Annex 6A

Water Quality Method Statement

CONTENTS

APPENDIXES

1 INTRODUCTION

This *Method Statement* presents information on the approach for the water quality assessment and modelling works for the study. The methodology has been based on the following three focus areas, as follows:

- Model Selection;
- Input Data; and,
- Scenarios.

1.1 INTERPRETATION OF THE REQUIREMENTS: KEY ISSUES AND CONSTRAINTS

The objectives of the modelling exercise are to assess:

- Effects of construction, which comprises the study of the dispersion of sediments released during construction, including the installation of a submarine pipeline, water main and power cables;

- Effects of operation due to reclamations (affecting flows and potentially water quality due to changing flows); discharges (potentially affecting temperatures and water quality due to chlorine or other antifoulants); and maintenance dredging (potentially increasing suspended solids in water column);

- Any residual impacts, which include any change in hydrodynamic regime; and,

- Any cumulative impacts due to other projects or activities within the study area.

The construction and operational effects have been studied by means of mathematical modelling using existing models that have been set up by WL | Delft Hydraulics (Delft) on behalf of the Environmental Protection Department (EPD) or approved by the EPD for use in environmental assessments.

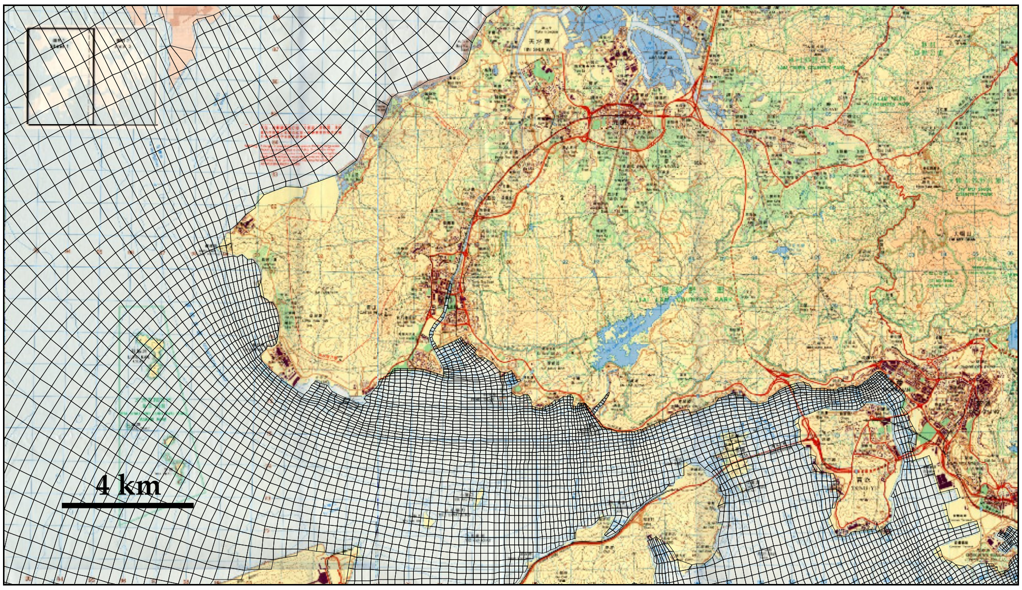
1.2 MODEL SELECTION

The existing Western Harbour Model of the Delft 3D water quality (WAQ) and hydrodynamic suite of models have been used to simulate effects on hydrodynamics and water quality. These models have been calibrated as part of the Landfill Extension Study.

The WAQ model has been used to simulate water quality impacts during construction and operation of the facility. The existing Update model has the required spatial extent. The existing grid of the model in the vicinity of South Soko and Black Point are shown in *Figure A1.1* and *Figure A1.2*.

Figure A1.1 Model Grid of the Update Model in the Vicinity of Soko Islands

Figure A1.2 Model Grid of the Update Model in the Vicinity of Black Point



As seen in *Figures A1.1* and *A1.2*, the grid size of the existing model near the site is in the order of about 300 m. It was, therefore, considered appropriate to carry out refinement of the water quality and hydrodynamic grids to provide improved resolution (less than 75 m) in key areas of interest. The refinements of the model grid of the Update Model in the vicinity of Soko Islands and Black Point are shown in *Figure A1.3* and *Figure A1.4* respectively.

Figure A1.3 Refinement of Model Grid of the Update Model in the Vicinity of Soko Islands

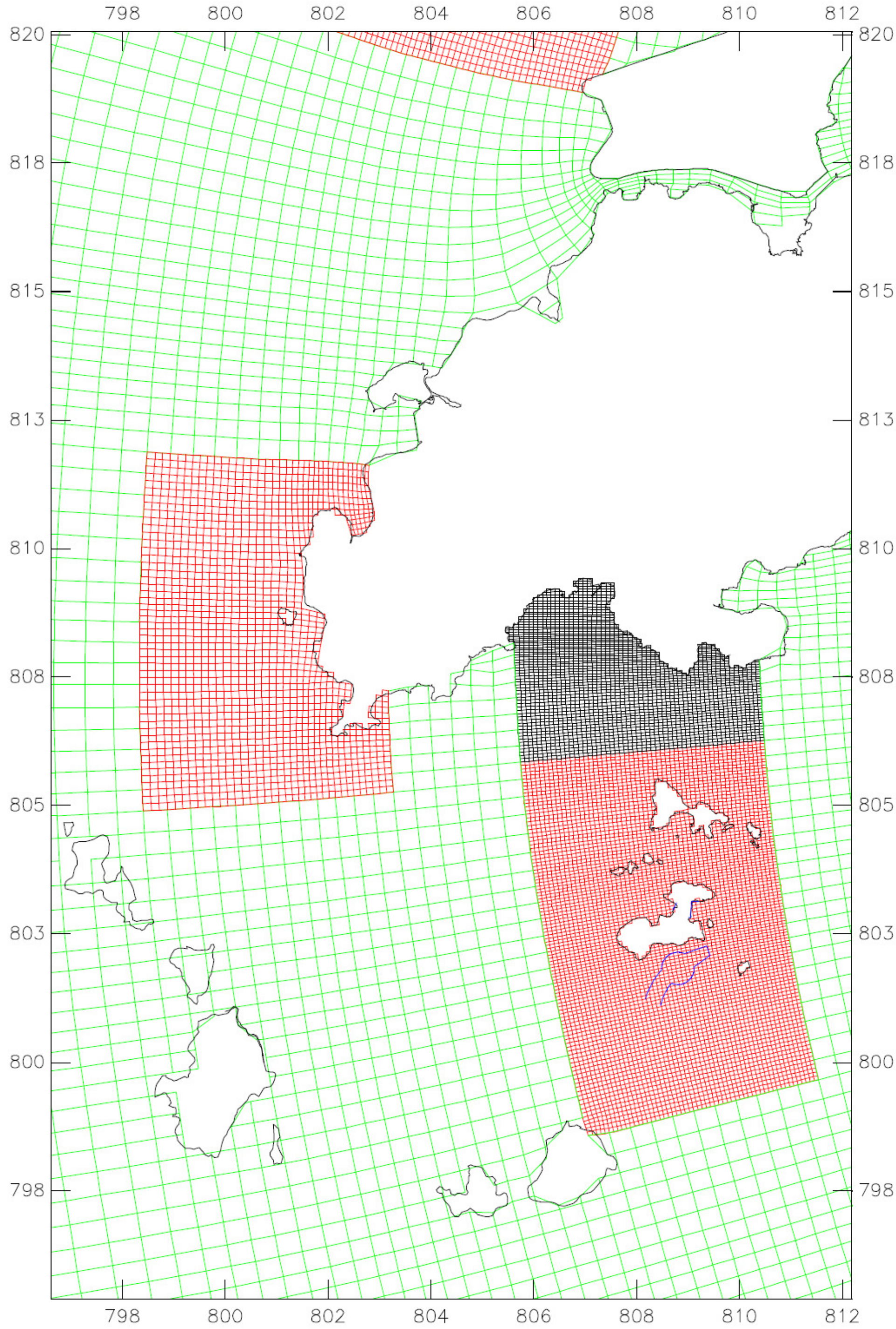
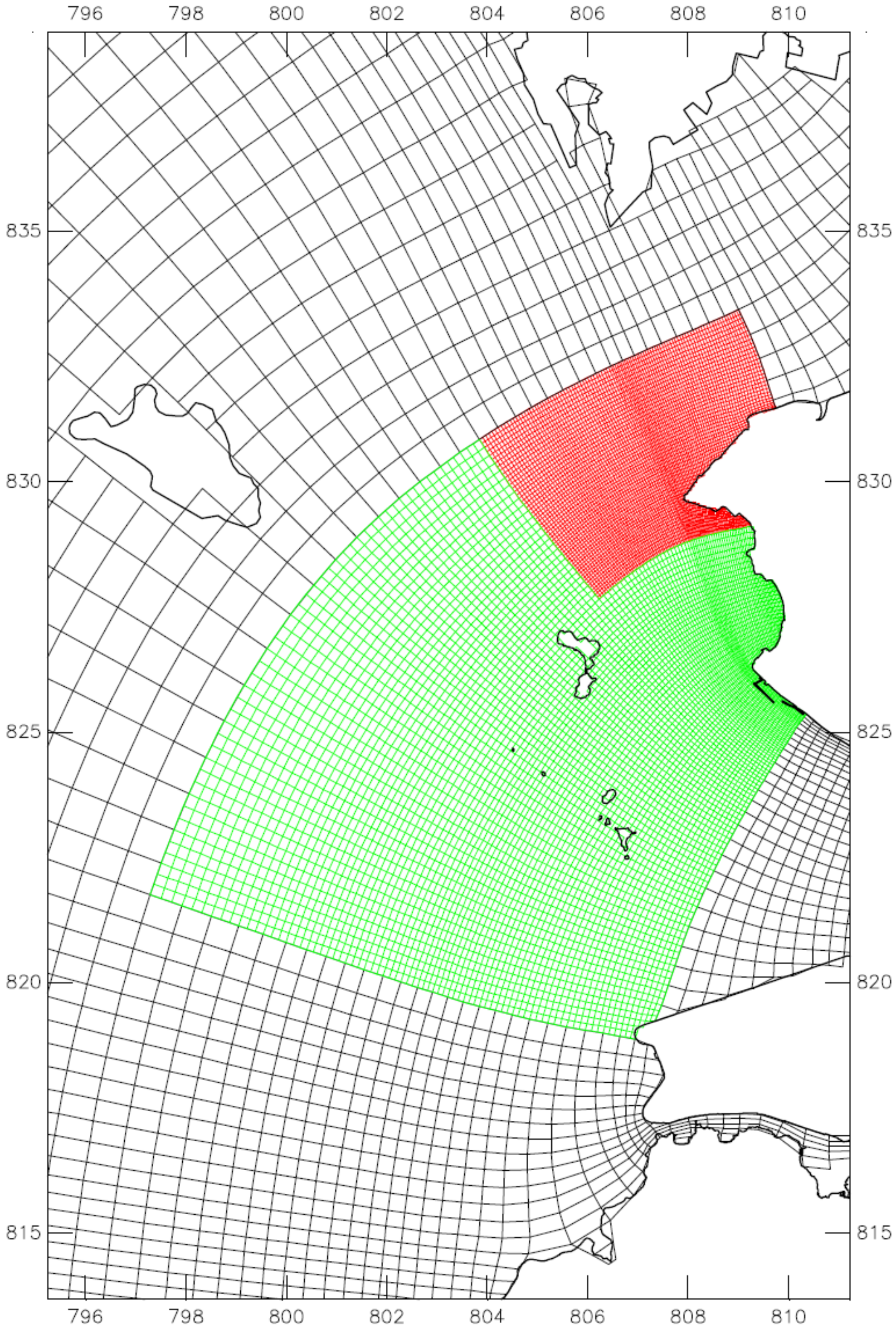


Figure A1.4 Refinement of Model Grid of the Update Model in the Vicinity of Black Point



1.3 *COASTLINE & BATHYMETRY*

Hydrodynamic data have been obtained using coastline and bathymetry for a time horizon representative of the construction and operation of the facility (i.e., 2007 onwards). *Figures A1.5a, A1.5b* and *A1.6* show the bathymetry and coastline during construction phase, whereas *Figure A1.7* during operational phase at the LNG terminal at South Soko Island.

