4 AIR QUALITY IMPACT ASSESSMENT

4.1 Introduction

4.1.1 This chapter evaluates the likely air quality impacts associated with the construction and operation phases of the proposed housing development at Telegraph Bay. The key issues identified include the generation of dust in the form of Total Suspended Particulates (TSP) during site preparation and construction, the future traffic emissions (Nitrogen Dioxide (NO_2) and Respirable Suspended Particulates (RSP)), as well as operational odours from the sewage treatment works. This assessment considers the existing air quality legislation (Air Quality Objectives (AQOs) defined under the Air Pollution Control Ordinance (APCO) and in the Technical Memorandum on Environmental Impact Assessment Process (EIA-TM), representative sensitive receivers and potential sources of air pollutants. Practical mitigation measures have been recommended for the control of adverse environmental impacts and assessments have been undertaken to evaluate potential residual impacts and determine their acceptability.

4.1.2 During construction works, there will be dust impacts from on-site truck movements, drilling and earth moving activities. There will also be gaseous emissions from trucks, i.e., NO_2 and RSP, and powered mechanical equipment that may affect the nearby sensitive users of the area, although due to the limited numbers of equipment proposed, they are considered to be insignificant and therefore are not addressed in this study. The extent of dust impacts will depend on the buffer distances between the work sites and the sensitive receivers, the construction schedule, and the work methodologies utilised. As detailed above, impacts from the equipment exhaust emissions are not anticipated. The likely air quality impacts associated with the operational activities of the development are limited to vehicle traffic from nearby road networks and the odour from the sewage treatment plant in Site 2.

4.1.3 Construction works may lead to the generation of dust emissions that exceed the hourly and daily (24 hour) TSP criteria. The main potential dust generating sources are as follows:

- removal of vegetation and topsoil;
- unloading and handling of fill for surcharging operations;
- truck movements over the unpaved haul roads.
- site excavation, levelling, filling , terracing and slope works;
- handling and stockpiling of excavated material;
- haulage of excavated top soil, vegetation and bed rock;
- wind blown dust from dry exposed site areas; and
- deposition of dust from haulage trucks onto local roads.

4.2 Assessment Criteria

4.2.1 The Air Pollution Control Ordinance (APCO) provides the statutory authority for controlling air pollutants from a variety of stationary and mobile sources, including fugitive dust emissions from construction sites. it encompasses a number of Air Quality Objectives (AQOs) which stipulate concentrations for a range of pollutants including Sulphur Dioxide (SO_2), Carbon Monoxide (CO), Nitrogen Dioxide (NO_2), Respirable Suspended Particulates (RSP) and Total Suspended Particulates (TSP). The relevant AQOs are presented in Table 4.1.

Table 4.1 Hong Kong Air Quality Objectives

Pollutant (μg/m^3)(1)	Averaging Time			
	1-hour(2)	**8-hours(3)**	**24-hours(3)**	**1-year(4)**
Sulphur Dioxide	800	-	350	80
Total Suspended Particulates (TSP)	-	-	260	80
Respirable Suspended Particulates (RSP)(5)	-	-	180	55
Nitrogen Dioxide	300	-	150	80
Carbon Monoxide	30,000	10,000	-	-

Notes:
(1) Measured at 298 K and 101.325kPa (one atmosphere).
(2) Not to be exceeded more than three times per year.
(3) Not to be exceeded more than once per year.
(4) Arithmetic means.
(5) Respirable suspended particulates means suspended particles in air with a nominal aerodynamic diameter of 10 micrometers or less.

4.2.2 In addition to the AQOs, Annex 4 of the Technical Memorandum on Environmental Impact Assessment Process (EIA-TM) also outlines criteria for evaluating air quality impacts, these include:

- An hourly TSP limit of 500 μg/m^3 (at 298 K and 101.325 kPA) for assessing construction dust impacts; and
- 5 odour units based on an averaging time of 5 seconds for odour prediction assessments.

4.2.3 Dust control standards are also set out in the Air Pollution Control (Construction Dust) Regulations (section 43, cap.311 of Air Pollution Control Ordinance) to ensure effective control of the dust impacts by the contractors.

4.2.4 While the AQOs dictate the required statutory air quality levels, the Practice Note for Professional Persons, PN 1/98, issued by the Environmental Protection Department through the Professional Persons Environmental Consultative Committee (ProPECC) in March 1998, details the recommended control methods required to prevent air pollution in semi-confined Public Transport Interchanges. The practice note on ‘ Control of Air Pollution in semi-confined Public Transport Interchanges’ was issued to provide guidance on:

- Air quality guidelines required for the protection of public health; and
- Factors that should be considered in the design and operation of the PTI in order to prevent an air pollution problem from arising.

4.2.5 For Public Transport Interchanges (PTI), the guidelines detailed in Table 4.2 below have been set by the Director of Environmental Protection.

Table 4.2 Air Quality guidelines for PTIs

Pollutant	**Maximum Concentration* Not to be Exceeded**	
	1-Hour Average μg/m^3	**5-Minute Average μg/m^3**
Carbon Monoxide (CO)	30,000	115,000
Sulphur Dioxide (SO_2)	800	1,000
Nitrogen Dioxide (NO_2)	300	1,800

Note: *Expressed at the reference conditions of 25 degC and 101.325 kPa (one atmosphere).

4.3 Description of Surrounding Environment

4.3.1 Telegraph Bay (Kong Sin Wan) is located on the western side of Hong Kong Island and is to be developed with residential towers and G/IC facilities which are compatible with existing developments in the area.

4.3.2 Details of the proposed site development are described in Chapter 2.

4.3.1 Baseline Conditions

4.3.1.1 There have been no “baseline” air quality measurements conducted for this study. However, the long term air quality monitoring programme carried out by the Environmental Protection Department (EPD) at Air Quality Monitoring Stations have provided an acceptable indication of the existing conditions. The Central / Western monitoring station is the closest station to the study area and it is proposed that monitoring data from this station be utilised as representative of current background conditions. Inspection of the “Air Quality in Hong Kong in 1996” report indicates the following annual averages for year 1996, TSP- 87 $\mu g/m^3$, RSP – 52 $\mu g/m^3$ and NO_2 – 47 $\mu g/m^3$. It is proposed that the annual average concentrations be adopted as background levels for construction and operation air quality modelling.

Table 4.3 Monitoring data obtained from Central / Western air quality Monitoring Station (1996)

Pollutant	**Concentration in microgram per cubic metre ($\mu g/m^3$)**			
	Highest 1-hour	**Highest 24-hour**	**Highest monthly**	**Annual Average**
NO_2	213	127	81 (December)	47
RSP	247	173	93 (December)	52
TSP	-	-	150 (January)	87*

Note: * Concentration level exceeds AQO

4.3.1.2 A marginal exceedance of the TSP annual AQO limit is observed, whereas the monthly TSP concentrations as well as concentration levels for other contaminants meet the applicable AQOs.

4.3.2 Future Trends

4.3.2.1 The characteristics of the proposed site area will be subject to significant change as the land becomes available for development. The future environment will include new road networks, i.e. the proposed Road D1, Road D2, Route 7 and its associated slip roads, within the Telegraph Bay Area. As a result, increased road traffic activity is anticipated for the region which will likely lead to an increase in the ambient levels of gaseous and particulate pollution.

4.4 Air Sensitive Receivers (ASRs)

4.4.1 The spatial scope for the assessment of air quality impacts is defined as 500 metres from the boundary of the work site. In accordance with the TM-EIA and the Air Pollution Control Ordinance (APCO), domestic premises, hotels, hostels, hospitals, clinics, nurseries, temporary housing accommodations, schools, educational institutions, offices, factories, shops, shopping centres, places of public worship, libraries, courts of law, sports stadiums and performing arts centres are considered as air sensitive receivers. Sensitive receiver locations have been identified through a review of both existing and committed land uses, site visits reference to the Outline Zoning Plans and a review of Planning Departments information.

4.4.2 A number of representative ASRs have been identified in the Final Working Paper No. ENWP1 (August 1998) for the construction and operation of the development. However, as Option B has been adopted as the alignment for the Northern Access Road, only ASRs associated with that alignment have been included in this assessment. The identified ASRs during the construction of the proposed development are summarised in Tables 4.4 and 4.5 and shown in Figure 4.1.

Table 4.4 Air Sensitive Receivers (ASRs) During the Advance Works of the Proposed Development

ASR No.	Description	Land Use[1]
SR5	45 Sasson Road	R
SR8	60 Sasson Road	R
SR9	Magnolia Villas	R
SR10	Point Breeze	R
SR19	Baguio villas	R
SR21	Pok Fu Lam Training Centre	S
SR23	Wah Fu Lam Training Centre	R
SR27	Kong Sin Wan Tsuen	R
SR24	Lui Ming Choi Secondary School	S
SR28	Boarding Clinic and Veterinary Clinic	O/C
SR40	Pui Ying Secondary School	S
SR41	Telegraph Bay Playground	Rec

Note: [1] Residential uses (R); School (S); Recreational uses (Rec); Office/Commercial (O/C)

Table 4.5 Air Sensitive Receivers (ASRs) During the Main Construction Works of the Proposed Development

ASR No.	Description	Land Use[1]
SR1	Stanley Ho Sports Centre	Rec
SR2	Tam Villa	R
SR3	HKU Staff Quarters	R
SR4,5,7 & 8	42,45,50 & 60 Sasson Road	R
SR9	Magnolia Villas	R
SR10	Point Breeze	R
SR11	Carriana Sasson	R
SR12	Stone Manor	R
SR13	Provident Villas	R
SR14	HKU Medical Faculty	S
SR15	HKU Lecture Buildings	S
SR17	Queen Mary Hospital	Med
SR18	Ebenezer Home for the Blind	S
SR19	Baguio Villas	R
SR21	Pok Fu Lam Training Centre	S
SR22	Pok Fu Lam Garden	R
SR23	Wah Fu Estate	R
SR24	Lui Ming Choi Secondary School	S
SR25	Precious Blood Primary School	S
SR26	Tsui Ching Tong School For the Handicap	S
SR27	Kong Sin Wan Tsuen	R
SR28	Boarding Clinic and Veterinary Clinic	O/C
SR40	Pui Ying Secondary School	S
SR41	Telegraph Bay Playground	Rec

Note: 1 Residential uses(R); School (S); Recreational uses (Rec); Office/Commercial (O/C); Medial (Med)

4.4.3 For the purpose of the Study, only the most impacted ASRs within the Telegraph Bay Development during the construction of Route 7, i.e. those closest to Route 7, are assessed (Figure 4.2). Table 4.6 lists the ASRs within the Telegraph Bay Development utilised for the assessment and their approximate distances from Route 7.

Table 4.6 ASRs during the Construction of Route 7 (within Telegraph Bay Development only)

Site 1		Site 2		Site 3		Site 4		Site 5	
ASR No	Approx. Distance from Route 7 (m)	ASR No	Approx. Distance from Route 7 (m)	ASR No	Approx. Distance from Route 7 (m)	ASR No	Approx. Distance from Route 7 (m)	ASR No	Approx. Distance from Route 7 (m)
120	96	**202**	66	**301**	72	**401**	37	**510**	106
121	97	**203**	56	**302**	111	**402**	39	**514**	104
-	-	**204**	77	**305**	75	**409**	155	**519**	74
-	-	-	-	**306**	117	**410**	182	**520**	71
-	-	-	-	-	-	-	-	**521**	92

4.4.4 Similarly, for the operational air quality assessment, only the most impacted ASRs, i.e. those closest to the proposed Roads D1, D2 and Route 7 are assessed (Figures 4.3 to 4.7). Should an exceedance occur at any identified ASRs that cannot be mitigated, the impacts at second tier ASRs will be further evaluated. Approximate distances between the ASRs in Sites 1 to 4 and Route 7, and between ASRs in Site 5 and Southern Access Road are given in Table 4.7.

Table 4.7 ASRs during the operation of Route 7 (within Telegraph Bay Development only)

Site 1		**Site 2**		**Site 3**		**Site 4**		**Site 5**	
ASR No	**Approx. Distance from Route 7 (m)**	**ASR No**	**Approx. Distance from Route 7 (m)**	**ASR No**	**Approx. Distance from Route 7 (m)**	**ASR No**	**Approx. Distance from Route 7 (m)**	**ASR No**	**Approx. Distance from Route 7 (m)**
101	236	**207**	77	**301**	72	**401**	37	**501**	56
102	248	**208**	56	**302**	111	**402**	39	**502**	24
103	292	**209**	66	**303**	45	**403**	57	**503**	48
104	303	**210**	89	**304**	46	**404**	60	**504**	23
105	322	**211**	98	**305**	75	**405**	32	**505**	45
106	322	**212**	93	**306**	117	**406**	35	**506**	21
107	223	**213**	120	**307**	113	**407**	168	**507**	56
108	222	**214**	132	**308**	154	**408**	198	**508**	67
109	181	**215**	160	**309**	155	**409**	155	**509**	59
110	172	**216**	160	**310**	168	**410**	182	**510**	86
111	168	**217**	123	**311**	187	**411**	119	**511**	93
112	152	-	-	**312**	203	**412**	144	**512**	62
113	96	-	-	**313**	183	**413**	128	**513**	42
114	97	-	-	**314**	220	**414**	154	**514**	36
-	-	-	-	**315**	152	**415**	100	**515**	41
-	-	-	-	**316**	190	**416**	129	**516**	43
-	-	-	-	-	-	**417**	72	**517**	59
-	-	-	-	-	-	**418**	102	-	-
-	-	-	-	-	-	**419**	49	-	-
-	-	-	-	-	-	**420**	83	-	-

4.4.5 For the odour assessment, the closest air sensitive receivers have been identified as the proposed school in Site 2 (ASR 201), as well the future school (in place after the decommissioning of CEPT) (ASR 213). The approximate distances from the odour emission location of the sewage treatment works to ASR 201 and ASR 213 are 38m and 47m, respectively (Figure 4.8).

4.5 Meteorology

4.5.1 The potential for the dispersion of air pollution is very much dependent on local factors such as wind speed and direction, and atmospheric stability.

4.5.2 Site specific meteorological data for the Telegraph Bay Area are limited. The study has therefore reviewed the nearest Hong Kong Observatory meteorological station data to gain an overall appreciation of likely meteorological conditions that would prevail at the study area.

4.5.3 The fugitive emissions will be determined by local prevailing meteorological conditions. An understanding of prevailing wind speed and direction at the study area will help to determine potential air quality concerns.

4.5.4 Hong Kong's climate is dominated by two monsoons:

- The warm rain bearing south easterly summer monsoon; and
- The cool dry north-easterly winter monsoon.

4.5.5 The cool season generally lasts from October until mid March. The hot season typically begins in April and continues until September. The annual wind roses for Hong Kong show corresponding wind directions. It must be noted that because of the undulating topography of Hong Kong and the presence of confined air sheds, winds vary widely with location. Moreover, differences can arise between the prevailing wind speed and direction at various locations and at different times of the day.

4.5.6 Much of the terrain in Hong Kong and the New Territories is above 200mPD, with isolated areas over 600mPD. Therefore, air flow in the boundary layer is significantly affected between the 300 metre and 600 metre levels, with the effects likely extending as high as 900 metres on occasion. Radiosonde studies show an increase in wind speed at 900 metres and 1,100 metres, respectively, compared to surface observations. The Observatory has confirmed these occurrences.

4.5.7 The frequency of stable atmospheric conditions over Hong Kong is about 10-20% whilst unstable conditions occur about 30-40% of the time.

4.5.8 The proposed development site at Telegraph Bay lies between the HK Observatory meteorological sites at Green Island and Wong Chuk Hang.

4.6 Construction Phase Air Quality Impacts

4.6.1 Identification of Air Quality Impacts

4.6.1.1 This section outlines the likely air quality impacts associated with the site preparation and construction activities for the proposed development at Telegraph Bay, as well as to highlight the potential impacts from the construction of the section of Route 7 within Telegraph Bay Area.

4.6.1.2 The atmospheric pollutants that may arise during the construction phase include dust and vehicular emissions. The major pollutant will be the fugitive dust if uncontrolled. Impacts from vehicle and plant exhaust emissions are considered to be insignificant due to their limited number. Therefore, dust impacts will be the most important construction phase air quality issue to be addressed in this Study.

4.6.1.3 During the construction phase, dust generating construction activities include vehicle movements, site clearance, drilling, ground excavation and material handling. Wheel wash units will be provided at the entrances and exits of the worksite and, with the proper use of these facilities, there will be minimal dust nuisance outside the worksite. However, fugitive dust will arise from the vehicle movements within the worksite.

4.6.1.4 The main dust impacts will arise from truck movements along the unpaved haul roads. Secondary impacts will be generated through the stockpiling and removal of spoil during the advance works and main infrastructure construction works period. The amount of material expected to be handled is summarised in Table 4.8.

Table 4.8 Spoil Handling During Construction Phases

Construction Activities	**Spoil Quantity (m^3) (soil and rock)**	**Estimated Number of Dump Trucks on Haul Roads [1, 2] (vehicles round trip per hour)**
<u>Advance Works</u> • Import - Sand Fill - Public Fill • Disposal	 360,000 m^3 270,000 m^3 330,000 m^3	 30 veh / hr [3] 23 veh / hr [3] 83 veh / hr [3]
<u>Main Construction Works</u> • Road D1 • Road D2 • Southern Access Road • Northern Access Road • Landscaping	 22,280 m^3 8,700 m^3 124,165 m^3 9,900 m^3 28,920 m^3	20 vehicles /hr [4]
<u>Route 7 Construction</u> • Reclamation/Surcharging/ Landscaping	300,000 m^3	20 vehicles /hr [4]

Note:
1. Refer to Appendix 2.1 for work schedules.
2. Assumption of 25 working days per month, and 11 working hours per day.
3. Dump truck capacity of 6 m^3.
4. Dump truck capacity of 8 m^3.

4.6.1.5 Due to the limited number of trips per day (i.e. vehicles, passenger boats and barges) associated with the off-site work areas at Sandy Bay and Ap Lei Chau, the air quality impacts from gaseous emissions are considered to be insignificant. Because the material to be handle in the off-site work areas will be limited to general construction materials, dust generation is anticipated to be limited.

4.6.2 Assessment Methodology

4.6.2.1 The likely types and sequences of construction activities that may give rise to potential dust impacts are identified based on the construction programmes and the work area locations. The Fugitive Dust Model (FDM) is used to predict the likely impacts from the dust generating activities upon the identified ASRs.

4.6.2.2 The particulate emission rates are estimated using the Compilation of Air Pollutant Emission Factors (AP-42), USEPA, 5th edition, 1995. The emission factors used in the modelling are tabulated in Table 4.9.

Table 4.9 Emission Factors of Dust Generating Activities

Activities	**Emission Factors***
Truck movements unpaved roads	1.766kg/VKT
Handling of spoil (loading/unloading)	2.54 x 10^{-4}kg/Mg
Wind erosion	39.33 kg/day/hectare

Note: * Calculations given in Appendix 4.1.

4.6.2.3 It is assumed that the construction activities will be carried out during daytime and therefore, the worst case daytime meteorological conditions, i.e. 1m/s wind speed and stability class D, are used. Worst case wind directions, i.e. blowing from the works area towards the ASRs, are also used in the model.

