Binnie 賓尼

Agreement No. CE 41/94

Additional Treatment and Water Transfer Facilities for the Metropolitan Area and North-eastern New Territories Investigation Study

EM&A MANUAL

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Water Supplies Department

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Additional Treatment and Water Transfer Facilities for the Metropolitan Area and North-eastern New Territories Investigation Study

EM&A MANUAL

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EM&A MANUAL

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Reviewed	A.H.S. Li	A H S Li	19.1.96

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EM&A MANUAL

Purpose of the Manual

1. This manual is a stand-alone document, while still forming a part of the EIA. The manual covers the mandatory requirements for the construction and operation under this assignment for:

   - environmental monitoring;
   - environmental auditing; and
   - environmental mitigation measures.

2. This manual defines the programme required to identify baseline conditions and to monitor impacts and compliance during construction, commissioning and operation of the scheme, and defines the requirements for reviewing, monitoring and identifying any necessary remedial works.

3. The main areas identified by the EIA as requiring environmental monitoring and auditing (EM&A) are:

   - noise generation;
   - dust generation;
   - surface water pollution;
   - solid and liquid waste management;
   - ecology.

4. Other areas that are not considered to be a problem but may require monitoring at various times and locations are:

   - odour (during operation of the treatment works);
   - radon (during tunnel excavation).

5. In addition, environmental auditing will be required for the reinstatement of non-operational sites and the landscaping of cut and fill areas. However, until the detailed design stage is initiated the landscaping measures cannot be formulated and hence detailed EM&A requirements cannot be fully identified.

Description of the Project

6. In the construction contract documents, the description of the project will be given in the Specification. A brief description of the project is given below:

7. The preliminary design phase, initially commissioned by Planning Department of Water Supplies Department (WSD) in 1993, is a result of a WSD study which revealed that there will be a shortage of treated water by the end of 1999. The project has a design life of 50 years and comprises:

- a water treatment works of 250,000 m^3/day initial capacity and an ultimate capacity of 1,200,000 m^3/day, including a chemical house, a sludge dewatering house, pumping station and a control centre;
- a treated water pumping station for the above capacities;
- a 1.4 km raw water aqueduct for the transfer of the above capacities from the existing Tai Po Tau 'D' pumping station to the treatment works;
- a 12 km treated water aqueduct for the transfer of the above capacities from the treatment works to the primary service reservoir;
- a primary service reservoir of 40,000 m^3 initial capacity, but designed for an ultimate capacity of 190,000 m^3;
- all associated works.

Construction Programme

8. A copy of the proposed construction programme is attached as Appendix A.

Sensitive Receivers

9. The location of noise and air sensitive receivers as identified during the EIA are shown in Figures 1-4 and 5-8. The location of water sensitive receivers are shown in Figure 9-11.

Monitoring and Auditing Objectives

Definition of Environmental Monitoring and Auditing

10. Monitoring can be most concisely defined as the systematic collection of data through a series of repetitive measurements. In this project this involves the measurement of environmental parameters during project construction and the identification of any changes in these parameters which may be attributed to the project so that proactive mitigation measures can be adopted to avoid the occurrence of adverse environmental impacts.

11. Baseline or control monitoring refers to the measurement of environmental parameters during a representative period for the purpose of determining the nature and range of "ambient", or natural, conditions in order to determine whether it is necessary to review or determine the standards with which construction monitoring results are to be compared.

12. The environmental audit system is intended to check methodically that the activities of the project are complying with previously defined environmental requirements and that the necessary measures have been identified to remedy any unacceptable or unforeseen environmental impacts. Environmental auditing is a check to reassure management and regulatory agencies that the facilities are being operated in an environmentally acceptable manner. It also enables a post analysis to be carried out to examine the accuracy of the original environmental impact assessment.

Objectives of the Environmental Monitoring and Auditing Programme

13. The Environmental Monitoring & Auditing Programme shall include a schedule of monitoring and auditing of noise, air and surface water quality in the locality of the works in order:

- to provide a baseline database of "ambient" conditions.
- to monitor and interpret conditions with respect to acceptance criteria during construction in order to provide an early indication that any of the environmental control measures or construction practices are failing to achieve the required standards.
- to provide data to determine the effectiveness of any mitigation or control measures implemented through changes in working practice undertaken if acceptance criteria are exceeded.

- to provide a database of conditions after construction for the assessment of the extended effects of construction and for the post project audit.

Scope of the Audit

14. The following points shall be considered, as appropriate, for each of the monitored environmental impacts, namely noise, air and surface water quality. The audit shall:

- check that the approved sampling procedures and analytical techniques are used to assess the quality of the collected data;

- consider wind and weather conditions where appropriate at the time of sampling;

- ascertain whether any extraneous activities, unrelated to the construction work on the site, may have influenced the data. Factors such as nearby construction works should be considered;

- ascertain what activities or operations take place at the site before or during the sampling period;

- compare the data with trigger, action and target (TAT) levels and identify any non-compliance as compared to data provided by baseline and control station monitoring;

  Trigger Levels - levels beyond which there is an indication of a deteriorating ambient environment for which a typical response would be more frequent monitoring;

  Action Limits - levels beyond which appropriate remedial actions may be necessary to prevent environmental quality from exceeding the *Target Limits*, which would be unacceptable;

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

- implement action plans where appropriate and communicate with all involved parties;

- review actions taken to deal with non-compliance;

- producing and circulating reports on:

  (i) a regular monthly basis;
  (ii) when action plans are implemented;
  (iii) when responding to public complaints;

- liaison with all relevant parties and dissemination of information regarding the EM&A programme;

- conducting a post construction review to compare the environmental impacts predicted in the EIA with those observed; and

- responding to public complaints via a formal procedure outlined in this manual.

21. The Engineer's Representative (ER) also has a key role to play with the EM&A programme, undertaking:

- an engineering audit of environmental reports;

- effective implementation of good site practice measures;

- site liaison on mitigation of impacts;

- implementing and enforcing event/action plans when exceedances of TAT levels occur.

22. Figure 12 presents a flowchart of lines of authority for the project EM&A programme.

The Reporting Function

23. The manager of the Monitoring Team, shall issue data reports as quickly as possible to:

- the Environmental Management Team;
- the ER; and
- the Contractor.

24. The format of these reports shall be agreed in consultation between the Environmental Management Team, the Monitoring Team and the ER. Presentation of data via modem or on disk will be preferred.

25. The Environmental Management Team shall be responsible for the main reporting function. Both regular monthly and unscheduled incident reports shall be circulated as appropriate to:

- the ER;
- the Contractor;
- the Monitoring Team;
- the Engineer;
- the Client; and
- EPD.

26. The flowchart presented in Figure 13 summarises the lines of communication for the reporting function.

Complaints Procedures

27. A formal procedure for handling complaints about environmental matters is outlined below. All complaints need sensitive handling. Figure 14 summarises the Complaints Procedure in diagrammatic form.

28. The Environmental Monitoring Team will be responsible for the implementation of complaints procedures.

29. Each complaint shall be logged and shall include:

- date and time;
- source of complaint;
- complainant's name and address;
- nature of the complaint;
- results of investigations into the complaints; and
- records of all communications made and actions taken.

30. A copy of this log shall form a part of the regular monthly reports and shall be accompanied by a review of the circumstances including any recommendations necessary to avoid future repetitions of complaints of a similar nature.

31. All complainants shall be answered within one week in writing acknowledging receipt of the complaint.

32. All complaints shall be investigated. The complainant shall be informed of any initial findings and/or subsequent actions, if any. The complainant may also need to be contacted after mitigation measures have been introduced, to ensure their sufficiency.

33. The Environmental Management Team shall use discretion and liaise with all relevant parties as necessary.

Presentation and format of monitoring results

34. Monthly EM&A reports will include the following:

- 1-2 page executive summary;
- brief project background information including a synopsis of the project organisation, programme and management structure;
- a summary of the EM&A requirements including:
- all monitoring parameters;
- environmental quality performance limits (trigger, action and target levels);
- event/action plans;
- recommended environmental mitigation measures;
- environmental requirements in contract documents;
- drawings showing sensitive receivers the locations of monitoring stations.

35. Monitoring results shall be provided in both hard copy and diskette format together with the following information:

- monitoring methodology;
- equipment used and calibration details;
- parameters monitored;
- monitoring locations;
- monitoring time, frequency, duration and period.

36. Similarly the EM&A monthly report shall contain graphical plots of trends of monitored parameters over the past four reporting periods for designated monitoring stations and control stations annotated against the following:

- weather conditions during the period;
- major activities being carried out on site during the period;
- other factors that may affect the monitoring results;

37. The monthly report shall also advise on:

- the solid and liquid waste management status;
- ecological issues, e.g. tree clearance, revegetation;
- the implementation status of environmental protection and pollution control measures as recommended in the EIA study report.

38. With regard to non-compliance and complaints the EM&A monthly report shall provide:

- a summary of non-compliance of the environmental quality performance limits (target, action and trigger levels);
- a review of the reasons for non-compliance including review of pollution sources and working procedures;
- a description of the actions taken in the event of non-compliance and any follow-up procedures relating to earlier non-compliance;
- a record of all complaints received, written or verbal, including locations and nature of complaints, liaison and consultation undertaken, actions and follow-up procedures and a summary of complaints.

39. The monthly report shall include comments and conclusions for the month and a forecast of the works programme and monitoring schedule for the coming month. Quarterly EM&A reports will also be prepared which will provide a review of the monitoring and audit developments during the previous three month programme. The exact format of the report should be agreed with EPD.

Event/Action Plans for Use with the EM&A Programme

40. Event/action plans to be implemented in the event of non-compliance with TAT levels are given in the following three tables:

Table 1 Actions in the Event of Exceedance of Trigger Levels

Event	Actions		
	Environmental Management Team	ER	Contractor
Trigger Level			
Exceedance for one sample at any station	1. Notify ER 2. Check Monitoring data	1. Identify source 2. Notify Contractor 3. Check Contractor's working methods.	1. Rectify any unacceptable practice.
Exceedance for two or more consecutive samples at any station	1. Notify ER 2. Instruct Monitoring Team to repeat measurement to confirm findings 3. Check monitoring data and instruct Monitoring Team to check equipment 4. If remedies required following liaison with ER, inform Engineer.	1. Identify source 2. Check Contractor's working methods 3. Discuss and agree remedial works with Contractor, if necessary	1. Rectify any unacceptable practice 2. Check all plant and equipment 3. Consider changes to working methods.

Note: For Tables 1 to 3 in relation to air quality, guidelines for dust monitoring by EPD's Air Management Group should be strictly followed, e.g. the repeated daily dust measurements and prompt action for carrying out dust mitigation measures as appropriate.

Table 2 Actions in the Event of Exceedance of Action Levels

Event	Actions		
	Environmental Management Team	ER	Contractor
Action Level			
Exceedance for one sample at any station	1. Notify ER 2. Instruct Monitoring Team to repeat measurements to confirm finding 3. Check monitoring data and instruct Monitoring Team to check equipment.	1. Identify source 2. Check Contractor's working methods.	1. Rectify any unacceptable practice 2. Check all plant and equipment 3. Amend working methods if appropriate.
Exceedance for two or more consecutive samples at any station	1. Notify ER 2. Instruct Monitoring Team to repeat measurement to confirm findings 3. Check monitoring data and instruct Monitoring Team to check equipment 4. Instruct Monitoring Team to increase monitoring frequency 5. Arrange meeting with ER/Contractor to discuss remedial actions to be taken. 6. Report to the Engineer and EPD the situation after implementation of remedial actions.	1. Identify source 2. Check Contractor's working methods 3. Discuss and agree with Contractor for remedial actions to be provided 4. Ensure remedial actions properly implemented	1. Confirm notification of the exceedances in writing to the ER 2. Submit proposals for remedial actions to the ER within 3 working days upon notification 3. Implement the agreed proposals 4. Amend proposals if appropriate and report to the ER.

Table 3 Actions in the Event of Exceedance of Target Levels

Event	Actions		
	Environmental Monitoring Team	ER	Contractor
Target Level			
Exceedance for one sample at any station	1. Notify ER 2. Inform EPD and the Engineer immediately 3. Instruct Monitoring Team to repeat measurement to confirm finding 4. Check monitoring data and instruct Monitoring Team to check equipment 5. Instruct Monitoring Team to increase monitoring frequency to daily 6. Report to the Engineer and EPD the situation after implementation of remedial actions.	1. Identify source 2. Check Contractor's working methods 3. Discuss and agree with Contractor for remedial actions to be provided and report to Engineer and EPD 4. Ensure remedial actions properly implemented	1. Confirm notification of the exceedance in writing to the ER 2. Take immediate action to avoid further exceedances 3. Check all plant and equipment to ensure compliance 4. Submit proposals for remedial actions to the ER within 3 working days upon notification 5. Implement the agreed proposals 6. Amend proposals if appropriate and report to the ER.
Exceedance of two or more consecutive samples at any station	1. Notify ER 2. Inform EPD and the Engineer immediately 3. Instruct Monitoring Team to repeat measurement to confirm finding 4. Check monitoring data and instruct Monitoring Team to check equipment 5. Instruct Monitoring Team to increase monitoring frequency to daily 6. Arrange meeting with ER/ Contractor to discuss the remedial actions to be taken 7. Report to the EPD and the Engineer the situation after implementation of remedial actions	1. Identify source 2. Check Contractor's working methods 3. Carry out thorough investigation of the causes for the exceedance 4. Discuss and agree with Contractor for remedial actions to be provided and report to EPD and the Engineer 5. Ensure remedial actions properly implemented 6. Discuss with the Engineer and EPD on the necessity of stopping the causitive works or other offending construction activity if the impacts persist. (The Engineer will discuss the need to stop work with the Client).	1. Confirm notification of the exceedance in writing to the ER 2. Take immediate action to avoid further exceedances 3. Check all plant and equipment to ensure compliance 4. Submit proposals for remedial actions to the ER within 3 working days upon notification 5. Implement the agreed proposals 6. Resubmit proposals if problem still not under control 7. As directed by the Engineer stop the causitive works or other offending construction activity.

EM&A Methodology

Noise

41. A system of noise monitoring and auditing of the construction and operational phases shall be established to ensure that construction of all works, and operation of the water treatment works, takes place with a minimum of adverse impact on nearby sensitive users.

42. The environmental monitoring and auditing of noise levels should:

- determine the essential environmental background and control data;
- collect the data necessary to monitor significant impacts;
- evaluate and report on the quality and significance of the data
- compare the measured effects with the acceptance criteria;
- identify any measures necessary to mitigate unacceptable effects (action plans); and
- report the details of the above on a regular monthly basis.

Noise Monitoring Methodology

43. Monitoring of noise shall be carried out with reference to the following documents:

- HK Government, *Technical Memorandum on the Assessment of Noise from Construction Work other than Percussive Piling*;
- HK Government, *Technical Memorandum on the Assessment of Noise from Places other than Domestic Premises, Public Places or Construction Sites.*
- the forthcoming *Noise Control (Construction) Ordinance* and the final version of the associated *Technical Memorandum on Noise from Work with a Designated Area* which is currently being drafted.

44. All measurements shall be carried out by suitably qualified and experienced staff.

45. Noise monitoring shall be carried out using approved equipment, which shall be tested and calibrated at regular intervals in a manner and in a laboratory approved by EPD.