Figure A1.5a Bathymetry and Coastline in the Vicinity of Black Point (2007 onwards)

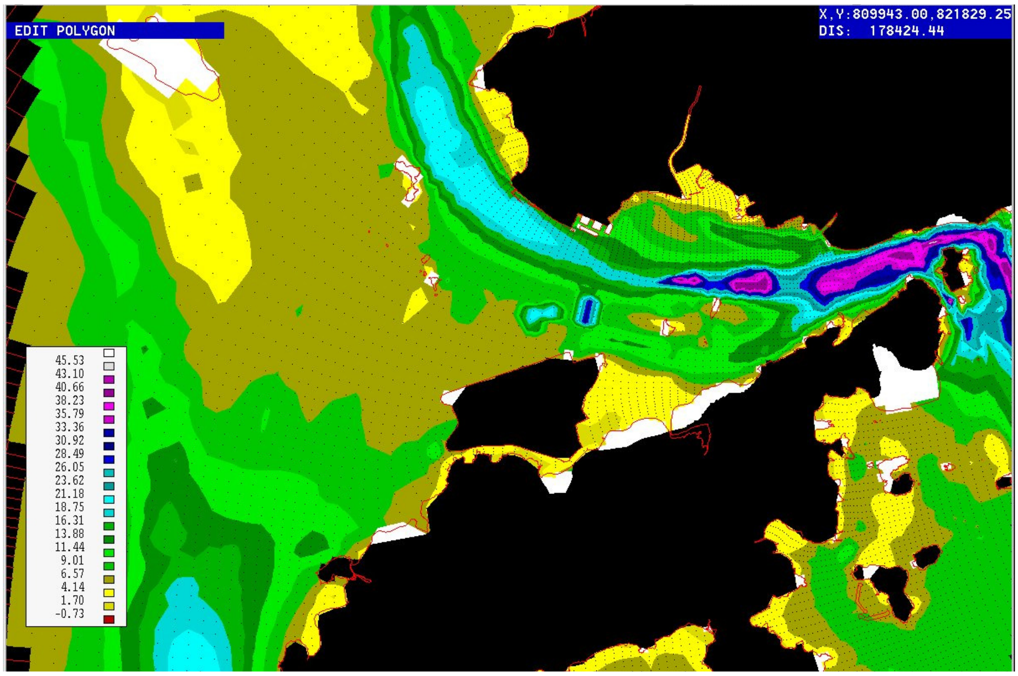


Figure A1.5b Coastline Used in the Model for the Project Area (2007 onwards)

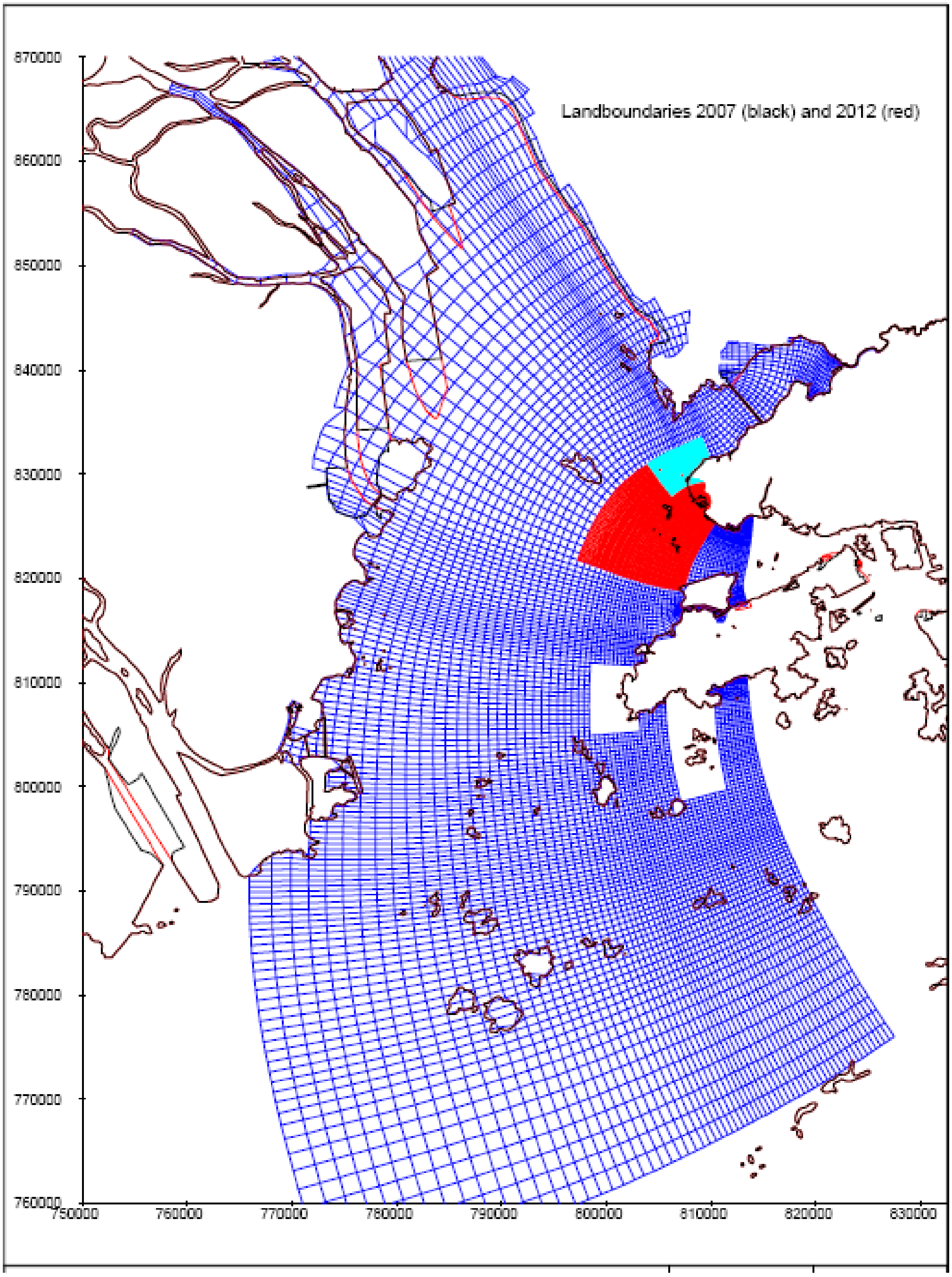


Figure A1.6 Bathymetry and Coastline in the Vicinity of South Soko Island (2007 onwards)

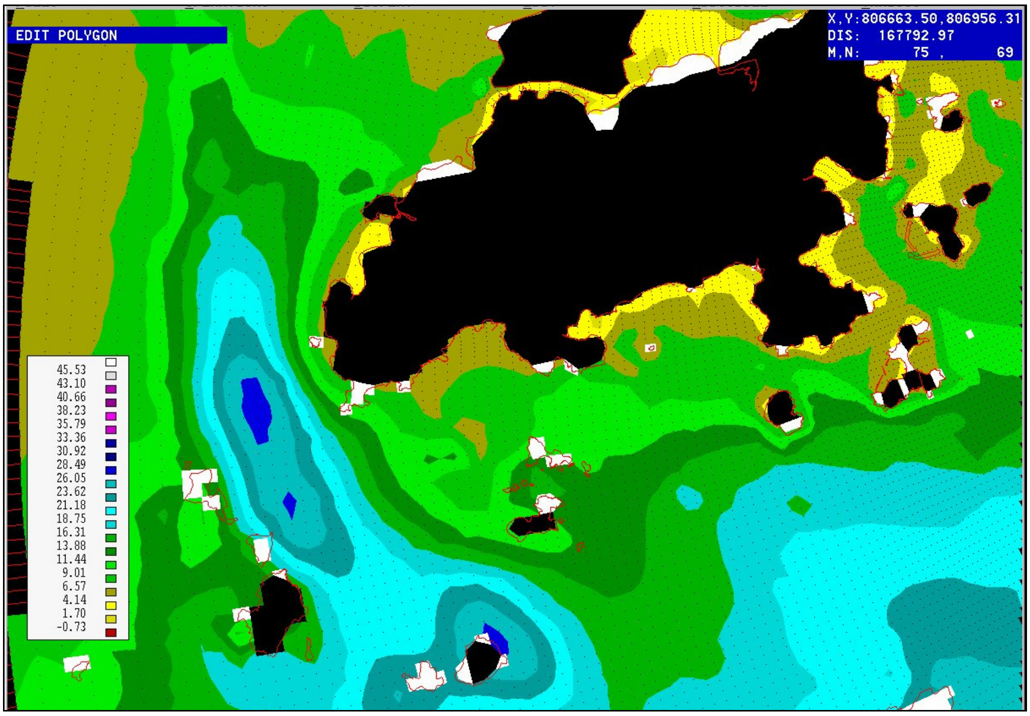
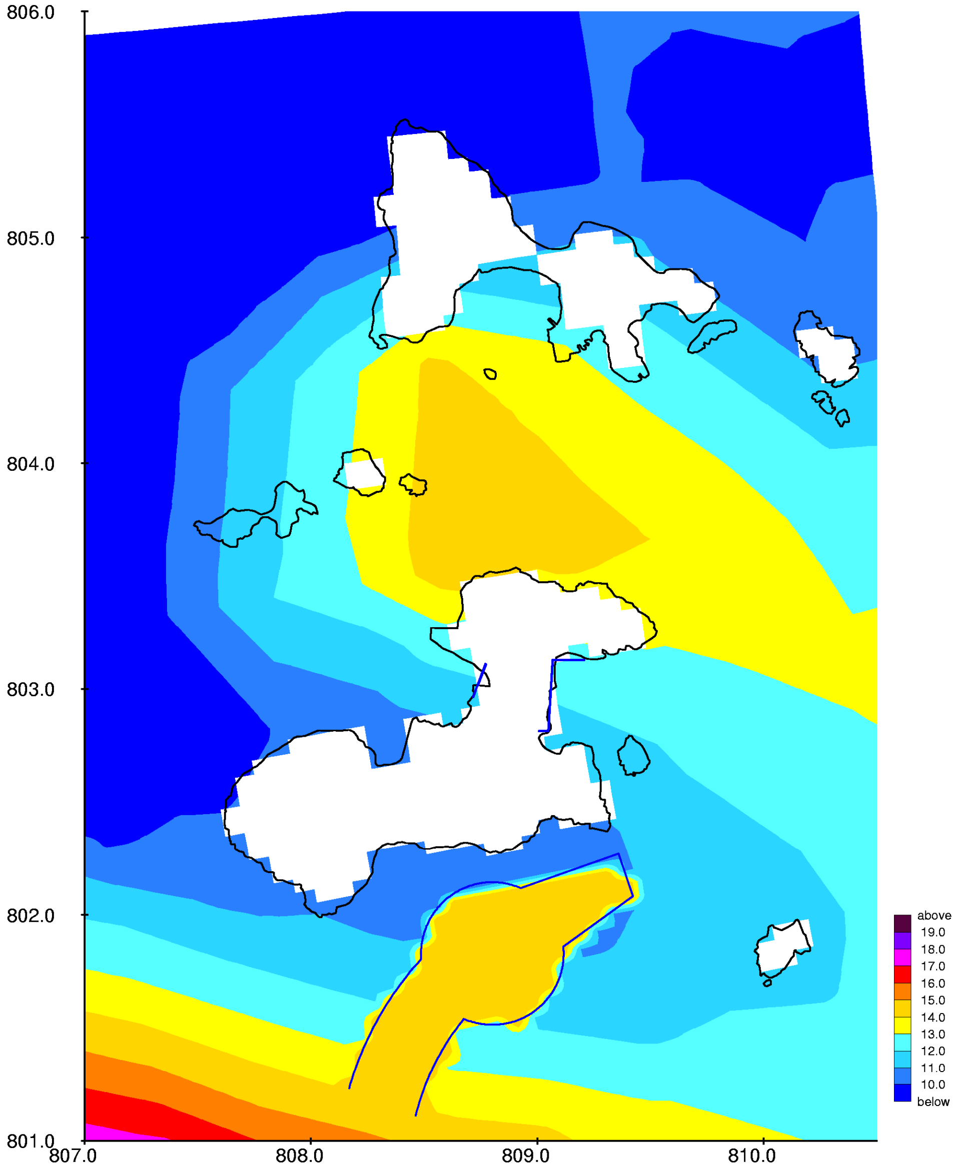


Figure A1.7 Operational Bathymetry at South Soko



1.4 *VECTOR INFORMATION*

The current patterns in the project area are presented in *Figures SK_B01-B08* (pre-project situation) and *Figures SK_F01-08* (post-project situation).

Under pre-project situation, the plots indicate that, in general, for the area in around the LNG terminal in South Soko Island current velocities rarely exceed 0.2 m s^{-1} in the dry season and 0.3 m s^{-1} in the wet season. Maximum current velocities appear to be in the order of 0.6 m s^{-1} in the dry season and 2 m s^{-1} in the wet season, in areas predominantly offshore, or on the south western headland of South Soko Island.

Under post-project situation, the current velocities are likely of similar magnitude at both seasons.

1.5 *INFORMATION ON MODEL INPUTS*

Details on the model input parameters are presented in *Appendix A* in this Annex.

1.6 *UNCERTAINTIES IN ASSESSMENT METHODOLOGIES*

Uncertainties in the assessment of the impacts from suspended sediment plumes should be considered when drawing conclusions from the assessment. In carrying out the assessment, the worst case assumptions have been made in order to provide a conservative assessment of environmental impacts. These assumptions are as follows:

- The assessment is based on the peak dredging and filling rates. In reality, these will only occur for short period of time; and,
- The calculations of loss rates of sediment to suspension are based on conservative estimates for the types of plant and methods of working.

The conservative assumptions presented above allow a prudent approach to be applied to the water quality assessment.

The following uncertainties have not been included in the modelling assessment.

- *Ad hoc* navigation of marine traffic;
- Near shore scouring of bottom sediment; and
- Access of marine barges back and forth the site.

2 *WATER QUALITY SENSITIVE RECEIVERS*

The water quality sensitive receivers (SRs) have been identified in the EIA (*Part 2 - Section 6: Water Quality Assessment*) in accordance with *Annex 14* of the *Technical Memorandum* on EIA Process (*EIAO, Cap.499, S.16*). These SRs are illustrated in *Figure A2.1* and listed in *Table A2.1*. In addition to the SRs, there are other additional water modelling output points at some representative locations are selected for further analysis (thereinafter regarded as MPs) and they are shown in *Table A2.2* and also presented in *Figure A2.1*. EPD routine water quality monitoring stations are shown in *Table A2.3* for reference.