4.6.2.4 Standard anemometer height (a necessary parameter in the FDM model) of 10m is used in the model.

4.6.2.5 The impact of fugitive dust sources on air quality depends upon the quantity as well as the drift potential of the dust particles injected into the atmosphere. Large dust particles will settle out near the source and particles that are 30-100μm in diameter are likely to undergo impeded settling. These particles, depending on the extent of atmospheric turbulence, would probably settle within 100m of the source. The main dust impacts are therefore likely to arise from particles less that 30μm in diameter, i.e. Total Suspended Particulates (TSP), which have a greater potential to disperse over greater distances.

4.6.2.6 The particle size distribution tabulated in Table 4.10 has been extracted from the FDM model default settings and is adopted for the Study. The gravitational settling velocity for each dust category was then calculated by FDM.

Table 4.10 Particle Size Distribution of Airborne Particulate Matter

Category	Mean particle Diameter (μm)	Fraction
1	1.25	0.0262
2	3.75	0.0678
3	7.50	0.1704
4	12.50	0.1536
5	20.00	0.5820

4.6.2.7 The variation in earth's surface condition will impose a surface shear stress to wind, known as "surface friction". The study area is close to open water surface and therefore a surface roughness length of 0.6m is adopted for the assessment.

4.6.2.8 1-hr concentrations will be predicted and compared with the hourly criterion of 500μg/m^3. The FDM model predicts 24-hours average concentrations, but as the standard construction hours in Hong Kong are 0700-1900 (Mondays to Saturdays), and that the variation of dust emissions with time is not considered in the FDM, the modelled 24-hour results are considered to be excessively high. Therefore, assuming the wind will be blowing from the works site directly at the ASR for the whole construction period (i.e. 11 hours a day), a conversion factor of 0.46 (i.e. 11 divided by 24) will be applied to determine 24-hour TSP concentrations from the 1-hour concentrations. The corrected 24-hour concentrations are then compared with the 24-hour AQO of 260μg/m^3.

4.6.2.9 The annual average TSP level of 87μg/m^3 , obtained from the 1996 monitoring results from the EPD Central/Western station, is used as background concentration level and is added to the predicted 1-hr and 24-hr TSP concentrations.

4.6.3 Impact Prediction

4.6.3.1 The extent of dust impacts affecting the nearby ASRs during the construction of the Telegraph Bay Development will vary from phase to phase due to the different types of construction works carried out. The construction activities can be categorised into two main stages:

- Advance Works – earthworks and surcharging on the reclamation area (Sites 2, 3 and 4 only) and construction of box culvert (Sites 1 and 2);
- Main Construction Works – access road-works, civil works and superstructure construction.

4.6.3.2 In addition to the construction stages identified above, the dust impacts upon the proposed development from the construction of Route 7 (in the Telegraph bay Area only) will also be assessed. In summary, dust impacts from the following stages will be evaluated:

1. Advance Works for Telegraph Bay Development;
2. Main Construction Works for Telegraph bay Development; and
3. Route 7 Construction within Telegraph Bay Area.

4.6.3.1 Advance Works for Telegraph Bay Development

4.6.3.1.1 The advance works comprise the following activities and will be carried out in accordance with the schedule outlined in Table 4.11a (refer to Figure 2.3 for reclamation areas):

- Activity 1 – Site clearance;
- Activity 2 – Pre-drilling and installation of band drains;
- Activity 3 – Importation and deposition of sand fill;
- Activity 4 – Importation and deposition of pubic fill;
- Activity 5 – Surcharging period;
- Activity 6 – Disposal of surplus material; and
- Activity 7 – Construction of box culvert (in Site 1).

Table 4.11a Advance Works – Works Schedule

Site Areas	**Phase**									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Site 4 (area 4 & 5)	Act 1	Act 2	Act 3	Act 4	Act 5					Act 6
Site 3 (area 4 & 5)		Act 1	Act 2	Act 3	Act 4	Act 5				Act 6
Site 4 (remaining)			Act 1	Act 2	Act 3	Act 4	Act 5			Act 6
Site 3 (remaining)				Act 1	Act 2	Act 3	Act 4	Act 5		Act 6
Site 2					Act 1	Act 2	Act 3	Act 4	Act 5	Act 6
Site 1	Act 7	Act 7	Act 7	Act 7						

Note:
Act 1 – Site clearance; Act 2 – Pre-drilling and installation of band drain; Act 3 – Importation and deposition of sand fill; Act 4 – Importation and deposition of pubic fill; Act 5 –Surcharging period; Act 6 – Disposal of surplus material; and Act 7 – Construction of box culvert.

4.6.3.1.2 The nearby ASRs identified for this assessment are given in Figure 4.1. The highest 1-hour and 24-hour average TSP concentrations predicted for the ASRs are given in Tables 4.11b and 4.11c, respectively.

4.6.3.1.3 It is noted that the unmitigated 1-hr TSP criterion of 500$\mu g/m^3$ and the 24-hour AQO of 260$\mu g/m^3$ are both exceeded at SR 19, SR27 and SR41 (Baguio Villas, Kong Sin Wan Tsuen and Telegraph Bay Playground).

Table 4.11b Predicted 1 hour TSP Concentrations at ASRs during Advance Works for Telegraph Bay Development (without Dust Suppression measures)

ASR	1 hour TSP Concentrations (μg/m^3) + Background									
	Construction Phases									
	1	2	3	4	5	6	7	8	9	10
SR5	99	90	107	98	100	100	91	89	88	101
SR8	126	98	154	126	130	130	101	93	92	135
SR9	128	102	154	133	131	130	108	97	93	141
SR10	118	97	139	119	120	120	100	93	91	126
SR19	392	313	**559**	**568**	349	429	347	232	124	**513**
SR21	87	87	87	87	87	87	87	87	87	87
SR23	234	170	311	276	272	248	221	157	115	293
SR27	295	197	395	357	330	307	255	171	125	378
SR24	**1318**	**1013**	**1697**	**1753**	**1464**	**1284**	**1304**	**777**	370	**1642**
SR28	225	179	283	297	262	243	233	165	116	306
SR40	254	175	337	305	284	266	223	155	118	324
SR41	**1845**	**1490**	**2267**	**2443**	**1762**	**1545**	**1635**	**1038**	462	**2004**

Note:
1. **Bold** figures indicate exceedance of the 1-hr TSP criterion 500μg/m^3.
2. Background concentration: TSP 87μg/m^3.

Table 4.11c Predicted 24 hour TSP Concentrations at ASRs during Advance Works for Telegraph Bay Development (without Dust Suppression measures)

ASR	24 hour TSP Concentrations (μg/m^3) + Background									
	Construction Phases									
	1	2	3	4	5	6	7	8	9	10
SR5	92	88	96	92	93	93	89	88	88	94
SR8	105	92	118	105	107	107	93	90	89	109
SR9	106	94	118	108	107	107	97	92	90	112
SR10	101	91	111	102	102	102	93	90	89	105
SR19	227	191	**304**	**308**	208	244	207	154	104	**283**
SR21	87	87	87	87	87	87	87	87	87	87
SR23	155	125	190	174	172	161	149	119	100	182
SR27	183	138	228	211	199	188	164	126	104	221
SR24	**653**	**513**	**828**	**854**	**721**	**638**	**647**	**404**	217	**802**
SR28	150	129	177	184	168	159	154	123	100	188
SR40	164	128	202	187	178	169	150	118	101	196
SR41	**896**	**732**	**1090**	**1171**	**858**	**758**	**799**	**524**	260	**969**

Note:
1. **Bold** figures indicate exceedance of the 24-hr TSP AQO 260μg/m^3.
2. Background concentration: TSP 87μg/m^3.

4.6.3.2 Main Construction Works for Telegraph Bay Development

4.6.3.2.1 For the purpose of this Study, 4 main construction phases for the Telegraph Bay Development have been adopted (see Table 4.12 and Appendix 2.1). The ASRs, the five different sites and three access roads are presented in Figures 4.1 and 4.9, respectively. The highest 1-hour and 24-hour average TSP concentrations predicted at the ASRs (without dust suppression measures) are given in Table 4.13.

4.6.3.2.2 It is noted that the unmitigated 1-hour TSP criterion and 24-hour TSP AQO are exceeded at Stanley Ho Sports Hall (SR 1), HKU Staff Quarters (SR 3), Precious Blood Primary School (SR 25), Tsui Ching Tong School (SR 26), Kong Sin Wan Tsuen (SR 27), Boarding Clinic and Veterinary Clinic (SR 28) and Telegraph Bay Playground (SR 41).

Table 4.12 Adopted Phasing for the Main Construction Works

Phase 1	Phase 2	Phase 3	Phase 4
Site1	Site 3	Site 4	Site 5
Site 2			
Southern Access Road	Northern Access Road		Roads D1/D2

Table 4.13 Predicted TSP Concentrations at ASRs during Main Construction Works for Telegraph Bay Development (without Dust Suppression Measures)

ASR	Phase 1 – TSP Concentrations (mg/m^3) + Background		Phase 2 – TSP Concentrations (mg/m^3) + Background		Phase 3 – TSP Concentrations (mg/m^3) + Background		Phase 4 – TSP Concentrations (mg/m^3) + Background	
	1-hour	24-hour	1-hour	24-hour	1-hour	24-hour	1-hour	24-hour
SR1	411	236	**655**	**348**	480	**268**	475	**265**
SR2	229	152	274	173	212	145	222	149
SR3	340	203	**1695**	**827**	**428**	244	422	241
SR4	174	127	147	115	118	101	129	106
SR5	149	116	114	99	98	92	109	97
SR7	180	130	141	112	111	98	124	104
SR8	212	144	162	121	119	102	141	112
SR9	180	130	143	113	116	101	127	105
SR10	184	132	138	110	111	98	124	104
SR11	177	129	149	115	117	101	130	107
SR12	170	125	145	114	118	101	131	107
SR13	162	121	140	111	117	101	129	106
SR14	133	108	114	100	103	94	111	98
SR15	112	99	99	93	93	90	98	92
SR17	97	92	90	89	88	88	90	89
SR18	108	97	94	90	90	88	94	90
SR19	393	228	456	257	310	190	336	202
SR21	88	88	88	88	87	87	87	87
SR22	88	88	90	88	87	87	87	87
SR23	415	238	228	152	183	131	204	141
SR24	490	**272**	284	178	228	152	429	244
SR25	**895**	**459**	**508**	**281**	**354**	210	**666**	**353**
SR26	**969**	**493**	**964**	**491**	**490**	**273**	**738**	**387**
SR27	**1357**	**671**	**1159**	**580**	**1195**	**597**	**1166**	**583**
SR28	**1481**	**728**	231	153	178	129	**559**	**304**
SR40	434	247	249	162	199	138	264	168
SR41	**1362**	**674**	**1188**	**593**	**1109**	**557**	**1070**	**539**

Note:
1. **Bold** figures indicate exceedance of either the 1-hr criterion 500μg/m^3 or 24-hr AQO 260μg/m^3.
2. Background concentration; TSP 87μg/m^3.

4.6.3.3 Route 7 Construction (within Telegraph Bay Area)

4.6.3.3.1 For the purpose of this study, the section of Route 7 within the Telegraph Bay Area has been separated into three parts, assuming works will be carried out in one section at any given time. Figure 4.10 presents the three sections of Route 7 within the Telegraph Bay Area. The identified ASRs within the Telegraph Bay Development are given in Figure 4.2.

4.6.3.3.2 The highest predicted concentrations of TSP at the identified ASRs (1-hour and 24-hour averages) are given in Table 4.14. It is noted that ASRs in Sites 2, 3 and 4 are impacted by dust generated during the construction of Route 7. The relevant criteria are exceeded during all phases of the construction works.

Table 4.14 Predicted TSP Concentrations at ASRs during Construction of Route 7 within the Telegraph Bay Area (without Dust Suppression Measures)

	Phase 1 – TSP Concentrations ($\mu g/m^3$) + Background		**Phase 2 – TSP Concentrations ($\mu g/m^3$) + Background**		**Phase 3 – TSP Concentrations ($\mu g/m^3$) + Background**	
	1-hour	**24-hour**	**1-hour**	**24-hour**	**1-hour**	**24-hour**
120	234	154	462	260	330	199
121	238	156	444	251	346	206
204	293	182	**926**	**473**	**778**	**405**
203	308	189	**1070**	**539**	**772**	**402**
202	315	192	**975**	**495**	**700**	**369**
301	401	231	**1004**	**509**	428	244
302	423	242	**985**	**500**	418	236
305	**507**	**280**	**1033**	**522**	362	213
306	**536**	**293**	**1063**	**536**	345	206
401	456	257	470	**263**	214	145
402	479	267	476	**266**	210	143
409	**552**	**301**	**560**	**305**	197	138
410	110	97	112	99	118	101
510	89	88	143	113	113	99
514	87	87	144	113	114	99
519	101	94	234	155	127	105
520	106	96	233	154	126	105
521	110	98	235	155	125	104

Note:
1. **Bold** figures indicate exceedance of either the 1-hr criterion 500$\mu g/m^3$ or 24-hr AQO 260$\mu g/m^3$.
2. Background concentration; TSP 87$\mu g/m^3$.
3. 1-hr criterion 500$\mu g/m^3$, 24-hr AQO 260$\mu g/m^3$.

4.6.4 Mitigation Measures

4.6.4.1 The predicted results indicate that construction works associated with the proposed development, as well as Route 7 (within the Telegraph Bay Area only) will likely cause dust levels at ASRs which exceed the 1-hour TSP criterion of 500$\mu g/m^3$ criterion and 24-hour TSP AQO 260 $\mu g/m^3$. Therefore, effective control measures are required. Typical dust control measures during the construction phases are discussed in the following sections.

4.6.4.1 Materials Handling

- The heights from which excavated materials are dropped should be as low as practical to minimise the fugitive dust arising from unloading/loading.
- All stockpiles of aggregate or spoil of more than 50m^3 should be enclosed, covered or dampened during dry or windy conditions.

Through the implementation of the above mitigation measures, dust emissions from materials handling will be reduced by 50% (KCRC, 1998).

4.6.4.2 Vehicle Movements

- Effective water sprays should be used to control potential dust emission sources such as unpaved haul roads and active construction areas.
- Vehicles that have the potential to create dust while transporting materials should be covered, with the cover properly secured and extended over the edges of the side and tail boards;
- Materials should be dampened, if necessary, before transportation.
- Travelling speeds should be controlled to reduce traffic induced dust dispersion and re-suspension within the site from the operating haul trucks.
- Wheel washing facilities should be provided and maintained at the exit of the site to minimise the quantity of material deposited on public roads.

4.6.4.2.1 Two practical dust suppression techniques which result in a significant reduction in dust generation are proposed for the Study, both are easily implemented and enforced:

- Speed control of dump trucks in site area (reduce from 20 km/hr to 10 km/hr) will reduce dust generation by 50% (see Appendix 4.1 for calculations); and
- Twice daily road watering with complete road surface coverage will reduce dust generation by 50% (Jutze *et. al.*, 1974), further reduction (up to 97%) can be achieved through more regular watering (KCRC, 1998). A watering program of once every 2 hours in normal weather conditions, and hourly in dry/windy conditions is proposed.

4.6.5 Residual Impacts

4.6.5.1 Advance Works for Telegraph Bay Development

4.6.5.1.1 Tables 4.11b and 4.11c indicate that the TSP concentrations at Baguio Villas, Kong Sin Wan Tsuen and Telegraph Bay Playground exceeded the relevant criteria during advance works. The following mitigation measures are proposed for all phases apart from Phase 9 (surcharge period):

- Regular watering (with complete coverage) of all unpaved access roads;
- Reduce speed control of access roads from 20 km/hr to 10 km/hr; and
- Covering/dampening of stockpiles above $50m^3$ in volume in dry and windy conditions.

4.6.5.1.2 The implementation of the proposed dust mitigation measures will reduce dust concentrations such that the established criteria will be met at all the identified nearby ASRs. Predicted 1-hour and 24-hour TSP concentrations after the incorporation of the mitigation measures are listed in Tables 4.15a and 4.15b below.

Table 4.15a Predicted 1 hour TSP Concentrations at ASRs during Advance Works for Telegraph Bay Development (with Dust Suppression Measures)

ASR	1 hour TSP Concentrations ($\mu g/m^3$) + Background									
	Construction Phases									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
SR5	88	88	88	88	88	88	88	88	n/a	88
SR8	90	90	90	90	91	91	90	90	n/a	91
SR9	91	90	91	91	91	91	91	90	n/a	91
SR10	90	89	90	90	90	90	89	89	n/a	90
SR19	111	106	109	110	112	111	106	105	n/a	113
SR21	87	87	87	87	87	87	87	87	n/a	87
SR23	104	105	103	108	106	87	104	102	n/a	107
SR27	110	111	108	115	112	104	109	107	n/a	113
SR24	258	327	246	351	261	109	251	237	n/a	267
SR28	103	106	103	109	105	251	105	103	n/a	106
SR40	106	107	104	110	107	105	106	104	n/a	108
SR41	307	417	204	446	309	106	297	281	n/a	316

Note:
1. 1-hr TSP criterion $500\mu g/m^3$.
2. Background concentration: TSP $87\mu g/m^3$.
3. n/a denotes no mitigation required.
4. Mitigation – Regular watering (with complete coverage) of all unpaved access roads and speed control to 10km/hr.

Table 4.15b Predicted 24 hour TSP Concentrations at ASRs during Advance Works for Telegraph Bay Development (with Dust Suppression Measures)

ASR	24 hour TSP Concentrations ($\mu g/m^3$) + Background									
	Construction Phases									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
SR5	87	87	87	87	87	87	87	87	n/a	88
SR8	89	88	88	89	89	89	88	88	n/a	89
SR9	89	89	89	89	89	88	89	88	n/a	89
SR10	88	88	88	88	88	88	88	88	n/a	89
SR19	88	96	97	97	99	98	96	96	n/a	99
SR21	87	87	87	87	87	87	87	87	n/a	87
SR23	95	95	94	97	96	95	95	94	n/a	96
SR27	97	98	97	100	98	98	97	96	n/a	99
SR24	165	198	100	208	167	165	163	156	n/a	170
SR28	95	96	94	97	95	95	95	94	n/a	96
SR40	96	96	95	98	96	96	96	95	n/a	97
SR41	188	239	182	189	189	189	184	176	n/a	192

Note:
1. 24-hr TSP AQO $260\mu g/m^3$.
2. Background concentration: TSP $87\mu g/m^3$.
3. n/a denotes no mitigation required.
4. Mitigation – Regular watering (with complete coverage) once every 2 hours in normal weather conditions and once hourly in dry/windy conditions of all unpaved access roads and speed control to 10km/hr, covering/dampening of stockpiles of more than $50m^3$ during windy/dry conditions.

4.6.5.2 Main Construction Works for Telegraph Bay Development

4.6.5.2.1 It is noted from Table 4.13 and Paragraph 4.6.3.2.2 that the TSP criteria are exceeded at 7 ASRs during the construction of the Telegraph Bay Development. The following mitigation measures are proposed:

- Twice daily watering (with complete coverage) of all unpaved access roads;

- Reduce speed control of access roads from 20 km/hr to 10 km/hr; and
- Covering/dampening of stockpiles above $50m^3$ in volume in dry and windy conditions.

