



**Hong Kong Government  
Territory Development Department  
NT North Development Office**

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*Agreement No. CE 10 / 95*

**Tin Shui Wai Development  
Engineering Investigations for  
Development of Areas 3, 30 & 31 of  
the Development Zone and the Reserve Zone**

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**ENVIRONMENTAL IMPACT ASSESSMENT**

**ENVIRONMENTAL MONITORING AND  
AUDIT MANUAL**

**MARCH 1997**

0018/600/00-1

 **Binnie Consultants Limited**

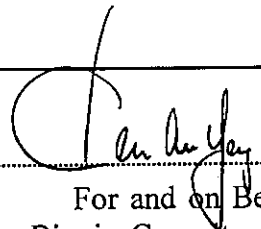
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**ENVIRONMENTAL IMPACT ASSESSMENT**  
**ENVIRONMENTAL MONITORING AND**  
**AUDIT MANUAL**

**MARCH 1997**

**0018/C09/09.1**

Report Authorized For  
Issue By:



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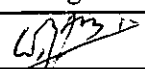
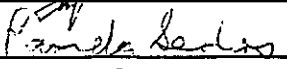

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## CONTENTS

		Page
	PREFACE	i
1	INTRODUCTION	1
	1.1 Project Description	1
	1.2 Objectives of the Monitoring and Audit	20
	1.3 Scope of the Monitoring and Audit	21
	1.4 Identification of Key Responsibilities	22
	1.5 Lines of Communication	26
	1.6 Complaints	27
	1.7 Report	28
2	AIR QUALITY	32
	2.1 Introduction	32
	2.2 Air Quality Parameters	32
	2.3 Monitoring Equipment	32
	2.4 Laboratory Measurement/Analysis	34
	2.5 Monitoring Locations	34
	2.6 Baseline Monitoring	35
	2.7 Impact Monitoring	36
	2.8 Records and Reporting	36
	2.9 Event and Action Plan for Air Quality	37
	2.10 Dust Mitigation Measures to be Implemented by the Contractor	39
3	NOISE	41
	3.1 Introduction	41
	3.2 Noise Parameters	42
	3.3 Monitoring Equipment	42
	3.4 Monitoring Locations	43
	3.5 Baseline Monitoring	44
	3.6 Impact Monitoring	44
	3.7 Records and Reporting	45
	3.8 Event and Action Plan for Noise	46
	3.9 Noise Mitigation Measures for Implementation by the Contractor	47

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CONTENTS  
(continued)

	Page
4 WATER QUALITY	50
4.1 Introduction	50
4.2 Water Quality Parameters	54
4.3 Monitoring Equipment	61
4.4 Monitoring Locations	63
4.5 Baseline Monitoring	64
4.6 Impact/Compliance Monitoring Schedule	65
4.7 Records and Reporting	67
4.8 Event and Action Plan for Water Quality	68
4.9 Water Quality Mitigation Measures to be Implemented by the Contractor	70
5 ECOLOGY	79
5.1 Introduction	79
5.2 Monitoring Locations	79
5.3 Monitoring Methodology	79
5.4 Intertidal Fauna	83
5.5 Mangroves	86
5.6 Mammal and Nesting Bird Surveys	87
5.7 Records and Reporting	87
5.8 Event and Action Plan for Ecology	88
5.9 Mitigation to be Implemented by the Contractor	92
5.10 References	93
6 WATERBIRDS	94
6.1 Introduction	94
6.2 Monitoring Locations	94
6.3 Monitoring Methodology	94
6.4 Waterbirds	98
6.5 Records and Reporting	99
6.6 Event and Action Plan for Waterbirds	100
6.7 References	102
7 WASTE MANAGEMENT	103
8 SITE ENVIRONMENTAL AUDIT	109
8.1 Site Inspections	109
8.2 Compliance with Legal and Contractual Requirements	110

9	POST PROJECT AND OPERATIONAL PHASE MONITORING	114
9.1	Introduction	114
9.2	EM&A Programme	114
9.3	A Summary of Mitigation to be Implemented under this Project	115

## LIST OF FIGURES

1.1	Areas within the Tin Shui Wai Development
1.2	Existing Ground Levels
1.3	Proposed Minimum Formation Levels
1.4	Temporary Drainage Installation (sheet 1 of 2)
1.5	Temporary Drainage Installation (sheet 2 of 2)
1.6	Road and Junction Nomenclature
1.7	Proposed LRT Reserve in Tin Shui Wai Reserve Zone
1.8	Locations of Highway Structures
1.9	Proposed Permanent Drainage Arrangement
1.10	Western Drainage Channel Extension
1.11	Recommended Sewerage Network for the Developments
1.12	Programme for Works and Concurrent Projects (based on Recommended Implementation Programme - version 2.2)
1.13	Works Year by Year Jul - Dec 1997
1.14	Works Year by Year Jan - Sep 1998
1.15	Works Year by Year Oct - Dec 1998
1.16	Works Year by Year Jan - Aug 1999
1.17	Works Year by Year Sep 1999 - Mar 2000
1.18	Works Year by Year Apr - Aug 2000
1.19	Works Year by Year Sep - Dec 2000
1.20	Works Year by Year Jan - Jul 2001
1.21	Works Year by Year Jul - Dec 2001
1.22	Works Year by Year Jan - Jul 2002
1.23	Works Year by Year Aug 2002 - Aug 2003
1.24	Concurrent Projects
1.25	Concurrent Projects within Inner Deep Bay Drainage Basin
1.26	Lines of Authority for EM&A Programme
1.27	Lines of Communication for Reporting Function for EM&A Programme
1.28	Action Flow Chart for Handling Complaints of EM&A Programme
2.1	EM&A - Locations of Air Monitoring Stations for Scenario 1 (Jul-Dec 1997)
2.2	EM&A - Locations of Air Monitoring Stations for Scenario 2 (Jan-Sep 1998)
2.3	EM&A - Locations of Air Monitoring Stations for Scenario 3 (Oct-Dec 1998)
2.4	EM&A - Locations of Air Monitoring Stations for Scenario 4 (Jan-Aug 1999)
2.5	EM&A - Locations of Air Monitoring Stations for Scenario 5 (Sep 1999-Mar 2000)
2.6	EM&A - Locations of Air Monitoring Stations for Scenario 6 (Apr-Aug 2000)
2.7	EM&A - Locations of Air Monitoring Stations for Scenario 7 (Sep-Dec 2000)
2.8	EM&A - Locations of Air Monitoring Stations for Scenario 8 (Jan-Jul 2001)
2.9	EM&A - Locations of Air Monitoring Stations for Scenario 9 (Jul-Dec 2001)
2.10	EM&A - Locations of Air Monitoring Stations for Scenario 10 (Jan-Jul 2002)

- 2.11 EM&A - Locations of Air Monitoring Stations for Scenario 11 (Aug 2002-Aug 2003)
- 2.12 Data Sheet for TSP Monitoring
  
- 3.1 Locations of Noise Barriers during Construction Stage
- 3.2 EM&A - Locations of Noise Monitoring Stations for Scenario 1 (Jul-Dec 1997)
- 3.3 EM&A - Locations of Noise Monitoring Stations for Scenario 2 (Jan-Sep 1998)
- 3.4 EM&A - Locations of Noise Monitoring Stations for Scenario 3 (Oct-Dec 1998)
- 3.5 EM&A - Locations of Noise Monitoring Stations for Scenario 4 (Jan-Aug 1999)
- 3.6 EM&A - Locations of Noise Monitoring Stations for Scenario 5 (Sep 1999-Mar 2000)
- 3.7 EM&A - Locations of Noise Monitoring Stations for Scenario 6 (Apr-Aug 2000)
- 3.8 EM&A - Locations of Noise Monitoring Stations for Scenario 7 (Sep-Dec 2000)
- 3.9 EM&A - Locations of Noise Monitoring Stations for Scenario 8 (Jan-Jul 2001)
- 3.10 EM&A - Locations of Noise Monitoring Stations for Scenario 9 (Jul-Dec 2001)
- 3.11 EM&A - Locations of Noise Monitoring Stations for Scenario 10 (Jan-Jul 2002)
- 3.12 EM&A - Locations of Noise Monitoring Stations for Scenario 11 (Aug 2002-Aug 2003)
- 3.13 Noise Monitoring Field Record Sheet
  
- 4.1 EM&A - Locations of Water Quality Monitoring Stations for Scenario 1 & 2 (Jul 1997-Sep 1998)
- 4.2 EM&A - Locations of Water Quality Monitoring Stations for Scenario 3 (Oct-Dec 1998)
- 4.3 EM&A - Locations of Water Quality Monitoring Stations for Scenario 4, 5, 6, 7 & 8 (Jan 1999-Jun 2001)
- 4.4 EM&A - Locations of Water Quality Monitoring Stations for Scenario 9, 10 & 11 (Jul 2001-Aug 2003)
- 4.5 Water Quality Monitoring Data Record Sheet
  
- 5.1 EM&A - Locations of Ecological Monitoring Stations
- 5.2 Before-After Sampling at Control-Impact Sites
- 5.3 BACI Design with Replicated Times of Sampling
- 5.4 "Beyond-BACI" Design with Multiple Control Areas
- 5.5 Ecology Monitoring Form I - Benthic Epifauna
- 5.6 Ecology Monitoring Form II - Benthic Infauna
- 5.7 Ecology Monitoring Form III - Mangrove Survey
- 5.8 Ecology Monitoring Form IV - Waterfowl Activity Scan
- 5.9 Ecology Monitoring Form V - Little Egret Continuous Observation
  
- 6.1 EM&A - Locations of Ecological Monitoring Stations
- 6.2 Before-After Sampling at Control-Impact Sites
- 6.3 BACI Design with Replicated Times of Sampling
- 6.4 "Beyond-BACI" Design with Multiple Control Areas
- 6.5 Waterbirds Monitoring Record
  
- 9.1 Location and Heights of Noise Barriers
- 9.2 Location and Heights of Noise Barriers
- 9.3 Location and Heights of Noise Barriers
- 9.4 Plan for Replacement Wetland and Buffer Area
- 9.5 Infiltration Channel

## LIST OF TABLES

- 1.1 Summary of Package I Priority Works Including Formation and Infrastructure
- 1.2 Summary of Package II, Remaining Works
- 1.3 Proposed Drainage Culverts within RZ
- 1.4 Concurrent Projects
  
- 2.1 Action and Limit Levels for Air Quality
- 2.2 Actions in the Event of Exceedance of Action/Limit Levels during Construction
  
- 3.1 Scenarios for Construction Noise Assessment
- 3.2 AL Levels for Noise Measured at NSRs during Construction
- 3.3 Event/Action Plan for Construction Noise
  
- 4.1 Potential Impacts from Construction Works during the Project
- 4.2 Mitigation Measures and Residual Impacts for Construction Works during the Project
- 4.3 Potential Impacts from Operation under the Project
- 4.4 Mitigation Measures and Residual Impacts from Operation Works Resulting from the Project
- 4.5 Rationale and Methodology for Water Quality
- 4.6 Summary of Monitoring Schedule and Parameters during the Works
- 4.7 Rationale for Water Quality Monitoring Locations
- 4.8 Action and Limit Levels for Water Quality
- 4.9 Actions in the Event of Exceedance of Action/Limit Levels
  
- 5.1 Potential Impacts of the Project on Ecological Resources
- 5.2 Mitigation Measures and Residual Impacts of the Project on Ecological Resources
- 5.3 AL Levels for Absolute Water Quality to be used for Ecological Event/Action Plans during Construction
- 5.4 AL Levels for Ecology during Construction
- 5.5 Actions in the Event of Exceedance of Action Levels for Ecology
- 5.6 Actions in the Event of Exceedance of Limit Levels for Ecology
  
- 6.1 Potential Impacts of the Project on Ecological Resources
- 6.2 Mitigation Measures and Residual Impacts of the Project on Ecological Resources
- 6.3 AL Levels for Absolute Water Quality to be used for Waterbirds Event/Action Plans during Construction
- 6.4 AL Levels for Waterbirds during Construction
- 6.5 Actions in the Event of Exceedance of Action Levels for Waterbirds
- 6.6 Actions in the Event of Exceedance of Limit Levels for Waterbirds
  
- 7.1 Wastes Arising as a Result of Package I Works
- 7.2 Wastes Arising as a Result of Package II Works
- 7.3 Classification of Sediments by Metal Content (mg/kg dry weight)
- 7.4 Waste Types and Their Potential for Recycling or Re-use



- 8.1 Summary of Monitoring Frequency during Project Works
- 8.2 Monitoring Locations during each Scenario of Project Works
  
- 9.1 Summary of Permanent Mitigation Measures under the Project
- 9.2 Noise Barriers to be Implemented under the Project
- 9.3 Planter/Parapet Barriers to be Implemented under the Project
- 9.4 Summary of Mitigation Measures during the Project Construction Works

## PREFACE

### Purpose of the Manual

1. This EM&A programme has been designated to monitor and audit the works under Project No. CE 10/95. It is the only EM&A programme occurring for most of the further development of Tin Shui Wai (TSW). There are no other major Government EM&A programmes currently planned although the private development of Areas 104, 112, 113, 115 and 116 may be monitored by the developers themselves.
2. The EM&A programme has two main objectives:
  - (i) to protect the current residents of TSW and its adjacent areas and those people who will move into TSW and its adjacent areas during the works period from excessive environmental impacts; and
  - (ii) to protect the future integrity of the Ramsar Site and its adjacent ecological resources.

### Protection of the People

3. Dust, noise and water quality are the most significant impacts on people residing in the area. The main potential sources of dust within the TSW area over the next seven years are related to site formation works under the Project.
4. Construction noise will emanate from both Project works and from other building works associated with the further development of TSW. The recommended noise monitoring programme for the Project will record noise from both sources. Although it will be possible for the team responsible for the EM&A programme for the Project to distinguish between the two sources of noise, only one source of noise will be subject to action. Excessive noise experienced by residents may not be due to the Project.
5. The control of water quality is important for both people and wildlife. The water quality monitoring programme is two-tiered. One tier consists of a regular global monitoring of water bodies which is integrated with the ecological monitoring programme. The other tier is site and activity specific. Control of water quality impacts arising from specific areas and works under the Project is feasible. However, damage to the downstream ecological receivers is most likely to arise as the result of both spacial and temporal cumulative impacts. Control of cumulative impacts or impacts arising from other works within TSW are dependent upon EPD receiving monthly Project reports, registering the problem and then taking action. The time-lag between impact and control could be considerable.

### Protection of Wildlife

6. Although dust, noise and disturbance, and waste could affect wildlife, most of these impacts will arise for the first few years as a result of the Project. Measures taken to protect residents will afford a great deal of protection to wildlife as well.

7. The most likely source of severe impacts on the Ramsar site will occur via the water bodies. These impacts will arise in a cumulative manner. Already badly polluted waters exert severe pressure on the food sources for both resident and migratory birds. A significant decrease in food organisms has been recorded during the EIA study period. Recolonization and re-establishment and stabilization of food supplies will be dependent on minimization of future ecotoxic events.

#### *The Implementation of the Programme*

8. The Project works, that is the works under CE 10/95 are the responsibility of TDD. Other concurrent works for the further development of TSW are the responsibility of a number of other Government Departments.
9. The EM&A programme described in this manual has been designed for the Project. It has a number of subsidiary objectives. The programme must make it possible for the Environmental Manager to distinguish between the sources of:

- (i) impacts arising from different contracts under the Project;
- (ii) impacts arising from other concurrent works for the further development of TSW; and
- (iii) impacts arising from other concurrent works.

(For example, when the wind blows from the north, dust levels can already be very high as a result of construction works in the PRC; water quality in the nearby water-bodies will be the cumulative result of many factors.)

10. The EM&A programme is not set up to simply measure problems after they occur. The aim is to prevent exceedances of environmental standards from occurring and ensure environmental performance. The monitoring data will reflect the standard of environmental performance of both the Project and other contracts.
11. The programme has been set-up in a long-term, integrated, cumulative manner. It is not contract by contract, or package based. The EM&A programme will pass from Environmental Manager to Environmental Manager at fixed dates. There is no overlap of data collection which should be continuous from the start of Contract 1 to the end of the Project works. A hand-over period from Manager to Manager has been arranged to enable each new Manager to learn about the Project before taking over the responsibility for the programme. There will be more than one Contractor on site concurrently. The Environmental Manager and his teams may be associated with one Engineer when two Engineers are concurrently involved with the Project. The Environmental Manager will be responsible for contracts under both Engineers and will need to liaise with both Engineers.
12. The success of the EM&A programme with the prevention of adverse impacts arising from the Project will depend on an effective and efficient Environmental Management System set up and led by a suitably qualified Environmental Manager. This is a senior position requiring both experience and innovation. The Environmental Manager and his key staff are expected to:

- (i) be aware of the progress of the detailed design and ensure this design contains all necessary environmental features and will not lead to unacceptable levels of environmental impact;
- (ii) follow up the recommendations of the EIA and the timely implementation of identified mitigation measures;
- (iii) review the EIA in the light of the detailed design to identify any previously unanticipated impacts;
- (iv) ensure the contracts, licences and detailed design of the Project incorporate the measures recommended in the EIA or from the environmental review of the EIA;
- (v) supervise the monitoring and audit the actual impacts arising from the implementation of the Project to enable preventative and remedial measures to be actioned where unanticipated or where greater than predicted impacts arise;
- (vi) form relationships with Contractors' key staff and liaise with them and the engineering team on a frequent, regular basis;
- (vii) obtain and use all relevant information about the Project including rolling Contractor's programmes, methodology statements, noise permit applications;
- (viii) if unsatisfactory methods are planned, give technical advice and assistance to Contractors on practical ways of implementing mitigation particularly when impacts that were unforeseen by the EIA arise; and
- (ix) visit and walk areas of the site frequently and regularly and record all observations which may have a bearing on the environmental performance of the site in addition to formal site visits.

## 1 INTRODUCTION

### 1.1 Project Description

1.1.1 The Project has been divided into Package I, the Priority Works and Package II, the Remaining Works. The Packages are further subdivided into eight Works contracts.

#### *Package I Priority Works*

1.1.2 The Package I Priority Works are summarized in Table 1.1, which includes estimated timescales and completion dates.

1.1.3 Six housing sites (Areas 3, 30 & 31 of the DZ and 102-104 of the RZ) (Figure 1.1) have been designated as Priority Sites. These will be given precedence to ensure timely completion of site formation, infrastructure and subsequent building works.

**Table 1.1 Summary of Package I Priority Works Including Formation and Infrastructure**

Contract (duration)	Areas	Objectives	Works
1 (July - Dec. '97)	102	Site formation	- formation of Priority Area 102 excluding adjoining road reserves
2 (Sept.'97 - Nov.'98)	101-111, excluding 102 & 109b	Site formation	- formation of Priority Areas
3 (Oct.'98 - Jan.'00)	3, 30 & 31	Existing DZ infrastructure upgrading	- including widening of DZ junctions; provision of additional lanes
4 (Nov.'98 - Mar.'01)	102 - 104, & 109a	Engineering infrastructure	- construction of Roads L12, L13 & L14 including associated drains, sewers and water reticulation system; - dualling of Tin Wah Road (D2) and widening of Junction K; - dualling of Tin Tsz Road (P2); - formation of LRT reserve adjacent to Tin Tsz Road, L12 and Central Path; - rising mains from sewage pumping station in Area 101 to Ha Tsuen Pumping Station; - construction of Area 101 pumping station, roadbridge D2/V1 over WDCE, footbridge D2/CF1 over Junction M, subways L13/S1, L14/S1, P1/S1, Garden South culvert, Eastern culvert realignment near Junction P
5 (Oct.'98 - Mar.'01)	102 - 104, & 109a	Engineering infrastructure	- construct grade separated interchanges at Junctions A, D & W, and associated utility and drainage diversion; - widening of Long Tin Road to 3-lane dual carriageway; - widening of Hung Tin Road to 3-lane dual carriageway; - construction of roadbridges P1/V1 at Junction A, P2/V1 at Junction D and P2/V2 at Junction W; footbridge P2/CF1 across Road P2; and Eastern culvert realignment, Hung Tin Road culvert realignment

### The Package II Remaining Works

1.1.4 The Package II Remaining Works are summarized in Table 1.2, which includes estimated timescales and completion dates.

**Table 1.2 Summary of Package II, Remaining Works**

Contract	Areas	Objectives	Works
6 (Mar.'99 - May '01)	105 - 108, 110 - 113, 115 & 116	Infrastructure including roadworks, and drains and sewers	- construction of Road L12 and D4 and associated drains, sewers and water reticulation system; - dualling of Tin Ying Road (P1) between Junctions A-K; - formation of the LRT reserve next to Roads L12 and D4; - river training of 500 m of WDCE; - construction of roadbridges P1/V2 and P1/V3; footbridges L12/CF1 at Junction S; D4/F1 at Junction T; subways L12/S1 across Road L12; D4/S1 across Road D4; Garden Path culvert; subway extensions P1/S2 and P2/S3; and the Northern culvert
7 (Feb.'99 - Mar.'02)	109b, 112 - 117 & 120	Infrastructure works including roads, drains and sewers, and bridges; and site formation	- construction of Road D4 and associated drains, sewers and water reticulation system; - site formation of Areas 109b, 112 to 117 and 120; - formation of the LRT next to Road D4; - construction of roadbridge P2/V3 at Junction P; footbridge D4/CF2 at Junction V; subway D4/S2 across Road D4; Northeastern culvert; Eastern culvert extension - wetland (initial works)
8 (Aug.'01 - Aug.'03)	Area 121, Road D3	Site formation, infrastructure and roadworks	- roads D3 and 1231 and associated drains, sewers and water reticulation system; - formation of Area 121; - construction of roadbridge D3/V1; road/footbridge L13/VCF1; footbridge WC/CF5 - wetland construction

Note: At the time of printing of this EM&A Manual, Contract 6 and 7 are being considered to be incorporated into one contract: Contract 6. Contract 8 is being renamed Contract 7. The duration of each associated construction works under each contract will not change.

1.1.5 Relevant works included under the EM&A programme are summarised below.

### *Site Formation*

- 1.1.6 Site formation is required for the RZ and for various Engineering Infrastructure/upgrading work sites. Areas 3, 30 and 31 are already formed. The site formation works required outside the RZ are almost wholly for road and junction upgrading works.
- 1.1.7 The current ground levels within the RZ are shown on Figure 1.2 and the proposed site formation levels are shown on Figure 1.3. Additional fill will have to be imported if all planning areas within the RZ are formed to above the average minimum formation levels at +5.5 mPD. Raising the general formation levels flush with the road formation levels of about +6.5 mPD further increases the need for additional fill.
- 1.1.8 For works outside the RZ, it is estimated that about 240,000 m<sup>3</sup> of fill will be required for the infrastructure and upgrading works, in particular dualling of Tin Ying Road and forming of Road D3 on the west bank of the WTC. In addition, about 40,000 m<sup>3</sup> of fill is likely to be needed: to replace the unsuitable materials which are to be dredged from the channels and from foundation of culverts, subways and bridges; to support the edge slopes of the formation and for the foundation of the Eastern Culvert extension.
- 1.1.9 Areas 101-108, 109a, 110 and 111 are to be formed under the first two works contracts. About 400,000 m<sup>3</sup> of surplus materials will be generated after the completion of these areas. The materials can be used in the site formation of the remainder of the RZ and in the Tin Ying Road dualling and Road D3 construction and other road works. Up to 58,000 m<sup>3</sup> may be used as additional fill to compensate for settlement.
- 1.1.10 Surplus material will be stockpiled just north of Road D4 in Area 114 between Areas 112 and 115. Currently, stockpiles of sand fill and pond bund materials are placed to an elevation of 11 mPD in Areas 115 and 116. Peripheral drainage ditches need to be provided at the toe of the stockpile for connection to the existing drainage ditch running north towards the Tin Shui Wai Bund.
- 1.1.11 Areas 109b, 112-117 and 120 will be formed to provide the sites for developments in the area under Contract 7. The stockpile will be used and removed for formation of the planning areas and infrastructure/upgrading works.
- 1.1.12 Area 121 and Road D3 will be formed under Contract 8 requiring about 159,000 m<sup>3</sup> of fill.
- 1.1.13 Temporary drainage ditches in the form of 1 on 1.5 side slopes trapezoidal channels with 25 mm shotcrete or chunam facing are proposed to intercept the runoffs from the formation. Silt traps will be provided at the downstream ends of the ditches before discharging into the existing drainage systems. Figures 1.4 and 1.5 illustrates the temporary drainage layout.

### *Transport Infrastructure*

- 1.1.14 As part of the engineering studies, extensive and comprehensive modelling of the existing, 2001, 2006 and 2011 road network has been undertaken. These studies have been endorsed. The endorsed traffic data results in traffic flows higher than those of the Layout Plan Study which have been used in assessment of traffic noise impacts on Areas 3, 30 and 31 by Housing Department. Road layouts described in later paragraphs are based on this endorsed data.

### *Roadworks*

- 1.1.15 Figure 1.6 shows the existing and the proposed road hierarchy of the Tin Shui Wai new town. Again please note that the details of these works may change during detailed design.

### *Road P1 (Tin Ying Road)*

- 1.1.16 Road P1 is a primary distributor along the western boundary of the DZ. It provides a direct link from the RZ to the expressway network via Hung Tin Road. To cater for the RZ development, Road P1 is proposed to be upgraded to a 7.3 m 2-lane and a 10 m 3-lane dual carriageway. Road widening reserves have been allowed for in some areas.
- 1.1.17 It is proposed that the additional northbound carriageway will be located to the west of the existing Road P1 with 4 m wide central reserve in between. A 3.5 m wide verge will also be provided on both side of Road P1.

### *Road P2 (Tin Tsz Road)*

- 1.1.18 Road P2 is a primary distributor along the eastern boundary of the DZ. It provides a direct link from the RZ to the expressway network via Long Tin Road and Yuen Long West Link.
- 1.1.19 Like Road P1, Road P2 was recommended under the engineering infrastructure study for the DZ to be constructed in stages. Originally, the northbound carriageway would be constructed to meet the developments in the DZ with provisions for future upgrading to a dual three-lane carriageway.
- 1.1.20 As a result of the Tin Shui Wai Town Centre Study, an additional junction with Road 1402 was introduced to Road P2 and the section between this new junction and Junction D was upgraded to a 7.3 m dual carriageway to serve the additional traffic.
- 1.1.21 As part of the upgrading works for the RZ, Road P2 will be upgraded to a 3-lane dual carriageway throughout.



*Road D2 (Tin Wah Road)*

- 1.1.22 Road D2 is a district distributor connecting the two primary distributors P1 and P2 at Junctions K and P respectively on the southern boundary of the RZ. It also connects with the local distributors in the southern part of the RZ.
- 1.1.23 Road D2 was constructed for the DZ initially as a 10.3 m wide single carriageway with footpath on the southern side only. A short cycle track was provided between Junctions K and M. Road widening reserve was provided on the northern side of the carriageway for future upgrading to a dual 2-lane carriageway.
- 1.1.24 To cater for the RZ development, Road D2 is proposed to be upgraded to a 7.3 m dual 2-lane carriageway.
- 1.1.25 A 3.5 m wide footpath will be provided on both sides of Road D2. The existing 3.5 m wide southern cycle track at the western end of Road D2 will be extended to Junction P at the eastern end.

*Road D3 (Formerly known as Road R1)*

- 1.1.26 Road D3 is a district distributor connecting the primary distributor Road P1 and the district distributor Road D4 at Junctions K and T respectively. It forms the west arm of the peripheral road around the RZ and connects to local distributors at Junctions R and T. Road D3 is a 7.3 m 2-lane dual carriageway with a 4.5 m central divider.
- 1.1.27 Due to the close proximity of the WTC, a 3.5 m wide footpath and a 3.5 m wide cycle track will be provided along the western promenade of the channel to enhance the amenity value of the channel.

*Road D4 (Formerly known as Road R3)*

- 1.1.28 Road D4 is a district distributor linking the primary distributor P2 and the district distributor Road D3 at Junctions P and T respectively. It forms the east arm of the peripheral road around the RZ. It connects to local distributor roads at Junctions T and V. Road D4 is a 7.3 m dual 2-lane carriageway with a 4.5 m central divider.
- 1.1.29 A 3.5 m wide footpath and a 3.5 m wide cycle track will be provided on each side of the road. The LRT Reserve will be provided to the south of the road.

*Road L12 (Formerly known as Road R2)*

- 1.1.30 Road L12 is a major local distributor connecting Junctions L and T. It provides access to planning areas 101, 102, 105, 106, 110 and 111. Due to the number of LRT/road junctions, Road L12 is proposed to be a 2-lane 7.3 m dual carriageway to accommodate right turning vehicular and pedestrian movements. A 4.5 m central divider is provided to accommodate a right turning lane at junctions.

- 1.1.31 A 3.5 m wide footpath will be provided on both sides of the road and a 3.5 m wide cycle track on the eastern side of the road. An LRT reserve will be provided to the east of the road.

*Road L13 (Formerly known as Road R5)*

- 1.1.32 Road L13 is a local distributor connecting the district distributor Road D3 and local distributor Road L14 at Junctions R and U respectively. It provides access to planning areas 102, 103, 106, 107 and 108. Road L13 is a 7.3 m wide dual carriageway. A 3.5 m wide footpath will be provided on both sides of the road and a 3.5 m wide cycle track on the southern side of the road. There is no significant deviation from the findings of the earlier Layout Plan Study.

*Road L14 (Formerly known as Road R4)*

- 1.1.33 Road L14 is a local district distributor connection Junctions N and V. It provides access to planning areas 103, 104, 108a, 108b and 109. In view of the multitude of junctions along this short section of road, Road L14 is proposed to be a 2-lane 7.3 m dual carriageway to smoothen traffic turning movements and to enhance pedestrian safety. A 4.5 m central divider is provided to accommodate a right turning lane at junctions. A 3.5 m wide footpath will be provided on both sides of the road and a 3.5 m wide cycle track on the east side of the road.

*Roads 1091 and 1201*

- 1.1.34 These roads will provide access to the GIC facilities in Area 109 and to Area 120 respectively. Both roads will comprise a 10.3 m 2-lane carriageway with 2.5 m footpath on both sides.

*Roads 1202 and 1231*

- 1.1.35 Road 1202 will provide access to the GIC facilities in Area 120. Road 1231 will provide access to Area 123 and connect to the access track to Mong Tseng Tsuen. Both roads will comprise a 7.3 m 2-lane carriageway with 1.6 m footpaths on both sides.

*Hung Tin Road and Long Tin Road*

- 1.1.36 The northern end of these roads will be upgraded to a 3-lane dual carriageway roads (Figure 1.6).

***LRT Provision***

- 1.1.37 Two types of LRT reserve have been proposed in order to serve the RZ population effectively:
- (i) local service - connecting the RZ development areas to the DZ.
  - (ii) express service - connecting the RZ development to the proposed West Rail station south of the DZ.

#### *LRV Stops*

- 1.1.38 Seven LRV stops will be provided in the RZ for the Development. The locations of the LRV stops and other aspects of the LRT are shown on Figure 1.7.

#### *LRT Terminus*

- 1.1.39 In accordance with the *Report on Preparation of Layout Plans for Tin Shui Wai Reserve Zone*, the LRT terminus will be located at Area 106 of the RZ. Provision of engineering infrastructure has been investigated on this basis.

#### *Rectifier Station*

- 1.1.40 A rectifier station will be located at Area 109 of the RZ.

#### *Highway Structures*

- 1.1.41 There are a number of highway structures being investigated in the Study Area. Broadly speaking, they are classified into the following categories:

- vehicular bridge;
- LRT bridge;
- footbridge; and
- subway.

- 1.1.42 Various forms and layout of the bridges and subways have been investigated. Bridges are mainly employed to cross the Western Drainage Channel Extension (WDCE) and at grade-separated junctions while subways are used to provide pedestrian and cycle movement crossing carriageway and LRT reserve at open and amenity areas. Footbridges are used to link residential and commercial centres.

#### *Pedestrian Networks*

- 1.1.43 Extensive footpath and cycle track networks will be provided along carriageways. To facilitate pedestrians crossing the carriageway and LRT track safely and efficiently, at-grade crossings, footbridges and subways are proposed to link up open spaces, amenity areas, LRV stops, population and commercial centres and the DZ to form an integral pedestrian network for the Tin Shui Wai new town.

#### *Highway Structures*

- 1.1.44 There are a number of proposed highway structures ranging from vehicular bridges, cycle and pedestrian bridges, footbridges and subways under investigation. Locations of the existing and proposed highway structures are illustrated in Figure 1.8.

#### *Local Drainage Systems*

- 1.1.45 The Developments including Areas 3, 30, 31 and 33 of the DZ and the RZ will be served by local drainage systems. These will be gravity systems designed to deliver surface runoff generated in each area to the catchment drainage systems.

- 1.1.46 There are two existing drainage culverts, namely Western Central Culvert (WCC) and Eastern Central Culvert (ECC), lying along the southern boundary of the RZ underneath Tin Wah Road (Road D2). The WCC has been designed to deliver runoff from the southern part of Area 102 and Road L12. The ECC has been sized to convey runoff from Areas 103, 104, and 108a, Road L14 and the LRT Reserve. To cater for further developments, four drainage culverts are proposed to discharge runoff generated within the RZ to the main catchment drainage system in the basin.
- 1.1.47 The proposed permanent drainage box culverts to be constructed within the RZ are shown on Figure 1.9. The sub-catchment areas they serve are given in Table 1.3.

**Table 1.3 Proposed Drainage Culverts within RZ**

Proposed Culvert	Location	Discharging Channel	Sub-catchment
Garden South Culvert (GSC)	Along Road L13	WDCE	Areas 101 (N), 102(N), 105(S), 106(S), 107a, Roads L12, L13
Garden Path Culvert (GPC)	Garden path	WDCE	Areas 105 (N), 106 (N), 110 (S), 111a, 107b, Garden Path, Road L12
Northern Culvert (NC)	Along Road D4	WDCE	Areas 110 (N), 111b, 112, 113a, b, Road D4
Northeastern Culvert (NEC)	Along Road D4	EDC	Areas 108, 109, 115, 116a, b, Roads D4, L14, 1091
Eastern Culvert Extension (ECE)	Along Road D4	EDC	Areas 117a, b, 120, Road D4, Culverts EC, ECC

Notes :  
 101 (N) denotes northern part of Area 101.  
 105 (S) denotes southern part of Area 105.  
 WDCE denotes Western Drainage Channel Extension.  
 EDC denotes Eastern Drainage Channel.

- 1.1.48 In order to reduce the impacts on the catchment drainage systems due to surface runoff coming from roads, sand traps and oil interceptors will be installed at the downstream end of the local drainage systems before they discharge into the catchment drainage systems.

***Western Drainage Channel Extension***

- 1.1.49 Paving of a 500 m length of the WTC immediately downstream of the inflatable dam for maintenance purposes will take place (refer to Figure 1.10). This will involve construction activities behind cofferdams to isolate the work area so that mud removal and paving can take place.

### Sewerage

- 1.1.50 The sub-regional sewerage strategy adopted by the SMP is to discharge sewage collected from the Yuen Long, Kam Tin and Tin Shui Wai areas through the NWNT sewerage system to the tidal channel at Urmston Road. The SMP has included a comprehensive network of new trunk sewers and sewage pumping stations to achieve this strategy. Implementation has been underway since 1992.
- 1.1.51 A number of the SMP trunk sewers have been proposed to run within Tin Shui Wai. Their key data are summarised in Table 1.4. These proposed provisions are currently under review.

**Table 1.4**  
**Proposed SMP Trunk Sewers within Tin Shui Wai**

Proposed Trunk Sewer	Diameter (mm)	Alignment within Tin Shui Wai	Implementation Programme
A pumping main/gravity sewer to transfer sewage from Ping Shun Street Pumping Station to the existing trunk sewer immediately upstream of Ha Tsuen Pumping Station	1000 (rising main) 1200 (gravity sewer)	Along Tin Fuk Road and Ping Ha Road	1995-1997 under construction
Two pumping mains to transfer sewage from Yuen Long Sewage Treatment Works to the sewer tunnel beneath Castle Peak Range	1200/1200	Along Tin Wah Road and eastern side of Western Drainage Channel	2000 - 2003 under review
Two pumping mains to serve Sha Kong Wai and Lau Fau Shan	200/250	Along western side of Western Drainage Channel	1999 - 2001 under review
One pumping main to serve Mong Tseng Tsuen and Mong Tseng Wai	150	Along western side of Western Drainage Channel (Extension)	2001 - 2003 under review

- 1.1.52 Concurrent with this engineering investigation for the RZ and related developments, a separate study entitled "Review of Yuen Long and Kam Tin Sewerage and Sewage Treatment Requirements" was commissioned by EPD in December 1995 to review the sewerage facilities in a sub-regional context taking account of the latest development forecasts. One of the objectives of the review is to assess whether all sewage flows from the latest Tin Shui Wai development could be discharged to Ha Tsuen Pumping Station or part of the sewage flows would have to be discharged directly to San Wai Sewage Treatment Works. Technical Note No. 1 of the review issued in February 1996 indicates that Ha Tsuen Pumping Station has sufficient capacity to receive all sewage flows from the ultimate Tin Shui Wai development.

### *Recommended Sewerage Strategy for the Development*

- 1.1.53 A preliminary sewerage assessment has been conducted in the earlier part of the Assignment to investigate sewerage options for the Priority Sites. The findings and recommendations are contained in the final Preliminary Sewerage Assessment Report issued in April 1996. The report has been discussed at working group and steering group meetings for the Assignment and the recommended sewerage option, annotated Option A2, has been accepted by the groups as a preferred option. The recommended sewerage network for the Development is illustrated on Figure 1.11.
- 1.1.54 The recommended option entails in broad terms discharging sewage generated from the Priority Sites to Ha Tsuen Pumping Station via the existing sewerage network in the DZ and constructing a new sewage pumping facility on the western fringe of TSW under a 2-stage implementation programme. The proposed sewerage works will form part of the permanent facilities for the Development.
- 1.1.55 Stage I utilizes the existing TSW sewerage network as an interim arrangement to meet the early population intakes of the development at Areas 3, 30 and 31. The interim arrangement will last for about half a year until the final sewerage scheme, under Stage II is complete. A short section (approximately 500 m) of the trunk sewer beneath Tin Shing Road will be surcharged but still have adequate factor of safety against overflow. In assessing the surcharged condition, sewage from Area 33 has been excluded in view of the high priority of the development at Areas 3, 30 and 31 and the unconfirmed status of the Area 33 development. Additional provision will be required if first occupation of the development at Area 33 takes place before completion of Stage II and would be the developer's responsibility.
- 1.1.56 Stage II involves constructing new gravity sewers beneath Roads L12, L13 and L14 and Tin Wah Road, a new sewage pumping station at Area 101 and a pair of rising mains along the Western Drainage Channel to convey sewage generated from Areas 102, 103 and 104 to Ha Tsuen Pumping Station. In order to dispense with the surcharge condition caused under Stage I to the existing TSW sewerage system, provision will be made under Stage II to re-route sewage from receiving points 27a, 31b and 33b for Areas 27, 31 and 33 respectively to the proposed trunk sewer beneath Tin Wah Road. After re-routing of the sewerage, the existing TSW sewerage network will be reverted to normal flow condition with no surcharge.

#### *Preliminary Design of Rising Mains*

- 1.1.57 The sewage of the RZ will be pumped to Ha Tsuen Pumping Station via 2 km long rising mains along the western bank of the WDC.
- 1.1.58 A preliminary assessment suggests that the rising mains should consist of a pair of 600 mm diameter ductile iron pipes. Twin instead of single pipe is selected from the maintenance point of view. These rising mains have been sized to serve the whole RZ development including any developments in the DZ which would discharge through them.

- 1.1.59 A buried pipe system is recommended to avoid any adverse visual impact to the surrounding environment. Open excavation is considered as a suitable and cost effective method to lay the pipe beneath footpaths/cycle tracks and drainage channels. Consideration should however be given during detailed design to using trenchless techniques at locations where the rising mains cross the drainage channels.
- 1.1.60 Access manholes will be provided at the location where the rising mains change in direction/gradient to facilitate the maintenance works.
- 1.1.61 The sewage retention time within the rising mains will be kept to a minimum to prevent the sewage from turning septic.

#### *Preliminary Design of Pumping Station*

- 1.1.62 According to the latest implementation programme, first occupation of the developments would happen between years 1999 and 2003. Staged installation of pumps should be considered during detailed design to tie in with the sewage build-up.
- 1.1.63 A preliminary assessment suggests that the proposed pumping station shall have an ultimate capacity for a peak flow of 1278 l/s. This flow is calculated from the respective sewage flows in the Sewage Flows Inventory for the developments served by the pumping station under the recommended option.
- 1.1.64 Electrically operated vertical spindle non-clog dry well sewage pumps have been recommended for their proven reliability and ease of inspection and maintenance.
- 1.1.65 The layout is similar to the existing station in Area 14. The pumping station will comprise a dry well, a divided wet sump and an intake channel.
- 1.1.66 The pumping station will be designed for unattended operation with appropriate instrumentation and control systems. Remote monitoring and alarms will be provided by a telemetry system if required.

#### *Utilities*

- 1.1.67 The proposed Developments have been planned to accommodate a population of approximately 59,000 in the DZ and 124,000 in the RZ. The roadworks and utilities networks have in general been completed in the DZ, whereas the RZ is presently undeveloped and equipped with no existing utility serving the areas.
- 1.1.68 The Developments are scheduled to be completed in stages. First occupation of the areas in the DZ is scheduled for 1999, followed by occupation of the areas in the RZ from year 2000 onward. It is therefore required to ensure that adequate utility service will be available to meet the development schedule.
- 1.1.69 The utility undertakings are generally responsible for the design and construction of utilities. At this preliminary design stage it is required to determine in consultation with the utility undertakings the locations of existing and proposed utilities affected by the engineering infrastructure, to make recommendations on utility diversions and to propose utility layout. The following utilities have been considered in the Assignment:-

- water supply;
- power supply;
- gas supply;
- telephone service;
- cable TV service;
- street lighting; and
- traffic signals.

1.1.70 Due consideration would be given to avoid conflicts with the provisions of sewers and stormwater drains including box culverts.

#### ***Water Supply***

- 1.1.71 To cope with increasing demand, a new treatment works would be built at Ngau Tam Mei. Stage 1 of this new treatment works is scheduled for commissioning in mid 1999.
- 1.1.72 Tan Kwai Tsuen North Service Reservoir will be built and the associated trunk mains will be completed in mid 1999 to coincide with the commissioning of Ngau Tam Mei Treatment Works.
- 1.1.73 In line with the current practice in Tin Shui Wai, the developments in the RZ would be provided with separate potable and non-potable water distribution systems. WSD have allowed for using fresh water for irrigation in the planning of the water supply system for Tin Shui Wai.

#### ***Power Supply***

- 1.1.74 China Light & Power Company Limited (CLP) have proposed that two primary substations, one in Area 32 of the DZ and one in Area 120 of the RZ, are needed for extension of their 132 kV circuit from DZ to RZ. Power supply to the proposed development in the DZ will be extended from the existing network.

#### ***Gas Supply***

- 1.1.75 The Hong Kong and China Gas Company Limited (HKCG) have confirmed that the gas supply to the proposed Developments will be fed from the existing gas supply network which includes the off-take plant at Au Tau, the distribution main through Yuen Long Town and beneath Long Tin Road and the distribution mains within Tin Shui Wai. The gas supply to the development areas in the RZ will be extended from the existing low and intermediate pressure gas mains beneath Tin Kwai Road, Tin Shing Road and Tin Shui Road in the DZ. No upgrading of the existing network will be required.
- 1.1.76 A new gas-off take station will be built in Tin Shui Wai or its vicinity to provide security of gas supply to Yuen Long Town and Tin Shui Wai including the RZ.



### *Telephone Service*

- 1.1.77 Hong Kong Telecom (HKT) have confirmed that their existing network and telephone exchange in Area 14 of the DZ are capable of providing telephone service for the proposed developments in the DZ. No new installation or upgrading of the existing network is required for provision of service to these developments.
- 1.1.78 It has also been confirmed with HKT that the existing telephone exchange in Area 14 has spare capacity to provide service for a population of 79,200 in the RZ development. HKT would upgrade the existing network by laying additional multi-way telephone ducts from the existing telephone exchange, along Tin Cheung Road and Tin Tsz Road and then across Tin Wah Road, to the RZ. This upgrading work is proposed to commence in mid 1996, subject to further confirmation by HKT.
- 1.1.79 A new telephone exchange will be required in Area 109 in the RZ at the end of 2000.
- 1.1.80 Other telecommunications companies will also provide telephone service for the Developments, through Hutchison Communication Ltd.

### *Cable TV Service*

- 1.1.81 Wharf Cable Limited (WCL) have planned to provide cable TV service to the DZ as well as the RZ. The proposed CATV cable network consists of a 2-way 100 mm diameter ducts and generally covers the whole Tin Shui Wai Development.

### *Other Utilities*

- 1.1.82 Provision of street lightings, traffic signals, fire hydrants and military utilities for the Developments are being investigated and the design will be addressed at the detailed design stage.

### *Temporary Utility Services*

- 1.1.83 Temporary utility services for construction of engineering infrastructure/upgrading work for the Development is under investigation. Telephone service, electricity and water supply will be the main services required for construction services.

### *Programme of the Project*

- 1.1.84 Figure 1.12 provides the current implementation programme for construction works associated with the Project. For ease of visualisation Figures 1.13 to 1.23 show the main works envisaged at this time, year by year.

### *Concurrent Projects*

- 1.1.85 During the construction phase for works under this Project many other major projects will be under construction (see Table 1.5). Those with the greatest potential for cumulative environmental impact with this Project are shown on the programme on Figure 1.12. Those within or close to Tin Shui Wai are shown on Figure 1.24. Those with the likelihood of impacting on water quality or ecological habitats just to the north of Tin Shui Wai are shown on Figure 1.25.

### *Housing Department Developments*

- 1.1.86 Throughout the construction phase of the Projects, new blocks of apartments and associated schools, commercial areas etc. will be erected. The Housing Department contracts are particularly substantial. There will be piling foundation works, general erection works and finishing activities occurring in various areas of Tin Shui Wai throughout the Project Works. These works for Housing Department are particularly intense between 1999 and 2001.

### *Private Developments in Tin Shui Wai*

#### *Proposed Commercial/Residential Development above the LRT Terminus/Bus Terminus in Area 33*

- 1.1.87 The development is a composite development with part of the G/F designed for the use of LRT terminus and bus terminus. The completion date of the proposed development had been anticipated to be 1999/2000.

### *Extension of the Low Flow Interceptor System*

- 1.1.88 DSD has constructed a 400 m x 1 m deep x 2.5 m wide low flow channel in the WDC, upstream of the inflatable dam. This interim measure to improve water quality in the WTC, will facilitate maintenance and is intended to alleviate the odour problem.

### *RZ Developments*

- 1.1.89 No detailed layouts for the private developments in the RZ will be available during the EIA study. However tentative occupation dates are known and these developments have been considered both as sources of cumulative impact and as sensitive receivers.

### *Developments near Tin Shui Wai*

#### *Residential Development and Recreational Facilities at Lau Fau Shan Area*

- 1.1.90 The proposed residential development (also referred as S. 16 planning report submitted on 24.1.95) was approved by the Town Planning Board upon review on 14.7.95. According to the proposed development programme, construction of the houses, club house and related recreation facilities was due to start in 01.07.96 lasting for 12 months. Land exchange and access road issues are delaying the programme and timing has to be confirmed.

#### *Other Developments*

- 1.1.91 Many other village-type developments are currently being considered by developers or have been submitted to the relevant government authorities. They are particularly common to the south of Tin Wah Road. While not all the development proposals will be approved it seems highly likely that many will proceed over the next eight or so years. In addition applications for other land-use changes are being made most of which will result in at least some site formation works and paving works.

#### *Yuen Long Water Supply, Tan Kwai Tsuen North Fresh Water Service Reservoir*

- 1.1.92 WSD has planned to augment the existing water supply system by construction of a new service reservoir in Tan Kwai Tsuen North together with associated trunk and distribution mains. The new reservoir is going to be constructed in two stages to meet the development programme. Planning Report No. 8/95 states that EPD completed an Environmental Review in 1994 of this project and concluded that no EIA was necessary.
- 1.1.93 WSD is commissioning a 5-month feasibility study on the service reservoir and the associated trunk mains. The implementation programme of the new service reservoir is expected to be finalised shortly.

#### *Diversion of 132 kV Overhead Cable*

- 1.1.94 The existing 132 kV overhead cable in the northeast portion of the RZ will need to be diverted before site formation of Areas 110, 111b, 107B and 109 can commence. The diversion was programmed to commence in November 1997 and be completed in April 1998, however the planning application was rejected by the TPB in August 1996. A new planning application is being made.

#### *CLP Substations*

- 1.1.95 To cope with electricity demand in the RZ, CLP anticipated 2 additional substations will be required, namely Stations B and C. Land application for Substation B in Area 32 of the DZ was submitted to District Lands Offices/Yuen Long in January 1995. CLP anticipated that substation B could be commissioned in 2000 to meet the population intake. Construction works will begin in January 1997.
- 1.1.96 A site in Area 120 has been reserved for Substation C. CLP envisage that Substation C will not be necessary before 2005; by then most of the development in the RZ will be completed.

### ***Telephone Exchange at Area 109a***

- 1.1.97 Hong Kong Telecom (HKT) confirmed that a new telephone exchange at Area 109a is needed to provide full telephone service to the Priority Sites (Areas 102 to 104) and subsequently, the rest of the development of the RZ. The site in Area 109a for the new telephone exchange will have to be formed and made available to HKT before February 1998, allowing two years for building construction to meet the population intake in Areas 102 to 104.

### ***Main Drainage Channels (MDC) for Ngau Tam Mei, Yuen Long and Kam Tin***

- 1.1.98 The MDC are currently being extensively dredged and widened. Very large volumes of materials have already been removed. The channels upstream of Castle Peak Road are to be cement-lined and these works will be concurrent with the construction phase of this Tin Shui Wai Project. Works will continue until mid 2004.

### ***Shenzhen River Training Project***

- 1.1.99 The Shenzhen and Hong Kong Authorities initiated cross border liaison meetings in 1982 to review and co-ordinate measures to prevent flooding and reduce pollution in the river catchment.
- 1.1.100 As a result of these initiatives a scheme to realign, widen and deepen the Shenzhen River downstream of Lo Wu was proposed in 1985.
- 1.1.101 This Project consists of a three stage scheme Stage 1 involves relatively localised works to truncate two existing meanders of the river close to Shenzhen City. Stage 2 involves more extensive dredging works downstream of Lo Wu to increase the depth and width of the Channel, and construction of flood protection works along both banks of the widened stream. Stage 3 involves dredging works upstream of Lo Wu.
- 1.1.102 Impacts from the concurrent project will be discussed further under each section of this report (e.g. noise, air, water quality, ecology).
- 1.1.103 Table 2.5 shows the summary of the concurrent projects likely to have an impact on the surrounding environment in Tin Shui Wai.

### ***West Rail Project***

- 1.1.104 The West Rail Project (previously known as Western Corridor Railway) is one of the several strategic routes that have been identified under the Railway Development Study, which is being managed by the Railway Division of Highways Department. The detailed feasibility of the West Rail is being undertaken by the KCRC. The project, currently the subject of much debate, has yet to be time tabled but would provide a new arterial transportation link to the border.
- 1.1.105 Part of the West Rail alignment will pass Tin Shui Wai, a rail station and public transport interchange is proposed for Tin Shui Wai.

1.1.106 Sections of the alignment in Tin Shui Wai will be constructed on a viaduct.

***Village Flood Protection Schemes River Training Works***

1.1.107 Only works for Ha Mei San Tsuen and Sheung Cheung Wai remain. Flood protection embankments are being completed and other upgrading works will be undertaken. The works at Ha Mei San Tsuen will be completed in early 2001. The works include formation of village expansion areas, stormwater drainage and sewerage systems, footpaths and landscaping. It is likely that minor river-training works on the secondary drainage system of the Tin Shui Wai Basin will be recommended as part of the Yuen Long, Kam Tin, Ngau Tam Mei and Tin Shui Wai Drainage Masterplan Study.

***Yuen Long and Kam Tin Sewerage Master Plan***

1.1.108 The Project is divided into five stages covering works in the whole North West New Territories, all of which will have a long term beneficial impact on watercourses draining into Inner Deep Bay.

1.1.109 The proposed Trunk Sewerage will be connecting areas surrounding the Tin Shui Wai DZ and RZ to the Ha Tsuen Pumping Station/San Wai Treatment Plant.

1.1.110 Stages 2, 4 and 5 involve a large area immediately south west and north of the Tin Shui Wai DZ and RZ respectively which will be connected by pumping and gravity mains via a series of receiving points and pumping stations to the Ha Tsuen Pumping Station.

Table 1.5  
Concurrent Projects

Projects	Start Date	Approx. Completion	Key Impacts		Sensitive Receivers	Comments
			construction noise construction dust construction waste surface water	medium light light light light		
Planning Application for proposed development over LRT/bus terminus	To be confirmed	To be confirmed	construction noise construction dust construction waste surface water	medium light light light light	Lynwood Court & Chestwood Court of Kingswood Villas	building construction works
CLP substation B at Area 32	Jan 1997	Dec 1999	construction noise construction dust construction waste surface water operational noise	medium light light light light light to medium	Tin Shui Estate, TWGH Yiu Dak Chi Memorial Primary School, TSW Public Primary School	construction works
CLP substation C at Area 120	mid 2001	mid 2003	construction noise construction dust construction waste surface water operational noise	medium light light light light light to medium	Maywood Court & Kenswood Court of Kingswood Villas, Area 104, Special Measure Zone (SMZ)	construction works
HKT telephone exchange at Area 109	May 1998	May 2000	construction noise construction dust construction waste surface water	medium light light light light	Area 104, SMZ	construction works
Proposed residential development at Lau Fau Shan	To be confirmed	To be confirmed	construction noise construction dust construction waste surface water	medium light light light light	Mong Tseng Tsuen, SMZ, Area 110	S.16 application submitted on 24.1.95, approved by Town Planning Board on 14.7.95, no further information received from developer

Table 1.5  
Concurrent Projects (cont'd)

Projects	Start Date	Approx. Completion	Key Impacts		Sensitive Receivers	Comments
			construction noise construction dust construction waste surface water operational noise	medium medium light light medium to heavy		
West Rail Project (Tin Shui Wai Station)	To be confirmed	To be confirmed	construction noise construction dust construction waste surface water operational noise	medium medium light light medium to heavy	Area 3, Area 13, Tin Yiu Estate, Tin Yau Court	construction of West Rail and Tin Shui Wai Station
Yuen Long water supply, Tan Kwai Tsuen North fresh water reservoir (Phase I & II)	Oct 1997	Dec 2000	construction noise construction dust water quality	light light light	Tin Shui Estate, Area 3, WTC	to be constructed along Western Drainage Channel Phase I (Oct 97 - Jul 99) Phase II (Jul 99 - Dec 00)
Diversion of CLP 132kV overhead cable	Dec 1997	April 1998				alignment of diversion route not yet finalised
Yuen Long, Kam Tin Sewerage Master Plan (all phases)	1999	2003 (under review)	construction noise construction dust water quality	light light light	Tin Shui Wai Estate Locwood Court Sha Chau Lei	currently under review
Shenzhen River Training Project (all stages)	Nov 1995	1999-2000	water quality hydrodynamics sedimentation erosion	heavy during Stage II light heavy during Stage II localised	Inner Deep Bay - especially at mouth Inner Deep Bay Inner Deep Bay -benthic organisms mangroves and mudflat	slight overall improvement in Inner Deep Bay increase in tidal range & velocities at mouth benthic organisms can withstand these levels deeper incised flow channels
Ngau Tam Mei, Yuen Long and Kam Tin - Main Drainage Channel (all phases)	Oct 1993	Dec 2000	water quality	very heavy	Inner Deep Bay	all stages involve some river training, deepening, widening and lining

## 1.2 Objectives of the Monitoring and Audit

- 1.2.1 Monitoring can be defined as the systematic collection of data through a series of repetitive measurements. For this project, monitoring involves the measurement of environmental parameters during Project works and the identification of any changes in these parameters which may be attributed to the Works so that proactive mitigation measures can be adopted to avoid the occurrence of adverse environmental impacts.
- 1.2.2 Baseline or control monitoring refers to the measurement of environmental parameters during a representative period for the purpose of determining the nature and range of "ambient", or natural, conditions in order to determine whether it is necessary to review or determine the standards with which construction monitoring results are to be compared.
- 1.2.3 The environmental audit system is intended to check methodically that the activities of the project will and are complying with previously defined environmental requirements and that the necessary measures have been identified to remedy any unacceptable or unforeseen environmental impacts. Environmental auditing is a check to reassure management and regulatory agencies that the Project will be and is being constructed in an environmentally acceptable manner. It also enables a post project analysis to be carried out to examine the accuracy of the original environmental impact assessment.
- 1.2.4 The EM&A Programme consists of a schedule of monitoring and auditing of designated environmental parameters of the area under the influence of development in order to:
- (i) provide a baseline database of "ambient", or pre-Project conditions;
  - (ii) follow up the recommendations of the EIA and the timely implementation of the identified mitigation measures;
  - (iii) ensure that the contracts, licences, working method statements, works programmes and detailed design of the Project incorporate the measures recommended in the EIA;
  - (iv) monitor and interpret conditions with respect to acceptance criteria during construction in order to provide an early indication that any of the environmental control measures or construction practices are failing to achieve the required standards;
  - (v) identify any additional preventive or remedial measures to be undertaken where unanticipated or where greater than predicted impacts arise.
  - (vi) provide data to determine the effectiveness of any mitigation or control measures implemented through changes in working practice undertaken if acceptance criteria are exceeded;
  - (vii) provide a database of conditions during and prior to the construction period for the assessment of the extended effects of construction and for the post-project audit;



- (viii) assess compliance with contractual or legislative environmental standards;
- (ix) assess the validity of the action and limit levels (AL levels) set for the event/action plans:

*Action Levels* - levels beyond which there is an indication of a deteriorating ambient environment for which a typical response would be more frequent monitoring. Appropriate remedial actions may be necessary to prevent environmental quality from exceeding the Limit Level which would be unacceptable;

*Limit Levels* - statutory limits stipulated in the relevant pollution control ordinances, *Hong Kong Planning Standards and Guidelines* or Environmental quality Objectives established by EPD.

- (x) ensure that only acceptable environmental impact impinges upon nearby sensitive uses and receivers with the aim of minimising adverse impact upon the surrounding environs.

### 1.3 Scope of the Monitoring and Audit

#### *The Monitoring Programme*

- 1.3.1 Air, noise, water quality and ecological monitoring programmes will be set up prior to the commencement of the construction works. Baseline monitoring will be undertaken before earth works begin. It has been recommended that the basic ecological, air, noise and water monitoring schedule established under the Project Works continues throughout the duration of Works under the Project. These Works are not scheduled for completion until the year 2003.

#### *The Auditing Programme*

- 1.3.2 The auditing and management role has a wide scope and should include all necessary actions to prevent environmental non-compliance. The scope of the audit includes but is not limited to the activities listed below.
- 1.3.3 The timely implementation of all the recommendations of the EIA should be followed up and reported in the EM&A reports.
- 1.3.4 The working method statements, the rolling works programmes, the licences, and the detailed design should be reviewed in order to identify as early as possible any unanticipated or greater than expected impacts. The reviews should be documented in the monthly EM&A reports.
- 1.3.5 Measures should be identified to prevent or remediate any unanticipated impacts.
- 1.3.6 In order to fulfil the requirements of the environmental auditing role, regular site inspections are essential and should be carried out as described in Section 7. In addition, site visits should be undertaken on an ad hoc basis as often as is necessary to ensure environmental compliance of the Project. The following points will be considered, as appropriate, for each of the monitored environmental impacts. The audit will:

- (i) check that the approved sampling procedures and analytical techniques are used to collect the data;
- (ii) consider wind and weather conditions where appropriate at the time of sampling;
- (iii) ascertain whether any extraneous activities, unrelated to the construction works on the site, may have influenced the data. Factors such as nearby construction works should be considered;
- (iv) ascertain what activities or operations take place at the site before or during the sampling period;
- (v) compare the data with AL levels and identify any non-compliance as compared to data provided by baseline and control station monitoring;
- (vi) implement action plans where appropriate and communicate with all involved parties;
- (vii) review actions taken to deal with non-compliance;
- (viii) evaluate the success of the mitigation measures implemented, for reduction of noise and dust impact, water quality impacts, waste impacts and ecological impacts;
- (ix) review the overall monitoring philosophy, in terms of sampling location, frequency, parameter measured, test method, acceptance criteria and control procedure. Revise if necessary;
- (x) revise the scope and frequency of the auditing system to reflect changes in environmental impacts and construction procedures;
- (xi) carry out a post project analysis to compare the environmental impacts predicted in the EIA with actual impacts;
- (xii) issue regular reports on the monitoring & auditing programme; and
- (xiii) review actions taken to deal with complaints from the general public and consider whether any fundamental changes are necessary. A clearly defined system shall be established to respond promptly to public complaints.

#### 1.4 Identification of Key Responsibilities

- 1.4.1 A flowchart of lines of authority for the EM&A programme is presented on Figure 1.26.

***The Client***

1.4.2 The Client shall be responsible for:

- (i) engaging a Monitoring Team(s) (MT) who will be under the direction of the Environmental Manager (EM).
- (ii) providing all necessary monitoring equipment via the MT.

1.4.3 The Client may require selected contractors to undertake the above roles on his behalf on a reimburseable basis to facilitate contract and financing arrangements.

***Each Contractor***

1.4.4 Each Contractor(s) shall be responsible for:

- (i) implementing environmental controls and mitigation as set out in this manual as well as any additional measures necessary for compliance with the environmental control standards;
- (ii) following any reasonable directions given by the Engineer or the ER(s) particularly as the result of the implementation of event/action plans;
- (iii) each Contractor shall comply with and observe all Ordinances, bye-laws, regulations and rules for the time being in force in Hong Kong governing the control of any form of pollution, including air, noise, water and waste pollution, and shall implement environmental controls and mitigation as set out in this manual as well as any additional measures necessary for compliance with the environmental control standards;
- (iv) each Contractor shall carry out all works in such a manner as to cause as little impacts as possible to environs and the Contractor shall be held responsible for any claims which may arise from such impacts.

***The Engineer***

1.4.5 The Engineer will be responsible for:

- (i) ensuring that the EM&A programme is fully implemented in accordance with the EM&A and the EIA study;
- (ii) providing an Environmental Management Team (EMT) headed by the EM;
- (iii) ensuring that the Contractor is implementing environmental controls and mitigation as set out in the Manual as well as any additional measures necessary for compliance with the environmental control standards;
- (iv) ensuring that the Contractor is implementing and enforcing event/action plans when exceedances of AL levels occur;

- (v) reviewing the monitoring and audit reports submitted by the EMT;
- (vi) implementing a 'stop work' action if repeated exceedance of target levels justifies this action.

1.4.6 The division of the responsibilities under the Engineer are given in the following paragraphs.

***The Engineer's Representative (ER(s))***

1.4.7 The ER(s) have a key role to play with the EM&A programme, undertaking:

- (i) an engineering audit of environmental reports;
- (ii) site liaison;
- (iii) implementing and enforcing event/action plans under the Contract when exceedances of AL levels occur; and
- (iv) ensuring that measures to protect surface water quality are both sufficient and properly and regularly maintained under the Contract.

***The Environmental Management Team (EMT)***

1.4.8 The EMT led by the EM will hold a key position with the EM&A programme, undertaking:

- (i) the approval of the appointment and the direction of the MT;
- (ii) the ecological monitoring including data collection;
- (iii) the auditing role;
- (iv) the main reporting function;
- (v) the liaison and communication function; and
- (vi) the implementation and/or the necessary arrangement to implement the EIA recommendations.

- 1.4.9 The EMT under the control of the EM will be responsible for:
- (i) reviewing the EIA and the detailed designs to ensure EIA recommendations and any other measures identified during the reviews are incorporated into the designs;
  - (ii) ensuring that the contracts, licences and detailed designs of the Project incorporate the measures recommended in the EIA;
  - (iii) checking that timely implementation of mitigation measures identified in the EIA occurs;
  - (iv) examining Contractors' rolling works programmes, method statements, licence application and other relevant documentation so as to ensure the best practice would be implemented to generate no unacceptable impacts to the established guidelines/standards;
  - (v) identifying any potential unanticipated or greater than expected impacts;
  - (vi) formulating any necessary preventative or remedial measures to be actioned for these potential impacts;
  - (vii) liaising with the Engineer(s), and Contractors on environmental considerations both regularly and as necessary;
  - (viii) undertaking site visits both regularly and on ad-hoc basis at a frequency appropriate to the intensity of the Works;
  - (ix) undertaking the ecological monitoring programme;
  - (x) supervising the MT;
  - (xi) reviewing the monitoring data produced taking into account any factors which may influence this data;
  - (xii) interpreting the reviewed data with reference to AL levels and baseline and control data;
  - (xiii) ascertaining whether any extraneous activities, unrelated to the construction work on the site, may have influenced the data. Factors such as nearby construction works should be considered;
  - (xiv) implementing event/action plans when exceedances of AL levels occur;
  - (xv) liaising and consulting with all relevant parties during the implementation of action plans;
  - (xvi) reviewing the EM&A programme after the collection and analysis of the baseline data. Modifying the EM&A programme in terms of parameters sites, sample sizes, frequency etc. if appropriate in consultation with the Engineer, EPD and AFD.

- (xvii) modifying the EM&A programme in consultation with the ER(s), EPD and AFD if necessary throughout the period of Works;
- (xviii) producing and circulating reports:
  - on a regular monthly basis;
  - when action plans are implemented;
  - when responding to public complaints; and
- (xix) implementing the complaints procedures.

1.4.10 The MT will be responsible for:

- (i) collecting all the necessary data using laboratory analyses as appropriate for the air, noise and the regular water programmes using the procedures outlined in the Manual;
- (ii) recording what activities or operations take place at the site before or during the sampling period;
- (iii) recording factors such as wind and weather conditions where appropriate at the time of sampling or data collection;
- (iv) undertaking regular maintenance and calibration of equipment so that accurate data is collected with precision;
- (v) reporting to the EM any abnormality in monitoring process and any difficulties encountered; and
- (vi) ensuring that monitoring results are sent to both the ER and the EMT as quickly as possible.

## 1.5 Lines of Communication

1.5.1 Summary of the lines of communication for the reporting function is illustrated on Figure 1.27.

### *Data Report*

1.5.2 The manager of the MT shall issue data reports as quickly as possible to:

- (i) the ER(s); and
- (ii) the EMT.

