

Quarterly Report (July-September 1993) on Environmental Monitoring
East Sha Chau Contaminated Mud Disposal

Summary

- o The monitoring programme at East Sha Chau has been designed to examine the effect on the environment of contaminated mud disposal operations. The two key issues which the monitoring needs to address is firstly whether any contaminated material is leaving the disposal pits and secondly to assess if there is any adverse effect on the environment.
- o There is some evidence that either some material has dispersed from the pits, or that material has been dispersed outside the pit during the dumping operations although no definite conclusions can be drawn either way. However, the elevated levels outside the pits do not indicate an increasing trend. Equally 'high' values were recorded in other parts of the study area which were quite remote (more than one kilometre distant) from the disposal pits.
- o The direct impact of the disposal operations on local water quality is in most cases completely obscured by the impact of other dredging and construction-related activities in the area. Transient high turbidity plumes are recorded on a regular basis at the disposal pits, but these are not related to dumping.
- o The populations of aquatic biota do not appear to have been affected by the disposal operations. However the occurrence of occasional high metal concentrations in some individual specimens requires further investigation. Also, further monitoring has been recommended to look into this issue.

Project Background

Monitoring of water quality and sediments in the East Sha Chau area was initiated in October 1992 prior to the commencement of dumping of contaminated materials. The monitoring objectives were to determine background water quality at Sha Chau as well as to establish the effects of dumping operations on the local waters and surrounding sediments.

The first contaminated mud pit (CMP I) has been filled to its capacity since mid July 1993. Since then, contaminated mud has been dumped in mud pit CMP IIa and CMP I is currently being capped by clean material. With the opening of CMP IIa and the anticipated opening of pits CMP IIb, c and d in the near future, an amended monitoring schedule has been implemented from July onward. The objective is broadly the same as before but there has been focus on two further aspects, namely :

- investigation of the effects of all pits on the environmental quality of the area on a regional basis (cumulative impact monitoring)
- investigation of local, pit-specific impacts (compliance monitoring).

The current programme can be viewed in terms of elements designed for monitoring of specific locations close to disposal pits and elements designed to investigate impacts on the wider area as a whole.

A new pit management programme (which includes a 24 hour site supervision and reporting system) was also introduced by Port Works Division of Civil Engineering Department in mid-July with the opening of CMP IIa in order to avoid inaccurate dumping.

Monitoring Programme

a. Cumulative impact monitoring

This part of the programme is designed to be undertaken on a long term basis with as little change as possible in station locations and monitoring methodology over time and includes the following elements :

- Sediment sampling at 37 stations, bi-monthly. Analysis of metals, pH, Eh, organic carbon content, organic contaminants (PAH and PCB) and particle size distribution.
- Water quality monitoring at 1 station, weekly for a full tidal cycle (24+ hours). Analysis of current velocity, turbidity, suspended solids, dissolved oxygen, temperature and salinity.
- Trawling for demersal nekton at 6 stations, monthly. Analysis of species abundance and diversity. Samples collected for the analysis of tissues metal content in selected species of commercial importance.
- Collection of benthic grab samples at 10 stations, monthly. Analysis of macroinfaunal species abundance and diversity.
- Analysis of at least 18 tissues samples monthly (from 3 species at 6 trawl stations) for content of metals
- Bio-monitoring of the uptakes of metals by the indicator species, green-lipped mussel), biannually

b. Pit-specific compliance monitoring programme

The pit-specific compliance monitoring involves short-term monitoring around each active pit during the operational period (including the capping phase). This part of the programme involves specific near-field monitoring and consists of the following elements:

- Sediment sampling at 8 stations around each active pit, monthly (bi-weekly during the capping phase). Analysis of metal contaminants, pH, Eh and organic carbon content.
- Water quality monitoring at 4 stations around each operational pit, weekly for a full tidal cycle and in addition, water column profiling at 5 stations on a transect across

each operational pit. Analysis of current velocity, turbidity, suspended solids, dissolved oxygen, temperature and salinity.

- Source material collection from a contaminated mud dredging site, monthly. Analysis for metal concentration, organic contaminants (PAH and PCB) and E. Coli. The results are linked to the collection of suspended solids.
- Suspended solids monitoring at 9 stations, quarterly. Analysis of metals and elemental fingerprinting.
- Dump trials, on an ad hoc basis, to quantify the amount, and to assess the extent of, dispersion losses following bottom dumping of dredged material at a disposal site.