4.6.5.2.2 The predicted TSP levels with mitigation implemented are given in Table 4.16. The 1-hour and 24-hour TSP criteria will be achieved at all identified ASRs.

Table 4.16 Predicted TSP Concentrations at ASRs during Main Construction Works for Telegraph Bay Development (with Dust Suppression Measures)

ASR	Phase 1 – TSP Concentrations (μg/m^3) + Background (Mitigation [1])		Phase 2 – TSP Concentrations (μg/m^3) + Background (Mitigation [1])		Phase 3 – TSP Concentrations (μg/m^3) + Background (Mitigation [1])		Phase 4 – TSP Concentrations (μg/m^3) + Background (Mitigation [1])	
	1-hour	**24-hour**	**1-hour**	**24-hour**	**1-hour**	**24-hour**	**1-hour**	**24-hour**
SR1	128	106	133	108	121	103	118	101
SR2	98	92	102	94	98	92	99	93
SR3	119	102	127	106	117	101	114	89
SR4	89	88	90	88	89	88	92	89
SR5	88	87	88	87	88	87	90	89
SR7	88	88	89	88	89	88	94	90
SR8	89	88	89	88	90	88	92	89
SR9	89	88	90	88	89	88	92	89
SR10	89	88	89	88	89	88	92	89
SR11	89	88	90	88	90	88	92	89
SR12	89	88	90	88	90	88	92	89
SR13	89	88	90	88	90	88	92	89
SR14	88	88	89	88	88	88	90	88
SR15	88	87	88	87	87	87	88	88
SR17	87	87	87	87	87	87	88	87
SR18	87	87	87	87	87	87	88	88
SR19	92	89	99	92	106	96	109	97
SR21	87	87	87	87	87	87	87	87
SR22	87	87	87	87	87	87	87	87
SR23	97	92	100	93	96	91	108	97
SR24	103	95	104	95	100	93	137	110
SR25	114	100	114	100	111	98	172	126
SR26	119	102	128	106	122	103	174	127
SR27	274	173	272	172	219	148	207	142
SR28	108	97	102	94	95	91	168	124
SR40	100	93	101	93	97	92	113	99
SR41	277	174	268	170	215	146	204	141

Note:
1. Mitigation[1] – Regular watering (with complete coverage) once every 2 hours in normal weather conditions and once hourly in dry/windy conditions of all unpaved access roads and speed control to 10km/hr, covering/dampening of stockpiles of more than $50m^3$ during windy/dry conditions.
2. Background concentration: TSP 87μg/m^3 .
3. 1-hr TSP criterion 500μg/m^3, 24-hr TSP AQO 260μg/m^3.

4.6.5.3 Route 7 Construction (within Telegraph Bay Area)

4.6.5.3.1 Without the implementation of dust suppression measures, 1-hour and 24-hour TSP concentrations at the ASRs in the proposed development will exceed the criterion as set out in EIA-TM during the construction of Route 7 (Table 4.14). The suppression techniques listed below are recommended for three phases of the Route 7 construction within the

Telegraph Bay area. The three phases adopted for this Study are presented in Figure 4.10.

- Phase 1 – Twice daily watering (with complete coverage) of all unpaved access roads;
- Phase 2 – Twice daily watering (with complete coverage) of all unpaved access roads and speed control of all on-site vehicles from 20 km/hr to 10km/hr; and
- Phase 3 – Twice daily watering (with complete coverage) of all unpaved access roads;

4.6.5.3.2 The predicted 1-hour and 24-hour TSP concentrations at all the ASRs are found to comply with the relevant criteria after the implementation of the proposed dust suppression measures. The results are given in Table 4.17.

Table 4.17 Predicted TSP Concentrations at ASRs during Construction of Route 7 within the Telegraph Bay Area (with Dust Suppression Measures)

ASR	Phase 1 – TSP Concentrations ($\mu g/m^3$)+ Background (Mitigation[1])		Phase 2 – TSP Concentrations ($\mu g/m^3$)+ Background(Mitigation [2])		Phase 3 – TSP Concentrations ($\mu g/m^3$) + Background (Mitigation [1])	
	1-hour	**24-hour**	**1-hour**	**24-hour**	**1-hour**	**24-hour**
120	169	104	230	117	223	116
121	171	105	225	116	232	118
204	203	111	393	152	474	169
203	211	113	451	164	470	168
202	215	114	421	158	430	160
301	263	124	477	169	278	127
302	275	127	466	167	269	125
305	322	137	450	164	241	120
306	338	140	477	169	231	118
401	294	131	232	118	158	102
402	307	133	234	118	156	102
409	347	142	262	124	148	100
410	100	90	96	89	104	91
510	88	87	108	91	101	90
514	87	87	108	91	102	90
519	95	89	143	99	109	92
520	98	89	142	99	109	92
521	100	90	143	99	108	92

Note:
1. Mitigation[1]-Twice daily watering (with complete coverage) of all unpaved access roads.
2. Mitigation[2]-Twice daily watering (with complete coverage) of all unpaved access roads and speed control to 10km/hr.
3. Background concentration: TSP 87$\mu g/m^3$.
4. 1-hr TSP criterion 500$\mu g/m^3$, 24-hr TSP AQO 260$\mu g/m^3$.

4.6.6 Cumulative Impacts

4.6.6.1 There will be a 6 month overlap in the works schedule where the main construction works will commence prior to the completion of the advance works. The main construction works include:

- Site clearance for Site 5, the Southern Access Road and the Northern Access Road; and
- Submarine outfall dredging.

4.6.6.2 The final 6 months of the advance works programme will comprise of surcharge material placement and removal. Separate modelling results for both the advance works and main construction works indicate that there are exceedance of 1-hour and 24-hour TSP criteria at several ASRs. Therefore, it is likely that the cumulative dust impacts due to the overlapping of the advance works and main construction works will exceed the relevant criteria also. However as the dust modelling assessments for both phases of works were performed to evaluate the theoretical worst case scenario, and with the implementation of the recommended dust control measures, as well as those set out in the Air Pollution Control (Construction Dust) Regulations (section 43, cap.311 of Air Pollution Control Ordinance), these cumulative dust impacts after mitigation will comply with the relevant criteria too.

4.7 Operational Phase Air Quality Impacts

4.7.1 There are two major types of air quality impacts to be considered during the operational phase of the development. These include the vehicle emission related impacts from road traffic, as well as the potential odour impacts associated with the proposed sewage treatment works in the G/IC area (Site 2). The internal air quality issues associated with the proposed Public Transport Interchange (PTI) in Site 1 are also considered in this study.

4.7.1 Identification of Air Quality Impacts

4.7.1.1 Vehicular Emissions

4.7.1.1.1 Air quality impacts associated with road traffic include Nitrogen Dioxide (NO_2) and Respirable Suspended Particulates (RSP). The predicted 1-hour and 24-hour contaminant levels of NO_2 and RSP will be evaluated, respectively, and compared with the applicable AQOs.

4.7.1.1.2 ASRs located within 500metres of the development site boundary are considered to be representative for this assessment. However, the ASRs identified within the development site are assessed first in this study because they are in closest proximity to the proposed Road D1 and Route 7 in the Telegraph Bay Area. If any adverse impacts are identified which cannot be mitigated, further assessments will be performed on other ASRs located further away from the proposed roads. The ASRs assessed in this study are within the future residential development and the proposed school.

4.7.1.2 Odour Emissions

4.7.1.2.1 The sewage treatment works in Site 2 has been identified as a potential source of odour which may pose a nuisance to the surrounding sensitive receivers, namely the proposed schools in Site 2.

4.7.1.2.2 In accordance with Annex 4 of the EIA-TM, the odour emissions from the sewage screening plant should not exceed a level of 5 Odour Units (OU) over a 5-second averaging period at an ASR. An odour unit is the measuring unit of odour level and is defined as the ratio of the volume which the sample would occupy when diluted with air to the odour threshold, and the volume of the sample. One odour unit can be considered as the concentration of the odourant which just induces an odour sensation.

4.7.1.2.3 The composition of sewage related odours is very complex. In this Study, only hydrogen sulphide (H_2S), the major component of an odour, is investigated.

4.7.1.2.4 The sewage treatment works will be completely enclosed in a structure, and any exhaust air will be treated (deodorization system) prior to discharge to the atmosphere. Chapter 6 –

"Sewage Impact Assessment" details the layout of the plant and the sewage treatment process.

4.7.1.2.5 The preliminary design parameters of the deodorization system are as follows:

- The deodorization system shall be able to handle foul air with a concentration of 5ppm hydrogen sulphide (H_2S) and other odour emitted from screenings, grit and sewage. Air extraction rate shall be 20 air changes per hour and residence time shall not be less than 1.5 seconds. The breakthrough time of the packing media shall be not less than one year under continuous 24 hour operation; and

- The specified H_2S removal efficiency shall be 99.5% at 5ppm or less with a maximum discharge concentration of 25ppb.

4.7.2 Assessment Methodology

4.7.2.1 Vehicular Emissions

4.7.2.1.1 The evaluation of traffic related air quality within the development sites was performed utilising the Gaussian dispersion model CALINE4. Roads, including the existing Victoria Road, the proposed Road D1, Route 7 and its associated slip roads, within a 500m radius of the subject site are considered in the CALINE4 model.

4.7.2.1.2 In order to verify the potential air quality impacts of the future vehicle traffic in the area, vehicle emissions from the worst case predicted traffic flow within 15 years of the commissioning of the proposed development is used. The worst case traffic flow is found to be year 2019 (supplied by MVA Asia Ltd and given in Appendix 5.14).

4.7.2.1.3 The most updated vehicular emission factors available from the EPD are for the year 2011 (Fax Ref.(60) in EP11/V1/52Pt IV) and these are adopted for this assessment. It is understood that the vehicular emission factors for the Hong Kong traffic will improve with time due to the trend of moving towards more stringent emission criteria. Nevertheless, the year 2011 vehicular emission factors are used in order to assess the worst case scenario.

4.7.2.1.4 Background levels used in this study are adopted from the Central / Western Air Quality Monitoring Station (Air Quality in Hong Kong 1996). They are as follows:

- NO_2: 47$\mu g/m^3$ - Annual Average
- RSP: 52$\mu g/m^3$ - Annual Average

4.7.2.1.5 In order to provide a conservative estimate of the modelling results, the worst case scenario is assumed where the wind speed is 1m/s and the atmospheric stability is neutral (class D).

4.7.2.1.6 For the calculation of NO_2 concentrations at the receptors, the option of 'inert gas' in the CALINE4 model is adopted. A 1/5 conversion factor is used for converting NOx into NO_2.

4.7.2.1.7 The CALINE4 model calculates hourly concentrations and, as the AQO for RSP is a 24-hour concentration, the hourly results are converted to 24-hour concentrations to enable direct comparison. This was achieved by dividing the day into daytime periods and night-time periods. Both periods were modelled, and to closely represent atmospheric conditions, a class stability of F and wind direction standard deviation of 5 degrees were adopted for the nigh-time model, and a class stability of D and wind direction standard deviation of 12 degrees were adopted for the daytime model. The 24-hour concentrations were then calculated by adding 2/3 of the daytime concentrations with 1/3 of the night-time concentrations.

4.7.2.1.8 Two options of mitigation measures, in the form of barriers and semi-enclosures, have been proposed to abate adverse traffic noise impacts arising from Route 7 and Roads D1 and D2 and Southern Access Road. Option 2 is found to be the preferred option (refer to Chapter 5 "Noise Impact Assessment" - Figure 5.15), therefore the vehicle air quality assessment adopts the mitigation measures in Option 2. In the case where noise barriers have been proposed, the approach of raising the vehicle related air pollutant release height to the top of the barriers has been adopted in the assessment, this assumes a worst case scenario and is considered to be very conservative. In the modelling assessment, the side effects due to the presence of the semi-noise enclosure are excluded. In view of the fact that a very conservative approach has been adopted for modelling calculations and the predicted concentrations of NO_2 and RSP at the air sensitive receivers are relatively low, it is unlikely that this semi-enclosure would cause exceedance of the AQOs.

4.7.2.2 Odour Emissions

4.7.2.2.1 The air quality impacts associated with odour emissions from the sewage treatment works was evaluated with the use of Gaussian dispersion model ISCST3 Industrial Source Complex – Short Term).

4.7.2.2.2 The sewage treatment works will be in continuous operation, therefore the worst case daytime and night-time meteorological conditions are used, i.e. 1m/s wind speed and stability classes D and F for daytime and night-time, respectively. Worst case wind direction, i.e. blowing from the works towards the ASR, are also used in the model.

4.7.2.2.3 Standard anemometer height of 10m is used in the ISCST3 model.

4.7.2.2.4 As the shortest period of odour concentrations produced by the ISCST3 model is one hour, this hourly averaged concentrations must be converted into a 5-second period for comparison with the allowable limited of 5 Odour Units (OU) over 5 seconds, as set out in Annex 4 of the EIA-TM. This conversion is done in two procedures (CDM, 1998). The hourly averaged concentration is first converted to a 3-minute averaged concentration using the empirical formula below (Duffee *et.al.,* 1996):

$$\frac{C_L}{C_S} = \left(\frac{t_S}{t_L}\right)^n \qquad \text{..(Eqn 4.1)}$$

Where

- C_L and C_S are the time averaged odour concentrations in longer and shorter periods, respectively (OU/m^3);
- t_L and t_S are the longer and shorter time averaging periods, respectively; and
- n is an exponential value which depends upon the atmospheric stability classes (see Table 4.18).

Stability classes D and F were selected for the assessment, the corresponding exponents values are 0.2 and 0.167, respectively.

Table 4.18 Exponential Values for Atmospheric Stability Classes

Atmospheric Stability Class	Exponential Value, n
A	0.5
B	0.5
C	0.33
D	0.2
E	0.167
F	0.167

4.7.2.2.5 The peak odour impact condition (i.e. over averaging period of a few seconds, say 5 seconds) can then be converted from a 3-minute averaging period by applying a conversion factor of 5 (OME, 1996).

4.7.3 Impact Prediction

4.7.3.1 Vehicular Emissions

4.7.3.1.1 The ASR locations utilised for the CALINE4 modelling of Sites 1 to 5 are presented in Figures 4.3 to 4.7. The contaminant levels were evaluated for ground level at each location, Sites 1 to 4 : 5.5 mPD plus 1.4m; Site 5: 47.5 mPD, 38.0 mPD and 29.0 mPD plus 1.4m. The additional 1.4m was added to better represent the actual receiver height of a person. The NO_2 and RSP modelling results for the 5 sites, including background concentrations are presented in the following sections (Tables 4.19 to 4.23). They indicate compliance with the statutory AQOs at all the ASRs. Concentrations contours for both NO_2 and RSP are presented in Figures 4.11 to 4.20.

4.7.3.1.2 A sample of the emission factor calculations and CALINE4 output file are given in Appendix 4.2.

Table 4.19 Predicted Vehicular Air Quality Impacts for Site 1

ASR	Predicted NO_2 $\mu g/m^3$	Predicted RSP $\mu g/m^3$		
	1hour + Background	Day (1-hour)	Night (1-hour)	24-hour+ Background
101	106.3	25.9	40.8	82.9
102	105.7	25.5	40.8	82.6
103	101.2	23.8	38.2	80.6
104	100.6	23.6	38.0	80.4
105	98.7	22.7	37.2	79.5
106	98.4	22.4	37.0	79.3
107	103.6	24.9	37.8	81.2
108	103.4	24.7	35.9	80.4
109	109.7	27.4	41.4	84.1
110	111.0	28.0	42.0	84.7
111	116.0	30.4	46.9	87.9
112	118.9	31.6	48.8	89.3
113	137.3	39.8	60.2	98.6
114	139.8	41.0	62.2	100.1

Note:
1. Prediction height: 6.9 mPD.
2. Background concentrations: NO_2 47µg/m^3, RSP 52µg/m^3.
3. AQOs: NO_2 1-hr 300µg/m^3, RSP 24-hr 180µg/m^3.

Table 4.20 Predicted Vehicular Air Quality Impacts for Site 2

ASR	Predicted NO_2 mg/m^3	Predicted RSPmg/m^3		
	1hour + Background	Day (1-hour)	Night (1-hour)	24-hour+ Background
207	161.4	52.6	93.7	118.3
208	173.1	58.3	100.4	124.3
209	178.5	60.8	102.5	126.7
210	168.0	55.8	91.9	119.8
211	156.1	50.3	88.7	115.1
212	162.5	53.1	90.7	117.6
213	158.0	53.7	93.5	119.0
214	150.0	48.9	85.1	113.0
215	146.0	47.3	82.3	111.0
216	152.0	49.7	86.5	114.0
217	163.0	54.5	94.9	120.0

Note:
1. Prediction height: 6.9 mPD.
2. Background concentrations: NO_2 47µg/m^3, RSP 52µg/m^3.
3. AQOs: NO_2 1-hr 300µg/m^3, RSP 24-hr 180µg/m^3.

Table 4.21 Predicted Vehicular Air Quality Impacts for Site 3

ASR	Predicted NO_2 mg/m^3	Predicted RSPmg/m^3		
	1hour + Background	Day (1-hour)	Night (1-hour)	24-hour+ Background
301	190.2	65.7	120.9	136.1
302	167.2	55.1	98.0	121.4
303	209.9	75.3	134.2	146.9
304	210.1	75.5	132.5	146.5
305	183.4	63.1	113.3	131.8
306	152.4	48.6	88.4	113.9
307	160.1	52.0	99.6	119.9
308	142.4	44.0	80.7	108.2
309	155.9	49.8	88.5	114.7
310	149.9	47.3	84.4	111.7
311	136.2	41.1	74.4	104.2
312	135.0	40.4	71.8	102.9
313	133.9	40.1	72.4	102.9
314	127.3	37.1	64.8	98.3
315	140.9	43.3	78.8	107.1
316	136.4	41.4	74.4	104.4

Note:
1. Prediction height: 6.9 mPD.
2. Background concentrations: NO_2 47µg/m^3, RSP 52µg/m^3.
3. AQOs: NO_2 1-hr 300µg/m^3, RSP 24-hr 180µg/m^3.

Table 4.22 Predicted Vehicular Air Quality Impacts for Site 4

ASR	Predicted NO_2 $\mu g/m^3$	Predicted RSP $\mu g/m^3$		
	1hour + Background	Day (1-hour)	Night (1-hour)	24-hour+ Background
401	203.3	72.3	129.5	143.4
402	200.7	71.3	129.1	142.6
403	176.8	60.2	105.2	127.2
404	177.6	60.4	104.4	127.1
405	185.5	64.2	106.4	130.3
406	181.0	62.1	101.8	127.3
407	139.8	42.7	75.5	105.6
408	137.5	41.7	70.8	103.4
409	142.0	43.9	75.5	106.4
410	136.0	41.1	69.5	102.6
411	150.9	48.2	82.4	111.6
412	140.9	43.4	74.0	105.6
413	143.7	44.8	74.5	106.7
414	137.5	41.9	68.8	102.9
415	149.7	47.6	80.0	110.4
416	142.0	44.1	73.5	105.9
417	159.3	52.0	89.7	116.6
418	147.3	46.5	80.5	109.8
419	152.0	48.6	85.9	113.0
420	133.0	39.8	65.8	100.5

Note:
1. Prediction height: 6.9 mPD.
2. Background concentrations: NO_2 47µg/m^3, RSP 52µg/m^3.
3. AQOs: NO_2 1-hr 300µg/m^3, RSP 24-hr 180µg/m^3.

