5 WATER QUALITY

5.1 INTRODUCTION

The EIA-IAR has qualitatively assessed the potential water quality impact associated with the construction and operation of the proposed housing development within the Study Area. Environmental mitigation measures have also been outlined in the EIA-IAR. This section presents a detailed assessment of construction and operational water quality impacts, refines the recommended site-specific mitigation requirements and measures, and provides an assessment of the residual water quality impact after implementation of recommended mitigation measures.

5.2 ENVIRONMENTAL LEGISLATION AND CRITERIA

The criteria for the evaluation of water pollution are set out in *Annex 6* of the EIAO-TM.

The legislation relevant to the control of water pollution in Hong Kong is the Water Pollution Control Ordinance (WPCO) (Cap 358). Under the WPCO, Hong Kong waters are subdivided into 10 Water Control Zones (WCZs), each of which has a designated set of statutory Water Quality Objectives (WQOs) that provide protection for the benefit of aesthetic enjoyment, human health, aquatic life and industrial uses. More than 95% of the Study Area fall within Tuen Mun (C) Subzone and the remaining 5% fall within Tuen Mun (A) Subzone of the North Western WCZ that were declared in 1992. The WQOs of most relevance during the construction phase will be those for suspended solids (SS) and dissolved oxygen (DO), as listed in *Table 5.2a*.

Table 5.2a ***Water Quality Objectives of Suspended Solids and Dissolved Oxygen Levels at North Western Water Control Zone***

Parameter	Part or Parts of Zone	Water Quality Objective
Suspended Solids	Tuen Mun (A and C) Subzones	Waste discharges shall not cause the annual median of suspended solids to exceed 20 mg per litre.
	Marine Waters	Waste discharge shall neither cause the natural ambient level to be raised by more than 30% nor give rise to accumulation of suspended solids which may adversely affect aquatic communities.
Dissolved Oxygen	Tuen Mun (A and C) Subzones	Waste discharges shall not cause the level of dissolved oxygen to be less than 4 mg per litre.
	Marine Waters	The level of DO should not fall below 4 mg l^{-1} for 90% of the sampling occasions during the whole year; values should be calculated as water column average (arithmetic mean of at least 3 measurements at 1 m below surface, mid-depth and 1 m above seabed). In addition, the DO concentration should not be less than 2 mg l^{-1} within 2 m of the seabed for 90% of the sampling occasions during the whole year.

In addition, all discharges during both the construction and operational phases of the potential housing site will be required to comply with the *Technical Memorandum for Effluents discharged into Drainage and Sewerage Systems, Inland and Coastal Waters*

(WPCO-TM) issued under *Section 21* of the WPCO, which defines acceptable discharge limits to different types of receiving waters. Under the WPCO-TM, effluents discharged into the sewerage system and the inshore and marine waters of the WCZ are subject to standards for particular volumes of discharge. These are defined by the EPD and specified in licence conditions for any new discharge within a WCZ. For this assessment, the WPCO-TM standards for effluents discharged into the sewerage system and the inshore waters of North Western WCZ will apply to the construction and operation of the Project. These discharge standards are presented in *Tables 5.2b* and *5.2c*, respectively.

5.3 DESCRIPTION OF THE ENVIRONMENT

The proposed housing development site is situated in an area that is presently comprised of village houses, open storage and small agricultural plots. Drainage from the site flows from the north / west to the Tuen Mun Nullah east of the site. The area has been subjected to flooding during heavy rains.

The watercourses within the immediate vicinity of the site include Chung Sha Creek and unnamed main storm water channels / streams located at the northern portion of the site, two drainage channels one situated in the central portion of the site and one at southern extent of the site, and a 14 m wide nullah along the Tsing Lun Road (Tsing Lun Nullah) at the eastern boundary of the site leading to Tuen Mun Nullah.

Water quality in the vicinity of the Study Area is well documented by the EPD routine river and marine water quality monitoring programme along Tuen Mun River Channel, Tuen Mun Typhoon Shelter and Castle Peak Bay.

5.3.1 *Baseline Conditions*

Tuen Mun River Channel

The Tuen Mun River has a catchment of about 16.5 km^2. There are six monitoring stations (TN1 - TN6) along the Tuen Mun River monitored by the EPD (*Figure 5.3a*). A summary of EPD monitoring data (for 1996) for these six stations is given in *Table 5.3a*.

The monitoring data for 1996 showed that the water quality of the lower section (TN3 - TN6) of the river was better than the upper sections (TN1 - TN2). However, the overall water quality is poor, reflected in non-compliance with the WQOs for DO, 5-day biochemical oxygen demand (BOD_5) and chemical oxygen demand (COD), as well as SS on occasions. Currently, there are about 3100 residents within Area 54 that are unsewered. Sewerage provision within the villages of Area 54 include septic tanks for modern village housing and toilet blocks serving older village houses. Industrial activities within the villages comprise dyeing and bleaching works that discharge effluent directly into a stream that flows into the head of the Tuen Mun River Channel.

Table 5.2b ***Standards for Effluents Discharged into Foul Sewers Leading into Government Sewage Treatment Plants***

Flow Rate (m^3 per day)	≤10	>10 & ≤100	>10 & ≤200	>200 & ≤400	>400 & ≤600	>600 & ≤800	>800 & ≤1000	>1000 & ≤1500	>1500 & ≤2000	>2000 & ≤3000	>3000 & ≤4000	>4000 & ≤5000	>5000 & ≤6000
Determinant													
pH	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10
Temperature (°C)	43	43	43	43	43	43	43	43	43	43	43	43	43
Suspended Solids	1200	1000	900	800	800	800	800	800	800	800	800	800	800
Settleable Solids	100	100	100	100	100	100	100	100	100	100	100	100	100
BOD	1200	1000	900	800	800	800	800	800	800	800	800	800	800
COD	3000	2500	2200	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Oil & Grease	100	100	50	50	50	40	30	20	20	20	20	20	20
Iron	30	25	25	25	15	12.5	10	7.5	5	3.5	2.5	2	1.5
Boron	8	7	6	5	4	3	2.4	1.6	1.2	0.8	0.6	0.5	0.4
Barium	8	7	6	5	4	3	2.4	1.6	1.2	0.8	0.6	0.5	0.4
Mercury	0.2	0.15	0.1	0.1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Cadmium	0.2	0.15	0.1	0.1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Copper	4	4	4	3	1.5	1.5	1	1	1	1	1	1	1
Nickel	4	3	3	2	1.5	1	1	0.8	0.7	0.7	0.6	0.6	0.6
Chromium	2	2	2	2	1	0.7	0.6	0.4	0.3	0.2	0.1	0.1	0.1
Zinc	5	5	4	3	1.5	1.5	1	0.8	0.7	0.7	0.6	0.6	0.6
Silver	4	3	3	2	1.5	1.5	1	0.8	0.7	0.7	0.6	0.6	0.6
Other toxic metals individually	2.5	2.2	2	1.5	1	0.7	0.6	0.4	0.3	0.2	0.15	0.12	0.1
Toxic metals total	10	10	8	7	3	2	2	1.6	1.4	1.2	1.2	1.2	1
Cyanide	2	2	2	1	0.7	0.5	0.4	0.27	0.2	0.13	0.1	0.08	0.06
Phenols	1	1	1	1	0.7	0.5	0.4	0.27	0.2	0.13	0.1	0.1	0.1
Sulphide	10	10	10	10	5	5	4	2	2	2	1	1	1
Sulphate	1000	1000	1000	1000	1000	1000	1000	900	800	600	600	600	600
Total nitrogen	200	200	200	200	200	200	200	100	100	100	100	100	100
Total phosphorus	50	50	50	50	50	50	50	25	25	25	25	25	25
Surfactants (total)	200	150	50	40	30	25	25	25	25	25	25	25	25

Note: All units in mg l^{-1} unless otherwise stated; all figures are upper limits unless otherwise stated.

