4. NOISE IMPACT

4.1 Introduction

4.1.1 This section presents an assessment of the potential noise impact associated with the construction and operation of Route 16 - Alternative Alignment. The quantitative assessment methodology which has been adopted for the assessment is presented and control measures, to ensure the effective protection of the identified sensitive receivers, are recommended.

4.2 Governmental Legislation and Standards

Construction Noise

4.2.1 The principal legislation on the control of construction noise is the Noise Control Ordinance (NCO) (Cap 400) and the Environmental Impact Assessment Ordinance (EIAO) (Cap 499). Various Technical Memoranda (TMs), which stipulate control approaches and criteria, have been issued under the NCO and EIAO. The following TMs are applicable to the control of noise from construction activities:

- Technical Memorandum on Noise from Percussive Piling (PP-TM);
- Technical Memorandum on Noise from Construction Work other than Percussive Piling (GW-TM);
- Technical Memorandum on Noise from Construction Work in Designated Areas (DA-TM); and
- Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM).

Percussive Piling

4.2.2 Percussive piling is prohibited at any time on Sundays and public holidays and during the weekday evening and nighttime hours (1900-0700 hours, Monday through Saturday). A Construction Noise Permit (CNP) is required for such works during the weekday daytime hours (0700-1900 hours, Monday through Saturday).

4.2.3 When assessing a CNP application for the carrying out of percussive piling, the Environmental Protection Department (EPD) is guided by the PP-TM. The EPD will look at the difference between the Acceptable Noise Levels (ANLs), as promulgated in the PP-TM, and the Corrected Noise Levels (CNLs) that are associated with the proposed piling activities. Depending on the level of noise impact on nearby Noise Sensitive Receivers (NSRs), the EPD would allow 3, 5 or 12 hours of daily piling time (see *Table 4.2a* below).

Table 4.2a Permitted Hours of Operation for Percussive Piling

Amount by which CNL exceeds ANL	Permitted hours of operation on any day not being a holiday
more than 10 dB(A)	0800 to 0900 and 1230 to 1330 and 1700 to 1800
between 0 dB(A) and 10 dB(A)	0800 to 0930 and 1200 to 1400 and 1630 to 1800
no exceedance	0700 to 1900

4.2.4 The Government is committed to phasing out the use of diesel, pneumatic and steam hammer pile drivers, which are particularly noisy. Such pile drivers cannot be used after 1 October 1999. In preparation for the incoming legislative control, the Government has

already (since July 1997) administratively banned the use of diesel hammers in Government projects.

General Construction Works

4.2.5 Noise impacts arises from general construction works during normal working hours (ie 0700 to 1900 hours on any day not being a Sunday or public holiday) at the openable windows of buildings is guided by the EIAO-TM. The recommended noise standards are presented in *Table 4.2b* below.

Table 4.2b EIAO-TM Daytime Construction Noise Standards ($L_{eq, 30 min}$ dB(A))

Uses	Acceptable Noise Standards
Domestic Premises	75
Educational institutions (normal periods)	70
Educational institutions (during examination periods)	65

4.2.6 Although there are currently no daytime construction noise standards that could apply to hospitals with openable windows, it is considered that the sensitive uses of hospitals will be similar to educational institutions during examination periods. Therefore, for the purpose of this study, the daytime construction noise standards for educational institutions (during examination periods) (ie $_{Leq, 30 min}$ 65 dB(A)) will be adopted.

4.2.7 The NCO provides statutory controls on general construction works during the restricted hours (ie 1900-0700 hours Monday to Saturday and at any time on Sundays and public holidays). The use of powered mechanical equipment (PME) for the carrying out of construction works during the restricted hours would require a CNP. The EPD is guided by the GW-TM when assessing such an application.

4.2.8 When assessing an application for the use of PME, the EPD will compare the ANLs, as promulgated in the GW-TM, and the CNLs (after accounting for factors such as barrier effects and reflections) associated with the proposed PME operations. A CNP will be issued if the CNL is equal to or less than the ANL. The ANLs are related to the noise sensitivity of the area in question and different Area Sensitivity Ratings have been drawn up to reflect the background characteristics of different areas. The relevant ANLs are shown in *Table 4.2c* below.

Table 4.2c Acceptable Noise Levels (ANL, $L_{eq, 5 min}$ dB(A))

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

4.2.9 In addition to the general controls on the use of PME during the restricted hours, the EPD has implemented a more stringent scheme via the DA-TM. The DA-TM regulates the use of five types of Specified Powered Mechanical Equipment (SPME) and three types of Prescribed Construction Work (PCW), which are non-PME activities, in primarily densely populated neighbourhoods called Designated Areas (DAs). The SPME and PCW are:

SPME:

- Hand-held breaker
- Bulldozer
- Concrete lorry mixer
- Dump truck
- Hand-held vibratory poker

PCW:

- Erection or dismantling of formwork or scaffolding
- Loading, unloading or handling or rubble, wooden boards, steel bars, wood or scaffolding material
- Hammering

4.2.10 In the interest of offering additional protection to the population, the carrying out of PCW is generally banned inside a DA. As for the use of SPME, it would be necessary to comply with DA-TM noise level requirements that are 15 dB(A) more stringent than those listed in the GW-TM before a CNP would be issued. As all sections of Route 16 will be within DA, the requirements stated in the DA-TM will be applicable for this study.

Operational Phase

Road Traffic Noise

4.2.11 Road traffic noise levels at the openable windows of buildings have been guided by the EIAO-TM and the relevant criteria are shown in *Table 4.2d*.

Table 4.2d EIAO-TM Road Traffic Noise Planning Criteria

Uses	Road Traffic Noise $L_{10, (1\ hr)}$ dB(A)
Domestic Premises	70
Hotel and Hostels	70
Offices	70
Educational institutions	65
Hospitals & clinics	55

4.2.12 For existing NSRs that are affected by noise from "new" roads, direct noise mitigation measures should be provided as far as practicable when the predicted road traffic noise levels exceeded the relevant noise criteria.

4.2.13 If, after implementation of direct technical remedies, any facades of existing sensitive uses are still exposed to predicted noise levels exceeding the relevant noise criteria, provision of indirect technical remedies in the form of acoustic insulation and air-conditioning should be considered under the ExCo directive "Equitable Redress for Persons Exposed to Increased Noise Resulting from the use of New Roads". The eligibility for indirect technical remedies will be tested against the following three criteria and recommendations should be presented to ExCo for approval.

i) The predicted overall noise level from the new road, together with other traffic noise in the vicinity must be above the specified noise levels ($L_{10,\ peak\ hour}$ 65 and 70 dB(A) for educational institutions and residential dwellings respectively);

ii) The predicted overall noise levels is at least 1.0 dB(A) more than the prevailing traffic noise level; ie the total traffic noise level existing before the works to construct were commenced; and

iii) The contribution to the increase in the predicted overall noise level from the new road must be at least 1.0 dB(A).

4.2.14 For the purpose of this Study, all roads are described as either:

- 'existing' which are unchanged by the proposed project except for possibly taking additional traffic; or
- 'new' which in the context of this report describes all roads that are completely new or are substantially altered by the proposed project (eg the location of the road has altered or has been widened substantially).

4.2.15 The 'new' roads adopted for this Study are the Route 16 - Alternative Alignment and slip road connections to and from Ching Cheung Road. It has been assumed that all other roads in the vicinity of Route 16 such as Butterfly Valley Road, Kwai Chung Road, Castle Peak Road, Lai Chi Kok Road, Cheung Sha Wan Road, West Kowloon Expressway and Route 9 between Tsing Yi and Cheung Sha Wan are classed as 'existing' roads. It has also been assumed that noise from existing roads cannot be mitigated by using direct mitigation measures, as there is currently no standing policy to redress traffic noise impact from existing road in the form of roadside noise barriers and enclosures. However, direct mitigation measures will be incorporated into the new road design where necessary to mitigate any unacceptable noise levels at nearby NSRs.

4.2.16 Low noise road surface has been assumed to be a standard feature for the proposed alignment (excluding the tunnel section) and slip roads with speed limit higher than 50 kph. Standard wearing course have been assumed for all other existing roads. Traffic speeds of 50 kph at all existing roads and 70 kph at Route 16 were assumed in this assessment.

Fixed Plant Noise

4.2.17 Noise from fixed sources, including that from industrial-type establishments, is controlled by the Technical Memorandum for the Assessment of Noise from Places other than Domestic Premises, Public Places or Construction Sites (IND-TM). This IND-TM establishes Acceptable Noise Levels (ANLs) for fixed noise sources depending upon the sensitivity of the area where the NSR is located. The relevant ANLs are shown in Table 4.2e.

Table 4.2e Acceptable Noise Levels for Fixed Noise Sources

Time Period	Area Sensitivity Rating		
	A	B	C
Day and Evening (0700 to 2300 hours)	60	65	70
Night (2300 to 0700 hours)	50	55	60

4.2.18 Noise assessments will normally be conducted in accordance with the IND-TM, which lays down statutory ANLs. However, in order to plan for a better environment, the level of the

intruding noise at the façade of the nearest sensitive use should be at least 5 dB(A) below the appropriate ANL or, the prevailing background noise levels, whichever is lower.

4.3 Baseline Condition

Existing Conditions

4.3.1 The West Kowloon area surrounding the Route 16 alternative alignment consists of both residential and industrial buildings with the main residential building complex and industrial on the western and eastern side of the alignment respectively. The Butterfly Valley Cottage area (Wai Man Tsuen), mainly consist of one to two storey high village type housing is located east of Butterfly Valley Road, with a number of existing industries and godowns located on the far eastern part of the valley. To the west of Wai Man Tsuen, an existing knoll, the Lai Chi Kok Hospital and Lai Chi Kok Reception Centre and its Staff Quarters are located west of Butterfly Valley. In addition, a planned housing site, Site 10, located to the north east of Lai Wan Interchange and a housing development site located at the old Lai Chi Kok Amusement Park have been identified.

4.3.2 The existing noise environment is dominate by road traffic and industrial activities. Three trunk roads, Kwai Chung Road, Ching Cheung Road and West Kowloon Expressway are the major traffic noise sources. The Cheung Sha Wan industrial area also have considerable noise impact upon the area. Noise from the traffic and industry all contribute to the daytime background noise levels in the area. Traffic noise is the major nighttime noise source as industrial activities decreases.

Noise monitoring has been carried out at the entrance of Bamboo Villa during the month of June 1999. The noise levels monitored are shown in Table 4.3a below. Monitoring data indicate that the noise levels in the vicinity of the proposed ventilation building are dominated by road traffic noise.

Table 4.3a Noise Monitoring Results at Bamboo Villa

Start Time	Finish Time	Influencing Factor	Leq (5 min)	L10 (5 min)	L90 (5 min)
Daytime					
10:43	10:48	traffic noise from Tai Po Road	77.7	81.5	66.5
10:49	10:54	traffic noise from Tai Po Road	78.8	82.5	70.5
10:55	11:00	traffic noise from Tai Po Road	77.2	81.0	66.0
11:01	11:06	traffic noise from Tai Po Road	78.4	81.5	69.0
11:07	11:12	traffic noise from Tai Po Road	79.0	82.0	66.5
11:13	11:18	traffic noise from Tai Po Road	78.7	82.5	64.5
Night-time					
23:14	23:19	traffic noise from Tai Po Road	75.9	79.5	62.0
23:20	23:25	traffic noise from Tai Po Road	74.6	77.0	59.0
23:26	23:31	traffic noise from Tai Po Road	74.9	78.0	60.5
23:32	23:37	traffic noise from Tai Po Road	76.3	80.0	60.5
23:38	23:43	traffic noise from Tai Po Road	76.8	80.5	61.5
23:44	23:49	traffic noise from Tai Po Road	75.9	79.5	62.5

Future Conditions

4.3.3 It is expected that the road traffic on the future Route 9 and Route 16 will increase the ambient noise levels in the area.

4.4 Noise Sensitive Receivers

Existing Noise Sensitive Receivers

4.4.1 Representative NSRs, as defined by EIAO-TM and NCO have been identified. The identified NSRs and their horizontal distance from the Alternative Alignment are presented in *Table 4.4a*. Locations of the NSRs are shown in *Figures 4.4a to 4.4h.*

4.4.2 As Wai Man Tsuen will be resumed in September 2001 (ie prior to the construction of Route 16), this NSR will not be included in this assessment. In addition, the village houses within the project limit will be resumed and these NSRs will not be included in this assessment.

Planned Sensitive Uses

4.4.3 Information on future/planned sensitive uses have been obtained from relevant Draft Outline Zoning Plans and Layout Plans:

- housing development site located northeast of Lai Wan Interchange, Site 10;
- housing development site located at the old Lai Chi Kok Amusement Park;
- KMB bus depot; and
- residential development at Sir Robert Black College .

4.4.4 Based on current information, it has been assumed that all planned NSRs will not be occupied before the construction of the Alternative Alignment except for the housing development at the old Lai Chi Kok Amusement Park and hence have not been included for the construction noise impact assessment. The latest layout plans for the Sir Robert Black College are not available at this stage, the potential traffic noise levels will only be predicted at 10 m from the site boundary for the purpose of the operational noise assessment. For Site 10, KMB Bus Depot CDA and the old Lai Chi Kok Amusement Park housing site, the latest layout plans have been incorporated into the assessment.

Table 4.4a Location of Noise Sensitive Receivers - Construction Phase

NSR	Location	Sensitive Uses	Buffer distance (m)
N1	Miu Kong Tsuen	Residential	125
N2	Tai Ching Cheung	Residential	185
N3	Tai Ching Cheung	Residential	135
N6	LCK Reception Centre Staff Quarters	Residential	20
N7	LCK Hospital	Hospital	170
N8	school development site located at the old Lai Chi Kok Amusement Park	Residential	70
N9	housing development site located at the old Lai Chi Kok Amusement Park	Residential	70

NSR	Location	Sensitive Uses	Buffer distance (m)
N10	Public Library	Library	65
N11	Mei Foo Sun Chuen, Phase 6, Blk 9	Residential	90
N12	Mei Foo Sun Chuen, Phase 5, Blk 9	Residential	100
N13	Mei Foo Sun Chuen, Phase 4, Blk 113	Residential	245
N14	Haking Wong TI	School	160
N15	Bamboo Villa	Residential	230
N16	Pinehill	Residential	85
N17	New residential development	Residential	80

4.5 Construction Phase

4.5.1 Potential Source of Impacts

4.5.1.1 Construction noise impacts arise from the various construction activities are expected to pose constraints at the nearby NSRs. A preliminary construction programme of Route 16 Alternative Alignment is shown in Figure 2.2a. The contractor may develop a different construction programme and construction method from the one presented in this report, the assessment presented in this report only illustrates one such package.

4.5.1.2 The construction sites could be separated into four main areas. These areas are as follows:

- Lai Chi Kok Viaduct;
- Ching Cheung Road slip road connections;
- Butterfly Valley; and
- Mid Ventilation Building.

Lai Chi Kok Viaduct

4.5.1.3 The main construction activities comprise:

- viaduct substructure;
- viaduct superstructure; and
- road pavement.

4.5.1.4 Construction activities at this section of Route 16 are expected to operate during normal daytime working hours (ie 0700 to 1900 hours on any day not being a Sunday or public holiday).

4.5.1.5 A plant inventory has been established based on previous relevant highways project experience and is presented in Table 4A-1 in Annex 4A.

Ching Cheung Road slip road connections

4.5.1.6 The main construction activities comprise:

- viaduct substructure;
- viaduct superstructure; and
- road pavement.

4.5.1.7 Construction activities at this section of Route 16 are expected to operate during normal daytime working hours (ie 0700 to 1900 hours on any day not being a Sunday or public holiday).

4.5.1.8 A plant inventory has been established based on previous relevant highways project experience and is presented in Table 4A-1 in Annex 4A.

Butterfly Valley

4.5.1.9 As indicated from the preliminary construction programme, the main construction activities will fall into four main categories including:

- construction of mainline viaduct;
- construction of road embankment;
- construction of Eagle's Nest Tunnel; and
- construction of south portal building.

4.5.1.10 Based on the construction programme, there will be a number of construction activities associated with each main construction task.

4.5.1.11 For the construction of mainline viaduct, the main construction activities that may have noise impacts on the nearby NSRs comprise:

- viaduct foundation;
- viaduct superstructure; and
- road pavement and finishes.

4.5.1.12 For the construction of road embankment, the main construction activities that may have noise impacts on the nearby NSRs comprise:

- site clearance & preparatory works;
- earthworks excavation; and
- road pavement.

4.5.1.13 Construction activities for the construction of mainline viaduct and road embankment are expected to operate during normal daytime working hours (ie 0700 to 1900 hours on any day not being a Sunday or public holiday).

4.5.1.14 The Eagle's Nest tunnel will be excavated by bored tunnelling machines at the northern end. Most of the excavated materials are expected to be transported by trunks at the mid ventilation building and the toll plaza. It is estimated that there will be approximately 360 m^3 of surplus of material to be delivered off-site per day. Hence, approximately 54 trucks will be required per 12 hour day shift. The Eagle's Nest south portal building will be construction at the tunnel portal.

4.5.1.15 The main construction activities that may have noise impacts on the nearby NSRs comprise:

- Preparatory works;
- portal construction;
- tunnel excavation; and
- portal building construction.

4.5.1.16 Tunnel excavation are expected to operate during normal daytime working hours (ie 0700 to 1900 hours on any day not being a Sunday or public holiday) for the first 100m. Beyond this initial length, 24 hour working is expected as the construction activities will be underground.

4.5.1.17 A plant inventory has been established based on previous relevant highways project experience and is presented in Table 4A-1 in Annex 4A.

Mid Ventilation Building

4.5.1.18 The main construction activities comprise:

- removal of spoil;
- ventilation building foundation; and
- superstructure.

4.5.1.19 Construction activities at this section of Route 16 are expected to operate during normal daytime working hours (ie 0700 to 1900 hours on any day not being a Sunday or public holiday).

4.5.1.20 A plant inventory has been established based on previous relevant highways project experience and is presented in Table 4A-1 in Annex 4A.

4.5.2 Assessment Methodology

4.5.2.1 A methodology for assessing construction noise other than percussive piling has been developed based on GW-TM. In general, the methodology is as follows:

- identify the likely type, sequence and duration of principal noisy construction activities required for the implementation of the proposed project;
- identify a list of plant inventory likely to be required for each construction activity;
- calculate the maximum total sound power level (SWL) for each construction activity using the plant list and SWL data given for each plant in the technical memorandum;
- representative NSRs as defined by the EIAO-TM will be identified, based on existing and committed landuses in the study area that may be affected by the worksite. For the purposes of this study, NSRs will be identified up to a distance of 300 m from the alignment. However, this distance may be reduced, subject to the first layer of NSRs providing adequate acoustic shielding;
- calculate the distance attenuation and barrier corrections to NSRs from worksite notional noise source point; and
- predict construction noise levels at NSRs in the absence of any mitigation measures.

4.5.2.2 If the noise assessment criteria are exceeded at NSRs, mitigation measures must be considered. A re-evaluation of the total SWL for each construction activity will be made assuming the use of practical mitigation measure such as "quiet" equipment and movable

noise barriers. If the criteria are still exceeded, further mitigation measures such as reduction in noisy plant working simultaneously would be considered.

4.5.3 Evaluation of Impacts

4.5.3.1 The unmitigated predicted noise levels at the worst case representative NSRs for each construction stage have been predicted and are shown in Table 4B-1 (Annex 4B) taking into account the distance attenuation.

Lai Chi Kok Viaduct

4.5.3.2 Table 4B-1 in Annex 4B indicated that unmitigated construction activities associated with the construction of Lai Chi Kok Viaduct would cause exceedances of the daytime construction noise criteria at the LCK Reception Centre Staff Quarters (N6), LCK hospital (N7) and Haking Wong TI (N14). Mitigation measures are therefore required for these NSRs in order to alleviate the noise impacts during the construction phase.

Cumulative Noise Impacts

4.5.3.3 As the contractor may develop a different construction programme from the one presented in this report, the following only illustrates one such combination to demonstrate the effect of construction activities operating concurrently during at one time. Information extracted from the preliminary construction programme were used in this study.

4.5.3.4 Based on the preliminary construction programme, two construction activities are likely to be undertaken concurrently. These activities include the construction of substructure and superstructure of the LCK viaduct. The cumulative effect of these construction activities are shown in Table 4.5a below. Exceedances of the daytime construction noise criteria are predicted at LCK Reception Centre Staff Quarters (N6), LCK hospital (N7) and Haking Wong TI (N14), and mitigation measures are therefore required to alleviate the noise impacts.

Table 4.5a Cumulative Noise Impacts (No Mitigation Measures) - ($L_{eq,\ 30\ min}$ dB(A))

NSR	Daytime Construction Noise Criterion	Substructure	Superstructure	Cumulative Impact
N3	75	71	72	75
N6	75	91	85	**92**
N7	65	72	72	**75**
N12	75	65	65	68
N13	75	69	69	72
N14	70	72	72	**75**

Note: Daytime construction noise criterion for schools during examination and hospital is 65 dB(A).

Ching Cheung Road slip road connections

4.5.3.5 Table 4B-1 in Annex 4B indicated that unmitigated construction activities associated with the construction of Ching Cheung Road slip road would cause exceedance of the daytime construction noise criterion at the planned school development at the old Lai Chi Kok Amusement Park (N8), public library (N10) and Mei Foo Sun Chuen Phase 5 & 6 (N11 & 12). Mitigation measures are therefore required for these NSRs in order to alleviate the noise impacts during the construction phase.

Cumulative Noise Impacts

4.5.3.6 Based on the preliminary construction programme, two construction activities are likely to be undertaken concurrently. These activities include the construction of substructure and superstructure of the Ching Cheung Road slip connections. The cumulative effect of these construction activities are shown in Table 4.5b below. Exceedances of the daytime construction noise criteria are predicted at the planned school development at the old Lai Chi Kok Amusement Park (N8), public library (N10) and Mei Foo Sun Chuen Phase 5 & 6 (N11 & 12), and mitigation measures are therefore required to alleviate the noise impacts.

Table 4.5b Cumulative Noise Impacts (No Mitigation Measures) - ($L_{eq, 30\,min}$ dB(A))

NSR	Daytime Construction Noise Criterion	Substructure	Superstructure	Cumulative Impact
N2	75	67	67	70
N3	75	71	71	74
N6	75	67	67	70
N7	65	**71**	**71**	**74**
N8	70	-	**78**	**78**
N9	75	70	69	73
N10	75	**81**	**80**	**84**
N11	75	**77**	**77**	**80**
N12	75	**77**	**76**	**80**

Butterfly Valley

4.5.3.7 Table 4B-1 in Annex 4B indicated that unmitigated construction activities associated with the construction of road embankment would cause exceedance of the daytime construction noise criterion at Miu Kong Village (N1) and Tai Ching Cheung (N2). Mitigation measures are therefore required for these NSRs in order to alleviate the noise impacts during the construction phase.

Cumulative Noise Impacts

4.5.3.8 Based on the preliminary construction programme, four construction activities are likely to be undertaken concurrently. These activities include the construction of road embankment, viaduct substructure, viaduct superstructure and south portal building. The cumulative effect of these construction activities are shown in Table 4.5c below. Exceedances of the daytime construction noise criteria are predicted at Miu Kong Village (N1) and Tai Ching Cheung (N2 & N3), and mitigation measures are therefore required to alleviate the noise impacts.

Table 4.5c Cumulative Noise Impacts (No Mitigation Measures) - ($L_{eq, 30\,min}$ dB(A))

NSR	Daytime Construction Noise Criterion	Road embankment	viaduct substructure	viaduct superstructure	south portal building	Cumulative Impact
N1	75	**81**	72	72	69	**82**
N2	75	**78**	71	71	67	**80**
N3	75	73	72	74	-	**78**

Mid Ventilation Building

4.5.3.9 Assessment indicated that unmitigated construction activities associated with the construction on ventilation building would cause daytime construction exceedance at Bamboo Villa (N15), Pinehill (N16) and the new residential development (N17). Mitigation measures are therefore required to alleviate the noise impacts during the construction phase. The construction of the mid ventilation building will be in sequential order and cumulative impacts are not expected.

4.5.4 Mitigation Measures

4.5.4.1 Mitigation measures for each construction site are detailed below, and the following forms of mitigation measures are recommended and should be incorporated into the Contract Specifications:

- good site practice to limit noise emissions at source
- selection of quieter plant and working methods
- reduction in number of plant operating in critical areas close to NSRs
- use of movable noise barriers.

4.5.4.2 The Contractor may develop a different package of mitigation measures to meet the required noise standards, but the following illustrates one such package to demonstrate an approach to mitigation that would be feasible.

Good Site Practice

4.5.4.3 Good site practice and noise management can considerably reduce the impact of construction site activities on nearby NSRs. The following package of measures should be followed during each phase of construction:

- only well-maintained plant should be operated on-site and plant should be serviced regularly during the construction works;
- machines and plant that may be in intermittent use should be shut down between work periods or should be throttled down to a minimum;
- plant know to emit noise strongly in one direction, should, where possible, be orientated to direct noise away from the NSRs;
- mobile plant should be sited as far away from NSRs as possible; and
- material stockpiles and other structures should be effectively utilised, where practicable, to screen noise from on-site construction activities.

Selecting Quieter Plant and Working Methods

4.5.4.4 The Contractor may be able to obtain particular models of plant that are quieter than standards given in GW-TM. The benefits achievable in this way will depend on the details of the Contractor chosen methods of working, and it is considered too restrictive to specify that a Contractor has to use specific items of plant for the construction operations. It is therefore both preferable and practical to specify an overall plant noise performance specification to apply to the total SWL of all plant on the site so that the Contractor is allowed some flexibility to select plant to suit his needs.

4.5.4.5 Quiet plant is defined as PME whose actual SWL is less than the valued specified in GW-TM for the same piece of equipment. Examples of SWLs for specific silenced PME taken from a

British Standard, namely *Noise Control on Construction and Open Sites, BS5228 : Part 1 : 1997*, which are known to be used are given in *Table 4.5d*.

Table 4.5d Sound Power Levels for Specific Silenced PME

PME	BS5228 Table no.	Ref no.	SWL dB(A) max
Breaker, hand-held	C.2	10	110
Bulldozer	C.3	65	110
Mobile Crane	C.7	110	106
Air Compressor	C.7	25	98
Concrete Pump	C.6	36	106
Circular Saw, Bench Mounted	C.7	78	106
Dump Truck	C.9	29	109
Excavator			
- for trenching	C.3	97	105
- for ground excavation	C.3	35	106
Generator	C.7	62	100
Lorry	C.9	27	105
Loader	C.3	97	105
Concrete Lorry Mixer	C.6	35	100
Vibratory Roller	C.3	115	102
Asphalt Paver	C.8	24	101
Road Roller	C.8	27	104
Poker Vibrator	C.6	32	100

4.5.4.6 It should be noted that various types of silenced equipment can be found in Hong Kong. However, EPD, when processing a CNP application, will apply the noise levels contained in the relevant statutory TM unless the noise emission of a particular piece of equipment can be validated by certificate or demonstration.

4.5.4.7 With the above quiet plant substituted in the equipment inventories given in Table 4A-2 (Annex 4A), the mitigated noise levels at each NSR would be shown in Table 4B-2 (Annex 4B).

4.5.4.8 With the use of the above quiet plant, the noise levels could be reduced, depending on the type of construction activities operating. The construction noise levels at the NSRs have generally been reduced although further mitigation is still required.

Lai Chi Kok Viaduct

4.5.4.9 Table 4B-2 in Annex 4B indicated that with the use of quiet plant, the construction of Lai Chi Kok Viaduct would cause exceedances of the daytime construction noise criteria at the LCK Reception Centre Staff Quarters (N6). Mitigation measures are therefore required for these NSRs in order to alleviate the noise impacts during the construction phase.

Cumulative Noise Impacts

4.5.4.10 With the use of quiet plant, assessment indicated that construction noise levels, up to 85 dB(A) are still predicted at the LCK Reception Centre Staff Quarters (N6). For the LCK hospital (N7), exceedances of the daytime construction noise criteria are predicted. Mitigation measures are therefore required to alleviate the cumulative noise impacts.

Table 4.5e Cumulative Noise Impacts - With the use of quiet plant (Mitigation 1) - Lai Chi Kok Viaduct - ($L_{eq,\ 30\ min}$ dB(A))

NSR	Daytime Construction Noise Criterion	Substructure	Superstructure	Cumulative Impact
N3	75	64	65	68
N6	75	84	79	**85**
N7	65	65	65	**68**
N12	75	58	58	61
N13	75	62	62	65
N14	70	65	65	68

Ching Cheung Road slip road connections

4.5.4.11 Table 4B-2 in Annex 4B indicated that with the use of quiet plant, the construction of Ching Cheung Road slip road would cause exceedance of the daytime construction noise criterion at the old Lai Chi Kok Amusement Park (N8). Mitigation measures are therefore required for these NSRs in order to alleviate the noise impacts during the construction phase.

Cumulative Noise Impacts

4.5.4.12 With the use of quiet plant, assessment indicated that construction noise levels, up to 71 dB(A) are still predicted at the planned school development at the old Lai Chi Kok Amusement Park (N8) and public library (N10). Mitigation measures are therefore required to alleviate the cumulative noise impacts.

Table 4.5f Cumulative Noise Impacts - With the use of quiet plant (Mitigation 1) - Ching Cheung Road slip road - ($L_{eq,\ 30\ min}$ dB(A))

NSR	Daytime Construction Noise Levels	Substructure	Superstructure	Cumulative Impact
N2	75	60	60	63
N3	75	64	64	67
N6	75	60	60	63
N7	65	64	64	**67**
N8	70	-	**71**	**71**
N9	75	63	62	66
N10	75	74	73	**77**
N11	75	70	70	73
N12	75	70	69	73

Butterfly Valley

4.5.4.13 Table 4B-2 in Annex 4B indicated that with the use of quiet plant, the construction of road embankment would cause exceedance of the daytime construction noise criterion at Miu Kong Village (N1) and Tai Ching Cheung (N2). Mitigation measures are therefore required for these NSRs in order to alleviate the noise impacts during the construction phase.

Cumulative Noise Impacts

4.5.4.14 With the use of quiet plant, assessment indicated that construction noise levels, up to 80 dB(A) are still predicted at the Miu Kong Village (N1) and Tai Ching Cheung (N2 & N3). Mitigation measures are therefore required to alleviate the cumulative noise impacts.

Table 4.5g Cumulative Noise Impacts - With use of quiet plant (Mitigation 1) - Butterfly Valley - ($L_{eq,\ 30\ min}$ dB(A))

NSR	Daytime Construction Noise Criterion	Road embankment	viaduct substructure	viaduct superstructure	south portal building	Cumulative Impact
N1	75	80	65	65	69	**80**
N2	75	76	64	64	67	**77**
N3	75	72	65	67	-	74

Mid Ventilation Building

4.5.4.15 Assessment indicated that with the use of quiet plant, the construction on ventilation building would cause daytime construction exceedance at Pinehill and the new residential development. Mitigation measures are therefore required to alleviate the noise impacts during the construction phase.

Reducing the Number of Plant Operating in Critical Areas Close to NSRs

4.5.4.16 With the use of quiet plant, exceedances of the daytime construction noise criteria are still predicted and further mitigation measures have been investigated. In general the number of plants should be left to the choice of the Contractor. However, in some cases it may be appropriate to restrict the number of particularly noisy plant operating within certain parts of the site that are very close to the NSRs. The effect of limiting the number of plants working concurrently has been investigated and the results are presented in Table 4B-3 (Annex 4B).

Lai Chi Kok Viaduct

4.5.4.17 With the incorporation of quiet plant and limiting the number of plant operating concurrently for the construction activities associated with the LCK viaduct, assessment indicated that high levels of construction noise levels, up to 83 dB(A) are still predicted during the substructure construction at the LCK Reception Centre Staff Quarters (N6) (see Table 4B-3 in Annex 4B). Mitigation measures are therefore required to alleviate the noise impacts.