Details of monitoring schedules are shown in Tables 1 and 2.

Summary of Main Findings

a. Sediment Quality

The concentrations of various metal and lanthanide elements in sediment collected from around the disposal pits as well as from farther afield show no consistent increase or trend over the monitoring period from July to September. The concentrations vary between stations and between months, some elements increasing and others decreasing.

Following the passage of a typhoon, the average concentration of most metals decrease, but the variance increases, with the result that a few replicates have high values whilst most replicates have lower values. This may indicate that discrete portions of material have left the pit, or more likely, that some contaminated material previously dumped outside the pit which has been buried by natural deposition of clean material, has lost this cover during the typhoon and is subsequently exposed. However no confirm conclusion can be drawn.

In general, there is some evidence of contaminated material dispersing from the disposal pits, but there is no evidence to suggest increasing concentrations because the material becomes re-mobilised and dispersed, mixing with or being covered by clean sediment. The four typhoons that came through Hong Kong during the reporting period appear to have produced some local redistribution of the sediments in and around the pits. However, this effect quickly vanished on subsequent sampling with all metals returning to their previous levels. This seems to indicate that the seabed is very active and is a site of net deposition of estuarine sediment resulting in any redistributed contaminated mud being covered with fresh clean sediment.

b. Water quality

There were high variations in the turbidity and suspended solid levels. There is no evidence to suggest that such variations are related to dumping activities. Field observation suggests that dredging activity and leakage from barge doors produces locally high turbidity,

which may account for some of the recorded transient peaks.

c. Aquatic Biota

The trawl samples retrieved to date from East Sha Chau have exhibited a large amount of variability in the species composition between stations, between months, and also between replicate samples. The variability is probably the result of the mobility of many of the species and differences in their feeding and breeding patterns across the sampling area.

Some samples recovered after Typhoon Koryn contained much rubbish and foul smelling sediments, but other samples and at other times (even following further typhoons) have not revealed any further detrital material. The benthic infaunal in these samples appeared little different to other stations.

In general, the high degree of between-station and between-month variability in species composition indicates that the community is probably subject to stress from a number of different factors, both natural (e.g. natural siltation from the Pearl River, changes in salinity and turbidity etc) and possibly man-induced (e.g. dredging). No additional adverse impacts from the disposal activity are evident.

d. Eco-toxicology

The results indicate that concentrations of metals in muscle tissue of selected species of commercial value caught at East Sha Chau are generally low. As the measured concentrations are not quoted on a wet weight but a dry weight basis they cannot be compared directly to limit values (where set in the Food Adulteration Regulations). The dry weight concentration, however, will be a higher value than the equivalent wet weight concentration so providing a very conservative comparison with the limit values. On a conservative basis, amongst the 41 samples analyzed, only 3 samples exceeded the relevant limit. At the moment, there is no evidence to suggest an increasing trend or the source of the contamination. Further monitoring has been recommended.

General Conclusion

The results so far suggest that dumping activity is not adversely affecting the environmental parameters which are being monitored. The range of natural variation at the site is often very large. This factor, together with effects from other activities such as marine traffic and dredging works in the vicinity effectively masked the impacts caused by the disposal of contaminated mud. There is no evidence of widespread detrimental effect on the health of the ecosystem and no consistent trends indicating deterioration of environmental quality.

The consultant is continuing their monitoring works at East Sha Chau and further findings will be reported in the next quarterly report.

Table 1 - Regional Cumulative Impact Monitoring

Task	Description	Parameters	No. of Stations	Samples per Station	Sampling Frequency & Duration
1	Sediment sampling and testing	Up to 15 elements incl. Cu, Cd, Cr, Pb, Ni, Zn, Hg, pH, Eh, TOC, Particle Size	37	5	Bi-monthly till one year after completion of dumping, then annually for 5 yr and just after typhoon*
		PAH & PCB	10	5	Bi-monthly, same duration
2	Suspended solids sampling and testing	10 elements	9	1	4 sampling events per year, same duration
3	In-situ water quality monitoring	Fixed mode : salinity, conductivity, temperature, turbidity, current	1	2-minute time series	1 24-hr period per week, decrease to once per month for 12 months after completion of dumping
4	Fisheries resources	Demersal nekton	6	4	Night-time trawling once per month till one year after completion of dumping, then twice annually for 5 years
5	Benthos	Macroinfaunal benthos	10, plus 2 pit after capping	2	Monthly till 12 months after completion of dumping, then twice annually for 5 years