Table 5.2c ***Standards for Effluents Discharged into the Inshore Waters of North Western Water Control Zone***

Flow Rate (m^3 per day)	**≤10**	**>10 & ≤200**	**>200 & ≤400**	**>400 & ≤600**	**>600 & ≤800**	**>800 & ≤1000**	**>1000 & ≤1500**	**>1500 & ≤2000**	**>2000 & ≤3000**	**>3000 & ≤4000**	**>4000 & ≤5000**	**>5000 & ≤6000**
Determinant												
pH	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9
Temperature (°C)	40	40	40	40	40	40	40	40	40	40	40	40
Colour	1	1	1	1	1	1	1	1	1	1	1	1
Suspended solids	50	30	30	30	30	30	30	30	30	30	30	30
BOD	50	20	20	20	20	20	20	20	20	20	20	20
COD	100	80	80	80	80	80	80	80	80	80	80	80
Oil & Grease	30	20	20	20	20	20	20	20	20	20	20	10
Iron	15	10	10	7	5	4	3	2	1	1	0.8	0.6
Boron	5	4	3	2	2	1.5	1.1	0.8	0.5	0.4	0.3	0.2
Barium	5	4	3	2	2	1.5	1.1	0.8	0.5	0.4	0.3	0.2
Mercury	0.1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Cadmium	0.1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Other toxic metals individually	1	1	0.8	0.7	0.5	0.4	0.3	0.2	0.15	0.1	0.1	0.1
Total toxic metals	2	2	1.6	1.4	1	0.8	0.6	0.4	0.3	0.2	0.1	0.1
Cyanide	0.2	0.1	0.1	0.1	0.1	0.1	0.05	0.05	0.03	0.02	0.02	0.01
Phenols	0.5	0.5	0.5	0.3	0.25	0.2	0.1	0.1	0.1	0.1	0.1	0.1
Sulphide	5	5	5	5	5	5	2.5	2.5	1.5	1	1	0.5
Total residual chlorine	1	1	1	1	1	1	1	1	1	1	1	1
Total nitrogen	100	100	80	80	80	80	50	50	50	50	50	50
Total phosphorus	10	10	8	8	8	8	5	5	5	5	5	5
Surfactants (total)	20	15	15	15	15	15	10	10	10	10	10	10
E. coli (count per 100 ml)	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000

Note: All units in mg l^{-1} unless otherwise stated; all figures are upper limits unless otherwise stated.

Table 5.3a ***Summary Statistics of 1996 Water Quality of Tuen Mun River Channel***

Parameter	TN1	TN2	TN3	TN4	TN5	TN6	WQOs for inland waters of North Western WCZ
DO (mg l^{-1})	2.1 (0.3 - 4.7)	8.3 (7.4 - 11.4)	3.1 (0.8 - 5.1)	3.8 (0.6 - 7.3)	3.8 (1.1 - 5.9)	3.3 (0.6 - 5.8)	4 mg l^{-1}
BOD_5 (mg l^{-1})	120 (31 - 410)	7 (2 - 26)	5 (2 - 11)	5 (3 - 13)	6 (3 - 11)	4 (2 - 12)	3 mg l^{-1}
COD (mg l^{-1})	87 (32 - 360)	13 (6 - 39)	103 (29 - 720)	130 (32 - 370)	93 (19 - 420)	216 (28 - 380)	15 mg l^{-1}
Oil and Grease (mg l^{-1})	16.0 (0.5 - 57.0)	1.6 (0.5 - 7.6)	0.8 (0.5 - 1.8)	0.5 (0.5 - 1.4)	0.5 (0.5 - 1.2)	0.5 (0.5 - 1.0)	n.a.
Suspended Solids (mg l^{-1})	88 (30 - 290)	19 (2 - 130)	6 (3 - 10)	6 (4 - 21)	6 (4 - 60)	5 (4 - 9)	Annual Median 20 mg l^{-1}
Ammoniacal Nitrogen (mg l^{-1})	7.75 (4.30 - 19.00)	0.76 (0.29 - 2.60)	0.68 (0.46 - 0.75)	0.68 (0.39 - 1.40)	0.58 (0.44 - 0.89)	0.49 (0.28 - 0.92)	n.a.
Total Kjeldahl Nitrogen (mg l^{-1})	12.5 (9.5 - 34.0)	1.35 (0.51 - 7.00)	1.20 (0.94 - 1.30)	1.35 (0.75 - 2.00)	1.20 (0.91 - 1.70)	0.87 (0.61 - 1.40)	n.a.
Total Phosphorous (mg l^{-1})	3.55 (1.70 - 8.80)	0.40 (0.15 - 0.95)	0.23 (0.11 - 0.37)	0.22 (0.15 - 0.60)	0.23 (0.08 - 0.38)	0.20 (0.10 - 0.42)	n.a.
pH value	8.3 (7.1 - 9.3)	7.4 (7.0 - 8.7)	7.3 (6.9 - 7.6)	7.5 (7.2 - 7.7)	7.4 (7.0 - 7.7)	7.1 (6.4 - 7.9)	6.5 - 8.5
E. coli (number per 100 ml)	1 184 435 (600 000 - 3 500 000)	117 163 (7000 - 530 000)	88 139 (5000 - 1 000 000)	115 158 (27 000 - 1 600 000)	124 066 (12 000 - 1 100 000)	39 003 (800 - 900 000)	1000 per 100 ml [3]
Sulphide (mg l^{-1})	0.09 (0.02 - 0.94)	0.02 (0.02 - 0.07)	0.04 (0.02 - 0.10)	0.02 (0.02 - 0.60)	0.04 (0.02 - 0.17)	0.20 (0.10 - 0.42)	n.a.
Aluminium (μg l^{-1})	280 (90 - 1100)	230 (170 - 640)	145 (70 - 360)	170 (100 - 2000)	135 (80 - 750)	105 (50 - 240)	n.a.
Cadmium (μg l^{-1})	0.20 (0.10 - 0.30)	0.10 (0.10 - 0.60)	0.10 (0.10 - 0.20)	0.10 (0.10 - 0.20)	0.10 (0.10 - 0.30)	0.10 (0.10 - 0.20)	n.a.
Chromium (μg l^{-1})	3.0 (2.0 - 17.0)	1.0 (1.0 - 4.0)	3.0 (1.0 - 12.0)	3.5 (1.0 - 32.0)	3.5 (1.0 - 14.0)	2.5 (1.0 - 14.0)	n.a.
Copper (μg l^{-1})	7.5 (3.0 - 15.0)	2.0 (1.0 - 5.0)	3.5 (1.0 - 10.0)	2.0 (1.0 - 10.0)	2.5 (1.0 - 22.0)	2.5 (1.0 - 9.0)	n.a.