### *Report Format*

1.5.3 The format of these reports shall be agreed in discussion between the EMT, the MT and the ER. Presentation of data via modem or on disk will be preferred.

### **Main Reporting Function**

1.5.4 The EMT shall be responsible for the main reporting function. Both regular monthly and unscheduled incident reports shall be circulated as appropriate to:

- (i) the ER(s);
- (ii) the Contractor;
- (iii) the MT;
- (iv) the Client; and
- (v) EPD.

### **1.6 Complaints**

1.6.1 Response must be made to all complaints received from all sources. All complaints need sensitive handling. The EM will be responsible for the implementation of complaints procedures in consultation with the ER(s). A flowchart of the tasks is given in Figure 1.28.

1.6.2 A formal procedure for handling complaints about environmental matters is outlined below:

- (a) Each complaint will be logged to record:
  - (i) data and time;
  - (ii) source of complaint;
  - (iii) complainant's name, telephone or fax number, and address;
  - (iv) nature of the complaint;
  - (v) site situations as observed by complainant;
  - (vi) results of investigations into the complaints; and
  - (vii) records of all communications made and actions taken.
- (b) A copy of this log will form a part of the regular monthly reports and will be accompanied by a review of the circumstances including any recommendations necessary to avoid recurrence of an error, if any, detected during the investigation of the complaints.
- (c) All complainants will be answered as soon as possible in writing acknowledging receipt of the complaint and explaining how the complaint process functions.
- (d) All complaints will be investigated. The complainant will be informed of any initial findings and/or subsequent actions, if any. The complainant may also need to be contacted after mitigation measures have been introduced, to ensure their sufficiency.
- (e) Additional monitoring will be recommended if appropriate.
- (f) The EM will use discretion and liaise with all relevant parties as necessary. EPD will normally be notified via the monthly report only when the complaint originates via EPD or the complaint is of a particularly serious nature.

## 1.7 Report

### *Baseline Monitoring Report*

1.7.1 The baseline monitoring report will be prepared and circulated by the EMT. It should include at least the following:

- (i) up to half a page executive summary;
- (ii) brief project background information;
- (iii) drawings showing locations of the baseline monitoring stations;
- (iv) monitoring results (in both hard and diskette copies) together with the following information:
  - monitoring methodology;
  - equipment used and calibration details;
  - parameters monitored;
  - monitoring locations (and depth);
  - monitoring data, time, frequency and duration;
- (v) details on influencing factors, including:
  - major activities, if any, being carried out on the site during the period;
  - weather conditions during the period;
  - other factors which might affect the results;
- (vi) determination of the Action and Limit Levels for each monitoring parameter;
- (vii) revisions for inclusion in the EM&A Manual; and
- (viii) comments and conclusions.

### *Monthly EM&A Reports*

1.7.2 The results and findings of each audit should be documented in monthly EM&A reports prepared by the EMT. Monthly EM&A reports shall include at least the following:

- (i) 1 to 2 page executive summary;
- (ii) basic project information including a synopsis of the project organisation, programme and management structure, and the work undertaken during the month;
- (iii) a brief summary of EM&A requirements including:
  - all monitoring parameters;
  - environmental quality performance limits (Action and Limit levels);



- Event-Action Plans;
  - environmental mitigation measures, as recommended in the project EIA study final report;
  - environmental requirements in contract documents;
- (iv) advice on the implementation status of environmental protection and pollution control (mitigation) measures, as recommended in the project EIA study report, summarised in updated implementation schedule;
- (v) document the audit conducted, such as, design audit, site inspection audit, construction methodology audit, construction programme audit, monitoring procedure audit, etc.;
- (vi) document the details as a result of Section 1.2 and 1.3;
- (vii) comment on the proactive measures taken and the effectiveness for impact prevention;
- (viii) drawings showing the project area, any environmental sensitive receivers and the locations of the monitoring and control stations;
- (ix) monitoring results (in both hard and diskette copies) together with the following information:
- monitoring methodology;
  - equipment used and calibration details
  - parameters monitored;
  - monitoring locations (and depth);
  - monitoring date, time, frequency, and duration;
- (x) graphical plots of trends of monitored parameters over the past four reporting periods for representative monitoring stations annotated against the following:
- major activities being carried out on site during the period;
  - weather conditions during the period; and
  - any other factors which might affect the monitoring results;
- (xi) reports of bird observations may be limited to species lists in this report;
- (xii) advice on the solid and liquid waste management status;
- (xiii) a review of the site inspection including the monitoring results during site visits and an evaluation of the success of mitigation measures;
- (xiv) a summary of noncompliance (exceedances) of the environmental quality performance limits (Action/Limit levels);
- (xv) a review of the reasons for and the implications of non-compliance including review of pollution sources and working procedures;

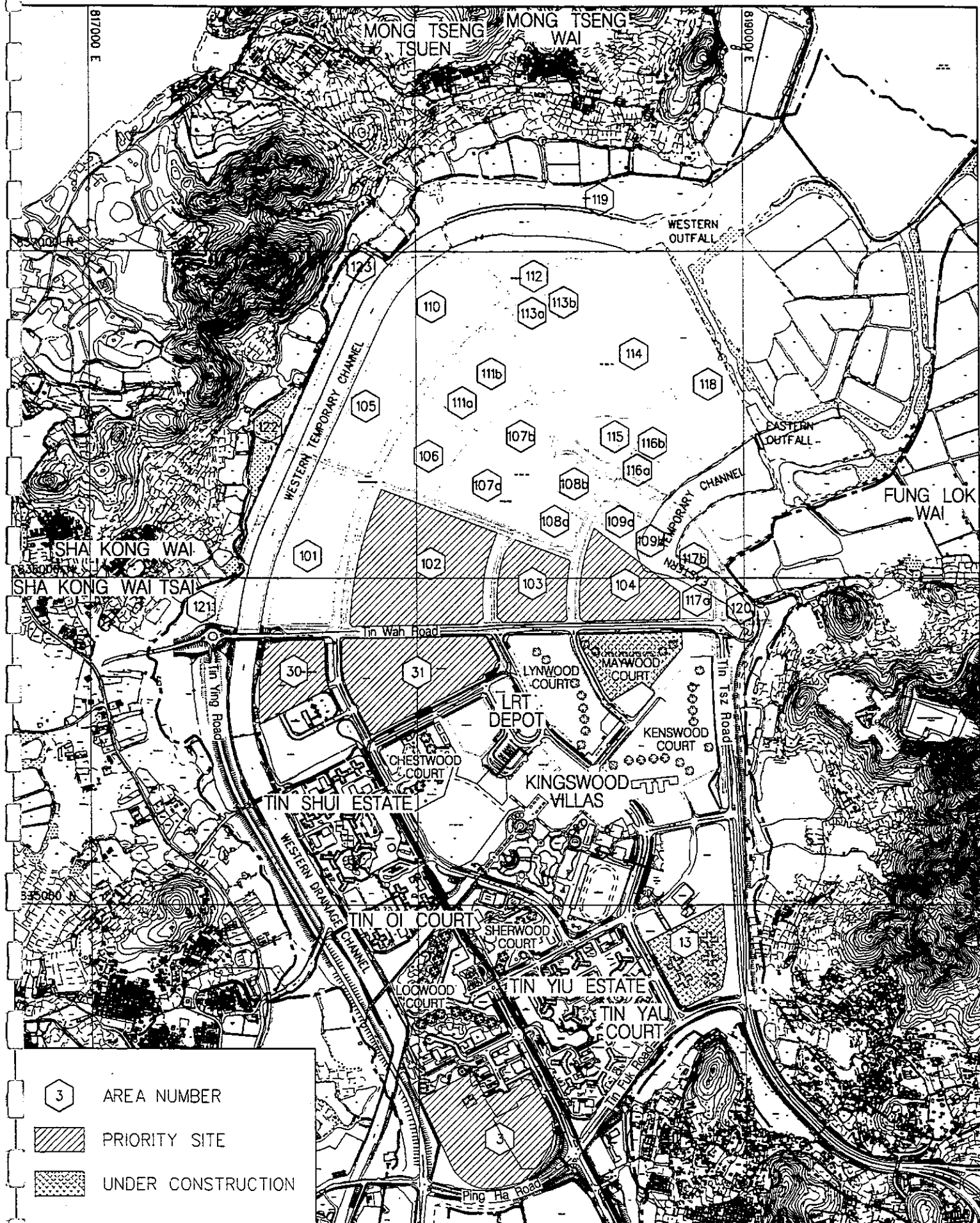
- (xvi) a description of the actions taken in the event of non-compliance and deficiency reporting and any follow-up procedures related to earlier noncompliance;
- (xvii) a summary record of all complaints received (written or verbal) for each media, including locations and nature of complaints, liaison and consultation undertaken, actions and follow-up procedures taken and summary of complaints;
- (xviii) a forecast of the works programme, impact predictions and monitoring schedule for the next three months; and
- (xix) comments, recommendations and conclusions for the month.




#### **Quarterly EM&A Reports**

1.7.3 The quarterly EM&A summary report prepared by the EMT should generally be around 5 pages long including about 3 pages of text and tables and 2 pages of figures. It should contain at least the following:

- (i) up to half a page executive summary;
- (ii) basic project information including a synopsis of the project organisation, programme, contacts of key management, and a synopsis of work undertaken during the quarter;
- (iii) a brief summary of EM&A requirements including:
  - monitoring parameters;
  - environmental quality performance limits (Action and Limit levels); and
  - environmental mitigation measures, as recommended in the project EIA study final report;
- (iv) advice on the implementation status of environmental protection and pollution control (mitigation) measures, as recommended in the project EIA study report, summarised in the updated implementation schedule;
- (v) drawings showing the project area, any environmental sensitive receivers and the locations of the monitoring and control stations;
- (vi) graphical plots of the trends of monitored parameters over the past 4 months (the last month of the previous quarter and the present quarter) for representative monitoring stations annotated against:
  - the major activities being carried out on site during the period;
  - weather conditions during the period; and
  - any other factors which might affect the monitoring results;details of numbers and species of birds shall be presented in this report;
- (vii) advice on the solid and liquid waste management status;

- (viii) review of site inspection records including evaluation of the success of mitigation measures;
- (ix) a summary of noncompliance (exceedances) of the environmental quality performance limits (Action/Limit levels);
- (x) a brief review of the reasons for and the implications of non-compliance including review of pollution sources and working procedures;
- (xi) a summary description of the actions taken in the event of non-compliance and any follow-up procedures related to earlier non-compliance;
- (xii) a summary record of all complaints received (written or verbal) for each media, liaison and consultation undertaken, actions and follow-up procedures taken;
- (xiii) comments, recommendations and conclusions for the quarter; and
- (xiv) proponents' contacts and any hotline telephone number for the public to make enquiries.



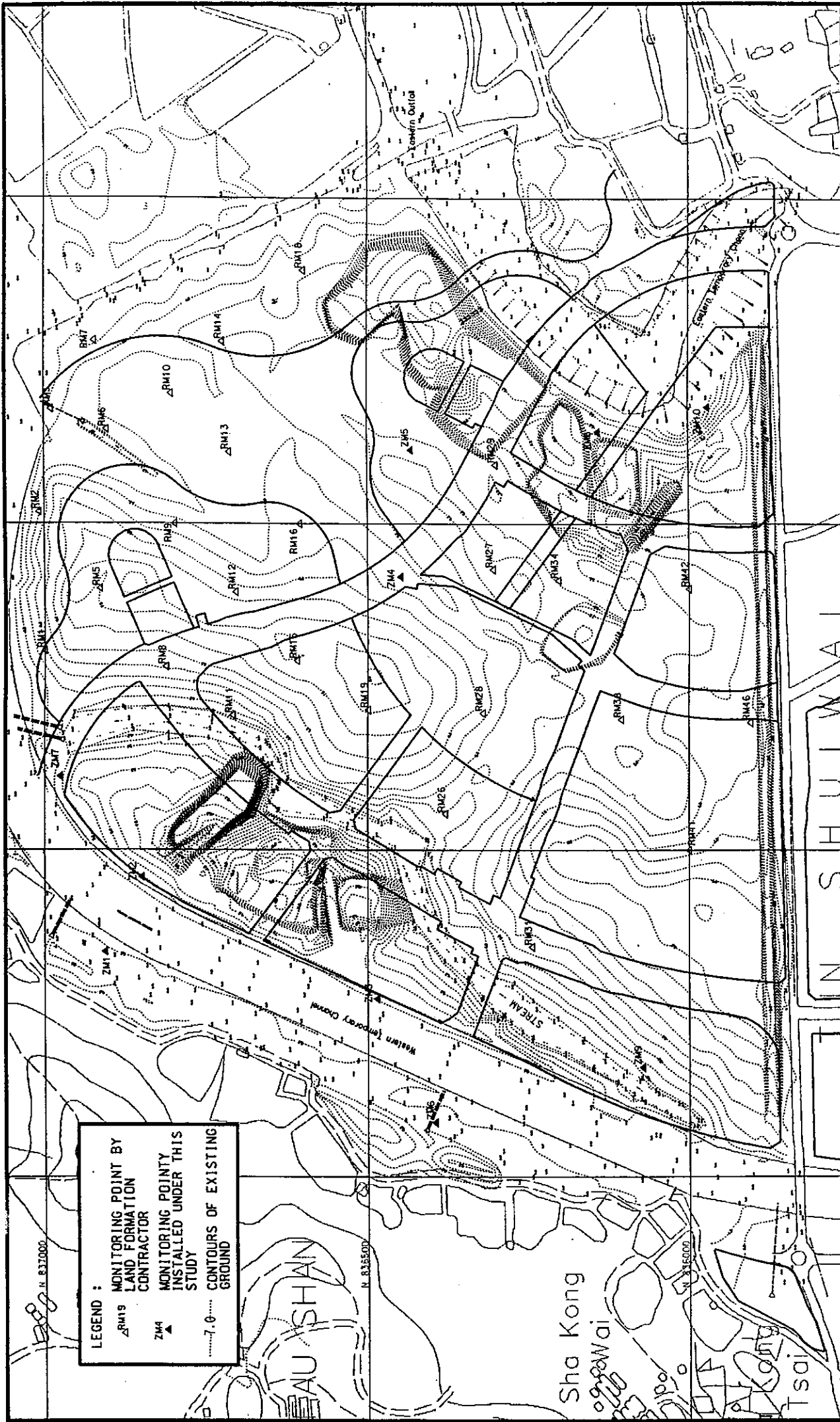
-  AREA NUMBER
-  PRIORITY SITE
-  UNDER CONSTRUCTION

TIN SHUI WAI DEVELOPMENT  
 AGREEMENT NO. CE 10/95  
 ENGINEERING INVESTIGATIONS FOR  
 DEVELOPMENT OF AREAS 3, 30 & 31  
 OF THE DEVELOPMENT ZONE  
 AND THE RESERVE ZONE

Title :

## AREAS WITHIN THE TIN SHUI WAI DEVELOPMENT

Figure No.	Revision
1.1	1
Reference	File Name
TSW-BASE	00110018.C09
Prepared	Checked
MC	PS
Date	Scale
OCT. 96	1:15000



**LEGEND :**  
 ▲ RM19 MONITORING POINT BY LAND FORMATION CONTRACTOR  
 ▲ ZM4 MONITORING POINT, INSTALLED UNDER THIS STUDY  
 ..... 7.0 ..... CONTOURS OF EXISTING GROUND

Figure no. 1.2

Prepared	CWT	Checked	KHL
Date	10/96	Scale	N.T.S.

**EXISTING GROUND LEVELS**  
 TIN SHUI WAI DEVELOPMENT  
 AGREEMENT NO. CE 10/95  
 ENGINEERING INVESTIGATIONS FOR  
 DEVELOPMENT OF AREAS 3, 30 & 31  
 OF THE DEVELOPMENT ZONE  
 AND THE RESERVE ZONE  
 SINHIE CONSULTANTS LIMITED  
 香港工程師有限公司  
 CONSULTANTS AND ARCHITECTS

TIN SHUI WAI

Sha Kong  
Wai

AU SHAN

TSAI

**LEGEND:**  
 MINIMUM FORMATION  
 LEVEL +4.8 mPD

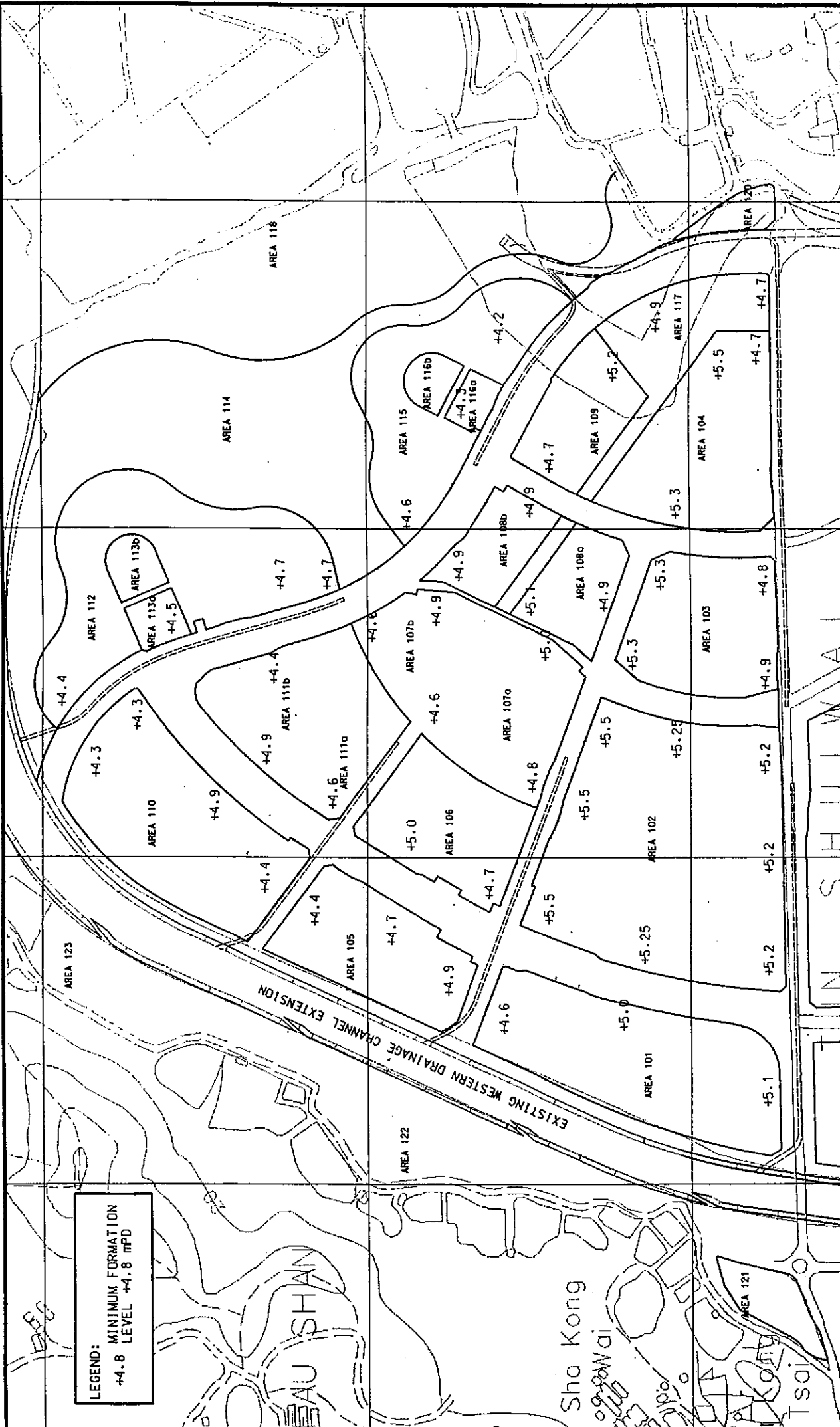
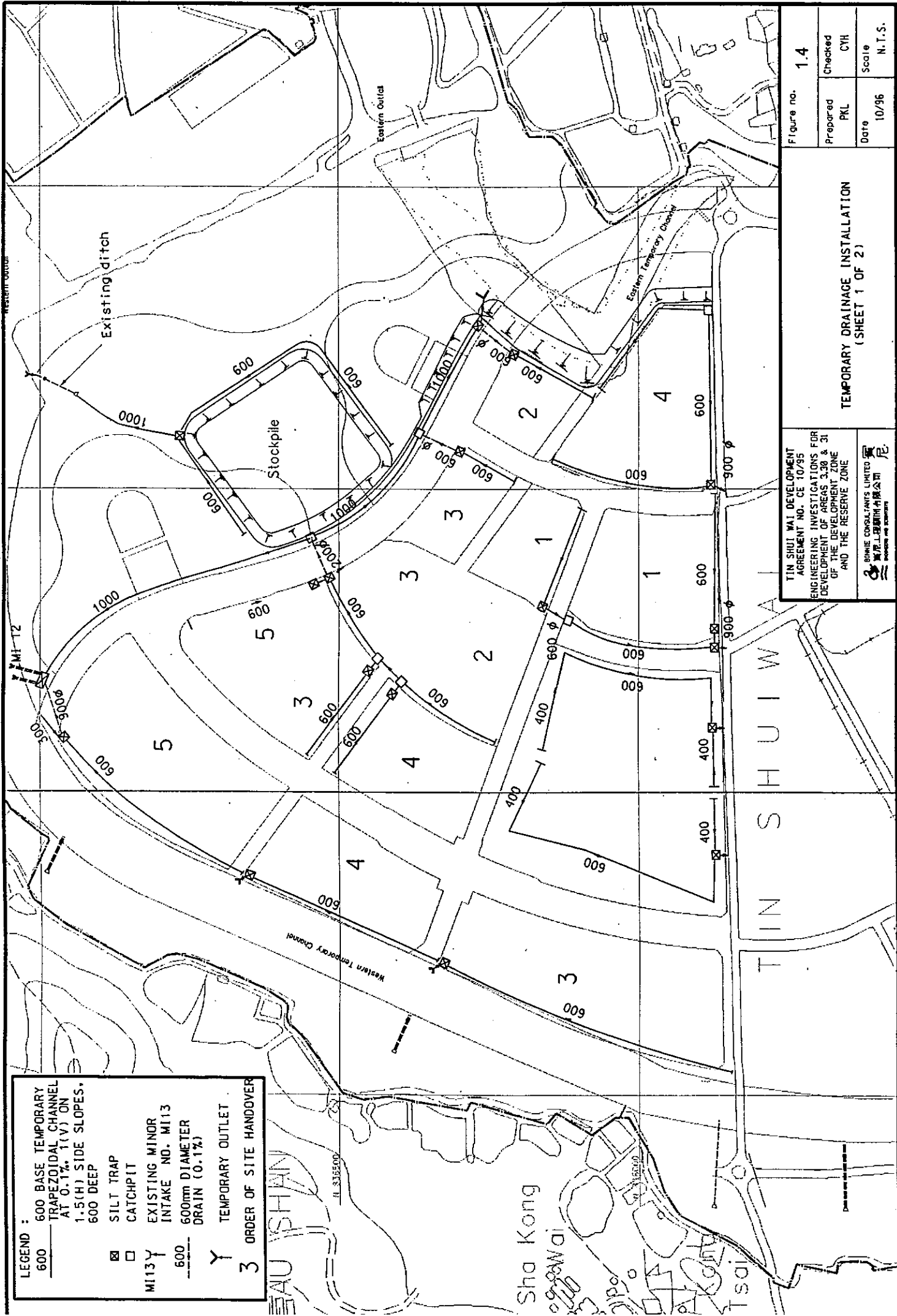


Figure no. 1.3	
Prepared	PKL
Checked	CYH
Date	11/96
Scale	N.T.S.

**PROPOSED MINIMUM FORMATION LEVELS**

TIN SHUI WAI DEVELOPMENT  
 AGREEMENT NO. CE 10/95  
 ENGINEERING INVESTIGATIONS FOR  
 DEVELOPMENT OF AREAS 3, 20 & 31  
 OF THE DEVELOPMENT ZONE  
 AND THE RESERVE ZONE

BINIE CONSULTANTS LIMITED  
 寶尼士工程顧問有限公司  
 INCORPORATED IN HONG KONG



**LEGEND :**  
 600 600 BASE TEMPORARY TRAPEZOIDAL CHANNEL AT 0.1%, 1(V) ON 1.5(H) SIDE SLOPES, 600 DEEP  
 ☒ SILT TRAP  
 ☐ CATCHPIT  
 MI13 Y EXISTING MINOR INTAKE NO. MI13  
 600 600mm DIAMETER DRAIN (0.1%)  
 Y TEMPORARY OUTLET  
 3 ORDER OF SITE HANDOVER

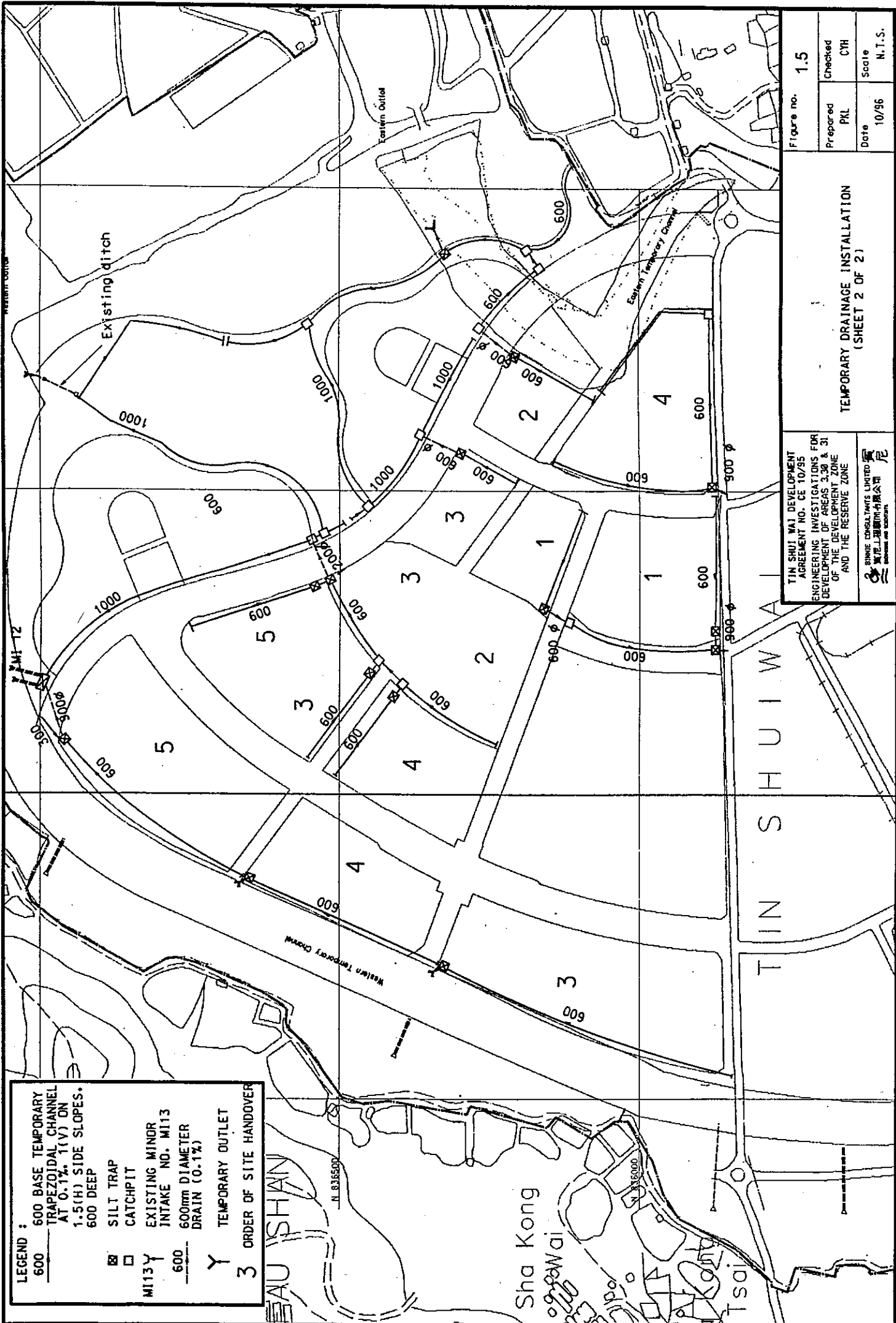
**TIN SHUI WAI DEVELOPMENT AGREEMENT NO. CE 10/95 ENGINEERING INVESTIGATIONS FOR DEVELOPMENT OF AREAS 3, 28 & 31 OF THE DEVELOPMENT ZONE AND THE RESERVE ZONE**

**SHINKE CONSULTANTS LIMITED**  
 香港工程師有限公司  
 INCORPORATED IN HONG KONG

**TEMPORARY DRAINAGE INSTALLATION (SHEET 1 OF 2)**

Figure no. 1.4

Prepared	PKL	Checked	CYH
Date	10/96	Scale	N.T.S.



**LEGEND :**

600 600 BASE TEMPORARY TRAPEZOIDAL CHANNEL AT 0.1% 1(V) ON 1.5(H) SIDE SLOPES, 600 DEEP

☒ SILT TRAP  
☐ CATCHPIT

M113 Y EXISTING MINOR INTAKE NO. M113

600 600mm DIAMETER DRAIN (0.1%)

Y TEMPORARY OUTLET

3 ORDER OF SITE HANDOVER

TIN SHUI WAI DEVELOPMENT  
AGREEMENT NO. CE 10/95  
ENGINEERING INVESTIGATIONS FOR  
DEVELOPMENT OF AREAS 3, 30 & 31  
OF THE DEVELOPMENT ZONE  
AND THE RESERVE ZONE

SHINE CONSULTANTS LIMITED  
新進顧問有限公司  
INCORPORATED IN HONG KONG

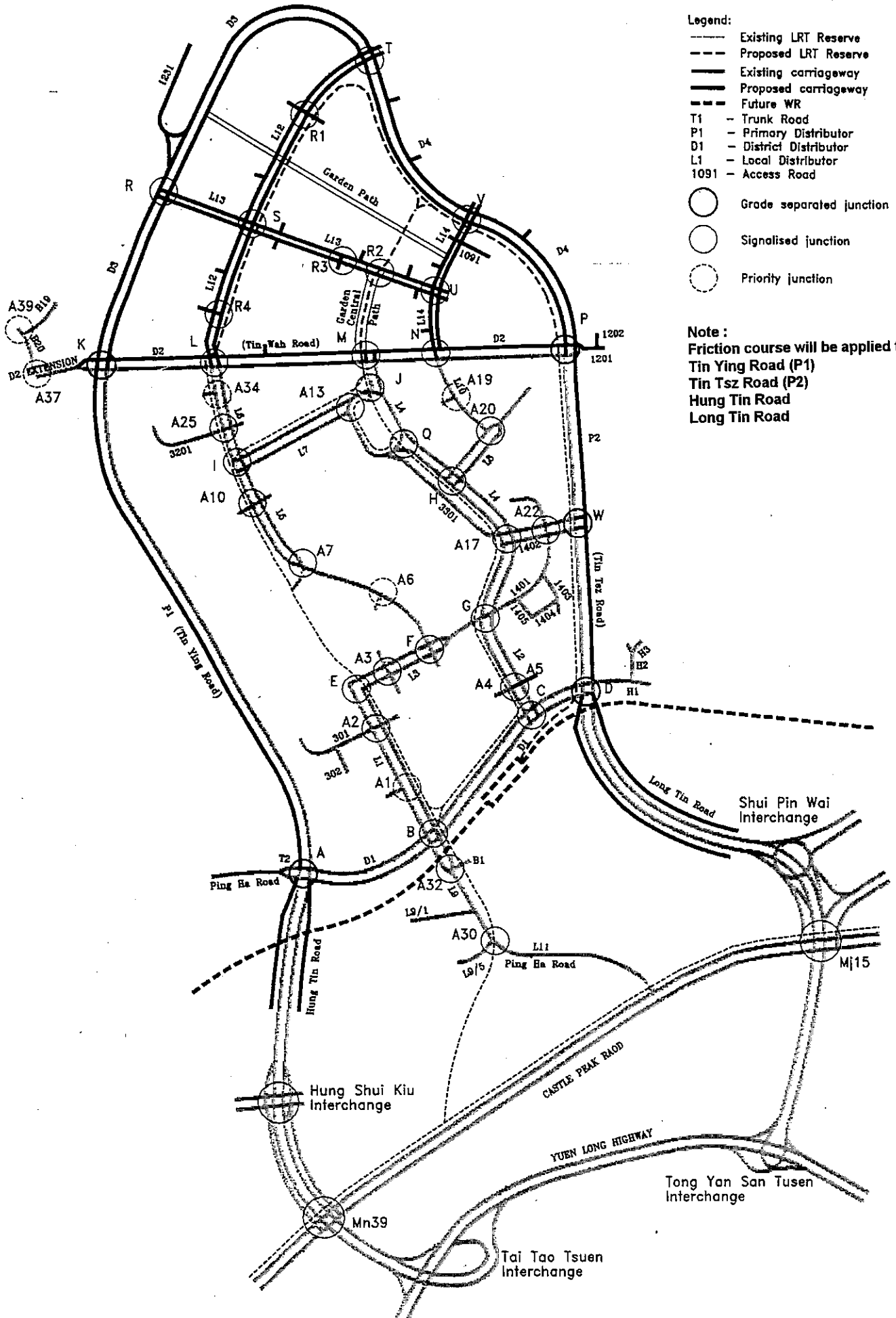
Figure no.	1.5
Prepared	PKL
Checked	CYH
Date	10/96
Scale	N.T.S.

**TEMPORARY DRAINAGE INSTALLATION  
(SHEET 2 OF 2)**



- Legend:**
- Existing LRT Reserve
  - - - Proposed LRT Reserve
  - Existing carriageway
  - Proposed carriageway
  - - - Future WR
  - T1 - Trunk Road
  - P1 - Primary Distributor
  - D1 - District Distributor
  - L1 - Local Distributor
  - 1091 - Access Road
- Grade separated junction
  - Signalised junction
  - Priority junction

**Note :**  
Friction course will be applied to:  
Tin Ying Road (P1)  
Tin Tsz Road (P2)  
Hung Tin Road  
Long Tin Road

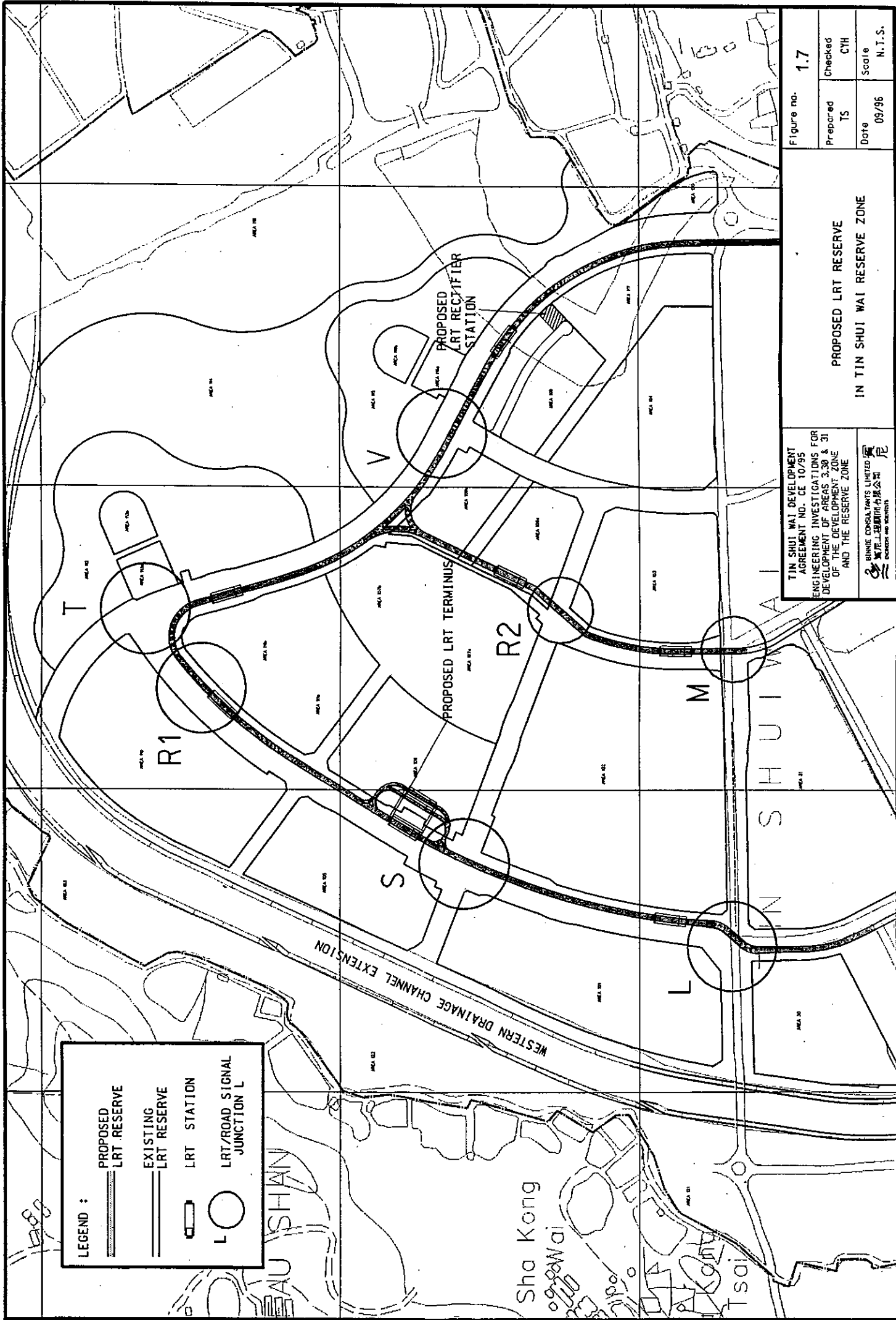


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AGREEMENT NO. CE 10/95  
ENGINEERING INVESTIGATIONS FOR  
DEVELOPMENT OF AREAS 3, 30 & 31  
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AND THE RESERVE ZONE

**BURNS CONSULTANTS LIMITED**  
怡和洋行有限公司

## ROAD AND JUNCTION NOMENCLATURE

Figure		1.6
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SCM	CYH	
Date	Scale	
FEB 97	NTS	



**LEGEND :**

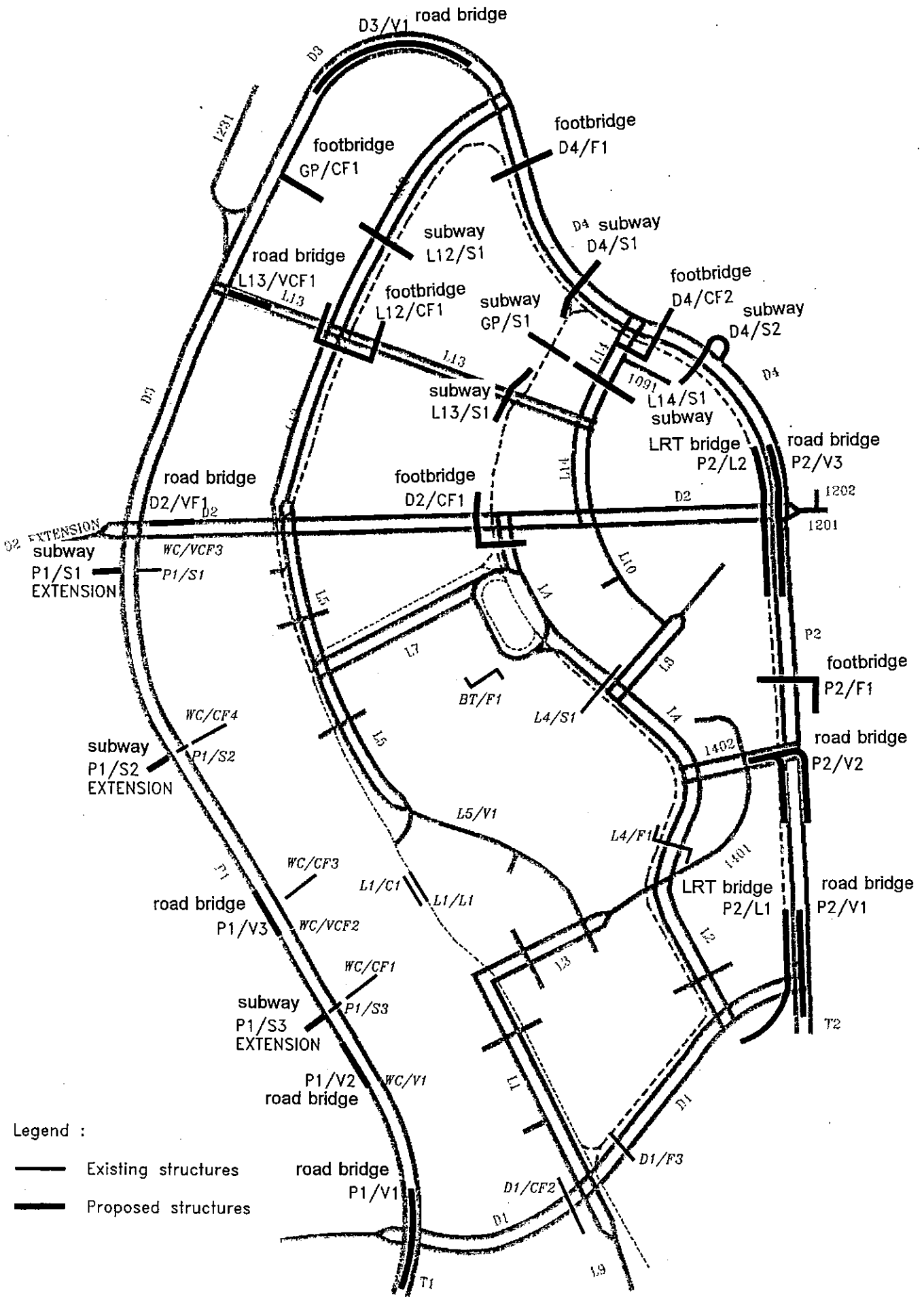
- PROPOSED LRT RESERVE
- EXISTING LRT RESERVE
- LRT STATION
- LRT/ROAD SIGNAL JUNCTION L

TIN SHUI WAI DEVELOPMENT  
 AGREEMENT NO. CE 10/95  
 ENGINEERING INVESTIGATIONS FOR  
 DEVELOPMENT OF AREAS 3, 20 & 31  
 OF THE DEVELOPMENT ZONE  
 AND THE RESERVE ZONE

BUNNIE CONSULTANTS LIMITED  
 寶龍工程顧問有限公司  
 ENGINEERS AND ARCHITECTS

**PROPOSED LRT RESERVE ZONE  
 IN TIN SHUI WAI RESERVE ZONE**

Figure no.	1.7
Prepared	TS
Checked	CYH
Date	09/96
Scale	N.T.S.



Legend :

— Existing structures

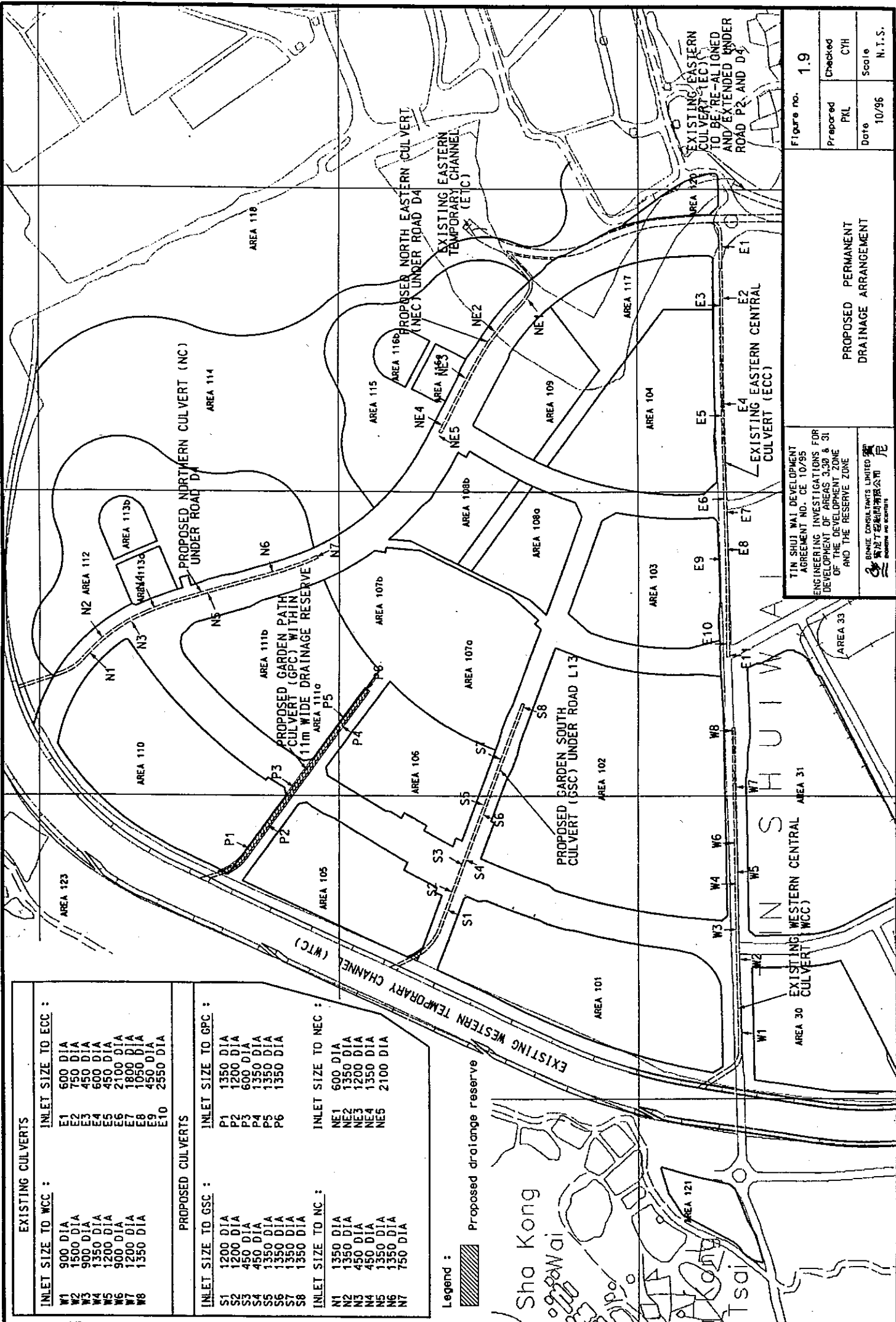
— Proposed structures

TIN SHUI WAI DEVELOPMENT  
 AGREEMENT NO. CE 10/95  
 ENGINEERING INVESTIGATIONS FOR  
 DEVELOPMENT OF AREAS 3, 30 & 31  
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 AND THE RESERVE ZONE

SHINTE CONSULTANTS LIMITED 實尼  
 實尼工程顧問有限公司  
 ENGINEERS AND ARCHITECTS

LOCATIONS OF  
 HIGHWAY STRUCTURES

Figure no. 1.8	
Prepared SCM	Checked CYH
Date 10/96	Scale NTS



EXISTING CULVERTS	
INLET SIZE TO WCC :	INLET SIZE TO ECC :
W1	600 DIA
W2	1500 DIA
W3	750 DIA
W4	450 DIA
W5	900 DIA
W6	1350 DIA
W7	1200 DIA
W8	1350 DIA

PROPOSED CULVERTS	
INLET SIZE TO GSC :	INLET SIZE TO OPC :
S1	1200 DIA
S2	1200 DIA
S3	450 DIA
S4	600 DIA
S5	1350 DIA
S6	1350 DIA
S7	1350 DIA
S8	1350 DIA

INLET SIZE TO NEC :	
NE1	600 DIA
NE2	1350 DIA
NE3	1200 DIA
NE4	450 DIA
NE5	1350 DIA
NE6	1350 DIA
NE7	2100 DIA

Legend : Proposed drainage reserve

Figure no.	1.9
Prepared	PKL
Checked	CYH
Date	10/96
Scale	N.T.S.

TIN SHUI WAI DEVELOPMENT AGREEMENT NO. CE 10/95  
 ENGINEERING INVESTIGATIONS FOR DEVELOPMENT OF AREAS 3, 30 & 31 OF THE DEVELOPMENT ZONE AND THE RESERVE ZONE

PROPOSED PERMANENT DRAINAGE ARRANGEMENT

BUNNIE CONSULTANTS LIMITED  
 寶尼士顧問有限公司

EXISTING EASTERN CULVERTS (EC) TO BE RE-ALIGNED AND EXTENDED UNDER ROAD P2 AND D4

PROPOSED NORTH EASTERN CULVERT (NEC) UNDER ROAD D4

PROPOSED NORTHERN CULVERT (NC) UNDER ROAD D4

PROPOSED GARDEN PATH CULVERT (GPC) WITHIN (11m WIDE DRAINAGE RESERVE

PROPOSED GARDEN SOUTH CULVERT (GSC) UNDER ROAD L13

EXISTING WESTERN CENTRAL CULVERT (WCC)

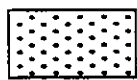
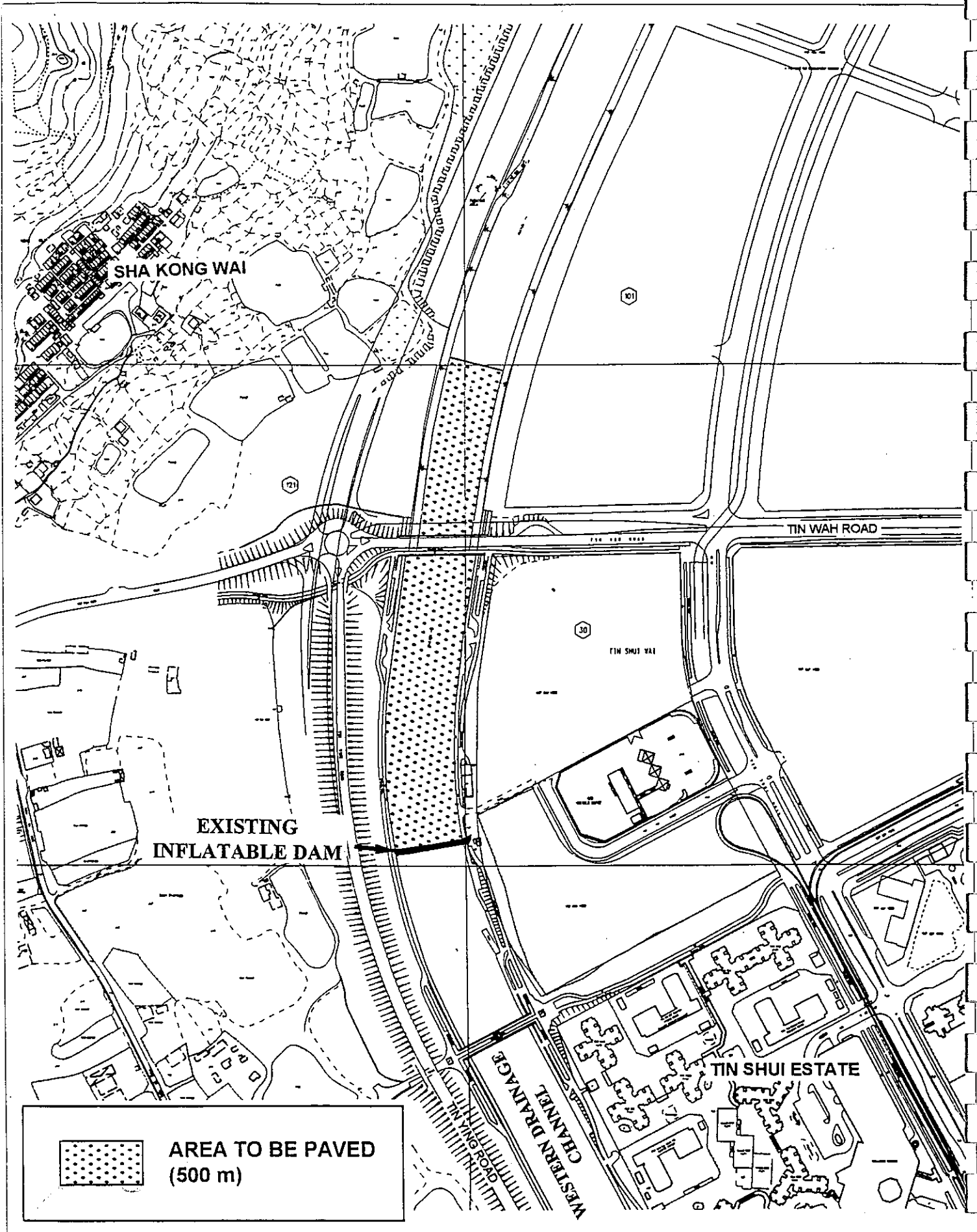
EXISTING EASTERN CENTRAL CULVERT (ECC)

Sha Kong  
 沙坑

Tsai  
 寨

WESTERN CENTRAL CULVERT (WCC)

EASTERN CENTRAL CULVERT (ECC)



**AREA TO BE PAVED  
(500 m)**

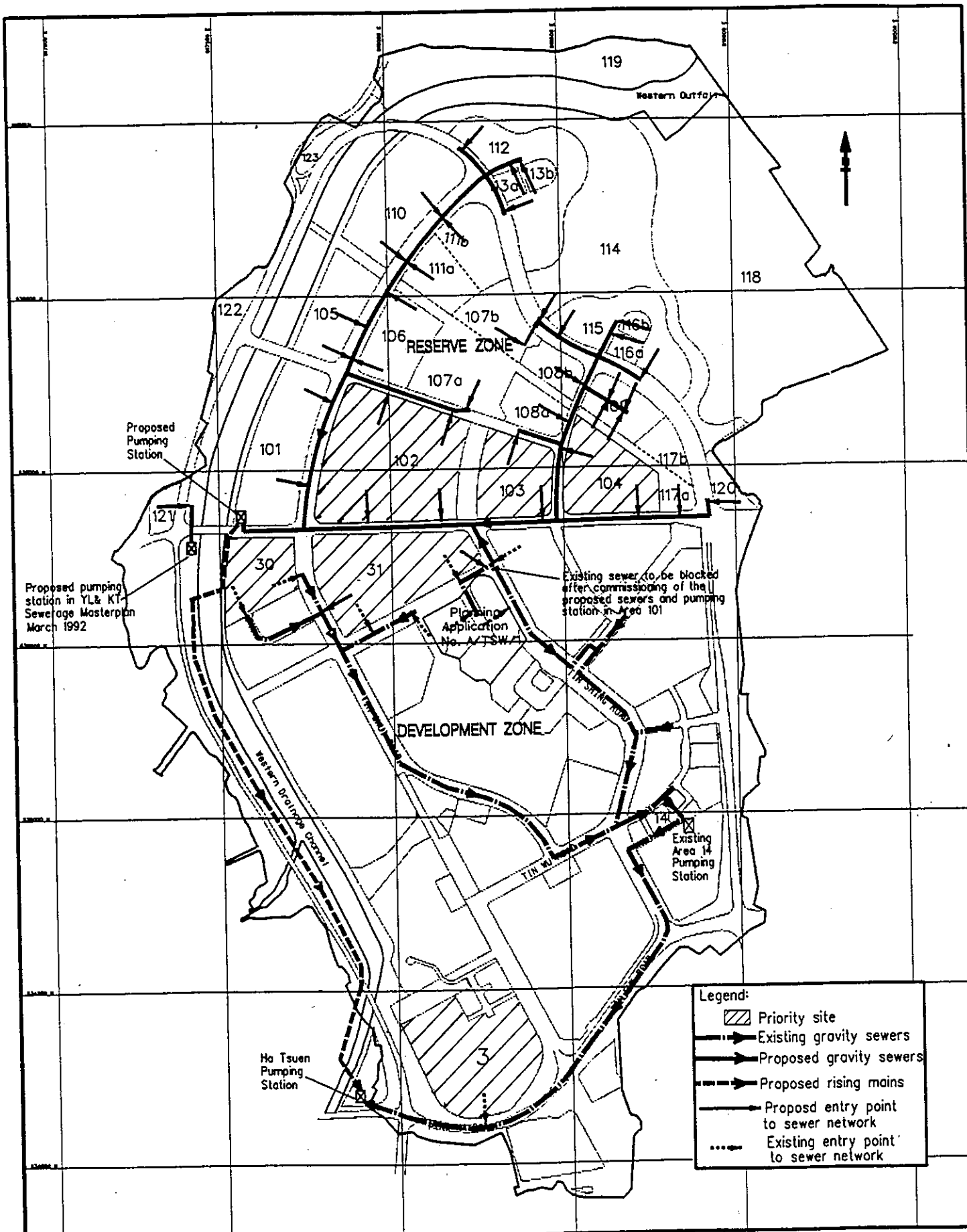
**TIN SHUI WAI DEVELOPMENT  
AGREEMENT NO. CE 10/95**  
ENGINEERING INVESTIGATIONS FOR  
DEVELOPMENT OF AREAS 3, 30 & 31  
OF THE DEVELOPMENT ZONE  
AND THE RESERVE ZONE

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ENGINEERS AND SCIENTISTS

Title :

**WESTERN DRAINAGE  
CHANNEL EXTENSION**

Figure No.	1.10	Revision	0
Reference No.	-	File Name	-
Prepared	MC	Checked	PS
Date	FEB 97	Scale	-



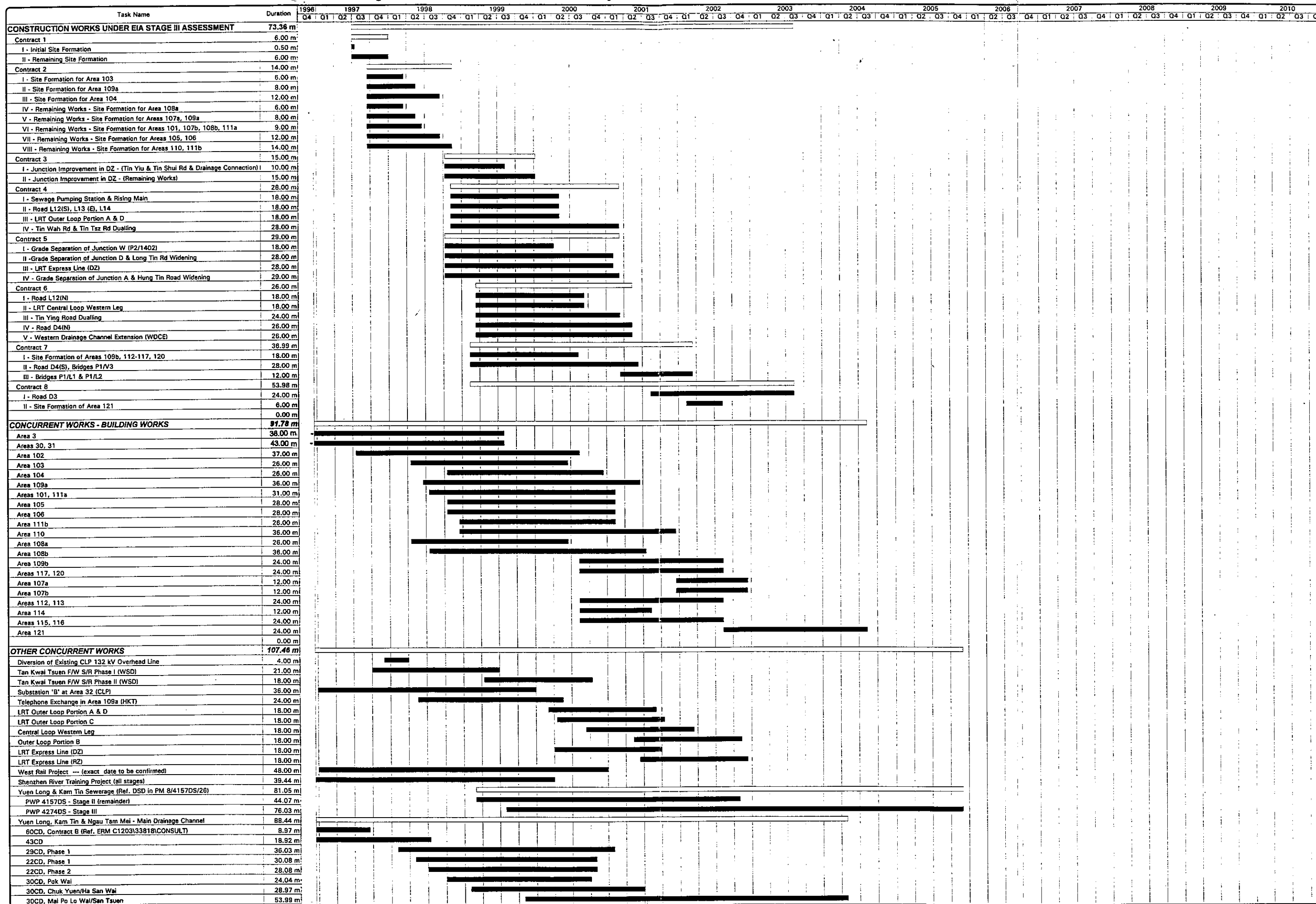
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 AGREEMENT NO. CE 10/95  
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 OF THE DEVELOPMENT ZONE  
 AND THE RESERVE ZONE

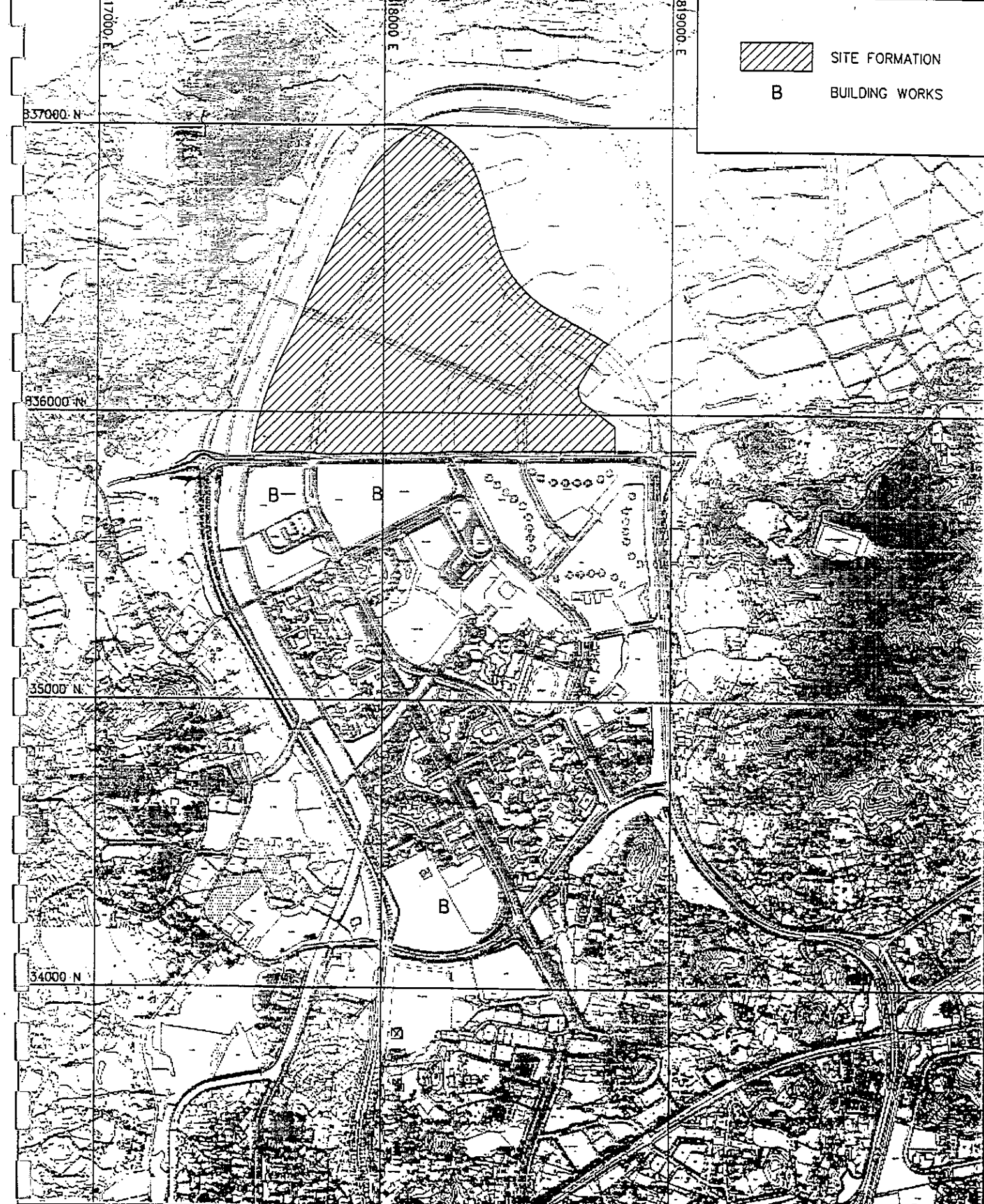
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### RECOMMENDED SEWERAGE NETWORK FOR THE DEVELOPMENTS

Figure No. 1.11	
Prepared GC	Checked CYH
Date 10/96	Scale N.T.S.

