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**ACE Paper 20/2007**

*For advice*

**Report on the 98<sup>th</sup>  
Environmental Impact Assessment Subcommittee Meeting**

**INTRODUCTION**

On 17 September 2007, the Environmental Impact Assessment (EIA) Subcommittee considered the EIA report on Harbour Area Treatment Scheme (HATS) – Provision of Disinfection Facilities at Stonecutters Island Sewage Treatment Works (ACE-EIA Paper 7/2007 refers).

**ADVICE SOUGHT**

2. Members are requested to advise whether the EIA report should be endorsed with the proposed conditions having regard to the views of the Subcommittee.

**VIEWS OF THE SUBCOMMITTEE**

**Need for the project**

3. The purpose of the project is to bring early water quality improvement to the western harbour and the bathing beaches along the Tsuen Wan coastline (Tsuen Wan beaches) by disinfecting the Stonecutters Island Sewage Treatment Works (SCISTW) effluent to reduce *E. coli* to a level that would restore the beach water quality to pre-HATS Stage 1 conditions. Advance disinfection facilities (ADF) will be constructed within the existing sewage treatment works (STW) on Stonecutters Island, which is providing Chemically Enhanced Primary Treatment (CEPT). This would facilitate the re-opening of the affected beaches at the earliest opportunity.

4. Based on the EIA report, HATS Stage 1 commissioned in 2001 has brought about water quality improvements to the Victoria Harbour. However, about 1.4 million m<sup>3</sup> per day of effluent from previously dispersed discharges along the coasts of Kowloon and eastern Hong Kong Island is now being disposed of via the SCISTW outfall. At present,

seven beaches along the Tsuen Wan coastline are closed for water quality reasons. Based on the EIA report, both the HATS Stage 1 effluent discharge and local pollution sources such as sewage from unsewered villages, are contributing to the poor beach water quality at the seven closed Tsuen Wan beaches. The proposed ADF, together with reduction of localized un-treated wastewater discharges being implemented under the regional sewerage improvement schemes, are necessary to improve the beach water quality and facilitate the re-opening of these beaches.

5. The Public Account Committee of the Legislative Council expressed concerns in May 2004 about the increase of *E. coli* levels at the Tsuen Wan beaches and urged the Administration to advance the provision of a part of the permanent disinfection facilities under HATS Stage 2A such that the gazetted beaches could be re-opened for public use. In response, the Government planned to expedite part of the permanent disinfection facilities for early completion in 2009 to facilitate the re-opening of the Tsuen Wan beaches at the earliest possible time.

### **Description of the project**

6. The project is to construct and operate ADF within the existing SCISTW, which is providing CEPT. Location plan and general layout of the project is shown at **Figure 1** attached. Key elements of the project include –

- (a) six sodium hypochlorite storage tanks (8 m in diameter, 12.5 m in height);
- (b) one day tank for sodium hypochlorite storage (capacity of about 100 m<sup>3</sup>);
- (c) two sodium bisulphite storage tanks (6 m in diameter, 6.2 m in height);
- (d) pipes in pipe trenches; and
- (e) other associated facilities including bund walls and switch rooms.

7. The project is classified as a designated project under item F.1 of Part I in Schedule 2 of the EIA Ordinance, i.e. “*Sewage treatment works with an installed capacity of more than 15,000m<sup>3</sup> per day*”.

### **Members’ views**

8. Members noted that two sets of public comments had been received by the Environmental Protection Department (EPD) during the public inspection period from 16 August to 14 September 2007. Separately, some Council Members had raised some questions to the project proponent, the Drainage Services Department, and had requested the project proponent to provide notes of the public consultation sessions on the EIA study. The public comments referred from EPD as well as the responses of the project proponent

to Members' questions and notes of relevant public consultation sessions had been circulated to Members before the meeting.

9. Members agreed that the discussion should focus on the justifications for the project, selection of disinfection options, impacts on water quality, impacts on marine ecology and fisheries, human health and ecological risks as well as Environmental Monitoring and Audit (EM&A) programme.

