FINAL REPORT

Environmental Protection Department
Hong Kong Government

West Kowloon Refuse Transfer Station Study: *Initial Environmental Impact Assessment*

May 1994

ERM Hong Kong
in association with

Mouchel Asia Limited
and
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Reference C1089

For and on behalf of ERM Hong Kong

Approved by: P. Flick

Position: Principal Consultant

Date: 26 May 1994

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1 INTRODUCTION

1.1 BACKGROUND

The long-term municipal waste disposal strategy for Hong Kong calls for the provision of three strategic landfills and a network of transfer stations to centralise the collection and transportation of waste in bulk to these landfills for disposal. Two refuse transfer stations have come into operation since 1990, namely the Kowloon Bay Transfer Station (KBTS) in Kowloon and the Island East Transfer Station (IETS) on Hong Kong Island. A third refuse transfer station located in Sha Tin will commence operation in 1994. In order to provide adequate disposal capacity and to cater for the general growth in waste arisings from Kowloon, Kwai Chung and Tsuen Wan, it has been proposed to construct a new transfer station at West Kowloon. The West Kowloon Transfer Station (WKTS) will provide for the reception and transfer of publicly and privately collected waste.

In January 1993, ERM Hong Kong (previously ERL (Asia)) was appointed by the Environmental Protection Department (EPD) of the Hong Kong Government to carry out a study into the requirements of the WKTS. Following the environmental issues considered in the previous working papers, this report presents the findings and recommendations of the Initial Environmental Impact Assessment (IEIA) for the WKTS.

1.2 OBJECTIVES OF THE IEIA

This IEIA is based on the outline design produced by the consultants and acts as a scoping document, outlining the main environmental issues and the preliminary mitigation measures.

This IEIA has been conducted in accordance with the Hong Kong Planning Standards and Guidelines (HKPSG) and with cognisance of relevant environmental legislations. The IEIA has the following objectives:

- to assess the potential environmental impacts upon sensitive receptors during the construction and operational phases of the WKTS;
- to recommend preliminary measures for the mitigation of any significant impacts to acceptable levels;
- to recommend environmental monitoring and audit requirements for the construction and operational phases; and
- to identify further work that may be required once the final design has been confirmed, in order to ensure that there are no significant impacts from the construction and operation of the WKTS.

1.3 STRUCTURE OF THE REPORT

In meeting the objectives set out above, the structure of the report is as follows:

- *Section* 2 describes the main features of the construction and operational phases of the WKTS.

- *Section 3* assesses the environmental impacts likely to occur during the construction phase of the WKTS, and recommends appropriate mitigation measures to minimise potential impacts. These issues include air quality, noise, water quality, landuse and visual impact.

- *Section 4* assesses the environmental impacts likely to occur during the operational phase and recommends appropriate mitigation measures. The issues include air quality (including odour), noise, water quality, visual impact, and bird, rodent and insect control.

- *Section 5* presents the environmental monitoring, audit and performance requirements during the construction and operation of the WKTS.

- *Section 6* concludes the findings of the study and summarises recommendations for mitigation and environmental protection.

2 THE WEST KOWLOON TRANSFER STATION (WKTS)

2.1 FACILITY CONCEPT

The WKTS will provide for the reception and transfer of publicly and privately collected waste. The waste received will be transported to the new West New Territories (WENT) Landfill at Nim Wan by sea in Lo-Lo type vessels. At present approximately 2,200 tonnes per day of municipal waste is collected by refuse collection vehicles (RCVs) in the whole of Kowloon, Kwai Chung, Kwai Tsing and Tsuen Wan areas. It is required that the KBTS and WKTS together can handle all public and private waste from Kowloon, Kwai Chung, Kwai Tsing and Tsuen Wan areas by the year 2011.

It is envisaged that the WKTS will be operational by 1996. The primary objectives of WKTS are to transfer the whole of the balance of publicly collected waste arising within the Kowloon/Kwai Tsing/Tsuen Wan catchment. This balance will be equal to about 1654 tonnes in 2011. However, the station should also be designed with the aim of transferring the maximum reasonable tonnage of privately collected waste arising within the same area.

2.2 STATION LAYOUT AND STRUCTURES

The site on which the outline design is based, has an area of about 1.85 ha. The proposed layout of the WKTS facility is shown in *Figure 2.1*. The transfer station building measures approximately 118 x 42 m in plan and lies parallel to the quayside, setback by approximately 35 m. The internal access road to provide traffic circulation for vehicles bringing wastes to the facility is 8 m wide, allowing two lanes of traffic. On the ramp, this width has been increased to 9 m to enable vehicles travelling in either direction to manoeuvre past a broken down vehicle or other blockage.

All traffic entering and leaving the site will be required to weigh in at the weighbridges unless alternative arrangements are agreed. There will be 4 weighbridge units (2 'in' and 2 'out') each with dimensions of 15 x 3 m. There will be three vehicle wash bays equipped with water collection and recycling facilities. Two crane units, with a semi-portal layout, with one long travel rail elevated and one at ground level, will be constructed between the transfer station building and the waterfront.

An office and maintenance workshop will also be constructed to the west of the transfer building bounded by the internal access road.

2.3 ACTIVITIES DURING CONSTRUCTION

The present construction programme for the works is expected to run from April 1995 to July 1996. All the construction activities will be restricted to the site. The main construction activities will include:

- *Site Formation Works*, as the site is reasonably level, grading works will only take place from April to June 1995;
- *Piling*, this will include driven steel H-piles during the period from May to August 1995;
- *Concrete Works*, for all buildings including paving and hardstanding from July to November 1995;
- *Steelwork Erection*, mainly in the transfer station building from October 1995 to February 1996;
- *Plant Erection*, from January to July 1996; and
- *Crane Erection*, from May to July 1996.

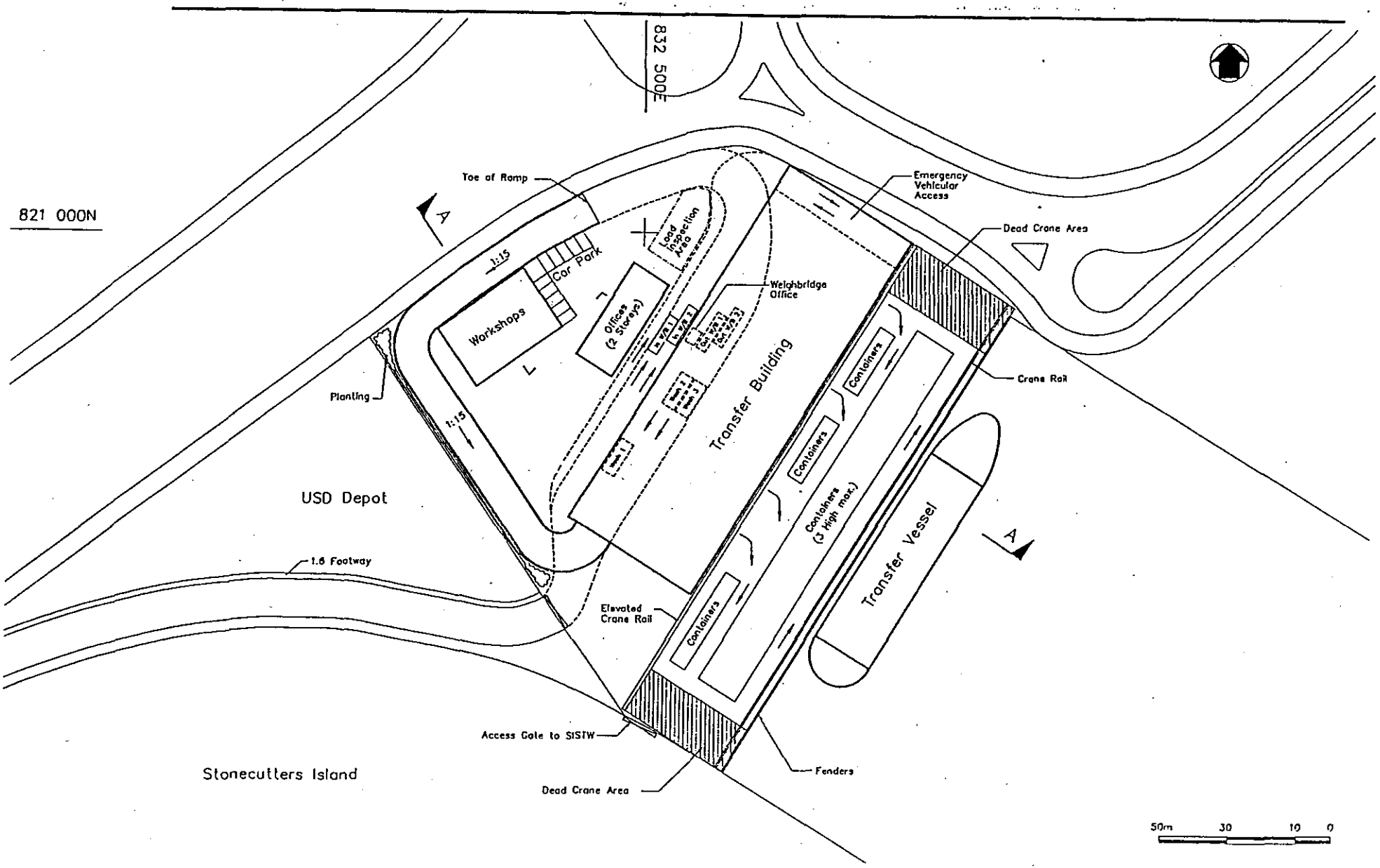
No major excavation work beyond that required for simple foundations is anticipated and therefore minimal quantities of material will be generated. All excavated material will be re-used on-site. There will be no on-site concrete batching plant as all concrete will be delivered ready-mixed to the site. No major stockpiling of materials is envisaged.

Major plant and equipment for the construction activities is likely to include:

- 1 piling rig;
- 1 concrete pump;
- 2 cranes (1 tower and 1 mobile); and
- other miscellaneous equipment.

The majority of movements into and out of the site will be for the delivery of ready-mix concrete with a peak delivery rate of about 40 wagons per day. The distribution will depend on the location of individual works areas. Other movements will be the irregular delivery of materials, dependant on the works progress, an estimate of 5 deliveries per day throughout works duration has been used in the subsequent analysis. There will be no unpaved haul roads due to the nature of the site. The proposed working hours will be 0700-1900 and the peak workforce will be about 75.

Figure 2.1 *Site Layout*



2.4 *ACTIVITIES DURING OPERATION*

Refuse Collection Vehicles (RCVs) carrying a typical payload of about 5 tonnes will enter the WKTS via the access road. The sequence of events at the transfer station will comprise:

- vehicle reception, weighing, checking documentation;
- vehicle discharge, return to service (collection round);
- waste processing and unit load formation; and
- unit load handling.

Vehicle reception will be over electronic weighbridges where they will be weighed, identified and if required, their loads sampled at the side of the route into the transfer station. Because of the variations in arrival patterns and discharge times, some queuing of delivery vehicles will occur on a regular basis, and the layout of the site takes this into account so that queuing back onto the public highway does not occur.

The preferred outline design utilises waste compactors with and without walking floor push pits. Access to the upper tipping floor by ramp will enable RCVs and other vehicles to discharge into the compacting equipment under gravity.

The waste process equipment will compact the waste into 20ft ISO containers which will be mounted on trailers towed by tug units. These will take full containers under shore mounted cranes which will perform the shore-ship (and vice versa) interchange.

The transportation system will normally be by sea-going vessel on a daily basis to WENT, where similar shore mounted cranes will unload the full containers to store or to landfill slave vehicles. In exceptional circumstances, such as when the typhoon warning is raised, alternative transport by road trailer will be employed if practicable.

The operational workforce would be about 60 (including EPD staff). The proposed normal working hours will be 0730-2330 with reduced operation from 2330-0130. The station will be open from 0430 to accept occasional deliveries of waste but other operations will not commence until 0730.

The WKTS will operate with the minimum environmental disturbance. Wastewater from RCVs, the vehicle wash bays (after reuse), from refuse during its compaction or from washing in the tipping hall and compactor floor, will be collected and drained to the on-site wastewater treatment plant. The refuse transfer operation will be enclosed within the transfer building which will be ventilated to avoid any build-up of dust and other air pollutants. The exhaust air from the ventilation system will be filtered to remove air pollutants and odourous substances to acceptable levels.

2.5 *WASTE ARISINGS*

Domestic and commercial/industrial waste arisings and catchment areas have been discussed in Working Paper 2 and the subsequent addendum to Working Paper 3. *Table 2.5a* outlines the estimated daily waste throughput to WKTS in different design years.

Table 2.5a ***Predicted Daily Waste Throughput***

Design Year		1996	2001	2006	2011
Daily Waste Throughput (tonne)	Domestic	1000	1510	1919	2500
	Commercial/Industrial	1450	990	581	0
	Total	2450	2500	2500	2500

2.6 *TRAFFIC GENERATION*

Working Paper 3 has addressed in detail the transportation issues of the WKTS. It is assumed that the commercial and industrial waste will arrive mainly on smaller vehicles of 3 tonne capacity which will be unloaded by hand. The arrival pattern of publicly collected waste will follow the patterns governed by USD/RSD working methods. This is best characterized by the early morning 'peak' in deliveries. The overall arrival pattern will be governed by those of the privately collected and commercial/industrial wastes. *Table 2.6a* shows the predicted daily and peak hour traffic generation due to the WKTS operation.

Table 2.6a ***Predicted Daily and Peak Hour Vehicle Trips***

Design Year		1996	2001	2006	2011
Daily vehicle trips	RCVs @ 5 tonne	200	302	384	500
	Other vehicles @ 3 tonne	484	330	194	0
	Total	684	632	578	500
Peak hour vehicle trips	Total	56	50	45	53

The highest delivery rates are expected around 0930 with a second, smaller, peak at about 1600. These figures reflect normal daily averages, for Monday peaks an additional 15% throughput can be assumed.

3 CONSTRUCTION PHASE: APPRAISAL OF ENVIRONMENTAL IMPACTS

3.1 LANDUSE IMPACT

3.1.1 Introduction

The WKTS will be located in the northern part of the West Kowloon Reclamation (WKR) in an area designated for the purpose (see *Figure 3.1a*). It is scheduled that the construction phase will last from early 1995 to mid-1996. This section assesses the potential landuse impacts associated with the construction works.

3.1.2 Existing and Planned Landuse

Existing Landuse

The nearest existing neighbourhood to the proposed WKTS is Lai Chi Kok District which is dominated by a large private residential estate, Mei Foo Sun Chuen which is bisected the Kwai Chung Trunk Road. To the northeast of the estate are Lai Chi Kok Hospital and Reception Centre and to the east of the estate there is a bus depot, a sand depot, a sewage treatment works, part of the premises of Haking Wong Technical Institute, and the decommissioned Lai Chi Kok Incinerator. To the west of the estate is the Lai Chi Kok Park Swimming Pool and Indoor Games Hall, and other Government/community facilities. Further west, to the north of Kwai Chung Road is Ching Lai Court, a residential development, and Princess Margaret Hospital and its associated quarters.

The majority of the reclamation for the area opposite Mei Foo Sun Chuen has been completed with the exception of a strip that borders the estate. A sewage treatment works, a water boat dock and a reprovisioned shipyard are in place in the reclaimed land close to Stonecutters Island, which is designated for military use. Container Terminals (CT) 7 and 8 have been started with some quay-side gantry cranes, rail-mounted gantry cranes and lighting poles already in place. Some of the reclaimed land is also being used for the temporary storage of containers.

Planned Landuse

In mid-1995, at the commencement of the construction activities, land use in the Kowloon hinterland will largely be as existing. The WKTS will be largely surrounded by land reserved for container terminals and container back-up uses, and other industrial uses.