Cumulative Noise Impacts

4.5.4.18 With the use of quiet plant and limiting the number of plant operating concurrently, assessment indicated that construction noise levels, up to 84 dB(A) are still predicted at the LCK Reception Centre Staff Quarters (N6). For the LCK hospital, marginal exceedances of the daytime construction noise criteria are still predicted. Mitigation measures are therefore required to alleviate the cumulative noise impacts.

Table 4.5h Cumulative Noise Impacts - With the use of quiet plant & limiting the no. of plant (Mitigation 2) - ($L_{eq, 30\ min}$ dB(A))

NSR	Daytime Construction Noise Criterion	Substructure	Superstructure	Cumulative Impact
N3	75	63	62	66
N6	75	83	76	**84**
N7	65	64	62	**66**
N12	75	57	55	59
N13	75	61	59	63
N14	70	65	62	67

Ching Cheung Road slip road connections

4.5.4.19 With the incorporation of quiet plant and limiting the number of plant operating concurrently for the construction activities associated with the Ching Cheung Road slips, assessment indicated that the construction noise levels the old Lai Chi Kok Amusement Park (N8) will comply with the daytime construction criterion. Further mitigation measures are not required.

Cumulative Noise Impacts

4.5.4.20 With the use of quiet plant and limiting the number of plant operating concurrently, assessment indicated that the cumulative construction noise levels will comply with the daytime construction noise criterion and mitigation measures are therefore not required for these construction activities.

Table 4.5i Cumulative Noise Impacts - With the use of quiet plant & limiting the no. of plant (Mitigation 2) - ($L_{eq, 30\ min}$ dB(A))

NSR	Daytime Construction Noise Criterion	Substructure	Superstructure	Cumulative Impact
N2	75	59	57	61
N3	75	63	61	65
N6	75	59	57	61
N7	65	63	61	65
N8	70	-	68	68
N9	75	62	59	64
N10	75	73	70	75
N11	75	70	67	72
N12	75	69	66	71

Butterfly Valley

4.5.4.21 With the incorporation of quiet plant and limiting the number of plant operating concurrently for the construction of road embankment, assessment indicated that marginal exceedance of the daytime construction noise criterion is still predicted during the earthwork excavation at

the Miu Kong Village (N1). Mitigation measures are therefore required to alleviate the noise impacts.

Cumulative Noise Impacts

4.5.4.22 With the use of quiet plant and limiting the number of plant operating concurrently, assessment indicated that the cumulative construction noise levels, up to 78 dB(A) are still predicted at the Miu Kong Village (N1). Mitigation measures are therefore required to alleviate the cumulative noise impacts.

Table 4.5j Cumulative Noise Impacts - With the use of quiet plant & limiting the no. of plant (Mitigation 2) - ($L_{eq, 30 min}$ dB(A))

NSR	Daytime Construction Noise Criterion	Road embankment	viaduct substructure	viaduct superstructure	south portal building	Cumulative Impact
N1	75	77	65	65	69	**78**
N2	75	73	64	64	67	75
N3	75	69	65	67	-	72

Mid Ventilation Building

4.5.4.23 Assessment indicated that with the use of quiet plant and limiting the number of plant operating concurrently, the construction noise levels associated with the ventilation building will comply with the daytime construction noise criterion and mitigation measures are therefore not required for these construction activities.

Constructing Temporary and Movable Noise Barriers

4.5.4.24 Based on site geometry, NSRs in the vicinity of the worksite are not expected to be protected by the use of temporary noise barriers located along site boundaries. However, movable barriers could be very effective in providing noise screening from a particular plant. It is anticipated that a movable noise barrier with a skid footing and a cantilevered upper portion located close to the noise generating part of the PME such that the line of sight could be blocked by the barriers when viewed from NSRs, can produce at least 10 dB(A) screening for stationary plant and 5 dB(A) for mobile plant. The noise screening benefit for each plant considered in this assessment is listed as follows:

- stationary plant - assuming 10 dB(A) reduction: generator, air compressor, concrete pump, poker vibrator and ballast tamper
- mobile plant - assuming 5 dB(A) reduction: excavator, loader, excavator mounted breaker, mobile crane, compactor, and road roller
- large plant - assuming 5 dB(A) reduction when the noise generating part of the PME such as engine and exhaust are blocked by the barriers: rock driller and tower crane

4.5.4.25 The use of this measures has only been applied to the following construction activities:

- construction of viaduct substructure; and
- earthworks excavation.

4.5.4.26 It is anticipated that for some construction activities such as viaduct superstructure, the use of movable barriers would not be practicable since most of the noisy PME will operate at a

high level. In these cases, the effect of the use of movable barriers have not been investigated for these operations.

4.5.4.27 The effect of the use of quiet plant, limiting the number of plants working concurrently and movable barriers have been investigated for the practicable construction activities and the results are presented in Table 4B-4 (Annex 4B).

Lai Chi Kok Viaduct

4.5.4.28 Due to the proximity of the LCK Reception Centre Staff Quarters (N6), assessment indicated that high levels of construction noise levels, up to 81 dB(A) are still predicted during the substructure construction even with the incorporation of quiet plant, limiting the number of plant operating concurrently and movable barriers.

Cumulative Noise Impacts

4.5.4.29 With the use of quiet plant, limiting the number of plant operating concurrently and movable noise barriers, assessment indicated that construction noise levels, up to 82 dB(A) are still predicted at the LCK Reception Centre Staff Quarters (N6). For the LCK hospital (N7), marginal exceedances of the daytime construction noise criteria are still predicted.

Table 4.5k Cumulative Noise Impacts - With the use of quiet plant, limiting the no. of plant and use of movable barriers (Mitigation 3) - ($L_{eq, 30 min}$ dB(A))

NSR	Daytime Construction Noise Criterion	Substructure	Superstructure	Cumulative Impact
N3	75	62	62	65
N6	75	81	76	**82**
N7	65	63	62	**66**
N12	75	56	55	59
N13	75	59	59	62
N14	70	63	62	66

Butterfly Valley

4.5.4.30 With the incorporation of quiet plant, limiting the number of plant operating concurrently and movable noise barriers, assessment indicated that the construction noise levels associated with the construction of road embankment will comply with the daytime construction noise criterion and additional mitigation measures are therefore not required for these construction activities.

Cumulative Noise Impacts

4.5.4.31 With the use of quiet plant, limiting the number of plant operating concurrently and movable noise barriers, assessment indicated that the cumulative construction noise levels will comply with the daytime construction noise criterion and additional mitigation measures are therefore not required.

Table 4.5l ***Cumulative Noise Impacts - With the use of quiet plant, limiting the no. of plant & use of movable barriers (Mitigation 3) - ($L_{eq, 30\ min}$ dB(A))***

NSR	Daytime Construction Noise Criterion	Road embankment	viaduct substructure	viaduct superstructure	south portal building	Cumulative Impact
N1	75	73	65	65	69	75
N2	75	69	64	64	67	73
N3	75	65	65	67	-	71

Residual Impacts

4.5.4.32 As can be seen from the above discussions, the use of the above described mitigation measures are insufficient in reducing the construction noise levels at NSRs N6 to below the daytime noise criteria. These predictions, however, represent the theoretically worst possible scenario, but are in fact unlikely as it would required all noisy plant to be operating concurrently at the nearest notional source point of each works area (most worksites are long and thin) to the NSRs, and to be fully active at exactly the same time. However, it is possible that these levels of impact, or impacts approaching these, could occur for a short duration.

4.5.4.33 Therefore, additional mitigation measures such as avoidance of simultaneous noisy activities and further reduction in the number of plant teams operating in critical areas close to NSRs may be required from time to time. Specific mitigation measures have been identified to further reduce the noise impacts and are as follows.

4.5.4.34 During the construction of the LCKV substructure, if the use of PME is required within a radius of 40m from the LCK Reception Centre, it is recommended that the formation of the bored pile should be carried out alone (ie without the use of other noisy PME working concurrently). In addition, a movable noise barrier should also be use for the mobile crane. The movable noise barrier should be located such that the noise generating part of the mobile crane are blocked. Predictions show that by limited the number of noisy PME operating concurrently within a distance of 40m to the LCK Reception Centre, the construction noise levels could be further reduced by 6 dB (A), implying that there will be no exceedances of the daytime construction noise criterion at the LCK Reception Centre (see Table 4A-5 in Annex 4A).

4.5.4.35 During the construction of the LCKV superstructure, if the use of PME is required within a radius of 40m from the LCK Reception Centre, it is recommended that a movable noise barrier should also be use for the mobile crane. The movable noise barrier should be located such that the noise generating part of the mobile crane are blocked. Predictions show that with the use of this addition mitigation measures, the noise levels could be further reduced by 1 dB (A), implying that there will be no exceedances of the daytime construction noise criterion at the LCK Reception Centre (see Table 4A-5 in Annex 4A).

4.5.4.36 Regular monitoring at the NSRs addressed in *Section 13* will be required during different construction phases. This will enable the contractor to react if the assessment criteria are approached and to reduce noise emissions at specific areas. *Table 4.5m* below summaries the predicted noise levels from each construction activities. Exceedances of the daytime construction noise criterion is shown in Bold.

Table 4.5m Predicted Construction Noise Levels - ($L_{eq, 30\ min}$ dB(A))

Construction Activities	Daytime Construction Noise Criterion	No mitigation	Mitigation 1	Mitigation 2	Mitigation 3
Miu Kong Village (N1)					
BV embankment - preparatory works	75	**78**	71	71	71
BV embankment - earthworks excavation	75	**81**	**80**	**77**	73
BV embankment - road pavement	75	69	69	69	66
BV viaduct - substructure	75	72	65	65	65
BV viaduct - superstructure	75	72	65	65	65
BV - road pavement	75	67	67	67	67
Tunnel - preparatory works	75	68	68	68	68
Tunnel - portal construction	75	74	74	74	74
Tunnel - excavation	75	65	65	65	65
South portal building	75	69	69	69	69
Tai Ching Cheung (N2)					
BV embankment - preparatory works	75	75	68	68	68
BV embankment - earthworks excavation	75	**78**	**76**	73	69
BV embankment - road pavement	75	66	66	66	66
BV viaduct - substructure	75	71	64	64	64
BV viaduct - superstructure	75	71	64	64	64
BV - road pavement	75	66	66	66	66
Tunnel - preparatory works	75	65	65	65	65
Tunnel - portal construction	75	71	71	71	71
Tunnel - excavation	75	62	62	62	62
South portal building	75	67	67	67	67
Ching Cheung Road slip - substructure	75	67	60	59	-
Ching Cheung Road slip - superstructure	75	67	60	57	-
Ching Cheung Road slip - road pavement	75	62	58	58	-
Tai Ching Cheung (N3)					
BV embankment - preparatory works	75	71	64	64	64
BV embankment - earthworks excavation	75	73	72	69	65
BV embankment - road pavement	75	62	62	62	62
BV viaduct - substructure	75	72	65	65	65
BV viaduct - superstructure	75	74	67	67	67
BV - road pavement	75	69	69	65	65
Ching Cheung Road slip - substructure	75	71	64	63	-
Ching Cheung Road slip - superstructure	75	71	64	61	-
Ching Cheung Road slip - road pavement	75	66	62	62	-
LCK viaduct - substructure	75	71	64	63	62

Construction Activities	Daytime Construction Noise Criterion	No mitigation	Mitigation 1	Mitigation 2	Mitigation 3
LCK viaduct - superstructure	75	72	65	62	62
LCK viaduct - road pavement	75	66	63	61	61
LCK Reception Centre Staff Quarters (N6)					
Ching Cheung Road slip - substructure	75	67	60	59	-
Ching Cheung Road slip - superstructure	75	67	60	57	-
Ching Cheung Road slip - road pavement	75	62	58	58	-
LCK viaduct - substructure	75	**91**	**84**	**83**	75 [1]
LCK viaduct - superstructure	75	**85**	**79**	**76**	75 [1]
LCK viaduct - road pavement	75	**80**	**77**	75	75
LCK Hospital (N7)					
Ching Cheung Road slip - substructure	65	**71**	64	63	-
Ching Cheung Road slip - superstructure	65	**71**	64	61	-
Ching Cheung Road slip - road pavement	65	**66**	63	63	-
LCK viaduct - substructure	65	**72**	65	64	63
LCK viaduct - superstructure	65	**72**	65	62	62
LCK viaduct - road pavement	65	**67**	63	62	62
School development at the old LCK amusement park (N8)					
Ching Cheung Road slip - substructure	70	0	0	0	-
Ching Cheung Road slip - superstructure	70	**78**	**71**	68	-
Ching Cheung Road slip - road pavement	70	**73**	70	70	-
Residential development at the old LCK amusement park (N9)					
Ching Cheung Road slip - substructure	75	70	63	62	-
Ching Cheung Road slip - superstructure	75	69	62	59	-
Ching Cheung Road slip - road pavement	75	64	60	60	-
Public Library (N10)					
Ching Cheung Road slip - substructure	75	**81**	74	73	-
Ching Cheung Road slip - superstructure	75	**80**	73	70	-
Ching Cheung Road slip - road pavement	75	75	72	72	-
Mei Foo Sun Chuen, Phase 5, Blk 9 (N11)					
Ching Cheung Road slip - substructure	75	**77**	70	70	-
Ching Cheung Road slip - superstructure	75	**77**	70	67	-
Ching Cheung Road slip - road pavement	75	72	68	68	-
Mei Foo Sun Chuen, Phase 6, Blk 9 (N12)					
Ching Cheung Road slip - substructure	75	**77**	70	69	-

Construction Activities	Daytime Construction Noise Criterion	No mitigation	Mitigation 1	Mitigation 2	Mitigation 3
Ching Cheung Road slip - superstructure	75	**76**	69	66	-
Ching Cheung Road slip - road pavement	75	71	67	67	-
LCK viaduct - substructure	75	65	58	57	56
LCK viaduct - superstructure	75	65	58	55	55
LCK viaduct - road pavement	75	60	57	55	55
Mei Foo Sun Chuen, Phase 4, Blk 113 (N13)					
LCK viaduct - substructure	75	69	62	61	59
LCK viaduct - superstructure	75	69	62	59	59
LCK viaduct - road pavement	75	64	60	58	58
Haking Wong TI (N14)					
LCK viaduct - substructure	70	**72**	65	65	63
LCK viaduct - superstructure	70	**72**	65	62	62
LCK viaduct - road pavement	70	67	64	62	62
Bamboo Villa (N15)					
Mid vent building - removal of spoil	75	**76**	69	63	63
Vent building foundation	75	75	67	60	60
Mid vent building - superstructure	75	68	60	60	60
Pinehill (N16)					
Mid vent building - removal of spoil	75	**84**	**78**	72	72
Vent building foundation	75	**84**	**76**	69	69
Mid vent building - superstructure	75	**76**	69	69	69
New residential development (N17)					
Mid vent building - removal of spoil	75	**85**	**78**	72	72
Vent building foundation	75	**84**	**77**	69	69
Mid vent building - superstructure	75	**77**	69	69	69

Note

(1): With the use of specific mitigation measures as described in para 4.5.4.34 & 4.5.4.35

4.5.4.37 A summary of the recommended mitigation measures for each construction activities is presented in Table 4.5n below.

Table 4.5n Summary of Proposed Mitigation Measures

Task	Mitigation Measures
LCK viaduct - substructure	Use of quiet PME, reducing the number of each type of PME to one and movable noise barriers located close to concrete lorry mixer, concrete pump, generator, air compressor and poker vibrator. If the construction activities is carrying out within 40m of LCK Reception Centre, further mitigation measures such as restricting the use of two noisy PME is recommended.
LCK viaduct - superstructure	Use of quiet PME and reducing the number of each type of PME to one If the construction activities is carrying out within 40m of LCK Reception Centre, further mitigation measures such as the use of movable noise barrier located close to mobile crane is recommended.
LCK viaduct - road pavement	Use of quiet PME and reducing the number of each type of PME to one
Ching Cheung Road slip - substructure	Use of quiet PME
Ching Cheung Road slip - superstructure	Use of quiet PME
Ching Cheung Road slip - road pavement	Use of quiet PME, reducing the number of each type of PME to one and movable noise barriers located close to concrete lorry mixer, concrete pump, generator, air compressor and poker vibrator
BV embankment - preparatory works	Use of quiet PME
BV embankment - earthworks excavation	Use of quiet PME, reducing the number of each type of PME to one and movable noise barriers located close to rock drill
BV embankment - road pavement	No mitigation measures required
BV viaduct - substructure	Use of quiet PME
BV viaduct - superstructure	Use of quiet PME
BV - road pavement	No mitigation measures required
Tunnel - preparatory works	No mitigation measures required
Tunnel - portal construction	No mitigation measures required
Tunnel - excavation	No mitigation measures required
South portal building	No mitigation measures required
Mid vent building - removal of spoil	Use of quiet PME and reducing the number of each type of PME to one
Vent building foundation	Use of quiet PME and reducing the number of each type of PME to one

Task	Mitigation Measures
Mid vent building - superstructure	Use of quiet PME

4.5.5 Restricted Hours Works

4.5.5.1 It is anticipated that restricted hour construction will also be required for construction activities such as tunnel excavation and further mitigation measures to those measures discussed above are anticipated to reduce noise impacts to within NCO criteria.

4.5.5.2 For the tunnel excavation, it is anticipated that beyond the initial length of 100m, excavation will be carried out well within the tunnel and the only noisy PME perceived by nearby NSRs will be noise from the ventilation fans. As the use of SPME as specified under the DA-TM has not been identified, the evening and night-time construction noise criteria would be 60 and 45 dB(A) respectively (assuming an Area Sensitivity Rating of A). Based on this assumption, the predicted noise levels at the worst case representative NSRs will comply with the evening noise criteria. However, exceedances (by up to 13 dB(A)) is predicted during the night-time period at all NSRs (see Table 4B-5 in Annex 4B). It is expected the use of appropriate silencer could be use to further reduce the noise from the ventilation fans.

4.5.5.3 However, it will be the responsibility of the contractors to comply with the NCO and relevant TMs. The contractor should submit CNP application and will be assessed by the Noise Control Authority based on prevailing conditions. Conditions stipulated in CNPs should be strictly followed.

4.5.5.4 As there are no NSRs in the vicinity of the Eagle's Nest tunnel, potential structural borne noise arising from the tunnel boring machine is not expected.

Environmental Monitoring and Audit

4.5.5.5 The recommended mitigation measures, monitoring procedures and locations are presented in the Environmental Monitoring and Audit Programme (EM&A) shown in *Section 13*. This will enable the Contractor to have early warning and provide necessary action to reduce noise emissions at specific areas if the assessment criteria are approached. The effectiveness of on-site control measures could also be evaluated through the monitoring exercise. All the recommended mitigation measures should be incorporated into the EM&A programme for implementation during construction.

4.6 Operational Phase

4.6.1 Road Traffic Noise

4.6.1.1 During the operational phase, road traffic noise will be the dominant noise source within the Study Area and potentially affecting both the existing and planned noise sensitive developments. Source of noise are identified to be road traffic on the proposed Route 16.

4.6.2 Noise Sensitive Receivers

4.6.2.1 In additional to the NSRs identified for the construction phase, worst impacted representative NSRs have been identified and are shown in Figures 4.6a to 4.6k. Where applicable, the noise levels for each NSRs have been predicted at three different floor levels (low, medium and top). Representative floors and the corresponding mPD height of each NSRs are shown in Table 4.6a.

Table 4.6a Noise Sensitive Receivers - Operational Phase

Description	NSR ID	Representative floors			Representative floors mPD		
Mei Foo Sun Chuen, Phase 8 (Block 132)	MF1	1/F	10/F	19/F	14.7	39.9	65.1
Mei Foo Sun Chuen, Phase 4 (Block 113)	MF2	1/F	10/F	19/F	14.7	39.9	65.1
Mei Foo Sun Chuen, Phase 4 (Block 113)	MF3	1/F	10/F	19/F	14.7	39.9	65.1
Mei Foo Sun Chuen, Phase 4 (Block 113)	MF4	1/F	10/F	19/F	14.7	39.9	65.1
Mei Foo Sun Chuen, Phase 6 (Block 46)	MF5	1/F	15/F	29/F	9.2	34.4	59.6
Mei Foo Sun Chuen, Phase 6 (Block 42)	MF6	1/F	15/F	29/F	9.2	34.4	59.6
Mei Foo Sun Chuen, Phase 6 (Block 9)	MF7	1/F	15/F	29/F	9.2	34.4	59.6
Mei Foo Sun Chuen, Phase 5 (Block 7)	MF8	1/F	15/F	29/F	9.2	34.4	59.6
Mei Foo Sun Chuen, Phase 5 (Block 7)	MF9	1/F	15/F	29/F	9.2	34.4	59.6
Mei Foo Sun Chuen, Phase 5 (Block 9)	MF10	1/F	15/F	29/F	9.2	34.4	59.6
Haking Wong TI	NO1	1/F	3/F	\	8.2	13.8	\
Haking Wong TI	NO2	1/F	3/F	\	8.2	13.8	\
KMB Bus Depot CDA Site (Tower 1)	511-518	1/F	17/F	34/F	31.2	79.2	130.2
KMB Bus Depot CDA Site (Tower 2)	521-528	1/F	17/F	33/F	31.2	79.2	127.2
KMB Bus Depot CDA Site (Tower 3)	531-538	1/F	16/F	31/F	28.1	73.1	118.1
KMB Bus Depot CDA Site (Tower 4)	541-548	1/F	14/F	27/F	28.1	64.1	103.1
Site 10 - Residential Blocks (Tower 1)	600-607	1/F	20/F	40/F	9.2	61.5	116.5
Site 10 - Residential Blocks (Tower 2)	608-615	1/F	20/F	39/F	9.2	61.5	113.7
Site 10 - Residential Blocks (Tower 3)	616-623	1/F	20/F	39/F	9.2	61.5	113.7
Site 10 - Residential Blocks (Tower 4)	624-631	1/F	20/F	37/F	9.2	61.5	108.2
Site 10 - Residential Blocks (Tower 5)	632-639	1/F	20/F	37/F	9.2	61.5	108.2
Site 10 - Residential Blocks (Tower 6)	640-647	1/F	20/F	40/F	9.2	61.5	116.5
Site 10 - Residential Blocks (Tower 7)	648-655	1/F	20/F	40/F	9.2	61.5	116.5
Site 10 - School 1	656-657	1/F	4/F	7/F	11.5	21.6	31.5
Site 10 - School 2	658	1/F	4/F	7/F	11.5	21.6	31.5

Description	NSR ID	Representative floors			Representative floors mPD		
Site 10 - School 3	659	1/F	4/F	7/F	11.5	21.6	31.5
LCK Reception Centre - New Staff Quarter (Block A)	NO6	3/F	7/F	15/F	20.5	31.7	54.1
LCK Reception Centre - New Staff Quarter (Block B)	NO7	1/F	7/F	15/F	14.4	31.7	54.1
LCK Reception Centre - New Staff Quarter (Block B)	NO8	1/F	7/F	15/F	14.4	31.7	54.1
LCK Reception Centre Staff Quarters	NO9	1/F	3/F	6/F	8.7	13.8	22.7
LCK Reception Centre Staff Quarters	NO10	1/F	3/F	6/F	8.7	13.8	22.7
LCK Reception Centre Staff Quarters	NO11	1/F	3/F	6/F	8.7	13.8	22.7
LCK Reception Centre Staff Quarters	NO12	1/F	5/F	9/F	8.7	19.9	31.1
LCK Reception Centre Staff Quarters	NO13	1/F	5/F	9/F	8.7	19.9	31.1
LCK Reception Centre Staff Quarters	NO14	1/F	5/F	11/F	8.7	19.9	36.7
LCK Reception Centre Staff Quarters	NO15	1/F	5/F	11/F	8.7	19.9	36.7
LCK Hospital	NO16	G/F	1/F	\	30.9	33.7	\
LCK Hospital	NO17	G/F	1/F	\	30.9	33.7	\
LCK Hospital	NO18	G/F	1/F	\	48.4	51.2	\
LCK Hospital	NO19	G/F	1/F	\	48.4	51.2	\
LCK Hospital	NO20	G/F	1/F	\	48.4	51.2	\
LCK Hospital	NO21	G/F	1/F	\	48.4	51.2	\
LCK Hospital	NO22	G/F	1/F	\	48.4	51.2	\
LCK Hospital	NO23	G/F	1/F	\	48.4	51.2	\
Ching Lai Court	NO24	1/F	7/F	13/F	22.8	39.6	56.4
Public Library	NO25	1/F	3/F	6/F	10.5	16.5	25.5
Site A - Block 4	L1	1/F	21/F	41/F	11.8	67.8	123.8
Site A - Block 4	L2	1/F	21/F	41/F	11.8	67.8	123.8
Site A - Block 5	L3	1/F	21/F	41/F	11.8	67.8	123.8
Site A - Block 5	L4	1/F	21/F	41/F	11.8	67.8	123.8
Site A - Block 5	L5	1/F	21/F	41/F	11.8	67.8	123.8
Site A - Block 5	L6	1/F	21/F	41/F	11.8	67.8	123.8
Site A - Block 5	L7	1/F	21/F	41/F	11.8	67.8	123.8
Site A - Primary School	L8	1/F	4/F	7/F	11.8	20.8	29.8
Site A - Primary School	L9	1/F	4/F	7/F	11.8	20.8	29.8
Site A - Primary School	L10	1/F	4/F	7/F	11.8	20.8	29.8
Site A - Block 1	L11	1/F	21/F	41/F	11.8	67.8	123.8
Site A - Block 1	L12	1/F	21/F	41/F	11.8	67.8	123.8
Site B Tower 1	L13	1/F	15/F	29/F	36.2	75.4	114.6
Site B Tower 3	L14	1/F	15/F	29/F	36.2	75.4	114.6

Description	NSR ID	Representative floors			Representative floors mPD		
Village House, Butterfly Valley	V1	G/F	1/F	\	116.5	119.5	\
Village House, Butterfly Valley	V2	G/F	1/F	\	116.5	119.5	\
Village House, Butterfly Valley	V3	G/F	1/F	\	126.5	129.5	\
Village House, Butterfly Valley	V4	G/F	1/F	\	126.5	129.5	\
Village House, Butterfly Valley	V5	G/F	\	\	81.5	\	\
Village House, Butterfly Valley	V6	G/F	\	\	81.5	\	\
O Pui Shan Boy's Home	V7	G/F	1/F	\	122.5	125.5	\
O Pui Shan Boy's Home	V8	G/F	1/F	\	122.5	125.5	\
O Pui Shan Boy's Home	V9	G/F	1/F	\	122.5	125.5	\
O Pui Shan Boy's Home	V10	G/F	1/F	\	123.2	126.2	\
O Pui Shan Boy's Home	V11	G/F	1/F	\	123.2	126.2	\
O Pui Shan Boy's Home	V12	G/F	1/F	\	123.2	126.2	\
Village House, Tai Ching Cheung Village	V13	G/F	\	\	113.5	\	\
Village House, Tai Ching Cheung Village	V23	G/F	\	\	99.5	\	\
Village House, Tai Ching Cheung Village	V24	G/F	\	\	91.5	\	\
Village House, Tai Ching Cheung Village	V28	G/F	1/F	\	77.5	80.5	\
Village House, Tai Ching Cheung Village	V30	G/F	\	\	71.5	\	\
Village House, Tai Ching Cheung Village	V31	G/F	\	\	69.5	\	\
Village House, Tai Ching Cheung Village	V32	G/F	\	\	81.5	\	\
Village House, Tai Ching Cheung Village	V33	G/F	\	\	87.5	\	\
Village House, Tai Ching Cheung Village	V34	G/F	\	\	87.5	\	\
Village House, Tai Ching Cheung Village	V35	G/F	\	\	105.5	\	\
Village House, Tai Ching Cheung Village	V36	G/F	\	\	111.5	\	\
Village House, Tai Ching Cheung Village	V37	G/F	\	\	110.5	\	\
Village House, Tai Ching Cheung Village	V38	G/F	\	\	111.5	\	\
Village House, Tai Ching Cheung Village	V39	G/F	\	\	112.5	\	\
G/IC - Butterfly Valley	P1	1/F	2/F	3/F	133.8	136.6	139.4
G/IC - Butterfly Valley	P2	1/F	2/F	3/F	133.8	136.6	139.4
G/IC - Butterfly Valley	P3	1/F	2/F	3/F	133.8	136.6	139.4
R (C) - Butterfly Valley	P4	1/F	2/F	3/F	123.8	126.6	129.4
R (C) - Butterfly Valley	P5	1/F	2/F	3/F	123.8	126.6	129.4
R (C) - Butterfly Valley	P6	1/F	2/F	3/F	123.8	126.6	129.4

4.6.3 Assessment Methodology

4.6.3.1 Road traffic noise calculations have been undertaken in accordance with the UK methodology *Calculation of Road Traffic Noise* (CRTN), which is currently required by the EPD.

4.6.3.2 The road scheme within the Study Area and the surrounding road network have been divided into 612 road segments, each of which has been assigned with one of 145 road layouts. A road layout defines the road width, surface type, traffic condition and if applicable, the height and locations of roadside barriers. The segmentation process was carried out in accordance with the CRTN procedure and the noise modelling was carried out using *HFANoise* road traffic noise model, which fully implements CRTN procedures and methodologies. Hard ground, as defined in CRTN, has been assumed throughout the Study Area and all other features that may result in noise screening are defined in the model.

4.6.3.3 The use of low noise road surfacing have been assumed for all "new" roads as a standard measures (excluding the tunnel section); while standard wearing course have been assumed for all the existing roads.

4.6.3.4 In order to predict impacts from future traffic conditions, the EPD recommends that, in line with CRTN procedures, traffic noise should be modelled based on the worst case year traffic forecast within 15 years after the opening of the development. Year 2019 is considered as the worst case year and has been used in this assessment to assess the road traffic noise impacts associated with the planned developments. *Figure 2.2c* presents the traffic data used in road noise assessment (pm peak hour traffic forecasts) which was abstracted from the TIA Study and was subsequently endorsed by the Transport Department. The year 2000 traffic data has been used to establish the prevailing noise levels (see *Figure 2.2b*).

4.6.3.5 Traffic noise impacts were then assessed against the EIAO-TM road traffic noise limits of $L_{10, \text{peak hour}}$ 70 dB(A) for residential uses and $L_{10, \text{peak hour}}$ 65 dB(A) for educational institutions and $L_{10, \text{peak hour}}$ 55 dB(A) for hospital (see *Table 4.2d*). Any predicted levels exceeding the EIAO-TM road traffic noise criteria are considered to constitute significant impacts and practicable direct mitigation measures will be recommended.

4.6.4 Evaluation of Impacts

4.6.4.1 The potential noise impacts on the NSRs by the year 2019 with the operation of Route 16 are discussed below and the unmitigated predicted noise levels are given in Table 4C-1 in Annex 4C.

4.6.4.2 As discussed in Section 2 it was originally anticipated that the use of a 400m long air-tight road enclosure extending from the Eagle's Nest South Portal is necessary to overcome the potential chlorine hazard from the Tai Po Road WTW. However, based on the latest development on the hazard assessment, the air-tight full enclosure could be eliminated as a result of the relocation of the chlorine store of the Tai Po Road WTW. Therefore as a worst case scenario, no enclosure extending from the Eagle's Nest South Portal has been assumed in this assessment.