*Justifications for the project*

10. Some Members expressed concern about the need and beneficial gain of the project having regard to the substantial financial resources required and the anticipated improvement in water quality of the western harbour after completion of the regional sewerage improvement schemes as well as the HATS Stage 2A for expanding the capacity of the SCISTW and Stage 2B for provision of secondary sewage treatment facilities. The project proponent team explained that without the disinfection project, the water quality of Tsuen Wan beaches could not be restored even with the completion of regional sewerage improvement schemes, which could only arrest the local pollution problems, and would remain jeopardized by the un-disinfected HATS Stage 1 effluent. More than \$700 million had already been spent on improving local sewers to address the local pollution problems at Sham Tseng, Ting Kau and Tsing Lung Tau areas. Branch sewers were being extended to nearby villages at an estimated cost of about \$100 million, the last phase of which was expected to be completed in 2009 to tie in with the completion of the ADF which would substantially reduce the *E. coli* levels in the western Harbour and Tsuen Wan beaches.

11. The project proponent team further explained that if disinfection facilities were not put in place, the water quality level of the western harbour would be even worse than that under Stage 1 due to the anticipated increase of 450,000 m<sup>3</sup> sewage flow per day conveyed under Stage 2A from the Hong Kong Island to SCISTW for centralized treatment and disposal. For HATS Stage 2B, the timetable had yet to be reviewed in light of the land problem and the change in population forecast. The review would be conducted in 2010/11 and hence Stage 2B might be difficult to be completed before 2020. Thus, the Tsuen Wan beaches could not be re-opened before the completion of Stage 2B if the disinfection facilities were not put in place. Even with the provision of secondary treatment facilities under Stage 2B, modelling results showed that due to high variability of the marine condition, the water quality in some of the beaches might still fall below the required *E. coli* standard if disinfection facilities were not provided.

12. On some Members' concern about parameters other than *E. coli* which would affect the water quality and thus re-opening of Tsuen Wan beaches, the project proponent

team explained that the water quality in Victoria Harbour had improved after implementation of HATS Stage 1. Even at the Tsuen Wan beach area, the levels of other parameters, such as biochemical oxygen demand (BOD), suspended solids (SS) and dissolved oxygen (DO), had also improved and thus were not of concern in considering whether the beaches could be re-opened. The only parameter which was of current concern was *E. coli*. The closure of Tsuen Wan beaches was mainly due to two sources, the HATS Stage 1 effluent discharge and local pollution sources. The proposed ADF, together with reduction of localized untreated wastewater discharges being implemented under the regional sewerage improvement schemes, were necessary to improve the water quality in the area and facilitate the re-opening of these beaches. As a large portion of the *E. coli* level at Tsuen Wan beaches was attributed to the HATS Stage 1 effluent discharge (ranging from 150 to 700 counts per 100 ml), the level could not be reduced to the acceptable level without the disinfection process.

13. Some Members expressed concern about the modelling of water quality parameters other than *E. coli* which might prevent the re-opening of Tsuen Wan beaches even if the level of *E. coli* could be reduced to an acceptable level after completion of the ADF. The project proponent team explained that as the current EIA report focused on the impacts of disinfection, modelling was thus conducted on *E. coli* and related parameters such as total residual chlorine (TRC) and chlorination by-products (CBPs). Modellings of other water quality parameters for various water control zones (including Tsuen Wan beach area) would be conducted under another EIA report on HATS Stage 2A to be completed in late 2007. After implementation of HATS Stage 1, water quality parameters (including DO and SS) at Tsuen Wan beaches were found acceptable. With implementation of the regional sewerage improvement schemes and then HATS Stage 2A, water quality other than *E. coli* in Tsuen Wan beaches would be expected to further improve and would not affect the re-opening of the beaches.

14. Members noted that the scope of the current EIA report was on impacts of the disinfection process in addressing the problem of *E. coli* attributed from the HATS Stage 1 effluent. The re-opening of beaches would depend on parameters related to health impacts (*E. coli* being the key parameter) rather than parameters related to water quality (such as DO and SS). Moreover, the decision of whether to open or close a beach to the public rested with the Leisure and Cultural Services Department which would consult the EPD for advice.

15. Members noted that from an overall perspective of the HATS project, the current project aimed at addressing the outstanding issue of the HATS Stage 1 commissioned in 2001. The completion of the ADF would not only bring about improvement to the water quality of the Tsuen Wan beach area, but also that of western

harbour in terms of bacterial content.