According to the *Stonecutters Island – Outline Zoning Plan S/SC/2 (1992)* and the *West Kowloon Reclamation Outline Development Plan – Northern Section D/K20A/A (1991)* , the following landuses will be in the immediate vicinity of the WKTS site (see *Figure 3.1a*):

- container related uses reserved for container back–up;
- CT 7 and 8;
- petrol filling station (PFS);
- sewage treatment works;
- possibly a Urban Services Department Depot;
- Industrial (B), boatyards and other marine–oriented industrial uses;
- Route 3/West Kowloon Expressway (WKE), Lantau and Airport Railway (LAR) and Route 9;
- Lai Chi Kok Park (to the immediate west of Mei Foo Sun Chuen);
- a strip of district open space as an extension of Lai Chi Kok Park, acting as a buffer for the transport corridor (Route 3/WKE and LAR);
- possibly a regional stadium; and
- Route 16 Interchange and surrounding amenity spaces.

By the time the WKTS construction phase starts, this part of the WKE will have been completed. CT 7 and 8 will be operational, forming an extension of the container facilities from Kwai Chung. The final construction phases of Route 3/WKE and LAR will be concurrent with the construction of the WKTS.

Construction works for Lai Chi Kok Park to the immediate west of Mei Foo Sun Chuen are scheduled to commence in 1994, and the rest of the park works (to the south of Mei Foo Sun Chuen) are to commence in 1996 with interim landscaping treatment commencing in 1994.

The WKTS site may become a Joint User Development (JUD) with 100 m^2 of office space provided for the Kowloon West District Land Office (DLO/KW).

The construction of the LAR and the WKE will overlap with the construction, and in the case of the LAR, the operation of the WKTS until mid–1977. All constuction works will require sea access and this will call for careful scheduling. Additionally, LAR construction access will need to be provided during the operation of the transfer station, possibly whilst the waste transfer vessel is berthed.

3.1.3 *Potential Impact and its Significance*

As most activities will be on newly reclaimed land where existing landuses are restricted to the boatyard and part of the sewage treatment works, direct disruption of existing land uses is unlikely. The traffic associated with the construction is considered to be too small to cause any traffic problem. The construction works may have impacts on adjacent sensitive receivers in terms of noise and dust generation, and they are discussed in the corresponding sections.

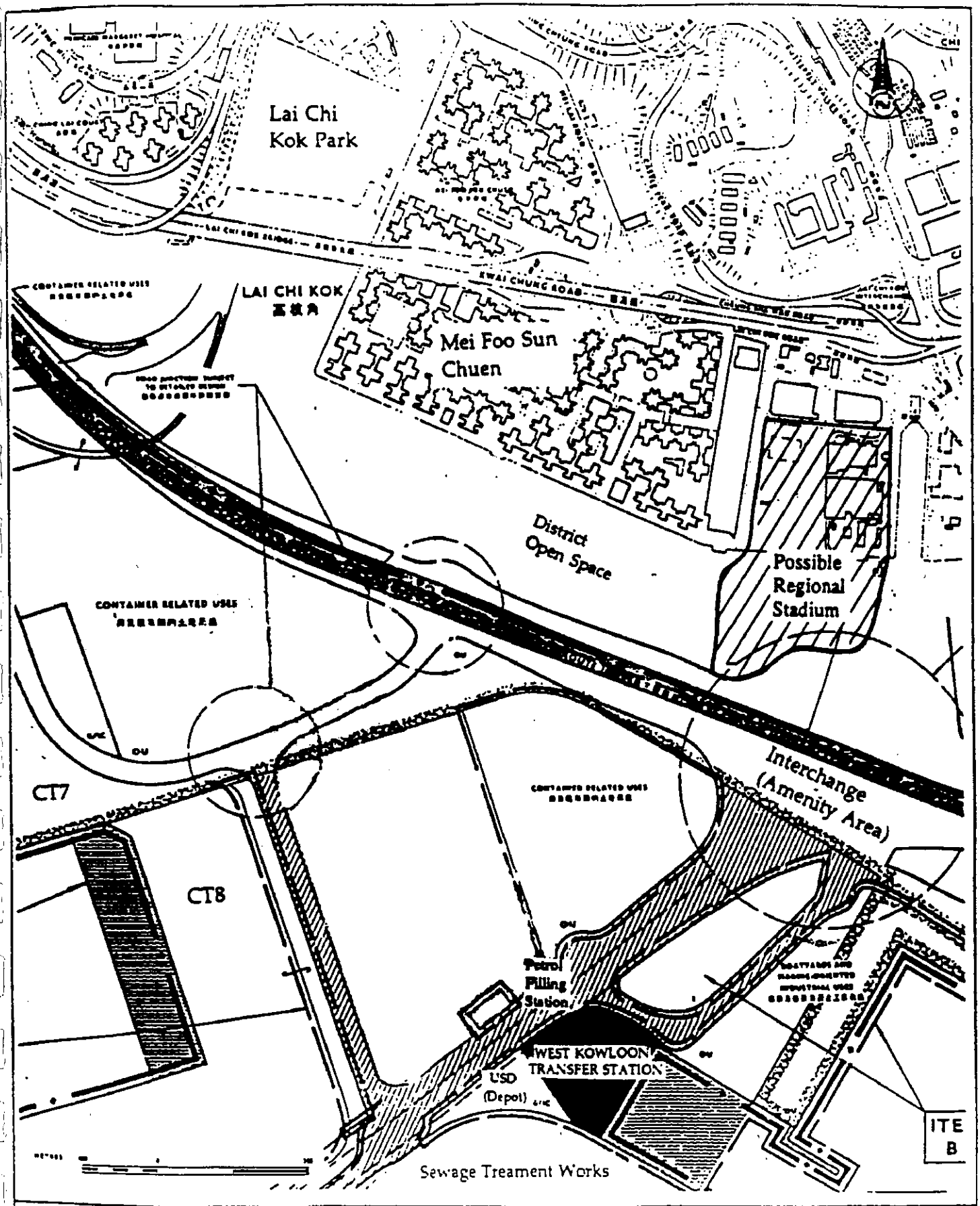


Figure 3.1a Planned Landuse in the Vicinity of the WKTS

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10-11th Floor
Hecny Tower
9 Chatham Road
Tsimshatsui, Kowloon
Hong Kong

Since all construction works will be within the boundary of the transfer station site, no land take issue is envisaged.

There will be various concurrent construction works for developments on the newly reclaimed land. Careful planning of construction works and liaison with responsible authorities will be essential to avoid any conflicts.

3.1.4 *Conclusions*

The WKTS will be built on newly reclaimed land planned for the purpose and no significant landuse impact is anticipated. However, construction of the LAR and WKE may impact upon the construction and early operational programmes of the WKTS.

3.2 AIR QUALITY

3.2.1 Introduction

Construction activities to be carried out at the proposed site have the potential to generate significant amounts of dust if uncontrolled. These dust generating activities include handling of excavated material and general construction works.

Other pollutants such as sulphur dioxide, nitrogen oxides and fine particulates may arise from the exhaust emissions of trucks and other diesel powered mechanical equipment within the works site. Due to the limited numbers of construction equipment and plant to be used on site, emission impacts from these sources are expected to be insignificant.

3.2.2 Government Legislation and Planning Standards

The limits of ambient dust levels are laid down in the Hong Kong Air Quality Objectives (AQO) as shown in *Table 3.2a*.

Table 3.2a *Hong Kong Air Quality Objectives*

Pollutant	Concentration ($\mu g\ m^{-3}$)	
	Averaging Time	
	24 Hours (ii)	1 Year (iii)
Total Suspended Particulates (TSP)	260	80
Respirable Suspended Particulates (RSP) (iv)	180	55

Note: (i) Measured at 298°K (25°C) and 101.325 kPa (one atmosphere).
(ii) Not to be exceeded more than once per year.
(iii) Arithmetic means.
(iv) Respirable suspended particulate means suspended particles in air with a nominal aerodynamic diameter of 10 μm and smaller.

An hourly average TSP limit of 500 $\mu g\ m^{-3}$ for construction dust is recommended by EPD for assessing construction dust impacts. This limit is not statutory but has been used in many construction works in Hong Kong as a contractual requirement.

3.2.3 Air Sensitive Receptors (ASRs)

The nearest existing ASRs are Mei Foo Sun Chuen and Haking Wong Technical Institute at Cheung Sha Wan and they are about 500 m from the proposed WKTS site. A regional stadium is proposed for the area adjacent to Mei Foo Sun Chuen.

3.2.4 *Baseline Conditions*

Existing Air Quality

The air quality of the area is predominantly affected by vehicle emissions from local road networks and to a lesser extent by industrial emissions from flatted factories at Cheung Sha Wan.

Air quality data from EPD's monitoring station at Sham Shui Po, closest to the proposed site can be used to give a general indication of the air quality of the study area. In addition, dust monitoring data from environmental monitoring and audit reports from the Environmental Project Office (EnPO) for West Kowloon Area can be used to give an indication of the existing dust levels in the area.

Dust monitoring results for the first quarter of 1993 indicate that the TSP levels at Cheung Sha Wan and Mei Foo Sun Chuen are acceptable with the 24-hours TSP levels ranging from approximately 75-140 $\mu g\ m^{-3}$ and 50-150 $\mu g\ m^{-3}$, respectively.

Future Air Quality

Construction of the WKE, Route 3, and LAR will be carried out concurrently with the construction of the WKTS on the WKR. In view of the number of construction programmes likely to take place concurrently with the construction of the WKTS, it is considered necessary to minimize any additional but temporary contribution of dust from the construction of the WKTS to the surrounding environment.

During the operation of the WKTS which is likely to be after 1996, the air quality of the area is expected to deteriorate in terms of NO_x and particulates due to additional traffic on new road networks.

Local Meteorological Conditions

Meteorological data from the Hong Kong International Terminal Automatic Weather Station (AWS) are considered to be adequate to present the general meteorological conditions for Lai Chi Kok. *Figure 3.2a* shows the wind rose for the Hong Kong International Terminal for the period of 1985-1987. It can be noted that the prevailing wind direction is from the northeasterly to southeasterly quadrant, and about 65% of the wind speeds are lower than 3 $m\ s^{-1}$.

3.2.5 *Potential Sources of Impacts*

The area of the works site is estimated to be about 18,500 m^2. The potential dust sources likely to be generated from the construction of the WKTS are:

- *Site Formation*

  It is expected site formation will only consist of grading works as the site should be reasonably level. Only a small amount of excavated material will result from site formation works and no major stock piling on site is envisaged. It is expected that the site formation works will only take 3 months from the commencement of the construction programme.

- *Concrete Works*

  Concrete works are required for all buildings including paving and hardstandings. All concrete will be delivered to the site as ready-mix and consequently no on-site concrete batching plant is required.

- *Truck Movements*

  Major vehicle movements into and out of the site are for the delivery of ready-mix concrete. It has been estimated that in total there would be about 45 vehicle movements each way per day during peak construction activities. It is expected that all haul roads will be paved.

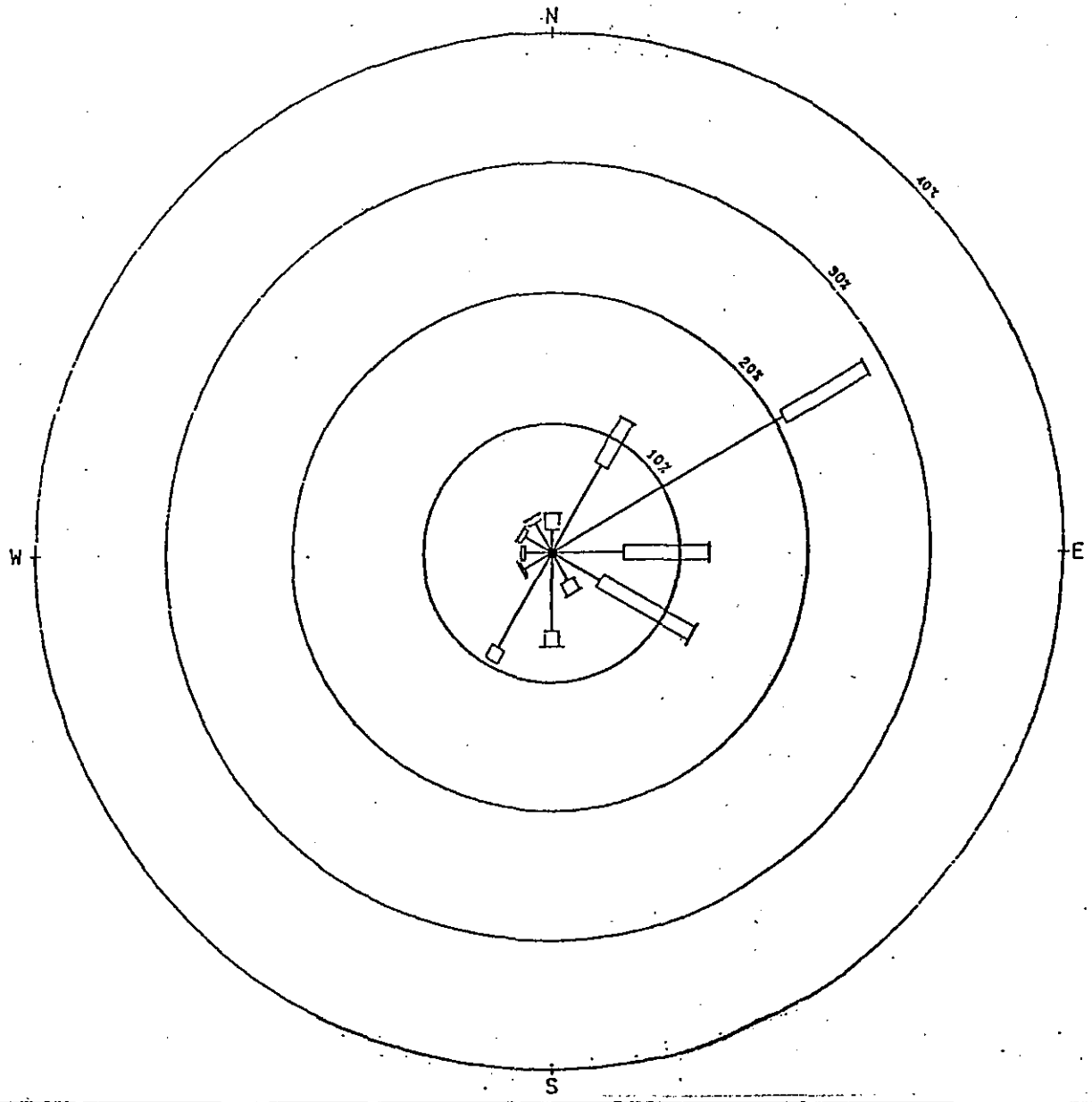
- *Other construction activities*

  Minimal dust will be generated from steelwork, plant erection and crane erection after the concrete works have been finished.

3.2.6 *Assessment Methodology*

The potential drift distance of dust particles is governed by the emission height, the particle terminal settling velocity and the degree of atmospheric turbulence. Particles with diameters between 30-100 μm are likely to undergo impeded settling. Normally these particles would settle within 100 m of the source of emission. It is generally recognized that dust nuisance to ASRs is mainly caused by particles with diameters less than or equal to 30 μm, which is the maximum size for TSPs. Therefore, this assessment will only consider TSP impacts.

Dust emissions from vehicle movements on paved haul roads is expected to be insignificant. The amount of excavation is expected to be small and due to the relatively wet nature of the excavated material, no significant dust impact from excavation is anticipated. Therefore this assessment only focuses on the dust emissions from general construction activities.