Mei Foo Sun Chuen

4.6.4.3 As indicated in Table 4C-1, the noise levels at Mei Foo Sun Chuen - Phase 4, 5 & 6 (NSRs MF3 to MF 10) will be dominated by road traffic noise from the existing road network. The noise levels from the existing road will already exceed the road traffic noise criterion of $L_{10, \text{peak hour}}$ 70 dB(A). Table 4C-1 in Annex 4C indicates that although the noise contribution from Route 16 are at least 10 dB(A) below the existing road networks, the noise due to the new roads still exceeds the road traffic noise criterion of $L_{10, \text{peak hour}}$ 70 dB (A) at MF07 to MF10. Therefore mitigation measures on Route 16 will be required.

4.6.4.4 The noise levels at Mei Foo Sun Chuen - Phase 4 & 8 (NSRs MF1 & MF2) will comply with the road traffic noise criterion of $L_{10, \text{peak hour}}$ 70 dB(A) implying traffic noise from the Route 16 alignment will not cause any adverse impacts at these NSRs. Therefore mitigation measures will not be required.

Haking Wong TI

4.6.4.5 As indicated in Table 4C-1, the noise levels at Haking Wong TI (NSR NO2) will be dominated by road traffic noise from the existing road network. The noise levels from the existing road will already exceed the road traffic noise criterion of $L_{10, peak\ hour}$ 65 dB(A). Table 4C-1 in Annex 4C indicates that although the noise contribution from Route 16 are at least 10 dB(A) below the existing road networks, the noise due to the new roads still exceeds the road traffic noise criterion of $L_{10, peak\ hour}$ 65 dB (A) at NO2. Therefore mitigation measures on Route 16 will be required.

4.6.4.6 The noise levels at south-western facade of Haking Wong TI (NSR NO1) will exceed the road traffic noise criterion of $L_{10, peak\ hour}$ 65 dB(A). Therefore mitigation measures will be required.

KMB Bus Depot CDA Site

4.6.4.7 The noise levels at the facade of the residential buildings facing the Route 16 alignment (NSRs 511 to 514, 521 to 524, 531 to 534 and 541 to 544) are above the road traffic noise criterion of $L_{10, peak\ hour}$ 70 dB (A) and hence mitigation measures are required. The main noise contribution are from traffic on the Route 16 alignment. Direct mitigation measures will be assessed to alleviate the noise impacts at these NSRs.

4.6.4.8 As indicated in Table 4C-1, the noise levels at NSRs 517, 518, 525, 526, 535, 536 and 545 to 548 will be dominated by road traffic from the existing road network. The noise levels from the existing road will already exceed the road traffic noise criterion of $L_{10, peak\ hour}$ 70 dB (A). Table 4C-1 in Annex 4C indicates that the noise contribution from Route 16 is at least 7 dB (A) below the existing road networks and comply with the road traffic noise criterion of $L_{10, peak\ hour}$ 70 dB (A). These NSRs are therefore excluded from the consideration of mitigation measures as it would not be effective to provide mitigation measures on Route 16.

4.6.4.9 Table 4C-1 indicates that the noise levels at the facade of the residential towers facing away from the Route 16 alignment (NSRs 515, 516, 527, 528, 537 and 538) will comply with the road traffic noise criterion of $L_{10, peak\ hour}$ 70 dB (A). Therefore mitigation measures will not be required for these NSRs.

Site 10

4.6.4.10 The noise levels at the facade of residential towers facing the Route 16 alignment (NSRs 629, 630, 632, 637 to 642, 645 to 650 and 655) are above the road traffic noise criterion and hence mitigation measures are required. The main noise contribution are from traffic on the Route 16 alignment. Direct mitigation measures will be assessed to alleviate the noise impacts at these NSRs.

4.6.4.11 Table 4C-1 indicates that the noise levels at the facade of residential towers facing away from the Route 16 alignment (NSRs 600 to 602, 608 to 610, 617 to 618, 625 to 626, 633 to 634, 643, 644, 651, 653 and 654) will comply with the road traffic noise criterion of $L_{10, peak\ hour}$ 70 dB(A) implying traffic noise from the Route 16 alignment will not cause any adverse impacts at these NSRs. Therefore mitigation measures will not be required for these NSRs.

4.6.4.12 As indicated in Table 4C-1, the noise levels at the facade of the residential towers facing the West Kowloon Expressway (NSRs 603 to 607, 611 to 616, 619 to 624, 627, 628, 631, 635, 636 and 652) will be dominated by road traffic from the existing road network. The noise levels from the existing road will already exceed the road traffic noise criterion of $L_{10, peak\ hour}$ 70 dB (A). Table 4C-1 in Annex 4C indicates that the noise contribution from Route 16 is at least 7 dB (A) below the existing road networks and comply with the road traffic noise criterion of $L_{10, peak\ hour}$ 70 dB (A). These NSRs are therefore excluded from the consideration

of mitigation measures as it would not be effective to provide mitigation measures on Route 16.

4.6.4.13 Exceedances of the road traffic noise criterion are also predicted at the sensitive facade of School 1 (NSRs 656 and 657) and hence mitigation measures are required. The main noise contribution are from traffic on the existing road network and Route 16 alignment. Direct mitigation measures will be assessed to alleviate the noise impacts at these NSRs.

4.6.4.14 Due to the large separation distance between Route 16 and the Schools 2 & 3, these schools will not be affected by road traffic noise from the Route 16. Table 4C-1 indicates that all NSRs (NSRs 658 and 659) will be dominated by road traffic noise from the existing road network. The noise levels from the existing road will already exceed the road traffic criterion of $L_{10, peak hour}$ 65 dB (A) and the noise levels due to new roads at these NSRs will comply with road traffic noise criterion of $L_{10, peak hour}$ 65 dB (A). Therefore mitigation measures will not be required.

LCK Reception Centre - New Staff Quarter

4.6.4.15 As indicated in Table 4C-1, the noise levels at the southern facade of Block A (NSR NO6) will be dominated by road traffic from the existing road network. The noise levels from the existing road will already exceed the road traffic noise criterion of $L_{10, peak hour}$ 70 dB(A). Table 4C-1 in Annex 4C indicates that the noise contribution from Route 16 is at least 8 dB(A) below the existing road networks and comply with the road traffic noise criterion of $L_{10, peak hour}$ 70 dB (A). This NSR is therefore excluded from the consideration of mitigation measures as it would not be effective to provide mitigation measures on Route 16.

4.6.4.16 As indicated in Table 4C-1, the Block B (NSR NO7 & NO8) is affected by noise contribution from exiting roads and the Route 16. Since the existing noise levels are already above the $L_{10, peak hour}$ 70 dB(A) limit, the road traffic noise criterion can not be achieved by direct mitigation measures on new roads alone. However, direct mitigation measures will be assessed to alleviate the noise impact from Route 16.

LCK Reception Centre Staff Quarters

4.6.4.17 Due to the high elevation of the alignment, the low and mid levels receivers are protected by the screening effect provided by the alignment structure and as indicated in Table 4C-1, the noise levels at the low level receivers are dominated by road traffic noise from the existing road network and the noise due to the new roads will comply with the road traffic noise criterion of $L_{10, peak hour}$ 70 dB (A). However, the top levels receivers (NSR NO 9 to NO 15) are affected by noise contribution from both existing roads and Route 16. Since the existing noise levels are already above the $L_{10, peak hour}$ 70 dB(A) limit, the road traffic noise criterion can not be achieved by direct mitigation measures on new roads alone. However, direct mitigation measures will be assessed to alleviate the noise impact from Route 16.

LCK Hospital

4.6.4.18 The noise levels at the eastern facade of LCK Hospital (NSRs NO16 to NO19) are above the road traffic noise criterion and hence mitigation measures are required. The main noise contribution are from traffic noise on the existing road network and the Route 16 alignment. Direct mitigation measures will be assessed to alleviate the noise impacts at these NSRs.

4.6.4.19 As indicated in Table 4C-1, the noise levels at the western and southern facades of LCK Hospital (NSR NO20 to NO23) will be dominated by road traffic noise from the existing road network. The noise levels from the existing road will already exceed the road traffic noise criterion of $L_{10, peak hour}$ 55 dB(A). Table 4C-1 in Annex 4C indicates that although the noise contribution from Route 16 is at least 8 dB(A) below the existing road networks, the noise

due to the new roads still exceeds the road traffic noise criterion of $L_{10, peak\ hour}$ 55 dB (A). Therefore mitigation measures on Route 16 will be required.

Ching Lai Court

4.6.4.20 As indicated in Table 4C-1, the noise levels at Ching Lai Court (NSR NO24) will be dominated by road traffic noise from the existing road network. The noise levels from the existing road will already exceed the road traffic noise criterion of $L_{10, peak\ hour}$ 70 dB(A). Table 4C-1 in Annex 4C indicates that the noise contribution from Route 16 is at least 15 dB(A) below the existing road networks and its within the road traffic noise criterion of $L_{10, peak\ hour}$ 70 dB (A). This NSR is therefore excluded from the consideration of mitigation measures as it would not be effective to provide mitigation measures on Route 16.

Public Library

4.6.4.21 As indicated in Table 4C-1, the noise levels at the Public Library (NSR NO25) will be dominated by road traffic noise from the existing road network. The noise levels from the existing road will already exceed the road traffic noise criterion of $L_{10, peak\ hour}$ 70 dB(A). Table 4C-1 in Annex 4C indicates that the noise contribution from Route 16 is at least 9 dB(A) below the existing road network and its within the road traffic noise criterion of $L_{10, peak\ hour}$ 70 dB (A). This NSR is therefore excluded from the consideration of mitigation measures as it would not be effective to provide mitigation measures on Route 16.

Housing development site located at the old Lai Chi Kok Amusement Park

4.6.4.22 As indicated in Table 4C-1, the noise levels at Site A - Blocks 1, 4 & 5 and the primary school (NSRs L1 to L6 and L9 to L12) will be dominated by road traffic noise from the existing road network. The noise levels from the existing road will already exceed the road traffic noise criterion of $L_{10, peak\ hour}$ 65 and 70 dB(A) for schools and residential uses respectively. Table 4C-1 in Annex 4C indicates that the noise contribution from Route 16 is at least 8 dB(A) below the existing road networks and its within the road traffic noise criterion of $L_{10, peak\ hour}$ 70 dB (A). These NSRs are therefore excluded from the consideration of mitigation measures as it would not be effective to provide mitigation measures on Route 16.

4.6.4.23 The noise levels at Site A - Block 5, primary school and Site B - Tower 1 & 3 (NSRs L7, L8, L13 and L14) will comply with the road traffic noise criterion of $L_{10, peak\ hour}$ 65 and 70 dB(A) for schools and residential uses respectively, implying traffic noise from the Route 16 alignment will not cause any adverse impacts at these NSRs. Therefore mitigation measures will not be required.

Village House, Butterfly Valley

4.6.4.24 Owing to the topography of the area, the noise levels at these village houses (NSRs V1 to V6) will comply with the road traffic noise criterion of $L_{10, peak\ hour}$ 70 dB(A) implying traffic noise from the Route 16 alignment will not cause any adverse impacts at these NSRs. Therefore mitigation measures will not be required.

O Pui Shan Boy's Home

4.6.4.25 Owing to the topography of the area, the noise levels at the boy's home (NSRs V7 to V12) will comply with the road traffic noise criterion of $L_{10, peak\ hour}$ 70 dB(A) implying traffic noise from the Route 16 alignment will not cause any adverse impacts at these NSRs. Therefore mitigation measures will not be required.

Village House, Tai Ching Cheung Village

4.6.4.26 Owing to the topography of the area, the noise levels at some village houses (NSRs V32, V33, V35, V36 and V39) will comply with the road traffic noise criterion of $L_{10, peak\ hour}$ 70 dB(A)

implying traffic noise from the Route 16 alignment will not cause any adverse impacts at these NSRs. Therefore mitigation measures will not be required.

4.6.4.27 The noise levels at some other village houses (NSRs V13, V23, V24, V37 and V38) are above the road traffic noise criterion and hence mitigation measures are required. The main noise contribution are from traffic noise on the existing road network and the Route 16 alignment. Direct mitigation measures will be assessed to alleviate the noise impacts at these NSRs.

4.6.4.28 As indicated in Table 4C-1, the noise levels at the western part of Tai Ching Cheung Village (NSR V28, V30, V31 and V34) will be dominated by road traffic noise from the existing road network. The noise levels from the existing road will already exceed the road traffic noise criterion of $L_{10, peak hour}$ 70 dB(A). Table 4C-1 in Annex 4C indicates that the noise contribution from Route 16 is at least 8 dB(A) below the existing road networks and the noise levels due to new roads at these NSRs will comply with the road traffic noise criterion of $L_{10, peak hour}$ 70 dB (A). These NSRs are therefore excluded from the consideration of mitigation measures as it would not be effective to provide mitigation measures on Route 16.

Planned landuse at Butterfly Valley

4.6.4.29 As indicated in Table 4C-1, the noise levels at the planned landuse (NSRs P2 to P5) are above the road traffic noise criterion and hence mitigation measures are required. The main noise contribution are from traffic noise on the Route 16 alignment. Direct mitigation measures will be assessed to alleviate the noise impacts at these NSRs.

4.6.4.30 As indicated in Table 4C-1, the noise levels at NSRs P1 and P6 will comply with the road traffic noise criterion of $L_{10, peak hour}$ 70 dB(A) implying traffic noise from the Route 16 alignment will not cause any adverse impacts at these NSRs. Therefore mitigation measures will not be required.

4.6.5 Traffic Noise Mitigation Measures

4.6.5.1 The assessment in the above section indicates that the most affected area will be at the Mei Foo Sun Chuen Phases 5 & 6, Haking Wong TI, KMB Bus Depot CDA site, Site 10, Lai Chi Kok Reception Center Staff Quarters, Lai Chi Kok Hospital, village houses in Tai Ching Cheung Village and the planned landuse at Butterfly Valley. Mitigation measures will be required to reduce these impacts to within the road traffic noise criterion.

4.6.5.2 A progressively extensive set of mitigation measures have been investigated in order to reduce the noise contribution from the Route 16 alignment. The different mitigation options are described in the section below.

Mitigation Option 1

4.6.5.3 Based on the recommendation presented in the previous EIA report, the use of a 5m high roadside noise barriers located along the northbound carriageway of Route 16 and 3m high roadside noise barrier located along southbound carriageway of Route 16 have been considered. The package of mitigation measures are as follows:

- 3m high roadside noise barrier located along the northbound and southbound carriageway of the direct connection to Route 9 (as recommended by the Route 9 study);
- 3m high roadside noise barrier located at both side of Slip A;
- 3m high roadside noise barrier located at both side of Slip B;

- 5m high roadside noise barrier located on the western side of the northbound carriageway of LCKV (opposite LCK Reception Centre Staff Quarters);
- 3m high roadside noise barrier located on the western side of the southbound carriageway of the LCKV (opposite LCK Reception Centre Staff Quarters);
- 5m high roadside noise barrier located on the western side of the northbound carriageway of Route 16 mainline (opposite the CLP substation);
- 5m high roadside noise barrier located on the eastern side of the southbound carriageway of Route 16 (opposite the planned landuse at Butterfly Valley);
- 3m high roadside noise barrier located on the southern side of Slip D; and
- 3m to 3.5m high roadside noise barrier located on the southern side of Slip E

4.6.5.4 Locations of the mitigation measures are shown in Figures 4.6 (l to o). The effect of the noise barriers is shown in Table 4C-2 of Annex 4C.

Mei Foo Sun Chuen

4.6.5.5 As shown in Table 4C-2 in Annex 4C, the predicted noise levels indicate that the 3 to 3.5m roadside noise barriers along the Ching Cheung Road Slops are effective in reducing the noise contribution from Route 16. The results indicate that whilst the road traffic noise criterion cannot be achieved because of contribution from existing roads, the noise levels from Route 16 have been reduced at the top floor receivers and are within the road traffic noise criterion. However, the traffic noise on the existing roads has a high noise impact on the NSRs. Further mitigation measures have not been considered as it would not be effective to provide mitigation measures on Route 16 alone and the overall noise levels will not be further reduced. It is considered that the combination of 3m to 3.5m noise barriers does represent a package of direct mitigation measures which would ensure the new Route 16 alignment does not further deteriorate the future noise environment. The residual impacts at this location will be assessed against the noise insulation criteria as discussed in Section 4.2.

KMB Bus Depot CDA Site

4.6.5.6 Due to the elevation of the road alignment, the predicted noise levels indicate that the barriers are effective at the low to mid floor receivers only as the upper floor residents will look down onto the roads at steep angle, and consequently the 3m high barrier will have limited effect. Hence, high levels of noise impacts are still predicted at NSRs 511 to 514, 521 to 524, 531 to 534, 541 and 542. Additional mitigation measures are therefore required.

Site 10

4.6.5.7 Due to the elevation of the road alignment, the predicted noise levels indicate that the barriers are effective at the low floor receivers only as the mid to upper floor residents will look down onto the roads at steep angle, and consequently the 3m high barrier will have limited effect. Hence, high levels of noise impacts are still predicted at NSRs 629, 630, 637 to 642, 647 to 650 and 655. Additional mitigation measures are therefore required.

4.6.5.8 As shown in Table 4C-2 in Annex 4C, the predicted noise levels indicate that the barriers are effective in reducing the noise contribution from Route 16 at NSR 657. However for NSR 656, the noise due to the Route 16 still exceeds the road traffic noise criterion and therefore additional mitigation measures are required.

Haking Wong TI

4.6.5.9 As shown in Table 4C-2 in Annex 4C, the predicted noise levels indicate that the barriers are effective in reducing the noise contribution from Route 16. The results indicate that whilst the road traffic noise criterion cannot be achieved because of contribution from existing roads, the noise levels from Route 16 have been reduced at the top floor receivers and are within the noise criterion of $L_{10, peak\ hour}$ 65 dB (A). However, as this package of mitigation measures is not adequate to reduce the noise impacts at Site 10 and the KMB Bus Depot CDA site, additional mitigation measures are required.

LCK Reception Centre - New Staff Quarters

4.6.5.10 As shown in Table 4C-2 in Annex 4C, the predicted noise levels indicate that the barriers are effective in reducing the noise contribution from Route 16. The results indicate that whilst the road traffic noise criterion cannot be achieved because of contribution from existing roads, the noise levels from Route 16 have been reduced by 4 dB(A) at the top floor receivers. However, the traffic noise on the existing roads (ie Kwai Chung Road and Butterfly Valley Road) has a high noise impact on the NSRs. Further mitigation measures have not been considered as it would not be effective to provide mitigation measures on Route 16 alone and the overall noise levels will not be further reduced. It is considered that the combination of 3m, 5m noise barriers does represent a package of direct mitigation measures which would ensure the new Route 16 alignment does not further deteriorate the future noise environment. The residual impacts at this location will be assessed against the noise insulation criteria as discussed in Section 4.2.

LCK Reception Centre Staff Quarters

4.6.5.11 As shown in Table 4C-2 in Annex 4C, the predicted noise levels indicate that the barriers are effective in reducing the noise contribution from Route 16. The results indicate that for all receivers, whilst the road traffic noise criterion cannot be achieved because of contribution from existing roads, the noise levels from Route 16 have been reduced by 5 to 10 dB(A) at top floor. However, the traffic noise on the existing roads (ie Butterfly Valley Road) has a high noise impact on the NSRs. Further mitigation measures have not been considered as it would not be effective to provide mitigation measures on Route 16 alone and the overall noise levels will not be further reduced. It is considered that the combination of 3m, 5m noise barriers does represent a package of direct mitigation measures which would ensure the new Route 16 alignment does not further deteriorate the future noise environment. The residual impacts at this location will be assessed against the noise insulation criteria as discussed in Section 4.2.

LCK Hospital

4.6.5.12 As shown in Table 4C-2 in Annex 4C, the predicted noise levels indicate that the barriers are effective in reducing the noise contribution from Route 16. The results indicate that for all receivers, whilst the road traffic noise criterion cannot be achieved because of contribution from existing roads, the noise levels from Route 16 have been reduced by 3 to 6 dB(A) at top level receivers. However, the traffic noise due to the Route 16 still exceeds the road traffic noise criterion of $L_{10, peak\ hour}$ 55 dB (A). Further mitigation measures are therefore required to reduce the noise from Route 16 to within the criterion. In view of the stringent noise criterion, extensive mitigation measures will be necessary in order to reduce the noise contribution from Route 16 to within the criterion.

Village houses at Tai Ching Cheung

4.6.5.13 As shown in Table 4C-2 in Annex 4C, the predicted noise levels indicated that the barriers are not effective in reducing the noise levels at NSRs V13, V23, V24, V37 and V38 which are located at an elevation approximately 50m above the alignment level. It is considered that

these village houses, although low rise in nature, will look down onto the road at a steep angle, and consequently the 5m barrier will have limited effect. Additional mitigation measures are added to this option to investigate further noise protection.

Planned Landuse at Butterfly Valley

4.6.5.14 As shown in Table 4C-2 in Annex 4C, the predicted noise levels indicated that the barriers are not effective in reducing the noise levels at NSRs P2 to P5. Additional mitigation measures are added to this option to investigate further noise protection.

Mitigation 2

4.6.5.15 Since exceedances of the road traffic noise criterion are still predicted with the use of Mitigation Option 1, additional mitigation measures have been investigated and are as follows:

- 3m high roadside noise barrier located along the northbound and southbound carriageway of the direct connection to Route 9 (as recommended by the Route 9 study);
- 5m high roadside noise barrier located at both side of Slip A;
- 5m high roadside noise barrier located at both side of Slip B;
- 5m high roadside noise barrier located on the western side of the northbound carriageway of LCKV (opposite LCK Reception Centre Staff Quarters);
- 3m high roadside noise barrier located on the western side of the southbound carriageway of the LCKV (opposite LCK Reception Centre Staff Quarters);
- 5m high roadside noise barrier located on the western side of the northbound carriageway of Route 16 mainline (opposite the CLP substation);
- 3m high median noise barrier located on the western side of the southbound carriageway of Route 16 (opposite the CLP substation);
- 100m long semi-enclosure extending from the southbound of the Eagle's Nest South Portal;
- 5m high roadside noise barrier located on the eastern side of the southbound carriageway of Route 16 (opposite the planned landuse at Butterfly Valley);
- 3m high roadside noise barrier located on the southern side of Slip D; and
- 3m to 3.5m high roadside noise barrier located on the southern side of Slip E.

4.6.5.16 Locations of the mitigation measures are shown in Figures 4.6 (p to s). The effect of the noise barriers is shown in Table 4C-3 of Annex 4C.

KMB Bus Depot CDA Site

4.6.5.17 Due to the elevation of the road alignment, the predicted noise levels indicate that the barriers are effective at the low to mid floor receivers only as the upper floor residents will look down onto the roads at steep angle, and consequently the 5m high barrier will have limited effect. As indicated in Table 4C-3 of Annex 4C, high levels of noise impacts are still predicted at NSRs 512 to 514, 521 to 524, 531, 532, 541 and 542. Additional mitigation measures are therefore required.

Site 10

4.6.5.18 Due to the elevation of the road alignment, the predicted noise levels indicate that the barriers are effective at the low floor receivers only as the mid to upper floor residents will look down onto the roads at steep angle, and consequently the 5m high barrier will have limited effect. As indicated in Table 4C-3 of Annex 4C, high levels of noise impacts are still predicted at NSRs 638 to 641, 647, 648 and 655. Additional mitigation measures are therefore required.

4.6.5.19 As shown in Table 4C-3 in Annex 4C, the predicted noise levels indicate that the barriers are effective in reducing the noise contribution from Route 16 at NSR 657. However for NSR 656, the noise due to the Route 16 still exceeds the road traffic noise criterion and therefore additional mitigation measures are required.

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4.6.5.20 As shown in Table 4C-3 in Annex 4C, the predicted noise levels indicate that the barriers are effective in reducing the noise contribution from Route 16. However, as this package of mitigation measures is not adequate to reduce the noise impacts at Site 10 and the KMB Bus Depot CDA site, additional mitigation measures are required.

Village houses at Tai Ching Cheung

4.6.5.21 As shown in Table 4C-3 in Annex 4C, the predicted noise levels indicated that the barriers are not effective in reducing the noise levels at NSRs V13, V23, V24 and V38 which are located at an elevation approximately 50m above the alignment level. It is considered that these village houses, although low rise in nature, will look down onto the road at a steep angle, and consequently the proposed barriers will have limited effect. Additional mitigation measures are added to this option to investigate further noise protection.

Planned Landuse at Butterfly Valley

4.6.5.22 As shown in Table 4C-3 in Annex 4C, the predicted noise levels indicated that the mitigation measures are not effective in reducing the noise levels at NSRs P3 to P5. Additional mitigation measures are added to this option to investigate further noise protection.

Mitigation 3

4.6.5.23 Since exceedances of the road traffic noise criterion are still predicted at some of the NSRs with the use of Mitigation Option 2, additional mitigation measures have been investigated and are as follows:

- 3m high roadside noise barrier located along the northbound carriageway of the direct connection to Route 9 (as recommended by the Route 9 study);
- 5m high roadside noise barrier located along the northbound carriageway of the direct connection to Route 9
- full enclosure located at Slip A;
- full enclosure located at Slip B;
- semi-enclosure located at Slip B;
- 5m high roadside noise barrier located on the western side of the northbound carriageway of LCKV (opposite LCK Reception Centre Staff Quarters);

- 3m high roadside noise barrier located on the western side of the southbound carriageway of the LCKV (opposite LCK Reception Centre Staff Quarters);
- 5m high roadside noise barrier located on the western side of the northbound carriageway of Route 16 mainline (opposite the CLP substation);
- 5m high median noise barrier located on the western side of the southbound carriageway of Route 16 (opposite the CLP substation);
- 100m long semi-enclosure extending from the southbound of the Eagle's Nest South Portal;
- 7m high roadside noise barrier located on the eastern side of the southbound carriageway of Route 16 (opposite the planned landuse at Butterfly Valley);
- 3m high roadside noise barrier located on the southern side of Slip D; and
- 3m to 3.5m high roadside noise barrier located on the southern side of Slip E.

4.6.5.24 Locations of the mitigation measures are shown in Figures 4.6 (t to w). The effect of the noise barriers is shown in Table 4C-4 of Annex 4C.

KMB Bus Depot CDA Site

4.6.5.25 As shown in Table 4C-4 in Annex 4C, the predicted noise levels indicate that the barriers are effective in reducing the noise contribution from Route 16. The results indicate that for all receivers, whilst the road traffic noise criterion cannot be achieved because of contribution from existing roads, the noise levels from Route 16 have been reduced at top floor. However, the traffic noise on the existing roads has a high noise impact on the NSRs. Further mitigation measures have not been considered as it would not be effective to provide mitigation measures on Route 16 alone and the overall noise levels will not be further reduced. It is considered that the combination of 5m noise barriers, semi and full enclosures on the LCK Viaduct Slips does represent a package of direct mitigation measures which would ensure the new Route 16 alignment does not further deteriorate the future noise environment.

Site 10

4.6.5.26 As shown in Table 4C-4 in Annex 4C, the predicted noise levels indicated that the barriers are effective in reducing the noise contribution from Route 16. The results indicates that for all receivers, while the road traffic noise criterion cannot be achieved because of contribution from existing roads, the noise levels from Route 16 have been reduced to within the noise criterion of $L_{10,\ peak\ hour}$ 70 dB(A).

4.6.5.27 As shown in Table 4C-4 in Annex 4C, the predicted noise levels indicate that the barriers are effective in reducing the noise contribution from Route 16 at NSR 657. However for NSR 656, the noise due to the Route 16 still exceeds the road traffic noise criterion and therefore additional mitigation measures are required.

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4.6.5.28 As shown in Table 4C-4 in Annex 4C, the predicted noise levels indicate that the mitigation measures are effective in reducing the noise contribution from Route 16. However, as this package of mitigation measures is not adequate to reduce the noise impacts at Site 10, additional mitigation measures are required.

Village houses at Tai Ching Cheung

4.6.5.29 As shown in Table 4C-4 in Annex 4C, the predicted noise levels indicated that the barriers are not effective in reducing the noise levels at NSRs V13, V23, V24 and V38. Additional mitigation measures are added to this option to investigate further noise protection.

Planned Landuse at Butterfly Valley

4.6.5.30 As shown in Table 4C-4 in Annex 4C, the predicted noise levels indicated that the mitigation measures are still not effective in reducing the noise levels at NSRs P3 to P5. Additional mitigation measures are added to this option to investigate further noise protection.

Mitigation Option 4

4.6.5.31 Since exceedances of the road traffic noise criterion are still predicted at some of the NSRs with the use of Mitigation Option 3, additional mitigation measures have been investigated and are as follows:

- 3m high roadside noise barrier located along the western side of the northbound carriageway of the direct connection to Route 9 (as recommended by the Route 9 study; CH: -410MN to -120MN);
- 5m high roadside noise barrier located along the eastern side of the northbound carriageway of the direct connection to Route 9 (CH: -410MN to -210MN);
- 5m high roadside noise barrier located along the eastern side of the southbound carriageway of the direct connection to Route 9 (CH: -450MS to -75MS);
- full enclosure located at Slip A (CH: +65A to +320A);
- full enclosure located at Slip B (CH: +150B to +370B);
- semi-enclosure located at Slip B (CH: +370B to +480B);
- 3m high roadside noise barrier located on the western side of the northbound carriageway of LCKV (CH: +320A to +100MN);
- 5m high roadside noise barrier located on the western side of the northbound carriageway of LCKV (opposite LCK Reception Centre Staff Quarters) (CH: +100MN to +455MN);
- 3m high roadside noise barrier located on the western side of the southbound carriageway of the LCKV (opposite LCK Reception Centre Staff Quarters) (CH: -75MS to +455MS);
- semi-enclosure located at the northbound carriageway of Route 16 mainline (opposite the CLP substation) (CH: +520MN to +650MN, +1074A to 970MN);
- 5m x 2m cantilevered barrier located on the western side of the northbound carriageway of Route 16 (opposite the CLP substation) (CH: +975A to +1074A);
- 200m long semi-enclosure extending from the southbound of the Eagle's Nest South Portal (CH: +1200MS to +1370MS);
- 7m high roadside noise barrier located on the eastern side of the southbound carriageway of Route 16 (opposite the planned landuse at Butterfly Valley) (CH: +970MS to +1200MS);

- 4m high roadside noise barrier located on the northern side of the northbound carriageway of Route 16 (CH: +970MN to +1070MN);
- 3m high roadside noise barrier located on the southern side of Slip D (CH: +445D to +565D); and
- 3m to 3.5m high roadside noise barrier located on the southern side of Slip E (CH: E+750E to +550D).

4.6.5.32 Locations of the mitigation measures are shown in Figure 4.6 (x to z, aa & ab). The effect of the noise barriers is shown in Table 4C-5 of Annex 4C.

Site 10

4.6.5.33 As indicated in Table 4C-5 of Annex 4C, the noise due to Route 16 still exceeds the road traffic noise criterion at NSRs 656. Due to the complicated traffic movement in the Lai Wan interchange, adequate sight-line is required for safe traffic operations. For the southbound slips, there would be traffic moving from Road D3 to Road P1 and traffic moving from Route16 slip to CP3, therefore a certain length of weaving section (ie to allow traffic movement across a traffic lane in both directions) have to be provided in addition to the sight-line required ahead of an interchange. Similar for the northbound slips, a certain length of weaving section is also required for the traffic moving from CP3 to Road D3 (see Figure 4.6ab-1).

4.6.5.34 Furthermore, the need to erect adequate directional sign on such a complicated interchange would be essential and to further extent the full enclosure would impose a sight-line problem to the design of direction sign and their location. Therefore in view of the above constraints, the full enclosure recommended for the LCKV Slip A & B could not be further extended.

4.6.5.35 A noise sensitivity test has been carried out to check the effectiveness of increasing the direct mitigation measures on the main carriageway. The effect of using a semi-enclosure located on the southbound carriageway of approximately length 190 m was calculated and the results are shown in Table 4C-7. Results indicated that with the use of a semi-enclosure, the overall noise levels at the NSRs could not be reduced by more than 0.5 dB(A), and therefore the use of direct mitigation measures on the proposed alignment are considered to be exhausted.