16. On the need for dechlorination after the disinfection process, the project proponent team explained that dechlorination would be necessary to ensure that any residual chlorine (including free available chlorine and chloramines) remaining in the effluent after chlorination would be removed to avoid causing any environmental impacts. If the level of residual chlorine exceeded a certain concentration level, there would be toxic effects on some marine organisms. For SCISTW, the concern would mainly be the toxic effects of chloramines on marine organisms. Due to the presence of ammonia in the effluent, the added chlorine would all be converted to chloramines which had less oxidative energies than free chlorine to react with most sewage organics to form any significant level of CBPs. The acceptable concentration level of total residual chlorine (TRC) was 0.38 mg/l based on literature research.

17. On the feasibility of operating the disinfection facilities only in swimming seasons from a cost-effectiveness perspective, the project proponent team confirmed that it was feasible for the disinfection facilities to be operated only in swimming seasons and to be closed in non-swimming seasons. This option had been looked into in the EIA study. However, there would still be swimmers in winter months requiring the operation of the facilities on public health grounds.

#### *Selection of disinfection options*

18. On the experience of using chlorination for disinfecting CEPT effluent in Hong Kong, the project proponent team confirmed that there was no such local experience. Ultra-violet (UV) radiation was used for some small-scale STWs in Hong Kong, such as those in Sham Tseng and Siu Ho Wan. Nonetheless, the considerations of selecting disinfection options were project-specific having regard to a number of factors, including the large scale of SCISTW, environmental setting of the existing outfall and the plan to upgrade the CEPT plant to secondary treatment plant under Stage 2B. Review had been conducted on the application of overseas experience. Overseas experience of using UV radiation on large-scale facilities was found significantly less when compared with the use of chlorination disinfection. The planned treatment capacity of SCISTW was 1.7 million to 2.5 million tonnes per day. Research of overseas examples showed that the processing capacity of the largest STW using UV radiation was about 680,000 tonnes per day while that of the largest primary treatment plant using chlorination was about 1.8 million tonnes per day. Making reference to the experience of proven application for large-scale STW with similar capacity would render more confidence in using chlorination for SCISTW. Another important consideration was that the existing SCISTW outfall was located in an area mainly used for marine traffic with low ecological and fisheries resources.

19. The project proponent team further explained that a multi-tier evaluation process was adopted for the selection of disinfection options for SCISTW. Under Tier 1, all available disinfection options were reviewed. Chlorination and UV radiation were found technically feasible in terms of functionality and provenness. Under Tier 2, both options were found environmentally acceptable with respect to marine water quality and human/ecological health. Under Tier 3, both options were found to comply with relevant environmental criteria. Under Tier 4, the two options were compared on various aspects, including scale-up factors, total life cycle cost, flexibility and implementation issues. Chlorination was a preferred option under all these criteria. Flexibility was a key criterion for HATS having regard to the upgrading plan. Under HATS Stage 2B, the demand for disinfection was expected to be greatly reduced. The use of chlorination would result in less abortive work. On the implementation issue, UV radiation would involve much more complicated installations and thus require a much longer timeframe.

20. On the consideration of membrane technologies which did not require the use of chemicals, the project proponent team explained that there was no large-scale application experience available which could compare with the requirement of SCISTW and thus was not considered as a technically feasible option under Tier 1 of the evaluation process.

#### *Impacts on water quality*

21. On the possibility of underestimating the toxicity reference value (TRV) of two chemicals, chloroacetic acid and bromoacetic acid, as they were derived from the testing of freshwater species and might not be suitable for assessing the risk to marine species, the project proponent team explained that bromoacetic acid was not selected as contaminants of concern in the risk assessment. The first page of Annex B of the EIA report listed the criteria adopted in deriving the TRV, which showed the preference of marine species over fresh water species. Since no marine species data was available from literature on chloroacetic acid and dibromoacetic acid, their TRVs were therefore derived from freshwater species. Uncertainty factor was generally not applied for conversion of TRV for risk assessment in marine environment from freshwater species toxicity data, as reviewed in previous relevant studies and USEPA assessment protocol. Moreover, the hazard quotient of the chloroacetic acid and dibromoacetic acid were very low, application of an uncertainty factor of as high as 100 would not result in considerable increase to hazard quotient and hazard index level.