Table A2.1 Water Quality Sensitive Receivers (SRs) around Proposed LNG Terminal at South Soko and Black Point and the Submarine Pipeline Section from South Soko to Black Point

Sensitive Receiver	Name	Water Quality Modelling Output Location	Included in the Model
Fisheries Resources			
Spawning/ Nursery Grounds	Fisheries Spawning/ Nursery Grounds in South Lantau	SR16b, SR24, SR27	Yes
	Fisheries Spawning Ground in North Lantau	SR8	Yes
Artificial Reef Deployment Area	Sha Chau and Lung Kwu Chau	SR6e	Yes
	Northeast Airport	SR7d	Yes
Fish Fry Habitat	Pak Tso Wan	SR16b	Yes
Fish Culture Zone	Cheung Sha Wan	SR38	No
	Ma Wan	SR40a-b	No
Marine Ecological Resources			
Seagrass Beds	Pak Nai	SR2	Yes
Marine Park	Designated Sha Chau and Lung Kwu Chau	SR6a-d	Yes
Potential Marine Park	South West Lantau	SR19a-c	Yes
Mangroves	Pak Nai	SR2	Yes
Intertidal Mudflats	Pak Nai	SR1	Yes
	Tai O	SR12	Yes
	Yi O	SR14	Yes
	Shui Hau Wan	SR33	Yes
Horseshoe Crab Nursery Grounds	Pak Nai	SR1	Yes
	Sham Wat Wan	SR10	Yes
	Tai O	SR12	Yes
	Yi O	SR14	Yes
	Sha Lo Wan	SR18	Yes
	Tong Fuk Miu Wan	SR33	

Sensitive Receiver	Name	Water Quality Modelling Output Location	Included in the Model
	Tung Chung Bay	SR39	Yes
Protection Zone	Chinese White Dolphin Protection Zone in Mainland Waters	SR11, SR11a-b	Yes
Water Quality Sensitive Receivers			
Gazetted Beaches	Butterfly Beach	SR5c	Yes
	Tuen Mun Beaches	SR5d	No
	Tong Fuk	SR34	Yes
	Upper Cheung Sha Beach	SR35	Yes
	Lower Cheung Sha Beach	SR36	No
	Pui O Wan	SR37	No
Non-gazetted Beaches	Lung Kwu Sheung Tan	SR5a	Yes
	Lung Kwu Tan	SR5b	Yes
	Fan Lau Sai Wan	SR15a	Yes
	Fan Lau Tung Wan	SR15b	Yes
	Tsin Yue Wan	SR15c	Yes
Seawater Intakes	Black Point Power Station	SR4	Yes
	Castle Peak Power Station	SR7a	Yes
	Tuen Mun Area 38	SR7b	Yes
	Airport	SR7c-f	Yes
	Tuen Mun WSD	SR7h	No

Table A2.2 Water Quality Modelling Output Points (MPs) around Proposed LNG Terminal at South Soko and Black Point and the Submarine Pipeline Section from South Soko to Black Point

Sensitive Receiver	Name	Water Quality Modelling Output Points	Included in the Model
Representative Intertidal & Subtidal Coastal Location	Kau Ling Chung (Rocky)	MP23, MP25-26, MP28-30	Yes
	Tai Long Wan (Sandy)	MP20-21	Yes
	Kau Ling Chung	MP23	Yes
Operational Seawater Intake	South Soko Island	MP40	Yes

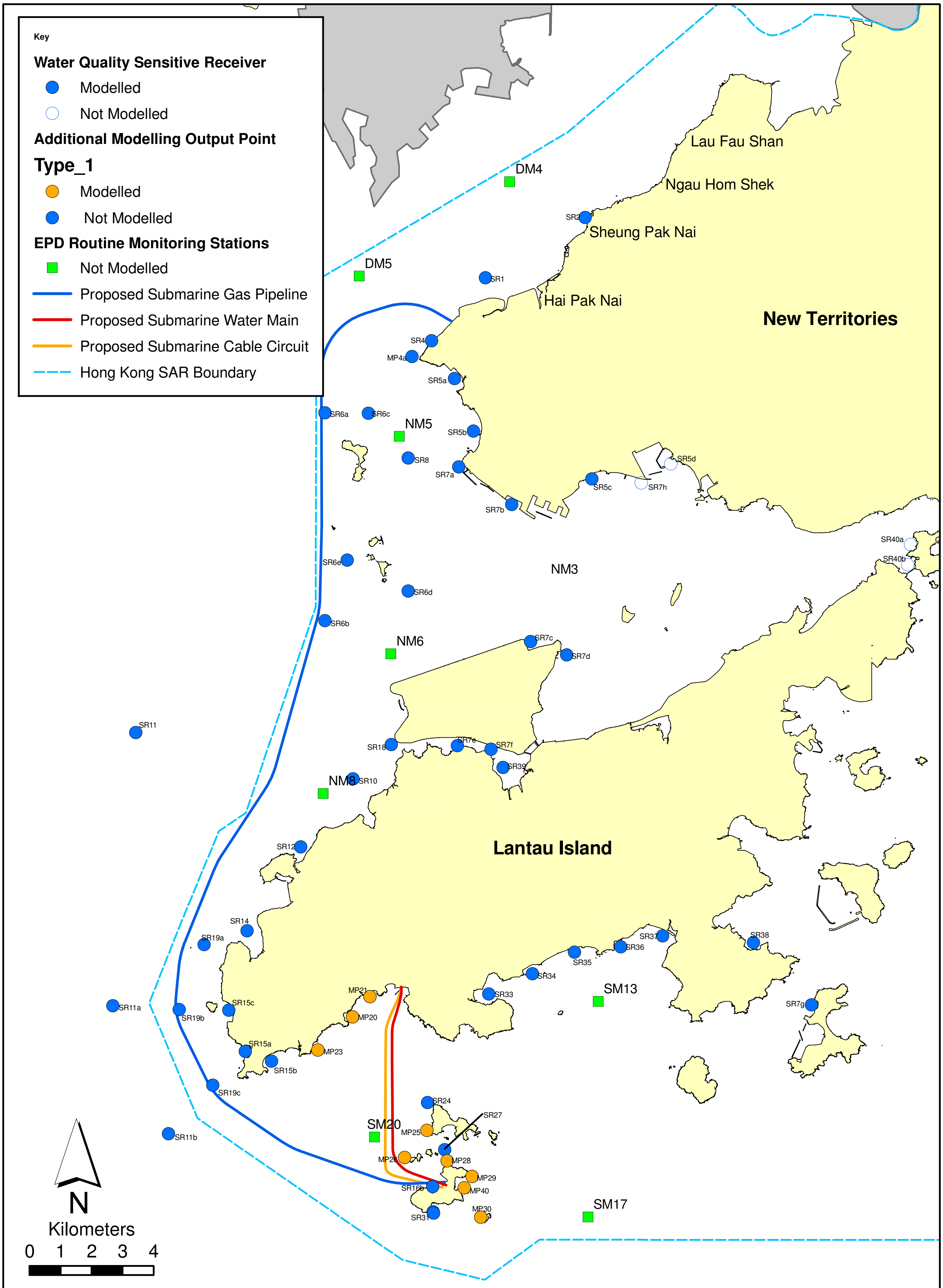


FIGURE A2.1

Water Quality Sensitive Receivers and
Additional Modelling Output Points in the Vicinity of
the Proposed LNG Terminal at South Soko and
along the Pipeline Route

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Table A2.3 EPD Routine Water Quality Monitoring Stations in the Vicinity of the Project Area

EPD Monitoring Stations	Respective WCZ	Included in the Model
DM4, DM5	Deep Bay WCZ	No
NM5, NM6, NM8	North Western WCZ	No
SM13, SM17, SM20	Southern WCZ	No

3 CONSTRUCTION PHASE

For the construction phase the WAQ model has been used to **directly** simulate the following parameters:

- suspended sediments; and
- sediment deposition.

It is assumed that the worst-case construction phase impacts will be at the commencement of dredging, when there is no depression formed to trap sediments disturbed during works.

Note that DO, TIN and NH_3-N are calculated using the modelled maximum SS concentrations as shown in *Section 6: Water Quality Impact Assessment*.

3.1 WORKING TIME

South Soko Island is relatively remote in nature and for water quality modelling a 24 working hours per day and 7 working days per week is assumed. Exception is given to submarine water mains construction and cable circuit installation. The former assumed 16 working hours per day at all locations except at the land and launching point where 24 working hours per day were assumed, and 7 working days per week while the latter assumed 12 working hours per day and 6 working days per week. These time differences relate to typical practices by contractors in Hong Kong that would be involved in these works. Working hours for gas receiving station at Black Point are assumed to be 16 per day and 7 working days per week.

The assumption of working time in the model is summaries in *Table A3.1*.

Table A3.1 A Summary of Working Time Assumed in the Model for Various Construction Activities

Construction Activities	Locations	Assumption of Working Time
Seawall Construction	Eastern berth at South Soko Island	24 hours per day and 7 days per week
	Western berth at South Soko Island	24 hours per day and 7 days per week
Approach Channel and Turning Basin	South of South Soko Island	24 hours per day and 7 days per week
Submarine Water Main	Landing point (using the common shore approach with cable)	24 hours per day and 7 days per week
	Other section in the open waters	16 hours per day and 7 days per week

Construction Activities	Locations	Assumption of Working Time
Submarine Cable Circuit	Landing point (using the common shore approach with cable)	24 hours per day and 7 days per week
	Other section in the open waters	12 hours per day and 6 days per week
Submarine Gas Pipeline	From South Soko Island to Black Point	For grab dredging, 12 hours per day (daytime) and 7 days per week For THSD dredging, 24 hours per day and 7 days per week
Submarine Gas Pipeline (Gas Receiving Station)	Black Point	16 hours per day and 7 days per week

3.2 OVERVIEW OF DREDGING PLANTS

3.2.1 *Grab Dredgers*

Grab dredgers will be utilised in the dredging works for the reclamation works at the terminal as well as the navigation channel, turning circle and berthing box. Also the submarine water mains, some sections of the submarine pipeline and the gas receiving station may need to be pre-trenched and this is likely to be done utilising a grab dredger.

Grab dredgers may release sediment into suspension by the following mechanisms:

- Impact of the grab on the seabed as it is lowered;
- Washing of sediment off the outside of the grab as it is raised through the water column and when it is lowered again after being emptied;
- Leakage of water from the grab as it is hauled above the water surface;
- Spillage of sediment from over-full grabs;
- Loss from grabs which cannot be fully closed due to the presence of debris;
- Release by splashing when loading barges by careless, inaccurate methods; and
- Disturbance of the seabed as the closed grab is removed.

In the transport of dredging materials, sediment may be lost through leakage from barges. However, dredging permits in Hong Kong include requirements that barges used for the transport of dredging materials have bottom-doors that are properly maintained and have tight-fitting seals in order to prevent leakage. Given this requirement, sediment release during transport is not proposed for modelling and its impact on water quality is not addressed under this Study.

Sediment is also lost to the water column when discharging material at disposal sites. The amount that is lost depends on a large number of factors including material characteristics, the speed and manner in which it is discharged from the vessel, and the characteristics of the disposal sites. As impacts due to disposal operations at potential disposal sites have been assessed under separate studies, they are not addressed further in this document.

Loss rates have been taken from previously accepted EIAs in Hong Kong (1) (2) and has been based on a review of world wide data on loss rates from dredging operations undertaken as part of assessing the impacts of dredging areas of Kellett Bank for mooring buoys (3). The assessment concluded that for 8 m^3 (minimum) grab dredgers working in areas with significant amounts of debris on the seabed (such as in the vicinity of existing mooring buoys) that the loss rates would be 25 kg m^{-3} dredged, while the loss rate in areas where debris is less likely to hinder operations would be 17 kg m^{-3} dredged.

For this Study it is proposed that the loss rate of 17 kg m^{-3} dredged for grab dredging (grab size of 12/16 m^3) be used as geophysical surveys have shown that there are no significant quantities of debris in the vicinity of the dredging works (4).

Generally, a split-bottom barge could have a capacity of 900 m^3. A bulk factor of 1.3 would normally be applied, giving a dredging rate of 700 m^3 per barge. The hopper dry density for an 800 to 1,000 m^3 capacity barge is around 0.75 to 1.24 ton m^{-3}.

The average release rates will, in fact, be somewhat less than those indicated above. The instantaneous dredging (and loss) rates will also decrease as the depth increases. This is because the assumed dredging production rates are instantaneous rates that will not be maintained due to delays for breakdowns, maintenance, crew changes and time spent relocating the dredgers. The release rates that are to be modelled area, therefore, considered to represent conservative conditions that will not prevail for any great length of time.

A review of the vector plots at the sites allowed identification of areas that would disperse sediment further than other areas due to higher current

(1) ERM - Hong Kong, Ltd (2005) Detailed Site Selection Study for Proposed Contaminated Mud Disposal Facility within the Airport East/East of Sha Chau Areas. Environmental Impact Assessment (EIA) and Final Site Selection Report. For the Civil Engineering and Development Department, Hong Kong SAR Government. Approved on 1 September 2005

(2) ERM-Hong Kong, Ltd (2000) Construction of an International Theme Park in Penny's Bay of North Lantau together with its Essential Associated Infrastructures - Final EIA Report. For the Civil Engineering and Development Department, Hong Kong SAR Government. Approved on 28 April 2000.

(3) ERM - Hong Kong, Ltd (1997) Environmental Impact Assessment: Dredging an Area of Kellett Bank for Reprovisioning of Six Government Mooring Buoys. Working Paper on Design Scenarios. For the Civil Engineering Department, Hong Kong Government.

(4) EGS (Asia) Limited (2005) Ground Investigation. For CLP Power Hong Kong Limited.

velocities. These areas were consequently chosen as the locations of the sources of sediment in the model.

3.2.2 *Trailing Suction Hopper Dredgers*

Trailing Suction Hopper Dredgers (TSHD) will be used mainly for the approach channel and turning circle. It may also be deployed during the dredging for the submarine gas pipeline.

