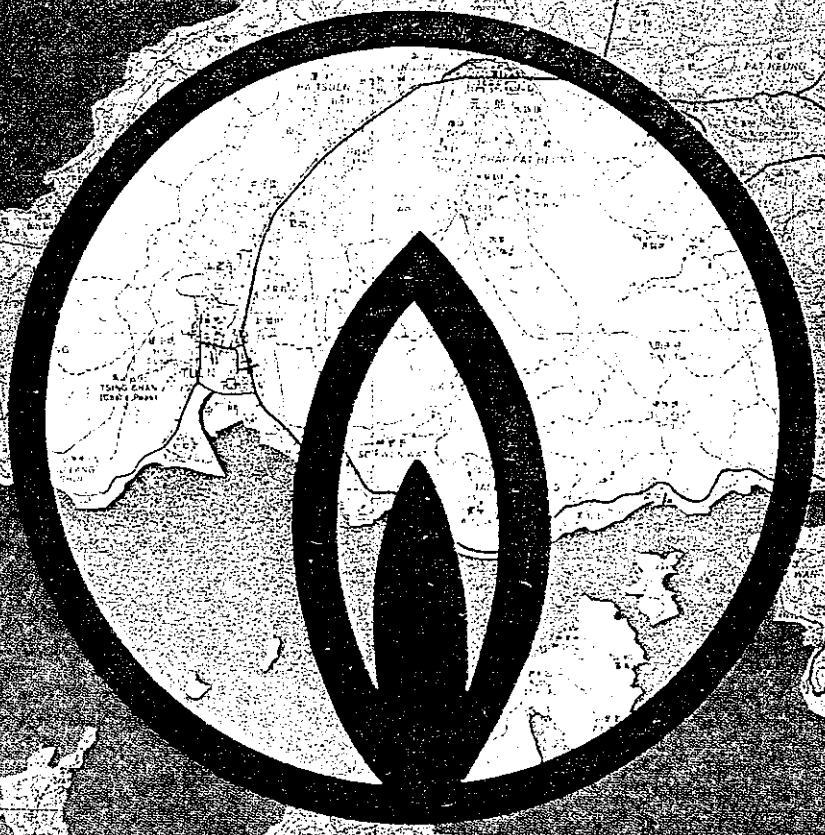
The Hong Kong and China Gas Company Limited

Towngas Lantau Link



Environmental Impact Assessment

Final Report

September 1992

Mott MacDonald Hong Kong Limited

in association with

EBC Hassell Limited

THE HONG KONG AND CHINA GAS CO LTD
LANTAU TOWNGAS LINK

ENVIRONMENTAL IMPACT ASSESSMENT
FINAL REPORT

SEPTEMBER 1992

THE HONG KONG AND CHINA GAS COMPANY LIMITED
LANTAU TOWNGAS LINK

FINAL REPORT

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1. Introduction

THE HONG KONG AND CHINA GAS COMPANY LIMITED
LANTAU TOWNGAS LINK

FINAL REPORT

1. INTRODUCTION

1.1 Background

A high pressure gas transmission pipeline is to be constructed by the Hong Kong and China Gas Company Limited to serve the New Airport at Chek Lap Kok, its support facilities and the community at Tung Chung New Town.

The section of the pipeline considered in this report is shown on Figure 1.1. The pipeline will connect to the existing network at Route Twisk (west of Chuen Lung) and will then pass through the Tai Lam Country Park exiting at the disused quarry near Tai Lam Chung Tsuen. This initial section of the route is about 11 km long and maintains a fairly consistent altitude between 400m and 450m, skirting the extensive cultivated land at Pak Shek Kiu having ascended through young woodland plantations from the proposed gas pigging station west of Chuen Lung. The pipeline reaches an altitude of around 450m at Lin Fa Shan and then descends along existing tracks and skirting around abandoned paddy fields into the major valley at Tsing Fai Tong. From there the route passes through undulating uplands skirting small valleys and areas of abandoned cultivation. The final 1.5km section descends from an altitude of about 300m following existing tracks on sparsely vegetated ridgelines.

A concealed vertical shaft will connect to a horizontal adit driven through the quarry face north of Tai Lam Chung Tsuen, from where the pipeline will connect with the upper marine section in the Tai Lam Nullah. The section will be submerged in the bed of the nullah for a distance of approximately 1km, before joining the foreshore section (0.5 km). From the landfall at Siu Lam the pipeline will cross the Urmston Road (4.15km) making landfall at Ta Pang Po. The final section of the pipeline will be laid in the utilities reserve of the North Lantau Expressway (NLE).

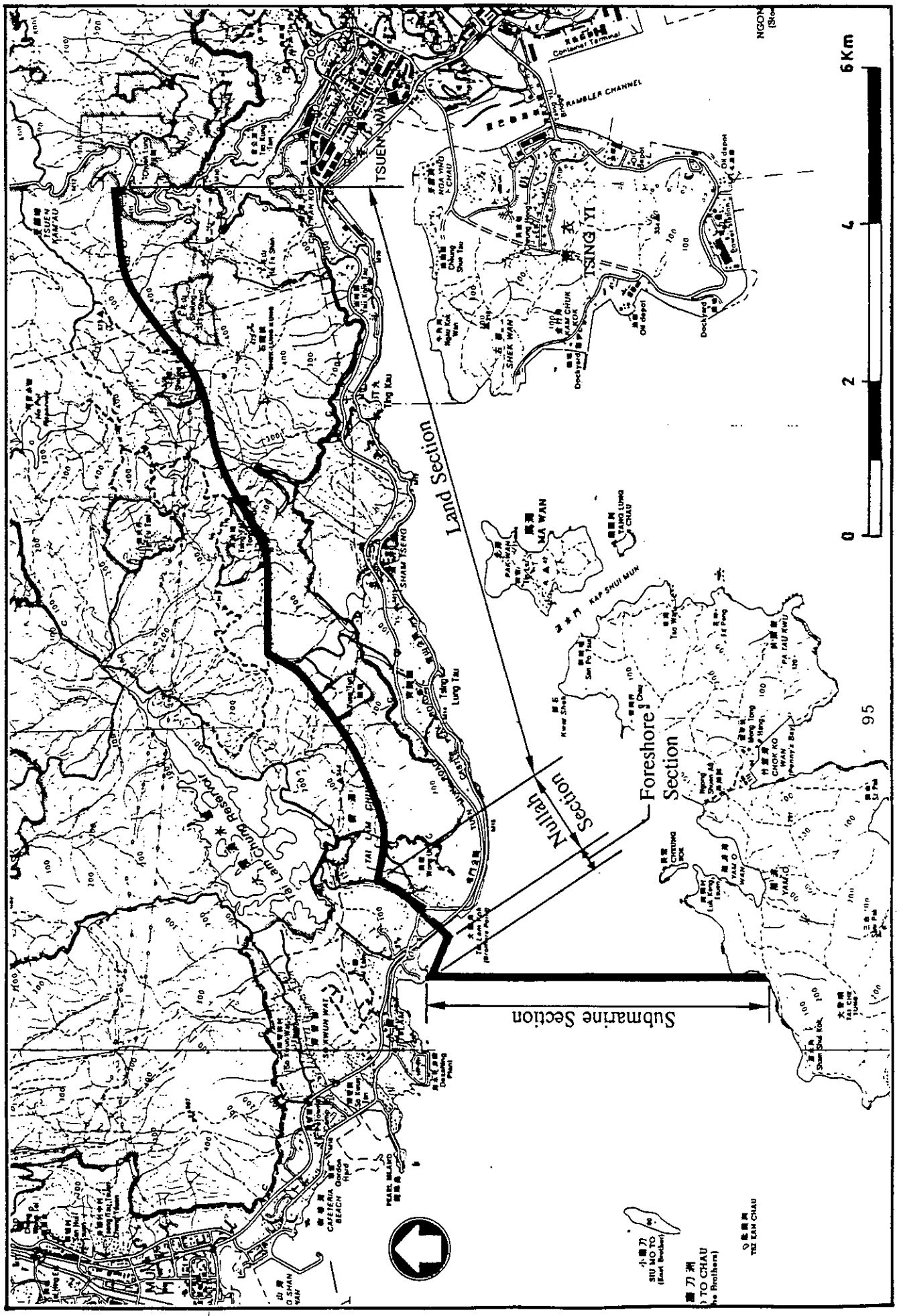
Gas pigging stations will be built at Siu Lam and at Chuen Lung West and a pigging and offtake station will be built at Ta Pang Po. The pipeline will be 750mm diameter across the Country Park and 300mm diameter across the submarine section and on North Lantau.

The proposed pipeline route through the New Territories was selected during an earlier Feasibility Study. Fine tuning of the route now proposed has avoided burial grounds, private lands and areas of particular ecological importance. This Environmental Impact Assessment (EIA) forms a part of the overall feasibility study and addresses potential environmental impacts arising from constructing the gas transmission pipeline and from the post commissioning stages.

1.2 Study Objectives

The purpose of the environmental assessment is to identify any likely impacts which may arise during and following the construction of the pipeline and its associated structures. Any mitigation measures which may be necessary to minimise such impacts are also proposed.

Figure 1.1 The Pipeline Route



The primary objectives of the EIA as stated in the Brief are as follows:

(a) to describe components of the project and identify requirements for their development;

(b) to identify potential impacts on the surrounding environment and any adjacent dwellings which may arise during construction and operation of the pipeline:

(c) to identify and specify any measures which may be required to minimise impacts identified in (b) above, which may need to be included in detailed design, construction and operation phases;

(d) to propose environmental monitoring and audit procedures necessary to ensure compliance with the standards and regulations already in place during both construction and operation of the pipeline;

(e) to set out a Landscape Master Plan designed to ensure restoration of the pipeline route achieves desired environmental standards; and

(f) to make any recommendations for further work which may be necessary to realise the aims and objectives of this Environmental Impact Assessment.

1.3 Structure of this Report

This EIA report is structured as follows:

(a) Details of construction activities required for the development of this project are outlined in Section 2;

(b) Section 3 outlines appropriate environmental legislation, standards and guidelines which have been taken into account throughout the EIA;

(c) Sections 4, 5 and 6 discuss the potential impacts in terms of air quality, noise, water movements and water and sediment quality during both phases of the project;

(d) Section 7 identifies solid waste arisings during the construction phase and proposes methods for their disposal;

(e) Sections 8, 9 and 10 formulate the Landscape Master Plan and identifies ecological issues which are principal issues of this project;

(f) Section 11 sets out restoration proposals and a technical specification for the required planting works;

(g) Section 12 investigates both marine and road transport related impacts during construction;

(h) Socio-economic issues relating to the development and operation of the pipeline are addressed in Section 13; and

(i) Sections 14 and 15 provide a summary of recommendations and conclusions to be drawn from the EIA.

2. Construction Activities

2. CONSTRUCTION ACTIVITIES

2.1 Introduction

Land based construction activities and those pertaining to the marine section of the pipeline route have been considered separately. The land based section extends from the Route Twisk connection through the Tai Lam Country Park to the disused quarry north of Tai Lam Chung Tsuen. The marine section includes the nullah, foreshore and submarine sections and extends from the upper reaches of the Tai Lam Nullah to the landfall at Ta Pang Po on Lantau Island. From the gas pigging and offtake station at Ta Pang Po the pipeline will be laid in the utilities reserve of the North Lantau Expressway (NLE).

The extent of the Study Area and the detail involved in this EIA has necessitated a set of four drawings showing the route of the transmission pipeline. The drawings are shown on Figures 2.1 to 2.4 inclusive.

Construction of the overland section is scheduled between October 1993 and November 1995. A preliminary construction programme has been drawn up (Appendix A) and used in the assessments of air quality, water quality, spoil disposal and noise impacts.

2.2 North Lantau Expressway

A full environmental impact assessment has previously been undertaken for the NLE which concluded that construction activities would be unlikely to create major dust impacts on sensitive receivers. Noise levels could achieve the standards set for daytime working but not evening or night time working.

The utilities service road of the NLE will accommodate water supply, telephone, electricity and gas services and will involve trench excavation, backfilling and surfacing of the road. On the basis of the EIA carried out for the NLE, it may be concluded that, while installation of utilities could create some noise impacts, these could be overcome by adoption of appropriate mitigatory measures. The key element to minimising noise impacts is coordination of these works, with the optimal solution being to lay all utilities together. No further assessment of this section of the route has thus been undertaken.

2.3 Description of Overland Activities

The connection to the existing gas transmission system will be made west of Chuen Lung where a gas pigging station will be constructed on a site with a surface area of 35m by 30m. Construction works will involve rock excavation, site preparation and assembly of components. Plant which may be required for this activity includes excavators, bulldozers and dump trucks. Site preparation and assembly of components is anticipated to take a minimum of six months.

From the pigging station the route will run parallel to a stream for 200m in a northerly direction and then westwards. The pipeline will be laid in a trench approximately 2m deep and 1m wide with sections of pipe being joined insitu. A protective coating will be applied to the joints, following which the trench will be backfilled to a minimum depth of 1m. Not all material excavated from the trench is considered suitable for backfill or revegetation purposes, and thus there will be some export of spoil from the site and some import of backfilling material. Excavation quantities are shown in Table 2.1. Much of the excavated material will be used on-site for the backfilling of the pipeline trench and for the construction of a rural path (Section 11.3(i)), with the remainder

disposed of offsite. Typically only about 100m of trench will be open at each workface at any one time.

Table 2.1 Excavation Quantities

Location	Excavation (cu m)	
	Soft Material	Rock
Tai Lam Chung quarry from nullah	20	420
Quarry shaft	-	445
Country Park section	25,300 (1)	700
Chuen Lung West pigging station	-	7,000

Notes (1) about 10,000 cu m of this material will be used for backfilling. The remainder will be exported. About 1,300 cu m of topsoil will be imported. Approximately 1,650 cu m of sand for a 150mm bedding layer will also be brought to the site.

A vertical shaft and horizontal adit, exiting in the abandoned quarry at Tai Lam Chung Tsuen will connect the land and marine sections. Equipment which may be required at this site include excavators, bulldozers, rock augers, rock drills, a concrete mixer and a pump. Once the pipeline has been laid the adit and shaft will be backfilled and both entrances will be grouted up.

Pipe lengths will be typically 12m long, and these and other construction materials will be brought to site by truck. The total number of trunk movements for pipe delivery will be about 200 in a two year period, or about 2 trucks per week. Each truck will carry about 60m of pipe.

2.4 Description of Marine Activities

The marine section of the route is shown on Figures 1.1 and 2.1. This section comprises:

(a) submarine section between the Siu Lam and Ta Pang Po landfalls (Figure 1.1);

(b) foreshore section between the Siu Lam landfall and the lower nullah section (Figure 2.1); and

(c) the nullah section along about 1km of the Tai Lam Nullah (Figure 2.1).

A schedule of construction equipment likely to be used for the marine contract is included in Appendix C.

Construction of the Marine Section

It has been assumed the bottom pull method will be adopted to lay the pipeline in the submarine section. The pipeline will be pulled from an anchored winch at the Ta Pang Po landfall. A temporary works platform will be created seaward of the Customs and Excise station at Siu Lam by driving piles to create a deck for storage of materials, forming pipe strings (including welding, joining pipes, painting and adding the concrete jacket), and launching of the pipeline. The temporary platform is programmed for construction during a period of four months between May and September 1994.

Materials and labour will be mainly brought to the site by barges and boats due to the difficulties of land access to the site and there will be only limited land access. Pipes will be brought to the Siu Lam site in 12m lengths. A period of four months has been allowed for the pipelaying for the submarine channel section.

Water depths within the nullah section are a limiting factor especially in the upper reaches. Pipes will be laid by floating and sinking into position. This activity has been scheduled for a one month period between February and March 1995. Bottom pulling of the foreshore pipelines may be possible but this section is more likely to be floated into position beneath the raised Discovery Bay electric cable.

Dredging

Approximately 10,000 cu m soft clayey silt will be dredged to form a trench in preparation for construction of the Siu Lam landfall and gas pigging station. Spoil will be disposed of at a gazetted dumping ground, probably Cheung Chau. Rockfill will be placed behind the seawall to provide a site area of approximately 35m by 50 m.

Dredging for the submarine section of the trench is provisionally scheduled over a six month period in 1995. Although the actual dimensions of the dredged trench will be determined by seabed conditions, it has been assumed for the purposes of this assessment that the trench will have a base width of 5m, 4m depth with side slopes of 1 in 3. A trench of 3m wide will also be dredged for the foreshore section. Within the nullah section dimensions of the dredged channel are assumed to be 3m base width, 3m in depth with side slopes of 1 in 3, although this also requires further confirmation during detailed design.

An estimated 1,320,000 cu m of spoil will be dredged from the marine and foreshore sections (excluding the Siu Lam landfall) with a further 70,000 cu m from the nullah section. About 45,000 cu m of sand and gravel from the nullah will be reused and other material will be disposed of at gazetted dumping grounds.

Backfilling

Placing rock armour protection and backfilling has been programmed for six months in the submarine section, three months in the foreshore section and one month for the nullah. Within the submarine and foreshore sections this may involve two hopper barges, two cranes and a tugboat. Backfilling in the nullah is likely to only involve a mobile crane and possibly a small marine vessel.

Site Formation for Landfalls

Land for the Ta Pang Po landfall will be formed as part of the NLE Contract.

The Siu Lam landfall will be built by placing rock up to an elevation of 6m and with concrete block retaining walls with vertical faces. Dredging will be necessary to remove unsuitable marine deposits prior to placing the rock.

2.5 Operation Phase

Once construction works have been completed, the temporary platform will be removed, and the Country Park area restored. Two gas pigging stations, one pigging and offtake station and two landfall sites will be the only visible features of this project once construction is complete. All of these will be landscaped to minimise visual impacts.

Only occasional visual inspections of the pipeline route will be necessary, either by walking overland or from the air.

Figure 2.1 The Study Area

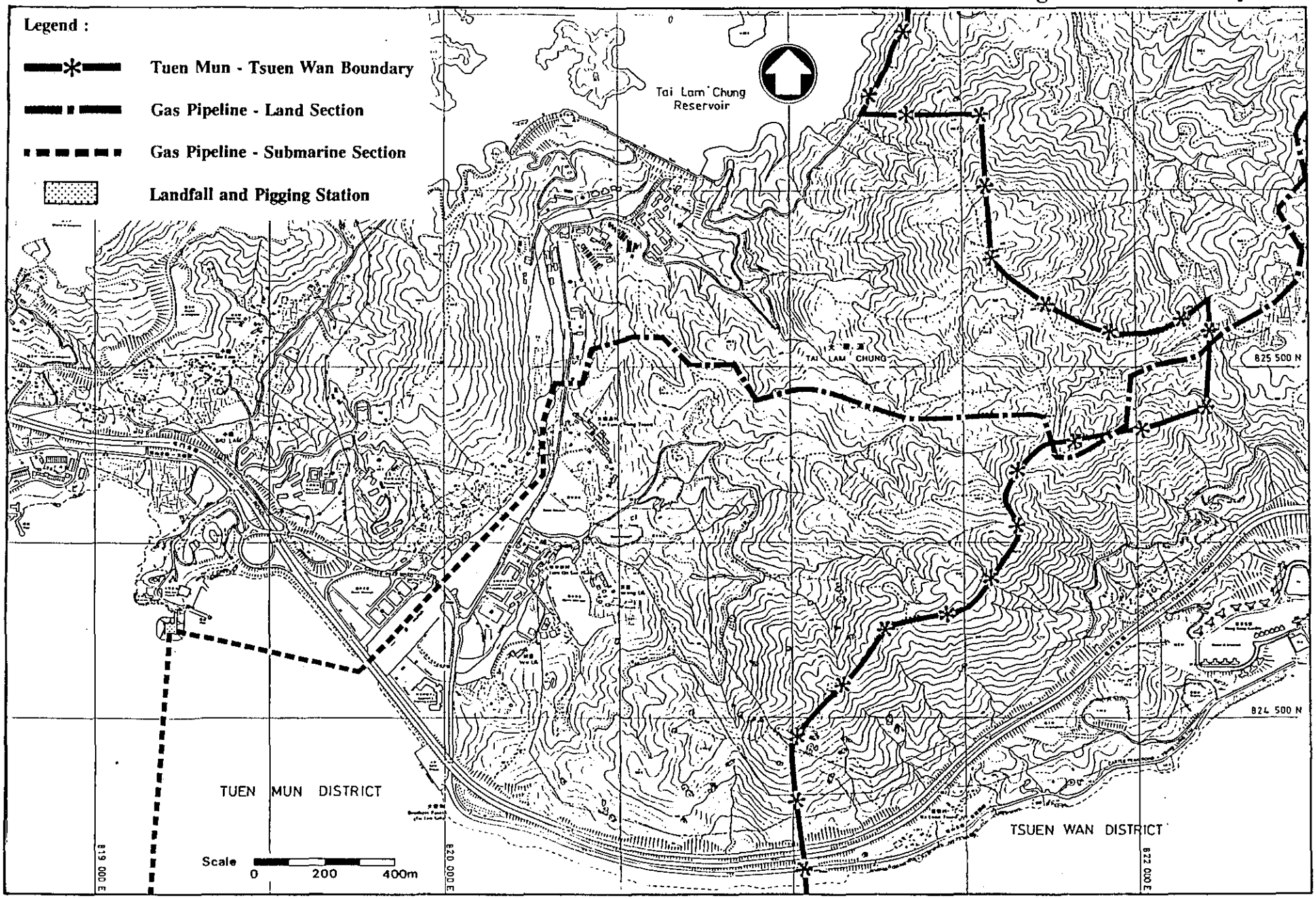


Figure 2.2 The Study Area

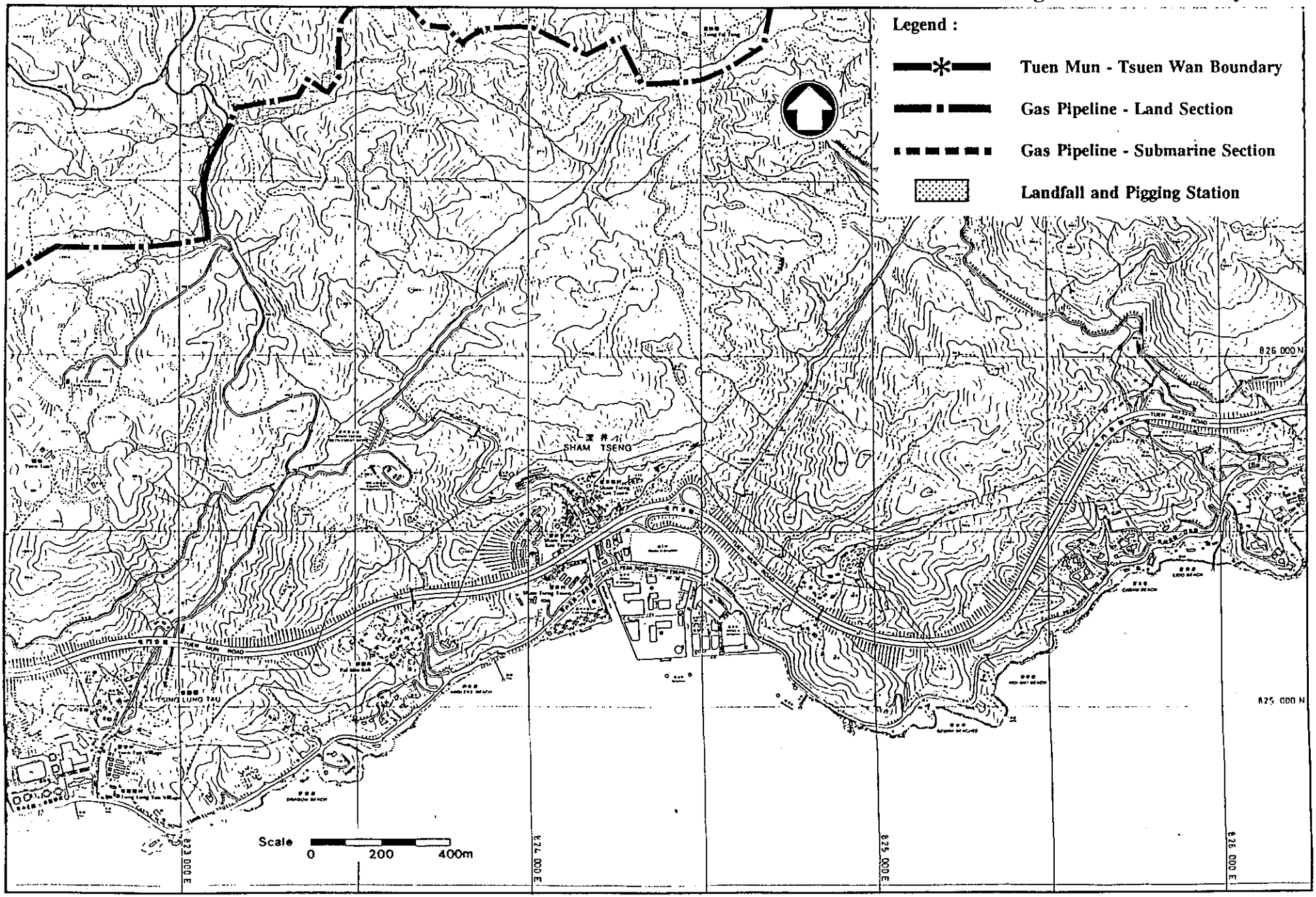


Figure 2.3 The Study Area

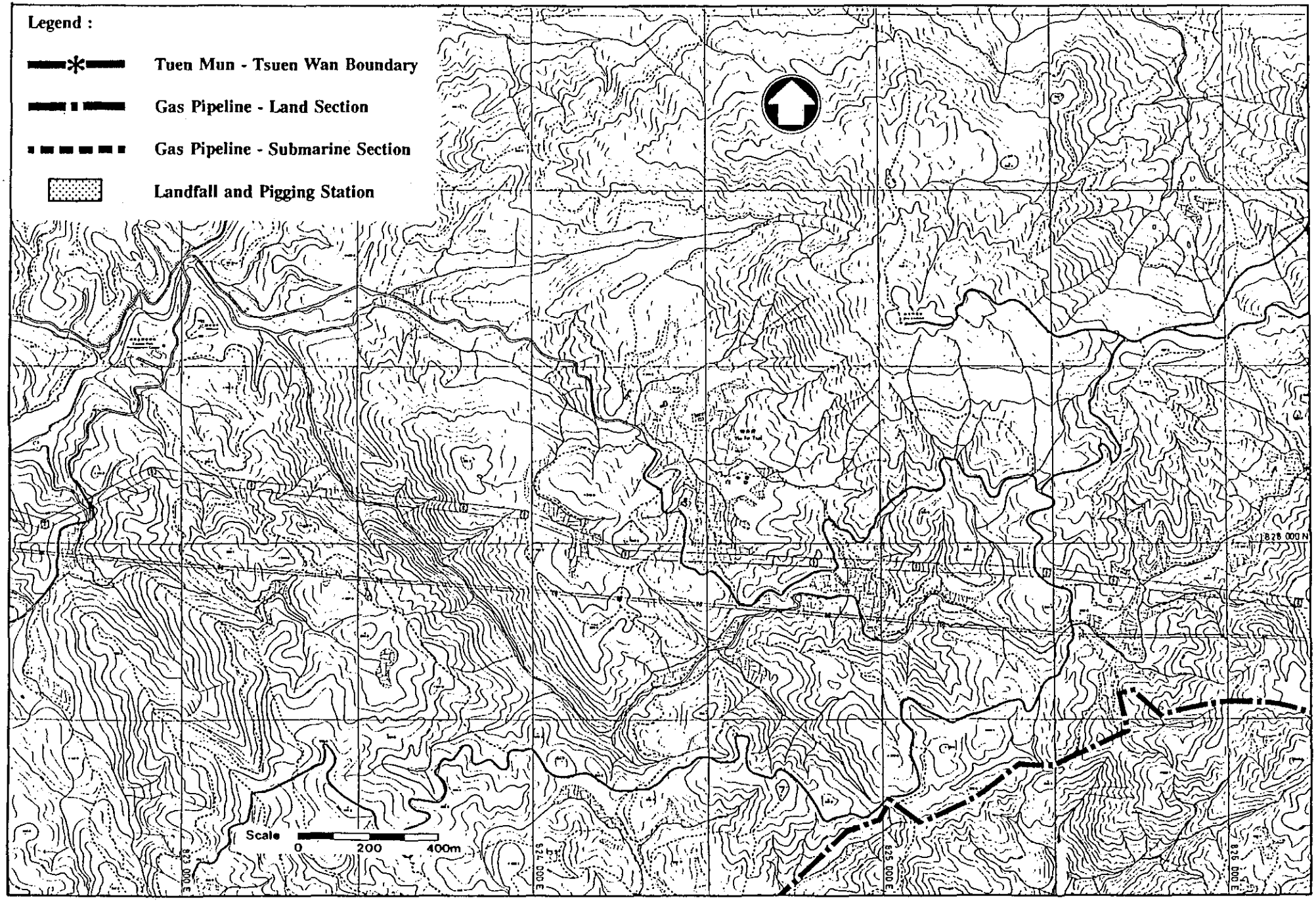
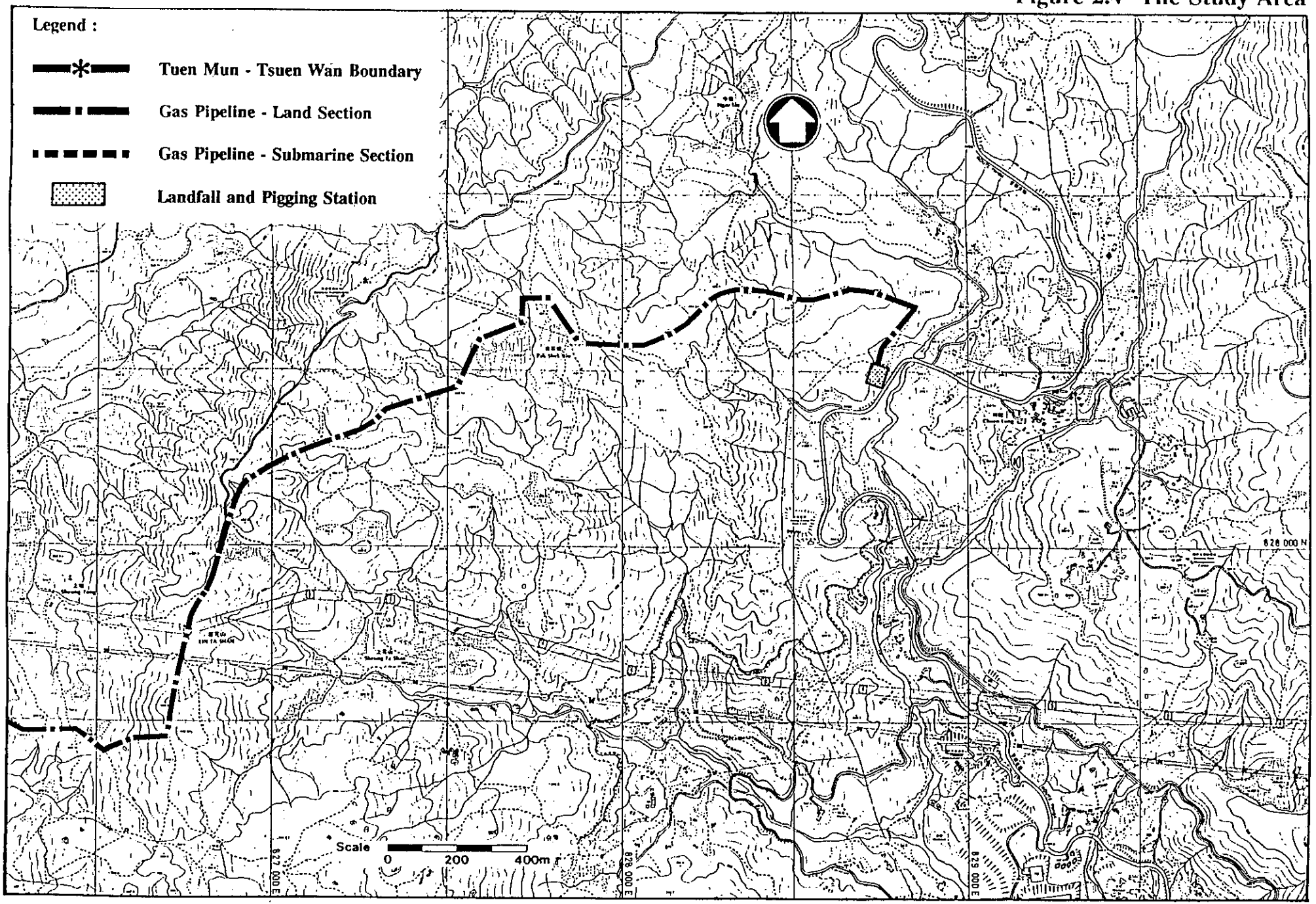


Figure 2.4 The Study Area



3. Environmental Legislation

3. ENVIRONMENTAL LEGISLATION

3.1 Water Quality

Control of pollution in marine waters in Hong Kong is legislated for under the provisions of the Water Pollution Control Ordinance (Cap 358), 1980 (WPCO). Territorial waters are sub-divided into Water Control Zones (WCZ) and each WCZ has been ascribed a series of Beneficial Uses (BU) and related Water Quality Objectives (WQO) reflecting the assimilative capacity of the water body, or parts thereof, and its predominant uses.

The Study Area lies within the North Western Water Control Zone (NWWCZ) which was gazetted on 1st April 1992. BU's assigned to the NWWCZ are given in Tables 3.1 with the relevant WQO's listed in Table 3.2.

Table 3.1 Beneficial Uses Ascribed to the North Western Water Control Zone

Beneficial Use	Applicability
BU1 Human Food	part of zone
BU2 Commercial Exploitation	part of zone
BU3 Marine Life	throughout zone
BU4 Bathing	part of zone
BU5 Secondary (Contact Recreation)	part of zone
BU6 Domestic/Industrial	part of zone
BU7 Navigation/Shipping	throughout zone
BU8 Aesthetic	throughout zone

In 1991, a Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters, referred to as the Technical Memorandum on Effluent Standards (TMES), was issued. This Technical Memorandum requires the licencing of all discharges, and sets effluent quality standards on a case by case basis, determined largely by the water body into which the discharge is made and the effluent flow rate.

Although dredging and reclamation works are excluded from the provisions of the Technical Memorandum they are covered under separate legislation, and normally also by inclusion of specification clauses in construction contracts.