Table 4.23 Predicted Vehicular Air Quality Impacts for Site 5

ASR	Elevation mPD	Predicted NO_2 $\mu g/m^3$	Predicted RSP $\mu g/m^3$		
		1-hr + Background	Day (1-hr)	Night (1-hr)	24-hr+ Background
501	48.9	81.1	15.9	21.8	69.9
502	48.9	90.8	20.3	27.8	74.8
503	48.9	80.9	15.7	21.7	69.7
504	48.9	106.1	27.4	35.4	82.1
505	48.9	83.5	16.9	23.4	71.1
506	48.9	89.7	19.8	27.2	74.3
507	39.4	83.3	17.0	25.0	71.7
508	39.4	86.1	18.2	28.3	73.6
509	39.4	84.3	17.3	25.3	72.0
510	39.4	86.5	18.3	28.1	73.6
511	39.4	86.5	18.4	27.5	73.4
512	39.4	89.9	19.9	30.5	75.4
513	30.4	105.5	27.5	42.6	84.5
514	30.4	106.8	27.8	42.6	84.7
515	30.4	108.0	28.2	43.2	85.2
516	30.4	108.0	28.3	44.3	85.6
517	30.4	109.1	28.8	46.2	86.6

Note:
1. Background concentrations: NO_2 47µg/m^3, RSP 52µg/m^3.
2. AQOs: NO_2 1-hr 300µg/m^3, RSP 24-hr 180µg/m^3.

4.7.3.1.3 As stated above, the air quality modelling was performed for the 5 development sites without including any direct mitigation. This was done to highlight the road based emission impacts and to confirm whether mitigation measures are required.

4.7.3.1.4 When considering the results, it must be recognised that due to a limitation with the CALINE4 model, the concentration at some receiver heights cannot be modelled directly. When the vertical separation between the road segment and the receiver is greater than 10 metres (if road segment is at a higher level than the receiver), the receiver is modelled at 10 metres below that particular segment(s). By doing so, a conservative prediction is obtained and this is considered to be representative of the worst case scenario. This condition arose during the modelling of potential impacts from vehicle traffic on Victoria Road.

4.7.3.1.5 From the modelling results, no exceedances are found at any of the identified ground level ASRs within the 5 sites. Essentially, since the vehicle related NO_2 and RSP concentrations decrease with height, no exceedances are anticipated at higher elevations.

4.7.3.1.6 The ASRs assessed, as mentioned earlier, are the closest ASRs to the development site and therefore are most likely to experience adverse impacts. Since no vehicular emission impacts are predicted at these ASRs during the operational phase of the development, it can be concluded that no operational impacts are anticipated at the other ASRs which are located further away from the proposed roads.

4.7.3.1.7 A Public Transport Interchange (PTI) will be located in the Site 1 and will be partially enclosed. The mechanical ventilation system will be designed to ensure that the internal air quality is consistent with the standards listed in Table 4.2 which reflects the requirements detailed in ProPECC PN1/98. However, no exceedances are found at ground level in Site 1, and traffic related air quality improves with elevation, it is also concluded that the air quality at the PTI air intakes (likely to be higher than 6.9mPD) will be acceptable. Consequently, no air quality constraints exist with respect to their positioning.

4.7.3.2 Odour Emissions

4.7.3.2.1 As outlined in Section 4.7.1.2, the design H_2S discharge concentration is 25 ppb. Given that one odour unit is equivalent to 0.47 ppb, the emission rate adopted for the assessment is 53 odour units. The predicted 1-hour odour concentrations at ASR 201 and ASR 213, the corresponding 5-second period concentrations at atmospheric stability classes D and F are given in Table 4.24. The predicted results indicate that the highest odour concentration will be 4.8 OU on the third floor of ASR 201 during night-time conditions (i.e. stability class F). However, it is noted that there will be no classroom activities at night-time. Given that ASR 201 and ASR 213 are the closest ASRs to the sewage treatment works and that the criterion set out in EIA-TM is met, odour assessment for ASRs located further away was not performed.

Table 4.24 Predicted Odour Concentrations at ASR 201

ASR	Level	Elevation mPD	Predicted Odour Concentration (μg/m^3)		5-second Odour Concentration (OU/ m^3)	
			Daytime	Night-time	Atmospheric Stability Class D	Atmospheric Stability Class F
201	**G/F**	6.9	0.04276	0.00274	0.4	0.0
201	**1/F**	11.0	0.14074	0.1011	1.3	0.8
201	**2/F**	14.7	0.24089	0.51048	2.2	4.2
201	**3/F**	18.0	0.25267	0.58324	2.3	4.8
201	**4/F**	21.3	0.17642	0.19360	1.6	1.6
201	**5/F**	24.6	0.08200	0.01867	0.7	0.2
201	**6/F**	27.9	0.02537	0.00052	0.2	0.0
201	**7/F**	31.2	0.00523	0	0.0	0.0
213	**G/F**	6.9	0.04724	0.00963	0.4	0.1
213	**1/F**	11.0	0.09665	0.09527	0.9	0.8
213	**2/F**	14.7	0.13446	0.26640	1.2	2.2
213	**3/F**	18.0	0.13846	0.28993	1.3	2.4
213	**4/F**	21.3	0.11097	0.14392	1.0	1.2
213	**5/F**	24.6	0.06921	0.03259	0.6	0.3
213	**6/F**	27.9	0.03660	0.00337	0.3	0.0
213	**7/F**	31.2	0.01269	0.00016	0.1	0.0

Note:
(a) EIA-TM odour Criterion: 5 OU/m^3 (5-second period).

4.7.4 Mitigation Measures

4.7.4.1 Vehicular Emissions

4.7.4.1.1 The predicted concentration levels of NO_2 and RSP at the identified ASRs comply with the applicable AQOs, therefore no mitigation measures are considered necessary.

4.7.4.2 Odour Emissions

4.7.4.2.1 A deodorization system has been proposed for the sewage treatment works, the treatment process and plant layout are given in Chapter 6 - Figures 6.3 and 6.6, respectively. A programme of maintenance will be established to ensure the performance of the odour control units, all components will be operated in accordance with manufacturer's instructions. The replacement intervals of the media will be determined during commissioning. There are two primary treatment systems in the deodorization unit, thereby allowing for emergency breakdowns as well as continuous odour treatment during media replacement.

4.7.4.2.2 The process where solids / dry sludge are removed will be carried out in a well-sealed enclosed environment with all air extracted to the deodorization system prior to discharge. Therefore no odour impacts are anticipated during maintenance stages of the sewage treatment works or media replacement of the deodorization units.

4.7.5 Residual Impacts

4.7.5.1 No adverse residual air quality impacts, from vehicle or odour emissions, are anticipated from the operation phase of the Telegraph Bay Development.

4.8 Conclusions and Recommendations

4.8.1 Fugitive dust is expected to be the major air pollutant during the construction of the proposed Telegraph Bay Development and Route 7. Predicted TSP concentrations at the identified ASRs indicate that without dust suppression measures, the 1-hour TSP criterion and 24-hour TSP AQO will be exceeded. Established dust suppression techniques such as regular watering of haul roads, reducing on-site vehicle speed to 10 km/hr and covering/dampening any stockpiles over $50m^3$ during windy and dry conditions, have been proposed. The assessments show that the proposed mitigation measures will reduce dust generation such that the established criteria will be met at all the identified ASRs.

4.8.2 The material to be handled in the off-site work areas will be limited to general construction material, therefore dust generation from these areas are also anticipated to be limited.

4.8.3 The CALINE4 modelling results indicate that the worst case NO_2 and RSP concentrations decrease with elevation and distance. Therefore, impacts upon ASRs at higher elevations and/or at greater distances from the proposed roads are not anticipated. It is concluded that the traffic related air quality impacts will be insignificant.

4.8.4 The mechanical ventilation system for the PTI will be designed in accordance with the guidelines outlined in ProPECC PN1/98, therefore controlling any potential air quality impacts from arising. The vehicle air quality impact assessment showed that there are no constraints with regard to the positioning of the fresh air intake locations.

4.8.5 Taking into consideration the proposed deodorization system for the sewage treatment works (STW), the odour concentration at the closest ASR to the STW is found to be in compliance with the criterion as set out in the EIA-TM. Additional mitigation measures are not anticipated to be necessary. An implementation schedule for odour control during maintenance periods has also been discussed.

4.9 References

Camp Dresser & McKee International Inc. (CDM), and Enviros Hong Kong Ltd., 1998 Addendum To Site Assessment Report (Lamma Island), In: Feasibility Study of Waste-Energy Incineration Facilities. Prepared for EPD, dated 20 August, 1998.

Department of Environment UK, Warren Spring Laboratory, 1980, Odour Control – A Concise Guide. Edited by F.H.H. Valentin and A.A. North.

Duffee, R.A., O'Brien, M.A., Ostojic, N., 1991, Odour Modelling – Why and How, Transactions – Air & Waste Management Association, Pittsburgh, Pennsylvania, 1991. In recent Developments and Current Practices in Odor Regulations, Control and Technology. Edited by D.R. Derenzo and A . Gnyp.

Environmental Protection Department (EPD), 1997, Technical Memorandum on Environmental Impact Assessment Process.

Environmental Protection Department (EPD), Air Services Group, 1996, Air Quality in Hong Kong 1996.

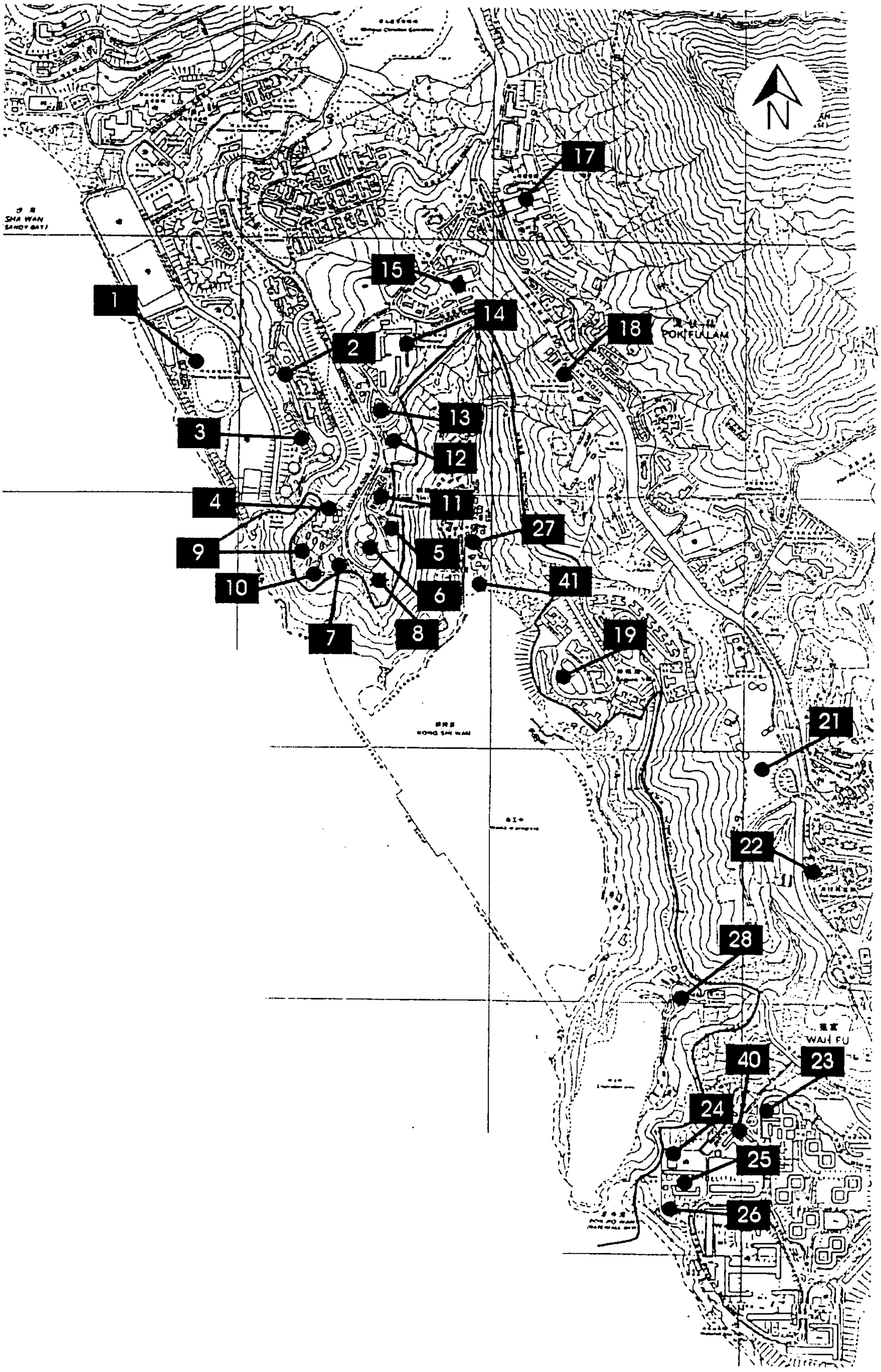
Environmental Protection Department (EPD), March 1998, Practice Note for Professional Persons, PN 1/98, Control of Air Pollution in Semi-confined Public Transport Interchanges.

Jutze, G.A., Aetell Jr, k., Parker, W., for USEPA, 1974, Investigation of Fugitive Dust – Sources, Emissions and Control.

Kowloon-Canton Railway Corporation (KCRC), 1998, West Kowloon to Tuen Mun Centre, Contract No TS-900, Environmental Impact Assessment – Final Assessment Report.

Ontario Ministry of Environment (OME), 1996, Odour Impacts – An Overview. Science and Technology Branch, Environmental Engineering Services, STB Technical Bulletin No. EES-1, February 1996.

Figures



Rev.	Description	Approved	Date

AGREEMENT NO. CE 92/97 INFRASTRUCTURAL WORKS FOR HOUSING DEVELOPMENT AT TELEGRAPH BAY - ENGINEERING FEASIBILITY STUDY

Air Sensitive Receivers During the Construction of Telegraph Bay Development

TERRITORY DEVELOPMENT DEPARTMENT, HONG KONG

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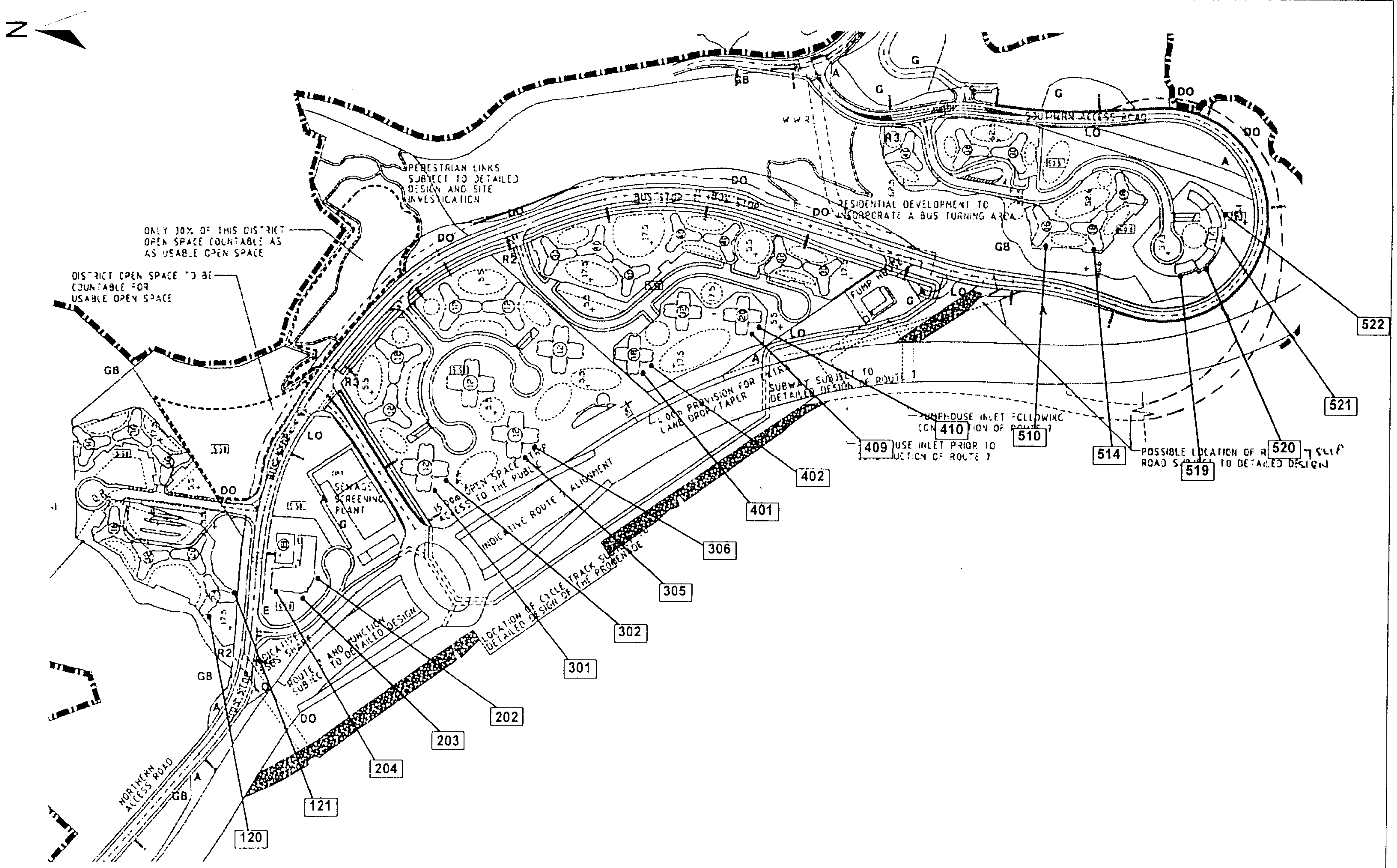

Rev.	Description	Approved	Date

AGREEMENT NO. CE 92/97 INFRASTRUCTURAL WORKS FOR HOUSING DEVELOPMENT AT TELEGRAPH BAY - ENGINEERING FEASIBILITY STUDY

Air Sensitive Receivers During the Construction of Route 7 (Within Telegraph Bay Area Only)