6	Eco-toxicology : body loading of metals	10 elements	6	3 species per station	Monthly till 12 months after completion of dumping, then twice annually for 5 years
7	Eco-toxicology : biomonitoring	17 elements	6	To be determined	Twice per year till 6 years after completion of dumping

*All replicates were analyzed in July. 5 replicates from 10 stations and a single replicate from the remaining 27 stations were analysed for subsequent months.

Table 2 - Pit Specific Compliance Monitoring

Task	Description	Parameters	No. of Stations	Samples per Station	Sampling Frequency & Duration
1	Sediment sampling and analysis	Cu, Cd, Cr, Pb, Ni, Zn, Hg + 3 elements, pH, Eh, TOC, Grain size	8	5	Monthly for the duration of the pit, and bi- weekly during capping
2	In-situ water quality monitoring	Salinity, turbidity, temperature, DO, pH, conductivity, current velocity	4 stations fixed mode, 5 stations profilin g mode	2-min and 1 sec time series	1 24-hr period (1 full tidal cycle) per week for the duration of the pit
3	Source material elutriate testing, E. Coli, organics	15 metals, PAH, PCB, E. Coli	1 per source	2 compo- site samples	Est. once per month

Table 3 - Prosecution Statistics - July to September 1993

Month	Company/Person	Date of Offence	Nature of Offence	Fine HK\$	Record of Offence
August	China Harbours Engineering Co.	5/1/93	Permit dumping of about 750m ³ of mud at sea south of Cheung Chau not in compliance with the licence condition	4,000	2nd
	Zhen Hua Engineering Co. Ltd.	5/1/93	Dumping of about 750m ³ of mud at sea south of Cheung Chau not in compliance with the licence condition	4,000	1st
	The Express Builders Co. Ltd.	14/1/93	Permit dumping of about 750m ³ of mud at sea near Ninepin Group not in compliance with the licence condition	4,000	1st
	Ditto	14/1/93	Ditto	4,000	2nd
	Ditto	14/1/93	Ditto	4,000	3rd
	Ditto	14/1/93	Ditto	4,000	4th
	Fanta (CFC) Construction Co. Ltd.	14/1/93	Dumping of about 750m ³ of mud at sea near Ninepin Group not in compliance with the licence condition	4,000	4th

August	Luen Cheong Tai Construction Co. Ltd.	26/3/92	Dumping of about 750m ³ of mud at sea near Cheung Chau not in compliance with the licence condition	200	1st
September	Geoworks Contractors (HK) Ltd.	15/2/93	Dumping of about 750m ³ of contaminated mud at sea east of Sha Chau not in compliance with the licence conditions	5,000	5th
	Hanison Construction Engineering Co. Ltd.	21/2/93	Permit dumping of about 750m ³ of mud at sea near Discovery Bay not in compliance with the licence conditions	5,000	1st
	Hon Yick Marine Engineering Co. Ltd.	21/2/93	Dumping of about 750m ³ of mud at sea near Discovery Bay not in compliance with the licence conditions	5,000	7th
	Mr. Cheung Chi-hung	21/2/93	Ditto	5,000	1st
	Mr. Kwok Kau-kan	21/2/93	Ditto	5,000	1st
	Philipp Holzmann Aktiengesellschaft	16/3/93	Permitt dumping of about 750m ³ of mud at sea near south of Cheung Chau not in compliance with the licence conditions	3,000	1st