Parameter	TN1	TN2	TN3	TN4	TN5	TN6	WQOs for inland waters of North Western WCZ
Lead ($\mu g\ l^{-1}$)	5.0 (2.0 - 72.0)	3.0 (2.0 - 9.0)	2.0 (1.0 - 9.0)	2.0 (1.0 - 3.0)	2.0 (1.0 - 9.0)	1.5 (1.0 - 7.0)	n.a.
Zinc ($\mu g\ l^{-1}$)	60 (20 - 150)	20 (10 - 30)	10 (10 - 30)	10 (10 - 20)	10 (10 - 60)	10 (10 - 70)	n.a.
Flow (litre per second)	73 (31 - 194)	29 (7 - 261)	NM	NM	NM	NM	n.a.

Notes:
1. Data presented are annual arithmetic means, except where specified otherwise.
2. Data enclosed in brackets are ranges.
3. The level of *E. coli* is calculated as the running median of the most recent five consecutive samples taken at intervals of between seven and 21 days.
n.a. = not available; NM = not measured.
Source: EPD (1997), *River Water Quality in Hong Kong for 1996*.

Tuen Mun Typhoon Shelter

The water quality of the Tuen Mun Typhoon Shelter is also well documented by EPD's routine marine water monitoring programme (at monitoring stations NT1, NT3, NT4 and NT5). A summary of monitoring data for 1995 for relevant stations is given in *Table 5.3b*.

Table 5.3b ***Summary Statistics of 1996 Water Quality of Tuen Mun Typhoon Shelter***

Determinant		NT1	NT3	NT4	NT5
Temperature (°C)	Surface	23.9 (18.1 - 28.5)	24.3 (18.0 - 29.3)	23.6 (17.9 - 28.7)	23.7 (18.0 - 28.4)
	Bottom	27.1 (27.1 - 27.1)	25.9 (25.9 - 25.9)	22.4 (17.9 - 26.3)	23.1 (17.8 - 27.4)
Salinity (ppt)	Surface	26.5 (14.6 - 33.5)	26.0 (13.5 - 33.4)	26.0 (13.4 - 33.6)	26.4 (13.7 - 33.8)
	Bottom	19.6 (19.6 - 19.6)	24.9 (24.9 - 24.9)	29.5 (24.1 - 33.7)	28.8 (23.2 - 33.6)
DO (% Saturation)	Surface	68.9 (54.4 - 82.2)	71.1 (57.0 - 84.6)	76.6 (64.1 - 83.8)	79.1 (59.6 - 86.9)
	Bottom	83.0 (83.0 - 83.0)	78.1 (78.1 - 78.1)	72.5 (58.7 - 81.5)	77.6 (62.0 - 90.8)
DO ($mg\ l^{-1}$)	Surface	5.0 (4.2 - 6.2)	5.1 (4.2 - 6.5)	6.6 (5.0 - 6.2)	5.7 (4.6 - 6.3)
	Bottom	5.9 (5.9 - 5.9)	5.5 (5.5 - 5.5)	5.3 (4.5 - 6.3)	5.6 (4.8 - 6.3)
pH		7.9 (7.7 - 8.0)	7.9 (7.7 - 8.2)	8.0 (7.8 - 8.2)	8.0 (7.9 - 8.3)
Suspended Solids ($mg\ l^{-1}$)		14.9 (11.5 - 27.0)	15.0 (7.9 - 24.0)	14.7 (7.6 - 34.5)	10.4 (5.8 - 18.7)
Turbidity (NTU)		7.2 (5.1 - 10.6)	7.0 (5.1 - 9.0)	11.0 (2.7 - 38.7)	4.7 (2.5 - 6.3)
BOD_5 ($mg\ l^{-1}$)		0.8 (0.5 - 1.2)	0.7 (0.5 - 1.3)	0.6 (0.3 - 0.9)	0.6 (0.4 - 1.3)
Ammoniacal Nitrogen ($mg\ l^{-1}$)		0.23 (0.03 - 0.73)	0.13 (0.03 - 0.20)	0.09 (0.03 - 0.17)	0.07 (0.01 - 0.16)
Total Nitrogen ($mg\ l^{-1}$)		0.63 (0.33 - 0.79)	0.63 (0.36 - 0.81)	0.73 (0.32 - 1.33)	0.62 (0.26 - 0.96)
Total Phosphorous ($mg\ l^{-1}$)		0.15 (0.06 - 0.36)	0.15 (0.08 - 0.35)	0.15 (0.07 - 0.33)	0.13 (0.08 - 0.32)
E. coli (number per 100 ml)		1617 (230 - 32 000)	4485 (300 - 28 000)	1677 (280 - 17 000)	2060 (440 - 7300)

Note:
1. Except as specified, data presented are depth-averaged data.
2. Data presented are annual arithmetic means except for *E. coli* data which are geometric means.
3. Data enclosed in parentheses are ranges.

Source: EPD (1997), *Marine Water Quality in Hong Kong for 1996.*

The monitoring results indicated that the water quality in the Tuen Mun Typhoon Shelter was generally acceptable with high levels of depth-averaged DO, and low total nitrogen and moderate *E. coli* counts.

Water quality of the North Western WCZ is also documented in reports from EPD's marine water quality monitoring programme. Station NM2 at the Castle Peak Bay is the nearest marine water quality monitoring station to the Study Area (*Figure 5.3a*). The monitoring result in 1996 for Station NM2 is summarised in *Table 5.3c*. The results indicated that marine water at the Castle Peak Bay is well-oxygenated in both surface and bottom layers. High *E. coli* counts are reported on occasions, reflecting bacterial loading from the Tuen Mun River Channel.

