

3. NOISE

3.1 Construction Noise

3.1.1 As the noise sensitive receivers (NSRs) near the Route 16 works area will be subjected to daytime, and possibly restricted-hour construction noise, a noise monitoring programme shall be developed by the ER to include daytime and restricted-hour (if necessary) noise measurement at the sensitive receivers. The programme shall be carried out by the ET to ensure that the noise level of construction works complies with the criteria of the Noise Control Ordinance (NCO) and other adopted noise criteria.

3.2 Noise Parameters

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

3.2.2 As supplementary information for data auditing, statistical results such as L_{10} and L_{90} shall also be obtained for reference. A sample data record sheet is shown in Annex A4 for reference.

3.3 Monitoring Equipment

3.3.1 As referred to in the Technical Memorandum (TM) issued under the Noise Control Ordinance (NCO), sound level meters in compliance with the International Electrotechnical Commission Publications 651: 1979 (Type 1) and 804: 1985 (Type 1) specifications shall be used for carrying out the noise monitoring. Immediately prior to and following each noise measurement the accuracy of the sound level meter shall be checked using an acoustic calibrator generating a known sound pressure level at a known frequency. Measurements may be accepted as valid only if the calibration level from before and after the noise measurement agree to within 1.0dB.

3.3.2 Noise measurements should not be made in the presence of fog, rain, wind with a steady speed exceeding 5ms^{-1} or wind with gusts exceeding 10ms^{-1} . The wind speed shall be checked with a portable wind speed meter capable of measuring the wind speed in m/s.

3.3.3 The ET Leader is responsible for the provision of the monitoring equipment. He shall ensure that sufficient noise measuring equipment and associated instrumentation are available for carrying out the baseline monitoring, regular impact monitoring and ad hoc monitoring. All the equipment and associated instrumentation shall be clearly labelled.

3.4 Monitoring Locations

3.4.1 The noise monitoring locations are shown in Figures 3.4a to d and Table 3.4a. The status and locations of noise sensitive receivers may change after issuing this manual. If such cases exist, the ET Leader shall propose updated monitoring locations and seek approval from ER and agreement from EPD of the proposal.

3.4.2 When alternative monitoring locations are proposed, the monitoring locations should be chosen based on the following criteria:

- a) at locations close to the major site activities which are likely to have noise impacts;
- b) close to the noise sensitive receivers (N.B. For the purposes of this section, any domestic premises, hotel, hostel, temporary housing accommodation, hospital, medical clinic,

educational institution, place of public worship, library, court of law, performing art centre should be considered as noise sensitive receiver); and

- c) for monitoring locations located in the vicinity of the sensitive receivers, care should be taken to cause minimal disturbance to the occupants during monitoring.

Table 3.4a Construction Noise Monitoring Locations

Monitoring Station	Location	Noise Criteria / dB(A)
NMC1	N1 - Miu Kong Village	75
NMC2	N6 - LCK Reception Centre Staff Quarters	75
NMC3	N7 - Lai Chi Kok Hospital	65
NMC4	N11- Mei Foo Sun Chuen, Phase 5, Blk 9	75
NMC5	N16 - Pinehill	75

- 3.4.3 The monitoring station shall normally be at a point 1m from the exterior of the sensitive receivers building facade and be at a position 1.2m above the ground. If there is problem with access to the normal monitoring position, an alternative position may be chosen, and a correction to the measurements shall be made. For reference, a correction of +3dB(A) shall be made to the free field measurements. The ET Leader shall agree with the ER on the monitoring position and the corrections adopted. Once the positions for the monitoring stations are chosen, the baseline monitoring and the impact monitoring shall be carried out at the same positions.

3.5 Baseline Monitoring

- 3.5.1 The ET Leader shall carry out baseline noise monitoring prior to the commencement of the construction works. The baseline monitoring shall be carried out daily for a period of at least two weeks. A schedule on the baseline monitoring shall be submitted to the ER for approval before the monitoring starts.
- 3.5.2 There shall not be any construction activities in the vicinity of the stations during the baseline monitoring.
- 3.5.3 In exceptional cases, when insufficient baseline monitoring data or questionable results are obtained, the ET Leader shall liaise with EPD to agree on an appropriate set of data to be used as a baseline reference and submit to the ER for approval.

3.6 Impact Monitoring

- 3.6.1 Noise monitoring shall be carried out at all the designated monitoring station. The monitoring frequency shall depend on the scale of the construction activities. The following is an initial guide on the regular monitoring frequency for each station on once per week basis when noise generating activities are underway:
 - (a) one set of measurements between 0700-1900 hours on normal weekdays;
 - (b) one set of measurements between 1900-2300 hours;
 - (c) one set of measurements between 2300-0700 hours of next day; and
 - (d) one set of measurements between 0700-1900 hours on holidays.