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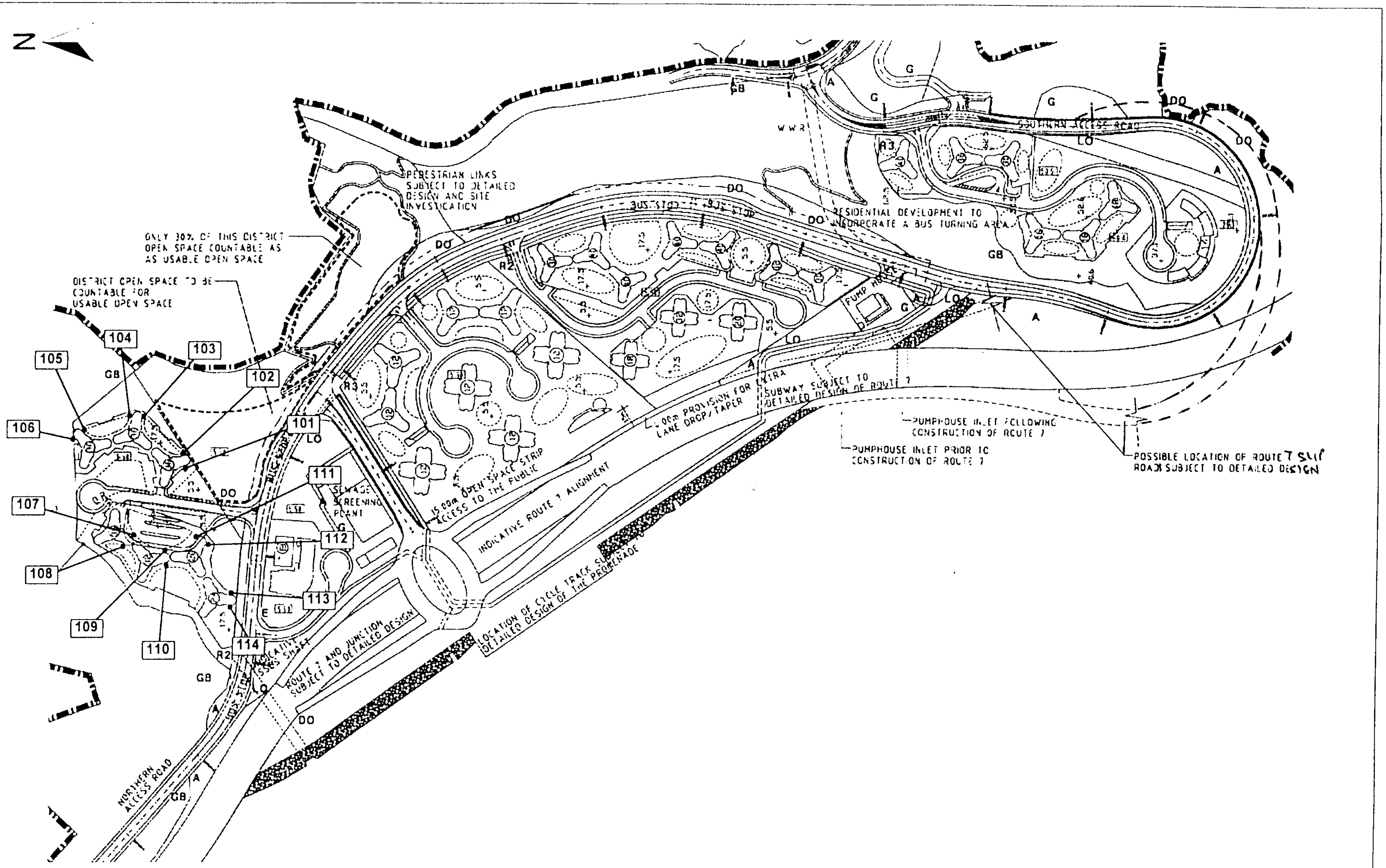

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AGREEMENT NO. CE 92/97 INFRASTRUCTURAL WORKS FOR HOUSING DEVELOPMENT AT TELEGRAPH BAY
- ENGINEERING FEASIBILITY STUDY

CALINE4 Prediction Locations at Site 1

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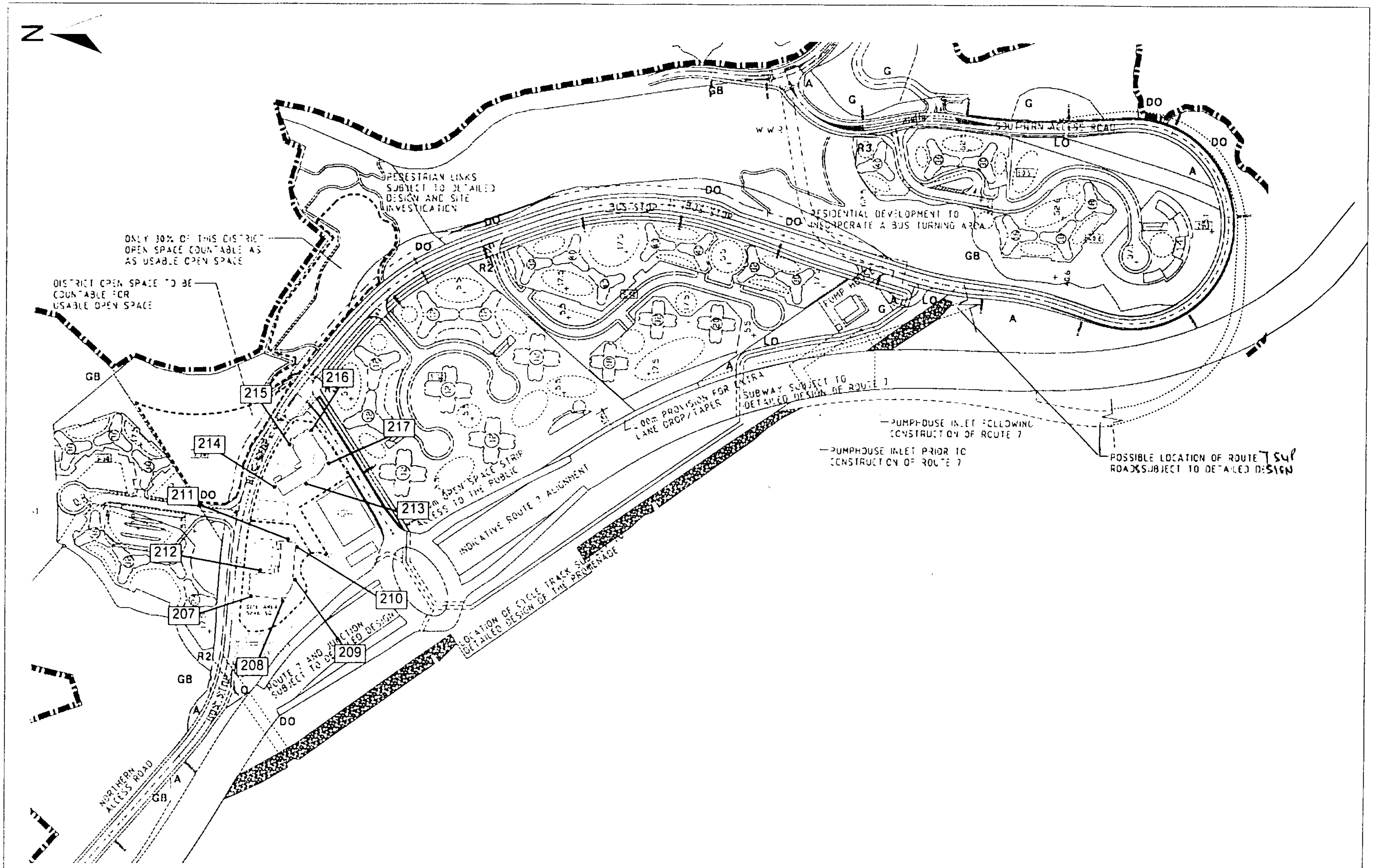

Rev.	Description	Approved	Date	AGREEMENT NO. CE 92/97 INFRASTRUCTURAL WORKS FOR HOUSING DEVELOPMENT AT TELEGRAPH BAY - ENGINEERING FEASIBILITY STUDY CALINE4 Prediction Locations at Site 2	TERRITORY DEVELOPMENT DEPARTMENT, HONG KONG HONG KONG ISLAND AND ISLANDS DEVELOPMENT OFFICE	PYPUN / PBA JOINT VENTURE PYPUN PB PARSONS BRINCKERHOFF (ASIA) LTD.	Figure No. 4.4	Rev. b
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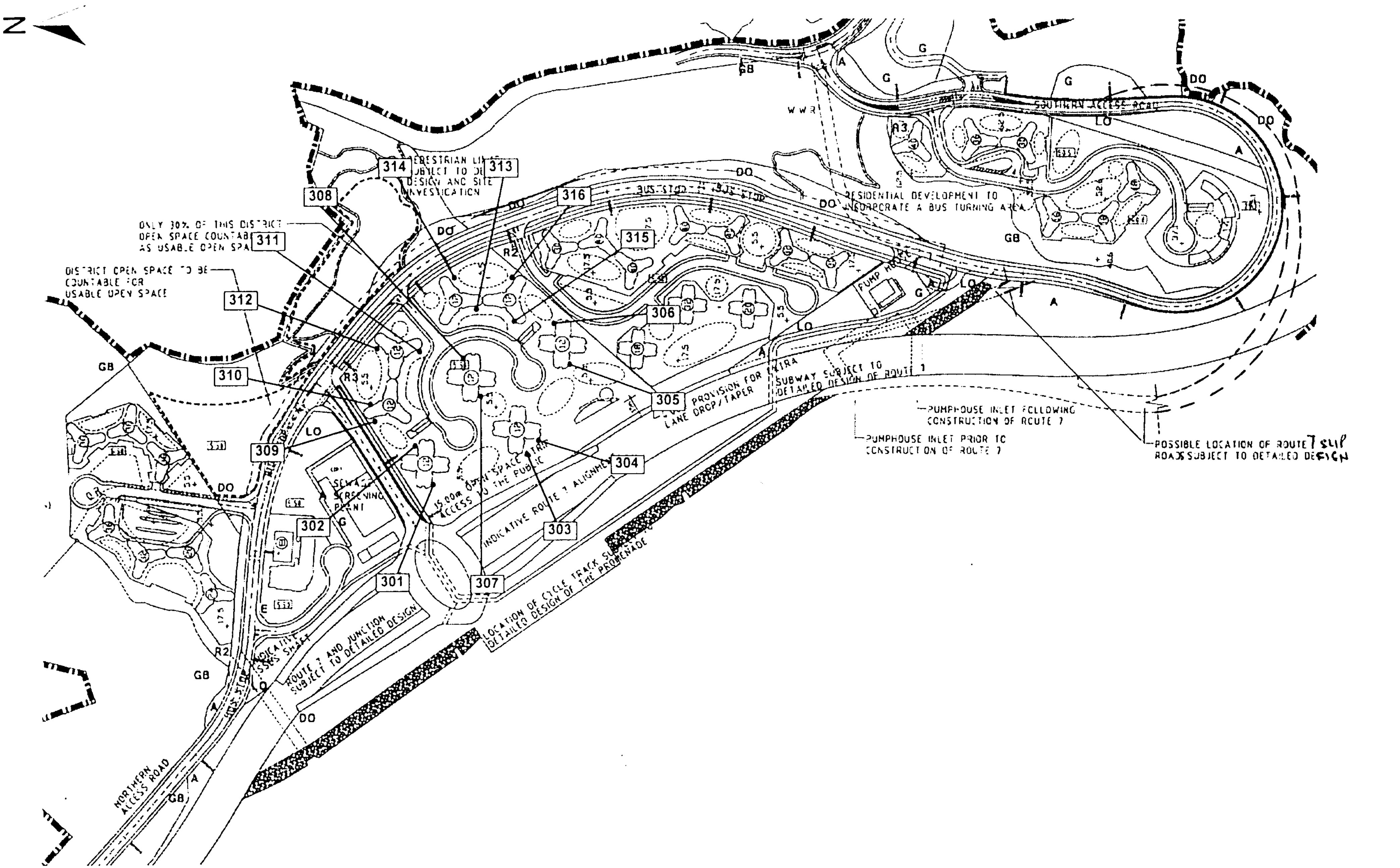

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AGREEMENT NO. CE 92/97 INFRASTRUCTURAL WORKS FOR HOUSING DEVELOPMENT AT TELEGRAPH BAY
- ENGINEERING FEASIBILITY STUDY

CALINE4 Prediction Locations at Site 3

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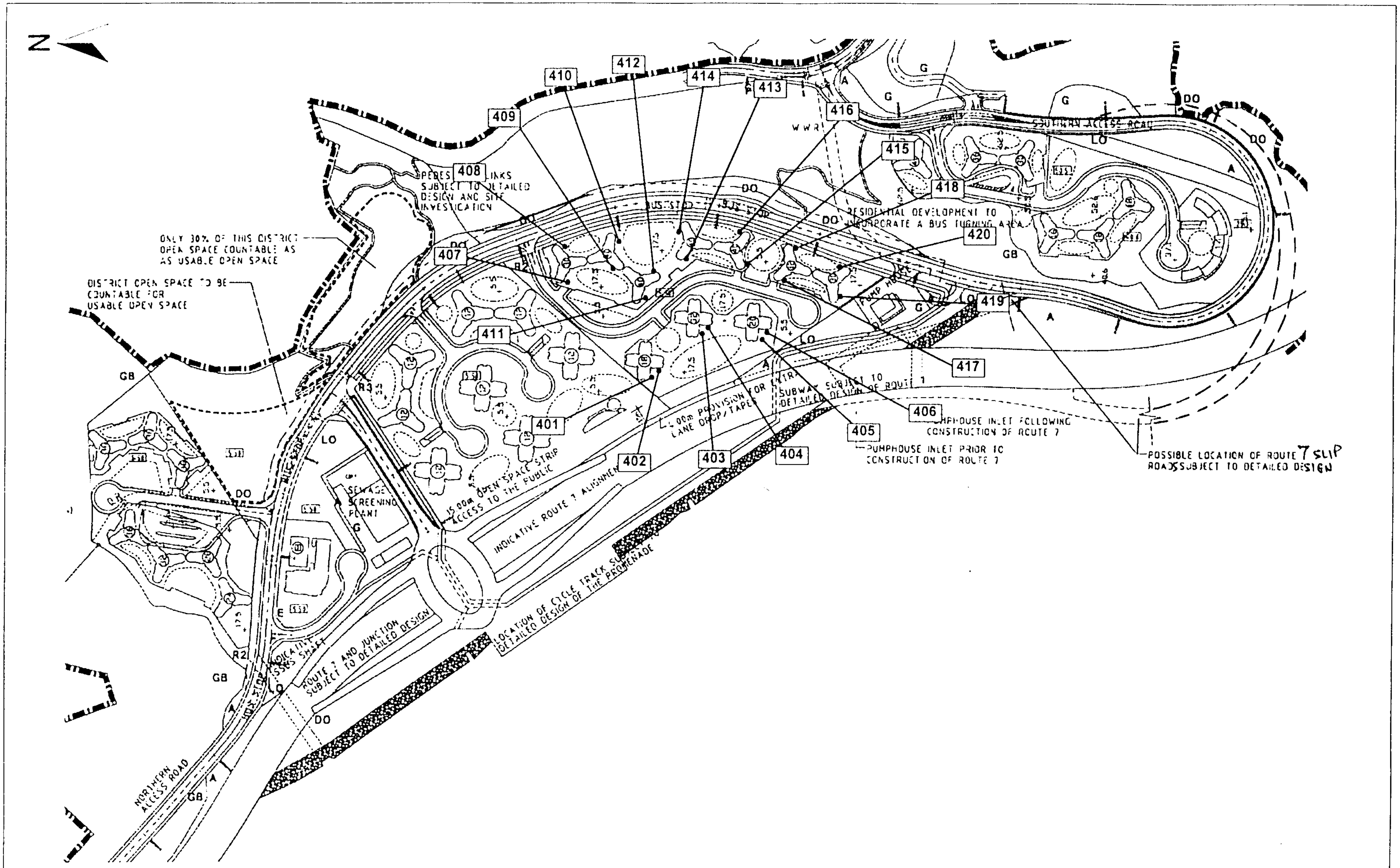

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AGREEMENT NO. CE 92/97 INFRASTRUCTURAL WORKS FOR HOUSING DEVELOPMENT AT TELEGRAPH BAY - ENGINEERING FEASIBILITY STUDY

CALINE4 Prediction Locations at Site 4

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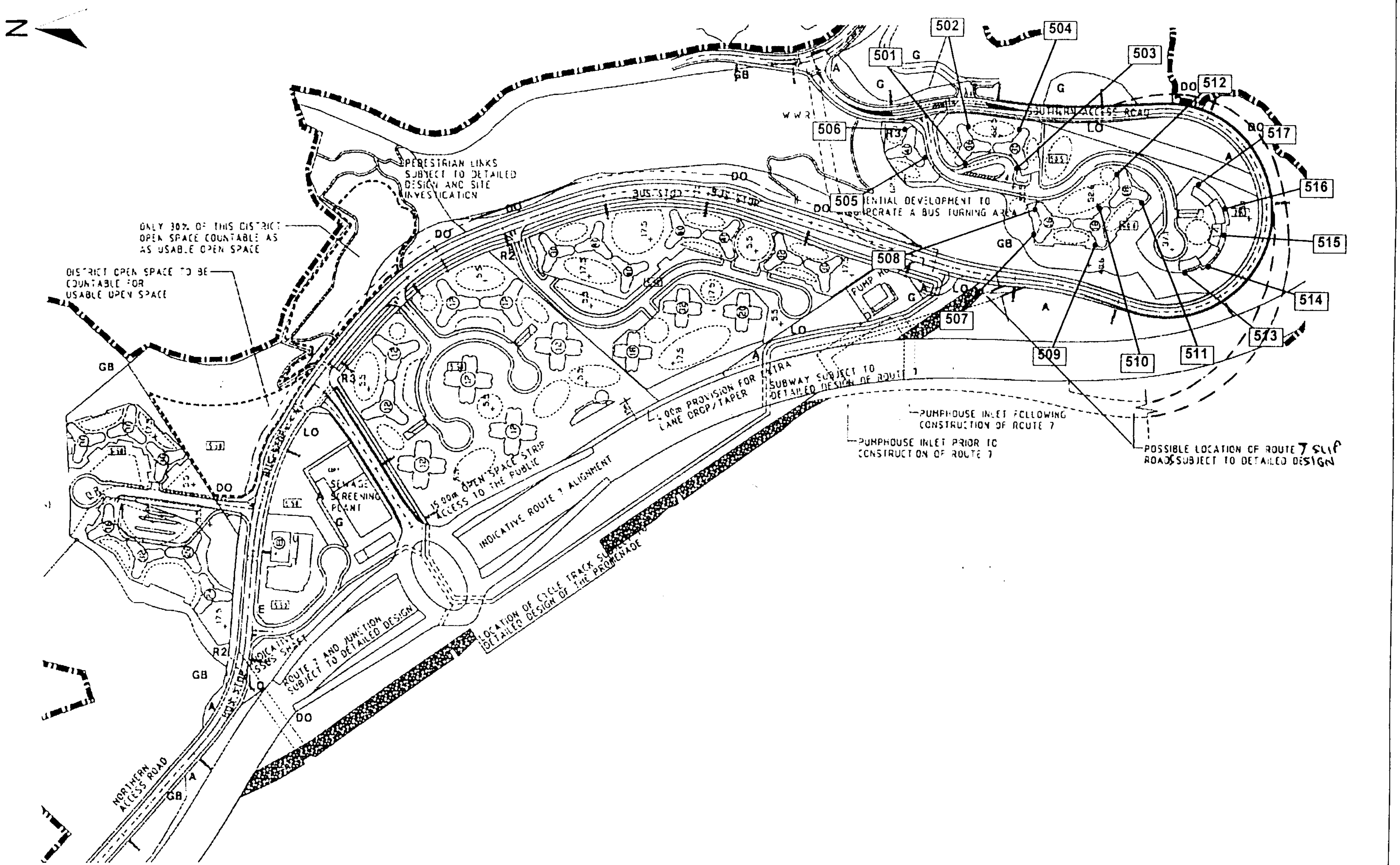