Figure 1.12 Programme for Works and Concurrent Projects (based on Recommended Implementation Programme - version 2.2)





 SITE FORMATION  
**B** BUILDING WORKS

TIN SHUI WAI DEVELOPMENT  
 AGREEMENT NO. CE 10/95  
 ENGINEERING INVESTIGATIONS FOR  
 DEVELOPMENT OF AREAS 3, 30 & 31  
 OF THE DEVELOPMENT ZONE  
 AND THE RESERVE ZONE

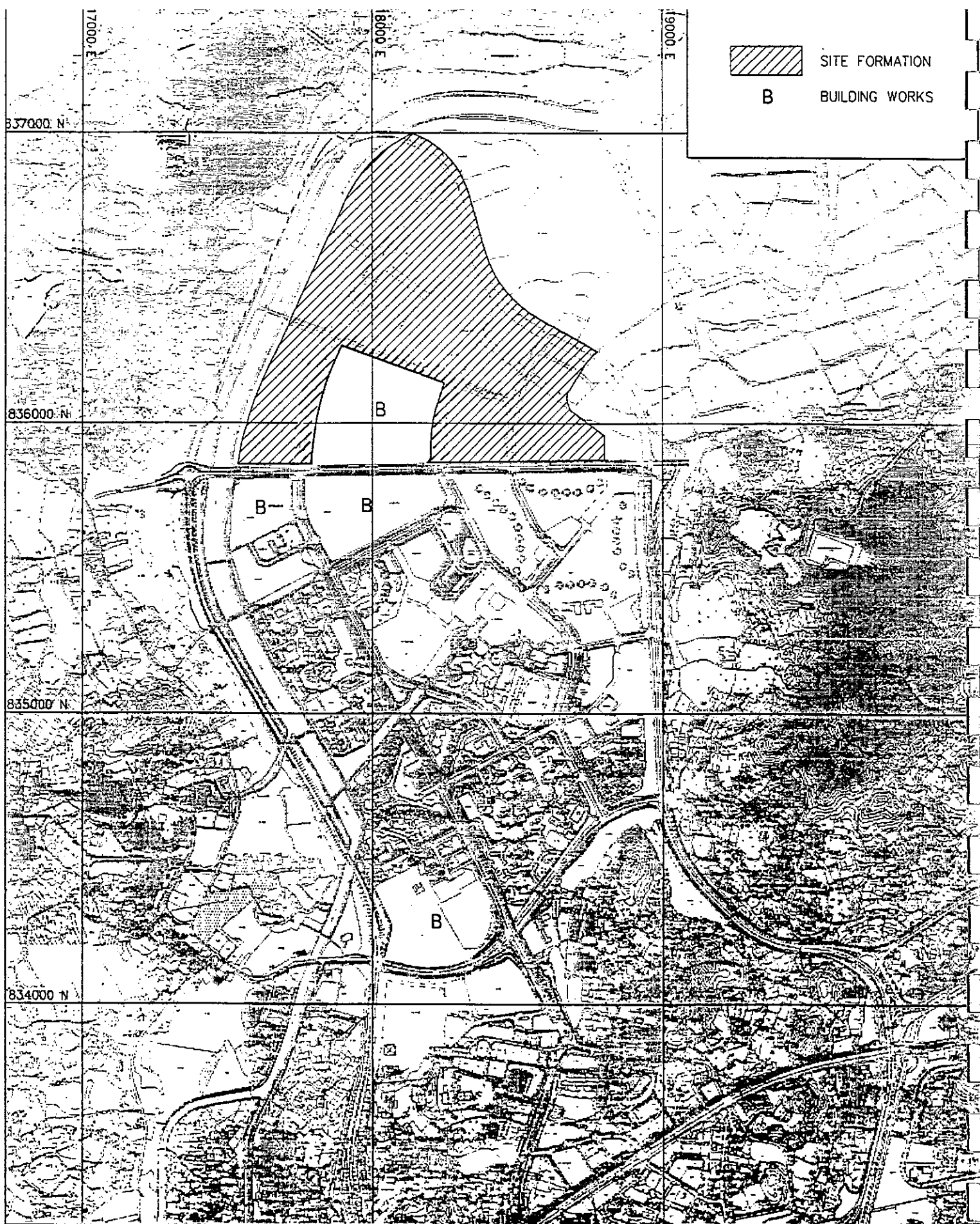
Title :  
**WORKS YEAR BY YEAR  
 JUL-DEC 1997  
 (SCENARIO 1)**

Figure No.	1.13	Revision	0
Reference	TSW-BASE	File Name	01420018.C09
Prepared	MC	Checked	PS
Date	NOV. 96	Scale	N.T.S.


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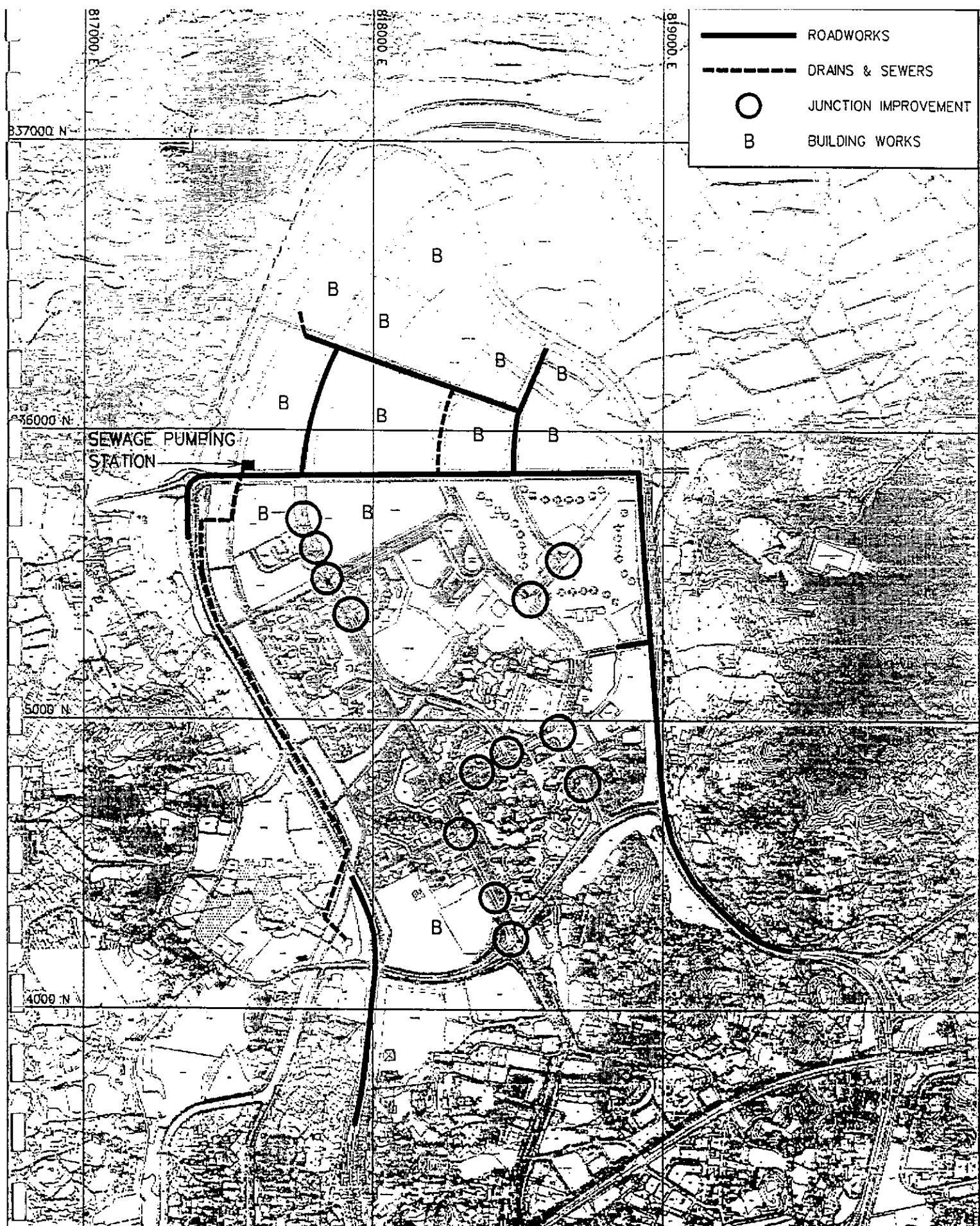
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 AGREEMENT NO. CE 10/95  
 ENGINEERING INVESTIGATIONS FOR  
 DEVELOPMENT OF AREAS 3, 30 & 31  
 OF THE DEVELOPMENT ZONE  
 AND THE RESERVE ZONE

Title :  
**WORKS YEAR BY YEAR  
 JAN-SEP 1998  
 (SCENARIO 2)**

Figure No.	1.14	Revision	0
Reference	TSW-BASE	File Name	01430018.C09
Prepared	MC	Checked	PS
Date	NOV. 96	Scale	N.T.S.

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Note : Date could be subject to change.



- ROADWORKS
- - - - - DRAINS & SEWERS
- JUNCTION IMPROVEMENT
- B BUILDING WORKS

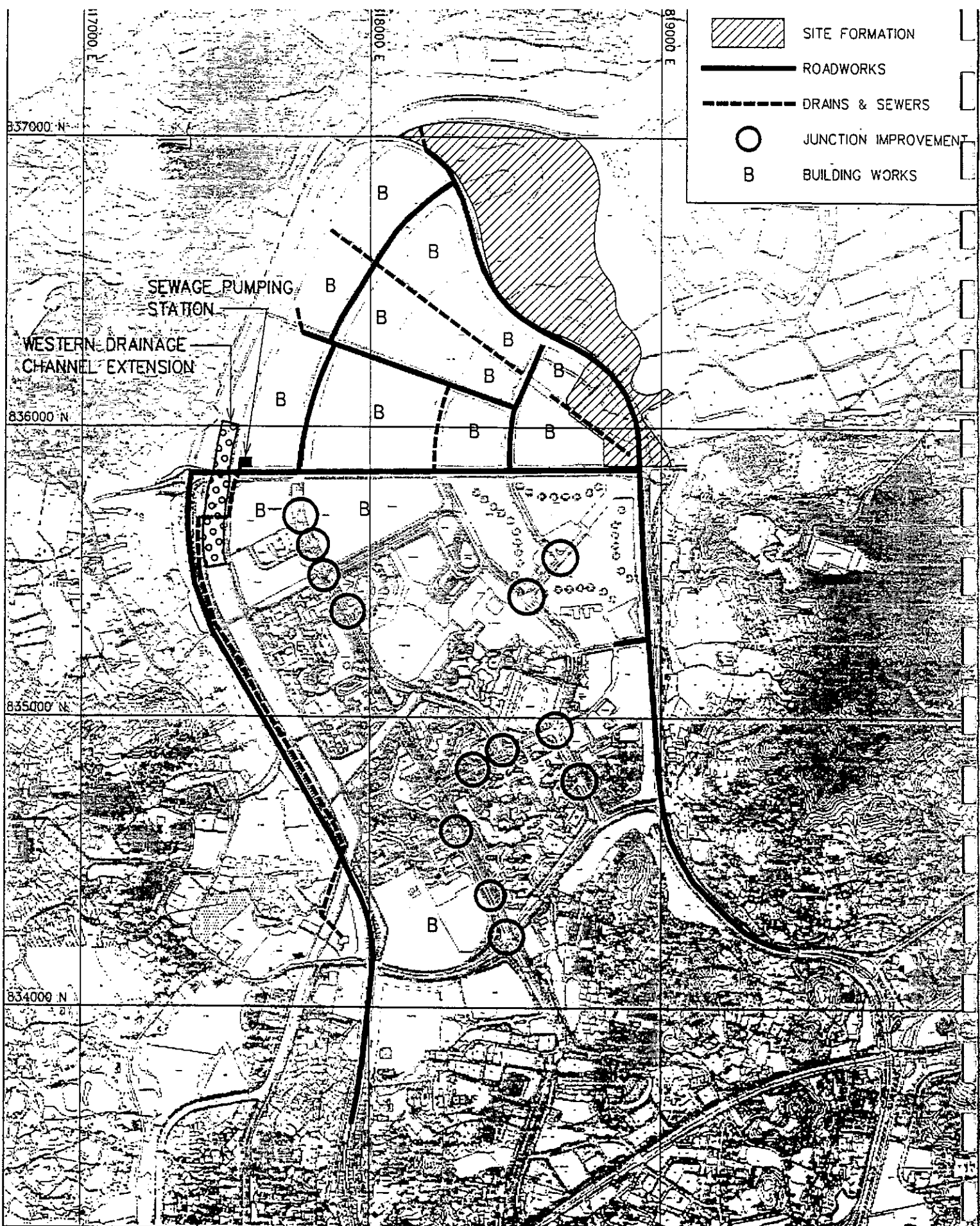
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 AGREEMENT NO. CE 10/95  
 ENGINEERING INVESTIGATIONS FOR  
 DEVELOPMENT OF AREAS 3, 30 & 31  
 OF THE DEVELOPMENT ZONE  
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Title :  
**WORKS YEAR BY YEAR**  
**OCT-DEC 1998**  
**(SCENARIO 3)**

Note : Date could be subject to change.

Figure No.	1.15	Revision	0
Reference	TSW-BASE	File Name	01440018.C09
Prepared	MC	Checked	PS
Date	NOV. 96	Scale	N.T.S.



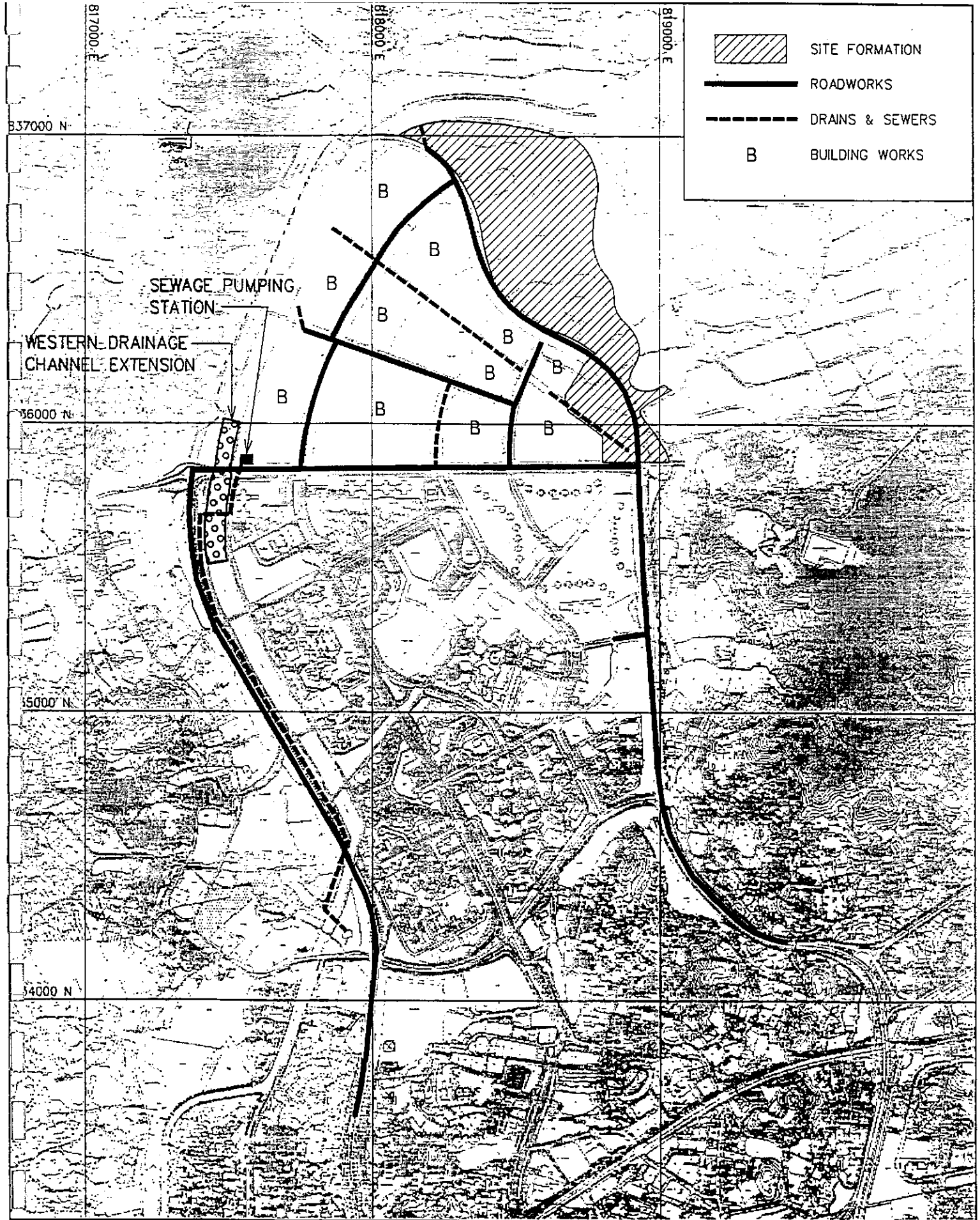
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 AGREEMENT NO. CE 10/95  
 ENGINEERING INVESTIGATIONS FOR  
 DEVELOPMENT OF AREAS 3, 30 & 31  
 OF THE DEVELOPMENT ZONE  
 AND THE RESERVE ZONE

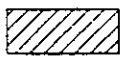


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Title : **WORKS YEAR BY YEAR  
 JAN-AUG 1999  
 (SCENARIO 4)**

Note : Date could be subject to change.

Figure No.	1.16	Revision	0
Reference	TSW-BASE	File Name	01450018.C09
Prepared	MC	Checked	PS
Date	NOV. 96	Scale	N.T.S.



-  SITE FORMATION
-  ROADWORKS
-  DRAINS & SEWERS
- B** BUILDING WORKS

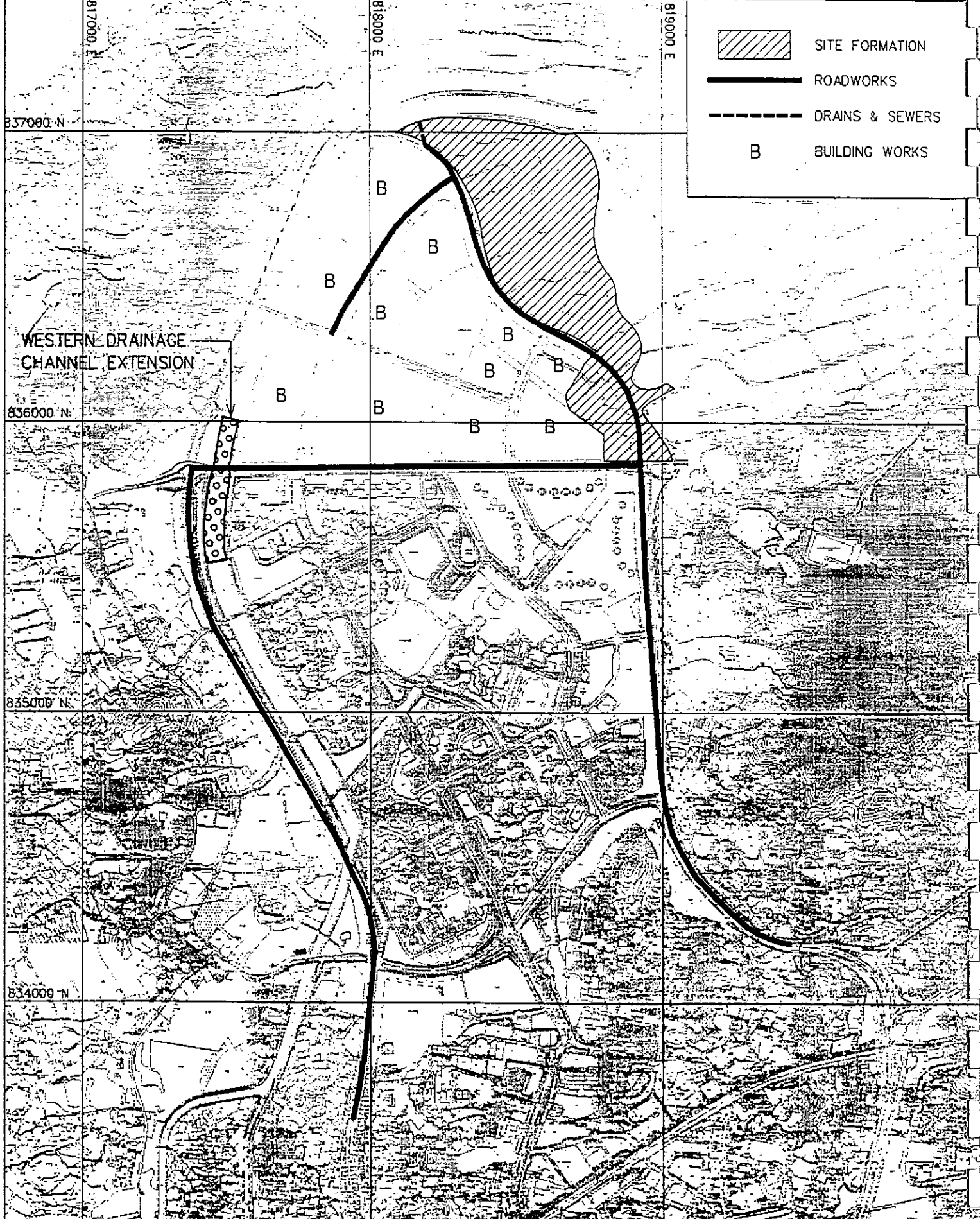
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 AGREEMENT NO. CE 10/95  
 ENGINEERING INVESTIGATIONS FOR  
 DEVELOPMENT OF AREAS 3, 30 & 31  
 OF THE DEVELOPMENT ZONE  
 AND THE RESERVE ZONE

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Title : **WORKS YEAR BY YEAR  
 SEP 1999-MAR 2000  
 (SCENARIO 5)**

Note : Date could be subject to change.  
 Note : Housing layout from HD as of July 1996.  
 [Occupation dates based on recommended implementation programme version 2.1]

Figure No.	1.17	Revision	0
Reference	TSW-BASE	File Name	01460018.C09
Prepared	MC	Checked	PS
Date	NOV. 96	Scale	N.T.S.



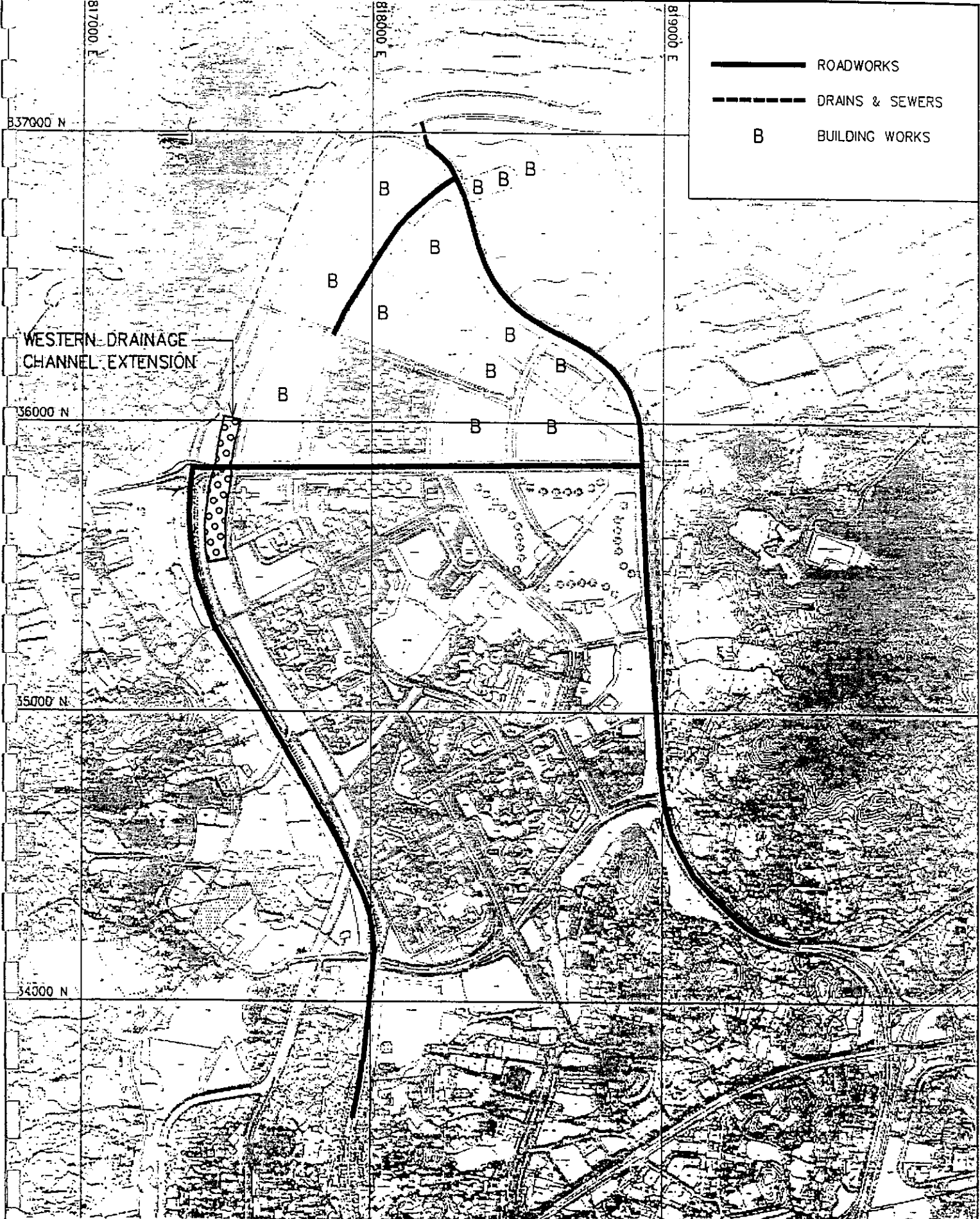
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 AGREEMENT NO. CE 10/95  
 ENGINEERING INVESTIGATIONS FOR  
 DEVELOPMENT OF AREAS 3, 30 & 31  
 OF THE DEVELOPMENT ZONE  
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Title : **WORKS YEAR BY YEAR  
 APR-AUG 2000  
 (SCENARIO 6)**

Note : Date could be subject to change.  
 Note : Housing layout from HD as of July 1996.  
 [Occupation dates based on recommended implementation programme version 2.1]

Figure No.	1.18	Revision	0
Reference	TSW-BASE	File Name	01470018.C09
Prepared	MC	Checked	PS
Date	NOV. 96	Scale	N.T.S.



WESTERN DRAINAGE  
CHANNEL EXTENSION

— ROADWORKS  
- - - DRAINS & SEWERS  
B BUILDING WORKS

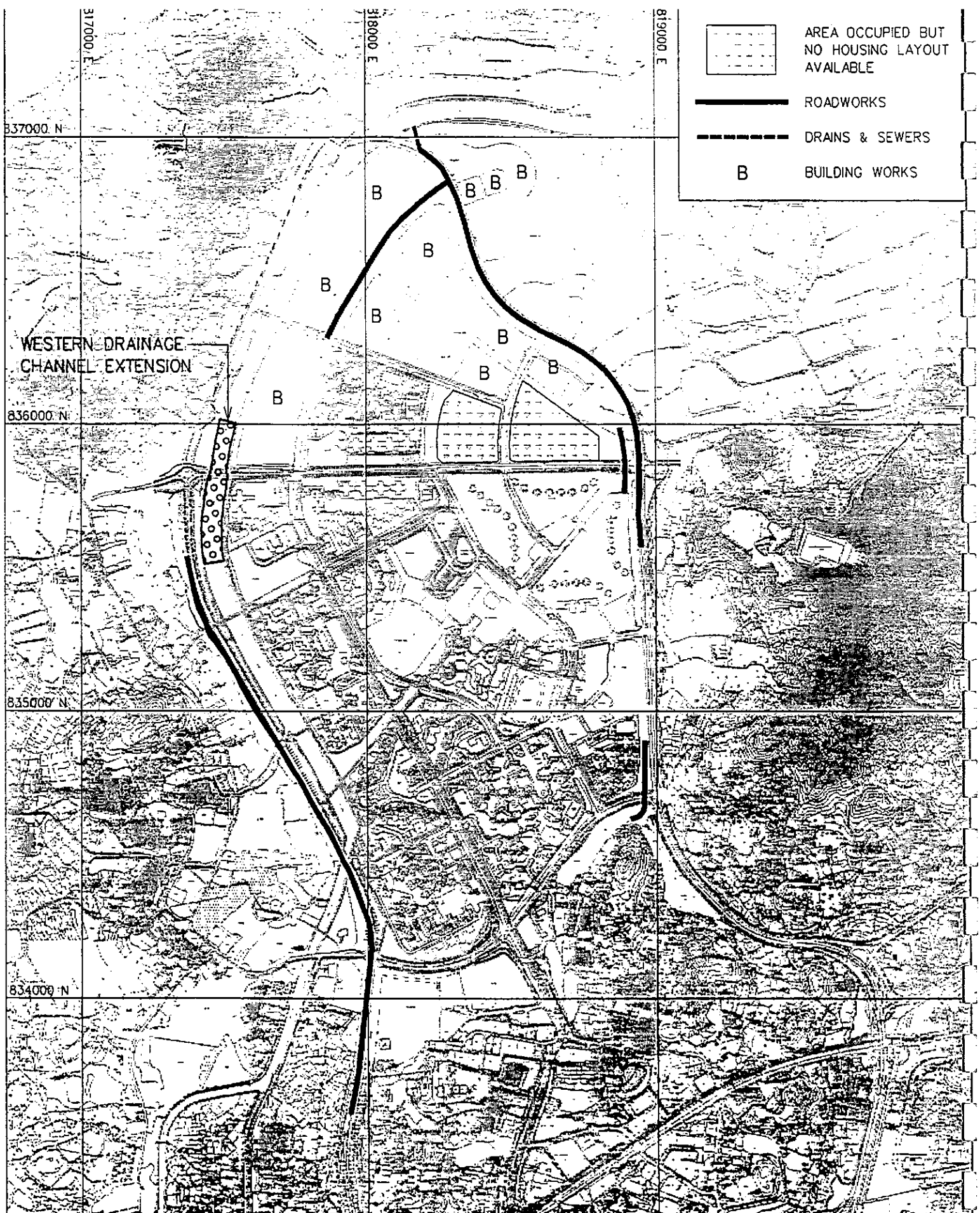
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DEVELOPMENT OF AREAS 3, 30 & 31  
OF THE DEVELOPMENT ZONE  
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Title :  
**WORKS YEAR BY YEAR  
SEP-DEC 2000  
(SCENARIO 7)**

Note : Date could be subject to change.  
Note : Housing layout from HD as of July 1996.  
[ Occupation dates based on recommended implementation programme version 21 ]

Figure No.	1.19	Revision	0
Reference	TSW-BASE	File Name	01480018.C09
Prepared	MC	Checked	PS
Date	NOV. 96	Scale	N.T.S.



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 AGREEMENT NO. CE 10/95  
 ENGINEERING INVESTIGATIONS FOR  
 DEVELOPMENT OF AREAS 3, 30 & 31  
 OF THE DEVELOPMENT ZONE  
 AND THE RESERVE ZONE



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Title :

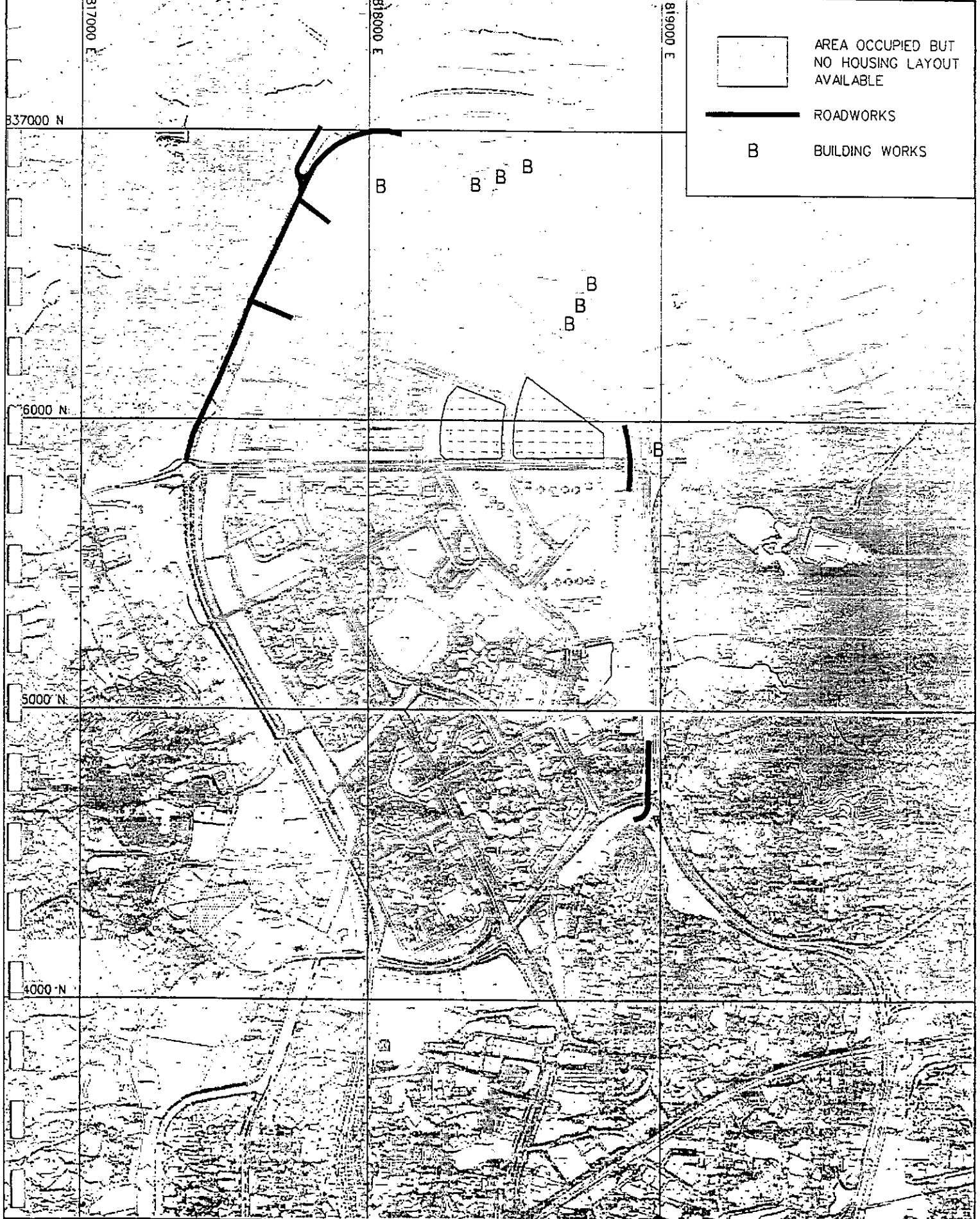
**WORKS YEAR BY YEAR  
 JAN-JUN 2001  
 (SCENARIO 8)**

Note : Date could be subject to change.

Note : Housing layout from HD as of July 1996.

[ Occupation dates based on recommended implementation programme version 2.1 ]

Figure No.	1.20	Revision	0
Reference	TSW-BASE	File Name	01490018.C09
Prepared	MC	Checked	PS
Date	NOV. 96	Scale	N.T.S.



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 AGREEMENT NO. CE 10/95  
 ENGINEERING INVESTIGATIONS FOR  
 DEVELOPMENT OF AREAS 3, 30 & 31  
 OF THE DEVELOPMENT ZONE  
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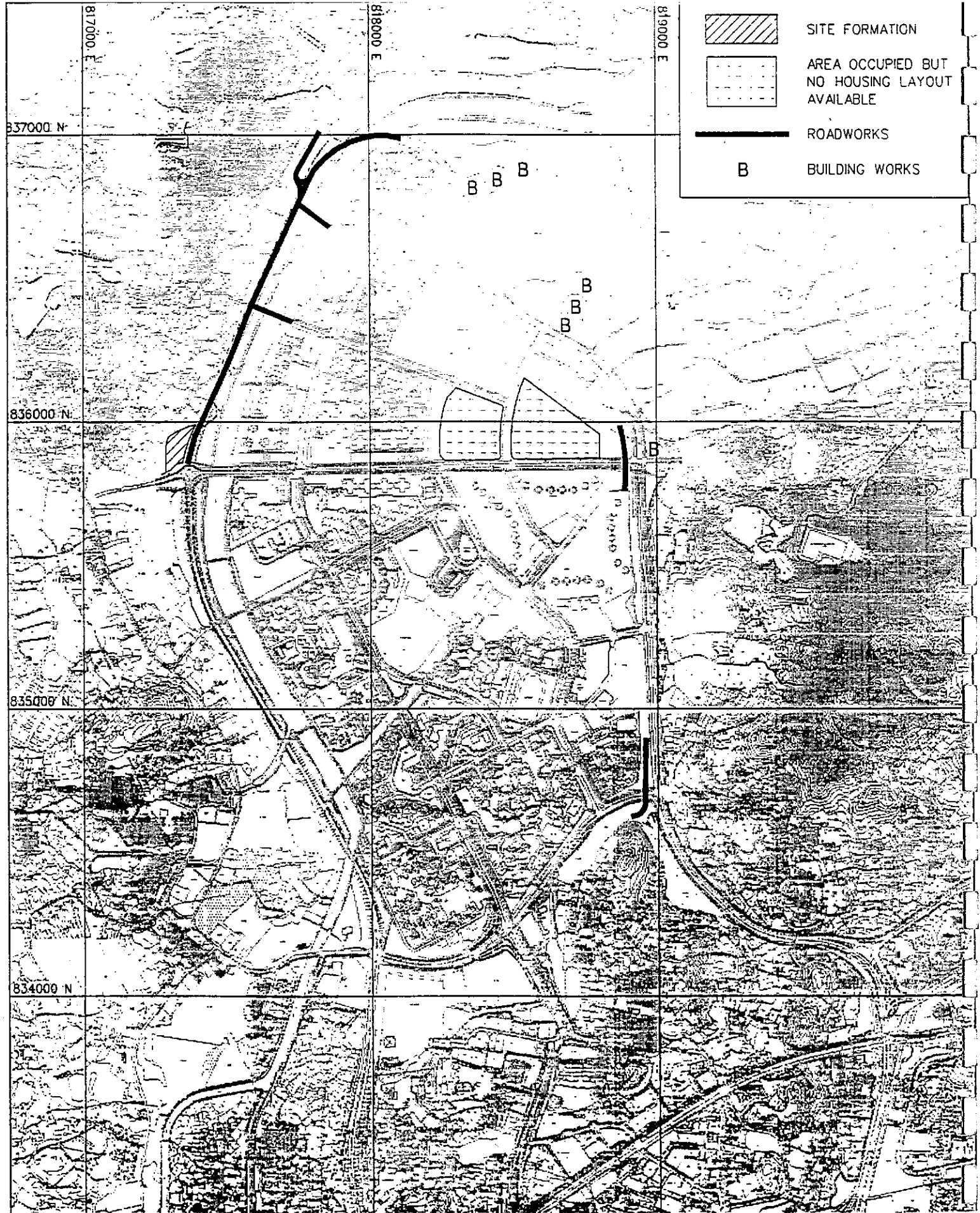
 MINNIE CONSULTANTS LIMITED  
 寶尼工程顧問有限公司  
 ENGINEERS AND SCIENTISTS 寶尼

Title :  
**WORKS YEAR BY YEAR  
 JUL-DEC 2001  
 (SCENARIO 9)**

Note : Date could be subject to change.  
 Note : Housing layout from HD as of July 1996.  
 [Occupation dates based on recommended implementation programme version 21]

Figure No.	1.21	Revision	0
Reference	TSW-BASE	File Name	01500018.C09
Prepared	MC	Checked	PS
Date	NOV. 96	Scale	N.T.S.





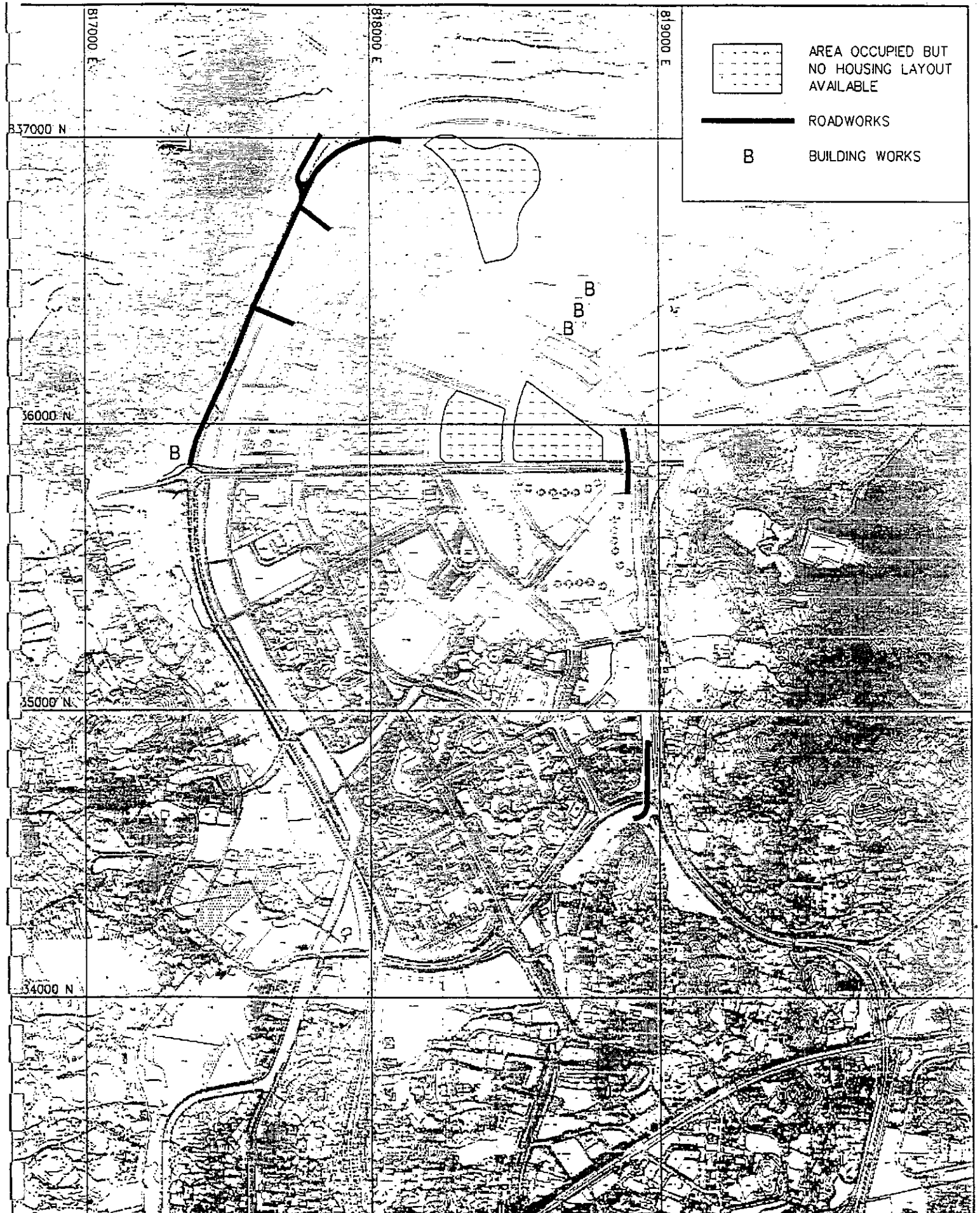
TIN SHUI WA DEVELOPMENT  
 AGREEMENT NO. CE 10/95  
 ENGINEERING INVESTIGATIONS FOR  
 DEVELOPMENT OF AREAS 3, 30 & 31  
 OF THE DEVELOPMENT ZONE  
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Title : **WORKS YEAR BY YEAR  
 JAN-JUL 2002  
 (SCENARIO 10)**

Note : Date could be subject to change.  
 Note : Housing layout from HD as of July 1996.  
 [ Occupation dates based on recommended implementation programme version 2 ]

Figure No. 1.22	Revision 0
Reference TSW-BASE	File Name 01510018.C09
Prepared MC	Checked PS
Date NOV. 96	Scale N.T.S.



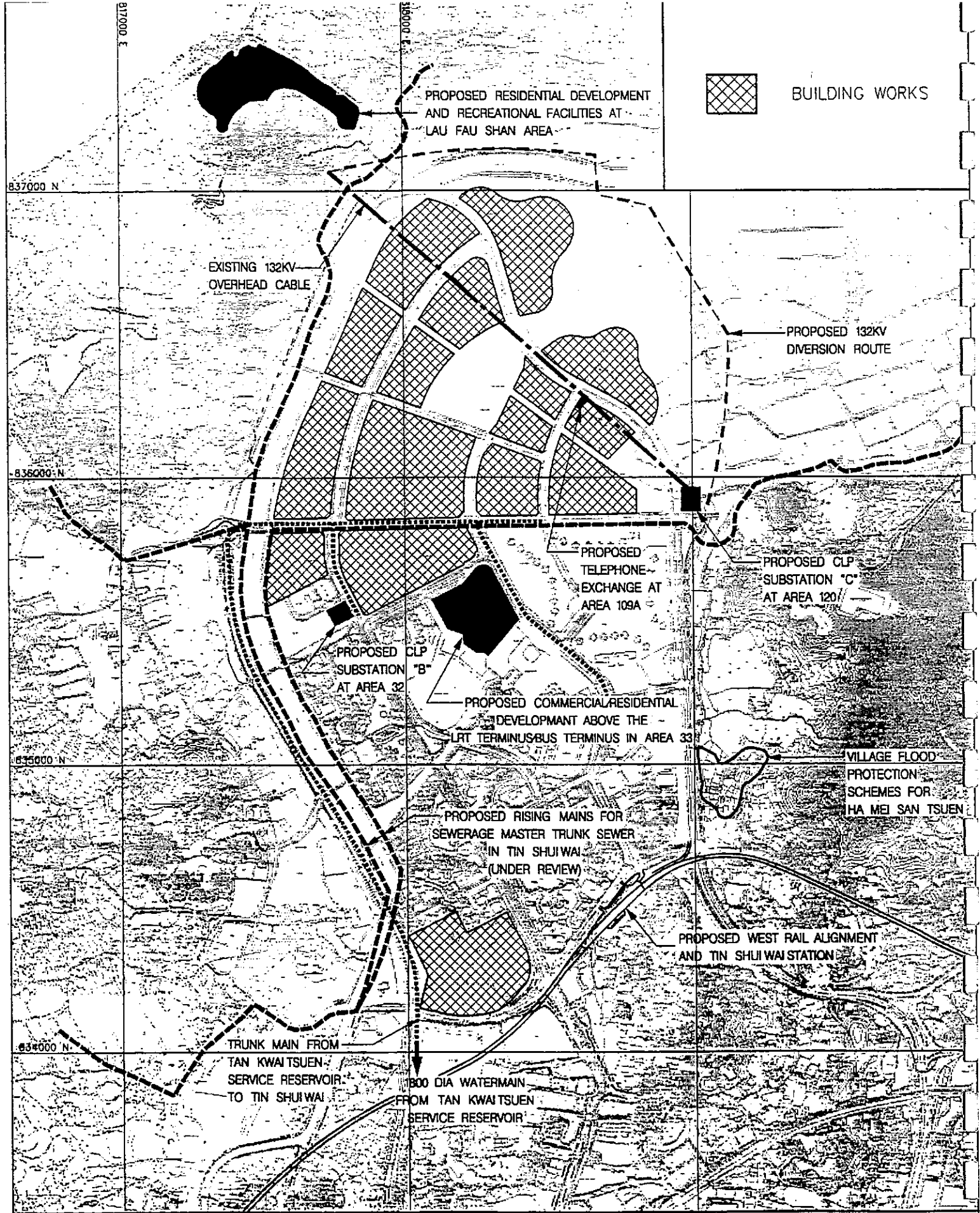
TIN SHUI WAI DEVELOPMENT  
 AGREEMENT NO. CE 10/95  
 ENGINEERING INVESTIGATIONS FOR  
 DEVELOPMENT OF AREAS 3, 30 & 31  
 OF THE DEVELOPMENT ZONE  
 AND THE RESERVE ZONE

Title : **WORKS YEAR BY YEAR  
 AUG 2002-AUG 2003  
 (SCENARIO 11)**

Note : Date could be subject to change.  
 Note : Housing layout from HD as of July 1996.  
 [Occupation dates based on recommended implementation programme version 21]

Figure No.	1.23	Revision	0
Reference	TSW-BASE	File Name	01520018.C09
Prepared	MC	Checked	PS
Date	NOV. 96	Scale	N.T.S.

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 ENGINEERING INVESTIGATIONS FOR DEVELOPMENT OF AREAS 3, 30 & 31 OF THE DEVELOPMENT ZONE AND THE RESERVE ZONE

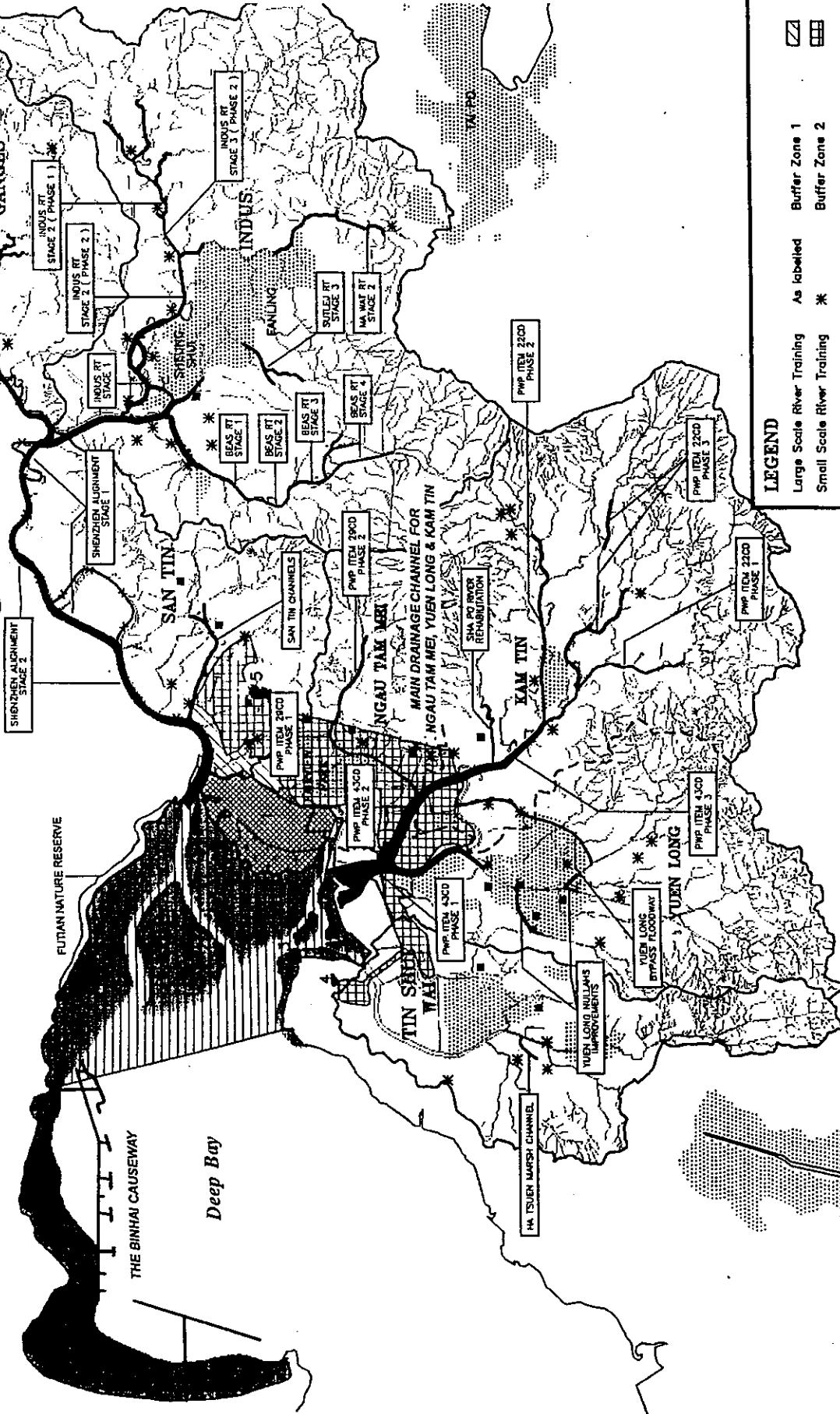


Title :  
**CONCURRENT PROJECTS**

Figure No.	1.24	Revision	0
Reference No.	TSW-BASE	File Name	02050018.C09
Prepared	MC	Checked	PS
Date	NOV. 96	Scale	N.T.S.

PEOPLE'S REPUBLIC OF CHINA

SHENZHEN RIVER REGULATION PROJECT



Project No.	1.25	Reference No.	TELADFL0002	NTS
Prepared	MC	Checked	PS	
Date		Issue		NOV 98
Project	TEN SHUI WAI DEVELOPMENT			
Contract No.	ENGINEERING INVESTIGATIONS FOR DEVELOPMENT OF AREAS 3, 30 & 31 OF THE DEVELOPMENT ZONE AND THE RESERVE ZONE			
Title	CONCURRENT PROJECTS WITHIN INNER DEEP BAY DRAINAGE BASIN			
Scale	1:25	Reference No.	TELADFL0002	NTS
Consultants	<b>TETRA TECH CONSULTANTS LIMITED</b> 天尼工程顧問有限公司 TETRA TECH CONSULTANTS			
Client	<b>新界北拓展處</b> NEW TERRITORIES NORTH DEVELOPMENT OFFICE 拓展署 Territory Development Department, Hong Kong			


(SOURCE: TELADFL0002: BINNIE / MAUNSELL, 6/1993)

<b>Client</b>
Contact person: _____
Organisation: _____
Phone no: _____
Fax no: _____

<b>Engineer</b>	
Contact person: _____	
Organisation: _____	
Phone no: _____	
Fax no: _____	
<b>Environmental Manager/ Environmental Management Team</b>	<b>Engineer's Representative(s)</b>
Contact person: _____	Contact person: _____
Organisation: _____	Organisation: _____
Phone no: _____	Phone no: _____
Fax no: _____	Fax no: _____

<b>Monitoring Team</b>
Contact person: _____
Organisation: _____
Phone no: _____
Fax no: _____

<b>Contractor(s)</b>
Contact person: _____
Organisation: _____
Phone no: _____
Fax no: _____

<b>TIN SHUI WAI DEVELOPMENT AGREEMENT NO. CE 10/95</b> ENGINEERING INVESTIGATIONS FOR DEVELOPMENT OF AREAS 3, 30 & 31 OF THE DEVELOPMENT ZONE AND THE RESERVE ZONE   <b>BINNIE CONSULTANTS LIMITED</b> 賓尼 賓尼工程顧問有限公司 ENGINEERS AND SCIENTISTS	Title :  <b>LINES OF AUTHORITY FOR EM &amp; A PROGRAMME</b>	Figure No. 1.26	Revision 0
		Reference No. -	File Name -
		Prepared MC	Checked RVC
		Date FEB 96	Scale -

<b>Monitoring Team</b>
Contact person: .....
Organisation: .....
Phone no: .....
Fax no: .....

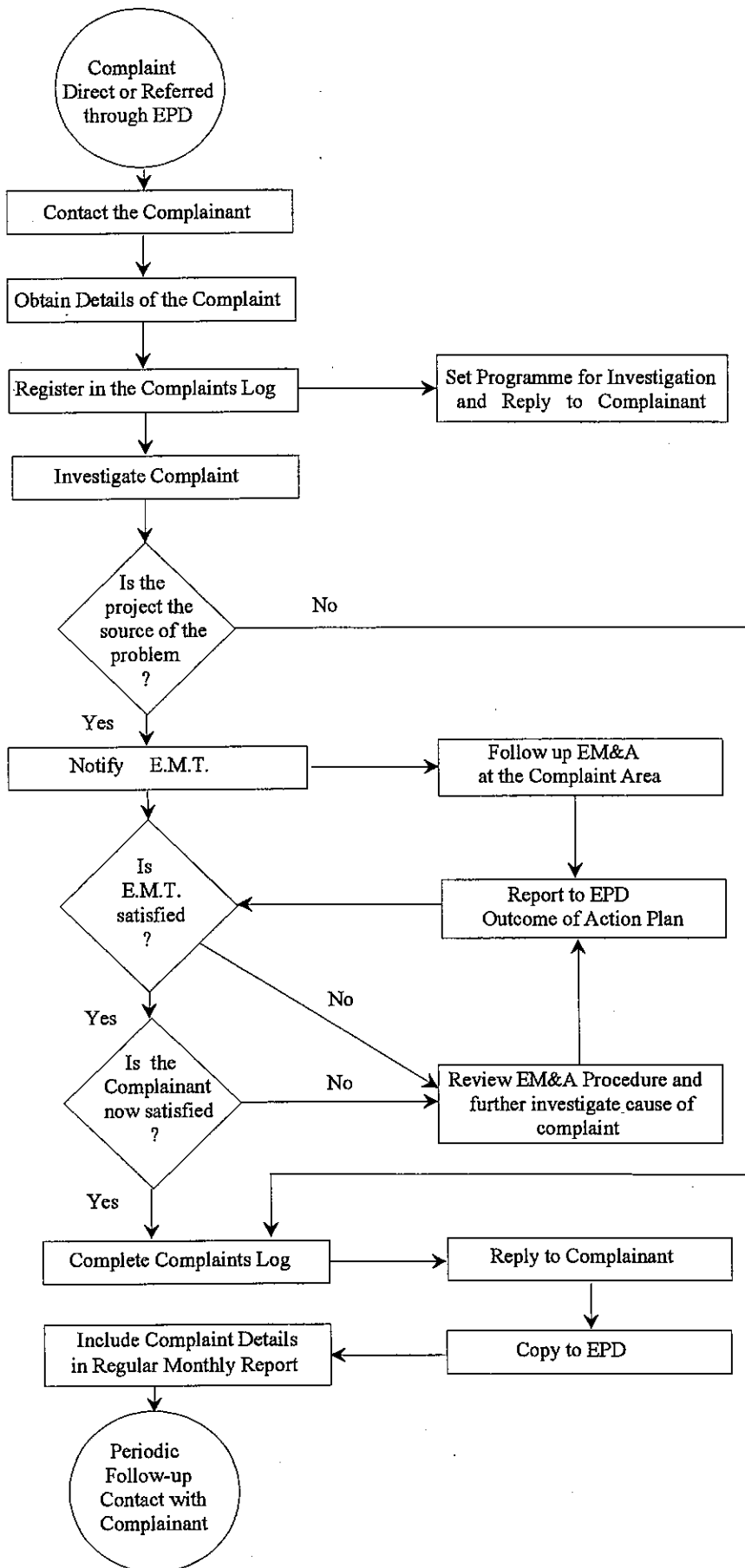
<b>Contractor(s)</b>
Contact person: .....
Organisation: .....
Phone no: .....
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<b>Environmental Manager/ Environmental Management Team</b>	<b>Engineer's Representative(s)</b>
Contact person: .....	Contact person: .....
Organisation: .....	Organisation: .....
Phone no: .....	Phone no: .....
Fax no: .....	Fax no: .....

<b>Engineer</b>
Contact person: .....
Organisation: .....
Phone no: .....
Fax no: .....

<b>EPD</b>
Contact person: .....
Organisation: .....
Phone no: .....
Fax no: .....

<b>Client</b>
Contact person: .....
Organisation: .....
Phone no: .....
Fax no: .....



## 2. AIR QUALITY

### 2.1 Introduction

2.1.1 Dust levels in the study area will be mainly dependent on the volume of vehicles travelling over unpaved roads or dirty paved roads and the frequency and efficiency of the watering of these roads. In addition, background dust levels may be high when winds blow from the north and north-east. The most northerly permanent dust monitoring station will act as a control station in the latter instance.

2.1.2 The sight of any visible dust arising from any part of the Project works should alert the EM and his team to the necessity for additional watering. Some EMs may prefer to carry portable dust meters.

### 2.2 Air Quality Parameters

2.2.1 Monitoring and audit of the Total Suspended Particles (TSP) levels shall be carried out to ensure that any deteriorating air quality could be readily detected and timely action taken to rectify the situation.

2.2.2 24-hour TSP levels shall be measured to indicate the impacts of construction dust on air quality. The TSP levels shall be measured by following the standard high volume sampling method as set out in the Title 40 of the Code of Federal Regulations, Chapter 1 (Part 50), Appendix B.

2.2.3 All relevant data including wind speed and wind direction, elapsed-time meter reading for the start and stop of the sampler, identification and weight of the filter paper, and other special phenomena and work progress of the concerned site etc. shall be recorded in detail.

### 2.3 Monitoring Equipment

#### *High Volume Sampler (HVS)*

2.3.1 Sufficient high volume samplers (HVS) in compliance with the following specifications shall be available for carrying out the 24-hour TSP monitoring:

- (i) 0.6 - 1.7 m<sup>3</sup>/min (20-60 SCFM) adjustable flow range;
- (ii) equipped with a timing/control device accurate to  $\pm 5$  minutes for 24 hours operation;
- (iii) installed with elapsed-time meter accurate to  $\pm 2$  minutes for 24 hours operation;
- (iv) capable of providing a minimum exposed area of 406 cm<sup>2</sup> (63 in<sup>2</sup>);
- (v) flow Control Accuracy : 2.5% deviation over 24-hour sampling period;
- (vi) equipped with shelter to protect the filter and sampler;



- (vii) incorporated with an electronic mass flow rate controller or other equivalent devices, and be calibrated against a traceable standard at regular intervals;
- (viii) equipped with a flow recorder for continuous monitoring;
- (ix) provided with a peaked roof inlet;
- (x) have a manometer incorporated;
- (xi) able to hold and seal the filter paper to the sampler housing in a horizontal position;
- (xii) easy to change filters;
- (xiii) capable of operating continuously for 24-hour period; and
- (xiv) transferable between monitoring locations.

2.3.2 All the equipment, filter papers, etc. shall be clearly labelled.

2.3.3 The high volume pumps and their accessories shall be properly maintained. Prior to each monitoring, appropriate checks shall be made to ensure that the equipment and necessary power supply are in good working order.

2.3.4 The flow-rate of the sampler before and after the sampling exercise with the filter in position shall be verified to be constant and be recorded.

2.3.5 Initial calibration of dust monitoring equipment shall be conducted upon installation and thereafter at bi-monthly intervals. The standard used for calibration shall be traceable to the internationally recognised primary standard and be calibrated annually. The calibration data shall be properly documented for future reference. All the data should be converted into standard temperature and pressure condition.

#### ***Wind Monitoring Equipment***

2.3.6 Wind data monitoring equipment shall be provided and set up at a conspicuous location near the dust monitoring locations for wind speed and wind direction determination. The equipment installation location shall be proposed by the EM and agreed with the ER.

2.3.7 The following points shall be observed in the installation and operation of wind data monitoring equipment:

- (i) the wind sensors shall be installed on masts, at an elevated level 10 m above ground, so that they are clear of obstructions or turbulence caused by buildings.
- (ii) the wind data shall be captured by a data logger and be downloaded to a computer for processing at least once a month.
- (iii) the wind data monitoring equipment shall be recalibrated at least once every six months.

(iv) wind direction shall be divided into 16 sectors of 22.5 degrees each.

2.3.8 In exceptional situations, the EM may propose alternative methods to obtain representative wind data upon approval from the ER and agreement from EPD.

#### 2.4 Laboratory Measurement/Analysis

2.4.1 A clean laboratory with constant temperature and humidity control, and equipped with necessary measuring and conditioning instruments, to handle the dust samples collected, shall be available for sample analysis, and equipment calibration and maintenance. The laboratory should be HOKLAS accredited.

2.4.2 If a site laboratory is set up or a non-HOKLAS accredited laboratory is hired for carrying out the laboratory analysis, the laboratory equipment shall be approved by the EM and the measurement procedures shall be witnessed by the EM. The EM shall provide the ER with one copy of the Title 40 of the Code of Federal Regulations, Chapter 1 (Part 50), Appendix B for his reference.

2.4.3 Filter paper of size 8" x 10" shall be labelled before sampling. It shall be a clean filter paper with no pin holes, and shall be conditioned in a humidity controlled chamber for over 24-hr and be pre-weighed before use for the sampling.

2.4.4 After sampling, the filter paper loaded with dust shall be kept in a clean and tightly sealed plastic bag. The filter paper is then returned to the laboratory for reconditioning in the humidity controlled chamber followed by accurate weighing by an electronic balance readable to 0.1 mg. The balance shall be regularly calibrated against standard masses which are traceable to international standard or certified by an accredited laboratory.

2.4.5 All the collected samples shall be kept in a good condition for 6 months before disposal.

2.4.6 Standard Operation Procedure (SOP) for 24-hr TSP measurement shall be prepared and validated. All 24-hr TSP measurements shall follow strictly the validated SOP.

#### 2.5 Monitoring Locations

2.5.1 The dust monitoring stations are shown on Figure 2.1 to 2.11 with planned timescales. They are selected so as to cover as many of the following criteria as possible:

- (i) at work site boundaries;
- (ii) close to the sensitive receivers;
- (iii) at the adjacent Special Measures Zone; and
- (iv) taking into account predictions made in the EIA and the prevailing meteorological conditions. The monitoring location north of the RZ will function as a control station, being upwind or downwind of the site in order to compare with on-site data collected.

- 2.5.2 The following points shall be considered when positioning the samplers:
- (i) continuous, stable power needs to be supplied;
  - (ii) security against theft, tampering or inadvertent damage is needed;
  - (iii) a horizontal platform with appropriate supporting to secure the samplers against gusty wind must be provided;
  - (iv) any two samplers must be more than 2 metres apart;
  - (v) the distance between the samplers and an obstacle, such as buildings, must be at least twice the height of the obstacle protruding above the samplers;
  - (vi) any rooftop sampler used must be at least 2 metres apart from walls, parapets and penthouses;
  - (vii) a minimum distance of 2 metres from any supporting structure measured horizontally must be kept;
  - (viii) no furnace or incinerator flues must be located nearby;
  - (ix) the airflow around the sampler must be unrestricted;
  - (x) every sampler must be more than 20 metres from any dripline;
  - (xi) any wire fence or gate used to protect a sampler must not cause any obstruction during monitoring;
  - (xii) permission must be obtained to set up the samplers and to obtain access to the monitoring stations.
- 2.5.3 The status and location of dust sensitive receivers may change after issuing this manual. If such cases exist, the EM shall propose updated monitoring locations and seek approval from ER and agreement from EPD on the proposal, following the same criteria, as far as practicable, as stated above.
- 2.6 Baseline Monitoring**
- 2.6.1 Baseline monitoring shall be carried out at all of the designated Permanent Air Monitoring Stations for a total of 15 days, either continuously or intermittently, prior to the commencement of Works to obtain daily 24-hr TSP samples.
- 2.6.2 During the baseline monitoring, there should not be any construction or dust generating activities in the vicinity of the monitoring stations.

- 2.6.3 In case the baseline monitoring cannot be carried out at the designated monitoring locations during the baseline monitoring period, monitoring at alternative locations which can effectively represent the baseline conditions at the impact monitoring locations shall be carried out. The alternative baseline monitoring locations shall be approved by the ER and agreed with EPD.
- 2.6.4 In exceptional case, when insufficient baseline monitoring data or questionable results are obtained, the EM shall liaise with EPD to agree on an appropriate set of data to be used as a baseline reference and submit to ER for approval.
- 2.6.5 Ambient conditions may vary seasonally and shall be reviewed at three monthly intervals. If the EM considers that the ambient conditions have been changed and a repeat of the baseline monitoring is required to be carried out for obtaining the updated baseline levels, the monitoring should be at times when the contractor's activities are not generating dust, at least in the proximity of the monitoring stations. Should change in ambient conditions be determined, the baseline levels and, in turn, the air quality criteria, should be revised. The revised baseline levels and air quality criteria should be agreed with EPD.
- 2.6.6 The baseline monitoring results will be used as the basis for determining the Action Levels for the impact monitoring.