4.6.5.36 Since the best practicable direct mitigation measures have been exhausted for the protection of the planned landuse. It is recommended as a last resort, that all the affected dwellings be fitted with Type I window insulation (6mm pane openable well-gasketted windows) and window-type air conditioners.

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4.6.5.37 As shown in Table 4C-5 in Annex 4C, the predicted noise levels indicate that the mitigation measures are effective in reducing the noise contribution from Route 16. The results indicate that whilst the road traffic noise criterion cannot be achieved because of contribution from existing roads, the noise levels from Route 16 are within the road traffic noise criterion. As the traffic noise on the existing roads has a high noise impact on the NSRs, further mitigation measures have not been considered as it would not be effective to provide mitigation measures on Route 16 alone and the overall noise levels will not be further reduced.

Village houses at Tai Ching Cheung

4.6.5.38 As shown in Table 4C-5 in Annex 4C, the predicted noise levels indicate that the mitigation measures are effective in reducing the noise levels to within the road traffic noise criterion at NSRs V13, V24 and V38.

4.6.5.39 As shown in Table 4C-5 in Annex 4C, the predicted noise levels indicate that the mitigation measures are effective in reducing the noise contribution from Route 16. The results indicate that whilst the road traffic noise criterion cannot be achieved because of contribution from existing roads, the noise levels from Route 16 are within the road traffic noise criterion. As the traffic noise on the existing roads has a high noise impact on the NSRs, further mitigation measures have not been considered as it would not be effective to provide mitigation measures on Route 16 alone and the overall noise levels will not be further reduced.

Planned Landuse at Butterfly Valley

4.6.5.40 As shown in Table 4C-5 in Annex 4C, the predicted noise levels indicate that the mitigation measures are effective in reducing the noise levels to within the road traffic noise criterion at NSRs P3 to P5.

Lai Chi Kok Hospital

4.6.5.41 As discussed in para 4.6.5.12, extensive mitigation measures will be required in order to reduce the noise contribution from Route 16 to the road traffic noise criterion of $L_{10, peak\ hour}$ 55 dB (A) at NSRs NO17, NO21 to NO23. Modelling results indicated that the noise contribution from each of the road link is already very low (ie in the region of 45 dB (A)). However, the combining effect of the alignment will result in exceedances of the stringent noise criterion. It is envisage that in order to further reduce the noise from the alignment, most road sections within a radius of 300m from the LCK hospital will need to be fully enclosed (ie the whole length of Ching Cheung Road Slip D & E).

4.6.5.42 As the proposed viaduct structure for the Ching Cheung Road Slips will be in the form of externally prestressed concrete girder bridge which are relatively less heavy structures, the use of high barriers or enclosures on the viaduct would not be engineering feasible and therefore further mitigation have not been recommended for this NSR. In addition since the noise levels from the existing roads are well above the noise levels from the Route 16, the use of direct mitigation measures on the Route 16 alone would not be effective.

Number of Dwellings Affected

4.6.5.43 Without any form of noise mitigation measures, it is estimate that the total number of dwellings and classrooms in the Study Area that would be subject to exceedances of the road traffic noise criteria is approximately 2760 and 40 respectively. However, out of the 2760 dwellings and 40 classrooms only approximately 900 dwellings and 24 classrooms would actually be affected by Route 16 as the other dwellings and classrooms would be mainly affected by existing roads. With the implementation of Mitigation Option 4, approximately 900 dwellings and 24 classrooms would benefit from noise reduction of 1 to 29 dB(A) from the Route 16 alignment. However, there would still be approximately 1800 dwellings and 26 classrooms that would subject to noise levels exceeding the noise criteria, due mainly to noise contribution from existing roads.

Residual Impacts

4.6.5.44 As discussed above, the use of direct mitigation measures have been evaluated and the best practicable package is recommended. However, owing to either environmental constraints or high existing background noise levels, residual impacts are predicted at some NSRs even with the use of the recommended direct mitigation measures. The residual impacts at these receivers have been assessed against the noise insulation criteria as stated in Section 4.2 above. In order to assess the number of dwellings that could qualified for noise insulation as a last resort, the mitigated noise levels have been compared with the three criteria as presented in Tables 4C-6 in Annex 4C.

4.6.5.45 From the assessment results presented in Tables 4C-6 in Annex 4C, results indicated that no NSRs will be eligible for indirect technical remedies in the form of window insulation and air conditioning.

4.6.6 Fixed Plant Noise Impact

4.6.6.1 The limiting Leq, period levels at 1m from the louvers of the ventilation building have been predicted to establish the limiting noise specifications, which will ensure that no exceedances of the noise criteria will result from the operation of the plant.

4.6.6.2 The location of the mid ventilation building for the Eagle's Nest Tunnel is shown in Figure 4.4h. Three receivers (as defined by NCO) namely Bamboo Villa, Pinehill and a new residential development site have been identified near the proposed ventilation building and are also shown in Figure 4.4h. The noise impacts from the operation of the ventilation building were assessed against the (ANL) minus 5 criteria or the prevailing background noise level, whichever is lower (see Table 4.2e). Based on the night-time monitoring results (Table 4.3a), it is envisaged that the background noise levels along Tai Po Road would not be lower than $L_{eq, 5\ min}$ 45 dB (A) . Therefore, in order to used the most stringent situation for assessment, the target levels at the receivers are the nighttime Acceptable Noise Levels (ANL) minus 5 (in line with the EIAO-TM), ie $L_{eq, 5\ min}$ 45 dB(A), since an Area Sensitivity Rating of A have been assumed for the residential buildings along Tai Po Road.

4.6.6.3 The preliminary design of the mid ventilation building indicates that the exhaust louvres will be of an area 300 m^2 and 140 m^2 located at the northern and western facade of the ventilation building respectively (ie pointing away from the nearby NSRs) (see Figures 4.6ac and 4.6ad). The worst case distance between the louvres and the NSRs are given in *Table 4.6b* below.

Table 4.6b Minimum Distance to NSRs

NSRs	Minimum distance from northern louvre to NSRs (m)	Minimum distance from western louvre to NSRs (m)
Bamboo Villa (1)	250	210
Pinehill (2)	135	110
New residential development (1)	135	130

Note:

(1) - There is no direct line of sight from these NSRs to both louvre locations

(2) - There is no direct line of sight from this NSR to the northern louvre location

4.6.6.4 Based on the existing topography, Bamboo Villa will be screened by the hill slope to the west of the mid ventilation building and a 10 dB(A) barrier reduction will be provided at this NSR. Similarly, as there is no direct line of sight from the New residential development to the louvre location, a 10 dB(A) barrier reduction will be applied to take into account the screening effect from the building structure.

4.6.6.5 Silencers and acoustical louvres would be installed to ensure the noise level (Leq, 30 min), as measured at 1m from the openings or louvres, would be less than 68 dB (A). The 1m facade noise levels of each NSRs taking into account distance and screening correction are given in Table 4.6c.

Table 4.6c Predicted facade noise levels (Leq, 30 min dB(A))

NSRs	Predicted facade noise levels (northern louvre)	Predicted facade noise levels (western louvre)	Total predicted facade noise levels
Bamboo Villa [1]	29.9	28.1	32.1
Pinehill [2]	35.2	43.7	44.3
New residential development [1]	35.2	32.2	36.9

Note:

(1) - There is no direct line of sight from this NSRs to both louvre location, a 10 dB(A) correction has been applied

(2) - There is no direct line of sight from this NSRs to the northern louvre location, a 10 dB(A) correction has been applied

4.6.6.6 The noise levels predicted at the NSRs are the worst case estimate as directivity has not been taken into account in the assessment. Table 4.6c, indicates that the noise generated from the mid ventilation building will comply with the EIAO-TM night-time criterion at all the nearby NSRs. It is anticipated that sizeable attenuators will be needed to achieve the recommended limiting SWL for each louvre and adequate space should be allocated to attenuators in the design.

4.7 Conclusion

4.7.1 Construction Phase

4.7.1.1 Unmitigated construction activities of Route 16 would cause exceedances of the daytime construction noise criteria at most of the nearby NSRs during the normal working hours. The most affected areas are the Lai Chi Kok Reception Centre Staff Quarters, LCK Hospital, the residential development at the old LCK amusement park and the residential buildings in the vicinity of the mid ventilation building along Tai Po Road.

4.7.1.2 Therefore, adequate control measures will be necessary for the works to meet the criteria. Mitigation measures including the use of quiet plant, on-site movable noise barrier, limiting the number of plant operating concurrently are required. It is also recommended that regular monitoring of noise at NSRs will be required during the construction phase.

4.7.1.3 Tunnel excavation are expected during the evening and night-time period. The predicted noise levels at the worst case representative NSRs for the tunnel excavation will comply with the evening noise criteria, however exceedances is predicted during the night-time period at all NSRs. It is expected the use of appropriate silencer could be used to further reduce the noise from the ventilation fans to comply with the night-time construction noise criteria. In any case, the contractor will be required to submit CNP application for any construction works carried out during the restricted hours period.

4.7.2 Operational Phase

4.7.2.1 This assessment has predicted that the traffic noise levels from Route 16 at the year 2019 will result in exceedances of the road traffic noise criterion at the nearby NSRs such as LCK Reception Centre Staff Quarters, housing development Site 10 and village houses at Tai Ching Cheung.

4.7.2.2 The best practicable mitigation package is recommended to comply with the road traffic noise criterion, comprising a combination of 3 to 7m high roadside noise barriers, semi and full enclosures as shown in Figure 4.6ab.

4.7.2.3 Residual impacts at the identified receivers with the implementation of the recommended direct mitigation measures have been assessed against the insulation criteria stated in Section 4.2. The assessment indicates that no existing NSRs will be eligible for indirect technical remedies in the form of window insulation and air-conditioning.

4.7.2.4 The specification of the fans for the ventilation building should be attenuated to the $L_{eq,\ 30\ min}$ 68 dB(A) at 1m from the main louvre area to ensure no exceedance of the NCO and EIAO-TM criteria at the nearby NSRs.

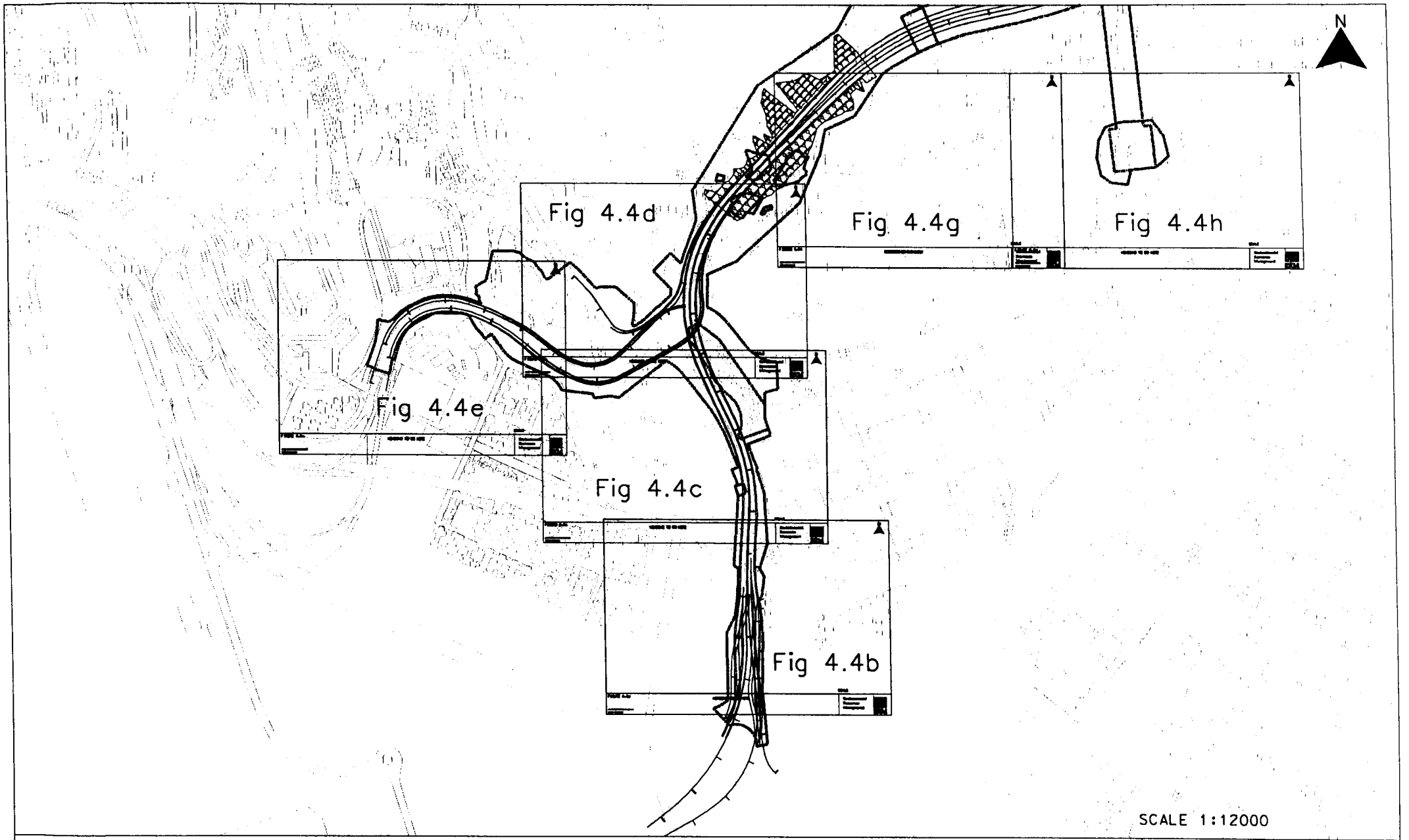

FIGURE 4.4a

LOCATION OF NOISE SENSITIVE RECEIVERS DURING CONSTRUCTION PHASE

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DATE: 18/03/99

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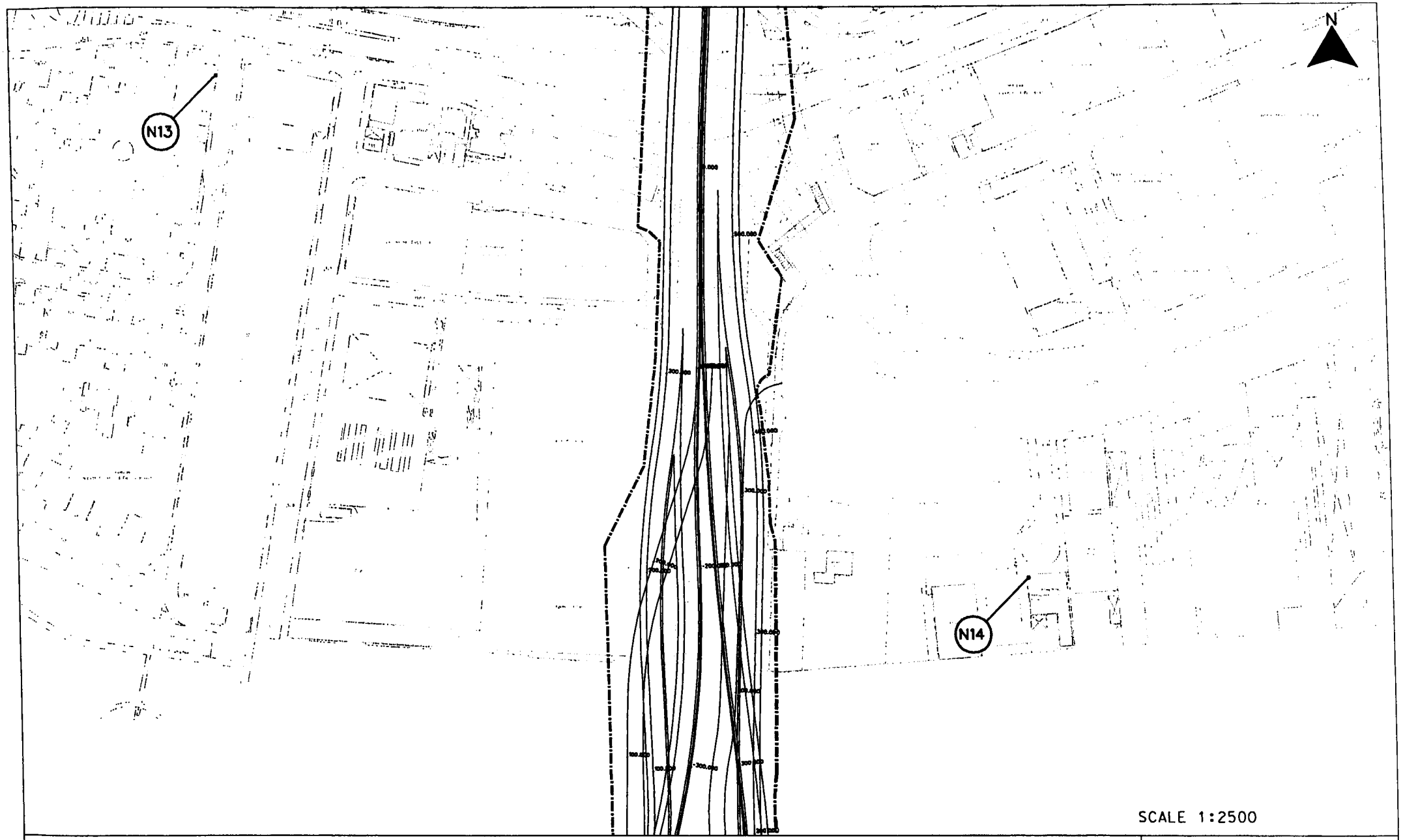

FIGURE 4.4b

LOCATION OF NOISE SENSITIVE RECEIVERS DURING CONSTRUCTION PHASE

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DATE: 03/05/99

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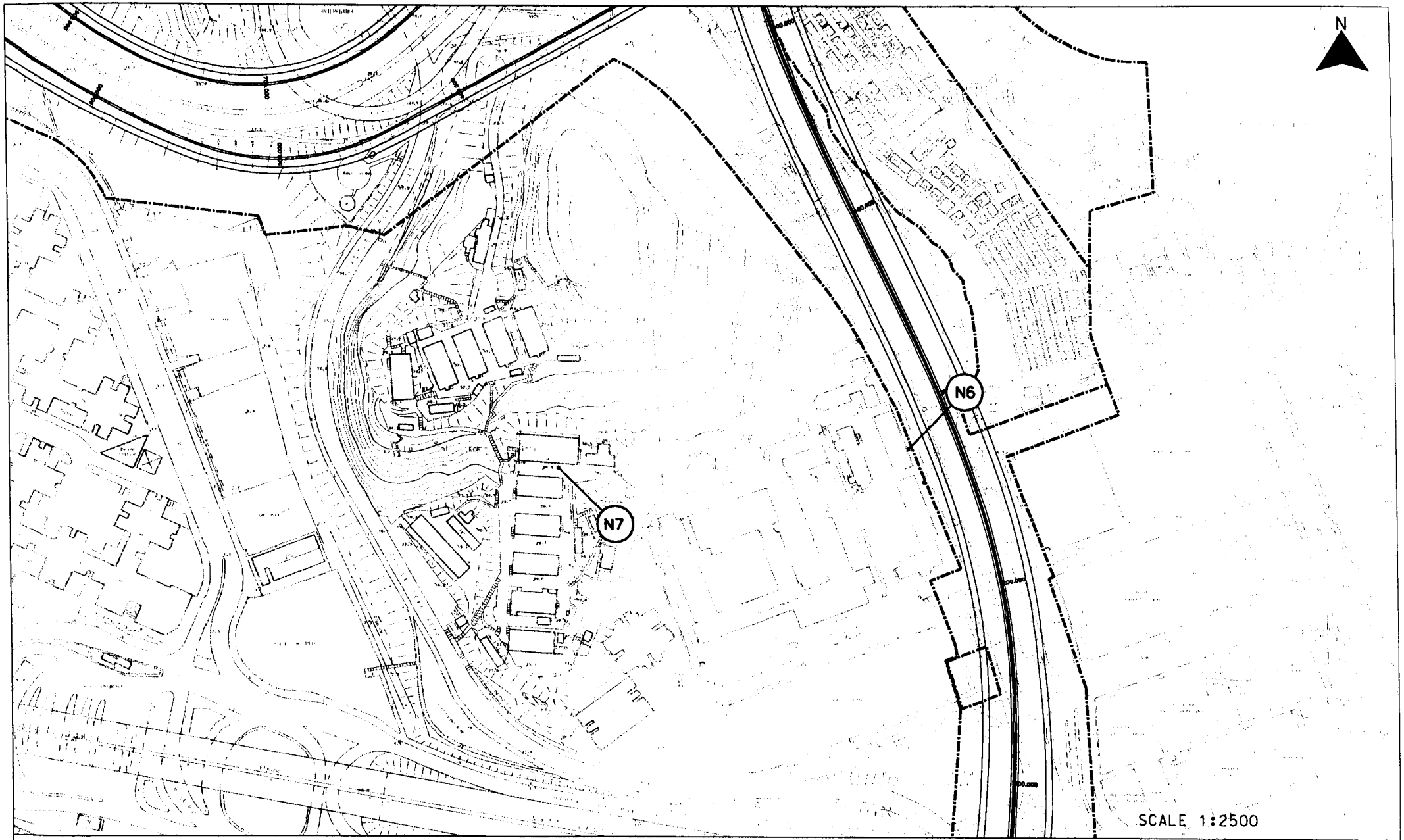

FIGURE 4.4c

LOCATION OF NOISE SENSITIVE RECEIVERS DURING CONSTRUCTION PHASE

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DATE: 03/05/99

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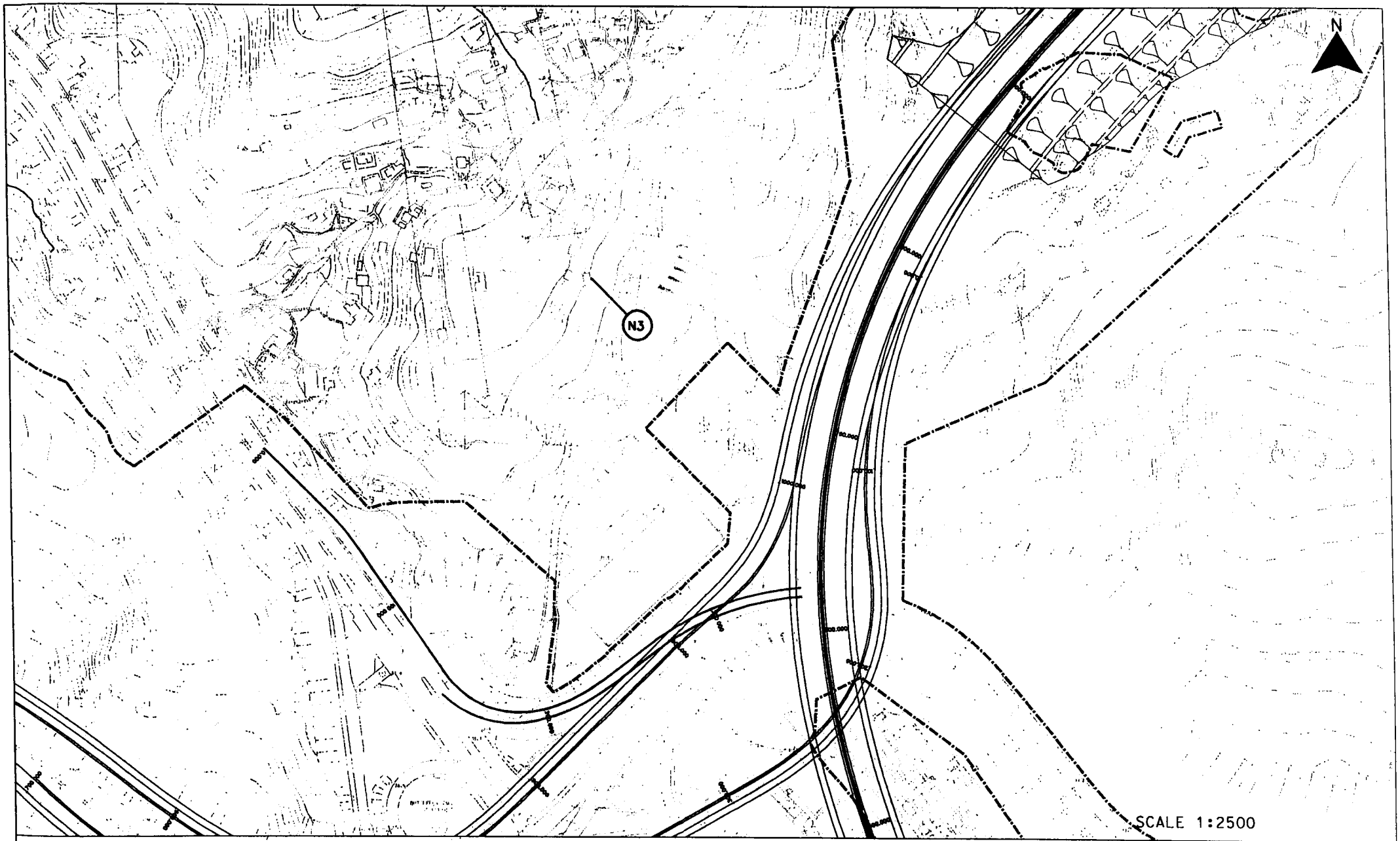

FIGURE 4.4d

LOCATION OF NOISE SENSITIVE RECEIVERS DURING CONSTRUCTION PHASE

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DATE: 03/05/99

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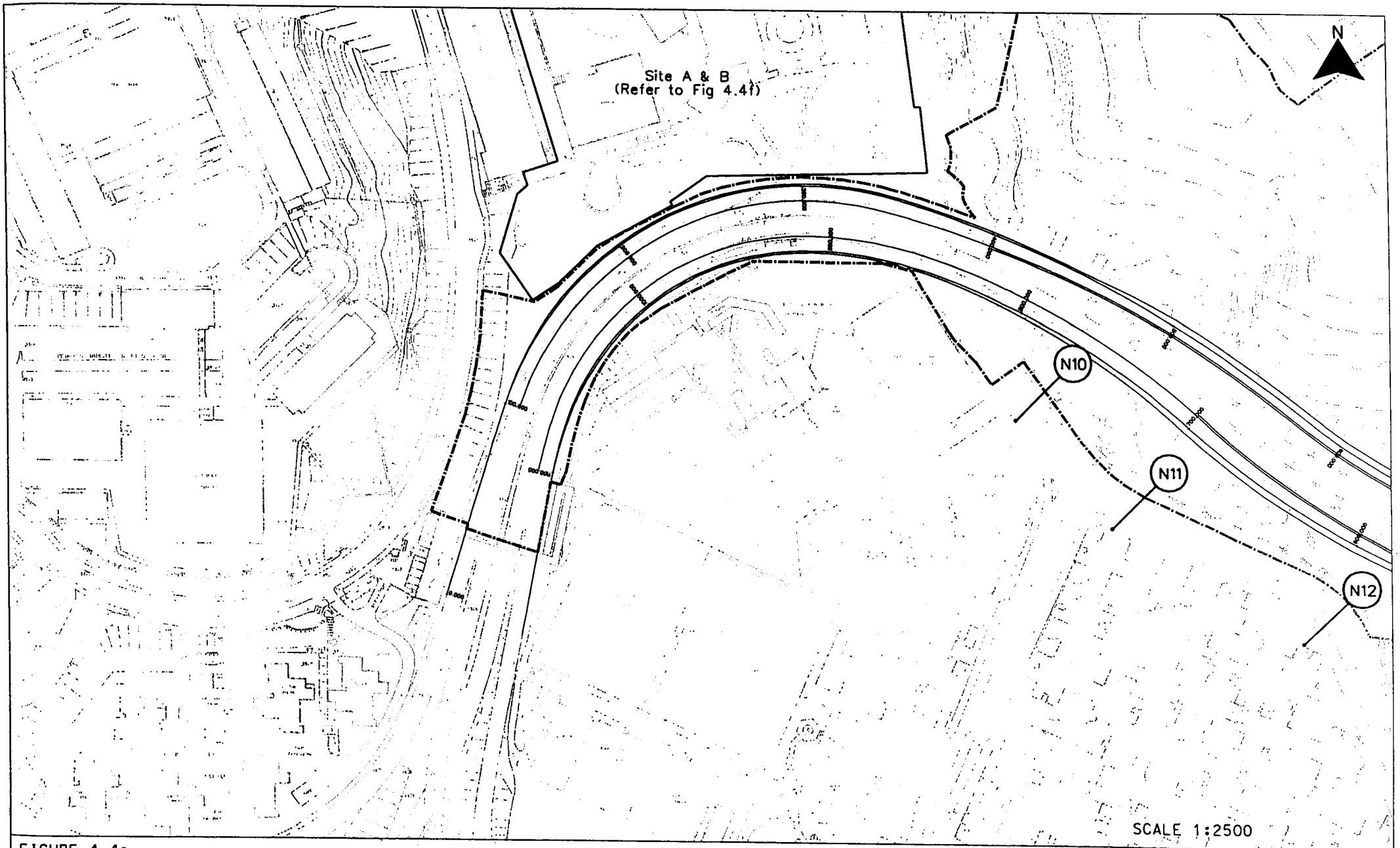

FIGURE 4.4e

LOCATION OF NOISE SENSITIVE RECEIVERS DURING CONSTRUCTION PHASE

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DATE: 03/05/99

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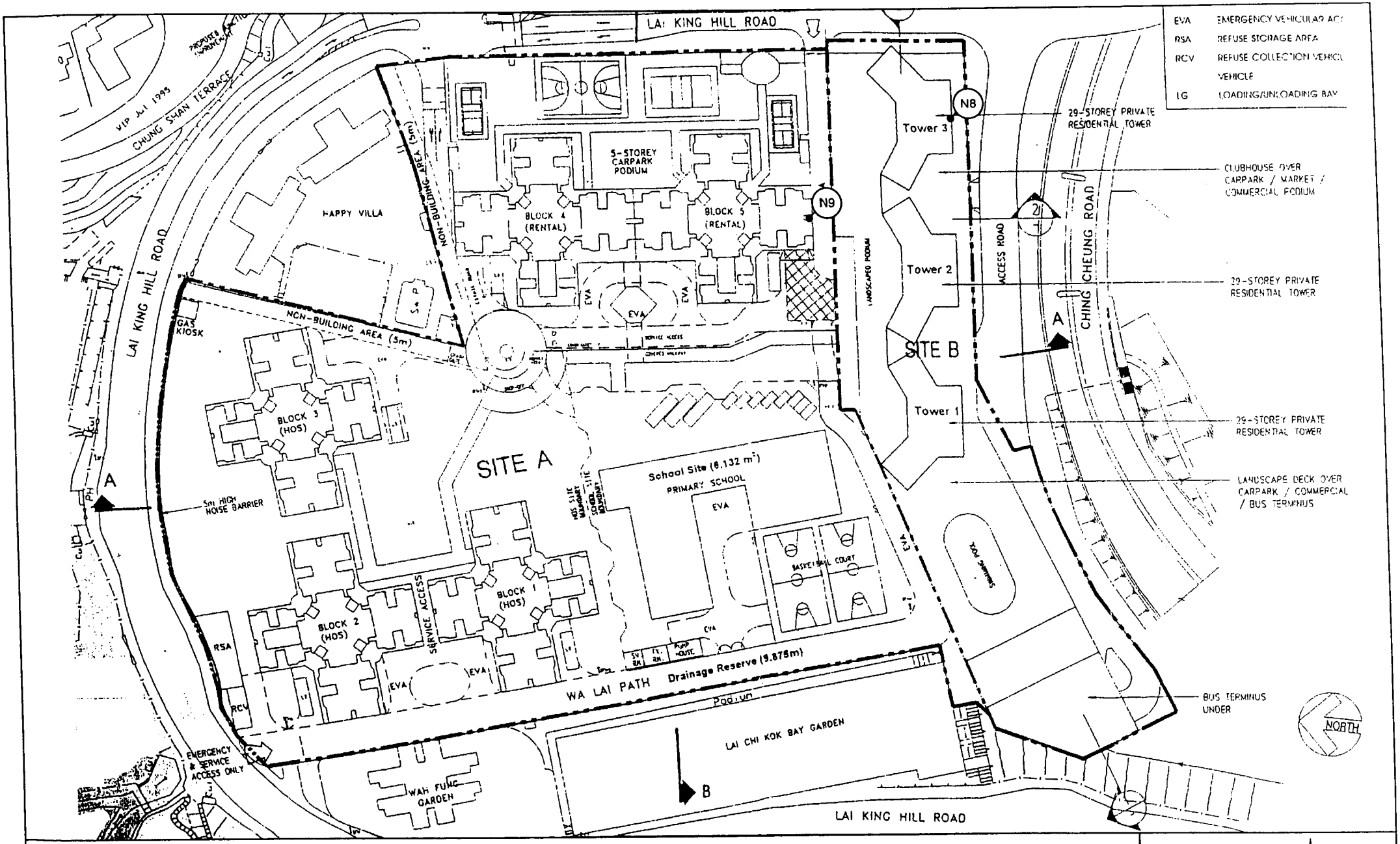