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AGREEMENT NO. CE 92/97 INFRASTRUCTURAL WORKS FOR HOUSING DEVELOPMENT AT TELEGRAPH BAY - ENGINEERING FEASIBILITY STUDY

CALINE4 Prediction Locations at Site 5

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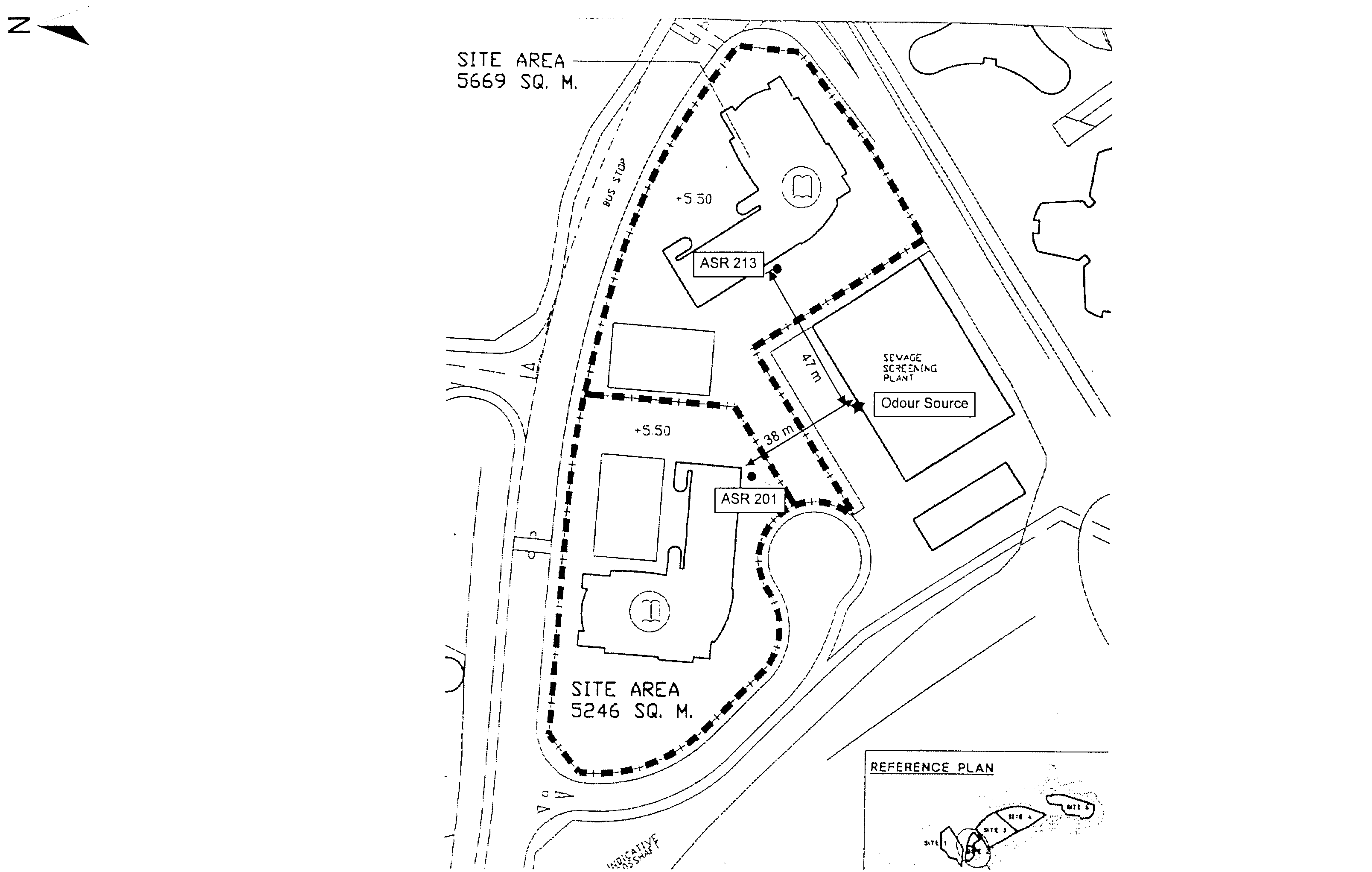

Rev.	Description	Approved	Date

AGREEMENT NO. CE 92/97 INFRASTRUCTURAL WORKS FOR HOUSING DEVELOPMENT AT TELEGRAPH BAY
- ENGINEERING FEASIBILITY STUDY

Distances between Closest ASRs and Sewage Treatment Works

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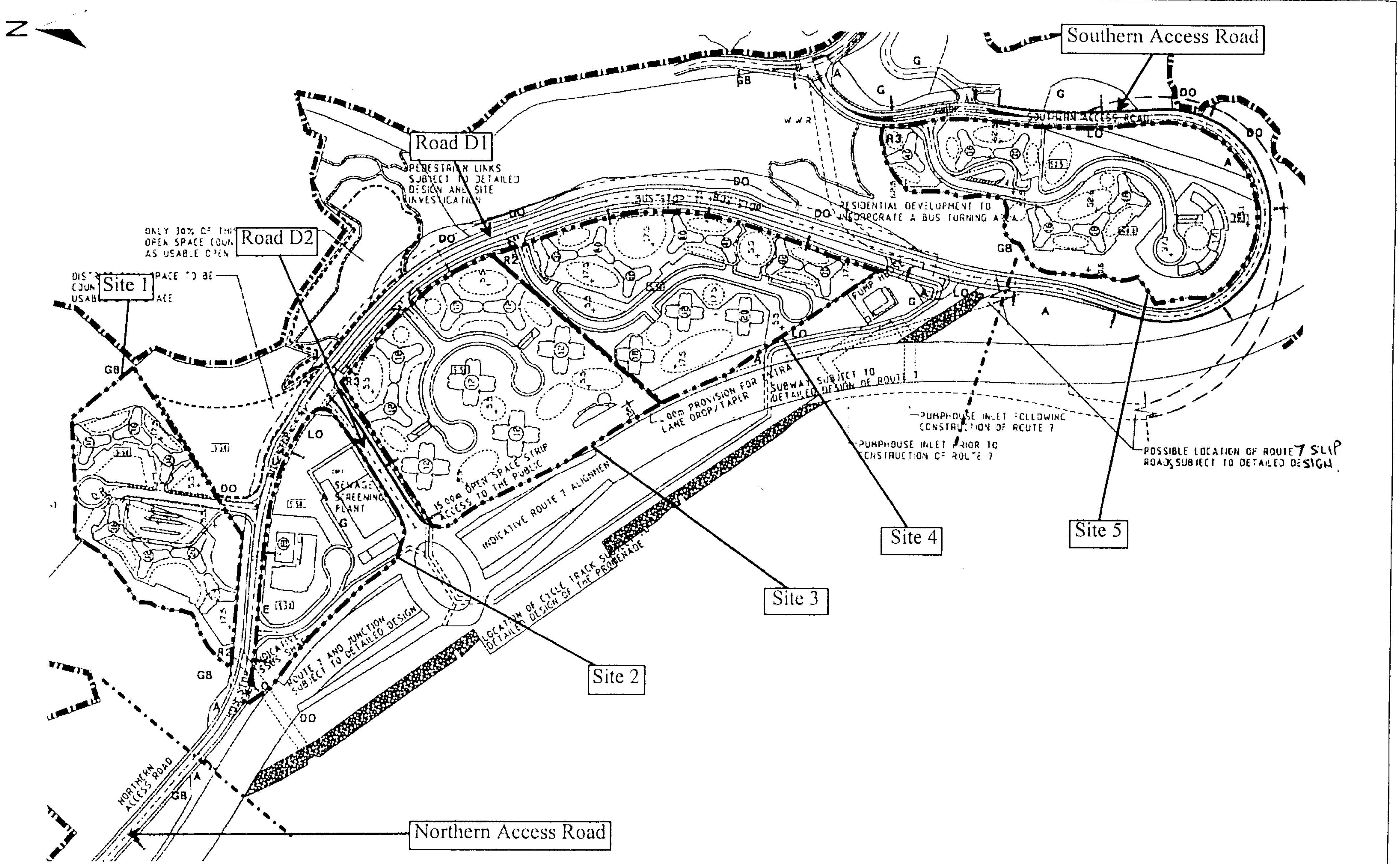

Rev.	Description	Approved	Date

AGREEMENT NO. CE 92/97 INFRASTRUCTURAL WORKS FOR HOUSING DEVELOPMENT AT TELEGRAPH BAY - ENGINEERING FEASIBILITY STUDY

Area of Main Development Works

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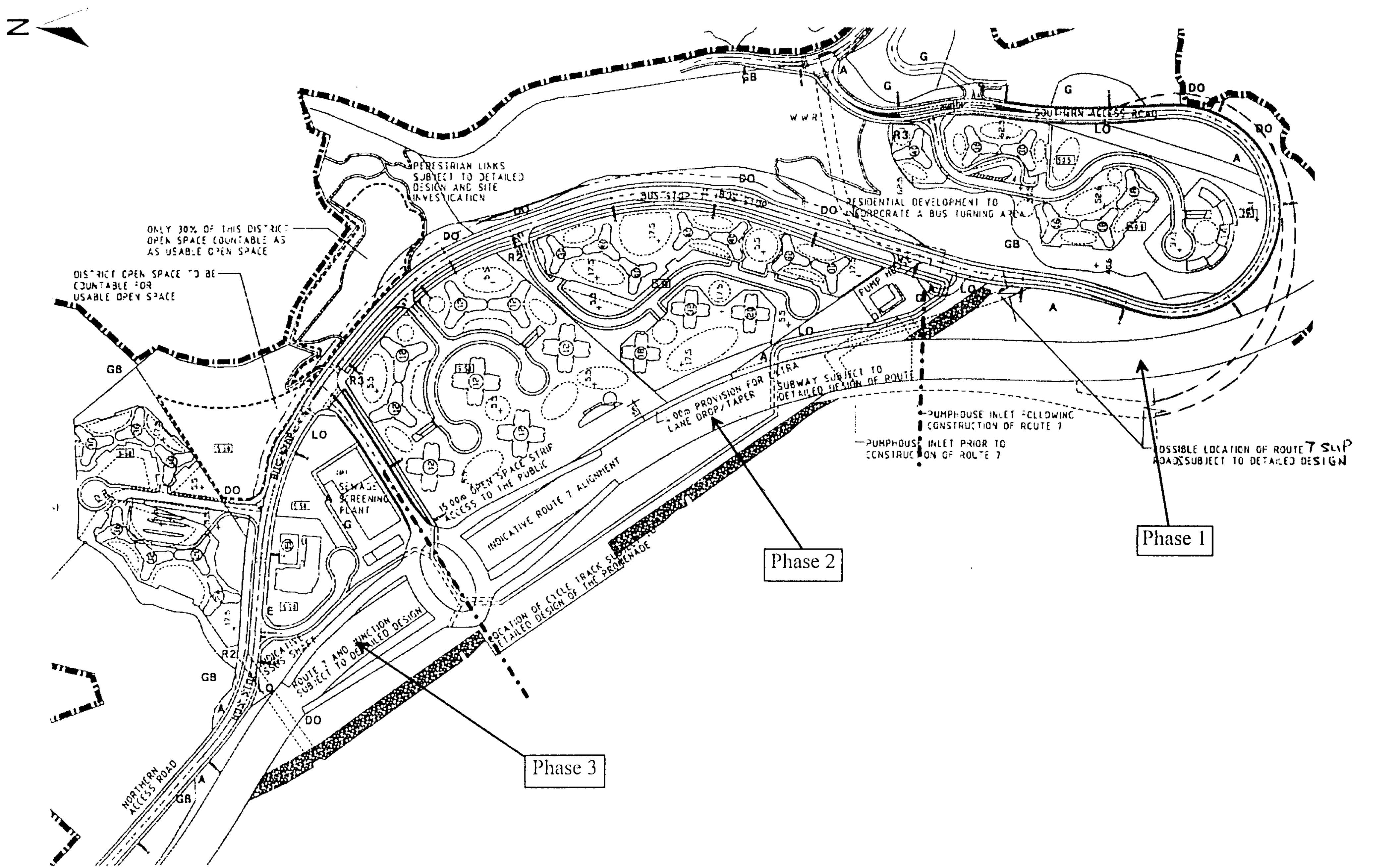

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AGREEMENT NO. CE 92/97 INFRASTRUCTURAL WORKS FOR HOUSING DEVELOPMENT AT TELEGRAPH BAY - ENGINEERING FEASIBILITY STUDY

Estimated Phasing of the Construction of Route 7

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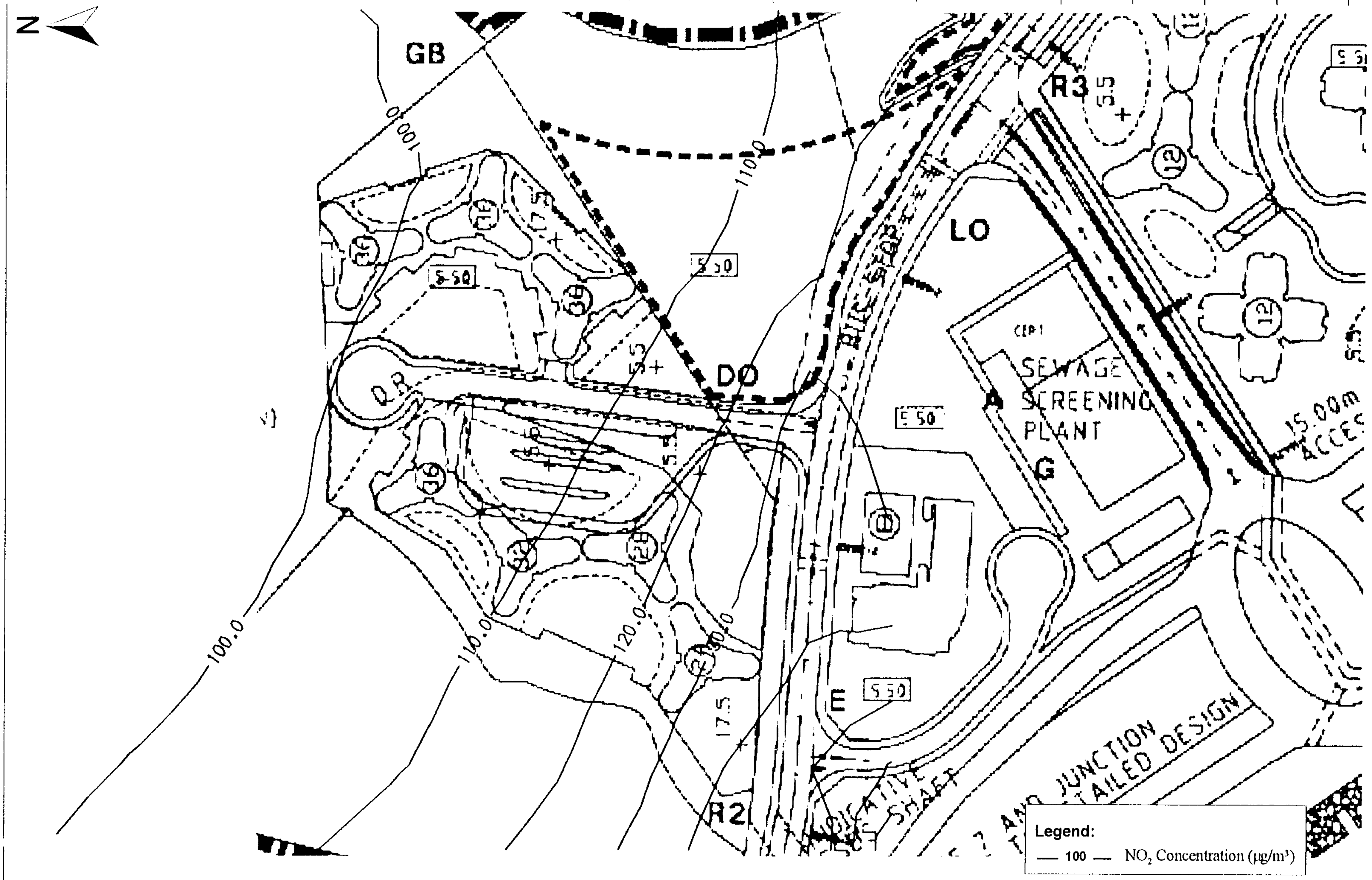

Rev.	Description	Approved	Date

AGREEMENT NO. CE 92/97 INFRASTRUCTURAL WORKS FOR HOUSING DEVELOPMENT AT TELEGRAPH BAY - ENGINEERING FEASIBILITY STUDY

CALINE4 - 1-Hour NO_2 Concentration Contour for Site 1 at 18.9 mPD

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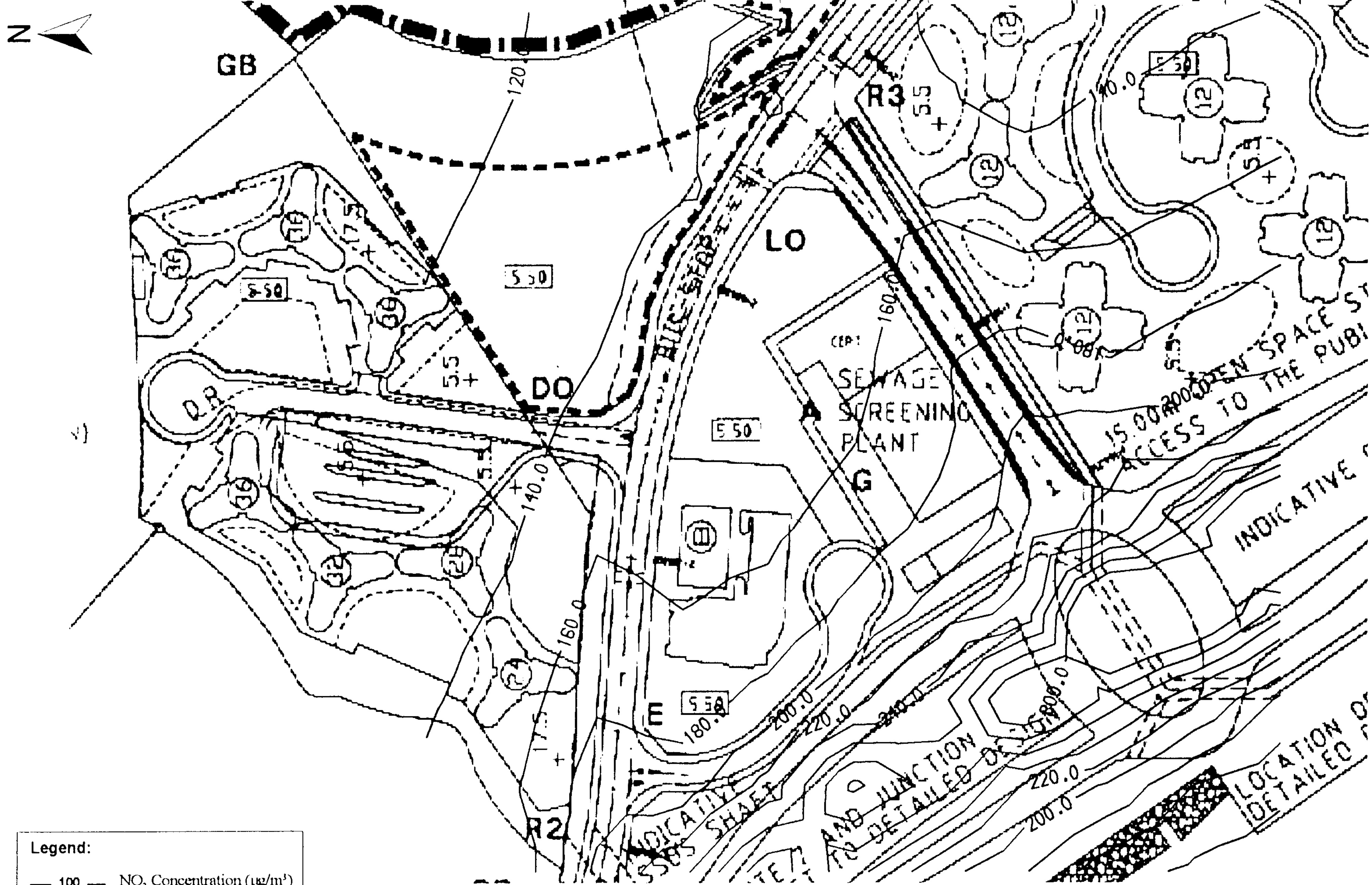