	Supreme Contractors Ltd.	16/3/93	Permit dumping of about 750m ³ of mud at sea near south of Cheung Chau not in compliance with the licence conditions	1,000	1st
September	Philipp Holzmann Aktiengesellschaft	18/3/93	Permit dumping of about 750m ³ of mud at sea north of Tsing Yi not in compliance with the licence conditions	5,000	2nd
	Supreme Contractors Ltd.	18/3/93	Dumping of about 750m ³ of mud at sea north of Tsing Yi not in compliance with the licence conditions	5,000	2nd
	Mr. Chan Wai-kit	18/3/93	Ditto	5,000	1st
	Mr. Lai Ah-choi	18/3/93	Ditto	5,000	1st
	Every On Ltd.	24/3/93	Permit dumping of about 1,000 pounds of metallic sand at sea north of Tsing Yi without dumping licence	3,000	1st
	Kei Hing Shot Blast & Painting Co.	24/3/93	Dumping of about 1,000 pounds of metallic sand at sea north of Tsing Yi without dumping licence	3,000	1st

	China Fujian Corp. for International Techno-Economic Cooperation	8/4/93	Permit dumping of about 750m ³ of mud at sea east of Ninepin Group not in compliance with the licence conditions	4,000	4th
Septem ber	Fanta (CFC) Construction Co. Ltd.	8/4/93	Dumping of about 750m ³ of mud at sea east of Ninepin Group not in compliance with the licence conditions	4,000	5th