Table 5.3c ***Summary Statistics of 1996 Marine Water Quality in the Castle Peak Bay, North Western Water Control Zone***

Determinant		NM2
Temperature (°C)	Surface	23.9 (18.1 - 28.4)
	Bottom	23.4 (17.9 - 27.8)
Salinity (ppt)	Surface	26.5 (13.4 - 33.6)
	Bottom	28.0 (18.3 - 34.0)
Dissolved Oxygen (% Saturation)	Surface	81.8 (64.7 - 92.2)
	Bottom	80.0 (65.5 - 86.3)
Dissolved Oxygen ($mg\ l^{-1}$)	Surface	5.9 (4.7 - 6.5)
	Bottom	5.8 (5.0 - 6.7)
Suspended Solids ($mg\ l^{-1}$)		12.5 (5.6 - 27.3)
Turbidity (NTU)		5.4 (4.0 - 6.7)
pH value		8.0 (7.9 - 8.4)
BOD_5 ($mg\ l^{-1}$)		0.6 (0.3 - 1.1)
Ammoniacal Nitrogen ($mg\ l^{-1}$)		0.06 (0.01 - 0.17)
Total Nitrogen ($mg\ l^{-1}$)		0.58 (0.28 - 0.86)
Total Phosphorous ($mg\ l^{-1}$)		0.13 (0.07 - 0.30)
E. coli (number per 100 ml)		428 (61 - 1250)

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

Source: EPD (1996), *Marine Water Quality in Hong Kong for 1996.*

5.3.2 *Future Conditions*

Tuen Mun River Channel

The statistical analysis reported in the EPD *River Water Quality in Hong Kong for 1996* indicates improvement of water quality at all monitoring stations along the Tuen Mun River Channel in 1996, including a long-term increase in DO, as well as decreases in SS, BOD_5, ammoniacal nitrogen, total Kjeldahl nitrogen, ortho-phosphate, total phosphorus and other heavy metal levels, including chromium, copper, lead and zinc. This is attributed to the rectification of expedient connections in the industrial and commercial areas, and the elimination of industrial pollution that has historically been a major contributor to the pollution load. The provision of village sewerage at Area 54 is currently at the planning stage and is programmed for completion by 2001. It is anticipated that pollution due to domestic sewage discharges from unsewered areas will be further reduced after the full implementation of the Tuen Mun Sewerage Master Plan (SMP) by 2002.

Tuen Mun Typhoon Shelter

As the water quality of the Tuen Mun Typhoon Shelter is under strong influence of the discharge from the Tuen Mun River Channel, it is expected that the long-term improvement of river water quality will also further improve the water quality within the typhoon shelter.

North Western Water Control Zone

According to the statistical analysis reported in the EPD *Marine Water Quality in Hong Kong for 1996*, there is no significant long-term water quality trend for NM2 for any of the water quality parameters except total phosphorus, that shows an increase in level of the determinant over time.

As the Tuen Mun SMP will be fully implemented in 2002, the domestic sewage discharges from unsewered areas along the Tuen Mun River Channel can be eliminated and the marine water quality, particularly the *E. coli* level, of NM2 is likely to be less influenced by the discharge from Tuen Mun River Channel.

5.4 *IDENTIFICATION OF SENSITIVE RECEIVERS*

The existing and potential beneficial uses that are sensitive to water pollution during the construction and operation of the proposed housing development at the Study Area include:

- Tuen Mun Typhoon Shelter located at the mouth of Tuen Mun River Channel and downstream of the potential housing development; and
- gazetted bathing beaches near the mouth of the Tuen Mun River Channel, including Castle Peak Beach, Kadoorie Beach, Cafeteria Old Beach and Cafeteria New Beach.

However, because the Tuen Mun Typhoon Shelter and gazetted bathing beaches at the Castle Peak Bay are more than 3.5 km away from the Study Area, it is considered that these sensitive receivers are too far to be directly impacted by the construction and operation of the proposed housing development provided suitable mitigation measures are implemented.

Other beneficial uses within or adjacent to the proposed housing development include Tuen Mun Nullah for recreationers and natural streams for aquatic ecology at the north and west of the site.

5.5 ASSESSMENT METHODOLOGY

The assessment methodology of water quality impact during construction and operation of the proposed Project has been subdivided into six tasks:

Task 1: *Baseline data collection and review (Section 5.3)*

Baseline data and information has been collected to reveal the existing environmental conditions within and near the proposed housing development area.

Task 2: *Identification of sensitive receivers (Section 5.4)*

Water quality sensitive receivers are identified with reference to the guidelines from the EIAO-TM and the HKPSG.

Task 3: *Identification of impacts (Section 5.6)*

The nature and characteristics of water quality impacts associated with the construction and operation of the proposed housing site are identified. The sources of pollution have been quantified wherever possible for subsequent impact assessment.

Task 4: *Evaluating the extent of environmental impact (Section 5.7)*

The impacts identified in Task 3 have been assessed in respect to their nature and characteristics. These impacts are quantified wherever the required engineering information (such as the population of the work force during construction and residents during operation) is available.

Task 5: *Recommendation of mitigation measures (Section 5.8)*

With respect to the extent of environmental impact, appropriate cost-effective mitigation measures are recommended to minimise the impact and to prevent any undesirable pollution. Guidelines from the Practice Note issued by the EPD and the Technical Circulars issued by the Works Branch have been included as part of the mitigation measures.

Task 6: *Evaluating the residual impact after implementation of mitigation measures (Section 5.8)*

The residual impact, that is, the impact after effective implementation of mitigation measures, have been evaluated to determine the acceptability of the proposed housing development in terms of the duration and extent of water quality pollution.

5.6 IDENTIFICATION OF IMPACTS

5.6.1 *Construction Phase*

The sources of water quality impacts in the Study Area during construction of the proposed housing site will comprise construction runoff and drainage, general

construction activities, and sewage from the on-site construction work force. The drainage impact during construction have been reported in detail in a separate the *Final Drainage Impact Assessment Report* for the Initial Development Proposal[1] issued in July 1998.

Construction Runoff and Drainage

This includes non-point pollution sources of runoff and erosion from site surfaces, interception of drainage channels and watercourses, earth working, and stockpiles that may contain increased loads of sediments, other SS and contaminants. Potential contaminants include:

- silt and contaminated runoff from on-site stockpiles;
- cement, bentonite slurries and other grouting materials; and
- fuel, oil and lubricants from construction vehicles and equipment.

In addition, the extent of water quality impact may be increased if demolition of existing buildings are required, as this would result in an increase in the volume of construction debris. Unless carefully controlled, this construction waste could enter any nearby water body and lead to impacts upon water quality.

Bentonite, grouting and cement materials may be used during the construction of residential buildings. Water quality impacts would occur if materials are allowed to enter into ponds and streams as surface runoff or underground storm water discharge.

Water quality impacts, including elevation of SS, could result from construction works at the western boundary of the site, including the potential for a road connection over the nullah adjacent to the site resulting in an increase in SS in the water. Moreover, soiling of road surfaces associated with the movement of vehicles or trucks from the construction sites may also cause nuisance to the surrounding environment.

General Construction Activities

On-going site construction activities have the potential to cause water pollution from rubbish such as food packaging and debris including used construction materials entering streams, nullahs, or river channels, resulting in floating refuse in the vicinity of the site. Spillages of liquids such as oil, diesel and solvents are also likely to affect water quality if they enter surrounding water bodies.