- 3.6.2 For the measurements (b), (c) and (d) above, one set of measurements shall at least include 3 consecutive Leq(5 min) results.
- 3.6.3 If a school exists near the construction activity, noise monitoring shall be carried out at the monitoring stations for the schools during the school examination periods. The ET Leader shall liaise with the school's personnel and the Examination Authority to ascertain the exact dates and times of all examination periods during the course of the contract.
- 3.6.4 In case of non-compliance with the construction noise criteria, more frequent monitoring as specified in the Action Plan in Section 3.7 shall be carried out. This additional monitoring shall be continued until the recorded noise levels are rectified or proved to be irrelevant to the construction activities.

3.7 Event and Action Plan for Noise

- 3.7.1 The Action and Limit levels for construction noise are defined in Table 3.7a Should non-compliance of the criteria occurs, action in accordance with the Action Plan in Table 3.7b shall be carried out.

Table 3.7a Action and Limit Levels for Construction Noise

Time Period	Action	Limit
0700-1900 hrs on normal weekdays	When one documented complaint is received	75* dB(A)
0700-2300 hrs on holidays; and 1900-2300 hrs on all other days	When one documented complaint is received	60/ 65/ 70** dB(A)
2300-0700 hrs of next day	When one documented complaint is received	45/ 50/ 55** dB(A)

(*) reduce to 70 dB(A) for schools and 65 dB(A) during school examination periods.

(**) To be selected based on Area Sensitivity Rating. If Specified Powered Mechanical Equipment (SPME) are employed, the noise limits should be 15 dB(A) less than that shown above for the restricted hours.

Table 3.7b Event/Action Plan for Construction Noise

EVENT	ACTION	
	ET Leader or ER	Contractor
Action Level	Notify Contractor	Submit noise mitigation proposals to Environmental Team Leader/Engineer's Representative
	Analyse investigation	
	Require Contractor to propose measures for the analysed noise problem	Implement noise mitigation proposals
	Increase monitoring frequency to check mitigation effectiveness	
Limit Level	Notify Contractor	Implement mitigation measures
	Notify EPD	Prove to Environmental Team Leader ER effectiveness of measures applied
	Require contractor to implement mitigation measures Increase monitoring frequency to check mitigation effectiveness	

3.8 Noise Mitigation Measures

3.8.1 The EIA report has recommended construction noise control and mitigation measures. The Contractor shall be responsible for the design and implementation of these measures. The mitigation strategy adopted are mainly good site practice, use of silenced equipment, reduction of PME used in the same notional source point and use of movable barriers as described below.

Good Site Practice

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

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

Selecting Quieter Plant and Working Methods

3.8.3 While it is not feasible to dictate the Powered Mechanical equipment employed by the contractor, they are strongly encouraged to use the quiet equipment that is commercially available in Hong Kong. Quiet plant is defined as PME whose actual SWL is less than the value specified in GW-TM for the same piece of equipment. More examples of SWLs for specific silenced PME could be referred in *Noise Control on Construction and Open Sites, BS5228 : Part 1 : 1997*,

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

3.8.4 Reducing the number of plant is the further noise abatement step after use of quiet plant, if exceedances of the daytime construction noise criteria are still predicted. Contractor should consider to restrict the number of particularly noisy plant operating at the notional noise sources very close to the NSRs as far as possible.

Constructing Temporary and Movable Noise Barriers

3.8.5 Movable barriers could be very effective in providing noise screening from a particular plant. It is anticipated that a movable noise barrier with a skid footing and a cantilevered upper portion located close to the noise generating part of the PME such that the line of sight could be blocked by the barriers when viewed from NSRs, can produce at least 10 dB(A) screening for stationary plant and 5 dB(A) for mobile plant. The noise screening benefit for each plant considered in this assessment is listed as follows:

- stationary plant - assuming 10 dB(A) reduction: generator, air compressor, concrete pump, poker vibrator and ballast tamper
- mobile plant - assuming 5 dB(A) reduction: excavator, loader, excavator mounted breaker, mobile crane, compactor, and road roller

- large plant - assuming 5 dB(A) reduction when the noise generating part of the PME such as engine and exhaust are blocked by the barriers: rock drill and tower crane

3.8.6 Having assessed the effectiveness of the mitigation measures aforementioned, the following mitigation program have been established corresponding to the construction activities at different locations.

Table 3.8a Summary of Proposed Mitigation Measures (Construction Noise)

Task	Mitigation Measures
LCK viaduct - substructure	Use of quiet PME, reducing the number of each type of PME to one and movable noise barriers located close to concrete lorry mixer, concrete pump, generator, air compressor and poker vibrator
LCK viaduct - superstructure	Use of quiet PME and reducing the number of each type of PME to one
LCK viaduct - road pavement	Use of quiet PME and reducing the number of each type of PME to one
Ching Cheung Road slip - substructure	Use of quiet PME
Ching Cheung Road slip - superstructure	Use of quiet PME
Ching Cheung Road slip - road pavement	Use of quiet PME, reducing the number of each type of PME to one and movable noise barriers located close to concrete lorry mixer, concrete pump, generator, air compressor and poker vibrator
BV embankment - preparatory works	Use of quiet PME
BV embankment - earthworks excavation	Use of quiet PME, reducing the number of each type of PME to one and movable noise barriers located close to rock drill
BV embankment - road pavement	No mitigation measures required
BV viaduct - substructure	Use of quiet PME
BV viaduct - superstructure	Use of quiet PME
BV - road pavement	No mitigation measures required
Tunnel - preparatory works	No mitigation measures required
Tunnel - portal construction	No mitigation measures required
Tunnel - excavation	No mitigation measures required
South portal building	No mitigation measures required
Mid vent building - removal of spoil	Use of quiet PME and reducing the number of each type of PME to one
Vent building foundation	Use of quiet PME and reducing the number of each type of PME to one
Mid vent building - superstructure	Use of quiet PME