## 2.7 Impact Monitoring

- 2.7.1 Impact monitoring shall be carried out during the course of the Works. For regular impact monitoring, the sampling frequency of once in every six days, shall be strictly observed at all the monitoring stations for 24-hour TSP monitoring.
- 2.7.2 The specific time to start and stop the 24-hr TSP monitoring shall be clearly defined for each location and be strictly followed by the operator.
- 2.7.3 In case of non-compliance with the air quality criteria, more frequent monitoring, as specified in the Action Plan in Section 2.8, shall be conducted within 24 hours after the result is obtained. This additional monitoring shall be continued until the excessive dust emission or the deterioration in air quality is rectified.

## 2.8 Records and Reporting

- 2.8.1 A sample data sheet for TSP monitoring is shown on Figure 2.12. All field information, laboratory data and calculations shall be recorded in the data sheet. The sheets shall be kept for at least 6 months after the completion of the Contract. The data recorded shall include at least the following:
- (i) date and time;
  - (ii) operator name;
  - (iii) identification of the monitoring station;
  - (iv) description of the site;
  - (v) description of the work progress and activities on site;

- (vi) temperature, pressure and weather conditions;
- (vii) elapsed-time meter readings;
- (viii) flow-rates before and after sampling;
- (ix) identification of filter papers; and
- (x) weighing data.

2.8.2 The information shall be collated and viewed by either the ER(s) or the EMT within 24 hours.

2.8.3 All data shall be checked before inclusion in the monthly report.

## 2.9 Event and Action Plan for Air Quality

2.9.1 The impact monitoring results shall be compared with air quality criteria set up for 24-hour TSP. Table 2.1 shows the air quality criteria, namely Action and Limit levels to be used. Should non-compliance with the air quality criteria occurs, the EM, the ER and the Contractor shall undertake the relevant action in accordance with the Action Plan in Table 2.2.

**Table 2.1**  
**Action and Limit Levels for Air Quality**

Parameters	Action Levels	Limit Level
24 Hour TSP Level in $\mu\text{g}/\text{m}^3$	For baseline <sup>(1)</sup> level < $108 \mu\text{g}/\text{m}^3$ , Action level = average of baseline level plus 30% and Limit level For baseline level > $108 \mu\text{g}/\text{m}^3$ and baseline level < $154 \mu\text{g}/\text{m}^3$ , Action level = $200 \mu\text{g}/\text{m}^3$ For baseline level > $154 \mu\text{g}/\text{m}^3$ , Action level = 130% of baseline level	260 <sup>(2)</sup>

- Notes:
- Measured at 298K and 101.325 kPa (one atmosphere).  
Concentration in micrograms per cubic metre in 24 hours.
  - <sup>(1)</sup> Baseline refers to the average value measured at the combined stations during the baseline period
  - <sup>(2)</sup> Hong Kong Air Quality Objectives and Construction Standard for the Project

**Table 2.2**  
**Actions in the Event of Exceedance of Action/Limit Levels**

Event	Actions		
	EMT	ER	Contractor
<b>Action Level</b>			
Exceedance for one sample	<ol style="list-style-type: none"> <li>1. Identify source</li> <li>2. Inform ER</li> <li>3. Repeat measurement to confirm finding</li> <li>4. Increase monitoring frequency to daily</li> </ol>	<ol style="list-style-type: none"> <li>1. Notify Contractor</li> <li>2. Check monitoring data and Contractor's working methods</li> </ol>	<ol style="list-style-type: none"> <li>1. Rectify any unacceptable practice</li> <li>2. Amend working methods if appropriate</li> </ol>
Exceedance for two or more consecutive samples	<ol style="list-style-type: none"> <li>1. Identify source</li> <li>2. Inform ER</li> <li>3. Repeat measurements to confirm findings</li> <li>4. Increase monitoring frequency to daily</li> <li>5. Discuss with ER for remedial actions required</li> <li>6. If exceedance continues, arrange meeting with ER</li> <li>7. If exceedance stops, cease additional monitoring</li> </ol>	<ol style="list-style-type: none"> <li>1. Confirm receipt of notification of failure in writing</li> <li>2. Notify Contractor</li> <li>3. Check monitoring data and Contractor's working methods</li> <li>4. Discuss with EMT and Contractor on potential remedial actions</li> <li>5. Ensure remedial actions properly implemented</li> </ol>	<ol style="list-style-type: none"> <li>1. Submit proposals for remedial actions to ER within 3 working days of notification</li> <li>2. Implement the agreed proposals</li> <li>3. Amend proposal if appropriate</li> </ol>
<b>Limit Level</b>			
Exceedance for one sample	<ol style="list-style-type: none"> <li>1. Identify source</li> <li>2. Inform ER and EPD</li> <li>3. Repeat measurement to confirm finding</li> <li>4. Increase monitoring frequency to daily</li> <li>5. Assess effectiveness of Contractor's remedial actions and keep EPD and ER informed of the results</li> </ol>	<ol style="list-style-type: none"> <li>1. Confirm receipt of notification of failure in writing</li> <li>2. Notify Contractor</li> <li>3. Check monitoring data and Contractor's working methods</li> <li>4. Discuss with EMT and Contractor potential remedial actions</li> <li>5. Ensure remedial actions properly implemented</li> </ol>	<ol style="list-style-type: none"> <li>1. Take immediate action to avoid further exceedance</li> <li>2. Submit proposals for remedial actions to ER within 3 working days of notification</li> <li>3. Implement the agreed proposals</li> <li>4. Amend proposal if appropriate</li> </ol>
Exceedance for two or more consecutive samples	<ol style="list-style-type: none"> <li>1. Identify source</li> <li>2. Inform ER and EPD the causes &amp; actions taken for the exceedances</li> <li>3. Repeat measurement to confirm findings</li> <li>4. Increase monitoring frequency to daily</li> <li>5. Investigate the causes of exceedance</li> <li>6. Arrange meeting with EPD and ER to discuss the remedial actions to be taken</li> <li>7. Assess effectiveness of Contractor's remedial actions and keep EPD and ER informed of the results</li> <li>8. If exceedance stops, cease additional monitoring</li> </ol>	<ol style="list-style-type: none"> <li>1. Confirm receipt of notification of failure in writing</li> <li>2. Notify Contractor</li> <li>3. Carry out analysis of Contractor's working procedures to determine possible mitigation to be implemented</li> <li>4. Discuss amongst EMT and the Contractor potential remedial actions</li> <li>5. Review Contractor's remedial actions whenever necessary to assure their effectiveness</li> <li>6. If exceedance continues, consider what portion of the work is responsible and instruct the Contractor to stop that portion of work until the exceedance is abated</li> </ol>	<ol style="list-style-type: none"> <li>1. Take immediate action to avoid further exceedance</li> <li>2. Submit proposals for remedial actions to ER within 3 working days of notification</li> <li>3. Implement the agreed proposals</li> <li>4. Resubmit proposals if problem still not under control</li> <li>5. Stop the relevant portion of works as determined by the ER until the exceedance is abated</li> </ol>

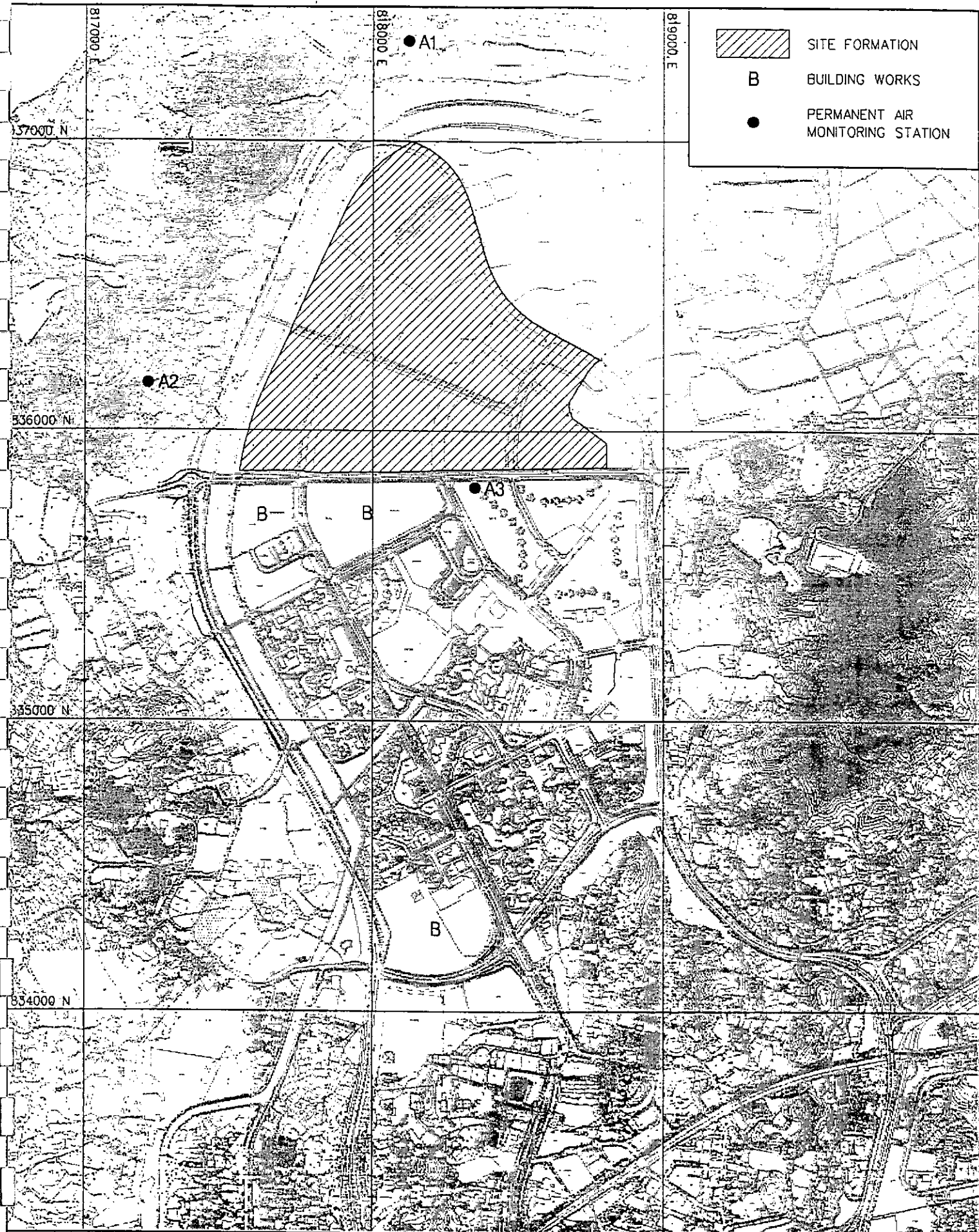
## 2.10 Dust Mitigation Measures to be Implemented by the Contractor


- 2.10.1 One of the potential impacts of the Site Formation Works is to generate fugitive dust emissions which exceed the maximum 24-hour averaged dust level (Total Suspended Particular Concentration of  $260 \mu\text{g}/\text{m}^3$ ) as stipulated in the Air Quality Objectives under CAP (311). The EIA report has recommended that the frequency and intensity of Site and haul road watering is a specified and priced feature of the Contract. The Contractor shall be responsible for the design and implementations of the dust control and mitigation measures recommended in the EIA:
- (i) The Contractor shall undertake at all times his activities in such a manner as to cause as little dust nuisance as possible. Effective dust suppression measures as are necessary should be installed to ensure that the air quality, at the boundary of the site and at any sensitive receivers, complies with the Hong Kong Air Quality Objectives.
  - (ii) The Contractor shall frequently clean and water the Site to minimise fugitive dust emissions.
  - (iii) Effective water sprays shall be used during the delivery and handling of aggregate, and other similar materials, when dust is likely to be created and to dampen all stored materials during dry and windy weather.
  - (iv) Watering of exposed surfaces shall be undertaken at least two times a day and be exercised as often as possible depending on the circumstances. In order to meet the requirement, it is necessary to install a water refilling system so that the water refilling time should be less than ten minutes.
  - (v) Areas within the Site where there is a regular movement of vehicles must be regularly watered as often as is necessary for effective suppression of dust or as often as directed by the Engineer. In most instances it will be necessary to water haul roads every two hours.
  - (vi) Should a conveyor system be used, the Contractor shall implement the following precautionary measures. Conveyor belts shall be fitted with windboards. Conveyor transfer points and hopper discharge areas shall be enclosed to minimise dust emission. All conveyors under the Contractor's control, and carrying materials which have the potential to create dust, shall be totally enclosed and fitted with belt cleaners.
  - (vii) Where dusty materials are being discharged to vehicle from a conveying system at a fixed transfer point, a three-sided roofed enclosure with a flexible curtain across the entry shall be provided. Exhaust fans shall be provided for this enclosure and vented to a suitable fabric filter system.
  - (viii) The Contractor shall confine haulage and delivery vehicles to designated roadways inside the Site. If, in the opinion of the Engineer, any motorized vehicle is causing dust nuisance, the engineer may require that the vehicle be restricted to a maximum speed of 15 km per hour while within the Site.

- (ix) Wheel washing facilities shall be installed and used by all vehicles leaving the Site. No earth, mud, debris, dust and the like shall be deposited on public roads. Water in the wheel cleaning facility shall be changed at frequent intervals and sediments shall be removed regularly. The Contractor shall submit details of proposals for the wheel washing facilities to the Engineer prior to construction of the facility. Such wheel washing facilities shall be usable prior to any earthworks excavation activity on the Site. The Contractor shall also provide a hard-surfaced road between any washing facility and the public road.
- (x) All site vehicle exhausts should be directly vertically upwards or directed away from the ground.
- (xi) At the end of the works, the stockpiles should be hydroseeded.

2.10.2 If the above measures are not sufficient to restore the air quality to acceptable levels upon the advice of the EM, the Contractor shall liaise with the EM on some other mitigation measures, propose to ER for approval, and implement the mitigation measures.





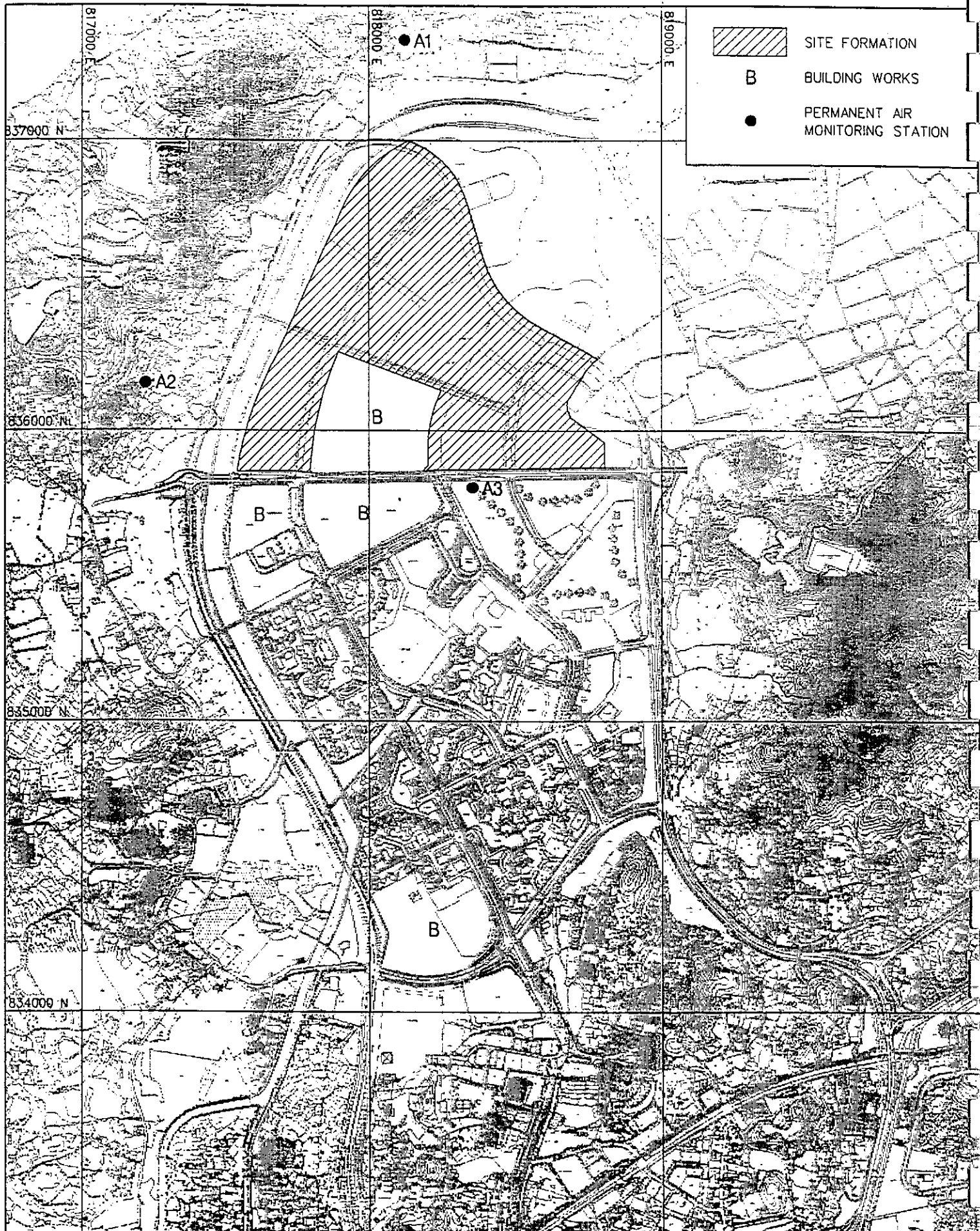
	SITE FORMATION
<b>B</b>	BUILDING WORKS
●	PERMANENT AIR MONITORING STATION

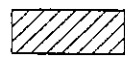

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 ENGINEERING INVESTIGATIONS FOR  
 DEVELOPMENT OF AREAS 3, 30 & 31  
 OF THE DEVELOPMENT ZONE  
 AND THE RESERVE ZONE

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Title :  
 EM & A - LOCATIONS OF AIR  
 MONITORING STATIONS  
 FOR SCENARIO 1  
 (JUL. - DEC. 1997)

Figure No. 2.1	Revision 0
Reference TSW-BASE	File Name 02420018.C09
Prepared MC	Checked PS
Date FEB. 97	Scale N.T.S.

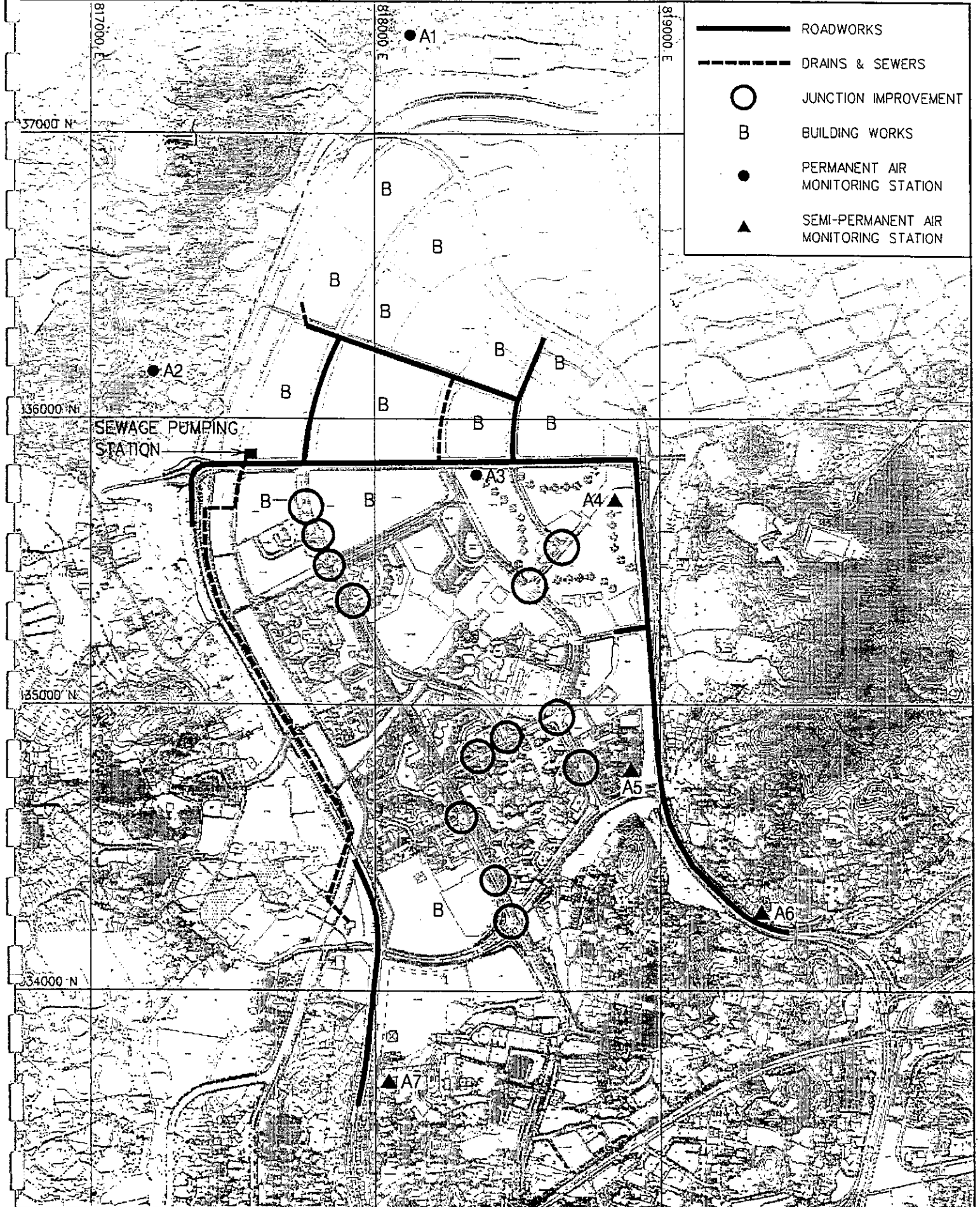


-  SITE FORMATION
- B** BUILDING WORKS
-  PERMANENT AIR MONITORING STATION

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Title :  
**EM & A - LOCATIONS OF AIR  
 MONITORING STATIONS  
 FOR SCENARIO 2  
 (JAN. - SEP. 1998)**

Figure No. 2.2	Revision 0
Reference TSW-BASE	File Name 02430018.C09
Prepared MC	Checked PS
Date FEB. 97	Scale N.T.S.



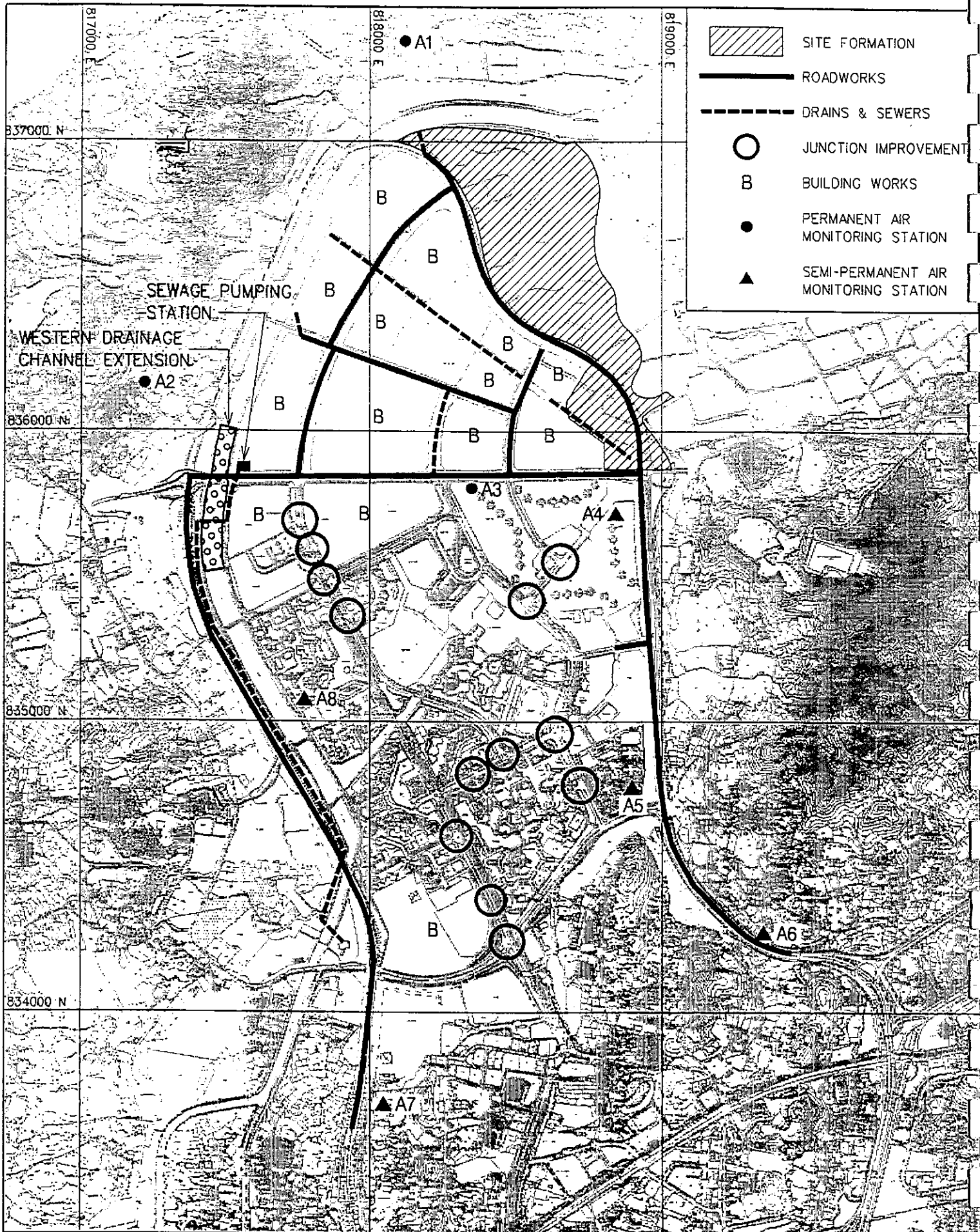
- ROADWORKS
- DRAINS & SEWERS
- JUNCTION IMPROVEMENT
- BUILDING WORKS
- PERMANENT AIR MONITORING STATION
- SEMI-PERMANENT AIR MONITORING STATION

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Title :  
 EM & A - LOCATIONS OF AIR  
 MONITORING STATIONS  
 FOR SCENARIO 3  
 (OCT. - DEC. 1998)

Figure No. 2.3	Revision 0
Reference TSW-BASE	File Name 02440018.C09
Prepared MC	Checked PS
Date FEB. 97	Scale N.T.S.

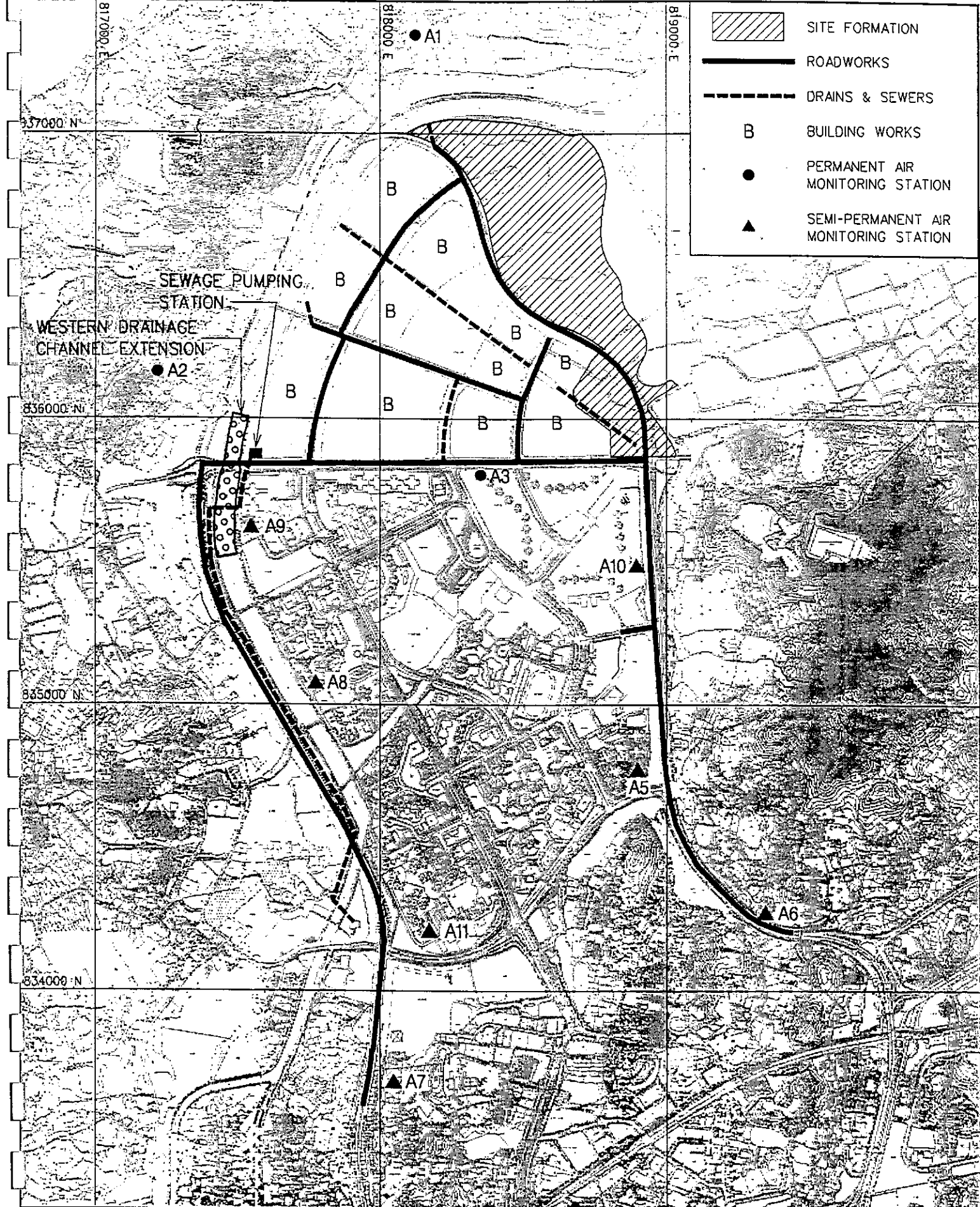


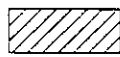





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Title :  
**EM & A - LOCATIONS OF AIR  
 MONITORING STATIONS  
 FOR SCENARIO 4  
 (JAN. - AUG. 1999)**

Figure No. 2.4	Revision 0
Reference TSW-BASE	File Name 02450018.C09
Prepared MC	Checked PS
Date FEB. 97	Scale N.T.S.

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-  ROADWORKS
-  DRAINS & SEWERS
-  BUILDING WORKS
-  PERMANENT AIR MONITORING STATION
-  SEMI-PERMANENT AIR MONITORING STATION

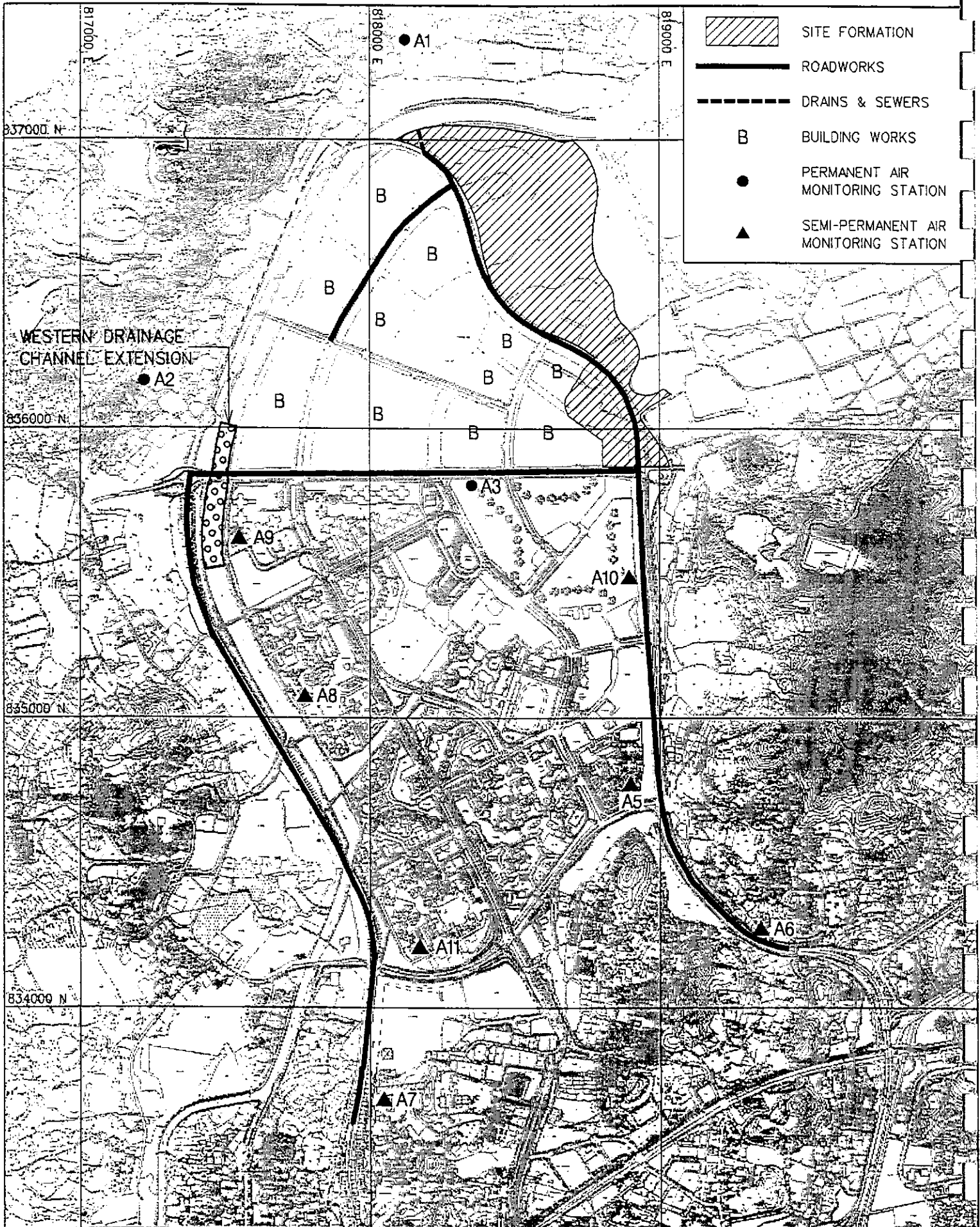
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 DEVELOPMENT OF AREAS 3, 30 & 31  
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Title : EM & A – LOCATIONS OF  
 AIR MONITORING STATIONS  
 FOR SCENARIO 5  
 (SEP 1999 – MAR 2000)

Figure No. 2.5	Revision 0
Reference TSW-BASE	File Name 02460018.C09
Prepared MC	Checked PS
Date FEB. 97	Scale N.T.S.

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Note : Housing layout from HD as of July 1996.  
 [Occupation dates based on recommended Implementation programme version 2.1]



-  SITE FORMATION
-  ROADWORKS
-  DRAINS & SEWERS
-  BUILDING WORKS
-  PERMANENT AIR MONITORING STATION
-  SEMI-PERMANENT AIR MONITORING STATION

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 AND THE RESERVE ZONE

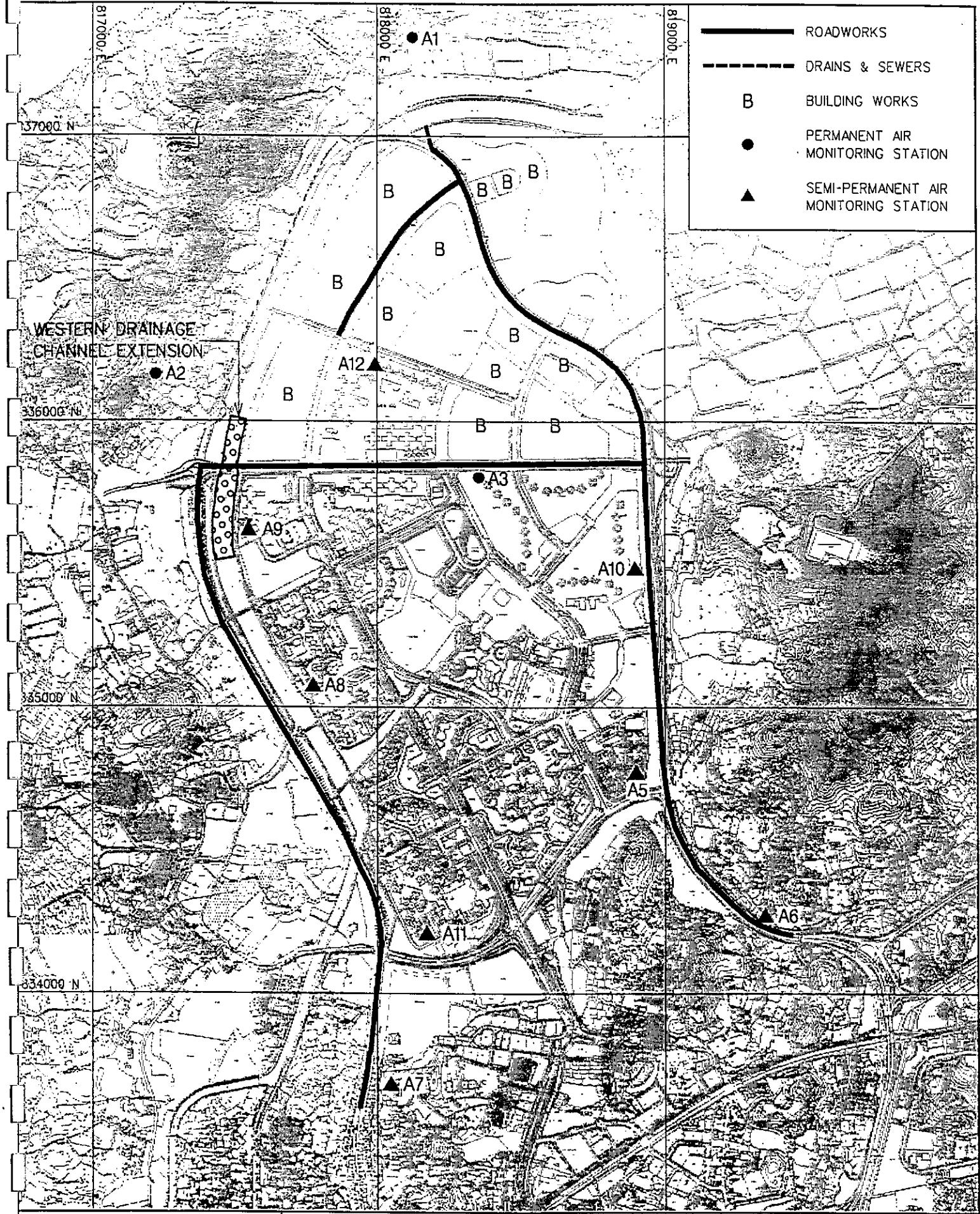
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Title : EM & A – LOCATIONS OF  
 AIR MONITORING STATIONS  
 FOR SCENARIO 6  
 (APR – AUG 2000)

Note : Housing layout from HD as of July 1998.

[Occupation dates based on recommended implementation programme version 2.1]

Figure No. 2.6	Revision 0
Reference TSW-BASE	File Name 02470018.C09
Prepared MC	Checked PS
Date FEB. 97	Scale N.T.S.

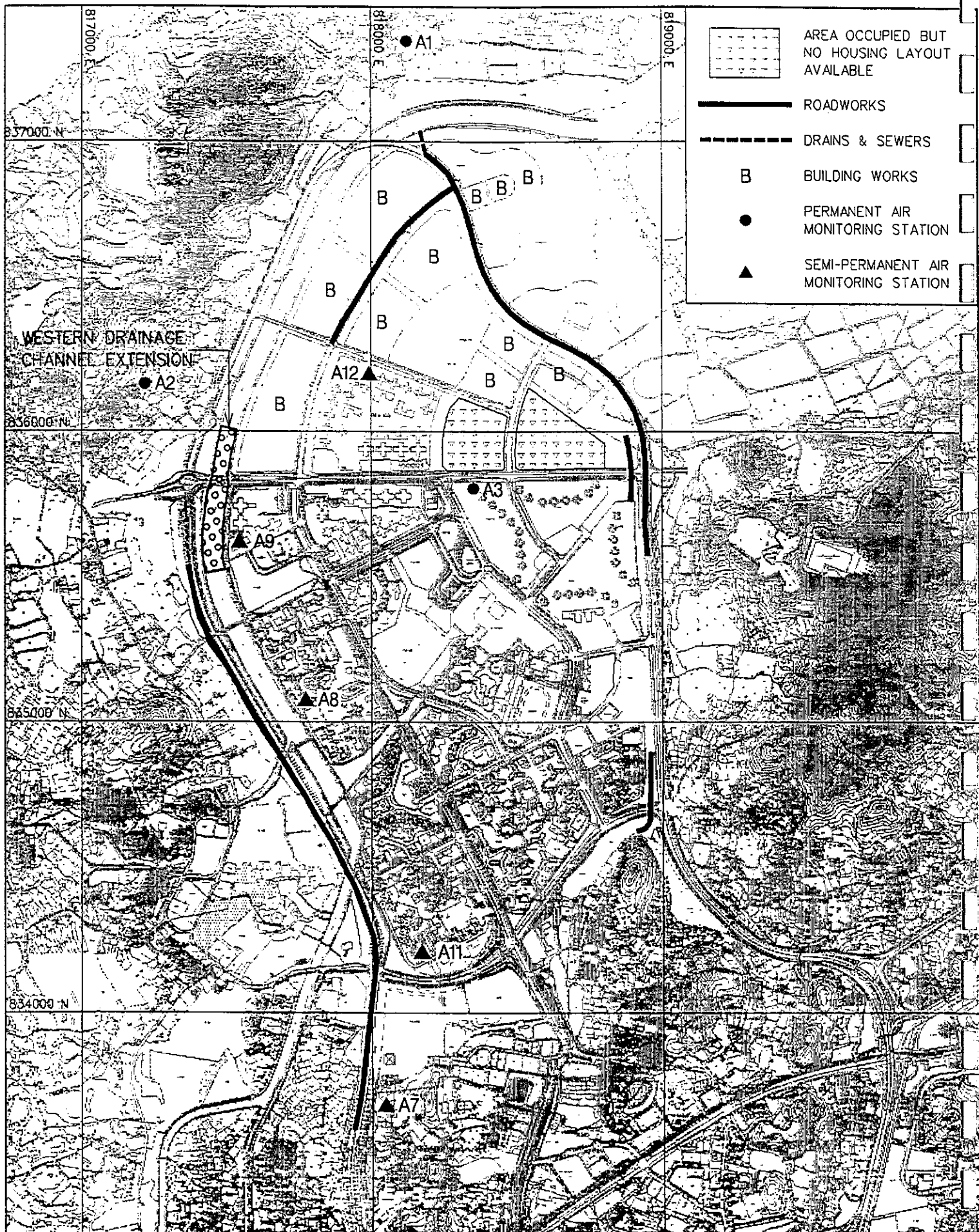


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 OF THE DEVELOPMENT ZONE  
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Title : EM & A - LOCATIONS OF  
 AIR MONITORING STATIONS  
 FOR SCENARIO 7  
 (SEP - DEC 2000)

Figure No. 2.7	Revision 0
Reference TSW-BASE	File Name 02480018.C09
Prepared MC	Checked PS
Date FEB. 97	Scale N.T.S.

(Note : Housing layout from HD as of July 1996. Area 102 layout as of December 1996)  
 (Occupation dates based on recommended implementation programme version 2.1)



	AREA OCCUPIED BUT NO HOUSING LAYOUT AVAILABLE
	ROADWORKS
	DRAINS & SEWERS
	BUILDING WORKS
	PERMANENT AIR MONITORING STATION
	SEMI-PERMANENT AIR MONITORING STATION

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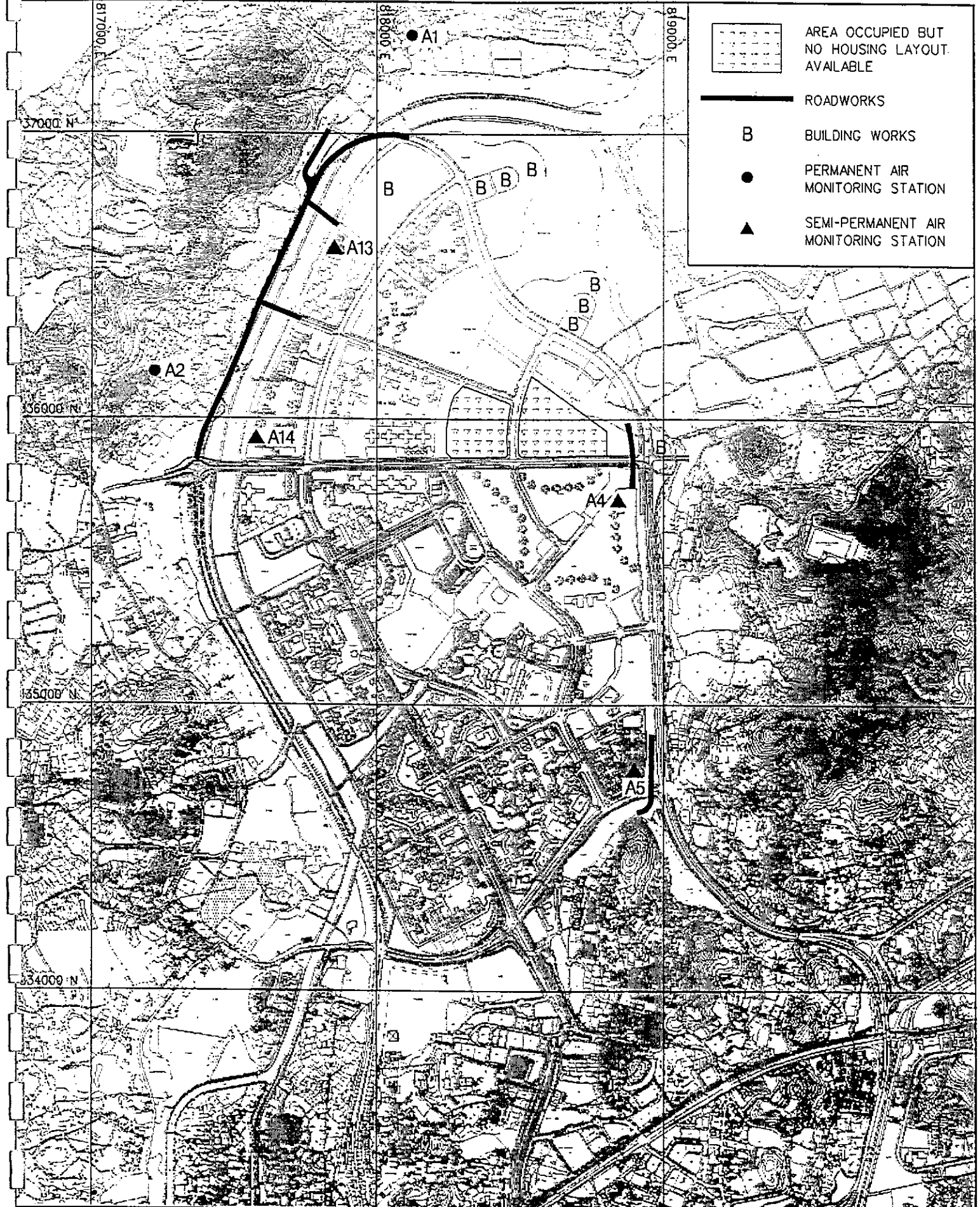
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Figure No. 2.8	Revision 0
Reference TSW-BASE	File Name 02490018.C09
Prepared MC	Checked PS
Date FEB. 97	Scale N.T.S.

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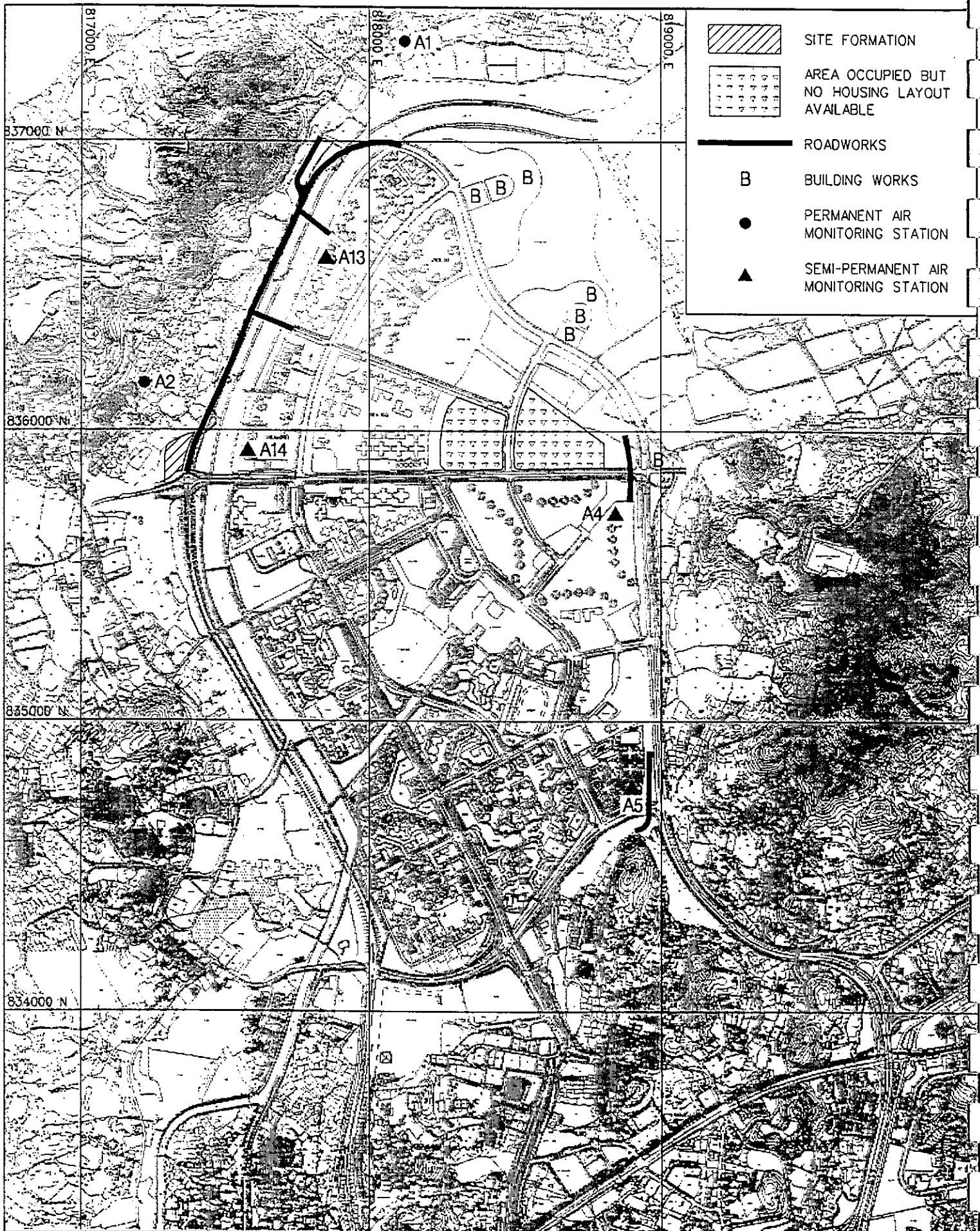
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Title : EM & A - LOCATIONS OF  
 AIR MONITORING STATIONS  
 FOR SCENARIO 9  
 (JUL - DEC 2001)

(Note : Housing layout from HD as of July 1996. Area 102, 106 layout as of December 1996)  
 [Occupation dates based on recommended implementation programme version 2.1]

Figure No. 2.9	Revision 0
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Prepared MC	Checked PS
Date FEB. 97	Scale N.T.S.



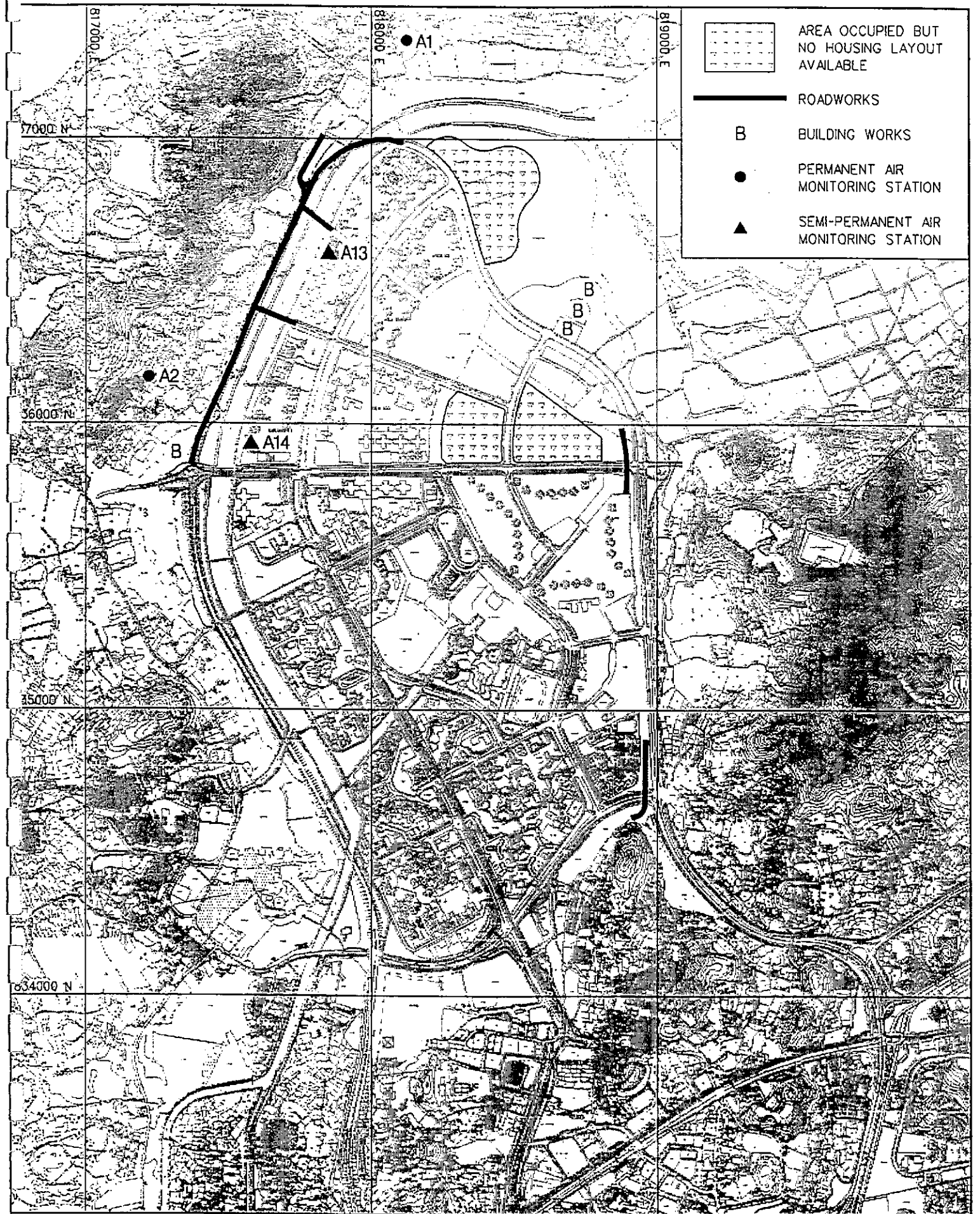
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Title : EM & A - LOCATIONS OF  
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 FOR SCENARIO 10  
 (JAN - JUL 2002)

(Note : Housing layout from HD as of July 1996. Area 102, 106 layout as of December 1996)  
 [Occupation dates based on recommended implementation programme version 2.1]

Figure No. 2.10	Revision 0
Reference TSW-BASE	File Name 02510018.C09
Prepared MC	Checked PS
Date FEB. 97	Scale N.T.S.



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Title : EM & A - LOCATIONS OF  
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 FOR SCENARIO 11  
 (AUG 2002 - AUG 2003)

(Note : Housing layout from HD as of July 1996. Area 102, 106 layout as of December 1996)  
 [ Occupation dates based on recommended implementation programme version 2.1 ]

Figure No. 2.11	Revision 0
Reference TSW-BASE	File Name 02520018.C09
Prepared MC	Checked PS
Date FEB. 97	Scale N.T.S.

Figure 2.12: Data Sheet for TSP Monitoring

Monitoring Location		
Details of Location		
Sampler Identification		
Date & Time of Sampling		
Elapsed-time Meter Reading	Start	(min.)
	Stop	(min.)
Total Sampling Time (min.)		
Weather Conditions		
Site Conditions		
Initial Flow Rate, Qsi	Pi	(mmHg)
	Ti	(°C)
	Hi	(in.)
	Qsi	(Std. m <sup>3</sup> )
Final Flow Rate, Qsf	Pf	(mmHg)
	Tf	(°C)
	Hf	(in.)
	Qsf	(Std. m <sup>3</sup> )
Average Flow Rate		(Std. m <sup>3</sup> )
Total Volume		(Std. m <sup>3</sup> )
Filter Identification No.		
Initial Wt. of Filter		(g)
Final Wt. of Filter		(g)
Measured TSP Level		(µg/m <sup>3</sup> )

	<u>Name &amp; Designation</u>	<u>Signature</u>	<u>Date</u>
Field Operator	:	_____	_____
Laboratory Staff	:	_____	_____
Checked by	:	_____	_____

### 3 NOISE

#### 3.1 Introduction

3.1.1 A detailed noise assessment was undertaken for the EIA. Table 3.1 summarises the activities with the most potential to generate unacceptable noise levels. Construction noise barriers are required as shown in Figure 3.1 by October 1998.

**Table 3.1**  
**Scenarios for Construction Noise Assessment**

Scenario	Duration	Contract	Construction Activities	NSRs, and the residents they represent, most likely to experience adverse impacts
1	Jul-Dec 1997	1 2	- site formation of Area 102 - site formation of Areas 101, 103-109a, 110 and 111	N3
2	Jan-Sep 1998	2	- site formation of Areas 101, 103-109a, 110 and 111	N3
3	Oct-Dec 1998	3 4 4 4 5 5 5	- junction improvement in DZ - sewage pumping station and rising mains - road L12(S), L13(E), L14 - Tin Wah Rd and Tin Tsz Rd dualling - grade separation of junction W (P2/1402) - grade separation of junction D & Long Tin Rd widening - grade separation of junction A & Hung Tin Rd widening	N3 N5 N8
4	Jan-Aug 1999	3 4 4 4 5 5 5 6 6 6 6 7 7	- junction improvement in DZ - sewage pumping station and rising mains - road L12(S), L13(E), L14 - Tin Wah Rd and Tin Tsz Rd dualling - grade separation of junction W (P2/1402) - grade separation of junction D & Long Tin Rd widening - grade separation of junction A & Hung Tin Rd widening - LRT central loop western leg - road L12(N) and road D4(N) - Tin Ying Rd dualling - Western Drainage Channel Extension - site formation of Areas 109b, 112-117 and 120 - road D4(S), bridge P1/V3	N5 N6 N4 N14
5	Sep 1999-Mar 2000	4 4 4 5 5 5 6 6 6 6 7 7	- sewage pumping station and rising mains - road L12(S), L13(E), L14 - Tin Wah Rd and Tin Tsz Rd dualling - grade separation of junction W (P2/1402) - grade separation of junction D & Long Tin Rd widening - grade separation of junction A & Hung Tin Rd widening - LRT central loop western leg - road L12(N) and road D4(N) - Tin Ying Rd dualling - Western Drainage Channel Extension - site formation of Areas 109b, 112-117 and 120 - road D4(S), bridge P1/V3	N3 N5 N4 N6 N16 N17
6	Apr-Sep 2000	4 5 5 6 6 6 6 7 7	- Tin Wah Rd and Tin Tsz Rd dualling - grade separation of junction D & Long Tin Rd widening - grade separation of junction A & Hung Tin Rd widening - LRT central loop western leg - road L12(N) and road D4(N) - Tin Ying Rd dualling - Western Drainage Channel Extension - site formation of Areas 109b, 112-117 and 120 - road D4(S), bridge P1/V3	N3 N5 N16 N18

**Table 3.1**  
**Scenarios for Construction Noise Assessment (cont'd)**

Scenario	Duration	Contract	Construction Activities	NSRs, and the residents they represent, most likely to experience adverse impacts
7	Oct-Dec 2000	4 5 5 6 6 6 7	- Tin Wah Rd and Tin Tsz Rd dualling - grade separation of junction D & Long Tin Rd widening - grade separation of junction A & Hung Tin Rd widening - road L12(N) and road D4(N) - Tin Ying Rd dualling - Western Drainage Channel Extension - road D4(S), bridge P1/V3	N3 N5 N16 N18
8	Jan-Jun 2001	5 6 6 6 7 7	- grade separation of junction A & Hung Tin Rd widening - road L12(N) and road D4(N) - Tin Ying Rd dualling - Western Drainage Channel Extension - road D4(S), bridge P1/V3 - bridges P2/L1 & P2/L2	N18
9	Jul-Dec 2001	7 8	- bridges P2/L1 & P2/L2 - road D3	N11
10	Jan-Jul 2002	7 8 8	- bridges P2/L1 & P2/L2 - road D3 - site formation of Area 121	N11
11	Aug 2002-Aug 2003	8	- road D3	N11

### 3.2 Noise Parameters

3.2.1 The construction noise level shall be measured in terms of the A-weighted equivalent continuous sound pressure level (Leq). Leq (30 min) shall be used as the monitoring parameter for the time period between 0700-1900 hours on normal weekdays. For all other time periods, Leq (5 min) shall be employed.

3.2.2 Noise monitoring shall be undertaken in accordance with:

- (i) the Noise Control Ordinance;
- (ii) the Deep Bay Guidelines; and
- (ii) as directed by the Engineer.

### 3.3 Monitoring Equipment

3.3.1 According to the Technical Memorandum (TM) issued under the Noise Control Ordinance (NCO), sound level metres in compliance with the International Electrotechnical Commission Publications 651: 1979 (Type 1) and 804: 1985 (Type 1) specifications shall be used for carrying out the noise monitoring.

3.3.2 The full instrumentation shall be of comparable professional quality. Microphones shall give free-field response and be suitable for outdoor measurements. The instruments shall be treated with great care as they are easily damaged. Protocol for field staff shall include instructions to store the equipment in the protective casing when not strictly in use.

- 3.3.3 Noise monitoring equipment shall be calibrated at least annually by an accredited calibration laboratory for compliance with the appropriate parts of IEC publications 651 and 804. On-site calibration equipment shall similarly be tested for compliance with IEC 942.
- 3.3.4 Immediately prior to, and following each noise measurement, the accuracy of the sound level meter shall be checked using an acoustic calibrator generating a known sound pressure level at a known frequency. In carrying out this procedure, the necessary barometric pressure corrections will be applied. In cases of long-term monitoring, the accuracy of the noise monitoring system shall be similarly checked on at least a daily basis. Measurements shall be accepted as valid only if the calibration levels before and after the noise measurement agree to within 1.0 dB.
- 3.3.5 Noise measurements should not be made in the presence of fog, rain, wind with a steady speed exceeding  $5 \text{ ms}^{-1}$  or wind with gusts exceeding  $10 \text{ ms}^{-1}$ . The wind speed shall be checked with a portable wind speed meter capable of measuring the wind speed in m/s.
- 3.3.6 Sufficient noise measuring equipment and associated instrumentation shall be available for carrying out the baseline monitoring, regular impact monitoring and ad hoc monitoring. All the equipment and associated instrumentation shall be clearly labelled.
- 3.3.7 Standard Operation Procedure (SOP) for noise measurement shall be prepared and validated. All noise measurement shall follow strictly the validated SOP.

#### 3.4 Monitoring Locations

- 3.4.1 The noise monitoring locations are shown on Figure 3.2 to 3.12 with planned time scales. The status and locations of noise sensitive receivers may change after issuing this manual. If such cases exist, the EM shall propose updated monitoring locations and seek approval from ER and agreement from EPD of the proposal.
- 3.4.2 When alternative monitoring locations are proposed, the monitoring locations should be chosen based on the following criteria:
- (i) at locations close to the major site activities which are likely to have noise impacts;
  - (ii) close to the noise sensitive receivers such as any domestic premises, hotel, hostel, temporary housing accommodation, hospital, medical clinic, educational institution, place of public worship, library, court of law, performing art centre; and
  - (iii) for monitoring locations located in the vicinity of the sensitive receivers, care should be taken to cause minimal disturbance to the occupants during monitoring.
- 3.4.3 The monitoring station shall normally be at a point 1 m from the exterior of the sensitive receivers building facade and be at a position 1.2 m above the ground. If there is problem with access to the normal monitoring position, an alternative position may be chosen, and a correction to the measurements shall be made. For reference, a correct of +3 dB(A) shall be made to the free field measurements. The EM shall agree with the ER on the monitoring position and the corrections adopted. Once the positions for the monitoring stations are chosen, the baseline monitoring and the impact monitoring shall be carried out at the same positions.

### 3.5 Baseline Monitoring

- 3.5.1 The baseline noise monitoring shall be carried out at three Permanent Noise Monitoring Stations for a period of two weeks, prior to the commencement of the construction works. Data of a total of three days with a minimum of three replicates shall be collected during the period. A schedule on the baseline monitoring shall be submitted to the ER for approval before the monitoring starts.
- 3.5.2 There shall not be any construction activities in the vicinity of the stations during the baseline monitoring.
- 3.5.3 In exceptional cases, when insufficient baseline monitoring data or questionable results are obtained, the EM shall liaise with EPD to agree on an appropriate set of data to be used as a baseline reference and submit to the ER.

