a scenario of 50% reduction in wind blown and vehicle movement emissions. Air quality impact can be further alleviated if further reduction in dust emission can be achieved.

Could you please review and propose further dust mitigation measures. It appears that this is a case requiring TSP monitoring and audit. Please prepare and submit this corresponding TSP monitoring and audit plan.

1.2 Noise issues

i) *Section 4.3.4: According to ... other than Percussive Pilin ... of the value quoted in ...*

As stated in S... were taken ... informat... open ... exp... c...

...WL of 112 dB(A) (Technical Memorandum); great. Alternatively, non-explosive ...faces prior to their removal. This ...erted into holes drilled in the ...expanding agent at Tsung ...h contamination. More ...rock drills to form the ...remove the cracked ...oncrete breaker, ...s above, the ...it is ...e

...available at the present stage, it ...icture of the construction impacts ...ailed design stage. Further dust ...be incorporated in the detailed ...ent will also be incorporated during

...to be exceeded more than once per year ...not got allowed exceedance frequency. ...cordingly.

...4.2' should be replaced by 'Figure 4.1'

...ical dust suppression measures to prevent ...l at air sensitive receivers 3 and 5.

Noted. Same as i) b) above.

iii) *Section 6.4: Comments as given in 2(b) is also applicable.*

Noted. Same as i) b) above.

2 Agriculture and Fisheries Department

i) *Section 2.2: I understand that the NENT DSR is still studying by the consultants. It may not be appropriate at such stage to quote the DSR which has not been finalised.*

Text amended.

A formal proposal for listing butterfly habitat as an SSSI is not yet produced. Therefore it is more appropriate to quote the site as an important butterfly habitat rather than a proposed SSSI. This comment also applies to Figure 2.2, other sections (eg 2.2.3, 6.1) and Annex 1

Text amended.

ii) *Section 2.2.2: "Any disturbance to bird species..." in line 2 of paragraph 3 should be amended as "Any disturbance to nests and eggs of birds..."*

Text amended.

A brief survey of amphibians and reptiles is needed to support the statements in paragraph 4.

A survey has been carried out. The results, which do not change our original assessment, are included in the revised text.

iii) *Section 4.1: The report mentioned that active and abandoned agriculture land will be affected (also in Section 2.2.1). However the report does not identify the extent and status of the agricultural use in the vicinity of the works. It has not come up with any suggested mitigation measures (Section 5) or recommendation for future work (Section 6) on agriculture.*

Only a very small amount of land under active cultivation is likely to be affected by the works. Some compensation payment will be required because mitigation measures will not be possible. Further work is not required nor justified.

iv) *Section 5.1: Will it be practical to avoid construction works when the butterfly larvae (which species?) are feeding? There must be full and rational justification for imposing such restriction. Moreover, the report does not suggest the exact period of the year for such restriction.*

Following a site visit with the engineering team to discuss mitigation measures, it was agreed that the culvert alignment and working areas could be adjusted so as to avoid the potential impacts listed in the draft IAR. Thus working areas and methods will be controlled so that impacts on the butterfly site are unlikely to be significant. Text has been amended.

The use of agrochemicals does not seem to be related to this flood control project.

Use of agrochemicals refers to possible future management of the flood control embankments. The recommendation is to encourage natural habitats to form on the restored works areas and embankments to provide additional wildlife habitat.

Good house keeping of the work site and proper control of workers will be substantial in preventing disturbance to the ecology of the site.

Noted.

Creation of wildlife habitats should only be considered if there is substantial impact to the habitats which cannot be mitigated or avoided.

It was not intended to neglect mitigation, rather to take advantage of all possible opportunities for environmental enhancement and habitat gain, in addition to minimising impacts from the works and mitigating adverse impacts.

A proposed planting list should be produced.

A detailed planting list would not normally be prepared for an initial assessment, however, detailed proposals will be developed in the next stage.

3. Architectural Services Department

It is considered that the information contained in the Report w.r.t. visual impact of the proposal on the study area is, in general, inadequate. Further information such as design of the proposed embankments (include, height, materials and landscape treatment, etc.) and view paths, etc. should be included.

The landscape and visual issues will be addressed in more detail in further work.

4. Drainage Services Department

a) *Section 4.3.7: Apart from pumping equipment, standby diesel generator is a standard equipment required in a floodwater pumping station. The need for noise mitigation during operation of the diesel generator should be anticipated.*

Please see the response to the following comment on Section 5. It is assumed that the standby diesel generator is intended for use only when the normal electricity supply is interrupted. Thus, it is notable that the operation of the diesel generator would not be frequent or long.

b) *Section 5: Emphasis has been put on noise reduction during construction. Noise reduction during the operation phase of the scheme is equally important. This should be included in section 5 of the report.*

The report found that, assuming the use of submersible electric water pumps (one duty and one stand-by)with a SWL of 85 dB(A) each, the need for noise mitigation is not anticipated. However attempts to minimise the tonal characteristics of the pump were recommended, particularly in the higher frequency ranges.