1985 - 1987

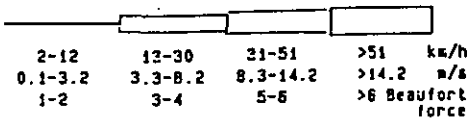
ANNUAL

NO. OF OBSERVATIONS = 21902

NO. OF VARIABLE = 6 (.0 %)

NO. OF CALM = 66 (.3 %)

PERCENTAGE FREQUENCY



WIND SPEED

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Figure 3.2a Wind Rose for the Hong Kong International Terminals AWS (1985 – 1987)

Dispersion Modelling

A Gaussian dispersion model, the Fugitive Dust Model (FDM), was used to predict the dust levels from potential sources to sensitive receptors. Gravitational settling velocity and deposition velocity was calculated by FDM for a particle size of 30 μm. A particle density of 2,500 kg m^{-3} was also assumed.

Meteorological Input

It is expected that the construction of the WKTS will be carried out during the day (0700–1900). Stability class D and a typical wind speed of 2 m s^{-1} are expected to be representative of daytime meteorological conditions, and were used as the meteorological input to FDM. Worst case wind directions (ie winds blowing directly from the works site to the ASRs) were used in the prediction of maximum dust impacts from the construction works.

Dust Emission Rates

The dust emission rate from construction activities is dependent on the total area of the works site where construction activities are likely to take place and the level of activities.

An emission rate of 1.16×10^{-4} g m^{-2} s^{-1} was adopted from the *US EPA – Compilation of Air Pollutant Emission Factors, AP–42, 4th Edition, 1985* for general construction works. Since the number of vehicle movements per day is expected to be low and the haul roads on the works site are expected to be paved, dust impacts from vehicle movements to ASRs about 500 m from the site are expected to be insignificant.

The model predictions are on an hourly basis and all results are primarily hourly dust concentrations. Since wind directions and speeds vary throughout the day, these variations would be likely to result in a lower daily average TSP level at a specific location than the predicted worst case (ie constant wind direction and speed throughout the hour) hourly average TSP level.

The predicted dust levels are compared to the recommended hourly dust limit of 500 μg m^{-3} for compliance.

Daily TSP Impact

Daily TSP impacts can be extrapolated from the hourly impacts with the knowledge of the daily variations of wind speeds and directions, and the daily construction programme. An estimate of the worst case daily TSP impacts can be easily calculated by considering the number of working hours per day. Without construction activities, the dust emissions should be negligible. It is anticipated that the construction of the WKTS will be carried out for 12 hours per day. As such, the worst case daily TSP impacts could be estimated by multiplying the predicted worst case 1–hour average

TSP concentrations with a working factor of 0.5 (ie construction will be carried out for only half a day).

Background TSP and Potential Cumulative Impacts

The background dust level at the time of the construction of the WKTS will depend on the progress of other construction activities associated with developments on the WKR. It would be unrealistic to assume any future TSP levels without a thorough and reliable knowledge of the programme of other constructions on the WKR. Therefore, this IEIA will only assess the potential impacts from the construction of the WKTS.

3.2.7 *Evaluation of Impacts*

Maximum hourly TSP levels of 16 $\mu g\ m^{-3}$ and 10 $\mu g\ m^{-3}$ were predicted at Mei Foo Sun Chuen and Haking Wong Technical Institute respectively. The potential dust impacts from the construction of WKTS alone will be well below the recommended hourly dust limit of 500 $\mu g\ m^{-3}$.

The estimated maximum daily TSP levels at the ASRs were 8 $\mu g\ m^{-3}$ and 5 $\mu g\ m^{-3}$ at Mei Foo Sun Chuen and Haking Wong Technical Institute respectively. It can be noted that dust impacts from the construction of the WKTS to ASRs 500 m from the works site will be insignificant and well below the AQO and the recommended 1-hour dust limit.

The worst case dust impacts are likely to occur during the early stage of the construction when a small amount of excavated material will result from site formation. After the site has been levelled, much of the construction will be steel works and the dust impacts would be much less.

However, it is considered desirable that the Contractor should implement dust suppression measures during the construction stage in order to minimize dust emissions and potential cumulative dust impacts with other developments in the area to the ASRs.

3.2.8 *Mitigation Measures*

Although the construction of the WKTS alone will not result in significant dust impacts on the nearest ASRs, cumulative dust impacts with other concurrent construction activities may pose a threat to the recommended hourly limit of 500 $\mu g\ m^{-3}$ and the daily AQO of 260 $\mu g\ m^{-3}$. In view of the potential cumulative dust impacts from other construction activities in the area, dust mitigation measures and good on-site management should be adopted in order to reduce dust impacts during the construction phase of the WKTS.

Dust suppression measures which would be required at the construction site and should be included in the tender documentation are as follows:

- regular watering of excavated material and stockpiles; and
- side enclosure and covering of any aggregate or stockpiles.

The initial dust assessment shows that no significant impacts would result from the construction of the WKTS. However, any further studies should take account of the potential cumulative dust impacts from other concurrent construction activities in the area. As the construction of the WKTS will contribute to the overall dust levels in the area, a dust monitoring and audit programme may be required. Details of the programme are presented in *Section 5.3.1.*

3.2.9 *Conclusions*

In this preliminary air quality assessment, no significant dust impacts on the distant ASRs are expected from the construction of the WKTS. Predicated dust levels from the WKTS alone being well below the daily AQO of 260 μg m^{-3} and the recommended hourly dust limit of 500 μg m^{-3}. However, dust suppression measures such as frequent watering should be adopted during the construction stage in order to minimize any dust contribution from the construction activities to the surrounding area in the light of the probable concurrent construction programmes.

With regard to construction impacts, the assessment of the finalised design should include a detailed environmental monitoring and auditing programme.

3.3 WATER QUALITY

3.3.1 *Introduction*

The proposed WKTS will be located on the newly reclaimed land connecting Stonecutters Island and the Kowloon Peninsula in West Kowloon. Water quality impacts arising from construction of the WKTS, and recommended mitigation measures are discussed in the following sections.

3.3.2 *Government Legislation and Planning Standards*

Under the Water Pollution Control Ordinance (WPCO), Hong Kong waters are subdivided into 10 Water Control Zones (WCZ). Each WCZ has a designated set of statutory Water Quality Objectives (WQO). The proposed WKTS is situated on the southern waterfront of the inlet created between Stonecutter's Island and West Kowloon. Stormwater discharged from the WKTS site will ultimately enter Lai Chi Kok Bay in North West Kowloon marine waters. Under the WPCO, this part of the marine water falls within the Victoria Harbour WCZ. The Victoria Harbour will be the last control zone to be declared and is tentatively scheduled for gazettal in 1995.

The **Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters** (TM), issued under Section 21 of the WPCO, defines acceptable discharge limits to different types of receiving waters. Under the TM, effluents discharged into the inshore and marine waters of the Victoria Harbour WCZ are subject to standards for particular volumes of discharge. These are defined by EPD and specified in licence conditions for any new discharge within a WCZ.

3.3.3 *Baseline Conditions*

Existing Environment

Water quality in the marine waters of North West Kowloon is well documented by the EPD marine water quality monitoring programme. A summary of EPD monitoring data (for 1990) is given in *Table 3.3a*.

In general, the data indicate that mean water quality conditions are acceptable with respect to biochemical oxygen demand (BOD) when compared to the WQO for the Western Buffer WCZ which lies immediately to the west of Victoria Harbour WCZ. The inorganic nitrogen level is high, with the mean level exceeding the WQO and indicating the potential for eutrophication. The *E. Coli* count is high and dissolved oxygen saturations are relatively low compared to mean saturations as a result of the discharge of untreated sewage from the West Kowloon area. Suspended solids levels in *Table 3.3a* are relatively low in the waters around the WKTS; although recent reclamation and dredging works have elevated ambient levels.

Table 3.3a Summary Statistics of Water Quality in Rambler Channel (1990)

Determinants		N. W. Kowloon
Temperature (°C)	Surface	23.1 (16.0 – 29.7)
	Bottom	22.9 (15.9 – 28.6)
Salinity (ppt)	Surface	30.1 (24.4 – 33.6)
	Bottom	30.5 (25.1 – 33.6)
DO (% satn.)	Surface	53.2 (13.5 – 128.1)
	Bottom	50.4 (15.6 – 106.6)
pH		8.1 (7.1 – 8.8)
Secchi Disc (m)		1.5 (0.8 – 3.2)
Turbidity (NTU)		6.7 (1.6 – 29.2)
SS (mg/l)		7.2 (1.8 – 23.0)
BOD_5 (mg/l)		1.5 (0.2 – 5.2)
Inorganic N (mg/l)		0.46 (0.05 – 0.80)
Total N (mg/l)		1.08 (0.43 – 1.94)
PO_4 –P (mg/l)		0.065 (0.002 – 0.130)
TP (mg/l)		0.114 (0.027 – 0.237)
Chlorophyll a (μg/l)		3.887 (0.200 – 18.667)
E. coli (no./100ml)		8914 (67 – 120000)

Note: 1. Except as specified, data presented are depth average data.
2. Data presented are annual means except for *E. coli* data which are annual geometric means.
3. Data enclosed in brackets indicate the ranges.

Future Conditions

Water quality may decline temporarily as a result of the West Kowloon Reclamation (WKR) programme until 1995. However, the water quality in north-west Kowloon is expected to improve by 1995 with the implementation of Stage I of the Strategic Sewage Disposal Scheme (SSDS). By 2006/2011, with gazettal of the Victoria Harbour WCZ and the implementation of Stage II of the SSDS, there will be improvement in the baseline water quality with reduced untreated effluent loadings.

Sensitive Receivers

In order to evaluate the water quality impacts during the construction phase, the proximity of Water Sensitive Receivers (WSRs) to the work sites must be considered.

There are no major biologically sensitive receivers such as mariculture zones, commercial fisheries, shellfisheries, or water gathering grounds within the vicinity of the study area.

Water intakes on the WKR need to be considered as WSRs for construction run-off and operational discharges.

3.3.4 *Potential Sources of Impact and their Significance*

The WKTS will be built on the WKR, the major sources of water quality impacts that can potentially arise from the construction of WKTS will be similar to those of normal construction activities. These will include:

- construction runoff and drainage;
- general construction activities; and
- sewage from on-site construction workforce.

These potential impacts on water quality and their significance are discussed in the following sections.

Construction runoff and drainage

Runoff and drainage from construction sites may contain increased loads of sediments, other SS and contaminants. Potential sources of pollution from site drainage include:

- runoff and erosion from site surfaces, drainage channels, earthworking and stockpiles;
- bentonite slurries and other grouting materials;
- concrete batching plant washout and drainage from dust suppression sprays; and
- fuel, oil and lubricants from construction vehicles.

Construction runoff and drainage may cause both physical and biological effects. The physical effects may include blockage of drainage channels and increased SS concentrations in receiving waters. Possible biological effects include toxicity caused by mixtures of hydrocarbons and grouting materials and reduction in DO levels caused by high SS concentrations.

Good site management such as the implementation of proper site practice measures to control and treat run-off prior to discharge will ensure that the construction works will not affect the quality of the receiving waters or have significant impact upon WSRs.

General Construction Activities

On-going site construction activities will have the potential to cause water pollution from the following:

- debris and rubbish such as packaging, used construction materials and floating refuse; and
- spillages of liquids such as oil, diesel and solvents are likely to affect water quality if they enter surrounding water bodies.

The effects on water quality from construction activities other than by runoff is likely to be minimal. Site boundary security will need to be maintained and good construction practice should be observed to ensure that litter, such as floating refuse, fuels and solvents do not gain access to the stormwater system in the area.

Sewage Effluents

Sewage effluent arises from sanitary facilities provided for the construction workforce. Based on the scale of the construction work, it is estimated that around 75 workers will be employed. However, this will greatly depend on the construction activities on site and will vary throughout the construction period. Assuming that each worker produces 55 litres of sewage effluent per day [1], the total sewage effluent discharge would be equivalent to about 4 m^3 per day for the on site workforce. This amount of sewage may require some form of treatment before discharge.

Depending on the availability of the public sewerage system, sewage effluents can be discharged to local sewer near the works site. However, if an existing foul sewer is not available, it is likely that interim sewage treatment facilities such as chemical toilets and packaged sewage treatment facilities will be necessary to treat the sewage arising from the on-site construction workforce, before discharging to the adjacent coastal waters.

[1] Guidelines for the design of small sewage treatment plant, EPD 1990.

The TM standards should be applied to any sewage effluent discharges. Assuming a site population of 75, a flow rate of approximately 4 m^3 per day is produced, for which the effluent standards are:

Suspended Solids	30 mg l^{-1}
Biochemical Oxygen Demand	20 mg l^{-1}

These standards should be readily achieved with the installation of portable treatment units.

3.3.5 *Mitigation Measures*

Although construction is not envisaged to cause any unacceptable impacts upon the surrounding waters, it is important that appropriate measures be implemented to minimise the cumulative impacts associated with other ongoing construction work in the area. Proper site management is essential to minimise wash off during rainy seasons and "good housekeeping" practices to ensure that debris and rubbish cannot gain access to the stormwater system should be implemented in order to meet the requirements of the TM.

The following provides a guideline on the standard measures which need to be enforced:

- *Site runoff* : All site construction runoff should be controlled and treated to prevent discharges of waste water with high levels of SS and to ensure the TM standards are met. The following measures may be utilised to achieve this result.
  - The boundaries of earthworks should be marked and surrounded by dykes or embankments for flood protection as necessary.
  - Temporary ditches should be provided to facilitate runoff discharge into the appropriate watercourses, via a silt retention pond.
  - Permanent drainage channels should also incorporate sediment basins or traps, and baffles to enhance deposition.
  - Sediment traps must be regularly cleaned and maintained by the contractor. Daily inspections of such facilities should be required of the contractor.
  - Collection of spent bentonite or other grouts in a separate slurry collection system either for reuse or disposal to landfill.
  - All traps (temporary or permanent) should also incorporate oil and grease removal facilities.
  - All drainage facilities must be adequate for the controlled release of storm flows.

- Minimising of exposed soil areas to reduce the potential for increased siltation and contamination of runoff.

- *Debris and Litter* : In order to comply with the aesthetic criteria for the proposed Victoria Harbour WQO, contractors should be required to ensure that site management is optimised and that disposal of any solid materials, litter or wastes should not occur to surface and marine waters.

- *Oils and Solvents* : All fuel tanks and store areas should be provided with locks and be sited on sealed areas, within bunds of a capacity equal to 110% of the storage capacity.

- *Sewage* : All polluted water should be treated before discharge. Small integrated treatment units are available which combine grease traps and treatment chambers with aeration and settlement facilities. The treated effluent can subsequently be discharged to 'storm sewer', providing it complies with the TM. This level of treatment should be readily achieved by standard portable treatment units.

3.3.6 *Monitoring Requirements*

No water quality monitoring is considered necessary.

3.3.7 *Conclusions*

The construction of the WKTS is unlikely to have significant impact on the surrounding water quality. However, proper site management and good construction practice is essential to ensure minimal water quality impact.

3.4 CONSTRUCTION NOISE

3.4.1 Introduction

In this section, the existing and future noise environment in the vicinity of the WKTS site is described, and noise sensitive receivers (NSRs) identified. Noise emissions from WKTS construction activities and the potential impacts on the NSRs are evaluated based on the best information available at the time of study.

3.4.2 Baseline Conditions

Noise Sensitive Receptors

The proposed location for the WKTS is on the WKR, which is planned predominantly for port and industrial development and transport infrastructure. The WKTS site is located between Mei Foo Sun Chuen (MFSC) to the north, and Stonecutters Island to the south.

In the immediate vicinity of the site the Water Supplies Department (WSD) depot contains offices and staff quarters some 100 m to the south-east, this will be the nearest NSR (*NSR 1*).

Stonecutters Island is a military base with scattered low-rise development, most of the dwellings are located on the south side of the island, and will be screened from the WKTS by a 40 m high ridge. A group of developments near the piers on the north-east side of the island, about 700 m south-east of the WKTS, have been identified as the nearest residential NSR *(NSR 2)* for the purposes of this study. Between NSR 2 and the WKTS, the direct noise propagation path will be partly obstructed by a group of 2-3 storey buildings along the northern seawall of the sewage treatment works currently under construction.