46. All noise monitoring equipment shall be properly maintained. If damage to equipment occurs, the equipment shall not be used until repaired. Sufficient equipment spare parts and any other necessary materials should be available to ensure that the schedule of noise measurement is achieved at all specified times.

47. All sound level meters shall comply with the International Electrotechnical Commission Publications 651: 1979 (Type 1) and 804:1985 (Type 1) specifications, as referred to in the Technical Memoranda to the *Noise Control Ordinance*.

48. Other measuring and analysis instrumentation used shall be of a comparable professional quality. Only microphones giving a free-field response shall be used. Wherever necessary, the equipment shall be protected against moisture.

49. Where a measurement is carried out at a building, the assessment point shall be at a point at 1 m from the exterior of the building facade at a height of at least 1.2 m above ground level, at an appropriate point.

50. Construction phase noise monitoring shall consist of:

- weekly measurements of LAeq(30 min) measurements during the daytime on normal weekdays at times chosen to fairly represent normal construction activities;

- the average of three consecutive Leq(5 min) measurements during restricted hours;

at each of the monitoring locations. Additional monitoring as devised by the EM&A team should take place on receipt of complaints.

51. Operational phase noise monitoring shall consist of weekly monitoring for one month during commissioning, thereafter six monthly monitoring.

52. Noise measurements shall not be made in the presence of mist, fog or rain or with wind at a steady speed exceeding 5 m/s, or gusts exceeding 10 m/s. Due account shall be taken of these factors when long term monitoring is being undertaken.

53. Noise measurements shall not be made when other intrusive noise sources (other than Influencing Factors) are apparent at the assessment point. If this cannot be practically avoided, due account shall be made of such sources in the assessment procedure.

54. Baseline noise monitoring shall be carried out for a period of at least two weeks prior to the commencement of construction works, with measurements taken every day during the day, evening and night at each site. From these measurements, the baseline noise levels as Leq(5min) shall be calculated.

55. Checking of baseline noise levels shall be carried out on at least four occasions during the year, at not less than one monthly intervals, for each site. The checking shall take place when construction activities are not taking place.

56. Nine monitoring stations are recommended for construction phase noise monitoring. Their positions are shown on Figures 1-4 and given below in Table 4. Two monitoring stations are recommended for operational phase noise monitoring of the treatment works: N2 and N4.

Table 4 Noise Monitoring Station Locations

Station No.	Location	Site Monitored
N1	Village house at San Uk Pai Tsuen (NSR 1)	Raw water aqueduct construction
N2	Village house at She Shan Tsuen (NSR 3)	TP WTW and treated water aqueduct construction; TP WTW operation
N3	Lin Hoi Public School (NSR 5)	TP WTW and treated water aqueduct construction
N4	Villa along Shek Lin Road (NSR 7)	TP WTW and treated water aqueduct construction; TP WTW operation
N5	Ling Hing Monastery (NSR 9)	TP WTW and treated water aqueduct construction
N6	Village house at Wo Yi Hop Tsuen (NSR 16)	Shing Mun shaft and treated water aqueduct construction
N7	Village house at Mui Kong Tsuen (NSR 18)	BVPSR and treated water aqueduct construction
N8	Government Staff Quarter, 8-11 Caldecott Road: middle floor (NSR 21)	BVPSR construction site
N9	Government Staff Quarter, 8-11 Caldecott Road: top floor (NSR 21)	BVPSR construction site

TAT Levels

57. Tables 4 and 5 show recommended TAT levels for construction and operational noise monitoring, subject to agreement with EPD.

Table 5 TAT Levels for Noise EM&A: Construction Phase

	Trigger	Action	Target
Normal working days (07:00-19:00), Mondays to Saturdays, excluding public holidays	Receipt of one documented complaint about construction noise by the Contractor, the Engineer or EPD	Receipt of more than one documented complaint about construction noise by the Contractor, the Engineer or EPD in the course of a two week period	Leq(30 min)75 dB(A) at Noise Sensitive Receivers for construction work not involving percussive piling
All days during the evening (19:00-23:00), and general holidays (including Sundays) during the daytime and evening	Receipt of one documented complaint about construction noise by the Contractor, the Engineer or EPD	Receipt of more than one documented complaint about construction noise by the Contractor, the Engineer or EPD in the course of a two week period	The appropriate criteria levels (ANLs) given in the TM *Noise from Construction Work other than Percussive Piling* and *Noise from Percussive Piling*
All days during the night-time (23:00-07:00)	Receipt of one documented complaint about construction noise by the Contractor, the Engineer or EPD	Receipt of more than one documented complaint about construction noise by the Contractor, the Engineer or EPD in the course of a two week period	The appropriate criteria levels (ANLs) given in the TM *Noise from Construction Work other than Percussive Piling* and *Noise from Percussive Piling*

Table 6 TAT Levels for Noise EM&A: Operation Phase

	Trigger	Action	Target
All days during daytime and evening (07:00-23:00)	Receipt of one documented noise complaint by WSD, the Engineer or EPD	Receipt of more than one documented complaint about noise by WSD, the Engineer or EPD in the course of a two week period	The appropriate criteria levels given in the *HKPSG* and *TM on the Assessment of Noise from Places other than Construction Sites, Domestic Premises or Public Places*
All days during the night-time (23:00-07:00)	Receipt of one documented noise complaint by WSD, the Engineer or EPD	Receipt of more than one documented complaint about noise by WSD, the Engineer or EPD in the course of a two week period	The appropriate criteria levels given in the *HKPSG* and *TM on the Assessment of Noise from Places other than Construction Sites, Domestic Premises or Public Places*

Airborne Dust

58. A system of dust monitoring and auditing of the construction works shall be established to ensure that construction takes place with a minimum of adverse impact on nearby sensitive users.

59. The environmental monitoring and auditing of dust pollution should:

- determine the essential environmental background and control data;
- collect the data necessary to monitor significant impacts;
- evaluate and report on the quality and significance of the data
- compare the measured effects with the acceptance criteria;

- identify any measures necessary to mitigate unacceptable effects (action plans); and

- report the details of the above on a regular monthly basis.

Dust Monitoring Methodology

60. Monitoring of dust shall be carried out in accordance with the following documents:

- USA *Standard Title 40, Code of Federal Regulations* Chapter 1 (Part 50) Appendix B and J;

- HK Government, *Air Quality Objectives.*

61. All measurements shall be carried out by suitably qualified and experienced staff.

62. Construction dust (Total Suspended Particles and Respirable Suspended Particles) monitoring shall be carried out using a high volume sampler whose performance specification complies with that required by USA *Standard Title 40, Code of Federal Regulations* Chapter 1 (Part 50). The RSP fraction (less than 10 μg) shall be collected by the use of an appropriate assembly attached to the sampler.

63. The equipment shall be tested and calibrated at regular intervals in a manner and in a laboratory approved by EPD.

64. All dust monitoring equipment shall be properly maintained. If damage to equipment occurs, the equipment shall not be used until repaired. Sufficient equipment spare parts and any other necessary materials should be available to ensure that the schedule of air quality measurement is achieved at all specified times.

65. Air sampling locations shall be sited at least 50 m from any dust generating activity and at the Site boundary; site specific locations shall depend upon:

- weather conditions (particularly the prevailing wind characteristics) at the time of the sampling;

- the location of dust generating activities on the Site;

- the location of the nearest sensitive receivers likely to be affected.

66. Construction dust (TSP) monitoring shall consist of:

- the collection of 24 hour samples using the High Volume Method once every six days; and
- the collection of one hour samples at least three times every week.

Additional sampling will take place on receipt of complaints and on exceedance of TAT stipulated in the Action Plan. Any variations to these proposals will be agreed with EPD.

67. Measurements shall be taken at times chosen to fairly represent normal construction activities.

68. Monitoring shall include monitoring and recording of the following parameters:

- Total Suspended Particles (TSP);
- Respirable Suspended Particles (RSP);
- Wind Direction;
- Wind Speed.

69. Wind data shall be obtained from a suitable source such as the Royal Observatory.

70. Baseline monitoring shall be carried out to determine the ambient dust (TSP) levels. Baseline monitoring of 24 hour TSP levels should be done for at least two consecutive weeks prior to construction. The timing of the baseline monitoring will be proposed by the Environmental Monitoring Team and agreed with EPD.

71. Portable equipment may be used to determine dust levels at various sites where construction works may be ongoing for less than two months.

72. Three fixed monitoring stations are recommended for dust monitoring, subject to agreement with EPD. Their positions are shown on Figures 6 and 8 and given below in Table 7.

Table 7 Dust Sampling Station Locations

Station No.	Location	Site Monitored
AQ1	Villa along Shek Lin Road (ASR 14)	TP WTW construction and operation
AQ2	Lin Hoi Public School (ASR 44)	TP WTW construction
AQ3	Government Staff Quarter, 8-11 Caldecott Road (ASR 28)	BVPSR construction site

TAT Levels

73. Table 8 shows recommended TAT levels for air quality monitoring, subject to agreement with EPD.

Table 8 TAT Levels for Dust EM&A

	Trigger	Action	Target
TSP (24 hours)	Baseline + 30%	The average of the Trigger and Target Levels	260 $\mu g/m^3$
RSP (24 hours)	Baseline + 30%	The average of the Trigger and Target Levels	180 $\mu g/m^3$
TSP (1 hour)	Baseline + 30%	The average of the Trigger and Target Levels	500 $\mu g/m^3$

Note:

Concentrations measured at 298°K (25°C) and 101.325 kPA.

Water Quality

74. A system of water quality monitoring and auditing of the works shall be established to ensure that construction and operation takes place with a minimum of adverse impact on surface waters and any associated environs.

75. Water quality will be monitored in three main areas:

- construction site runoff;
- tunnel drainage discharge; and
- treatment works discharge.

76. The environmental monitoring and auditing programme of surface water quality shall:

- determine the essential environmental background and control data;
- collect all data necessary to monitor significant impacts;
- evaluate the quality and significance of the data;
- compare the measured effects with acceptance criteria and any licences issued;
- identify any measures necessary to mitigate unacceptable effects;
- determine any extra monitoring necessary to assess the effectiveness of the mitigation measures;
- ensure that construction and operation is undertaken in the most environmentally acceptable way and in such a manner as to cause as little nuisance as possible to the general public or any sensitive uses;
- assess compliance with the Environmental and Pollution Control Requirements; and
- issue reports on the above procedures on a regular monthly basis.

Water Quality Monitoring Equipment

77. Construction site drainage at all construction sites shall be tested for the following parameters:

- pH (pH units);
- Temperature (°C);
- Dissolved Oxygen (mg/l and % saturation);
- Biochemical Oxygen Demand (BOD mg/l);
- Chemical Oxygen Demand (COD mg/l);
- Ammoniacal Nitrogen (mg/l);
- Grease and Oil
- Suspended Solids

78. Monitoring of construction site surface water drainage shall be conducted monthly. Additional monitoring shall be conducted in the event of complaints or if required by EPD.

79. Tunnel drainage discharge monitoring shall be conducted monthly or at more frequent intervals if required by EPD or if excessive discharge occurs such as would happen if the tunnel passes through an aquifer, or if testing of rock samples at the site investigation stage should indicate the presence of any heavy metals.

Tunnel Discharge

80. During excessive groundwater bleeding into the tunnel drainage during tunnel excavation, samples of the drainage water shall be taken to be tested for the following determinands:

- Lead (mg/l)
- Zinc (mg/l)
- Silver (mg/l)
- Tin (mg/l)

81. Laboratory analyses should be undertaken by a HOKLAS accredited (or equivalent) laboratory and results made available to the Engineer's Representative within 48 hours. Results of in-situ measurements should be made available within 24 hours.

Treatment Works Discharge

82. Treatment works site runoff shall be tested for:

- Biochemical Oxygen Demand (BOD mg/l);
- Chemical Oxygen Demand (COD mg/l);
- Grease and Oil

In-situ Water Quality Monitoring Equipment

83. Dissolved Oxygen and Water Temperature Measurement Equipment

The instrument shall be a portable, weatherproof dissolved oxygen measuring instrument complete with cable, sensor, comprehensive operation manuals, and be operable from a DC power source. It shall have a membrane electrode with automatic temperature compensation complete with a cable of not less than 30 m in length. It shall be capable of measuring:-

(i) a dissolved oxygen level in the range of 0-20 mg/l and 0-200% saturation; and

(ii) a temperature of 0-45 degree Celsius.

84. Suspended Solids/Water Sampler

A water sampler, made of a transparent PVC or glass cylinder (capacity not less than 2 litres) which can be effectively sealed with cups at both ends. The sampler shall have a positive latching system to keep it open and prevent premature closure until released by a messenger when the sampler is at the selected water depth (Kahlaico Water Sampler 135WB203 or similar approved). Water samples shall be kept in high density polythene bottles and packed in an ice container for transport to the laboratory as soon as possible. Upon arrival at the laboratory, the suspended solids shall be determined in accordance with the 2540D of *Standard Methods for the Examination of Water and Wastewater* (APHA, 18th edition, 1992). An accurate electronic balance with precision level not less than 0.1 mg (i.e. 0.0001 g) shall be used.

85. Thermometer

A laboratory standard certified mercury thermometer with an accuracy of at least 0.5 degree Celsius shall be provided for measuring the ambient (air) temperature.

86. All monitoring instruments shall be checked, calibrated and certified by an approved laboratory, preferably a HOKLAS accredited one, before use on the Works. The instruments shall be subsequently re-calibrated at 3 month intervals throughout all stages of the water quality monitoring. Responses of sensors and electrodes should be checked with certified standard solutions before each use.

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

Laboratory Analysis

88. All analysis should be carried out by a HOKLAS accredited, or similarly approved laboratory. All methodology should follow that set out in the *Standard Methods for the Examination of Water and Wastewater*, APHA-AWWA-WEF, 18th Edition, 1992. Metal analysis should be carried out using APHA or similar methodology such as ASTM as approved by EPD.

- pH (pH units);
- Biochemical Oxygen Demand (BOD mg/l);
- Chemical Oxygen Demand (COD mg/l);
- Ammoniacal Nitrogen (mg/l);
- Grease and Oil
- Lead (mg/l)
- Zinc (mg/l)
- Silver (mg/l)
- Tin (mg/l)

Water Quality Monitoring Schedule

89. Water quality monitoring programmes can be divided into three stages: baseline, impact/compliance and post project. These three stages of monitoring shall be carried out in accordance with the following:-

90. Duration and Frequency

(i) Baseline monitoring for site runoff shall be undertaken monthly over a 3 month period.

(ii) Impact/Compliance Monitoring of the site runoff and the tunnel drainage discharge shall be undertaken monthly or at more frequent intervals if required by EPD or upon receipt of complaints.

(iii) Operational monitoring of the treatment works shall be undertaken monthly or at more frequent intervals if required by EPD or upon receipt of complaints.

91. General Rules for Monitoring

(i) Dissolved oxygen, turbidity and temperature measurements and sampling for suspended solids determinations shall be taken in-situ.

(ii) All in-situ measurements of dissolved oxygen and sampling for suspended solids determinations shall be done in duplicate. If the difference of the first and second reading of each set exceeds 25%, both readings shall be discarded and measurement shall be repeated.

(iii) Should the impact monitoring record levels of suspended solids or dissolved oxygen levels which are indicative of a deteriorating situation such that closer monitoring is reasonably indicated, then the Engineer will arrange to undertake more frequent monitoring at each monitoring station until the results indicate an improvement to acceptable water quality.