N.B. No prosecution was undertaken in July

Table 3 - Number of Cases of Illegal Dumping Observed - July to September 1993

	July	August	September
No. of Cases of Illegal Dumping Observed	3	3	1

Environmental Protection Department
February 1994

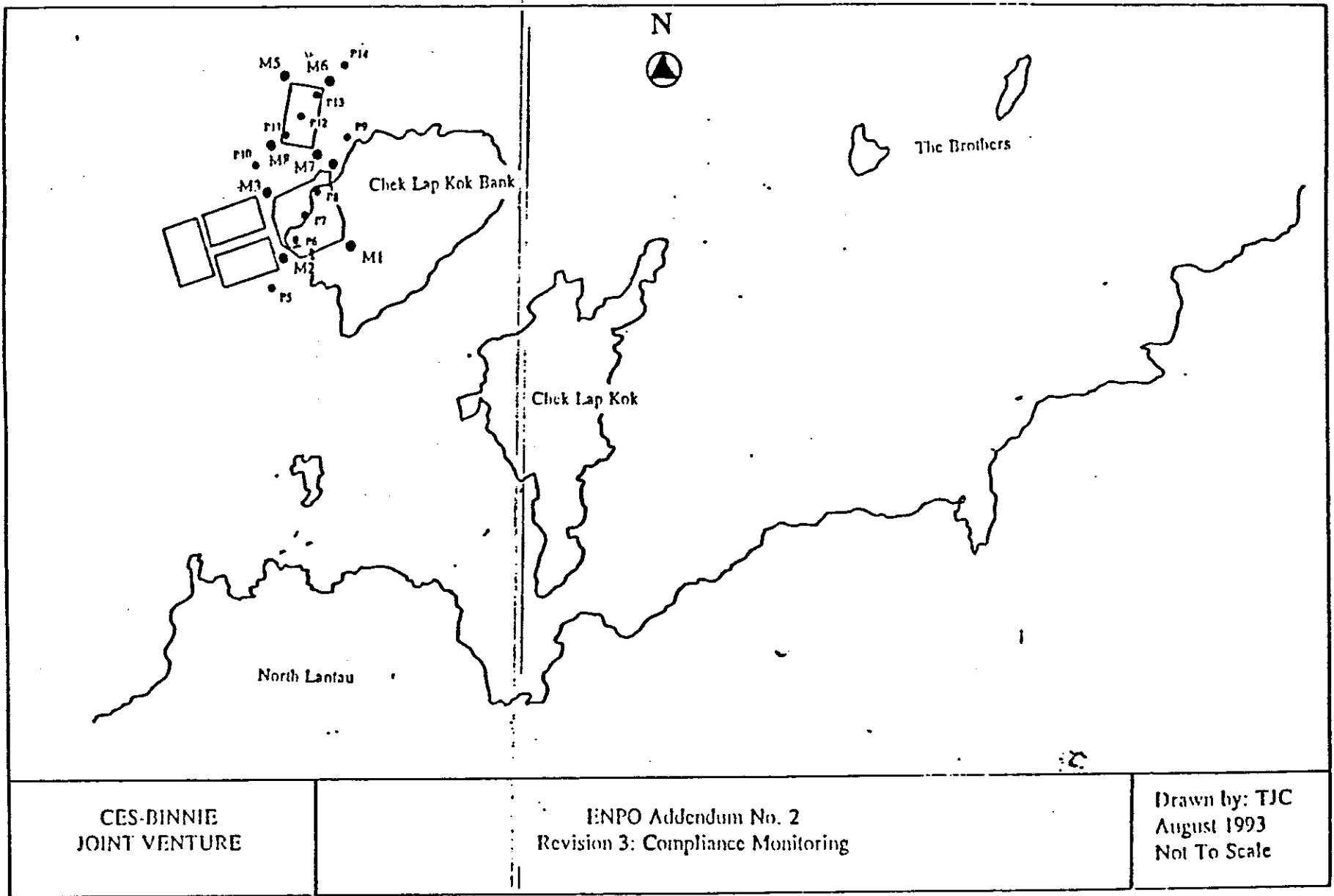