The hopper dry density for a TSHD is typically 0.75 ton m^{-3}. TSHD could dredge at a faster rate than grab dredgers (typical dredging rate of 5,400 m^3 per trip per TSHD with a maximum dredging rate up to 7,200 m^3 per trip depending on the vessel size). For the modelling scenarios it has been assumed that the Contractor will utilise a small (<5,000 m^3) to medium (5,000 – 10,000 m^3) TSHD.

A review of international data on losses from trailer dredgers has determined that a loss rate of 7 kg m^{-3} dredged would be appropriate irrespective of the size of the dredger, assuming no overflowing but that the Lean Mixture Overboard (LMOB) systems are in operation [(1)] [(2)] [(3)]. LMOB is used at the beginning and end of the dredging cycle when the suction arm is being lowered and raised. At these times the majority of the material entering the hopper will be water with small amounts of fine sediments, which is discharged to the sea via the overflow system.

Overflowing refers to the discharge of fine sediment and water during bulk dredging and results in high losses of sediment to suspension. Overflowing is not usually permitted when dredging in marine mud and is usually only allowed during dredging of sand deposits, when overflowing is utilised to increase the density of the material in the hopper.

The value of 7 kg m^{-3} [(1)] [(2)] [(3)] dredged for dredging using trailing suction hopper dredgers will be appropriate for this Study as LMOB will be used but overflowing will not be permitted. It has also been assumed that no more than one THSD dredger will be operating at any one time.

During dredging the drag head will sink below the level of the surrounding seabed and the seabed sediments will be extracted from the base of the trench formed by the passage of the draghead. The main source of sediment release is the bulldozing effect of the draghead when it is immersed in the mud. This mechanism means that sediment is lost to suspension very close to the level of the surrounding seabed and a height of 1 m has been adopted for the initial location of sediment release in the model.

(1) ERM - Hong Kong, Ltd (1997) Op cit.

(2) Kirby, R and Land J M (1991). The impact of Dredging - A Comparison of Natural and Man-Made Disturbances to Cohesive Sedimentary Regimes. Proceedings CEDA-PIANC Conference (incorporating CEDA Dredging Days), November 1991, Amsterdam. Central Dredging Association, the Netherlands.

(3) Environment Canada (1994). Environmental Impacts of Dredging and Sediment Disposal. Les Consultants Jaques Beraube Inc for the Technology Development Section, Environmental Protection Branch, Environment Canada, Quebec and Ontario Branch.

Disposal site at South Cheung Chau is assumed to be available at the time of dredging works commissioned. Contractor should confirm the availability of the disposal site prior to any disposal events. Based on this assumption, the cycle time for a TSHD is calculated as presented in *Table A3.2*.

Table A3.2 Cycle Time for a TSHD

Disposal Site	**TSHD Works Site**	**Distance (km)**	**Sailing Speed (km hr-1)**	**Off-site (Travel) Time (hr)**	**On-site Dredging Time (hr)**	**On-site Idle Time (hr)**	**Total Cycle Time (hr)**	**Working hours per day (hr)**	**Number of Cycles per day**
(a)	(b)	(c)	(d)	(e) = 2*(c)/(d)	(f)	(g) = 2 hr - (f)	(h) = (e) + (f) + (g)	(i)	(j) = (i)/(h)
South Cheung Chau	South Soko	11	28.34	0.78	0.75	1.25	2.78	24	9
South Cheung Chau	Fan Lau Crossing	17	28.34	1.20	0.75	1.25	3.20	24	8
South Cheung Chau	Lantau Channel	24	28.34	1.69	0.75	1.25	3.69	24	6
South Cheung Chau	West Lantau	30	28.34	2.12	0.75	1.25	4.12	24	6

3.3 *JETTING*

The speed of the machine will progress depending on the construction type. Jetting speeds have been taken as 65 m hr^{-1} for water mains construction, 150 m hr^{-1} for cable circuit installation and 21 m hr^{-1} for gas pipeline installation. These rates relate to typical practices by contractors in Hong Kong that would be involved in these works.

The maximum burial depth for each installation will be 5 m. For water mains and gas pipeline, it is envisaged that it will require three passes of the jetting machine to reach the required burial depth. The volumes of sediment disturbed will vary depending upon whether it is the first, second or third pass. The consecutive passes may uplift the bottom sediment in a short period of time. Despite, this will be temporary and instantaneous disturbance to the seabed since the disturbed sediment is expected to settle on the seabed in a short period after the jetting machine has passed.

For the water main, if we assume a conservative case for the third pass (17.5 m^3 per m), the rate of disturbance will be 0.32 $m^3 s^{-1}$ (1). Similarly, for the cable circuit installation, the rate of disturbance will be 0.06 $m^3 s^{-1}$ (1.5 m^3 per m) (1). The rate of disturbance for the pipeline will be 0.09 $m^3 s^{-1}$ (15 m^3 per m) (1).

(1) For Water Main: 65 m hr^{-1} × (1 ÷ 3600 s hr^{-1}) × 17.5 $m^3 m^{-1}$ = 0.32 $m^3 s^{-1}$;
For Cable Circuit: 150 m hr^{-1} × (1 ÷ 3600 s hr^{-1}) × 1.5 $m^3 m^{-1}$ = 0.0625 $m^3 s^{-1}$;
For Gas Pipeline: 21 m hr^{-1} × (1 ÷ 3600 s hr^{-1}) × 15 $m^3 m^{-1}$ = 0.0875 $m^3 s^{-1}$ when the gas pipeline trench is fully fluidised.

The disturbed sediment will constitute a layer of fluid mud flowing across the seabed either side of the jetting machine and only a small portion of this sediment will enter the water column.

It is conservatively assumed that 20% of the disturbed sediment enters suspension and this would give a loss rate. The loss rate used here has been used in previous projects for submarine utility installations under the *EIAO* that have been installed using jetting methods and have obtained Environmental Permits:

- *The Proposed Submarine Gas Pipelines from Cheng Tou Jiao Liquefied Natural Gas Receiving Terminal, Shenzhen to Tai Po Gas Production Plant, Hong Kong – EIA Study* (AEIAR-071/2003). EP granted on 23 April 2003 (EP-167/2003).
- *132kV Submarine Cable Installation for Wong Chuk Hang - Chung Hom Kok 132kV Circuits* (AEP-126/2002). EP granted on 2 April 2002 (EP-126/2002).
- *FLAG North Asian Loop* (AEP-099/2001). EP granted on 18 June 2001 (EP-099/2001).
- *East Asian Crossing (EAC) Cable System (TKO), Asia Global Crossing* (AEP-081/2000). EP granted on 4 October 2000 (EP-081/2000).
- *East Asian Crossing (EAC) Cable System, Asia Global Crossing* (AEP-079/2000). EP granted on 6 September 2000 (EP-079/2000).
- *Submarine Cable Landing Installation in Tong Fuk Lantau for Asia Pacific Cable Network 2 (APCN 2) Fibre Optic Submarine Cable System, EGS.* EP granted on 26 July 2000 (EP-069/2000).
- *Telecommunication Installation at Lot 591SA in DD 328, Tong Fuk, South Lantau Coast and the Associated Cable Landing Work in Tong Fuk, South Lantau for the North Asia Cable (NAC) Fibre Optic Submarine Cable System* (AEP-064/2000). EP granted in June 2000 (EP-064/2000).

To calculate the mass entrainment rate it is necessary to apply a dry density for the material, which is conservatively assumed to be 700 kg m^{-3}. The sediment will be entered into the model in the model layer closest to the seabed because this will represent the entrainment of sediment to suspension from the layer of fluid mud flowing over the existing seabed. This approach is considered valid as the jetting machine is fluidising the seabed sediments and not excavating the sediments, consequently there will be little vertical entrainment of sediment into the water column.

The sediment will be entered into the model within a series of grid cells to represent the jetting machine moving along the pipeline route. Thus each grid cell will represent a section of the pipeline route and sediment will be entered into that grid cell for the length of time it takes the jetting machine to pass the length of that cell, based on the jetting machine speeds given above. Once the jetting machine has passed that grid cell, sediment will then be entered in the next grid cell on the route. The sediment release in the bed layer (constitute 10 %) of the water column is assumed in the model.

It should be noted that the assumptions in the model has been adopted in the previous approved EIAs and a number of jetting contractors have confirmed that the assumptions adopted in the model for the jetting are reasonable and practical. Further information of the jetting operation is presented in *Annex 6K*.

3.4 DREDGING SCENARIOS

3.4.1 Construction Works for Seawall and Reclamation Areas (Scenario 1)

Dredging

Dredging works will be carried out at eastern and western side of South Soko Island (*Figure A3.1*). The estimated dredged volume under the seawalls and for the approach channel at western berth is approximately 0.28 Mm^3 in total.

With the assumption of 24 hours working at South Soko Island, the average dredging rate would become, 6,300 m^3 (based on 12 m^3 grab size) or 8,400 m^3 day^{-1} (based on 16 m^3 grab size). At the site, taking a conservative assumption when the grabs are just commencing dredging in relatively shallow water and hence a higher production output, the maximum daily rate of production (with a minimum grab size of 8 m^3) will be about 10,000 m^3 day^{-1}, giving a rate of release for the dredger of **1.97 kg s^{-1}**.

Hence, two grab dredgers will be used for the continuous dredging with an emission of **1.97 kg s^{-1}** (whole column).

In view that the inshore part of the eastern berth is too narrow that it does not cover a complete grid cell in the model. A stationary emission point, SS01, is defined at the offshore breakwater. Continuous release at SS01 is considered to be conservative and representative for the dredging area. A stationary emission point, SS02, (*Figure A3.1*) is chosen at a location that has the shortest distance to the nearby sensitive receiver, i.e., fish fry habitat at Pak Tso Wan. This will prevent any underestimation of the impacts to the habitat.

Backfilling

Sandfilling for seawall trench and the reclamation at western berth by a pelican barge (rainbowing) is simulated by assuming a filling rate of 75,000 m^3 day^{-1}. Working hours have been assumed to be 24 per day. The fill material will be marine sand which generally has a fine content ranging from 2% to 10%. As the source of material could not be confirmed at time of EIA compiled, the upper bound of the fine content, i.e. 10% is assumed for the conservative case. The dry density of sand fill will be approximately 1,938 kg

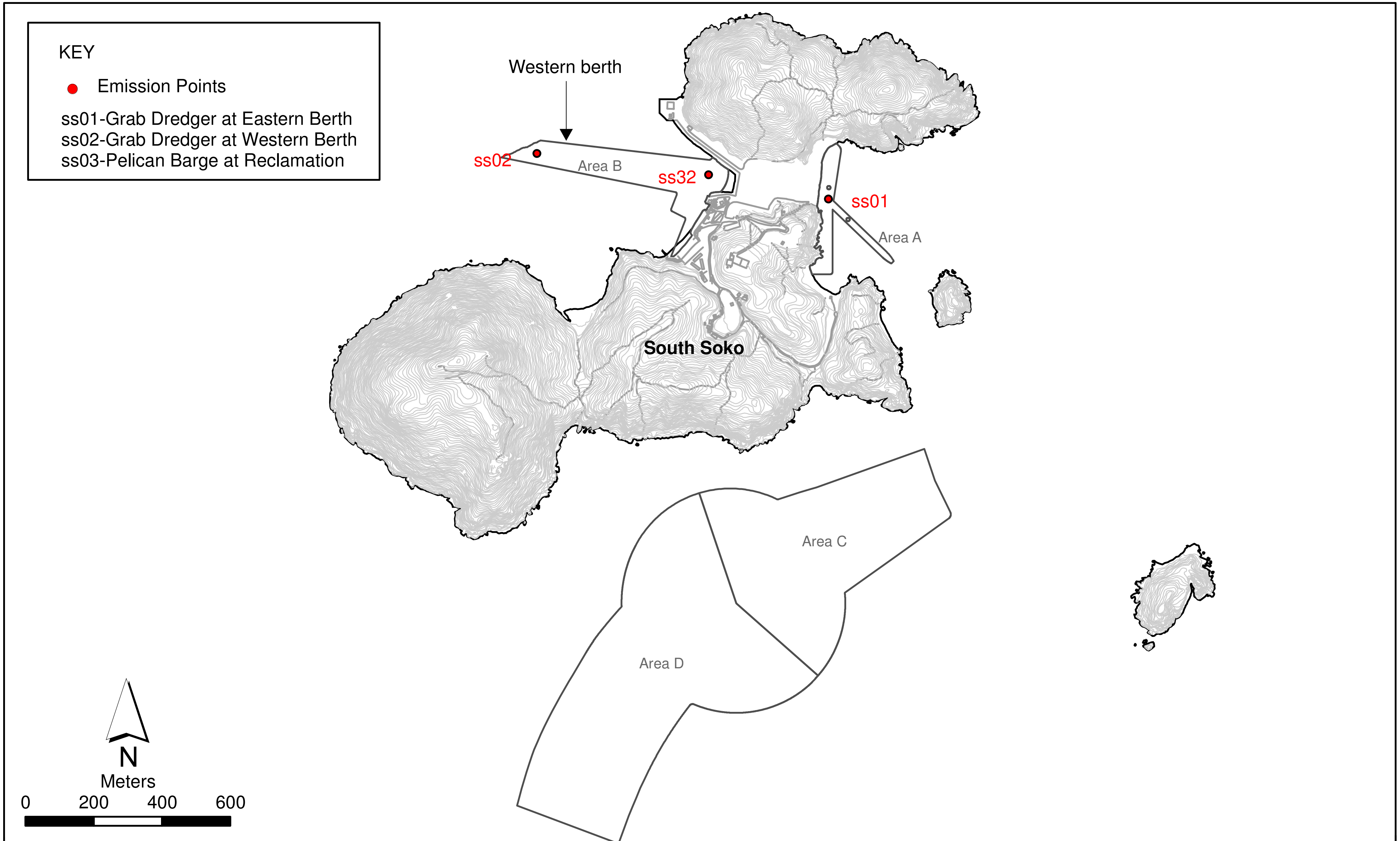

Figure A3.1

Emission Points Defined in the Model for the Construction of the Seawall and the Main Reclamation at South Soko (Scenario 1)

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Date: 14/11/2006

Environmental Resources Management

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m^{-3}. A highly conservative loss rate of 10% is assumed, giving a rate of release of **16.8 kg s^{-1}** (continuous in whole column).