Water Quality Monitoring and Control Sites

92. It is recommended that a total of seven monitoring stations are established as listed in Table 9. The position of the six surface level monitoring stations are shown on Figures 9-11. The seventh station will be located within Shing Mun shaft, or at the tunnel drainage discharge point, and is designed to sample tunnel drainage water quality. All locations are subject to the approval of EPD.

Table 9 Water Quality Sampling Station Locations

Station No.	Location	Site Monitored
WQ1	Raw water aqueduct site near Lam Tsuen river	Raw water aqueduct construction site
WQ2	Raw water aqueduct portal	Tunnel drainage (north end)
WQ3	She Shan Tsuen stream at TP WTW site boundary	TP WTW construction site
WQ4	Eastern TP WTW site boundary at junction of two streams	TP WTW construction site
WQ5	Treated water aqueduct portal, Butterfly Valley	Tunnel drainage (south end)
WQ6	BVPSR site runoff discharge point	BVPSR construction site
WQ7	Base of Shing Mun shaft of tunnel drainage discharge point	Tunnel drainage

Trigger, Action, Target (TAT) Levels

93. Table 10 shows recommended TAT levels for water quality monitoring, subject to agreement with EPD.

Table 10 TAT Levels for Water Quality EM&A

	Trigger	Action	Target
pH	baseline + 30%	average of Trigger and Target	6.5-8.5
Temperature	baseline + 30%	average of Trigger and Target	35
Suspended solids	baseline + 30%	average of Trigger and Target	10 mg/l
Dissolved oxygen	baseline + 30%	average of Trigger and Target	$\geq$ 4 mg/l
BOD	baseline + 30%	average of Trigger and Target	10 mg/l
COD	baseline + 30%	average of Trigger and Target	50 mg/l
Oil & grease	baseline + 30%	average of Trigger and Target	1 mg/l
Lead	baseline + 30%	average of Trigger and Target	0.1 mg/l
Zinc	baseline + 30%	average of Trigger and Target	1 mg/l
Silver	baseline + 30%	average of Trigger and Target	0.1 mg/l
Tin	baseline + 30%	average of Trigger and Target	0.1 mg/l
Total toxic metals	baseline + 30%	average of Trigger and Target	0.3 mg/l
Ammoniacal nitrogen	baseline + 30%	average of Trigger and Target	1 mg/l

Odour

94. Odour emissions are not considered to cause a major problem during operation of the water treatment works. However, the EIA has identified that some slight sludge odour may occur during under certain conditions.

95. Monitoring shall be undertaken to ensure that odour is below nuisance levels. Odour monitoring shall be carried out in the form of a routine odour patrol to ensure that no odour nuisance occurs beyond the site boundary of the water treatment works. The odour intensities detected shall be categorised into the following classes:

(a) 0 Not detected - No odour perceived or an odour so weak that it can not be readily characterised or described;

(b) 1 Slight - Slightly identifiable odour;

(c) 2 Moderate - Moderately identifiable odour;

(d) 3 Strong - Strongly identifiable odour;

(e) 4 Extreme - Severely identifiable odour.

96. Baseline odour levels shall also be checked immediately prior to the commencement of the operation.

97. Table 11 shows recommended TAT levels for odour monitoring, subject to agreement with EPD.

Table 11 TAT Levels for Odour EM&A

	Trigger	Action	Target
Odour	One independently documented complaint about odour, or recording of a slight odour on 2 consecutive patrols	More than one independently documented complaint about odour within 2 weeks, or recording of a moderate odour on 2 consecutive patrols	More than three independently documented complaint about odour within 2 weeks, or recording of a strong odour on 2 consecutive patrols

Radon Monitoring

98. Although the EIA did not identify radon as being a particular hazard as the tunnel will be well ventilated, it is considered that monitoring should be conducted within the tunnel at regular intervals to ensure that the workers are not exposed to excessive levels which may be harmful.

Radon Monitoring Methodology

99. Radon monitoring during construction of the tunnel shafts and portals shall be conducted weekly. In addition, continuous monitoring should be undertaken to determine the long term build up of radon gas and the associated exposure levels of the workers.

115. All revegetation and landscaping shall be undertaken under the supervision of a qualified ecologist/botanist with advice from AFD to ensure that appropriate native species are selected. Aftercare of trees planted will be required for an appropriate period to ensure that they become properly re-established.

Environmental Controls and Mitigation Measures

116. The Contractor shall comply with and observe all ordinances, by-laws regulations and rules for the time being in force in Hong Kong governing any form of pollution and the protection of the environment.

Mitigation of Construction Impacts

Avoidance of nuisance and socio-economic impacts

117. The Contractor shall comply with the Public Cleansing and Prevention of Nuisances Bye-law 1972.

118. The site shall be maintained in a clean and tidy condition. Materials, including materials required for temporary works shall be stored in an orderly manner. Rubbish and debris shall be removed from the site at a frequency agreed by the Engineer.

119. Earth, rock or debris shall not be deposited on public or private Rights of Way. This includes deposits arising from the movement of construction plant. Wheel washing and vehicle cleaning facilities shall be provided for all site vehicles at the exit of the construction sites and be used to wash mud from the wheels and bodywork of all vehicles leaving the site. Cement and concrete trucks in particular shall be thoroughly cleaned prior to leaving the site.

120. Where the construction work temporarily affects any public roads, private roads, footpaths and other Public Rights of Way, the Contractor shall provide alternative access. Where construction movements cause an unacceptable increase in local road traffic, sufficient to cause regular inconvenience to local residents, the Contractor shall ensure that only essential vehicles and plant use the affected road(s) during the local peak traffic times. This is particularly relevant at Caldecott Road which is a proposed access route for the service reservoir site. The traffic lights at the Caldecott-Tai Po road junction have a very short sequence resulting in only one or two vehicles being able to exit Caldecott Road during one series of signal changes. Increased traffic numbers exiting this road would need to be accommodated by increasing the length of time the traffic signals allow vehicles to exit this junction.

121. If during excavation and earthwork the Contractor unearths materials which may be of archaeological value, the finds shall be reported to the Antiquities and Monuments Office (AMO). Where it is deemed appropriate the AMO may wish to undertake a watching brief of any further excavation work in that area to ensure that the archaeology of the site is adequately recorded. In this instance the Contractor shall comply with the requests of the AMO representative.

122. All provisions for the relocation of graves and burial grounds shall be strictly adhered to. This will involve arranging notification and exhumation through RSD in the usual way and will be subject to discussions between the indigenous peoples affected.

123. All construction sites shall be securely fenced off to prevent members of the public from accidentally entering the site.

124. The 24 hour tunnelling programme will require the tunnel portal and access areas to be floodlit during the evening and night-time. Screens shall be provided around parts of the site which are adjacent to residential areas. Floodlights shall be cowled to prevent direct glare.

125. Public nuisance mitigation measures dealing specifically with noise disturbance, dust and air quality are dealt with separately below.

Noise

126. The Contractor shall comply with the *Noise Control Ordinance (Cap 400)* (NCO) and with any Regulations made under the ordinance. Before the commencement of work which requires a Construction Noise Permit, the Contractor shall obtain the relevant documentation and shall provide a copy of the application and permit to the Engineer. Construction noise shall not exceed the terms and conditions defined in Construction Noise Permits obtained for the site.

127. Rock breakers shall not be used within 125 m of Noise Sensitive Receivers unless permitted by the Engineer in writing.

128. Blasting shall be carried out in strict accordance with the conditions of the blasting permit.

129. Immediately prior to the excavation of the treated water tunnel section from Shing Mun to Butterfly Valley, the residents of the Shek Lei Estate in Kwai Cheung shall be informed of the construction work to allay any concerns residents may have regarding minor structural vibrations due to drill and blast. Similarly residents at Caldecott Road shall be informed of blasting at the Butterfly Valley Service Reservoir site.

130. Site formation and blasting work at the Butterfly Valley service reservoir site shall be undertaken as soon as possible to avoid conflicting activities between the construction of the service reservoir and the ensuing construction of Route 16 which will be in tunnel approximately 40-50 m below the bottom of the service reservoir.

131. Construction plant shall be effectively sound-reduced by the use of, for example, mufflers, silencers and freestanding movable screens and acoustic linings or shields.

132. Hand held percussive breakers and air compressors shall comply with the *Noise Control (Hand-held Percussive Breakers) Regulations* and *Noise Control (Air Compressors) Regulations* under the NCO.

133. Noise control monitoring procedures shall comply with the *Technical Memorandum on Noise from Construction Work other than Percussive Piling*, issued under Section 9 of the NCO, and with the procedures outlined in this EM&A manual.

134. Silenced equipment and quieter construction methods should be chosen whenever possible. Particular care should be taken to ensure that equipment is well-maintained. Some equipment (e.g. compressors) require noise labels under the NCO. For these classes of equipment, only items with the appropriate labels should be used on Site.

Air Quality

135. Work shall be carried out in such a manner that dust is not generated. Regular watering of unpaved areas, access roads, construction areas and dusty stockpiles shall be undertaken after starting work each day and at least once every three hours thereafter during the operation day to attain the invisible dust emission level. Screens, dust sheets, tarpaulins or other methods agreed by the Engineer shall be used to prevent generation of dust. Materials, including earthworks material, from which dust may be generated when being transported to or from the Site shall be sprayed with water or covered.

136. The Contractor shall ensure that necessary equipment for water spraying, such as water bowsers and spray bars, is available on site at all times. The Contractor shall provide sufficient bowsers to achieve a minimum of five passes per day on all haul roads.

137. The Contractor shall ensure that areas within the site where there are regular movements of vehicles, particularly access roads from the construction sites to public roads, shall have a hard core surface and be kept clear of loose surface material. Storage and handling areas in particular should be located on a hard surface to facilitate cleaning and minimise dust generation.

138. Earth, rock or debris shall not be deposited on public or private Rights of Way as a result of the Contractor's activities, including any deposits arising from the movement of plant or vehicles. Wheel washing and vehicle cleaning facilities shall be provided for all site vehicles at the exit of the construction sites and be used to wash mud from the wheels and bodywork of all vehicles leaving the site. Cement and concrete trucks in particular shall be thoroughly cleaned prior to leaving the site.

139. In the event of any spoil or debris from the Contractor's activities being deposited on public or private rights of way, then all such material shall be immediately removed to the satisfaction of the Engineer.

140. Stockpiles of sand, aggregate, excavated spoil and other fine material which are greater than 30 m^3 shall be fully enclosed and screens shall extend 2 m beyond the front of the stockpile area. All stockpiles of aggregates with a nominal size of less than 5 mm shall be stored in a totally enclosed structure. Stockpiles less than 30 m^3 shall be enclosed on three sides with screens extending above the stockpile to prevent wind whipping.

141. Earth moving operations should be carefully controlled when winds are strong particularly when blowing towards nearby sensitive receivers. Sheltered areas of the site shall be used for dusty operations during these periods. During high winds, earth moving activities may need to be curtailed unless all materials handled and transport routes are very damp.

142. Cement delivered in bulk shall be stored in closed silos fitted with a high level alarm indicator. The high level alarm indicators shall be linked to the filling line such that in the event of a hopper approaching its storage capacity an audible alarm will sound and the delivery line will automatically close.

143. If any dry mix batching is undertaken on the site, the truck batching aperture shall be shrouded and fitted with water suppression sprays.

144. Vehicles with an open load carrying area for moving spoil, debris and other dust generating material shall have properly fitted side and tail boards and shall not be loaded to a level higher than these boards. Dust generating material shall be covered by a well secured, properly fitting tarpaulin which should extend at least 300 mm over the edges of the sides and tail boards.

145. Conveyor belts shall be fitted with wind boards and conveyor transfer points and hopper discharge areas shall be enclosed to minimise dust emission. Conveyors which carry materials with particular fine particulates and which are likely to generate a significant dust problem, shall be totally enclosed and fitted with belt washers.

146. Motorised vehicle movement on the construction sites shall be subject to a speed limit of 15 km per hour.

147. All vehicles shall be regularly inspected to ensure that they are operating efficiently and that the exhaust emissions are not causing an air quality nuisance. Exhaust systems on site dump trucks should be routed vertically upwards behind the cab.

148. Furnaces, boilers, and other similar construction plant which uses fuel which may produce air pollution shall not be used without the prior written consent of the Director of Environmental Protection. Wastes and other materials shall not be burned on the site.

149. Throughout the tunnel excavations, forced ventilation shall be maintained to ensure noxious or asphyxiating gases do not accumulate within the tunnels. At the tunnel access shafts or portals the expelled air will require venting to atmosphere ensuring adequate diffusion of gases. Expelled ventilation air shall be directed away from nearby buildings.

150. Tunnel ventilation will also contain high levels of TSP and should therefore be filtered prior to being vented to atmosphere. The filters should be regularly changed to ensure blockages, which are likely to affect the performance of the system, do not occur.

151. The extent of odour nuisance from the water treatment works is likely to be dependant on the length of time sludge is stored on site. The length of time that sludge is stored on site should be minimised. Odour monitoring shall be carried out in the form of an odour patrol and to ensure that no odour nuisance occurs beyond the site boundary of the water treatment works.

Water Quality

152. The Contractor shall comply with the *Buildings Ordinance,* the *Water Pollution Control Ordinance* and the Technical Memorandum on *Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters.*

153. The Contractor shall take all such necessary measures as may be reasonably required by and to the satisfaction of the Engineer to ensure that the operation of all plant and construction processes on site will not cause unnecessary or unacceptable pollution of Hong Kong Waters.

154. The Contractor shall ensure that the water quality at the specified monitoring locations is within the acceptable range as proposed by the Engineer and approved by DEP. The Contractor shall take action as set out in the Action plans as quickly as possible in the event that any TAT levels are exceeded.

155. Water and liquid waste products arising from the construction sites, and which do not contain levels of contamination which exceed the defined action levels, shall be collected and removed by a suitable and adequately designed temporary drainage system. Where possible permanent drainage works shall be accommodated within temporary works. The site drainage system shall be designed to accommodate a one in five year rainfall event. The Contractor shall construct, maintain, remove and reinstate any temporary drainage facilities. Maintenance requirements to be undertaken by the Contractor include the regular removal of solids from sand traps, wheel washes, man holes and stream beds.

156. The Water Pollution Control Ordinance requirements specify that any effluent discharged from the site into waters of Hong Kong, will require to be licensed. The Contractor shall apply for the WPCO license before discharging any effluent from the construction site, including those from any concrete batching plant. The content of effluent to be discharged into the waters near the site shall strictly comply with the limits set in the WPCO.

157. Wastewater due to construction activities will include runoff from silt and dust suppression activities, washout from concrete mixing/batching, runoff from soil/spoil and fuel and lubricating oil spillage. To prevent the wastewater from any concrete mixing/batching plant from contaminating the operation area or the surrounding streams, the concrete mixing/batching plant area shall be properly bunded off from the operation area. Wastewater within the bunded plant area shall be conveyed to an similarly appropriate system and disposal facility.

158. Discharges from concrete batching shall be settled and necessary pH adjustments shall be made to the supernatant liquor. If settlement alone is insufficient to settle colloidal materials further treatment with settlement agents shall be undertaken prior to discharge.

159. All other wastewater and runoff shall be routed to an appropriate treatment system and disposal facility. The treatment system and disposal facility shall ensure that effluent released to the environment complies with limits set out in the *Technical Memorandum on Standards for Effluent Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters.*

160. The drainage system will be adequately supplied with silt traps. Any muddy and silty water collected from cleaning activities shall be conveyed to a treatment system for settlement/filtering before being discharged.