Figure 1 Location of Water Quality Monitoring and Profiling Stations

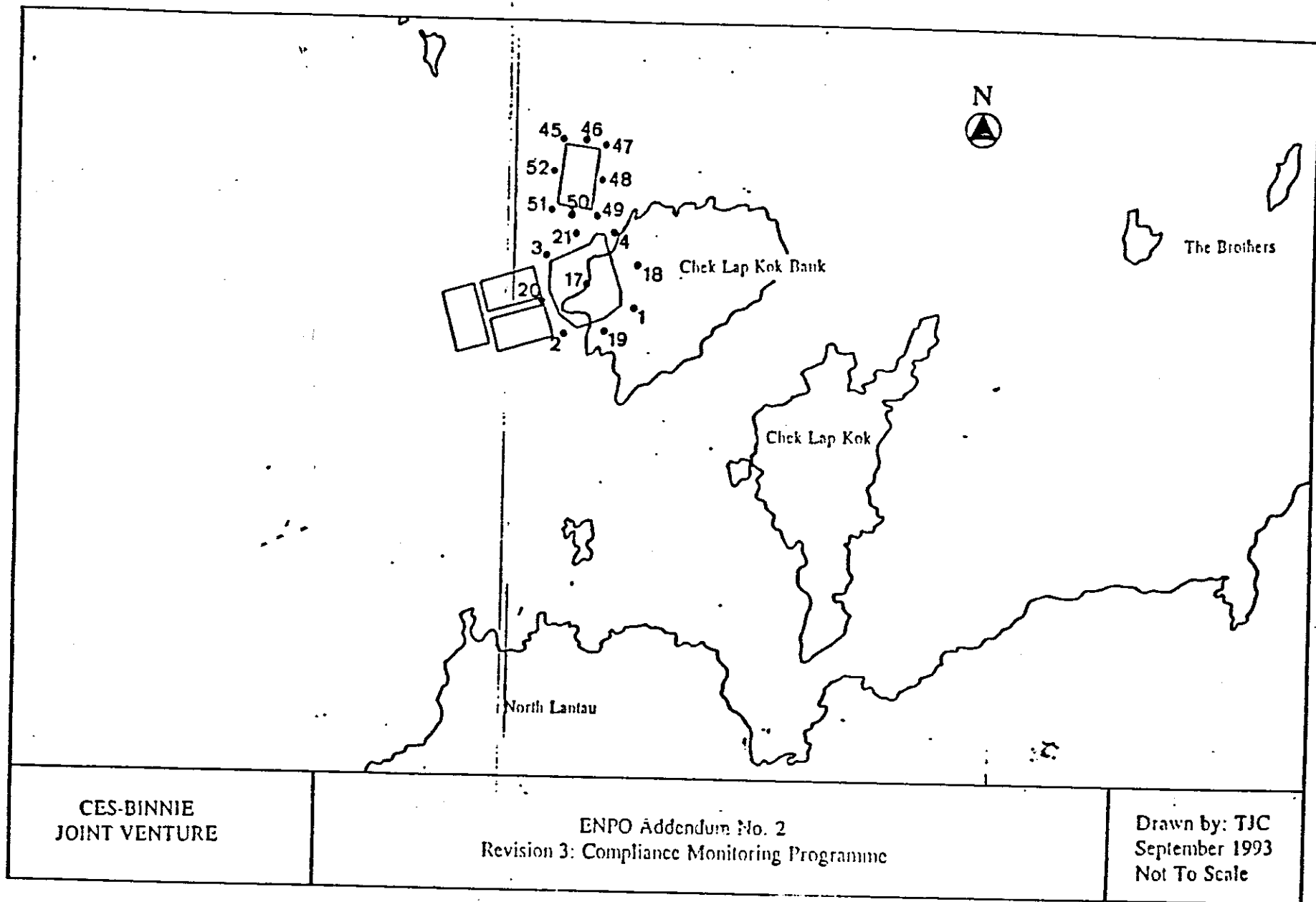


Figure 2 Location of Sediment Sampling Stations, CMP1 and CMP2a

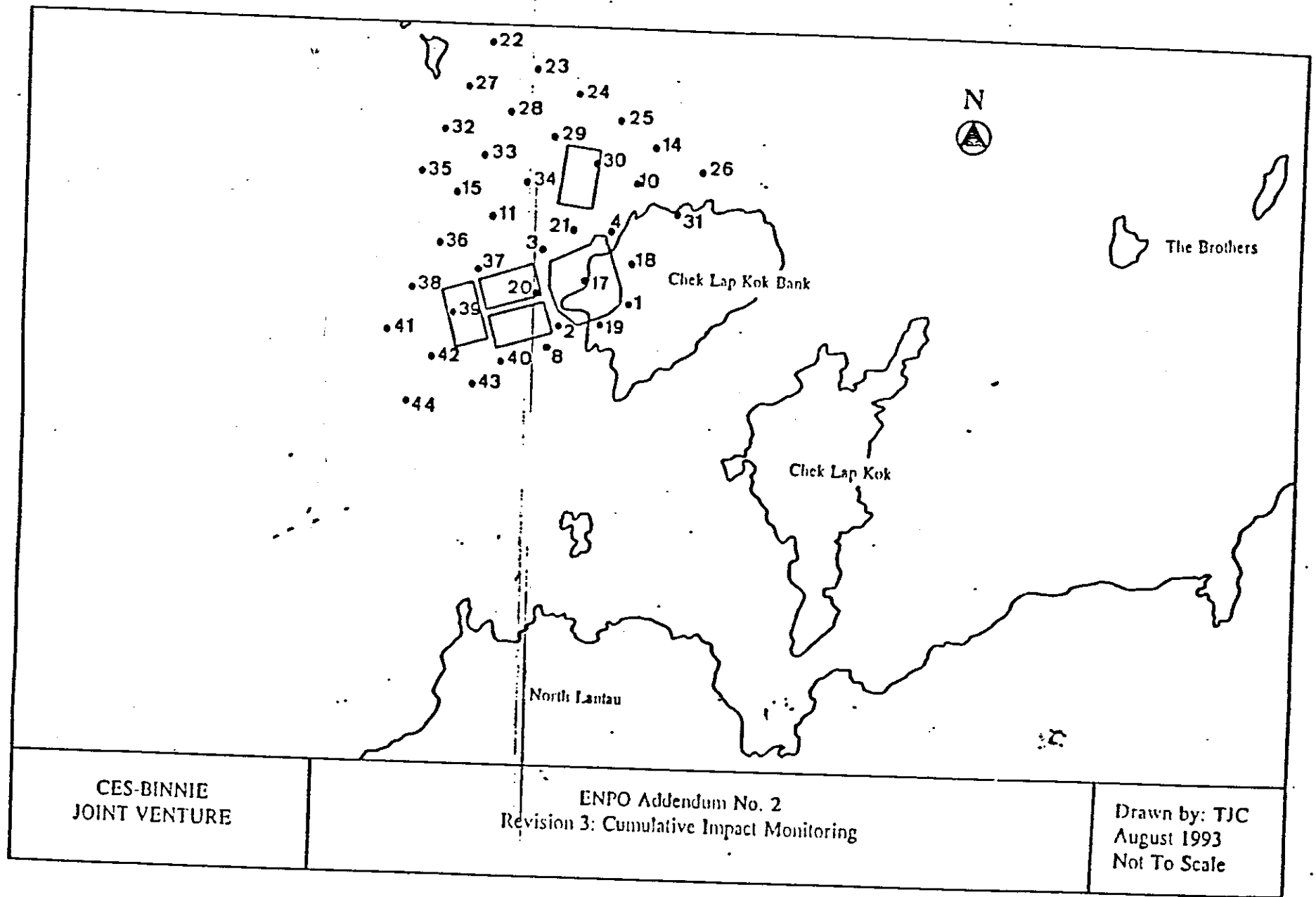


Figure 3 Location of Sediment Sampling Stations, Cumulative Impact Monitoring.