3.2 Noise

The Noise Control Ordinance (NCO) gazetted in 1988, is the main legislation controlling noise levels at industrial and commercial premises and construction works. The Ordinance is enacted through three Technical Memoranda and two sets of Regulations. Noise standards are also set in Chapter 9 of the Hong Kong Planning Standards and Guidelines.

Table 3.2 Water Quality Objectives for the North Western Water Control Zone

Objective	Description	Part or Parts of Zone
Aesthetic Appearance	(a) Waste discharges shall cause no objectionable odours or discolouration of the water	Whole zone
	(b) Tarry residues, floating wood, articles made of glass, plastic, rubber or of any other substances should be absent.	Whole zone
	(c) Mineral oil should not be visible on the surface. Surfactants should not give rise to a lasting foam.	Whole zone
	(d) There should be no recognisable sewage-derived debris.	Whole zone
	(e) Floating, submerged and semi-submerged objects of a size likely to interfere with the free movement of vessels, or cause damage to vessels, should be absent.	Whole zone
	(f) Waste discharges shall not cause the water to contain substances which settle to form objectionable deposits.	Whole zone
Bacteria	(a) The level of Escherichia coli should not exceed 610 per 100mL, calculated as the geometric mean of all samples collected in a calendar year.	Secondary Contact Recreation Subzones
	(b) The level of Escherichia coli should be less than 1 per 100mL, calculated as the running median of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days.	Water Gathering Ground Subzones
	(c) The level of Escherichia coli should not exceed 1000 per 100mL, calculated as the running median of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days.	Tuen Mun (C) Subzones and other inland waters
	(d) The level of Escherichia coli should not exceed 180 per 100mL, calculated as the geometric mean of all samples collected from March to October inclusive. Samples should be taken at least 3 times in one calendar month at intervals of between 3 and 14 days.	Bathing Beach Subzones
Colour	(a) Waste discharges shall cause the colour of water to exceed 30 Hazen unit.	Tuen Mun (A) and Tuen Mun (B) Subzones and Water Gathering Ground Subzones
	(b) Waste discharge shall not cause the colour of water to exceed 50 Hazen units.	Tuen Mun (C) Subzone and other inland waters
Dissolved Oxygen	(a) Waste discharges shall not cause the level of dissolved oxygen to fall below 4mg per litre for 90% of sampling occasions during the whole year; values should be calculated as water column average (arithmetic mean of at least 3 measurements at 1m below surface, mid-depth and 1m above seabed). In addition, the concentration of dissolved oxygen should not be less than 2mg per litre within 2m of the seabed for 90% of the sampling occasions during the whole year.	Marine waters

Table 3.2 Water Quality Objectives for the North Western Water Control Zone (Cont'd)

Objective	Description	Part or Parts of Zone
	(b) Waste discharges shall not cause the level of dissolved oxygen to be less than 4mg per litre.	Tuen Mun (A), Tuen Mun (B) and Tuen Mun (C) Subzones, Water Gathering Ground Subzones and other inland waters
pH	(a) The pH of the water should be within the range of 6.5-8.5 units. In addition, waste discharges shall not cause the natural pH range to be extended by more than 0.2 unit.	Marine waters excepting Bathing Beach Subzones
	(b) Waste discharges shall not cause the pH of the water to exceeed the range of 6.5-8.5 units.	Tuen Mun (A), Tuen Mun (B) and Tuen Mun (C) Subzones and Water Gathering Ground Subzones
	(c) The pH of the water should be within the range of 6.0-9.0 units.	Other inland waters
	(d) The pH of the water should be within the range of 6.0-9.0 units for 95% of samples collected during the whole year. In addition, waste discharges shall not cause the natural pH range to be extended by more than 0.5 unit.	Bathing Beach Subzones
Temperature	Waste discharges shall not cause the natural daily temperature range to change by more than 2.0°C.	Whole zones
Salinity	Waste discharges shall not cause the natural ambient salinity level to change by more than 10%.	Whole zones
Suspended Solids	(a) Waste discharges 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.	Marine waters
	(b) Waste discharges shall not cause the annual median of suspended solids to exceed 20mg per litre.	Tuen Mun (A), Tuen Mun (B) and Tuen Mun (C) Subzones and Water Gathering Ground Subzones
	(c) Waste discharges shall not cause the annual median of suspended solids to exceed 25 mg per litre.	Other inland waters
Ammonia	The un-ionized ammoniacal level should not be more than 0.021 mg per litre, calculated as the annual average (arithmetic mean).	Whole zone
Nutrients	(a) Nutrients shall not be present in quantities sufficient to cause excessive or nuisance growth of algae or other aquatic plants.	Marine waters
	(b) Without limiting the generally of objective (a) above, the level of inorganic nitrogen should not exceed 0.3 mg per litre, expressed as annual water column averager (arithmetic mean of at least 3 measurements at 1m below surface, mid-depth and 1m above seabed).	Castle Peak Bay Subzone

Table 3.2 Water Quality Objectives for the North Western Water Control Zone (Cont'd)

Objective	Description	Part or Parts of Zone
	(c) Without limiting the generality of objective (a) above, the level of inorganic nitrogen should not exceed 0.5 mg per litre, expressed as annual water column average (arithmetic mean of at least 3 measurements at 1m below surface, mid-depth and 1m above seabed).	Marine waters excepting Castle Peak Bay Subzone
5-Day Biochemical Oxygen Demand	(a) Waste discharges shall not cause the 5-day biochemical oxygen demand to exceed 3mg per litre.	Tuen Mun (A), Tuen Mun (B) and Tuen Mun (C) Subzones and Water Gathering Ground Subzones
	(b) Waste discharges shall not cause the 5-day biochemical oxygen demand to exceed 5mg per litre.	Other inland waters
Chemical Oxygen Demand	(a) Waste discharges shall not cause the chemical oxygen demand to exceed 15mg per litre.	Tuen Mun (A), Tuen Mun (B) and Tuen Mun (C) Subzones and Water Gathering Ground Subzones
	(b) Waste discharges shall not cause the chemical oxygen demand to exceed 30mg per litre.	Other inland waters
Toxins	(a) Waste discharges shall not cause the toxins in water to attain such levels as to produce significant toxic, carcinogenic, mutagenic or teratogenic effects in humans, fish or any other aquatic organisms, with due regard to biologically cumulative effects in food chains and to toxicant interactions with each other.	Whole zone
	(b) Waste discharges shall not cause a risk to any beneficial use of the aquatic environment.	Whole zone
Phenol	Phenols shall not be present in such quantities as to produce a specific odour, or in concentration greater than 0.05 mg per litre as C_6H_5OH.	Bathing Beach Subzones
Turbidity	Waste discharges shall not reduce light transmission substantially from the normal level.	Bathing Beach Subzones

The NCO imposes stringent controls on construction works involving percussive piling in close proximity to noise sensitive receivers. The regulations for control of percussive piling are set out in the Technical Memorandum on Noise from Percussive Piling (TM2). Piling times are restricted and work is only allowed within the limits of a Noise Control Permit (NCP) issued by the Environmental Protection Department (EPD).

The Technical Memorandum on Construction Noise other than Percussive Piling (TM1) prescribes Basic Noise Levels (BNL's) for areas according to their sensitivity rating. This reflects the predominant character and activities undertaken within an area. The Area Sensitivity Rating (ASR) of the Study Area will be 'A' for the Country Park and traditional village type dwellings in the upper section of Tai Lam Nullah. A Sensitivity Rating of 'B' is ascribed to the lower nullah section due to the proximity of the Tuen Mun Highway and Castle Peak Road. The BNLs that will apply to this project are listed in Table 3.3.

Table 3.3 **Basic Noise Levels for Construction Activities Other than Percussive Piling dB(A)**

Time Period	Area Sensitive Rating	
	A	B
Period I All evenings (1900-2300 hrs) and general holidays and Sundays (0700-2300 hrs)	60	65
Period II All night times (2300-0700hrs)	45	50

3.3 Air Quality

Air quality legislation is enacted under the Air Pollution Control Ordinance (APCO) (Cap 311) which encompasses all emissions from chimneys, furnaces, ovens or industrial plant. Under this legislation, Government has declared Air Control Zones (ACZ) for the whole Territory. Air Quality Objectives (AQO) for Hong Kong are given in Table 3.4.

Control programmes cover emissions from both stationary and mobile sources. Stationary sources of air pollution for this project will include rock cutting and trench excavation and loading and unloading of spoil and backfilling material. Mobile sources will be mainly associated with vehicular movements needed for delivery of materials and spoil disposal.

3.4 Solid Waste

The Waste Control Ordinance (WCO) (Cap 354) was enacted in 1980 and provided the framework for the Waste Disposal Plan for the Territory which was formulated in 1989. Reference has been made to the aforementioned when considering waste arisings and disposal methods during the construction phase of this project.

Oil and fuel spillages in coastal waters are under the control of the Marine Department and regulated by the Oil Pollution Ordinance (Cap 247).

Table 3.4 Hong Kong Air Quality Objectives

Pollutant	Concentration in micrograms per cubic metre (i)					Health effects of pollutant at elevated ambient levels
	Averaging Time					
	1 Hour (ii)	8 Hours (iii)	24 Hours (iii)	3 Months (iv)	1 Year (iv)	
Sulphur Dioxide	800		350		80	Respiratory illness; reduced lung function; morbidity and mortality rates increase at higher levels.
Total Suspended Particulates			260		80	Respirable fraction has effects on health.
Respirable (v) Suspended Particulates			180		55	Respiratory illness; reduced lung function; cancer risk for certain particles; morbidity and mortality rates increase at higher levels.
Nitrogen Dioxide	300		150		80	Respiratory irritation; increased susceptibility to respiratory infection; lung development impairment.
Carbon Monoxide	30000	10000				Impairment of co-ordination; deleterious to pregnant women and those with heart and circulatory conditions.
Photochemical Oxidants (as Ozone) (vi)	240					Eye irritation; cough; reduced athletic performance; possible chromosome damage.
Lead				1.5		Affects cell and body processes; likely neuropsychological effects, particularly in children; likely effects on rates of incidence of heart attacks, strokes and hypertension.

Legend:

(i) Measured at 298°CK (25°C) and 101.325 kPa (one atmosphere)
(ii) Not to be exceeded more than three times per year.
(iii) Not to be exceeded more than once per year.
(iv) Arithmetic means.
(v) Respirable suspended particulates means suspended particles in air with a nominal aerodynamic diameter of 10 micrometres and smaller.
(vi) Photochemical oxidants are determined by measurement of ozone only.

3.5 Ecology

A wide range of legislative and regulatory controls are in place for the conservation of species and the protection of the environment. These include, inter alia, the Forests and Countryside Ordinance (Cap 96) 1984, the Country Parks Ordinance (Cap 208) 1986, the Country Parks Special Areas Regulations 1989, Wild Animals Protection Ordinance (Cap 170) 1980, Animals and Plants Protection of Endangered Species (Cap 187), the Antiquities and Monuments Ordinance (Cap 53) 1986, the Town Planning Ordinance (Cap 131) 1988 and the revised Town Planning Amendment Ordinance 1991.

The Town Planning Ordinance encompasses Sites of Special Scientific Interest (SSSI), coastal protection areas and any other area or use that could protect the environment.

As part of the assessment for the overland section of the gas pipeline route, consideration has been given to the preservation of trees and native species of particular conservation significance, encompassed within the Forestry Regulations (Cap 96).

3.6 Hong Kong Planning Standards and Guidelines

In addition to the foregoing, Chapter 9 of the Hong Kong Planning Standards and Guidelines provides guidance and standards to be adopted in environmental planning.

4. Air Quality

4. AIR QUALITY

4.1 Introduction

This section of the EIA identifies and quantifies the potential impacts on air sensitive receivers (ASRs) during construction of the pipeline and proposes any measures necessary to minimise the impacts.

4.2 Existing Air Quality

Tai Lam and the Country Park are classed as rural areas. The main sources of air pollution at Tai Lam are currently from road traffic using the Castle Peak, Tuen Mun and Tai Lam Chung roads.

While the Environmental Protection Department routinely monitor air quality at their fixed monitoring stations, there is no specific air quality monitoring station close to the proposed route of the pipeline.

For the purposes of this assessment it has been assumed that the background total suspended particulate (TSP) levels for Tai Lam may be within the range of 121 μg/cu m and 50 μg/cu m (based on measurements by EPD at Tsing Yi and by the North Lantau Development Consultants in January 1991 at Tung Chung). Ambient TSP levels for the Country Park will be similar to those measured at Tung Chung. The following conservative estimates have thus been adopted as background levels to take account of the degree of urbanisation of this rural area:

Tai Lam	:	100 μg/cu m TSP
Tai Lam Country Park	:	50 μg/cu m TSP

4.3 Sensitive Receivers

ASRs have been identified according to the Hong Kong Planning Standards and Guidelines (HKPSG). The ASRs are shown on Figures 4.1 to 4.4 and are listed in Table 4.1 below.

Users of the Country Park should also be considered as being sensitive to dust from construction works. Country Park users who could be affected would be those walking along footpaths and roads as there are no picnic sites or other fixed recreation areas that are close to the pipeline.

The submarine, foreshore and nullah sections of the pipeline are not expected to cause any impact on ambient air quality; nor have any sensitive receivers been identified near the Ta Pang Po landfall.

Table 4.1 Air Sensitive Receivers

Air Sensitive Receivers	Minimum Distance from pollution source (m)		ASR ID (see Figures 4.1 to 4.4)
	Works Site	Haul Road	
Scattered Dwellings at:			
Chuen Lung,	155	155	A1, A2, A3
Sheung Fa Shan,	485	485	A4
Sheung Tong,	350	350	A5
South of Sheung Tong, and	225	225	A6
Tsing Fai Tong.	60	60	A7
CAS Yuen Tun Camp,	200	200	A8
Yuen Tun.	125	125	A9
Tai Lam Correctional Institute,	140	150	A10
Tai Lam Dental Clinic,	15	30	A11
Tai Lam Chung Tsuen,	80	25	A12
Scattered village housing on east bank of nullah, and	140	20	A13
Scattered village housing on west bank.	200	65	A14

4.4 Dust from Construction

Methodology

The Contractor will be required to comply with the 24 hour AQO of 260 μg/cu m. However a 24-hour concentration is not always the best measure for determining construction impacts as the levels can fluctuate significantly during the day. EPD therefore recommend a maximum 1-hour TSP level of 500 μg/cu m at the site boundary in addition to the AQO. The 1-hour level is normally the controlling criterion and this has been used to measure the impacts.

Predictions of TSP generated by construction activities have been modelled using the Industrial Source Complex Short Term Model (ISCST). To determine the greatest possible impact on sensitive receivers, the air quality modelling has been carried out assuming worst case conditions.

Meterological Data

For the modelling of construction impacts the following worst case meterological conditions for dust dispersion have been used:

Wind Speed	:	2 m/s
Stability Class	:	D
Temperature	:	25°C
Mixing Height	:	1000 metres

Construction Programme and Activities

An assessment of construction methods for the pipeline has been made on the basis of information presently available. Activities which could result in air quality impacts include excavation for the Chuen Lung West pigging station, excavation for pipeline trenches across the Country Park and across the quarry, rock drilling and excavation for the shafts near Tai Lam Tsuen Chuen and the use of unpaved roads for haulage of spoil and delivery of materials to any of the construction sites.

Emission Factors

The emission factors adopted for excavation and traffic on unpaved haul roads, have been estimated using USEPA AP-42 4th edition, 1985. The emission factors and rates for each activity are included in Appendix B(i).

In assessing the worst case situation, potential impacts on air quality have been calculated for increasing distances from the source. The ASR most affected by each construction activity has then been determined. Modelling results are included in Appendix B(ii).

Assessment of Impacts

Chuen Lung West Pigging Station

About 12,500 cu m of material will be excavated for the pigging station at Chuen Lung West over a period of about six months. Spoil will be transported off site by truck. The worst affected ASRs will be those in Chuen Lung 155 metres away. Figure 4.5 illustrates the impact on the ASRs from excavation and hauling and shows that the target of 500 μg/cu m will not be exceeded at Chuen Lung. Excavation alone will have an extremely limited impact (7 - 8 μg/cu m) and most of the impact will be from truck movements.

Excavation of Trenches

Prediction of dust levels from excavation of the trenches across the Tai Lam Country Park and the quarry floor has assumed that hydraulic rock excavators will be used.

As shown on Figure 4.6, the predicted one hour TSP levels generated by excavation across the Country Park at fixed sensitive receivers are below 20 μg/cu m. The closest dwelling is A7 60 metres from the site. Residents at A7 will thus not be significantly affected by the works.

The highest 1-hour dust levels predicted are about 70μg/cu m at about 30m from the works. The impact on users of the Country Park will thus also not be significant.

Excavation along the quarry floor will have most impact on the Dental Clinic 15 metres away. Maximum predicted TSP levels of 100 μg/cu m shown on Figure 4.7, easily comply with the 500 μg/cu m level recommended by EPD for construction activities.

Rock Drilling and Excavation of the Shaft

An estimated 300 cu m of material will be drilled and excavated for the shafts during a two month period. This activity will have negligible impact on air quality.

Haulage Along Unpaved Roads

It has been estimated that there could be up to ten truck-trips per day importing and exporting materials to the Country Park. Air quality impacts could also be generated by vehicles removing spoil and delivering materials to and from sites at the head of the Tai Lam nullah. Vehicles travelling along the Route Twisk, Tai Lam Chung, Castle Peak and Tuen Mun roads will have a negligible impact on air quality as all these roads are paved.

Fugitive Emissions

Impacts from other pollutants such as vehicular emissions (SO_2, CO, NO_2, NO) will be insignificant.

Mitigation Measures

The assessment has shown that construction of the pipeline is not likely generate dust levels in excess of the objectives. However mitigation measures to reduce dust should be implemented to reduce the impacts. These mitigation measures should include the following:

(a) spraying rock surfaces with water prior to excavation and using the minimum practicable charge during any blasting that proves necessary;

(b) containing dust emissions from rock drilling;

(c) storing materials under cover and periodically damping down during dry and windy weather;

(d) spraying spoil and raw materials during handling and delivery when dust is likely to be created;

(e) damping down of haul roads and access roads to minimize dust generation;

(f) loading spoil below the height of the sides of the truck and covering during transportation with a fixed tarpaulin;

(g) restricting vehicle speeds on haul roads to a maximum of 15 km/h; and

(h) keeping all equipment properly maintained to minimise fugitive emissions.

In addition to the above hoardings should be constructed around the works in the Tai Lam quarry to minimise dust impacts on the dental clinic.

4.5 Operation Phase

Operation of the pipeline will have no impact on air quality.

4.6 Air Quality Monitoring And Audit

Air quality monitoring and audit should be carried out prior to and during construction to ensure compliance with the requirements of the APCO and with the 1-hour target of 500$\mu g/m^3$.

To establish baseline conditions, dust monitoring should be undertaken during the first month of the works to provide 1-hour and 24-hour TSP background levels. Readings should be taken daily for seven days each week to establish 24-hour TSP levels, and three times per day for a period of one week to determine 1-hour TSP levels.

To identify any variation in ambient conditions, baseline monitoring should be repeated at six-monthly intervals, at times when no activities are being undertaken on-site which may influence dust levels.

During the working of land based construction activities, one hour and 24 hour dust monitoring should be carried out at the sensitive receiver closest to the source.

A programme of dust monitoring should specify the use of equipment such as the following:

(a) high volume sampler to measure the 24 hour TSP μg/cu m in accordance with the methodology described in USEPA 40 CFR Part 50; and

(b) direct reading dust meter to measure the one hour TSP μg/cu m in the range of 0.1-100 mg/cu m.

Further details of the monitoring programme will be available when the Contractors work schedule is determined.

To ensure environmental controls are effected during the construction phase, a set of trigger, action and target levels have been established for this EIA. These are given in Table 4.2 below.

Table 4.2 Trigger, Action and Target Levels Proposed for Dust

Parameter	Trigger μg/cu m	Action μg/cu m	Target μg/cu m
1 hour TSP	Background level plus 30%	Average of trigger and target level	500
24 hour TSP	Background level plus 30%	Average of trigger and target level	260

A proposed action plan for dust monitoring has been included in Table 4.3 providing recommendations on action to be taken in the event of trigger, action or target levels being exceeded.

Table 4.3 Proposed Action Plan for Dust

Event	Action	
	Engineer	Contractor
Trigger level exceeded for one sample	Repeat measurement as soon as possible	-
Trigger level exceeded for more than one consecutive sample	Repeat measurements Notify contractor	Review plant and methods Implement remedial actions Notify Engineer of action taken
Action level exceeded for one sample	Repeat measurement as soon as possible Notify contractor	-
Action level exceeded for more than one consecutive sample	Increase frequency of monitoring to daily Notify contractor Require contractor to make proposals to reduce dust	Review plant and methods Submit proposals for reducing dust to Engineer Implement remedial actions Notify Engineer of action taken
Target level exceeded for one sample	Repeat measurement as soon as possible Notify contractor	-
Target level exceeded for more than one sample	Increase frequency of monitoring to at least daily Notify contractor Require contractor to implement immediate steps to reduce dust	Review plant and methods Submit proposals for reducing dust to Engineer Implement measures to reduce dust immediately Notify Engineer of action taken

4.7 Summary and Recommendations

The assessment has concluded that construction of the pipeline is unlikely to generate significant dust levels at any of the ASRs.

It is recommended that compliance standards of 1-hour TSP 500 μg/cu m and 24-hour TSP 260 μg/cu m should be specified in the pipeline construction contract. Dust monitoring should be carried out prior to and during construction so that any impact on air quality may be identified.

The dust monitoring should be carried out close to ASRs and at the site boundary.