161. The Contractor shall maintain all sanitary facilities in good condition.

162. The Contractor shall prevent fuel and lubricating oil leakage from plant and storage sites contaminating the construction site. The Contractor shall prepare and submit to the ER a spill action plan and keep suitable clean-up materials on-site. Layers of sawdust, sand or equivalent material shall be laid underneath and around any construction plant and equipment that may possibly leak oil. The polluted clean-up materials shall be replaced with some clean materials on a regular basis. Any polluted material shall be disposed of in an acceptable and regular manner. Plant and storage sites for fuel and lubricating oil should be formed on bunded and impervious ground. Adequate numbers of oil/petrol interceptors should be provided.

163. The Contractor shall operate a slurry collection and recycling system for spent bentonite or other grouts.

164. Boundaries of earth works shall be surrounded by temporary flood protection works.

165. Storage areas for hazardous materials such as fuels, chemicals etc. shall be bunded to a capacity 110% of the storage capacity and the storage areas shall be securely locked.

166. Emergency procedures for chemical spillages shall be established between the Engineer, Engineer's Representative, the Contractor and the Environmental Management Team.

167. Under no circumstances shall contaminated construction site drainage, wastewater or site runoff be allowed to discharge into the She Shan Tsuen stream. The detailed Method Statement for Site clearance, tree removal, excavation and drainage of the ridge overlooking She Shan Tsuen Village shall be agreed with the Engineer prior to commencement of work. All materials arising from this task and the tunnel waste from the north-west portal of the treated water tunnel shall be withdrawn via the main area of the treatment works site.

168. Provision shall be made for the collection, treatment and, if necessary, the removal off site of contaminated tunnel drainage. Under no circumstances shall tunnel drainage containing high concentrations of metals be allowed to discharge into natural watercourses.

169. Water courses and drains intercepted by the works shall be trained or diverted and, where possible, reinstated to their original courses on completion of the works.

170. Existing water courses and drains within and adjacent to the construction sites shall be kept free from debris arising from the construction works.

171. Areas of surface excavation work shall be minimised. Suitable chemical wetting agents shall be used where appropriate, on completed cuts and fills to reduce wind erosion. Exposed surfaces shall be stabilised as soon as possible by means such as hydroseeding, compaction, covering with aggregate etc.

172. The detailed design of the concrete aprons used for the unloading bays and around the chemical and fuel storage tanks will ensure that all spillages and surface water runoff from any washdown would be rerouted into settlement tanks and passed into the sewerage system for treatment.

173. General site runoff will be rerouted eastwards towards the Kam Shan stream and ultimately into the Lam Tsuen floodway. This will avoid site runoff to the She Shan Tsuen Stream. Under no circumstances shall contaminated water treatment works drainage or runoff be allowed to discharge into the She Shan Tsuen stream.

Construction Waste

174. Construction waste is likely to include packaging materials, used wooden blocks and boards, concrete debris, disposed soil or sand, etc. In order to comply with the *New Disposal Arrangement for Construction Waste* set by the EPD in 1992, no construction waste more than 20% inert material by volume shall be disposed of at two older operational landfills, Tseung Kwan O Landfill Stage III and Shuen Wan Landfill, or the new Strategic Landfills. Inert material like rock, sand, concrete debris should be sorted out from construction waste before disposal. Dry concrete waste should be recycled for reuse or sorted for disposal at public dumps.

Waste Storage and Disposal

175. The Contractor shall comply with the *Waste Disposal Ordinance*, *Public Health and Municipal Services Ordinance*, *Water Pollution Control Ordinance* and the *Air Pollution Control (Open Burning) Regulation.*

176. Spoil, debris and construction materials which are stored on adjacent land shall be effectively removed following construction and the land area shall be reinstated to its natural state.

177. Wastes and other materials shall not be burned on the site.

178. Waste collected from grease traps shall be collected and disposed of by a licensed contractor.

179. Layers of sawdust, or a similar inert absorbent material, shall be laid underneath or around any construction plant or equipment that leaks oil. Absorbent material contaminated with fuel or oil shall be regularly replaced.

180. The Contractor shall provide a refuse storage area at each construction site. Adequate temporary toilet facilities will be provided at each site and at tunnel portals.

181. Tunnel and site formation spoil shall only be taken off site during daytime hours between 07.00 and 19.00 except on Sundays and Public Holidays when no material shall be transported off site. Spoil generated in evening or on Sundays or Public Holidays shall be temporarily stored on site until the designated disposal time. Material from the formation of the water treatment works may be taken off site at any time as access from this site is via a private (WSD) road along which there are no residences.

182. Waste material, in particular tunnel and site formation spoil, which is suitable for use in any of the Fill Management Committee projects shall be segregated and disposed of at site requested by FMC. Material which is deemed unsuitable for reclamation or construction shall be disposed of at the Contractor's tip or at a public landfill.

Cleared Vegetation

183. On site incineration of vegetation or other materials shall be prohibited.

Domestic-Type Sewage

184. Sewage generated from toilets, washing facilities and any temporary canteen provided for staff should be separately collected and suitable treatment should be provided before discharge. It should not be discharged into the local water courses. The Contractor should be responsible for supplying adequate, suitable temporary arrangements such as sufficient chemical toilets and ensuring the waste generated is properly handled.

185. Should any washwaters or other wastewaters be discharged into the local water courses, it is necessary for their composition to comply with the requirements specified by the *Technical Memorandum on Effluent Standards*.

Domestic-Type Solid Waste

186. A refuse collection station should be established for the collection and temporary storage of municipal waste. All municipal waste should be collected in black refuse bags and delivered to, and disposed of at, the approved landfill.

Waste Oil and Chemicals

187. Waste oil and other chemicals will be required to be disposed of at the Government Chemical Waste Treatment Centre at Tsing Yi. Sludge from the clarifiers and from the clearance of the service reservoir, shall be dewatered and disposed of to landfill in accordance with the Government's Waste Management Strategy.

188. Wastes and other materials shall not be burned on the site.

Ecology and the Natural Environment

189. All mitigation measures to minimise detrimental impacts on surface water quality shall be strictly adhered to avoid adverse effects on aquatic ecology.

190. The loss of mature trees shall be minimised by means of avoiding established woodland where such areas are not necessary to the site formation. Site clearance and in particular the removal of trees within the Limit of Works and Limit of Site shall not be undertaken without consultation and approval of the Engineer. Mature trees in this zone should be identified, marked and considered individually for site clearance with the consent of the Engineer.

191. Where possible, mature trees will be left *insitu* or transplanted within a short period of their being uprooted. Where this is not possible, the trees will be replaced with saplings of the same or other native species to be planted elsewhere on the Site as indicated in the Master Landscape Plan.

192. Following construction, site reinstatement shall include replanting using native species which are appropriate to each particular site. All revegetation and landscaping should be undertaken under the supervision of a qualified ecologist/botanist with advice from AFD.

193. Landscaping of the water treatment and service reservoir sites shall be undertaken during the construction period. Where possible, material excavated from the site shall be used for this landscaping as it will be compatible with remaining soil/subsoil and is likely to contain a similar organic content, chemical composition and seed bank.

194. Compensation flow in the form of unpolluted runoff shall be provided to the She Shan Tsuen stream.

Mitigation of Operational Impacts

Avoidance of nuisance and socio-economic impacts

195. Construction sites shall be adequately reinstated to a condition as close as possible to the original landform prior to construction.

196. An adequate fire break shall be maintained between the water treatment works site and the surrounding area.

197. Operational and security lighting at the water treatment works and service reservoir sites should be minimised. Where such lighting is necessary the lights should be suitably cowled and directed away from residential areas.

Air quality

197.1 The extent of odour nuisance from the water treatment works is likely to be dependent on the length of time sludge is stored on site. The length of time that sludge is stored on site should be minimised. Odour monitoring shall be carried out in the form of an odour patrol and to ensure that no odour nuisance occurs beyond the site boundary of the water treatment works.

Water quality

197.2 The detailed design of the concrete aprons used for the unloading bays and around the chemical and fuel storage tanks will ensure that all spillages and surface water runoff from any washdown would be rerouted into settlement tanks and passed into the sewerage system for treatment.

197.3 General site runoff will be rerouted eastward towards the Kam Shan stream and ultimately into the Lam Tsuen floodway. This will avoid site runoff to the She Shan Tsuen Stream. Under no circumstances shall be water treatment works drainage or runoff be allowed to discharge into the She Shan Tsuen stream.

Waste disposal

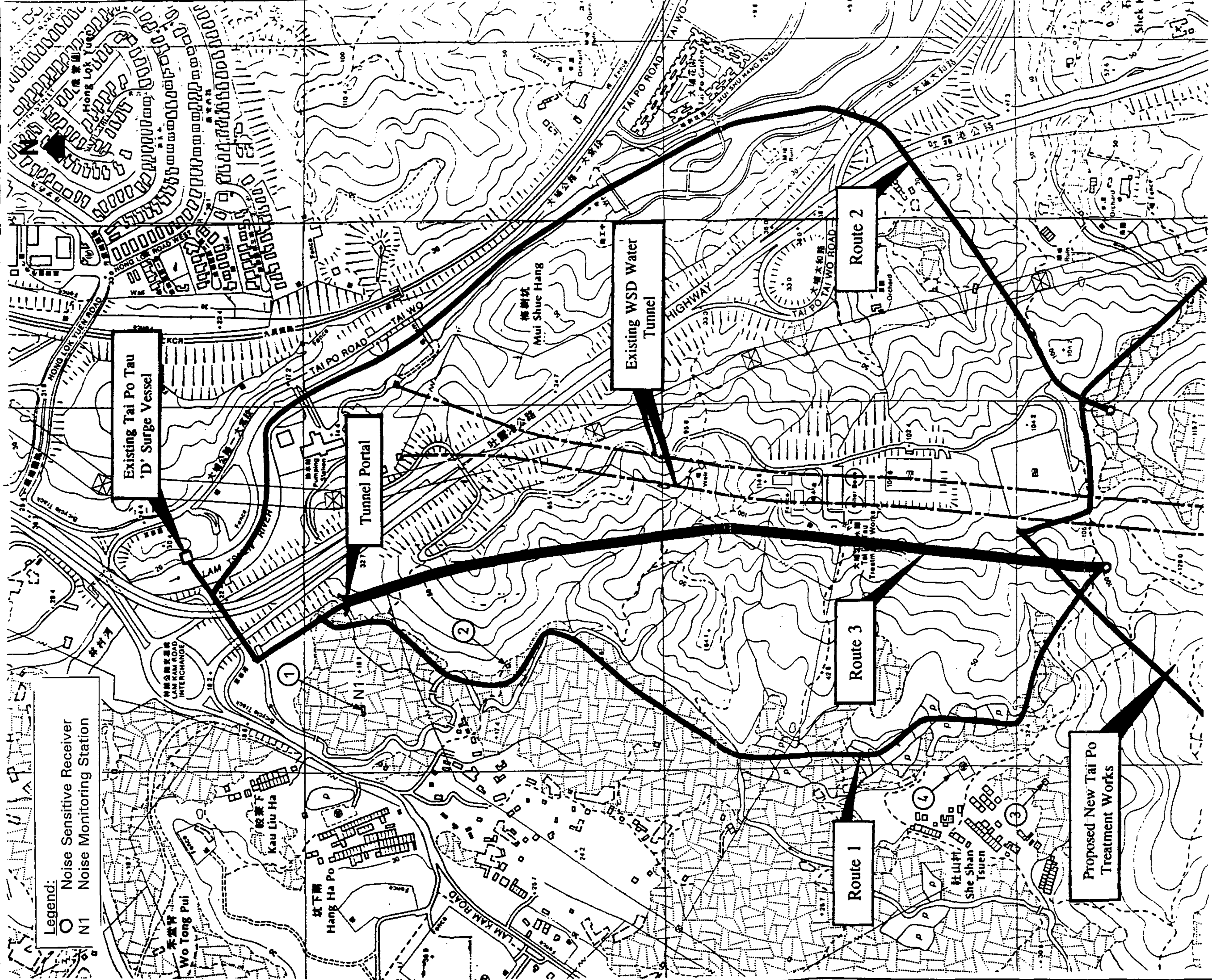
197.4 Waste oil and other chemicals will be required to be disposed of at the Government Chemical Waste Treatment Centre at Tsing Yi. Sludge from the clarifiers and from the clearance of the service reservoir, shall be dewatered and disposed of to landfill in accordance with the Government's Waste Management Strategy.

197.5 Wastes and other materials shall not be burned on the site.

Visual impacts

198. All artificial slopes shall be graduated and excavated so as to blend in as best as possible with the adjacent landscape; no artificial slopes shall appear angular.

199. The external colours and textures of all visible buildings shall be designed to blend into the surrounding landscape. The specification for landscaping will be devised by a qualified landscape architect.



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no.	date	description	initial

REVISION

	name	date
Designed	RVC	5/95
Traced		
Checked	AL	5/95
Approved		

Agreement no. CE 41/94

Contract no

Project title

Additional Treatment And Transfer Facilites For The Metropolitan Area And North-Eastern New Territories

Raw Water Aqueduct: Noise Sensitive Receivers & Monitoring Sites

Plan register No.

Figure No. 1

Scale 1 : 5000

Water Supplies Department

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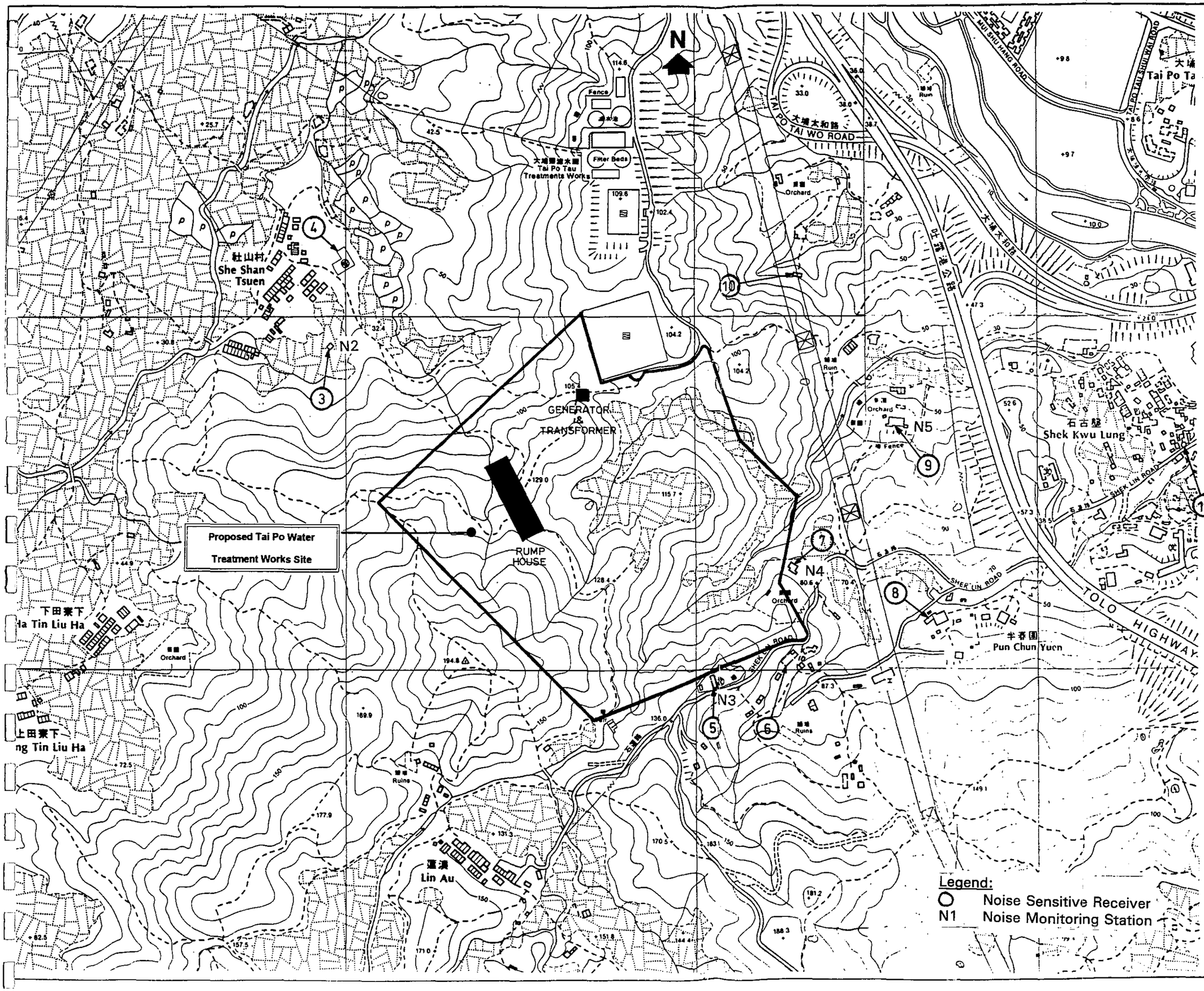

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Contract no.