Since the seawall trench and reclamation area is small and close to the shore which is covered by approximately two grid cells in the model, a stationary emission point, SS32, (*Figure A3.1*) has been chosen at a cell that well represents both the seawall trench and the reclamation.

3.4.2 *Construction Works for Water Main Installation (Scenarios 2 and 3)*

The estimated dredged volume for the utility shore approach at South Soko and at Shek Pik is approximately 35,000 m^3 and 37,000 m^3, respectively. At the existing marine sand borrow area and navigation channel, the estimated dredged volume is approximately 140,500 m^3. Working hours have been conservatively assumed to be 16 hours per day and 7 working days per week.

The grab dredging will be operated at South Soko shore approach; Shek Pik shore approach; and waterway crossing sand borrow area and marine navigation channel and will be followed by backfilling operations. Jetting will be used for post trenching near South Soko and Shek Pik.

Grab Dredging (Scenario 2)

Grab dredging at three sections, i.e., South Soko Island shore approach, Shek Pik shore approach and waterway across sand borrow and marine channel, is modelled in Scenario 2. Working hours have been conservatively assumed to be 16 per day. Using the dredging rate of 8,000 m^3 day^{-1} a continuous emission rate of **2.36 kg s^{-1}** has been modelled throughout the whole water column.

Figure A3.2 indicates the location of the water mains as well as the emission sources. The dredging area at the shore is small and hence two stationary emission sources, SS09 and SS10, are chosen for the shore approaches at South Soko Island and Shek Pik respectively. A moving source, SS08, is defined in the model to represent a longer section in the waterway.

Jetting (Scenario 3)

Following grab dredging there will be post trenching jetting at South Soko and Shek Pik sections. Although the jetting works will be carried out one by one without overlapping, Scenario 3 simulates the most conservative case, i.e. the jetting works is conducted simultaneously at the two sections.

Two moving sources (SS09 and SS10 in *Figure A3.3*) with continuous emission rates of **14.7 kg s^{-1}**, **29.5 kg s^{-1}** and **44.2 kg s^{-1}** are defined for the 1st, 2nd and 3rd passes respectively whereas the jetting rate to be 10,400 m^3 day^{-1} and the dry density of sediment to be 700 kg m^{-3}. Working hours have been assumed to be 16 per day. One of the moving sources (SS09) will start at west South Soko (extent seawards following the curve of the watermain over a distance of 1,700 m) and another (SS10) will begin at Shek Pik (extend seawards following

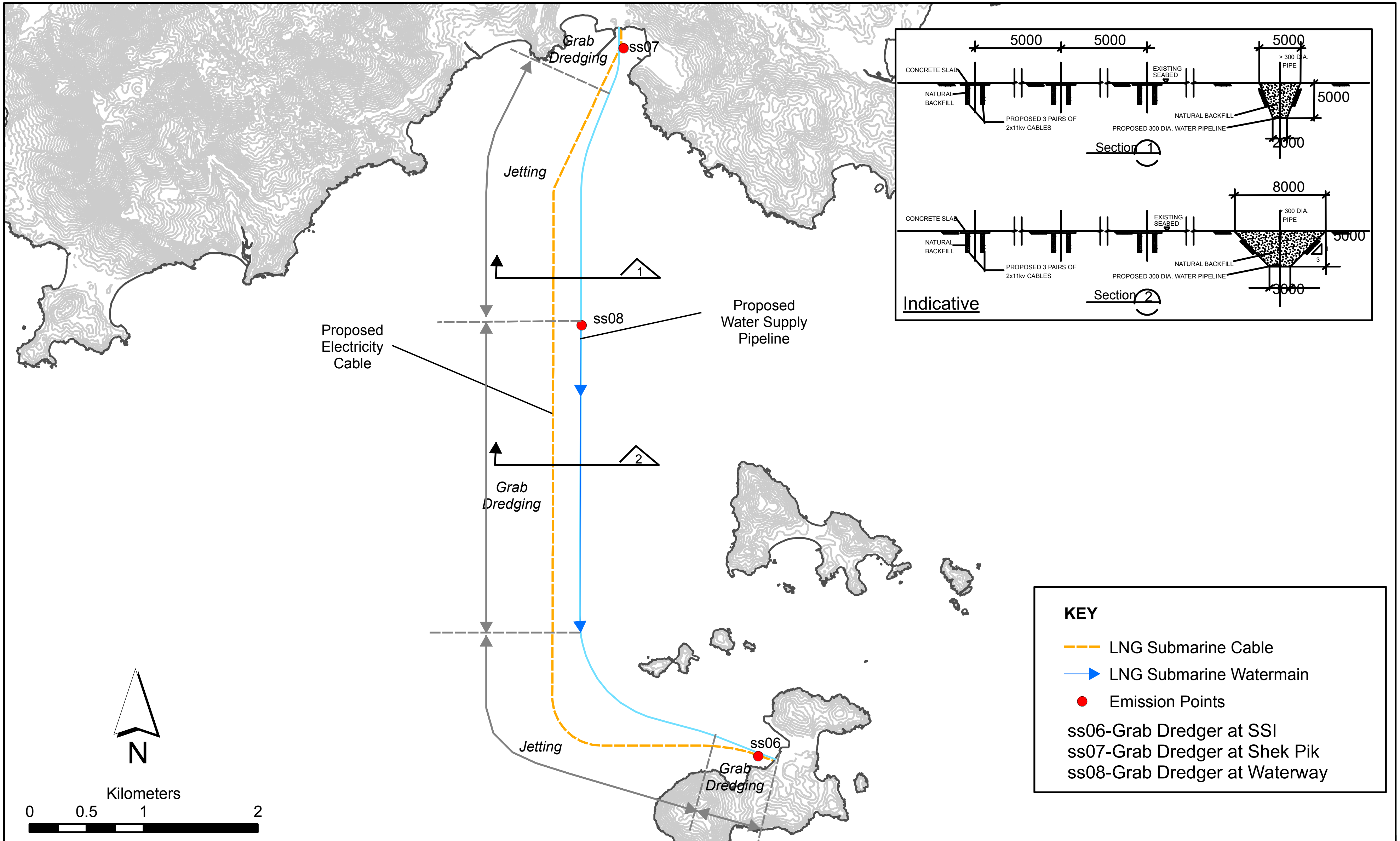

Figure A3.2

Emission Points defined in the Model for the Construcciton of the Water Supply between South Soko and Shek Pik (Scenario 2)

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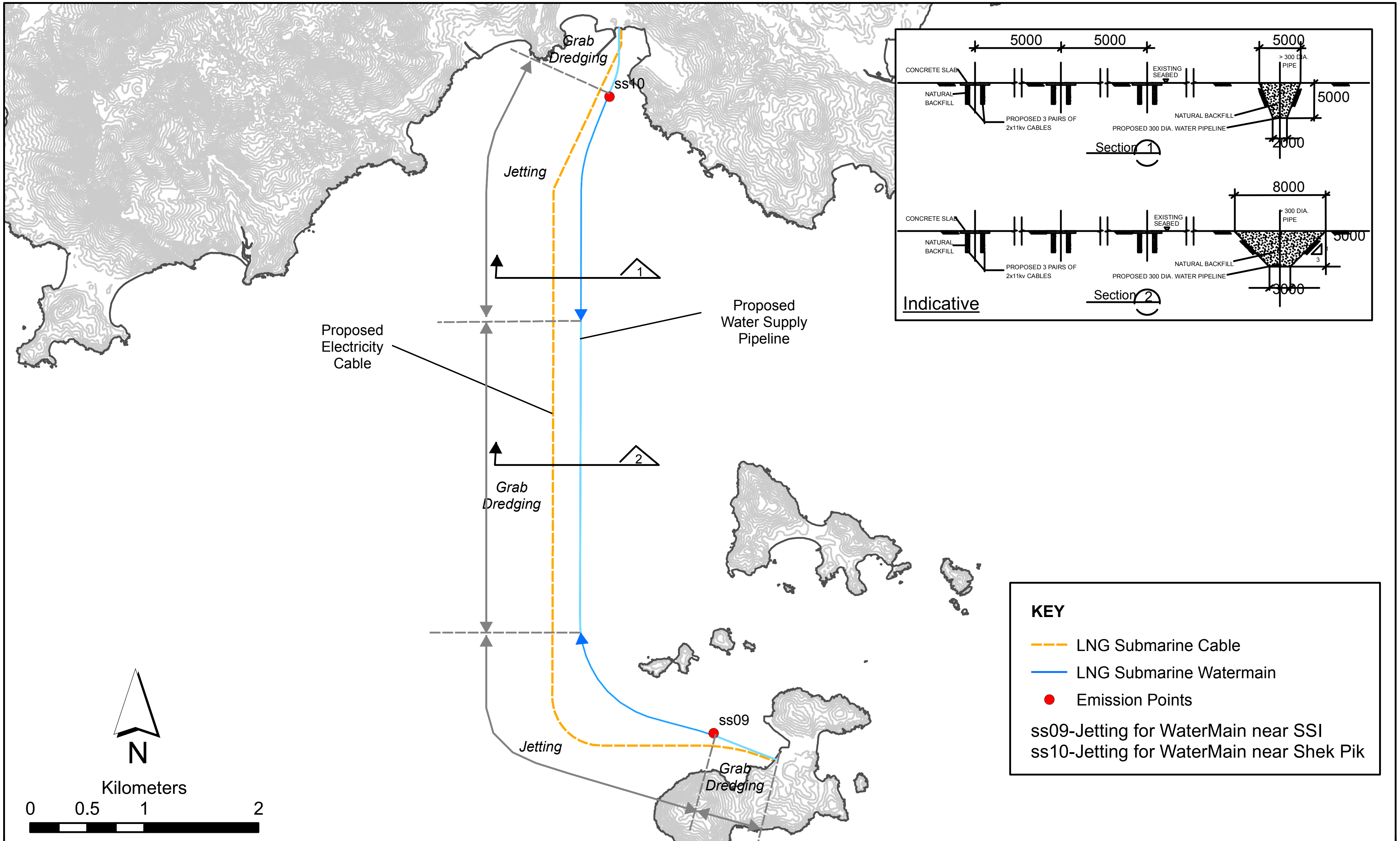

Figure A3.3

Emission Points defined in the Model for the Construcciton of the Water Supply between South Soko and Shek Pik (Scenario 3)

File: 0018180_Dredging_SK_Lantau2.mxd
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the curve of the watermain over a distance of 2,300 m). The speed of progress will be 65 m h^{-1} and three passes will be made without down time between passes. As the disturbed layer would be confined to the seabed the emission will be put at bed layer (10% of the water column).

3.4.3 *Construction Works for Approach Channel and Turning Basin (Scenarios 4a and 4b)*

It is estimated that dredged volume along the approach channel and turning basin is approximately 1.07 Mm^3 in total. There are two dredging options which were defined as Scenarios 4a and 4b. *Figures A3.4* and *A3.5* illustrate the location of the emission for these two options:

- **Scenario 4a:** Deployment of 2 grab dredgers; and,
- **Scenario 4b:** Combination of 1 grab dredger and 1 TSHD.

Deployment of Grab Dredgers (Scenario 4a)

Three grab dredgers will be used to dredge the material within Areas C and D (*Figure A3.4*). On the same basis of the grab dredging of seawall, the emission rate of the grab dredgers is **1.97 kg s^{-1}** (emitted continuously at the whole water column).

A stationary emission point, SS03, is defined in the model to represent the grab dredgers for the jetty whereas SS04a and SS05 are chosen for Areas C and D (the approach channel and basin) respectively. SS04a and SS05, which are also stationary points, are well represent the most conservative case in view of their proximity to the shore and hence the sensitive receiver, i.e., the coral habitat. In reality, the grab dredgers will move around the approach channel and turning basin, i.e., farther away from the sensitive receiver, and hence less impacts to the coral are expected.

Combination of Grab Dredgers and TSHD (Scenario 4b)

As indicated in *Figure A3.5*, a TSHD (SS04b) will be used at Area C while two grab dredgers (SS03 and SS05) will be deployed at Area D. The emission rate of the grab dredgers is **1.97 kg s^{-1}** as discussed above.