Sewage Effluent from Construction Workforce

Sewage effluent arising from the on-site construction work force and the canteen facilities has the potential to cause water pollution if it is not properly collected. Sewage is characterised by high levels of biochemical oxygen demand, ammoniacal nitrogen and *E. coli*. Owing to the lack of established guidelines of sewage generation rate for construction sites, the recommended design rate for offices, specified in the *Guidelines for the Design of Small Sewage Treatment Plants, EPD Solids Waste Control Group, March 1990* has been used for in this assessment. A volume of approximately 11.0 m^3 per day could be generated by every 200 workers working at the site.

(1) Scott Wilson (Hong Kong) Ltd (July 1998), *Planning & Development Study of Potential Housing Site in Area 54, Tuen Mun, Final Drainage/Sewerage Impact Assessment Report (Initial Development Proposal), Volume 1 - Drainage Impact Assessment.*

5.6.2 *Operational Phase*

The sources of water quality and drainage impacts in the Study Area during operation of the proposed housing site comprise sewage from the residential development, surface runoff from the road surfaces, open spaces, and roofs and walls of the buildings and change of drainage characteristics due to change in land use.

Sewage from the Residential Development

The proposed housing development within the Study Area will accommodate about 54,500 residents (including the village population) when it is fully developed. It is anticipated that domestic and commercial sewage, including effluents from toilet flushing with human waste, local restaurants, food markets and offices will be the main type of sewage from the development. A unit flow of 0.300 m^3 per head per day has been assumed within Area 54[2]. Thus, about 16,350 m^3 of domestic sewage will be generated by the residents per day. All domestic and commercial sewage will be collected by sewerage systems and will be directed to the Pillar Point Sewage Treatment Works (PPSTW) for treatment.

Surface Runoff

Surface runoff from the road surfaces, open spaces, and roofs and walls of the buildings during rainfall events may be contaminated by grease, oil, grits and silts left on the hard surfaces. As the nature of the proposed development is essentially residential, the extent of contamination should be smaller in contrast to industrial uses. However, floating debris, rubbish, food wastes from markets and restaurants and other illegal dumping or discharges may also be carried by the surface runoff, depending on the effectiveness of enforcing laws which prohibits these practices.

Drainage

As reported in the Drainage Impact Assessment Report[3], the proposed potential housing development at Tuen Mun Area 54 will substantially change the current land uses and inevitably obstruct some existing flood paths and drainage.

5.7 *EVALUATION OF IMPACTS*

5.7.1 *Construction Phase*

Construction Runoff and Drainage

The runoff and drainage may include varying amounts of SS, fuel, oil, lubricants and other contaminants such as silt released with the runoff from on-site stockpiles. Water quality impact will become significant only if the runoff and drainage are allowed to discharge directly into the receiving water body without treatment. Thus, provided the surface runoff and drainage are effectively managed and controlled over the site by the mitigation measures recommended in *Section 5.8.1*, adverse water quality impacts are not anticipated.

(2) Scott Wilson (Hong Kong) Ltd (January 1999), *Planning & Development Study of Potential Housing Site in Area 54, Tuen Mun, Final Drainage/Sewerage Impact Assessment Report (Initial Development Proposal), Volume 2 - Sewerage Impact Assessment.*

(3) Scott Wilson (Hong Kong) Ltd (July 1998), *Planning & Development Study of Potential Housing Site in Area 54, Tuen Mun, Final Drainage/Sewerage Impact Assessment Report (Initial Development Proposal), Volume 1 - Drainage Impact Assessment.*

General Construction Activities

The impacts of used construction materials, debris, rubbish, liquid fuels and solvents allowed to dispose into receiving water body are likely to be minimal, provided that site boundaries are well maintained and good construction practices are observed to ensure that litter, fuels and solvents are managed, stored and handled properly, as recommended in *Section 5.8.1*. Thus, provided that these measures are incorporated into the Project, adverse water quality impacts are not anticipated.

Sewage Effluent from Construction Workforce

Sewage generated from on-site workers and any temporary canteens serving the construction workers could be substantial. However, it is considered that significant water quality impact will occur only if the sewage is not handled properly and is discharged into the receiving water body without any treatment. With implementation of measures recommended in *Section 5.8.1*, adverse impacts from sewage effluent are not expected to occur.

5.7.2 *Operational Phase*

Sewage from the Residential Development

Sewage generated from the residential development, primary schools and commercial centres within Area 54 will be essentially domestic, with small amount of commercial sewage. The sewerage facilities should be designed to provide sufficient capacity to handle and divert the sewage effluent to the Pillar Point Sewage Treatment Works. Issues concerning sewage generation and design of sewerage and drainage system have been addressed in a separate *Sewerage Impact Assessment Report*[4]. This includes a preferred Western Interceptor Sewer following Ming Kum Road together with a new sewage pumping station in Area 54. The proposed sewer could serve a population of some 256,046 from various planning areas at Tuen Mun that already exceeds the overall projected population increase (about 250,000) between 1998 and 2008. Thus, a net reduction of flow and the risk of flooding in the existing trunk sewer system could be achieved. It should be noted that the *Review of Tuen Mun and Tsing Yi Sewerage Master Plans (Agreement CE30/98)* will look into various options of sewerage improvement schemes, including the Western Interceptor option, in order to cater for proposed developments in the Tuen Mun Area including Area 54. Since the upgrading of the regional sewage treatment works, Pillar Point Sewage Treatment Works (PPSTW), has yet to be formulated[5], interim measures prior to the completion of the upgrading of PPSTW will need to be addressed in the detailed design stage of this project. *Section 5.8.2* presents preliminary findings and recommendations as outlined in the Sewerage Impact Assessment report for upgrading the sewerage system and the PPSTW on the regional level. Prior to the completion of the finalised upgraded sewerage scheme including the PPSTW for Tuen Mun which will be recommended in the review of Tuen Mun and Tsing Yi Sewerage Master Plans (Agreement CE30/98), the acceptability of the impact on local river water quality and downstream marine water quality will be determined on the implementation of proper interim measures by the project.

(4) Scott Wilson (Hong Kong) Ltd (January 1999), *Planning & Development Study of Potential Housing Site in Area 54, Tuen Mun, Final Drainage/Sewerage Impact Assessment Report (Initial Development Proposal), Volume 2 - Sewerage Impact Assessment.*

(5) Agreement No. CE 30/98 Review of Tuen Mun and Tsing Yi Sewerage Master Plans

Surface Runoff

At the beginning of a rainfall event, any grease, oil, grits and silts accumulated on the hard surfaces since the last rainfall event will be swept by the surface runoff, forming the "first flush" of the stormwater discharge which is characterised by high content of suspended solids and high biochemical oxygen demand. The stormwater collected by the on-site drainage system will be converted to the outfall at the Tuen Mun River Channel and eventually discharged into Castle Peak Bay. The water quality impact of this "first flush" is likely to cause concern if expedient connections to the stormwater drainage system cannot be avoided. In addition, stormwater contamination will be more severe when there are minor road works or construction at the development that discharge effluents with high silt content.