3.8.7 If the above measures are not sufficient to restore the construction noise quality to an acceptable levels upon the advice of ET Leader, the Contractor shall liaise with the ET Leader on some other mitigation measures, propose to ER for approval, and carry out the mitigation measures.

3.8.8 Moreover, ET leader should design the implementation status sheet to audit and regulate the contractor's performance so as to ensure the all recommended mitigation measures are duly implemented.

3.9 Operational Noise

3.9.1 As the noise sensitive receivers close to the Route 16 will be exposed to traffic noise during the operational phase, a noise monitoring programme shall be developed to include noise measurements at noise sensitive receivers during the peak traffic hour. The programme shall be carried out by the ET to ensure that the traffic noise levels are comparable to those predicted in the EIA under the full provision of the mitigation measures recommended.

3.10 Noise Parameters

3.10.1 The traffic noise level shall be measured twice within the first year of the road opening. Measurements shall be made in terms of the A-weighted L_{10} over 3 half hour periods during the peak traffic hour. A sample data record sheet is shown in *Annex A5* for reference. More details could be referred to section 3.11.

3.11 Monitoring Equipment

3.11.1 As referred to in the Technical Memorandum on Noise From Construction Work other than Percussive Piling (GW-TM) issued under the Noise Control Ordinance (NCO), sound level metres in compliance with the International Electrotechnical Commission Publications 651: 1979 (Type 1) and 804: 1985 (Type 1) specifications shall be used for carrying out the noise monitoring. Immediately prior to and following each noise measurement the accuracy of the sound level meter shall be checked using an acoustic calibrator generating a known sound pressure level at a known frequency. Measurements may be accepted as valid only if the calibration level from before and after the noise measurement agree to within 1.0 dB(A).

3.11.2 Noise measurements should be made in accordance with standard acoustical principles and practices in relation to weather conditions. In particular, noise measurements should not be made in the presence of fog, rain, wind with a steady speed exceeding 5 m/s or winds with gusts exceeding 10 m/s. The wind speed should be checked with a portable wind speed meter.

3.11.3 The ET Leader is responsible for the provision and maintenance of the monitoring equipment. He shall ensure that sufficient noise measuring equipment and associated instrumentation are available for carrying out the baseline monitoring, regular impact monitoring and ad hoc monitoring. All the equipment and associated instrumentation shall be clearly labelled.

3.12 Monitoring Locations

3.12.1 The operational noise monitoring locations are shown in Figures 3.12a to c and summarised in Table 3.12a. The status and locations of noise sensitive receivers may change after issuing this manual. In such cases, the ET Leader shall propose updated monitoring locations and seek approval from ER, and agreement from the IC(E) and EPD of the proposal.

3.12.2 The monitoring locations were selected according to the following criteria:

1. They should be at NSRs in the vicinity of recommended direct technical remedies; preferably, there should be one representative monitoring locations near each types of noise screening element (i.e. vertical barrier, cantilever barrier and enclosure)

2. One high floor and one medium floor monitoring points should be chosen at each location as far as possible;
3. Selected monitoring locations should enable monitoring to be done twice within one year after implementation of the mitigation measures during operation of Route 16.

Table 3.12a Operational Noise Monitoring Locations

Monitoring Station	Location	Floor
NMO1	V13 (Village house in Tai Ching Cheung Village)	G/F
NMO2	NSR 640 of Site 10	1/F and 20/F
NMO3	ST-N3 (Southern facade of Shatin Heights)	1/F and 8/F

3.12.3 When alternative monitoring locations are proposed, the monitoring locations shall be chosen based on the following criteria:

- (a) alternative location shall be similarly exposed to potential noise impacts;
- (b) it shall be close to the noise sensitive receivers ; and
- (c) shall be located so as to cause minimal disturbance to the occupants.

3.12.4 The operational noise monitoring shall be carried out at a distance of 1 m from the openable window and 1.2 m above the floor level of the noise sensitive receivers identified in *Table 3.12a*. The ET Leader shall agree with the IC(E) on any necessary corrections adopted.

3.13 Baseline Monitoring

3.13.1 No baseline operational noise monitoring is required.

3.14 Noise Monitoring

3.14.1 Noise monitoring shall be carried out at all the designated traffic noise monitoring stations. The following is an initial guide on the traffic noise monitoring requirements during the operational phase:

- a) one set of measurements at the morning traffic peak hour on normal weekdays;
- b) one set of measurements at the evening traffic peak hour on normal weekdays;
- c) a concurrent census of traffic flow and percentage heavy vehicle shall be obtained for far-side and near-side of the road and the existing road network in the vicinity of each measuring point;
- d) average vehicle speed estimated for far-side and near-side of the road and the existing road network in the vicinity of each measuring point; and
- e) the two sets of monitoring data should be obtained within the first year of operation.