Figure 4.1 Location of Air Quality Sensitive Receivers

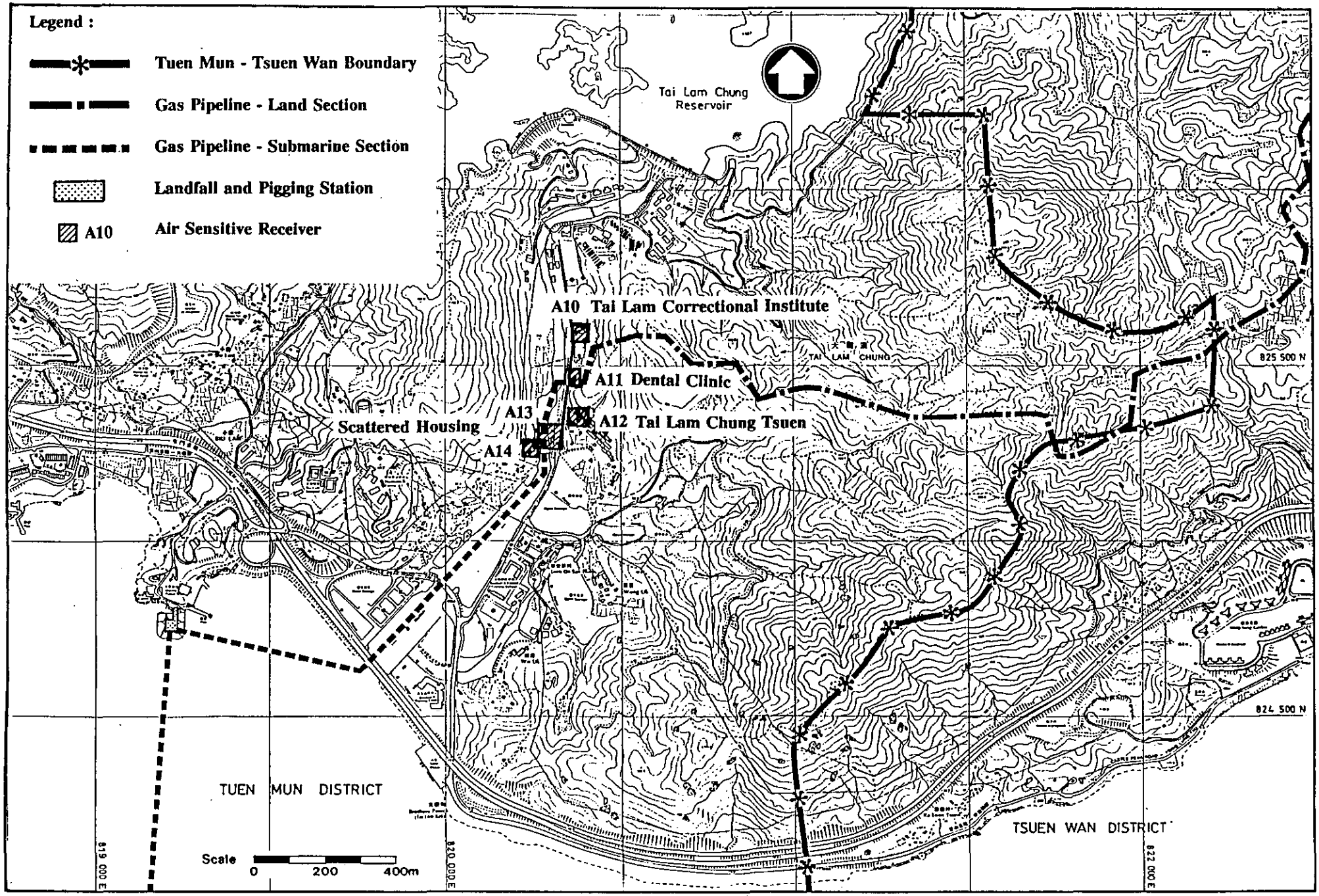


Figure 4.2 Location of Air Quality Sensitive Receivers

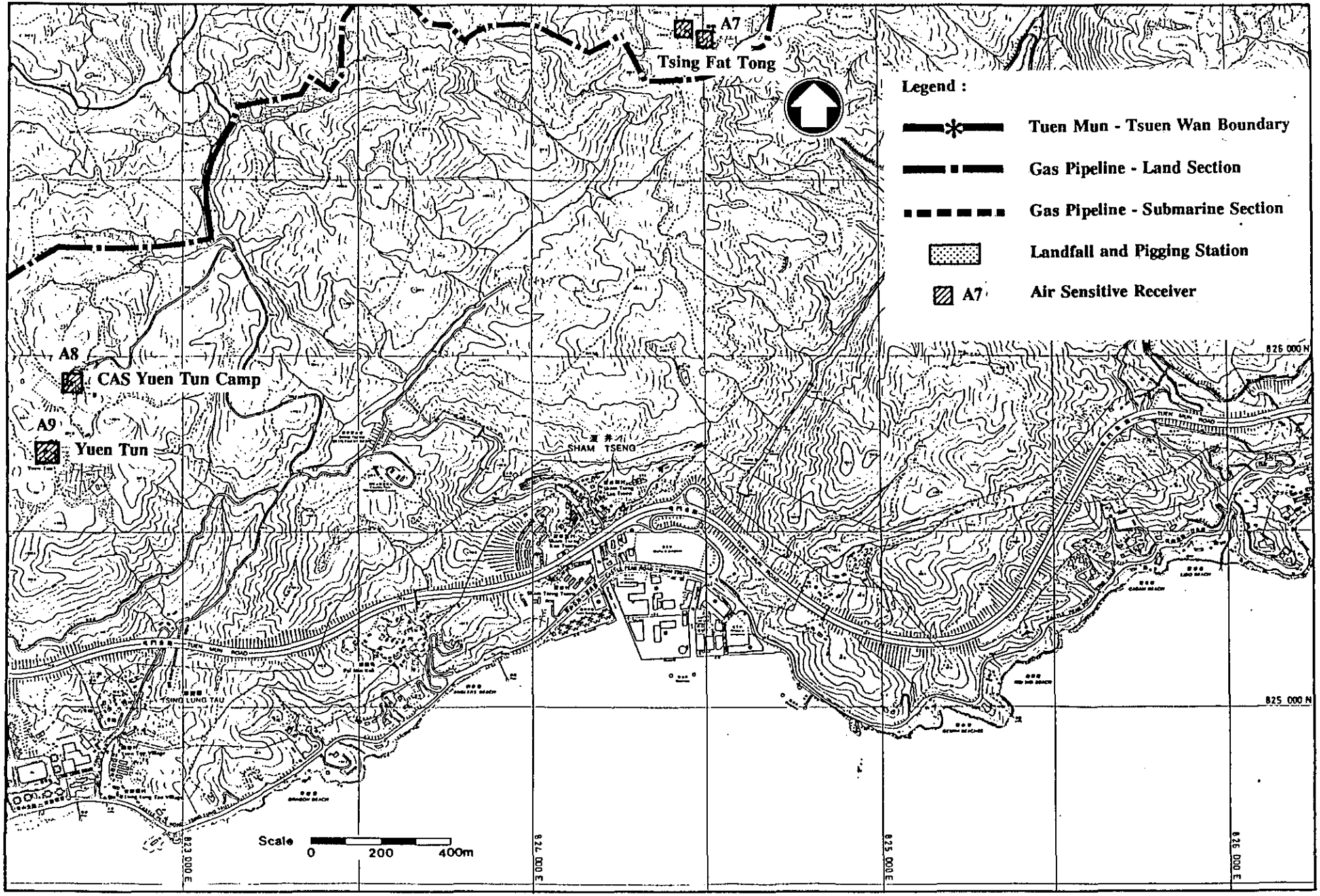


Figure 4.3 Location of Air Quality Sensitive Receivers

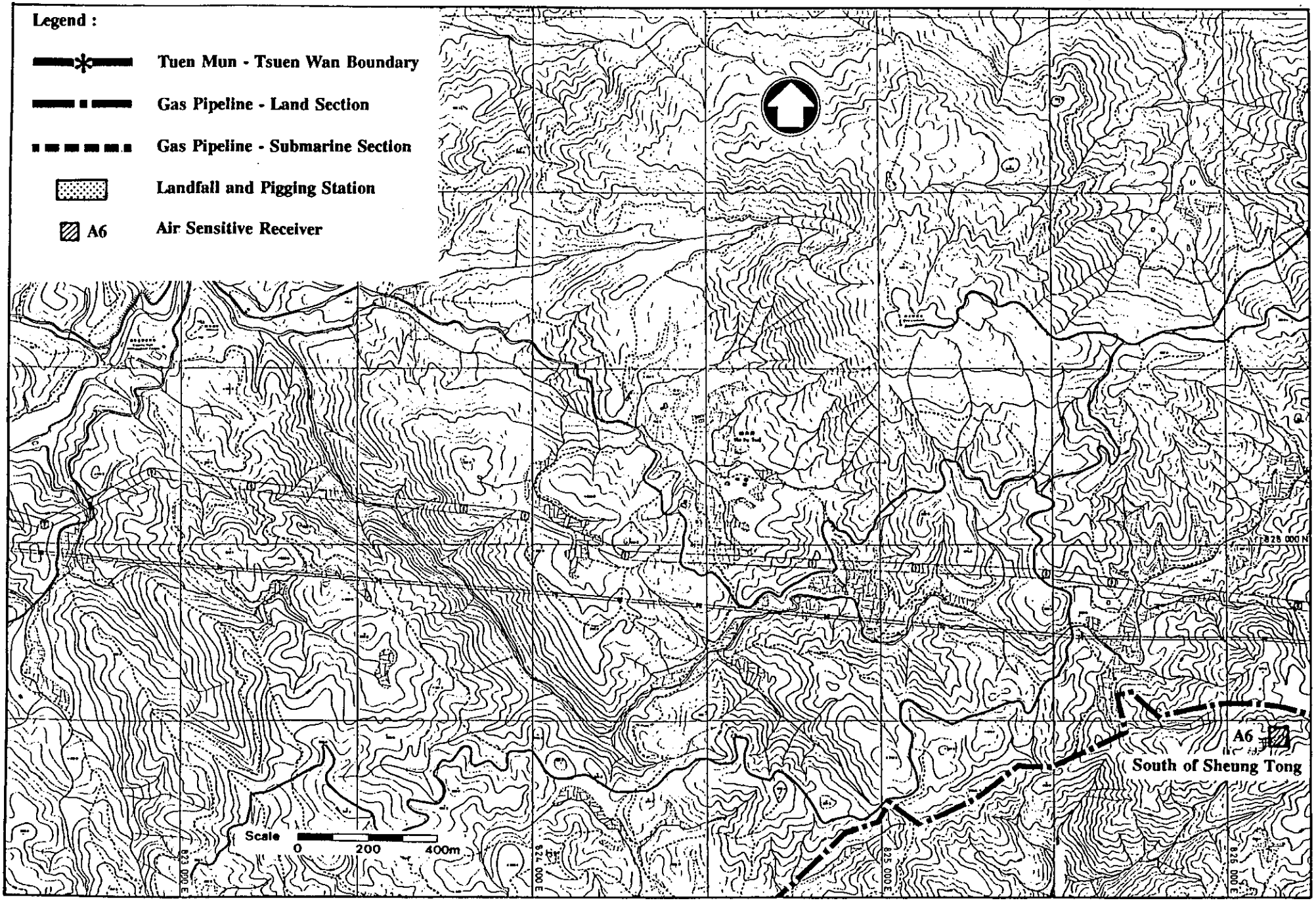


Figure 4.4 Location of Air Quality Sensitive Receivers

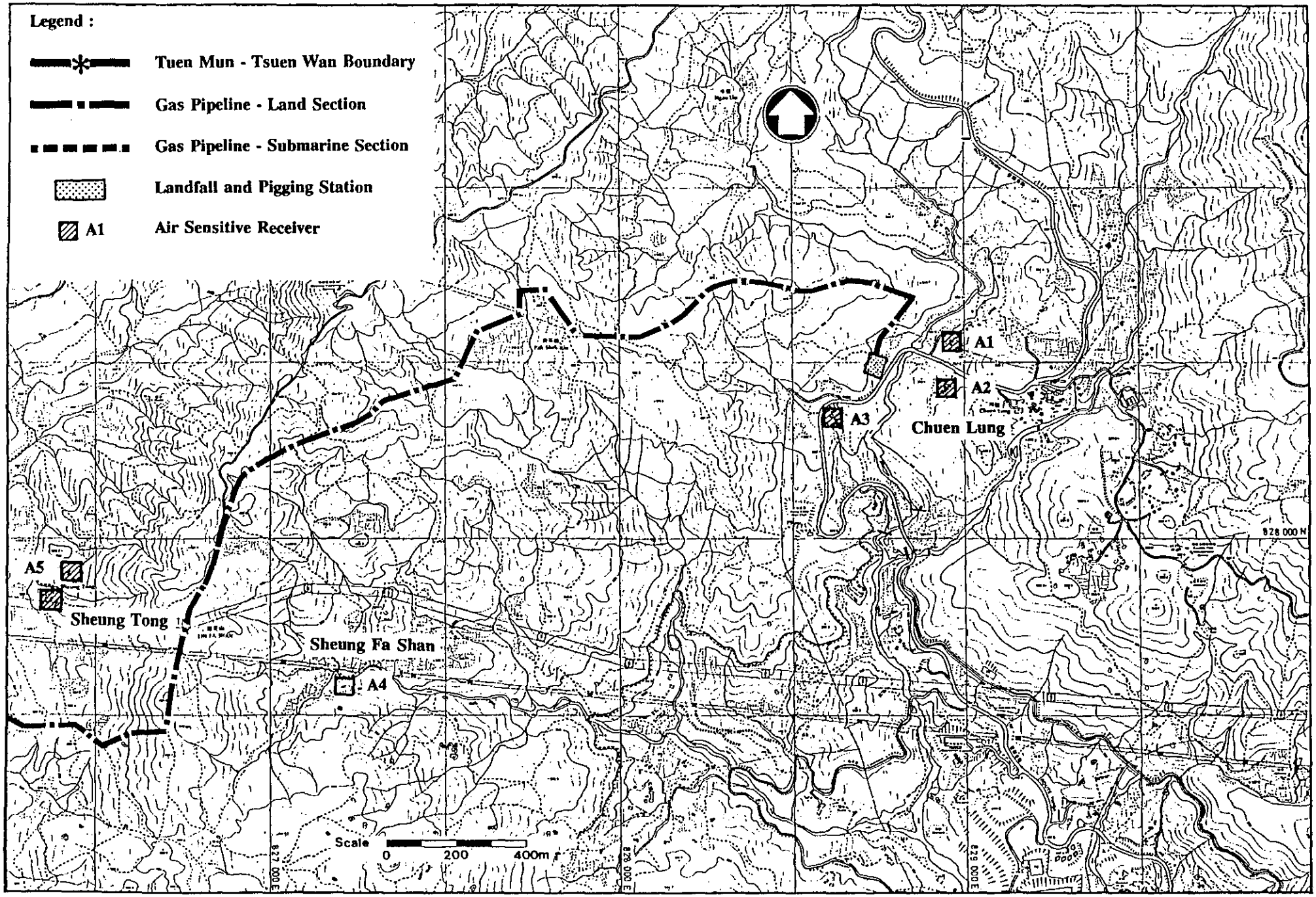


Figure 4.5
One Hour TSP Levels at the Chuen Lung West Pigging Station

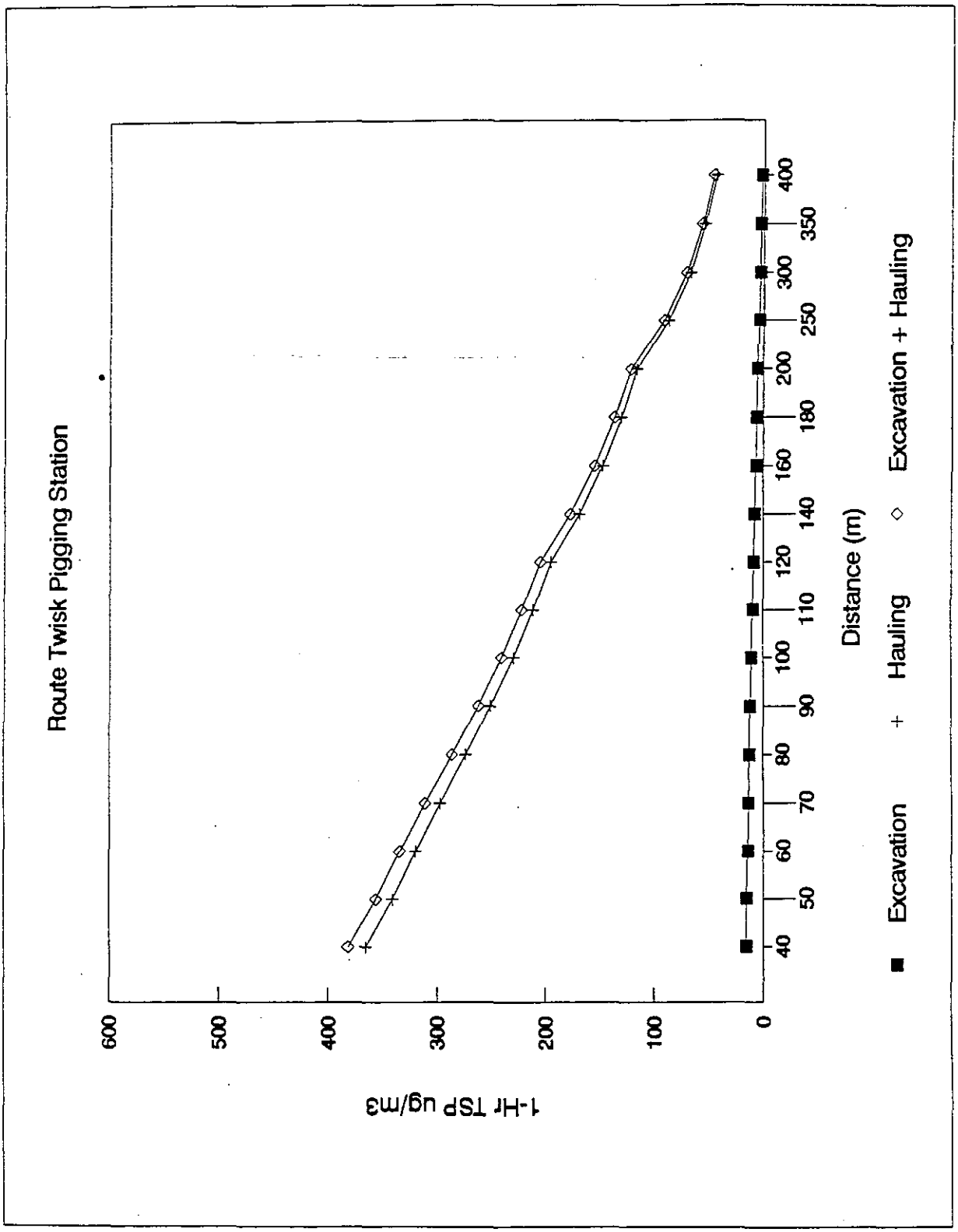


Figure 4.6
One Hour TSP Levels in the Tai Lam Country Park

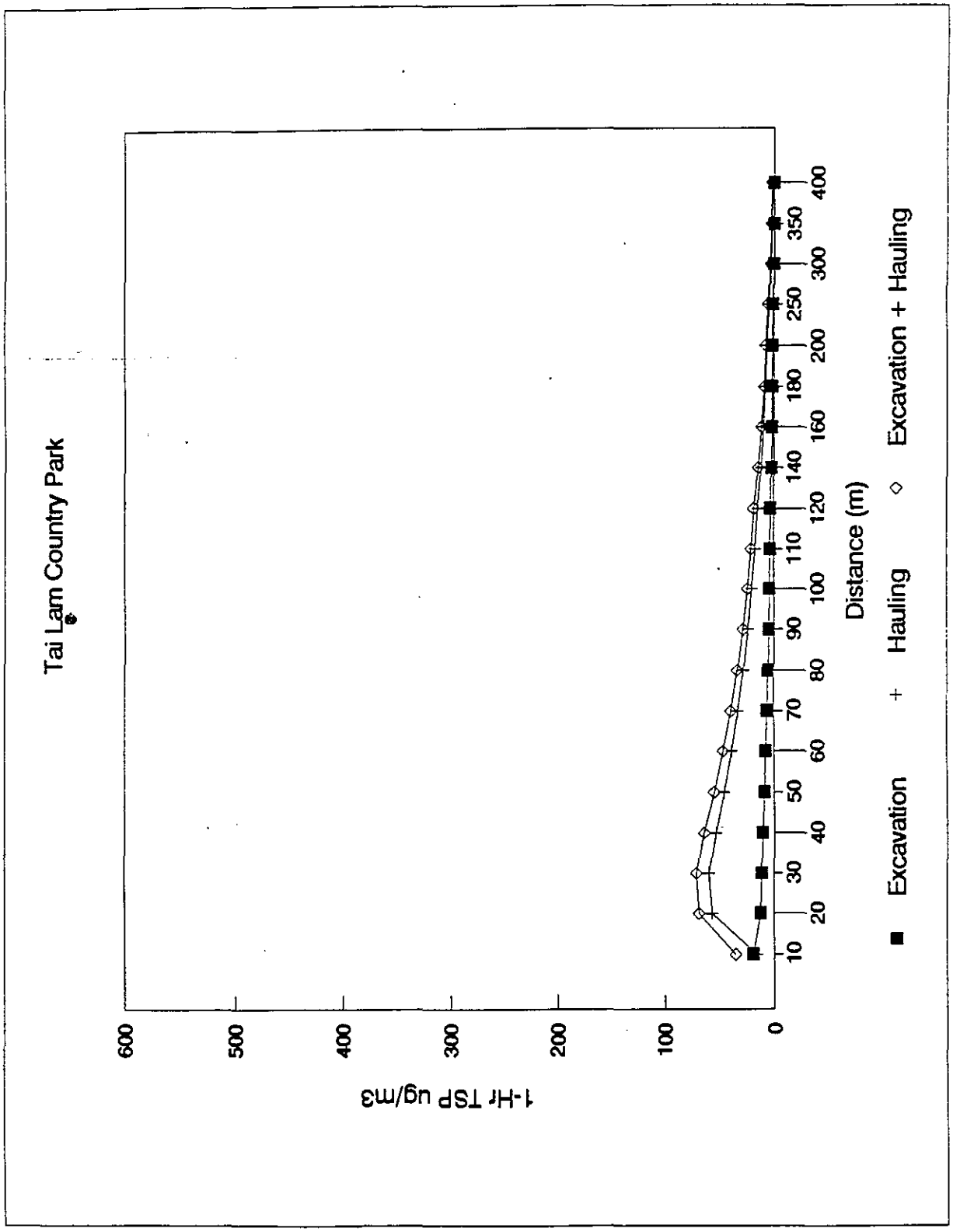
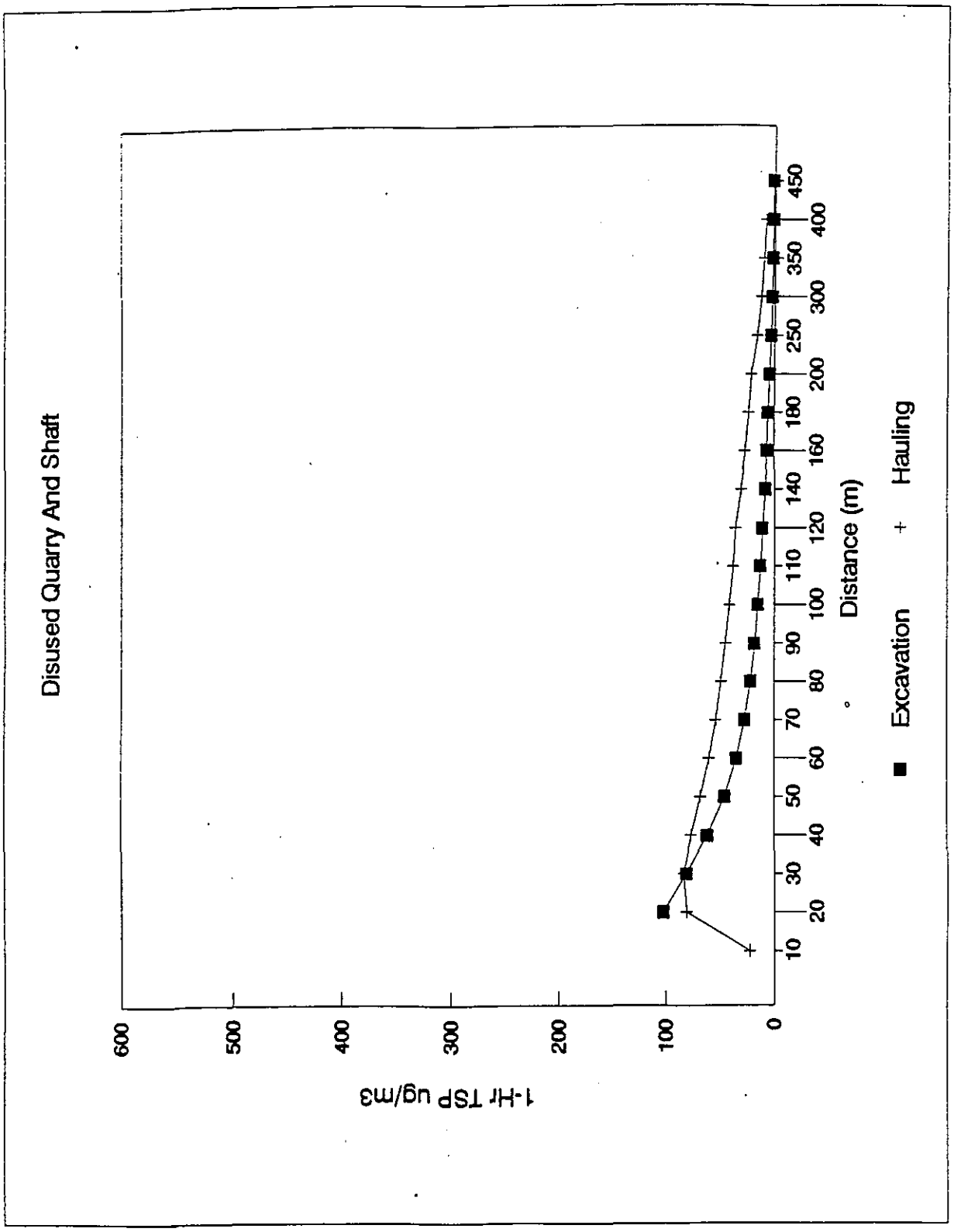


Figure 4.7
One Hour TSP Levels at the Quarry



5. Noise

5. NOISE

5.1 Introduction

This assessment focuses on potential impacts arising during the construction phase, with particular attention given to the section through Tai Lam Chung. Noise levels have been predicted at potential Noise Sensitive Receivers (NSRs) and assessed in accordance with the methods specified in the Technical Memorandum on Noise from Construction Work other than Percussive Piling (TM1). There will be some piling for the works area for the submarine section of the pipeline. The noise levels from piling have been assessed in accordance with the methodology specified in the Technical Memorandum on Noise from Percussive Piling (TM2). Where necessary, mitigation measures are recommended.

5.2 Existing Noise Environment

The pipeline route traverses an area classified as "a rural area, including Country Parks or village type developments". The Area Sensitivity Rating should thus be 'A' or 'B' as indicated in Table 5.1.

Part of the Tai Lam area will receive an ASR rating of 'B' because of road traffic noise from the Tuen Mun and Castle Peak Roads, which will contribute to background noise levels. The remainder of the area will have an ASR of A.

Table 5.1 Area Sensitivity Ratings (ASRs)

Type of Area Containing NSR	Degree to Which NSR is Affected by Influencing Factors	
	Not Affected	Indirectly Affected
Rural area including Country Parks or village type developments	A	B

5.3 Sensitive Receivers

NSRs have been identified according to the Hong Kong Planning Standards and Guidelines (HKPSG).

The majority of NSRs are generally located in Tai Lam Chung and Siu Lam, within 500m of the limit of the works. Further NSRs have been identified through the Tai Lam Country Park and at the Chuen Lung West pigging station and generally comprise single scattered dwellings near cultivated paddy areas. There are no NSRs near the Ta Pang Po landfall.

The NSRs are listed in Table 5.2 and their location are shown in Figures 5.1 to 5.4. Users of the Country Park will also be sensitive to noise from the works. People who could be affected will be walkers on footpaths and roads as there are no fixed recreational areas close to the pipeline route.

Table 5.2 Noise Sensitive Receivers

Noise Sensitive Receivers	NSR Identification Number	Area Sensitivity Rating	Approximate Population
Scattered Dwellings at:			
Chuen Lung,	N1, N2	A	<10
Sheung Fa Shan,	N3	A	<10
Sheung Tong,	N4	A	<10
South of Sheung Tong and	N5	A	<10
Tsing Fai Tong.	N6	A	<10
CAS Yuen Tun Camp,	N7	A	Varies
Yuen Tun,	N8	A	<10
Tai Lam Correctional Institute,	N9	A	about 300
Dental Clinic,	N10	A	n/a
Scattered Village Houses,	N11, N12	A	400
Fire Station,	N13	A	n/a
Customs Training and Excise School,	N14	B	n/a
Village House,	N15	B	60
Psychiatric Centre,	N16	B	not known
Seamen's Training Centre,	N17	B	n/a
Marine Police Base, and	N18	B	n/a
Excise Station.	N19	B	n/a

5.4 Construction Phase

Acceptable Noise Levels

The Acceptable Noise Levels (ANLs) imposed by TM1 according to the ASR of the Study area are those given previously in Table 3.3.

Although there are no noise limits during the unrestricted periods, a maximum limit of 75 dB(A) is considered prudent to reduce the social impact. If construction work other than percussive piling is required during the restricted periods a construction noise permit will be necessary.

Criteria For Percussive Piling

The ANLs for percussive piling are determined according to TM2 and are shown below in Table 5.3.

Table 5.3 Acceptable Noise Levels (ANLs) For Percussive Piling

NSR Window Type or Means of Ventilation	ANL dB(A)
NSR (or part of NSR) with no windows or other openings.	100
NSR with central air conditioning system.	90
NSR with windows or other openings but without central air conditioning system.	85

It should be noted that 10 dB(A) should be subtracted from the ANLs for uses which are considered particularly sensitive to noise. These include hospitals, medical clinics and educational institutions.

Percussive piling is stringently controlled and may only be undertaken in accordance with a Construction Noise Permit (CNP) issued by the Environmental Protection Department (EPD) which will prescribe working between 0700 hours and 1900 hours. No permit is issued for percussive piling between 1900 hours and 0700 hours, or at any time on a general holiday or Sunday. The permitted hours for percussive piling will be determined as shown in Table 5.4 based on the level that the CNL exceeds the ANL.

Table 5.4 Permitted Hours For Percussive Piling

Corrected Noise Levels (CNLs)	Permitted Hours for Percussive Piling on any Day other than a General Holiday or Sunday
more than 10 dB(A)	0800 - 0900 hours 1230 - 1330 hours 1700 - 1800 hours
1 dB(A) - 10 dB(A)	0800 - 0930 hours 1200 - 1400 hours 1630 - 1800 hours
no correction	0700 - 1900 hours

Construction Programme and Activities

The type, sequence and duration of the construction activities are included in Appendix C along with the items, location and sound power levels of powered mechanical equipment which could be used. In the overland section of the works NSRs potentially affected include N1-N9. For the marine works, N9 and N14-N19 could be affected.

Assessment of Impacts

Impacts from construction activities have been calculated at the NSRs which may be most affected. CNLs have also been calculated from the ANLs, and mitigation measures have been recommended where appropriate.

Table 5.5 shows the anticipated construction activities and the sound power levels with and without mitigation measures applied used in the prediction of noise impacts.

Table 5.5 Sound Power Levels (SWL) of Anticipated Construction Activities Without And With Mitigation Measures

Activity	Sub-activity	Plant and Equipment	Qty	SWL dB(A)	
				Without mitigation	With mitigation
Establish Landfall & Temporary Working Platform & Lift Discovery Bay Line	Percussive Piling	Option of percussive piling stated in TM2	2	127[1]	
	Non-percussive Piling	Option of non-percussive piling stated in TM1	2	111[2]	
Pipe Laying and Works at Platform Pipe Formulation and Placement	Pipe Jacketting	Concrete Pump	1	109	94[4]
		Concrete Mixer (electric)	1	96	
	Pipe Placement across Land & in Nullah	Hoist	1	108	
		Crane (mobile)	2	112	107[3]
	Pipe Laying in Channel & Foreshore	Winch	1	110	107[3]
		Crane	1	112	107[3]
Trench Dredging	Nullah Dredging	Dredger (grab)	1	112	107[3]
	Foreshore Dredging	Dredger (suction cutter) or trailer suction	1	112	107[3]
	Landfall Dredging	Dredger (trailer or grab)	1	112	107[3]
	Channel Dredging	Dredger (trailer suction)	1	112	107[3]
Excavation across Country Park & Quarry	Rock Excavation	Breaker, excavator mounted (hydraulic) - Optional	1	122	107[3,6]
		Excavator	1	112	107[3]
		Dump truck	1	117	107[3]
	Soil Excavation	Excavator	1	112	107[3]
		Dump truck	1	117	
Tunnel Excavation and Shaft Sinking	Rock drilling Excavation	Rock Drill	1	128	
		Excavator	1	122	107[3,6]
		Dump Truck	1	117	107[3]

Note :

1 Average of SWLs of all percussive piling options in TM2
2 Average of SWLs of all non-percussive piling options in TM1
3 Fit exhaust muffles and an acoustic lining to the engine compartments of mobile plant
4 Construct an acoustic enclosure around the diesel engines of stationary plant
5 Construct an acoustic enclosure around stationary plant
6 Acoustic enclosure of hydraulic breaker hammer bracket

Chuen Lung West Pigging Station

The noisiest activities and predicted noise levels at the worst affected NSRs are shown in Table 5.6.

Table 5.6 Predicted Noise Levels From Construction Of The Chuen Lung West Pigging Station

Noise Sensitive Receivers	Predicted Noise Levels dB(A)	
	Excavation	Haulage
N1	69 (61)	66
N2	69 (61)	66

Note: The figures in brackets are noise levels with mitigation measures applied. Underlined figures are those which exceed the standards for Period I or Period II

Noise levels have been calculated assuming that only one activity will be in progress at any one time and although there will be some parallel working, noise levels are still likely to be within the ANLs. Predicted noise levels at both N1 and N2 (69 dB(A) and 66 dB(A) respectively) comply with the recommended daytime noise level of 75 dB(A). However, if construction works are carried out during Period I or II, the ANLs will be exceeded.

Tai Lam Country Park

The NSRs likely to be affected across the Tai Lam Country Park are generally single dwellings. Excavation, pipe laying, and haulage are likely to have greatest impact. The predicted noise levels are shown in Table 5.7.

Table 5.7 **Predicted Noise Levels From Pipeline Construction Across the Tai Lam Country Park**

Noise Sensitive Receivers	Predicted Noise Level dB(A)		
	Excavation	Pipe Laying	Haulage
N1	64 (59)	67 (63)	67 (66)
N2	64 (59)	68 (64)	67 (66)
N3	49 (44)	53 (49)	53 (52)
N4	59 (54)	60 (55)	60 (59)
N5	72 (69)	76 (71)	77 (77)
N6	79 (76)	83 (78)	83 (82)
N7	62 (60)	62 (62)	68 (68)
N8	65 (64)	71 (66)	71 (70)

Note: The figures in brackets are noise levels dB(A) with mitigation measures applied. Underlined figures are those which exceed the standards for Period I or Period II.

The NSRs at N5 and N6 may experience noise levels in excess of the recommended limit of 75dB(A) during the daytime. However it should be noted that the number of people affected will be very small (only one or two at each of these receivers) and the construction activities will only be in progress close to the NSRs for a very short period of time. It is likely that the noise levels shown in Table 5.7 will only be reached at N5 and N6 for about one week.

Working in periods restricted under the NCO in the vicinity of any of the NSRs will not be permissible.

The noise impact on users of the Country Park is not likely to be significant. Any passers by will only be affected by noise when they are close to the works. The noise from construction plant will be heard over some distance but noise levels will not be high.

Adit Shaft and Quarry

From the head of the Tai Lam nullah, the pipeline will run horizontally across the disused quarry floor and into the cliff face and thence up a 70 metre shaft. Rock drilling, excavation and haulage of spoil will cause noise impacts over a period of approximately two months.

Tai Lam Correctional Institute, the dental clinic and dwellings along the Tai Lam Chung Road are likely to suffer most from construction activities. The predicted impacts are shown in Table 5.8.

Table 5.8 Predicted Noise Levels from Construction in the Quarry and at the Shaft

Noise Sensitive Receiver	Predicted Noise Levels dB(A)		
	Rock Drilling	Excavation	Haulage
N9	79 (73)	69 (64)	79 (74)
N10	93 (87)	83 (79)	92 (88)
N13	64 (59)	54 (50)	64 (60)
N14	63 (58)	53 (50)	63 (60)

Note: The figures in brackets are noise levels dB(A) with mitigation measures applied. Underlined figures are those which exceed the standards for Period I or Period II.

The calculation has assumed that rock drilling and excavation would be carried out using pneumatic breakers and hydraulic rock excavators.

The noise levels are predicted to be within the 75 dB(A) daytime limit except at receiver N10, the dental clinic, which is very close to the works. The impacts will only exceed the limit for a very short period of time as the shaft itself will shield the noise once the work has moved away from the entrance.

Nevertheless mitigation of the noise should be implemented and the following should be considered:

(a) screens should be erected around the entrance to the shaft while rock drills are being used; and

(b) the alignment of the shaft will not be finally determined until the detail design and one of the objectives should be to move the shaft as far as possible from the clinic.

The alignment along this section has already been reviewed following the noise assessment and this has resulted in the alignment being moved about 65m further away from the dental clinic. This will result in a significant reduction in noise levels at the clinic. Any further opportunities to move the alignment away from the clinic should be investigated during the detail design.

Haulage along the Tai Lam Chung Road is not likely to generate noise levels in excess of 75dB(A) daytime limit or the ANLs.

Percussive and Non Percussive Piling

Piling will be carried out over a period of four months for the reclamation for the Siu Lam pigging station and the adjacent temporary works area. Noise sensitive receivers include the marine police base, customs and excise station, and seamen's training centre. The Discovery Bay electricity cable will need to be temporarily diverted to enable the pipeline to be laid.

Maximum predicted noise levels arising from percussive and non percussive piling are shown in Table 5.9. The corrected noise levels determine permitted working hours for percussive piling within the CNP.

Table 5.9 Maximum Predicted Noise Levels From Piling Activities

Noise Sensitive Receivers	Corrected Noise Levels dB(A)	
	Percussive Piling	Non Percussive Piling
N14	64	48
N15	66	51
N16	69	54
N17	77	62
N18	83	68
N19	82	68

Predicted noise levels generated by percussive piling (64 - 83 dB(A)) are mostly higher than non percussive piling (48 - 68 dB(A)). NSRs most likely to be affected are the Marine Police Station (N18) and the Customs and Excise Station (N19).

The CNLs for percussive piling exceed the ANL of 75 dB(A) by less than 10 dB(A) at N17, N18, and N19. No restrictions will be placed on normal working days during the periods 0800 - 0900 hours, 1230 - 1330 hours, and 1700 - 1800 hours. At N14, N15 and N16 percussive piling could be undertaken between 0700 - 1900 hours as the noise levels comply with the ANLs. Noise levels from non percussive piling also comply with ANLs during the unrestricted period, and apart from N18 and N19, this activity would also be allowed during Period I.

Tai Lam Nullah

Dredging, excavation, jacketting and laying of the pipeline in the nullah could have the greatest impact on noise levels. It has been assumed that the trench will be dredged in the lower section and excavated in the upper section. Predicted noise levels are shown in Table 5.10.

Table 5.10 Predicted Noise Levels From Tai Lam Nullah

Noise Sensitive Receivers	Predicted Noise Levels dB(A)		
	Dredging (Lower Nullah)	Excavation (Upper Nullah)	Pipe Jacketting/ Laying
N9	-	63	62 (58)
N10	-	80	74 (70)
N11	-	81	81 (77)
N12	-	83	83 (79)
N13	-	72	72 (68)
N14	-	71	71 (68)
N15	-	71	71 (68)
N16	-	64	63 (59)
N17	68 (67)	-	-

Note: The figures in brackets are noise levels dB(A) with mitigation measures applied. Underlined figures are those which exceed the standards during either Period I or Period II.

Construction in the upper section of the nullah will generate noise levels in excess of the recommended daytime limit of 75 dB(A) (N10, N11, and N12) even if mitigation measures are applied although this will be for no more than a few days at each NSR. At N9, N13, N14, N15, and N16 construction would be permitted during normal working hours and at N9, N15 and N16 during Period I assuming mitigation measures are applied. Noise levels of 66 dB(A) and 68 dB(A) have been predicted at the worst affected NSR (N17) for works carried out in the lower section of the nullah.

Submarine and Foreshore Sections

The submarine contract will include dredging, pipe string formation and pulling, followed by backfilling of the trench in the submarine and foreshore sections. NSRs most likely to be affected are the psychiatric centre, seamen's training centre, customs and excise training school, a village house, marine police base, and the customs and excise station. The predicted noise levels from these activities at NSRs are shown in Table 5.11.

Table 5.11 Predicted Noise Levels From The Foreshore and Submarine Sections Other Than Piling

Noise Sensitive Receivers	Predicted Noise Levels dB(A)		
	Dredging	Pipe String Formation	Pipe Pulling
Foreshore			
N14	56	57 (50)	58 (56)
N15	60	59 (52)	61 (58)
N16	60	59 (52)	61 (58)
N17	66	66 (60)	68 (65)
N18	71	73 (67)	75 (72)
N19	71	72 (67)	74 (72)
Submarine			
N18	75 (71)	73 (67)	75 (72)
N19	74 (70)	72 (67)	76 (73)

Note: The figures in brackets are noise levels with mitigation measures applied.

Along the foreshore section a maximum noise level of 75 dB(A) has been predicted at N18 during pipe pulling. The noise levels at the worst affected NSRs range from 58 dB(A) to 75 dB(A). Work would be allowed during Period I for N14, N15, and N16 only if mitigation measures are applied. Levels at the remaining NSRs exceed the Period I ANLs.

Mitigation Measures

The predictions have shown that construction noise will generally be within the recommended maximum level during normal working hours but that working in the restricted periods will not be possible close to any NSRs. The daytime noise limits will only be exceeded for very short periods of time and only a small number of people will be affected.

Noise from the works in the Country Park will be heard over some distance but noise levels will not be obtrusive except immediately alongside the works.

The following noise mitigation should be specified in the construction contract

(a) scheduling activities to ensure that only one noisy activity is in progress at any one time;

(b) use of silenced equipment;

(c) reduction in the number of items of powered mechanical equipment operating at a given time;

(d) siting of equipment as far as practical away from the NSRs;

(e) use of temporary noise barriers or earth bunds to screen specific NSRs;

(f) scheduling of noisy operations for periods with high background noise (e.g. during the day time);

(g) avoid working in unrestricted periods; and

(h) maintenance of all equipment so that it all remains in good condition.

5.5 Noise During Operation

Once the pipeline has been commissioned there will be no further noise impacts.

5.6 Noise Monitoring And Audit

Noise monitoring should be carried out prior to and during construction to determine compliance with the recommended trigger action and target levels. Measurements should be made at the facade of the worst affected dwellings and the parameters to be measured should include $Leq_{(5\ min)}$ between 1900 hours and 0700 hours and between 0700 hours and 1900 hours.

Noise measurements should be made as the A-weighted equivalent continuous sound level using precision integrating sound level meters which comply with IEA:651:1979 (Type I) and 804:1985 (Type II).

Baseline monitoring should be required for a period of one month prior to commencement of construction to establish the ambient conditions. During construction regular monitoring should be undertaken at NSRs closest to the contractor's activities and whenever complaints are received.

Recommended trigger, action and target levels for areas with ASRs 'A' and 'B' have been calculated and are shown in Table 5.12.

Table 5.12 Trigger, Action and Target Levels For Construction Noise dB(A) for NSRs with ASRs 'A' And 'B'

Time Period	Trigger Levels		Action Levels		Target Levels	
	ASR A	ASR B	ASR A	ASR B	ASR A	ASR B
Period I	50	55	55	60	55	60
Period II	35	40	40	45	45	50
Unrestricted Daytime	65		70		75	

Note: Period I includes all evenings (1900 - 2300 hours), and general holidays and Sundays (0700 - 2300 hours).
Period II includes all night times (2300 - 0700 hours).

Table 5.13 outlines a proposed action plan should any of the trigger, action or target levels be exceeded.

Table 5.13 Construction Noise Action Plan

Event	Action	
	Engineer	Contractor
Time Period I or II trigger levels exceeded. Daytime trigger or action levels exceeded.	Notify Contractor.	Review plant and working methods. Implement noise mitigation.
Period I or II action levels exceeded. Daytime target level exceeded	Notify Contractor. Require Contractor to propose measures to reduce noise. Increase monitoring frequency to at least two measurements per daytime Period I/II as appropriate.	Submit noise mitigation proposals to Engineer. Implement noise mitigation proposals.
Period I or II target level exceeded.	Notify Contractor. Require Contractor to implement mitigation measures. Increase monitoring frequency to hourly	Implement mitigation measures. Advise Engineer of measures applied.

It is recommended that the trigger, action and target levels be included in the contract along with the action plan.

5.7 Summary and Recommendations

The NSRs most likely to be affected by construction noise are N5, N6, N9, N10, N11, N12, N17, N18 and N19.

Work on the Chuen Lung West pigging station will comply with the recommended daytime noise limit and thus special migitation measure will not be required. Noise levels generated by excavation, pipelaying and haulage across the Country Park will be within the recommended daytime limit for most of the works. The recommended noise limit will only be exceeded for very short periods of time at isolated locations where only one or two people live. Mitigation measures will be required for work in the quarry to minimise noise impacts. Work outside normal daytime working hours will not be permissible close to sensitive receivers but would be possible over most of the pipeline if required by the Contractor.

There will be some noise impacts on users of the Country Park but noise levels will not be high except immediately alongside the works.

Non percussive piling will be allowed during normal working hours but restrictions are likely for percussive piling.

Mitigation measures will need to be applied to reduce impacts from construction noise in the vicinity of the Tai Lam nullah. One of the mitigation measures available is to move the works away from the receivers and this has already been done in the quarry where the proposed route has been moved away from the dental clinic to reduce the noise impact. In other places noise screens and other measures to reduce noise will need to be applied. However only a very few people will be affected and the duration of activities will be short.

It is recommended that specific noise levels are set for the Contractor to work to, with noise control requirements specified in contract documents. The Contractor may then achieve working within these limits as follows:

(1) the NCO should apply to all construction contracts with no exemptions permitted. Contracts should also specify a maximum noise level of 75 dB(A) at any NSR for day time working (ie. 0700 -1900 hours for days not holidays or Sundays); and

(2) contracts should stipulate that the works are designed, phased and planned to minimise noise levels at NSRs. The contract should allow sufficient time for scheduling the works within the day time periods so that activities do not have to occur at night time or other the restricted periods.