FIGURE 4.4f

LOCATION OF NOISE SENSITIVE RECEIVERS DURING CONSTRUCTION PHASE

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DATE: 03/05/99

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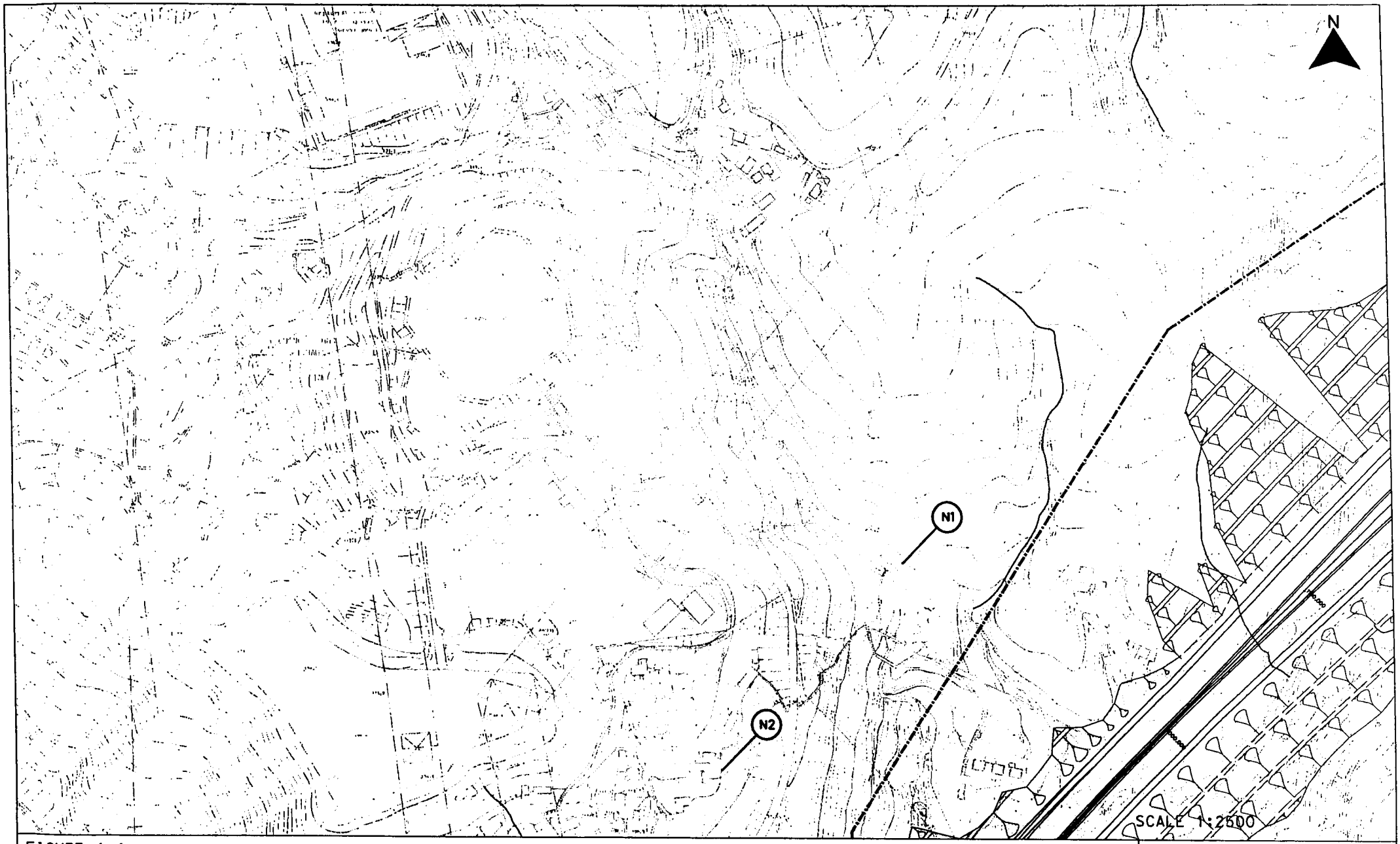

FIGURE 4.4g

LOCATION OF NOISE SENSITIVE RECEIVERS DURING CONSTRUCTION PHASE

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DATE: 03/05/99

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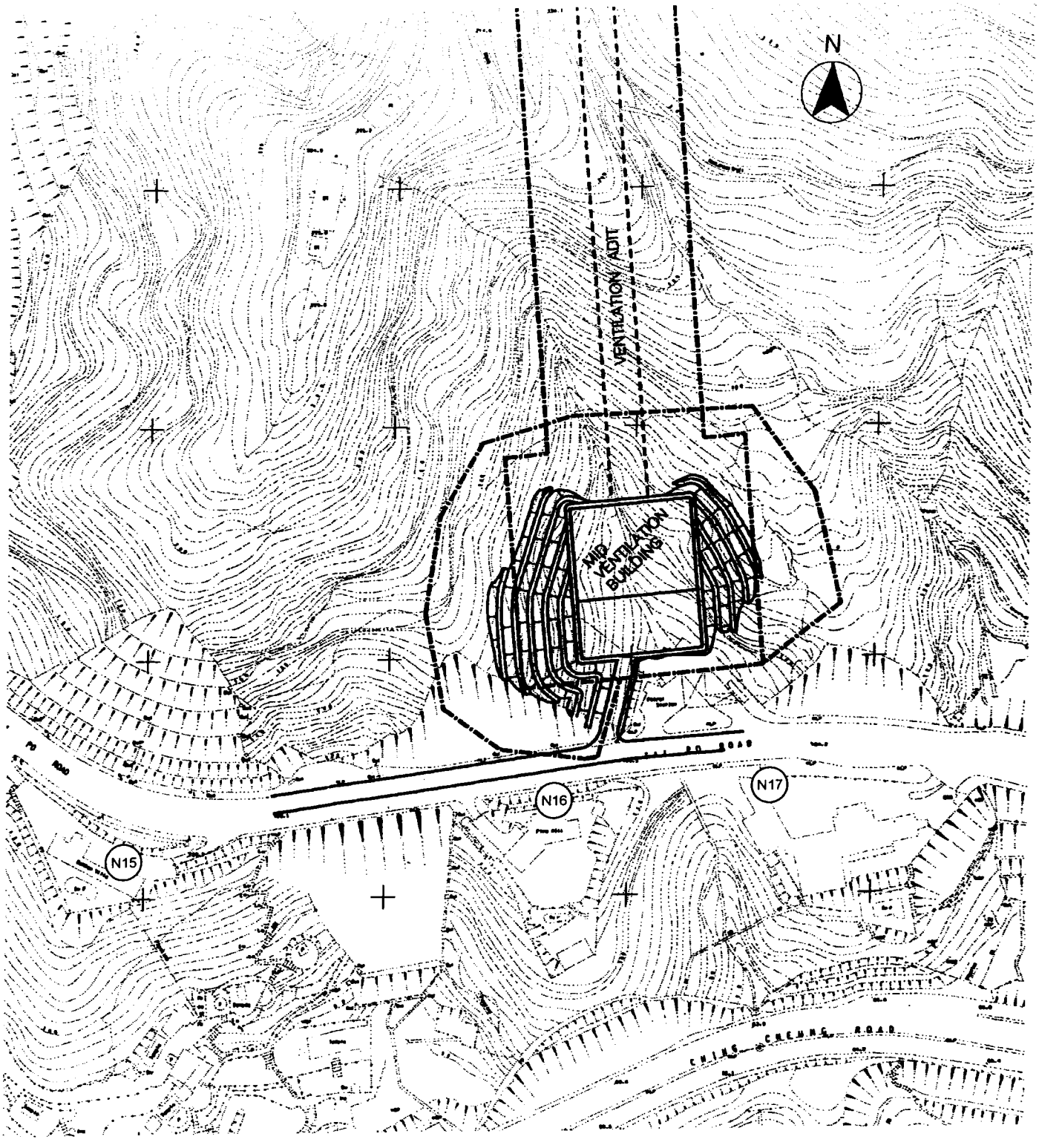

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FIGURE 4.4h

LOCATION OF NOISE SENSITIVE RECEIVERS

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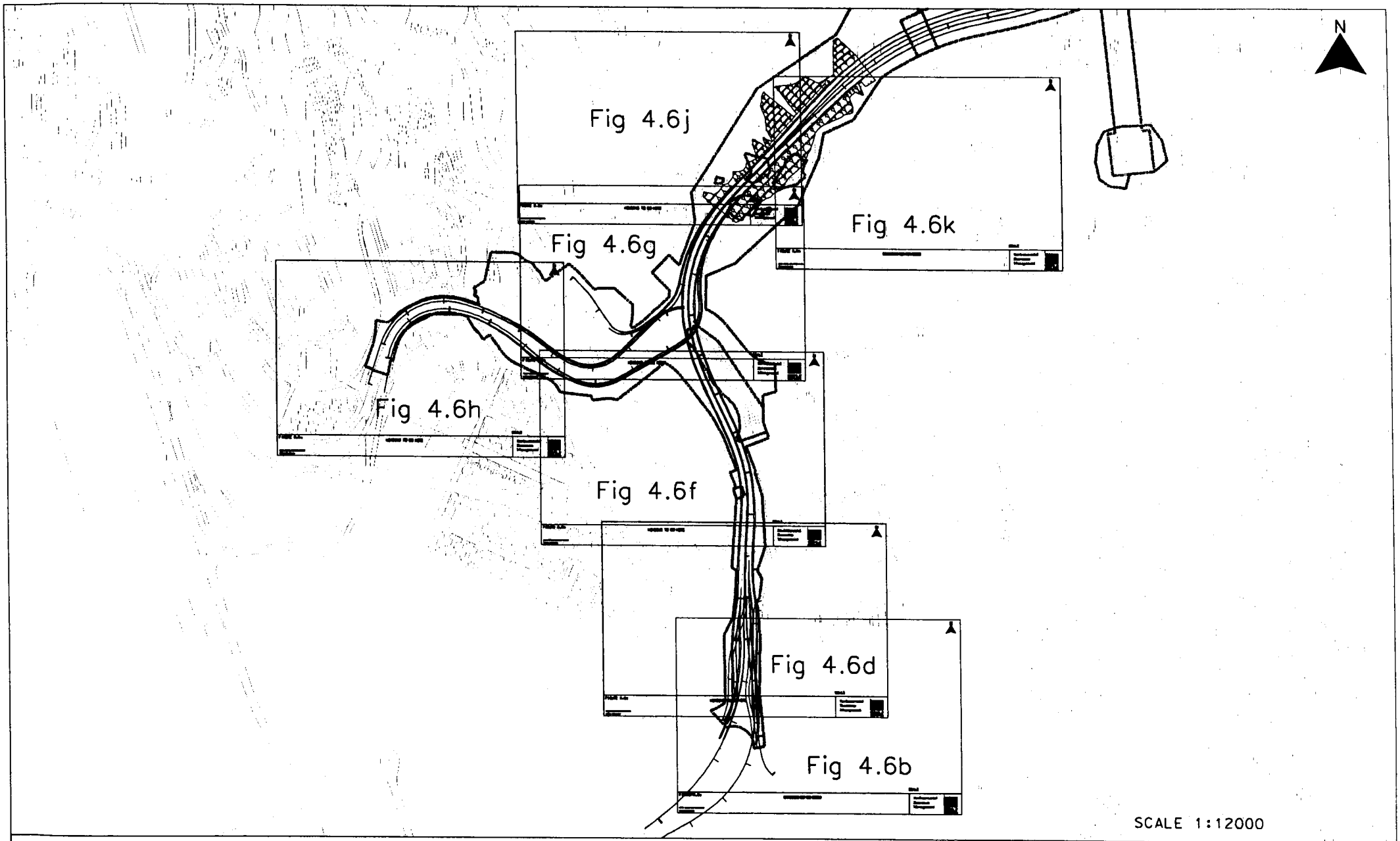

FIGURE 4.6a

LOCATION OF NOISE SENSITIVE RECEIVERS DURING OPERATIONAL PHASE

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DATE: 18/03/99

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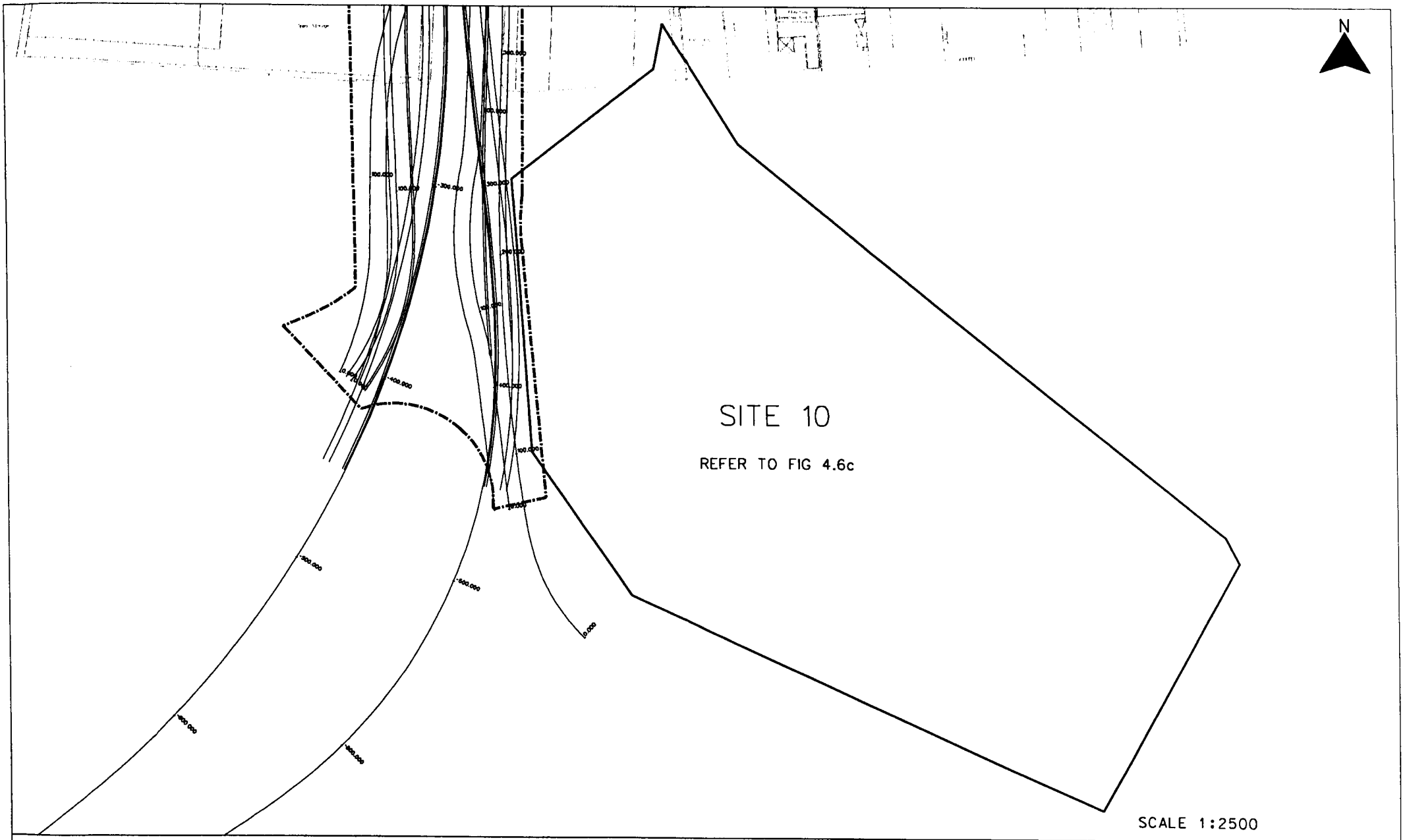

FIGURE 4.6b

LOCATION OF SITE 10

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DATE: 22/03/99

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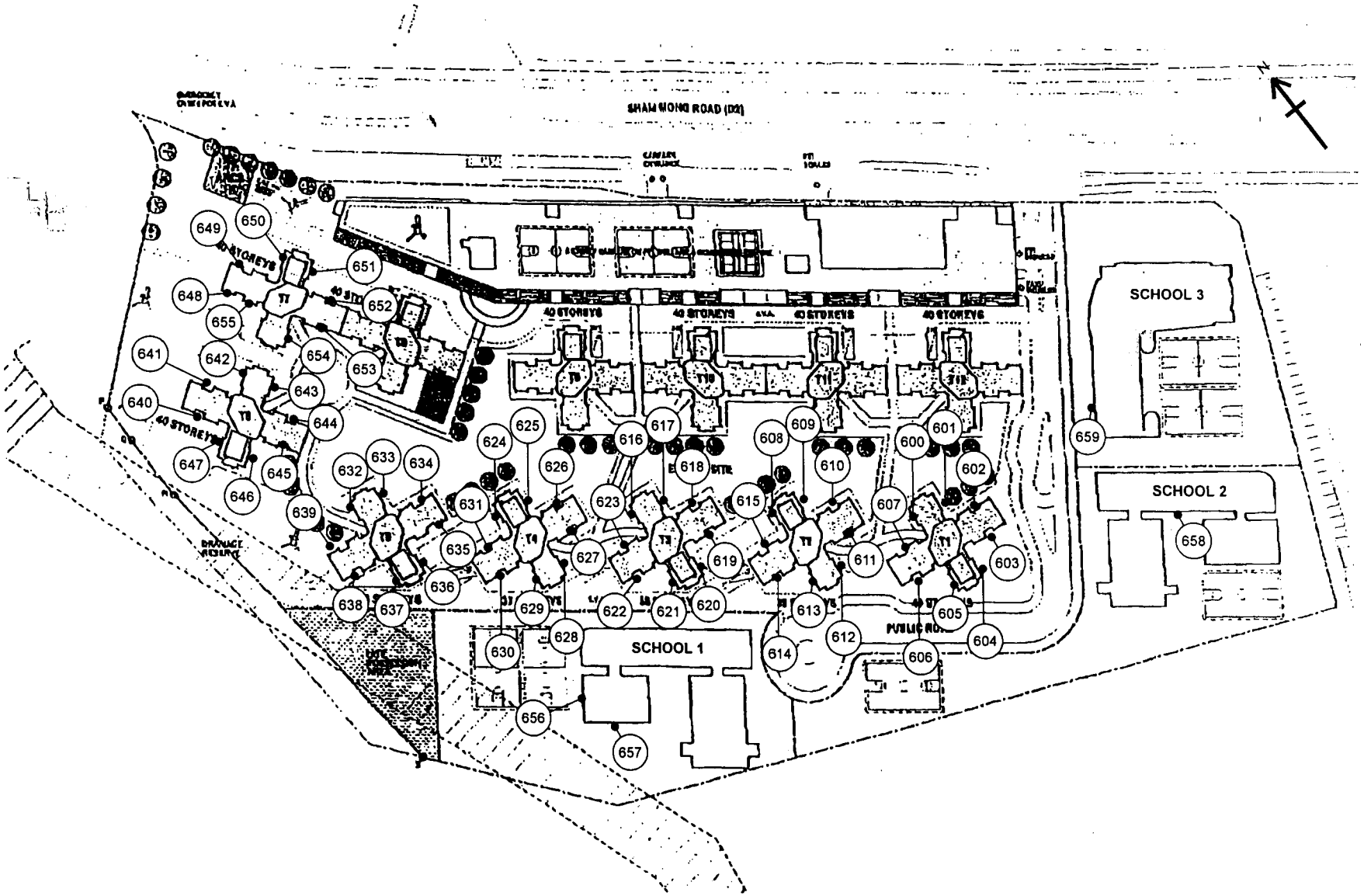

FIGURE 4.6c

SITE 10 - NSRs LOCATION

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DATE: 29/06/99

Environmental Resources Management

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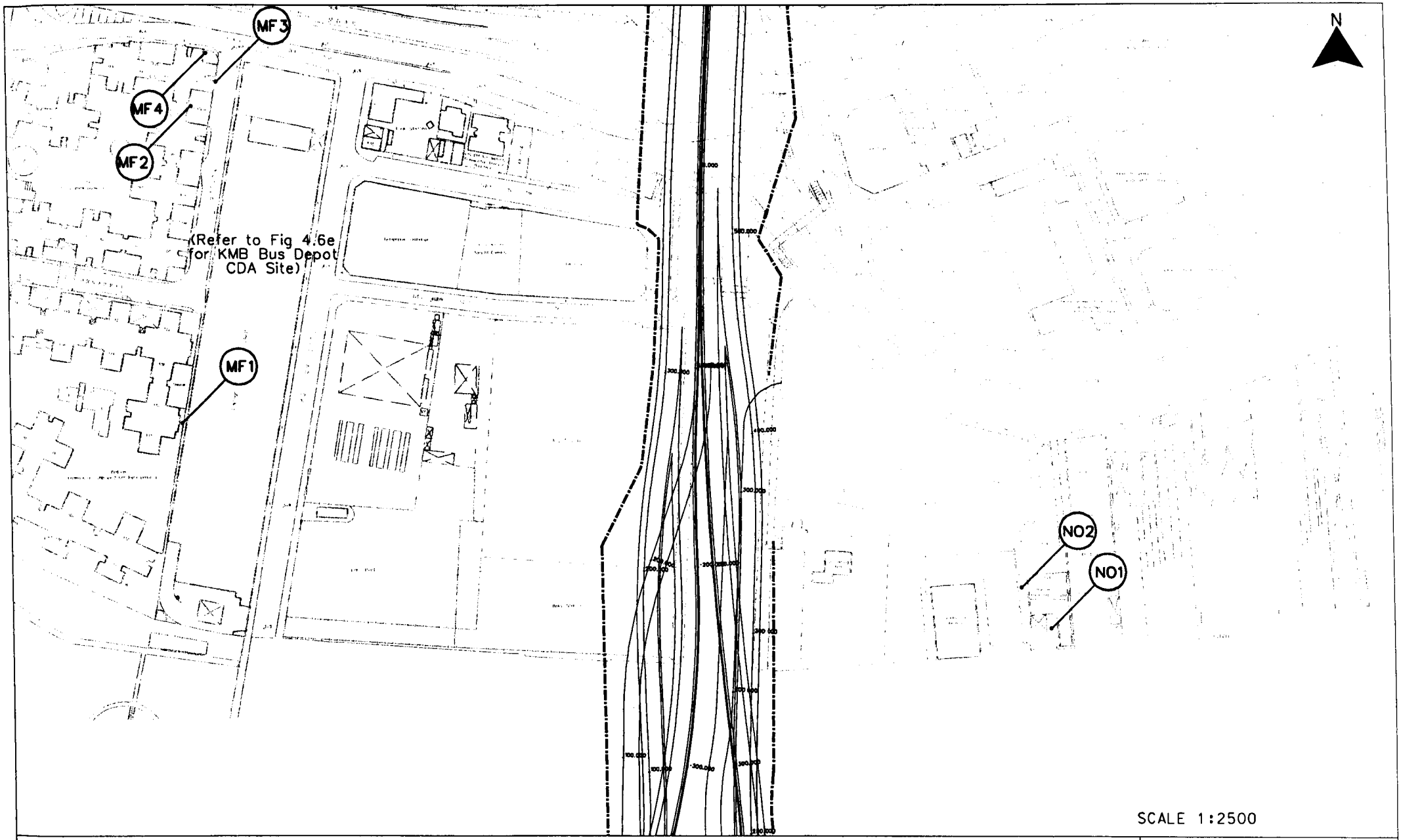