3.14.2 Measured noise levels should be compared with predicted noise levels by applying appropriate conversion corrections to allow for the traffic conditions at the time of measurement. Annex A5 shows a sample data record sheet for operational noise monitoring.

3.15 Noise Mitigation Measures

- 3.15.1 In the EIA Report, a series of mitigation measures have been considered for Route 16 to reduce the noise impacts at these NSRs. The best practicable mitigation package is recommended, comprising a combination of 3 to 7m high roadside noise barriers, semi and full enclosures to protect NSRs such as the Mei Foo Sun Chuen Phases 5 & 6, LCK Reception Centre Staff Quarters, KMB Bus Depot CDA site, Site 10 and village houses at Tai Ching Cheung. Details could be found in the Implementation Schedule in Section 9.

3.16 Event and Action Plan

- 3.16.1 The measured/monitor noise levels shall be compared with the predicted results and the predicted traffic flow conditions (calculated noise levels based on concurrent traffic census obtained). In case discrepancies are observed, explanation should be given to justify the discrepancies.



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LOCATION OF CONSTRUCTION NOISE MONITORING STATIONS

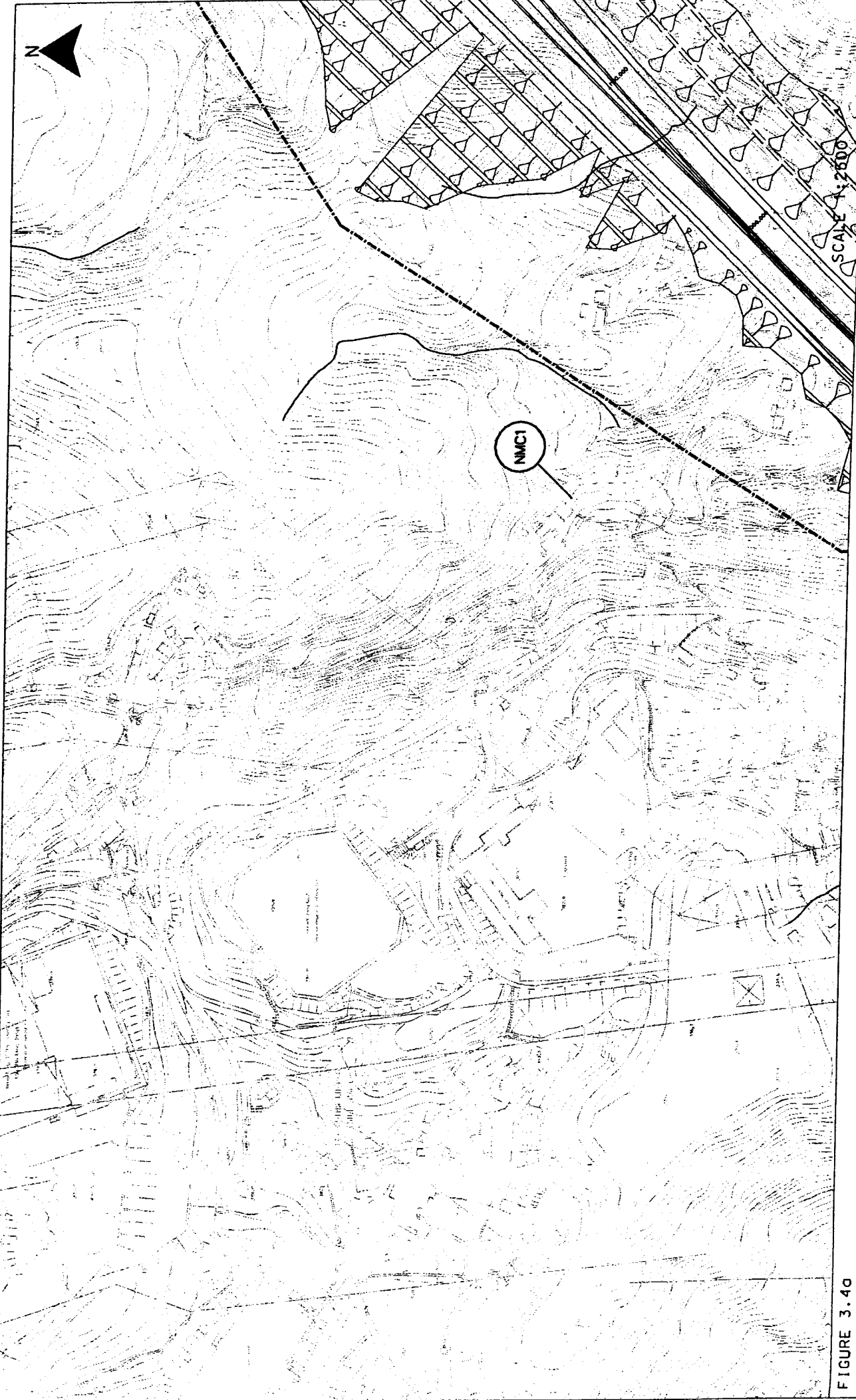
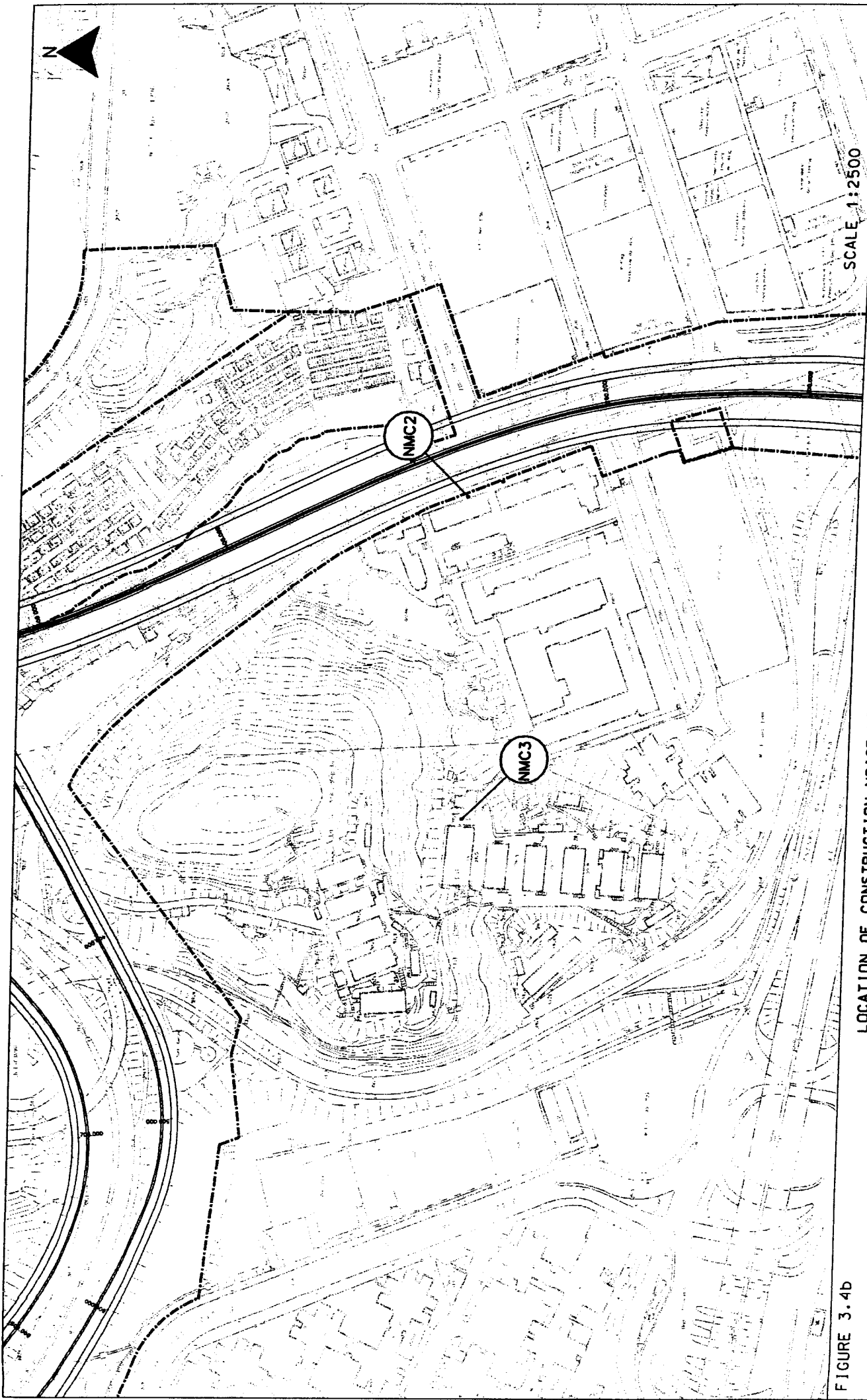