22. On the assessment of over-dosage of sodium bisulphite (the dechlorination agent which would be injected to the disinfected effluent prior to submarine discharge to remove any remaining TRC), the project proponent team explained that assessment had

been conducted by evaluating impacts of sodium bisulphite on the potential of DO depletion in the water. The results showed that the impact on DO depletion was insignificant and there was no toxicity effect.

23. On the review of long-term monitoring results on water quality from overseas experience using similar technology, the project proponent team explained that discharge of effluent from a STW to receiving waters was regulated under the National Pollutant Discharge Elimination System in the US. All discharge permits specified effluent limitations and monitoring requirements. A routine monitoring programme (including LC<sub>50</sub> and C-NOEC) for receiving waters was required for all STWs with or without disinfection. When chlorination was adopted, limit for TRC was required. The monitoring of coastal discharge in the US was mainly based on industrial discharge and chlorine residue. For the case of Deer Island STW in Boston, the results of the marine water monitoring were available on the website. The monitoring results of acute and chronic toxicity tests showed that there were no unacceptable environmental impacts on Massachusetts Bay arising from the discharge of chlorinated/dechlorinated effluent.

24. On the monitoring of CBPs in the US, the project proponent team explained that CBPs were not of general concern under the US monitoring system on effluent discharge and they were mainly of concern in drinking water. Nonetheless, a more prudent approach would be adopted in monitoring the effects of the effluent discharge on the environment after chlorination/dechlorination was applied for the ADF.

#### *Impacts on marine ecology and fisheries*

25. On some Members' concern about the impacts of the disinfection process on marine mammals, the project proponent team explained that risk assessments had been conducted for different phases of HATS Stage 2 (including ADF, Stage 2A and 2B). While there was no dolphin activity detected around the SCISTW outfall, very conservative assumptions were made by assuming that dolphins appeared 25% of the time at the outfall area and exposed to CBPs. Under the disinfection process plus existing pollutants, the hazard index on marine mammals was about 0.1 which was well below the USEPA hazard risk criteria of 1 to 10.

26. On the doubt about the conclusion of no adverse impacts on fish eggs and larvae based on the whole effluent toxicity test (WETT) results on five marine species, the project proponent team explained that the conclusion made in Chapter 9 of the EIA report under Fisheries Impact that "fish eggs and larvae would not be adversely impacted by the chlorination and dechlorination effluent discharge" was made not in the context of whole effluent toxicity but in the context of impact on fishery resources. This conclusion was

derived from the following –

- (a) TRC discharge standard (0.2 mg/l) would be less than the TRC concentration of 0.31-0.38 mg/l reported in literature that could cause abnormal development of fish eggs and larvae. Actual TRC concentration at the edge of the zone of initial dilution after initial dilution of 34 times minimum would be considerably less than the discharge standard;
- (b) the nearest spawning ground was over 14 km from the SCISTW outfall;
- (c) the nearest nursery ground was over 40 km from the SCISTW outfall; and
- (d) Dichloroacetic acid would have the largest mixing zone among all CBPs detected, with a size of 1685 m X 2450 m in the wet season of year 2020. At the edge of this mixing zone, all CBPs detected would be at background levels. The CBP impact area was therefore inside this mixing zone, which was more than 10 km from the nearest spawning ground and more than 35 km from the nearest nursery ground.

27. On the sites of nearest fisheries spawning grounds, the project proponent team stated that the grounds were mainly at the southern waters of Hong Kong near Cheung Chau South and Lamma South which were about 14 km away from the outfall based on the information of Agriculture, Fisheries and Conservation Department. There was a fish farm near Ma Wan which was about 7 to 8 km away from the mixing zone.

#### *Human health and ecological risks*

28. On some Members' concern about the impacts of CBPs, which were carcinogenic, on human life due to the passing of CBPs in the marine environment along the food chain, the project proponent team explained that risk assessments were conducted on aquatic life. The hazard index under the disinfection process was about 0.7 which was well below the USEPA risk criteria of 1 to 10. It was found that the hazard index under disinfection process plus existing pollutants was about 3.4 which showed that the influence of existing pollutants was much more serious than that of disinfection process. In the EM&A programme, a chronic WETT was recommended to monitor the impacts of existing pollutants on aquatic life.