The second closest residential NSR to the proposed WKTS is MFSC, the blocks are about 620 m to the north of the WKTS and are identified as *NSR 3*. MFSC is a large private residential estate comprising densely developed building blocks of less than 20 storeys in height.

Existing Conditions

The WSD depot is located in an area of noisy port and industrial related activities amongst extensive reclamation and construction work all of which is likely to have a direct impact upon the immediate noise climate.

Stonecutters Island is outside the Noise Exposure Forecast (NEF) 30 contour for Kai Tak Airport flight path. As the NSR is within the restricted area of the military base, noise measurements have not been conducted for the study. It is considered that the current WKR construction works would have only indirect affect on the local noise climate.

As MFSC is located within the NEF 30 contour of Kai Tak, the noise contribution from aircraft noise is noticeable. Twenty-four hour noise monitoring surveys were carried out as part of the WKR study in August 1990 on the roof of two MFSC residential blocks, located at the southern edge of the estate. During the surveys, the noise contribution from the reclamation works for the north portion of the WKR, which is now mostly completed, was also measured. The results of the measurements [1] indicated that the estate was comparatively quiet. Typical background noise levels (L_{90}) for daytime and night-time were 60 and 52 dB(A) respectively.

Future Conditions

During the construction stage of the WKTS (planned for 1995-9), it is expected that ambient noise levels will increase significantly due to the construction and operation of the WKE/Route 3, the LAR and the operation of CT7 and 8, and the cumulative noise effect of other industrial developments in the vicinity, such as the container back-up facilities, and the sewage treatment works and this will affect NSR 1.

NSR 1 will be located in the midst of many of these activities, whilst NSR 2 is not expected to be significantly affected by any of the surrounding developments. NSR 3, notwithstanding the fact that a open space buffer zone of approximately 150 m wide has been planned to protect the MFSC residents, will be affected by these noise sources.

3.4.3 *Government Legislation and Planning Standards*

General Construction Works

For the general construction works, noise emissions during restricted working hours are controlled by the application of a construction noise permit (CNP) system, under the provisions of the Noise Control Ordinance (NCO), and enacted in accordance with the procedures stipulated in *Technical Memorandum on Noise from Construction work other than Percussive Piling* (TM 1).

There are no statutory criteria for the control of construction noise during daytime hours (0700-1900), Monday to Saturday.

Noise restrictions are imposed during the evenings (1900-2300), night-tim (2300-0700), and all day on Sundays and Public Holidays. For construc works during these restrictive hours, a CNP is required from the EPD will assess the application in accordance with the TM. Acceptable Noi Levels (ANLs), which must not be exceeded, have been stipulated ass no correction for the duration of the CNP or multiple site effects. The are given in the following table:

[1] "West Kowloon Reclamation - Construction EIA Report" ERL at el, Jan 1991.

Table 3.4a *Acceptable Noise Levels (ANLs) for General Construction Work*

Time Period	Area Sensitivity Rating		
	A	B	C
All days during the evening (1900 to 2300 hours), and general holidays (including Sundays) during the daytime and evening (0700 to 2300 hours)	60	65	70
All days during the night time (2300 to 0700 hours)	45	50	55

Area Sensitivity Ratings (ASRs) have been assigned for the NSRs based on the consideration of the future noise conditions in the study area and indicated in *Table 3.4b* below.

Table 3.4b *Area Sensitivity Rating Criteria*

Type of area containing NSR	Not Affected[1]	Indirectly Affected[2]	Directly Affected[3]
(i) Rural area, including country parks or village type developments	A	B	B
(ii) Low density residential area consisting of low-rise or isolated high-rise developments	A	B	C
(iii) Urban area	B	C	C
(iv) Area other than those above	B	B	C

(1) Not Affected means that the NSR is at such a location that the noise generated by the influencing factors[4] (IF) is not noticeable at the NSR.
(2) Indirectly Affected means that the NSR is at such a location that the noise generated by the IF, whilst noticeable at the NSR, is not a dominant feature of the noise climate of the NSR.
(3) Directly Affected means that the NSR is in such a location that the noise generated by the IF is readily noticeable at the NSR and is a dominant feature of the noise climate of the NSR.
(4) Influencing Factors are defined as industrial areas, major roads or the area within the boundary of Hong Kong International Airport.
Source: Technical Memorandum on Noise from Construction Work other than Percussive Piling.

NSR 2 at Stonecutters Island, being a low-rise development, and only indirectly affected by noise from the sewage treatment works in the main, has been allocated an ASR of "A". The corresponding ANLs for general construction works are 60 dB(A) for all evening and public holiday work, and 45 dB(A) at night.

For NSR 1 at the WSD depot and NSR 3 at the MFSC, the ASR is taken as "C", and the corresponding ANLs for general construction works are 70 dB(A) for all evening and public holiday work, and 55 dB(A) at night.

Percussive Piling Works

Noise criteria applied to control the noise from percussive piling activities are detailed in the *Technical Memorandum on Noise from Percussive Piling* (TM 2). Considering the receivers as having windows or other openings but no

central air conditioning system, the ANL for piling noise is given in the TM as 85 dB(A) for all three NSRs.

A permit will be required from EPD for the carrying out of percussive piling. In determining the issue of a permit, EPD compares the corrected noise limit (CNL) with the ANL, and in the event that the CNL exceeds the ANL, EPD will impose restrictions on the permitted hours of piling operation in accordance with *Table 3.4c.*

Table 3.4c ***Permitted Hours of Percussive Piling Operation***

Amount by which CNL exceeds ANL	**Permitted hours of operation on any day not being a general holiday**
more than 10 dB(A)	0800–0900 and 1230–1330 and 1700–1800
between 1 dB(A) and 10 dB(A)	0800–0930 and 1200–1400 and 1630–1800
no exceedance	0700–1900

3.4.4 Potential Sources of Impact

The Design–Build–Operate nature of the project allows flexibility for the Tenderers in the detailed design, such as details of the actual construction methods and arrangements which are therefore not available for this study. The scope of this study is to establish a notional inventory of the major powered mechanical equipment (PME) likely to be used during the peak construction periods, as in *Table 3.4d,* and to evaluate the possible extent of the noise impacts from the key construction activities.

Table 3.4d *Notional Inventory of Major PMEs*

Works Description	Duration	Equipment	Quantity	Sound Power Level dB(A)
Site Formation	April–Jun 95	Bulldozer	1	115
		Rollers	2	108+3[1]
		Grader	1	113
		Total		**118**
Piling	May–Aug 95	Piling Rig (internal drop, drop hammer, or diesel hammer)	1	113–132
		Mobile Crane	1	112
		Lorry	1	95
		Total		**112[2]**
Concrete Work	Jul–Nov 95	Truck mixers	3	109
		Concrete pump	1	109
		Poker vibrators	2	113+3
		Compressor	1	109
		Generator	1	108
		Total		**119**
Steel Work/Plant Erection	Tower crane	1	1	95
	Mobile crane	1	1	112
	Lorries	2	2	112+3
		Total		**117**

(1) A doubling of the sound power level increases the noise level by 3 dB.
(2) Excluding contributions from percussive piling.

3.4.5 *Assessment Methodology*

Assumptions for noise prediction

The noise assessment methodology used was generally in accordance with the TM procedures. However, as the distance between source and receiver for NSRs 2 and 3 is in excess of 300 m, the following adjustments were included with regard to standard acoustical principles and practices.

- Atmospheric absorption: The correction depends on noise frequency and climatic conditions. Conservative corrections based on the CONCAWE [1] report were used. Analysis showed that the most important frequencies for the construction noise were 500 Hz, 1 kHz and 2 kHz. The correction used was therefore derived as the logarithmic average of the corrections for each of these frequencies.

- Barrier Attenuation: A correction of 0 dB, –5 dB, or –10 dB is taken in TM1 depending on whether the noise source is fully visible, partially or completely screened respectively. The noise propagation between the

(1) The Propagation of Noise from Petroleum and Protrochemical Complexes to neighbouring communities, Nov 1977 and April 1981.

sources and the NSR 1 is identified as being partially screened by the 2 – 3 storey buildings of the sewage treatment works and a barrier correction of –5 dB is taken in the assessment.

- Facade correction: A 3 dB correction is be added to account for the facade reflection effect of the high rise development of MFSC.

Analysis of the Noise Sources

Exact prediction of construction noise is not possible, as it varies in intensity and character, much depends on the location and duration of activities as well as variations in the types of activity and plant involved. The approach of this study was to analyse all the activities involved, and to model the major noise emission in a logical way.

The assessment for the general construction works will be considered collectively at notional source positions 50 m from the point on the site boundary nearest to the NSRs. The possible requirement for percussive piling of the driven steel H-piles for the station building is analysed separately under TM2 at the same notional points.

The analysis of construction noise is based on a tentative works programme from April 1995 to July 1996. CNLs can be calculated at the NSRs by taking the total corrections [1] due to distance, atmospheric absorption, barrier, and facade effect from the combined source sound power level (SWL). The corrections are shown in *Table 3.4e* below.

Table 3.4e *Noise Attenuation Corrections (dB(A))*

Receiver	Distance	Atmospheric Absorbtion	Barrier Correction	Facade Effect	Total Correction
NSR 1	–48	0	0	+3	–45
NSR 2	–66	–5	–5	+3	–73
NSR 3	–64.5	–4.6	0	+3	–66

3.4.6 *Evaluations of Impacts*

The results of the initial construction noise predictions, carried out in accordance with the methodology discussed in *Section 3.4.5*, are summarized in *Table 3.4e.*

When the predicted CNLs were compared with the noise criteria discussed in *Section 3.4.3*, it was found that general construction activities would result in noise levels at NSRs 2 and 3 below the evening and holiday criteria by more than 20 dB(A).

[1] The total correction for NSR 1 is –73 dB, an assumption of 770 m, –5 dB for atmospheric absorption, –5 dB for barrier, and +3 dB for facade effect. The total correction for NSR 2 is –66 dB, as summations of the 4 corrections at –64.5, –4.6, 0, and +3 respectively.

The notional construction programme was proposed on the basis of the working hours 0700–1900, and no evening or night-time work will be required. For the consideration of the worst-case scenario, evaluation of the predicted noise levels against night-time criteria was also included in *Table 3.4f*, based on the assumption that the same scale of activities are maintained. It is indicated that the night-time noise criteria can generally be met at NSRs 2 and 3, however, the margin below the criteria is less than 3 dB(A) during periods for the combined works of site formation/piling, piling/concrete works, and concrete/steel works.

At NSR 1 it is possible that the daytime criteria may be exceeded by some of the combined activities, evening and night-time criteria will certainly not be achieved.

Table 3.4f *Initial Construction Noise Prediction*

General Construction Works								
Scheduled Months	**Works Description**	**Total SWL**	**NSR2 – Stonecutter Island**			**NSR3 – MFSC**		
			CNL dB(A)	**Possible Constraint by TM1 Criteria**		**CNL dB(A)**	**Possible Constraint by TM1 Criteria**	
				65 dB(A)	**Night 50 dB(A)**		**70 dB(A)**	**Night 55 dB(A)**
Apl 95	Site Formation	118	42	No	No	52	No	No
May 95	Site Formation/Piling	119	43	No	No	53	No	Marginal
Jun 95	Piling	112	36	No	No	46	No	No
Jul 95	Piling/Concrete Work	120	44	No	No	54	No	Marginal
Aug 95	Concrete Work	119	43	No	No	53	No	No
Sep 95	Concrete Work	119	43	No	No	53	No	No
Oct 95	Concrete/Steel Work	121	45	No	No	55	No	Marginal
Nov 95 – Jul 96	Steel/Erection Work	117	41	No	No	51	No	No

Percussive Piling Works						
Scheduled Months	**Piling Methods**	**Total SWL**	**NSR2 – Stonecutter Island**		**NSR3 – MFSC**	
			CNL dB(A)	**Possible Permitted Hours for piling by TM2**	**CNL dB(A)**	**Possible Permitted Hours for piling by TM2**
May – Jul 95	Internal drop hammer	113	37	0700 to 1900 hrs	47	0700 to 1900 hrs
	Drop hammer	126	50	0700 to 1900 hrs	60	0700 to 1900 hrs
	Diesel hammer	132	56	0700 to 1900 hrs	66	0700 to 1900 hrs
	Double acting hammer	135	59	0700 to 1900 hrs	69	0700 to 1900 hrs

The noise generated by the percussive piling operation of the WKTS will be below the ANL of 85 dB(A) for all different piling methods considered (by more than 15 dB(A) at NSRs 2 and 3). Thus piling is likely to be permitted on any day not being a general holiday, between the period of 0700–1900.

3.4.7 *Conclusions and Recommendations*

The noise emissions associated with the construction of the WKTS can be controlled by the application of separate permits, for piling operations and for other general construction works, during restricted hours in the evenings, public holidays, and night-time. Impacts from daytime construction work are not expected to exceed the 75 dB(A) criterion.

If evening or night-time construction working is required it will be necessary to reassess noise impacts upon NSR 1 (the WSD depot) when the details of the site layout and construction programme are finalised. The use of acoustic screens or restriction on the SWL during these periods may be required in order to obtain a CNP.

3.5 VISUAL IMPACTS

3.5.1 Introduction

The visual impacts which are likely to arise during the construction phase of WKTS are assessed below. The assessment has been based largely on information presented in previous related environmental studies. Site visits and a review of maps have also been undertaken to gather further information to allow this preliminary assessment of the extent and levels of impacts.

3.5.2 Baseline Conditions

Existing Visual Quality

The WKTS will be situated on the WKR. The immediate visual catchment area is shown in *Figure 3.5a*, which indicates the areas from which the WKTS might be a significant visual addition to the surrounding area. The boundary of the catchment is largely contained by development along the original waterfront to the north and east, and by the container storage areas to the west. To the south the views open to more distant vantage points from Stonecutters Island and Hong Kong Island.

To the north of the WKTS site is Mei Foo Sun Chuen, a large residential estate containing a number of 20-storey blocks. To the northwest of the site is another residential development, Ching Lai Court, behind which lies the Princess Margaret Hospital.

On the coastal plain and associated reclaimed land northwest of the site, the container terminals stretch north towards Kwai Chung. The reclaimed land is flat, and is covered with bulky sheds and depots associated with the storage industries, and the container storage areas themselves. The skyline is broken by a profusion of large multicoloured cranes and mechanical lifting devices juxtaposed with the waterfront areas.

The area southeast of Mei Foo is currently given over to a number of different waterfront activities, ranging from small shipyards to wholesale markets and storage depots. Further south, it is dominated by the more visually sensitive housing areas of Nam Cheong and Tai Kok Tsui. The visual environment is generally degraded with the exception of Nam Cheong Estate and the recently completed park at Tung Chau Street.