FIGURE 3.40

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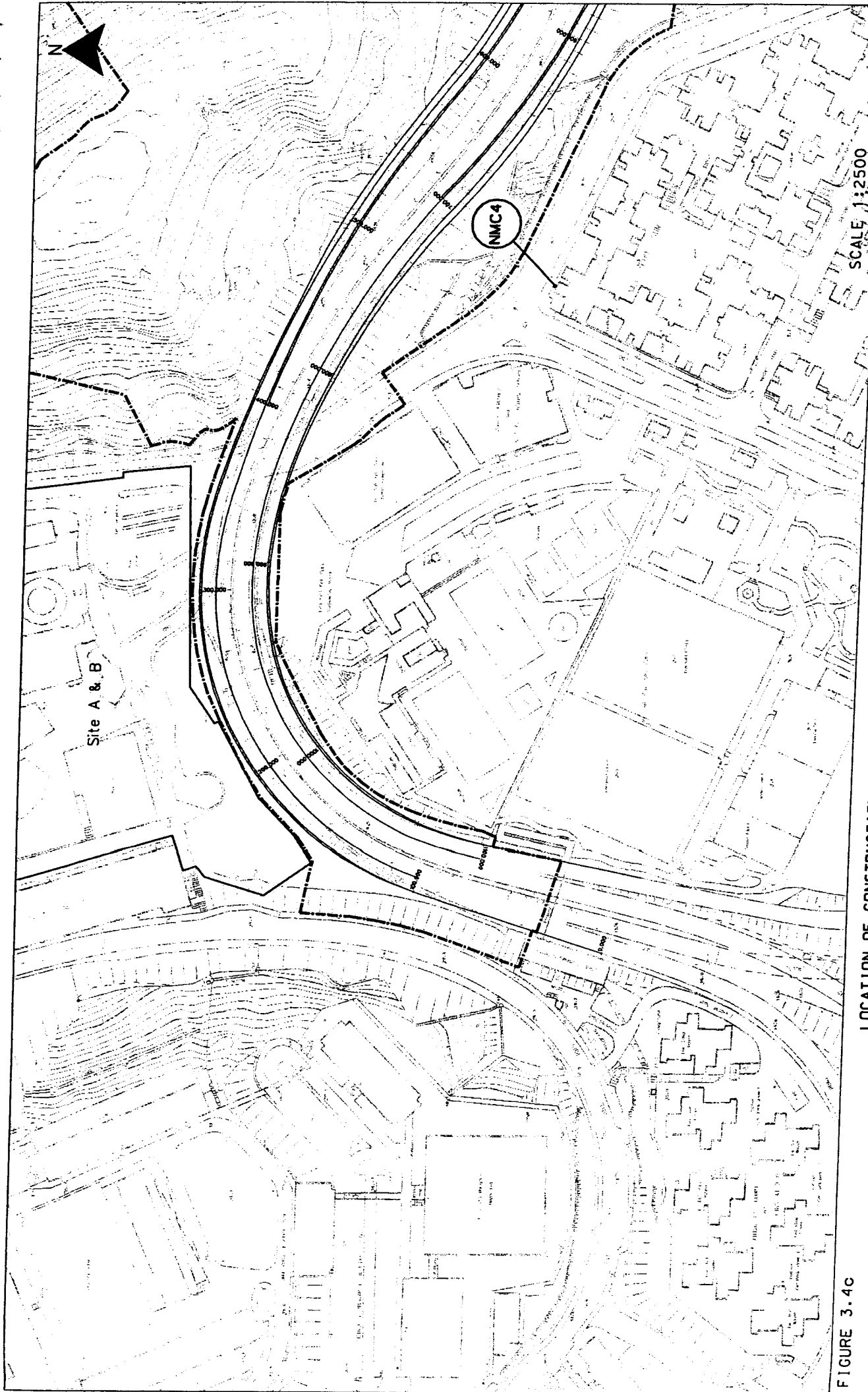
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LOCATION OF CONSTRUCTION NOISE MONITORING STATIONS