Legend:

— 100 — NO_2 Concentration ($\mu g/m^3$)

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AGREEMENT NO. CE 92/97 INFRASTRUCTURAL WORKS FOR HOUSING DEVELOPMENT AT TELEGRAPH BAY - ENGINEERING FEASIBILITY STUDY

CALINE4 - 1-Hour NO_2 Concentration Contour for Site 2 at 9.5 mPD

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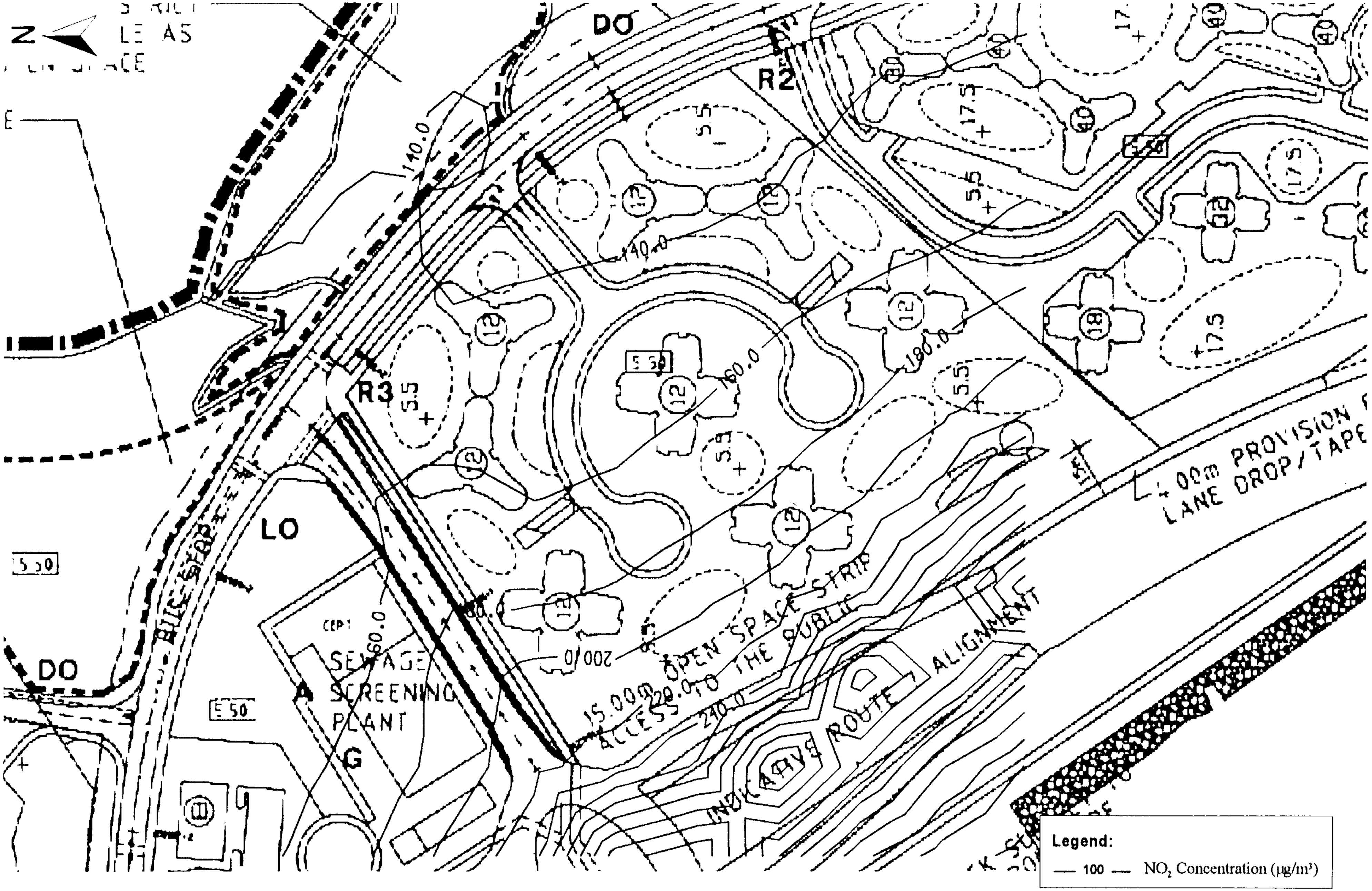

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AGREEMENT NO. CE 92/97 INFRASTRUCTURAL WORKS FOR HOUSING DEVELOPMENT AT TELEGRAPH BAY
- ENGINEERING FEASIBILITY STUDY

CALINE4 - 1-Hour NO_2 Concentration Contour for Site 3 at 9.5 mPD

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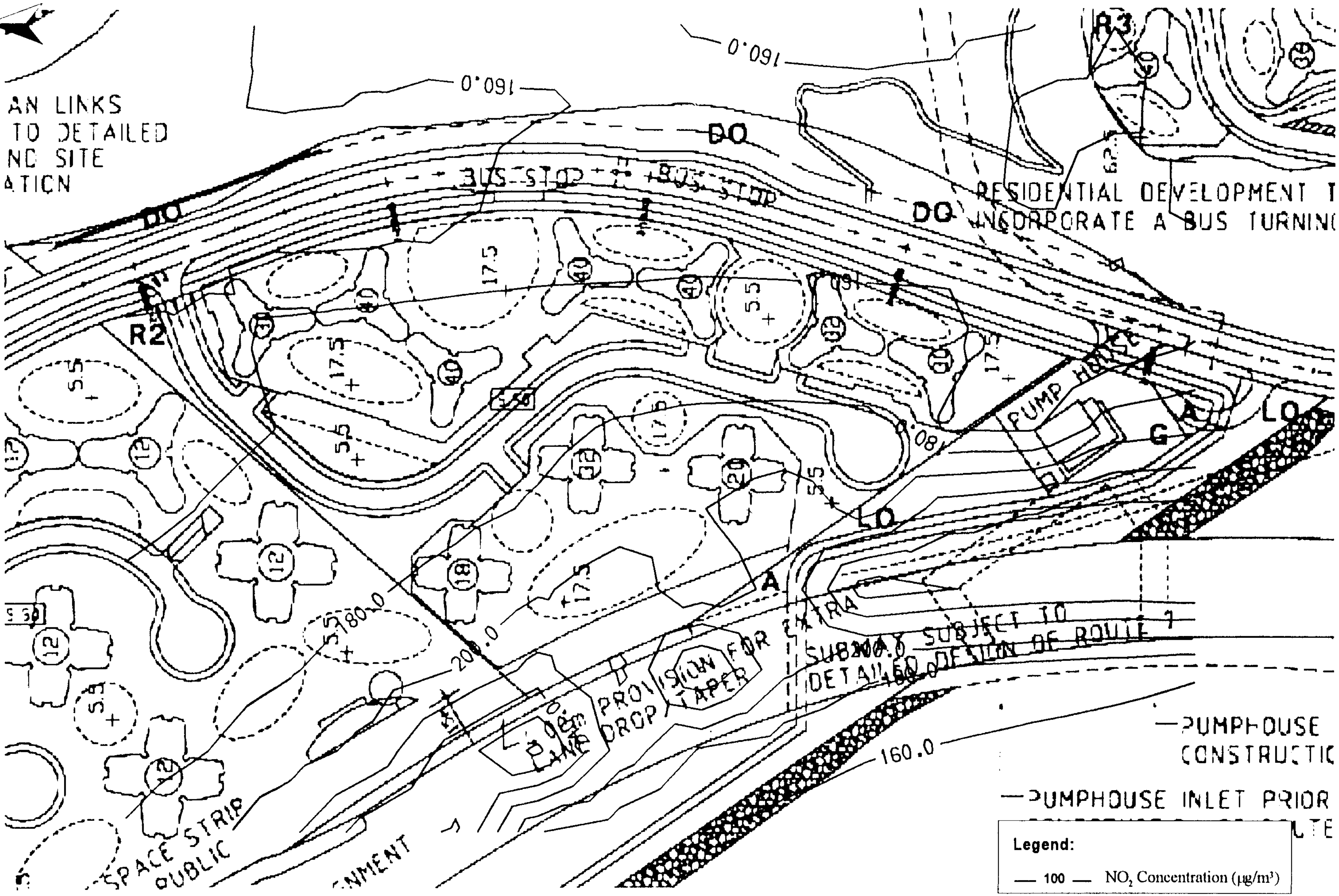
Figure No.	4.13	Rev. a
Designed By		Scale NTS
Checked By		Date Feb 99



AGREEMENT NO. CE 92/97 INFRASTRUCTURAL WORKS FOR HOUSING DEVELOPMENT AT TELEGRAPH BAY - ENGINEERING FEASIBILITY STUDY

CALINE4 - 1-Hour NO_2 Concentration Contour for Site 4 at 18.9 mPD

TERRITORY DEVELOPMENT DEPARTMENT, HONG KONG

HONG KONG ISLAND AND ISLANDS DEVELOPMENT OFFICE

PYPUN / PBA JOINT VENTURE

PYPUN

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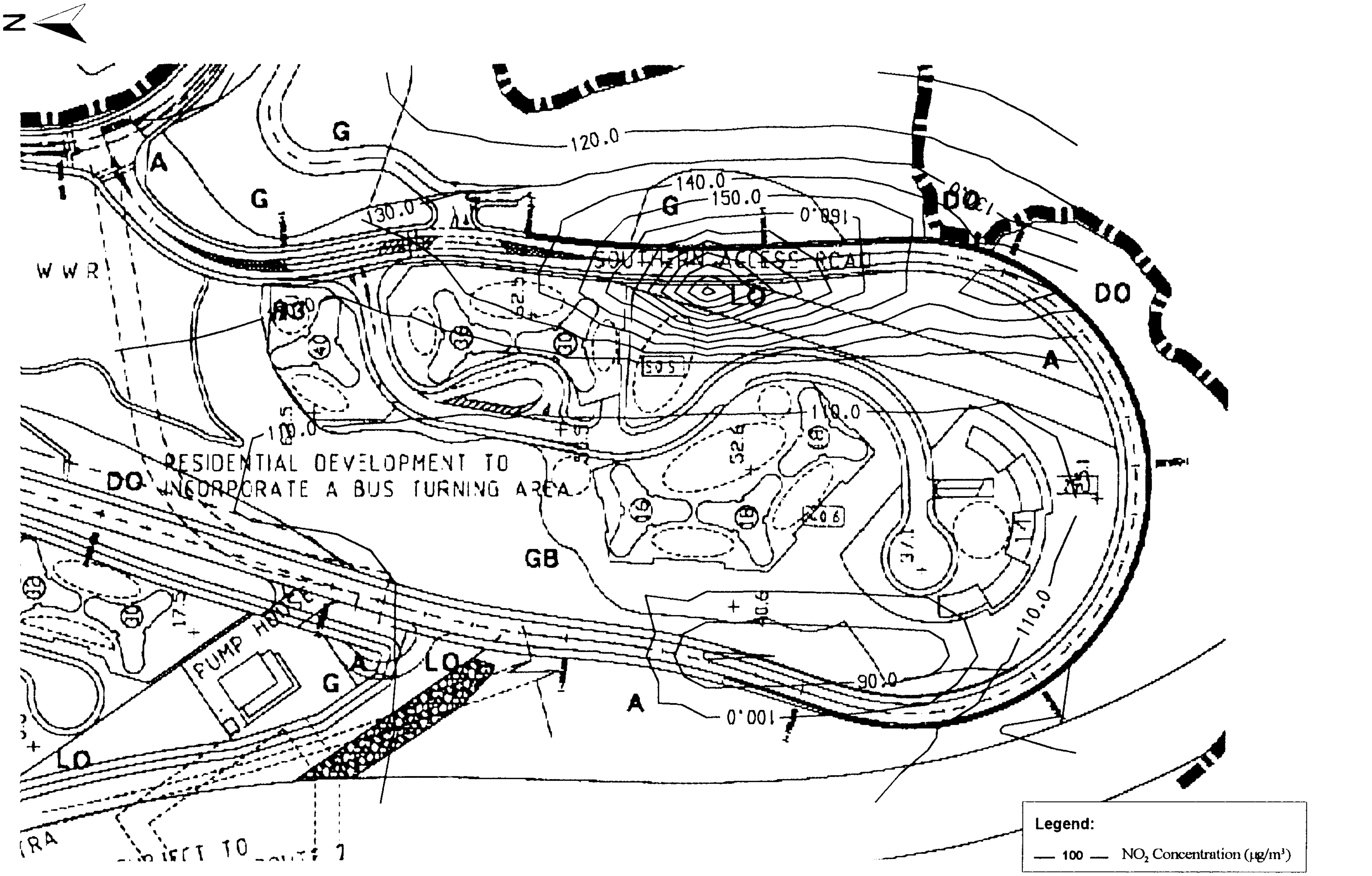
Figure No.	4.14	Rev. a
Designed By		Scale NTS
Checked By		Date Feb 99

Rev.	Description	Approved	Date



Rev.	Description	Approved	Date

AGREEMENT NO. CE 92/97 INFRASTRUCTURAL WORKS FOR HOUSING DEVELOPMENT AT TELEGRAPH BAY - ENGINEERING FEASIBILITY STUDY

CALINE4 - 1-Hour NO_2 Concentration Contour for Site 5 at 38.5 mPD

TERRITORY DEVELOPMENT DEPARTMENT, HONG KONG

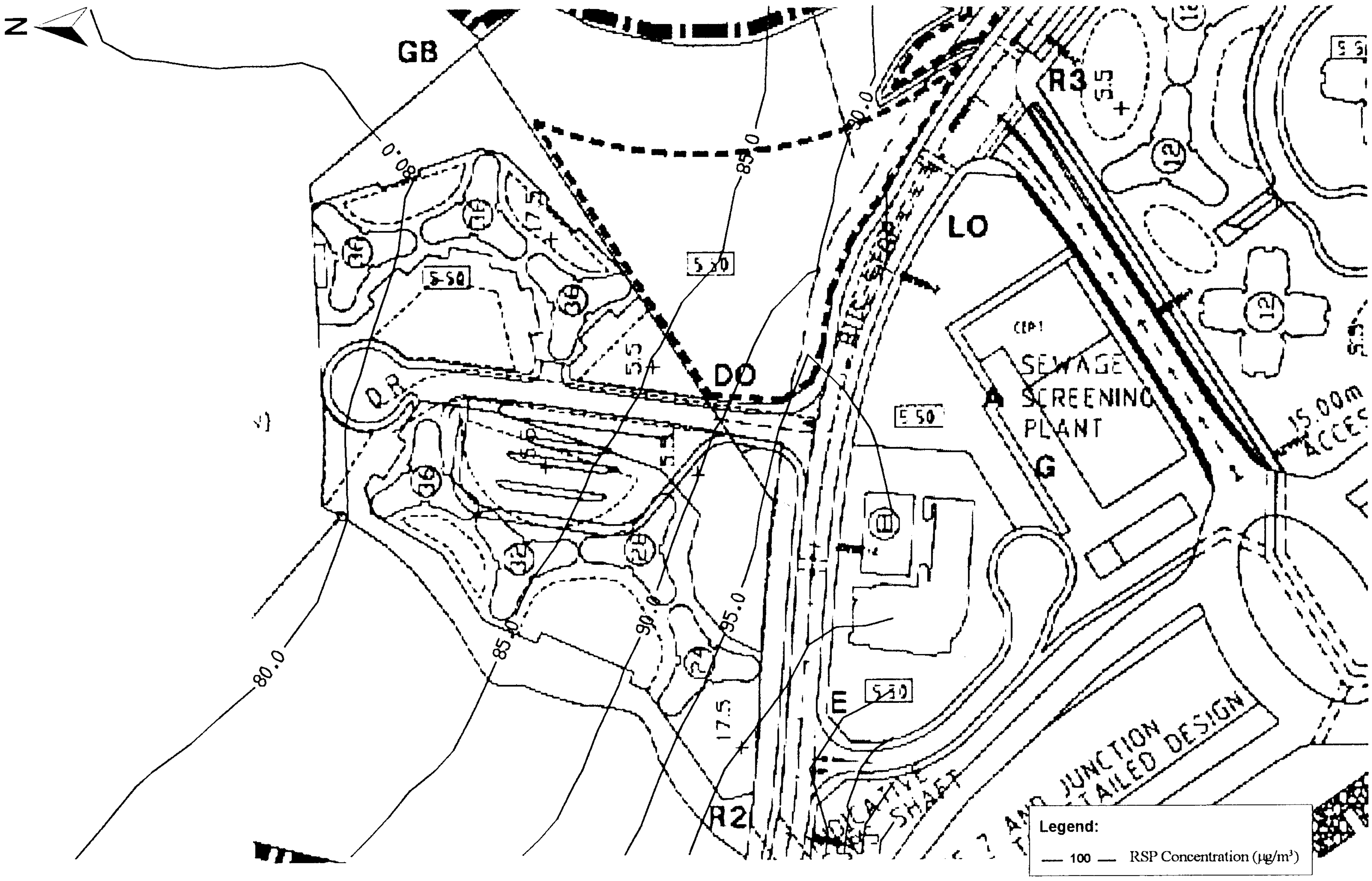
HONG KONG ISLAND AND ISLANDS DEVELOPMENT OFFICE