Project title

Additional Treatment And Transfer Facilites For The Metropolitan Area And North-Eastern New Territories

TP WTW: Noise Sensitive Receivers & Monitoring Sites

Plan register No.

Figure No. 2

Scale 1 : 5000

Water Supplies Department

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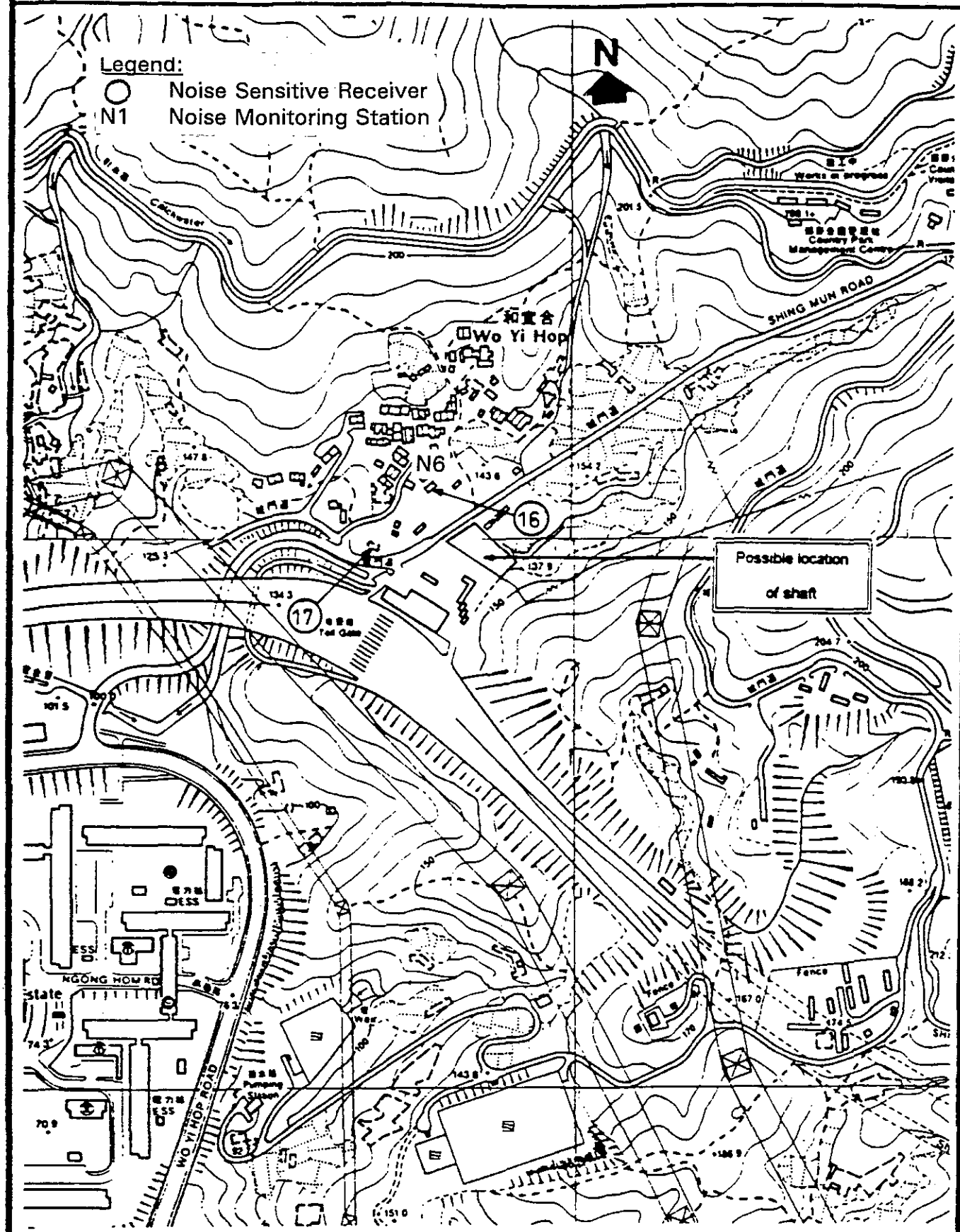
CONSULTING ENGINEERS

Additional Treatment And Water Transfer Facilities For
The Metropolitan Area And North-Eastern New Territories
Agreement No. CE 41/94

Water Supplies Department



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Shing Mun: Noise Sensitive Receivers & Monitoring Sites

Figure No.	Scale		Name	Date
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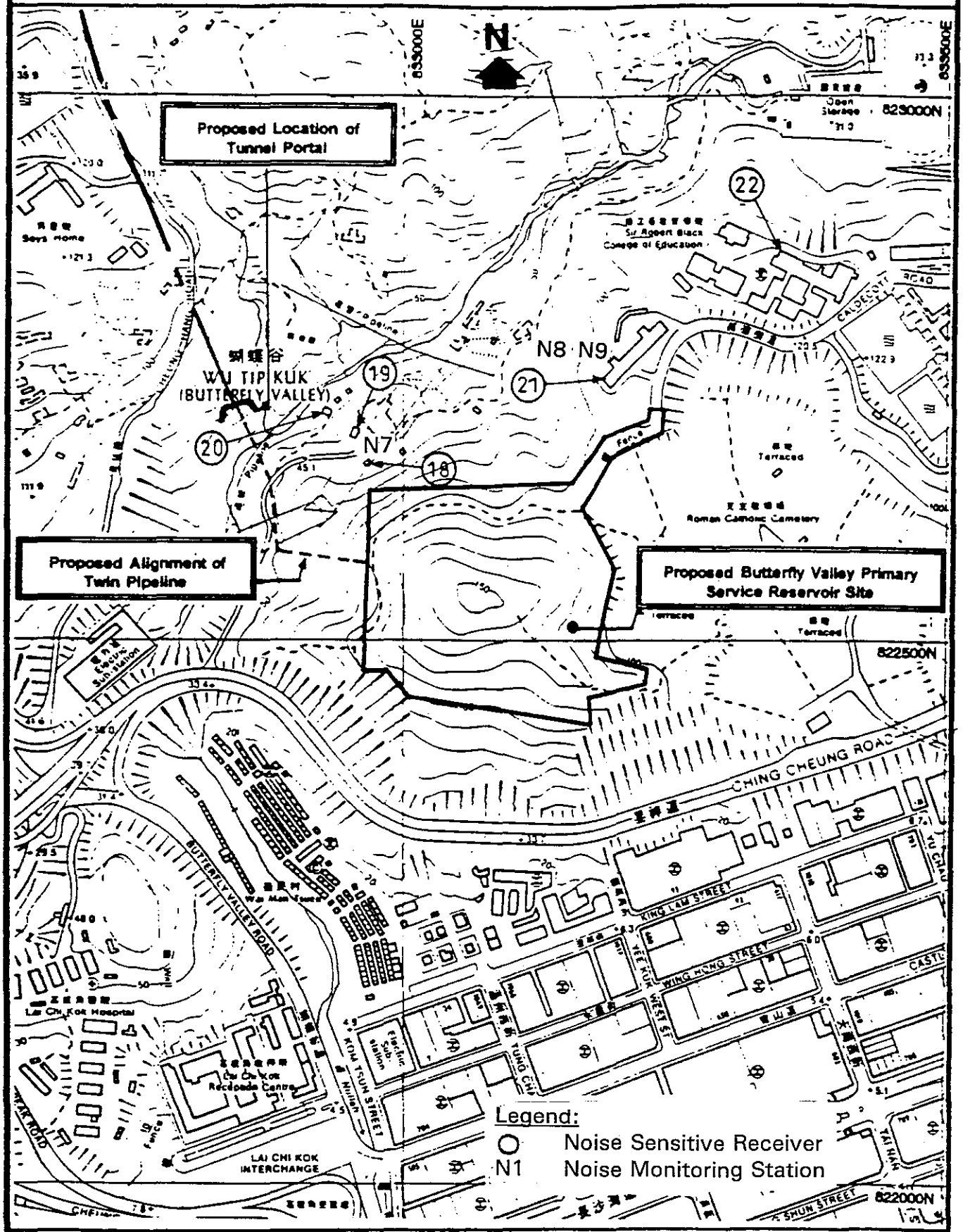
Additional Treatment And Water Transfer Facilities For
The Metropolitan Area And North-Eastern New Territories
Agreement No. CE 41/94

Water Supplies Department



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BVPSR: Noise Sensitive Receivers & Monitoring Sites

Figure No.	Scale		Name	Date
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no.	Date	description	initial
REVISION			

	name	date
Designed	RVC	5/95
Traced		
Checked	AL	5/95
Approved		

Agreement no. CE 41/94

Contract no

Project title

Additional Treatment And Transfer Facilites For The Metropolitan Area And North-Eastern New Territories

Raw Water Aqueduct : Air Sensitive Receivers

Plan register No.

Figure no. 5

Scale 1 : 5000

Water Supplies Department

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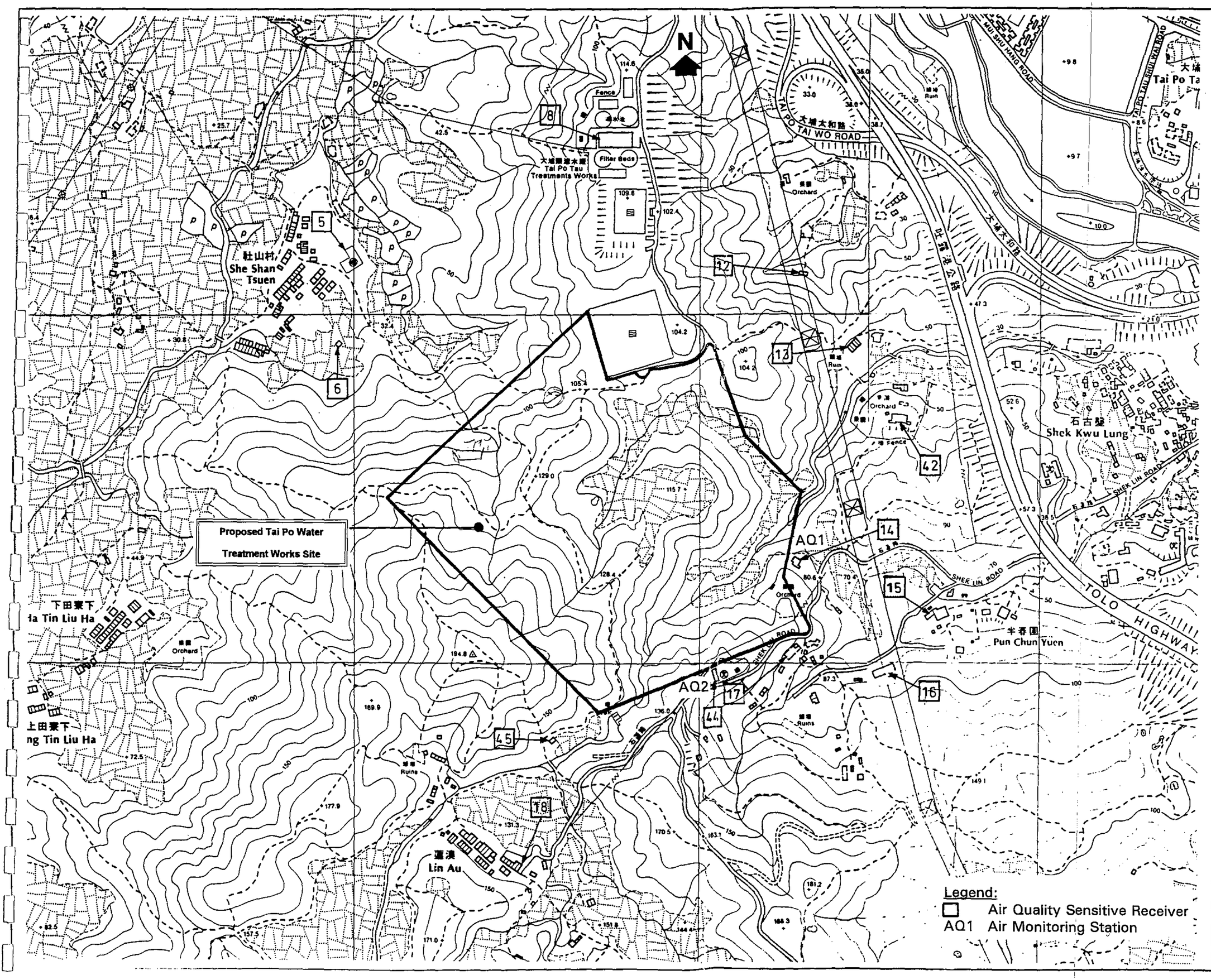
Legend:
- Air Quality Sensitive Receiver
- AQ1 Air Monitoring Station



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Agreement no CE 41/94

Contract no.

Project title

Additional Treatment And Transfer Facilites For The Metropolitan Area And North-Eastern New Territories

TP WTW: Air Sensitive Receivers & Monitoring Sites

Plan register No.