### 3.6 Impact Monitoring

- 3.6.1 Noise monitoring shall be carried out once every two weeks between 0700-1900 on normal weekdays at all the designated monitoring station shown on Figure 3.2 to 3.12.
- 3.6.2 The following point shall be taken into consideration when carrying out any noise monitoring:
- (i) The time of day when any monitoring is undertaken shall be appropriate for the activities on Site. Where works are to be carried out under the terms of a Construction Noise Permit, monitoring shall be carried out in accordance with the conditions and hours permitted in the Permit. If a Construction Noise Permit applies during any phase of the Works, the EMT will consult with EPD and the Engineer regarding an appropriate noise monitoring schedule.
  - (ii) Noise measurements shall be carried out with an integration sound level meter using the "fast" response mode, and the results shall be rounded to nearest whole dB.
  - (iii) Measurements shall not be made when the temperatures at the monitoring sites are outside the range recommended by the equipment manufacturers and when other intrusive noise sources (other than Influencing Factors) are apparent at the assessment point, or due account will be made of such sources in the auditing of the data.
  - (iv) Those monitoring stations which fall within the Special Measures Zone will be subject to the noise limits recommended in the *Deep Bay Guidelines*. Monitoring at other locations may be required by the Engineer and EMT.
  - (v) Noise measurements should be scheduled to ensure any particularly noisy activities are monitored. Measurements at the three Permanent Noise Monitoring Stations shall be included throughout the duration of Works within the RZ under the Project.



3.6.3 In case of non-compliance with the construction noise criteria, more frequent monitoring as specified in the Action Plan in Section 3.7 shall be carried out. This additional monitoring shall be continued until the recorded noise levels are rectified or proved to be irrelevant to the construction activities.

### 3.7 Records and Reporting

3.7.1 A sample data sheet for noise monitoring is shown on Figure 3.13. All the field data results and calculation shall be recorded in the data sheet to include at least the following:

- (i) site name;
- (ii) the area of the site and/or source and/or activity under investigation;
- (iii) the date and time period over which the monitoring is undertaken;
- (iv) details of the assessment point, including its location, distance from the construction activity being monitored, description of the intervening topography, height above sea and ground level and distance from any reflecting surface;
- (v) weather conditions including wind speed and direction, rain, mist and fog. Data taken under the latter conditions will be invalidated;
- (vi) details of the equipment used including the manufacturer, model/type, serial number and date of last full calibration by an accredited laboratory;
- (vii) equipment settings;
- (viii) calibration levels before and after measurements;
- (ix) battery voltage before and after measurements;
- (x) presence of Influencing Factors; and
- (xi) any other information likely to be appropriate (e.g. presence of other noise sources during the monitoring period activities on the Site that are not representative).

3.7.2 The information shall be reviewed by a competent, experienced person within 24 hours.

3.7.3 Any print-outs produced by the noise monitoring equipment shall be labelled and stored until at least 6 months after the project is completed.

3.7.4 The relevant data shall be summarized for each monthly report and the details given in appendices.

3.7.5 All data shall be checked before inclusion in the monthly report.

3.7.6 In the event of non-compliance, special reports shall be issued and these shall be collated and discussed in the monthly reports.

### 3.8 Event and Action Plan for Noise

3.8.1 The Action and Limit levels for construction noise are defined in Table 3.2. Should non-compliance with the criteria occurs, action in accordance with the Action Plan in Table 3.3, shall be carried out.

**Table 3.2**  
**Action and Limit Levels for Noise Measured at NSRs during Construction**

Period	Weekdays <sup>(1)</sup> 0700 to 1900 hours  L <sub>Aeq</sub> (30 min) (dB(A))	Evenings <sup>(2)</sup> 1900 to 2300 hours Sundays and General Holidays  L <sub>Aeq</sub> (5 min) (dB(A))	Night-time <sup>(3)</sup> 2300 to 0700 hours  L <sub>Aeq</sub> (5 min) (dB(A))
Action Level	When a complaint is received	When a complaint is received	When a complaint is received
Limit Level	75 <sup>(3)</sup>	65 <sup>(3)</sup>	50 <sup>(4)</sup>

Notes:

- (1) At schools AL levels are 5 dB(A) lower, 10 dB(A) lower during examinations.
- (2) Applicable only if working during these hours are necessary.
- (3) *Deep Bay Guidelines for Dredging, Reclamation and Drainage Works*<sup>1</sup> recommends that 60 dB(A) should never be exceeded for all days 0700 to 2300 hours within the Special Measures Zone, as measured as a point 100 m outside the site boundary. This will apply to monitoring at N1.
- (4) *Technical Memorandum on Noise from Construction Work other than Percussive Piling* issued under the *Noise Control Ordinance*. The finalisation of target levels is subject to the Area Rating of the NSR to be determined by EPD. Area Rating 'B' is suggested, as most of the NSRs are high rise buildings without any nearby Influencing Factors. If the following equipment or processes were in use then the levels will be 15 dB lower:
  - . bulldozer
  - . hand held breakers
  - . vibrator concrete poker
  - . dump truck
  - . concrete lorry mixer
  - . hammering
  - . any process concerning scaffolding or formwork making.

**Table 3.3**  
**Event/Action Plan for Construction Noise**

Event	Action	
	EM or ER	Contractor
Action Level	<ol style="list-style-type: none"> <li>1. Notify Contractor</li> <li>2. Analyse investigation</li> <li>3. Require Contractor to propose measures for the analysed noise problem</li> <li>4. Increase monitoring frequency to check mitigation effectiveness</li> </ol>	<ol style="list-style-type: none"> <li>1. Submit noise mitigation proposals to Environmental Manager/Engineer's Representative</li> <li>2. Implement noise mitigation proposals</li> </ol>
Limit Level	<ol style="list-style-type: none"> <li>1. Notify Contractor</li> <li>2. Notify EPD</li> <li>3. Require contractor to implement mitigation measures. Increase monitoring frequency to check mitigation effectiveness</li> </ol>	<ol style="list-style-type: none"> <li>1. Implement mitigation measures</li> <li>2. Prove to Environmental Manager/ER effectiveness of measures applied</li> </ol>

<sup>1</sup> *Deep Bay Guidelines for Dredging, Reclamation and Drainage works* (September 1991) ERL (Asia) Ltd in association with Binnie Consultants Ltd.

### 3.9 Noise Mitigation Measures for Implementation by the Contractor

- 3.9.1 (i) The Contractor shall consider noise as an environmental constraint in the planning and execution of the Works.
- (ii) The Contractor shall comply with the *Noise Control Ordinance (Cap 400)* and with any regulations made under the Ordinance, including restrictions placed on noise from construction work and the requirements to seek Construction Noise Permits. Before commencing work which requires Construction Noise Permits, the Contractor should obtain such permits and display these appropriately.
- (iii) In addition to the requirements imposed by the *Noise Control Ordinance*, to control noise generated from equipment and activities for the purpose of carrying out any construction work other than percussive piling during the time period from 0700 to 1900 hours on any day not being a general holiday (including Sundays), the following requirements shall also be complied with:
- (a) The noise level measured at 1 m from the most affected external facade of the nearby noise sensitive receivers from the construction work alone during any 30 minute period shall not exceed an equivalent sound level (Leq) of 75 dB(A).
- (b) The noise level measured at 1 m from the most affected external facade of any nearby schools from the construction work alone during any 30 minute period shall not exceed an equivalent sound level (Leq) of 70 dB(A) [65 dB(A) during school examination periods].
- The Contractor shall liaise with the schools and the Examination Authority to ascertain the exact dates and times of all examination periods during the course of the contract.
- (c) The noise level measured at a point 100 m outside the Site boundary within the Special Measures Zone (as defined under the *Deep Bay Guidelines for Dredging, Reclamation and Drainage Works*<sup>2</sup>) should never exceed 60 dB(A) for all days 0700 to 2300 hours.
- (d) Should the limits stated in the above sub-clauses (a) and (b) or, where applicable, (c) be exceeded, the construction shall stop and shall not recommence until appropriate measures acceptable to the Engineer that are necessary for compliance have been implemented. If two contractors working under this Project are both working close to the same NSR, both contractors may be required to reduce the noise level from their individual contract to 3 dB(A) less than the levels stipulated above so that the combined noise level does not exceed these limits.

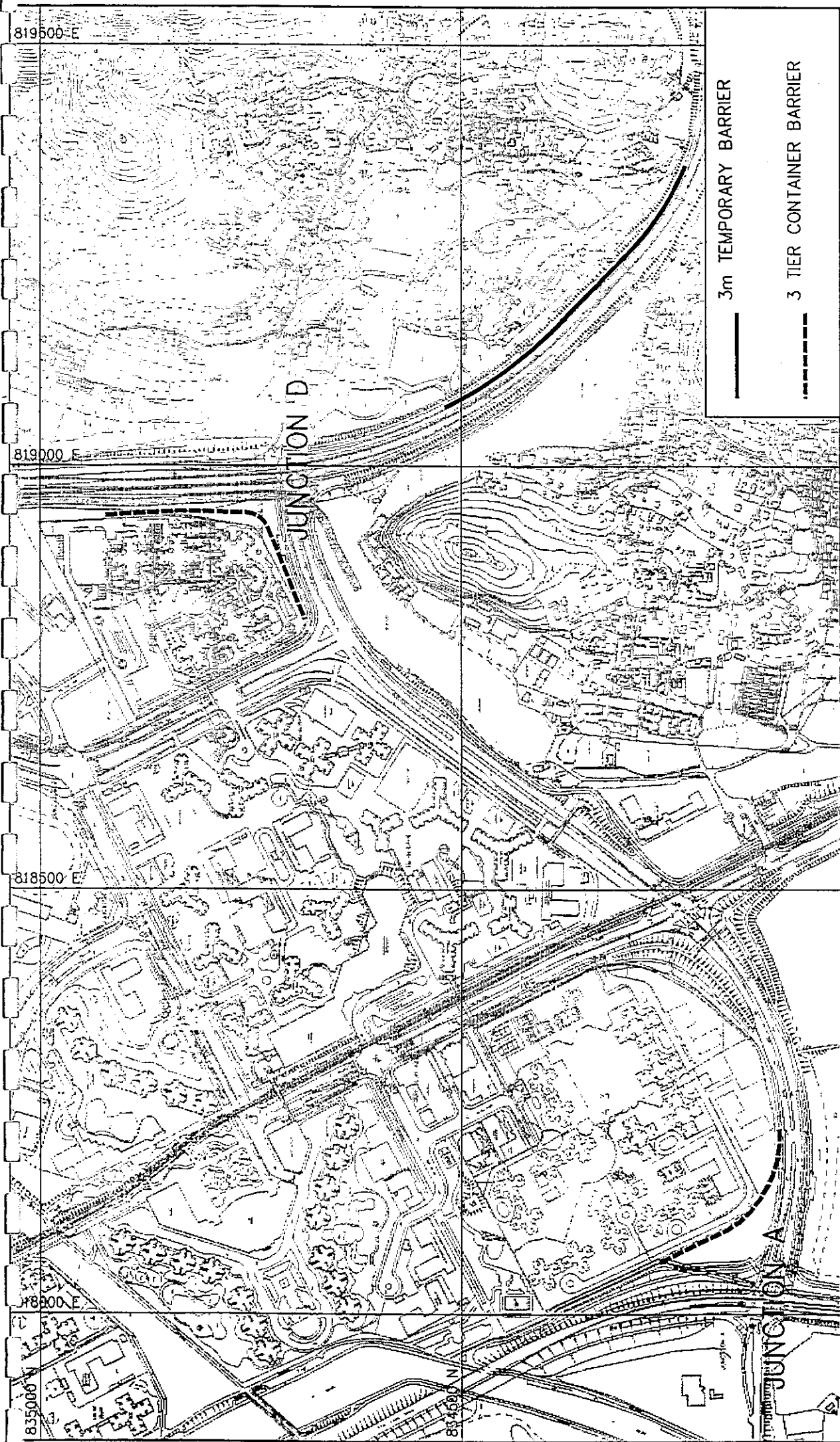
Any stoppage or reduction in output resulting from compliance with this clause shall not entitle the Contractor to any extension of time for completion or to any additional costs whatsoever.

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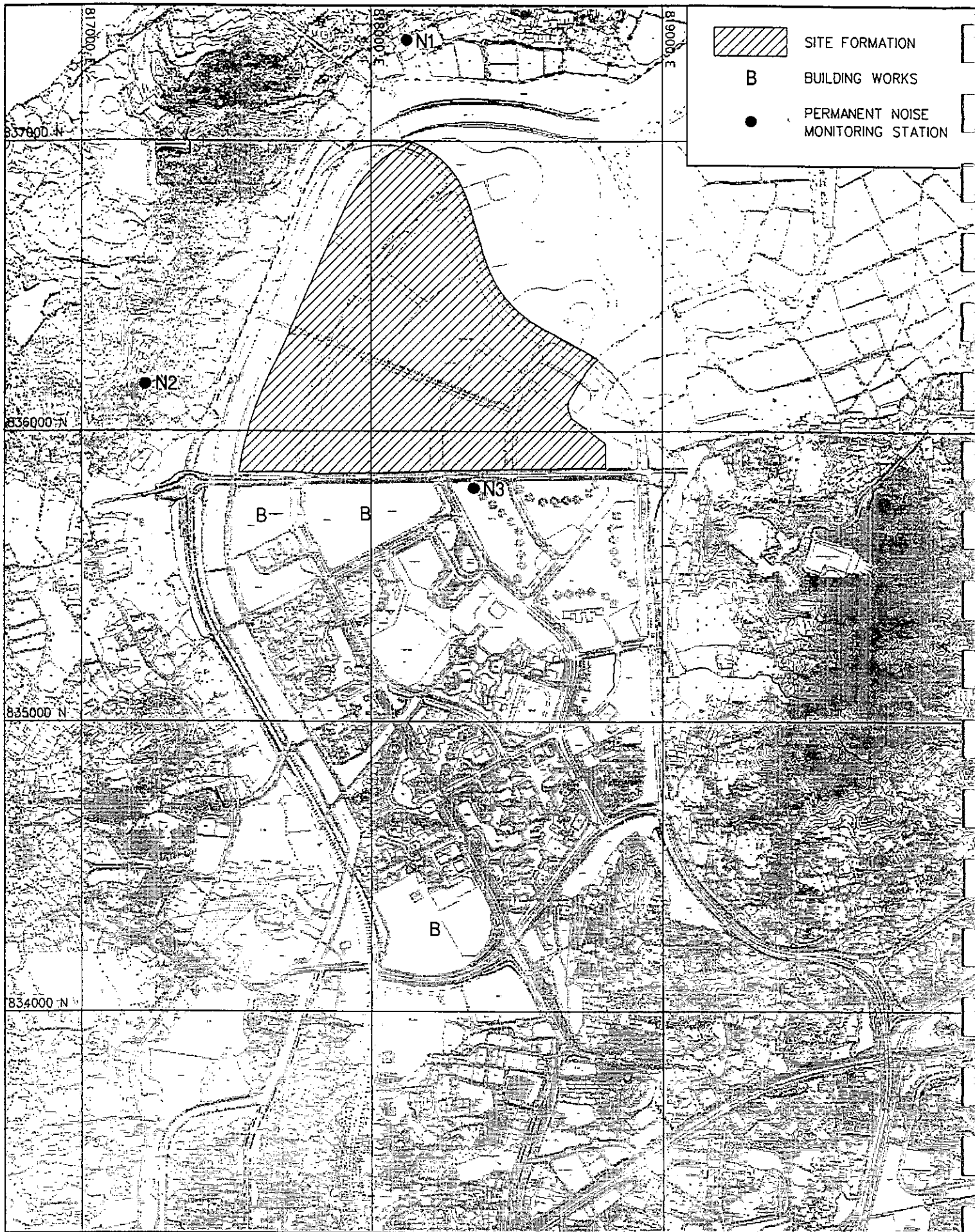
<sup>2</sup> *Deep Bay Guidelines for Dredging, Reclamation and Drainage Works* (1991), Environmental Protection Department.

- (iv) The Contractor shall devise, arrange methods of working and carry out the works in such a manner as to minimise noise impacts on the surrounding environment, and shall provide experienced personnel with suitable training to ensure that these methods are implemented.
- (v) Before the commencement of any work, the Engineer may require the methods of working, equipment and sound-reducing measures intended to be used on the Site to be made available for inspection and approval to ensure that they are suitable for the project.
- (vi) The Contractor shall ensure that all plant and equipment to be used on the Site likely to cause excessive noise effectively sound-reduced by means of silencers, mufflers, acoustic linings or shields, acoustic sheds or screens or other means to avoid disturbance to any nearby noise sensitive receivers (NSRs). All hand-held percussive breakers and air compressors will comply with the *Noise Control (Hand-held Percussive Breakers) Regulations* and *Noise Control (Air Compressors) Regulations* respectively under the *Noise Control Ordinance (Ordinance No. 75/88, NCO Amendment 1992 No. 6)*.
- (vii) The Contractor shall ensure that all plant and equipment to be used on Site are properly maintained in good operating condition.
- (viii) It is recommended that construction noise should be mitigated using a suitable combination of the following measures:
  - (a) Noisy equipment and activities should be sited by the Contractor as far from close-proximity sensitive receivers as is practical. Prolonged operation of noisy equipment close to dwellings should be avoided.
  - (b) Noisy plant or processes should be replaced by quieter alternatives where possible. Silenced diesel and gasoline generators and power units, as well as silenced and super-silenced air compressors, can be readily obtained.
  - (c) Noisy activities should be scheduled to minimise exposure of nearby sensitive receivers to high levels of construction noise. For example, noisy activities can be scheduled for midday, or at times coinciding with periods of high background noise (such as during peak traffic hours).
  - (d) Idle equipment should be turned off or throttled down. Noisy equipment should be properly maintained and used no more often than is necessary.
  - (e) The power units of non-electric stationary plant and earth-moving plant should be quietened by vibration isolation and partial or full acoustic enclosures for individual noise-generating components.
  - (f) Construction activities should be planned so that parallel operation of several sets of equipment close to a given sensitive receiver is avoided. The numbers of operating items of powered mechanical equipment should be minimised.

- (g) Construction plant should be properly maintained and operated. Construction equipment often has silencing measures built in or added on, e.g. bulldozer silencers, compressor panels, and mufflers. Silencing measures should be properly maintained and utilised.
- (h) Acoustic barriers should be used to protect nearby noise sensitive receivers if necessary. Barriers can be made of mounds of fill or any material having a surface density of  $20 \text{ kg/m}^3$ .
- (ix) Acoustic barriers shall be constructed as indicated in Figure 3.1 from the beginning of the construction of infrastructure works (end of 1998).
- (x) Mitigation measures should be adopted to protect birds from excessive noise.
  - (a) The Contractor should avoid any sudden banging and clanging of materials. Sudden revving of engine on any mobile plants should also be avoided.
  - (b) The Contractor should warn workers to avoid disturbing the birds as far as possible.
  - (c) Noise close to the north of the RZ should be kept as constant as possible. Alternatively, noisy construction works close to the north of the RZ should be scheduled during the summer months to avoid the migratory season during the winter months as far as practicable.
  - (d) The Contractor should use quiet piling equipments and silenced equipment as far as practicable during construction works.
- (xi) For the purposes of the above clauses, any domestic premises, hotels, hostel, temporary housing accommodation, hospital, medical clinic, educational institution, place of public worship, library, court of law, performing arts centre or office building shall be considered a noise sensitive receiver.
- (xii) Notwithstanding the requirements and limitations set out in clause (iv) above and subject with clauses (v), (vi) and (viii) above, the Engineer may upon application in writing by the Contractor, allow the use of any equipment and the carrying out of any construction activities for any duration provided that he is satisfied with the application which, in his opinion, to be of absolute necessity and adequate noise insulation has been provided to the educational institutions to be affected, or of emergency nature, and not in contravention with the *Noise Control Ordinance* in any respect.



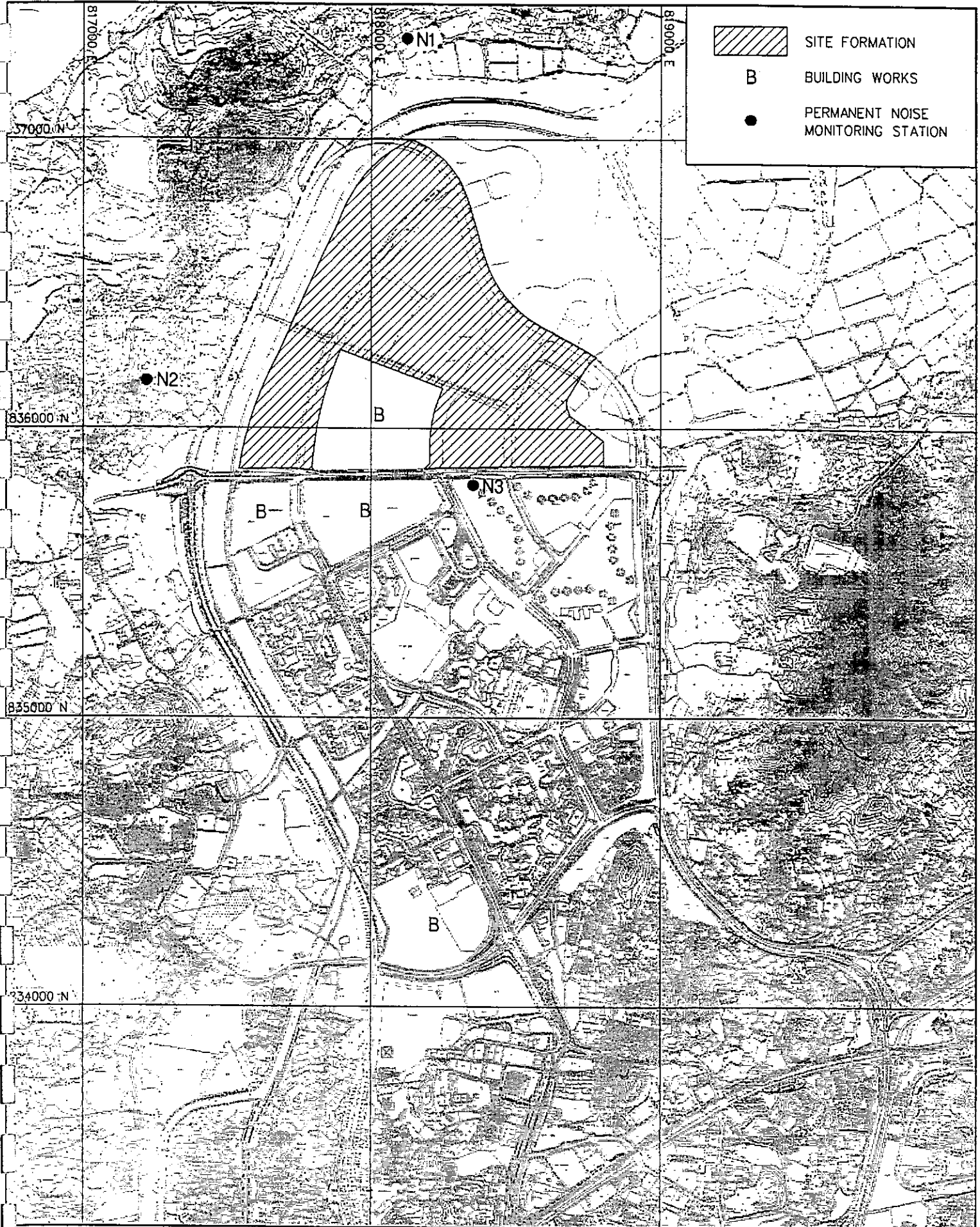
<p>TIN SHUI WAI DEVELOPMENT          AGREEMENT NO. CE 10/95          ENGINEERING INVESTIGATIONS FOR          DEVELOPMENT OF AREAS 3, 30 &amp; 31          OF THE DEVELOPMENT ZONE          AND THE RESERVE ZONE</p>		<p>Title :</p>		<p>Figure No. 3.1</p>		<p>Revision 1</p>	
<p>ENGINEERING INVESTIGATIONS FOR          DEVELOPMENT OF AREAS 3, 30 &amp; 31          OF THE DEVELOPMENT ZONE          AND THE RESERVE ZONE</p>		<p>Reference          TSW-BASE</p>		<p>File Name          01400018.C09</p>		<p>Checked          PS</p>	
<p>ENGINEERING INVESTIGATIONS FOR          DEVELOPMENT OF AREAS 3, 30 &amp; 31          OF THE DEVELOPMENT ZONE          AND THE RESERVE ZONE</p>		<p>Prepared          MC</p>		<p>Date          JAN. 97</p>		<p>Scale          1 : 6000</p>	
<p>LOCATION OF NOISE BARRIERS DURING CONSTRUCTION STAGE</p>				<p>3m TEMPORARY BARRIER          3 TIER CONTAINER BARRIER</p>			
<p>TIN SHUI WAI DEVELOPMENT          AGREEMENT NO. CE 10/95          ENGINEERING INVESTIGATIONS FOR          DEVELOPMENT OF AREAS 3, 30 &amp; 31          OF THE DEVELOPMENT ZONE          AND THE RESERVE ZONE</p>				<p>BINNIB CONSULTANTS LIMITED          賓尼工程顧問有限公司          ENGINEERS AND SCIENTISTS</p>			





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 DEVELOPMENT OF AREAS 3, 30 & 31  
 OF THE DEVELOPMENT ZONE  
 AND THE RESERVE ZONE

Title :  
 EM & A - LOCATIONS OF NOISE  
 MONITORING STATIONS  
 FOR SCENARIO 1  
 (JUL - DEC 1997)

Figure No. 3.2	Revision 0
Reference TSW-BASE	File Name 02530018.C09
Prepared MC	Checked PS
Date FEB. 97	Scale N.T.S.



	SITE FORMATION
<b>B</b>	BUILDING WORKS
	PERMANENT NOISE MONITORING STATION

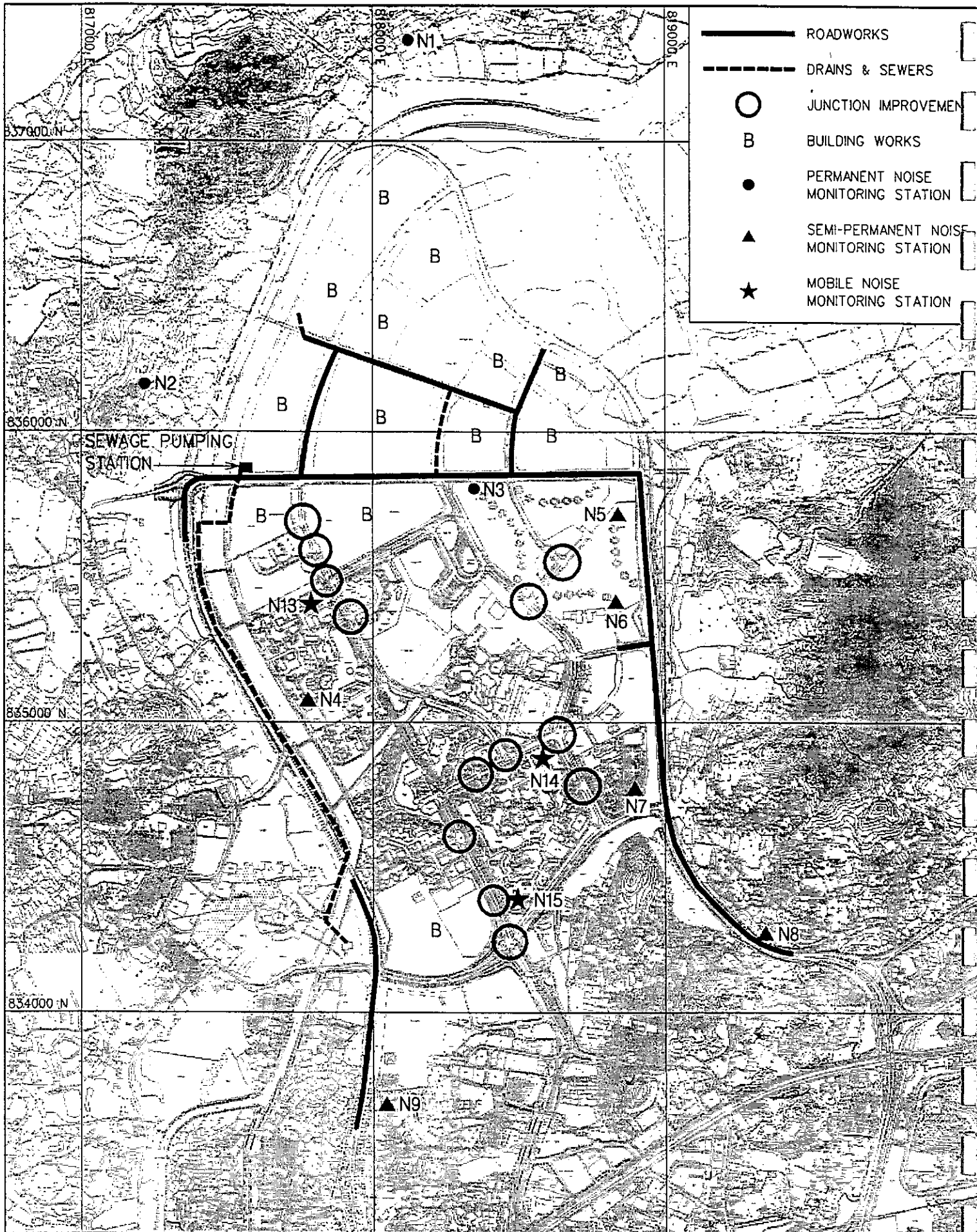
TIN SHUI WAI DEVELOPMENT AGREEMENT NO. CE 10/95  
 ENGINEERING INVESTIGATIONS FOR DEVELOPMENT OF AREAS 3, 30 & 31 OF THE DEVELOPMENT ZONE AND THE RESERVE ZONE

Title :  
**EM & A - LOCATIONS OF NOISE MONITORING STATIONS FOR SCENARIO 2 (JAN - SEP 1998)**

Figure No.	Revision
3.3	0
Reference	File Name
TSW-BASE	02540018.C09
Prepared	Checked
MC	PS
Date	Scale
FEB. 97	N.T.S.

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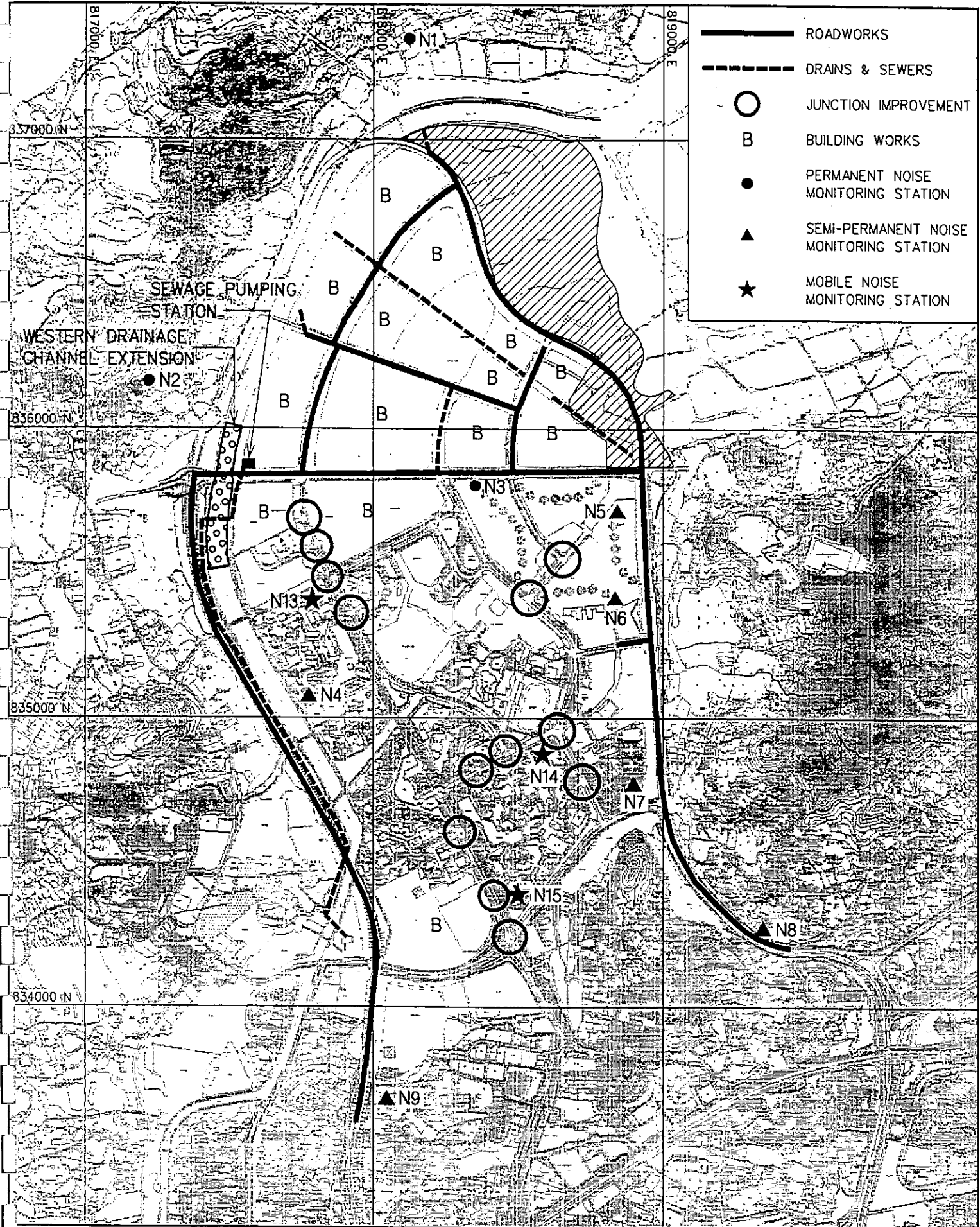




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 ENGINEERING INVESTIGATIONS FOR  
 DEVELOPMENT OF AREAS 3, 30 & 31  
 OF THE DEVELOPMENT ZONE  
 AND THE RESERVE ZONE

Title :  
 EM & A - LOCATIONS OF NOISE  
 MONITORING STATIONS  
 FOR SCENARIO 3  
 (OCT - DEC 1998)

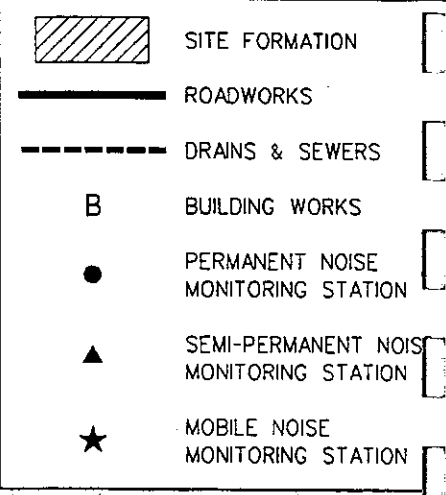
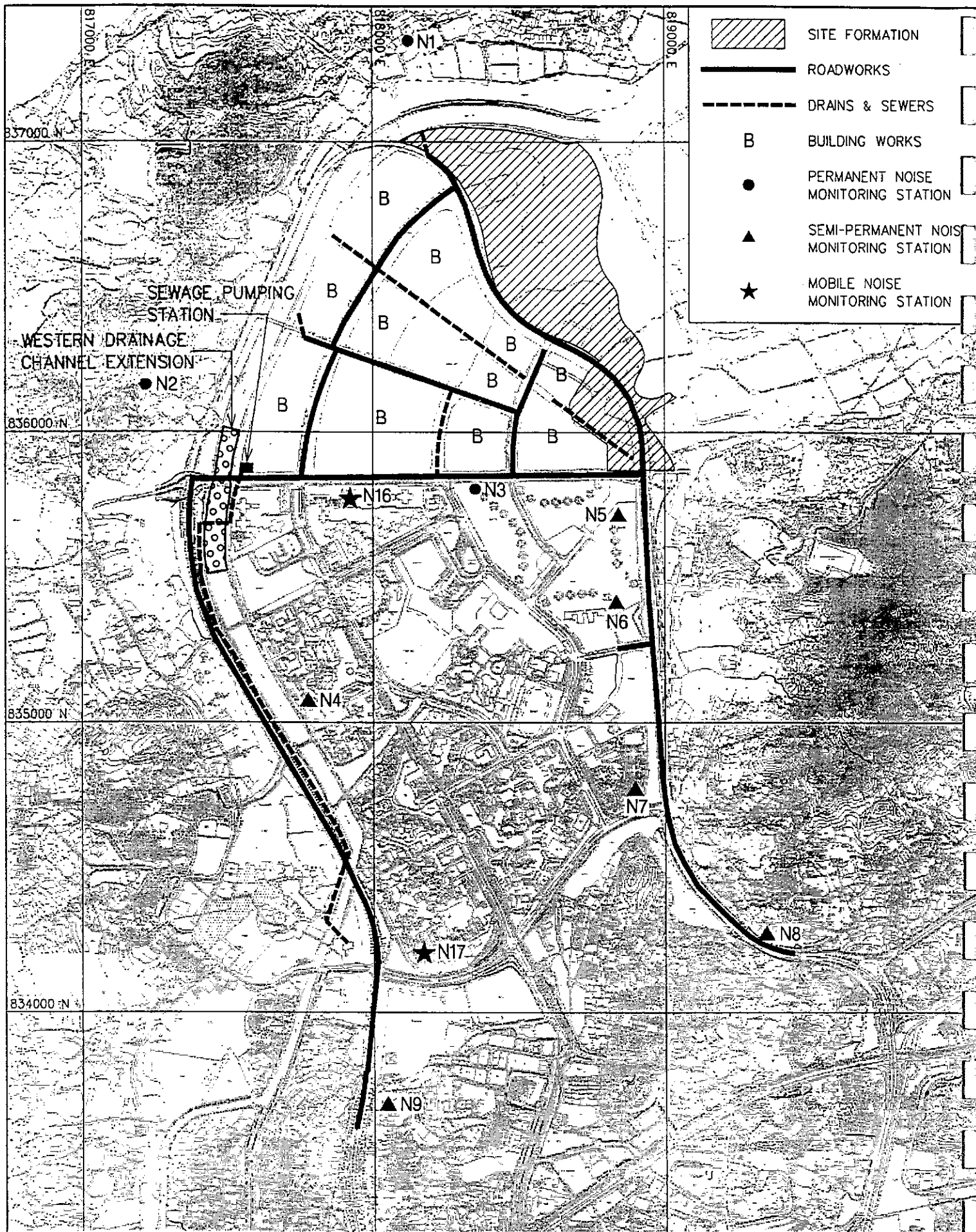
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Prepared MC	Checked PS
Date FEB 07	Scale N.T.S.



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 ENGINEERING INVESTIGATIONS FOR  
 DEVELOPMENT OF AREAS 3, 30 & 31  
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 AND THE RESERVE ZONE

Title :  
 EM & A - LOCATIONS OF NOISE  
 MONITORING STATIONS  
 FOR SCENARIO 4  
 (JAN - AUG 1999)

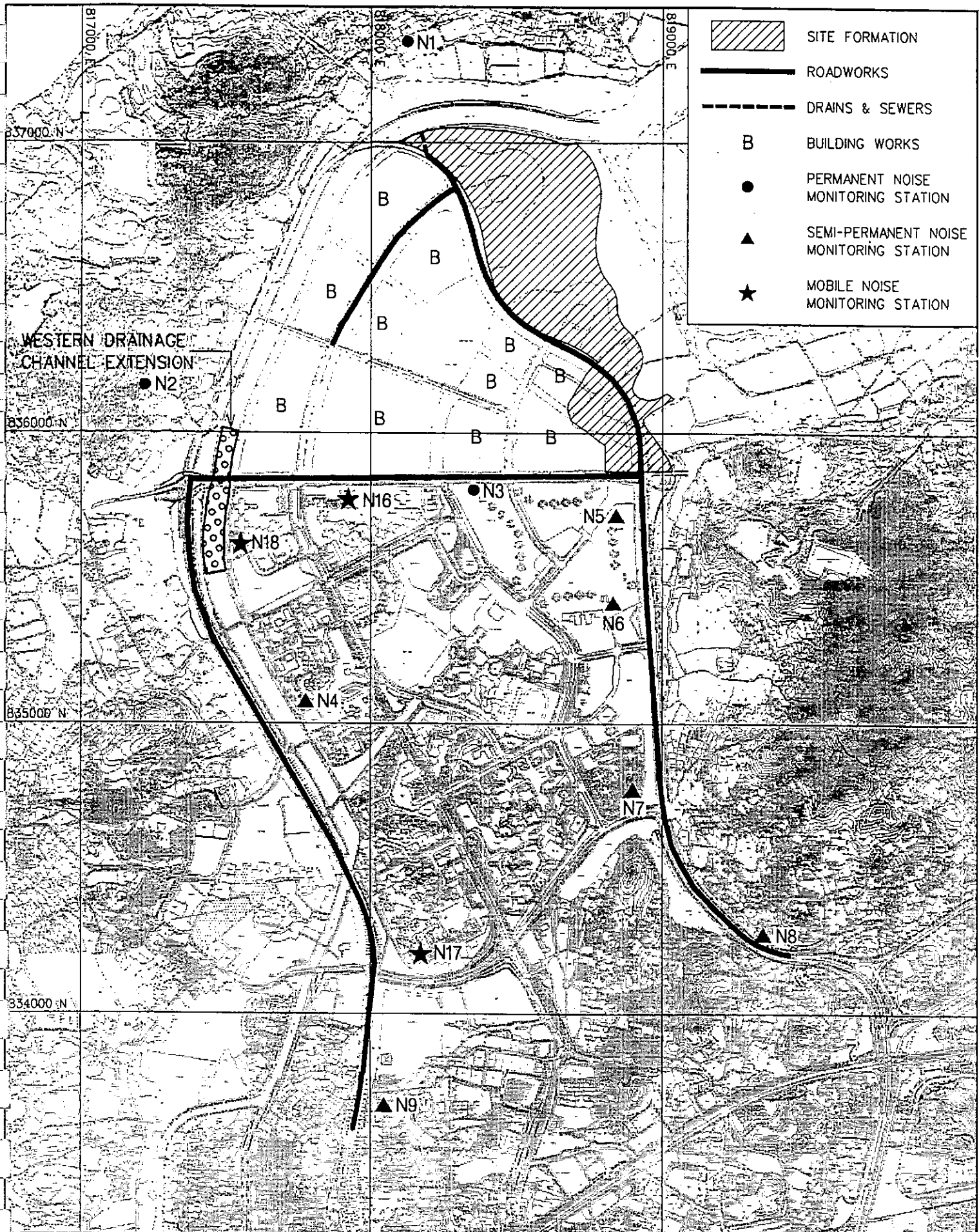
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Date FEB. 97	Scale N.T.S.










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 ENGINEERING INVESTIGATIONS FOR  
 DEVELOPMENT OF AREAS 3, 30 & 31  
 OF THE DEVELOPMENT ZONE  
 AND THE RESERVE ZONE

Title : EM & A - LOCATIONS OF  
 NOISE MONITORING STATIONS  
 FOR SCENARIO 5  
 (SEP 1999 - MAR 2000)

Figure No. 3.6	Revision 0
Reference TSW-BASE	File Name 02570018.C09
Prepared MC	Checked PS
Date	Scale



-  SITE FORMATION
-  ROADWORKS
-  DRAINS & SEWERS
-  BUILDING WORKS
-  PERMANENT NOISE MONITORING STATION
-  SEMI-PERMANENT NOISE MONITORING STATION
-  MOBILE NOISE MONITORING STATION

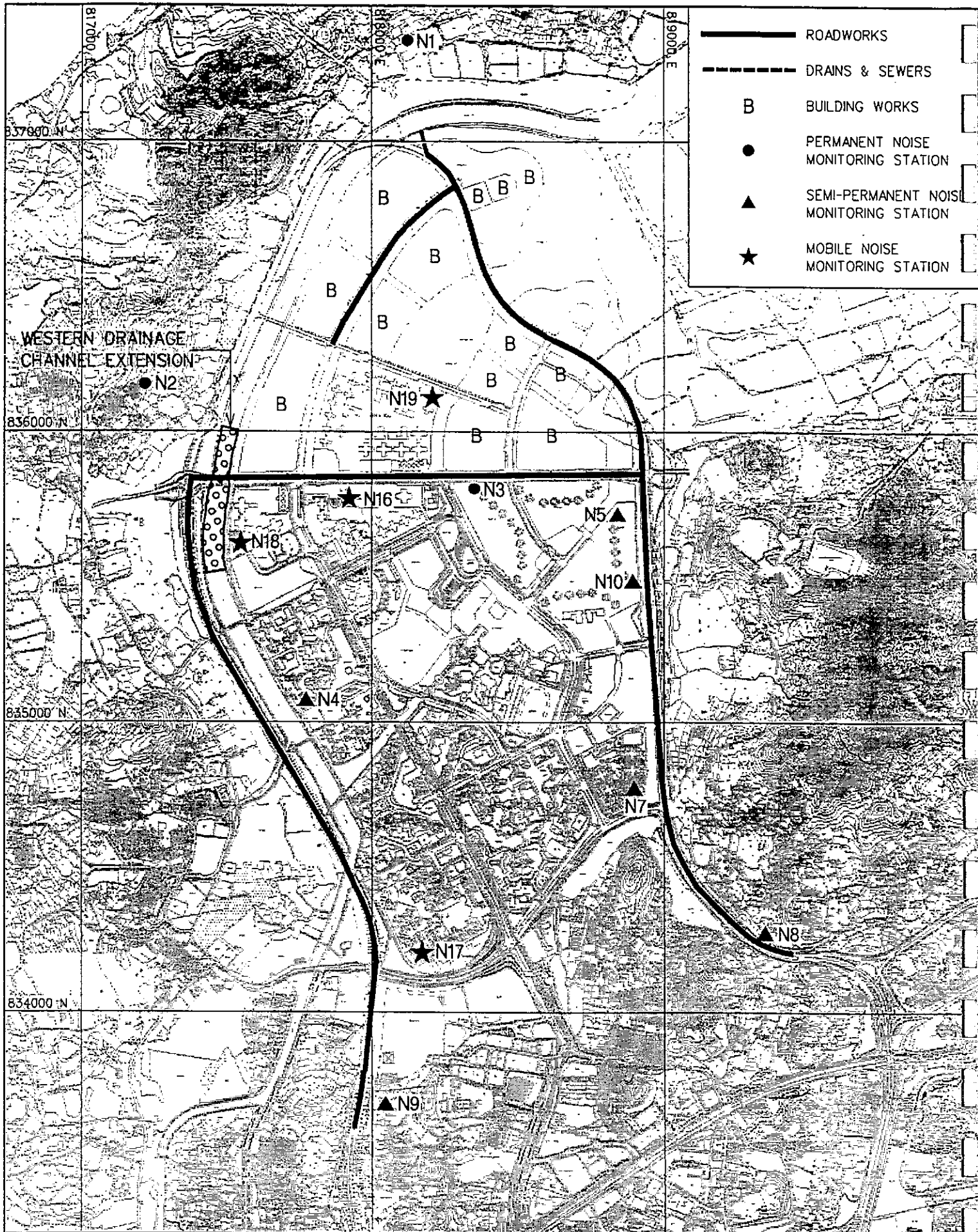
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 ENGINEERING INVESTIGATIONS FOR  
 DEVELOPMENT OF AREAS 3, 30 & 31  
 OF THE DEVELOPMENT ZONE  
 AND THE RESERVE ZONE

Title : EM & A - LOCATIONS OF  
 NOISE MONITORING STATIONS  
 FOR SCENARIO 6  
 (APR - AUG 2000)

Figure 3.7	Revision 0
Reference TSW-BASE	File Name 02580018.C09
Prepared MC	Checked PS
Date FFR 07	Scale MTC

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Note : Housing layout from HD as of July 1996.

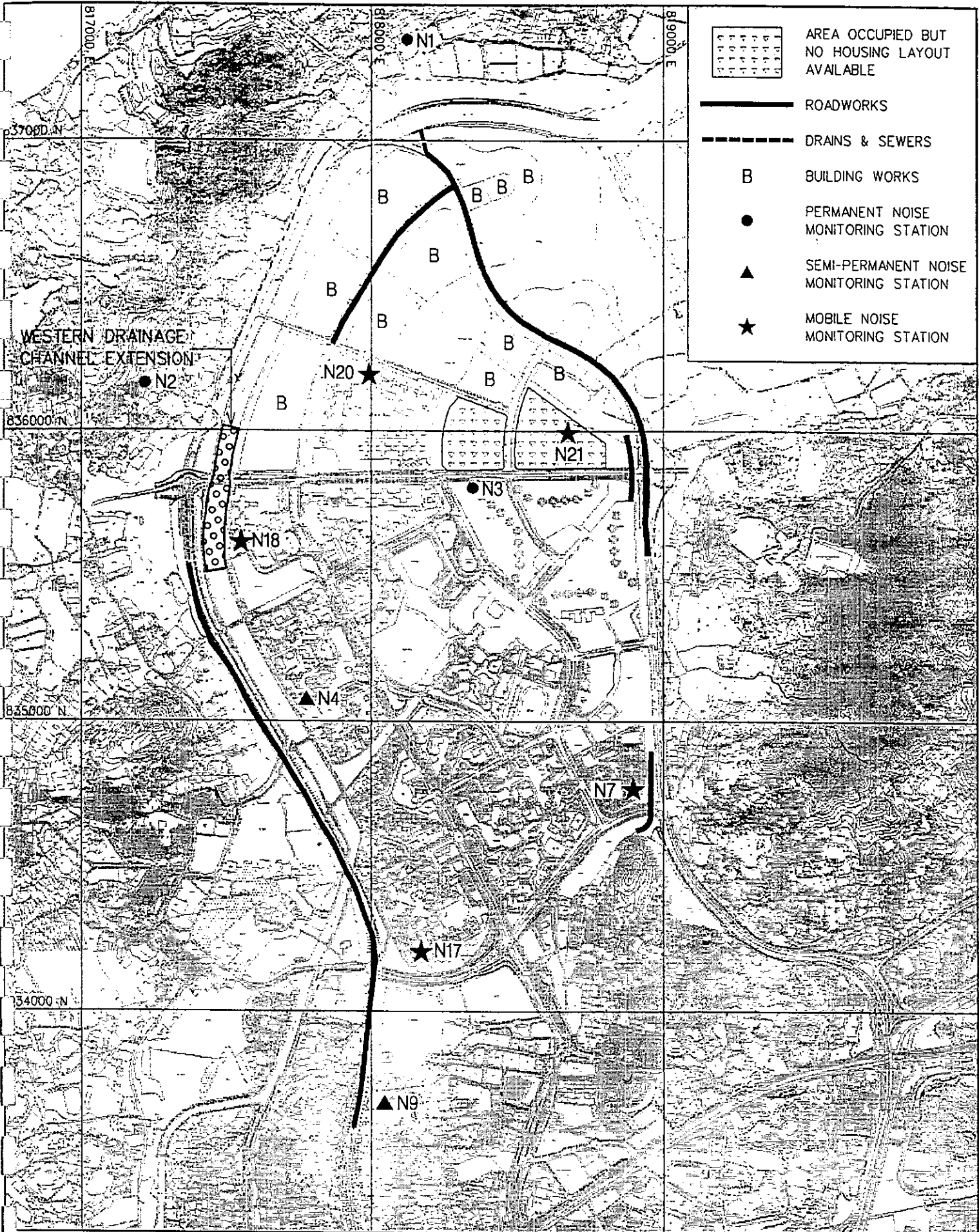


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 AGREEMENT NO. CE 10/95  
 ENGINEERING INVESTIGATIONS FOR  
 DEVELOPMENT OF AREAS 3, 30 & 31  
 OF THE DEVELOPMENT ZONE  
 AND THE RESERVE ZONE

Title : EM & A - LOCATIONS OF  
 NOISE MONITORING STATIONS  
 FOR SCENARIO 7  
 (SEP - DEC 2000)

Figure No. 3.8	Revision 0
Reference TSW-BASE	File Name 02590018.C09
Prepared MC	Checked PS
Date FFR 07	Scale NTS

(Note : Housing layout from HD as of July 1996. Area 102 layout as of December 1996)



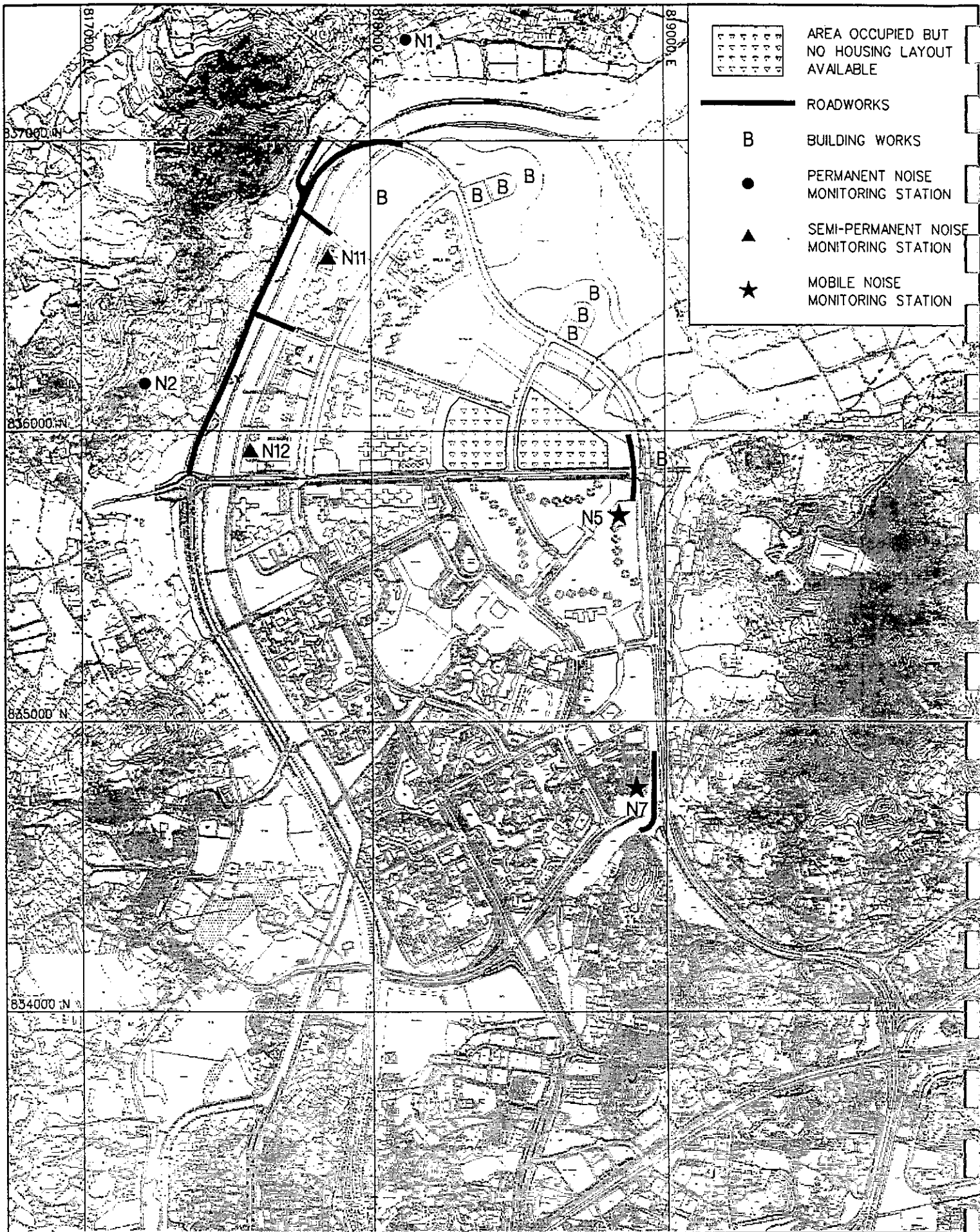
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 ENGINEERING INVESTIGATIONS FOR  
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 OF THE DEVELOPMENT ZONE  
 AND THE RESERVE ZONE

Title : EM & A - LOCATIONS OF  
 NOISE MONITORING STATIONS  
 FOR SCENARIO 8  
 (JAN - JUL 2001)

Figure No. 3.9	Revision 0
Reference TSW-BASE	File Name 02600018.C09
Prepared MC	Checked PS
Date FEB. 97	Scale N.T.S.

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(Note : Housing layout from HD as of July 1996. Area 102 layout as of December 1996)



	AREA OCCUPIED BUT NO HOUSING LAYOUT AVAILABLE
	ROADWORKS
	BUILDING WORKS
	PERMANENT NOISE MONITORING STATION
	SEMI-PERMANENT NOISE MONITORING STATION
	MOBILE NOISE MONITORING STATION

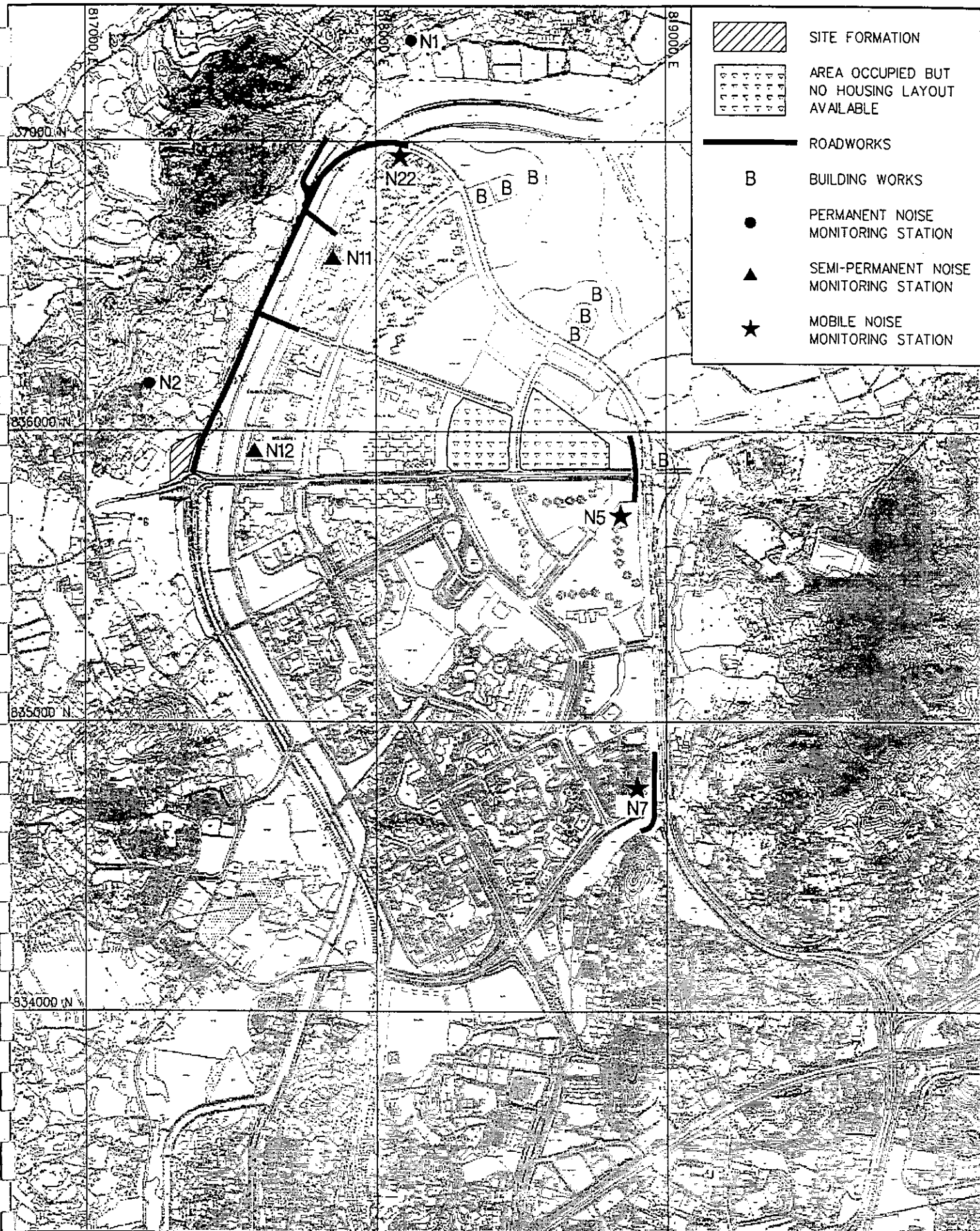
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 AGREEMENT NO. CE 10/95  
 ENGINEERING INVESTIGATIONS FOR  
 DEVELOPMENT OF AREAS 3, 30 & 31  
 OF THE DEVELOPMENT ZONE  
 AND THE RESERVE ZONE








Title : EM & A - LOCATIONS OF  
 NOISE MONITORING STATIONS  
 FOR SCENARIO 9  
 (JUL - DEC 2001)

Figure No. 3.10	Revision 0
Reference TSW-BASE	File Name 02610018.C09
Prepared MC	Checked PS
Date FEB. 97	Scale N.T.S.

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(Note : Housing layout from HD as of July 1996. Area 102, 106 layout as of December 1996)



-  SITE FORMATION
-  AREA OCCUPIED BUT NO HOUSING LAYOUT AVAILABLE
-  ROADWORKS
-  BUILDING WORKS
-  PERMANENT NOISE MONITORING STATION
-  SEMI-PERMANENT NOISE MONITORING STATION
-  MOBILE NOISE MONITORING STATION

TIN SHUI WA DEVELOPMENT  
 AGREEMENT NO. CE 10/95  
 ENGINEERING INVESTIGATIONS FOR  
 DEVELOPMENT OF AREAS 3, 30 & 31  
 OF THE DEVELOPMENT ZONE  
 AND THE RESERVE ZONE

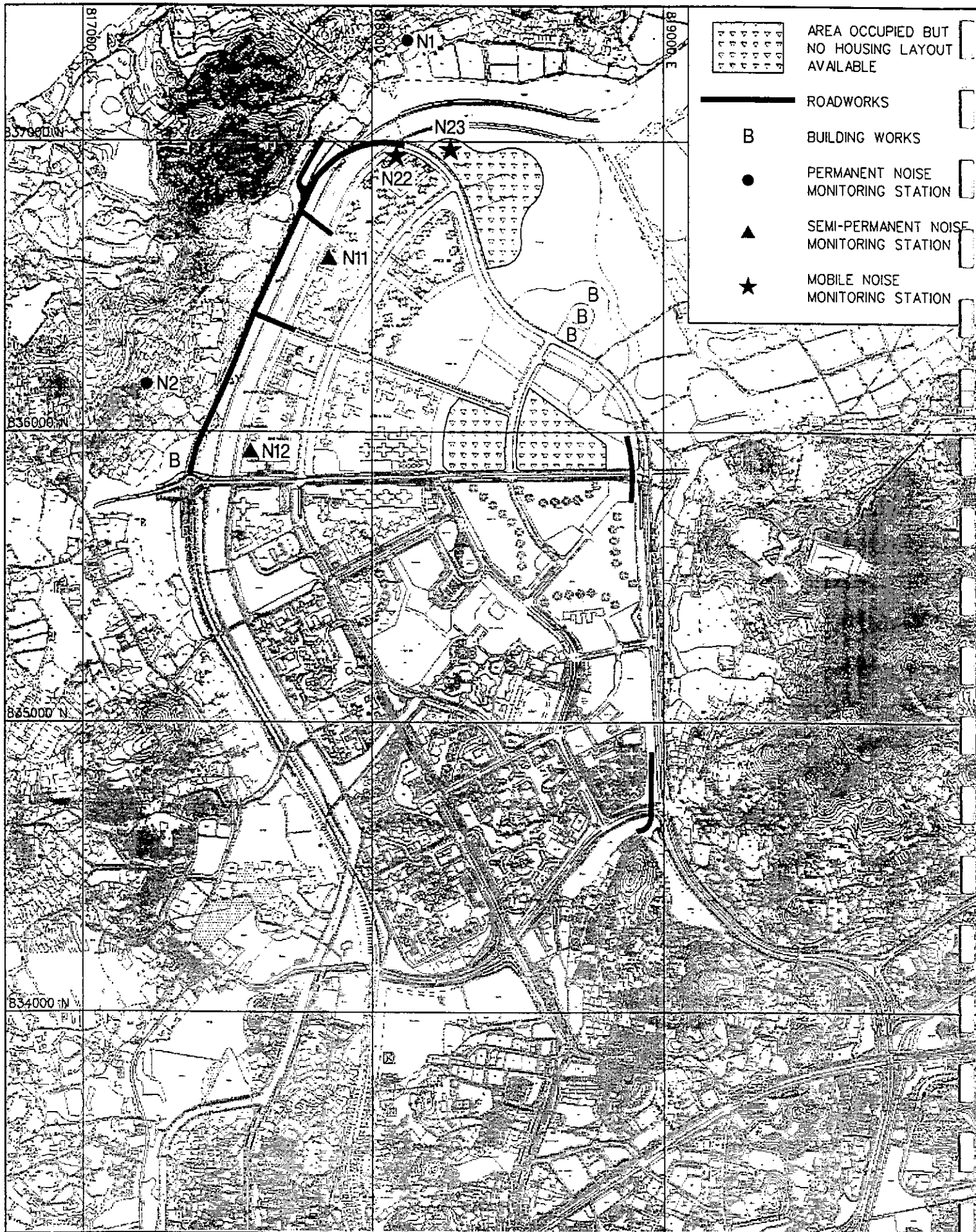
Title : EM & A – LOCATIONS OF  
 NOISE MONITORING STATIONS  
 FOR SCENARIO 10  
 (JAN – JUL 2002)

Figure No. 3.11	Revision 0
Reference TSW-BASE	File Name 02620018.C09
Prepared MC	Checked PS
Date FEB. 97	Scale N.T.S.