According to a recently completed *Pilot Study on Urban Stormwater Pollution: Agreement No. WP98/060 (February 1999)*, the potential pollution loadings of stormwater from housing areas in Hong Kong similar to the proposed development in Area 54 are shown in *Table 5.7a*.

Table 5.7a ***Unit-Area Pollution Loading from Stormwater Runoff (kg/km^2/yr)***

Parameters	Tai Po No. 1	Tai Po No. 2	Tin Shui Wai No. 1	Tin Shui Wai No. 2	Average
TSS	93,978	76,273	55,970	137,574	90,949
COD	51,756	142,473	46,751	146,217	96,799
BOD_5	30,645	66,199	24,034	70,228	47,777
TP	306	389	158	576	357
Ortho-P	136	122	46	32	84
TKN	2,452	2,806	2,766	3,745	2,942
$NO_3 + NO_2$	1,723	741	494	339	824

Based on these unit-area pollution loadings, the loadings of stormwater runoffs from the proposed housing area of Tuen Mun Area 54 are estimated in *Table 5.7b*. These are calculated by multiplying the pollution loads with the area of the housing area which is approximately 98 ha (i.e. 0.98km^2).

As shown in *Table 5.7b*, the annual pollution loadings of the main pollutants COD, BOD_5 and TSS from the Area 54 stormwater runoffs are estimated to be 94,863kg/yr, 46,821kg/yr and 89,130kg/yr respectively. These, when compared with the pollution loadings of treated sewage in a typical sewage treatment works in Hong Kong (the Sha Tin Sewage Treatment Work)[6], are equivalent to 3.2%, 14.9% and 7.7% respectively. Although the stormwater pollution loadings are relatively small compared to treated sewage works loading (Note: BOD loading is about 15% of that for treated sewage), this form of non-point source pollution should not be neglected as the discharges are directly flowing into water courses with particular beneficial uses. Possible measures to minimise the potential pollution due to stormwater runoffs are recommended in *Section 5.8.2*.

[6] Territory Development Department (1996). Sha Tin Sewage Treatment Works Stage 3: Project Review - Final Report. New Territory East Development Office, Sha Tin New Town Stage II.

Table 5.7b *Estimated Pollution Loading of Stormwater Runoffs from the Proposed Housing Area of Tuen Mun Area 54*

Parameters	Annual Pollution Loads (kg/yr)
TSS	89,130
COD	94,863
BOD_5	46,821
TP	350
Ortho-P	82
TKN	28,755
$NO_3 + NO_2$	807

Table 5.7c *Comparison of Area 54 Pollution Loadings from Stormwater Runoffs with Pollution Loading from Treated Sewage of Typical Sewage Treatment Works in Hong Kong (kg/yr)*

Parameters	Estimated Area 54 Stormwater Load (kg/yr)	Treated Sewage Load of Sha Tin STW (kg/yr)	% of Stormwater Load vs Treated Sewage Load
TSS	89,130	1,153,400	7.7
COD	94,863	2,978,400	3.2
BOD_5	46,821	313,900	14.9
TP	350	131,400	0.27
Ortho-P	82	109,500	0.07
TKN	28,755	474,500	6.1
$NO_3 + NO_2$	807	240,900	0.33

Drainage

The existing flood paths and drainage will be substantially altered by the proposed housing development. This may result in adverse drainage impacts on the existing drainage facilities and on the four recognised villages Po Tong Ha, Siu Hang Tsuen, Tsz Tin Tsuen and Kei Lun Wai. The impact will be more frequent and extensive flooding over low lying and poor drainage areas during heavy rainfalls. Poor drainage will also lead to slow flow, enhanced sedimentation and accumulation of pollutants, debris and rubbish along the drainage. It should however be emphasised that the existing streamcourses that are not being engineered by the Rural Planning and Improvement Strategy (RPIS) - Minor Rural Improvement Works, Package 4, particularly those that run through the villages and support agricultural activities, will not be affected. Mitigation measures including the provision of new drainage facilities and regular maintenance of these facilities are recommended in *Section 5.8.2*.

5.8 MITIGATION OF ADVERSE IMPACTS

5.8.1 Construction Phase

Construction phase mitigation measures, in accordance with the Practice Note for

Professional Persons, *Construction Site Drainage* (ProPECC PN 1/94), issued in 1994, include the use of sediment traps, wheel washing facilities for vehicles leaving the site, adequate maintenance and provision of drainage systems (such as the box culvert / pipe) to prevent flooding and overflow due to interception of the existing streams, sewage collection and treatment, and comprehensive waste management (collection, handling, transportation, disposal) procedures.

Construction Runoff and Drainage

The construction of housing development will start with site clearance and formation works, preferably in the dry season. During construction, a temporary drainage channel should be provided to divert any runoff away from the site. It is important to ensure that the proposed drainage can take its full drainage function prior to the commencement of the landfill in the concerned area.

At the start of site establishment, perimeter cut-off drains to direct off-site water around the site should be constructed. Internal drainage works and erosion and sedimentation control facilities should be implemented. Channels, earth bunds or sand bag barriers should be provided on site to direct storm water to silt removal facilities. The design of efficient silt removal facilities should be based on the guidelines in *Appendix A1* of ProPECC PN 1/94.

The overall slope of the site should be kept to a minimum to reduce the erosive potential of surface water flows. In addition, all the entrances and exits of construction sites should be protected by coarse stone ballast. An additional advantage accruing from the use of crushed stone is the positive traction gained during prolonged periods of inclement weather and the reduction of surface sheet flows.

Sediment tanks of sufficient capacity, constructed from pre-formed individual cells of approximately 6 to 8 m^3 capacity, are recommended as a general mitigation measure which can be used for settling storm water prior to disposal. The system capacity should be flexible and able to handle multiple inputs from a variety of sources and particularly suited to applications where the influent is pumped.

All drainage facilities and erosion and sediment control structures should be regularly inspected and maintained to ensure proper and efficient operation at all times and particularly following rainstorms. Deposited silt and grit should be removed regularly and disposed of by spreading evenly over stable, vegetated areas.

Measures should be taken to minimise the ingress of any site drainage into excavations. If the excavation of trenches in wet periods is necessary, they should be dug and backfilled in short sections wherever practicable. Water pumped out from trenches or foundation excavations should be discharged into storm drains via silt removal facilities.

Precautions to be taken at any time of year when rainstorms are imminent or forecasted, and actions to be taken during or after rainstorms are all summarised in *Appendix A2* of ProPECC PN 1/94. Particular attention should be paid to the control of silty surface runoff during storms events, especially for areas located near steep slopes.