Figure no. 6

Scale 1 : 5000

Water Supplies Department

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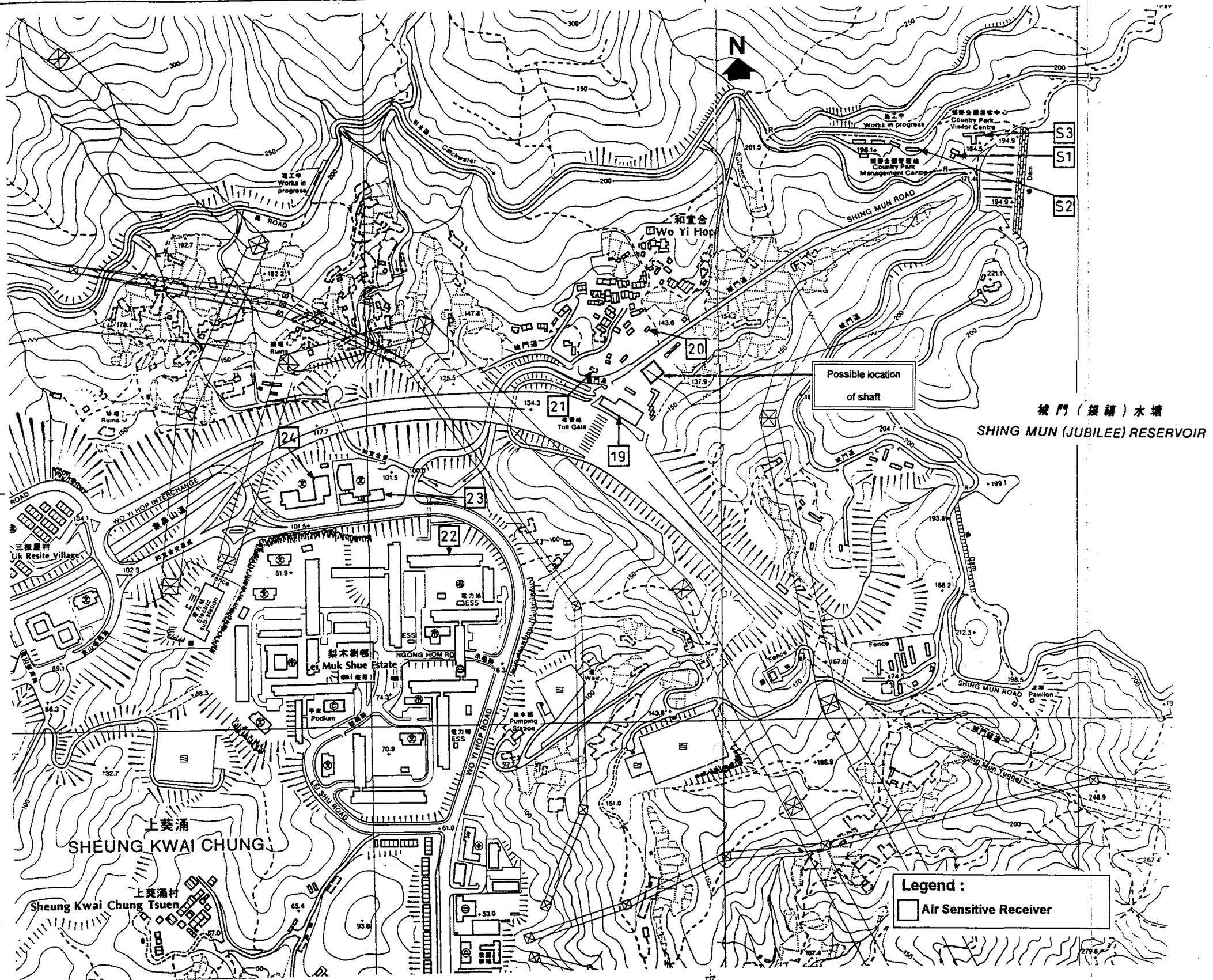

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REVISION			

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Traced		
Checked	AL	5/95
Approved		

Agreement no. CE 41/94

Contract no.

Project title

Additional Treatment And Transfer Facilites For The Metropolitan Area And North-Eastern New Territories

Shing Mun Access Shaft : Air Sensitive Receivers

Plan register No.

Figure no. 7

Scale 1 : 5000

Water Supplies Department

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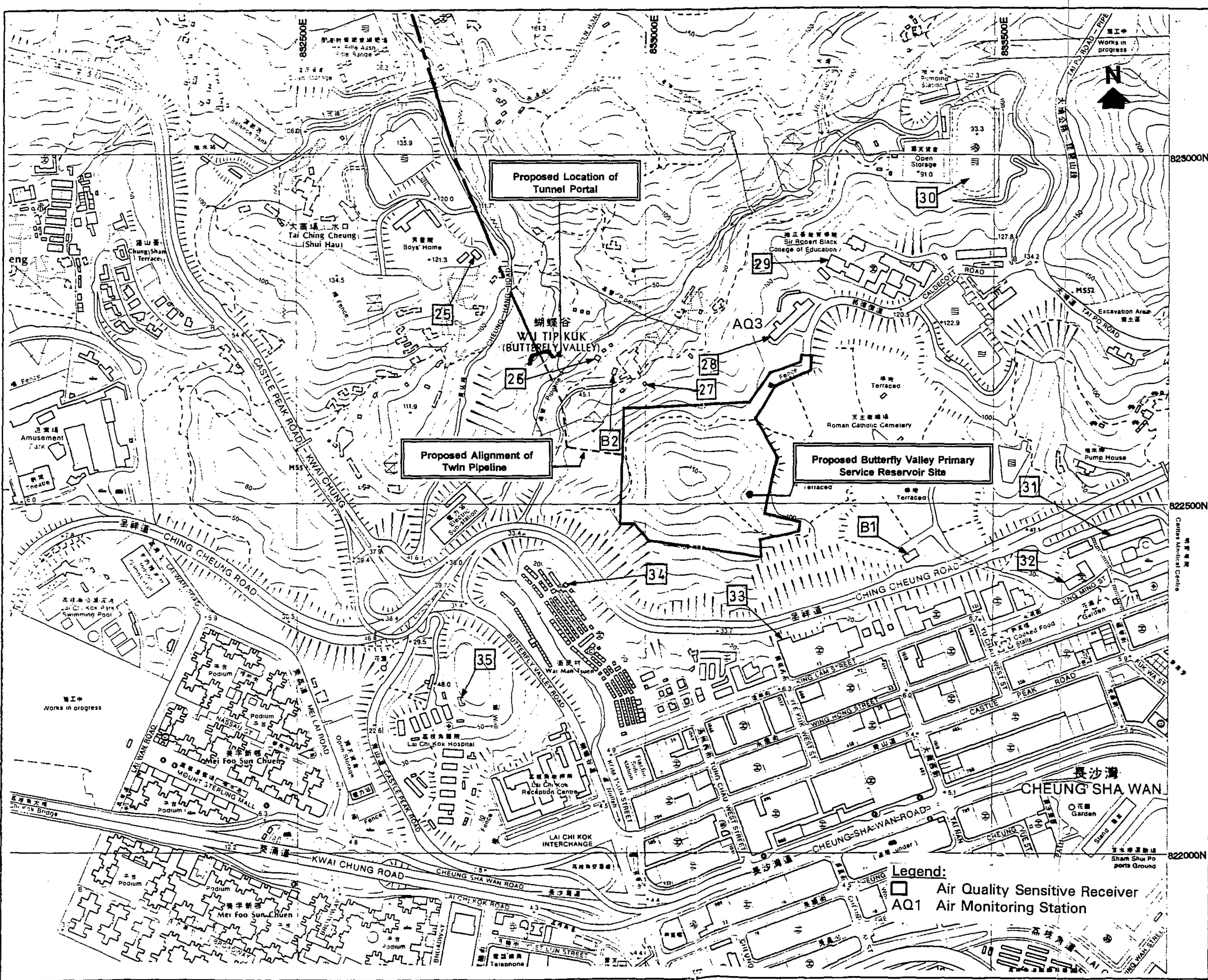
5



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Checked	AL	5/95
Approved		

Agreement no CE 41/94

Contract no

Project title

Additional Treatment And Transfer Facilites For The Metropolitan Area And North-Eastern New Territories

BVPSR: Air Sensitive Receivers & Monitoring Sites

Plan register No.

Figure no. 8

Scale 1 : 5000

Water Supplies Department

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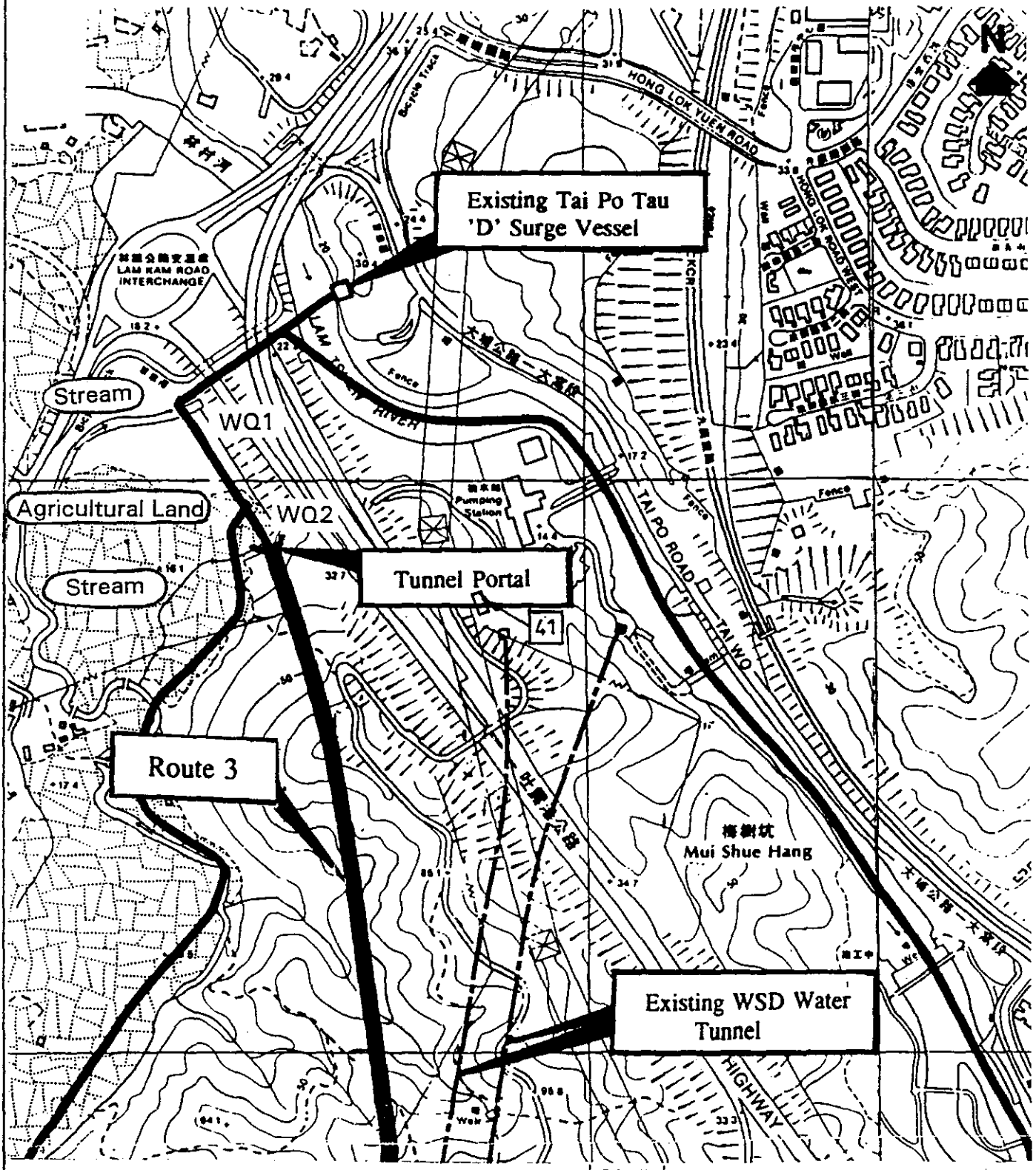
CONSULTING ENGINEERS

5

Additional Treatment And Water Transfer Facilities For
The Metropolitan Area And North-Eastern New Territories

Agreement No CE 41/94

Water Supplies Department



Legend:

Water Quality Sensitive Receiver

WQ1 Water Monitoring Station

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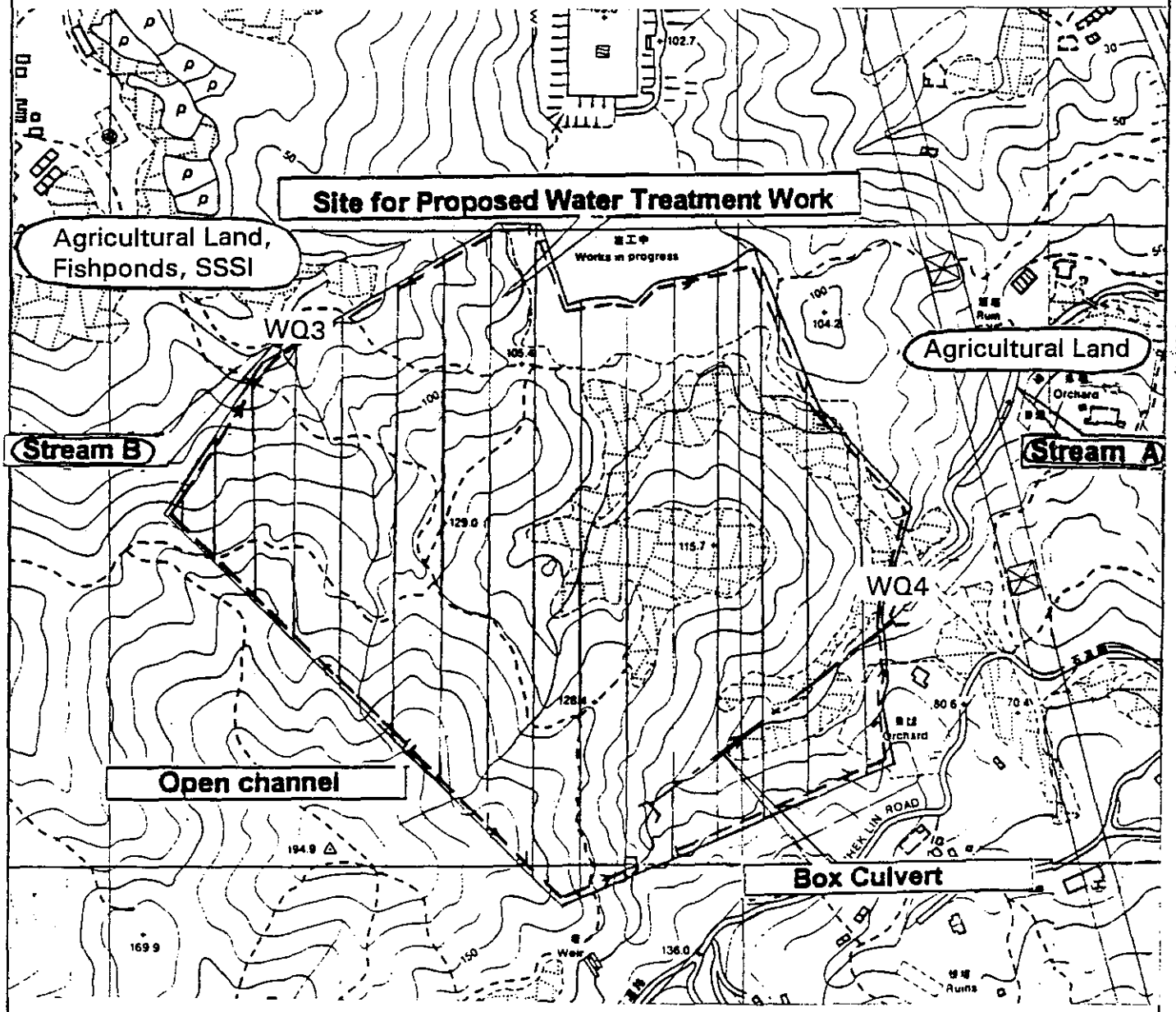
Raw Water Aqueduct: Water Quality Sensitive Receivers & Monitoring Sites