The WKR works currently being undertaken opposite Mei Foo have largely altered the character of the area. The reclamation is almost completed except for the area bordering the estate. A reprovisioned shipyard and a sewage treatment works have been established on the reclaimed land close to Stonecutters Island. In the area designated for container use, some areas have been occupied for container storage, and CTs 7 and 8 are under construction with some of the gantry cranes (coloured orange) and large lighting poles already in place. The extensive reclaimed sea area, together

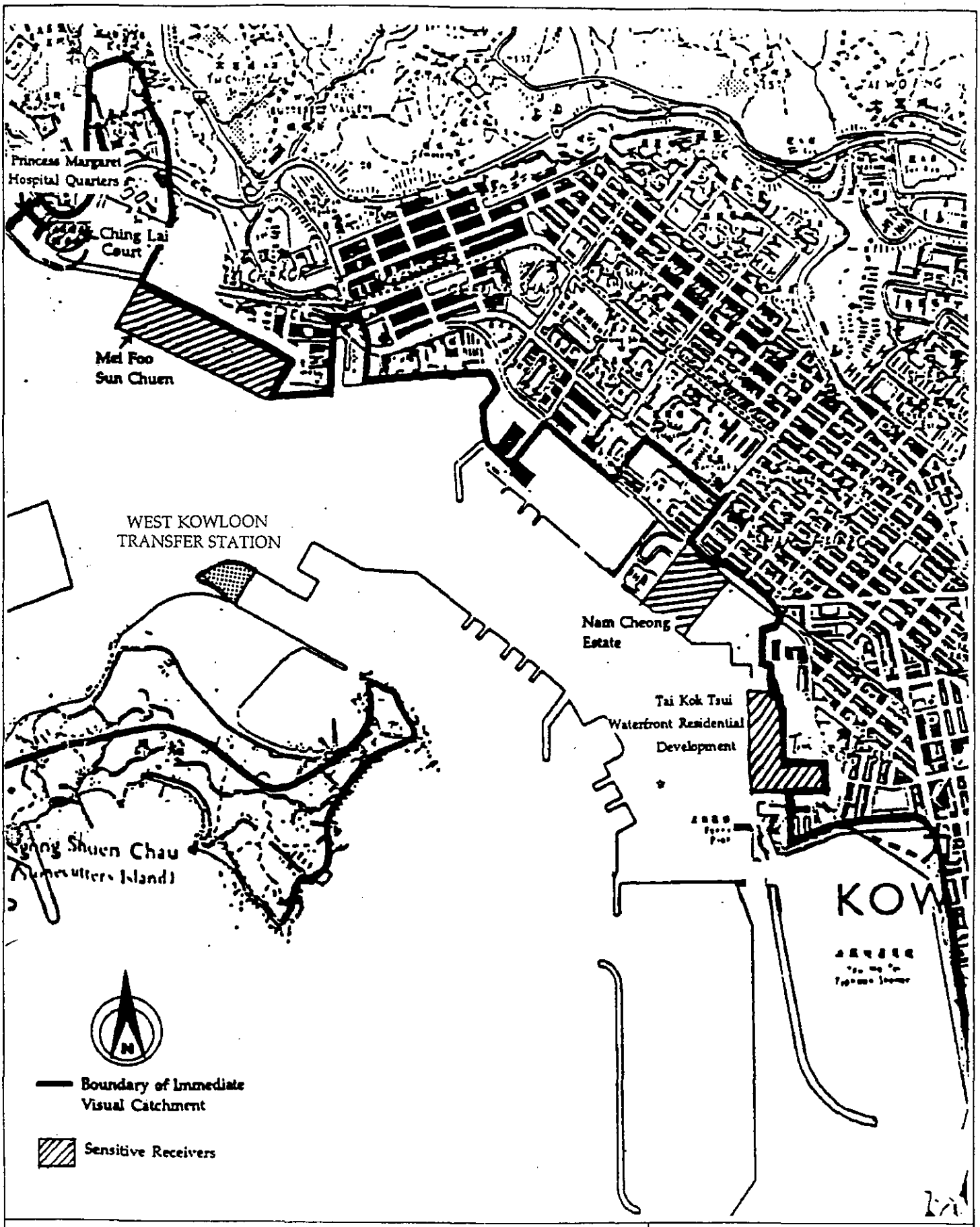

Figure 3.5a Immediate Visual Catchment and Sensitive Receivers

ERM Hong Kong

10-11th Floor
Hecny Tower
9 Chatham Road
Tsimshatsui, Kowloon
Hong Kong

ERM

with the ongoing reclamation and construction works, is highly visually intrusive.

The existing visual quality of the area is low, with its mixture of residential and industrial character, and the expanse of newly reclaimed land.

Future Visual Quality

By the time the WKTS construction phase starts, this part of the WKE will have been completed. CT 7 and 8 will be operational forming an extension of the container facilities from Kwai Chung characterised by large multicoloured gantry cranes and stacked containers.

The construction phases of Route 3/WKE and LAR, and possibly the Port Rail Terminal, will be concurrent with the construction of the WKTS.

The construction works, the transport corridor and the industrial development will reinforce an already disturbed visual environment.

3.5.3 *Sensitive Receptors*

The WKTS is highly visible from the waterfront development to its north, with medium to long views from the east and south.

Sensitive receptors during the construction works are largely restricted to land uses located on the original water front. The receptors identified in this assessment are residential and open space areas. Various institutions, and commercial and industrial areas are considered to be less sensitive. Sensitive receptors in the immediate environment of the proposed works include :

- Mei Foo Sun Chuen;
- Ching Lai Court;
- Princess Margaret Hospital Quarters;
- Nam Cheong Estate in Sham Shui Po; and
- Waterfront residential blocks in Tai Kok Tsui.

These are shown in *Figure 3.5a*.

Most of the views into the works site will be characterised by disturbed sea views with extensive newly reclaimed land and construction works for new development.

All the distant views such as from waterfront residential blocks along Ferry Street in Yau Ma Tei and Hong Kong Island can be considered as having a background view of the site. The scale of the surrounding urban framework will reduce the perceived level of impact and the visual intrusion will be insignificant. Therefore, this distant viewer group is not considered further.

Transitory views from roads and ferries are not considered to be affected as their length of exposure is limited.

3.5.4 *Potential Sources of Impact*

The construction activities and structures involved in the roughly 1.8 ha site may be visually intrusive due to their proximity to local residents. The main activities will be associated with site formation, piling, concrete works, steelwork erection, plant erection and crane erection.

Larger construction plant and equipment present on the site will be visible and may be highly intrusive from certain vantage points. The intrusive elements include a piling rig, a concrete pump, mobile and tower cranes, and trucks.

3.5.5 *Evaluation of Impacts*

In general, the presence of construction plant and materials, spoil heaps, access roads, site traffic, general working areas and possibly night time lighting (including security lighting) may cause a visual disturbance.

However, the current WKR work has already disturbed the view of the waterfront area and will form an extensive area of bare earth ready for development. By the time the WKTS construction starts, the works will be viewed against the already disturbed surroundings with development works concurrently taking place, in particular the LAR and Route 3/WKE construction are closer to and have larger impacts upon sensitive receivers to the north. The specific intrusion from the WKTS will be seen as a small part of a wider range of activity. In addition, the approximately 150 m wide planted open space buffer and the elevated transport structures will provide low level screening of the WKTS development. Therefore, it is considered that the construction activities of the WKTS will not significantly increase already existing visual intrusions.

3.5.6 *Conclusion*

Significant impacts from the WKTS construction works are not expected considering the existing visual intrusion due to other WKR works and the future effects of the LAR and Route 3/WKE. In addition, the planned open space buffer will be planted and will provide low level screening to the Mei Foo Sun Chuen residents to the north.

4 OPERATION PHASE: APPRAISAL OF ENVIRONMENTAL IMPACTS

4.1 AIR QUALITY

4.1.1 Introduction

The main air quality issues associated with the operation of the WKTS are identified as follows:

- traffic emissions due to exhausts from associated movements of refuse collection vehicles (RCVs);
- operational dust from tipping of refuse into compacting hoppers;
- operational odour and litter from tipping of refuse into hoppers and interface of compactors; and
- odour from RCV's travelling to and from WKTS.

Most of the potential impacts can be mitigated through careful design of the transfer station and good on-site management. It should be noted that most of the dust and odour emissions will be confined within the station and potential air quality impacts upon the surrounding area are considered to be insignificant.

4.1.2 Government Legislation and Planning Standards

Operational Dust

The dust limits have been discussed in *Section 3.2.2* and shown in *Table 3.2a*. In addition to complying with the Hong Kong AQOs for dust at the site boundary, it is also recommended that Contractor should control the level of dust within the transfer station to below 1 mg m^{-3} (24 hours average). The level, being one tenth of the Occupational Exposure Limit (EH40/92) level, is not statutory in Hong Kong but has been adopted in the environmental performance tests during the commissioning of the Island East Transfer Station (IETS).

Vehicle Emissions

WKTS deliveries will be made using heavy duty diesel-powered vehicles. Under the 1989 Road Traffic Ordinance (*Road Traffic (Construction and Maintenance of Vehicles) Regulations*), vehicles shall be constructed and maintained so as not to emit excessive smoke. Vehicles may be stopped and examined for excessive smoke emission. These vehicles will not be under the control of the WKTS operators.

It is recommended that carbon monoxide (CO) and nitrogen dioxide (NO_2) in the tipping hall should be maintained in accordance with EH40/92, the maximum allowable CO and NO_2 levels are 55 mg m^{-3} and 5 mg m^{-3} respectively.

Containers will be moved from the compactors to the quayside using diesel powered tugs, these would not normally be used off site.

Under extreme weather conditions it may be necessary to transport the containers by road, in this case heavy-duty diesel powered vehicles will be used.

Operational Odour

EPD identify an offensive odour as one which exceeds two odour units as indicated by the EPD odour panel. This definition can be used to identify odours which are considered to cause a nuisance beyond the site boundary.

4.1.3 *Potential Sources of Impacts*

Operational Dust

The only source of dust during the operation of the WKTS is from the tipping of refuse into hoppers.

When the waste falls into the hoppers, air is displaced which will drive dust particles of various sizes and small debris from the waste into the atmosphere of the tipping hall. Confining dust laden air to the immediate vicinity of the hopper by means of flexible curtain will enable the dust to be collected, or in the case of heavier particles, to fall back into the hopper, thus minimising dust nuisance within the WKTS.

Vehicle Emissions

Future developments in the vicinity of the station will be affected by emissions from vehicles associated with the operation of the WKTS. The extent of vehicle emission impacts on the nearest ASRs (see *Section 3.2.3)* depends on the number of vehicle movements. The peak traffic associated with the operation of the WKTS has been estimated to be about 56 vehicle movements each way per hour in 1996, reducing to 53 vehicles each way per hour in 2011.

At the time of writing, the JUD option to be considered is 100 m^2 of office space for DLO/KW, traffic numbers associated with this should be negligible.

Operational Odour

- *Transfer Station*

  The atmosphere of the tipping hall is expected to be odorous from the tipping of refuse into the hoppers. Thus, odour removal equipment (such as activated carbon adsorption) is required on the discharge from the tipping hall air extraction/scrubbing system. The odour removal equipment should have a very high affinity for volatile organic nitrogen and sulphur compounds and should be easily renewable upon exhaustion of the adsorbent material.

  In addition, the air in the compactor area is expected to be odorous. An air collection and odour treatment system should also be provided for this area.

- *Off-site impacts*

  It has been noted from the environmental performance tests of the IETS that some detectable odours in the vicinity may be traceable to the incoming RCVs.

- *Wastewater treatment system*

  The wastewater treatment system has the potential to produce odour emissions, and in particular when the system is under batch mode operation. The Contractor will be required to take into account odour control in the design of the treatment system, eg inclusion of odour filter in the ventilation system.

4.1.4 *Evaluation of Impacts*

Operational dust

Under normal operation of the WKTS, the site will be regularly swept and air from the tipping area vented through a dust filter. As dust can interfere with the efficiency of odour removal equipment, in particular activated carbon beds, as well as increasing the pressure drops, efficient dust removal prior to odour removal is therefore cost effective. No significant amounts of dust will be generated to cause a nuisance to the surrounding environment.

Operational odour

There is no recognised prediction methodology for the quantitative assessment of odour impacts that can be effectively applied to a waste transfer station.

The prediction of odour levels beyond the site boundary is constrained because a perceived odour nuisance can be caused by brief exposures which are very difficult to model and results may be non-representative due to uncertainties in the odour constituents and source concentrations. In

addition, the off-site operations of the RCV's are beyond the control of WKTS's operator.

For the purpose of this IEIA, it is more useful to review the findings with regard to odour in the environmental performance tests for a similar transfer station in Hong Kong. For the IETS, it was noted from the environmental performance tests that odours were not detectable across the street from the site.

As mentioned above, odour control equipment should be installed within the ventilation system of the WKTS. Several suitable types of plant are available and this, combined with a comprehensive cleaning programme, will ensure that off-site operational odour impacts can be effectively controlled.

Vehicle Emissions

During the operation of the WKTS, vehicles are likely to arrive at the station using different road networks and from all directions. The nearest ASRs identified at Mei Foo Sun Chuen will be mainly affected by vehicles on Kwai Chung Road and future road networks on the WKR such as Route 3. It is expected that the peak hourly vehicle flow on Kwai Chung Road in 1996 would be more than 10,000 vehicles and the contribution to the air quality at the ASRs from vehicles associated with the operation of the WKTS would be insignificant.

As only two car parking spaces will be required, additional traffic from the JUD will not create any significant air quality impacts.

4.1.5 *Mitigation Measures*

Operational Dust

The tipping hall should be kept under a negative pressure by an air extraction system, the air discharge should be scrubbed, with dust collection and separation. Thus any dust emitted in the tipping hall should be collected in the air ventilation/scrubbing system.

The air ventilation/scrubbing system for the tipping area should include the following features:

- tipping hall should be enclosed as far as practicable;
- tipping hall control room should be served by filtered, air conditioned air;
- containment should be fitted over hoppers on an individual basis by cladding and rubber or plastic curtains where there is a need for vehicle access for discharging;

- air should be extracted to a central cleaning plant via ducts from the containment area;

- all air should be circulated through the air cleaning plant in order to ensure minimum dust emissions off-site; and

- the ventilation exhausts should not be positioned facing directly onto any sensitive receptors.

Vehicle Emissions

To ensure no unacceptable exposure of workers in the tipping hall to NO_2 and CO, the air change rate (ie number of air change per hour) of the ventilation/scrubbing system for the tipping hall should be designed to meet the criteria of EH40/92 and avoid excessive accumulation of vehicle emissions.

Operational Odour

- *Station*

  Aside from a dust scrubber, odour control equipment should also be installed at the discharge of the tipping hall ventilation/scrubbing system. An air collection and odour treatment system should also be employed for the compactor area. Outlets of exhaust air from the WKTS should not impinge upon the air conditioning inlet of the office block in order to ensure there is no intake of odorous air or vehicle emissions to the JUD or other offices.

- *Water Treatment Works*

  Stagnation and accumulation of leachate will be odorous. Therefore, all leachate should be collected and transferred to an on-site wastewater treatment works as soon as possible.

- *Off-site Impact*

  In order to prevent any off-site odour nuisance, design of the WKTS should ensure that all RCVs will queue up within the WKTS.

  Possible odour impacts from vehicles leaving the WKTS will be mitigated by their passing through the vehicle wash prior to exiting the site. Vehicles coming to the site, and any odour emanating from them, are clearly beyond the control of the WKTS's operator. The station, parking areas and roads should also be regularly cleaned. Regular cleaning of the site will keep odour to a minimum. Provision of adequate vehicle washing facilities has been considered in the WKTS Outline Design. The outlined vehicle washing takes about 1 minute for RCVs and 1.5 minutes for an articulated vehicle. These times are for full wash cycles rather than a perfunctory rinse.

Windborne litter from the site should not be a major problem as the site will be regularly swept, and potential litter sources generally enclosed.

Acceptability of JUD

The JUD option of office development for DLO/KW under consideration will not produce any noticeable air quality impacts to the surrounding area. On the other hand, impacts from WKTS may be of concern. Although it is possible to design a central air conditioning system for site offices, including the JUD, in such a way as to further minimise odour nuisance from the operation of WKTS, incidents like mechanical equipment breakdown and power failure may still cause problematic consequences of odour nuisance. However, it is expected that the WKTS will be designed with sufficient back-up systems to deal with such eventualities.

4.1.6 *Conclusions*

In this preliminary assessment, no significant air quality impacts are anticipated from the operation of the WKTS provided effective mitigation measures are integrated into the design and good on-site practices are enforced.

4.2 WATER QUALITY

4.2.1 Introduction

The operation of the proposed WKTS and the associated JUD is not envisaged to generate a significant volume of effluent. An evaluation of the potential sources of impacts and the proposed mitigation measures are presented in the following section.