It is also recommended that noise levels are monitored and audited throughout the construction period to ensure compliance with the standards set.

Figure 5.1 Location of Noise Sensitive Receivers

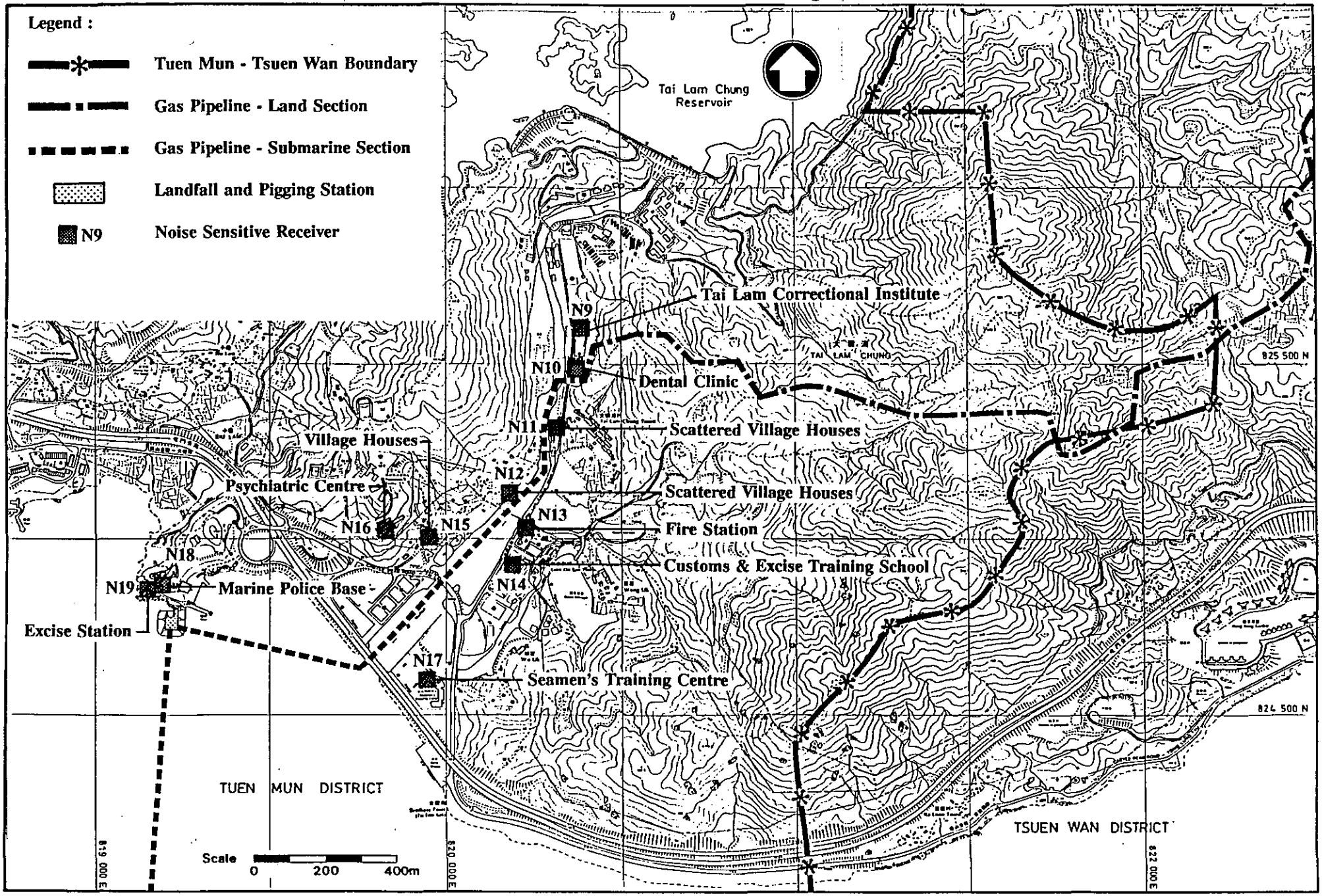


Figure 5.2 Location of Noise Sensitive Receivers

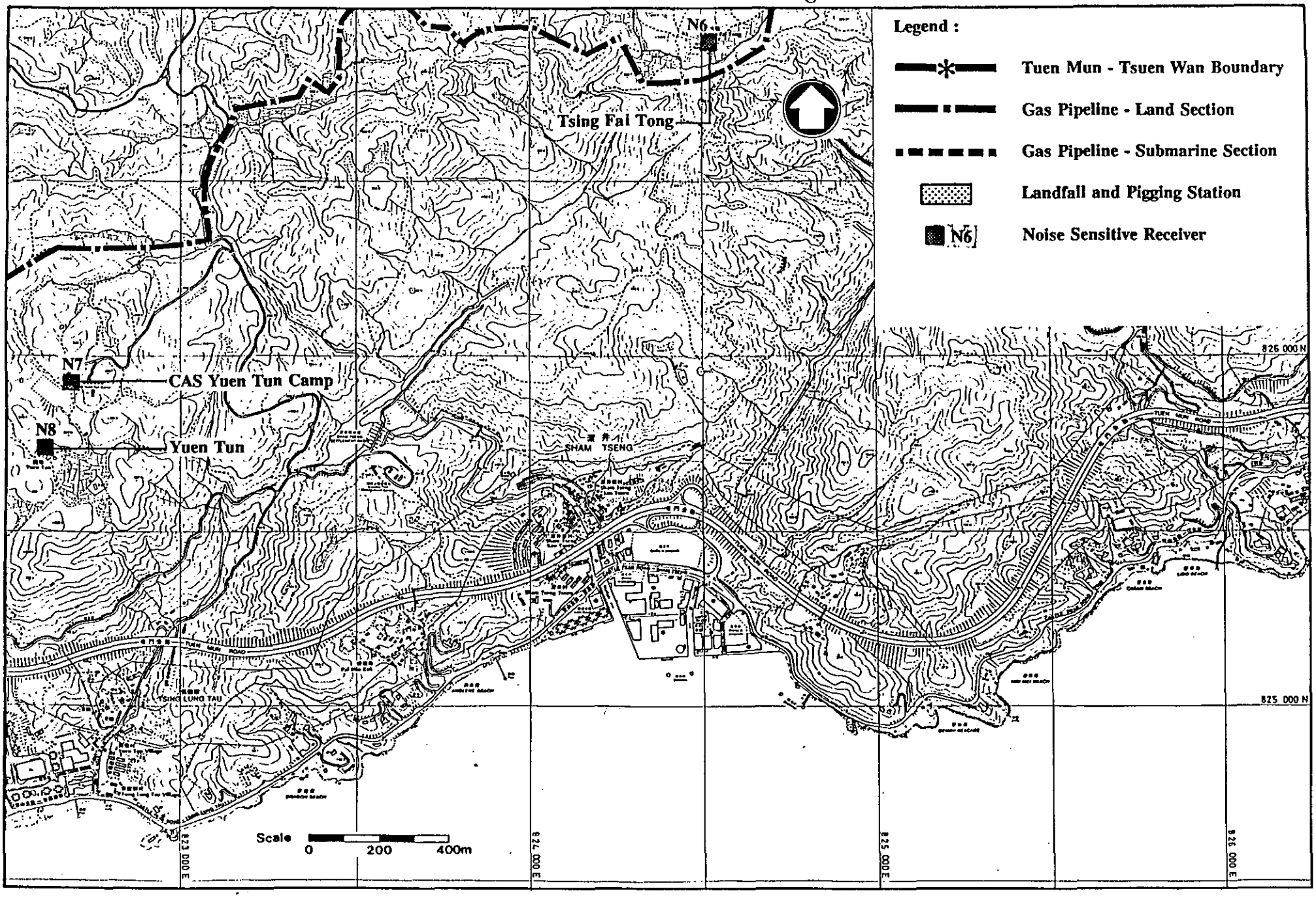


Figure 5.3 Location of Noise Sensitive Receivers

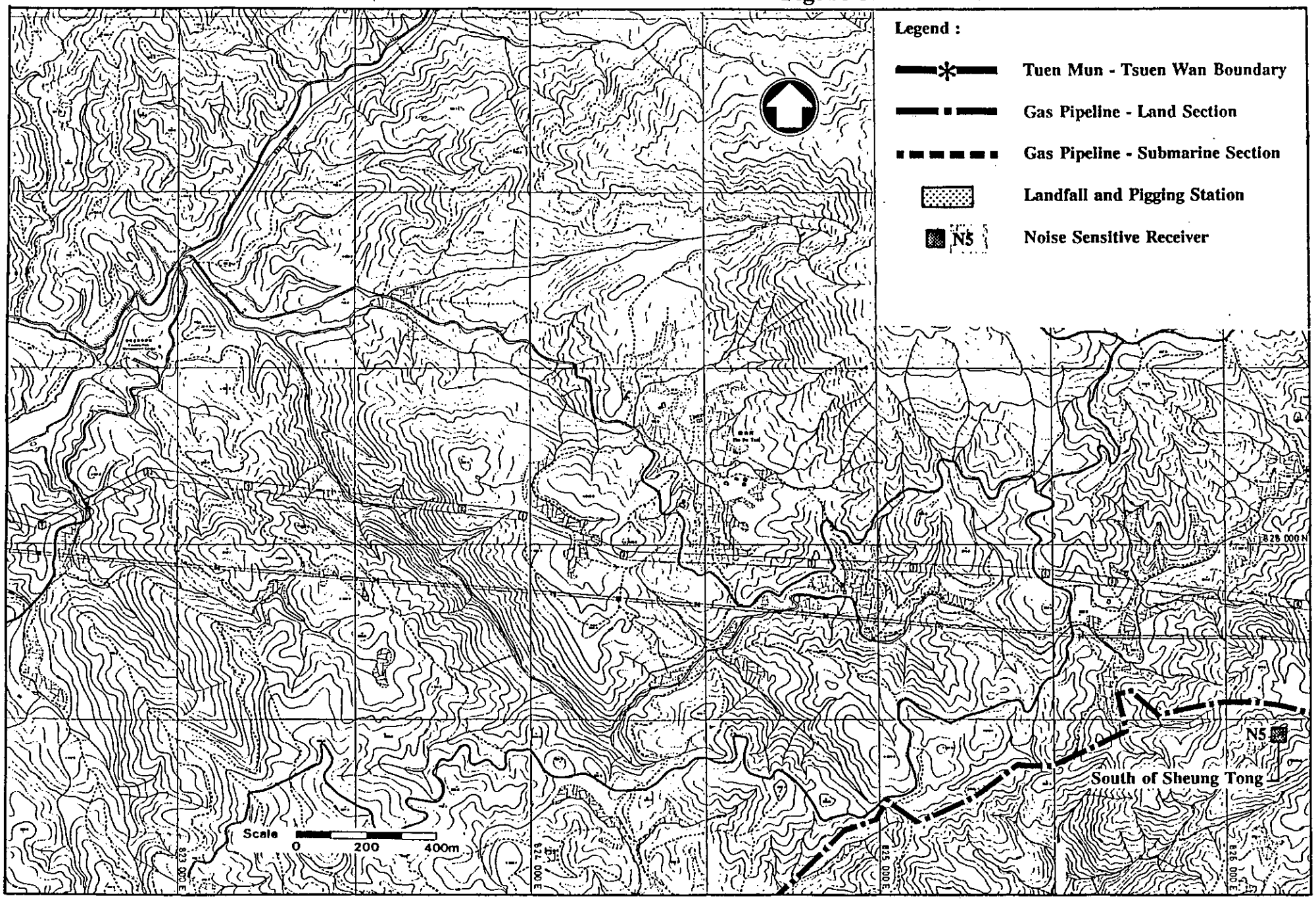
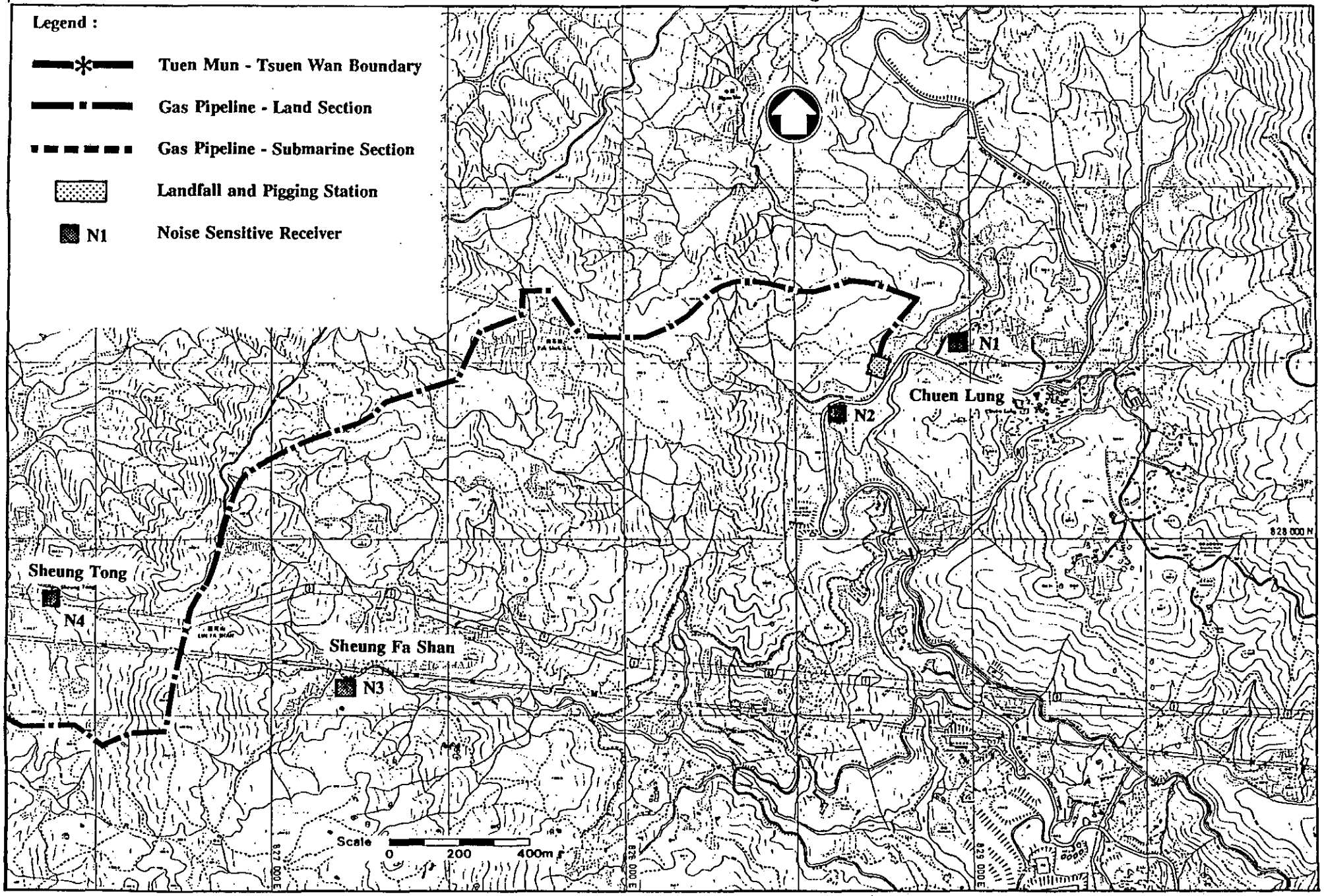


Figure 5.4 Location of Noise Sensitive Receivers



6. Water Movement, Water Quality and Sediment

6. WATER MOVEMENT, WATER QUALITY AND SEDIMENT

6.1 Existing Environment

Water Movements

Water movements in the Study Area are very complex with marked seasonal variations. An influx of freshwater runoff from the Pearl River catchment results in sharp salinity gradients during the wet season. This freshwater flow conveys a silt and pollutant load with a consequential impact on water quality. In the dry season, oceanic waters move in a northwards direction and generally well mixed conditions prevail. Seasonal variations in salinity are observed in parts of the water column, especially the deep channel of Urmston Road, where surface waters often travel in an opposing direction to the bottom layer.

Current velocities range from less than 0.1m/s for inshore waters to well in excess of 1m/s in parts of the Urmston Road.

Water Quality

Water quality in the NWWCZ is influenced by pollution loads generated in Hong Kong waters and the immediate catchment area, and also through discharges conveyed by the Pearl River. Data sources for water quality within the NWWCZ include the Environmental Protection Department's (EPD) routine water quality monitoring programme. Monitoring stations are shown on Figure 6.1. A summary of wet and dry season data is included as Table 6.1 for the five stations (NM1-5) routinely monitored by EPD.

Variations in salinity of 6 ppt, on average, are recorded between wet and dry seasons. In the wet season oxidised nitrogen values are two or three times higher than those reported for the dry season.

The data indicate that well oxygenated conditions prevail within the NWWCZ with dissolved oxygen values in excess of 6mg/l and relatively low BOD values of generally less than 1mg/l. The summary data have been included to highlight the temporal and spatial variations observed in this complex water body.

No water quality sampling has been carried out in the Tai Lam Nullah and while there are obvious discharges of domestic effluent to the nullah, from observations during site visits, waters within the lower reaches of the nullah appear relatively clear.

Sediment Quality

Sediment surveys been undertaken by the Consultants for the North Lantau Expressway and the North Lantau Development along the North Lantau coastline and sediment samples are routinely taken and tested by EPD. The locations of sediment sampling stations are shown on Figure 6.1. Of these, station ES15 is relevant as it is close to the Ta Pang Po landfall. Two sediment samples were collected during July 1992 in the Tai Lam Nullah and analysed for heavy metals.

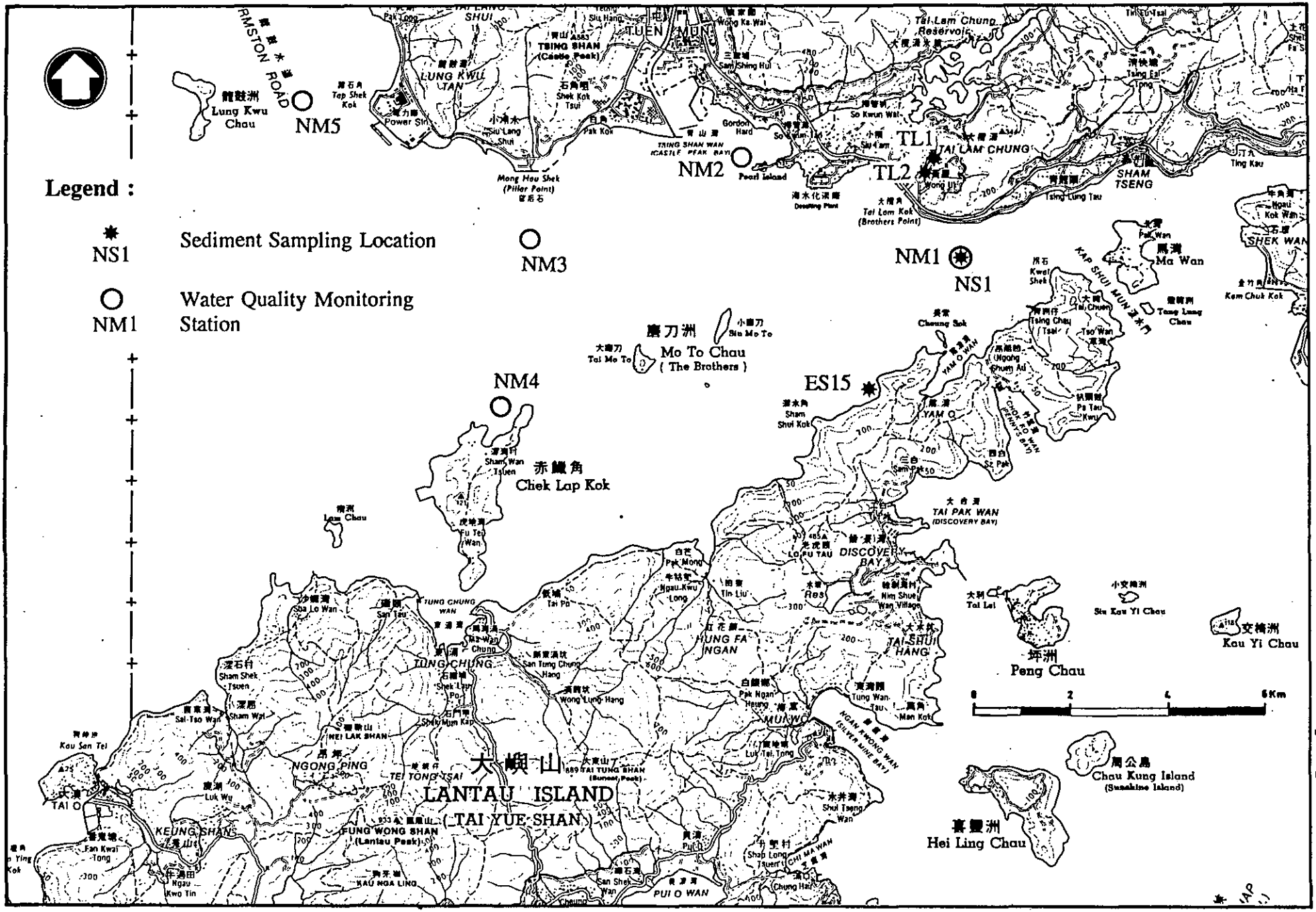


Figure 6.1 Water Quality Monitoring and Sediment Sampling Locations

Table 6.1 Mean Water Quality in North Western Water Control Zone

Wet Season (March - October)						
Station		**NM1**	**NM2**	**NM3**	**NM4**	**NM5**
BOD_5	mg/l	0.6	1.0	0.8	0.8	0.7
DO	mg/l	5.9	6.5	6.0	6.8	6.2
DO%	%	80	89	82	92	84
pH		8.31	8.38	8.32	8.39	8.30
Salinity	%	29.33	25.98	27.73	25.13	25.68
SS	mg/l	7.2	9.6	8.1	10.7	10.3
Temperature	°C	23.1	24.3	23.7	24.4	24.0
Turbidity	NTU	7.5	10.3	10.5	11.1	13.0
E.Coli	No/100ml	67	267	286	16	251
NH_4-N	mg/l	0.073	0.069	0.072	0.057	0.081
NO_2-N	mg/l	0.018	0.030	0.026	0.037	0.042
NO_3-N	mg/l	0.144	0.231	0.188	0.287	0.275
Dry Season (November - February)						
Station		**NM1**	**NM2**	**NM3**	**NM4**	**NM5**
BOD_5	mg/l	0.6	0.7	0.7	0.9	0.6
DO	mg/l	6.2	6.3	6.5	6.0	6.4
DO%	%	79	80	83	88	81
pH		8.32	8.22	8.18	8.26	8.21
Salinity	%	31.69	31.36	31.34	31.34	31.20
SS	mg/l	12.4	13.8	10.6	10.3	10.3
Temperature	°C	19.1	19.1	18.9	19.9	18.9
Turbidity	NTU	11.0	12.8	9.5	7.7	10.5
E.Coli	No/100ml	94	118	510	5	296
NH_4-N	mg/l	0.075	0.088	0.065	0.039	0.086
NO_2-N	mg/l	0.019	0.023	0.023	0.025	0.030
NO_3-N	mg/l	0.076	0.108	0.107	0.100	0.124

BOD = Biological Oxygen Demand
DO = Dissolved Oxygen
SS = Suspended Solids

A summary of the data collected are presented in Table 6.2 to illustrate the quality of material likely to be encountered during dredging works.

Table 6.2 Summary of Sediment Quality Data

	Metal (mg/kg)						
	Zn	Cu	Ni	Pb	Cd	Cr	Hg
Sample Number							
NS1	30	8	-	27	<0.1	5	-
ES15	20	8	5	24	0.2	7	0.1
Tai Lam Nullah 1	120	20	4	100	<0.5	6	<0.1
Tai Lam Nullah 2	370	46	9.7	95	0.7	20	0.2
Assessment Criteria							
Class A	0-140	0-54	0-34	0-64	0.0-0.9	0-49	0.02-0.7
Class B	150-190	55-64	35-39	65-74	1.0-1.4	50-79	0.8-0.9
Class C	>200	>65	>40	>75	>1.5	>80	>1.0

The criteria for determining whether or not sediments are contaminated are the levels promulgated under the Environmental Protection Department Technical Circular TC No. 1.1.92. Comparison of the survey data with these criteria suggest that the levels of heavy metal in the marine sediments are low and these sediments are considered to be uncontaminated. As such no special disposal methods are required for spoil from the marine section. Sediment samples taken from the nullah however reveal contamination by zinc and lead. The construction contract should specify that all spoil excavated from this area should be dumped in an environmentally acceptable manner.

The sediment samples in the nullah were taken from the upstream section. There has been no sediment sampling in the lower section of the nullah below the Castle Peak Road bridge or in the foreshore section. Further sampling in these areas will be necessary during the detail design of the project to establish the extent of the contamination downstream.

6.2 Sensitive Receivers

Water Quality Objectives for the NWWCZ were listed in Chapter 3. There are no specific sensitive receivers for water quality in view of the following:

(a) there are no bathing waters or other contact recreational facilities in the Study Area;

(b) the fish culture zone at Tung Chung will be relocated in 1993 well in advance of the commencement of marine works. The fish culture zone at Ma Wan is remote from the works and will not be affected;

(c) lands designated for cultivation around Tai Lam are now used as container storage, breakers yards and vehicle repair shops, and are not considered sensitive uses;

(d) the water gathering grounds for the Tai Lam Reservoir are upstream of the area allocated for the pipeline;.and

(e) there are no seawater intakes with specific standards for intake water quality. China Light and Power have previously indicated that the area of influence is a 5km radius from the Castle Peak Power Station. The approximate distance between Tai Lam and Castle Peak Power Station is approximately 10km and thus this project is outwith the area of influence.

6.3 Construction Phase

Construction Activities

Activities which could have a direct impact on local water movements and water quality include dredging, land formation, pipelaying and backfilling of trenches. Other potential impacts considered, include diversion of streams and water courses in the Country Park, spoil disposal, off-site discharges, and storage of materials in abandoned paddy fields.

To a large extent, impacts on water quality will depend on phasing and timing of the works and whether or not any other parallel activities are being undertaken in the area of influence. In the latter connection it is relevant to note the location of the marine borrow areas for the New Airport Contracts, either side of the submarine section of the crossing, and dredging works required prior to laying the water supply pipeline which will be laid adjacent to the gas pipeline also serving Tung Chung New Town and the Airport.

The impacts have been assessed with respect to their effect on the WQO's for the NWWCZ outlined in Section 3.1. The Technical Memorandum on Effluent Standards provides standards to be achieved for discharge of effluent from construction worksites and off-site drainage.

Assessment of Impacts

Dredging and Spoil Disposal

About 1,320,000 cu m of soft clayey silt will be dredged from the submarine and foreshore sections (Figure 1.1). A further 10,000 cu m of similar material will be removed for the seawall at the Siu Lam landfall. Gravel and sand from the nullah will be reused on site unless contaminated while soft material will be disposed at a spoil dumping area. The location of the spoil dumping area will be determined during detail design. Up to 24,500 cu m of spoil from the nullah will need to be dumped in a contaminated spoil disposal ground.

Potential impacts from dredging include alterations in water movements due to the relative change in water depth, increases in suspended solids and turbidity, alterations to dissolved oxygen concentration and BOD levels, and possibly the release of chemicals or metals previously bound to sediment particles to the water column.

The depth of the mid-channel is in excess of 20m and the base width of the trench will be 5m with side slopes of 1 in 3. There will thus be only a local impact on current velocities. The situation may be different near the landfalls as the relative depth of water is closer to the width of the dredged channel. However impacts will be minor, localised and very short term.

Suspended solids and turbidity levels would be increased in the vicinity of the dredgers and hopper barges if the hoppers are allowed to overflow. In view of all other marine works which will be undertaken in parallel in the Urmston Road, estimations of suspended solids concentrations in the receiving waters have not been carried out. Monitoring procedures in addition to mitigatory and water quality protection measures for the submarine and foreshore sections have however been considered.

Sediment transport is the result of a complex interaction of flow processes, salinity variations and individual characteristics. It is considered that any resuspension and transport of sediment will have no impact on any of the WQOs except those BU3 and BU8 and the impact on these will be small.

Chemical effects of dredging marine deposits may include the release of ammonia, sulphides and hitherto bound heavy metals to the water column. Release of these components may result in a temporary depletion in dissolved oxygen levels in the immediate vicinity of the works. This could be identified by impact or compliance monitoring of water quality when marine works are being undertaken allowing appropriate action taken if necessary.

Reclamation

Land formation will be required at Siu Lam to provide a site for the landfall, and the gas pigging station. Infilling behind a newly formed seawall and the existing coastline will minimise any localised impact of reclamation on water quality. Inshore current velocities and settling velocities of materials used for the reclamation are both low. Hence, any suspended material will be locally confined. The final seawall alignment will have only a minor impact on the local tidal regime.

Backfilling

Backfilling and rock armour placement in the submarine and foreshore section is unlikely to have other than very localised impacts on receiving water quality. Potential impacts relate to disturbance of seabed material. However the depth of water and salinity gradients within the water column, will ensure any resuspended sediments are suppressed.

Control of Spillages

Off-site discharges may include spillages from the temporary worksite. Oil or petroleum based spills need to be rapidly contained perhaps by employing containment booms or by spreading adsorbent material onto the surface of the water. The WQO for NWWCZ requires that mineral oil should not be visible on the surface of the water throughout the entire zone, nor should discharges settle to form objectionable deposits. The standards given in the Technical Memorandum will apply and the contractor will need to apply effective pollution control measures.

Work Sites

Although details of works sites along the land or nullah sections are not yet available, some provision for food preparation and temporary sanitary facilities may be required. Disposal of liquid waste arisings is controlled by the Technical Memorandum on Effluent Standards. It will also be especially important to prevent littering or discharge of effluent to the hitherto unpolluted streams in the Country Park.

Water Courses

Small streams, water courses and wetland areas have been identified along the route through the Country Park. Care will need to be taken to avoid dumping silty material in the stream courses during excavation for the trench. Many of the streams have rocky streambeds and thus it is important to avoid dumping sediments in these areas as it will eventually be conveyed downstream where it could impact on the ecological balance. Reinstatement of streams after the pipeline has been laid will ensure the natural drainage pattern is restored. Proposals made in the habitat restoration strategy, Section 11, have taken this aspect into account.

Mitigation Measures

Dredging and Reclamation

Low impact dredging techniques such as trailer suction or closed grab dredgers are recommended in the lower nullah section. Aligning the pipeline route parallel and close to the bank will maintain flow and permit some flushing to continue.

Low impact dredging is also recommended for the submarine and foreshore sections of the trench. Furthermore overflowing of hoppers should not be permitted.

The contract specification should include clauses designed so that the contractor has the obligation to meet water quality standards during dredging and reclamation. The contractor's performance in meeting the specification should be monitored throughout by the Engineer using the monitoring and audit procedures detailed in section 6.5. The following provisions should be included in the contract specification:

(a) All the contractor's equipment should be designed and maintained to minimise the risk of silt and other contaminants being released into the water column or deposited in other than designated locations.

(b) Pollution avoidance measures should be implemented by the contractor. These should include:-

  (i) mechanical grabs should be designed and maintained to avoid spillage and should seal tightly while being lifted;

  (ii) cutterheads of suction dredgers should be suitable for the material being excavated and be designed to minimise overbreak and sedimentation around the cutter;

  (iii) overflow from the dredger and the operation of lean mixture overboard systems should not be permitted where trailing suction hopper dredgers are in use for dredging of marine mud.

  (iv) all vessels should be sized such that adequate clearance is maintained to the sea bed at all states of the tide to ensure that undue turbidity is not generated by turbulence from vessel movement or propeller wash;

  (v) all pipe leakages should to be repaired promptly and plant is not to be operated with leaking pipes;

(vi) the works should cause no visible foam, oil, grease, scum, litter or other objectionable matter to be present on the water within the site or dumping grounds;

(vii) all barges and hopper dredgers should be fitted with tight fitting seals to their bottom openings to prevent leakage of material;

(viii) excess material should be cleaned from the deck and exposed fittings of barges and hopper dredgers before the vessel is moved;

(ix) loading of barges and hoppers should be controlled to prevent splashing of dredged material to the surrounding water and barges or hoppers should not be filled to a level which will cause overflow of material or polluted water during loading or transportation; and

(x) adequate freeboard should be maintained on barges to ensure that decks are not washed by wave action.

Additional provisions will be needed where seabed sediments are contaminated. The locations and depths of any areas of contaminated marine mud should be indicated in the construction contract. The contractor should be required to ensure that the contaminated marine mud is dredged, transported and placed in approved special dumping grounds in accordance with the provisions listed below and in such a manner as to minimise the loss of material to the water column.

(a) dredging of contaminated marine mud should only be undertaken by a suitable grab dredger using a closed watertight grab;

(b) transport of contaminated marine mud should be by split barge of not less than 750mm^3 capacity; well maintained and capable of rapid opening and discharge at the disposal site;

(c) the material should be placed in the pit by bottom dumping, at a location within the pit specified by the Secretary of Fill Management Committee;

(d) discharge should be undertaken rapidly and the hoppers should then immediately be closed; and material adhering to the sides of the hopper should not be washed out of the hopper and the hopper should remain closed until the barge next returns to the disposal site;

(e) the Contractor must be able to position the dumping vessel to an accuracy of +/-10m; and

(f) the dumping vessel should be stationary throughout the dumping operation.

Work Sites

Any wastes arising at work sites will require appropriate disposal. Screenings from grit and grease traps, if these are used, should be taken to WENT landfill. Oily materials should be either recycled or disposed of at the Chemical Waste Treatment Facility, scheduled to be commissioned in 1993.

Disposal of domestic sewage will require further consideration when more details of the construction programme and staffing levels are confirmed. Treatment and discharge of domestic effluent will need to comply with the requirements of the Technical Memorandum. Portable latrines should be provided for workers throughout the works. The contractor should be instructed that no construction waste is to be burnt on site and that fire fighting equipment should be maintained at each work site. The scope of the fire fighting equipment should be agreed with AFD prior to inclusion in the contract and the contractor's workers should be trained in its use.

Control of Spillages

Any spillages, either off-site or to water courses, will require to be cleaned up immediately.