Figure No.	Scale		Name	Date
9	1:5 000	Designed	RVC	Mar 95

Additional Treatment And Water Transfer Facilities For
The Metropolitan Area And North-Eastern New Territories

Agreement No CE 41/94

Water Supplies Department



Legend:

Water Quality Sensitive Receiver

WQ1 Water Monitoring Station

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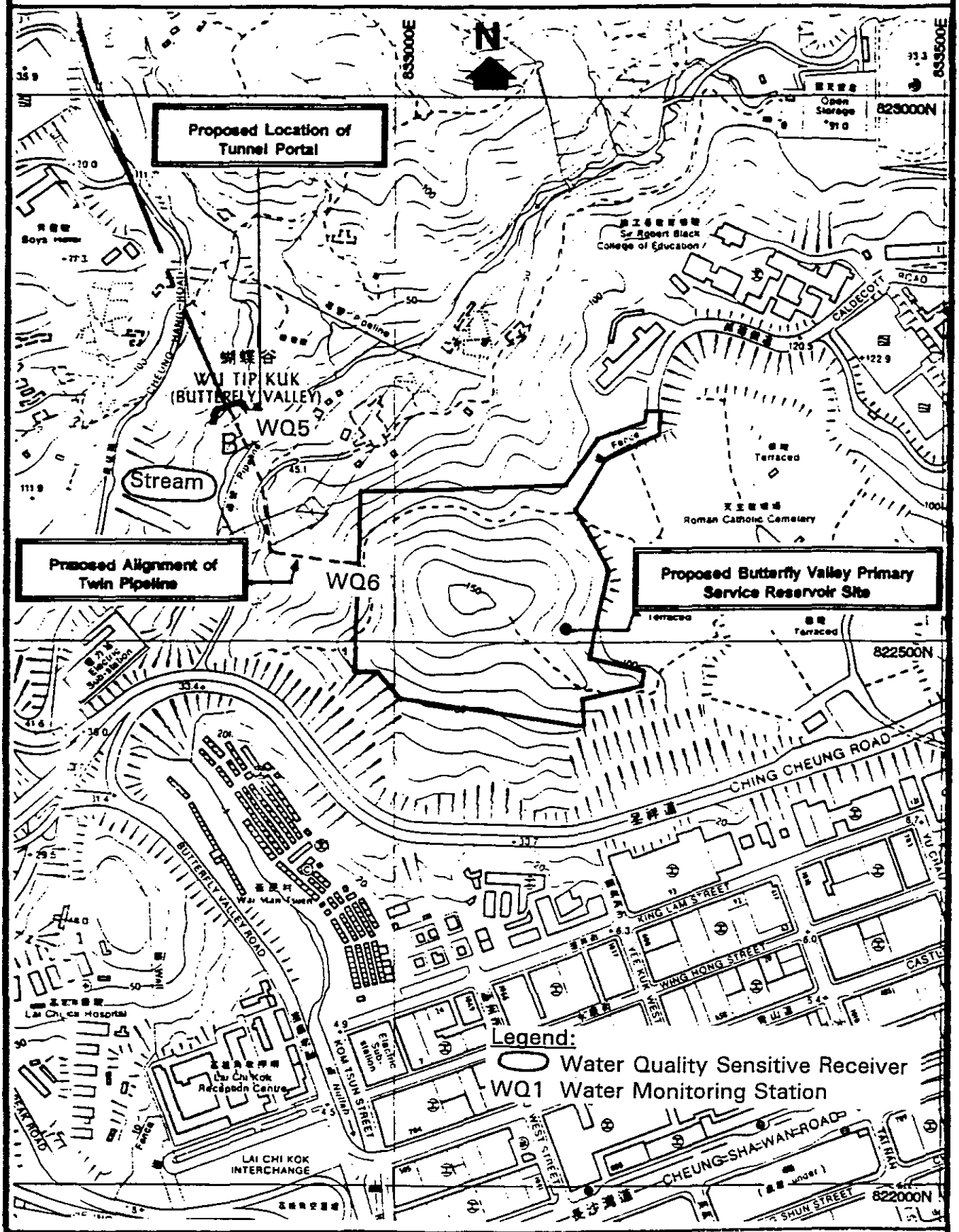
CONSULTING ENGINEERS 賓尼

TP WTW: Conceptual Drainage Layout, Water Quality Sensitive Receivers & Monitoring Sites

Figure No.	Scale		Name	Date
10	NTS	Designed	RVC	Mar 95

Additional Treatment And Water Transfer Facilities For
The Metropolitan Area And North-Eastern New Territories
Agreement No. CE 41/94

Water Supplies Department



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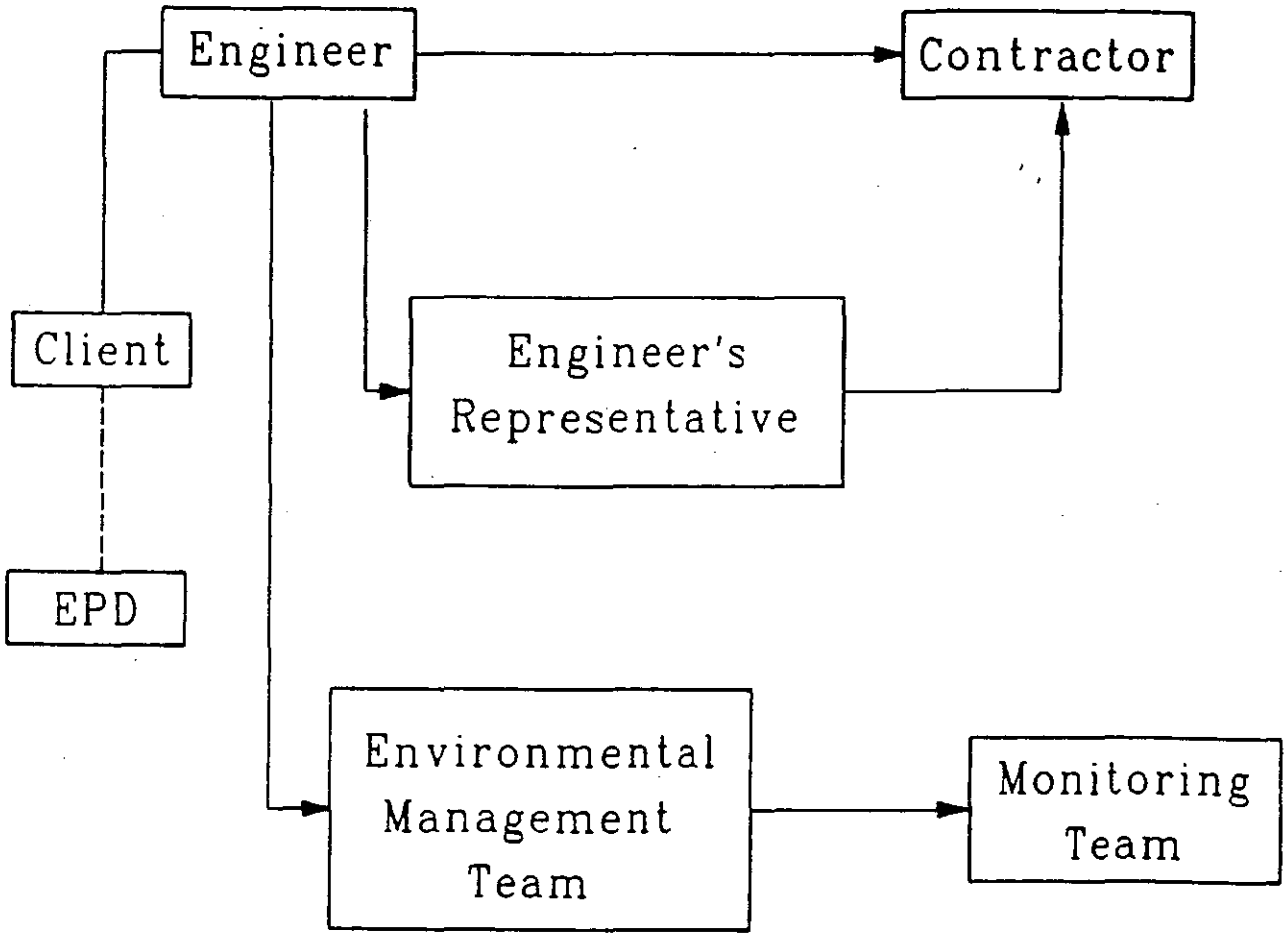
BVPSR: Water Quality Sensitive Receivers & Monitoring Sites

Figure No.	Scale		Name	Date
11	1:5 000	Designed	RVC	APR.95



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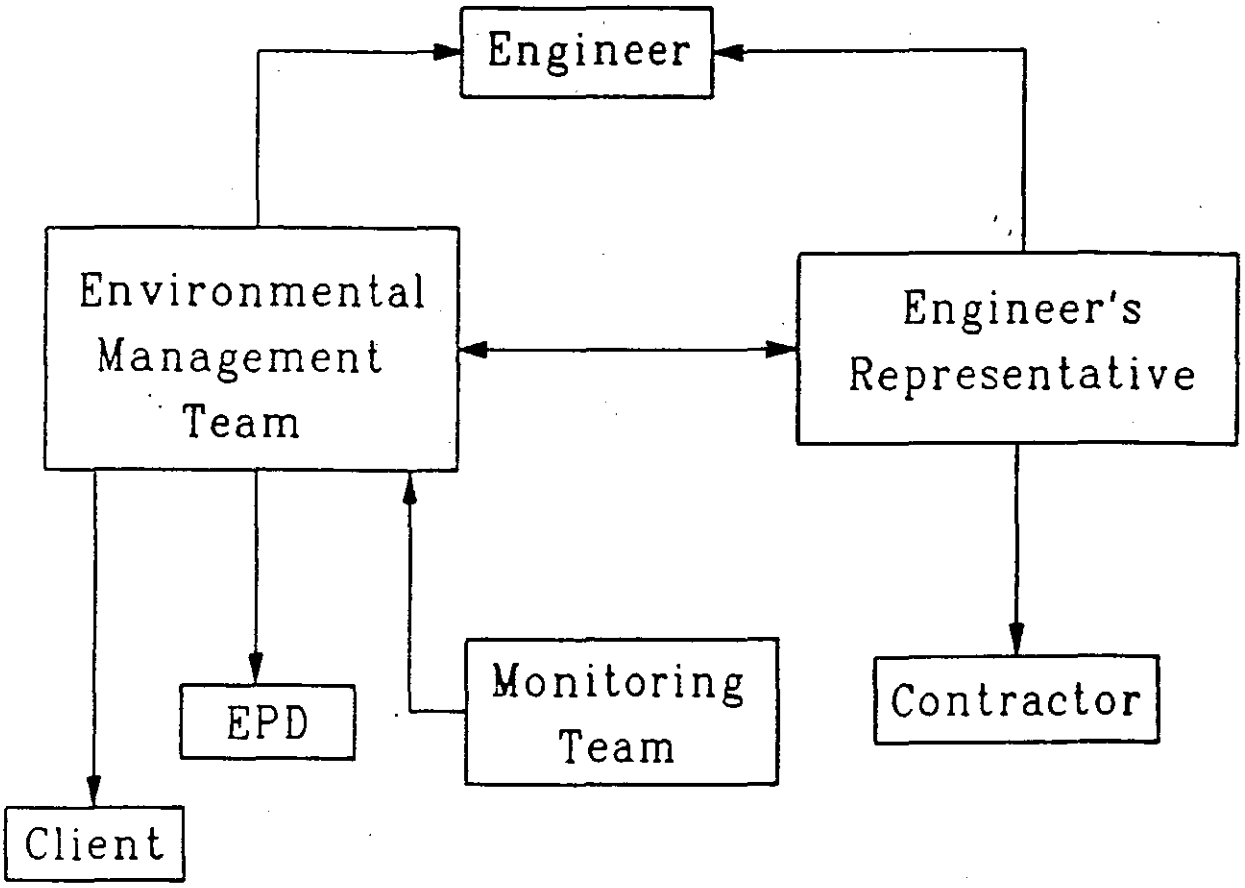
EM&A: Lines of Authority

Figure No.	Scale		Name	Date
12		Designed	RVC	May 1995



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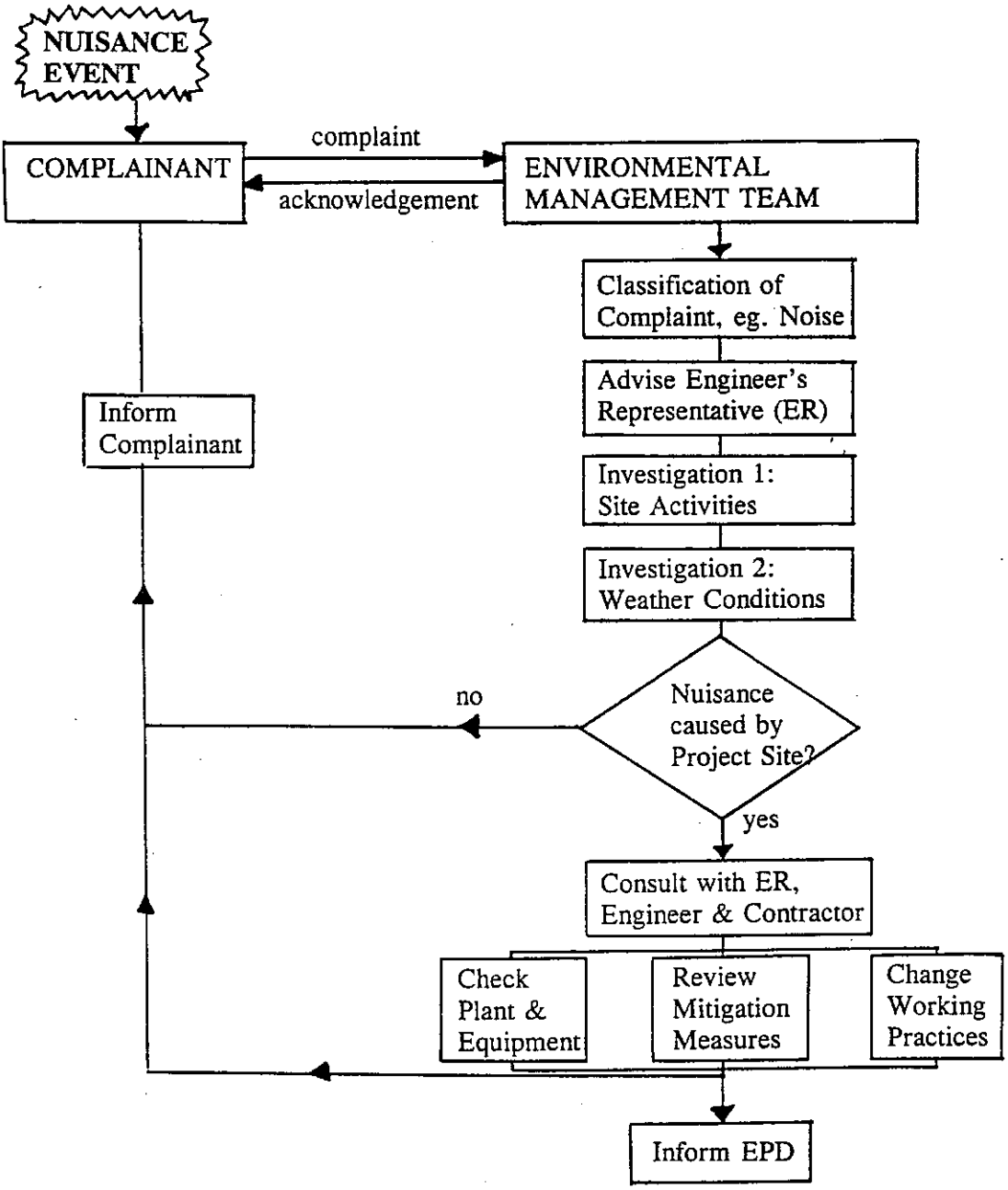
EM&A: Reporting