4.2.2 Government Legislation and Planning Standards

The TM sets out the limits for discharges and as discussed in Section 3.3.2, discharges to foul sewer and storm water will have to comply with the stipulated limits.

4.2.3 Baseline Conditions

Baseline conditions on water quality and water sensitive receivers have been discussed in Section 3.3.

4.2.4 Potential Sources of Impacts and Their Significance

Effluent from the WKTS

The operation of the proposed WKTS is not envisaged to generate great volumes of effluent discharges, there are three main sources of effluent arisings:

- foul water;
- sewage from on-site staff; and
- stormwater runoff.

Foul water and sewage will be discharged to the local sewage system for treatment at the nearby sewage works whilst clean runoff will be discharged to the stormwater drain.

- *Foul Water*

  Contaminated liquids may arise from RCVs; waste processing and unit load formation; washdown from the tipping hall and other internal operational areas; runoff from the ramp leading to the tipping area; liquids from road sweepers and gully emptiers; and vehicle washwater. These contaminated liquids will be high in BOD, oil and grease, in varying quantities, an estimation of wastewater quality is given in *Table 4.2a*. The foul water from the plant will have to undergo aerobic biological treatment to reduce the BOD, oil and grease levels to the TM limits given in *Table 4.2b*. A wastewater treatment plant will have to be installed on-site for this required treatment.

The on-site wastewater treatment plant will probably be similar to that currently being installed at the IETS which is essentially a batch reactor system with filter press. While detailed design capacity of the plant is not available at this stage, it is envisaged that the volume generation will be in the order of a few hundred cubic metres per day.

Table 4.2a ***Estimated Wastewater Quality***

Parameter	Estimated Concentration in Wastewater
pH	4–7
Total Suspended Solids (SS)	500–15000 mg l^{-1}
BOD_5	10000 mg l^{-1}
COD	20000 mg l^{-1}
Total Kjeldahl nitrogen	500 mg l^{-1}
Total phosphorus	0.1 mg l^{-1}
Oil and grease	10–300 mg l^{-1}

Source: Balfours International (Asia), 1991, Shatin Refuse Transfer Station – consultancy Study

Table 4.2b ***Effluent Discharge Standards[1] (mg l^{-1})***

Parameter	Limit
pH (pH units)	6–10
BOD	800
COD	2000
Oil & Grease	50
Total N	200
Total P	50

(1) Limit Values taken from the Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters, a flow rate of 200–600 m^3 per day has been assumed.

- *Domestic Sewage*

It is envisaged that around 60 staff (including EPD site staff) will be employed at the proposed WKTS. Sewage from toilets for on-site staff; washing facilities; and occasional visits by the RCV drivers, is expected to be discharged to the foul sewer which leads to the North West Kowloon Sewage Treatment Works.

The JUD option under consideration is 100 m^2 of office space for DLO/KW plus 2 carparks. Taking an estimated flow per employee of 0.25 m^3 per day, this JUD will produce an additional amount of sewage of several cubic metres per day.

- *Stormwater Runoff*

  Rainwater runoff is essentially uncontaminated run-off from "clean" areas such as roofs and car parking lots and may contain suspended solids and grit, particularly during the initial "first flush" of rainfall following periods of dry weather. It should be well segregated from contaminated areas such as the truck washing area, unloading zone, etc. and may be discharged to the storm water drain.

  Discharge to the local foul sewer will have to meet standards stipulated in the TM. In general, BODs and SS loads from normal office activities on site should comfortably meet their requirements and therefore be readily acceptable by the local sewer.

4.2.5 *Mitigation Measures*

Discharges from the WKTS must be controlled to comply with the effluent standards stipulated in the TM, mitigation measures to ensure no unacceptable impact on the nearby water bodies are outlined below.

- An on-site wastewater treatment plant will be necessary to treat the "contaminated water" from the plant prior to discharge to the foul sewer system.

- Contaminated runoff from ramps leading to the tipping hall should be properly diverted to the on-site wastewater treatment plant prior to discharge to public sewer.

- The site should be kept clean at all times. A detailed spill plan is recommended to outline action plans and mitigation measures required in the event of any spills, accidental or emergency discharges.

- Sediment traps and oil interceptors should be provided and maintained for discharges to the storm water drain. Regular inspection and cleaning of the traps is recommended to prevent release of sediment and oils to the drainage system or the receiving waters. Oily contents of the traps should then be disposed of to an appropriate facility, such as the Chemical Waste Treatment Centre on Tsing Yi.

- Sewage from on-site workforce and JUD under consideration should be connected to the local foul sewer system.

4.2.6 *Monitoring Requirements*

Effluent from the wastewater treatment plant must be constantly monitored to ensure that the discharge limits are met. A detailed monitoring and audit programme is recommended. An action plan should be included in the operations manual to outline the procedure and remedial action required in the event of an exceedance in the discharge limits.

4.2.7 *Conclusions*

The operation of the proposed WKTS is anticipated to generate small volumes of effluent which will most probably be discharged to the local sewer system. Contaminated water from the refuse transfer operation will need to be treated on site prior to discharge. However, as detailed design of the plant becomes available and information on the quality and quantity of discharges known, further assessment will be required to determine the most appropriate disposal option. The assessment should include detailed monitoring and audit requirements together with an action plan outlining any remedial action required if discharge limits are exceeded. A detailed spill plan should also be outlined.

The quality of effluent from the site during the operational phase will depend on the type of water treatment plant which is chosen for the WKTS. If the end product is of sufficiently high quality it could be used for the washdown of the tipping hall and compactor floor, thus reducing the demand for fresh water. This would need to be agreed with EPD once the plant performance parameters are known.

4.3 NOISE

4.3.1 Introduction

In this section, the existing and the future noise environments in the vicinity of the WKTS site are described, and noise sensitive receivers (NSRs) identified. Noise emissions from the WKTS operation, and its potential impacts on the NSRs, are considered on the basis of the best information available.

4.3.2 Baseline Conditions

The characteristics of the existing and the future noise conditions have been considered under Section 3.4.2 of the report, NSR 1 at the WSD depot, NSR 2 at Stonecutters Island and NSR 3 at MFSC were identified as the nearest noise sensitive uses to the WKTS development. The findings regarding the baseline conditions in *Section* 3.4.2 are also applicable to the appraisal of operational noise impacts.

4.3.3 Government Legislation and Planning Standards

Noise emissions from permanent sources in Hong Kong are controlled by the NCO, the details of the assessment procedure and criteria are stipulated in the "*Technical Memorandum for the Assessment of Noise from Places other than Domestic Premises, Public Places or Construction Sites*" (TM3). For major new development, reference is also made to the *Hong Kong Planning Standards and Guidelines* (HKPSG).

Procedures are stipulated in TM3 to determine the Acceptable Noise Level (ANL), these are measured as the $L_{Aeq,\ 30\ min}$ at the NSR in question depending on the Area Sensitive Rating (ASR). The ANLs in TM3 are given in the following table:

Table 4.3a *Acceptable Noise Levels ($L_{Aeq,\ 30\ min}$)*

Time Period	Area Sensitive Rating		
	A	B	C
Daytime (0700 to 1900 hours) and Evening (1900 to 2300 hours)	60	65	70
Night time (2300 to 0700 hours)	50	55	60

As discussed previously, NSR 2 has an ASR of "A", and the corresponding ANLs for general operations are 60 dB(A) for all evening and public holiday work, and 50 dB(A) at night.

For NSRs 1 and 3, the ASR has been taken as "C", and the corresponding ANLs are 70 dB(A) for all evening and public holiday work, and 60 dB(A) at night.

As an allowance for the cumulative effects of additional future noise sources, the HKPSG stipulates that for the planning of major new developments, the noise impact on the NSR should be restricted to 5 dB(A) below the appropriate ANL, or to the prevailing background noise level, whichever is lower.

As there are several large scale developments taking place concurrently, the prevailing background criterion is unlikely to be the limiting concern. The adoption of the ANL less 5 dB(A) criterion will be appropriate for the study, and the target noise levels (TNLs) are therefore:

TNL for NSR 2 at Stonecutters Island;

- L_{eq} 55 dB(A) for daytime and evening periods (0700–2300);
- L_{eq} 45 dB(A) for the night-time period (2300–0700).

TNL for NSR 1 at the WSD depot and NSR 3 at MFSC:

- L_{eq} 65 dB(A) for the daytime and evening periods (0700–2300);
- L_{eq} 55 dB(A) for the night-time period (0300–0700).

4.3.4 *Potential Sources of Impacts*

In the conceptual site plan, the WKTS is identified as being made up of three zones of approximate equal area. The vehicle access ramp, a workshop, an office building, weighbridges and vehicle wash equipment are planned for the north-west area which is mainly an open site.

The transfer station plant house, which is a two-level steel clad structure, is situated in the middle area. The upper level is the enclosed tipping hall, designed to accommodate the discharge of the refuse from RCVs into the hoppers. Plant house ventilation fans will also be located at this level. The ground level is mainly the loading area where the waste is fed by a total of 9 compactors into the 20 ft ISO containers. The auxiliary service system, including a waste water treatment room, a transformer room, and a fire service plant room, are also accommodated here.

The south-east of the site is planned as an open area for refuse containers which are moved by tug units between the compaction area, the container stacks, and the quay. The quay has berthing space for one of the two dedicated container vessels at a time. The transfer of the containers, full or empty, between the container vessel, the container stacks, and the awaiting tugs, is undertaken by two shore-based portal cranes with cantilever spans over the deck of the vessel.

The proposed normal working hours for the WKTS are planned to be 0730–2330. However, the WKTS will also be required to work on "reduced operation" to handle "mid-night waste", between the hours of 2330–0130, and 0430–0730. It is assumed in this study that the equipment utilisation and vehicle movements will be reduced to about 10% of full operational capacity during the night.

The potential noisy activities and equipment during the operation of the WKTS are identified and considered below.

Vehicle Movements on Internal Access Roads

The highest vehicle movements (forecasted for the years of 1996, 2001, 2006 and 2011) are predicted to reach a peak of about 112 per hour. This will comprise mainly 3 tonne open trucks and 5 tonne RCVs. It is estimated that on average there will be two of these vehicles moving along the access road and the elevated ramp, within the open area of the site at any one time.

Relevant noise test results and data on a number of types of diesel powered vehicles, similar to those which are expected to be used on site, as reported in several published sources, are referred to and summarised in *Table A4.3b* for comparison.

Table 4.3b *Comparative Tractor Noise Data*

Description	Reference	Drive-by maximum noise level dB(A)	Sound Power Levels SWL dB(A)
Tractor (CNP 222)	HK EPD, TM on noise from Construction Work other than Percussive Piling	N.A.	118
Dump Truck, 310 kw, 35 tonne	BS 5228: Part 1: 1984	91 at 10 m and 20 kph	119
Articulated Tractor, 255 kw, 38 t GVW	"Transportation Noise Reference Book", ed by Paul Nelson, Page 6/6	Standard vehicle -91 Quietened vehicle -79 (at 7.5 m, 50 kph and full throttle)	(116.5)[1] (104.5)
Yard Tractor/Trailers, Rail/Road container transfer in Los Angeles	"Noise Assessment Study for the Intermodel Container Transfer Facility", Noise Control Engineering Journal May-June 1986	82 at 100 feet	(119)

(1) SWL in brackets are derived on the basis as point source propagation in free field over reflective ground.

The noise data presented are derived from measurements of the maximum noise levels in the vehicle drive-by test, in which measurements are made at a fixed distance from vehicles under specific driving settings and full-throttle conditions. To apply the above data in deriving the average sound level (L_{eq}) to represent the combined noise emission in the study, a number of refinements will be required when detailed design and operation information is available.

For example, the factors for the time averaging are accounted for in BS:5228 with correction for the percentage on-time, which is taken as the duration of the activity for which the sound level is within 3 dB(A) of the maximum. The percentage of on-time generally differs from the plant on-time and it is

difficult to establish accurate values for mobile plant. It is often only possible to make an estimation based on measurements from existing or similar facilities.

The maximum drive-by sound power levels for the tugs, and the RCVs/lorries, are taken as 118 and 112 dB(A) respectively, these are based on the "Technical Memorandum on noise from Construction Work other than Percussive Piling".

As a different approach to the prediction of road vehicle noise emissions, the procedures stipulated in the "Calculation of Road Traffic Noise" (CRTN), DOE, UK, as adopted in the HKPSG, are often used. The CRTN is not specifically derived for traffic consisting solely of such highly powered vehicles in confined manoeuvring conditions and will be likely to lead to underestimates if applied directly in this study. Noise predictions based on CRTN are presented as $L_{10\,(1\text{-hour})}$ for a wide range of traffic conditions and it can be assumed that the road traffic noise L_{eq} is generally 3 dB(A) below the L_{10} figure, within a deviation of 0.5 dB(A) [1].

For the purposes of this study, noise predictions can be carried out under similar assumed design conditions, using both the "on-haul-road" equation in BS5228, and the CRTN procedures. It is believed the actual noise levels will be likely to fall between the predicted results under the above two methods and for this study, will be considered as average values.

Using BS5228 haul road equation:

$$L_{Aeq} = SWL - 33 + 10 \log Q - 10 \log V - 10 \log d$$

where SWL is sound power level, taken as 118 dB(A) for tractor, and 112 dB(A) for RCV/lorry.

Q is the projected traffic per road segment taken as 220 vehicles per hour

V is vehicle speed, taken as 50 and 20 kph respectively

d is the distance to the nearest NSR, taken as 440 m

The L_{Aeq} are calculated to be 69 dB for the tugs, and 63 dB for the RCV/lorry.

Using CRTN, and assuming 100% heavy vehicles with two streams of 220 vehicles per hour, at 20 kph, 440 m distance, and 120° view angle. The calculated noise levels are 56.7 dB $L_{A10\,(1\text{-hr})}$ and 53.7 $L_{Aeq\,(1\text{-hr})}$ respectively.

From a comparison of the above calculations, it is clear that BS5228 predicts significantly higher noise levels than CRTN, by about 15 dB(A) for tugs, and 7 dB(A) for RCVs or lorries, under the specified conditions.

[1] "A Guide to measurement and prediction of the Equivalent Continuous Sound Level L_{eq}." The Noise Advisory Council, UK, 1978.

In this study, the noise predictions have been based on the average values from the calculations using BS5228 above, this produces SWLs of 110 dB(A) for the tugs and 107 dB(A) for the RCVs or lorries.

Maintenance of the smaller components of the mobile stock and equipment will be carried out within a dedicated workshop building on site, this will minimise the potential for causing significant noise nuisance. Maintenance of larger equipment, including broken down vehicles, will probably be done in the open. Consideration should be made to minimise this source of noise nuisance by avoiding night-time work and keeping the work at locations distant from, or screened from, the NSRs.

The following noisy activities and equipment are identified as causing potentially significant impacts.

- At the tipping floor level, the manoeuvring of the RCV, the operation of the tipping mechanisms, and impacts between hard objects and surfaces.

- The operation of exhaust ventilation fans emitting noise from motors and fan casings, air flow and blade noise. Based on the designed fan specification adopted in IETS, a sound power level of 90 dB(A) has been assumed at the ventilation openings.

- The major noisy service equipment will be contained within designated equipment rooms, namely, blowers/compressors in the wastewater treatment plant, electrical transformers and the fire service pumping units.

- The noise from operation of 9 compactors with powerpack units, and the 4 pushpit units, may be audible at NSRs 1 and 2 through the large openings required for tug access. An estimation of the unit sound power levels for the compactors and the pushpits can be made based on the performance test of the IETS, at 101 and 99 dB(A) respectively.

Container Handling Operation

20 tugs and 24 trailers are allowed for in the conceptual design. It is estimated that during full operation the number of moving tugs in the area, that manoeuvre at slow speed around the container stacks, will be less than 5 units. A sound power level of 110 dB(A) is assumed for each of the moving tug units.