If, during interruptions in the electricity supply, it is necessary to use the standby diesel generator, then noise levels may exceed permissible levels. In this case, it is recommended that the generator be silenced. Several methods of silencing are possible:

(i) Structure-borne noise can be significantly reduced by mounting the generator on flexible mounts. Individual springs and rubber or polystyrene pads may be used.
(ii) The generator should be mounted (on isolators) on a solid floor.
(iii) Panels, which are prone to vibration and therefore radiate noise, should be damped. This can often be accomplished by using a laminated layer on the metal panel.
(iv) Vibrations may be transmitted by connections such as electrical conduits. In order to avoid this situation, flexible couplings should be used.
(v) The generator should be enclosed within substantial walls, which may be lined with absorbent material to absorb sound energy.
(vi) With regard to ventilation, the incoming and outgoing ducts should not be directly opposite each other (in order to prevent the direct passage of high frequencies). Ventilation openings should face away from the nearest sensitive receivers.

ANNEX 7
COMMENTS AND RESPONSES ON THE FINAL ASSESSMENT REPORT

COMMENTS	RESPONSES
From : EPD Air Policy Group Ref : (14) in EP 2/N7/14(III) Date : 9 May 1995	
a) The output file given in Annex 4 is not complete and CES has been advised to submit data for air quality modelling methodology by our modelling section. CES submitted floppy disk containing the revised dust emission factors Table TPLX590.XLS and FDM output file for receptor 3. After reviewing the newly submitted output files, the air quality modelling is acceptable and assessment is in order. However, the revised emission factor table should replace that in Annex 4 in Final Report.	Noted and Table TPLX590.XLS of Annex 4 of the FAR is revised accordingly.
For completeness of information in the revised table, Consultants should note the following points which we had advised them when we commented on their responses to comments on draft Initial Assessment Report (see my M.6) and they have noted:- * Units of total retaining wall length; * Units of total embankment length; * In calculation of TSP emission factor for bulldozing, the working hours per day should be specified; * In calculation of TSP emission factor for grader, the working hours per day and distances travelled by grader per day should be specified; * In calculation of TSP emission factor for site erosion, area of land involved should be specified.	Table revised.
b) Consultants please note that 1-hour TSP level has not got exceedance allowance. Second paragraph of S.4.4.4, P.39 should be amended to reflect this requirement.	Noted. The third paragraph of S.4.4.4 of the FAR is amended to read: "Modelling results indicate that there would not be exceedance of the 1-hour average TSP guideline level and the 24-hour and annual average TSP AQOs at any of the sensitive receivers except two exceedances and one exceedance of the 1-hour average TSP guideline level at receiver 3 and receiver 5 respectively. Based on the 1990 Ta Kwu Ling meteorological data, exceedances of the 1-

	hour average TSP guideline level at receivers 3 and 5 occurred during low wind speed conditions. By implementing the dust suppression measures in Section 5.4 and adopting more frequent watering of dusty site surfaces, especially those close to receivers 3 and 5, during low wind speed conditions, exceedance of the TSP guideline level and AQOs at the sensitive receivers is not expected."
c) It is noted that additional dust suppression measures are proposed in the Final Report (S.5.4, P.61). However, Consultants should clarify whether TSP levels at air sensitive receivers will be different from that given in Table 4.23, P.39 with additional mitigation measures (in the Draft Final Report, additional dust suppression measures have not been proposed, but the prediction of TSP levels are same as that given in the Final Report).	All the dust mitigation measures that could be modelled by the FDM model have already been incorporated in the modelling and were elaborated in S.4.4.3 and Table TPLX0590.XLS in Annex 4. The modelling results are tabulated in Table 4.23 of S.4.4.4. Additional dust suppression measures proposed in S.5.4 and more frequent watering, especially during low wind speed conditions, could further reduce the dust impacts at the sensitive receivers to an acceptable level. The following paragraph is appended to S.5.4 of the FAR: "By implementing dust suppression measures given above and adopting more frequent watering of dusty site surfaces, in particular those close to receivers 3 and 5, during low wind speed conditions, dust impact at the sensitive receivers can be further reduced."
d) In order to confirm the proposed mitigation measures are effective, Consultants should plot 1-hour TSP level, 24-hour and annual average TSP levels for both mitigated and unmitigated conditions in the Final Report.	The maximum 1-hour, maximum 24-hour and annual average TSP concentration contours for both the unmitigated and mitigated scenario are presented in Figures 4.2 to 4.7 of the FAR. All the plots are produced based on predicted TSP levels at receivers 1 to 10 only, TSP levels at other locations in the area should be viewed with care.
e) Dust monitoring and audit (s.4.4.5, P.39) * Baseline monitoring should be taken at least two consecutive weeks (14 readings) prior to commissioning of the construction work-daily for 24-hour sampling, at least 3 times per day for the 1-hour sampling should be taken while the highest dust impact is expected (not when such impacts occur).	Noted. The monitoring requirements and the action plan for dust impact and audit will be incorporated in an EM&A manual and will be submitted for EPD approval. The last sentence in the second paragraph of S.4.4.5 of the FAR is amended to read: "The baseline monitoring should be carried out for a period of at least two consecutive weeks (14 readings) prior to commissioning of the construction work - daily for 24-hour sampling, at least 3 times per day for 1-hour sampling while the highest dust impact is expected."