PYPUN / PBA JOINT VENTURE

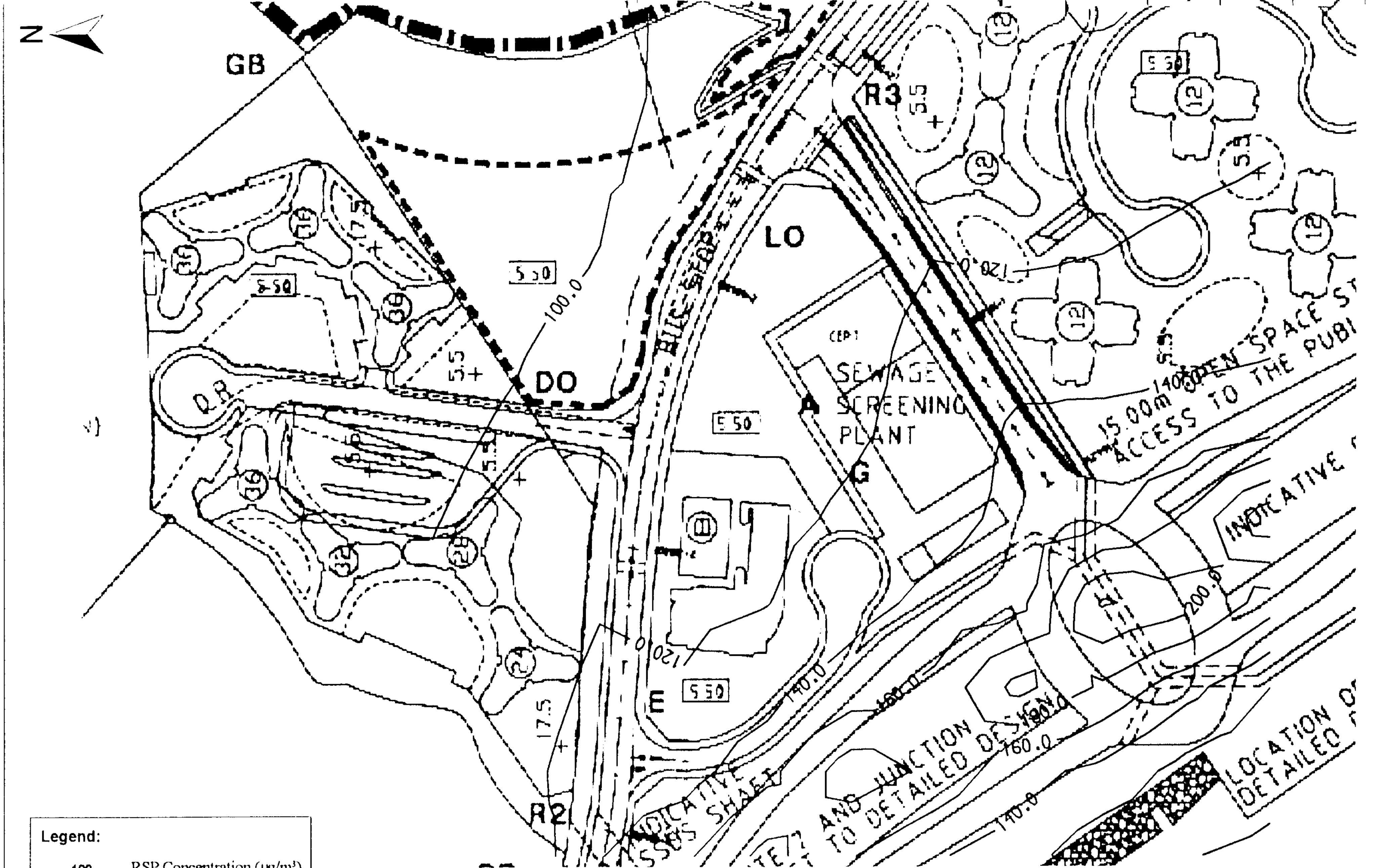
PYPUN

PB PARSONS BRINCKERHOFF (ASIA) LTD.

Figure No.	4.15	Rev. a
Designed By		Scale NTS
Checked By		Date Feb 99



Rev.	Description	Approved	Date					
				AGREEMENT NO. CE 92/97 INFRASTRUCTURAL WORKS FOR HOUSING DEVELOPMENT AT TELEGRAPH BAY - ENGINEERING FEASIBILITY STUDY	TERRITORY DEVELOPMENT DEPARTMENT, HONG KONG	PYPUN / PBA JOINT VENTURE	Figure No. 4.16	Rev. a
				CALINE4 - 24-Hour RSP Concentration Contour for Site 1 at 18.9 mPD	HONG KONG ISLAND AND ISLANDS DEVELOPMENT OFFICE	PYPUN; PB PARSONS BRINCKERHOFF (ASIA) LTD.	Designed By; Checked By	Scale NTS; Date Feb 99



Legend:

— 100 — RSP Concentration (μg/m³)

Rev.	Description	Approved	Date

AGREEMENT NO. CE 92/97 INFRASTRUCTURAL WORKS FOR HOUSING DEVELOPMENT AT TELEGRAPH BAY - ENGINEERING FEASIBILITY STUDY

CALINE4 - 24-Hour RSP Concentration Contour for Site 2 at 9.5 mPD

TERRITORY DEVELOPMENT DEPARTMENT, HONG KONG

HONG KONG ISLAND AND ISLANDS DEVELOPMENT OFFICE

PYPUN / PBA JOINT VENTURE

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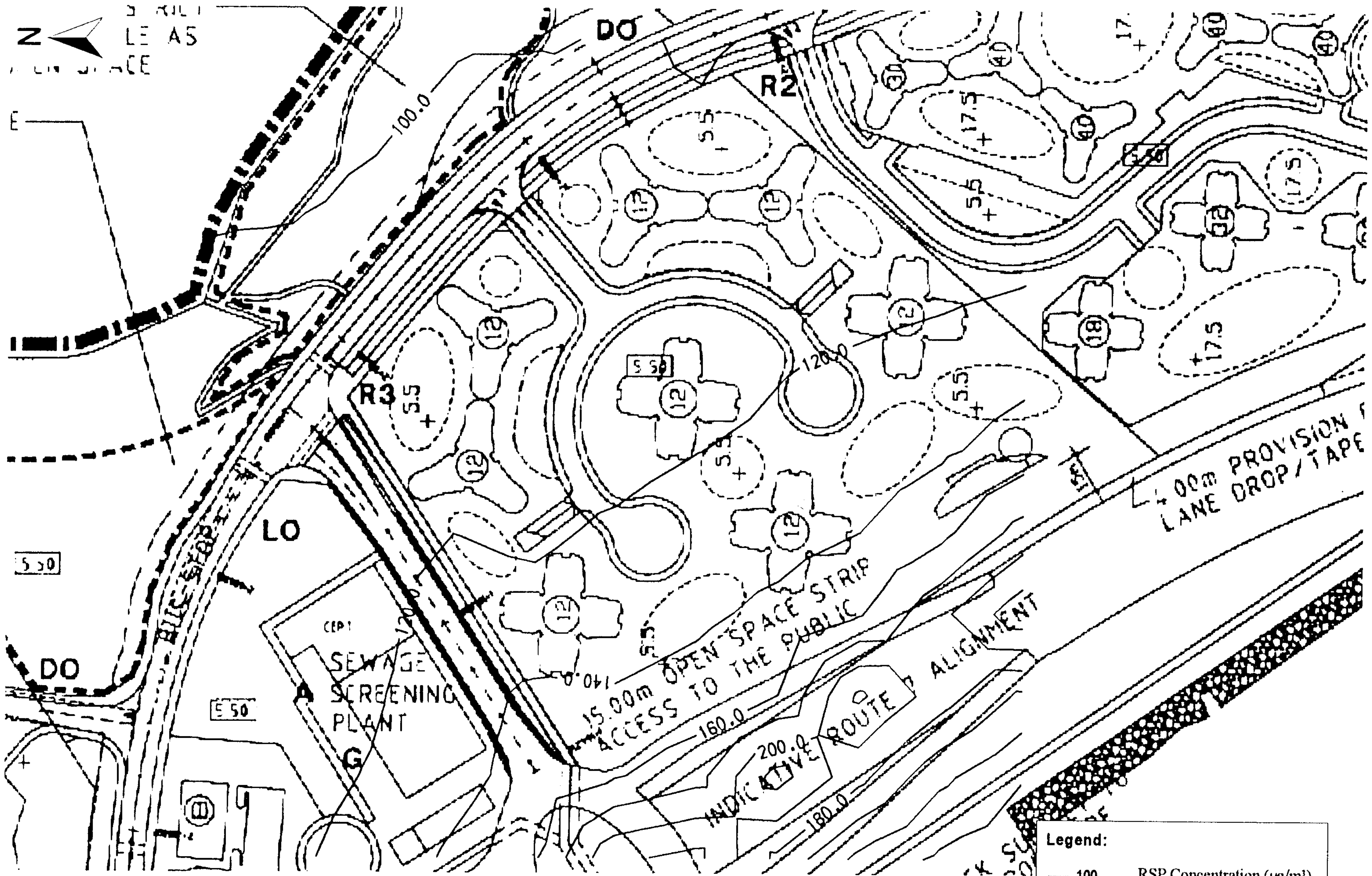
Figure No.	4.17	Rev.	a
Designed By		Scale	NTS
Checked By		Date	Feb 99



Rev.	Description	Approved	Date

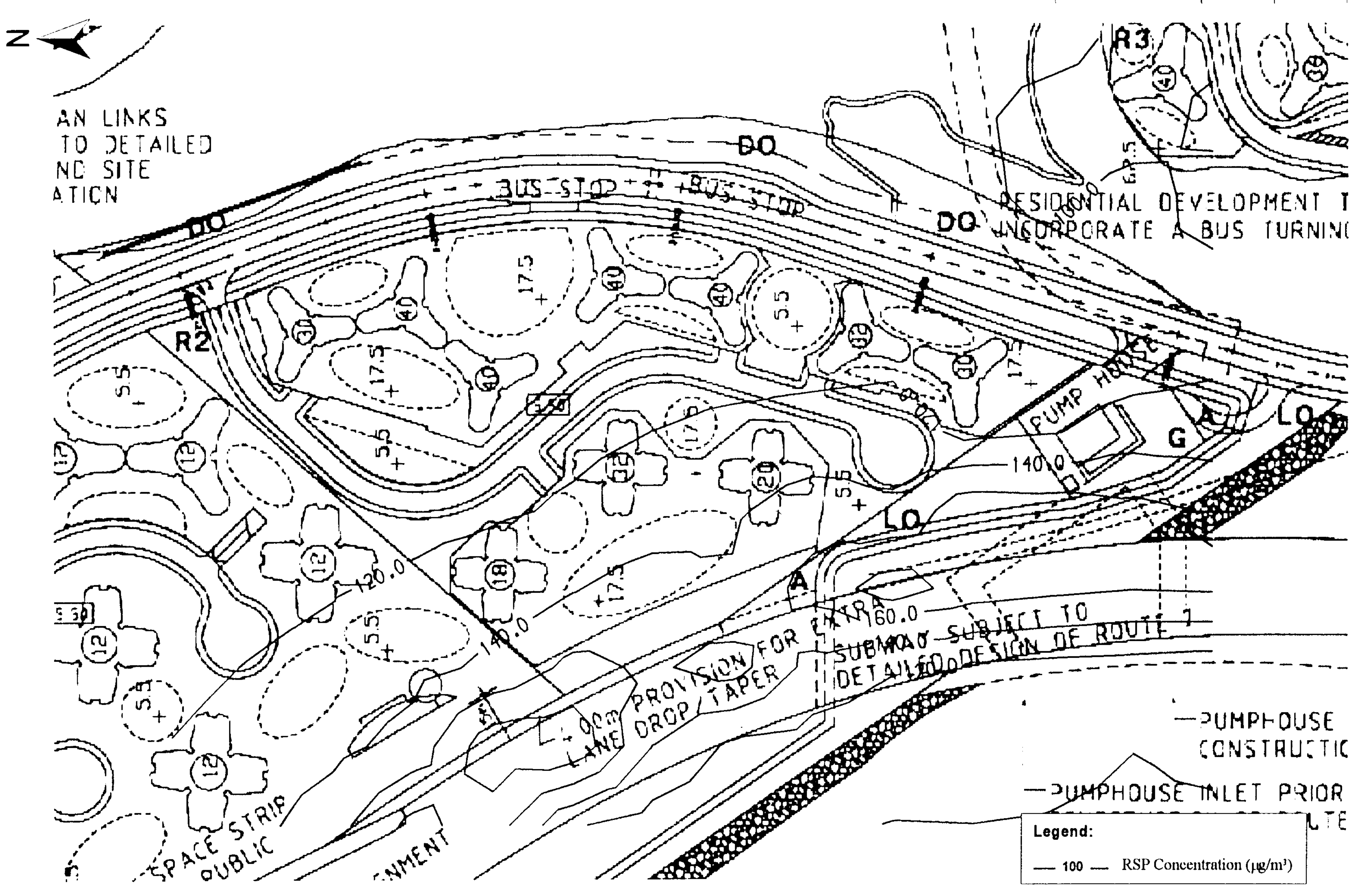
AGREEMENT NO. CE 92/97 INFRASTRUCTURAL WORKS FOR HOUSING DEVELOPMENT AT TELEGRAPH BAY
- ENGINEERING FEASIBILITY STUDY

CALINE4 - 24-Hour RSP Concentration Contour for Site 3 at 9.5 mPD

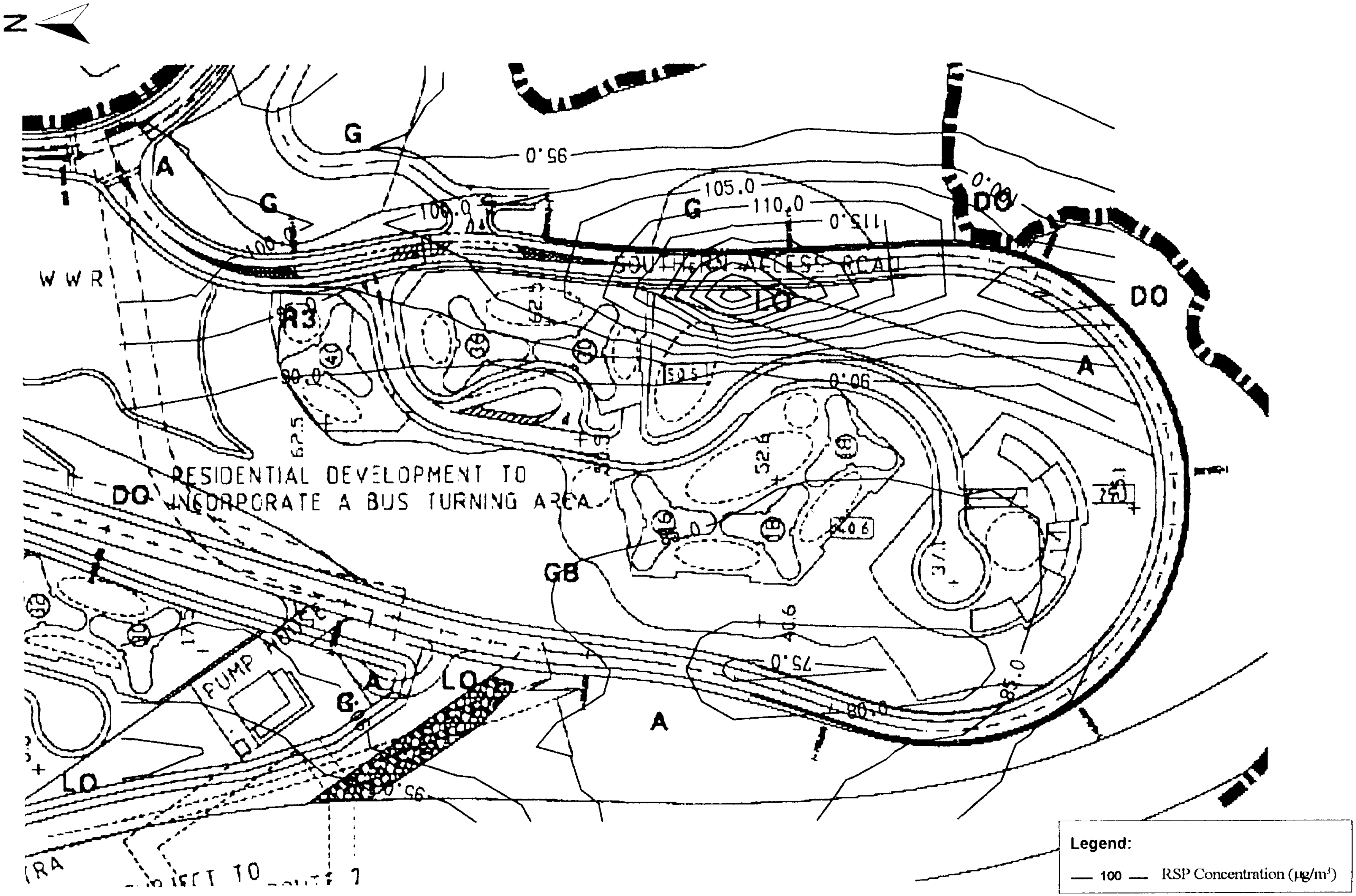
TERRITORY DEVELOPMENT DEPARTMENT, HONG KONG
HONG KONG ISLAND AND ISLANDS DEVELOPMENT OFFICE

PYPUN / PBA JOINT VENTURE
PYPUN
PB PARSONS BRINCKERHOFF (ASIA) LTD.

Figure No.	4.18	Rev. a
Designed By		Scale NTS
Checked By		Date Feb 99



Rev.	Description	Approved	Date	AGREEMENT NO. CE 92/97 INFRASTRUCTURAL WORKS FOR HOUSING DEVELOPMENT AT TELEGRAPH BAY - ENGINEERING FEASIBILITY STUDY CALINE4 - 24-Hour RSP Concentration Contour for Site 4 at 18.9 mPD	TERRITORY DEVELOPMENT DEPARTMENT, HONG KONG HONG KONG ISLAND AND ISLANDS DEVELOPMENT OFFICE	PYPUN / PBA JOINT VENTURE PYPUN PARSONS BRINCKERHOFF (ASIA) LTD.	Figure No. 4.19	Rev. a
							Designed By	Scale NTS
							Checked By	Date Feb 99



Rev.	Description	Approved	Date

AGREEMENT NO. CE 92/97 INFRASTRUCTURAL WORKS FOR HOUSING DEVELOPMENT AT TELEGRAPH BAY - ENGINEERING FEASIBILITY STUDY

CALINE4 - 24-Hour RSP Concentration Contour for Site 5 at 38.5 mPD

TERRITORY DEVELOPMENT DEPARTMENT, HONG KONG
HONG KONG ISLAND AND ISLANDS DEVELOPMENT OFFICE

PYPUN / PBA JOINT VENTURE
PYPUN
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Figure No.	4.20	Rev. a
Designed By		Scale NTS
Checked By		Date Feb 99