It is assumed that the TSHD will move at a speed of 0.3 m s^{-1} starting at utmost northeast of the approach channel along the direction of the channel. The suggested size of trailer dredger is approximately 8,000 m^3 and the effectively capacity is 5,400 m^3, which commonly operate in Hong Kong. The TSHD is expected to dispose of the material off-site, potentially at South Cheung Chau disposal site. The number of trips per day varies depending on the distances between the working locations and the disposal site (*Table A3.2*). For each trip, the dredging volume will be 7,200 m^3, the most conservative case, lasting for approximately 45 minutes. Based upon the loss

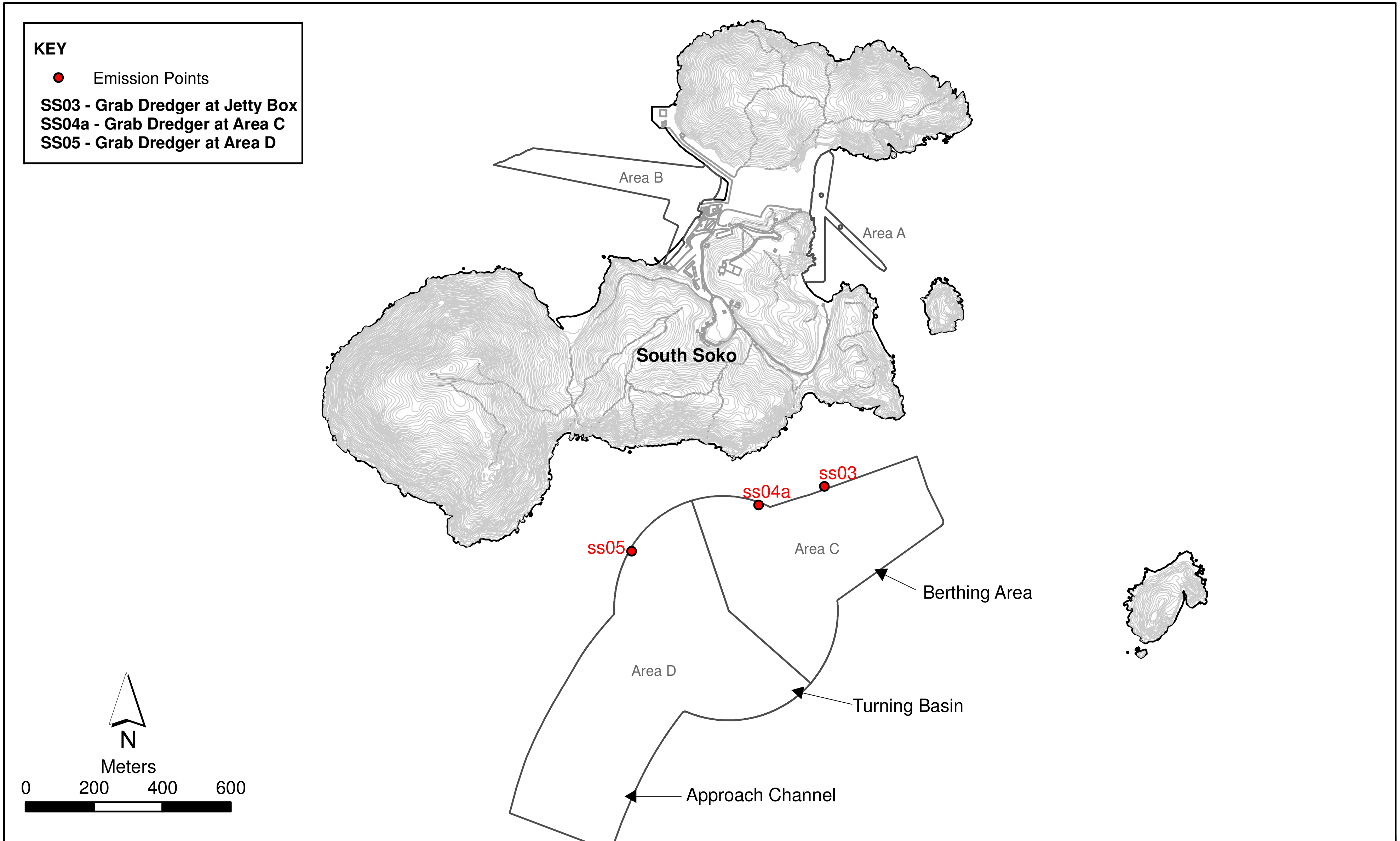

Figure A3.4

Emission Points Defined in the Model for the Construction of the Jetty Box, the Approach Channel and the Turning Basin at Sout Soko (Scenario 4a)

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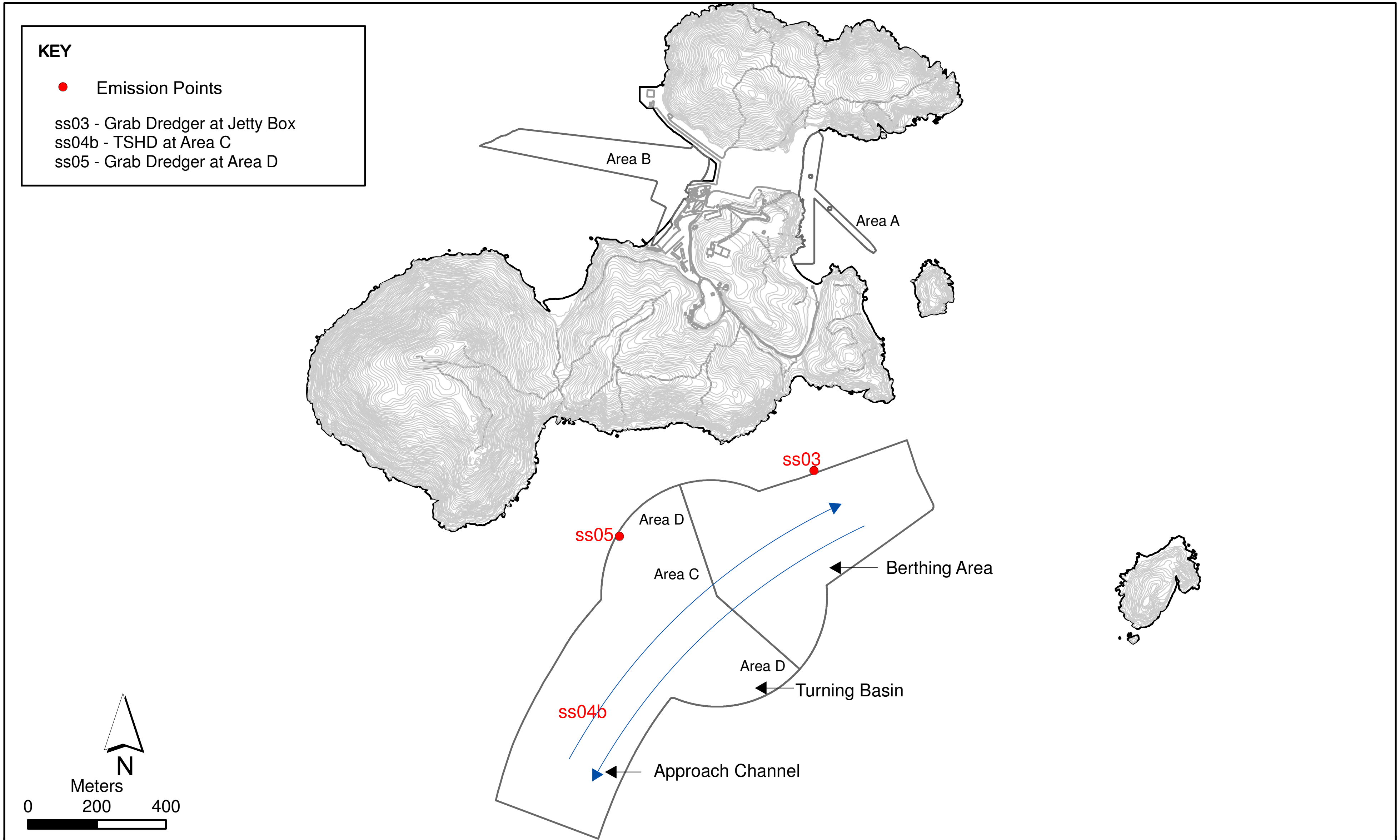

Figure A3.5

Emission Points Defined in the Model for the Construction of the Jetty Box, the Approach Channel and the Turning Basin at South Soko (Scenario 4b)

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rate assumption of 7 kg m^{-3}, the calculated loss rate will be **18.67 kg s^{-1}** (about 10% bottom of water column).

3.4.4 *Construction Works for Submarine Cable Installation (Scenario 5)*

Grab Dredging

Dredging will be carried out at Shek Pik and South Soko shore Approach. The dredging works for submarine cable will be done together with the dredging works for water main detailed in *Section 3.4.2*. In Scenario 2, it has been conservative assumed that a 16 hour working day will be employed with a 6 day working week throughout the works. Using the dredging rate of 8,000 m^3 day^{-1} a continuous emission rate of **2.36 kg s^{-1}** has been modelled throughout the whole water column.

Jetting

Working hours have been assumed to be 12 per day. One jetting machine, moving at speed of 150 m hr^{-1}, will work along the cable alignment from Shek Pik to South Soko Island. The dry density of sediment is assumed to be 700 kg m^{-3}. The submarine cable will be installed by direct burying with a rate of 150 m hr^{-1} per machine and thus the jetting rate will be 2,700 m^3 day^{-1}, which equates to a continuous emission rate of 8.75 kg s^{-1} (bed layer). *Figure A3.6* presents the start point of the moving source (SS14) and it will move seawards following the curb of the cable.

3.4.5 *Construction Works for Submarine Intake and Outfall (Scenario 5)*

The approach is similar to that for seawall construction. It is conservative to assume that two separate grab dredgers will be used for the dredging at the submarine intake and outfall locations respectively although the dredging works is likely to occur one followed one without overlapping. Working hours have been assumed to be 24 per day. The estimated dredged volume is approximately 0.03 Mm^3 in total.

As seen from *Figure A3.6*, a stationary point source at each of the intake (SS15) and outfall (SS28) will release at a continuous emission rate of **1.97 kg s^{-1}**.

3.4.6 *Construction Works for Gas Receiving Station (Scenarios 6)*

Scenario 6 simulates the concurrent dredging and sandfilling works at the GRS.

Grab Dredging

Dredging volume is approximately 0.29 Mm^3. Working hours have been assumed to be 16 per day. Assuming the deployment of two dredgers and using the dredging rate of 8,000 m^3 day^{-1} a continuous emission rate of **2.36 kg s^{-1}** has been modelled throughout the whole water column.

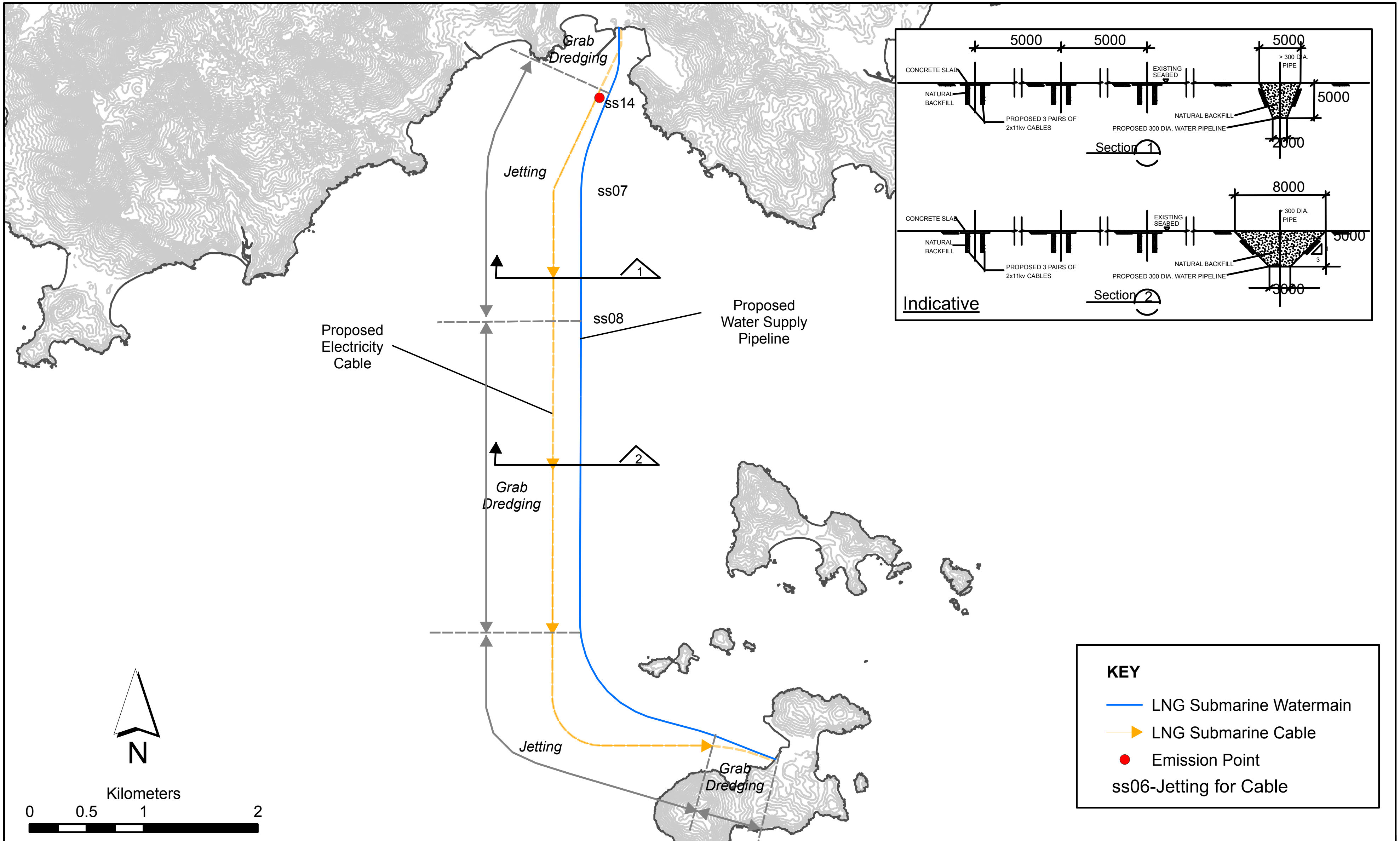

Figure A3.6

Emission Point defined in the Model for the Installation of the Electricity Cable, Intake and Outfall

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In view of the small size of dredging area (covered by two grid cell in the model), two stationary emission points are defined (SS29 and SS30 shown in *Figure A3.7*).