All vehicles and mechanical plant should be cleaned before leaving a construction site to ensure no earth, mud, debris and the like is deposited by them on roads. An adequately designed and located wheel washing bay should be provided at every site exits. Wash-water should have sand and silt settled out and removed at least on a weekly basis to ensure the continued efficiency of the process.

The bentonite, grouting and cement materials should only be delivered to the construction site when they are to be used. They should be stored in a covered warehouse and the excess amount should be removed from the site as soon as the construction is completed.

General Construction Activities

Construction solid waste, debris and rubbish on site should be collected, handled and disposed of properly to avoid water quality impacts. Requirements for solid waste management are outlined in *Section 7* of this Report.

Any fuel tanks and storage areas on site should be provided with locks and placed on sealed areas, within bunds of a capacity equal to 110% of the storage capacity of the largest tank to prevent spilled fuel oils from reaching adjacent water sensitive receivers.

Domestic Sewage Effluent

Construction work force sewage should be handled by temporary or permanent public toilets constructed at the site or by portable chemical toilets or sewage holding tanks with the sewage regularly collected by a reputable sewage collector for disposal at Pillar Point or other specified sewage treatment works. Sewage from on-site canteen facilities, if any, should be diverted to and stored within sewage holding tanks for later disposal.

Residual Impact

The construction activities associated with the potential housing development in the Study Area could lead to site runoff containing elevated concentration of SS and associated contaminants that may enter and impact identified water sensitive receivers within and adjacent to the Study Area. However, with implementation of the recommended mitigation measures, including appropriate drainage, silt runoff collection facilities, and local flood prevention measures during heavy rainfall, compliance with the WPCO-TM standards, adverse impacts will be reduced to acceptable levels. Therefore, no unacceptable residual water quality impact are predicted to result from the construction phase of the proposed development.

5.8.2 *Operational Phase*

Sewage from the Residential Development

In the *Sewerage Impact Assessment Report*[7], major upgrading of the sewerage infrastructure within Tuen Mun (including the construction of a the Western Interceptor Sewer, new pumping stations and upgrading of Pillar Point Sewage Treatment Works) is recommended to cater for an increase of population from the existing 483,000 to approximately 766,000 (Year 2006 including Area 54 and other planned and committed developments). This issue will be addressed under the forthcoming *Review of Tuen Mun and Tsing Yi Sewerage Master Plans*. No direct water quality impact upon identified water sensitive receivers within and adjacent to the Study Area is predicted, provided that:

- all domestic and commercial sewage is diverted to appropriate sewage treatment

[7] Scott Wilson (Hong Kong) Ltd (January 1999), *Planning & Development Study of Potential Housing Site in Area 54, Tuen Mun, Final Drainage/Sewerage Impact Assessment Report (Initial Development Proposal), Volume 2 - Sewerage Impact Assessment.*

works for treatment via the upgraded sewerage system as recommended in the *Sewerage Impact Assessment Report;*

- the recommendations from the *Review of Tuen Mun and Tsing Yi Sewerage Master Plans* are incorporated into the detailed design stage of the Project; and

- no occupancy of residential / commercial units should take place unless there is adequate sewer capacity for the development at any given implementation stage.

The design of the sewerage systems should also take into account the guidelines published in the Practice Note for Professional Persons, *Drainage Plans Subject to Comment by the Environmental Protection Department* Issued in 1993 (ProPECC PN 5/93). Issues concerning sewerage design are also addressed in more detail in the *Sewerage Impact Assessment Report.*

A sewage pumping station is tentatively proposed as part of the sewerage infrastructure improvements recommended in the *Sewerage Impact Assessment Report.* The sewage pumping station would be a *Schedule* 2 Designated Project under the EIAO. In the event that this sewage pumping station is confirmed to be required by the forthcoming *Review of Tuen Mun and Tsing Yi Sewerage Master Plans,* a separate EIA Study would be conducted for the pumping station.

As the proposed sewage pumping station would divert the sewage via the underground sewer to the Pillar Point Sewage Treatment Works, it will not generate effluent during the operation and thus, will not result in operational water quality.

To address the undercapacity issues during the interim period before the completion of upgrading of the general sewerage system and the PPSTW and when Site 1 of Area 54 is completed, the *Sewerage Impact Assessment Report* of this Study has recommended the installation of an on-site storage facility which would retain sewage flows from Area 54 Site 1 during periods of high flow as a stop-gap option. A site for such a storage tank has been identified within the Area 54 Site immediately south of the Site 1 development. The sizing of the tank assumes a requirement to receive and retain peak flow for 24 hours. The size of the tank would therefore be be in the order of 4,000 m^3. It is envisaged that this tank would only be required until a major resewerage scheme could be completed. Therefore long term maintenance may not be an issue. This holding tank option will be reviewed and further assessed in the detailed design stage taking into account the latest findings of the Tuen Mun Sewerage Master Plan Reveiw (Agreement CE30/98).

Surface Runoff and Drainage

A new drainage system should be properly provided to the development site for the drainage purpose and to minimise any induced impacts. New drainage facilities such as box culverts and pipes will be deployed to serve low-lying areas and the existing streams that will be intercepted by the development. Open channels or pipes should be provided along / under the proposed road to collect and divert the floodwater to the main stream courses. The existing drainage facilities that will be subject to increased flow resulting from the housing development should be upgraded. All drainage facilities should also be regularly maintained once installed to avoid blocking by debris and rubbish. The design of the drainage systems should take into account the guidelines published in the Practice Note for Professional Persons, *Drainage Plans Subject to Comment by the Environmental Protection Department* issued in 1993 (ProPECC PN 5/93) and *Stormwater Drainage Manual*[8]. This includes the provision of silt

removal facilities at the stormwater drains. Runoff in kerb gutters of roads or channels of building platforms should pass through a gully pit with the necessary gratings to prevent floating debris or objects from entering the stormwater drains. Drainage serving any open transport interchanges and cargo handling areas should be connected to stormwater drains via a petrol interceptor. Issues concerning drainage design are also discussed in more detail in the *Drainage Impact Assessment Report*[9]. Preferably, the upgrading and provision of drainage facilities are completed before construction of the proposed housing development.

With the drainage improvements to be implemented as part of the proposed developments, the threat of flooding at a number of blackspots in the Study Area, which is temporarily relieved by the RPIS Works, will be substantially reduced.

In addition, in order to avoid expedient connections from markets and restaurants and other form of illegal dumping to the stormwater drainage system, the enforcement of laws prohibiting these practices should be tightened and fines should be strictly imposed on these illegal activities. These together with enhanced public education programme and the provisions of proper wastewater disposal facilities in markets and restaurants should greatly reduce the level of stormwater pollution.

Residual Impact

With the implementation of all recommended mitigation measures and the guidelines of sewerage design, the operational discharges from the residential development in the Study Area will comply with the WPCO-TM. No unacceptable water quality impact upon identified water sensitive receivers within and adjacent to the proposed housing development site is predicted.