Figure No.	Scale		Name	Date
13		Designed	RVC	May 1995



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EM&A: Complaints Procedure

Figure No.	Scale		Name	Date
14		Designed	RVC	July 1995

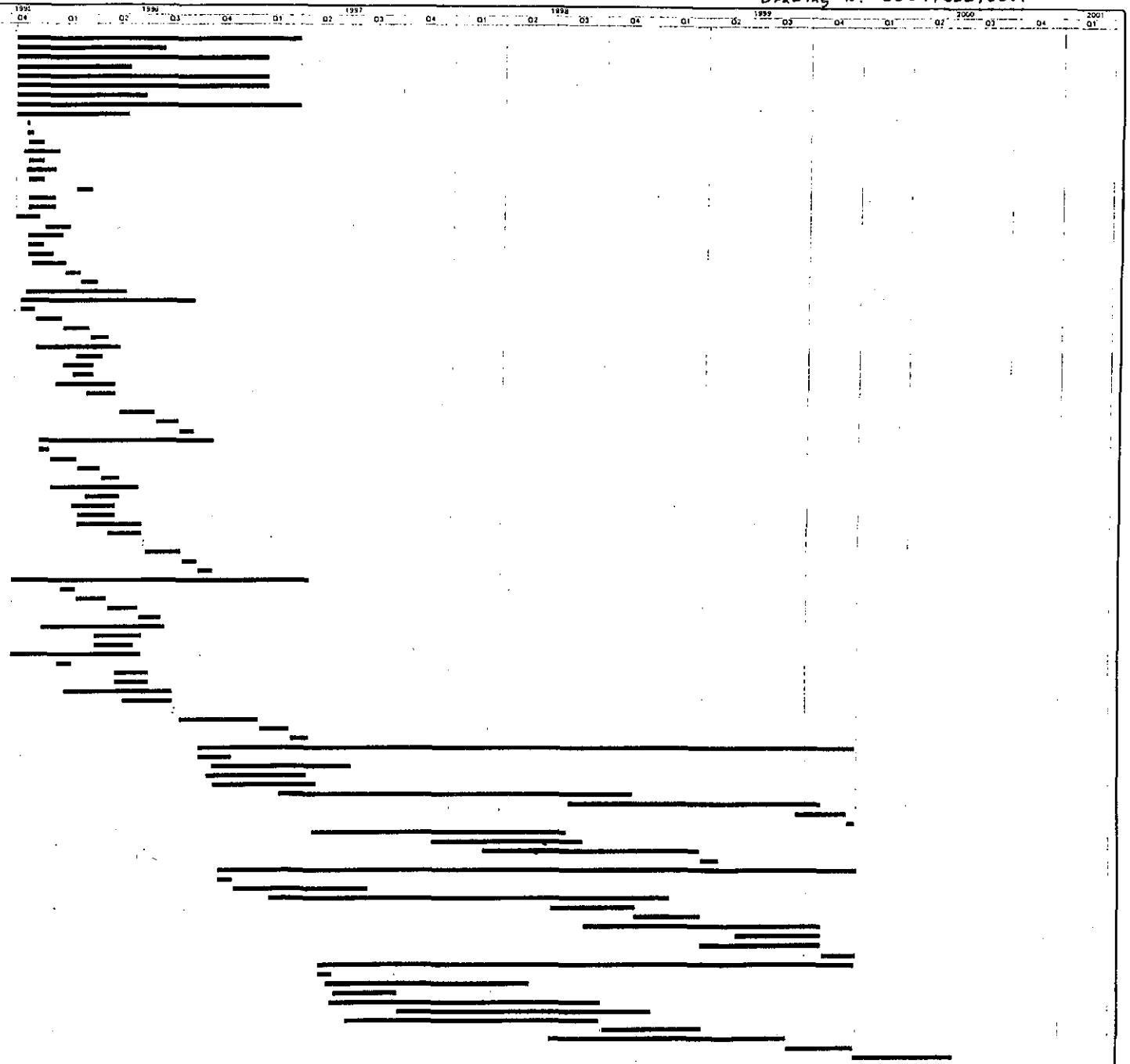
APPENDIX A

CONSTRUCTION PROGRAMME

CE 59/95 Additional Treatment and Water Transfer Facilities for the Metropolitan Area and NENT Project Programme - Issue 1 (22nd November 1995)

- Drawing No. 0001/BCL/0001

Task #	Task Name	Duration	Start	End
1	Appoint Consultant	0.00 d	08/Nov/1995	08/Nov/1995
2	LAND RESUMPTION	364.00 d	08/Nov/1995	31/Mar/1997
3	TWorks Site (part Portion) & Treated Water Tunnel Portal	151.00 d	08/Nov/1995	31/Jul/1996
4	TWorks Site (Remaining)	323.00 d	08/Nov/1995	31/Jan/1997
5	Treated Water Tunnel (BV) Portal	148.00 d	08/Nov/1995	31/May/1996
6	Treated Water Tunnel	323.00 d	08/Nov/1995	31/Jan/1997
7	Raw Water Tunnel	322.00 d	08/Nov/1995	31/Jan/1997
8	Primary Service Reservoir & Inlet Tunnel	168.00 d	08/Nov/1995	28/Jun/1996
9	Primary Service Reservoir Outlet Tunnel	364.00 d	08/Nov/1995	31/Mar/1997
10	DESIGN REVIEW PHASE	145.00 d	08/Nov/1995	28/May/1996
11	Identify Key Issues Independent Review	5.00 d	27/Nov/1995	01/Dec/1995
12	Agreement on Key Issues with WSD	10.00 d	27/Nov/1995	08/Dec/1995
13	Preparation and Approval of Design Memoranda	31.00 d	01/Dec/1995	29/Dec/1995
14	Discuss and Agree with CLP & WSD on power supply arrangement	46.00 d	22/Nov/1995	26/Jan/1996
15	Land Survey	31.00 d	01/Dec/1995	29/Dec/1995
16	Planning Permission from Town Planning Board	40.00 d	27/Nov/1995	19/Jan/1996
17	Tree Survey	21.00 d	01/Dec/1995	29/Dec/1995
18	Reptile Survey	21.00 d	26/Feb/1996	25/Mar/1996
19	Drainage Review	36.00 d	01/Dec/1995	19/Jan/1996
20	Environmental Review	36.00 d	01/Dec/1995	19/Jan/1996
21	Review Access to Sites	32.00 d	06/Nov/1995	21/Dec/1995
22	Traffic Impact Study	33.00 d	02/Jan/1996	15/Feb/1996
23	Hazard Assessment and submission to CCPH	45.00 d	01/Dec/1995	01/Feb/1996
24	Connection to Fun Chun Yuen SR	21.00 d	01/Dec/1995	29/Dec/1995
25	Connection to Tan Kwai Tsuen in Yuen Long	33.00 d	01/Dec/1995	15/Jan/1996
26	Draft Review Report	44.00 d	08/Dec/1995	07/Feb/1996
27	Comment by WSD	20.00 d	08/Feb/1996	06/Mar/1996
28	Final Review Report	22.00 d	07/Mar/1996	05/Apr/1996
29	Site Investigation by GEO Term Contractor	130.00 d	28/Nov/1995	28/May/1996
30	DETAILED DESIGN & TENDER PHASE - TREATED/RAW WATER TUNNELS	225.00 d	20/Nov/1995	27/Sep/1996
31	Prepare Prequalification Document	20.00 d	20/Nov/1995	15/Dec/1995
32	WSD Comment & Approval	35.00 d	18/Dec/1995	02/Feb/1996
33	Prequalification submission by Contractors	35.00 d	05/Feb/1996	22/Mar/1996
34	Assessment & Recommendation to WSD	25.00 d	25/Mar/1996	26/Apr/1996
35	Design General	110.00 d	18/Dec/1995	17/May/1996
36	Public Consultation	34.00 d	26/Feb/1996	15/Apr/1996
37	Submission to GEO	40.00 d	05/Feb/1996	28/Mar/1996
38	Discussion/Liaison with Mines Department	27.00 d	22/Feb/1996	28/Mar/1996
39	Tender Document	78.00 d	22/Jan/1996	08/May/1996
40	WSD's comments and response	38.00 d	18/Mar/1996	08/May/1996
41	Approval to call tender	0.00 d	13/May/1996	13/May/1996
42	Tender	46.00 d	17/May/1996	19/Jul/1996
43	Tender Assessment and recommendation	30.00 d	22/Jul/1996	30/Aug/1996
44	WSD & Tender Board Approval	20.00 d	02/Sep/1996	27/Sep/1996
45	DETAILED DESIGN & TENDER PHASE - PRIMARY SERVICE RESERVOIR & INLET/OUTLET TUNNELS	226.00 d	28/Dec/1995	01/Nov/1996
46	Prepare Prequalification Document	15.00 d	28/Dec/1995	12/Jan/1996
47	WSD Comment and Approval	35.00 d	15/Jan/1996	01/Mar/1996
48	Prequalification Submission By Contractors	30.00 d	04/Mar/1996	12/Apr/1996
49	Assessment & Recommendation to WSD	25.00 d	15/Apr/1996	17/May/1996
50	Detailed Design	119.00 d	18/Jan/1996	21/Jun/1996
51	Public Consultation	45.00 d	16/Apr/1996	17/May/1996
52	Submission to GEO	57.00 d	22/Feb/1996	10/May/1996
53	Discussion/Liaison with Mines Department	50.00 d	04/Mar/1996	10/May/1996
54	Tender Document	88.00 d	04/Mar/1996	28/Jun/1996
55	WSD's comments and responses	45.00 d	29/Apr/1996	28/Jun/1996
56	Approval to call tender	0.00 d	02/Jul/1996	02/Jul/1996
57	Tender	46.00 d	05/Jul/1996	06/Sep/1996
58	Tender Assessment and recommendation	20.00 d	09/Sep/1996	04/Oct/1996
59	WSD & Tender Board Approval	20.00 d	07/Oct/1996	01/Nov/1996
60	DETAILED DESIGN & TENDER PHASE - WATER TREATMENT WORKS AND PUMPS	383.00 d	08/Nov/1995	25/Apr/1997
61	Prepare Prequalification Document	20.00 d	05/Feb/1996	01/Mar/1996
62	WSD Comment and Approval	40.00 d	04/Mar/1996	26/Apr/1996
63	Prequalification Submission by Contractors	40.00 d	29/Apr/1996	21/Jun/1996
64	Assessment & Recommendation to WSD	30.00 d	24/Jun/1996	02/Aug/1996
65	Detailed Design	159.00 d	02/Jan/1996	08/Aug/1996
66	Public Consultation	61.00 d	06/Apr/1996	28/Jun/1996
67	Submission to GEO	61.00 d	05/Apr/1996	14/Jun/1996
68	Pilot Plant Study	168.00 d	08/Nov/1995	28/Jun/1996
69	Agree Layout with WSD	20.00 d	30/Jun/1996	26/Feb/1996
70	Agree pump characteristics with WSD	45.00 d	13/May/1996	12/Jul/1996
71	Agree control and automation with WSD	45.00 d	13/May/1996	12/Jul/1996
72	Tender Document	140.00 d	12/Feb/1996	23/Aug/1996
73	WSD's comments and responses	65.00 d	27/May/1996	23/Aug/1996
74	Approval to call Tender	0.00 d	27/Aug/1996	27/Aug/1996
75	Tender	101.00 d	06/Sep/1996	24/Jan/1997
76	Tender Assessment and recommendation	40.00 d	27/Jan/1997	21/Mar/1997
77	WSD and Tender Board Approval	25.00 d	24/Mar/1997	25/Apr/1997
78	CONSTRUCTION AND COMMISSIONING - TUNNEL CONTRACT	841.00 d	08/Oct/1996	28/Dec/1999
79	Mobilization	44.00 d	08/Oct/1996	06/Dec/1996
80	Portals & Shafts	180.00 d	01/Nov/1996	10/Jul/1997
81	Embankment across stream at Butterfly Valley	130.00 d	22/Oct/1996	21/Apr/1997
82	Inmal Site Formation at Tai Po	135.00 d	04/Nov/1996	09/May/1997
83	Driving of Treated Water Tunnel	455.00 d	03/Mar/1997	27/Nov/1998
84	Lining of Treated Water Tunnel	325.00 d	03/Aug/1998	28/Oct/1999
85	Pipeline	63.00 d	15/Sep/1999	14/Dec/1999
86	Testing of pipeline	10.00 d	15/Dec/1999	28/Dec/1999
87	Driving of Raw Water Tunnel	325.00 d	01/May/1997	29/Jul/1998
88	Lining of Raw Water Tunnel	195.00 d	01/Dec/1997	28/Aug/1998
89	Pipeline from "D" Station to Portal	280.00 d	02/Mar/1998	28/Mar/1999
90	Testing of pipeline	21.00 d	29/Mar/1999	30/Apr/1999
91	CONSTRUCTION AND COMMISSIONING - PRIMARY SERVICE RESERVOIR	820.00 d	11/Nov/1996	31/Dec/1999
92	Mobilization	20.00 d	11/Nov/1996	06/Dec/1996
93	Inlet Tunnel & Shaft	176.00 d	09/Dec/1996	08/Aug/1997
94	Site Formation	515.00 d	11/Feb/1997	01/Feb/1999
95	Enlarge and line Shaft	110.00 d	01/Jul/1998	01/Dec/1998
96	Outlet Tunnel	65.00 d	01/Dec/1998	29/Mar/1999
97	Stage 1 Reservoir	305.00 d	31/Aug/1998	29/Oct/1999
98	Landscaping	109.00 d	01/Jul/1999	29/Oct/1999
99	Pipework	155.00 d	29/Mar/1999	29/Oct/1999
100	Testing of Reservoir and Pipework	46.00 d	01/Nov/1999	31/Dec/1999
101	CONSTRUCTION AND COMMISSIONING - WATER TREATMENT WORKS	687.00 d	12/May/1997	28/Dec/1999
102	Mobilization	20.00 d	12/May/1997	06/Jun/1997
103	Plant Design & Approval	261.00 d	26/May/1997	25/May/1998
104	Review and revise structure design by the Contractor	82.00 d	09/Jun/1997	30/Sep/1997
105	Site Formation for Ultimate Development	348.00 d	02/Jun/1997	30/Sep/1998
106	Plant manufacture and delivery	327.00 d	01/Oct/1997	31/Oct/1998
107	Construction of Structure	325.00 d	01/Jul/1997	28/Sep/1998
108	Landscaping	126.00 d	05/Oct/1998	31/Mar/1999
109	Installation and Preliminary Testing of Plant	305.00 d	01/Jul/1998	31/Aug/1999
110	Commissioning Tests	85.00 d	01/Sep/1999	28/Dec/1999
111	PROJECT CONTINGENCY	130.00 d	29/Dec/1999	27/Jun/2000



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Page 1

Milestone
Summary
Fixed Delay

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