Sandfilling

Sandfilling for seawall trench and the reclamation at GRS by a pelican barge (rainbowing) is simulated by assuming a filling rate of 50,000 m^3 day^{-1} with working hours to be 16 per day. The fill material will be marine sand which generally has a fine content ranging from 2% to 10%. As the source of material could not be confirmed at time of EIA compiled, the upper bound of the fine content, i.e. 10% is assumed for the conservative case. The dry density of sand fill will be approximately 1,938 kg m^{-3}. A highly conservative loss rate of 10% is assumed, giving a rate of release of **16.8 kg s^{-1}** (continuous in whole column).

Since the seawall trench and reclamation area is small and close to the shore which is covered by approximately one grid cells in the model, a stationary emission point, SS31, (*Figure A3.7*) has been chosen at a cell that well represents both the seawall trench and the reclamation.

3.4.7 *Construction Works for Gas Pipeline (Scenarios 7 to 13)*

The estimated dredged volume, the number of plant and the distance apart between each plant at the associated pipeline section is shown in *Table A3.3*. The working hours have been assumed to be 24 per day for TSHD dredging and 12 hour per day for grab dredging. The route is shown in *Figure A3.8*.

Table A3.3 Submarine Gas Pipeline Construction Details

Zone (KP)	Scen-ario	Plant Used	Dredged Volume (Mm^3)	Moving Speed ($m\ h^{-1}$)	Number of Plant	Minimum Distance Apart between Each Plant (m)
South Soko Approach (0-1)	7	Grab Dredger (a)	0.07	2.5	1	N/A
West of South Soko to West Lantau (1-24.5)	8	TSHD (b)	1.28	33	1	N/A
Northwest Lantau to Urmston Road Crossing (24.5-31)	9	Grab Dredging (a)	0.17	2.5	3	2,167
Urmston Road Crossing (31-33.5)	10	Grab Dredging (a)	0.07	2.5	1	N/A
West of Black Point (33.5-37)	11	Grab Dredger (a)	0.30	2.6	3	1,167
West of Black Point (37-37.803)	12	Grab Dredger (a)	0.02	2.5	1	N/A

Zone (KP)	Scen-ario	Plant Used	Dredged Volume (Mm^3)	Moving Speed ($m\ h^{-1}$)	Number of Plant	Minimum Distance Apart between Each Plant (m)
Black Point Shore Approach (37.803-38.303)	13	Grab Dredger (a)	0.02	4.75	1	N/A

Notes:
(a) Grab dredger denotes a closed grab with a minimum grab size of 8 m^3.
(b) TSHD denotes Trailer Suction Hopper Dredger with hopper capacity of 11,300 m^3.

Combination of Grab Dredge and TSHD Dredging

Grab Dredging: The dredging will be carried by one to three closed grab dredgers. It is assumed that the grab dredging rate is 4,000 m^3 day^{-1} for the pipeline dredging, which gives a loss rate of **0.79 kg s^{-1}** per plant respectively throughout the whole water column.

TSHD Dredging: The dredging will be carried by one TSHD. It is assumed that the dredging rates are 7,200 m^3 per trip and each dredging event lasts approximately 0.75 hour, which gives a loss rate of **18.7 kg s^{-1}** for KP1 – KP24.5 respectively releasing at the bed layer (10% of the water column).

Alternative Gas Pipeline Route

Potentially, a container port, CT10, will be built to the west of Lantau (near Tai O). If this is the case, it will hence be necessary to alter the LNG submarine gas pipeline in order to avoid the intersection with the CT10 which may require dredging the port area to substantial depth for reclamation. An alternative pipeline route was designed to bypass the CT10. To assess any potential impacts due to the alternative pipeline route was thus simulated by Delft3D model. The modelling is mainly carried out for KP7 – 14, KP14 – KP20 and KP20 – KP34.5 since the changes are mainly at these three zones. The model results are presented in *Appendix 6C* in this Annex.

3.4.8 *Construction Programme and Sequence*

Tentative construction programme and indicative construction sequence are shown in *Figures A3.9* and *A3.10* respectively.

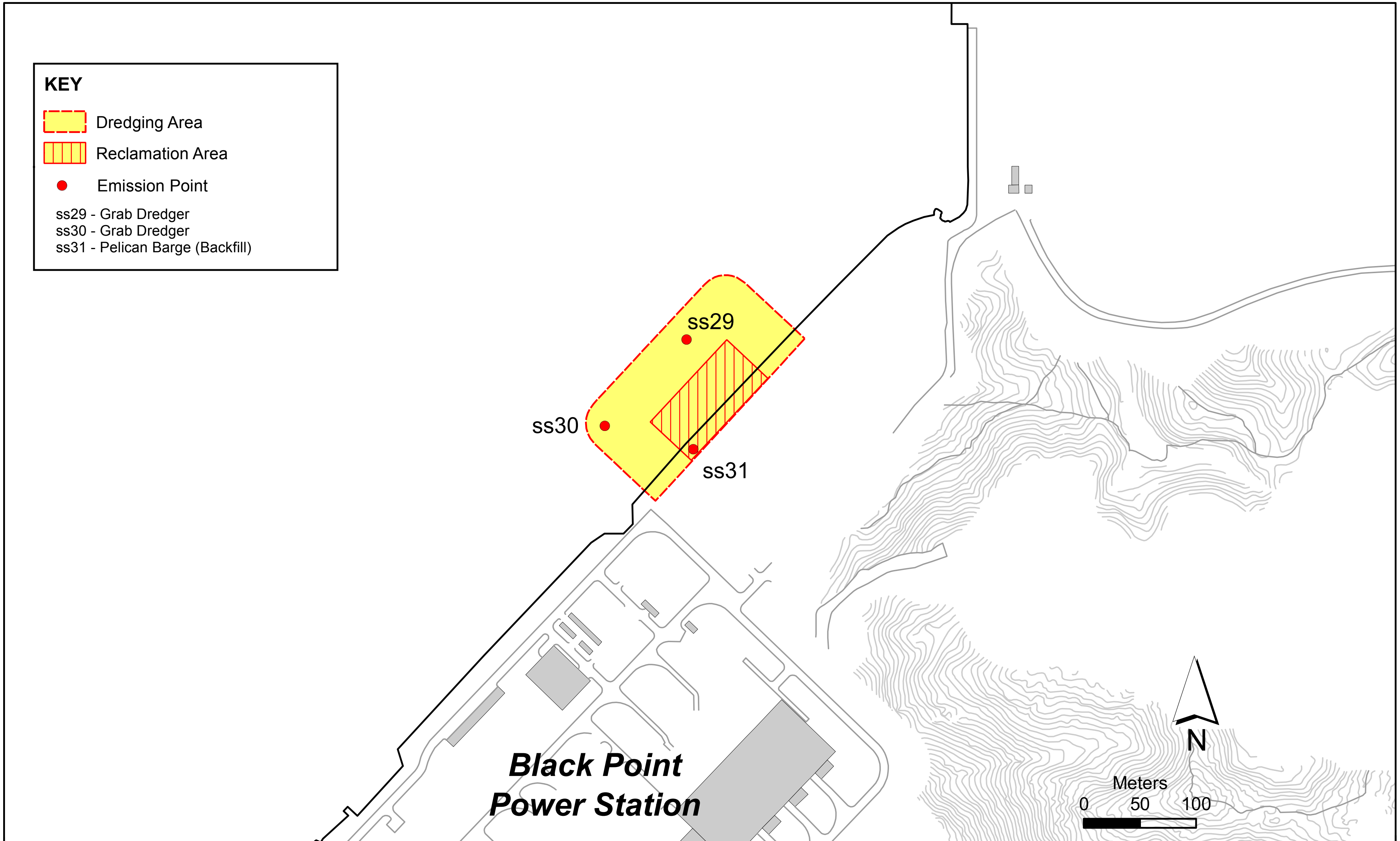

Figure A3.7

Emission Points defined in the Model for the Construction of the Gas Receiving Station at Black Point (Scenario 6)

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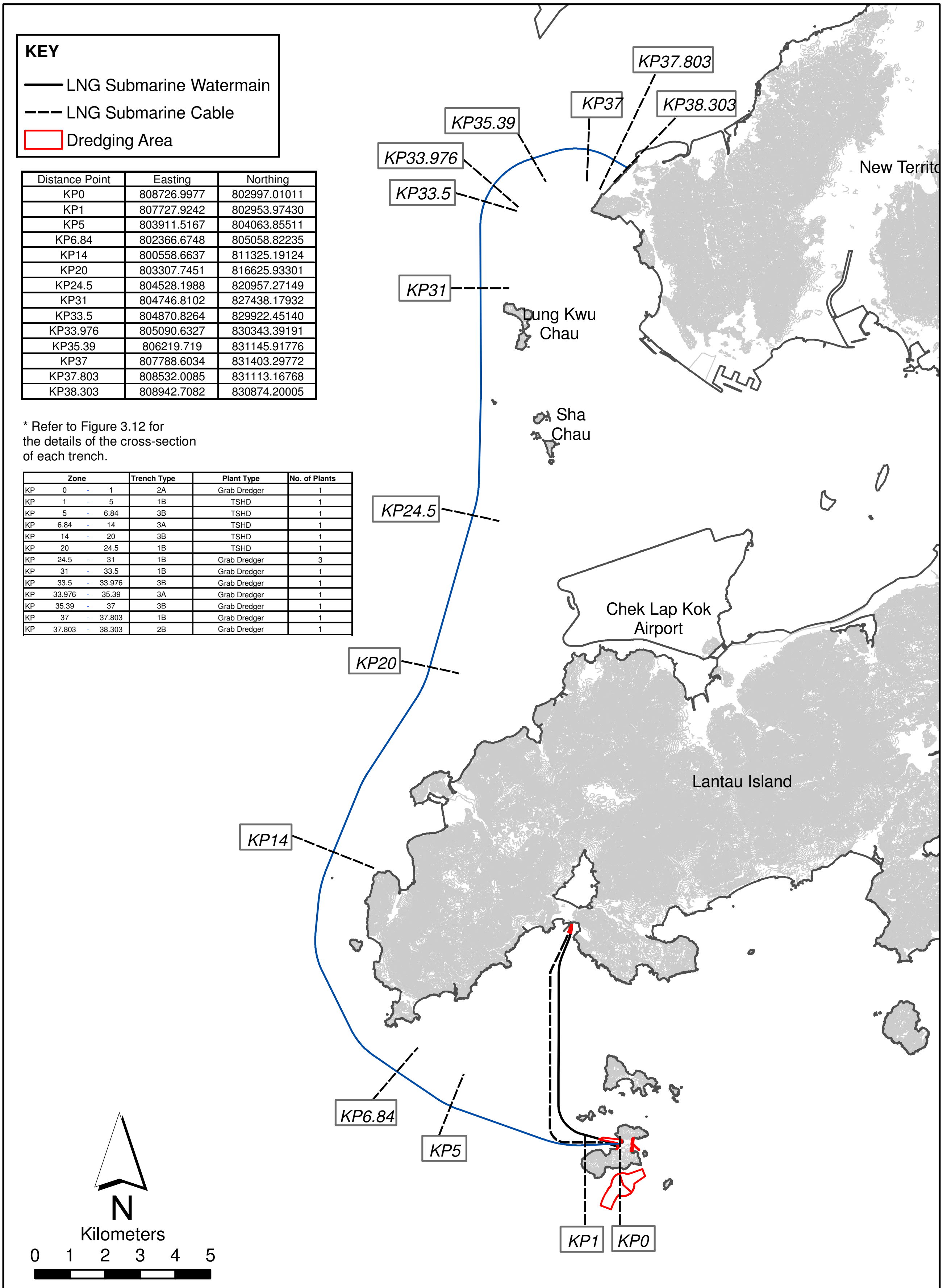

Distance Point	Easting	Northing
KP0	808726.9977	802997.01011
KP1	807727.9242	802953.97430
KP5	803911.5167	804063.85511
KP6.84	802366.6748	805058.82235
KP14	800558.6637	811325.19124
KP20	803307.7451	816625.93301
KP24.5	804528.1988	820957.27149
KP31	804746.8102	827438.17932
KP33.5	804870.8264	829922.45140
KP33.976	805090.6327	830343.39191
KP35.39	806219.719	831145.91776
KP37	807788.6034	831403.29772
KP37.803	808532.0085	831113.16768
KP38.303	808942.7082	830874.20005

* Refer to Figure 3.12 for the details of the cross-section of each trench.