FIGURE 4.6d

LOCATION OF NOISE SENSITIVE RECEIVERS DURING OPERATIONAL PHASE

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DATE: 22/03/99

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Management

ERM

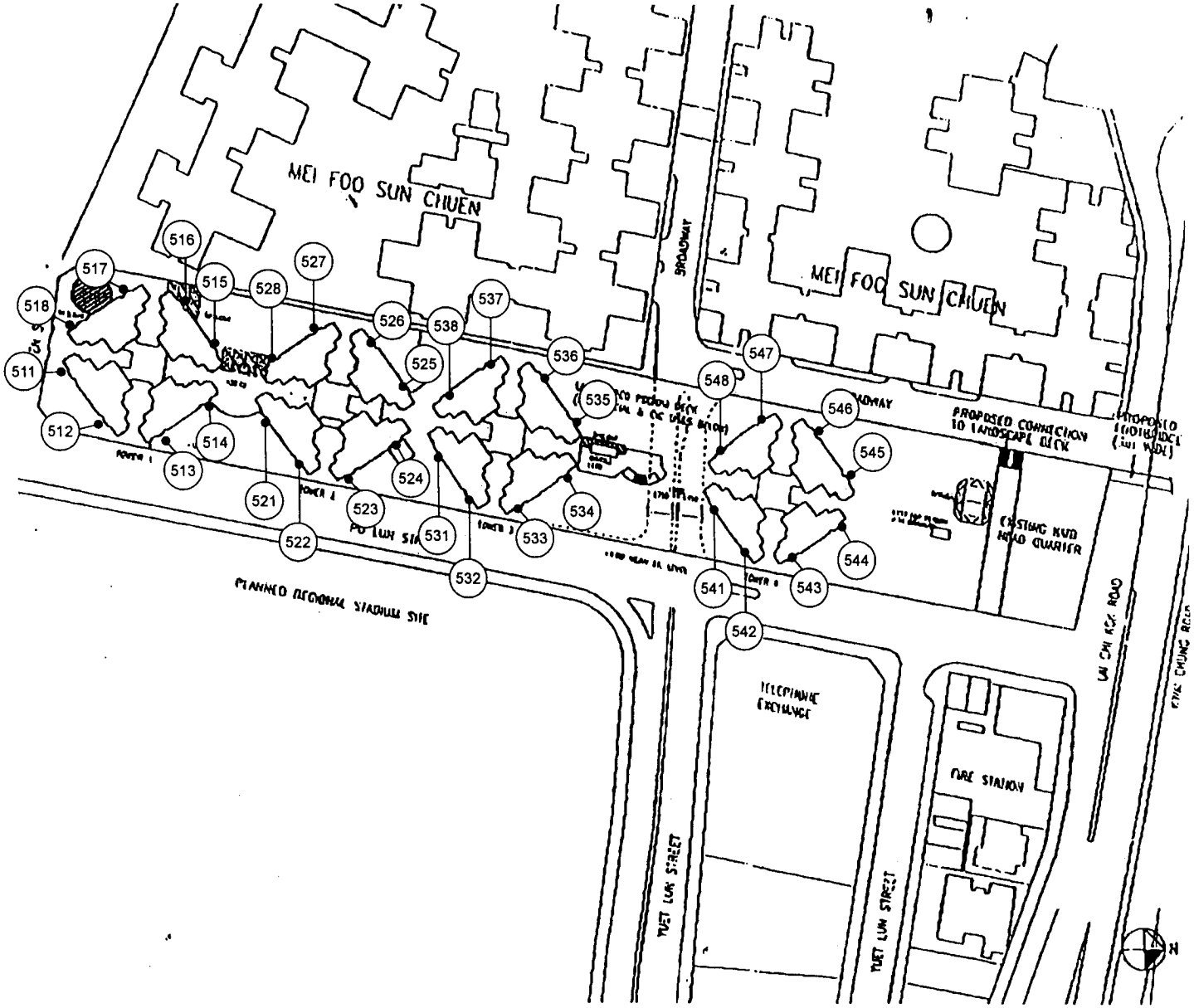


FIGURE 4.6e

KMB BUS DEPOT - CDA SITE

FILE: C1884k3
DATE: 29/06/99

Environmental Resources Management

ERM

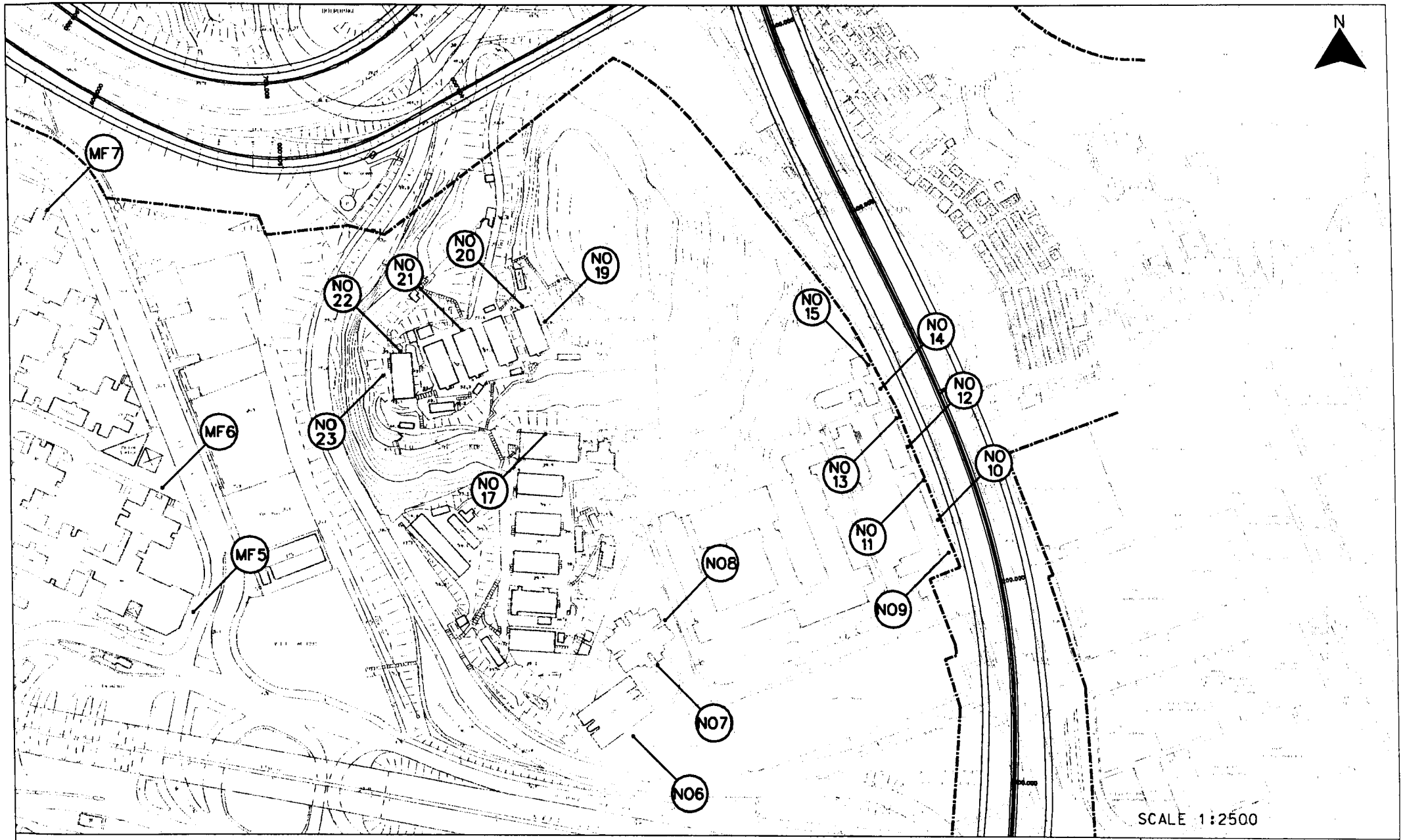


FIGURE 4.6f

LOCATION OF NOISE SENSITIVE RECEIVERS DURING OPERATIONAL PHASE

USTN FILE: C1884_59
DATE: 22/03/99

Environmental Resources Management

ERM

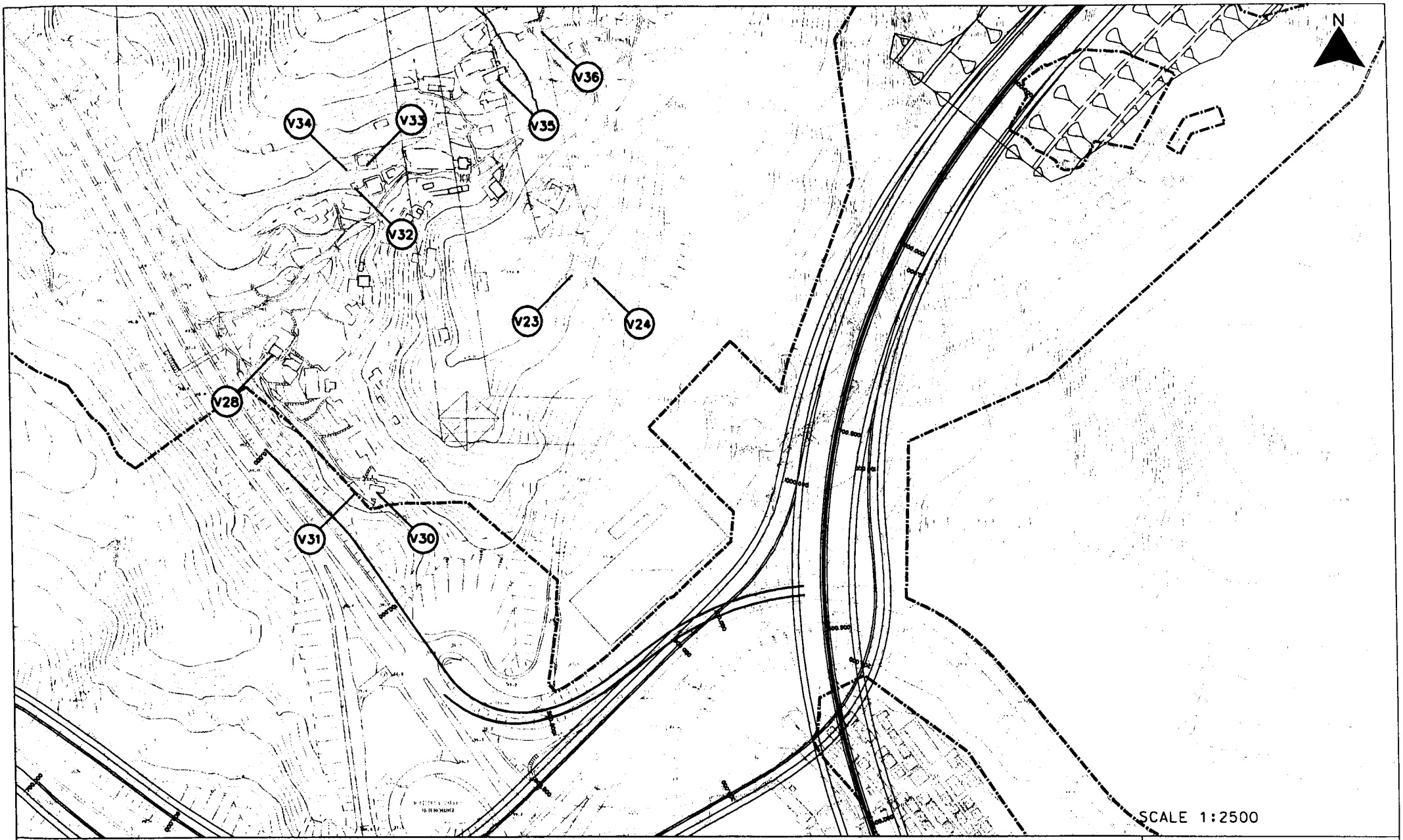


FIGURE 4.6g

LOCATION OF NOISE SENSITIVE RECEIVERS DURING OPERATIONAL PHASE

Environmental Resources Management

ERM

USTN FILE: C1884_57
DATE: 18/03/99

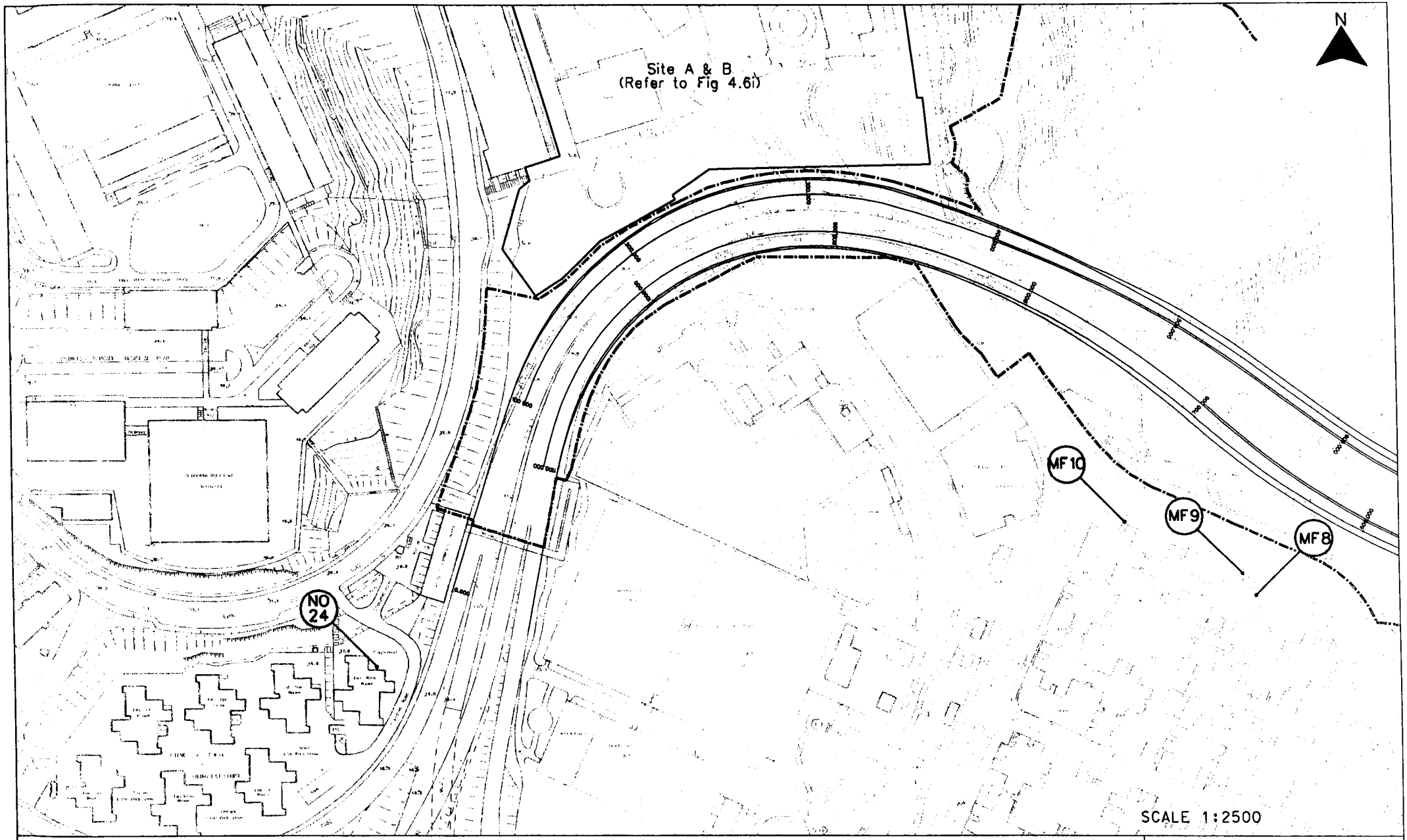


FIGURE 4.6h

LOCATION OF NOISE SENSITIVE RECEIVERS DURING OPERATIONAL PHASE

Environmental Resources Management

ERM

USTN FILE: C1884_58
DATE: 22/03/99

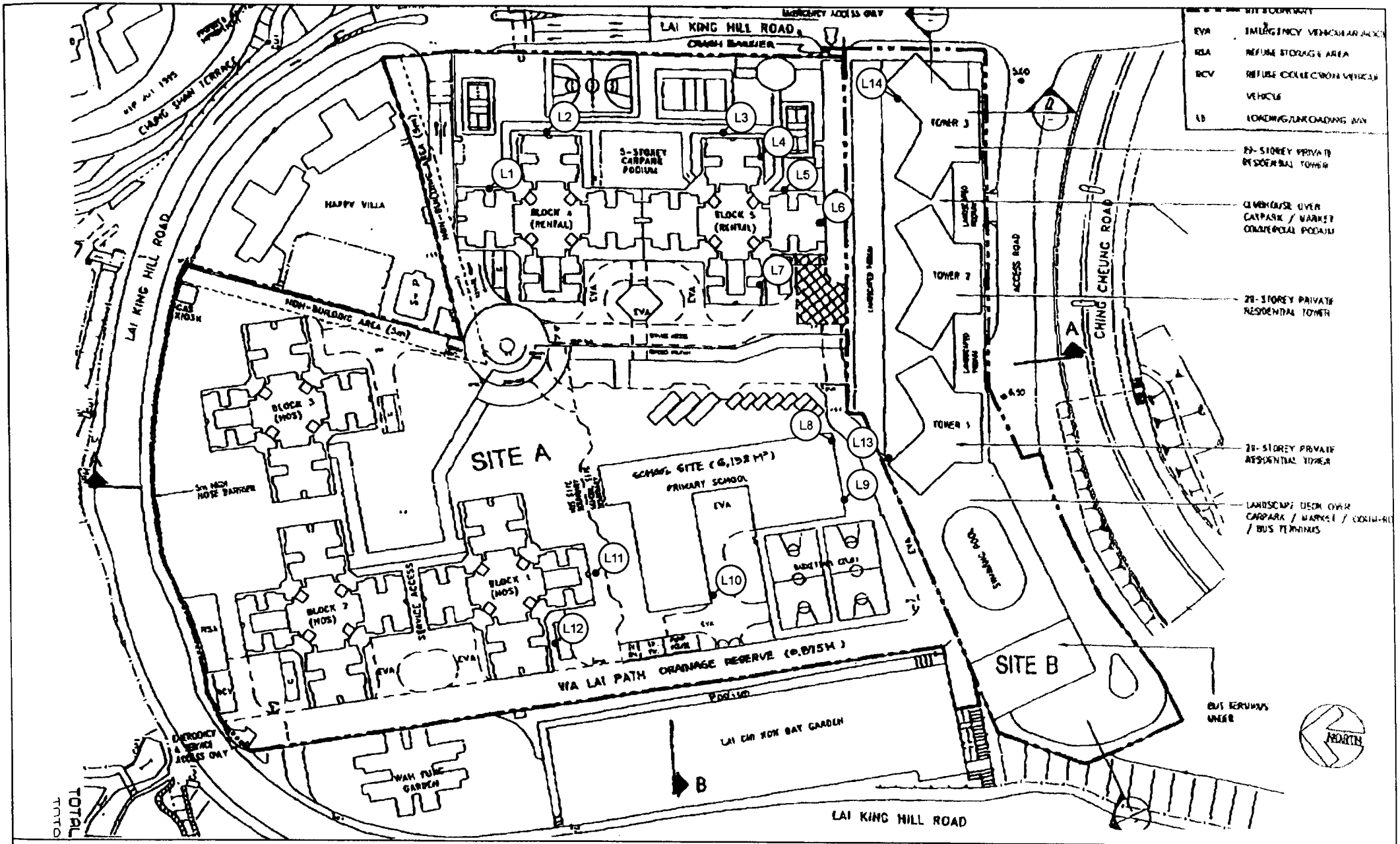


FIGURE 4.6i

SITE A & B - NSRs LOCATION

FILE: C1884k7
DATE: 30/06/99

Environmental Resources Management

ERM

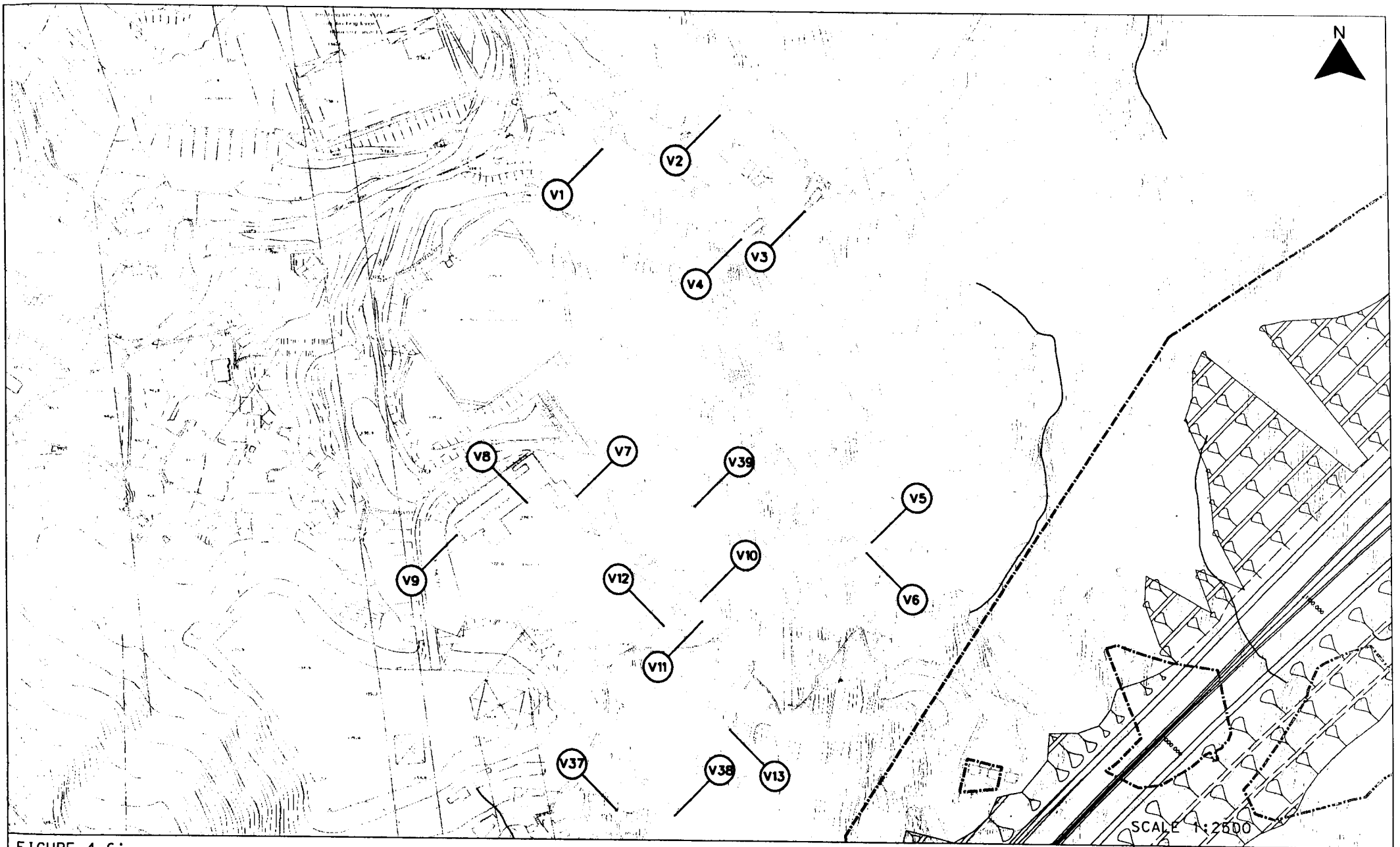


FIGURE 4.6j

LOCATION OF NOISE SENSITIVE RECEIVERS DURING OPERATIONAL PHASE

USTN FILE: C1884_55
DATE: 18/03/99

Environmental Resources Management

ERM

FIGURE 4.6k

LOCATION OF NOISE SENSITIVE RECEIVERS DURING OPERATIONAL PHASE

USTN FILE: C1884_56
DATE: 22/03/99

Environmental Resources Management

ERM

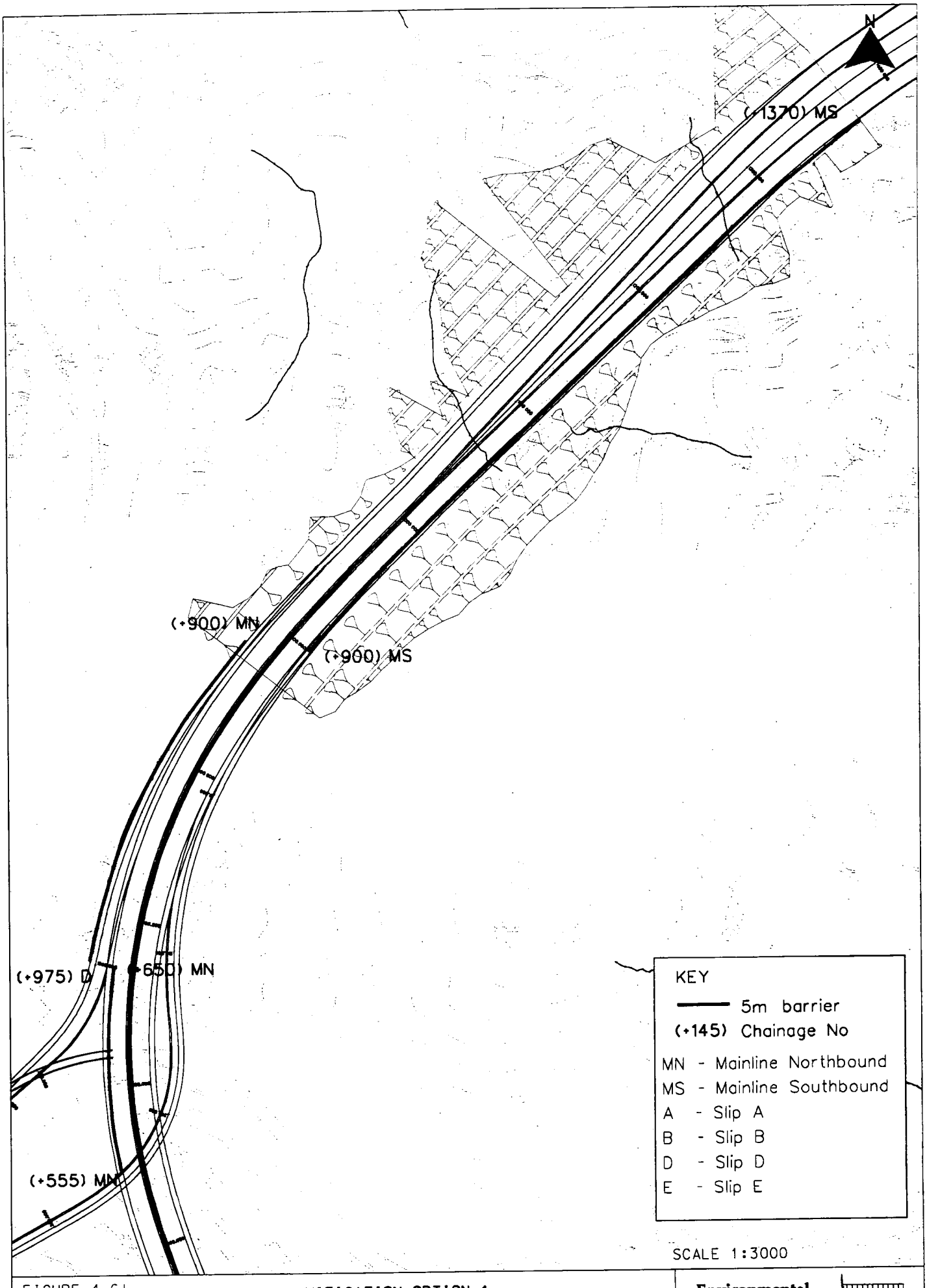


FIGURE 4.6I

MITIGATION OPTION 1