Two rail-mounted portal cranes will be used to move the containers and to transfer them to and from trailers and vessels, a sound power level of 115 dB(A) is assumed for each crane.

Two Lo-Lo type container vessels will be employed for marine conveyance of the containers to WENT reception. Each vessel will berth along WKTS site for the full normal working day (0730-2330). Manoeuvring of the vessel will be assisted by a bow thruster when berthing, and use of tug boats will not be required. The mechanical noise associated with the main

propulsion equipment will be contained within the massive ship hull structure. No significant external noise emission from these movements is, therefore, anticipated.

4.3.5 *Assessment Methodology*

Inventory of Major Noise Sources

The major noise sources, as identified in *Section 4.3.5*, will be modelled for further evaluation of their impacts. In the initial assessment it is assumed that in the daytime and evening the operation of the noise sources is continuous and that during the night the percentage on-time of equipment is reduced to about 10%. An inventory of these major operational noise SWLs are detailed in *Table 4.3c* below.

Table 4.3c *Inventory of Major Operation Noise Sources*

Source Description	Unit SWL dB(A)	Quantity	Assumed SWL Day/Evening dB(A)	Assumed SWL Night-time dB(A)
Tugs	110	5	117	107
Portal cranes	115	2	118	108
Fan openings	90	6	98	88
Compactors	101	9	110-5	100.5
Push-pits	99	4	105	95
The total equivalent sources SWL affecting NSR 1 and 2			***121***	***111***
RCVs/Lorries	107	2	110	100
The total equivalent sources SWL affecting NSR 3			***110***	***100***

Assumptions for Noise Prediction

Potential noise emission from WKTS operations have been modelled at two notional points with SWLs of 121 dB(A) (111 dB(A) in mid-night operation) and 110 dB(A) (100 dB(A) in mid-night operation). The two sources are modelled at the south-west and north-east sections of the site, affecting NSR 1 at the WSD depot and NSR 2 at Stonecutters Island, and NSR 3 at MFSC respectively.

The assumptions regarding the atmospheric air absorption, barrier attenuation, and facade correction are the same as those used in the construction noise prediction in *Section 3.4.4*. The noise emissions associated with the mobile movements and container handling operation in WKTS will be impulsive in nature, a correction of 3 dB(A) (as stipulated in TM3) will, therefore, also be included in the calculation.

4.3.6 *Evaluation of Impacts*

Environmental Noise

The results of the operational noise assessment, carried out in accordance with the methodology discussed in *Section 4.3.6* are summarised in *Table 4.3d.*

When the predicted CNLs were compared with the TNL discussed in *Section 4.3.3*, it was found that the noise criteria are likely to be fulfilled at NSRs 2 and 3 with a margin of 3 and 19 dB(A) respectively during daytime and evening working.

Operations between 2300 and 2330 will exceed the TNL at NSR 2 if the levels of activity are not significantly reduced. Operations between 0430–0730 are expected to be restricted to deliveries of waste only and will not affect NSRs 1 and 2.

The WSD depot (NSR 1) adjacent to the WKTS will provide offices and overnight accommodation for up to four staff. Daytime and evening operations at the WKTS are predicted to cause noise levels in excess of the TNL by as much as 14 dB(A).

The depot may also be affected by mid–night operations. However, given the low level of site activity and the separation distance of over 100 m, noise levels at the staff quarters are expected to be below the TNL and no adverse impacts are anticipated.

4.3.7 *Mitigation Measures*

Noise impacts upon the WSD depot are likely to be significant and mitigation measures will be required to achieve satisfactory noise levels. The following recommendations should be considered to reduce noise levels at the depot:

- Detailed noise predictions should be undertaken once the layout of the WKTS and WSD depot are confirmed and the operational procedures at the WKTS are known, in order to make accurate calculations of any exceedances.

- The options for screening noisy plant (for instance, by using container storage sites to screen plant and tug noise) and the use of "quiet" plant where necessary (it is unlikely that the cranes can be screened) should be fully investigated.

- Alternative options such as insulation and air conditioning for the WSD depot should also be considered.

Measures to protect the WSD depot will also reduce noise levels at NSR 2 which will probably resolve the concern over the period of night–time work at levels of evening activity (2300–2330).

Table 4.3d *Initial Operation Noise Prediction*

NSR	Source Description	Period	Total SWK dB(A)	Noise Corrections dB					CNL dB(A)	ANL–5 dB(A)
				Dist	Atmospheric	Barrier	Facade	Impulsive–ness		
NSR 1	5 Tugs, 2 cranes, 6 fans, 9 compactors, and 4 pushpits	Day/evening	121	–48	0	0	+3	+3	79	65
		Night–time	111	–48	0	0	+3	+3	69	55
NSR 2	5 Tugs, 2 cranes, 6 fans, 9 compactors, and 4 pushpits	Day/Evening	121	–65.5	–5	–5	+3	+3	51.5	55
		Night–time	111	–65.5	–5	–5	+3	+3	41.5	45
NSR 3	2 RCV/Lorries	Day/Evening	110	–65	–5	0	+3	+3	46	65
		Night–time	100	–65	–5	0	+3	+3	36	55

Noise at Work

Occupational noise exposure for workers, is controlled under the Factories and Industrial Undertakings (Noise At Work) Regulation. The potential occupational noise impacts to workers at the WKTS are controlled separately by the Factories and Industrial Undertakings (Noise At Work) Regulation, the following noise action levels are stipulated:

- **First action level (FAL) – Daily personal noise exposure of 85 dB(A);**
- **Second action level (SAL) – Daily personal noise exposure of 90 dB(A); and**
- **Peak Action Level (PAL) – peak sound pressure level of 140 dB.**

It is required by the regulation that the proprietors protect their employees hearing by the following measures:

- **Carry out a noise-at-work assessment at a place where a worker is likely to be exposed to a FAL/PAL or above;**

- **Demarcate an ear protection zone where a worker is likely to be exposed to a SAL/PAL or above, and ensure that ear protectors are worn within the ear protection zone.**

- **Provide at a worker's request ear protectors at the place where he is likely to be exposed to levels between the FAL and SAL.**

- **Reduce equipment noise as far as practicable, at any place where a worker is likely to be exposed to a FAL/PAL or above.**

In general a noise at work assessment is outside the scope of an environmental noise study. However, in view of the interactions between the environmental and occupational noise concerns (eg the enclosure of noisy equipment inside plant house to reduce environmental noise emission and the consequent increase the in-plant noise exposure due to the reverberant effect) it is recommended that as part of the IEIA, a surface noise level specification should be established for the major noisy equipment on the basis of the F&IU (Noise At Work) Regulation. The surface noise level specification is recommended as an L_{eq} of 85 dB(A) measured as an average of noise levels, 1 m from the surface of the equipment, at representative locations on the equipment.

On the basis of the E&IU Regulation, a 1 m surface noise level specification of 85 dB(A) is recommended, measured as an average of L_{eq} noise levels 1 m from the surface of the equipment at representative locations.

The WKTS Tenderers should identify in their proposal, the equipment that has designed noise levels higher than the noise specification of 85 dB(A) at 1 m from the equipment, and practicable means of noise reduction should be proposed by the Tenderer.

4.3.8 *Conclusions and Recommendations*

The noise emissions associated with the operation of the planned WKTS, as presented in the Consultant's Outline Design will be lower than the target noise criteria during all operational periods at the existing receivers in Stonecutters Island (NSR 2) and in MFSC (NSR 3) with the exception of 2300–2330 at NSR 2. Noise levels at the WSD depot (NSR 1) are predicted to exceed the TNL by a significant margin during daytime and evening operations.

However, it is concluded that, with the inclusion of mitigation measures of the type described in *Section 4.3.7*, these NSRs will not be adversely affected by the operation of the WKTS.

4.4 VISUAL IMPACTS

4.4.1 *Introduction*

This section considers the future visual environment of the WKR area when the station becomes operational, against which the potential visual impact of the WKTS is assessed. Mitigation measures are recommended to minimise any severe impacts.

4.4.2 *Baseline Conditions*

The reclaimed area opposite Mei Foo has been planned for predominantly container-related uses as described in *Section 3.5*. A significant portion of the land in the southeastern part of the Stonecutters Island reclamation has also been allocated for marine oriented and port related industrial uses. The visual quality of the area will be low as it will be visually dominated by the container facilities of CT 7 and 8 and other backup uses.

Visually sensitive receivers will be similar to those identified in *Section 3.5*, however those in Tai Kok Tsui will be replaced by new residential development at the new waterfront formed by the WKR.

4.4.3 *Potential Impacts and Their Significance*

The tender documents for the construction of the WKTS are expected to specify a clean appearance with smooth external lines. Physical features of the WKTS are determined mainly by its functional requirements, and are described in *Section 2.2*. The main visual elements are likely to include :

- the main buildings (including structures for the JUD);
- the ramp, in particular the elevated sections;
- movements of large vehicles;
- rail-mounted gantry cranes;
- stacked containers;
- two-storey office buildings;
- the workshops;
- waste water treatment plant; and
- barges.

The character of the transfer station will be in line with the surrounding port and industrial uses. Considering also the great separation between the WKTS and centres of population; and the small scale of the development compared to the surrounding container related facilities, boatyards and sewage treatment works, the transfer station operation is not expected to cause any significant visual intrusion.

4.4.4 *Mitigation Measures*

To further minimise any visual impact of the WKTS, planting/landscaping may be useful to provide a softer edge. Low level, directional lighting should also be used where practicable for operational and safety purposes to minimise night-time off-site intrusion from the WKTS.

4.4.5 *Conclusion*

The WKTS will be in line with the planned industrial character of the area and will not have any significant visual impact.

4.5 BIRD, RODENT AND INSECT CONTROL

4.5.1 Introduction

Rats and mice are a perennial problem in refuse collection areas in Hong Kong and control measures will need to be taken to avoid encouraging their spread. Rodents may enter the site in the RCVs with the incoming waste, as found at the Kowloon Bay Transfer Station, or they may be attracted by any refuse held on the site. Insects (flies, cockroaches, ants) and birds are also likely to be attracted by the refuse.

The following areas of the WKTS operation have been identified as possible attractions to birds, rodents or insects:

- the transfer building;
- accumulation of refuse, especially in infrequently maintained areas of the site and particularly inaccessible places; and
- spillage of refuse.

4.5.2 Mitigation Measures

Bird Control

Bird nesting can be discouraged through building design. All buildings should be designed externally and, as far as practicable internally, so that there are no ledges or obvious perches for birds. Measures to prevent birds entering the operational areas of the facility should also be included.

It is recommended that the following features be incorporated into the design of all site buildings:

- smooth rounded corners on the buildings;
- corrugated roofing and rainwater guttering protected with 45° inclined plates; and
- covering of ventilation inlets and outlets with 20 mm diameter mesh.

It will not be possible to cover or enclose the main RCV entrance and birds are likely to fly into the tipping hall.

In addition, operational procedures should be adopted to prevent the attraction of birds in large numbers. The following procedures are recommended:

- prevention of refuse accumulation in accessible areas;
- maintenance of a clean, odour-free site;
- regular cleaning of all vehicles to ensure that no refuse or refuse liquors adhere to vehicle bodies;
- flushing of any refuse remaining on compactor hopper and push pit sides;
- rapid clean-up of any refuse spillages; and
- regular inspection of the transfer station building for nests.

A negative pressure ventilation system with odour scrubbing will also ensure that birds are not attracted by odours.

Rodent Control

The transfer building should be designed to be rodent-proof as far as possible, and poisonous baits and traps will be required. The following design features are recommended to be incorporated in all site buildings:

- sealing around pipes; and
- covering of vents with 20 mm diameter mesh.

The operational procedures listed above for bird control will also reduce rodent attraction to the site. In addition, regular inspection of the site to check for the presence of rodents and removal of rodent carcases should be a specific operational requirement. The inspectors should also look for evidence of rodent existence such as droppings, burrows, holes in buildings and gnawing.

Insect Control

In view of the operational nature of the WKTS, with rapid throughput and no exposure of refuse, other than in the push-pits, insect nuisance is not considered to be significant.

However, a programme of site spraying to eliminate cockroaches will be required. The design of the site and the intended cleansing operations should not give rise to standing pools of water which could attract mosquitoes. It is recommended that regular inspection of the building for insect nests be undertaken.

4.5.3 *Conclusions*

The detailed design of the WKTS buildings and operational procedures will require consideration of bird, rodent and insect control measures. It is recommended that regular inspections of the facility are conducted to assess the presence of birds, rodents and insects and to undertake appropriate removal of such pests if necessary.

The prevention of bird attraction to the external areas of the site is less critical than at the Kowloon Bay Transfer Station, where a potential bird strike risk exists at Kai Tak International Airport. The use of trees in landscaping will therefore be permissible and will assist in mitigating visual impacts of the WKTS development.

5 ENVIRONMENTAL PERFORMANCE, MONITORING AND AUDIT

Environmental monitoring, audit and performance requirements for air quality, water quality and noise are recommended for the WKTS development in this section. The requirements specify the parameters to be measured, and the location, frequency and duration of the measurements. These requirements will be incorporated into the tender document for the construction of WKTS at a later stage.

5.1 ENVIRONMENTAL MONITORING

The objectives of the required environmental monitoring and audit at the WKTS include:

- to provide a data base against which to determine any short or long term environmental impacts of the WKTS;
- to provided an early indication that any of the environmental control measures or practices are failing to achieve the acceptable standards; and
- to provide data to enable an environmental audit of the construction and operation of the WKTS.

5.2 BASELINE MONITORING

Baseline dust monitoring, measured as TSP, should be carried out prior to the commencement of site works. The baseline monitoring should be carried out for a continuous period of at least two weeks with daily ambient measurements to be taken every day, and at least three times per day for hourly sampling when the highest dust impacts are expected. The monitoring locations should be agreed with EPD. Checking of baseline dust levels may also be required depending on the length of the subsequent construction dust monitoring.

As a regular practice, checking of baseline dust levels should be carried out at three-monthly intervals.

5.3 CONSTRUCTION IMPACT MONITORING

5.3.1 Air

A schedule of the dust monitoring programme activities should be drawn up by the Contractor, one month prior to the commencement of the scheduled construction period, *Table 5.3a* provides an indicative list of requirements. Regular daily monitoring of dust should be carried out at least once every six days, and the day chosen should be fairly representative

of normal construction activities. One-hour dust monitoring should be carried out three times in every 6-days during the period of site levelling works. Wind speed and direction should be recorded during dust samplings. Sampling locations should be agreed with EPD. Baseline odour levels should also be checked immediately before the WKTS becomes operational.

5.3.2 *Water*

No water quality monitoring is considered necessary during the construction phase.

5.3.3 *Noise*

No noise monitoring is considered necessary during the construction phase. However, if night-time working should prove to be necessary this may need to be reconsidered if site activities approach daytime levels.

5.4 *OPERATIONAL IMPACTS/COMPLIANCE MONITORING*

5.4.1 *Air*

A series of environmental performance tests should be carried out during the commissioning of the WKTS. These should include dust monitoring and odour patrol at the site boundary and dust, NO_2 and CO monitoring in the tipping hall, *Table 5.4a* provides an indicative list of requirements. These will be continued during the operational phase at a frequency to be agreed with EPD.

For dust monitoring at the site boundary, both TSP and RSP should be carried out. Dust in the tipping hall should be measured as TSP.

To ensure that no odour nuisance is caused beyond the site boundary, odour monitoring should be carried out in the form of an odour patrol.

Odour intensities detected may be categorized into the following classes:

0	Not detected	No odour perceived or an odour so weak that it cannot be readily characterized or described.
1	Slight	Identifiable Odour, slight.
2	Moderate	Identifiable odour, moderate.
3	Strong	Identifiable odour, strong.
4	Extreme	Severe odour.