Water Courses and Wetlands

The pipeline route has been modified during this environmental impact assessment so that wetlands will not be affected by the pipeline itself or by storage areas. There should therefore be no direct impacts on the wetlands and no mitigation measures will be necessary. Nevertheless the construction contract should include clauses stating that the contractor should not carry out any activities which affect the wetland areas directly or indirectly and that none of the contractor's activities should be allowed to alter the drainage into or out of the wetlands.

A number of stream courses will be crossed by the pipeline route. These should be identified during the detail design phase of the project when more detailed survey plans of the route will be available and a detailed ecological survey prepared of each stream crossing. Stream crossings should be constructed outside the breeding season of the fauna inhabiting the streams. This will generally mean that the stream crossings should be built during the dry season and this may have to be in advance of other construction activities in that area. Each stream should be diverted into a concrete or steel pipe of sufficient size to carry the full flow of the stream during the wet season. The pipe should be sealed across the whole width of the contractor's work area and the contractors should be instructed that he will not be permitted to carry out any works that have any effect on the stream course either upstream or downstream.

Restoration of stream courses should be designed to recreate the natural conditions as far as possible. A detailed survey of each stream crossing should be carried out during the detail design to enable this to be done. The detailed survey should include photographs and notes on the stream topography and ecology. Restoration should be carried out with the objective of recreating a natural habital to allow recolonisation. For example rough granite blocks should be placed in the stream beds rather than forming a smooth bed across the pipeline.

6.4 Operation Phase

The pipeline will be completely submerged in the trench between Tai Lam and Ta Pang Po and there will be no impact on water movements, water quality or sedimentation rates.

Similarly, the pipeline will be completely buried in the nullah and the bed will be restored to the present level.

6.5 Water Quality Monitoring and Audit

Baseline Monitoring

Baseline water quality monitoring in the vicinity of the pipeline will be required at least one month prior to commencing any marine works. This will provide a reference against which to compare all future data gathered, and will thus determine whether the standards set are being achieved. Furthermore, if any remedial action is required this can also be identified.

Monitoring and Audit

Impact monitoring will be undertaken for the duration of any marine works. A monitoring schedule can be prepared only when the Contractors working methods are defined. Parameters which will require monitoring include suspended solids, turbidity, dissolved oxygen, salinity and temperature.

In the event that impact monitoring indicates elevated levels of turbidity, suspended solids, or a decrease in dissolved oxygen which suggest a significant deterioration in water quality, then daily monitoring may be required. This should be continued until the recorded values of the parameters indicate an improvement and an acceptable level of water quality is achieved.

All necessary steps will need to be taken to ensure the works being carried out by the Contractor are not contributing to any deterioration in water quality. This may be difficult to achieve in the submarine section where other dredging contracts will be in progress at the same time and in the same area.

Table 6.3 sets out recommendations for trigger, action and target levels for a water quality audit.

Table 6.3 Recommended Trigger, Action and Target Levels for Water Quality Audit

Impact	Trigger	Action	Target
Suspended Solids	30% increase above baseline level	15% increase above the maximum level recorded upstream of the works on that sampling day	30% increase above the maximum level recorded upstream of the works on that sampling day
Dissolved Oxygen	As for suspended solids but 30% decrease	As for suspended solids but 15% decrease	As for suspended solid but 30% decrease

Monitoring data will need to be routinely analysed, to ascertain whether any undesirable trends in water quality are occurring. If trends observed indicate a deterioration in water quality, relevant action can be taken promptly.

A recommended action plan for monitoring water quality, given in Table 6.4, summarizes action to be taken in event of the trigger, action and target levels proposed in Table 6.3 being exceeded.

Table 6.4 Proposed Action Plan for Water Quality

Event	Action	
	Engineer	Contractor
Trigger level exceeded for one sample	Repeat measurement as soon as possible	-
Trigger level exceeded for more than one consecutive sample	Repeat measurements Notify contractor	-
Action level exceeded for one sample	Repeat measurement as soon as possible Notify contractor	-
Action level exceeded for more than one consecutive sample	Increase frequency of monitoring to at least daily Notify contractor Require contractor to make proposals to reduce water pollution	Review plant and methods Submit proposals for improving water quality to Engineer Implement remedial actions
Target level exceeded for one sample	Repeat measurement as soon as possible Notify contractor	-
Target level exceeded for more than one sample	Increase frequency of monitoring to at least daily Notify contractor Require contractor to implement immediate steps to improve water quality	Review plant and methods Submit proposals to improve water quality to the Engineer Implement measures to improve water quality immediately Notify Engineer of action taken

6.6 Summary and Recommendations

(a) The majority of dredged material will be disposed of at gazetted spoil dumping grounds without special treatment. Sediments from the nullah will need special disposal arrangements. Uncontaminated gravel and sand from the nullah will be stored temporarily and used as backfill within the same section of the works.

(b) It is recommended that low impact dredging techniques are adopted for works in the submarine, foreshore and lower nullah sections of the route, to minimise the effect of dredging on receiving water quality.

(c) Spillages and offsite discharges will be controlled under the provisions of the Technical Memorandum on Effluent Standards. It is recommended that a spill action plan is formulated by the Contractor to deal with any events promptly for the protection of receiving waters and the maintenance of beneficial uses of the water body.

(d) It will be important to prevent dumping of soil, silt or excavated materials in water causes or streams or on private lands within the Country Park and nullah sections.

(e) It is recommended that baseline and impact monitoring surveys are undertaken for the duration of the marine works to ensure the Contractor is carrying out the works within the established environmental framework.

(f) An environmental auditor/officer should be employed throughout the works to monitor the contractor's compliance with the contract conditions and mitigation measures.

7. Solid Waste Disposal

7. SOLID WASTE DISPOSAL

7.1 Construction Wastes

Building Wastes

Solid wastes arising on-site during construction could include bamboo, formwork, scrap metal in addition to spent oils and lubricants. There will significant quantities of waste material to be disposed of when the temporary platform at Siu Lam is dismantled.

While it is not possible to quantify the wastes arising at this stage, recommendations in principle for appropriate disposal can be made. Wherever possible material should be recycled and reused on-site. Chemical wastes, spent oil and lubricants will be directed to the Chemical Waste Treatment Facility scheduled to be commissioned in 1993. Scrap, bamboo and other wooden materials should be sent to the WENT landfill. It is strongly recommended that the Contractor breaks down such bulky material into small pieces to minimise potential differential settlement rates at the landfill, and also to reduce the possibility of puncturing the landfill liner.

Spoil Disposal

Dredging trenches for the submarine and foreshore sections will generate approximately 1,320,000 cu m and 70,000 cu m of soft clayey silt respectively. In addition to this an estimated 10,000 of similar material will be dredged from the landfall at Siu Lam with 24,500 cu m from the lower reaches of the nullah. All this soft material should be disposed of at a designated spoil dumping ground. Although requiring confirmation from EPD and the Fill Management Committee, spoil could be disposed of at Cheung Chau Spoil Dumping Ground and at a contaminated spoil disposal ground to be determined.

Excavated Material

Although it is desirable to use excavated materials on-site, the Contractor will probably need to export some of the excavated rock and rubble and bring in materials such as sand, gravel and topsoil more suitable for the works.

Rock and rubble from the excavation for the pigging station at Chuen Lung West and the horizontal and vertical shaft at the disused quarry could be used, if suitable, for landscaping works. It has been suggested that a footpath could be laid alongside the route of the pipeline as part of the restoration works through the Country Park. Excavated material could be used for the footpath providing benefits not only in terms of reuse of material, but also reducing vehicular movements and maintenance work.

Domestic Waste from Workforce

Solid wastes generated by the workforce will need daily collection and disposal at a central refuse collection point.

7.2 Mitigation Measures

All rubbish, debris and any disused formwork accumulating at worksites will need to be removed at frequent intervals to maintain clean and tidy works areas. Attention will need to be given to preventing debris, mud or earth from being deposited on adjacent private lands and in streamcourses. This is particularly relevant for works in the nullah section and within the Country Park.

7.3 Summary and Recommendations

(a) It is recommended that materials arising on site should be reused and recycled wherever possible. Where this is impractical, alternative disposal methodologies should be adopted.

(b) It is further recommended that surplus excavated rock and rubble are used to reinstate existing tracks along the route of the pipeline. Not only would this reduce maintenance of the site, as works progress in the Country Park, but it would reduce disposal requirements. It would additionally, contribute to the value of the existing Country Park trail network.

(c) It is recommended that bamboo, wood and other scrap materials to be disposed of at WENT are crushed into small pieces to minimise the risk of puncturing the landfill liner.

(d) No construction waste should be burnt on site and fire fighting equipment should be maintained by the contractor at all works sites.

8. The Landscape Master Plan

8. THE LANDSCAPE MASTER PLAN

8.1 Introduction

A key aspect of the pipeline study is the need to minimise visual impacts and ensure proper landscape restoration of the pipeline route construction access roads and storage areas. The following sections set out the landscape master plan in terms of design objectives, site analysis, restoration proposals and monitoring techniques.

8.2 Route Selection

Based upon the preliminary pipeline route alignment, field studies were carried out to assess the topography and landscape resources of the pipeline corridor. Combined with aerial photograph interpretation, the landscape profile of the route was plotted and analysis of the terrain and vegetation patterns permitted refinement of the route to minimise the visual impacts and disturbance to existing vegetation.

From this analysis a number of landscape objectives were derived regarding the route selection, namely;

(a) the pipeline route should be selected to minimise impacts on users of the Country Park;

(b) the route should whenever possible, avoid cutting across the face of steep slopes as the cutting and benching works required to accommodate the pipe and trench would be extensive and be highly visible in most cases from adjacent footpaths in the Country Park;

(c) the route should follow existing footpath/track alignments wherever possible, particularly on high ground such as along ridgelines. Thus, disturbance to adjacent vegetation and the visual impact is minimised; and

(d) where the pipeline encounters valleys or areas of cultivation which are more fertile and have greater diversity of habitats and vegetation cover, particular care should be taken to ensure the detailed routeing does not disturb the existing drainage regime, e.g. affect the water table of the paddy cultivations, or affect mature stands of trees or "fung shui" plantations in the valleys or associated with village settlements.

8.3 Site Analysis

A number of factors were considered in the site analysis of the pipeline route, namely;

(a) Physiology

The influence of landform on vegetation growth and visibility of the pipeline. For example, establishment of plants on steep slopes, can be difficult with rapid drainage. Also, clearance of vegetation can result in rapid soil erosion.

(b) Soil Type

The soil types occurring along the pipeline route fall into three broad categories, namely;

Alluvial Soils - Medium to high fertility. Some soils in low-lying areas such as the abandoned paddies may be clayey and wet.

Granitic Soils - Relatively low fertility. Normally, these are easily eroded, particularly on steep slopes forming a hard-pan when top layers of soil are removed. This is clearly evident on the western portion of the route above Tai Lam Chung.

Volcanic Soils - Relatively low fertility with moderate to low erosion potential, typical of the eastern portion of the route towards Route Twisk.

(c) Altitude

The pipeline route is at a relatively high altitude throughout and generally exposed. Therefore, vegetation may be more difficult to establish in places.

(d) Aspect

In Hong Kong slopes with a northern aspect normally have a higher growth potential than those with a southern aspect due to relatively less exposure to direct sunlight. However, exposed upland areas facing the prevailing N.E. winds in winter are more prone to fire-damage.

(e) Existing Vegetation

Restoration planting should reinstate the original vegetation profile and species mix wherever possible. Retention of topsoil during construction and proper ground contouring is vital for successful restoration works.

(f) Growth Potential

The vegetation growth potential of different sections of the route is dictated by the above factors a) to e). To help guide formulation of restoration proposals and plant selection, three categories for vegetation growth potential are identified below.

(i) High Growth Potential

Typical areas include low-lying alluvial or farmland areas, lower hill slopes and deep valleys, particularly with northern aspects, which can sustain broadleaf forest trees and a wide variety of other species.

(ii) Medium Growth Potential

Typical areas include mid-slopes and upper slopes along deep valleys with southern aspects and mid to upper slopes with northern aspects which can sustain hardy tree or tree/shrub species.

(iii) Low Growth Potential

Typical areas include exposed hilltops, crests, ridges and spurs, upper slopes with northern aspects and mid to upper slopes with southern aspects. It is important to establish vegetation cover quickly to avoid erosion. Suitable site treatment and selection of hardy tree and shrub species is required.

8.4 Existing Vegetation

Vegetation surveys of the route identified main vegetation types through which the proposed pipeline will pass and when analysed further in section 9.0, in the ecological assessment, will form the basis for plant selection for the restoration proposals. The main vegetation categories are listed as follows :

(a) Woodland

This category can be sub-divided into three sub-groups :

(i) Plantation : Typically Tristania, Pinus elliottii and Acacia tree species located on portions of Country Park hillside as restoration to previous fire-damage.

(ii) Roadside planting : Typically Acacia species, located alongside the Country Park access roads.

(iii) Mixed broadleaf woodland : Typically comprising a diverse mix of trees and shrub understorey and located in sheltered valleys adjacent to village settlements and abandoned paddies.

(b) Shrubland

This category describes the majority of the route in upland slopes or ridges and comprises a relatively dense mix of Rhodomyrtus, Baeckia, Dicranopteris, Smilax and Melastoma species.

(c) Bamboo

This category applies to only two areas, one of which comprises a large tract of Arundinaria bamboo species encircling the cultivated area at Pak Shek Kiu.

(d) Grassland

This category typically applies to areas of previous fire-damage or thin soils where tree and shrub species have not yet colonised. The grassland areas usually contain a mix of wild grass with Dicranopteris, Melastoma or Baeckia species in a less dense mix than the scrubland.

(e) Cultivations

This category applies to the areas of abandoned paddy fields and cultivated land adjacent to village settlements. Many of these areas, due to the more favourable drainage regime, fertility and shelter, comprise a mix of grassland, shrubs which have invaded the abandoned paddies and small stands of woodland.

The location and extent of the existing vegetation categories itemised above are plotted on Figures 8.1 and 8.2 (contained at the back of this report) where they are encounted along the pipeline route. Figures 8.3, 8.4, 8.5 and 8.6 illustrate, with photographs, the typical landscape character of different sections of the route.

It should be noted that the landscape assessment for the environmental impact assessment has been based on identification of habitats so that any important habitats can be avoided. This has been largely achieved but more detailed surveys and lists of dominating species will be necessary during detail design when more detailed maps will be available. The lists of dominating species will be used in developing final restoration proposals.

8.5 Planting Restoration

The construction area of the pipeline will be typically 5m in width to accommodate th trench, storage of excavated materials and access for machinery and personnel alongsid the trench.

The pipeline route generally follows areas of shrubland so it will be possible to reinstate the route without the need for deep rooting trees. Shallow rooting shrubs may be planted over the pipeline to match with the adjacent vegetation. Shallow rooting tree species may also be planted close to the pipeline where the route passes close to forested areas.

8.6 Works Access and Storage Areas

Provisional routes for temporary access tracks between existing Country Park roads and the pipeline route during construction have been proposed. These, as well as the temporary storage areas, will require more detailed study and approval to ensure that the quantity of such tracks and storage areas is kept to the practical minimum and that the detailed routeing does not have detrimental impacts on the existing landscape. In such areas, there will be no engineering restrictions on planting such as for those above the pipeline. Therefore, total revegetation of trees and shrubs will be possible where required.

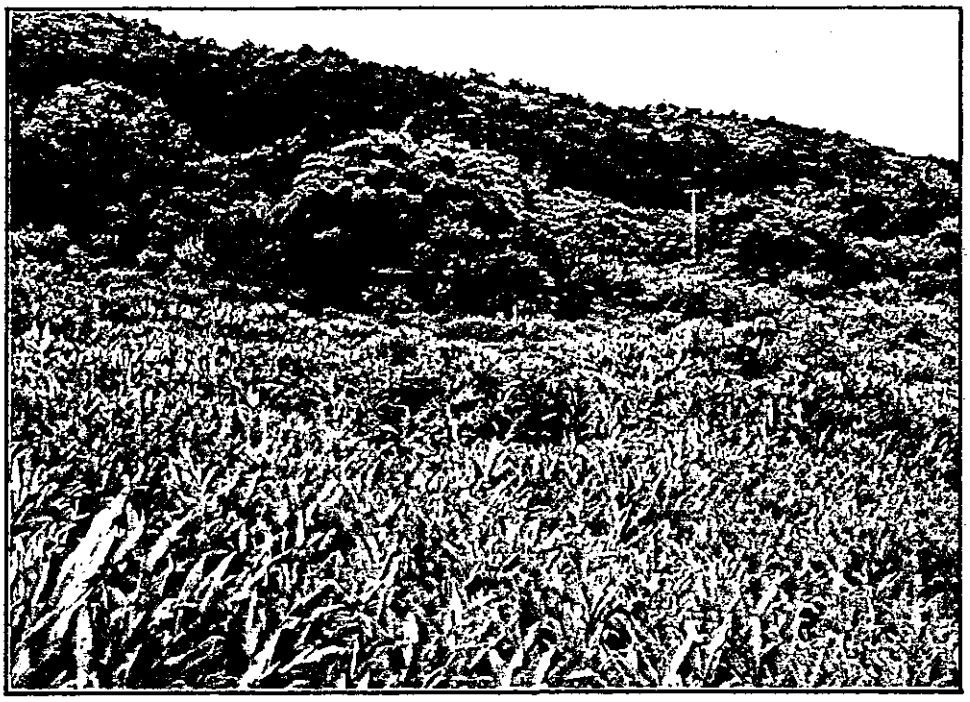
Storage areas will require level ground. However, although the abandoned paddy fields appear to be suitable, two important restrictions should be considered, namely; the difficulty of gaining such access to what is typically private land and the need to fill and drain the paddy fields to function as storage areas. Little is known about wetland restoration and thus storage areas should be restricted to roadside verges, saddles or areas of level ground wherever possible. Wetlands should not be used for storage and contractors should not be allowed to enter these areas for any reason.

8.7 Summary and Recommendations

(a) The overland route selection of the pipeline has endeavoured to minimise visual and ecological impacts in the surrounding landscape, and thereby impacts on the Country Park users, by following existing hillside tracks and, whenever possible, avoiding slope cutting and valley areas of more mature vegetation and habitat diversity.

(b) Analysis of the topography and vegetation cover along the pipeline indicates that the route passes through predominantly shrub vegetation and encounters steeply undulating terrain in many areas. As a result, proposals for careful control and monitoring of the construction work to prevent soil erosion and successful revegetation are required. These are discussed in Section 9.

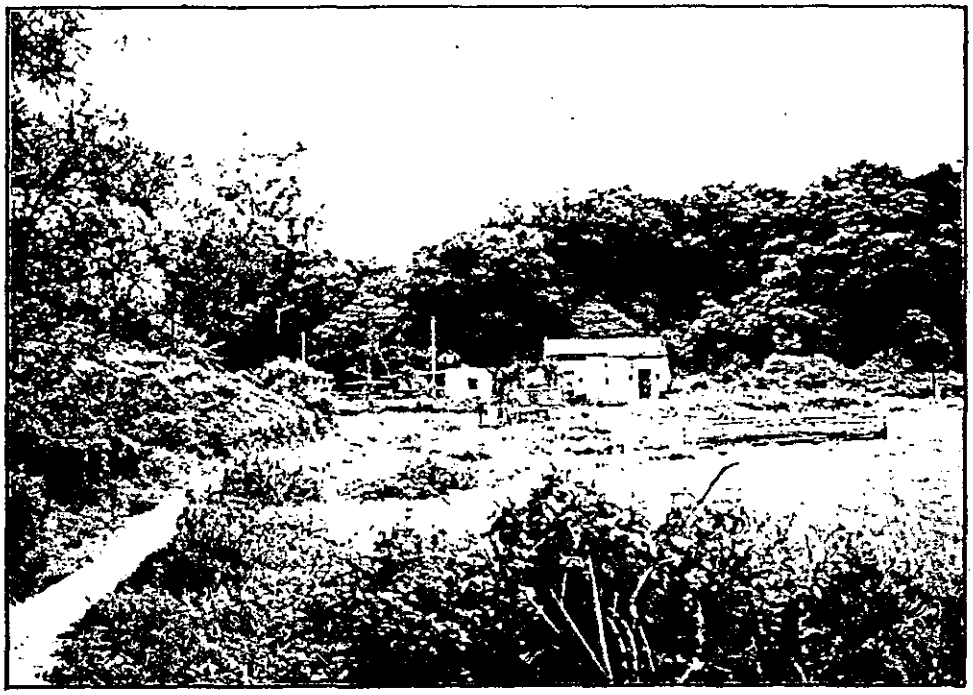
Figure 8.3 Cultivated Grasslands and Shrublands



Cultivated land at Pak Shek Kiu where ginger lilies are grown. Arundinaria bamboo groves encircle the cultivations.

View towards Lin Fa Shan showing grassland and open shrubland in foreground. The pipeline skirts the edge of the woodland and boulder strewn area.

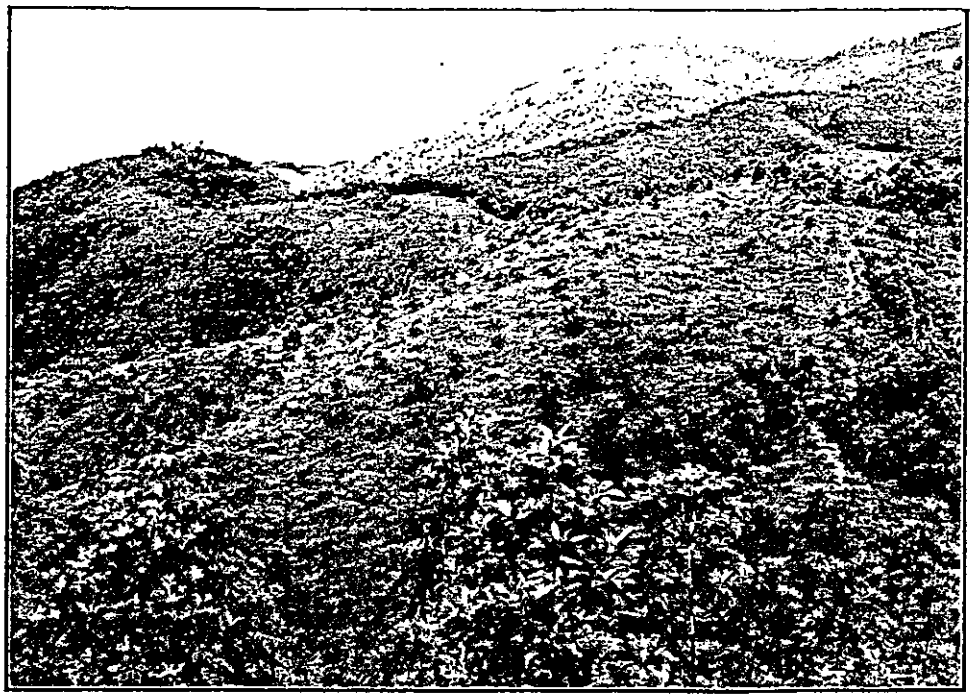
Figure 8.4 Examples of Mixed Woodland and Shrublands



Mixed woodland behind Tsing Fai Tong village unaffected by the pipeline route.

Typical shrubland mix through which the majority of the route passes

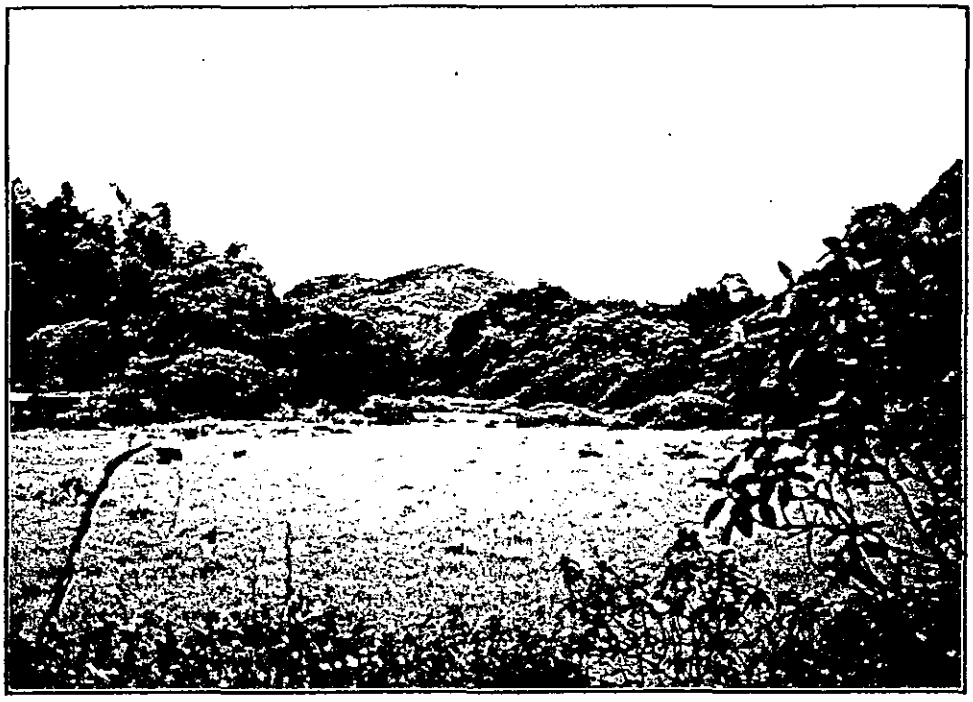
Figure 8.5 Young Plantations and Mature Trees



Young plantations establishing on slopes above Route Twisk. The proposed pipeline route will follow the existing earth track shown along the ridgeline.

Country Park road near CAS Yuen Tun Camp. The proposed pipeline route follows the road to avoid felling any of the mature trees on each side.

Figure 8.6 Paddy Fields and Fire Damaged Vegetation



Former paddy fields at Tsing Fai Tong fringed by mixed broadleaf woodland and now used by villagers for grazing goats.

Fire-damaged vegetation on slopes above Tai Lam Chung with thin, erodable granitic soils.

9. Terrestrial Ecology

9. TERRESTRIAL ECOLOGY

9.1 Existing Environment

The majority of the proposed route within the Country Park consists of fire-maintained grassland and shrubland or exotic plantations. Although these vegetation types provide habitat for native plants and animals, they are well-represented elsewhere in the Territory and are of no special ecological or conservation value. Moreover, being a consequence of recent disturbance, they can relatively easily be recreated. The ecological value of both shrublands and plantations increases with age (which can be roughly assessed from the canopy height and density), as does the time taken for restoration, so disturbance to older areas should be avoided wherever possible. Less than one percent of the proposed route passes through more valuable and sensitive habitats.

Secondary Woodland

There is no sharp distinction between secondary woodland and tall shrubland : woodland is just older and taller. The oldest woodlands on the route are between 20-30 years old. Their ecological value results from their rarity in the Tai Lam Country Park area and some species of plants and animals are probably confined to them.

Abandoned Paddy Fields

The small pockets of abandoned paddy along the route vary considerably in their current state. The most valuable are those which remain wet throughout the year or for a high proportion of the year. These wetland areas provide habitat for a variety of amphibia, reptiles, birds and invertebrates. These islands of diversity among the dry hillsides, have been recently been surveyed in connection with the use of some such areas for on-site storage. Several of the wetland areas were originally identified as storage areas but this has been reviewed as a result of the ecological surveys and the environmental assessment and no wetland areas will now be used for any purposes.

During the survey of potential storage areas and the surrounding agricultural fields, which form one habitat system together, amphibians were identified by direct observation and by their mating calls. A total of five systems were recognized. Eggs and tadpoles in the water were sampled with a dip-net and later identified under laboratory conditions. The large area and dense vegetation made direct counting of the amphibians and hence estimation of population densities impossible within the time available.

A total of six species were found in the five systems of agricultural fields and their distribution are listed in the following table.

Table 9.1 Species Found at Wetland Areas

Species	Wetland Areas				
	W1 and W2	W3 and W4	W5	W6	W7
Rana limnocharis Paddy Frog	A(calling) Y, T, E		A(calling)		A(Calling)
Rana guentheri Guenther's Frog	A(calling)	A(calling)	A(calling) T		T
Rana macrodactyla Long-toed Frog				A Y	
Rhacophorus leucomystax Brown Tree Frog	A(calling)		A(calling)		A(calling)
Microhyla butleri Butler's Pigmy Frog		A(calling)			A(calling) T
Microhyla pulchra Marbled Pigmy Frog					T

A - adult frog
Y - young frog
T - tadpole
E - egg

In addition to these listed above, *Bufo melanostictus* (Asiatic Common Toad) was commonly encountered on the path along the proposed pipeline route. Two other species, *Amolops hongkongensis* (Hong Kong Cascade Frog) and *Rana exilispinosa* (Lesser Spiny Frog) were found in the streams nearby.

As indicated by the calling activities of the males of *Rana limnocharis*, *R. guentheri*, *Rhacophorus leucomystax* and *Microhyla butleri*; the presence of *M. pulchra* tadpoles; and the presence of young *R. macrodactyla* frogs all six species use the wetlands as breeding grounds. Species of interest are *M. butleri* and *R. macrodactyla*. The former is scarce and has a restricted distribution locally. The latter inhabits grassy marsh in fields and along rivers and a considerable number of its former habitats have been destroyed by development.

This survey was carried out in late July when the breeding season of most amphibians is ending or has already finished. Therefore some other species which breed in still water in and around agricultural fields were not identified in this survey. The amphibian species which are almost certain to breed in some of these sites include *Bufo melanostictus, Kaloula pulchra* (Asiatic Painted Frog), and *M. omata* (Ornate Pigmy Frog). The areas may in fact support most of the amphibian species associated with agricultural fields in Hong Kong.

9.2 Construction Impacts

Secondary Woodland

In order to clear the route for the pipeline some of the secondary woodland and tall shrubs will need to be felled. This should be kept to a minimum for various reasons not least that vegetation will require reinstatement.

Paddy Fields and Wetlands

Freshwater wetlands can be damaged by changes in local drainage patterns even if they are not directly on the pipeline route. Because of the complexity of the processes which produces wetlands, it is very unlikely that such areas could be restored to previous conditions.

The five wetland systems identified in the Study Area support discrete and diverse amphibian fauna. Potential impacts of utilising these areas for storage on the ecological systems could be significant and it has therefore been decided that no wetland areas should be used.

Since the protected and endemic *A. hongkonensis* occurs in the cascades in the Study Area, streams affected by the construction should be properly and promptly diverted. If possible, the diversion should be carried out in autumn and winter when nearly all the amphibians have finished breeding and become less vulnerable to disturbance of their habitats. The risk of rainwater carrying silts from the construction site down to the wetlands is also reduced in the dry season. Mitigatory measures will be required to prevent this from happening if construction is carried out in the rainy season. Following construction reinstated ground levels should be same as, or slightly lower, than the original level.

All use of wetlands should be avoided where possible as restoration cannot be guaranteed. The raising of this issue in the EIA has already resulted in route changes such that the project now avoids the wetlands. Any review of the route during detail design should also avoid the wetlands.

9.3 Ecological Principles of Restoration

Secondary Woodland

Restoration of mixed, native woodland has not been attempted in Hong Kong and is likely to take many years to fully complete the restoration. These areas should be avoided if feasible and compensatory planting of mixed, native tree species should be carried out as close to the impacted area as possible.

Grassland and Shrubland

Restoration of grassland and shrubland areas should be guided by aesthetic rather than ecological considerations. Most of the flora and fauna of such areas has a broad range of ecological tolerance and is highly invasive. Hydroseeding with a proven seed mixture to provide rapid ground cover and to control erosion is recommended. A limited range of common native shrub species should then be planted into the grassed area to match the surroundings. Native grasses and other ground-cover plants will invade rapidly as long as erosion is prevented. These issues are further discussed in Section 11. It may also be necessary to exclude or discourage the feral cattle which roam freely in the

Country Park in the initial stages to avoid destruction of the replacement planting. This could be done by erecting temporary fencing around the critical areas.

Plantations

Replanting with the same tree species would minimize visual impact. Replanting with mixed, native species, in contrast, would enhance the ecological value. If neither is practicable similar treatment as outlined above for grassland and shrubland is recommended.

Native Secondary Woodland

Replanting with mixed, native tree species is preferable, although if this is impossible for engineering reasons, the aim should be to create as dense a plant cover as possible. For existing plantations, replanting with the same tree species would minimize visual impact. Replanting with mixed, native species, in contrast, would enhance the ecological value. If neither is possible, due to engineering constraints then the same treatment as recommended above for grassland and shrubland, below, should be adopted.

Wetlands

There is no local experience to date in restoring such areas and wherever possible areas of wetland should be avoided. The best approach, is to attempt to restore the original drainage pattern and to leave revegetation to natural processes.

These ecological principles are expanded further in the detailed landscape restoration proposals given in Section 11 in the form of practice guidelines and a technical specification.

9.4 Summary and Recommendations

(a) On the basis of the assessment it was identified that less than one percent of the route passes through sensitive and valuable habitats.

(b) Of the nine potential storage areas surveyed in the amphibian survey only two were identified as unsuitable on account of their ecological sensitivity.

(c) It is recommended that the minimum number of tall shrubs and secondary woodland should be cleared.

(d) It is recommended that since works will take place in the rainy (and breeding) season, mitigatory measures will be required to prevent silt and sediment from construction works from being transported to wetland areas.

(e) It is recommended that native tree species be used wherever possible for replanting. Rapid ground cover is recommended to control possible erosion of the area to be restored.

(f) Storage of materials in wetlands and paddy fields should be avoided wherever possible. The areal extent of any use of wetlands and paddy fields should be confined and attention given to maintaining existing drainage patterns.

10. Aquatic Ecology

10. AQUATIC ECOLOGY

10.1 Introduction

The proximity of the CSD Correctional Facility has limited human intervention in the upper reaches of the nullah or river system. In the middle reaches the river passes through Tai Lam Chung village were the Tai Lam Chung road follows the eastern bank of the river and is itself bordered by container storage areas and vehicle workshops. In the lower reaches the estuary broadens out and at low water, channels form between the exposed stony gravel banks. Finer sediments deposited on the eastern side of the estuary provide habitat for a different benthic fauna to the western and central areas and provide feeding areas for birds.

This section focuses on the impacts through the Tai Lam nullah. An assessment has also been carried out to identifying any impacts from the construction works on the aquatic ecology of the submarine and foreshore sections. This assessment has concluded that there are unlikely to be any significant impacts over these sections so long as the impacts on water quality (and in particular sedimentation) are minimised as discussed in Chapter 6 of this report.