#### *Environmental Monitoring and Audit*

29. On the contingency measures in case the disinfection process turned out to be

not as effective as anticipated in improving the beach water quality, the project proponent team explained that modellings conducted were based on very conservative assumptions and calibrated against *E. coli* monitoring data provided by EPD and the design chemical dosages were estimated based on two comprehensive bench-scale testing programmes. Contingency measures would include re-assessment of the dosages required to achieve the disinfection target.

30. On the determination of the maximum chemical dosage which was environmentally acceptable, the project proponent team explained that the design dosage was found to be about 11 to 15 mg/l based on bench-scale tests to achieve the disinfection target. Tests on marine organisms and chemical tests were however performed based on dosages up to 20 mg/l. The usual control of the disinfection process was on the TRC rather than on the dosage level. The maximum level of TRC in the effluent would be set at 0.4 mg/l.

31 On the benchmarking of the dosage of sodium hypochlorite as compared with those used in the Deer Island STW, the project proponent team confirmed that the dosage of sodium hypochlorite used in the Deer Island STW for primary treatment was in the same order as those proposed for SCISTW.

32. On some Members' concern about the monitoring process to ensure that the disinfection process would not have adverse impacts on the marine ecology, the project presentation team explained that the EIA assessment results showed a large safety margin and the modellings were based on the worst-case scenarios. Reference had been made to the experience and monitoring information of the Deer Island STW. Moreover, EM&A would be conducted during the operation phase with emphasis on the concentration level of TRC and CBPs. Chronic WETTs on effluent would also be carried out.

33. On the storage of sodium hypochlorite on the site, the project proponent team explained that six storage tanks plus one-day dosing tank were recommended for the storage of sodium hypochlorite. The dosing tank next to the dosing point could hold a half-day dosage and pumping would be required only twice a day to transfer the sodium hypochlorite from the main storage tanks for use at the dosing point. This would facilitate the control of dosage level at the dosing point and reduce the operating problems and costs for continuous pumping directly from the main storage tanks to the dosing point which was more than 300 m apart. The daily volume of sodium hypochlorite for the ADF operation was estimated to be about 200 m<sup>3</sup>. The capacity of the main storage tanks was based on a 7-day storage at average design hypochlorite dosage and flow rate after taking into account various factors, such as reliability of supply, allowance for decay and avoidance of over-storage of hazardous chemicals. To minimize the rate of decay, the sodium

hypochlorite would be stored in a shed house.