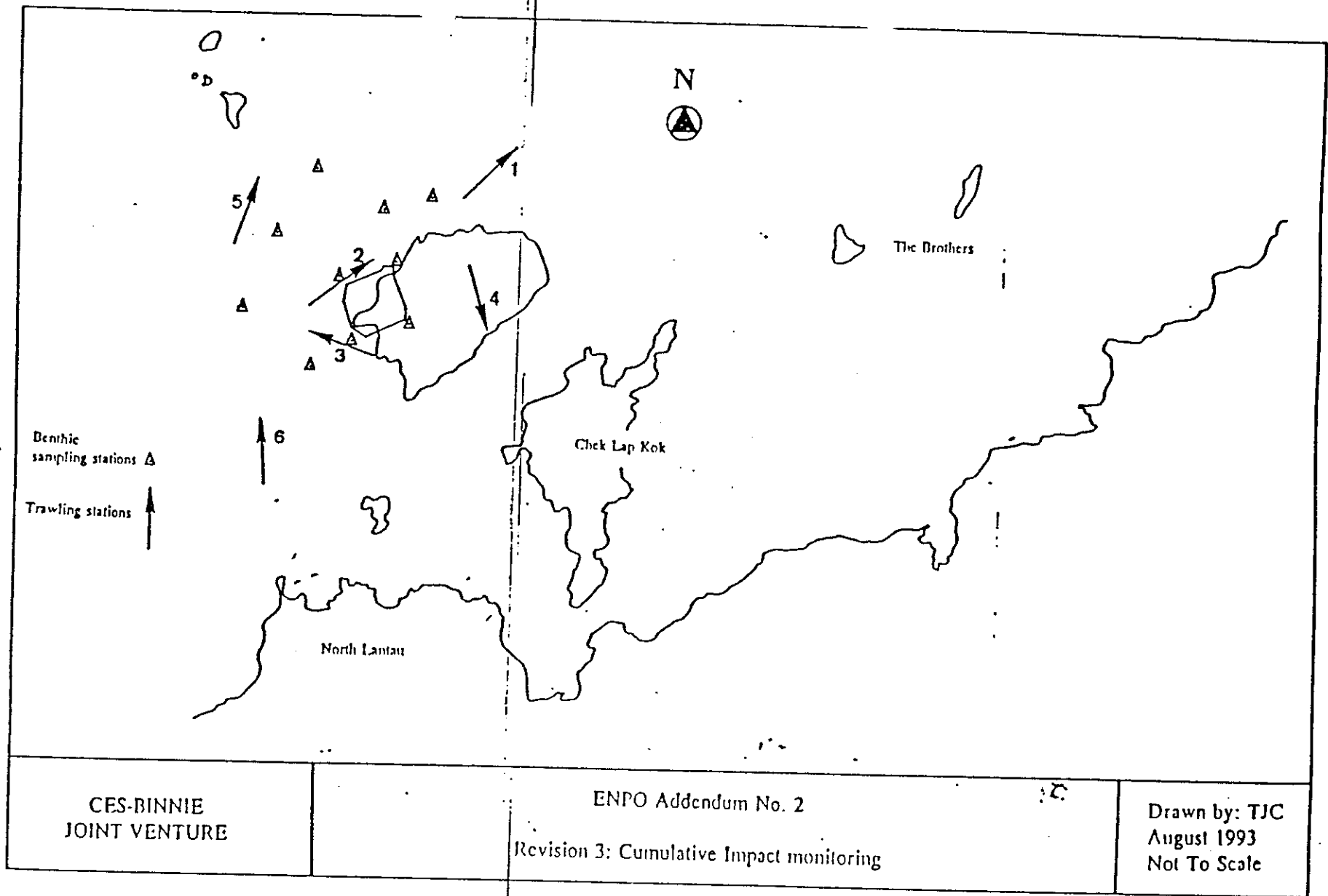


Figure 4 Location of Trawling and Benthic Grab Sampling Stations