Urmston Road is known to be used by the Chinese White Dolphin *Sousa Chinensis* and there is some indication that an area near the Brothers Islands could be a breeding ground. However marine works for this project are likely to be minor in comparison with other marine works in the same area and the impacts will be small. Only very limited data on the Chinese White Dolphins are available and a study is to be carried out shortly with a view to obtaining more data.

There will be no significant impacts on capture fishing in the Study Area and there are no fish culture activities that could be affected.

10.2 Existing Conditions

Because of the apparently rapid changes in the physical and biological characteristics of the river over a relatively short distance the nullah is discussed in terms of the upper, middle and lower reaches.

Upper Reaches

In the upper sections the riverbed is composed largely of coarse gravels and larger cobbles. In limited areas deposits of finer sediments have encouraged the establishment of dwarf mangroves (*Kandelia candel*) and associated successional plant species. The banksides in the upper reaches are well vegetated as is the roadside bank of the river which is largely screened from the road.

Benthic and/or invertebrate organisms in the upper reaches of the river include a number of both *Grapsid* (including *Grapsus alboneatus*) and *Portunid* crabs in the boulder/rock areas. In the vicinity of *Kandelia* deposit feeding gastropods may be found (Terrebralia and Cerithidea) where softer sediment deposits have aggregated.

The upper reaches exist mainly as a freshwater stream. As a result of reduced salinity in this area the diversity of organisms that may be classified as marine is therefore quite limited.

Associated with the relatively high level of productivity in the river, the river valley sustains an interesting bird population. In the upper reach, three of Hong Kongs four species of kingfisher have been observed fishing at the same time. The species concerned are, the white breasted Kingfisher (*Halcyon smyrnensis*), the Common kingfisher (*Alcedo athis*), and the Pied kingfisher (*Ceryle rudis*). The latter species was seen on every site visit, although the sighting probably relates to the same pair on each occasion.

Although not confined to the upper reaches of the river, other bird species common to the area include the cattle egret (*Bubulcus ibis*), the little egret (*Egretta garzetta*), and the chinese pond heron (*Ardeola bacchus*). One of the more unusual observations among this group, (sightings made of three birds on two occasions) was of the Little Green Heron (*Butorides stratus*). A feature of the bird species recorded during field observations was the high proportion that are associated with secluded woodland and aquatic habitats.

Middle Reaches

Where it passes through Tai Lam Chung, the middle reaches of the river are characterised by increased depth and a more regular flow as the channel width narrows. The riverbed comprises coarse gravel overlain by a thin layer (2 - 8 cms) of sediment. Conditions in this part of the river are typically more estuarine reflected by a significant increase in both the diversity of fish and invertebrate species.

Despite a reduction in bankside vegetation, more noise and general human intervention, the middle reaches of the river still attract significant numbers of birds including the white breasted Kingfisher (*Halcyon smyrnensis*), and the egrets.

Lower reaches

The lower reaches of the nullah are more representative of true estuarine conditions. The substrate is again composed primarily of coarse gravels and cobbles. The coarse nature of the material coupled with a good nutrient supply appears to promote bivalve growth. The presence of the Corbiculid bivalve *Geloina erosa* (the large Mangrove clam) up to 100mm diameter, harvested by the local villagers, would suggest that at some time in the past the estuary sustained a more prolific mangrove community than now occurs.

Also occurring in significant densities in the lower estuary are the pacific (or japanese) oyster) *Crassostrea gigas*, and the rock oyster *Saccostrea*. Associated with the latter are the predatory gastropod *Thais sp.*

10.3 Construction Impacts

Sensitive receivers which may be impacted by the proposed dredging and pipelaying in the nullah include:

- Fisheries
- Invertebrates
- Avifauna

There is evidence to suppose the lower nullah serves as a nursery area for the post larval and juvenile stages of a range of marine fish species. Destabilisation of the river bed and existing stream eco-system would directly affect fish populations. Measures to mitigate this impact are discussed in the next section.

10.4 Mitigation Measures

Construction activities will have an impact in the lower estuary but the water body is much wider at this point and there are opportunities to mitigate against the effects of the construction by ensuring that where the pipeline passes down the river bed it keeps to the margins as much as possible.

Impacts can be reduced in the upper reaches by minimising the width of the excavation for the trench and by restricting the contractor's activities to the minimum width of works area.

10.5 Summary and Recommendations

(a) From this assessment it is apparent that aquatic ecology within Tai Lam Nullah varies over a relatively short distance. There will be some effect on the ecosystem when the trench is being dug and pipeline is laid but the effect can be reduced by minimising the area of disturbance. The ecosystem should rapidly recover following completion of construction so long as the nullah bed is restored to its present level with similar materials.

(b) It is recommended that diversion of the freshwater flow from the catchment is undertaken during the works period and reinstated as quickly as possible afterwards.

(c) In the lower reaches of the nullah the impacts will be even less. It is however recommended that the alignment of the pipeline follows the bank of the river as far as is practical.

(d) Works in the nullah should avoid the breeding season wherever possible.

11. Restoration Proposals

11. RESTORATION PROPOSALS

11.1 Objectives

The main objectives of the landscape master plan and restoration strategy are as follows:

(a) to ensure proper stability of the area disturbed during construction is achieved by means of proper soiling and revegetation; and

(b) to minimise the visual impact of the pipeline and restore the original natural habitats by replanting of similar species at compatible densities to the surrounding vegetation within the engineering constraints.

11.2 Restoration of Upland Vegetation

Restoration of vegetation in upland areas can prove difficult for a number of reasons although with care these can be avoided. This section summarises the main problems encountered and the proposed preventative treatment in terms of the restoration guidelines and technical specification.

As expected, the most difficult sites for plant establishment are those of low growth potential due to steep terrain, exposure and relatively thin topsoil and surrounding vegetation cover. Typical problems encountered include the following :

(a) erosion of the topsoil by rainfall before the reinstated grass cover can establish and bind the soil;

(b) plant retardation from exposure to strong prevailing winds. This in turn can delay plant establishment binding the soil and allow soil erosion to take place; and

(c) fire damage leading to a loss of vegetation cover and soil erosion by rainfall before plants can re-establish.

11.3 Restoration Guidelines

In order to achieve the landscape restoration objectives and overcome the technical difficulties encountered in upland terrain the following guidelines are proposed :

(a) Where local drainage patterns create a sheet flow across the site, the provision of temporary drainage channels should be considered to minimise soil erosion during construction.

(b) Immediately after the pipe trench is backfilled, any aggregate layer on or adjacent to the trench, access road or storage area, placed by the contractor, should be removed and hollows or eroded gulleys backfilled and compacted with surplus soil from the trench excavations. If the aggregate/fill material is not removed, rapid water run-off and gulleying of the subsoil can occur. Plant roots cannot establish themselves in such an unstable soil structure. The site requiring reinstatement should then be fertilised, cultivated and grassed as specified.

(c) Large portions of the route above Tai Lam Chung show signs of previous fire damage and have only a thin vegetation cover comprising grass or hill fern. Once a fire has removed the vegetation cover, soil erosion can easily take place.

The areas most vulnerable to hillfires include slopes facing the prevailing N.E. winter winds with a predominantly grass or pine tree vegetation cover. In addition, sites adjacent to graves or burial grounds may be accidentally set on fire during the Ching Ming and Cheung Yeung grave sweeping festivals. It is proposed that the reinstatement of a more resilient species mix can be provided if the quantity of conifers is restricted and predominantly broadleaf species are used.

(d) Establishment of vegetation on sites disturbed by the pipeline installation will generally be easier and more successful if a layer of topsoil can be replaced after backfilling works are completed. The availability of topsoil on individual sites will vary greatly, depending on soil type and the degree of erosion. Before work commences, the layer of topsoil should be removed carefully from areas where excavation will take place. Any topsoil should be stored separately from the subsoil material alongside the trench.

(e) Subsoil material excavated for the pipe trench should not be allowed to spread down slopes on steep sites for the following reasons :

(i) A large surface area of exposed soil is created which is subject to severe erosion during periods of rainfall;

(ii) Recovery of all the excavated soil is extremely difficult and most contractors are unlikely to make the necessary effort. The result will be a layer of subsoil remaining after construction which, unless it is grassed, will wash into adjoining streams.

(iii) Existing vegetation may be destroyed by storage of soil on top of it for extended periods. Excavated soil should be confined to a minimum storage area on sloping sites by the use of temporary structures as shown in Figure 11.1. During rainy periods the stored soil should be covered by plastic sheeting to prevent surface erosion and possible saturation which could produce slumping.

(f) The planting must be the final stage of the works since subsequent access by machinery would damage the plants. The majority of the route is in areas with little or no vehicular access making the delivery of materials difficult. Initial cover will be carried out predominantly by broadcast seeding or sprigging and the more accessible areas by hydroseeding. The latter requires access for equipment and a water supply for pumping and would therefore be impractical on most sites. On highly eroded sites it will be necessary to incorporate an organic soil conditioner into the top layer to allow grass cover to establish. It is not considered practical to import topsoil to some of the less accessible sites. Instead, as described above, topsoil should be carefully excavated and stored during construction for reuse at completion of the backfilling stage. Plants should be containerised and pit planted. Each pit would be backfilled with the plant's own topsoil and the remaining voids filled by the existing material, i.e., the subsoil trench excavation material where suitable, with the addition of organic material as specified to improve the soil condition. Surplus rocks and stones over 50mm diameter excavated from the trench should be removed from site. This is refered to in item (i) below.

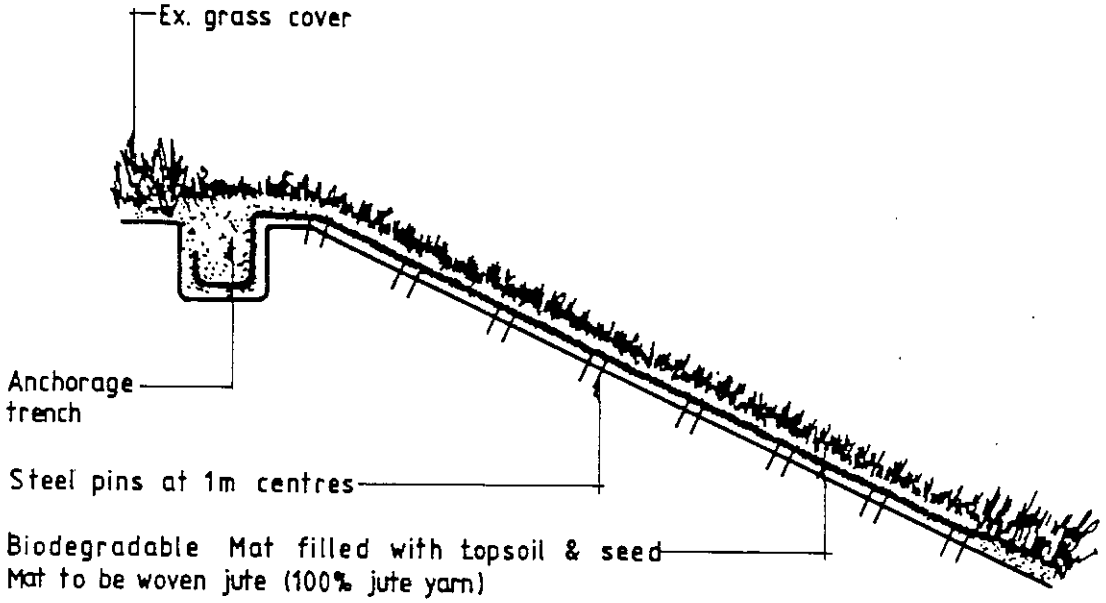
(g) The tree and shrub plant material should be relatively maintenance free and be able to establish quickly. Large plants tend to suffer more stress when transplanted to sites where there will be no regular watering. Therefore to avoid unnecessary plant failure smaller plant sizes are specified and will be planted at relatively close centres. It is preferable to adopt a fairly dense planting matrix (where applicable to the surrounding vegetation regime) to ensure the early establishment of plants over the site and then carry out plant thinning at the end of the establishment period if required. Planting at lower densities may necessitate substantial replacement planting as the failure of even a small number of plants may create large voids in the vegetation cover allowing erosion to dislodge adjacent plants.

(h) Grass establishment on more exposed sites such as ridges, spurs or steep slopes is not always successful. Accordingly, in addition to the sprigging and hydroseeding techniques specified in the Technical Specification in section 11.6, the soil stabilisation method illustrated in Figure 11.2 is suggested for application in a few suitable sites. This method requires the laying of a protective mesh onto the affected area after grassing. Due to the biodegrable mesh structure, pit planting for seedling trees and shrubs would be difficult. Therefore, it is recommended that this technique is applied to the barer hillside sites where the only surrounding vegetation cover is grass or low hill-fern and where blocks of tree or shrub species planted along the route would be inappropriate.

(i) Removal of surplus rock material from site after excavation and backfilling of the trench is difficult. Without care, it may become hillside debris instead of being properly removed. Therefore, it is proposed that in accordance with the landscape objective of routeing the pipeline to coincide as far as practicable with existing hillside tracks, and thus reduce visual scarring to the landscape, that such rock material can be utilised in resurfacing such tracks in areas of bad erosion. The existing earth tracks enountered en route are not very well used. However, they do connect with other more popular routes within the Country Park and there is a good opportunity, subject to approval of the Country Parks Board, to formalise sections of the pipeline as a valuable addition to the footpath network.

(j) Where the pipeline route coincides with the Country Park roads, it is recommended that the pipeline be laid below the road to avoid felling the mature trees that typically form an attractive avenue to such roads. Careful co-ordination and agreement is required with the Country Parks Board to minimise access disturbance during construction. However, it is considered that every effort be made to avoid the alternative which will require extensive tree felling.

(k) In order to prevent damage to grass and planting reinstatement works from the feral cattle that roam freely through the Country Park it may be necessary to provide temporary fence protection to vulnerable areas during initial establishment to prevent erosion. This will have to be closely monitored as the project progresses. However, once the disturbed areas have been revegetated and the plants are well established, such fencing should be removed.



Operation:
1 50mm topsoil dressing beneath mat
2: Sow grass
3: Place and secure mat
4: Brush in mixture of soil and seed completely filling apertures

Figure 11.2 Soil Stabilisation Using Biodegradable Mat

(l) In addition to the technical specification for grassing and planting works (section 11.6) it is vital that the planting works be properly supervised by an independent horticultural expert. Also, the establishment period, during which the Contractor is responsible for maintaining and replacing plants, should be monitored and similarly supervised at intervals of not more than 3 months to ensure proper landscape restoration is achieved.

(m) With the exception of the proposed pigging stations and the offtake station, the pipeline is totally buried. To ensure the pigging station at Chuen Lung West is concealed from the view of road users it is proposed that an earth bund and planting be placed along the roadside to form a strategic screen. Sketch proposals for this screen treatment are indicated in Figure 11.3. The pigging station will be approximately 2.5-3.0 metres high and be set back at least 15m from the highway. The height and width of the earth bund should be determined during detail design to minimise the visual impact of the pigging station.

(n) The pigging station at Siu Lam and the pigging and offtake station at Ta Pang Po will be similarly treated, typically with an earth bund surrounding the site. Screen planting will be undertaken with coastal species hardy to wind and salt exposure.

11.4 Restoration of Other Affected Areas

Where other areas are affected by the construction works, they will be treated, on completion of the relevant works, in accordance with the restoration planting proposals to be compiled by the Landscape Restoration Consultant following the techniques given in this document. Exceptional cases of repairs or renovation of access tracks, storage areas and footpaths shall be subject to agreements with the relevant Government Department.

Further work on detailing restoration will need to be carried out during the detail design of the project. A clear record with photographs should be kept of all affected areas. Lists of dominant species in all these areas should be prepared during detail design.

11.5 Plant Species for Restoration

In addition to grassing the disturbed areas on and adjacent to the pipeline at completion of the installation works to ensure soil stability, planting of trees and shrubs will be carried out to compensate for vegetation clearance and help blend the works area into the surrounding landscape. Based on the vegetation types surveyed and the practical issues of restoration works identified above, the following plant species are proposed for restoration planting. Trees are not permitted directly above the pipeline so the majority of plants will be shrubs. It is proposed that drawing upon past experience of hillside restoration works and the need to maximise plant survival that a small number of common species with wide ecological tolerance be used. They should be planted at a similar density to the surrounding vegetation.

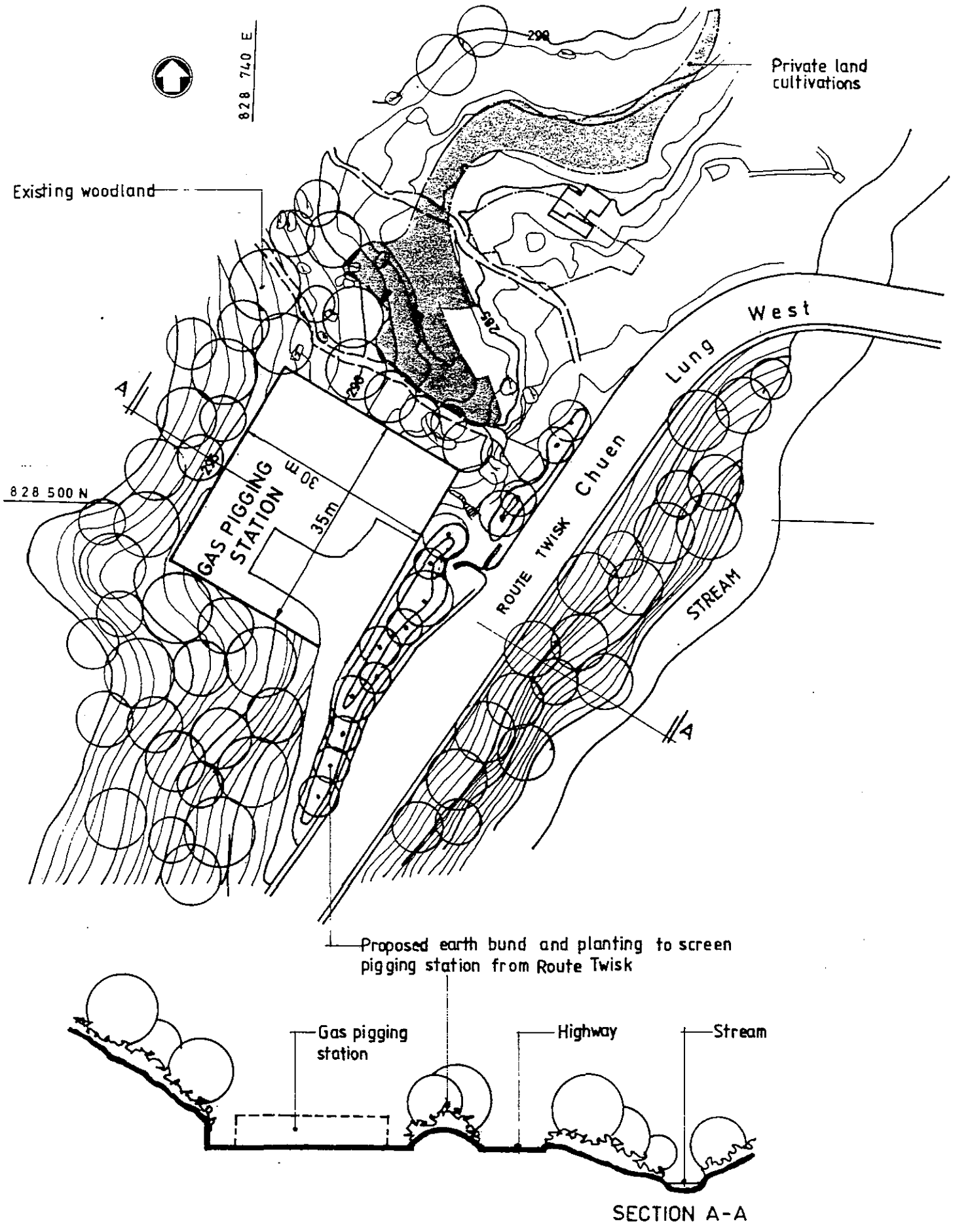


Figure 11.3 Proposed Screen Planting to Tuen Lung West Gas Pigging Station

Table 11.1 Plant Selection Matrix

	Native Secondary Woodland	Plantations	Tall Shrub	Low Shrub	Streamsides and Wetlands
Trees					
Machillus spp.	o				
Sapium discolor	o				
Schefflera octophylla	o				
Acacia confusa		o			
Celtis sinensis	o				
Cleistocalyx operculata					o
Ficus hispida					o
Litsea glutinosa	o				
Pinus elliotii		o			
Tristania conferta		o			
Shrubs					
Baeckia frutescens				o	
Litsea rotundifolia			o		
Rhodomyrtus tomentosa				o	
Aporusa chinensis			o		
Eurya chinensis				o	
Evodia lepta			o		
Gordonia axillaris			o		
Ilex asprella				o	
Melastoma candidum				o	
Melastoma sanguineum				o	
Rhus hypoleuca			o		

Note: Plant species in bold type should represent the larger proportion of the relevant plant group.

11.6 Technical Specification for Planting Works

S.1 Grassing Methods - Definitions

S.1.1 Sprigging

Is the planting of small cuttings of the specified grass species.

S.1.2 Hydroseeding

Is the application by high pressure spraying of the specified mixture of Grass Seed, Fertiliser and Mulch and other additives in aqueous suspension.

S.1.3 Broadcast Seeding

Is the sowing by hand of the specified grass seed mix.

S.2 Grassing - Materials

S.2.1 Sprigging - Materials

S.2.1.1 Sprigs

Shall be stoloniforous grass with blades at least 150mm long and a vigorous root system at least 100mm long.

S.2.1.2 Sprig Species

Unless otherwise specified, shall be one or a mixture of the following species:

Botanical Name
(English Name)

Axonopus cupressus
(Carpet Grass)

Cynodon dactylon
(Bermuda Grass)

Eremochloa ciliaris
(Centipede Grass)

S.2.1.3 Pre-sprigging Fertiliser

Shall be quick release granular NPK chemical fertiliser with the formula 18:18:10.

S.2.1.4 Topsoil

Prior to grassing, the topsoil shall be prepared by removing all aggregate deposits used during construction works. Soil for planting and grassing will be generally derived from original deposits and excavations on site, where suitable, and should be free from stones greater than 50mm in any dimension except where removal of stones will affect the stability of the slope.

S.2.1.5 Organic Material

Shall consist of moist peat.

S.2.2 Sprigging - Workmanship

S.2.2.1 Cultivations for Sprigging

Areas to be sprigged shall be scarified and thoroughly moistened prior to sprigging. On eroded sites lacking topsoil, organic material as clause S.2.1.5 shall be incorporated into the top layer of soil during cultivation as required.

S.2.2.2 Programming Sprigs

Sprigs shall be planted in their final positions within 36 hours of lifting.

S.2.2.3 Pre-sprigging Fertiliser

Apply evenly 40gm per m2 of fertiliser as Clause S.2.1.3 and lightly rake into the soil, 4-7 days prior to sprigging.

S.2.2.4 Laying of Sprigs

Sprigs shall be laid at 50mm staggered centres, to achieve a uniform cover. After laying the area shall be top dressed with topsoil or topsoil mix as approved by the Engineer to cover the sprigs. Firm the ground and water in immediately.

S.2.2.5 Sprigging Take

Where grass areas do not show a 90% take 28 days after sprigging to the satisfaction of the Engineer the area shall be immediately recultivated and re-sprigged at the Contractor's own expense.

S.2.3 Hydroseeding - Materials

S.2.3.1 Germination

The germination capacity of each constituent of a Grass Seed Mix shall be at least 80%.

S.2.3.2 Purity

The purity of each constituent of the Hydroseeding Seed Mix shall be greater than 90%. Total pernicious weed seed content shall be less than 0.5% and total content of other crop seeds shall be less than 1.0%.

S.2.3.3 Pre-seeding Fertiliser

Shall be as quick release granular NPK chemical fertiliser with the formula 18:18:10.

S.2.3.4 Mulch

Shall be organic material such as fine ground tree bark, peat moss or equal and approved.

S.2.3.5 Hydroseeding Seed Mix

Between April and August inclusive the minimum seed mix shall total 25 g/m2 and shall consist of :

Botanical Name (English Name)	Quantity
Cynodon dactylon (Bermuda Grass)	13g/m2
Paspalum notatum (Bahia Grass)	8g/m2
Eremochloa ciliaris (Centipede Grass)	4g/m2
	25g/m2

Between September and March inclusive the minimum seed mix shall total 30g/m2 and shall consist of :

Botanical Name (English Name)	Quantity
Cynodon dactylon (Bermuda Grass)	15g/m2
Paspalum notatum (Bahia Grass)	10g/m2
Lolium perenne (Manhattan Rye Grass)	5g/m2
	30g/m2

S.2.3.6 Hydroseeding Solution

Shall consist of :

Ingredient	Rate
Seed mix (as Clause S.2.3.5)	25-30g/m2*
Mulch (as Clause S.2.3.4)	100g/m2
Fertiliser (as Clause S.2.3.3)	60g/m2
Soil Binding Agent	25g/m2
Non-Toxic Dye (Green Colour)	0.5g/m2
	210.5-215.5g/m2

* Refer seasonal mixes.

S.2.3.7 Protective Layer

Protective material shall be laid and fastened immediately following spraying. It shall be "Bem-net" cellulose netting or equal and approved.

S.2.4 Hydroseeding - Workmanship

S.2.4.1 Surface Preparation

Prior to hydroseeding, the surface shall be scarified to a regular but rough textured surface to aid the retention and absorption of sprayed materials. The site shall be moist prior to hydroseeding.

S.2.4.2 Other requirements

The contractor shall undertake any additional preparatory works required by the Engineer.

S.2.4.3 Programming Hydroseeding

Hydroseeding shall be carried out during damp overcast conditions but not during rain or periods of strong winds.

S.2.4.4 Germination

Grass areas which do not show germination, 28 days after sowing the area, shall be immediately recultivated and re-sown, at the Contractors own expense. Grass areas shall show 90% germination after 28 days.

S.2.4.5 Erosion

The contractor shall prevent or treat erosion of the hydroseeded areas at all times during the Contract and Establishment Period.

S.2.5 Broadcast Seeding - Materials

S.2.5.1 Germination

Shall be as Clause S.2.3.1.

S.2.5.2 Purity

Shall be as Clause S.2.3.2

S.2.5.3 Grass Seed Mix

Shall consist of the following species and proportions :

Botanic Name (English Name)	%by weight
Axonopus compressus (Carpet Grass)	20
Cynodon dactylon (Bermuda Grass)	30
Eremochloa ciliaris (Centipede Grass)	50

S.2.5.4 Pre-seeding Fertilizer

Shall be a quick release granular NPK chemical fertiliser with the formula 18:18:10.

S.2.6 Broadcast Seeding - Workmanship

S.2.6.1 Cultivations for Broadcasting

Areas to be sown shall be scarified prior to sowing. On highly eroded sites lacking topsoil, organic material as Clause S.2.1.5 shall be incorporated into the top layer of soil during cultivation as required.

S.2.6.2 Pre-seeding Fertilizer

Apply evenly 40gm per m2 of fertiliser as Clause S.2.5.4 and lightly rake into soil, 4 to 7 days prior to broadcast sowing.

S.2.6.3 Broadcasting

Seed shall be evenly broadcast at half the specified rate in two equal sowings at right angles to each other by hand.

S.2.6.4 Post-seeding Fertilizer

After broadcast sowing, apply evenly 20gm per m2 of fertiliser as Clause S.2.5.4.

S.2.6.5 Germination of Broadcast and Hydroseeding Areas

Where grass areas do not show 90% germination, 28 days after sowing the area shall be immediately recultivated and re-sown, at the contractors own expense.

S.3 Trees and Shrubs

S.3.1 Planting - Materials

S.3.1.1 Seedling Trees

Shall have all the following characteristics :

(a) aged between 1-2 years old

(b) a single vigorous stem

(c) a well developed vigorous root system

(d) a height above soil level of 300-600mm

(e) grown in a container not less than 75mm in diameter and 100mm deep or a tube not less than 60mm in diameter and 150mm long.

S.3.1.2 Shrubs

Shall be a seedling or rooted cutting with all the following characteristics :

(a) a minimum of three, one year old vigorous shoots with a well-balanced shape.

(b) a well-developed vigorous root system

(c) 300-400mm in height

(d) grown in a container not less than 125mm in diameter and 150mm deep.

S.3.1.3 Ground Cover Plants

Shall have all the following characteristics :

(a) a minimum of three well developed vigorous shoots

(b) a well developed vigorous root system

(c) 150-300mm high with 200-300mm spread

(d) grown in a container not less than 125mm in diameter and 150mm deep.

S.3.1.4 Fertiliser

Shall be a slow release granular NPK chemical fertiliser with the formula 22:11:11.

S.3.1.5 Mulch

Shall be organic material such as decomposed leaf litter, ground tree bark, wood chips or equal and approved.

S.3.2 Planting - Workmanship

S.3.2.1 Grass Cutting

Prior to planting seedling trees and shrubs, grass areas shall be cut as necessary by an approved mechanical or manual means to avoid root pulling to reduce the grass sward to not more than 50mm high. All cuttings shall be raked up and removed from site.

S.3.2.2 Planting Tubed Seedling (refer to Figure 11.4)

The planting sequence shall be :

(a) Excavate planting pit 300 x 300 x 300mm

(b) Approximately 0.5kg of moist peat and 100gm of fertiliser, as Clause S.2.1.3, should be added to and thoroughly mixed with the backfill soil.

(c) Refill the bottom of the pit with soil to bring the junction between stem and root to or just below soil level.

(d) Remove the polythene tube, disturbing the soil as little as possible.

(e) Hold the plant in position and completely fill the pit by stages, avoiding air pockets.

(f) Tread down the soil firmly to ensure good contact between the soil and root, finally making sure that it is level with the remainder of the site.

(g) Place layer of mulch, as Clause S.3.1.5, 75mm thick to the surface of all planted areas, excluding grass, as directed by the Engineer.

S.3.2.3 Planting Shrubs and Ground Covers

Excavate a hole to the depth of the rootball and to a diameter 100mm greater than that of the rootball.

S.3.2.4 Fertilising Shrubs and Ground Covers

Approximately 0.5kg of peat moss, as Clause S.2.1.5, and 100gm of fertiliser as Clause S.2.1.3 and should be added to and thoroughly mixed with the soil.

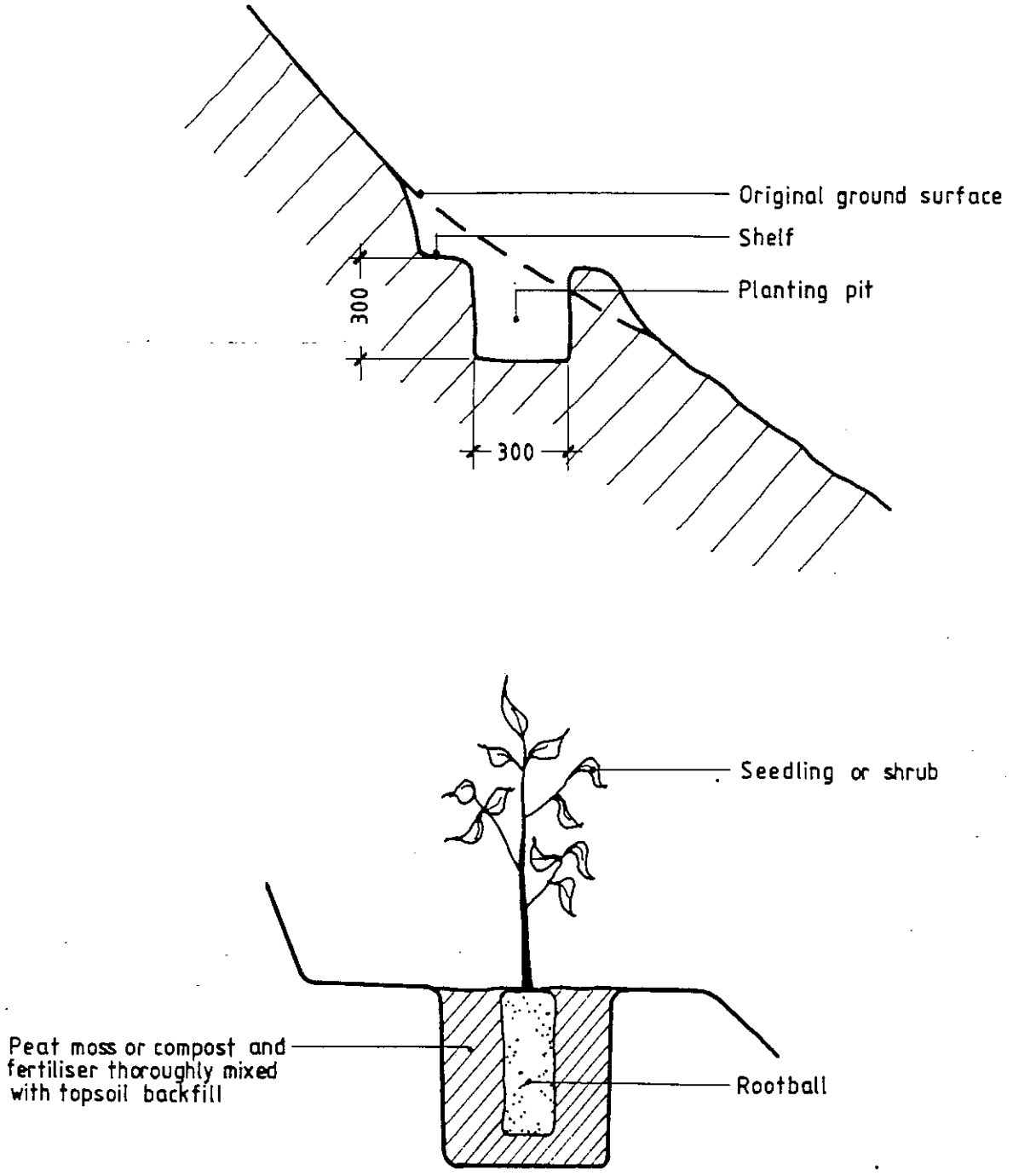


Figure 11.4 Pit Planting Detail

S.3.2.5 Mulching to Shrubs and Ground Covers

Place layer of mulch, as Clause S.3.1.5, 75mm thick to the surface of all planted areas, excluding grass, as directed by the Engineer.