FIGURE 3.4b

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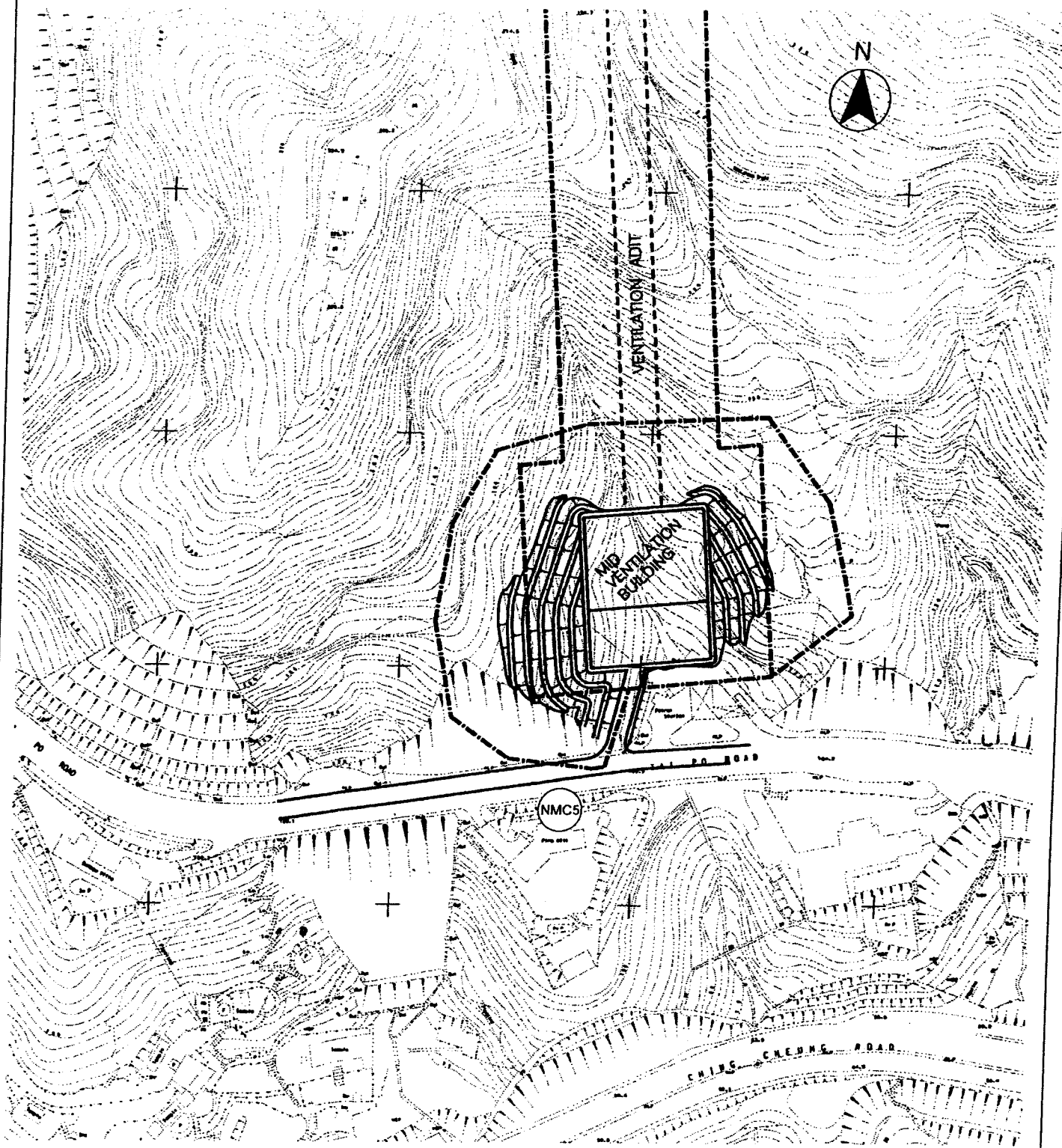


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LOCATION OF CONSTRUCTION NOISE MONITORING STATIONS

FIGURE 3.4C

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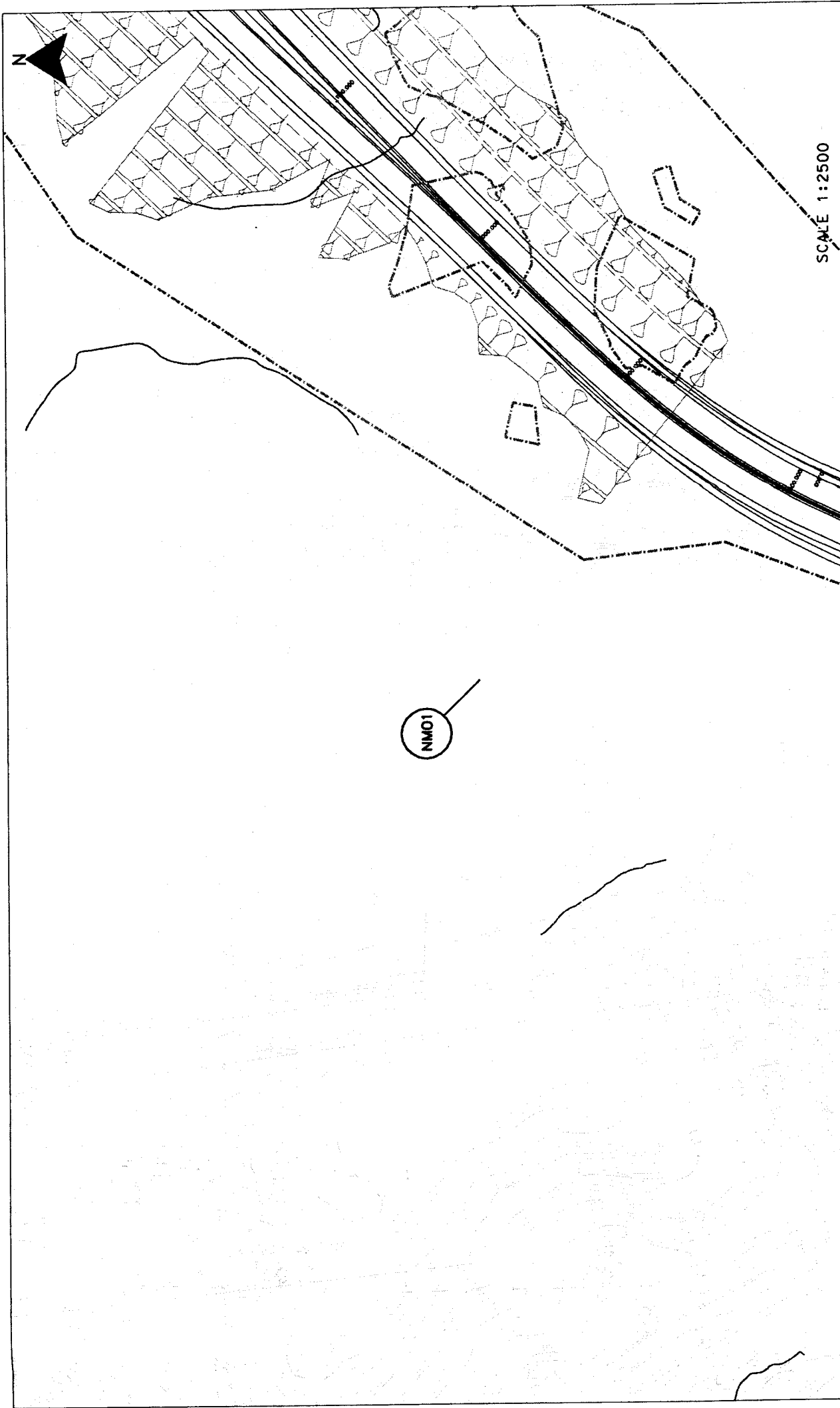
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FIGURE 3.4d LOCATION OF CONSTRUCTION NOISE MONITORING STATIONS