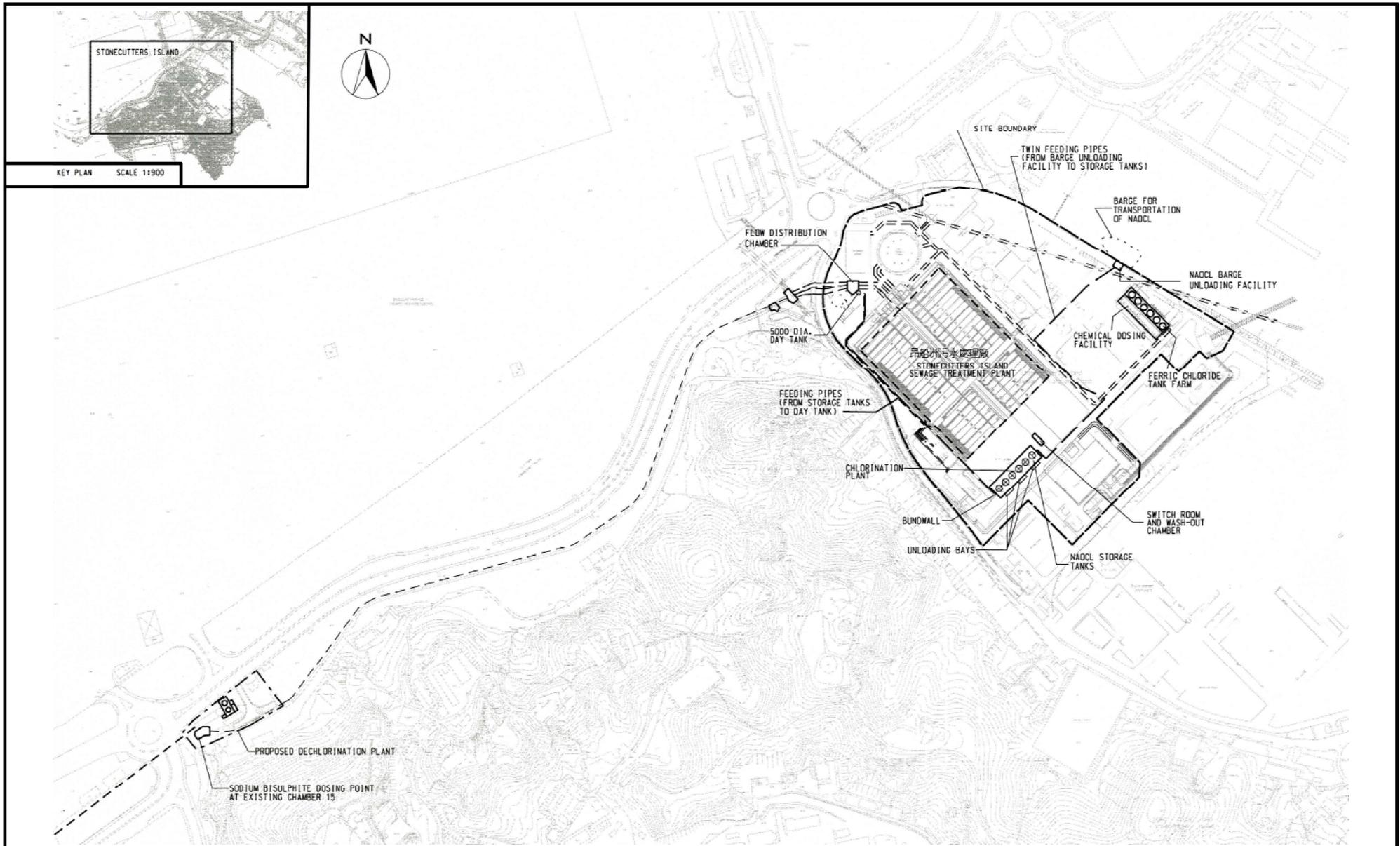
## Conclusion

34. Having regard to the findings and recommendations of the EIA report and information provided by the project proponent, Members agreed to recommend to the full Council that the EIA report could be endorsed with the following proposed conditions –

- (a) a suitable control mechanism should be put in place on the dosage of sodium hypochlorite and sodium bisulphite in the disinfection process to avoid over-dosage and adverse environmental impacts on water quality and marine ecology;
- (b) close to real time on-line monitoring should be conducted on the dosage of sodium hypochlorite and sodium bisulphite as well as TRC concentration at the inlet chamber to the submarine outfall and marine water quality as far as practicable;
- (c) the quality of the effluent discharge (including but not limiting to pH, BOD, SS, *E. coli*, TRC and CBPs) into the inlet of the submarine outfall should be able to meet the discharge limits to be established by the EPD;
- (d) the monitoring programme during the operation phase should be enhanced on the marine water quality for chemical parameters on TRC and CBPs as well as the whole effluent toxicity tests having regard to international best practices for similar large-scale disinfection facilities. The monitoring schedule should be enhanced by increasing the frequency of tests and subject to a period of review. The monitoring reports should be put on a designated website;
- (e) the results of the monitoring should be reported to the EIA Subcommittee of ACE on a quarterly basis; and
- (f) a suitable emergency response plan should be put in place to deal with deviation of monitoring results from the predictions in respect of water quality and marine ecological risk.

EIA Subcommittee Secretariat

October 2007



**Figure 1: General Layout of Proposed Chlorination / Dechlorination Disinfection System (Reproduced from Figure 2.1 of the EIA Report)**

**Project Title: Harbour Area Treatment Scheme (HATS) – Provision of Disinfection Facilities at Stonecutters Island Sewage Treatment Works**