S.3.2.6 Planting Season

Planting shall take place in suitable weather conditions. Planting shall take place within the generally recognised planting season (1st March to 31st October) unless otherwise agreed in writing with the Engineer.

S.4 Plant Establishment & Maintenance

S.4.1 Period

The Maintenance Period shall extend for 24 months from the date of Substantial Completion of the works and run concurrent with the Defects Liability Period.

S.4.2 Fire Damage

Where a restored site is subject to fire damage further restoration work will be carried out as required in accordance with the relevant clauses of this specification.

S.4.3 Weeding

Planting shall be maintained by cutting down all competing and overhanging weed growth to less than 25mm above ground level. A weeding radius of 300mm around plants shall be maintained in a weed free condition. All fast growing climbing weeds shall be removed entirely from the general planting area.

S.4.4 Replacement Planting

Dead or ailing plants shall be replaced within two weeks of being identified unless otherwise instructed by the Engineer.

S.4.5 Pests & Fungal Growth

The Contractor shall regularly check for any insect attack or fungus infestation particularly during known periods of activity. If a particular species proves to be prone to attack by pests or disease it should be replaced with other species.

S.4.6 Fertilising

Two applications of fertiliser in accordance with Clause S.3.1.4 shall be made during the two-year establishment period, i.e. one application each Spring, at the following rates.

Tree species	50 gm/plant
Shrub & Ground Cover species	15 gm/plant

Additional fertilising may be carried out in some areas as directed by the Engineer.

S.4.7 Firming Up

Firming-up of plants shall be undertaken from time to time during the period particularly after heavy rain and/or strong winds.

S.4.8 Thinning

Before the end of the period it may be necessary to reduce the number of plants due to overcrowding as instructed by the Engineer.

11.7 Summary and Recommendations

(a) Landscape restoration must achieve soil stability over the entire works area for the pipeline as well as minimise the visual and habitat impact by replanting similar plant species at compatible densities to the surrounding vegetation. To this end, soil retention and detailed planting techniques and specifications are included in the restoration guidelines.

(b) Prevention of soil erosion and damage to adjacent vegetation to be retained during construction will require close supervision. Similarly, after the pipeline is completed, the replanting works will be closely monitored to ensure proper restoration is achieved.

(c) To minimise visual impact, the pipeline route coincides wherever practicable with existing hillside paths which are often earth tracks subject to erosion in places. Accordingly, it is proposed that as part of the restoration works, surplus rock material excavated during construction could be used to rebuild and formalise these tracks as a valuable addition to the existing Country Park trail network.

(d) Landscape restoration to temporary access roads required during construction will be subject to the same stringent restoration requirements proposed for the pipeline route.

12. Transport Related Issues

12. TRANSPORT RELATED ISSUES

12.1 Construction Traffic

Road Traffic

The main access to the Siu Lam site will be from the sea and only a very small volume of road traffic will be generated. This will have an insignificant impact on the local road network.

Vehicles movements within the Country Park section will include lorries bringing the pipework to the site, earthmoving plant, dozers, excavators and dump trucks and transport for workers. Existing roads through the Country Park will be used wherever possible and the pipeline route has been designed to minimise the need for and length of haul roads. The impact on the Country park roads will be small.

Marine Traffic

Materials, equipment and workers for marine sections of the pipeline will be transported by barge and launch. Even when dredging works are being undertaken it is anticipated that fewer than ten marine vessels will be engaged on-site at any one time. Assuming the Contractor complies with Marine Department regulations there should be little impact on other marine traffic in the area.

13. Recommendations

13. RECOMMENDATIONS

On the basis of the assessments carried out for this EIA, the following recommendations are made:

(a) baseline and impact water quality, air quality and noise monitoring will all be required to ensure the environmental standards set for construction works are achieved;

(b) noise generating activities should be scheduled to ensure compliance with the NCO without involving additional mitigatory measures;

(c) dust suppression measures should be employed by the contractor throughout the project;

(d) sediments in the upper section of the nullah are contaminated and will need special disposal arrangements;

(e) freshwater flow from the upper reaches of the nullah should be diverted during construction. Once construction has been completed, the river should be rapidly retrained, allowing mudflats to form and former habitats to restore naturally;

(f) within the nullah, the route should keep close to and parallel to the river bank, as far as is practical, to minimise adverse impacts on water quality and the existing flow regime;

(g) wherever possible, diversion of streams should be undertaken in autumn and winter after the amphibian and avifauna breeding seasons have finished;

(h) measures will be required to prevent ingress of silt and sediment to water courses especially in the wet season;

(i) close supervision will be requiring during and following construction to prevent soil erosion. This supervision should involve both experienced pipeline engineering and environmental professionals;

(j) a suitable plant and vegetation reestablishment period is recommended;

(k) surplus rock and excavated material should be used to rebuild and formalise existing tracks along the overland route. Paths could be worked in natural materials and would contribute significantly to the Country Park trail network; and

(l) landscape restoration to temporary roads and storage areas should follow the same stringent requirements as for the pipeline route.

Further work will be required during the detail design of the project to implement the recommendations of this environmental impact assessment. In particular the environmental impact assessment has identified restoration of the works areas in the Country Park, and impacts on streams and wetlands as being key issues. The impacts of the project on the wetlands has been avoided by realigning the pipeline route away from these areas and by avoiding their use for storage as was earlier proposed.

Detailed plans should be prepared showing each stream crossing and including photographs and an ecological and topographic survey. The ecological survey should include a list of species found together with data such as breeding seasons. Diversions for each stream should then be detailed and these will need to agreed with AFD before being incorporated in the construction contract. Details of the stream diversion should also be discussed with specialists from WWFHK to ensure their compatibility with wildlife preservation.

Landscape restoration proposals have to be finalised during detail design and these should follow the guidelines outlined in this report. Lists of dominant species in each restoration area should be prepared during detail design for use in finalising restoration plans.

14. Conclusions

14. CONCLUSIONS

On the basis of the environmental assessment it is concluded that:

(a) there will be no impact on air, noise and water quality following construction of the pipeline;

(b) the only visible features after completion of construction will be the two pigging stations, one pigging and offtake station and the landfall of the submarine pipeline. These will all be landscaped and long term visual impacts will not be significant;

(c) any impacts arising during the construction phase will be local to the works and, statutory environmental standards and criteria should be achieved;

(d) it should be possible to schedule the works to ensure noise levels comply with the NCO at all times;

(e) construction work will have little impact on water movements except in the nullah where diversion of freshwater flow will be required in the upper reaches;

(f) impacts on wetland areas should be minimal but the use of these areas for storage and other construction activities should be avoided to minimise impacts on amphibian fauna;

(g) about 1.4 million cu m of marine mud will require disposal at a gazetted spoil dumping grounds. About 25,000 cu m of this is contaminated and will require special disposal;

(h) the overland section of the route has minimised visual and ecological impacts by following hillside tracks and avoiding cutting wherever possible;

(i) careful control and monitoring of construction works will be required to prevent soil erosion and to promote successful revegetation;

(j) the ecosystem in the nullah will be affected during construction but will recover shortly after;

(k) there will be minimal impacts from marine or vehicular traffic.

Appendix A
Construction Programme

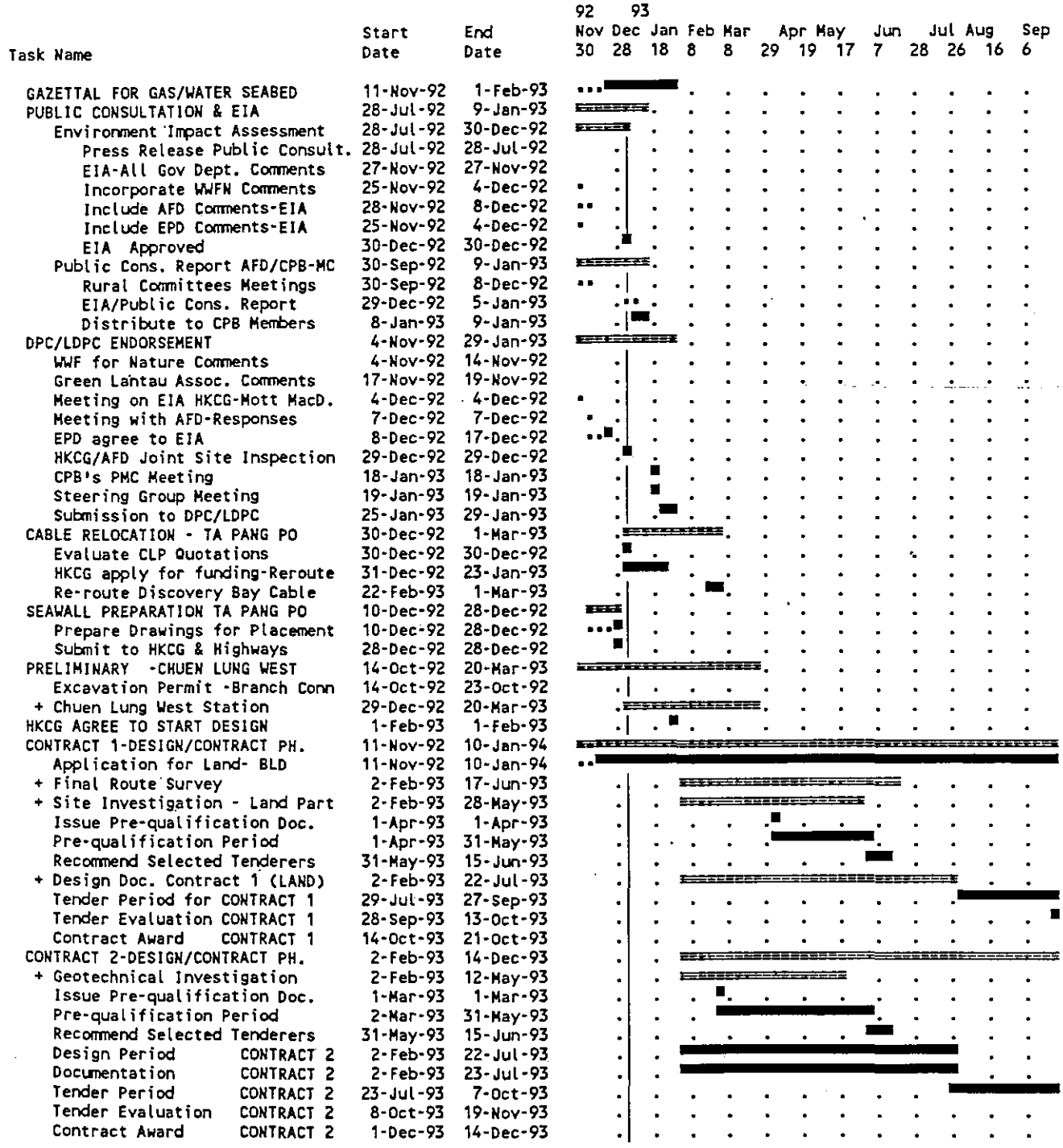
APPENDIX A

CONSTRUCTION PROGRAMME

Figure 1

Towngas Lantau Link

Design/Contract Phase



Task Name	Start Date	End Date
GAZETTAL FOR GAS/WATER SEABED	11-Nov-92	1-Feb-93
PUBLIC CONSULTATION & EIA	28-Jul-92	9-Jan-93
Environment Impact Assessment	28-Jul-92	30-Dec-92
Press Release Public Consult.	28-Jul-92	28-Jul-92
EIA-All Gov Dept. Comments	27-Nov-92	27-Nov-92
Incorporate WWFN Comments	25-Nov-92	4-Dec-92
Include AFD Comments-EIA	28-Nov-92	8-Dec-92
Include EPD Comments-EIA	25-Nov-92	4-Dec-92
EIA Approved	30-Dec-92	30-Dec-92
Public Cons. Report AFD/CPB-MC	30-Sep-92	9-Jan-93
Rural Committees Meetings	30-Sep-92	8-Dec-92
EIA/Public Cons. Report	29-Dec-92	5-Jan-93
Distribute to CPB Members	8-Jan-93	9-Jan-93
DPC/LDPC ENDORSEMENT	4-Nov-92	29-Jan-93
WWF for Nature Comments	4-Nov-92	14-Nov-92
Green Lantau Assoc. Comments	17-Nov-92	19-Nov-92
Meeting on EIA HKCG-Mott MacD.	4-Dec-92	4-Dec-92
Meeting with AFD-Responses	7-Dec-92	7-Dec-92
EPD agree to EIA	8-Dec-92	17-Dec-92
HKCG/AFD Joint Site Inspection	29-Dec-92	29-Dec-92
CPB's PMC Meeting	18-Jan-93	18-Jan-93
Steering Group Meeting	19-Jan-93	19-Jan-93
Submission to DPC/LDPC	25-Jan-93	29-Jan-93
CABLE RELOCATION - TA PANG PO	30-Dec-92	1-Mar-93
Evaluate CLP Quotations	30-Dec-92	30-Dec-92
HKCG apply for funding-Reroute	31-Dec-92	23-Jan-93
Re-route Discovery Bay Cable	22-Feb-93	1-Mar-93
SEAWALL PREPARATION TA PANG PO	10-Dec-92	28-Dec-92
Prepare Drawings for Placement	10-Dec-92	28-Dec-92
Submit to HKCG & Highways	28-Dec-92	28-Dec-92
PRELIMINARY -CHUEN LUNG WEST	14-Oct-92	20-Mar-93
Excavation Permit -Branch Conn	14-Oct-92	23-Oct-92
+ Chuen Lung West Station	29-Dec-92	20-Mar-93
HKCG AGREE TO START DESIGN	1-Feb-93	1-Feb-93
CONTRACT 1-DESIGN/CONTRACT PH.	11-Nov-92	10-Jan-94
Application for Land- BLD	11-Nov-92	10-Jan-94
+ Final Route Survey	2-Feb-93	17-Jun-93
+ Site Investigation - Land Part	2-Feb-93	28-May-93
Issue Pre-qualification Doc.	1-Apr-93	1-Apr-93
Pre-qualification Period	1-Apr-93	31-May-93
Recommend Selected Tenderers	31-May-93	15-Jun-93
+ Design Doc. Contract 1 (LAND)	2-Feb-93	22-Jul-93
Tender Period for CONTRACT 1	29-Jul-93	27-Sep-93
Tender Evaluation CONTRACT 1	28-Sep-93	13-Oct-93
Contract Award CONTRACT 1	14-Oct-93	21-Oct-93
CONTRACT 2-DESIGN/CONTRACT PH.	2-Feb-93	14-Dec-93
+ Geotechnical Investigation	2-Feb-93	12-May-93
Issue Pre-qualification Doc.	1-Mar-93	1-Mar-93
Pre-qualification Period	2-Mar-93	31-May-93
Recommend Selected Tenderers	31-May-93	15-Jun-93
Design Period CONTRACT 2	2-Feb-93	22-Jul-93
Documentation CONTRACT 2	2-Feb-93	23-Jul-93
Tender Period CONTRACT 2	23-Jul-93	7-Oct-93
Tender Evaluation CONTRACT 2	8-Oct-93	19-Nov-93
Contract Award CONTRACT 2	1-Dec-93	14-Dec-93

92 93
Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep
30 28 18 8 8 29 19 17 7 28 26 16 6

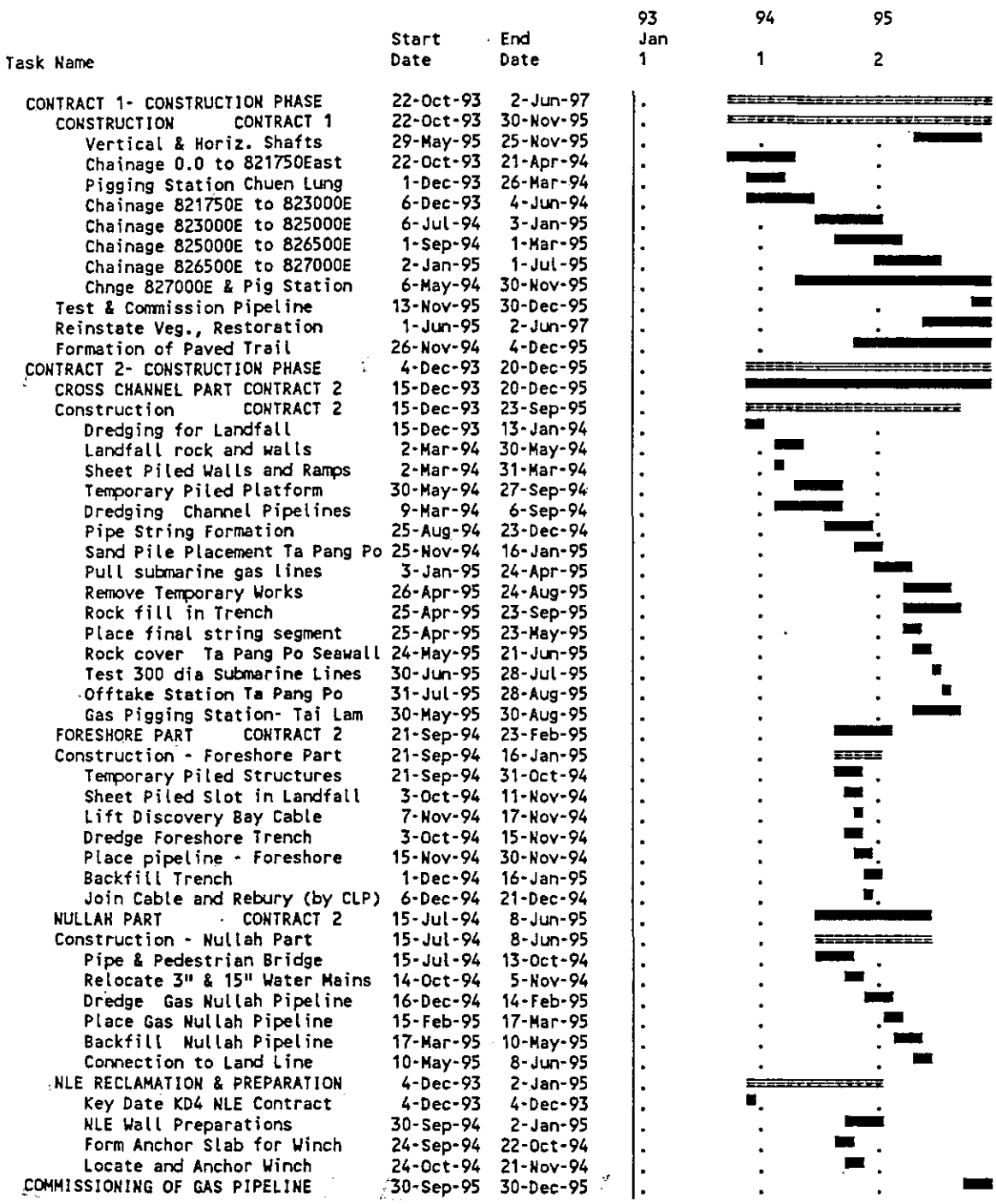
Detail Task — Summary Task — Baseline
(Progress) — (Progress) — Conflict
(Slack) — (Slack) — Resource delay
Progress shows Percent Achieved on Actual — Milestone
Scale: 5 days per character

TIME LINE Gantt Chart Report, Strip 1, Page 1

Figure 2

Towngas Lantau Link

Construction Phase



Task Name	Start Date	End Date
CONTRACT 1- CONSTRUCTION PHASE	22-Oct-93	2-Jun-97
CONSTRUCTION CONTRACT 1	22-Oct-93	30-Nov-95
Vertical & Horiz. Shafts	29-May-95	25-Nov-95
Chainage 0.0 to 821750East	22-Oct-93	21-Apr-94
Pigging Station Chuen Lung	1-Dec-93	26-Mar-94
Chainage 821750E to 823000E	6-Dec-93	4-Jun-94
Chainage 823000E to 825000E	6-Jul-94	3-Jan-95
Chainage 825000E to 826500E	1-Sep-94	1-Mar-95
Chainage 826500E to 827000E	2-Jan-95	1-Jul-95
Chnge 827000E & Pig Station	6-May-94	30-Nov-95
Test & Commission Pipeline	13-Nov-95	30-Dec-95
Reinstate Veg., Restoration	1-Jun-95	2-Jun-97
Formation of Paved Trail	26-Nov-94	4-Dec-95
CONTRACT 2- CONSTRUCTION PHASE	4-Dec-93	20-Dec-95
CROSS CHANNEL PART CONTRACT 2	15-Dec-93	20-Dec-95
Construction CONTRACT 2	15-Dec-93	23-Sep-95
Dredging for Landfall	15-Dec-93	13-Jan-94
Landfall rock and walls	2-Mar-94	30-May-94
Sheet Piled Walls and Ramps	2-Mar-94	31-Mar-94
Temporary Piled Platform	30-May-94	27-Sep-94
Dredging Channel Pipelines	9-Mar-94	6-Sep-94
Pipe String Formation	25-Aug-94	23-Dec-94
Sand Pile Placement Ta Pang Po	25-Nov-94	16-Jan-95
Pull submarine gas lines	3-Jan-95	24-Apr-95
Remove Temporary Works	26-Apr-95	24-Aug-95
Rock fill in Trench	25-Apr-95	23-Sep-95
Place final string segment	25-Apr-95	23-May-95
Rock cover Ta Pang Po Seawall	24-May-95	21-Jun-95
Test 300 dia Submarine Lines	30-Jun-95	28-Jul-95
Offtake Station Ta Pang Po	31-Jul-95	28-Aug-95
Gas Pigging Station- Tai Lam	30-May-95	30-Aug-95
FORESHORE PART CONTRACT 2	21-Sep-94	23-Feb-95
Construction - Foreshore Part	21-Sep-94	16-Jan-95
Temporary Piled Structures	21-Sep-94	31-Oct-94
Sheet Piled Slot in Landfall	3-Oct-94	11-Nov-94
Lift Discovery Bay Cable	7-Nov-94	17-Nov-94
Dredge Foreshore Trench	3-Oct-94	15-Nov-94
Place pipeline - Foreshore	15-Nov-94	30-Nov-94
Backfill Trench	1-Dec-94	16-Jan-95
Join Cable and Rebury (by CLP)	6-Dec-94	21-Dec-94
NULLAH PART CONTRACT 2	15-Jul-94	8-Jun-95
Construction - Nullah Part	15-Jul-94	8-Jun-95
Pipe & Pedestrian Bridge	15-Jul-94	13-Oct-94
Relocate 3" & 15" Water Mains	14-Oct-94	5-Nov-94
Dredge Gas Nullah Pipeline	16-Dec-94	14-Feb-95
Place Gas Nullah Pipeline	15-Feb-95	17-Mar-95
Backfill Nullah Pipeline	17-Mar-95	10-May-95
Connection to Land Line	10-May-95	8-Jun-95
NLE RECLAMATION & PREPARATION	4-Dec-93	2-Jan-95
Key Date KD4 NLE Contract	4-Dec-93	4-Dec-93
NLE Wall Preparations	30-Sep-94	2-Jan-95
Form Anchor Slab for Winch	24-Sep-94	22-Oct-94
Locate and Anchor Winch	24-Oct-94	21-Nov-94
COMMISSIONING OF GAS PIPELINE	30-Sep-95	30-Dec-95

Detail Task Summary Task Baseline
(Progress) (Progress) Conflict
(Slack) (Slack) Resource delay
Progress shows Percent Achieved on Actual Milestone
Scale: 4 weeks per character

TIME LINE Gantt Chart Report, Strip 1, Page 1

Appendix B
Emission Rates and Model Results

Appendix B

Emission Rates and Model Results

Emission Rates for Each Construction Activity Modelled

I. (A) Excavation of Material was based on AP42 : "Compilation of Air Pollutant Emission Factors"

$$\text{Emission Rate (kg/Mg)} = \frac{k\,(0.0009)\left(\frac{s}{5}\right)\left(\frac{u}{2.2}\right)\left(\frac{H}{1.5}\right)}{\left(\frac{M}{2}\right)^{2}\left(\frac{Y}{4.6}\right)^{0.33}}$$

where k = particle size multiplier
s = material silt content in %
u = mean wind speed m/s
H = drop height m
M = material moisture content in %
Y = dumping device capacity m^3

(B) Hauling was based on AP42: "Compilation of Air Pollutant Emission Factors"

$$\text{Emission Rate (kg/v-km)} = k(1.7)\left(\frac{s}{12}\right)\left(\frac{S}{48}\right)\left(\frac{W}{2.7}\right)^{0.7}\left(\frac{w}{4}\right)^{0.5}$$

where k = particle size multiplier
s = silt content of road surface material
S = mean vehicle speed km/h
W = mean vehicle weight Mg
w = mean number of wheels

II. (A) Tai Lam Country Park

(i) Excavation

Typical values for these parameters were taken as:

k = 0.73
s = 10 %
u = 2 m/s
H = 1 m
M = 10 %
Y = 2 m**3

Emission Rate (Kg/Mg)	=	0.000042
Loading Rate (Mg/hr)	=	9.99
Emission Rate (g/s)	=	0.00116

(ii) Hauling

Typical values for these parameters were taken as:

k = 0.8
s = 10 %
S = 10 km/hr
W = 10 Mg (unloaded), 17.25 Mg (loaded)
w = 10

Total Emission Rate (kg/v-km)	=	2.30090
Amount of brought in material	=	4950 cu m
Amount of diposed materials	=	31810 cu m
No. of Vehicles/hr	=	1.11
Emission Rate (g/s)	=	0.00569

(B) Disused Quarry & Shaft

(i) Hauling

Typical values for these parameters were taken as:

k = 0.8
s = 10 %
S = 10 km/hr
W = 10 Mg (unloaded), 17.25 Mg (loaded)
w = 10

Total Emission Rate (kg/v-km)	=	2.3009016
Amount of disposed material	=	40 cu m
No. of Vehicles/hr	=	0.78
Emission Rate (g/s)	=	0.2506

(ii) Excavation

Typical values for these parameters were taken as:

k = 0.73
s = 10 %
u = 2 m/s
H = 1 m
M = 10 %
Y = 2 m**3

Emission Rate (Kg/Mg)	=	0.00210
Loading Rate (Mg/hr)	=	5.88
Emission Rate (g/s)	=	0.00343

(C) Chuen Lung Pigging Station

(i) Excavation

Typical values for these parameters were taken as:

k = 0.73
s = 10 %
u = 2 m/s
H = 1 m
M = 10 %
Y = 2 m**3

Emission Rate (Kg/Mg)	=	0.00042
Loading Rate (Mg/hr)	=	52.52
Emission Rate (g/s)	=	0.00612

(ii) Hauling

Typical values for these parameters were taken as:

k = 0.8
s = 10 %
S = 10 km/hr
W = 10 Mg (unloaded), 17.25 Mg (loaded)
w = 10

Total Emission Rate (Kg/v-km)		2.30090
Amount of diposed materials	=	30000 cu m
No. of Vehicles/hr	=	7.00
Emission Rate (g/s)	=	0.13047

One Hour TSP Concentration ($\mu g/m^3$)
From Construction At The Chuen Lung Pigging Station

Distance (m)	TSP Levels ($\mu g/m^3$)		
	Excavation	Hauling	Excavation + Hauling
40	15.97	366	381.96
50	15.22	340.89	356.12
60	14.57	320.05	334.62
70	13.74	297.60	311.34
80	12.75	273.42	286.17
90	11.75	250.20	261.94
100	10.82	229.30	240.12
110	9.99	210.99	220.98
120	9.26	195.03	204.29
140	8.03	168.68	176.71
160	7.04	147.60	154.64
180	6.21	130.10	136.32
200	5.51	115.27	120.77
250	4.14	86.72	90.86
300	3.20	66.91	70.10
350	2.54	53.31	55.85
400	2.07	43.40	45.47

One Hour TSP Concentrations ($\mu g/m^3$) from Construction Across The Country Park

Distance (m)	TSP Levels ($\mu g/m^3$)		
	Excavation	Hauling	Excavation + Hauling
10	19.44	15.95	35.40
20	12.29	56.46	68.74
30	11.39	59.40	70.79
40	10.44	53.62	64.07
50	9.16	46.10	55.26
60	7.85	38.95	46.81
70	6.68	32.82	39.50
80	5.69	27.77	33.46
90	4.87	23.67	28.54
100	4.20	20.35	24.55
110	3.65	17.65	21.29
120	3.19	15.43	18.62
140	2.50	12.06	14.56
160	2.01	9.68	11.69
180	1.65	7.95	9.59
200	1.38	6.64	8.02
250	0.93	4.51	5.45
300	0.68	3.28	3.95
350	0.52	2.52	3.04
400	0.41	2.00	2.41

One Hour TSP Concentrations ($\mu g/m^3$) from Construction At The Quarry And Shaft

Distance (m)	TSP Levels ($\mu g/m^3$)		
	Excavation	Hauling	Excavation + Hauling
10	*	22.63	*
20	102.69	80.97	183.66
30	81.48	83.95	165.43
40	61.80	76.50	138.30
50	46.23	68.10	114.33
60	35.49	60.70	96.19
70	27.79	54.53	82.32
80	22.27	49.41	71.68
90	18.22	45.13	63.35
100	15.18	41.50	56.68
110	12.83	38.36	51.19
120	11.00	35.60	46.60
140	8.35	30.91	39.26
160	6.56	27.03	33.59
180	5.30	23.77	29.07
200	4.38	21.01	25.48
250	2.92	15.75	18.67
300	2.09	12.15	14.24
350	1.59	9.70	11.29
400	1.26	7.92	9.18
450	1.02	*	*

Notes * not calculated

Appendix C
Construction Methods, Equipment and Sound Power Levels

APPENDIX C

CONSTRUCTION METHODS, EQUIPMENT AND SOUND POWER LEVELS

APPENDIX C

Construction Programme, Construction Methods, Equipment and Sound Power Levels

Activity	Sub-Activity and Time Period	Items and Numbers of Powered Mechanical Equipment		Sound Power Levels dB(A)
Overland Section				
Tai Lam Country Park Section - Route Twisk to Tai Lam	Pigging Station Chuen Lung West (16.12.93 - 31.3.94)	Excavator	1	112
		Bulldozer	1	115
		Dump Truck	1	117
	Tai Lam Country Park Operations (30.11.93 - 30.2.96)	Excavator	3	112
		Mobile Crane	2	112
		Hoist	2	108
		Pipe Cladding Gear	1	108
		Concrete Mixer	1	96
		Compactor	1	105
		Concrete Pump	1	109
		Dump Trucks (Daily Haulage)	10	117
	Tai Lam Disused Quarry Site Operations (16.6.95 - 16.7.95)	Excavator	1	112
		Mobile Crane	1	112
		Hoist	1	108
		Pipe Cladding Gear	1	108
		Concrete Mixer	1	96
		Compactor	1	105
		Concrete Pump	1	109
		Dump Trucks (Daily Haulage)	1	117
	Vertical and Horizontal Shaft (16.6.95 - 16.8.95)	Rock drills	1	128
		Excavator	1	112
		Dump Truck	2	117
		Concrete Pump	2	109
		Concrete Mixer	2	96
		Crane	2	112
		Dump Trucks (Daily Haulage)	2	117

Construction Programme, Construction Methods, Equipment and Sound Power Levels (Cont'd)

Activity	Sub-Activity and Time Period	Items and Numbers of Powered Mechanical Equipment		Sound Power Levels dB(A)
Marine Section				
Nullah Section	Dredging for Gas Pipeline (15.2.95 - 17.4.95)	Cutter Suction Dredger	1	112
		Small Barge	2	104
		Small Grab Dredger	2	112
		Tugboat	2	110
		Launch	1	110
	Place Pipeline (15.4.95 - 16.5.95)	Barge	2	104
		Lifting Gear	2	108
		Mobile Crane	1	112
	Backfill Trench (17.5.95 - 16.6.95)	Barge	2	104
		Grab Crane	2	112
Submarine Foreshore Section	Lifting of Discovery Bay Pipeline (3.12.94 - 2.1.95)	Piling Barge	2	104
		Percussive Piling Plant	2	115
		Non Percussive Piling Plant	2	115
		Hoist	2	108
		Crane	2	112
		Tugboat	1	110
	Dredging for Gas Pipeline (3.1.95 - 28.4.95)	Barge	1	104
		Suction Cutter Dredger	1	112
		Tugboat	1	110
		Launch	1	110
	Place Pipeline (3.1.95 - 28.4.95)	Barge	2	104
		Erection Crane	2	112
	Backfill Trench (29.4.95 - 23.8.95)	Hopper Barge and Delivery Equipment	1	104
		Grab Crane	2	112
	Transportation of Pipe and Personnel to Site	Barge	2	104
		Launch	2	110

Construction Programme, Construction Methods, Equipment and Sound Power Levels (Cont'd)

Activity	Sub-Activity and Time Period	Items and Numbers of Powered Mechanical Equipment		Sound Power Levels dB(A)
Submarine Cross Channel Section to Ta Pang Po	Landfall Dredging (20.3.95 - 18.4.95)	Hopper Suction Barge	1	112
		Grab Dredger	1	112
		Tugboat	1	110
		Launch	1	110
	Landfall Rock and Reclamation (20.3.95 - 18.7.95)	Hopper Barge	2	104
		Crane	2	112
	Sheet Piling of Walls (20.3.95 - 18.4.95)	Diesel Percussive Piling Plant	2	115
		Non Percussive Piling Plant	2	115
		Piling Barge	2	104
		Crane	2	112
	Piling of Temporary Platform (20.3.95 - 18.7.95)	Diesel Percussive Piling Plant	2	115
		Non Percussive Piling Plant	2	115
		Piling Barge	2	104
		Crane	2	112
	Dredging for Main Channel (20.3.95 - 16.9.95)	Large Hopper Trailer Suction Barge	1	104
		Grab Dredger	1	112
		Tugboat	1	110
		Launch	1	110
	Pipe String Formulation (20.3.95 - 18.7.95)	Concrete Pump	2	109
		Concrete Mixer	1	96
		Erection Crane	2	112
	Pull Submarine Gasline (20.3.95 - 8.7.95)	Barge	2	104
		Tugboat	1	110
		Crane	2	112
		Hoist	2	108
		Launch	1	110
		Anchor Winch	1	110
		Pulling Winch	1	110
	Rock Fill in Trench (25.4.95 - 23.10.95)	Hopper Barge and Delivery Equipment	2	104
		Tugboat	1	110
		Crane	2	112
	Delivery of Pipe and Personnel to Site	Barge	3	104
		Launch	3	110

Appendix D
Comments and Responses

APPENDIX D

COMMENTS AND RESPONSES

THE HONG KONG AND CHINA GAS CO LTD
LANTAU TOWNGAS LINK

ENVIRONMENTAL IMPACT ASSESSMENT
DRAFT FINAL REPORT

Comments	Responses
Item 1: World Wide Fund For Nature **Ref No. (3) CHK/LDD 21/92** **dated 2 November 1992**	
Thank you for your letter dated 12 October 1992 and the draft EIA report for this project enclosed therein.	
We apologize for being unable to forward our comment on this draft EIA report earlier. Nevertheless, we have the following specific comments and queries on the captioned project:	
6.1 Sediment Quality	
The sediments in the middle reaches of the Tai Lam Nullah (i.e. sampling station TL2) are considered to be contaminated, especially for Zinc- it is nearly double the "action level" of the sediment quality criteria. We consider that samples should also be collected at the foreshore and sea-bed between the Tai Lam pigging station and the mouth of the nullah (i.e. the Foreshore Section of the pipeline, Figure 2.9). Sampling station NS1 is quite far away from the mouth of the nullah so that the heavy metals transported downstream will not reach a very high concentration at station NS1.	Agreed. We will be taking additional samples during the detail design phase to determine the extent of the contamination. We will supply WWFHK with results of the sampling and analysis in due course.
We would like to see a more detailed description of the conditions for dredging, transportation and disposal of the contaminated and uncontaminated sediments in the final EIA report. These conditions, after being agreed by Government, should be included in the technical clauses of the final contract. We believe that this project will need to be published in the Government Gazette under the Foreshore and Sea-bed (Reclamations) Ordinance (Cap. 127) and WWF HK will be likely to have the same request if no detailed conditions regarding dredging, transportation and disposal of sediments are proposed in this final EIA report.	Agreed and we will add a list of dredging specification clauses to the Final Report. It should be noted, however, that the specification will be performance based rather than method based. It is much better to specify performance targets, for example standards for water quality, rather than actual dredging methods. It is important to allow the contractor flexibility in determining methods and the performance specification will allow control over the contractor's operations. The performance specification will be controlled by the Engineer via monitoring and audit.