* In regular impact monitoring, the sampling frequency should be at least once for every six days for 24-hour monitoring at all monitoring stations, 1-hour monitoring should be carried out 3 times for every 6 days at the highest dust impact occasion.	Noted. The following text is added to the first sentence of the third paragraph of S.4.4.5 of the FAR: " . . . 1-hour monitoring should be carried out 3 times for every 6 days at the highest dust impact occasion.".
* Action plan for dust impact and audit should be proposed.	Action plan for dust monitoring and audit will be incorporated in the EM&A Manual and the following sentence is appended to the third paragraph of S.4.4.5 of the FAR: "Action plan for dust monitoring and audit should be carried out and this will be specified in the EM&A Manual.".
f) In S.6.4, P.69, Consultants should state that it is necessary to carry out dust monitoring and audit.	Noted. The EM&A manual will be submitted for EPD approval. The following text is appended to the third paragraph of S.6.4 of the FAR: "Dust monitoring and Audit should be carried out and this will be specified in the EM&A Manual." The second paragraph of S.6.4 of the FAR is revised to incorporate the responses in items b) and c) above.

From : EPD
Ref : (10) in EP2/N7/14 (III)
Date : 6 May 1995

Water Quality Issues

1.1 In S.4.2.3, the EIA study for the MDC of Fanling, Sheung Shui and Hinterland, which will address the issues of cumulative impacts of the whole catchment, should be referred to.	The following text has been added to S.4.2.3: "Cumulative impacts will be addressed in the EIA study for the MDC of Fanling, Sheung Shui and Hinterland."
1.2 In the detailed design of the drying facilities for land-based disposal (Fig. 5.1), the arrangement of the existing spoil designed to flush with the top of the protective bunds <u>is considered to be not satisfactory</u> Additional measures/arrangements (e.g. enough freeboard and drainage provision) are necessary to control contaminated runoff during rainy season..	The existing drying facilities at Sha Ling were designed to accommodate 5,500 m^3 of material. Once the existing material in the facility is removed to landfill the capacity will be 5,500 m^3 which is excess of the 500 - 1,000 m^3 of contaminated material that is expected to arise from the works. Therefore adequate freeboard can be provided.
1.3 The title pages of Annex 2 & 3 should be swapped.	The pages have been corrected in the F.A.R.
1.4 As explained by our Mr K F Tang in the meeting of 25 April 1995, the following	

issues should be properly responded to:

i) Explain the peculiar results of DO, Temperature, Turbidity & SS in Table 3.3;

DO readings were all quite low, as expected. Two readings around 30% saturation could be expected from local variation. The stream is so small that wide variation in measurement was anticipated.

Temperature difference of 2°C is not substantial and is expected in such a small stream, particularly on sunny days.

Turbidity and SS readings are anticipated to vary widely in such a small stream due to localised variations.

ii) Provide further laboratory test results for sediment contamination between 300mm & 400mm of the core samples so as to confirm the conclusion that the extent of the contaminated layer only confine to a depth 300mm;

Cores were driven into the stream bed sediment by hand as far as possible. The depth of penetration was limited primarily by the presence of concrete or rock at shallow depth. Sub-samples of the core were collected at 0-50mm ('surface'), 150-200mm and 300-350mm. It was not possible to collect deeper, discrete sub-samples. We are of the opinion that removal of 300 mm of stream bed sediment as recommended, is adequate to remove any contaminated material.

iii) Show a table to indicate the respective volume and fate of dredged spoil.

Preliminary disposal figures are:-

Uncontaminated Material	15,000 m^3
Contaminated Material (assuming 5,500 m^3 from Sha Ling drying facility)	6,500 m^3

All materials are to be disposed of to landfill.

Air Quality Issues

2. Air quality issues stated in our fax of 29 March 1995 have not been responded to.

We trust that all your comments have now been addressed fully. (see response to comments sent on 9 may ref(14) in EP 2/N7/14(III)

Waste Disposal Issues

3. Page 50, second last line, states that 'approval has been given by EPD to dispose it (contaminated material) to an approval landfill....' Please clarify.

Letter from EPD attached regarding approval to landfill.

From : DSD, Chief Engineer
Ref : MN 8/15/6-17
Date : 4 May 1995

2. As screw pumps will be used in the captioned scheme, "submersible pumps" appears in S.4.3.6 of the report should be replaced by "screw pumps". Similar amendments should be made in other sections of the report where necessary.

We confirm that `submersible pumps' have been substituted in the assessment with `screw pumps' as advised.

S.4.3.6 (p.35) para. 2 has been revised to read "Three screw pumps with a SWL of 85 dB(A) each . . .". It should be noted that the figures in Table 4.21 are very conservative as they do not include mitigation afforded by shielding effect of building walls, and assumes simultaneous operation of two pumps and generator.