5.9 ENVIRONMENTAL MONITORING AND AUDIT REQUIREMENTS

Based on this assessment, it is considered that the residual construction and operational impacts will be confined within the statutory limits and there will be no unacceptable residual impacts, provided the recommended mitigation measures are implemented. As there will be no direct impact upon those identified sensitive receivers, the water quality monitoring associated with the proposed housing development are not required. Regular site inspections are proposed to ensure proper implementation and effectiveness of the recommended mitigation measures. Requirements of site inspection are reported in details in a stand-alone EM & A Manual.

5.10 CONCLUSIONS

5.10.1 *Construction Phase*

Construction activities associated with construction of potential housing development in Tuen Mun Area 54 could lead to site runoff containing elevated concentration of SS and associated contaminants in the water column. Detailed mitigation measures have been described which should effectively control all potential impacts. Unacceptable

[8] Drainage Services Department (1995), *Stormwater Drainage Manual. Planning, Design and Management*, Second Edition.

[9] Scott Wilson (Hong Kong) Ltd (July 1998), *Planning & Development Study of Potential Housing Site in Area 54, Tuen Mun, Final Drainage/Sewerage Impact Assessment Report (Initial Development Proposal), Volume 1 - Drainage Impact Assessment.*

residual (that is, after adoption of the recommended mitigation measures) water quality impacts are not expected to occur.

5.10.2 *Operational Phase*

It is considered that, with the adoption of the recommended mitigation measures, no unacceptable water quality and drainage impacts will result from the operational phase of the potential housing development within and downstream of the proposed housing development site.

Appropriate sewage collection facilities should be incorporated into the design of the housing developments. Sewerage systems for residential development should be installed and designed according to the EPD's guidelines. A sewage pumping station is tentatively proposed as part of the sewerage infrastructure improvements recommended in the *Sewerage Impact Assessment Report*. The sewage pumping station would be a *Schedule* 2 Designated Project under the EIAO. In the event that this sewage pumping station is confirmed to be required by the forthcoming *Review of Tuen Mun and Tsing Yi Sewerage Master Plans*, a separate EIA Study would be conducted for the pumping station.

It is considered that the existing drainage facilities at Area 54 require upgrading and provision of new facilities to minimise the impact of flooding during heavy rainfalls at low lying and poor drainage area. New drainage systems should be designed according to the guidelines from the EPD and the Drainage Services Department. With the drainage improvements to be implemented as part of the proposed developments, the threat of flooding at a number of blackspots in the Study Area, which is temporarily relieved by the RPIS Works, will be substantially reduced. In addition, measures to avoid stormwater pollution should also be devised during the detailed design of the housing area. In particular, sufficient wastewater disposal facilities in markets, carparks, garages and restaurants in the housing areas should be incorporated, as these are considered as the key sources of expedient connections and stormwater pollution.

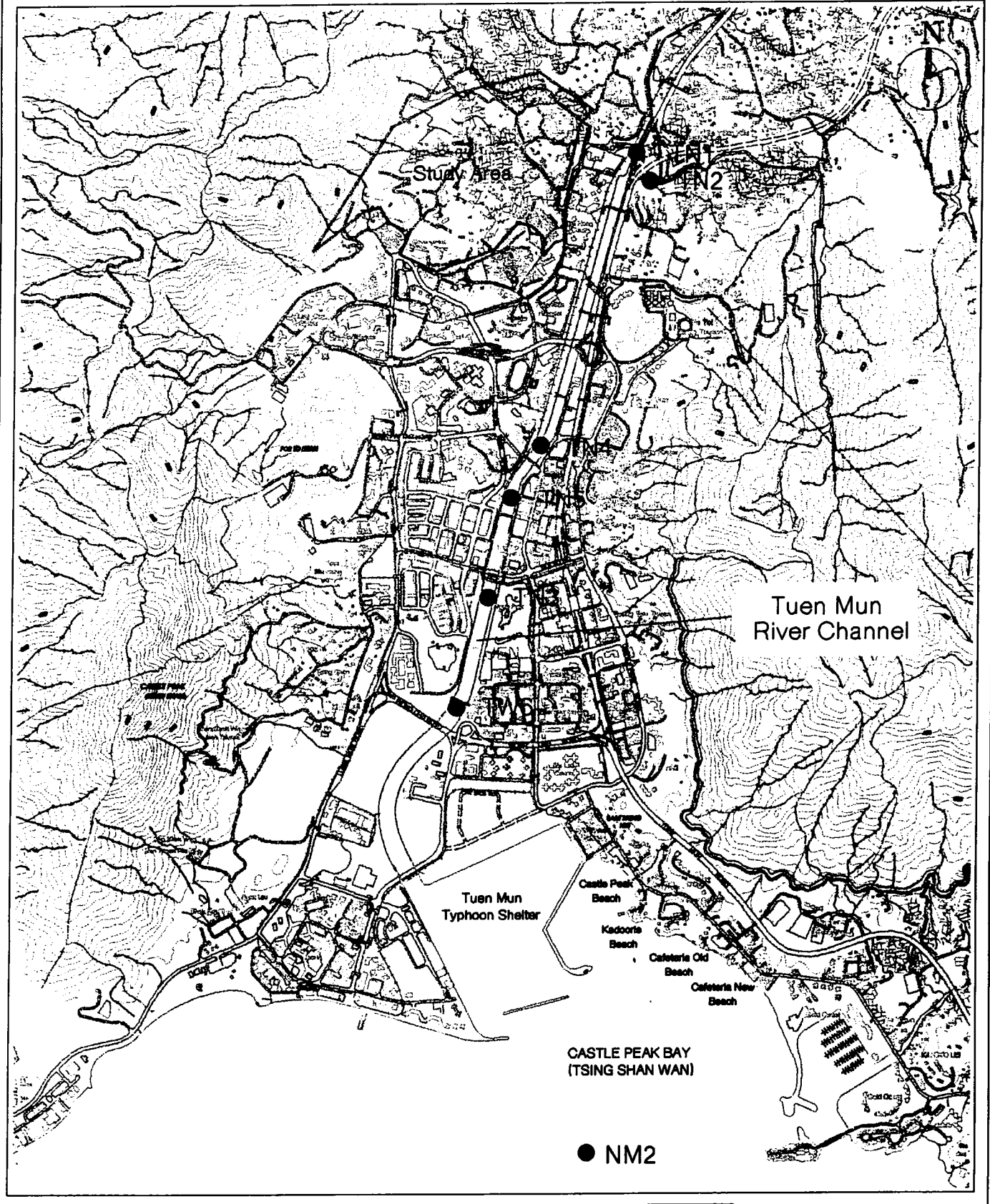

FIGURE 5.3a Locations of River and Marine Water Quality Monitoring Stations near the Study Area

Date : FEB 99	Drawing No. /ermhk/c1707/wq.dgn

KEY
● Water Quality Monitoring Station

ERM Hong Kong
6th Floor
Hecny Tower
9 Chatham Road
Tsimshatsui, Kowloon
Hong Kong

ERM