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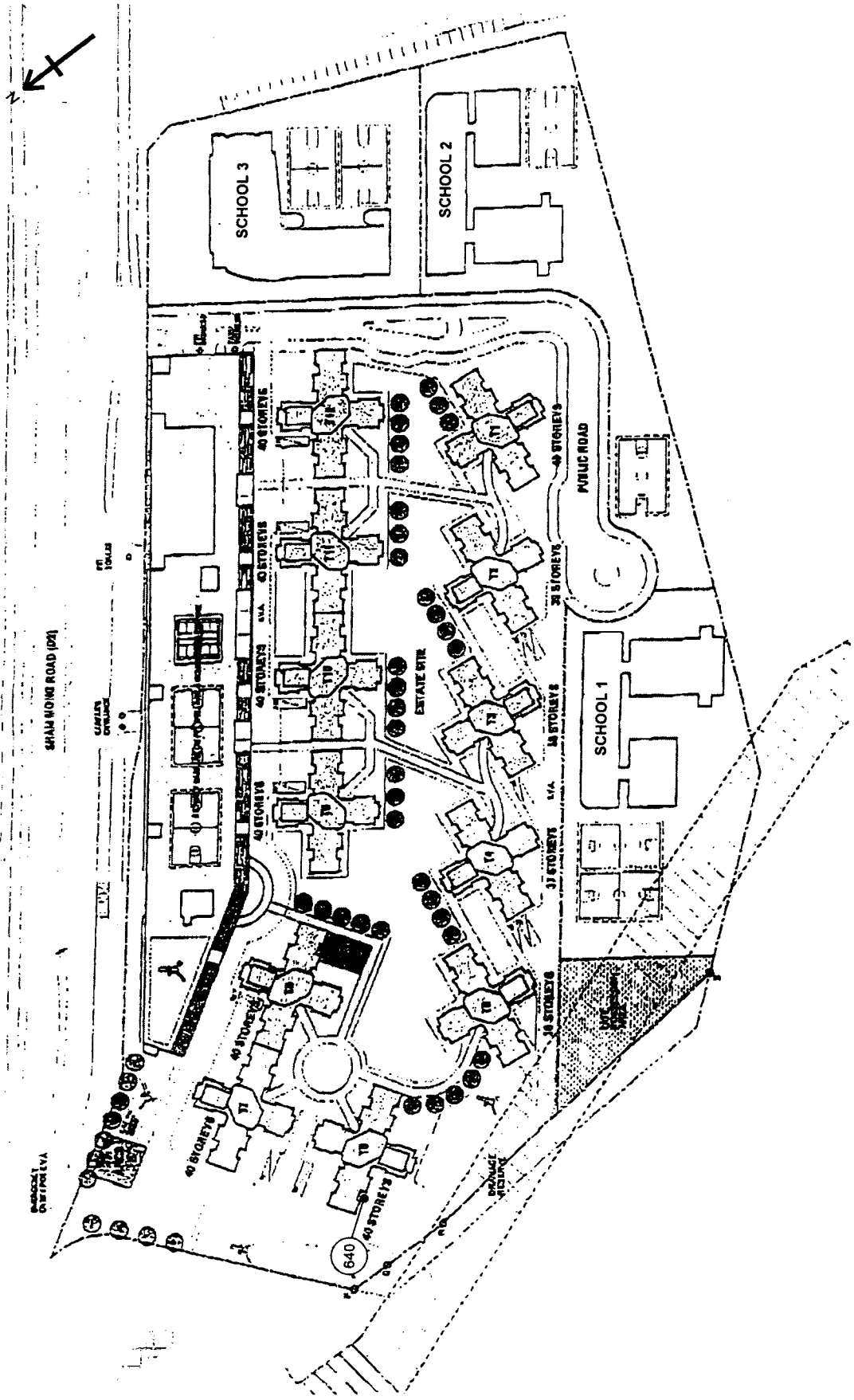
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LOCATION OF OPERATIONAL NOISE MONITORING STATIONS

FIGURE 3.12a

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LOCATION OF OPERATIONAL NOISE MONITORING STATIONS

FIGURE 3.12b