Environmental Resources Management

ERM

USTN FILE: C1881_62

DATE: 30/06/99

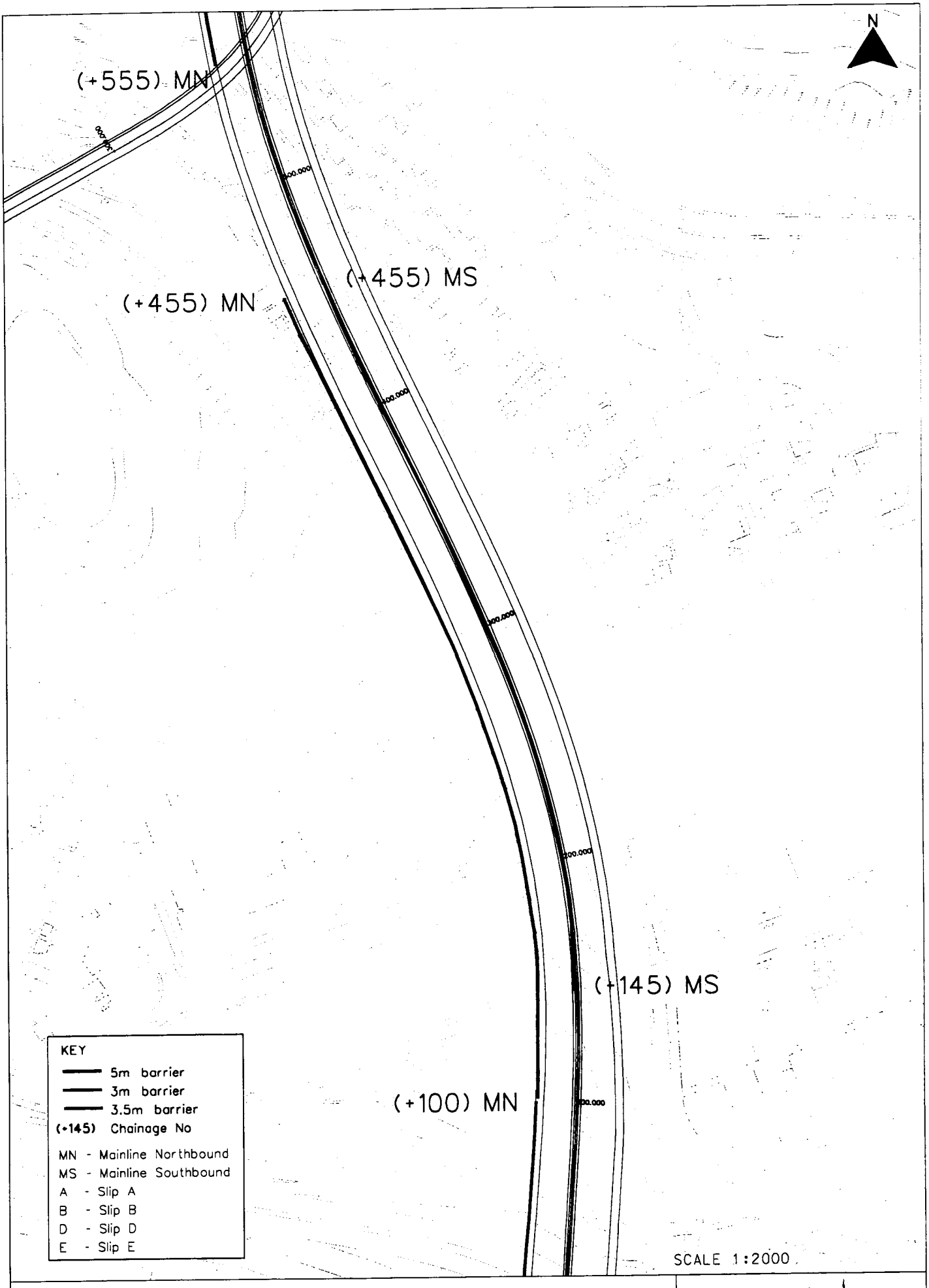


FIGURE 4.6m

MITIGATION OPTION 1

Environmental Resources Management

ERM

USTN FILE: C1884_64
DATE: 30/06/99

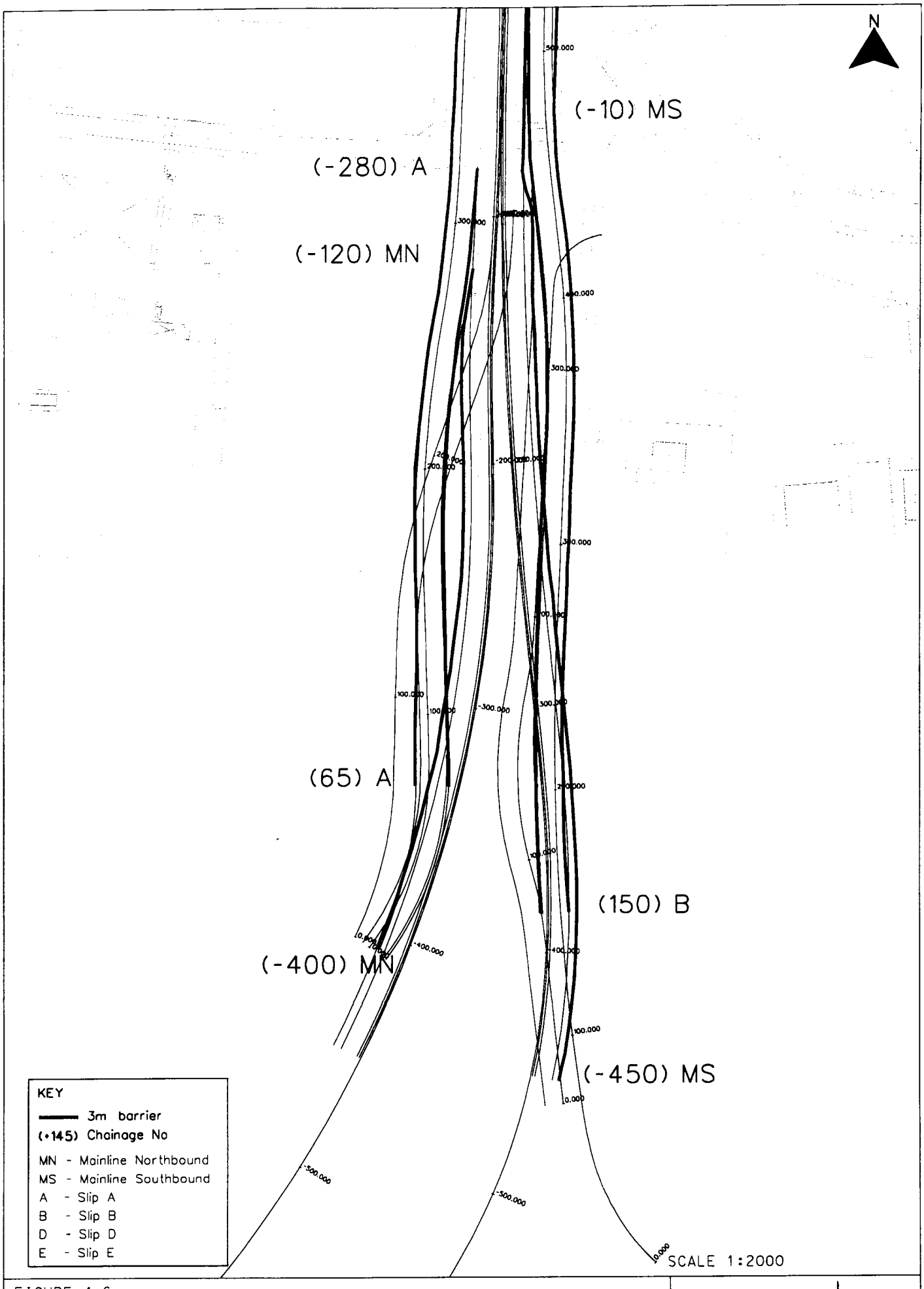


FIGURE 4.6n

MITIGATION OPTION 1

Environmental Resources Management

ERM

USTN FILE: C1884_65

DATE: 30/06/99

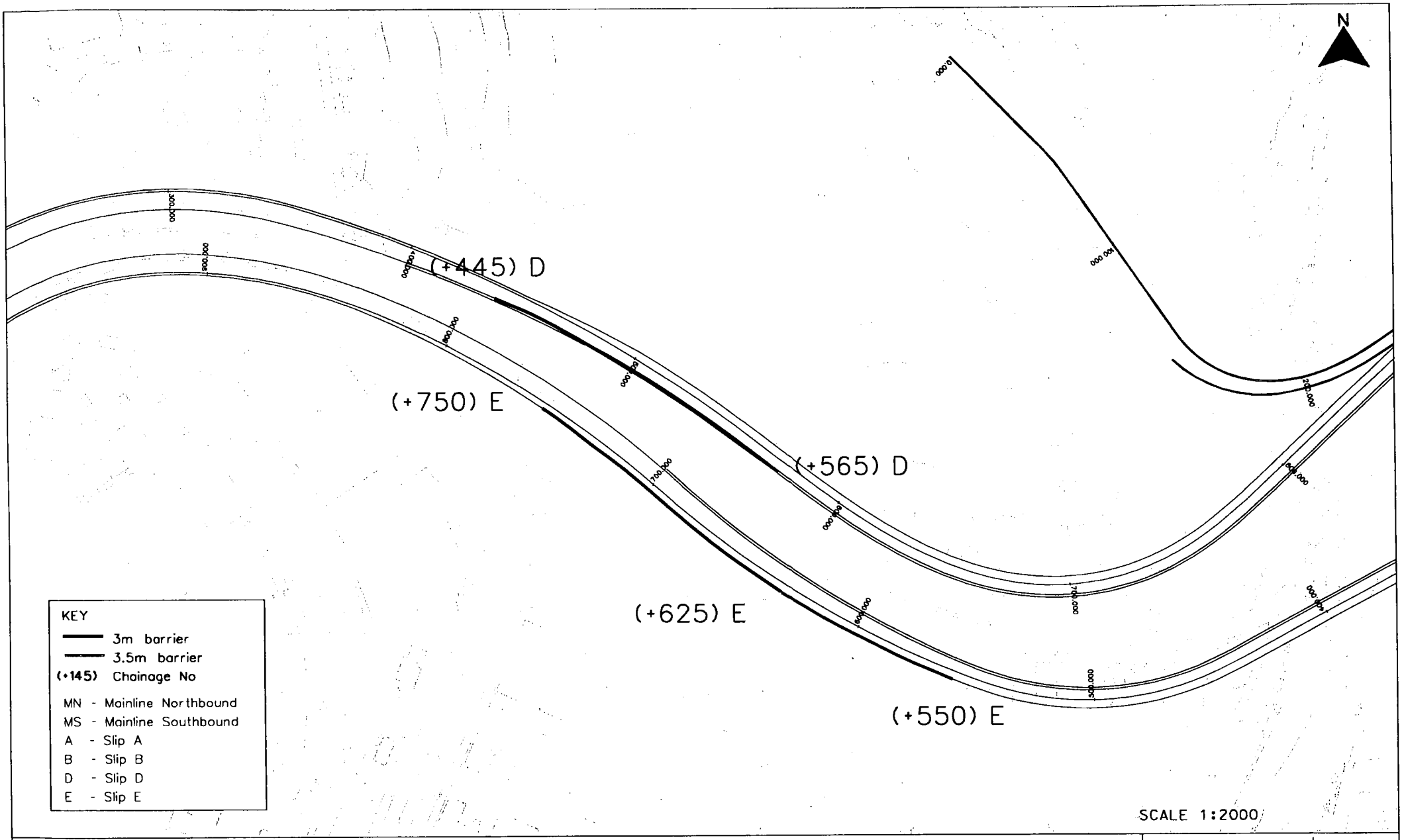


FIGURE 4.60

MITIGATION OPTION 1

USTN FILE: C1884_63
DATE: 30/06/99

Environmental Resources Management

ERM

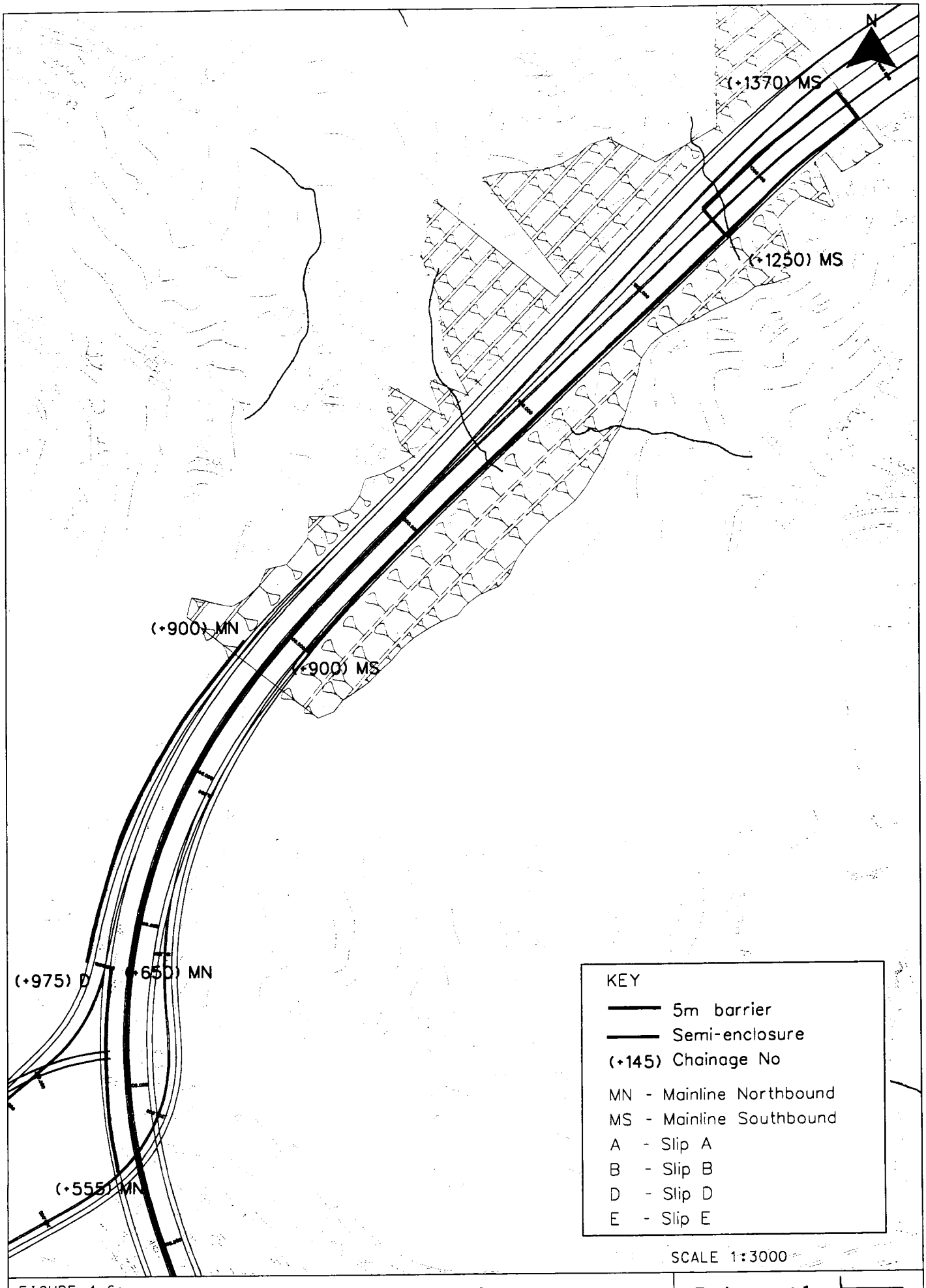


FIGURE 4.6D

MITIGATION OPTION 2

Environmental Resources Management

ERM

USTN FILE: C1884_66
DATE: 30/06/99

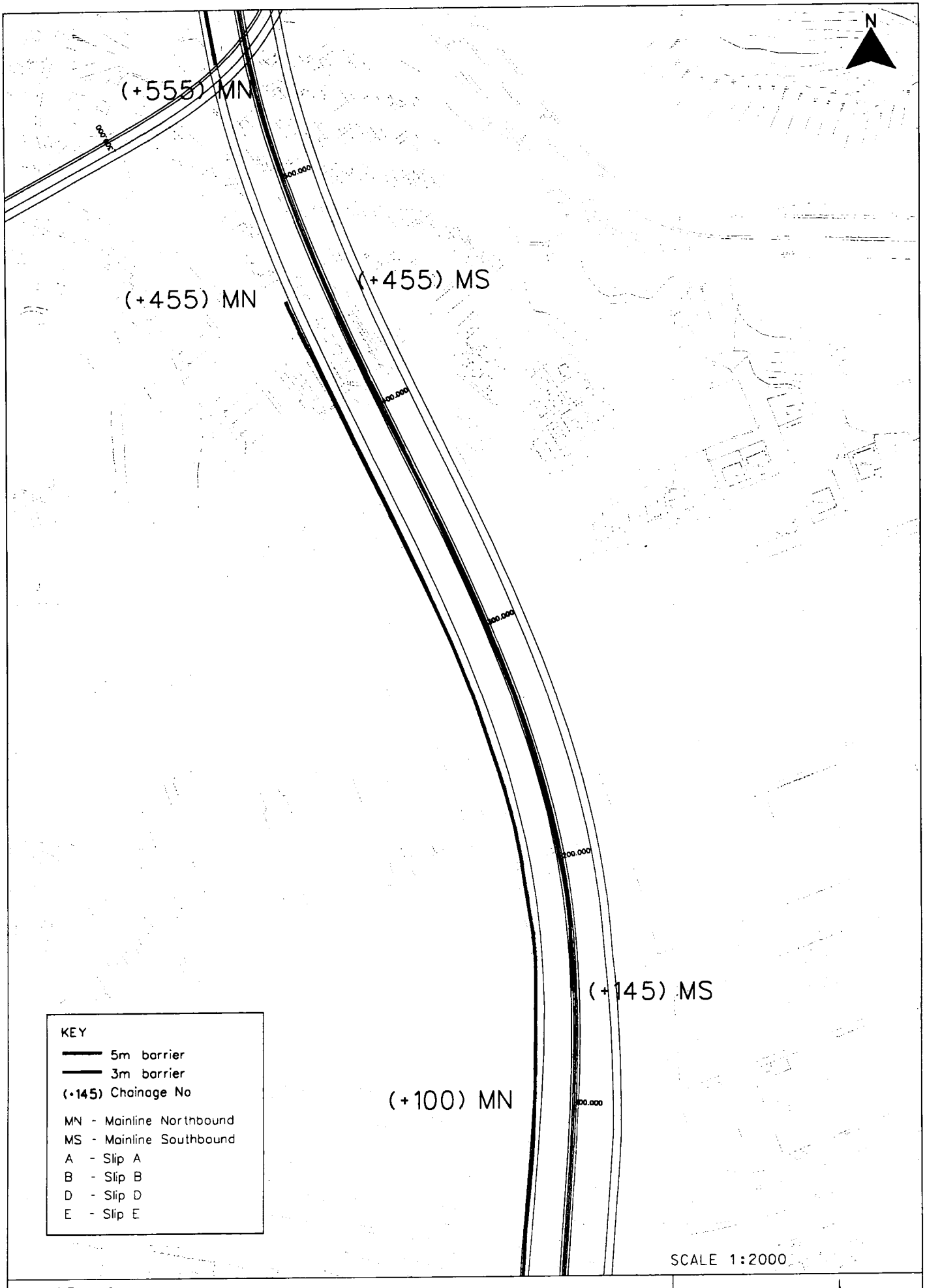


FIGURE 4.6q

MITIGATION OPTION 2

Environmental Resources Management

ERM

USTN FILE: C1884_68

DATE: 30/06/99

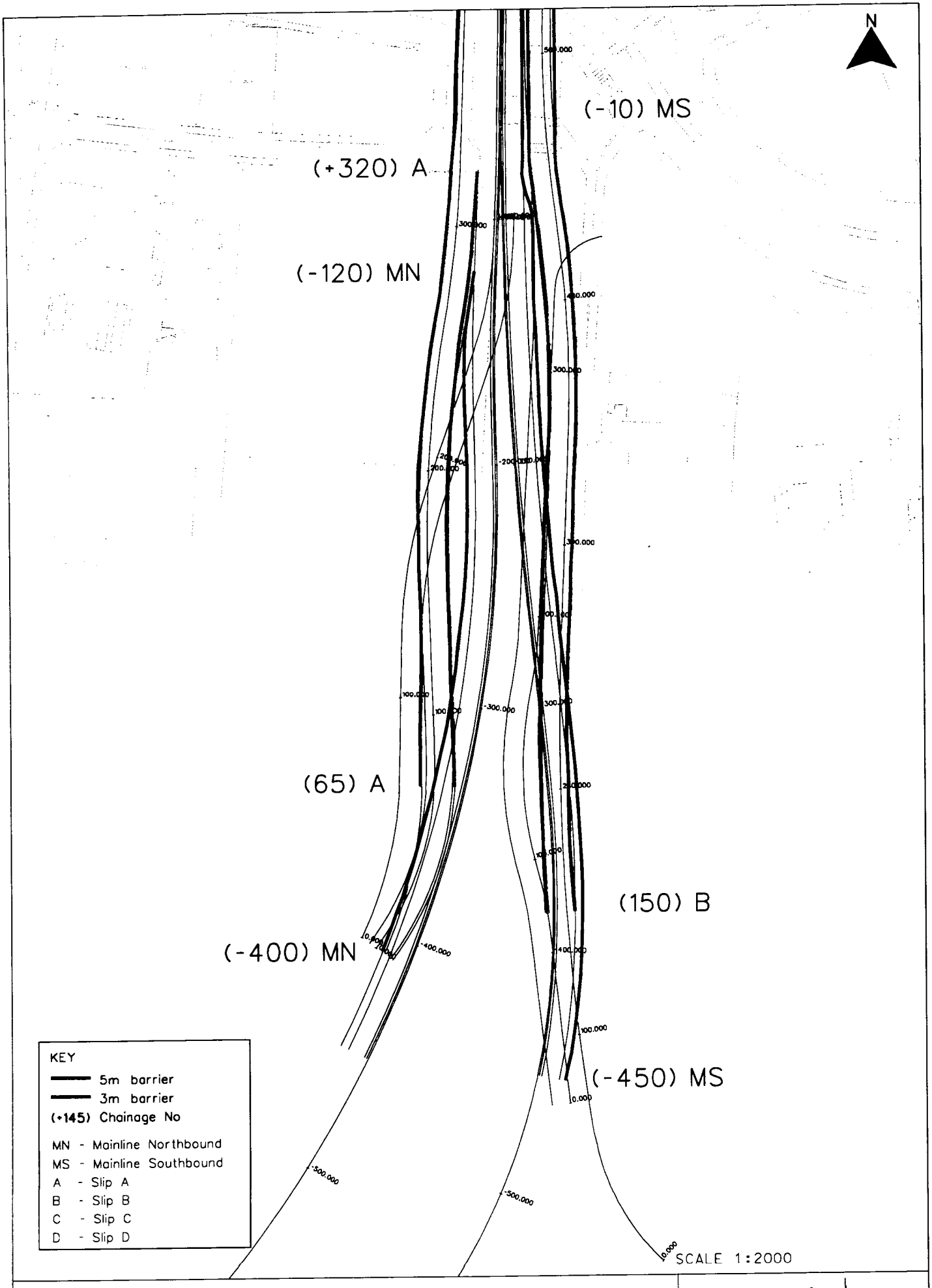


FIGURE 4.6r

MITIGATION OPTION 2

Environmental Resources Management

ERM

USTN FILE: C1884_69

DATE: 30/06/99

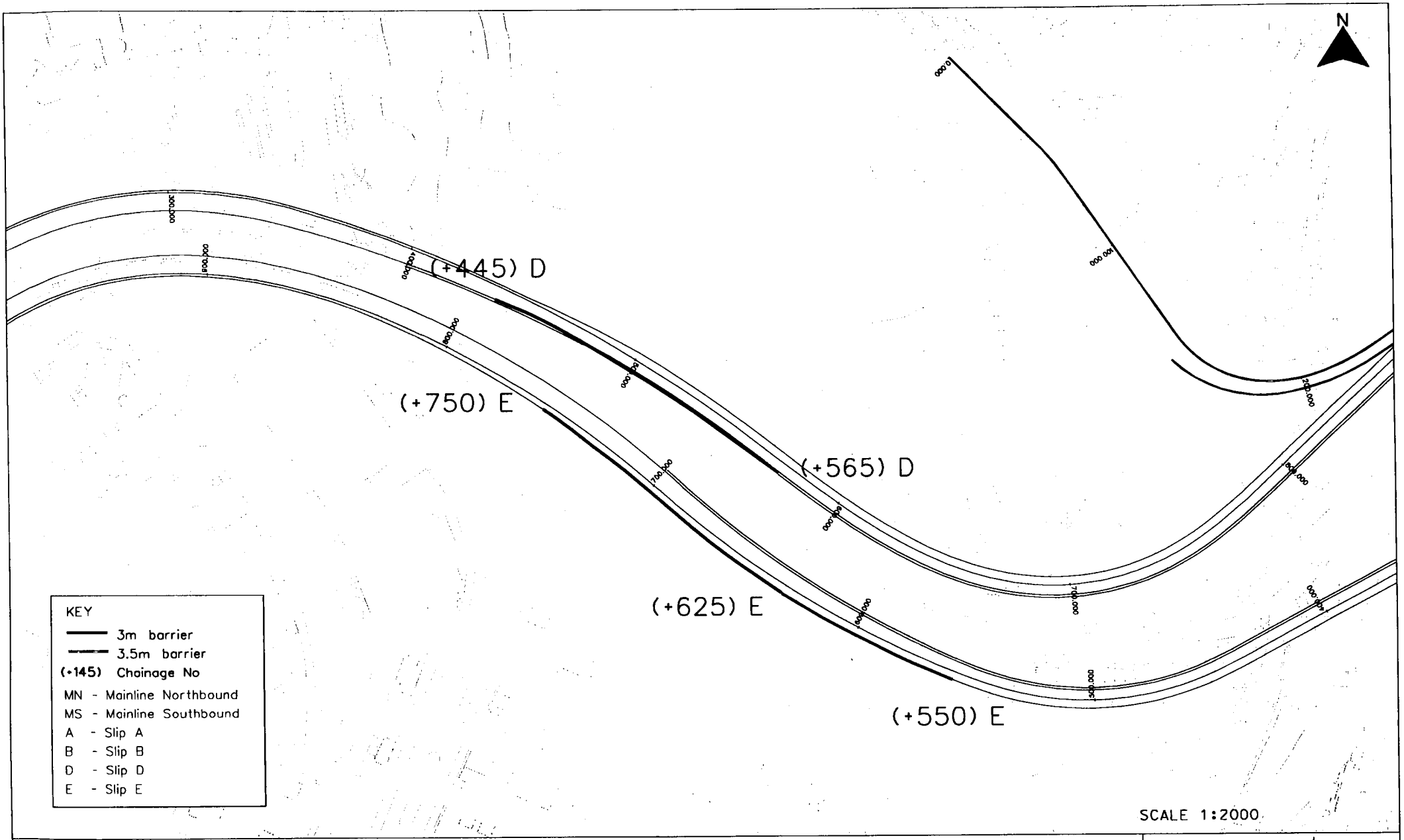


FIGURE 4.6s

MITIGATION OPTION 2

Environmental Resources Management

ERM

USTN FILE: C1884_67
DATE: 30/06/99

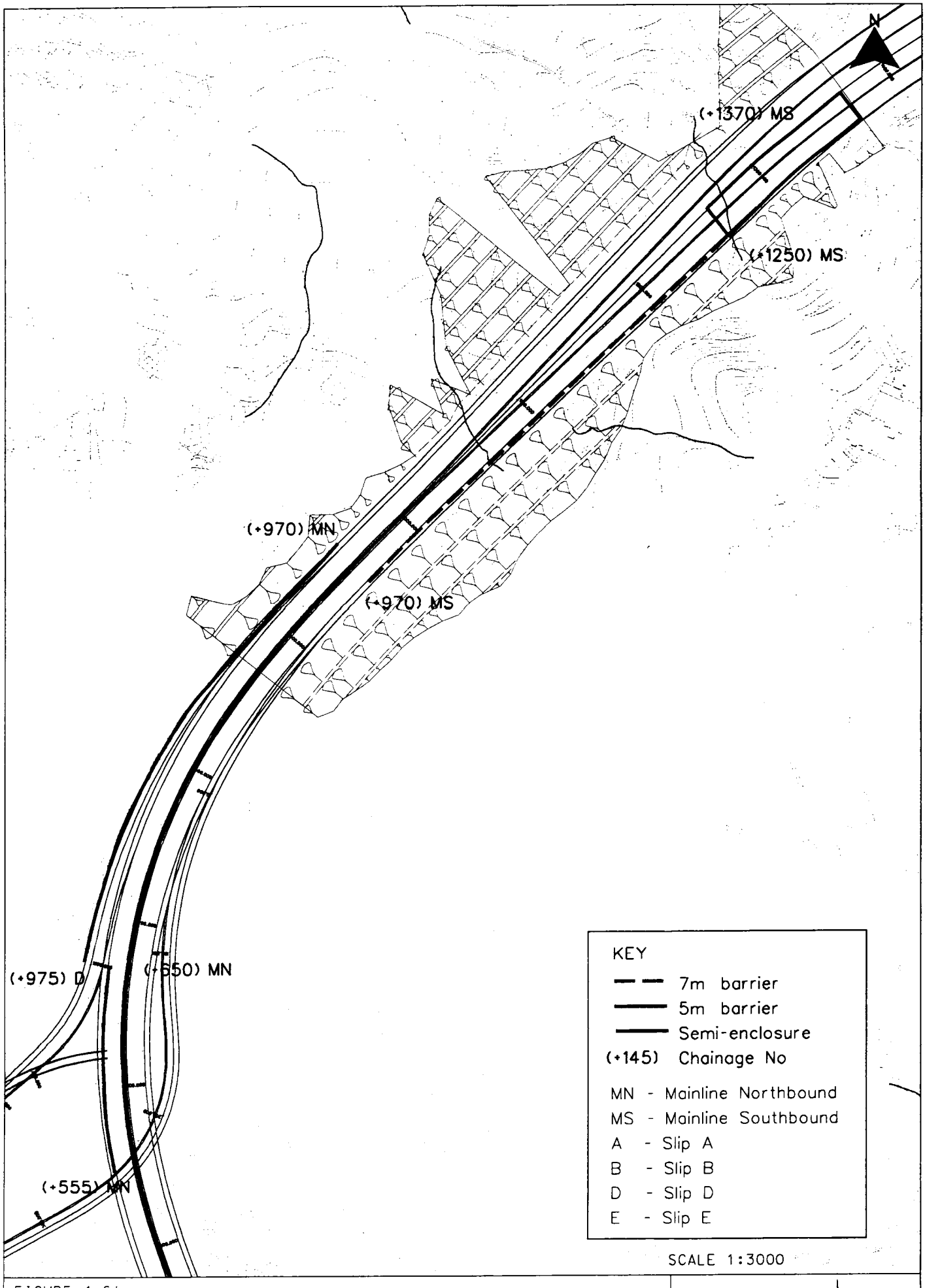


FIGURE 4.6†

MITIGATION OPTION 3

Environmental Resources Management

ERM

USTN FILE: C1884_70
DATE: 30/06/99

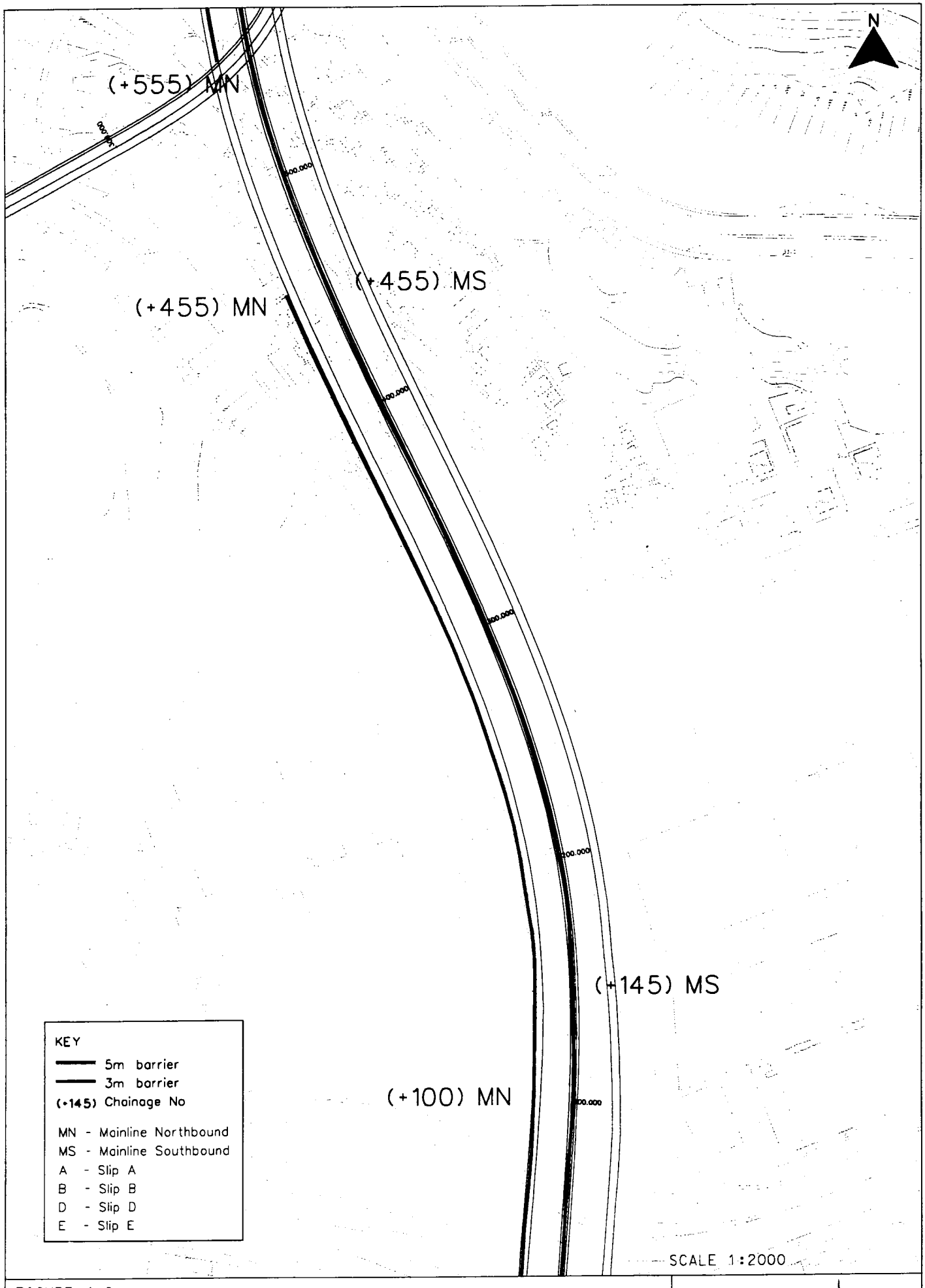


FIGURE 4.6U

MITIGATION OPTION 3

Environmental Resources Management

ERM

USTN FILE: C1884_72

DATE: 30/06/99

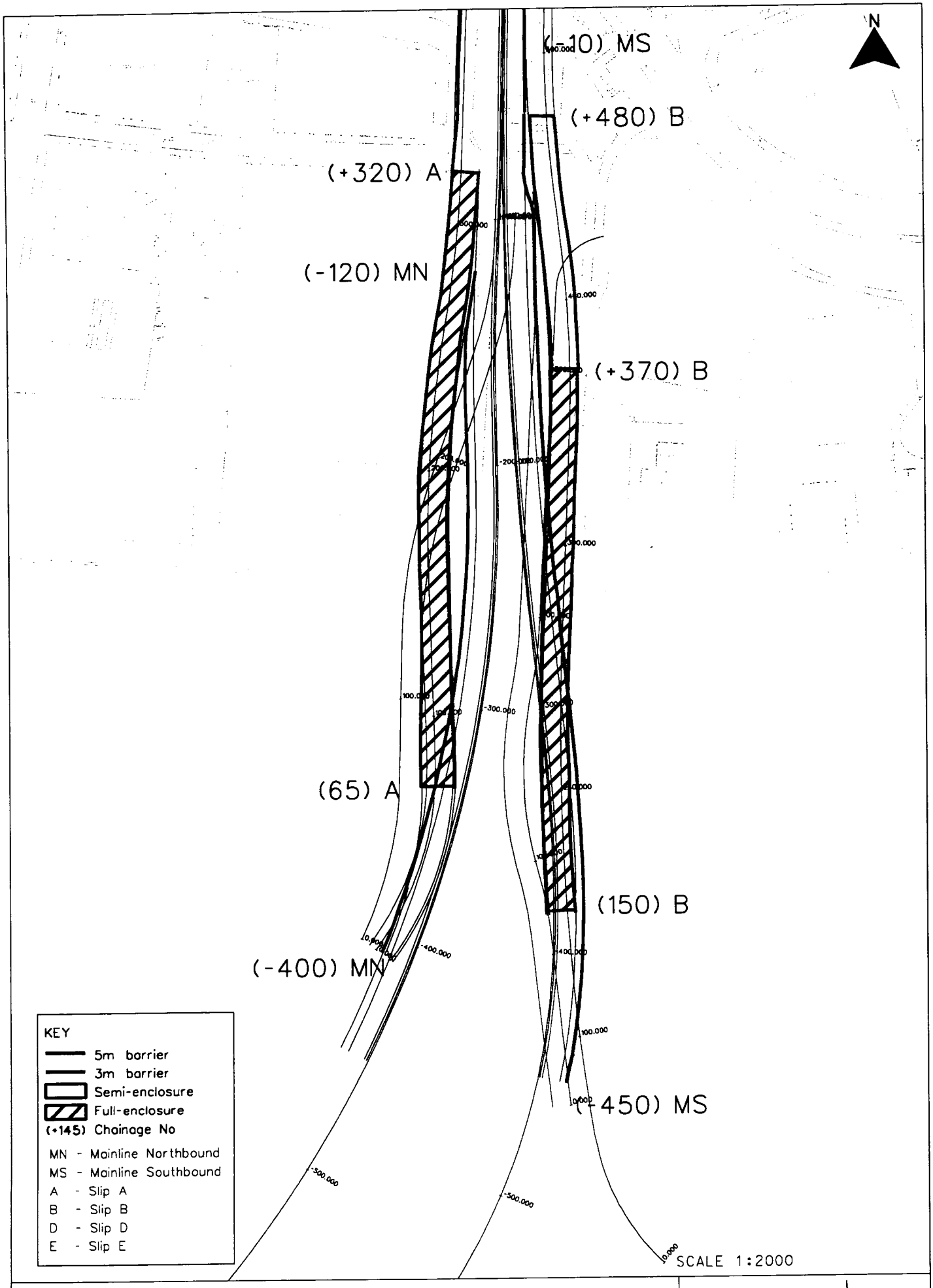


FIGURE 4.6v

MITIGATION OPTION 3

Environmental Resources Management