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(Note : Housing layout from HD as of July 1996. Area 102, 106 layout as of December 1996)  
 † Orientation dates based on recommended implementation programme version 2.11





TIN SHUI WA DEVELOPMENT  
 AGREEMENT NO. CE 10/95  
 ENGINEERING INVESTIGATIONS FOR  
 DEVELOPMENT OF AREAS 3, 30 & 31  
 OF THE DEVELOPMENT ZONE  
 AND THE RESERVE ZONE

Title : EM & A - LOCATIONS OF  
 NOISE MONITORING STATIONS  
 FOR SCENARIO 11  
 (AUG 2002 - AUG 2003)

Figure No. 3.12	Revision 0
Reference TSW-BASE	File Name 02630018.C09
Prepared MC	Checked PS
Date	Scale

Figure 3.13: Noise Monitoring Field Record Sheet

Monitoring Location		
Description of Location		
Date of Monitoring		
Measurement Start Time (hh:mm)		
Measurement Time Length (min.)		
Noise Meter Model/Identification		
Calibrator Model/Identification		
Measurement Results	L <sub>90</sub> (dB(A))	
	L <sub>10</sub> (dB(A))	
	L <sub>eq</sub> (dB(A))	
Major Construction Noise Source(s) During Monitoring		
Other Noise Source(s) During Monitoring		
Remarks		

	<u>Name &amp; Designation</u>	<u>Signature</u>	<u>Date</u>
Recorded by	_____	_____	_____
Checked by	_____	_____	_____

## 4 WATER QUALITY

### 4.1 Introduction

- 4.1.1 A system of water quality monitoring and auditing of the Project works and all future development works to be carried out in the Tin Shui Wai RZ under the Project shall be established to ensure that works take place with a minimum of adverse impact on water sensitive receivers and downstream ecological receivers.
- 4.1.2 A two-tier approach to the EM&A of water quality is required:
- 1) at source; and
  - 2) within nearby water-bodies.
- 4.1.3 The monitoring and audit of water quality impacts at source will be undertaken by the EMT. The discharges will not be constant and vigilance on the part of the EMT is required. This is necessary in order to identify the source and quantify all impacts arising from the works. All construction site runoff should meet the WPCO Technical Memorandum standards for Group B Inland Waters. The method for this approach is given in Section 7 and summarised below in Table 4.6.
- 4.1.4 Water quality monitoring in nearby water-bodies should be undertaken on a routine basis from the commencement of any works under this Project and continued throughout the Project until after the completion of all works as described in this section. Site formation works require monitoring of fewer parameters to ascertain the effects of the Works on the aquatic environment. Additional parameters will be monitored during Scenario 3 (Figure 4.2 to 4.4) onwards. Normally water quality monitoring is carried out at ebb tide. However, quarterly monitoring is undertaken over 2 tidal cycles for a number of parameters. This data will ensure that the EM has sufficient information on the water quality impinging on ecological receivers. The tidal cycle data will enable the EM to determine whether changes in concentrations of various parameters at different points is tidal related and hence determine the source of any adverse water quality or ecological impacts.
- 4.1.5 The potential impacts from construction works are summarised in Table 4.1. Mitigation measures and residual impacts are summarised in Table 4.2. The principal operation impact is summarised in Tables 4.3 and 4.4.

**Table 4.1**  
**Potential Impacts from Construction Works during the Project**

Area of Works	Works to be carried out	Potential impact(s)
Eastern Culvert Extension (ECE)	Eastern Culvert Extension under Road D4 south partially infilling ETC in Areas 104, 109 and 117	Areas potentially impacted will be the TSW Creek and Inner Deep Bay, via the water column of the ETC, affecting benthos and consequently birdlife in the area.  ETC sediments are of Class C contamination. Impacts on water quality are potentially very heavy dependent on construction methodology.
Western Temporary Channel	Paving of 500 m of the WTC immediately downstream of the inflatable dam for maintenance purposes	Impacts on water quality are potentially heavy dependent on construction methodology. Large scale disturbance of channel sediments will increase turbidity/SS and decrease dissolved oxygen levels, affecting water quality and ecology downstream;  Without tight mitigation there is potential for site runoff, concrete washings or accidental spill to affect water quality;  Permanent loss of benthos in construction site area.
Site Formation	Levelling of RZ and relocation of stockpile material	Increase in suspended solids runoff in the receiving water bodies, affecting the hydrology and ecology of the WTC and ETC.
Site runoff	All construction works	Potential impact on all water bodies.
Eastern Culvert Re-alignment	Construction of new section of Eastern Culvert under Road P2 at Junction P and removal of redundant Culvert in ETC	Potentially minor impacts during final connection of re-aligned section of culvert with the ETC.
Bridge Construction	WTC vehicle bridges D3/V1 and L13/VCF1 and footbridge WC/CF5 to be constructed	Minor impact on water quality when channel sediments are disturbed. Channel sediments are Class A and therefore not expected to yield metal pollutants.
Installation of rising mains and new sewage pumping station	Installation of rising mains on the western side of the WDC and WTC. Crossing the WDC and two tributaries, by 'no-dig' method, to link new and old pumping stations	Impacts on WDC and WTC, runoff from construction activities, increasing turbidity decreasing DO.
Construction and upgrading of roads, junctions and flyovers	Construction works related to development of road infrastructure in Study Area	Increase in pH levels from concrete washings which affects dissociation of ammonia and hence its ecotoxicity.
Construction of permanent drainage culverts	3 culverts will be built, 2 draining into the WDCE, and one into the ETC	Increase in pH levels and suspended solids from runoff.
Freshwater Wetland Habitat	Wetland habitat will be created in Areas 114 and 118. Deepening of ETC and construction of diversion dams and wetland channels	Increase in pH levels, suspended solids, pollutants from disturbed sediments.

**Table 4.2**  
**Mitigation Measures and Residual Impacts for Construction Works during the Project**

Works to be carried out	Mitigation to minimise impacts	Residual Impacts
Eastern Culvert Channel Extension (ECE)	<p>The Contractor must use a coffer dam during works within or near the channel.</p> <p>ETC sediments are of Class C contamination therefore works should be carried out during the dry season or periods of low flow in the channel.</p> <p>Design of ECE shall ensure that the amount of contaminated mud removed is minimised to avoid water quality impacts.</p> <p>Diversion of flow during the final section of culvert must be carried out with minimal disturbance of bed sediments and impact on water quality.</p> <p>EM&amp;A should include monitoring of downstream water sampling locations for ammonia levels which can worsen ecotoxic levels with elutriate from this mud.</p> <p>In addition, pH levels of runoff should be kept below 8.5 to protect aquatic life in the channel and in Inner Deep Bay. pH should be checked and neutralisation undertaken as necessary.</p>	<p>Minimal residual impact should occur if removal of mud is carried out following the defined procedures.</p>
Western Temporary Channel Extension	<p>Works should be carried out during the dry season or periods of low flow in the channel in order to minimise affects on water quality downstream.</p> <p>The Contractor must use a silt curtain or preferably a coffer dam during works within the channel.</p> <p>The EM&amp;A programme will incorporate a fixed monitoring station just downstream of the proposed works to monitor for suspended solids and ammonia. This will act as a warning signal to check Contractor procedures.</p> <p>In addition, pH levels of runoff should be kept below 8.5 to protect aquatic life in the channel and in Inner Deep Bay.</p>	<p>Minimal residual impacts should occur if mitigation measures are implemented.</p>
Site Formation	<p>Silt traps or sedimentation ponds to settle out sediment in runoff. Ponds also encourage infiltration instead of runoff.</p>	<p>Minimal residual impacts should occur if sedimentation ponds are constructed and adequately maintained.</p>

**Table 4.2 (cont'd)**  
**Mitigation Measures and Residual Impacts for Construction Works during the Project**

Works to be carried out	Mitigation to minimise impacts	Residual Impacts
Site runoff	<p>Each work site shall have a temporary drainage ditch draining to a sedimentation pond;</p> <p>Hard standing compounds shall drain via an oil interceptor;</p> <p>All oil interceptors shall be drained and oil exposed of in a appropriate manner.</p>	Minimal residual impacts should occur on water quality if mitigation measures are implemented. However, the hydraulics of the runoff will be altered with the increase in impermeable surfaces.
Eastern Culvert Re-alignment	Recommended final connection of re-aligned section of culvert with the ETC to take place during the dry season or period of low flow in the ETC. Cofferdams to be used.	Minimal residual impacts should occur if mitigation measures are implemented.
Bridge Construction	<p>Use of silt curtains or cofferdam to ensure minor impact on water quality when channel sediments are disturbed. Channel sediments under L13/VCF2 and GP/CF1 are Class A and therefore not expected to yield metal pollutants.</p> <p>Class C sediments under D3/V1 require careful handling and monitoring of ammonia levels to minimise impacts. Avoid high pH levels and pollutant release through engineering programme design.</p>	Minimal residual impacts should occur if mitigation measures are implemented.
Installation of rising mains	Impacts on WDC and WDCE from runoff from construction activities can be minimised by the diversion of drainage water through sediment ponds.	Minimal residual impacts should occur if mitigation measures are implemented.
Construction of permanent drainage culverts	An earth-bund of clays and silts or a cofferdam will be built to prevent runoff from the construction of the culverts from entering the channel. Earth bund will then be removed.	Minimal residual impacts should occur if cofferdam construction is carried out properly.
Construction and upgrading of roads, junctions and flyovers	Minimising runoff, particularly in area of potential ammonia toxicity from contaminated runoff. Settlement ponds to settle out sediment in runoff. Ponds to encourage infiltration instead of runoff.	Minimal residual impacts should occur as long as runoff can be minimised. During wet season works, increases in pH from runoff will lead to an increase in ammonia toxicity, especially in ETC where sediment elutriate ammonia levels are high. Further mitigation is required to prevent potentially toxic waters from entering the receiving channel.
Fresh water wetland	Dry season workings. Use of coffer dams, pH testing of waters.	Minimal residual impacts should occur if mitigation measures are implemented.

**Table 4.3**  
**Potential Impacts from Operation under the Project**

Activity	Consequences of activity	Potential impacts
Creation of infrastructure, housing and other developments	Reduction in infiltration due to 65% of RZ being covered in concrete. Increased urban stormwater runoff.	Impacts potentially severe with proven cases of high levels of pollutants in urban stormwater runoff from similar urban areas in the USA.  Water quality and associated wildlife in receiving water bodies could be adversely affected in the long term.

**Table 4.4**  
**Mitigation Measures and Residual Impacts for Operation Works Resulting from the Project**

Activity	Mitigation to minimise impact	Residual impacts
Creation of infrastructure, housing and other developments	Reduction in contaminated runoff will be achieved through the following Best Management Practices:  - silt and sand traps, infiltration devices, catchpits, road sweeping, debris removal, oil and grease traps, maintenance of stormwater drains.  Proper collection and disposal of chemical and oil wastes. ProPECC recommendations, and TMs closely enforced.  HA is currently researching methods of reducing urban storm-water impact.  Treatment of polluted stormwater by replacement wetland.  The banks of the channel downstream of WDCE should be retained to encourage growth of vegetation through which stormwater runoff can infiltrate with partial pollutant removal.	Hydraulic increase in runoff is expected as a result of increased impermeable cover of RZ and hence any pollutants will be carried rapidly downstream.  Minimal adverse residual impacts should occur on water quality with proposed mitigation.

## 4.2 Water Quality Parameters

4.2.1 The EIA report has recommended the water quality parameters to be monitored during the Project works and all future development works. The parameters as well as the rationale and methodology for the parameters are summarised in Table 4.5.

**Table 4.5**  
**Rationale and Methodology for Water Quality Parameters**

Parameters	Rationale	Method Reference
1. Dissolved Oxygen (DO)	<p>DO is a key water quality parameter in water pollution and waste treatment process control. It indicates ability of a water body to support a well balanced aquatic fauna.</p> <p>Sufficient DO in water is required for protection of aesthetic quality of water as well as maintenance of fish and other aquatic life. Insufficient DO develops septic conditions, causing malodorous emission resulted from anaerobic decomposition of organic and other oxygen-demanding matters present in water. Insufficient DO also adversely affects aquatic insects and other animals upon which fish and waterbirds feed, causing eventually loss of the ecological balance.</p> <p>A minimum DO level of 4 mg/l is set as limit level in this EM&amp;A.</p> <p>DO could be reduced by the pollutants in site run-off.</p> <p>Turbidity is an expression of the optical property that causes light to be scattered and absorbed rather than transmitted in straight lines. Optically black particles increase turbidity.</p> <p>Turbidity in water may be caused by suspended matter such as clay, silt, finely divided organic and inorganic matter, soluble organic compounds, plankton and other microscopic organisms as are likely in site runoff.</p> <p>Turbidity is a measure of clarity which indicates the condition and productivity of a water body. It may be used as a quick reference to the amount of total suspended solids (TSS) in water, although the correlation of turbidity with TSS is difficult because the size, shape and reflective index of the particulates affect the light-scattering properties of the suspension.</p>	<p>Standard Methods for the Examination of Water and Waste Water 17th Edition (APHA, AWWA, WEF) 4500-0 G</p> <p>Standard Methods for the Examination of Water and Waste Water 17th Edition (APHA, AWWA, WEF) 2130</p>
2. Turbidity		



Table 4.5  
 Rationale and Methodology for Water Quality Parameters (cont'd)

Parameters	Rationale	Method Reference
3. Temperature	<p>Water temperature regulates to some extent the metabolism and ability to survive and reproduce effectively of aquatic life.</p> <p>Temperature also affects the self-purification phenomenon in water bodies and henceforth affects the aesthetic and sanitary qualities of the water bodies. Increased temperatures accelerate biodegradation of organic matters both in water and in bottom deposits, demanding more dissolved oxygen. This is exacerbated by the fact that oxygen becomes less soluble as water temperature increases. Increased temperatures also increase the odour of water because of the increased volatility of odour-causing compounds.</p> <p>Temperature affects many chemical equilibriums, therefore, it is used in calculation of various laboratory studies and chemical operations. In this EM&amp;A, interpretation of monitoring results of some water quality parameters such as pH, DO and un-ionized ammonia, etc. require temperature data.</p> <p>In conclusion, "Temperature, a catalyst, a depressant, an activator, a restrictor, a stimulator, a controller, a killer, is one of the most important and most influential water quality characteristics to life in water." (FWPCAC (1967))</p>	<p>Standard Methods for the Examination of Water and Waste Water 17th Edition (APHA, AWWA, WEF) 2550</p>
4. pH	<p>pH is a measure of hydrogen ion activity in water. The mathematical expression of pH is:</p> $\text{pH} = -\log_{10} [\text{H}^+]$ <p>where <math>[\text{H}^+]</math> is the activity of hydrogen ion</p> <p>The pH value of natural waters is a measure of acid-base equilibrium of various dissolved compounds, salts or gases. It does not indicate the ability of a water to neutralized additions of acids or bases due to the 'buffering capacity' of the water. However, it affects the degree of dissociation of weak acids and bases, causing variation of toxicity of many compounds, typical examples of which being toxicity of cyanides, sulphides and ammonia. In the case of ammonia, the chemical equilibrium is shifted towards an increased concentration of toxic un-ionized ammonia as pH is increased. pH is raised by concrete washings.</p>	<p>Standard Methods for the Examination of Water and Waste Water 17th Edition (APHA, AWWA, WEF) 4500-H<sup>+</sup></p>

**Table 4.5**  
**Rationale and Methodology for Water Quality Parameters (cont'd)**

Parameters	Rationale	Method Reference
5. Total Suspended Solids (TSS)	<p>Water high in TSS may aesthetically be unsatisfactory for many purposes such as bathing. More significantly, TSS affects fish and fish food populations. Being components of TSS, clay, silt and other settleable particulates blanket the bottom of water bodies, damaging invertebrate populations and blocking gravel spawning beds. The organic parts of TSS remove dissolved oxygen from overlying water, causing another adverse effect to aquatic life (refer to DO).</p> <p>High TSS levels can occur in runoff from site formation works, removal of material, concrete washings. etc.</p>	<p>Standard Methods for the Examination of Water and Waste Water 17th Edition (APHA, AWWA, WEF) 2540D</p>
6. Ammonia	<p>Ammonia is present at high levels in the nearby water bodies. It is a component of the nitrogen cycle which consists of nitrates, nitrites, nitrogen gas, ammonia and organic nitrogen. It is biochemically interconvertible. When disturbed, ammonia can be leached from bottom deposits. Ammonia is toxic to aquatic life. The toxicity of ammonia is attributed to the un-ionized <math>\text{NH}_3</math> species which increase as pH and temperature of water are increased. In most natural waters, especially in waters with high salinity, the non-toxic ionized fraction of ammonia predominates.</p>	<p>Standard Methods for the Examination of Water and Waste Water 17th Edition (APHA, AWWA, WEF) 4500-NH<sub>3</sub></p>
7. Salinity	<p>Salinity is an oceanographic term. Form most purposes, salinity are broadly equivalent to the term total dissolved salt content. The principal dissolved inorganic anions include carbonates, chlorides, sulphates and nitrates and the principal cations are sodium, potassium, calcium and magnesium.</p> <p>Marine water exhibit very high salinity. In this EM&amp;A, salinity data in waters collected from various monitoring location are used to verify tidal effects and to calculate unionized ammonia levels.</p>	<p>Standard Methods for the Examination of Water and Waste Water 17th Edition (APHA, AWWA, WEF) 2520</p>
8. Biochemical Oxygen Demand (BOD)	<p>High BOD in water depletes DO level of the water, causing adverse effects to the aesthetic qualities and aquatic life of the water (see also DO). BOD is an index of the biodegradable organics. It is widely used to indicate the organic pollution of a water body. It is also used to determine the relative oxygen requirements of wastewaters, effluents and polluted waters such as some forms of site-runoff.</p>	<p>British Standard: BS 6068: Section 2.14: 1984</p>

**Table 4.5**  
**Rationale and Methodology for Water Quality Parameters (cont'd)**

Parameters	Rationale	Method Reference
9. Chemical Oxygen Demand (COD)	<p>COD is the oxygen equivalent of the organic matter content in water that is susceptible to oxidation by a strong chemical oxidant. The dichromate reflux method is recommended in the Technical Memorandum of EPD due to its superior oxidizing ability, applicability to a wide variety of samples and ease of manipulation. Oxidation of most organic compounds is 95 to 100% of the theoretical value, including the fraction represented by BOD. For a specific source of water COD can be related empirically to BOD and to organic carbon (TOC) and used for control and monitoring organic pollution from domestic, industrial and agricultural effluents. High COD in waters generally indicates organic pollution which may demand more dissolved oxygen in water, causing adverse effects to the aesthetic quality and aquatic life of the water and can be analysed much faster than BOD.</p>	<p>Standard Methods for the Examination of Water and Waste Water 17th Edition (APHA, AWWA, WEF) 5220</p>
10. Total Organic Carbon (TOC)	<p>The organic carbon in water is composed of a variety of organic compounds. The presence of organic carbon that does not respond to either BOD or COD makes them unsuitable for the measurement of total organic carbon. TOC is a more convenient and direct expression of total organic content than BOD or COD, but does not provide the same kind of information. TOC can be used to estimate the accompanying BOD or COD if a repeatable empirical relationship is established among TOC, BOD and COD. However, TOC does not replace BOD and COD because it is independent of the oxidation state of the organic matter, and does not measure other organically bound elements such as nitrogen and hydrogen, and inorganics that can contribute to BOD and COD.</p> <p>High TOC in waters indicates organic pollution which increases oxygen demand of the water, causing adverse effects to the aesthetic qualities and aquatic life of the water (see also DO, BOD and COD). TOC distinguishes between the oxygen demand from carbon from that of ammonia.</p>	<p>Standard Methods for the Examination of Water and Waste Water 17th Edition (APHA, AWWA, WEF) 5310C</p>

Table 4.5  
 Rationale and Methodology for Water Quality Parameters (cont'd)

Parameters	Rationale	Method Reference
11. Copper (Cu)	<p>Cu is an essential trace element for propagation of plants and performs vital functions in several enzymes and a major role in the synthesis of chlorophyll. It is added to fertilizers as a trace nutrient supplement for copper deficient soils. Cu is required in animal metabolism and in invertebrate blood chemistry and in the synthesis of haemoglobin. Commercial food for animals is usually enriched with copper.</p> <p>Cu is also widely used in electrical products, coins, metal plating, alloy, pesticides, algicides, fungicides, paints, wood preservatives, and is increasing common in road runoff.</p> <p>Cu can usually be found in wastewaters from industrial and agricultural effluents. It is an indicative parameter to control pollution from industrial and agricultural.</p> <p>The toxicity of Cu to aquatic life depends on the alkalinity of the waters as Cu ion is complexed by anions present which in turn affect toxicity. At lower alkalinity, Cu is generally more toxic to aquatic life, particularly to young or juvenile fish. Accumulation of Cu can be observed in certain marine animals, e.g. oyster. Cu concentrations in the WTC are close to ecotoxic levels.</p>	<p>Standard Methods for the Examination of Water and Waste Water 17th Edition (APHA, AWWA, WEF) 3500-Cu</p>
12. Zinc (Zn)	<p>Zn is an essential and beneficial element in metabolism of human and animals. It is accumulated by some species of marine animals, with a range of 6-1500 mg/kg of Zn content. Although few data are available on the effects of Zn in the marine environment, it is important to control the Zn level within the toxic concentrations of fish and other aquatic life.</p> <p>Zn is widely used in galvanizing or coating various iron and steel surfaces to retard corrosion of the coated metal. It is used in electroplating and preparation of alloys. Commercial food for animals is usually enriched with Zn. Zn is found in increasing quantities in runoff from roads.</p>	<p>Standard Methods for the Examination of Water and Waste Water 17th Edition (APHA, AWWA, WEF) 3500-Zn</p>

- 4.2.2 Table 4.6 shows the parameters which shall be monitored during different periods of the Works.
- 4.2.3 The frequency and extent of site inspections and audits for water quality EM&A is also described in Table 4.6.
- 4.2.4 Where possible, samples collected for ammoniacal-nitrogen, COD, TOC and metals should be preserved on site, or transported to the laboratory in an ice container and preserved immediately upon arrival at the laboratory. Remaining samples should be kept until analytical results are confirmed or maximum storage times are reached, whichever is shorter. In the event of non-compliance, extra analyses can be checked on the remaining preserved sample.
- 4.2.5 Sample presentation and maximum storage times shall be in accordance with Standard Methods for the Examination of Water and Wastewater, APHA-AWWA-WEF.
- 4.2.6 All laboratory measurement/analysis shall be carried out in a HOKLAS or other international accredited laboratory. All methodology shall follow that set out in the *Standard Methods for the Examination of Water and Wastewater*, APHA-AWWA-WEF. Results should be made available to the Engineer's Representative as soon as possible. Results of *in situ* analysis should be available within 24 hours.
- 4.2.7 If a site laboratory is set up or a non-HOKLAS and non-international accredited laboratory is hired for carrying out the laboratory analysis, the laboratory equipment, analytical procedures, and quality control shall be approved by the DEP. All the analysis shall be witnessed by the ER. The EM shall provide the ER with one copy of the relevant chapters of the "Standard Methods of the Examination of Water and Wastewater" updated edition and any other relevant document for his reference.
- 4.2.8 Un-ionized ammonia levels shall be calculated as in the Lotus file NH3SALT.WK1 supplied by the US EPA through internet. The calculation uses pH, salinity, temperature and total ammoniacal-nitrogen levels.

**Table 4.6**  
**Summary of Monitoring Schedule and Parameters<sup>1</sup> during the Works**

	Period of Works	
	Scenarios 1 & 2 <sup>2</sup>	Scenarios 3 to 11 <sup>3</sup>
Routine Monitoring in Nearby Water Bodies by MT		
Parameters to be monitored every time in-situ	Dissolved Oxygen Dissolved Oxygen (% saturation) Turbidity (NTU) Air and Water Temperature (°C) pH (pH units) Salinity (µs/cm)	Dissolved Oxygen Dissolved Oxygen (% saturation) Turbidity (NTU) Air and Water Temperature (°C) pH (pH units) Salinity (µs/cm)
Additional parameters to be monitored routinely (weekly, monthly or quarterly)	Suspended Solids Ammoniacal nitrogen	Suspended solids Ammoniacal nitrogen COD TOC Zinc (µg/l)
Site Inspection and Audits by EMT		
Daily spot checks	-	<u>Spot check</u> Water pH, DO, turbidity General observations
Weekly spot checks/ formal audit	<u>Spot check</u> Water pH, DO, turbidity General observations	<u>Formal audit</u> Water pH, DO, turbidity Takes samples for analysis of: - Suspended solids - COD - Ammoniacal nitrogen
Monthly formal audit	<u>Format audit</u> Take samples for Suspended Solids Analysis	

- Notes:
- 1 All parameters are measured in mg/l unless otherwise stated.
  - 2 Refer to Figure 4.1.
  - 3 Refer to Figure 4.2 to 4.4.

### 4.3 Monitoring Equipment

#### *Dissolved Oxygen/Temperature Meter*

4.3.1 The instrument shall be a portable, weatherproof dissolved oxygen measuring instrument complete with cable, sensor, comprehensive operation manuals, and be operable from a DC power source. It shall have a membrane electrode with automatic temperature compensation complete with a cable of sufficient length. It shall be capable of measuring:

- (i) a dissolved oxygen level in the range of 0-20 mg/L and 0-200% saturation; and
- (ii) a temperature of 0-45 degree Celsius.

### *Turbidity Meter*

- 4.3.2 A portable turbidity-measuring instrument operating on a nephelometric principle. It shall contain a photoelectric sensor(s) and come with comprehensive operation manuals. The equipment shall be operable from a DC power source. It shall have a photoelectric sensor capable of measuring turbidity at least between 0-200 NTU and shall be calibrated using a set of secondary turbidity standards in each range the equipment can measure (Hach 2100P Turbidimeter or similar approved).

### *Suspended Solids*

- 4.3.3 A water sampler, made of a transparent PVC or glass cylinder (capacity not less than 2 litres) which can be effectively sealed with cups at both ends. The sampler shall have a positive latching system to keep it open and prevent premature closure until released by a messenger when the sampler is at the selected water depth (Kahlaico Water Sampler 135WB203 or similar approved). Water samples shall be kept in high density polythene bottles and packed in an ice container for transport to the laboratory as soon as possible.
- 4.3.4 Upon arrival at the laboratory, the water samples for suspended solids shall be refrigerated at 4°C and determined within 7 days in accordance with the 2540D of *Standard Methods for the Examination of Water and Wastewater* (APHA, 17th edition, 1989). An electronic balance readable to not less than 0.1 mg (i.e. 0.0001 g) shall be used.

### *pH Meter*

- 4.3.5 The instrument shall consist of a potentiometer, a glass electrode, a reference electrode and a temperature-compensating device. It shall be readable to 0.1 pH in a range of 0 to 14. Standard buffer solutions of at least pH 7 and pH 10 shall be used for calibration of the instrument before and after use. Details of the method are given in APHA, 17th ed. 4500-H<sup>+</sup>B.

### *Salinity*

- 4.3.6 A portable salinity meter should be used. Calibration against at least two concentrations of salt solution (including blank) should be carried out each time the instrument is used.

### *Thermometer*

- 4.3.7 A certified mercury-in-glass thermometer with an accuracy of at least 0.5 degree Celsius shall be used for measuring the ambient (air) temperature.
- 4.3.8 All in-situ monitoring instruments shall be checked, calibrated and certified by an approved laboratory, preferably HOKLAS accredited, before use on the Works. The instruments shall be subsequently re-calibrated at 3 month intervals throughout all stages of the water quality monitoring. Responses of sensors and electrodes should be checked with certified standard solutions before each use.

4.3.9 A set of backup equipment must be available to ensure that if any of the monitoring equipment is sent for repair or re-calibration, the monitoring programme can continue uninterrupted. In addition, sufficient stocks of spare parts and consumables for the equipment such as electrodes, membranes and cable shall be maintained.

#### 4.4 Monitoring Locations

4.4.1 Some of the monitoring locations change as the Project progresses.

4.4.2 For most of the construction periods, seven Monitoring Stations and two Control Stations have been established for water quality monitoring. The locations of the monitoring stations are shown in Figures 4.1 to 4.4 with planned timescales. At least seven locations, including two control stations, shall be monitored during routine monitoring.

4.4.3 The rationale for the location of the Monitoring Stations is shown in Table 4.7.

4.4.4 In addition, monitoring locations will be identified on site, appropriate to the works being carried out by the EMT, for monitoring of discharges from site. The EMT will be responsible for monitoring these locations during spot checks and, where necessary, taking samples.

4.4.5 Measurements shall be taken at mid-water depth and the depth recorded.



**Table 4.7**  
**Rationale for Water Quality Monitoring Locations**

Monitoring Station	Rationale for Location
W1	First station to assess impacts from concurrent projects being carried out in Deep Bay e.g.: Shenzhen River Project and Ngau Tau Mei Channel construction.
W8	This station, like W1, will detect estuarine changes before other stations.
W2 and W7	These stations are at the mouth of the WTC and cross channel respectively. These enable monitoring of the water quality discharged from each channel and match data with the ecological data collected at each site.
W3	In the WTC, this station is the closest impact monitoring point. The tidal nature of this point will present some difficulties in determining the cause of an impact. For example, the presence of a gradual trend of increasing suspended solids from W1 to W2 to W3, particularly on an outgoing tide, may indicate a potential problem of sediment run-off on site which can be investigated through on-site monitoring and visual assessment during monitoring. Action levels may apply only to the actual run-off point, or to the location at which the WTC leaves the site.
W4	Upstream of the culvert from which site run-off arises, this location provides "baseline" data before the site influences the channel water. Tidal effects will cause some difficulties interpreting this data, but if taken on an ebb tide, in conjunction with dam from W3, the trend may be determined, if the site activity is still proceeding. Evidence to implicate the site may be lacking and may indicate sediment is being carried from the estuary, from concurrent projects. This location will move slightly north when works are carried out on WDCE.
W5	Represents the control location upstream of run-off from the RZ. Water in this channel also comes from the DZ and industries and agricultural discharges outside of the Tin Shui Wai area. After the end of Scenario 3, this control location will no longer exist. If practical it should be replaced.
W6	This is a monitoring station at the outfall of the ETC, which is not tidal and therefore represents the accumulated run-off from culverts and drains feeding off the site.
W9, W10 and W11	Upstream locations in WDC to act as impact locations or control stations during works on Tin Ying Road and the concrete batching plant south of Area 3.

#### 4.5 Baseline Monitoring

- 4.5.1 Baseline conditions for water quality shall be established prior to the commencement of works. The purposes of the baseline monitoring are to establish ambient conditions prior to the commencement of the works and to demonstrate the suitability of the proposed impact, control and reference monitoring stations.
- 4.5.2 There shall not be any marine construction activities in the vicinity of the stations during the baseline monitoring.
- 4.5.3 Baseline Monitoring of the following parameters shall be carried out at all Monitoring Stations every two hours over one tidal cycle, three times per week over a three week period prior to the Commencement of Works:

Dissolved Oxygen  
 Dissolved Oxygen (% saturation)  
 Turbidity (NTU)

Air and Water Temperature (°C)  
pH (pH units)  
Salinity ( $\mu\text{s}/\text{cm}$ )  
Suspended Solids  
Ammoniacal nitrogen

and the following at mid-ebb tides:

COD  
TOC  
Zn

#### 4.6 Impact/Compliance Monitoring Schedule

##### Scenario 1

4.6.1 Monitoring of the following parameters shall be undertaken according to the following schedules at the monitoring locations shown on Figure 4.1.

(i) Weekly Monitoring at ebb tide:

Depth  
pH  
Dissolved Oxygen  
Dissolved Oxygen Saturation  
Turbidity  
Suspended Solids  
Air and Water Temperature  
Salinity

(ii) Monthly Monitoring at ebb tide:

Depth  
pH  
Dissolved Oxygen  
Dissolved Oxygen Saturation  
Turbidity  
Suspended Solids  
Air and Water Temperature  
Ammoniacal Nitrogen  
Salinity

(iii) Quarterly monitoring, every two hours throughout one tidal cycle:

Depth  
pH  
Dissolved Oxygen  
Dissolved Oxygen Saturation  
Turbidity  
Suspended Solids  
Air and Water Temperature  
Ammoniacal Nitrogen  
Salinity

4.6.2 Monitoring of TOC, COD, BOD<sub>5</sub>, Zinc and Copper are not required during this period.

Scenario 2

4.6.3 The schedule is the same as that for Scenario 1 except that during works in Area 104, parameters measured monthly shall be measured three times a week at Stations W5 and W6 (Figure 4.1).

Scenarios 3 to 11

4.6.4 Monitoring of the following parameters shall be undertaken throughout all works according to the following schedules at the monitoring locations shown on Figure 4.2 to 4.4 for the various scenarios.

(i) Weekly Monitoring at ebb tide:

Depth  
pH  
Dissolved Oxygen  
Dissolved Oxygen Saturation  
Turbidity  
Suspended Solids  
Air and Water Temperature

(ii) Monthly Monitoring at ebb tide:

Depth  
pH  
Dissolved Oxygen  
Dissolved Oxygen Saturation  
Turbidity  
Suspended Solids  
Air and Water Temperature  
Ammoniacal Nitrogen  
Salinity  
COD  
TOC  
Zinc

(iii) Quarterly Monitoring, every two hours throughout one tidal cycle:

Depth  
pH  
Dissolved Oxygen  
Dissolved Oxygen Saturation  
Turbidity  
Suspended Solids  
Air and Water Temperature  
Ammoniacal Nitrogen  
Salinity  
TOC  
Zinc

4.6.5 During works on the Western or Eastern Drainage Channels or in any other area where contaminated mud is removed. Figure 6.4 shows the amount and location of contaminated mud to be removed. The following schedule will apply to Stations W3, W4, W5 and W6 as appropriate.

(iv) Three Times a Week at ebb tide

Depth  
pH  
Dissolved Oxygen  
Dissolved Oxygen Saturation  
Turbidity  
Suspended Solids  
Air and Water Temperature  
Ammoniacal Nitrogen  
Salinity

4.6.6 Works on the Western Channel are likely to occur during Scenarios 4, 5, 6, 7 and 8 with minor works likely during Scenarios 3, 9, 10 and 11. The duration and timing of these works must be confirmed by the EM from the works programmes and methodology statements.

4.6.7 Works on the Eastern Temporary Channel are most likely during Scenarios 4, 5, 6 and 11. It should be noted that the Eastern Temporary Channel, to be known as the Eastern Drainage channels after the works, is not tidal.

#### 4.7 Records and Reporting

4.7.1 A sample data sheet for in-situ tests and TSS is shown on Figure 4.5. Data sheets for other parameters shall also be prepared. The data sheets should include at least the following:

- (i) date and time;
- (ii) operator name;
- (iii) identification of the monitoring station;
- (iv) description of the site;
- (v) description of the work progress and activities on site;
- (vi) temperature, pressure and weather conditions;
- (vii) sample ID;
- (viii) information of sample pretreatment;
- (ix) information of analytical methodology;
- (x) analytical data and calculation.

4.7.2 All field information, laboratory data and calculation shall be recorded in the data sheet.

4.7.3 The data sheets shall be kept for at least 6 months after the completion of the Contract.

4.7.4 The information shall be collated and viewed by either the ER(s) or the EMT within 24 hours.

4.7.5 All data shall be checked before inclusion in the monthly report.

#### 4.8 Event and Action Plan for Water Quality

##### *DO, TSS, Turbidity and Un-ionized Ammonia*

4.8.1 The water quality criteria, namely Action and Limit levels are shown in Table 4.8. Should the monitoring results of the water quality parameters at any designated monitoring stations indicate that the water quality criteria are exceeded, the actions in accordance with the Action Plan in Table 4.9 shall be carried out. In addition, adverse water quality may trigger ecological action plans and vice versa.

**Table 4.8**  
**Action and Limit Levels for Water Quality<sup>1</sup>**  
 (Reference must also be made to Table 5.3)

Parameter	Action Levels	Limit Levels
pH <sup>2</sup>	≥ 8.5	≥ 9.0
DO in mg/l <sup>3</sup>	1%-ile of baseline <sup>4</sup> data, or midway between 5%-ile of baseline data and Limit levels	< 4 mg/l
SS in mg/l <sup>3</sup>	> 95%-ile of baseline data and 120% of upstream control station's SS at the same tide of the same day	> 99%-ile of baseline, 130% of upstream control station's SS at the same tide of the same day
Turbidity (Tby) in NTU <sup>3</sup>	> 95%-ile of baseline data and 120% of upstream control station's Tby at the same tide of the same day	> 99%-ile of baseline and 130% of upstream control station's Tby at the same tide of the same day
Unionized ammonia <sup>5</sup>	≥ 0.035 mg/l for one week or more	≥ 0.233 mg/l

- Notes:
1. These Action and Limit levels may be adjusted following the collection and audit of baseline data.
  2. Action and Limit levels are set at levels recommended in Water Quality Objectives (Deep Bay Water Control Zone).
  3. Action and Limit levels are set at levels recommended in EPD Generic Environmental Monitoring and Audit Manual (May 1996).
  4. Baseline data is taken over the tidal cycle. The data collected at ebb tide should be used in defining action and limit levels in order to ensure compatibility with weekly and monthly impacts/compliance monitoring data.
  5. Levels will be reviewed with reference to baseline data. Ambient Action and Limit levels are set at levels recommended in USEPA Water Quality Criteria for Ammonia (Saltwater) - 1989.

**Table 4.9**  
**Actions in the Event of Exceedance of Action/Limit Levels**  
 (Reference must also be made to Tables 5.3, 5.5 and 5.6)

Event	Actions		
	EMT	ER	Contractor
<b>Action Level</b>			
Water: Action level being exceeded by one sampling day	<ol style="list-style-type: none"> <li>Repeat in-situ measurement to confirm findings;</li> <li>Identify source(s) of impact;</li> <li>Inform contractor and EPD;</li> <li>Check monitoring data, all plant, equipment and Contractor's working methods;</li> <li>Discuss mitigation measures with ER and Contractor;</li> <li>Repeat measurement on next day of exceedance.</li> </ol>	<ol style="list-style-type: none"> <li>Discuss with EMT and Contractor on the proposed mitigation measures;</li> <li>Make agreement on the mitigation measures to be implemented;</li> <li>Assess the effectiveness of the implemented mitigation measures.</li> </ol>	<ol style="list-style-type: none"> <li>Inform the Engineer and confirm notification of the non-compliance in writing;</li> <li>Rectify unacceptable practice;</li> <li>Check all plant and equipment; consider changes of working methods;</li> <li>Propose mitigation measures to ER and discuss with EMT and ER;</li> <li>Implement the agreed mitigation measures.</li> </ol>
Water: Action level being exceeded by more than two consecutive sampling days	<ol style="list-style-type: none"> <li>Repeat in-situ measurement to confirm findings;</li> <li>Identify source(s) of impact;</li> <li>Inform contractor and EPD;</li> <li>Check monitoring data, all plant, equipment and Contractor's working methods;</li> <li>Discuss mitigation measures with ER and Contractor;</li> <li>Ensure mitigation measures are implemented;</li> <li>Prepare to increase the monitoring frequency to daily;</li> <li>Repeat measurement on next day of exceedance.</li> </ol>	<ol style="list-style-type: none"> <li>Discuss with EMT and Contractor on the proposed mitigation measures;</li> <li>Make agreement on the mitigation measures to be implemented;</li> <li>Assess the effectiveness of the implemented mitigation measures.</li> </ol>	<ol style="list-style-type: none"> <li>Inform the Engineer and confirm notification of the non-compliance in writing;</li> <li>Rectify unacceptable practice;</li> <li>Check all plant and equipment; consider changes of working methods;</li> <li>Propose mitigation measures to ER within 3 working days and discuss with EMT and ER;</li> <li>Implement the agreed mitigation measures.</li> </ol>
Water: Limit level being exceeded by one sample at any monitoring station	<ol style="list-style-type: none"> <li>Repeat in-situ measurement to confirm findings;</li> <li>Identify source(s) of impact;</li> <li>Inform contractor and EPD;</li> <li>Check monitoring data, all plant, equipment and Contractor's working methods;</li> <li>Discuss mitigation measures with ER and Contractor;</li> <li>Ensure mitigation measures are implemented;</li> <li>Increase the monitoring frequency to daily until no exceedance of Action level.</li> </ol>	<ol style="list-style-type: none"> <li>Discuss with EMT and Contractor on the proposed mitigation measures;</li> <li>Request Contractor to critically review the working methods;</li> <li>Make agreement on the mitigation measures to be implemented;</li> <li>Assess the effectiveness of the implemented mitigation measures.</li> </ol>	<ol style="list-style-type: none"> <li>Inform the Engineer and confirm notification of the non-compliance in writing;</li> <li>Rectify unacceptable practice;</li> <li>Check all plant and equipment; consider changes of working methods;</li> <li>Propose mitigation measures to ER within 3 working days and discuss with EMT and ER;</li> <li>Implement the agreed mitigation measures.</li> </ol>
Water: Limit level being exceeded by more than two consecutive samples at any monitoring station	<ol style="list-style-type: none"> <li>Repeat in-situ measurement to confirm findings;</li> <li>Identify source(s) of impact;</li> <li>Inform contractor and EPD;</li> <li>Check monitoring data, all plant, equipment and Contractor's working methods;</li> <li>Discuss mitigation measures with ER and Contractor;</li> <li>Ensure mitigation measures are implemented;</li> <li>Increase the monitoring frequency to daily until no exceedance of Action level for two consecutive days.</li> </ol>	<ol style="list-style-type: none"> <li>Discuss with EMT and Contractor on the proposed mitigation measures;</li> <li>Request Contractor to critically review the working methods;</li> <li>Make agreement on the mitigation measures to be implemented;</li> <li>Assess the effectiveness of the implemented mitigation measures;</li> <li>Consider and instruct, if necessary, the Contractor to slow down or to stop all or part of the marine work until no exceedance of Limit level.</li> </ol>	<ol style="list-style-type: none"> <li>Inform the Engineer and confirm notification of the non-compliance in writing;</li> <li>Rectify unacceptable practice;</li> <li>Check all plant and equipment; consider changes of working methods;</li> <li>Propose mitigation measures to ER within 3 working days and discuss with EMT and ER;</li> <li>Implement the agreed mitigation measures;</li> <li>As directed by the Engineer, to slow down or to stop all or part of the marine work or construction activities.</li> </ol>

### **Other Parameters**

4.8.2 No action or limit levels have been set for other water quality parameters such as total ammoniacal-N, TOC or Zinc because of the natural fluctuation which may occur in these parameters. However, the significance of a change in the concentration of these parameters can be determined through the establishment of a control chart and warning and control limits as described in APHA 17th Edition Section 1020B.

4.8.3 A mean value is calculated from baseline data using at least 20 data points from which a warning limit (2.S.D.) and a control limit (3.S.D.) is established. If, during routine monitoring, a measurement exceeds the warning or control level, actions should be taken as described below:

- (i) one value greater than the Control Limit;
- (ii) two values greater than the Warning Limit;
- (iii) six suppressive values on the same side of the mean.

In any of these cases, sampling and analysis shall be repeated and if the situation persists, the cause shall be determined and rectified before work continues.

### **4.9 Water Quality Mitigation Measures to be Implemented by the Contractor**

- 4.9.1
- (i) The Contractor shall be aware of and comply with the *Buildings Ordinance*, the *Water Pollution Control Ordinance* and the *Technical Memorandum Standards for Effluent Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters*.
  - (ii) The Contractor shall not discharge directly or indirectly (by runoff) or cause or permit or suffer to be discharged into any public sewer, storm-water drain, channel, stream-course or sea any effluent or foul or contaminated water or cooling or hot water without the prior consent of the Engineer and the EMT who may require the Contractor to provide, operate and maintain at the Contractor's own expense, within the premises or otherwise, suitable works for the treatment and disposal of such effluent or foul or contaminated or cooling or hot water. The design of such treatment works shall be submitted to the Engineer for approval not less than one month prior to the commencement of construction or as agreed by the Engineer.
  - (iii) Surface run-off from the Site shall be discharged into storm drains via adequately designed sand/silt removal facilities such as sand traps, silt traps and sediment basins. Channels or earth bunds or sand bag barriers should be provided on Site to properly direct stormwater to such silt removal facilities. Perimeter channels at the Site boundaries shall be provided where necessary to intercept storm run-off from outside the Site so that it will not wash across the Site. Catchpits and perimeter channels shall be constructed in advance of site formation works and earthworks.

Before any site formation works commence in any area including stockpile areas, temporary drainage systems must be set up with at least the following capacity. A metre high bund must surround each site works area. A channel about 1 metre deep and 1 metre wide shall be formed just inside these bunds leading to the discharge points. Drains in nesting areas should be built during the non-breeding season. Existing drains should be re-aligned away from nesting sites. Before each outlet or discharge point the channels shall be widened to at least 1.5 metres and deepened to at least 1.5 metres for at least a length of 6 metres to form a settlement pond except that for the main stockpile the settlement pond should be 12 m long. These ponds and the channels and bunds must be kept in good working order at all times until they are replaced by the more permanent temporary drainage systems. The system must be adapted as site works proceed to take the changing ground levels into account.

- (iv) The chunam-lined channels designated for the intermediate drainage systems should be implemented such that infiltration of run-off can occur wherever a solid bed to a channel is not essential. The base of the channel should be formed of granular material (Figure 4.7).
- (v) The Contractor shall ensure that works within the Eastern Temporary Channel in Area 104 take place in the dry season as far as practicable or else additional temporary works such as cofferdam or temporary earth bund will be required.
- (vi) Works within the ETC and the WTC should be concentrated to dry periods as much as practicable. Temporary works such as cofferdams and temporary earth bunds should be used to minimise runoff and pollution from the works entering the water column. Water collecting behind the cofferdam shall be either pumped onto the land-bank or collected, settled and pH adjusted to 8.5 or less before being allowed to enter the channels.
- (vii) The Contractor shall take all reasonable measures to minimise adverse impacts resulting from construction activities associated with dredging and spoil disposal. These measures shall include ensuring that all plant and equipment and working methods meet the following criteria. The Engineer may monitor any or all vessels transporting material to ensure that loss of material does not take place during transportation. The Contractor shall:
  - utilise a floating silt curtain to contain excessive suspended solids;
  - minimise disturbance of the channel bed while dredging;
  - minimise leakage of dredged material during lifting;
  - use closed grabs: mechanical grabs shall be designed and maintained to avoid spillage and seal tightly while being lifted;
  - prevent the overflowing of any hopper or barge;



- not fill any barge or hopper to a level that can cause overflowing;
  - not wash out any hopper or barge while dredging and loading;
  - ensure that any barge or any sediment transport vessel is fitted with tight fitting seals to the bottom openings to prevent leakage of material;
  - ensure that bottom openings are properly closed when vessels are full and on their way to the disposal site;
  - ensure that bottom-openings are properly closed when empty and returning to the site;
  - remove any excess dredged material from the decks and exposed fittings of barges before the vessel is moved;
  - cause no visible foam, oil, grease, scum, litter or other objectionable matter to be present on the water within the Site or dumping grounds;
  - use vessels of such a size that adequate clearance of the vessel with the seabed is maintained at all stages of the tide thereby minimising turbidity generation by vessel movement or propeller wash;
  - repair all pipe leakages immediately;
  - keep the decks of all vessels tidy and free of oil and any other substances or articles which may be washed overboard. Rubbish shall not be dumped in the sea;
  - control the loading of barges or hopper so as to prevent splashing or spillage of dredged material to the surrounding water;
  - prevent the unacceptable deterioration of marine water; and
  - take any reasonable measures, as directed by the Engineer.
- (viii) The disposal of dredged or contaminated material will comply with the following:
- The Contractor shall be responsible for disposing of all dredged material. All material shall be dumped within the designated marine dumping ground;
  - The Contractor shall apply for the necessary licence from the Director of Environmental Protection (DEP) for the marine disposal of material, and shall at all times comply with his requirements. All fees in respect of applications for disposal permits shall be borne by the Contractor. A copy of the disposal licence held or obtained by the Contractor shall be given to the Engineer and no disposal may be carried out until a licence permitting such disposal has been obtained;

- The Contractor shall properly locate and fix the boundaries of the dumping area to ensure that the material is dumped at the correct location. The Contractor shall dump material in uniform layers over the dumping area under the agreed schedule such that no high spots are formed;
  - Before commencing the dumping works, the Contractor shall provide, through the Engineer, to the Director of Environmental Protection (DEP) and the Secretary of the Fill Management Committee (FMC), a programme for the approval of the dumping works. Dumping works shall only be carried out in accordance with the approved programme which may be amended from time to time with the approval of DEP and FMC;
  - The Contractor shall provide, through the ER, the DEP and FMC, a schedule containing details of the work included in, and the frequency of, the dumping works, on a monthly basis. A return showing the number of barge loads and the estimated quantity of surplus mud dumped within the mud disposal site shall be submitted to the DEP and FMC within one week after completion of the dumping works.
- (ix) In the event of dredging of contaminated mud the following applies:
- The Contractor shall ensure that all contaminated mud is dredged, transported and placed in approved special dumping grounds in accordance with the provisions in Works Branch Technical Circular No. 22/92 and in such a manner to minimise the loss of material to the water column. THE classification on the contamination levels shall comply with the EPD TC No. 1-1-92.
  - The Contractor shall be responsible for securing a licence for the disposal of contaminated marine mud to a disposal works area. The Contractor shall submit to the Director of Environmental Protection (DEP) a method statement covering the disposal of contaminated mud and this method statement must be approved before a licence to dump can be issued.
  - The Contractor shall place the contaminated mud at a location and in a manner as stipulated in the disposal licence and as directed by the Engineer. The Contractor shall proceed with the disposal operation in accordance with the relevant sections in the Management Scheme for Contaminated Mud Disposal Pits at East Sha Chau - Guidance Notes for Dumping which may be modified from time to time. The Contractor shall not carry out any dumping without the permission of the Engineer.
  - Flushing of the hopper is not permitted within the disposal works area.
  - The Contractor shall maintain detailed daily records of the number of the vessels transporting dredged material to the disposal works area, including details of the vessels capacities, the approximate volumes of material transported, the vessels' registration numbers, and the location, time and duration of all disposal operations. The daily records shall be submitted to the Engineer's Representative on the following day.

- (x) When dredging, transporting and disposing of contaminated mud, the Contractor shall implement additional special procedures for the avoidance of pollution which shall include but not be limited to the following:
- Dredging of contaminated marine mud shall only be undertaken by a suitable grab dredger using a closed watertight grab.
  - Transport of contaminated marine mud from Tuen Mun to East Sha Chau shall be by split barge of not less than 750 m<sup>3</sup> capacity, well maintained and capable of rapid opening and discharge at the disposal works area.
  - Discharge from split barges shall be placed in the contaminated mud disposal pit by bottom dumping, at a location within the pit to be specified, from time to time, by the Secretary of the Fill Management Committee (FMC) and Geotechnical Engineering Office of Civil Engineering Department.
  - The dumping vessel shall be stationary throughout the dumping operation. Discharge shall be undertaken rapidly and the hoppers shall remain closed until the barge next returns to the disposal works area.
  - Any substance which is found dumped by the Contractor outside the contaminated mud disposal pit shall be removed by the Contractor at his own cost.
  - The Contractor shall install an automatic self monitoring device on the dumping barges as required by the Director of Environmental Protection. The device should be maintained functional at all times, and the equipment together with its stored record should not be tampered with.
- (xi) The Contractor shall not permit any sewage, waste water or effluent containing sand, cement, silt or any other suspended or dissolved material to flow from the Site onto any adjoining land or allow any waste matter or refuse to be deposited anywhere within the Site or onto any adjoining land. The Contractor shall collect and remove such water and liquid waste products by a suitable and properly designed temporary drainage system and dispose of at a location and in a manner that will not cause pollution or public health nuisance.
- The Contractor shall construct, maintain, remove and reinstate such temporary drainage system, take precautions necessary to avoid damage by flooding and by material washed down from the Site and to ensure that spoil or debris is not allowed to be pushed, washed down, fallen or deposited on land or in the watercourses adjacent to the Site;
- (xii) The Contractor shall be liable for any damages caused to adjoining area through his failure to comply with the previous clause 4.9.1 (xi).

- (xiii) The Contractor shall be responsible for adequate maintenance and clearance of channels, gullies and any existing Site drainage system at all times including removal of solids in sand traps, manholes and stream beds. Dredging of water courses shall be carried out only after informing the ER and EMT.
- (xiv) Silt removal facilities, channels and manholes shall be maintained and the deposited silt and grit shall be removed regularly, at the onset of, and after each rainstorm to ensure that these facilities are functioning properly at all times. Disposal of material shall be carried out properly and with the knowledge and approval of the ER and EMT.
- (xv) The Contractor shall provide and maintain such pedestrian and vehicular access as shall be directed within the Site. Temporary access roads shall be protected by crushed stone or gravel, particularly during the rainy season. Intercepting channels shall be provided to prevent storm runoff from washing across exposed soil surfaces. Arrangements shall always be in place to ensure that adequate surface protection measures can be safely carried out well before the arrival of a rainstorm.
- (xvi) Earthworks final surfaces shall be well compacted. Appropriate drainage such as intercepting channels shall be provided where necessary.
- (xvii) Open stockpiles of construction materials (e.g. aggregates, sand and fill material) on site shall be protected from erosion during rainstorms. Measures shall be taken to prevent the washing away of construction materials, soil, silt or debris into any drainage system.
- (xviii) Discharge of surface run-off into foul sewers must always be prevented in order not to unduly overload the foul sewerage system.
- (xix) The Contractor shall furnish, for the Engineer's information, particulars of the Contractor's arrangements for ensuring that material from any earthworks does not wash into the drainage system. If at any time such arrangements prove to be ineffective the Contractor shall take such additional measures as the Engineer and EMT shall deem necessary and shall remove all silt which may have accumulated in the drainage system whether within the Site or not.
- (xx) Precautions to be taken at any time of year when rainstorms are likely, actions to be taken when a rainstorm is imminent or forecast and actions to be taken during or after rainstorms are summarized in the following:
  - (1) Precautions to be taken at any time of year when rainstorms are likely
    - (a) Silt removal facilities, channels and manholes should be maintained and the deposited silt and grit should be removed regularly.


- (b) Temporary access roads should be protected by crushed stone or gravel.
- (c) Intercepting channels should be provided (e.g. along the crest/edge of excavation) to prevent storm runoff from washing across exposed soil surfaces.
- (2) Actions to be taken when a rainstorm is imminent or forecast
  - (a) Silt removal facilities, channels and manholes should be checked to ensure that they can function properly.
  - (b) Open stockpiles of construction materials (e.g. aggregates, sand and fill materials) on Site should be surrounded by suitable bunds and temporary channels.
- (3) Actions to be taken during or after rainstorms
  - (a) Silt removal facilities, channels and manholes should be checked and maintained to ensure satisfactory working conditions. Attention should be given to safety when carrying out this work.
- (xxi) All vehicles and plant shall be cleaned before they leave the Site to ensure no earth, mud, debris and the like is deposited on roads. A wheel washing bay shall be provided at every Site exit and wash-water shall have sand and silt settled out or removed before discharging into the site drainage system. The section of construction road between the wheel washing bay and the public road shall be paved to reduce vehicle tracking of soil and to prevent site run-off from entering public road drains.
- (xii) The transport of sediment to the environment shall be minimised by the installation of appropriate sediment traps within the drainage system. Sediment traps shall be designed with adequate capacity and constructed within the surface water drainage systems at appropriate locations.
- (xiii) Any stockpile of spoil or fill materials shall be treated to reduce erosion of the stockpile and sediment release. A separate settlement system for a large stockpile will be provided as necessary to collect contaminated surface water prior to release to the works area drainage system.
- (xiv) All compounds in works areas shall be located on areas of hardstanding with provision of drainage channels and settlement ponds where necessary to allow interception and controlled release of settled/treated water; and provision of bunding for all potentially hazardous materials on Site including fuels. The Contractor shall establish emergency procedures in the event of any spills of hazardous materials.

- (xv) Oil interceptors shall be provided in Site compounds and regularly emptied to prevent release of oils and grease into the surface water drainage system after accidental spillages. The interceptor shall have a bypass to prevent flushing during periods of heavy rain. Oil and fuel bunkers shall be bunded to prevent discharge due to accidental spillages or breaching of tanks.
- (xvi) If any office, works area-canteen or toilet facilities are erected, foul water effluent should be directed to a foul sewer or to a sewage treatment facility either directly or indirectly by means of pumping or other means approved by the Engineer.
- (xvii) Wastewater generated from the washing down of mixer trucks and drum mixers and similar equipment should wherever practicable be recycled. The discharge of wastewater should be kept to a minimum.
- (xviii) To prevent pollution from wastewater overflow, the pump sump of any water recycling system should be provided with an on-line standby pump of adequate capacity and with automatic alternating devices.
- (xxix) Any waters entering the storm drains must have a pH less than 8.5. Under normal circumstances, surplus wastewater may be discharged into foul sewers after treatment in silt removal and pH adjustment facilities (to within the pH range of 6 to 9). Disposal of wastewater into storm drains will require more elaborate treatment. Surface run-off should be segregated from the concrete batching plant and casting yard area as much as possible, and diverted to the stormwater drainage system. Surface run-off contaminated by materials in a concrete batching plant or casting yard should be adequately treated before disposal into stormwater drains.
- (xxx) Bentonite slurries used in diaphragm wall and bore-pile construction should be reconditioned and reused wherever practicable. If the disposal of a certain residual quantity cannot be avoided, the used slurry may be disposed of at the marine spoil grounds subject to obtaining a marine dumping licence from EPD on a case-by-case basis.
- (xxi) If the used bentonite slurry is intended to be disposed of through the public drainage system, it should be treated to the respective effluent standards applicable to foul sewers, storm drains or the receiving waters as set out in the WPCO Technical Memorandum on Effluent Standards.
- (xxxii) The Contractor is reminded that all discharges into any drainage or sewerage systems, or inland or coastal waters within a Deep Bay Water Control Zone are controlled under the *Water Pollution Control Ordinance* (WPCO), except the discharge of domestic sewage into foul sewers or the discharge of unpolluted water into storm drains or into the waters of Hong Kong. Construction site discharges are controlled under the WPCO.

- (xxxiii) Discharges controlled under the WPCO must comply with the terms and conditions of a valid WPCO licence.
- (xxxiv) The WPCO licence application form (Form A) can be obtained from any EPD office or from District Offices. The applicant should include in the application, inter alia, information on the various points of discharge of storm run-off and wastewater, and the corresponding maximum (or range of) volume of discharge expected on a dry day. The application form, which can be filled in by the Owner, the Authorized Person, the Consulting Engineer or the Contractor, should be submitted to EPD as early as possible before the commencement of any discharge. In general, assuming adequate information has been provided together with the licence application, EPD would need at least 20 days for the processing of a licence for a discharge, and in the case of a discharge directly into any waters of Hong Kong, EPD would need at least 50 days to allow time for public notification as required by the WPCO.



TIN SHUI WAI DEVELOPMENT  
 AGREEMENT NO. CE 10/95  
 ENGINEERING INVESTIGATIONS FOR  
 DEVELOPMENT OF AREAS 3, 30 & 31  
 OF THE DEVELOPMENT ZONE  
 AND THE RESERVE ZONE

 BINNIE CONSULTANTS LIMITED  
 賓尼工程顧問有限公司  
 ENGINEERS AND SCIENTISTS

Title :

**EM & A - LOCATIONS OF WATER  
 QUALITY MONITORING STATIONS  
 FOR SCENARIO 1 & 2  
 (JUL 1997 - SEP 1998)**


Figure No.	4.1	Revision	0
Reference No		File Name	
Prepared	MC	Checked	LS
Date	NOV 96	Scale	NTS





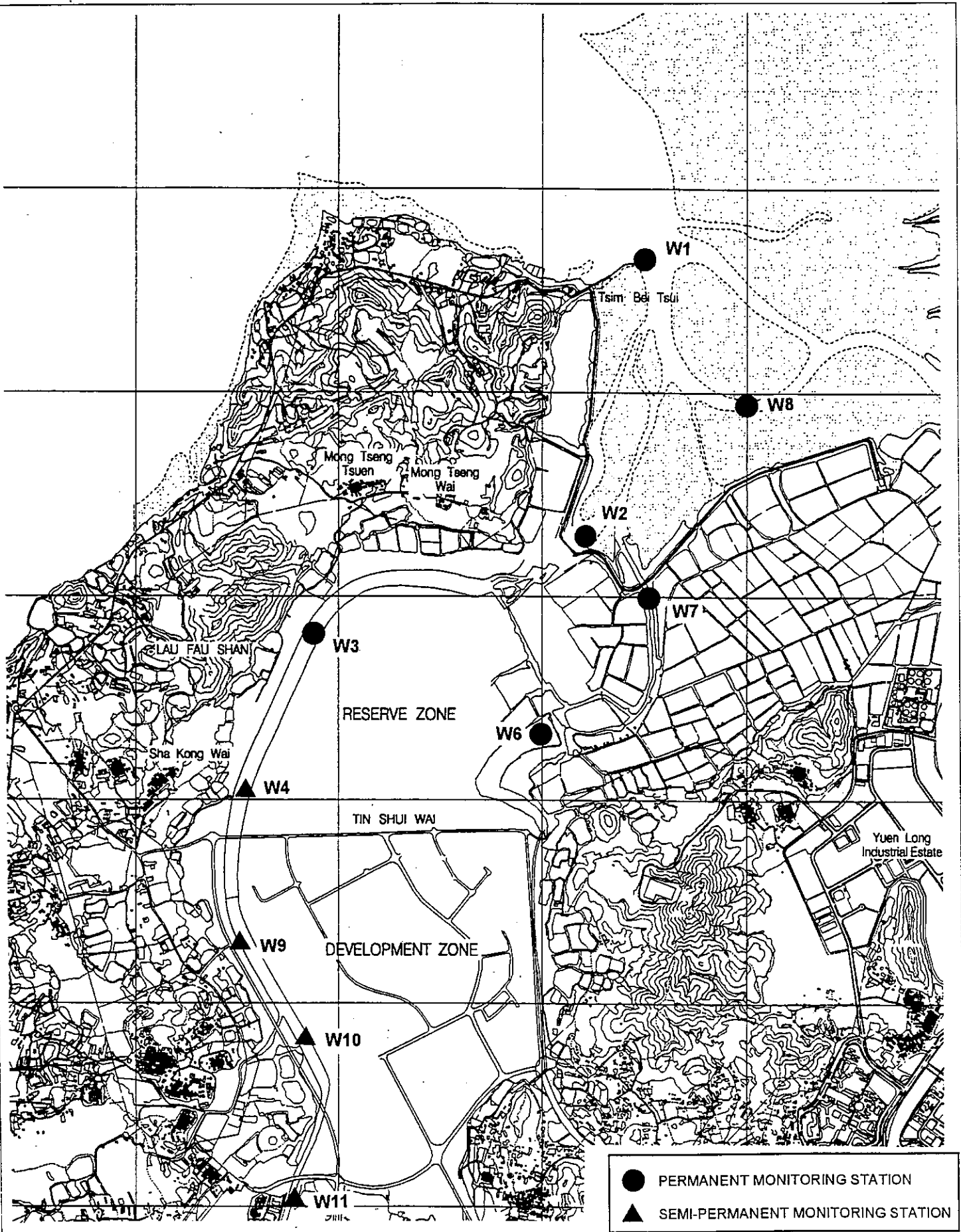
● PERMANENT MONITORING STATION  
 ▲ SEMI-PERMANENT MONITORING STATION

TIN SHUI WAI DEVELOPMENT  
 AGREEMENT NO. CE 10/95  
 ENGINEERING INVESTIGATIONS FOR  
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 BINNIE CONSULTANTS LIMITED  
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 ENGINEERS AND SCIENTISTS

Title :  
**EM & A - LOCATIONS OF WATER  
 QUALITY MONITORING STATIONS  
 FOR SCENARIO 3  
 (OCT - DEC 1998)**

Figure No.	4.2	Revision	0
Reference No.		File Name	
Prepared	MC	Checked	LS
Date	NOV 96	Scale	NTS

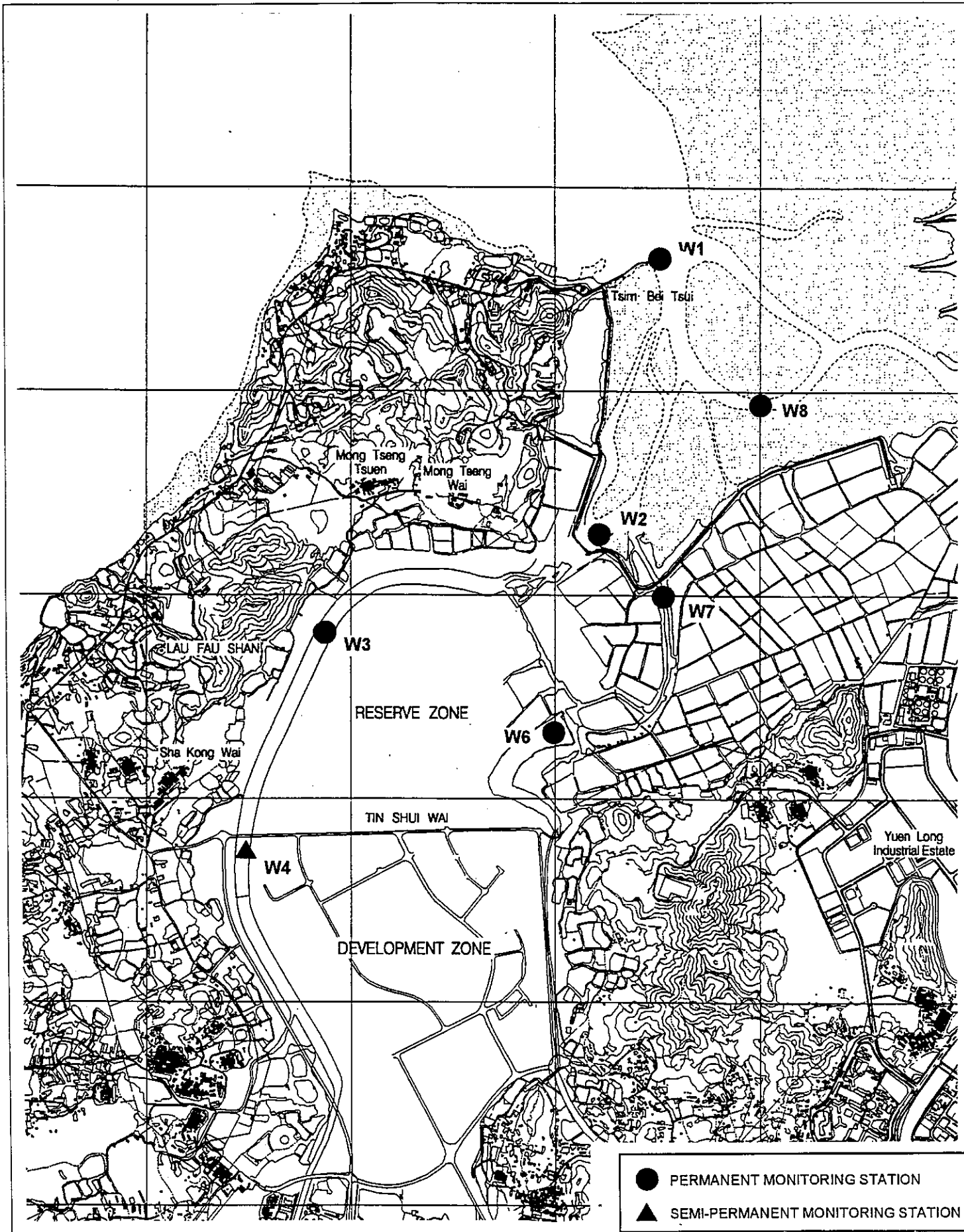


TIN SHUI WAI DEVELOPMENT  
 AGREEMENT NO. CE 10/95  
 ENGINEERING INVESTIGATIONS FOR  
 DEVELOPMENT OF AREAS 3, 30 & 31  
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Title :  
**EM & A - LOCATIONS OF WATER  
 QUALITY MONITORING STATIONS  
 FOR SCENARIO 4, 5, 6, 7 & 8  
 (JAN 1999 - JUN 2001)**

Figure No.	4.3	Revision	0
Reference No.		File Name	
Prepared	MC	Checked	LS
Date	NOV 96	Scale	NTS



● PERMANENT MONITORING STATION  
 ▲ SEMI-PERMANENT MONITORING STATION

**TIN SHUI WAI DEVELOPMENT AGREEMENT NO. CE 10/95**  
 ENGINEERING INVESTIGATIONS FOR DEVELOPMENT OF AREAS 3, 30 & 31 OF THE DEVELOPMENT ZONE AND THE RESERVE ZONE  
 BINNIE CONSULTANTS LIMITED  
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Title :  
**EM & A - LOCATIONS OF WATER QUALITY MONITORING STATIONS FOR SCENARIO 9, 10 & 11 (JUL 2001 - AUG 2003)**

Figure No.	4.4	Revision	0
Reference No		File Name	
Prepared	MC	Checked	LS
Date	NOV 96	Scale	NTS

Figure 4.5: Water Quality Monitoring Data Record Sheet

Location				
Date				
Start Time (hh:mm)				
Weather				
Sea Conditions				
Tidal Mode				
Water Depth (m)				
Monitoring Depth		Surface	Middle	Bottom
Salinity				
Temperature (°C)				
DO Saturation (%)				
DO (mg/l)				
Turbidity (NTU)				
SS Sample Identification				
Observed Construction Activities	< 100 m from location			
	> 100 m from location			
Other Observations				

Name & Designation

Signature

Date

Recorded by : \_\_\_\_\_

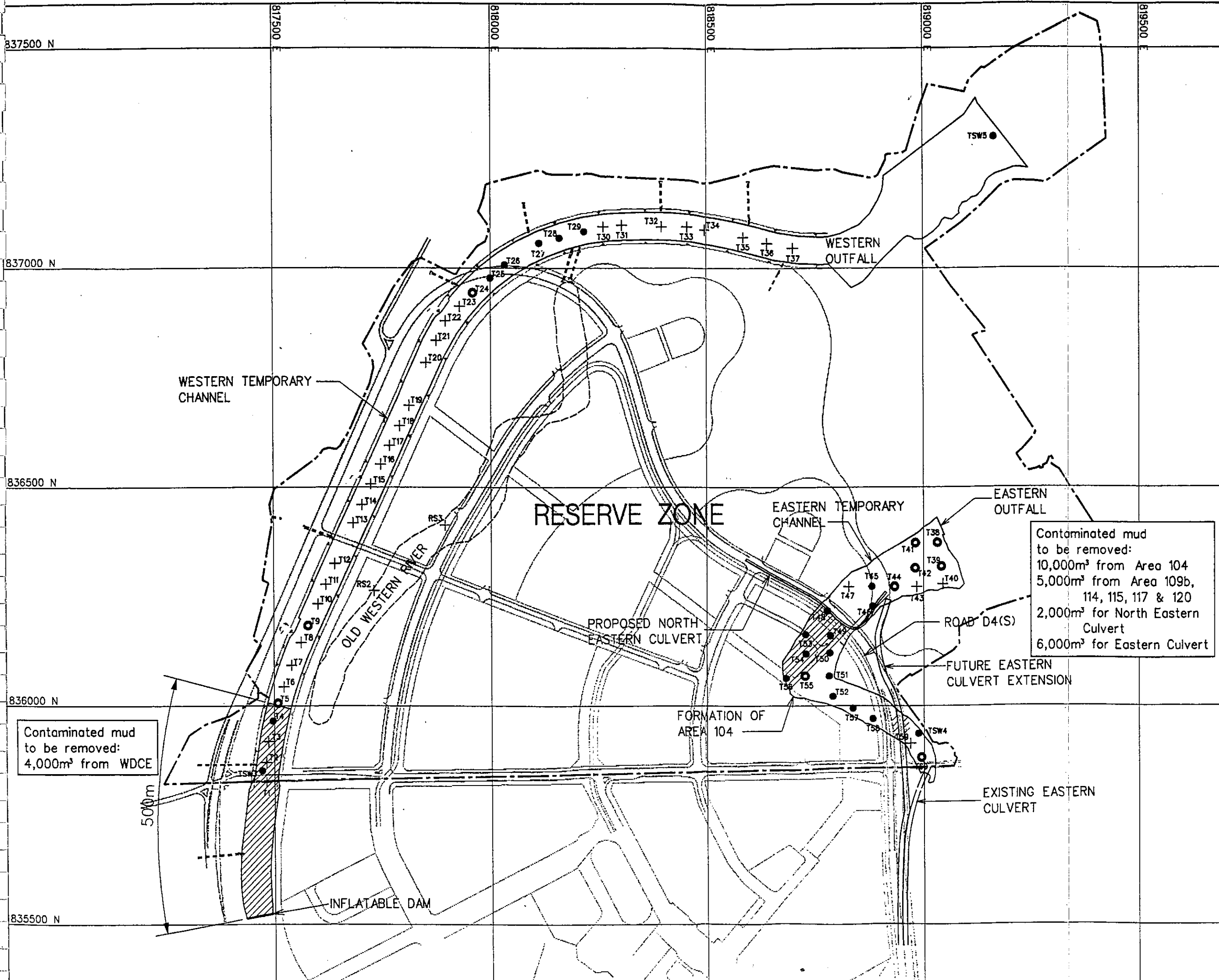
\_\_\_\_\_

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Checked by : \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_



**Notes:**

- + - CLASS A
- - CLASS B
- - CLASS C
- - - - - OUTFALL
- AREA OF CONTAMINATED MUD TO BE REMOVED UNDER THE PROJECT

Contaminated mud to be removed:  
4,000m<sup>3</sup> from WDCE

Contaminated mud to be removed:  
10,000m<sup>3</sup> from Area 104  
5,000m<sup>3</sup> from Area 109b, 114, 115, 117 & 120  
2,000m<sup>3</sup> for North Eastern Culvert  
6,000m<sup>3</sup> for Eastern Culvert

Prepared	MC	Checked	AMP
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File name	Revision	Date
00680018.C09	2	FEB. 97

Project: TIN SHUI WAI DEVELOPMENT

Contract title:  
ENGINEERING INVESTIGATIONS FOR DEVELOPMENT OF AREAS 3, 30 & 31 OF THE DEVELOPMENT ZONE AND THE RESERVE ZONE

Title:  
CONTAMINATED MUD AREAS IMPACTED BY CONSTRUCTION

Figure no.	Reference	Scale
4.6	TSW-BASE	1: 8000

**BINNIE CONSULTANTS LIMITED**  
寶尼工程顧問有限公司  
ENGINEERS AND SCIENTISTS

Office:  
**新界北拓展處**  
NEW TERRITORIES NORTH DEVELOPMENT OFFICE  
 **拓展署**  
Territory Development Department, Hong Kong

## 5 ECOLOGY

### 5.1 Introduction

- 5.1.1 The following EM&A programme has been based on the data collected during the 12 month Eco-IA conducted as part of the EIA Studies.
- 5.1.2 The main potential impacts, mitigation and residual impacts for the Project Works are given in Tables 5.1 and 5.2.