Comments	Responses
6.3 Work Sites We are concerned that some provision for food preparation may be required on the work sites along the land section of the proposed pipeline. There is no doubt that this would increase the fire hazard. We would like to see very strong control on the use of fire on the work site and the requirements for the provision of fire fighting equipment on site.	Agreed. Construction waste will not be burnt on site and requirements for fire fighting equipment will be included in the contract. We can also include a clause in the construction contract prohibiting fires for any purpose. We will consult AFD on fire fighting equipment.
6.3 Water Courses "Small streams, water courses and wetland areas have been identified along the route through the Country Park." We would like to see a map showing all these wetland habitats and have those habitats that are likely to be directly and indirectly affected marked.	Noted. It is now proposed that wetland habitats should not be used for storage, and thus no wetland habitats will be affected. We will provide a map showing stream courses affected and populations of the Cascade Frog and Lesser Spring Frog during the detail design.
It is stated that Section 11 has taken into account the reinstatement of streams after the pipeline has been laid. However, Section 11 contains a very detailed description of hillside and upland terrain vegetation restoration and we cannot identify and consideration of stream reinstatement there.	The Final Report will include descriptions of proposed stream reinstatement. We propose to divert streams outside the breeding season for the Cascade Frog and Lesser Spring Frog even if this has to be done in advance of the main pipelaying works. The streams will be diverted into a concrete or steel pipe across the pipeline reserve and will then be diverted back to an open channel after the pipeline has been laid. The final reinstatement will be in keeping with the nature of the country park and we will try and encourage recolonisation of the stream bed, for example by using rough concrete or granite blocks for the stream bed.
6.3 Dredging and Reclamation We would like to see provision to prevent control on overflowing of hoppers during the dredging works.	Agreed. See response to Item 2 comment c(vi) below.
Table 6.4 Proposed Action Plan for Water Quality There appear to be no regulations regarding the suspension of works in the event of major problems. Please advise us whether there will be provision in the works contract to suspend works if necessary and, if so, under what conditions.	The main purpose of the proposed action plan for water is to identify deteriorating water quality and to prevent major problems arising. However, if the contractor fails to implement immediate steps to improve water quality the engineer will be empowered to suspend the works.

Comments	Responses
6.6 (e) We support the recommendation that baseline and impact monitoring surveys will be conducted for the duration of the marine works. In addition, we consider that an environmental auditor/officer should be employed by the developer to monitor the contractor's compliance with the contract conditions and the mitigation measures.	Noted. The Engineer will be empowered to monitor the contractor's compliance with contract conditions. We support the view that an environmental officer be employed throughout the works.
7.3 Summary and Recommendations Regarding construction waste, under no circumstances should such waste be burnt on site.	Agreed. See response to comment on section 6.3 above.
9.1 Abandoned Paddy Fields It is stated that "some of the potential storage areas preliminary identified in Figure 2.5, have now been eliminated for other reasons." Which of these storage areas have been eliminated? Do they include the five wetlands systems?	See response to comment on section 6.3 above.
It is stated that Hong Kong Cascade Frog and Lesser Spiny Frog were found in the streams nearby the proposed pipeline route. Is there any map showing these streams? How will these streams be directly or indirectly affected?	The proposed pipeline route will avoid wetland areas in order to protect amphibian species. Detailed plans of stream courses are not available at the present time but will be available during detailed design. We will also prepare drawings during the detailed design phase showing how streams will be affected .
Please note that the Hong Kong Cascade Frog *Amolops hongkong gensis* is a protected species under the Wild Animals Protection Ordinance (Cap. 170) and any activities which impact it will require a special licence issued by the Director of Agriculture and Fisheries.	Noted.
9.2 Paddy Fields and Wetlands We would like to know how Table 9.2 was obtained? - it is meaningless in its present form. Based on what criteria are the storage areas classified to have "negligible", "slight" or "significant" impact?	See response to comment on section 6.3 above. Table 9.2 will be deleted in the Final Report in view of the fact that wetland areas will now not be used. The intention of the use of the words "negligible", slight and "significant" were intended to give a measure of comparison.
Once again, how many streams with Hong Kong Cascade Frog will be affected and which of those will require diversion? We consider that the consultant should produce a detailed guideline to the contractor regarding stream diversion. The environmental auditor/officer we suggested earlier	Very few streams are crossed by the proposed pipeline route and almost all streams crossed have rocky bottoms. Most of the streams are upland and have little flow in the dry season. See also responses to comments on section 6.6(e) and 9.1 above.

Comments	Responses
should be responsible to observe the contractor's compliance with this guideline.	It is difficult for us to provide comprehensive details of all stream crossings at this stage of the project and this is really a matter for the detail design. We propose to develop a specification rather than a guideline for stream diversions and we agree that the environmental protection officer will be responsible for ensuring compliance.
9.4 (b) Please refer to our query on Table 9.2 above.	See response to comment on Table 9.2 above.
9.4 (f) We consider that the consultant should produce a detailed guideline regarding the use of wetlands as storage areas for the contractor. The environmental auditor/officer we suggested earlier should be responsible to observe the contractor's compliance with this guideline.	See response to comment on section 6.3 above. See also response to comment on sections 9.1 and 6.6(e) above. Wetlands will now not be used for storage.
10.2 Middle Reaches What are the 10 distinct fish species? Are they of any economical or ecological importance?	The ecological survey was habitat based not species based and thus individual fish species data are not available. We concluded that the habitats are not unique and that the pipeline construction would not have a significant or long term impact so long as the Works are restricted to a narrow strip through the nullah.
10.2 Lower Reaches The bivalve should be spelled *Geloina erosa* instead of *Gelloina erosa* and the rock oyster should be spelled *Saccostrea* instead of *Saccorstria*.	Noted. These will be corrected in the Final Report.
10.5 Summary and Recommendations Without knowing the ecological importance of the fish species, we are not sure whether the work should be limited to non-breeding seasons.	It will probably not be practical to limit the works in the nullah to non-breeding seasons although we agree that this would be preferable. Our ecological survey concluded that there are no unique habitats in the nullah. We have therefore concluded that the work in the nullah will not have a major impact and so long as the work is restricted to a narrow strip the ecology should regenerate shortly after completion of construction. These should thus be no long term impacts.

Comments	Responses
There is no assessment in this report regarding the Submarine Section of the proposed pipeline. Even if there are no impacts or the impacts are minimal, it has to be mentioned. However, we note that the Submarine Section of the proposed pipeline is in an area where we have a lot of records of the Chinese White Dolphin *Sousa chinensis*. Please find enclosed the updated summary of our records of Chinese White Dolphin for your reference.	Noted. No significant impacts are predicted for the submarine section of the proposed pipeline. This is discussed in Chapter 6 of the report. The records of Chinese White Dolphin are noted and it should also be noted that a study of this species is due to commence shortly. However we do not believe that this project will have a significant effect on the dolphins as the only marine impact will be localised increases in sediment loads. We will add some comments on the impacts on the dolphins to the Final Report.
11.4 Restoration of Other Affected Area Reference to our comment on 6.3 above, the technique given in this document concern only with the restoration of terrestrial habitats. There are no proposals regarding the restoration of wetlands.	Wetlands will now not be used for storage.
Table 11.1 Plant Selection Matrix Please note that due to a parasitic nematode, the Agriculture and Fisheries Department has stopped planting *Pinus elliotii* in Hong Kong.	We have been advised by AFD that they are still planting *Pinus elliotii*.
11.7(d) The use of wetlands as temporary storage areas have not been totally ruled out by the consultants although such uses will be avoided as far as possible. We consider that wetlands are more important than most of the other habitats that will be affected by this project. We request that the consultant should seriously consider our earlier suggestion in our comment on Section 9.4(f) above.	Agreed. We have now agreed that wetlands will not be used.
12.1 Road Traffic In case there are no existing access roads to the work sites, what will happen?	The only area where there are no existing access roads comprises fire maintained scrub of low ecological value and in these instances construction access will have to be established. The areas affected will be restored after completion of construction. Existing roads are available throughout the Country Park and the only areas where new access will have to be formed are outside the Country Park.

Comments	Responses
13 (h)	
We consider that close supervision will be required during and following construction not only to prevent soil erosion but to observe the contractor's compliance with the environmental impact mitigation measures proposed in the final EIA report and the contracts. This can be effectively carried out by the appointment of an on-site environmental auditor/officer with the relevant knowledge and experience.	Noted. The Engineer will closely supervise all works to prevent such problems. See response to comment on section 6.6(e).
We apologise once again for our delay in sending in our comments to this draft final EIA report. We would welcome an opportunity to discuss with you if necessary.	Noted.
Item 2: Environmental Protection Department, Headquarter **Ref (6) in EP2/N4/28 Pt II** **dated 3 November 1992**	
Thank you for submitting the Draft Final Report (DFR) of the captioned for our comment. Our comments on the DFR are as follows:-	
(a) Air Quality Impact	
(i) The report has made reference to the TSP hourly standard as AQO (e.g. fourth last line on page 4-3 and Figures 4.5 - 4.7). Please note that there is no hourly AQO for TSP and preferably it should be referred as criteria or standard.	Noted. This will be corrected in the Final Report.
(ii) A list of standard dust suppression measures has been suggested in case TSP levels are in excess (page 4-4). However, it is considered that these measures are basically good engineering practice. Hence, in order to minimise dust generation from the construction of this project, it is recommended that these measures should be implemented irrespective of whether the dust level is excessive or not. Furthermore, it is noted that the Tai Lam Dental Clinic is only 15m from the work site (Table 4.1). It is recommended hoardings should also be put up along the work	Agreed, dust suppression measures will be included in the list of recommendations in Section 13. The proposed pipeline route has been changed in the vicinity of the Tai Lam Chung Dental clinic and the route is now about 50m from this building. Nevertheless hoardings will be specified.

Comments	Responses
site near the clinic to further minimise the dust nuisance therefrom.	
(iii) The suggestion of establishing trigger, action and target levels is welcome. Please clarify who, the Engineer or the Contractor would carry out the dust monitoring.	It is better for the Engineer to carry out dust monitoring as the Contractor should not be expected to monitor his own work.
(iv) Under section 13 - Recommendation, it is suggested to include a recommendation that standard dust suppression measures should be specified in the construction contract. (See item (ii) above).	See response to comment Item 2 : a(ii) above.
(v) Appendix B(ii)	
(a) Table for Chuen Lung Pigging Station - 'Our' should read 'One'.	Noted. This will be corrected in the Final Report
(b) Table for Quarry and Shaft - For consistence with other tables, this table should also give the total of Excavation + Hauling.	These will be added to Final Report.
(b) Noise Impact	
(i) Para 2.3, the amount of rock to be excavated is quite substantial. Could the consultant propose/consider other excavation technique such as controlled explosion to speed up the installation programme. The impacts of removal of excavated material to nearby dumping site should also be addressed.	Excavation techniques could be reviewed following the findings of the geotechnical site investigation although noise and air quality impacts will have to be considered.
(ii) Para 3.2, references should be made to HKPSG as well.	Noted. Reference to HKPSG will be added in the Final Report.
(iii) Para 5.3, would the consultant quantify the no. of dwellings and NSRs, which may be affected by the proposed work. The existing background noise level should be stated here and, the change of environment.	The NSRs have been identified in Table 5.2 and located on Figures 5.1 to 5.4 as those who are expected to receive the greatest impact from the works. The existing background noise levels were not measured but the assessment of NSRs was based on the area sensitivity.

Comments	Responses
(iv) Para 5.4, could the consultant adding the predicted noise levels at NSR in Fig. 5.1 - 5.4 and high light, if appropriate, the noise levels exceeding the proposed limit.	This would not be appropriate as the impact from each activity has been assessed individually rather the collectively. However, we would be able to highlight noise levels increases of the NCO criteria in Tables 5.7 to 5.11.
(v) Table 5.8, the haulage activity seems excessive here with predicted noise level up to 92 dB(A). A more detailed investigation should be provided here with a review to protect the dental clinic. Can the clinic be shielded from the construction noise by site offices, portacabins etc.?	See response to comment Item 2 : (ii) above. We have proposed including a maximum noise level in the contract and it will be the contractor's responsibility to ensure that noise level is not exceeded.
(vi) Table 5.9, at location N18 & N19, the construction noise will be quite disturbing and non-percussive piling is definitely preferred.	Noted.
(vii) When HK & China Gas grants the works, the construction contract should be passed to you for comment incorporating mitigation clauses and specifications, and the consultant should be allowed to take the responsibility that specified noise mitigation measures are used and noise monitoring may be carried out. The detail phasing and planning of site activities should be made available to the noise consultant for comment prior to the finalisation of works arrangement.	Agreed.
(c) Water Quality Impact	
(i) Section 3.1, p3.1, 2nd para., Table 3.2 shows the original Water Quality Objectives which were proposed following the Sewage Strategy Study in 1989, but not the actual Objectives which were gazetted for this Water Control Zone earlier this year.	Noted. Table 3.2 will reviewed based on the gazetted WQOs for NWWCZ (April 1992).
(ii) Section 6.1, p6.1, 5th para., suspended solid levels may be regarded as the key water quality control parameter during the construction phase. The consultant should therefore justify the claim that EPD's monitoring data may not adequately reflect the sediment loading	The data in Table 6.1 are seasonal averages. The daily data can often show large fluctuations from the seasonal average.

Comments	Responses
carried in the study area.	
(iii) Section 6.3, p6.4, 5th para. and p6.5, para 3, it is not made clear where the contaminants spoil referred to originates from. The nature and extent of contamination should be described. Mitigatory measures may be required to control adverse impacts arising as a consequence of the dredging of this material in addition to those potentially arising following disposal.	The nature and extent of contaminated spoil is described in section 6.1, 8th paragraph, in Table 6.2 and Figure 6.1. See response to comment Item 2 : (iv) below.
(iv) Remobilisation of heavy metals or other toxic contaminants should be considered in the impact/compliance monitoring programme and associated action plans as appropriate.	We agree that monitoring should be carried out wherever possible but there are a number of difficulties in this instance. Monitoring could be by sampling and testing the adjacent waters for trace metals or by bio-monitoring. However only very small quantities of trace metals are likely to be lost during the dredging and the changes will be barely discernable with analysis techniques that are available. Certainly the results could not be used as the basis of an action plan. We therefore propose to monitor sediment loads to confirm that the Contractor is meeting the dredging specification. Compliance with the specification for suspended sediments will also indicate compliance for loss of contaminants.
(v) Section 6.3, p6.6, 2nd and 3rd paras., it is not clear what mitigation measures would be adopted should 'practical reasons' preclude the adoption of low impact dredging techniques.	We propose to specify low impact dredging techniques and apply a strict water quality specification to ensure compliance.
(vi) You should elaborate on the extent of hopper overflow that would be considered 'excessive' and the means by which this could be controlled in practice.	This will be controlled by a performance specification (the contractor will have to meet set standards for suspended solids). Overflowing of hoppers should not be permitted when dredging mud.
(vii) Table 6.3, p6.7, the proposed Action Level is termed in such a way as to permit a continuous deterioration in water quality as the project proceeds. Impacts caused by construction activities during the preceding month should not be considered as a legitimate element of the baseline. Consideration should be given to either establishing Action Levels based on upstream	The action level can only vary between the trigger and target level and therefore cannot allow a continuous deterioration of water quality. However will establish action levels on the basis now proposed by EPD.

Comments	Responses
'control' conditions or alternatively basing these on a more thoroughly evaluated baseline taking into account expected climatic and other variations beyond the control of the engineering contractor.	
(viii) The distance of the control station from the works area should be specified. Your DFR implies that the control levels are to be regarded as the maximum recorded levels at this location. Using this logic, the target should be that no samples from the works area will be in excess of the Target Level. You could usefully comment as to how realistic such a target will be, given ambient conditions and anticipated equipment usage and working practice.	We consider the standards to be realistic.
(ix) Table 6.4, p6.8, it is important to bear in mind that the Target Level is intended to represent the border line beyond which a construction impact is considered unacceptable i.e. a limit. Action plans should therefore be established and implemented to prevent breach of these levels. The Trigger Level provides warning that the Target Level is being approached. The Action Level as its name suggests should be the cue for action. As the proposed Action Plan stands, no action need actually be taken until such time as the Target Level is exceeded.	The action plan states that the contractor has to implement remedial actions whenever the action level is exceeded for more than one sample.
(x) The Action Level response should be to take action if exceedence of the Target seems likely, rather than waiting for this to occur before taking any action. The emphasis at the Target Level should be on restoring water quality to the levels deemed acceptable, i.e. below the Target levels, and on preventing reoccurrence.	Agreed.

Comments	Responses
(d) Dredging and Waste Disposal	
(i) p. 2-3 & 7-1 on dredging and spoils disposal, please note that for any dredging activation to be carried out, a contamination assessment should be conducted for the spoils going to be dredged so as to allow to proper disposals of the dredged spoils such that the contaminated spoils would go to the designated pits as allocated by the FMC and the uncontaminated spoils would go to the general spoil dumping grounds. Special dredging and disposal methods are required for the contaminated spoils.	Noted. This was stated in section 6.3, 5th paragraph.
(e) Other aspects	
In regard to the conservation, landscape and other aspects, I am still awaiting comments from other departments/offices, these information, once received, will be forwarded to you for necessary follow up action.	Noted.
Item 3 : Agriculture & Fisheries Department **Ref. (27) in AF DVL 10/14 III** **dated 26 November 1992**	
I refer to the captioned Report sent to me by EPD for comments.	
I have the following general comments on the Report:	
(a) The scale of the maps is too small to show clearly the terrain of the route and the exact locations of the proposed temporary storage areas.	The maps were the most detailed that we had available at the time the environmental assessment was carried out. More detailed plans will be available during the detail design phase and these can be discussed with AFD at that time. The temporary storage areas in wetlands have now been deleted.
(b) The numbering of the possible storage areas is not in order (Map 1-4).	Noted. This is be reviewed based on the response to comment on Item 1 : section 6.3.
(c) Figure 8.1 and 8.2 should be elaborated to show the list of dominating species for each type of terrestrial habitats along the route.	The ecological survey was habitat based and thus a list of dominating species has not been prepared. A species list can be prepared during detail design and this will be used to finalise restoration plans.

Comments	Responses
(d) The study is generally weak in assessing the impacts on ecology and landscape. Besides amphibians and wetland, there should be survey of other habitats, flora and fauna affected by the project. (Please refer to para. 5.7 of the EIA Study Brief).	Habitats impacted by the project were surveyed. The level of detail is appropriate to an environmental assessment. A greater level of detail will be available during the detail design stage.
(e) The impact on country park visitors is not covered in the study. It is stated in para. 5.2 of the EIA Study Brief that the Study should make particular reference to the Country Park setting and the assessment should include the impact on Country Park visitors.	Noted. The EIA has made particular reference and emphasis on the Country Park setting and the route has aimed to minimise impacts on the Country Park and its visitors.
(f) Visual impacts of the project during the construction stage are not assessed.	One of the main objectives in determining the alignment has been to minimise the visual impact. This is discussed in section 8.2.
The followings are specific comments on the Report:	
Para. 2.3	
Concerning the 'rural path', please note that making and upgrading of tracks and paths in the Country Park are subject to the consent of the Country Parks Authority.	Noted.
I note that about 100 m of trench will be open at any one time and planting must be the Final Stage of the works (para. 11.3(f). What interim measures will be taken to stop erosion and washing away of loose materials?	The report does not say that planting must wait until after all construction works have been completed. Planting along each section can start as soon as that section has been completed. Chapter 11 discusses temporary measures to minimise erosion.
Map 1-4	
Please clarify the exact locations, sizes and access tracks of the possible storage areas. It is advisable to take photos of these areas before use for record purpose. All these sites would be subject to the agreement of the CPA.	We could not do this until the detail design stage. However storage areas will not be in wetlands.

Comments	Responses
Para.2.5 I note that visual inspections of the pipeline route will be made from the air. Does it imply that a set of marker posts will have to be installed inside Country Park for such purpose? We are very concerned with the visual impact of similar marker post along Route Twisk.	Visual inspections will be made but will not necessarily be from the air. The design of any marker posts that have to be installed will be submitted to AFD for approval. Marker posts with less visual impact than those along Route Twisk can be used.
Para. 6.3 Regarding food preparation and sanitary facilities on the work sites. Please note that the use of fire and store inside Country Park is not allowed and most of the project site is water catchment area where Water Supplies Department should be consulted on waste disposal. It is our requirement that all waste should be disposed outside Country Park and water catchment.	Noted and agreed.
Para. 7.1 Please refer to my comments to para. 2.3 for making and upgrading of footpaths.	Noted.
Para. 8.6 Temporary access tracks and storage areas will warrant further study. In any event, they should be kept to the minimum. Details of such sites should be submitted to AFD for agreement.	Agreed.
Para. 9.3 It seems that you are not too confident with the restoration of mixed, native woodland. Shall we extent the Maintenance period beyond 24 months to allow for more lengthy observation.	The normal maintenance period for landscaping works is 12 months but it is accepted that a longer period may be necessary in this case. The specification for landscape restoration works will be agreed with AFD. We are confident that the pipeline route can be restored but we do not wish to understate the difficulties.
You should avoid disturbing the wetland habitat as little is known about its restoration.	Noted. See response to comment on Item 1 : section 6.3.
Para. 11.3(h) There is successful precedent in which biodegradable mesh has been used with mixed planting of tree seedlings and shrubs.	Noted.

Comments	Responses
Para. 11.3(m) What is the proposed width and height of the earth bund?	This will be determined during detail design.
Para. 11.4 A clear record, with photos, should be kept for all access tracks, storage areas and any other affected to areas.	Agreed.
Para. 11.6 S.2.1.5 I have reservation on the use of "Agribusiness Formula 15" as "Organic Material".	Noted. This will be reviewed.
S.2.4.4 Grass areas which do not show 90% germination 28 days after sowing shall be immediately recultivated and re-sown .	Agreed.
S.3.2(b), S3.2.4 I think 'compost' is no longer applicable.	Agreed.
The possibility of creating an environmental friendly footpath along the pipeline should be further explored. This might require stone paving along slopes and footbridges crossing streams.	Agreed.
Finally, may I reiterate that the assessments of the impacts on flora, fauna, habitats and country park visitors are generally insufficient in this Study.	We have avoided carrying out species surveys and have concentrated a habitat surveys. The purpose of the environmental assessment has been to identify impacts and propose mitigation measures. Species surveys would have been very time consuming and would not have added to the conclusions. Species surveys can be carried out during detail design when detailed survey plans are available.
Item 4 : Green Lantau Association dated 26 November 1992 Thank you for your letter of 11.11.92 and for the copy of the Town Gas Lantau Link Executive Summary.	

Comments	Responses
In a recent telephone conversation your Mr. Tim Peirson-Smith has extensively answered all the questions we had on the environmental impact of the gas-pipeline project and the mitigation measures envisaged. I am happy to notice that a great deal of attention has been paid to ways of minimizing environmental impacts on the Tai Lam Country Park and other areas of conservation significance.	Noted.
I am also pleasantly surprised to see the extent to which Mott MacDonald has consulted the public on this issue and hope that in the management of more of your projects, notably those related to the Port and Airport Development Strategy (PADS), a similar approach will be initiated.	
Item 5 : **District Lands Officer, Tuen Mun** **Ref. (21) in DLOTM 150/6/04** **dated 10 November 1992**	
With reference to your above memo and the Draft Final Report from the consultant of The Hong Kong and China Gas Company Limited attached hereto, I wish to stress that the proposed gas pipeline runs very near to the Burial Ground (Site No. 17) for the Tai Lam Chung Tsuen. The alignment should be adjusted to avoid passing over the burial ground. Removal of graves should as far as possible be avoided.	This has been done.
2. The delay in replying is regretted.	
Item 6 : **Agriculture & Fisheries Department** **Ref. (29) in Af DVL 10/14 III** **dated 28 November 1992**	
Further to my letter dated 26.11.1992 on the captioned subject, I wish to convey the comments from the Fisheries Branch of our department.	There will be no impact on capture fisheries. This will be added to the Final Report.
The study does not adequately cover capture fisheries aspects. If no significant impact in this regard is anticipated, it should be clearly stated in the Report.	

Comments	Responses
Item 7 : Green Lantau Association 15th December 1992	
Thank you for your letter of 4.12.92 and for the copy of the Lantau Towngas Link Environmental Impact Assessment Draft Final Report.	Noted.
I hereby confirm that your response to concerns we have raised about the report are acceptable and that we have no further comment.	
Item 8 : Environmental Protection Department 20th December 1992	
I refer to your responses to our comments on the captioned Draft Final Report.	The specification for the dredging will be prepared during detail design.
We have no major additional comments to your responses at this stage. However, I would still highlight the fact that there are a few loose ends remaining regarding the monitoring/mitigation of the dredging & reclamation impact and noise assessment work.	
In regard to the potential noise problem, the DFR recommendations under para 2.3 should be updated with our endorsement when the findings of the geochemical investigation are available.	Noted.
Referring to para 5.3 of the DFR, it would be necessary to know the approximate number of people to be affected by the proposed project. Merely stating the noise level figures only describe half of the story.	We have added an extra column to Table 5.,2 showing approximate populations.
Furthermore, for para 5.4, it will give a better feel of the impact at each of the NSR, knowing the maximum noise level likely to be received and the duration of the disturbance at each location.	The maximum noise levels are given in the report. Durations will depend on the contractor's method of working but the works alongside each receiver are only likely to last for one or two weeks.
Lastly, as you would undoubtly noticed, AFD's conservation and landscape requirements form an integral part of the Environmental Assessment. Your are, therefore, required to meet their requests and keep our department informed in order to satisfy the EIA Study Brief requirements.	Noted.

LEGEND :

- GOVERNMENT LAND ALLOCATION
- TEMPORARY GOVERNMENT LAND ALLOCATION
- PRIVATE LAND HOLDINGS
- PROPOSED GAS PIPELINE
- BAMBOO GROVE
- WOODLAND / PLANTATION
- SHRUBLAND
- GRASSLAND
- CULTIVATIONS

H-I Existing Conditions
- Plantations and woodland copse with shrub understorey

Restoration Proposals
- Pipeline route to follow existing track to minimise disturbance to vegetation and retain mature woodland copse
- Regrass and mixed shrub planting
- Reinstate track using surplus excavated rock material

G-H Existing Conditions
- Abandoned cultivations

Restoration Proposals
- Pipeline route to skirt woodland and shrubland edge to valley
- Regrass and mixed shrub planting

F-G Existing Conditions
- Mixed woodland and shrub understorey

Restoration Proposals
- Pipeline route to follow existing track to minimise vegetation clearance
- Regrass and mixed shrub planting
- Reinstate track using surplus excavated rock material

E-F Existing Conditions
- Tree-lined Country Park access road

Restoration Proposals
- Pipeline located below access road subject to Country Park's approval to phasing of works
- Roadside trees retained
- Concrete road reinstated at completion

D-E Existing Conditions
- Abandoned cultivations and mixed woodland

Restoration Proposals
- Pipeline route to skirt adjacent woodland, crossing valley floor
- Regrass

C-D Existing Conditions
- [illegible] shrub and grassland vegetation cover

Restoration Proposals
- Pipeline route to follow existing track and skirt woodland
- [illegible] extent of vegetation clearance
- Regrass and mixed shrub planting
- Reinstate track using surplus excavated rock material

A-B Existing Conditions
- Recently fire-damaged grass and shrubland
- Granitic soil with erosion

Restoration Proposals
- Pipeline to follow existing track to minimise visual impact on hillside
- Use biodegradable mat as required to stabilise soil backfill to trench
- Repair adjacent gulley erosion with surplus excavated soil material
- Reinstate track using surplus excavated rock material
- Regrass and mixed shrub planting

PROPOSED PERMITTED BURIAL AREA FOR INDIGENOUS VILLAGERS TSUEN WAN N.T. SITE NO. TW/I006 FILE NO. L/M in 2/WPY/53 TWM 1751 A

BARREL GROUND SITE NO.117 FOR TAI LAM CHUNG TSUEN AREA 2.55 ha (ABOUT) TWM 1751 A (PT.) & 1831 (PT.) & (LOT)

TAI LAM CHUNG 大欖涌

TSING LUNG TAU

TOLA-TTM 3

SIU LAM

TAI LAM CHUNG RESERVOIR

Brothers Point (Ha Lan Kok)

Ka Loon Tsuen

Hong Kong Wetland Park

Yuen Tun Village

Tsing Lung Tau Village

TSUEN WAN ROAD - TSING LUNG TAU

CASTLE PEAK ROAD - TSING LUNG TAU

825 000 N

824 500 N

819 000 E

819 500 E

820 000 E

820 500 E

821 000 E

821 500 E

822 000 E

822 500 E

823 000 E

SCALE

metres 100 0 200 400 600

1 000 metres 800

Rev.	Date	Description	Drn.	Chd.
Designed:		Date:	Checked:	
Drawn: KY		Date: JUN 92	Checked:	
Approved:		Date of issue :		

The Hong Kong and China Gas Company Limited

TOWNGAS LANTAU LINK
SIU LAM TO ROUTE TWISK

EXISTING CONDITIONS & LANDSCAPE RESTORATION PROPOSALS

SHEET 1 OF 2

Consultants
Mott MacDonald Hong Kong Ltd.
12/F Sun Hung Kai Centre
30 Harbour Road
Hong Kong
Tel. No. 8285757

Mott MacDonald

Scale: 1 : 5000

Dimensions are in MILLIMETRES

FIGURE 8.1

Rev.


LEGEND:
GOVERNMENT LAND
TEMPORARY GOVERNMENT LAND ALLOCATION
PRIVATE LAND HOLDINGS
PROPOSED GAS PIPELINE
BAMBOO GROVE
WOODLAND / PLANTATION
SHRUBLAND
GRASSLAND
CULTIVATIONS
GAS PIGGING STATION
825 000 N
825 500 N
J-K Existing Conditions
Mixed shrub vegetation cover
Restoration Proposals
Pipeline route to follow existing track to minimise disturbance of vegetation
Regrass and mixed shrub planting
Reinstate existing track using surplus excavated rock material
K-L Existing Conditions
Mixed woodland and shrub understorey with abandoned cultivations
Restoration Proposals
Pipeline route to follow existing track and skirt woodland at fringe of cultivations to minimise disturbance of vegetation
Regrass and mixed shrub planting with tree-planting where possible
Reinstate track with surplus excavated rock material
L-M Existing Conditions
Mature plantations with steep, badly eroded footpath
Restoration Proposals
Pipeline route to follow existing track to minimise disturbance of vegetation
Regrass and mixed shrub planting with tree planting where possible
Reinstate track using surplus excavated rock material
Existing Conditions
Grassland and open shrub vegetation with partly eroded track
Restoration Proposals
Pipeline route to follow existing track to minimise visual impact and disturbance of vegetation
Regrass and mixed shrub planting
Reinstate track using surplus excavated rock material
Existing Conditions
Cultivations with mixed woodland and shrub understorey to valley hillsides
Restoration Proposals
Pipeline route to skirt woodland and cultivated land and aligned through shrubland to minimise disturbance of vegetation
Regrass and mixed shrub planting
S-T Existing Conditions
Shrubland vegetation and woodland fringe
Restoration Proposals
Pipeline route follows existing earth track to minimise visual impact and disturbance to vegetation, avoiding woodland areas
Regrass and mixed shrub planting
Reinstate existing footpath using surplus excavated rock material
R-S Existing Conditions
Cultivations and bamboo groves
Restoration Proposals
Pipeline route skirts cultivations beside bamboo thicket
Regrass and connect existing tracks by using surplus excavated rock material to prevent regrowth of bamboo obscuring future pipeline access route
Q-R Existing Conditions
Mixed shrubland vegetation
Restoration Proposals
Pipeline route to follow existing earth track as far as possible to minimise visual impact
Regrass and mixed shrub planting
Reinstate and connect existing tracks using surplus excavated rock material
Existing Conditions
Tree lined Country Park access road
Restoration Proposals
Pipeline route to follow access road and avoid
J
K
L
M
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01
O
P
Q
R
S
T
U
深井
SHAM TSENG
CASTLE PEAK ROAD
SCALE
Rev. | Date | Description | Drn. | Chd.
Designed: | Date: | Checked:
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EXISTING CONDITIONS &
LANDSCAPE RESTORATION PROPOSALS
SHEET 2 OF 2
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Scale: 1 : 5000
Dimensions are in MILLIMETRES
FIGURE 8.2