ERM

USTN FILE: C1884_73

DATE: 30/06/99

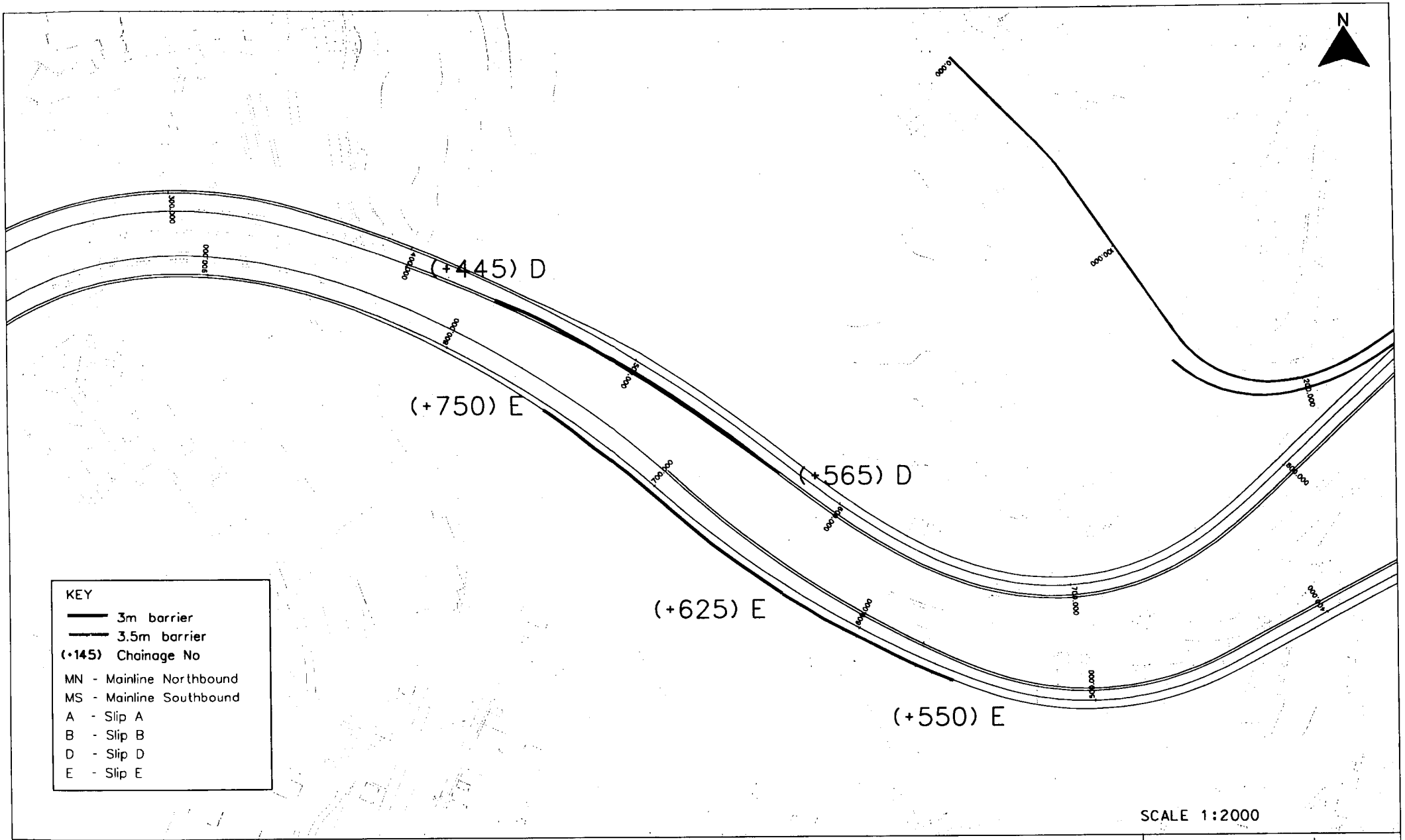


FIGURE 4.6w

MITIGATION OPTION 3

Environmental Resources Management

ERM

USTN FILE: C1884_71
DATE: 30/06/99

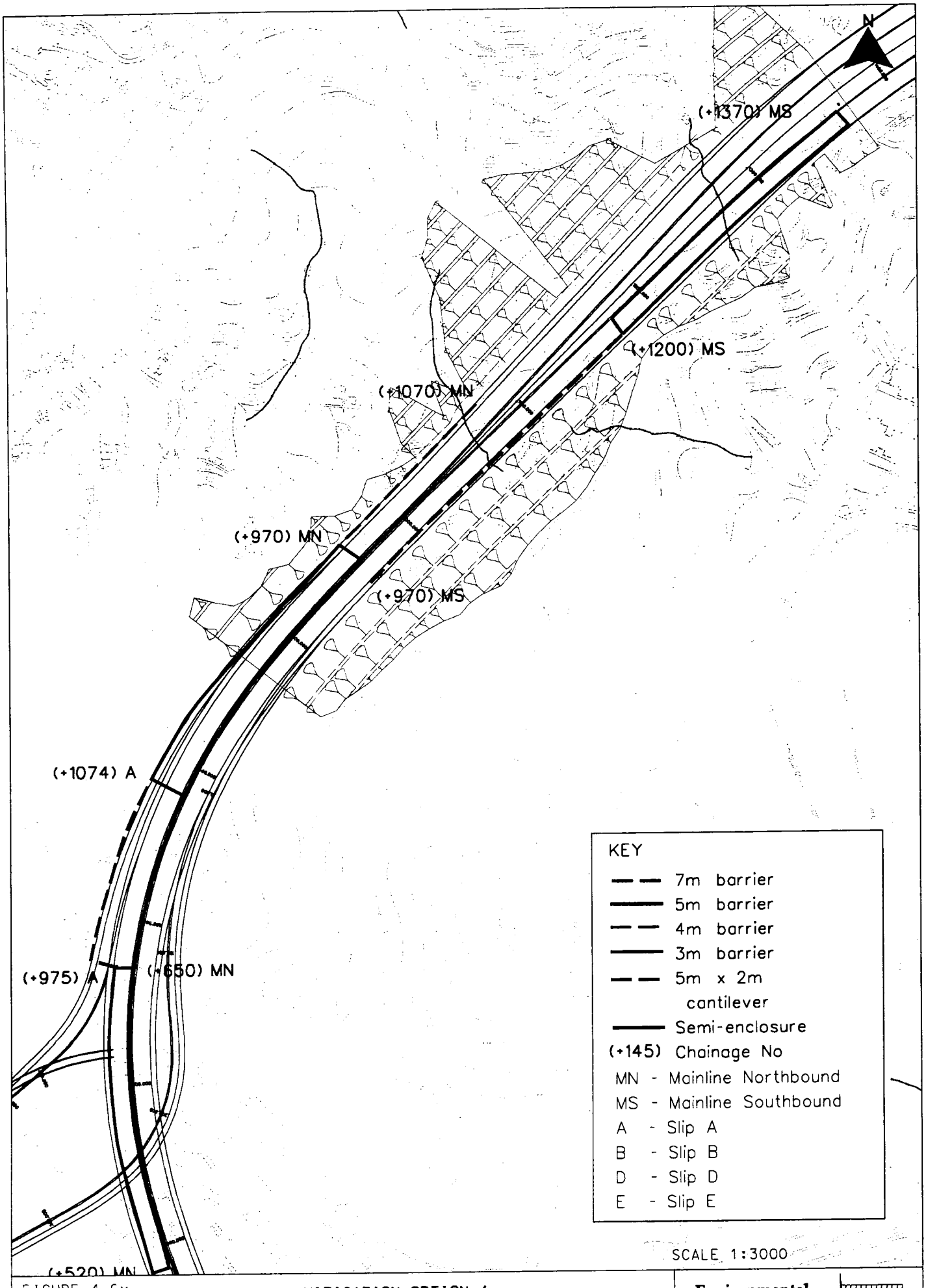


FIGURE 4.6x

MITIGATION OPTION 4

Environmental Resources Management

ERM

USTN FILE: C1884_74

DATE: 30/06/99

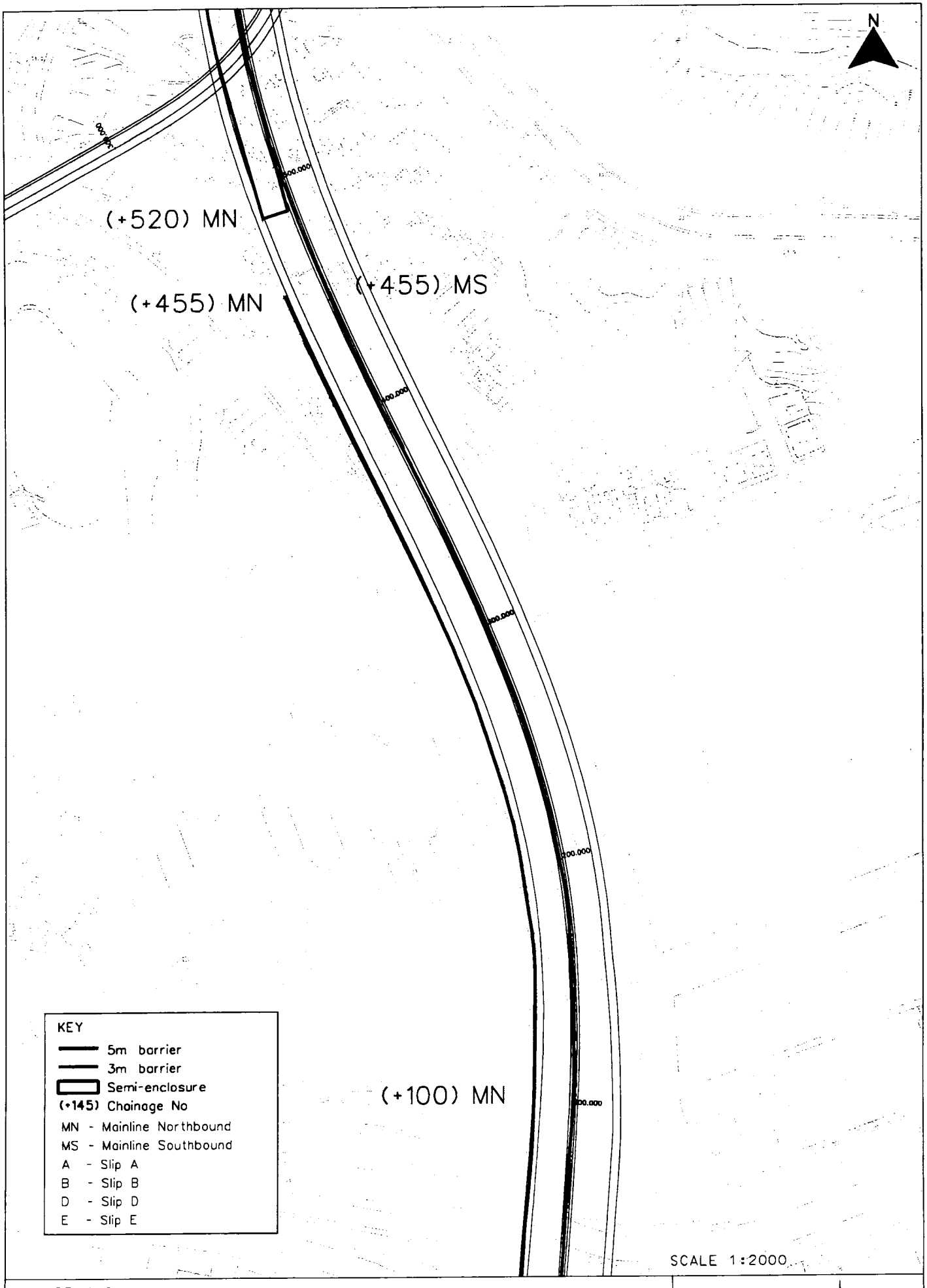


FIGURE 4.6y

MITIGATION OPTION 4

Environmental Resources Management

ERM

USTN FILE: C1884_76
DATE: 30/06/99

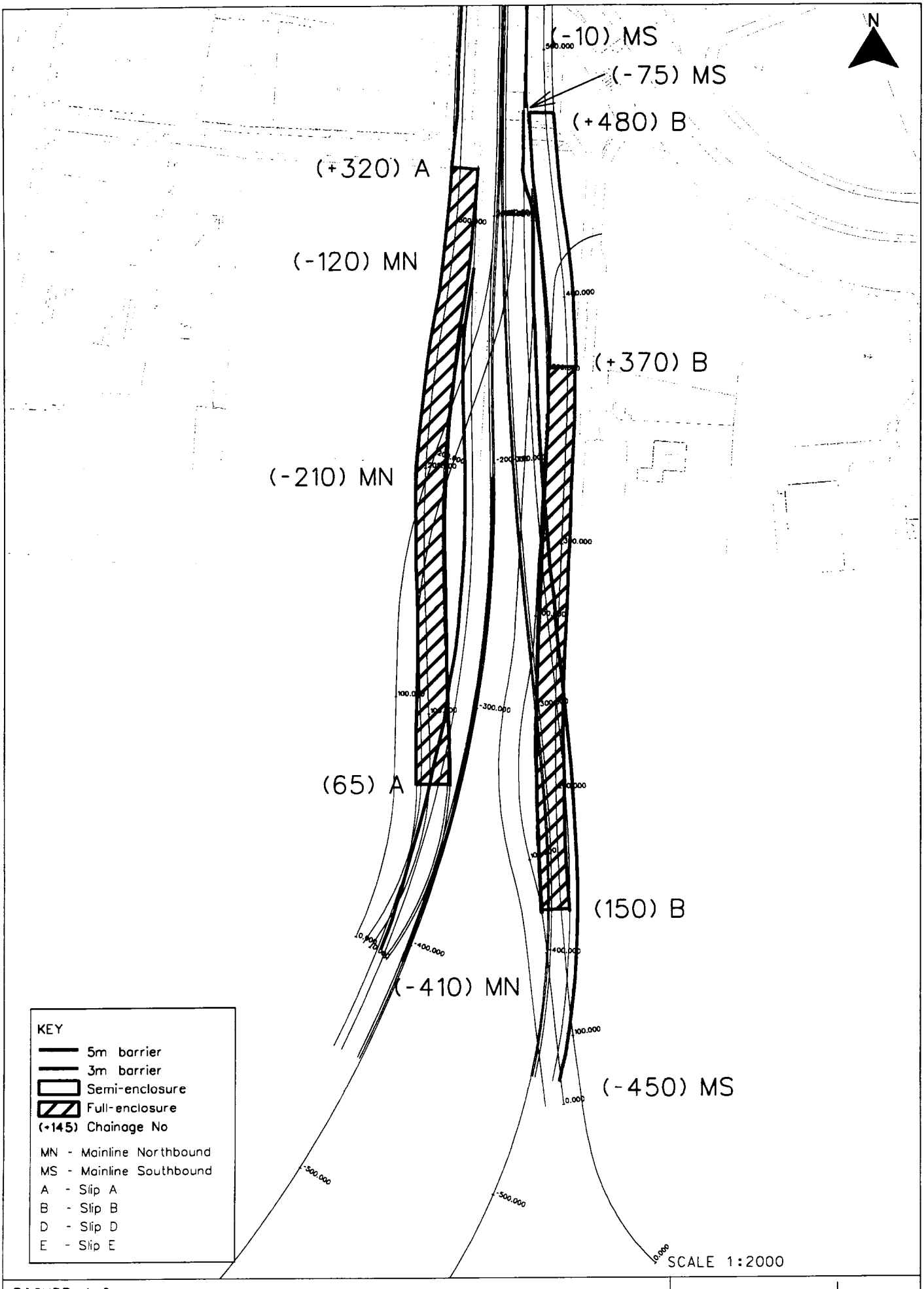


FIGURE 4.6z

MITIGATION OPTION 4

Environmental Resources Management

ERM

USTN FILE: C1884_77

DATE: 30/06/99

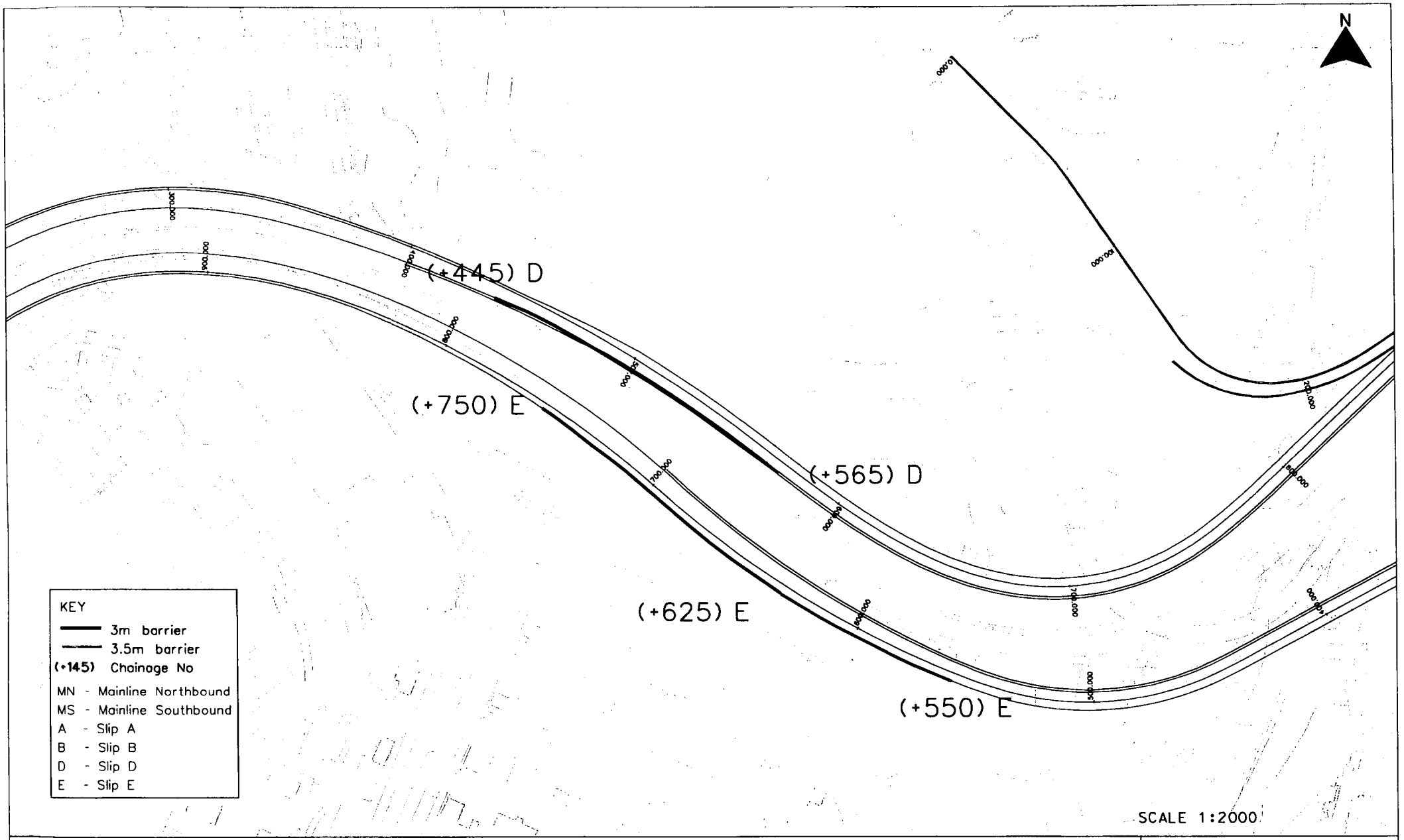


FIGURE 4.6aa

MITIGATION OPTION 4

Environmental Resources Management

ERM

USTN FILE: C1884_75
DATE: 30/06/99

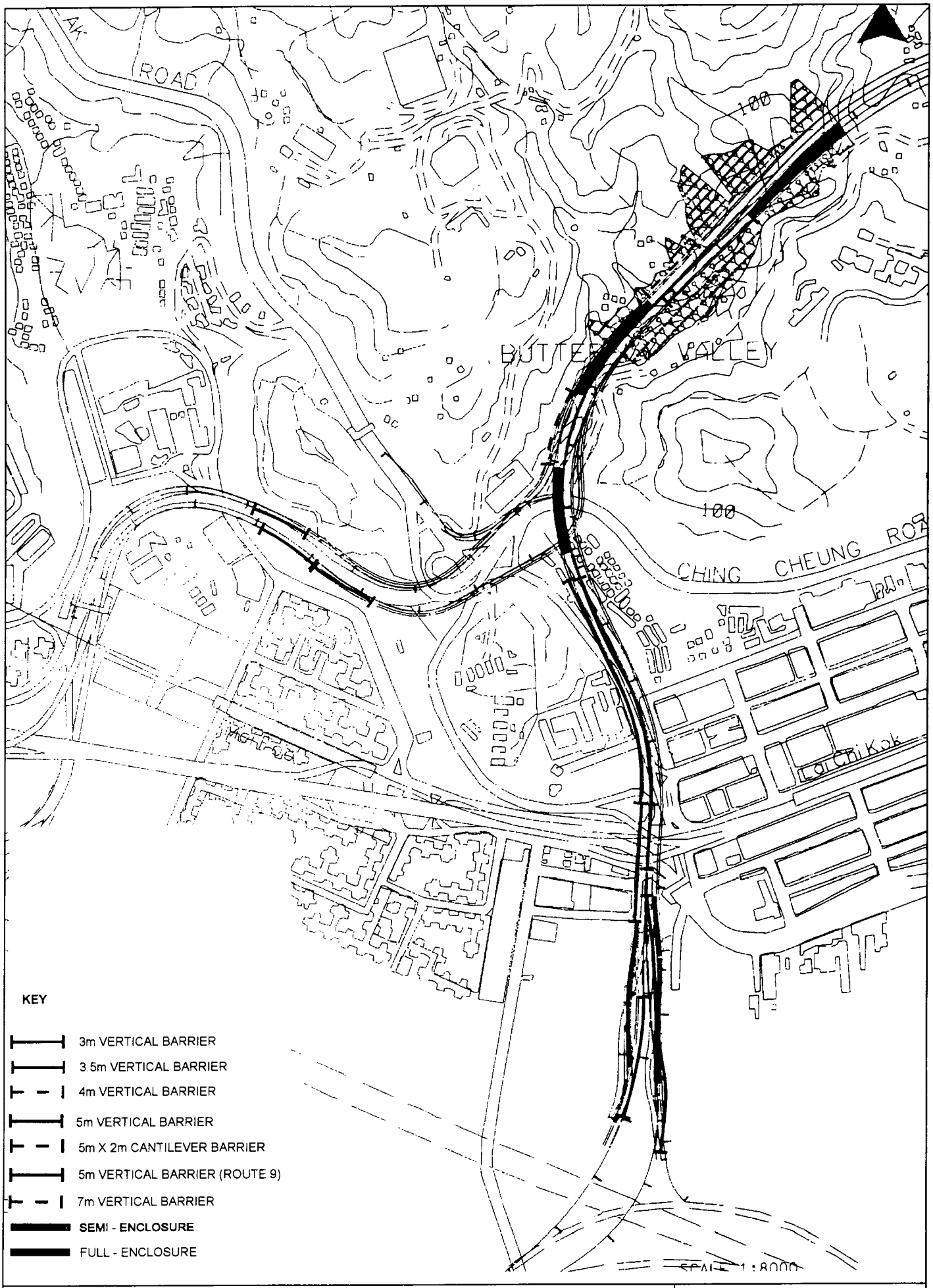


FIGURE 4.6ab

PROPOSED MITIGATION MEASURES

Environmental Resources Management

ERM

FILE: C1884j4
DATE: 31/06/99

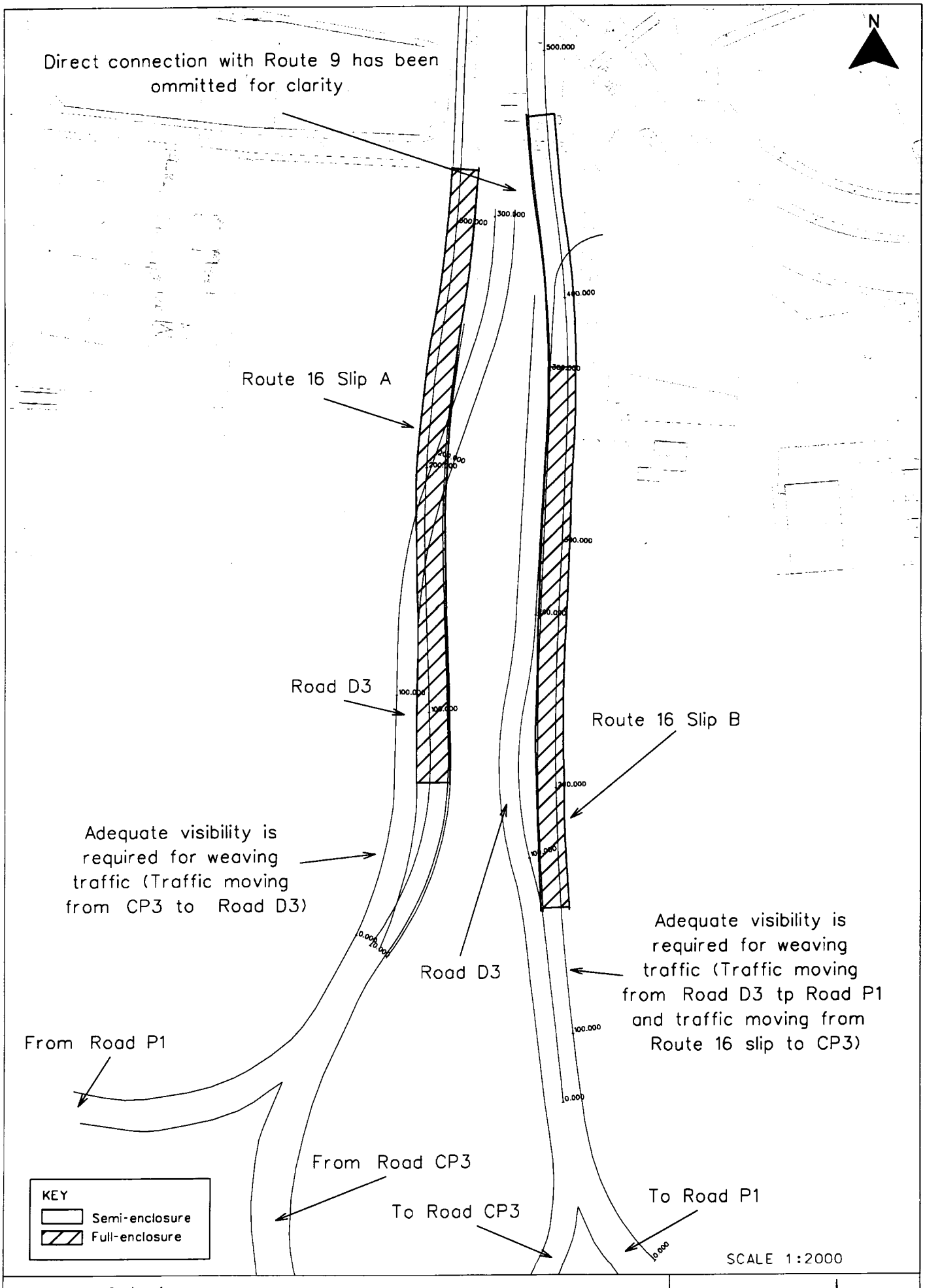


FIGURE 4.6 ab - 1 PHYSICAL LIMITATION OF ROUTE 16 SLIPS

Environmental Resources Management

ERM

USTN FILE: C1884_78
DATE: 30/06/99

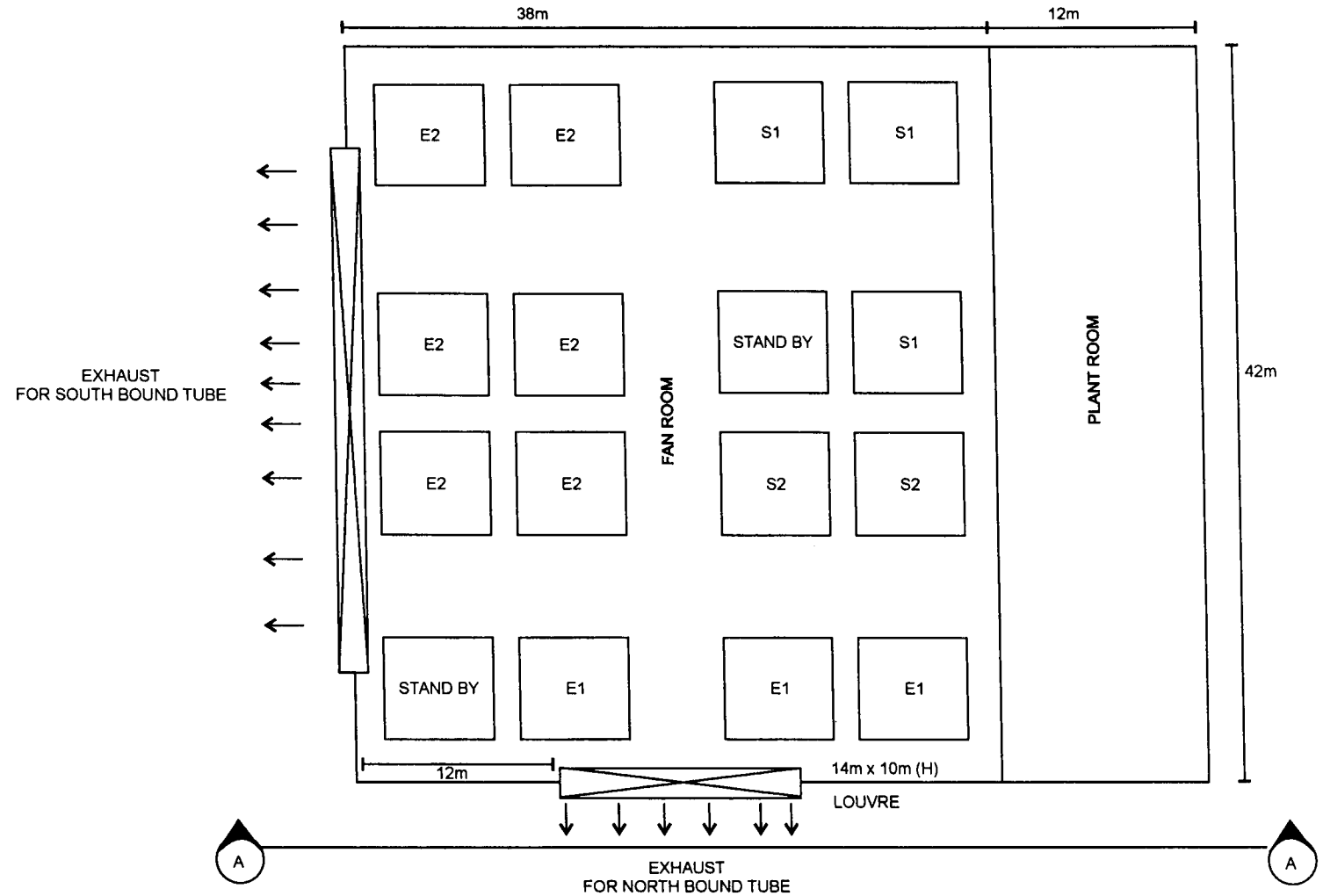


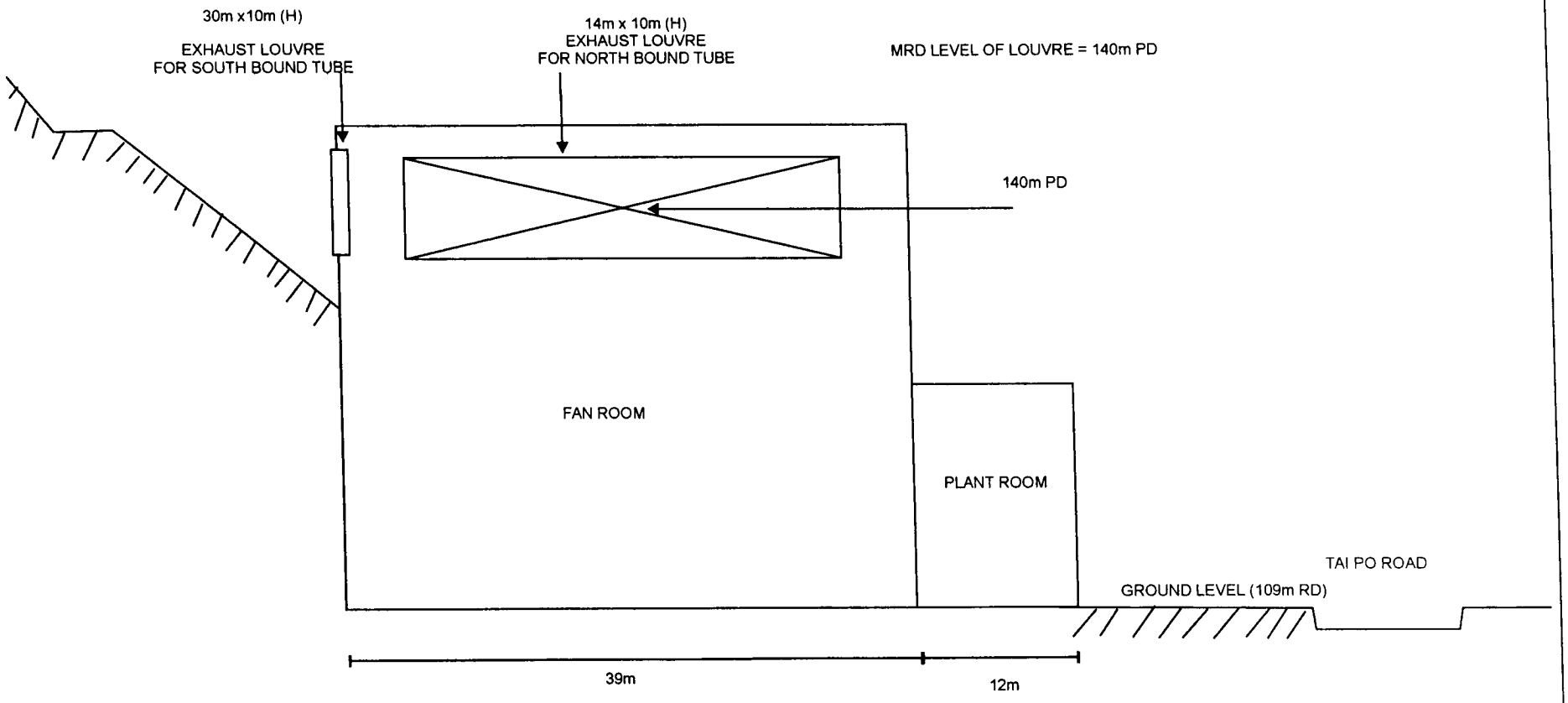
FIGURE 4.6ac

PRELIMINARY DESIGN OF MID VENTILATLION BUILDING (PART 1)

FILE: C1884f
DATE: 30/03/99

Environmental
Resources
Management

ERM



VIEW A

NOT TO SCALE

FIGURE 4.6ad

PRELIMINARY DESIGN OF MID VENTILATLION BUILDING (PART 2)

Environmental Resources Management

ERM

FILE: C1884f1
DATE: 30/03/99