### 5.2 Monitoring Locations

- 5.2.1 During the Eco-IA, monitoring stations were established for intertidal fauna, epifauna, water birds, mangrove, and mammals, determined by the requirement for at least one control area, unlikely to be impacted by the works under the current Project or by concurrent projects in the area.
- 5.2.2 Other monitoring locations were defined by consideration of the most likely areas of impact under the Project activities, and with consideration of the current environmental condition of the Site. For example, locations for monitoring intertidal benthos include the mouth of the Western Drainage Channel which may potentially be impacted by contaminated runoff from the site, and the mudflats at Tsim Bei Tsui on the edge of Inner Deep Bay which serve as a control site representing the existing benthic community conditions. A third site, at Mai Po, is designated as an Action Plan Site, and is to be sampled at the same time as the other sites, during the EMA. Samples should be processed and preserved so that the information is available in the case of action or limit levels being exceeded. All locations for ecological monitoring during the Project are shown in Figure 5.1.

### 5.3 Monitoring Methodology

- 5.3.1 Determination of the significance of a change in the ecological community is achieved through a beyond-BACI statistical approach (Underwood 1992). This enables the probability of any observed changes in the ecosystem being due to project activities to be evaluated.
- 5.3.2 Attributing the cause of impacts requires rigorous experimental design in a laboratory, so for measurements taken in the field, demonstrating causality is even more difficult. Comparing the potentially impacted site to a distant control site both before and after the impact is the essence of the approach (Green 1979). However, there is potential for misinterpretation.
- 5.3.3 If a control site is compared to a potential impact site, both before and after a Project begins, there are two possible errors. The control site may show a change relative to the impact site entirely by chance; an interpretation would be that a Project impact has caused the difference between the control and impact sites, but no impact at all may have occurred (Figure 5.2A). The second error is that a Project impact has occurred, but by chance the control site has changed in the same direction (Figure 5.2B). The impact on the environment would go undetected.

**Table 5.1**  
**Potential Impacts of the Project on Ecological Resources**

Period of Works	Potential Impacts
<p><u>Site Formation</u>                      Levelling of landbank</p>	<p>Project activities related to road building and site formation result in the loss of &lt; 5% of the Territory's freshwater wetlands including the Old Western River and part of ETC.</p> <p>Reedbed habitat lost under the Project.</p> <p>Faunal impacts include loss of feeding, courtship and breeding habitat for freshwater and grassland insects, birds, mammals and amphibians.</p> <p>Potential increase in sedimentation from movement of sand around landbank during site formation, which will impact freshwater fauna, marine infauna and epifauna, and mangroves.</p> <p>Noise and disturbance impacts on birds and mammals.</p>
<p>Removal of mud from ETC</p>	<p>Potential impacts on water quality from increases in pollutants resulting from disturbance of sediment in channel. This will impact freshwater and marine fauna.</p> <p>Noise and disturbance during works will impact mammals.</p>
<p><u>Infrastructure Works</u>                      Construction of drainage, sewerage and utilities</p>	<p>Potential impacts on water quality from increase in pH from concrete washings entering the channel. In the presence of high concentrations of ammonia, freshwater and marine fauna will be subjected to ecotoxic levels of un-ionized ammonia.</p> <p>Noise and disturbance during works will impact birds and mammals.</p> <p>Covering of vegetated areas with an impermeable surface will increase hydraulic runoff, with potential increases in erosion and sedimentation.</p>
<p>Construction of WDCE and construction of road bridges</p>	<p>Potential impacts of increased sedimentation and loss of sediment habitat for benthic fauna.</p> <p>Loss of mangrove habitat on site.</p> <p>Potential deterioration in water quality due to increased pH from concrete washings.</p> <p>Noise and human disturbance during works will impact birds and mammals.</p>
<p><u>Operation</u>                      Urban stormwater runoff; waste production                      Accidental spills including discharge of untreated sewage                      Presence of residences and increased population                      Maintenance dredging of WDCE and EDC</p>	<p>Potential contamination of water courses, impacting freshwater and marine fauna in receiving waters.</p> <p>Noise and disturbance impacts on birds and mammals inhabiting the area.</p> <p>Potential increase in sedimentation which will impact the benthic infauna and epifauna of the receiving water.</p>

**Table 5.2**  
**Mitigation Measures and Residual Impacts of the Project on Ecological Resources**

Impact	Mitigation	Residual Impact
Loss of grassland habitat under site formation	Replacement cannot be achieved within the site under this Project.	Loss of 133 ha of grassland which is habitat for breeding, feeding and nesting of songbirds, mammals and amphibians. This impact is minimal providing recolonization is successful elsewhere.
Loss of freshwater habitat under site formation	Creation of freshwater wetland habitat as part of the Project in Areas 114 and 118.  Works for construction of habitat will be scheduled for Contract 8.	Minimal residual impacts should occur providing habitat rehabilitation is successful.
Loss of habitat for mammals, amphibians and breeding birds	Site should be inspected for mammals before site formation and individuals relocated as required.  Stockpile drain should be aligned to avoid nesting areas and grading of stockpiles where nests occur should be avoided in the breeding season.	Minimal residual impact should occur providing mitigation measures are implemented.
Loss of intertidal habitat	Native woodland planting will isolate part of channel from human disturbance.	Minimal residual impact should occur as area lost is small and degraded. Mangroves colonize replacement habitat.
Deterioration in water quality during construction (increase in pH)	Minimise runoff to avoid impacts of raised pH or SS levels on receiving water environment.	Some residual impact from increased pollutants in runoff, however, ecological impact will be minimal if mitigation implemented.
Impacts on birds and mammals from increased noise and disturbance during operation	Little mitigation is planned because of temporary nature of impact.	Short term residual impact on birds and mammals in construction area.
Impacts on birds and mammals from increased noise and disturbance during operation	Barrier planting and sensitive areas e.g. replacement wetland areas, control of public access in these areas. Adherence to DBG for noise levels.	Residual impacts of increased noise are inevitable, however some birds and mammal species in adjacent areas are expected to adapt to the additional disturbance.
Impacts on freshwater and marine fauna from deterioration in water quality during operational urban stormwater runoff	Installation of sediment and silt traps on site, oil interceptors and constructed wetland to treat polluted runoff.	Minimal residual impacts should occur if mitigative devices are well designed, constructed and maintained.
Accidental spills	No hazardous installations will be constructed on site. Good preventative maintenance will be carried out in sewage pumping station.	No residual impacts should occur if mitigation measures are implemented.
Maintenance dredging of WDCE and EDC	Dredge one side of channel at a time, to allow for recolonization of dredged mud if extended lengths of channel need dredging.	Temporary residual impact of loss of benthos in dredged mud.



- 5.3.4 The "BACI" anagram (e.g. Stewart-Oaten *et al.* 1986) stands for before-after-control impact, referring to a monitoring program that measures ecological parameters on several occasions both before and after a Project begins. The parameters are monitored both at a control site, as well as at the potentially impacted site (Figure 5.3A). The several measurements of the ecological parameter taken both before and after the Project begins act as replicates with which to assess whether differences before and after the Project begins are sustained, reliable differences, or noise. However, if the control and impact sites are changing relative to each other before the impact begins, the Project may be incorrectly blamed for the change (Figure 5.3B). A simple BACI design is not sufficient to assess whether an impact from the Project has occurred (Underwood 1992).
- 5.3.5 The "beyond-BACI" design consists of recording ecological parameters at replicate times both before and after the Project begins, but at more than one control site. This provides the best chance for determining whether or not the Project is responsible for any observed ecological changes. The "beyond-BACI" modification reduces the errors possible in the BACI approach. The error of falsely attributing a change in the measured ecological parameter to the Project is greatly reduced by showing that there are no important differences among the impact and control sites from before to after the Project begins. Even if the measured ecological parameter changes in the direction expected by an impact after the Project begins, if there is no important difference between the impact site and the control sites, the Project is not implicated (Figure 5.4A). The "important differences" show up as presence or absence of statistical interactions in the before and after values between control sites as well as between control and impact site (Underwood 1992).
- 5.3.6 The environment is similarly protected, because an impact of the Project is far less likely to go undetected. There will be a far greater confidence that a significant interaction between control and impact site samples taken before and after the Project begins (Figure 5.4B) is attributable to the Project if an impact does occur. This observation, combined with a smaller interaction between control site samples taken before and after the Project begins, would implicate the Project as a source of the impact.
- 5.3.7 Under the current Project, the Tsim Bei Tsui site will be utilized as the main control site for the infaunal monitoring programme. If a change is observed between the control and potential impact sites, the second control site at Mai Po, is examined to determine the trend at this site.
- 5.3.8 A knowledge of the trend occurring at the second site is required to judge whether the two control sites are changing in a similar way. Monitoring of the second control site should therefore be carried out regularly.
- 5.3.9 If an impact is suspected, re-sampling of the impact site and the main control site is required at the same time as sampling of the second control site.
- 5.3.10 In order to reduce the amount of effort required, samples should be collected from the second control site at the regular monitoring time for other locations, but only sieved, preserved and retained in case identification and measurement is required in the case of a suspected impact.

## 5.4 Intertidal Fauna

### *Purpose*

5.4.1 An EM&A programme of the organisms (benthos) living within and on the surface of the intertidal mudflats shall be established to ensure the Project takes place with minimum adverse impact and to allow detection of impacts arising from the Project.

5.4.2 The EM&A of ecological impact should:

- (i) collect data to monitor and interpret conditions to give early warning of adverse impacts arising from the Project by comparison with baseline data;
- (ii) evaluate and report on the quality and significance of the data;
- (iii) identify any measures necessary to mitigate any adverse effects; and
- (iv) report the details of the above on a regular basis.

### *Hypotheses*

5.4.3 Works within the RZ could lead to changes in water quality or erosion of, or sedimentation on, the intertidal mudflats. The resultant deterioration in water quality or a decrease in food available to organisms living within the intertidal habitat could lead to changes in the composition and abundance of organisms. Individuals of a particular species which cannot cope with the changes are expected to be eliminated, thus resulting in a decrease in population number. Other species tolerant of disturbance may increase in abundance.

### *Parameters measured*

5.4.4 In order to assess impacts on the intertidal ecology, the abundance and biomass of selected intertidal invertebrates (worms, crabs other than fiddler crabs) and mud skippers shall be monitored.

5.4.5 Four types of worms have been selected for infauna monitoring:

- (i) *Dendronereis pinnaticirrus*;
- (ii) *Neanthes glandicincta* and any other nereid polychaetes;
- (iii) capitellid polychaetes; and
- (iv) sabellid polychaetes.

5.4.6 *D. pinnaticirrus* is harvested by all types of birds foraging on the mudflat (Peking University, 1995), and has low variance, hence is appropriate to monitor. *N. glandicincta* and capitellid polychaetes are particularly sensitive to disturbance (Pearson and Rosenberg, 1978; Rhodes and Germano, 1986; Peking University, 1995). Sabellid polychaetes were distinctly zoned in monitoring work completed in February 1996 (BCL 1996).

- 5.4.7 Capitellid polychaetes are accepted indicators of organic pollution (Pearson and Rosenberg, 1978), and are early recolonizers after physical disturbance (Rhoads and Germano, 1986). Increases in the abundance of capitellids could indicate organic pollution or physical disturbance at the site.
- 5.4.8 Crabs other than fiddler crabs and mud skippers are detritis feeders and a decrease in numbers could indicate physical disturbance or pollution at the monitoring site.

#### *Monitoring Sites*

- 5.4.9 Monitoring sites shall be located on the potentially-impacted mudflat at the mouth of the drainage channels, and a similar site in Inner Deep Bay will act as a control site. The "beyond-BACI" (Before-After Control-Impact) design (Underwood, 1992) would allow detection of any changes due to anthropogenic impacts of the Project. Action plans will implement additional sites in Deep Bay necessary to apply the beyond-BACI design.
- 5.4.10 The intertidal fauna study is one component of the overall Ecological Monitoring Programme. The sites chosen for the epifauna and infauna monitoring correspond to the sites selected for the monitoring of waterbird use of Deep Bay, mangrove habitat, water and sediment quality. Considering these sites together, changes detected by any one monitoring study can be checked against the others to evaluate the extent of changes on other components of the ecosystem.

#### *Monitoring Methodology*

- 5.4.11 The study is designed to use parametric Analysis Of Variance (ANOVA) in a Before-After Control-Impact (beyond-BACI)-type comparison to investigate temporal-spatial interactions attributable to impact.
- 5.4.12 The number of samples to be collected during each round of monitoring is determined with reference to the statistical requirements of the monitoring and auditing programme.
- 5.4.13 Doubling or halving the abundance of a benthic organism as a result of anthropogenic disturbance would generally be accepted as a large impact. Statistical Power analyses of existing invertebrate density data (eg. Chan, 1989; Peking University, 1995) indicated the necessary sampling effort to detect changes of given magnitude. Thirteen samples in each of three areas would allow the detecting of a doubling or halving of abundance in some infaunal species.
- 5.4.14 To detect smaller differences requires more effort. For example, if a change of 1/3 in the abundance was taken as indicating impact, each of three areas would have to yield 17 samples to detect the difference in *D. pinnaticirrus*, or 67 samples for capitellids, or about 40 samples in each area for *N. glandicincta*.

#### *Field Methods*

##### *Infauna*

- 5.4.15 During the EM&A for the Project, cores of mud shall be collected bi-monthly.

- 5.4.16 At least fourteen cores shall be collected at each of the three sites with a distribution shown in Figure 5.1. Cores shall be 10 cm in diameter and will sample the mudflat to a depth of 20 cm. Samples must be sieved through a 500  $\mu\text{m}$  screen. Benthos remaining on the mesh shall be fixed in 10% borax-buffered formalin stained with 0.1g.L<sup>-1</sup> rose bengal.
- 5.4.17 Benthos shall be washed in a lab across a 250  $\mu\text{m}$  screen, and rose-bengal stained benthos shall be separated from any remaining sediment, and preserved in 70% ethanol pending further analysis.
- 5.4.18 The following categories of benthos shall be identified and their abundance recorded:
- (i) *Dendronereis pinnaticirrus*;
  - (ii) *Neanthes glandicincta* and any other nereid polychaetes;
  - (iii) capitellid polychaetes; and
  - (iv) sabellid polychaetes.
- 5.4.19 Abundance shall be counted for entire individuals and for fragments with heads. Fragments without heads should not be counted.
- 5.4.20 Wet-weight biomass for these four categories and total biomass of these in the sample shall be determined to 4 decimal places by air-drying the benthos on paper towelling for ten to fifteen minutes prior to weighing. Wet-weight has been used in previous research in Hong Kong so will allow these data to be compared with previous studies.
- 5.4.21 Average body size for these four benthic groups at each site shall be determined. The slope of the linear regression line through a plot of points relating total number of individuals and their biomass in each of the cores at each station will measure average body size.
- 5.4.22 After biomass is determined, benthos should be archived in 70% ethanol for a period of one year. Unanticipated ecological changes can be assessed by reference to the archived samples if necessary, and taxonomic problems can be re-checked.

#### *Epifauna*

- 5.4.23 The intertidal epifauna, (mud skippers), shall be sampled six times per year during the EM&A for the Project.
- 5.4.24 For crabs other than Fiddler crabs (*Uca* spp.) and mud skippers, five permanent 5x5 m<sup>2</sup> quadrats shall be laid on the mud flat where a representative population of the animal is present. All crabs and mudskippers within the quadrats shall be counted and recorded using a telescope.

- 5.4.25 Since crabs and mud skippers tend to be inactive when air temperature falls below 20°C (remaining in their burrows), all field surveys shall be conducted at air temperature >20°C to ensure that numbers of organisms recorded are representative populations in the field. During each survey, air temperatures and information on weather conditions shall be recorded.
- 5.4.26 For each complete survey, the organisms within each quadrat are to be counted three times, each 30 minutes apart, to give an average number.

#### *Statistical Analysis*

- 5.4.27 The monitoring data shall be analysed using a parametric ANOVA within a beyond-BACI design (Underwood, 1992) to detect impacts on the benthic organisms outside of the normal seasonal variation in populations. This will trigger appropriate follow-up actions to be undertaken on Site as detailed in Section 5.8.

### **5.5 Mangroves**

#### *Purpose*

- 5.5.1 Deep Bay supports one of the largest remaining stands of mangroves in China. Of the 330 ha of mangrove forest remaining around Deep Bay, Mai Po contains approximately 40% (Fan, 1993). Monitoring of the mangroves will be established to ensure that the Project takes place with a minimum of adverse impact and that any impacts arising from the Project are detected.

#### *Hypothesis*

- 5.5.2 Works within the RZ could lead to erosion or sedimentation of the intertidal mudflats. Mangroves are susceptible to sedimentation and water pollution. Increased sedimentation can smother aerial roots; water pollution can affect seed germination; erosion can lead to loss of habitat.

#### *Parameters Measured*

- 5.5.3 At each monitoring station, the following information will be gathered:
- (i) the density of mangrove trees and their species composition;
  - (ii) other pertinent parameters that can help characterise the mangrove assemblage at the station, e.g. basal area, basal diameter and biomass. The exact parameters to be measured will depend on the nature of the stand such as tree height and growth form. Information gathered on the selected parameters will augment that gathered in (i) to give an adequate characterisation of the mangrove assemblage present and their ecological and conservation values;
  - (iii) the presence of any special or rare species in the area. For example, *Bruguiera gymnorhiza*, a rare species in the Deep Bay area, will be accorded special attention in the survey.

### **Monitoring Sites**

- 5.5.4 Stations will be selected to act as monitoring/reference stations during the survey. A reference station will be established at the mangrove site adjacent to the Tsim Bei Tsui peninsula (Figure 5.1).
- 5.5.5 The monitoring station should be able to act as a spatial control for the Development's potential impacts on the mangroves in the area. The potential impact station will be established at the entrance of the drainage channel leading to the Development Site. This station will serve mainly as temporal control in the long term monitoring programme as well as representing the impacted site during the initial operation of the project.

### **Monitoring Methodology**

- 5.5.6 At each of the study stations, a representative plot will be set up for the measurement of the above mentioned parameters once per annum. These plots will also serve as long term reference plots for the future monitoring programme. Where appropriate, a land-sea transect will also be run to give information on the distribution and abundance of the various species.

### **Analysis**

- 5.5.7 Follow-up actions would be triggered in cases including the following:
- (i) changes in the total abundance of mangroves;
  - (ii) changes in the distribution of mangroves.

The details of the action plans in the case of changes are given in Section 5.9 below.

## **5.6 Mammal and Nesting Bird Surveys**

- 5.6.1 Mammal surveys at areas of the site about to be disturbed for the first time should be undertaken before works begin. These surveys should check for the presence of active burrows or gestating leopard cats.
- 5.6.2 Nesting bird surveys should be made prior to disturbance of existing stockpiles and in the northern part of the site prior to building the temporary drain for the new stockpile areas.

## **5.7 Records and Reporting**

- 5.7.1 Sample Ecology Monitoring Form I to Form III are shown on Figures 5.5 to 5.7. All monitoring information shall be recorded in the Forms. The Ecology Monitoring Forms shall be kept for at least 6 months after the completion of the Contract.

5.7.2 The information shall be collated and viewed by either the ER(s) or the EMT within 24 hours.

5.7.3 All data shall be checked before inclusion in the monthly report.

### 5.8 Event and Action Plan for Ecology

5.8.1 Action and limit levels for ecology are illustrated in Table 5.3 and 5.4.

5.8.2 Event and action plan for ecology is summarised in Table 5.5.

**Table 5.3**  
**AL Levels for Absolute Water Quality to be used for**  
**Ecological Event/Action Plans During Construction**

Parameter	Action	Limit
pH	≥ 8.5	≥ 9.0
Dissolved oxygen (DO)	≤ 4 mg/l	≤ 2 mg/l
Suspended solids (SS)	≥ 150 mg/l for one week or more	≥ 200 mg/l for one week or more
Unionized ammonia	≥ 0.035 mg/l* for one week or more	≥ 0.233 mg/l*

\* These are USEPA recommended levels. Levels will be reviewed with reference to baseline data.

**Table 5.4**  
**AL Levels for Ecology During Construction**

Parameter	AL Levels
Intertidal fauna: - abundance of <i>D. pinnaticirrus</i> , other nereids, sabellids and capitellids - total biomass of these groups Epifauna: - abundance of mudskippers - abundance of crabs Mangroves: - abundance - distribution	Variations in one or more parameters recorded at monitoring stations when compared with control station results as given in Event/Action Plan Tables.

**Table 5.5**  
**Actions in the Event of Exceedance of Action Levels for Ecology**

Event	Actions		
	EMT	ER	Contractor
<b>Action Level</b>			
<p><b>Ecology:</b></p> <p><u>Intertidal Fauna</u></p> <p>1. if dissolved oxygen, suspended solids or ammonia levels exceed the absolute water quality Action Level (Table 5.3) at the water quality monitoring station within Inner Deep Bay implement points 1-7 for Action level action plan                      OR</p> <p>2. 20-40% decrease in total biomass from baseline at impact station B3, but not at control station B2; implement points 1 and 3-6 of Action Level action plan                      OR</p> <p>3. if a 20-40% decrease in total biomass from baseline occurs at both impact B3 and control B2 stations then implement points 1, 4 and 7 of Action Level action plan (next column).</p>	<p>1. Repeat water quality monitoring data to ensure validity</p> <p>2. Implement a presence/absence study at impact station immediately. If any of the four taxa are absent, but were present in the baseline studies for the same time of year, then go to Limit level action plan for intertidal fauna (points 1-6)</p> <p>3. Increase frequency of intertidal fauna monitoring to monthly until a return to below Action Levels</p> <p>4. Check position and state of current works to determine possible cause</p> <p>5. Notify ER and Engineer in writing. If a works related cause is suspected arrange meeting with ER to discuss possible solutions</p> <p>6. Report situation to ER in writing after remedial action has been taken</p> <p>7. Increase frequency of intertidal fauna monitoring to monthly, which shall include the Mai Po control station and determine abundance and biomass of target intertidal fauna (Table 5.4) from preserved Mai Po monitoring station. Apply beyond-BACI analysis to determine if regional event.</p>	<p>1. Confirm notification in writing to EMT and Engineer</p> <p>2. Notify Contractor in writing</p> <p>3. Check Contractor's working methods</p> <p>4. Discuss situation with EMT</p> <p>5. Discuss and agree with Contractor and EMT for remedial actions to be provided and report to Engineer and EMT.</p>	<p>1. Confirm notification in writing to ER</p> <p>2. Take immediate action to avoid further exceedances</p> <p>3. Check all plant and equipment and working methods</p> <p>4. Submit proposals for remedial actions to the ER within 3 working days upon notification</p> <p>5. Implement the agreed proposals</p> <p>6. Amend proposals if appropriate and report to the ER.</p>
<p><u>Intertidal Epifauna</u></p> <p>1. If a 20-40% decrease in total numbers of crabs or mud skippers from baseline at impact site B3, and no similar decrease at control station B2; implement points 1-6 of Action Level action plan                      or</p> <p>2. If a 20-40% decrease in total numbers of crabs or mud skippers from baseline at impact station B3 and control station B2, then implement points 1, 3, 4 and 7 of Action Level action plan                      or</p> <p>3. DO or NH<sub>3</sub> exceed the absolute water quality limit levels (Table 5.3) for one week. Implement points 1-7 of next column.</p>	<p>1. Check monitoring data to ensure validity</p> <p>2. Increase frequency of monitoring to twice monthly until a return to below Action Levels</p> <p>3. Check position and state of current works to determine possible cause</p> <p>4. Notify ER and Engineer in writing</p> <p>5. If a works related cause is suspected arrange meeting with ER to discuss possible solutions</p> <p>6. Report situation to ER in writing after remedial action has been taken</p> <p>7. Increased frequency of monitoring to twice monthly shall include the Mai Po control station to determine if a regional event.</p>	<p>1. Confirm notification in writing to EMT and Engineer</p> <p>2. Notify Contractor in writing</p> <p>3. Check Contractor's working methods</p> <p>4. Discuss situation with EMT</p> <p>5. Discuss and agree with Contractor and EMT for remedial actions to be provided and report to Engineer and EMT.</p>	<p>1. Confirm notification in writing to ER</p> <p>2. Take immediate action to avoid further exceedances</p> <p>3. Check all plant and equipment and working methods</p> <p>4. Submit proposals for remedial actions to the ER within 3 working days upon notification</p> <p>5. Implement the agreed proposals</p> <p>6. Amend proposals if appropriate and report to the ER.</p>



**Table 5.5**  
**Actions in the Event of Exceedance of Action Levels for Ecology (cont'd)**

Event	Actions		
	EMT	ER	Contractor
Action Level			
<b>Mangroves</b> 1. A subjective assessment of a drop in health of mangrove indicated by appearance of leaves (yellowing, blemished, wilting) or 5% loss of mangrove cover from baseline at impact station M5, with no similar loss at control station M1-M2 or 2. If SS exceed absolute water quality Limit levels (Table 5.3) for two consecutive weeks	1. Notify ER 2. Check position and state of works to determine possible cause.	1. Notify Contractor in writing 2. Check Contractor's working methods 3. Discuss and agree remedial works with Contractor, if necessary 4. Inform EMT of any remedial works to be undertaken.	1. Rectify any unacceptable practice 2. Check all plant and equipment and working methods 3. Consider changes to working methods.

**Table 5.6**  
**Actions in the Event of Exceedance of Limit Levels for Ecology**

Event	Actions		
	EMT	ER	Contractor
Limit Level			
Ecology:			
<p><b>Intertidal Fauna</b></p> <p>1. If dissolved oxygen, suspended solids or ammonia levels exceed absolute water quality Limit Level (Table 8.4) for 2 or more consecutive samples at monitoring station W2 or</p> <p>2. If a 41% (or greater) decrease in total biomass from baseline at impact station B3, but not at control station B2; implement points 1-5 of action plan (next column) or</p> <p>3. If a 41% (or greater) decrease in total biomass from baseline occurs at both impact B3 and control station B2 then implement point 1-3 and 6 of Limit Level action plan.</p>	<p>1. Check monitoring data to ensure validity</p> <p>2. Increase frequency of monitoring to twice monthly until a return to below Action Levels</p> <p>3. Check position and state of current works to determine possible causes</p> <p>4. Notify ER and Engineer. Notify EPD/AFD. Arrange meeting to discuss remedial actions</p> <p>5. Report to ER, Engineer and EPD/AFD on the situation after remedial action has been taken</p> <p>6. Implement twice-monthly monitoring to include monitoring at Mai Po control station and determine abundance and biomass of target intertidal fauna (Table 5.4) from preserved Mai Po monitoring station samples. Apply "beyond-BACI" analysis to determine if a regional event.</p>	<p>1. Confirm notification in writing to EMT and Engineer</p> <p>2. Notify Contractor in writing</p> <p>3. Check Contractor's working methods</p> <p>4. Discuss situation with EMT</p> <p>5. Discuss and agree with Contractor and EMT for remedial actions to be provided and report to Engineer and EMT</p> <p>6. Ensure remedial actions are properly implemented</p> <p>7. Report to the Engineer and EMT the situation after implementation of remedial actions</p> <p>8. Discuss with the engineer, EMT, EPD and AFD on the necessity of stopping the construction activity (The Engineer will discuss the need to stop work with the Client).</p>	<p>1. Confirm notification in writing to ER</p> <p>2. Take immediate action to avoid further exceedances</p> <p>3. Check all plant and equipment and working methods</p> <p>4. Submit proposals for remedial actions to the ER within 3 working days upon notification</p> <p>5. Implement the agreed proposals</p> <p>6. Resubmit problems if the problem still not under control</p> <p>7. As directed by the Engineer slow down or stop part of or all of the construction activities until the situation is rectified.</p>
<p><b>Intertidal Epifauna</b></p> <p>1. If a 41% or greater decrease in total numbers of crabs or mud skippers from baseline at impact site B3, and no similar decrease at control station B2; implement points 1-5 of Limit Level action plan or</p> <p>2. If a 41% or greater decrease in total numbers of crabs or mud skippers from baseline at impact station B3 and control station B2, then implement points 1, 3, 4 and 6 of Limit Level action plan (next column) or</p> <p>3. DO or NH<sub>3</sub> exceed the absolute water quality Limit levels (Table 5.3) for two consecutive weeks, implement points 1-6 of Limit Level action plan.</p>	<p>1. Check monitoring data to ensure validity</p> <p>2. Increase frequency of monitoring to weekly until a return to below Action Levels</p> <p>3. Check position and state of current works to determine possible cause</p> <p>4. Notify ER, Engineer, EPD and AFD in writing. Meet to discuss remedial actions</p> <p>5. Report to ER, Engineer, EPD and AFD on the situation after remedial action has been taken</p> <p>6. Weekly monitoring to include Mai Po control station to determine if a regional event.</p>	<p>1. Confirm notification in writing to EMT and Engineer</p> <p>2. Notify Contractor in writing</p> <p>3. Check Contractor's working methods</p> <p>4. Discuss situation with EMT</p> <p>5. Discuss and agree with Contractor and EMT for remedial actions to be provided and report to Engineer and EMT</p> <p>6. Ensure remedial actions are properly implemented</p> <p>7. Report to the Engineer and EMT the situation after implementation of remedial actions</p> <p>8. Discuss with the engineer, EMT, EPD and AFD on the necessity of stopping the construction activity (The Engineer will discuss the need to stop work with the Client).</p>	<p>1. Confirm notification in writing to ER</p> <p>2. Take immediate action to avoid further exceedances</p> <p>3. Check all plant and equipment and working methods</p> <p>4. Submit proposals for remedial actions to the ER within 3 working days upon notification</p> <p>5. Implement the agreed proposals</p> <p>6. Resubmit problems if the problem still not under control</p> <p>7. As directed by the Engineer slow down or stop part of or all of the construction activities until the situation is rectified.</p>

**Table 5.6**  
**Actions in the Event of Exceedance of Limit Levels for Ecology (cont'd)**

Event	Actions		
	EMT	ER	Contractor
Limit Level			
<b>Mangroves</b>			
1. Greater than 5% loss of mangrove cover from baseline at impact station M5, with no similar loss at control stations M1, M2 or	1. Check data to ensure validity	1. Confirm notification in writing to EMT and Engineer	1. Confirm notification in writing to ER
2. If SS exceed absolute water quality Limit levels (Table 5.3) for four consecutive weeks.	2. Check position and state of works to determine possible cause	2. Notify Contractor in writing	2. Take immediate action to avoid further exceedances
	3. Activate Mai Po control sites M3, M4 and carry out a full study of all stations	3. Check Contractor's working methods	3. Check all plant and equipment and working methods
	4. Notify ER and AFD/EPD. Arrange meeting to discuss possible causes and solutions	4. Discuss situation with EMT	4. Submit proposals for remedial actions to the ER within 3 working days upon notification
	5. Continuous monitoring of mangroves to detect any further effects of the impact.	5. Discuss and agree with Contractor and EMT for remedial actions to be provided and report to Engineer and EMT	5. Implement the agreed proposals
		6. Ensure remedial actions are properly implemented	6. Resubmit problems if the problem still not under control
		7. Report to the Engineer and EMT the situation after implementation of remedial actions	7. As directed by the Engineer slow down or stop part of or all of the construction activities until the situation is rectified.
		8. Discuss with the engineer, EMT, EPD and AFD on the necessity of stopping the construction activity (The Engineer will discuss the need to stop work with the Client).	

## 5.9 Mitigation to be Implemented by the Contractor

- 5.9.1 A survey of mammals and burrowing activities will be undertaken by the EMT along the edge of each Area immediately prior to commencement of Works. Areas of particular importance for mammals are wetland areas and marshy ground. In the event that either leopard cats, otters, or active burrows are detected, then relocation shall be undertaken by the Contractor in discussion with AFD.
- 5.9.2 A survey for nesting birds shall be undertaken by the EMT for Areas 110, 112, 113 and 114 if works are to be undertaken during the nesting season, i.e. March to July and if the area has not been worked for three months. If nesting birds are found, advice should be sought by the Contractor from AFD. AFD will issue a permit or recommend other measures. Trapping and relocation of birds may be requested. Kingfishers were nesting in the stockpile within Areas 105 and 110 in 1996.
- 5.9.3 Contractors should ensure their staff minimise disturbance to wildlife in areas adjacent to the Works. Unwanton destruction of wildlife such as birds, bats and larger mammals is illegal.

## 5.10 References

Chan Ka Yi, Phoebe (1989) *The Ecology of Mudskippers (Pisces: Periophthalmidae) at the Mai Po Marshes Nature Reserve, Hong Kong*. Unpublished M. Phil thesis, University of Hong Kong.

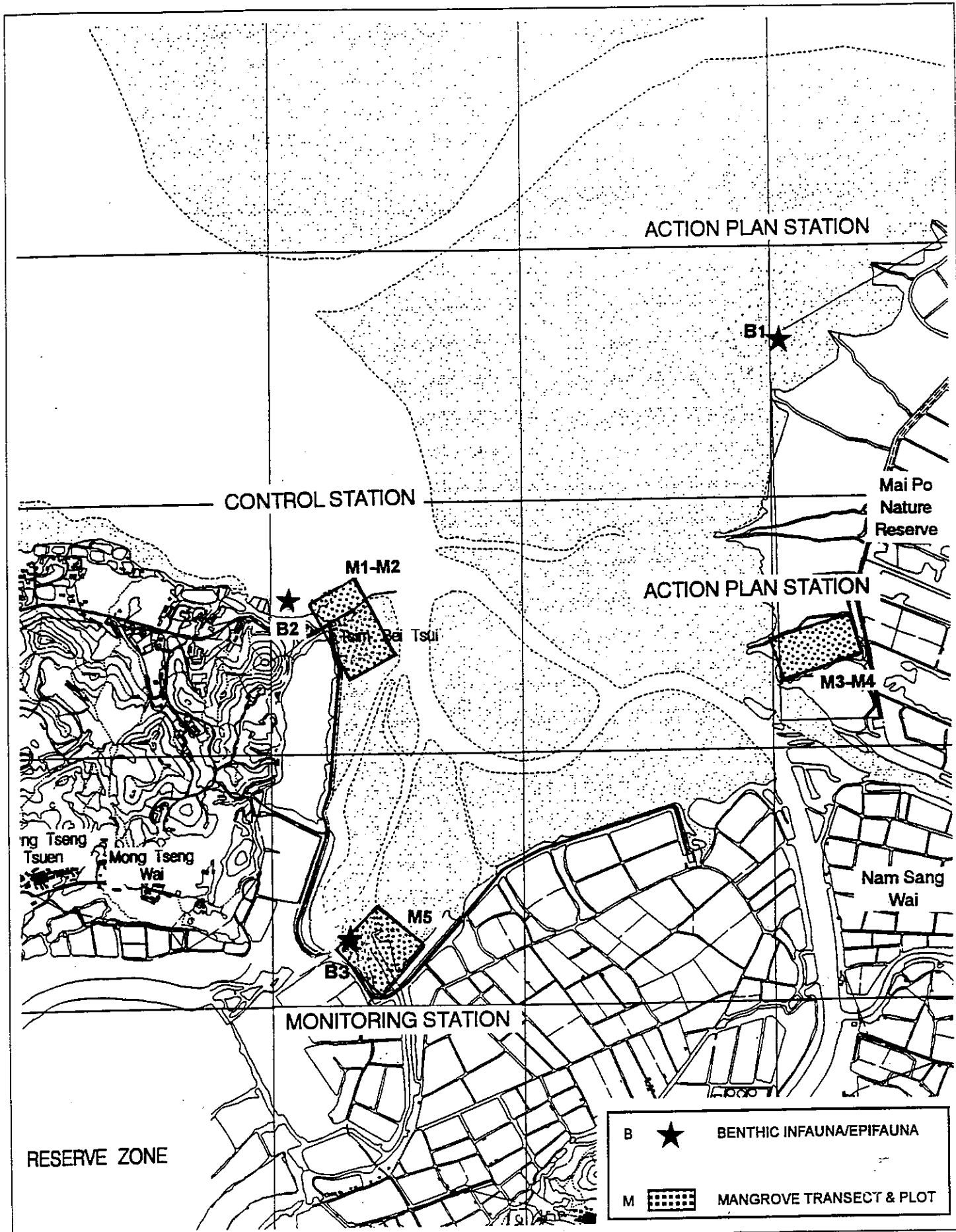
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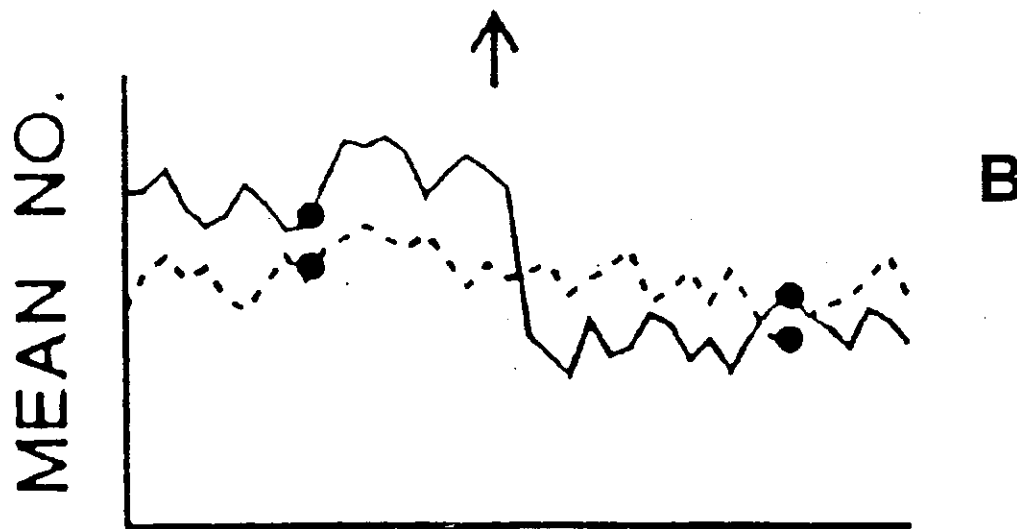
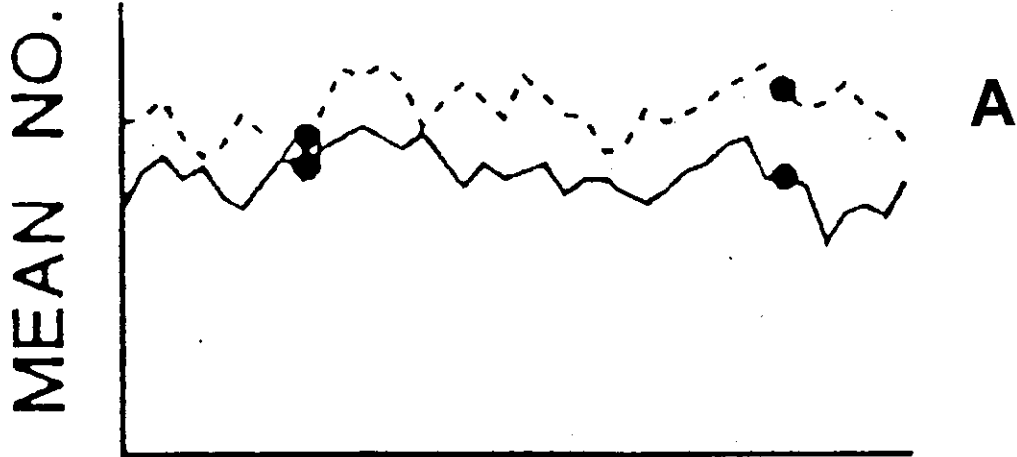
TIN SHUI WAI DEVELOPMENT  
 AGREEMENT NO. CE 10/95  
 ENGINEERING INVESTIGATIONS FOR  
 DEVELOPMENT OF AREAS 3, 30 & 31  
 OF THE DEVELOPMENT ZONE  
 AND THE RESERVE ZONE

 BINNIE CONSULTANTS LIMITED  
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 ENGINEERS AND SCIENTISTS

Title:

**EM&A - LOCATIONS OF ECOLOGICAL  
 MONITORING STATIONS**

Figure No.	5.1	Revision	0
Reference No.		File Name	
Prepared	MC	Checked	SMC
Date	MAY 96	Scale	NTS



BEFORE ↑ AFTER

**Key**  
 ----- Control site  
 ————— Potential impact site  
 Arrows mark the time of impact

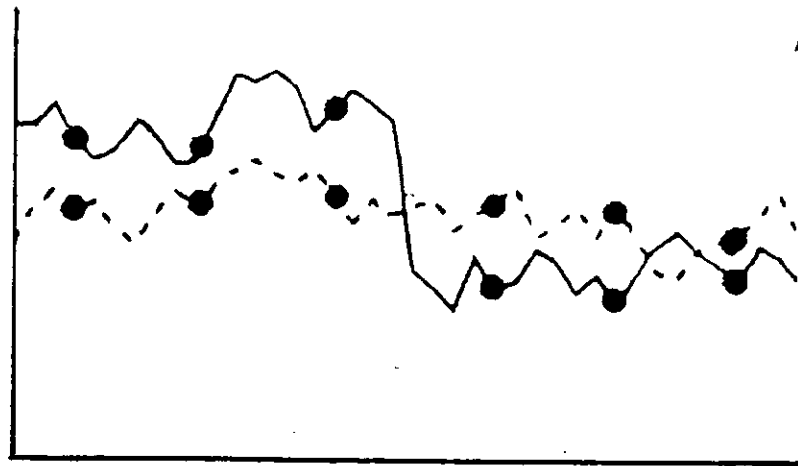
(Reproduced from Underwood, 1992)

TIN SHUI WAI DEVELOPMENT AGREEMENT NO. CE 10/95 ENGINEERING INVESTIGATIONS FOR DEVELOPMENT OF AREAS 3, 30 & 31 OF THE DEVELOPMENT ZONE AND THE RESERVE ZONE	Title :  <b>BEFORE-AFTER SAMPLING AT          CONTROL-IMPACT SITES</b>	Figure No. <b>5.2</b>	Revision 0
		Reference No. UNDERWOOD 92	File Name
		Prepared MC	Checked FNW
		Date FEB 97	Scale NTS


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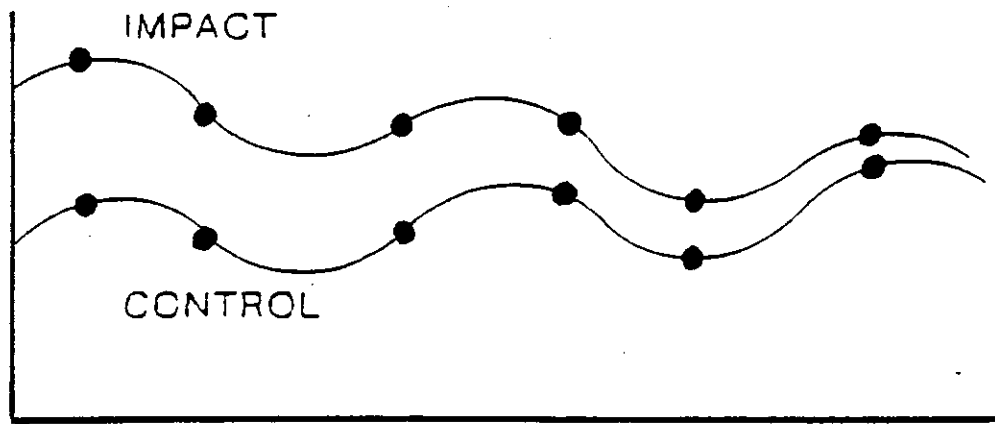
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MEAN NO.



A

BEFORE ↑ AFTER



B

BEFORE START-UP AFTER

TIME

**Key**

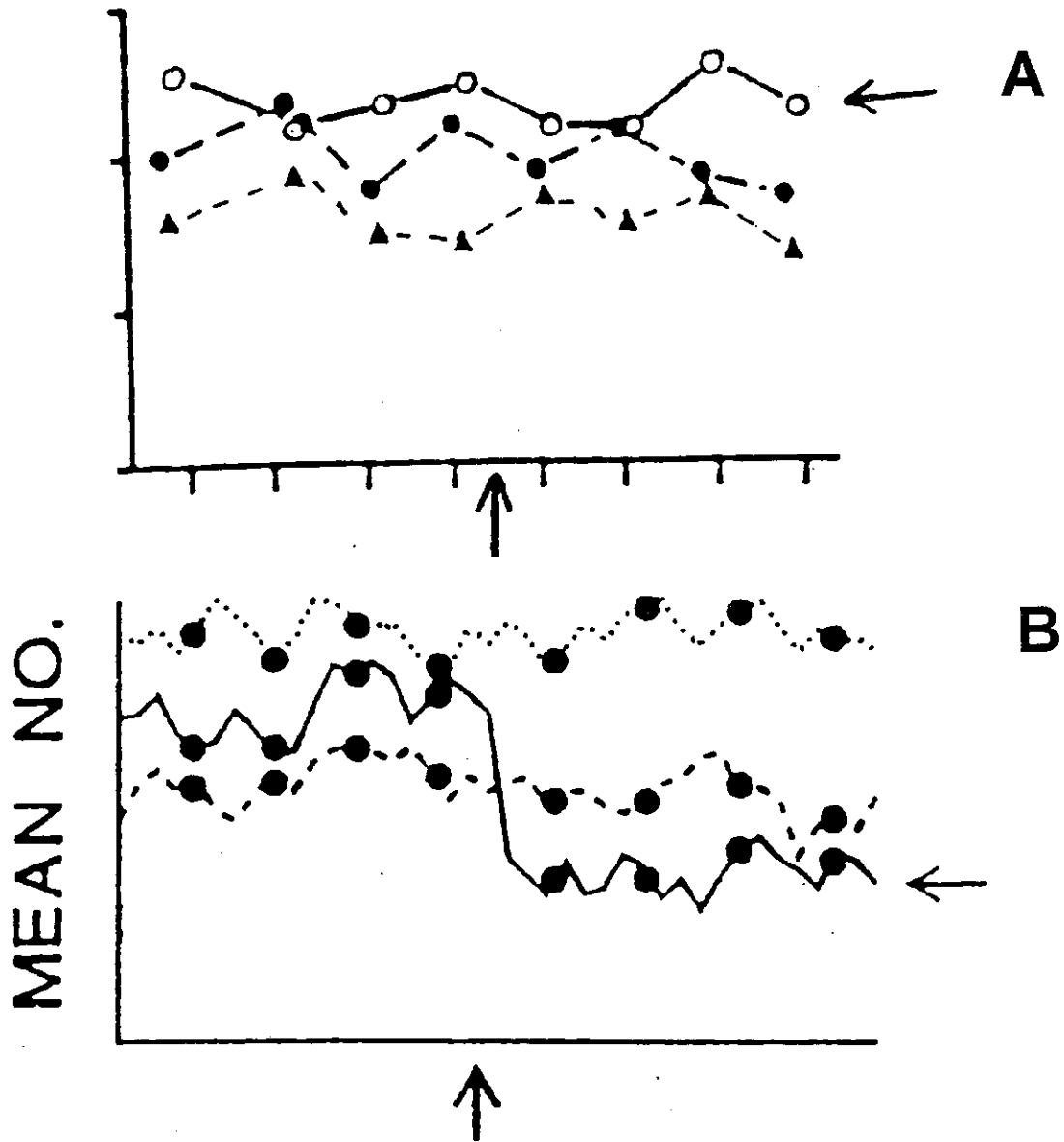
----- Control site

————— Potential impact site

Arrows mark the time of impact


(Reproduced from Underwood, 1992)

<p>TIN SHUI WAI DEVELOPMENT AGREEMENT NO. CE 10/95 ENGINEERING INVESTIGATIONS FOR DEVELOPMENT OF AREAS 3, 30 &amp; 31 OF THE DEVELOPMENT ZONE AND THE RESERVE ZONE</p>	<p>Title :</p> <p style="text-align: center;"><b>BACI DESIGN WITH REPLICATED TIMES OF SAMPLING</b></p>	<p>Figure No. <b>5.3</b></p>	<p>Revision <b>0</b></p>
		<p>Reference No. <b>UNDERWOOD 92</b></p>	<p>File Name</p>
		<p>Prepared <b>MC</b></p>	<p>Checked <b>FNW</b></p>
		<p>Date <b>FEB 97</b></p>	<p>Scale <b>NTS</b></p>
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Key	
.....	Control site 1
-----	Control site 2
————	Potential impact site

( Reproduced from Underwood, 1992 )

TIN SHUI WAI DEVELOPMENT AGREEMENT NO. CE 10/95 ENGINEERING INVESTIGATIONS FOR DEVELOPMENT OF AREAS 3, 30 & 31 OF THE DEVELOPMENT ZONE AND THE RESERVE ZONE	Title :  <b>"BEYOND-BACI" DESIGN WITH          MULTIPLE CONTROL AREAS</b>	Figure No. <b>5.4</b>	Revision <b>0</b>
		Reference No. <b>UNDERWOOD 92</b>	File Name
 BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 ENGINEERS AND SCIENTISTS		Prepared <b>MC</b>	Checked <b>FNW</b>
		Date <b>FEB 97</b>	Scale <b>NTS</b>





**Figure 5.6**  
**Ecology Monitoring Form II**  
**Benthic Infauna (Polychaeta) Sampling Record**

**Project:** TSW EM&A

**Site:** Mai Po / Tsim Bui Tsui / Western Temporary Channel

**Date:** \_\_\_\_\_

**Weather:** \_\_\_\_\_ **Tide Level:** \_\_\_\_\_

**Sample ID.:** \_\_\_\_\_

**Collector(s):** 1 \_\_\_\_\_

2 \_\_\_\_\_

3 \_\_\_\_\_

4 \_\_\_\_\_

5 \_\_\_\_\_

6 \_\_\_\_\_

**Other Observation:**

**Check By:** \_\_\_\_\_

**at:** \_\_\_\_\_

Figure 5.7

Ecology Monitoring Form III

Mangrove Survey Record

Project: TSW EM&A

Site: Mai Po / Tsim Bui Tsui / Western Temporary Channel

Date: \_\_\_\_\_

Weather: \_\_\_\_\_

Tide Level: \_\_\_\_\_

Plot I.D. \_\_\_\_\_

Plot Size (m<sup>2</sup>): \_\_\_\_\_

Species	Height (m)	d.b.h. (cm)	Developmental Stage (Mature/Sapling/Seedling)	Health Remark
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

d.b.h. is the Diameter at Breast Height (~1.3 m)

Record By: \_\_\_\_\_

Check By: \_\_\_\_\_

at (date): \_\_\_\_\_

## 6 WATERBIRDS

### 6.1 Introduction

6.1.1 The following EM&A programme has been based on the data collected during the 12 month Eco-IA conducted as part of the EIA Studies.

6.1.2 The main potential impacts, mitigation and residual impacts for the Project Works are given in Tables 6.1 and 6.2.

### 6.2 Monitoring Locations

6.2.1 During the Eco-IA, monitoring stations were established for intertidal fauna, epifauna, water birds, mangrove, and mammals, determined by the requirement for at least one control area, unlikely to be impacted by the works under the current Project or by concurrent projects in the area.

6.2.2 Other monitoring locations were defined by consideration of the most likely areas of impact under the Project activities, and with consideration of the current environmental condition of the Site. For example, locations for monitoring intertidal benthos include the mouth of the Western Drainage Channel which may potentially be impacted by contaminated runoff from the site, and the mudflats at Tsim Bei Tsui on the edge of Inner Deep Bay which serve as a control site representing the existing benthic community conditions. A third site, at Mai Po, is designated as an Action Plan Site, and observations are to be collected at the same time as the other sites during the EMA, so that the information is available in the case of action or limit levels being exceeded. All locations for ecological monitoring during the Project are shown in Figure 6.1.

### 6.3 Monitoring Methodology

6.3.1 Determination of the significance of a change in the ecological community is achieved through a beyond-BACI statistical approach (Underwood 1992). This enables the probability of any observed changes in the ecosystem being due to project activities to be evaluated.

6.3.2 Attributing the cause of impacts requires rigorous experimental design in a laboratory, so for measurements taken in the field, demonstrating causality is even more difficult. Comparing the potentially impacted site to a distant control site both before and after the impact is the essence of the approach (Green 1979). However, there is potential for misinterpretation.

6.3.3 If a control site is compared to a potential impact site, both before and after a Project begins, there are two possible errors. The control site may show a change relative to the impact site entirely by chance; an interpretation would be that a Project impact has caused the difference between the control and impact sites, but no impact at all may have occurred (Figure 6.2A). The second error is that a Project impact has occurred, but by chance the control site has changed in the same direction (Figure 6.2B). The impact on the environment would go undetected.

**Table 6.1**  
**Potential Impacts of the Project on Ecological Resources**

Period of Works	Potential Impacts
<p><u>Site Formation</u>                      Levelling of landbank</p>	<p>Project activities related to road building and site formation result in the loss of &lt; 5% of the Territory's freshwater wetlands including the Old Western River and part of ETC.</p> <p>Reedbed habitat lost under the Project.</p> <p>Faunal impacts include loss of feeding, courtship and breeding habitat for freshwater and grassland insects, birds, mammals and amphibians.</p> <p>Potential increase in sedimentation from movement of sand around landbank during site formation, which will impact freshwater fauna, marine infauna and epifauna, and mangroves.</p> <p>Noise and disturbance impacts on birds and mammals.</p>
<p>Removal of mud from ETC</p>	<p>Potential impacts on water quality from increases in pollutants resulting from disturbance of sediment in channel. This will impact freshwater and marine fauna.</p> <p>Noise and disturbance during works will impact birds and mammals.</p>
<p><u>Infrastructure Works</u>                      Construction of drainage, sewerage and utilities</p>	<p>Potential impacts on water quality from increase in pH from concrete washings entering the channel. In the presence of high concentrations of ammonia, freshwater and marine fauna will be subjected to ecotoxic levels of un-ionized ammonia.</p> <p>Noise and disturbance during works will impact birds and mammals.</p> <p>Covering of vegetated areas with an impermeable surface will increase hydraulic runoff, with potential increases in erosion and sedimentation.</p>
<p>Construction of WDCE and construction of road bridges</p>	<p>Potential impacts of increased sedimentation and loss of sediment habitat for benthic fauna.</p> <p>Loss of mangrove habitat on site.</p> <p>Potential deterioration in water quality due to increased pH from concrete washings.</p> <p>Noise and human disturbance during works will impact birds and mammals.</p>
<p><u>Operation</u>                      Urban stormwater runoff; waste production                      Accidental spills including discharge of untreated sewage                      Presence of residences and increased population                      Maintenance dredging of WDCE and EDC</p>	<p>Potential contamination of water courses, impacting freshwater and marine fauna in receiving waters.</p> <p>Noise and disturbance impacts on birds and mammals inhabiting the area.</p> <p>Potential increase in sedimentation which will impact the benthic infauna and epifauna of the receiving water.</p>

**Table 6.2**  
**Mitigation Measures and Residual Impacts of the Project on Ecological Resources**

Impact	Mitigation	Residual Impact
Loss of grassland habitat under site formation	Replacement cannot be achieved within the site under this Project.	Loss of 133 ha of grassland which is habitat for breeding, feeding and nesting of songbirds, mammals and amphibians. This impact is minimal providing recolonization is successful elsewhere.
Loss of freshwater habitat under site formation	Creation of freshwater wetland habitat as part of the Project in Areas 114 and 118.  Works for construction of habitat will be scheduled for Contract 8.	Minimal residual impacts should occur providing habitat rehabilitation is successful.
Loss of habitat for mammals, amphibians and breeding birds	Site should be inspected for mammals before site formation and individuals relocated as required.  Stockpile drain should be aligned to avoid nesting areas and grading of stockpiles where nests occur should be avoided in the breeding season.	Minimal residual impact should occur providing mitigation measures are implemented.
Loss of intertidal habitat, including disturbance of feeding area for waterbirds in WTC	Native woodland planting will isolate part of channel from human disturbance.	Minimal residual impact should occur as area lost is small and degraded. Mangroves colonize replacement habitat.
Deterioration in water quality during construction (increase in pH)	Minimise runoff to avoid impacts of raised pH or SS levels on receiving water environment.	Some residual impact from increased pollutants in runoff, however, ecological impact will be minimal if mitigation implemented.
Impacts on birds and mammals from increased noise and disturbance during operation	Little mitigation is planned because of temporary nature of impact.	Short term residual impact on birds and mammals in construction area.
Impacts on birds and mammals from increased noise and disturbance during operation	Barrier planting and sensitive areas e.g. replacement wetland areas, control of public access in these areas. Adherence to DBG for noise levels.	Residual impacts of increased noise are inevitable, however some birds and mammal species in adjacent areas are expected to adapt to the additional disturbance.
Impacts on freshwater and marine fauna from deterioration in water quality during operational urban stormwater runoff	Installation of sediment and silt traps on site, oil interceptors and constructed wetland to treat polluted runoff.	Minimal residual impacts should occur if mitigative devices are well designed, constructed and maintained.
Accidental spills	No hazardous installations will be constructed on site. Good preventative maintenance will be carried out in sewage pumping station.	No residual impacts should occur if mitigation measures are implemented.
Maintenance dredging of WDCE and EDC	Dredge one side of channel at a time, to allow for recolonization of dredged mud if extended lengths of channel need dredging.	Temporary residual impact of loss of benthos in dredged mud.

- 6.3.4 The "BACI" anagram (e.g. Stewart-Oaten *et al.* 1986) stands for before-after-control impact, referring to a monitoring program that measures ecological parameters on several occasions both before and after a Project begins. The parameters are monitored both at a control site, as well as at the potentially impacted site (Figure 6.3A). The several measurements of the ecological parameter taken both before and after the Project begins act as replicates with which to assess whether differences before and after the Project begins are sustained, reliable differences, or noise. However, if the control and impact sites are changing relative to each other before the impact begins, the Project may be incorrectly blamed for the change (Figure 6.3B). A simple BACI design is not sufficient to assess whether an impact from the Project has occurred (Underwood 1992).
- 6.3.5 The "beyond-BACI" design consists of recording ecological parameters at replicate times both before and after the Project begins, but at more than one control site. This provides the best chance for determining whether or not the Project is responsible for any observed ecological changes. The "beyond-BACI" modification reduces the errors possible in the BACI approach. The error of falsely attributing a change in the measured ecological parameter to the Project is greatly reduced by showing that there are no important differences among the impact and control sites from before to after the Project begins. Even if the measured ecological parameter changes in the direction expected by an impact after the Project begins, if there is no important difference between the impact site and the control sites, the Project is not implicated (Figure 6.4A). The "important differences" show up as presence or absence of statistical interactions in the before and after values between control sites as well as between control and impact site (Underwood 1992).
- 6.3.6 The environment is similarly protected, because an impact of the Project is far less likely to go undetected. There will be a far greater confidence that a significant interaction between control and impact site samples taken before and after the Project begins (Figure 6.4B) is attributable to the Project if an impact does occur. This observation, combined with a smaller interaction between control site samples taken before and after the Project begins, would implicate the Project as a source of the impact.
- 6.3.7 Under the current Project, the Tsim Bei Tsui site will be utilized as the main control site for the infaunal monitoring programme. If a change is observed between the control and potential impact sites, the second control site at Mai Po, is examined to determine the trend at this site.
- 6.3.8 A knowledge of the trend occurring at the second site is required to judge whether the two control sites are changing in a similar way. Monitoring of the second control site should therefore be carried out regularly.
- 6.3.9 If an impact is suspected, collecting observations at the impact site and the main control site is required at the same time as sampling of the second control site.
- 6.3.10 In order to reduce the amount of effort required, observations should be collected from the second control site at the regular monitoring time for other locations, but only retained in case identification and measurement is required in the case of a suspected impact.