Monitoring of NO_2 and CO in the tipping hall should be carried out by analyzers or methods approved by EPD.

The whole monitoring programme should be approved by EPD.

5.4.2 *Water*

Effluent discharge from the on-site wastewater treatment plant should be monitored to ensure that the discharges from the plant can meet the standards stipulated in the TM. Monitoring parameters should include pH, COD, BOD, total suspended solids, total phosphorus, total kjeldahl nitrogen, oil and grease. Samples should be taken for each batch. Sampling locations should be agreed with EPD and should be located before point of discharge. If the operators wish to re-use treated water for washdown purposes acceptable standards and monitoring procedures will need to be agreed with EPD. The whole monitoring programme should be approved by EPD.

Table 5.3a *WKTS Construction Impacts Monitoring Requirements*

Parameter	Location	Duration	Frequency	Performance Requirement	Note/Remark
AIR QUALITY					
TSP	2 locations and as agreed with EPD	During the early stage of construction when most of the earthworks are carried out	Daily 24-hour sampling once per six days	Daily TSP AQO: 260 ug/m^3	General wind condition to be recorded
			Hourly sampling three times per six days	Recommended TSP hourly limit: 500 ug/m^3	Ditto; to be carried out during the anticipated peak construction activities

Table 5.4a *WKTS Operational Impacts – Compliance Monitoring Requirements*

Parameter	Location	Duration	Frequency	Performance Requirements	Notes/Remarks
WATER QUALITY					
Total Suspended Solids, Dissolved Oxygen, BOD, COD, Total Kjeldahl Nitrogen, Oil and grease, Total phosphorus	Sampling location before point of discharge and as agreed with EPD	Prior to discharge	every batch and as agreed with EPD	TM standard for discharge to foul sewer	
AIR QUALITY					
TSP	2 locations and as agreed with EPD	During the commissioning and operation as agreed with EPD	As agreed with EPD	Daily TSP AQO: 260 ug/m^3	General wind condition to be recorded
RSP	ditto	ditto	ditto	Daily RSP AQO: 180 ug/m^3	ditto
Odour	Patrolling at the site boundary	ditto	ditto	No off-site offensive odour	ditto
NO_2	Inside tipping hall	ditto	ditto	EH 40/92: 5.0 mg/m^3 (or as agreed with EPD)	Vehicle movements to be recorded
CO	Inside tipping hall	ditto	ditto	EH 40/92: 55 mg/m^3 (or as agreed with EPD)	ditto
TSP	Inside tipping hall	ditto	ditto	1.0 mg/m^3 (or as agreed with EPD)	ditto
NOISE					
$L_{eq, (5\ min)}$	1 m and 6 m from ventilation fans, wastewater treatment blower, power packs of the compactor and pushpit units	During comissioning as agreed with EPD	2–3 times	85 dB at 1 m from source	primarily required for hearing protection purposes

5.4.3 *Noise*

The environmental performance tests should also include noise measurement at the site boundary of the WKTS, and at specified distances from the identified noise sources including the ventilation fans, wastewater treatment aeration blower, and the power packs of the compactors and pushpit units. The test should last for 2–3 weeks. Depending on the measurement results, further tests may be required after the initial environmental performance tests, or after the first year of operation.

For noise monitoring, $L_{eq\ (5\text{-}min)}$ levels at 1 m and 6 m from the fixed noise sources should be measured. Sound power levels should be established, derived from the measurement results. The monitoring programme should be approved by EPD.

5.5 *AUDIT REQUIREMENTS*

The purpose of an environmental audit is to:

- review changes in measured parameters during construction and after commissioning;
- assess compliance of the WKTS development with Government environmental quality objectives;
- examine the effectiveness of any mitigation or control measures in achieving environmental protection; and
- recommend amendments in procedures or remedial actions in the event that performance is unsatisfactory.

Construction phase monitoring/audit reports should be submitted on a monthly basis. All monitoring results should be submitted in the form of a report with format approved by EPD. The report should include a brief account of construction activity during the month; an interpretation of the significance of the monitoring results by verifying compliance and highlighting any failure to comply with the target levels; and an account of the remedial measure recommended and taken by the Contractor as a result.

Exceedance of the target levels should be reported immediately to the engineer's representative as well as the progress of the findings and remedial action taken. The event should also be included in the monthly report.

Post-project audits will be required for the WKTS soon after commissioning, and 6 months and one year afterward. Based on the findings of these three audits, frequencies for further audits will be determined. Post-project monitoring/audit reports can be submitted as a single document.

5.6 *ENVIRONMENTAL PERFORMANCE REQUIREMENTS*

The performance requirements specified in this section are derived from statutory limits, planning guidelines and occupational health criteria. Compliance with these limits should ensure no adverse environmental impacts during construction or operation of the facility.

In association with the monitoring activities, an action plan is recommended to ensure that if any significant pollution (either accidental or through inadequate implementation of mitigation measures on the part of the Contractor) does occur, that the cause of this is quickly identified and remedied, and that the risk of a similar event re-occurring is reduced.

The principle upon which the action plan is based is the prescription of procedures and actions associated with the recording of certain defined levels of pollution recorded by the environmental monitoring. These levels are:

- Trigger Levels: beyond which there is an indication of a deteriorating ambient environment for which a typical response could be more frequent monitoring.

- Action Levels: beyond which appropriate remedial actions may be necessary to prevent environmental quality from going beyond the Target Levels, which would be unacceptable.

- Target Levels: statutory limits stipulated in the relevant pollution control ordinances, environmental quality objectives or HKPSG established by EPD. If these are exceeded, works should not proceed without appropriate remedial action, including a critical review of plant and working methods.

The following defines the different levels recommended for air quality, water quality and noise during the construction and operational phases of the WKTS. The recommended action plan is shown in *Table 5.6a below.*

Table 5.6a *Recommended Action Plan*

EVENT	ACTION		
	Environmental Supervisor	**Engineer's Representative (ER)**	**Contractor**
TRIGGER LIMIT			
Exceedance for one sample	· Identify source · Inform ER · Repeat measurement to confirm finding	· Notify Contractor · Check monitoring data and Contractor's working methods	· Rectify any unacceptable practice
Exceedance for two or more samples	· Identify source · Inform ER · Repeat measurement to confirm findings · Increase monitoring frequency · Discuss with ER for remedial actions required · If remedies required, contact ER to make arrangement and inform EPD · If problem is short term, continue monitoring and notify EPD following termination of exceedance · If exceedance stops, additional monitoring can be ceased	· Notify Contractor · Check monitoring data and Contractor's working methods · Discuss with Contractor for remedial works, if necessary	· Rectify any unacceptable practice · Consider changes to working methods
ACTION LIMIT			
Exceedance for one sample	· Identify source · Inform ER · Repeat measurement to confirm finding · Increase monitoring frequency	· Notify Contractor · Check monitoring data and Contractor's working methods	·Rectify any unacceptable practice ·Amend working methods if appropriate

EVENT	ACTION		
	Environmental Supervisor	**Engineer's Representative (ER)**	**Contractor**
Exceedance for two or more samples	· Identify source · Inform ER · Repeat measurement to confirm findings · Increase monitoring frequency · Discuss with ER for remedial actions required · Notify EPD of cessation or continuation of exceedance · If exceedance continues, arrange meeting with EPD, ER, and Contractor · If exceedance stops, additional monitoring can be ceased	· Confirm receipt of notification of failure in writing · Notify Contractor · Check monitoring data and Contractor's working methods · Discuss with Environmental Supervisor and Contractor on remedial actions to be provided · Ensure remedial actions properly implemented	·Submit proposals for remedial actions to ER within 3 working days upon notification ·Implement the agreed proposals ·Amend proposal if appropriate
TARGET LIMIT			
Exceedance for one sample	· Identify source · Inform ER and EPD verbally · Repeat measurement to confirm finding · Increase monitoring frequency · Assess effectiveness of Contractor's remedial action keep EPD and ER informed of the results	· Confirm receipt of notification of failure in writing · Notify Contractor · Check monitoring data and Contractor's working methods · Discuss with Contractor for remedial actions · Ensure remedial actions properly implemented	·Take immediate action to avoid further exceedance ·Submit proposals for remedial actions to ER within 3 working days upon notification ·Implement the agreed proposals ·Amend proposal if appropriate
Exceedance for two or more samples	· Identify source · Inform ER and EPD verbally · Repeat measurement to confirm finding · Increase monitoring frequency · Investigate the cause of exceedance · Arrange meeting with EPD and ER to discuss the remedial actions to be taken · Assess effectiveness of Contractor's remedial actions and keep EPD and ER informed of the results · If exceedance stops, additional monitoring can be ceased	· Confirm receipt of notification of failure in writing · Notify Contractor · Carry out analysis of Contractor's working procedures to determine possible mitigation to be implemented · Discuss amongst Environmental Supervisor and the Contractor on remedial actions to be provided · Review Contractor's remedial actions whenever necessary to assure their effectiveness	·Take immediate action to avoid further exceedance ·Submit proposals for remedial actions to ER within 3 working days upon notification ·Implement the agreed proposals ·Resubmit proposals if problem still not under control

5.6.1 *Air Quality*

Construction Dust Monitoring

- Trigger Level: 30% mark up of the baseline monitoring data. The levels beyond which there is an indication of deteriorating ambient environmental quality.

- Action Level: Average value of the trigger and target levels. The levels beyond which appropriate remedial actions are necessary to prevent the environmental quality from going beyond the target limits.

- Target Level: Hourly level of 500 μg m^{-3} or the AQO value for TSP (ie 260 *ug* m^{-3} for 24 hour average).

Operational Impacts/Compliance Monitoring

The tipping hall air quality should not exceed eight hour average NO_2 and CO levels of 5.0 mg m^{-3} and 55 mg m^{-3} respectively (time weighted average). These are the Occupational Exposure Limits recommended by EH40/92.

The 24 hour average general dust level in the tipping hall should not exceed 1 mg m^{-3}. This level, being one-tenth of the EH40/92 level, is not statutory in Hong Kong but has been exercised in the environmental performance tests during the commissioning of the IETS.

The 24 hour average levels of TSP and RSP at the site boundary should not exceed 260 *ug* m^{-3} and 180 *ug* m^{-3} respectively. These are the Hong Kong AQOs.

Odour

Odour should be controlled such that it does not cause offence beyond the site boundary (EPD Odour Panel Level of 2 Odour Units).

The definitions of odour trigger/action/target levels are as follows:

- *Trigger Level*: one independently documented complaint about odour, or recording of a slight odour on 2 consecutive patrols;

- *Action Level*: more than one independently documented complaint within 2 weeks, or recording of a slight odour on more than 2 consecutive patrols; and

- *Target Level*: more than 3 independently documented complaints within 2 weeks, or recording of moderate odour (EPD Odour Panel Level of 2 Odour Units) on 2 consecutive odour patrols.

5.6.2 *Water*

Construction Monitoring

No monitoring is considered necessary for water quality during the construction phase.

Operation Impacts/Compliance Monitoring

The discharge limits stipulated in the *Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, on Inland and Coastal Waters* should apply.

5.6.3 *Noise*

Construction Noise Monitoring

This will not be required unless night-time working at daytime levels of activity proves necessary.

Operational Impacts

Due to the distances to the nearest NSRs and the nature of the local environment this will not be necessary.

Compliance Monitoring

This will only be required for hearing protection surveys.

6 OVERALL CONCLUSIONS AND RECOMMENDATIONS

6.1 INTRODUCTION

The IEIA of the WKTS has assessed the potential environmental impacts on sensitive receptors during the construction and operational phases, based on the level of detail available in the preferred outline design. The Consultants consider that all the issues identified in this report can be resolved provided that the recommended mitigation measures are adopted.

6.2 OVERALL CONCLUSIONS

The WKTS will be built on newly reclaimed land planned for the purpose and no significant landuse impacts are anticipated.

Dust impacts from the construction of the WKTS upon ASRs will be insignificant and well below the AQO and the recommended 1-hour dust limit. The worst case dust impacts are likely to occur during the early stage of the construction when a small amount of excavated material will be generated by site formation work. After the site has been levelled, most of the activity will be steel works and dust impacts would be much less.

However, it is considered desirable that the Contractor should implement dust suppression measures during the construction stage in order to minimise dust emissions and potential cumulative dust impacts with other developments in the area of the ASRs. The integration of the recommended mitigation measures into the WKTS design and good on-site practice will ensure that air quality impacts during the WKTS operation are not significant.

Significant off-site odour impacts are not expected to occur as a result of the operation of the WKTS. However, the operators of the transfer station will have no control over the impacts from RCVs travelling to and from the site beyond the use of vehicle washers.

Water quality impacts that may arise during the construction stage will be similar to those from general construction activities, and no significant impacts are anticipated on the surrounding water bodies. However, proper site management and good construction practice is essential to ensure minimal water quality impacts. The operation of the WKTS is anticipated to generate small volumes of effluent which will most probably be discharged to the local sewer system. Contaminated water from the refuse transfer operation will need to be treated to acceptable standards on-site prior to discharge.

The distances to the nearest NSRs mean that construction noise impacts will no be significant under normal working conditions. If night-time work is needed it may be necessary to restrict activities to ensure no adverse impacts. Operational noise levels are not predicted to affect either NSR.

A significant increase in visual intrusion from the WKTS construction works is not expected considering the impacts due to the existing and future WKR, WKE, Route 3, and LAR works. In addition, an open space buffer will be planted to provide low level screening for the Mei Foo Sun Chuen residents to the north.

The detailed design of the WKTS buildings and operational procedures will require consideration of bird, rodent and insect control measures. Regular inspections of the facility to assess the presence of birds, rodents and insects and appropriate removal or extermination of such pests will be required.

Environmental monitoring, audit and performance requirements for air quality (dust and odour), water quality and noise are recommended for the WKTS development, in order that performance compliance can be ensured.

6.3 *RECOMMENDATIONS*

All mitigation measures and requirements identified in the IEIA as necessary for environmental protection should be incorporated into the tender documents for the construction of the WKTS at a later stage. A number of issues are recommended for more detailed consideration in the tender requirements in order to ensure compliance with environmental protection legislation.

This IEIA has been carried out based on the outline design for the facility described in *Section* 2. However as the contract is for the design, construction and operation of the WKTS, the successful tenderer may well decide upon a different site layout and/or operational procedure. It is therefore considered that it may be necessary for the successful tenderer to carry out a detailed environmental impact assessment (EIA) for their proposed design.

The requirements of the detailed EIA should be scoped in conjunction with EPD to ensure that the assessment addresses all the relevant impacts. However, it should be borne in mind when undertaking the scoping exercise that nothing has been identified in the course of the IEIA which would indicate that significant impacts will arise from a properly designed, built and operated waste transfer station.

The specific issues which should be addressed by the tenderer are detailed below.

6.3.1 *Air quality*

- Evaluation of tipping area air quality by considering the design of tipping hall and ventilation/scrubbing system and the effects of vehicle emissions.

- Identification of an effective odour treatment system.

6.3.2 *Water quality*

- Identification and evaluation of aqueous emissions (in terms of discharges from road sweepers and gulley empties, liquor from the compaction process, effluent from vehicle washing operations, surface drainage both from areas where there is a risk of contamination from accidental spillage and from areas where there is little or no risk of contamination and domestic wastewater effluent) with due consideration for adequate reception, handling, treatment and disposal to comply with discharge and disposal guidelines.

- A detailed spill plan to mitigate any spills and emergency discharges.

6.3.3 *Noise*

- Confirmation of operational noise impacts by examining the exact number of vehicle movements and locations of fixed noise sources within the site during operation.

6.3.4 *Bird, rodent and insect control*

- Detailed design of the WKTS buildings and operational procedures to control bird, rodent and insect populations.

6.3.5 *Environmental monitoring and audit*

- Review of environmental monitoring and audit requirements identified in the IEIA and in consideration of the above studies.