## 6.4 Waterbirds

### *Purpose*

- 6.4.1 Waterbirds are the internationally important focus of the Ramsar site which is immediately downstream of and adjacent to the Tin Shui Wai Project area. A baseline of waterbird populations and their utilization of intertidal resources, and a monitoring programme will be established in this EM&A.

### *Hypotheses*

- 6.4.2 If development of the RZ infrastructure causes changes in water quality, or erosion or sedimentation of the mudflat, birds will be affected through impact on their food resources. Some birds (e.g. ducks) appear capable of exploiting high densities of pollution-tolerant capitellid worms, while other birds (e.g. egrets and herons) appear to feed on larger prey. Large prey tend to be displaced by pollution. If impacts cause a change in the prey base, both the total density of birds and the numbers of bird within groups (e.g. gulls, cormorants, waders, ducks, and egrets) may change. The EM&A methods are capable of detecting both changes. Little Egret (*Egretta garzetta*) densities will continue to be monitored for continuity with the Eco-IA.

### *Parameters Measured*

- 6.4.3 The density of all birds present in the monitoring areas will be recorded in 6 categories: gulls (Laridae), ducks (Anatidae), waders (Recurvirostridae, Charadriidae and Scolopacidae), herons and egrets (Ardeidae), Cormorants (Phalacrocoridae), and the target species Little Egret (*Egretta garzetta*). Density and activity of Little Egret will be determined at a potentially impacted site, and at two control sites. This "beyond-BACI" design (Underwood 1992) would allow detection of any changes due to anthropogenic impacts of the Project. The action plans for waterbirds analyse the data from all monitoring sites to allow the application of the "beyond-BACI" technique.
- 6.4.4 Little Egret will be observed because it is easy to identify, and has the advantage of being the subject species for several studies in Deep Bay (e.g. Wong 1990, Britan 1992, Cornish 1995 and in press) as well as from a variety of other sites worldwide. Regionally significant populations breed in Deep Bay (0.4 to 10% of S. China population, Young, 1995).

### *Monitoring Sites*

- 6.4.5 The potentially impacted location will be the mudflat at the mouth of the drainage channels. The control location is the intertidal mudflat north of the Tsim Bei Tsui Police post. A second control location exists at Mai Po Marshes Nature Reserve (Figure 6.1).
- 6.4.6 Ideally observations will be recorded from the observation tower, or alternatively from the bridge, at the potentially impacted site. Observations for the Tsim Bei Tsui site will be obtained from the hilltop above the police post, and/or from the Tsim Bei Tsui jetty. Observations at Mai Po should be recorded from the old boardwalk hide.



### *Monitoring Methodology*

6.4.7 Quadrats will be established on the mudflat, at each of three monitoring locations. Quadrats will be approximately 200 m x 200 m. The quadrats adjacent to Tsim Bei Tsui and Mai Po will be marked off with sticks every ten metres along each side; the channel mouth site is defined by the edges of intertidal channels and the mangrove (see Figure 6.1). Fieldwork will require a two-person monitoring team and include three tasks to be carried out at bi-monthly intervals:

1. *Identify and Count all Waterbirds in Monitoring Areas*

Using binoculars and a telescope, the team will identify and count all waterbirds present in the 6 categories (Section 6.4.3). Temperature, wind conditions (direction and the description "strong", "light", or "calm") and estimated percent cloud cover and precipitation (mist, rain) should be recorded. If visibility is limited (e.g. fog) that should be noted.

2. *Bird Density*

Bird density within quadrats will be recorded in the 6 groups (section 6.4.3).

3. *Activity Scans*

Using a telescope, each bird within the quadrat is identified in one of the six groups, and the behaviour noted. One team member dictates the data to the other team member, who records each bird type identified in a column of Form IV, and ticks the behaviour in the correct row. Activity scans record the number of birds engaged in various activities, such as standing, foraging, preening. Information to be recorded includes the epifauna present, area scanned, time, date, observations on the weather, and location and motion of the tide (Figure 6.5).

Activity should be recorded every 10 minutes during the flood and ebb tide, and at low water.

### *Statistical Analysis*

6.4.8 The goal will be to use parametric ANOVA in a BACI-type design to investigate temporal-spatial interactions attributable to impact. Changes will trigger appropriate follow-up actions to be undertaken.

6.4.9 In addition the results of waterfowl counts in Deep Bay carried out monthly between November and March by the Hong Kong Bird Watching Society shall be reported in the quarterly reports.

## **6.5 Records and Reporting**

6.5.1 Sample Field Record Sheet for Waterfowl Activity Scan is shown on Figure 6.5. All monitoring information shall be recorded in the Forms. The Ecology Monitoring Forms shall be kept for at least 6 months after the completion of the Contract.

6.5.2 The information shall be collated and viewed by either the ER(s) or the EMT within 24 hours.

6.5.3 All data shall be checked before inclusion in the monthly report.

**6.6 Event and Action Plan for Waterbirds**

6.6.1 Action and limit levels for ecology are illustrated in Table 6.3 and 6.4.

6.6.2 Event and action plan for ecology is summarised in Table 6.5.

**Table 6.3**  
**AL Levels for Absolute Water Quality to be used for**  
**Waterbird Event/Action Plans During Construction**

Parameter	Action	Limit
pH	≥ 8.5	≥ 9.0
Dissolved oxygen (DO)	≤ 4 mg/l	≤ 2 mg/l
Suspended solids (SS)	≥ 150 mg/l for one week or more	≥ 200 mg/l for one week or more
Unionized ammonia	≥ 0.035 mg/l* for one week or more	≥ 0.233 mg/l*

\* These are USEPA recommended levels. Levels will be reviewed with reference to baseline data.

**Table 6.4**  
**AL Levels for Waterbirds During Construction**

Parameter	AL Levels
Waterbirds: - abundance - relative proportion of species - foraging intensity	Variations in one or more parameters recorded at monitoring stations when compared with control stations results as given in Event/Action Plan Tables.

**Table 6.5**  
**Actions in the Event of Exceedance of Action Levels for Waterbirds**

Event	Actions		
	EMT	ER	Contractor
<b>Action Level</b>			
<b>Wading Birds</b>			
1. 30-50% change from baseline levels, in the proportion of foraging Little Egrets at impact station WB3  or	<ol style="list-style-type: none"> <li>1. Check monitoring data to ensure validity</li> <li>2. Implement a 1 day rapid qualitative assessment 10 days after last monitoring. If those results also show the proportion of foraging Little Egrets is 20-35% different from the baseline, then go to the Limit Level action plan</li> <li>3. Check position and state of current works to determine possible cause</li> <li>4. Notify ER and Engineer in writing.</li> </ol>	<ol style="list-style-type: none"> <li>1. Notify Contractor in writing</li> <li>2. Check Contractor's working methods</li> <li>3. Discuss and agree remedial works with Contractor, if necessary</li> <li>4. Inform EMT of any remedial works to be undertaken.</li> </ol>	<ol style="list-style-type: none"> <li>1. Rectify any unacceptable practice</li> <li>2. Check all plant and equipment and working methods</li> <li>3. Consider changes to working methods.</li> </ol>
2. If intertidal Infauna Action Level is activated due to a 20-40% decrease in the total biomass from baseline levels.	<ol style="list-style-type: none"> <li>1. Check monitoring data to ensure validity</li> <li>2. Implement a 1 day rapid qualitative assessment immediately. If the proportion of foraging Little Egrets is 20-35% different from the baseline, go to the Limit Level action plan</li> <li>3. Check position and state of current works to determine possible cause</li> <li>4. Notify ER and Engineer in writing.</li> </ol>	<ol style="list-style-type: none"> <li>1. Notify Contractor in writing</li> <li>2. Check Contractor's working methods</li> <li>3. Discuss and agree remedial works with Contractor, if necessary</li> <li>4. Inform EMT of any remedial works to be undertaken.</li> </ol>	<ol style="list-style-type: none"> <li>1. Rectify any unacceptable practice</li> <li>2. Check all plant and equipment and working methods</li> <li>3. Consider changes to working methods.</li> </ol>

**Table 6.6**  
**Actions in the Event of Exceedance of Limit Levels for Waterbirds**

Event	Actions		
	EMT	ER	Contractor
<b>Limit Level</b>			
<b>Wading Birds</b>			
1. 51% or greater change from baseline levels, in the proportion of foraging Little Egrets at impact station WB3  or	<ol style="list-style-type: none"> <li>1. Check monitoring data to ensure validity</li> <li>2. Increase frequency of monitoring to twice monthly until a return to below Action Levels</li> <li>3. Check position and state of current works to determine possible cause</li> <li>4. Notify ER, Engineer, EPD and AFD in writing. Arrange meeting to discuss remedial actions</li> <li>5. Report to ER, Engineer, EPD and AFD in writing on the situation after remedial action has been taken</li> <li>6. Activate/continue monitoring at Mai Po control station WB1.</li> </ol>	<ol style="list-style-type: none"> <li>1. Confirm notification in writing to EMT and Engineer</li> <li>2. Notify Contractor in writing</li> <li>3. Check Contractor's working methods</li> <li>4. Discuss situation with EMT</li> <li>5. Discuss and agree with Contractor and EMT for remedial actions to be provided and report to Engineer and EMT</li> <li>6. Ensure remedial actions are properly implemented</li> <li>7. Report to the Engineer and EMT the situation after implementation of remedial actions</li> <li>8. Discuss with the engineer, EMT, EPD and AFD on the necessity of stopping the construction activity (The Engineer will discuss the need to stop work with the Client).</li> </ol>	<ol style="list-style-type: none"> <li>1. Confirm notification in writing to ER</li> <li>2. Take immediate action to avoid further exceedances</li> <li>3. Check all plant and equipment and working methods</li> <li>4. Submit proposals for remedial actions to the ER within 3 working days upon notification</li> <li>5. Implement the agreed proposals</li> <li>6. Resubmit problems if the problem still not under control</li> <li>7. As directed by the Engineer slow down or stop part of or all of the construction activities until the situation is rectified.</li> </ol>
2. If Intertidal Infauna Limit Level is activated.			

## 6.7 References

- Chan Ka Yi, Phoebe (1989) *The Ecology of Mudskippers (Pisces: Periophthalmidae) at the Mai Po Marshes Nature Reserve, Hong Kong*. Unpublished M. Phil thesis, University of Hong Kong.
- Fan, H.Q. (1993) Necessity of establishing China Mangrove Research Centre and its task. *Journal of the Guangxi Academy of Sciences*. 9(2) 122-129.
- Pearson, T.H., and R. Rosenberg (1978) Macrobenthic succession in relation to organic enrichment and pollution of the marine environment. *Oceanography and Marine Biology An Annual Review* 16: 229-311.
- Peking University (1995) *Environmental Impact Assessment Study on Shenzhen River Regulation Project*.
- Rhoads, D.C. and J.D. Germano (1986) Interpreting long-term changes in benthic community structure: a new protocol. *Hydrobiologia* 142: 291-308.
- Underwood, A.J. (1992) Beyond BACI: the detection of environmental impacts on populations in the real, but variable, world. *Journal of Experimental Marine Biology and Ecology* 161: 145-178.

ACTION PLAN STATION

WB1



Mai Po Nature Reserve

CONTROL STATION

WB2



M1-M2

Tsui Tsui

ACTION PLAN STATION

M3-M4

Nam Sang Wai

Ng Tseng Tsuen

Mong Tseng Wai

WB3



M5

MONITORING STATION

RESERVE ZONE

B	★	BENTHIC INFAUNA/EPIFAUNA
WB	□	WATER BIRD OBSERVATION
M	▨	MANGROVE TRANSECT & PLOT

TIN SHUI WAI DEVELOPMENT AGREEMENT NO. CE 10/95

ENGINEERING INVESTIGATIONS FOR DEVELOPMENT OF AREAS 3, 30 & 31 OF THE DEVELOPMENT ZONE AND THE RESERVE ZONE

Title :

EM&A - LOCATIONS OF ECOLOGICAL MONITORING STATIONS

Figure No. 6.1

Revision 0

Reference No.

File Name

Prepared

MC

Checked

SMC

Date

MAY 96

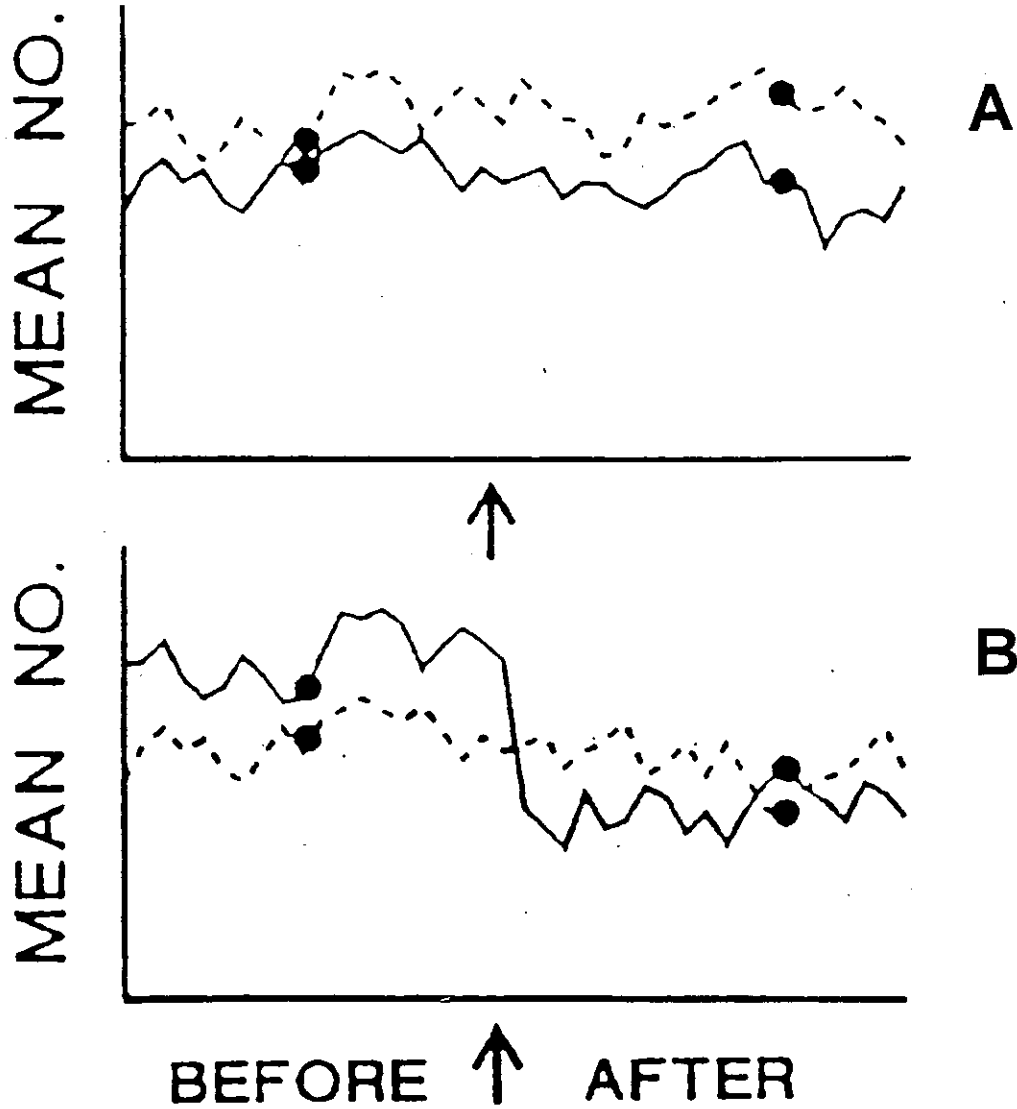
Scale

NTS



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ENGINEERS AND SCIENTISTS





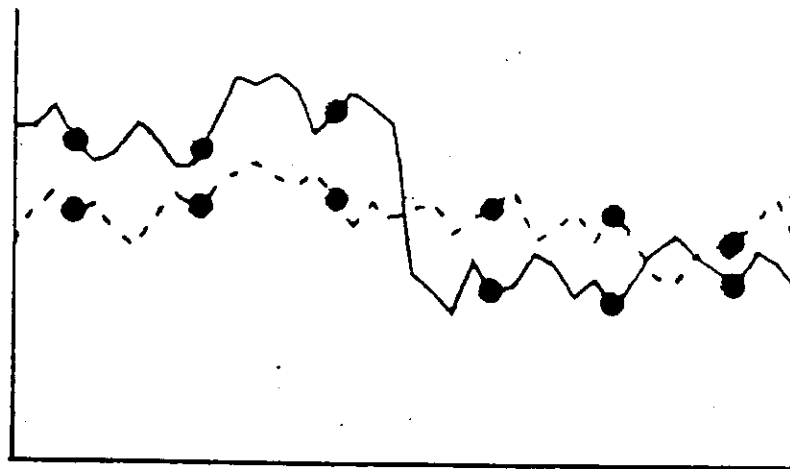
**Key**

- Control site
- Potential impact site
- Arrows mark the time of impact

(Reproduced from Underwood, 1992)

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		<p>Reference No. <b>UNDERWOOD 92</b></p>	<p>File Name <b>-</b></p>
		<p>Prepared <b>MC</b></p>	<p>Checked <b>FNW</b></p>
		<p>Date <b>FEB 97</b></p>	<p>Scale <b>NTS</b></p>

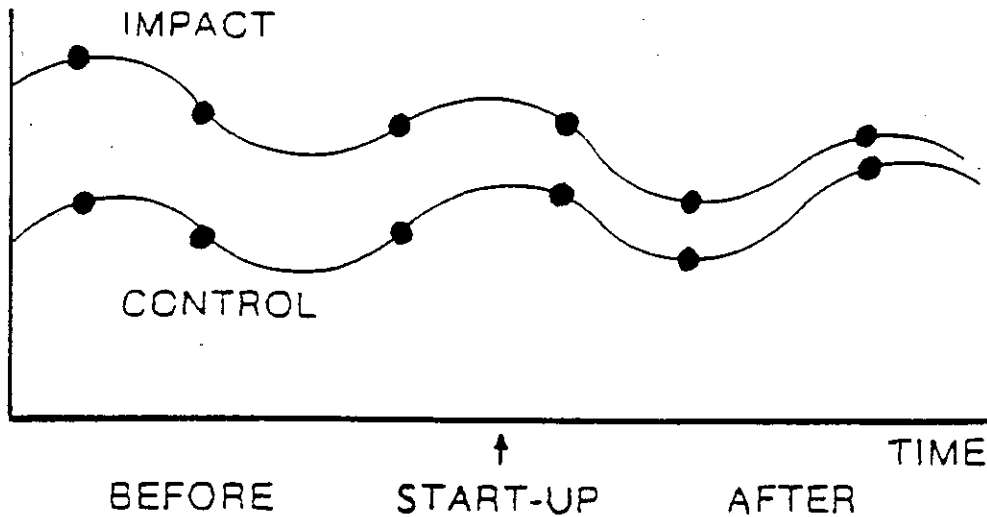
MEAN NO.



A

BEFORE ↑ AFTER

B



BEFORE START-UP AFTER

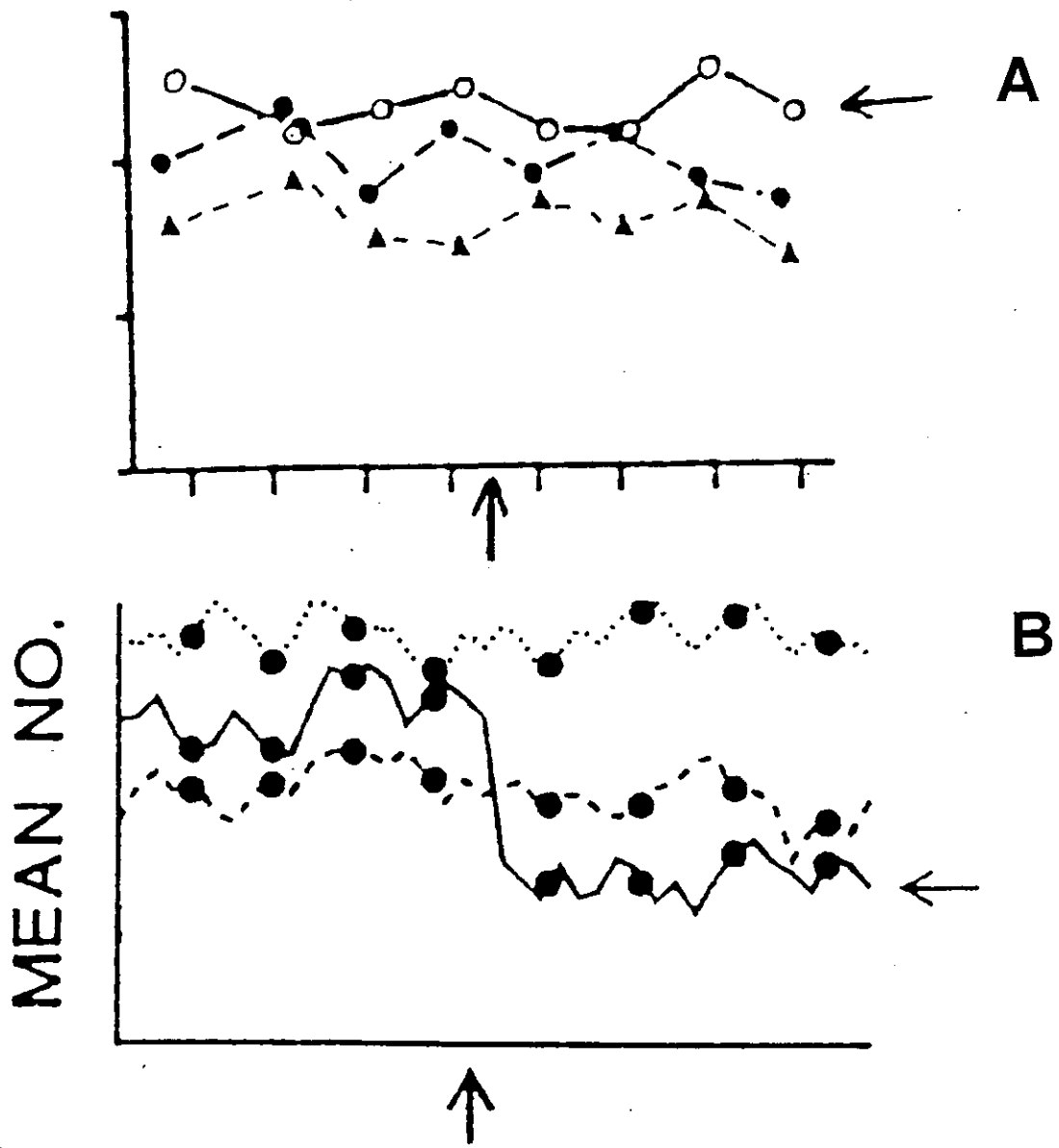
Key	
-----	Control site
————	Potential impact site
Arrows mark the time of impact	

(Reproduced from Underwood, 1992)

TIN SHUI WAI DEVELOPMENT AGREEMENT NO. CE 10/95 ENGINEERING INVESTIGATIONS FOR DEVELOPMENT OF AREAS 3, 30 & 31 OF THE DEVELOPMENT ZONE AND THE RESERVE ZONE	Title :  <b>BACI DESIGN WITH REPLICATED                  TIMES OF SAMPLING</b>	Figure No. <b>6.3</b>	Revision <b>0</b>
		Reference No. <b>UNDERWOOD 92</b>	File Name <b>-</b>
		Prepared <b>MC</b>	Checked <b>FNW</b>
		Date <b>FEB 97</b>	Scale <b>NTS</b>


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MEAN NO.

Key	
.....	Control site 1
-----	Control site 2
————	Potential impact site

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TIN SHUI WAI DEVELOPMENT AGREEMENT NO. CE 10/95 ENGINEERING INVESTIGATIONS FOR DEVELOPMENT OF AREAS 3, 30 & 31 OF THE DEVELOPMENT ZONE AND THE RESERVE ZONE	Title :  <b>"BEYOND-BACI" DESIGN WITH          MULTIPLE CONTROL AREAS</b>	Figure No. <b>6.4</b>	Revision <b>0</b>
		Reference No. <b>UNDERWOOD 92</b>	File Name
 BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 ENGINEERS AND SCIENTISTS		Prepared <b>MC</b>	Checked <b>FNW</b>
		Date <b>FEB 97</b>	Scale <b>NTS</b>



## Figure 6.5 Birds Monitoring Record

### Waterfowl Activity Scan

Project: TSW EM&A Date: \_\_\_\_\_  
 Site: \_\_\_\_\_ Time: \_\_\_\_\_  
 Tide Level: ( rising / falling; distance of bird from strand: \_\_\_\_\_ m): \_\_\_\_\_

WEATHER: Temperature: \_\_\_\_\_ Cloud cover (%): \_\_\_\_\_  
 Wind (Direction/Strength): \_\_\_\_\_

Epibenthos Fiddler crab / Crab / Mudskipper / Others:

Record by:

species	cormorants	ducks	gulls	herons	little egret	other egrets	waders
fly							
forage							
preen							
sleep							
stand							
walk							

Project: TSW EM&A Date: \_\_\_\_\_  
 Site: \_\_\_\_\_ Time: \_\_\_\_\_  
 Tide Level: ( rising / falling; distance of bird from strand: \_\_\_\_\_ m): \_\_\_\_\_

WEATHER: Temperature: \_\_\_\_\_ Cloud cover (%): \_\_\_\_\_  
 Wind (Direction/Strength): \_\_\_\_\_

Epibenthos Fiddler crab / Crab / Mudskipper / Others:

Record by:

species	cormorants	ducks	gulls	herons	little egret	other egrets	waders
fly							
forage							
preen							
sleep							
stand							
walk							

Check by: \_\_\_\_\_ at (date): \_\_\_\_\_

## 7 WASTE MANAGEMENT

- 7.1 The Contractor is responsible for waste control within the construction site, removal of the waste material produced from the site and implementation of any mitigation measure to minimise waste or redress problems arising from the waste from the site. The waste material may include any sewage, waste water or effluent containing sand, cement, silt or any other suspended or dissolved material to flow from the site onto any adjoining land, storm sewer, sanitary sewer, or any waste matter or refuse to be deposited anywhere within the site or onto any adjoining land.
- 7.2 Recycling of waste, where possible, is encouraged. Summaries of the likely waste arisings are given in Table 7.1 and 7.2. Their potential for recycling is given in Tables 7.3 and 7.4.
- 7.3 When handling the waste material, the following measures shall be undertaken by the Contractor:
- (i) The Contractor shall be aware of, and comply with, the *Waste Disposal Ordinance*, the *Public Health and Municipal Services Ordinances*, the *Water Pollution Control Ordinance* and the *Waste Disposal (Chemical Waste) (General Regulation)*.
  - (ii) The excavation of soft, contaminated mud and its removal must, as far as is practicable, be carried out during the dry season.
  - (iii) The Contractor's attention is drawn to *A Guide to the Chemical Waste Control Scheme*; *A Guide to the Registration of Chemical Waste Producers*; and the *Code of Practice on the Packing, Labelling and Storage of Chemical Wastes*.
  - (iv) The Contractor shall segregate all inert construction waste material suitable for reclamation or land formation and shall dispose of such material at public dumping areas or at a location agreed in advance by the FMC and EPD.
  - (v) All non-inert construction waste material deemed unsuitable for reclamation or land formation and all other waste material shall be dumped at public landfill.
  - (vi) The Contractor shall comply with and complete the procedures in WBTC No. 22/92 and/or EPD's ProPECC PN 3/94 regarding marine or land-based disposal of dredged mud, prior to the commencement of Works.
  - (vii) The new *Air Pollution Control (Open Burning) Regulation* came into effect on 26th February 1995. This regulation prohibits open burning for the disposal of construction waste or the clearance of a site in preparation for construction work. Certain other types of open burning are allowed under permits issued by the EPD.
  - (viii) Fossil fuel and used lubricants for trucks and machinery are classified as chemical wastes. The Contractor shall register with EPD as a chemical waste producer and observe all the requirements under the storage, labelling, transportation and disposal of chemical waste.

**Table 7.1**  
**Wastes Arising as a Result of Package I Works**

Major Activities	Works Description	Waste Type	Disposal
Site Formation	Areas 101-111, excluding 109b	contaminated mud	Up to 10,000 m <sup>3</sup> to East Sha Chau (ESC) <sup>(a)</sup>
Infrastructure for Priority Sites	- Garden South culvert, Hung Tin Road culvert realignment and Eastern culvert realignment near Junction P	concrete waste wooden waste steel contaminated mud	- To public dump (Tseung Kwan O) - Reuse or to landfill - Recycle - 500 m <sup>3</sup> to ESC <sup>(b)</sup>
	- construction of Roads L12, L13 & L14 including associated drains, sewers and water reticulation system; - roadbridge D2/V1 over WDCE, footbridge D2/CF1 over Junction M, subways L13/S1, L14/S1, P1/S1, - construct grade separated interchanges at Junctions A, D & W, and associated utility and drainage diversion; - construction of roadbridges P1/V1 at Junction A, P2/V1 at Junction D and P2/V2 at Junction W; footbridge P2/CF1 across Road P2	concrete waste wooden waste steel	- Public dump - Reuse or to landfill - Recycle
	formation of LRT reserve adjacent to Tin Tsz Road, L12 and Central Path;	concrete waste wooden waste steel	- Public dump - Reuse or to landfill - Recycle
Interim Road Upgrading Works	- including junction widening of DZ junctions; provision of additional lanes - dualling of Tin Wah Road and widening of Junction K; - dualling of Tin Tsz Road; - widening of Long Tin Road and Hung Tin Road to 3-lane dual carriageway	concrete waste wooden waste steel	- Public dump - Reuse or to landfill - Recycle
Trunk sewer from RZ to NWNT Sewerage Scheme	- rising mains from sewage pumping station in Area 101 to Ha Tsuen Pumping Station; - construction of Area 101 pumping station,	concrete waste wooden waste steel	- Public dump - Reuse or to landfill - Recycle
General Site Activities		sewage wastes domestic wastes packaging materials chemical waste waste oil	- sewage treatment - landfill - landfill - CWTP - licensed contractor

- (a) Contract 2  
(b) Contract 4

**Table 7.2**  
**Wastes Arising as a Result of Package II Works**

Major Activities	Works Description	Waste Type	Disposal
Site Formation	- site formation of Areas 109b, 112 to 117, 120 and 121	@ 5000 m <sup>3</sup> <sup>(a)</sup> contaminated mud from Areas 109b, 114, 115, 117 & 120	- to East Sha Chau
Infrastructure	- construction of Road L12, D4, D3 and 1231 and associated drains, sewers and water reticulation system; - construction of footbridges L12/CF1 at Junction S; D4/F1 at Junction T; subways L12/S1 across Road L12; D4/S1 across Road D4; Garden Path culvert; and the Northern culvert - construction of roadbridge P2/V3 at Junction P; footbridge D4/CF2 at Junction V; subway D4/S2 across Road D4 - construction of roadbridges P1/V2 and P1/V3; subway extensions P1/S2 and P2/S3 - construction of roadbridge D3/V1; road/footbridge L13/VCF1; footbridge WC/CF5	- concrete waste - wooden waste - steel	- Public dump - Reuse or to landfill - Recycle
	Northeastern culvert; Eastern culvert extension; - river training of 500m of WDCE	- @ 2000 m <sup>3</sup> <sup>(a)</sup> contaminated mud from excavations Northeastern culvert - @ 6000 m <sup>3</sup> <sup>(a)</sup> contaminated mud arising from Eastern Culvert under Road D4;	- to East Sha Chau
	Formation of LRT reserve next to Roads L12 and D4	- @ 4000 m <sup>3</sup> <sup>(b)</sup> contaminated mud from WDCE	
Road Upgradings	Dualling of Tin Ying Road between Junctions A-K including associated sewers and drains	concrete waste wooden waste steel	- Public dump - Reuse or to landfill - Recycle
General Site Activities		sewage wastes domestic wastes packaging materials chemical waste waste oil	- sewage treatment - landfill - landfill - CWTP - licensed contractor

(a) Contract 7

(b) Contract 6

**Table 7.3**  
**Classification of Sediments by Metal Content (mg/kg dry weight)**

	Class A	Class B	Class C
Cd	0.0-0.9	1.0-1.4	1.5+
Cr	0-49	50-79	80+
Cu	0-54	55-64	65+
Hg	0.0-0.7	0.8-0.9	1.0+
Ni	0-34	35-39	40+
Pb	0-64	65-74	75+
Zn	0-140	150-190	200+

**Table 7.4**  
**Waste Types and Their Potential for Recycling or Re-use**

Waste type	Works generating waste	Volumes lost as waste	Potential re-use or recycling	Disposal Options
Fill material	Site Formation	None	Material balance in deficit for site formation, and excess fill material produced during piling activities will be used to balance the deficit	No disposal considered - all fill will be used
	Construction of buildings*	None		
Concrete	Road building	3-5%	Needs to be separated; re-useable material needs to be crushed	To public dump
	Construction of buildings*			
Wood formwork, fencing	Road building	20%	Used as lower grade shuttering or fencing on-site or other sites	To public dump
	Construction of buildings*			
Reinforcing steel, steel cable and shutters	Road building	1%	Most material can be re-used after cleaning	To public dump
	Construction of buildings*			
Chemical waste	General site activities	Small amounts	Recycling/disposal firms will collect chemicals or waste oil, or refill oil containers	Chemical waste, including paints disposed of to treatment facility - <b>REQUIRES LICENSE</b>  Oil can be removed for recycling or soaked up by sand for disposal to landfill.  Grease trap waste collected and disposed of to licensed contractor.
Oil waste				
Grease trap waste				
Wheel wash waste	Vehicle use during general works	Total volume when replaced	Recycling through filter until replacement of water is required	Onto sand area where natural filtration occurs, and oils can be retained before landfill disposal.
Domestic waste	General site activities	Putrescible waste, wet paper, fabrics	Cans, bottles, dry paper	To landfill

\* These works are under Housing Authority control.

- (ix) The Contractor shall prevent fuel and lubricating oil leakage from plant and storage sites from contaminating the construction site. All compounds in works areas shall be located on areas of hardstanding with provision of drainage channels and settlement lagoons where necessary to allow interception and controlled release of settled water; and provision of bunding for all potentially hazardous materials on Site including fuels. The Contractor shall prepare a spill action plan and keep suitable clean-up materials on site.
- (x) Care must be taken to prevent spillages:
  - (a) the storage area for fuels and lubricants shall be isolated from working areas and kept secure;
  - (b) use of fuels and lubricants shall be carried out with care;
  - (c) any spillage problem due to any truck and machinery shall not be ignored;
  - (d) emulsifier and absorbent shall be available on Site, so that immediate action can be taken when there is minor spillage;
  - (e) all containers shall be stored so as to prevent any spillage of the contents and disposed of carefully; and
  - (f) concepts of 'Site cleanliness' shall be introduced to workers, to gather and store construction waste in an appropriate manner.
- (xi) Temporary waste facilities shall be set up by the Contractor. Municipal waste shall be collected in black refuse bags and delivered to, and disposed of at, an approved landfill.
- (xii) No monitoring is proposed to identify the nature of waste arising. It is the responsibility of the Contractor to measure the contaminant level of dredged mud and classify it before disposal. The success of measures to minimise impact on the aquatic environment may be reflected by water quality monitored as described in Section 4.
- (xiii) During the site inspections and the document review procedures as mentioned in Sections 8.1 and 8.2 of this manual, the EM shall pay special attention to the issues relating to waste management, and check whether the Contractor has followed the relevant contract specifications and the procedures specified under the laws of Hong Kong.

## 8 SITE ENVIRONMENTAL AUDIT

### 8.1 Site Inspections

8.1.1 Site Inspections provide a direct means to trigger and enforce the specified environmental protection and pollution control measures. They shall be undertaken routinely to inspect the construction activities in order to ensure that appropriate environmental protection and pollution control mitigation measures are properly implemented. With well defined pollution control and mitigation specifications and a well established site inspection, deficiency and action reporting system, the site inspection is one of the most effective tools to enforce the environmental protection requirements on the construction site.

8.1.2 A formal site inspection shall be carried out at least once a month for Scenarios 1 and 2 and once a week for Scenarios 3 to 11 by the EM (or his representative from the EMT) and ER(s). During the first audit by each succeeding EM, the format and depth of the audit will be presented to the ER and each Contractor by the EM for the present and future audits. During the audit at least the following inspections shall be made:

- (i) the works progress and programme will be inspected to determine how closely the current activities match with proposed activities;
- (ii) changes since the last audit in works being carried out, with particular reference to construction of new sedimentation ponds, silt traps, production of waste requiring disposal and activities which may increase the noise and dust levels;
- (iii) methodologies submitted by the contractors will be matched with existing practices to ensure adequacy of the associated pollution control measures;
- (iv) water quality results will be examined to determine compliance of each Contractor with the defined limits for measured parameters. Effectiveness of mitigation measures implemented as specified in the Contract will be evaluated. Samples will be taken from sedimentation ponds and other run-off points at the time of the audit, as described in Section 4;
- (v) noise and dust data collected during the period since the previous audit will be evaluated for compliance. In the case of non-compliances the corrective action taken and success of implementation will be examined;
- (vi) waste collection, handling, storage and disposal practices will be examined to ensure compliance with contractual requirements. Implementation of corrective actions in cases of unacceptable practices will be agreed and the completion of these actions checked at a later date agreed by the EM and ER(s). Ecological data will also be examined with reference to other monitoring results to assess the cause of any observed changes;
- (vii) In addition to on-site activities, the EM or his representatives in the EMT will examine the environmental situation off-site to determine whether there has been any impact, direct or indirect, from site activities.



- 8.1.3 The Contractor shall update the EMT with all relevant information required for them to carry out the EM&A programme.
- 8.1.4 In addition to the formal site inspections, site visits will be carried out throughout the works.
- 8.1.5 The following equipment must be available during these site visits:
- (1) noise meter;
  - (2) pH paper and pH meter/water quality meter;
  - (3) camera;
  - (4) sampling bottles; and
  - (5) optionally a portable dust meter.
- 8.1.6 During these site visits, the following observations and records of these observations shall be made as appropriate:
- (1) noise levels;
  - (2) dust observations;
  - (3) quality of water leaving the Project sites; and
  - (4) general observations including work practices.
- 8.1.7 The frequency of the site visits depends upon the intensity of Works. Site formation works during Scenarios 1 and 2 require weekly site visits at minimum and samples for analyses of suspended solids should be taken at least monthly. It is expected that between five to twenty samples be sent for analysis each month.
- 8.1.8 During Scenarios 3 onwards, site visits should be daily and samples of water for laboratory analysis should be taken at a minimum frequency of once a week if discharges are occurring. These requirements are summarised in Table 4.6. It is expected that between ten and thirty samples be sent for analyses each month.
- 8.1.9 The results of each site inspection including details of recommended actions to be taken where deficiencies are recorded will be submitted by the EMT to the ER and Contractor within 24 hours for reference and immediate action. A time-frame will be stipulated and followed for corrective actions to be carried out. Actions will be followed up by the EMT as specified on the time-frame.
- 8.1.10 The report will also include the successful implementation of any actions recommended in the previous audit.
- 8.2 Compliance with Legal and Contractual Requirements**
- 8.2.1 There are contractual environmental protection and pollution control requirements as well as environmental protection and pollution control laws in Hong Kong which the construction activities shall comply with.

- 8.2.2 In order that the works are in compliance with the contractual requirements, all the works method statements submitted by the Contractor to the ER for approval shall be sent to the EM for vetting to see whether sufficient environmental protection and pollution control measures have been included.
- 8.2.3 The EM shall also review the progress and programme of the works to check that relevant environmental laws have not been violated, and that any foreseeable potential for violating the laws can be prevented.
- 8.2.4 The Contractor shall regularly copy relevant documents to the EM so that the checking work can be carried out. The document shall at least include the updated Work Progress Reports, the updated Works Programme, the application letters for different licence/permits under the environmental protection laws, and all the valid licence/permit. The site diary shall also be available for the EM's inspection upon his request.
- 8.2.5 After reviewing the document, the EM shall advise the ER and the Contractor of any non-compliance with the contractual and legislative requirements on environmental protection and pollution control for them to take follow-up actions. If the EM's review concludes that the current status on licence/permit application and any environmental protection and pollution control preparation works may not cope with the works programme or may result in potential violation of environmental protection and pollution control requirements by the works in due course, the EM shall also advise the Contractor and the ER accordingly.
- 8.2.6 Upon receipt of the advice, the Contractor shall undertake immediate action to remediate the situation. The ER shall follow up to ensure that appropriate action has been taken by the Contractor in order that the environmental protection and pollution control requirements are fulfilled.
- 8.2.7 To ease site environmental audit, requirements for EM&A regular compliance monitoring are summarised in Tables 8.1 and 8.2.

Table 8.1 Summary of Monitoring Frequency during Project Works

Monitoring Programme	Baseline Monitoring	Routine Monitoring Scenario 1 and 2	Routine Monitoring Scenario 3-11	Action Level exceeded	Limit Level exceeded
NOISE	3 locations on each of 3 days (with 3 replicates)	Fortnightly	Fortnightly	Daily (where non-compliance)	Daily (where non-compliance)
AIR	24 hours TSP for a total of 15 days before works commence (at each permanent station)	Every 6 days	Every 6 days	<u>1 non-compliance</u> Repeat after 48 hours  <u>2 non-compliances</u> 3 times each week (24 hours TSP) 1 hour readings during each of 3 days	Daily
WATER	3 times each week for a 3-week period - every 2 hours for 24 hours (at each station for all parameters to be measured during EM&A programme)	<u>Weekly (ebb tide)</u> DO, pH, temperature, turbidity, SS, salinity  <u>Three times weekly when channel works occurring (ebb tide)</u> DO, pH, temperature, turbidity, SS, salinity and ammonia  <u>Monthly (ebb tide)</u> All of above and ammonia.  <u>Quarterly</u> All of above every 2 hours over 24 hours cycle  <u>At source checks</u> Spot checks to be carried out - visual inspection and between 5 and 20 samples to be taken for pH and SS. If spot checks visually bad - sample to be taken for analysis of SS, pH, ammonia as appropriate.	<u>Weekly (ebb tide)</u> DO, pH, temperature, turbidity, SS, salinity  <u>Three times weekly when channel works occurring (ebb tide)</u> DO, pH, temperature, turbidity, SS, salinity and ammonia  <u>Monthly (ebb tide)</u> All of above and ammonia, TOC, Zinc  <u>Quarterly</u> All of above every 2 hours over 24 hours cycle  <u>At source checks</u> Spot checks to be carried out - visual inspection and between 5 and 20 samples to be taken for pH and SS If spot checks visually bad - sample to be taken for analysis of COD, SS, pH, ammonia as appropriate	<u>1 non-compliance</u> Repeat after 24 hours  <u>2 non-compliances</u> Daily	<u>1 non-compliance</u> Daily  <u>2 non-compliances</u> Daily until 2 consecutive measurements are below Action Limits
ECOLOGY	Survey mammals Survey nesting birds	<u>Bimonthly</u> Infauna (only sample, sieve, and preserve infauna from second control site) Epifauna Waterbirds  <u>Annually</u> Mangrove	<u>Bimonthly</u> Infauna (only sample, sieve, and preserve infauna from second control site) Epifauna Waterbirds  <u>Annually</u> Mangrove	<u>Twice monthly</u> Epifauna (including second control site)  <u>Monthly</u> Infauna (including second control site)  Birds - repeat assessment within 10 days	<u>Weekly</u> Epifauna (including second control site)  <u>Twice monthly</u> Infauna  Birds (including second control site)  Mangrove - activate control site and carry out full study

**Table 8.2. Monitoring Locations during each Scenario of Project Works**

Monitoring Programme	Scenario										
	1	2	3	4	5	6	7	8	9	10	11
<b>Noise Locations</b>											
Permanent	3	3	3	3	3	3	3	3	3	2	2
Semi-permanent	-	-	6	6	6	6	6	2	2	2	2
Mobile	-	-	3	3	2	3	4	5	2	3	2
<b>Air Locations</b>											
Permanent	3	3	3	3	3	3	3	3	2	2	2
Semi-permanent	-	-	4	5	7	7	8	5	4	4	2
<b>Water Locations</b>											
Permanent	6	6	6	6	6	6	6	6	6	6	6
Semi-permanent	2	2	4	4	4	4	4	4	1	1	1
Site run-off monitoring stations	to be identified and monitoring by EMT according to works schedule and site visits										
<b>Ecology Locations</b>											
Mangroves	2 + 1	2 + 1	2 + 1	2 + 1	2 + 1	2 + 1	2 + 1	2 + 1	2 + 1	2 + 1	2 + 1
Benthic	2 + 1	2 + 1	2 + 1	2 + 1	2 + 1	2 + 1	2 + 1	2 + 1	2 + 1	2 + 1	2 + 1
Waterbirds											
	2 + 1	2 + 1	2 + 1	2 + 1	2 + 1	2 + 1	2 + 1	2 + 1	2 + 1	2 + 1	2 + 1

**Table 9.1**  
**Summary of Permanent Mitigation Measures under the Project**

Mitigation Measure	When and Who Implements	How Implemented	References <sup>1</sup>
Low-noise road surfacing i) Tin Tsz Road North ii) Tin Tsz Road South iii) Hung Tin Road iv) Long Tin Road v) Tin Ying Road	C4 <sup>2</sup> C5 C5 C5 C6	DD <sup>3</sup>	
Permanent Noise Barriers 1, 2, 3, 4, 5, 14 8, 9, 10, 15 (North) 6, 7, 11, 12, 13, 17 15 (South), 16	C3 C4 C5 C6	DD DD DD DD	Figures 6.2.10 - 6.2.43, 6.3.3, 6.3.49 Figures 8.1 - 8.3 Details of Barriers in Tables 8.2 and 8.3; Details of materials to be used for barriers in end of Section 6.3 of the FIR
Gulley-pots Low flow infiltration chambers Planters, planter-strips Soft landscaping	C4 - C8 as each road is built	DD DD DD DD	Section 6.2 Fig 6.4.8 Figures 6.2.10 - 6.2.43 Figures 6.7.2 - 6.7.18 and Section 6.7
Replacement Habitat			Figure 9.4 at the end of this section.
Site Formation for Wetland Remainder of Works	C7 C8	DD DD	As per FIR
Permanent Culverts with silt traps (sand traps) Garden South Culvert Garden Path Culvert Northern Culvert North Eastern Culvert Eastern Culvert Extension	C4 C6 C6 C7 C7	DD DD DD DD DD	Figures 3.3.3, 3.4.10, 5.6.1, 6.2.93
500 metre concreted extension to WDC (WDCE)	C6	DD	Figures 6.4.2, 6.4.3
Sewerage Pumping Station including: - Deodorisation units using either activated carbon or biofilter - Standby capacity	C4	DD	Figures 6.5.16 - 6.5.19
Twin Rising Mains	C4	DD	Figures 6.5.10, 6.5.15 and Section 6.5

- Notes: 1. References apply to the Final Investigation Report unless stated otherwise.  
 2. Timing of each contract is shown on the Programme (Dates may change). C stands for Contract, e.g. C1 = Contract 1, C4 = Contract 4, etc.  
 3. DD = Detailed Design.  
 4. CC = Contract Clauses.

**Table 9.2<sup>1</sup>**  
**Noise Barriers to be Implemented under the Project**

Barrier No.	NSRs	Area protected	Locations	Length of barrier, m	Height of barrier, m	Area of barrier, m <sup>2</sup>	On an elevated structure?
1	78, 80	3	On earth bund at Junction B	86	3	258	No
2	78, 80	3	D1	45	4.5	203	No
3	79, 80	3	D1	130	4	520	No
4	79, 80	3	D1	44	4.5	198	No
5	76, 79	3	D1	159	4	636	No
6	75, 76	3	P1 on elevated flyover	105	1.5	158	Yes
7	76	3	Hung Tin Road East - P1 Slip Road	146	3	438	No
8*	64, 43, 44	27, 103	Tin Wah Road	113	3.5	396	No
9	64	27	Tin Wah Road	50	5.5	275	No
10**	65, 137, 46, 47	28, 104	Tin Wah Road	352	5.5	1,936	No
11	65	28	Tin Wah Road	123	5.5	677	No
12	53	30	P1	249	2	498	No
13	96	/	Long Tin Road	228	1.5	342	No
14	99	/	Hung Tin Road East	235	2	470	No

<sup>1</sup> Please refer to Figures 9.1 to 9.3.

\* on central mound, absorptive type to minimise noise reflection on opposite NSR.

+ cantilevered.

**Table 9.3<sup>1</sup>**  
**Planter/Parapet Barriers to be Implemented under the Project**

Barrier No.	NSRs	Area protected	Locations	Length of barrier, m	Height of barrier, m	Area of barrier, m <sup>2</sup>	On an elevated structure?
15	90, 95	/	Long Tin Road East	475	1	475	No
16	97, 98	/	Ping Ha Road East	356	1	356	No
17	70, 48	CDA West of Tin Ying Road, South of Tin Wah Road	Tin Ying Road, Tin Wah Road	1130	0.8	904	No
18	165	16	Tin Ying Road	161	0.5	80.5	No
19	75, 76	3	P1, on elevated flyover, eastern side	85	1	85	Yes
20	73, 141	3	P1, slip road north east of Junction A	284	0.8	227	No

<sup>1</sup> Please refer to Figures 9.1 to 9.3.

**Table 9.4**  
**Summary of Mitigation Measures during Project Construction Works**

Mitigation Measure	When Implemented	How Implemented	References
<b>Air Quality</b>			
Installation of tanker filling system and watering haul roads every two hours	All contracts particularly C1 <sup>2</sup> , C2, C7 Critical during dry or windy weather and when frequent movement of vehicles over dirt roads	CC <sup>4</sup>	Contract clauses as in Section 2 of EM&A Manual
Watering of exposed surfaces two times a day	All contracts particularly C1, C2, C7 Necessary during dry or windy weather and when large areas exposed	CC	as above
Water sprays	All contracts for stockpiles and during handling and delivery of aggregates and other dusty materials	CC	as above
Installation of conveyor windboards, enclosures at conveyor transfer points and hopper discharge areas, three-sided roofed enclosure with flexible curtain across the entry, conveyor belt cleaners and exhaust fans with suitable fabric filter system	All contracts If conveyor system is used to transfer dusty materials	CC	as above
Wheel washing facilities, changing washing water, removal of sediments from washing facilities and provision of hard-surfaced road between washing facilities and public roads	All contracts	CC	as above
Road-cleaning	Particularly if material is spilt	CC	as above
Cover all loads using public roads	All contracts	CC	as above
Arrangement of vehicle exhausts so that they are directly vertically upwards or directed away from the ground	All contracts All vehicles	CC	as above

**Table 9.4**  
**Summary of Mitigation Measures during Project Construction Works (cont'd)**

Mitigation Measure	When Implemented	How Implemented	References
Hydroseeding	Any area left undisturbed for 6 months or more	CC	as above
	Particularly C2 C7	DD <sup>3</sup> DD	Figure 3.4.11 Figure 3.4.12 End of Section 3.4
<b>Noise</b>			
Specific noise levels set	All contracts	CC	Section 3 of EM&A Manual
Arrangement of minimum parallel operation of noisy equipments and direction away from NSRs	All contracts	CC	as above
Maintenance of all noisy plant and equipment to be used on site	All contracts	CC	as above
Replacement of noisy plant and equipment by quieter alternatives, isolation or full acoustic enclosures of noisy components or silencing measures for noisy equipment	All contracts	CC	as above
Careful scheduling of noisy activities	All contracts	CC	as above
Installation of acoustic barriers	C5	CC	As in Figure 3.1 of EM&A Manual and Section 3 of EM&A Manual
	All contracts if necessary	CC	
Avoidance of unnecessary noise in northern part of site	C2, C7, C8	CC	Section 3 of EM&A Manual
Instruction of workers to avoid disturbance of birds	All contracts particularly C2, C7, C8	CC	as above
<b>Water Quality</b>			
Installation of temporary drainage ditch draining to a sedimentation pond which should be regularly maintained.	All contracts at beginning of works in new area. Particularly contracts C1, C2, C7	CC	Section 4 of EM&A Manual



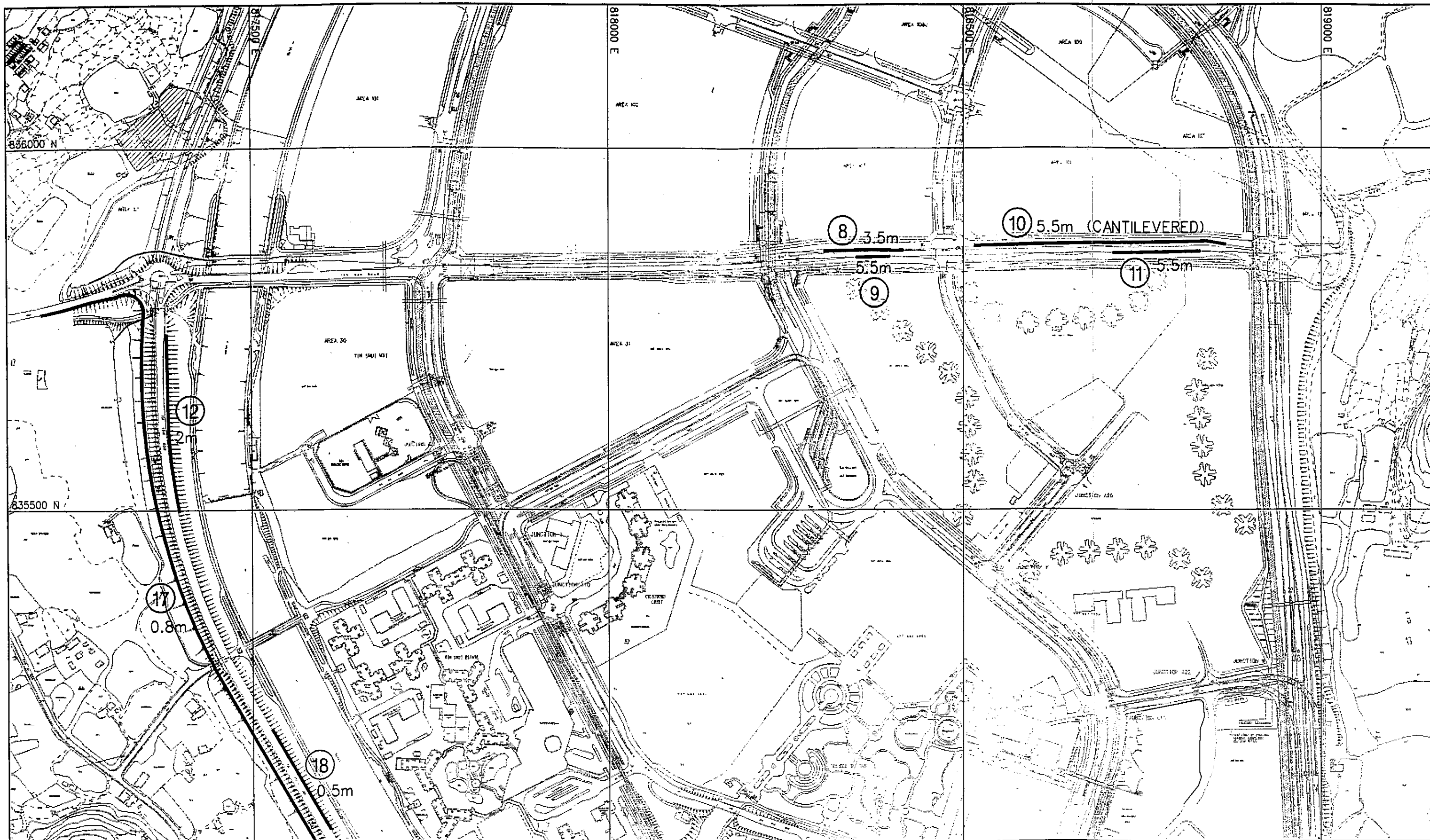
**Table 9.4**  
**Summary of Mitigation Measures during Project Construction Works (cont'd)**

Mitigation Measure	When Implemented	How Implemented	References
Installation of engineered temporary drainage system with silt traps etc.	C1, C2	CC and DD	as above Figures 3.4.8, 3.4.9, 3.4.10 and Section 5.4 and 5.6
Use of infiltration channel in temporary drainage system	C1, C2	DD	Figure 7.1 (FIR) and Figure 9.5 at the end of this section
Particular care directed towards temporary drainage systems for - stockpiles - works near the channels	All contracts  Every contract except C1 involves works within these categories	DD  CC	As per Section 4 of EM&A Manual
Works in channels - minimization of mud removed particularly if contaminated - use of 'dry' working methods including scheduling and use of cofferdams - any dredging undertaken with silt curtains etc.	C2, C5, C6, C7, C8  as above  as above	DD  CC Checking of works programmes and method statements  CC checking of method statements	as above  as above  as above
Prevention of concrete washings entering the permanent culverts or the channels, Sedimentation ponds and neutralisation	C3 - C8	CC	as above
An earth-bund of clays and silts will be built to prevent runoff from the construction of the culverts from entering the channel. After completion of the works, the earth-bund will be removed.	Construction of permanent drainage culverts (see Table 8.1)	DD and method statements	
Contaminated muds to be handled and transported with care	C2, C5, C6, C7, C8	CC	as above
Minimization of all site-runoff. Minimisation of pollutants entering the channels	All contracts	CC WPCO - TM Pro-PECC /94	as above

**Table 9.4**  
**Summary of Mitigation Measures during Project Construction Works (cont'd)**

Mitigation Measure	When Implemented	How Implemented	References
Construction of oil interceptors for hard standing compounds and site runoff	All contracts where appropriate	CC	as above
<b>Ecology</b>			
Site inspection for mammals and nesting birds	C1, C2, C7	By EMT	EM&A Manual Section 5
Relocation of mammals or nesting song birds	C1, C2, C7 as necessary	By Contractor CC	as above
Obtain licence from AFD if necessary	As above	By Contractor CC	as above
Stockpile drain should be aligned to avoid nesting areas and grading of stockpiles where nests occur should be avoided in the breeding season	C2	DD and CC	as above
<b>Waste</b>			
Correct disposal of wastes, recycling and reuse of wastes	All contracts	CC	Section 6 of EM&A Manual Details tabulated Section 3.4 of FIR

- Notes:
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  3. DD = Detailed Design.
  4. CC = Contract Clauses.



TIN SHUI WAI DEVELOPMENT  
 AGREEMENT NO. CE 10/95  
 ENGINEERING INVESTIGATIONS FOR  
 DEVELOPMENT OF AREAS 3, 30 & 31  
 OF THE DEVELOPMENT ZONE  
 AND THE RESERVE ZONE

 BINNIE CONSULTANTS LIMITED  
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Title :

### LOCATION AND HEIGHTS OF NOISE BARRIERS

Figure No. <b>9.1</b>	Revision 4
Reference TSW-BASE	File Name 02370018.C09
Prepared WYC	Checked BH
Date MAR. 97	Scale N.T.S.



Figure No.	9.2	Revision	4
Reference	TSW-BASE	File Name	02340018.C09
Prepared	WYC	Checked	BH
Date	MAR. 97	Scale	N.T.S.

Title :

**LOCATION AND HEIGHTS  
OF NOISE BARRIERS**

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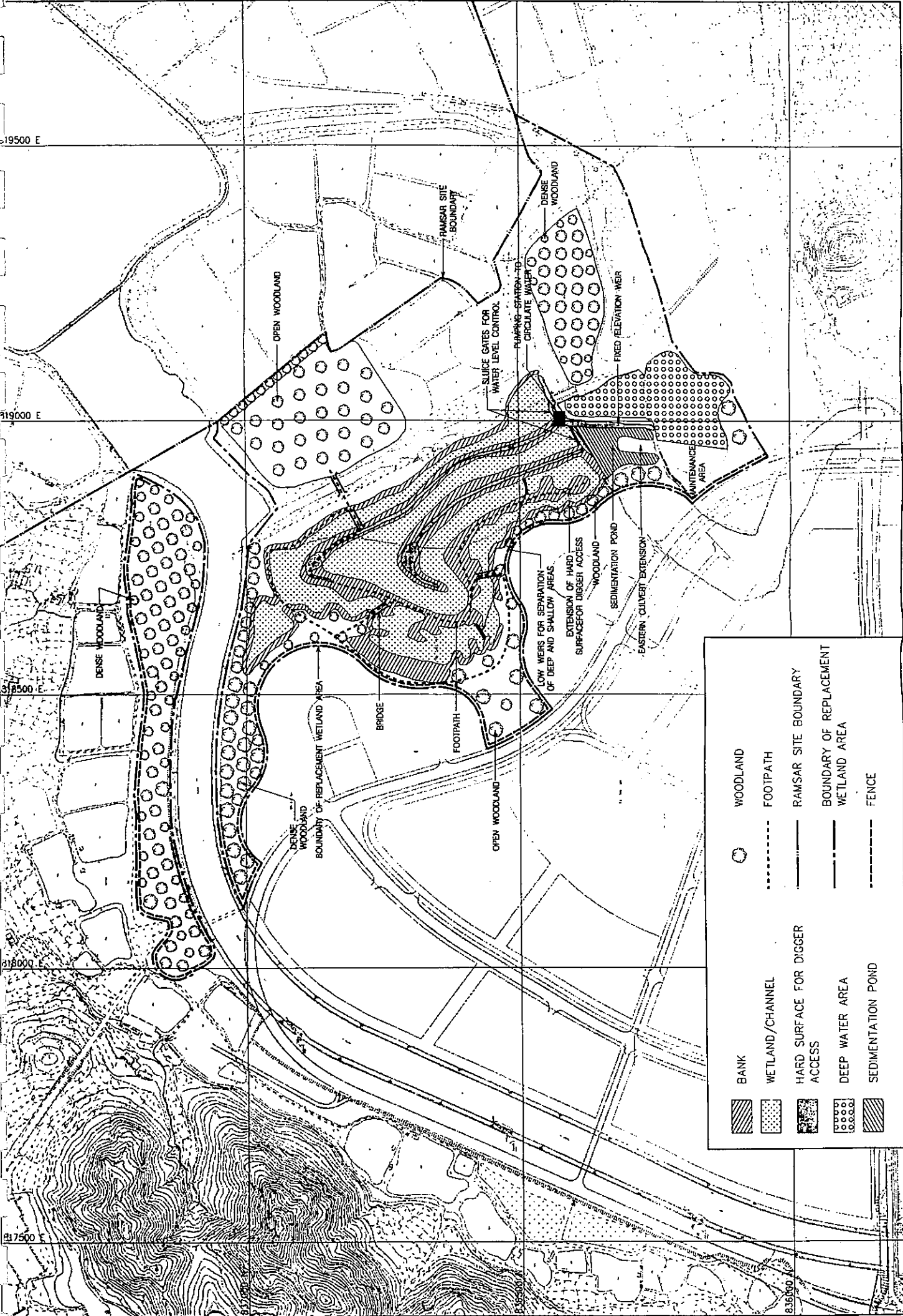
Figure No.	9.3	Revision	5
Reference	TSW-BASE	File Name	02310018.C09
Prepared	WYC	Checked	BH
Date	MAR. 97	Scale	N.T.S.

Title :

**LOCATION AND HEIGHTS  
OF NOISE BARRIERS**

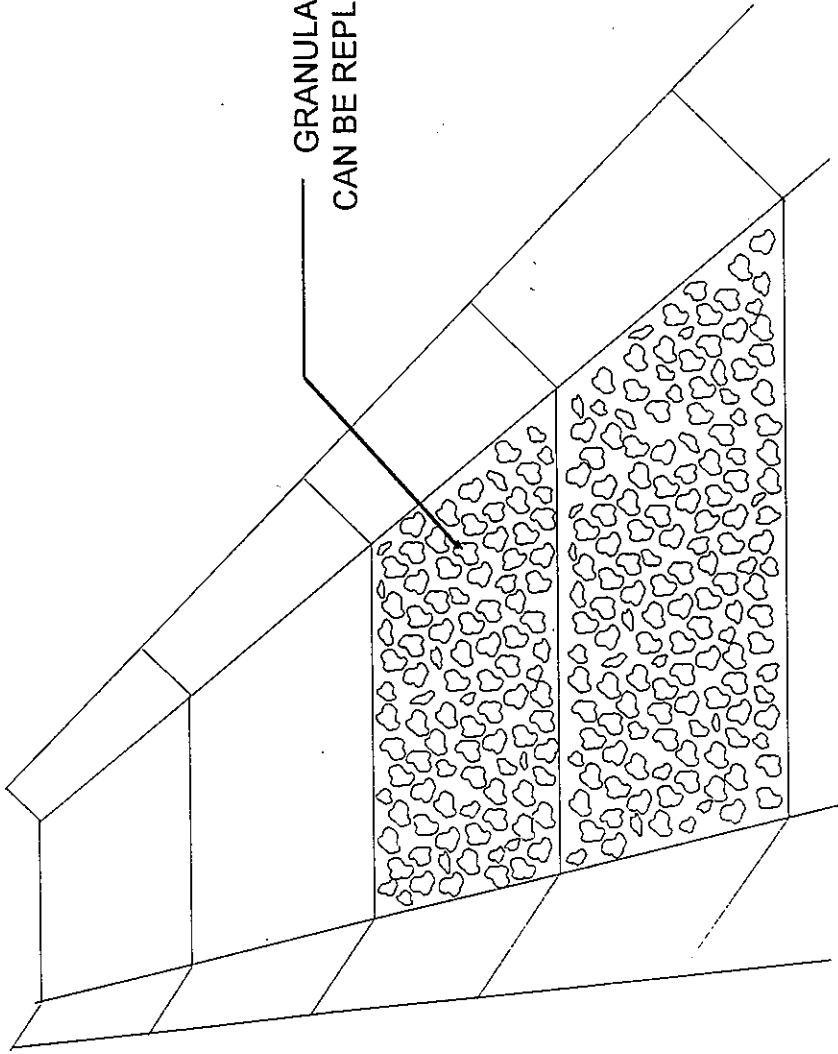
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	BANK		WOODLAND
	WETLAND/CHANNEL		FOOTPATH
	HARD SURFACE FOR DIGGER ACCESS		RAMSAR SITE BOUNDARY
	DEEP WATER AREA		BOUNDARY OF REPLACEMENT WETLAND AREA
	SEDIMENTATION POND		FENCE

Date : FEB. 97  
 Figure : 9.4 PLAN FOR REPLACEMENT WETLAND AND BUFFER AREA Scale : NTS  
 Prepared : SMC/LS  
 Checked : PS



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Figure No. **9.5**

Revision **0**

Reference No.

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### INFILTRATION CHANNEL