Zone	Trench Type	Plant Type	No. of Plants
KP 0 - 1	2A	Grab Dredger	1
KP 1 - 5	1B	TSHD	1
KP 5 - 6.84	3B	TSHD	1
KP 6.84 - 14	3A	TSHD	1
KP 14 - 20	3B	TSHD	1
KP 20 24.5	1B	TSHD	1
KP 24.5 - 31	1B	Grab Dredger	3
KP 31 - 33.5	1B	Grab Dredger	1
KP 33.5 - 33.976	3B	Grab Dredger	1
KP 33.976 - 35.39	3A	Grab Dredger	1
KP 35.39 - 37	3B	Grab Dredger	1
KP 37 - 37.803	1B	Grab Dredger	1
KP 37.803 - 38.303	2B	Grab Dredger	1

FIGURE A3.8

Sections of the Submarine Gas Pipeline defined in the Model (Scenarios 7-13)

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Figure A3.9 Tentative Construction Programme

Task Name	Respective Scenario	Respective ID Code	Month																		
			M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15	M16	M17	M18	M19
Reclamation Works																					
Dredging Underneath Seawall at Eastern Berth	1	SS01																			
Dredging Underneath Seawall at Western Berth	1	SS02																			
Sandfilling for Seawall Trench	1	SS32																			
Placing Sand Fill for Reclamation	1	SS32																			
Water main Activities																					
Dredging at SSI Shore Approach	2	SS06																			
Dredging at Shek Pik Shore Approach	2	SS07																			
Dredging at waterway across sand borrow and marine channel	2	SS08																			
Post Trenching Jetting at South Soko	3	SS09																			
Post Trenching Jetting at Shek Pik	3	SS10																			
GRS																					
Dredging at GRS	6	SS29 & 30																			
GRS Sandfilling for the Sewall Trench	6	SS31																			
Main Jetty																					
Dredging at Jetty	4a/4b	SS03																			
Dredging at Approach Channel and Turning Basin at Area C	4a/4b	SS04a/4b																			
Dredging at Approach Channel and Turning Basin at Area D	4a/4b	SS05																			
Intake and Outfall Construction																					
Dredging under intake	5	SS15																			
Dredging under outfall	5	SS28																			
Submarine Cable Installation																					
Submarine Power Cable Installation by Direct Burying (Jetting)	5	SS14																			
Submarine Gas Pipeline																					
SSI Shore Approach by grab dredger (KP0 - KP1)	7	SS21																			
Pre-dredging by TSHD (KP1 - KP24.5)	8	SS32																			
Pre-dredging by grab dredger (KP24.5-31)	9	SS33																			
Pre-dredging by grab dredger (KP31-33.5)	10	SS34																			
Pre-dredging by grab dredger (KP33.5-37)	11	SS19																			
Pre-dredging by grab dredger (KP37-37.803)	12	SS35																			
BPPS Shore Approach by grab dredger (KP37.803 - KP38.303)	13	SS16																			

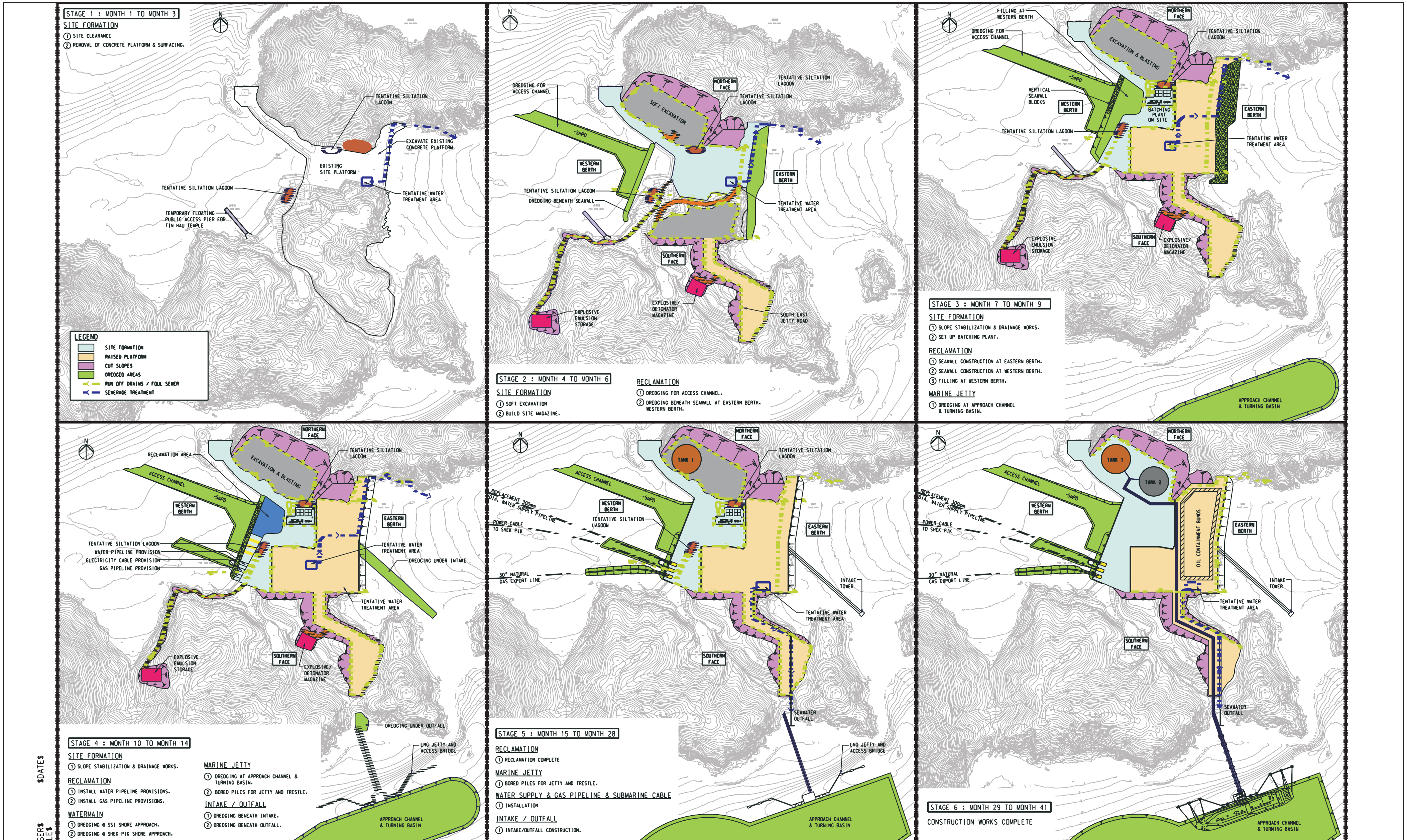

Figure A3.10

South Soko Island
Indicative Construction Sequence

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3.5 SEWAGE DISCHARGE

During construction of the LNG terminal the maximum work force is estimated to be around 1,600 people maximum. Based on *Table 2* of the *Drainage Service Department's (DSD's) Sewerage Manual* for domestic type sewage, the unit flow factor for an employed population is 150 L per head per day. A calculation of the Average Dry Weather Flow (ADWF) is given in *Table A3.4*. According to the Sewerage Manual, a peaking factor of 6 should be applied to the average flow to determine the peak flow which is also shown.

Table A3.4 Calculation of Sewage Flow LNG Construction Phase

Population	Unit Flow Factor (L/head/day)		Average Dry Weather Flow (ADWF) (m^3/day)	Peak Flow (6 x ADWF) (m^3/day)
1,600	Domestic Type 150 L/head/day		240	1,440
		Total	**240**	**1,440**

From the above, the effluent discharge consent standard, based on the ADWF, can be obtained from *Table 10a* of the *TM* and is summarised in *Table A3.5*. As the sewage from the LNG terminal at South Soko Island is of domestic sewage type, the parameters as shown in *Table A3.5* are applicable to the sewage treatment process. The other parameters that comprise restrictions on chemicals are not a concern for domestic type sewage and are therefore considered. For oil and grease this requires to be controlled by fitting grease traps to the sewage outlets from the kitchens. The design load of the sewage discharge is the same as the effluent discharge standard and also shows in *Table A3.6*.

Table A3.5 Effluent Discharge Standard and Design Load for the Sewage Treatment Works during Construction Phase

Site	Corresponding WCZ	BOD (mg/L)	SS (mg/L)	Total Nitrogen (mg/L)	*E.Coli* (count/100mL)
South Soko	Southern	20	30	100	1,000

3.6 HYDROTEST DISCHARGE

An assessment of the impacts from hydrotest discharges is required. These tests are needed to check the integrity of the pipeline from Soko Island to Black Point. In the freshwater testing additives are used. At this stage an assessment of the initial dilution suffices because the discharge is relatively small and decay rates of the additives are unknown. A most conservative approximation is thus applied because dilution only provides the upper bound of concentrations in the discharge plume.

3.6.1 *Discharge Location*

There are two alternative locations where the hydrotest water will be discharged:

- Black Point, where the hydrotest discharge water is combined with the existing thermal effluent flow from the Black Point Power Station; or
- Soko Island, where the discharge is located at the south of Soko Island (proposed outfall).

3.6.2 *Discharge Rate*

It is estimated that 20,000 m^3 hydrotested water from the pipeline with a rate of 0.19 $m^3 s^{-1}$ will be discharged (last for about 1.2 days).

3.6.3 *Modelling Approach*

Near-field model, CORMIX, is used to investigate dilution of discharges in varying but steady state conditions for both the dry and wet seasons. The area of the diluted plume (in terms of distance from the source) has been assessed.

4 OPERATIONAL PHASE

For the study of operational effects, the approach requires several steps:

1) Running a near-field model (i.e. CORMIX) for the operational discharges to characterise the initial mixing of the effluent discharge. The results of the near-field model has been used to define the manner in which the discharge would be included in the far-field hydrodynamic and the water quality models (at which depth, the number of cells over which the discharge will be distributed). The results from the CORMIX analysis have also provided information of the near field dispersion and dilution of the effluent plumes and hence chlorine and/or other biocide concentrations.

   The details of CORMIX simulation is presented in *Appendix B* of this Annex.

2) Adapting the hydrodynamic model for the new conditions, including the reclamations and discharges.

3) Running the hydrodynamic model for the specified conditions (wet/dry season). Both sites can be implemented within one hydrodynamic run for a dry and wet seasons spring-neap cycle, since there will be no significant interaction between the effects of the two sites.

4) Running the water quality model (i.e. Delft3D-WAQ). The objectives are twofold:

   a) to qualitatively assess the concentrations of residual chlorine or other biocides: to this end up to 5 decayable tracers may be defined, which will be released from the two candidate sites (the analysis has been carried out assuming that the background concentration is zero); and

   b) to qualitatively assess the potential changes in water quality as a result of changes in the circulation near the project sites: to this end up to 5 conservative, i.e. non-decayable, tracers have been defined, which will be discharged from a number of locations representing main pollution sources (e.g. Hong Kong as a whole, major point sources in the vicinity of the candidate sites).

The general water quality is the result of transport phenomena and transformation and retention processes. The operation of the project may locally affect the transport patterns. Transformation and retention processes are not affected. Consequently, validation of the Delft3D-WAQ model is not required. The analysis under 4b) requires the running of a baseline scenario to assess the pre-project conditions.

4.1 THERMAL AND ANTIFOULANT DISCHARGE

Stored LNG will need to be re-gasified in order for it to be conveyed along the gas pipeline to the point of use. Seawater discharged from the LNG terminal is expected to have a decreased temperature of approximate Δ 12.5°C at the discharge point. The flow rate is expected to be equivalent to 18,000 $m^3\ hr^{-1}$ (peak flow).

The dosing level of Chlorine is expected to be at approximately 3 mg L^{-1}. Residual Chlorine level is expected to be less than 0.3 mg L^{-1}. Hence 0.3 mg L^{-1} is simulated in the model for both maximum discharge flow and the seasonal varied discharge flow as shown in *Table A4.1*.

Table A4.1 Cooling Water Discharge Flow Rate

Hour	Summer ($m^3\ hr^{-1}$)	Winter ($m^3\ hr^{-1}$)
0	13500	9000
1	13500	6750
2	11250	4500
3	11250	4500
4	11250	4500
5	11250	4500
6	11250	4500
7	11250	6750
8	15750	9000
9	18000	11250
10	18000	15750
11	18000	18000
12	18000	18000
13	18000	18000
14	18000	18000
15	18000	18000
16	18000	18000
17	18000	18000
18	18000	18000
19	18000	18000
20	18000	18000
21	18000	18000
22	18000	15750
23	15750	11250

Residual chlorine is known to decay rapidly in the marine environment, as the chlorine demand of the receiving waters is likely to be high. A preliminary review of literature on chlorine decay has indicated that there are a number of factors that determine decay, including reactivity of organic matter, temperature, (UV) light, pH and salinity. However, chlorine decay has been studied mostly for freshwater systems and in distribution system.

Based on this review, a conservative rate of decay has been taken as first order decay (i.e., 100 day^{-1}) at 30°C. As chlorine will be discharged in cooled water from the gas warming vaporisation system, a similarly conservative temperature dependency of 1.0996 has been used in the modelling (1).

4.2 *SEWAGE DISCHARGE*

During operation of the LNG receiving terminal the maximum work force is estimated to be around 100 people maximum. Based on *Table 2* of the *Drainage Service Department's (DSD's) Sewerage Manual*, the unit flow factor for an employed population is 60 L per head per day.

However, this unit flow rate does not comprise wastewater generated from staff showers or any canteen facilities to be provided. Considering the nature of the work and remote locations, some of the work force may use shower facilities and also canteen facilities will be required. In this case subject to discussion and agreement with Environmental Protection Department (EPD) a commercial unit flow factor may be applied to the work force on top of the employed population unit flow factor. *Table A4.2* shows a calculation of the Average Dry Weather Flow (ADWF) and the peak flow for which a peaking factor of 6 is applied.

Table A4.2 Calculation of Sewage Flow LNG Operational Phase

Population	Unit Flow Factor (L/head/day)	Average Dry Weather Flow (ADWF) (m^3/day)	Peak Flow (6 x ADWF) (m^3/day)
100	Employed Population 60L/head/day	6.0	36.0
100	Commercial Activities	29.0	174.0
	Total	**35.0**	**210.0**

From the above, the effluent discharge standard, based on the ADWF, can be obtained from *Table 10a* of the *TM* and is summarised in *Table A4.2*. As the sewage from the LNG Plant is of domestic sewage type, the parameters as shown in *Table A4.3* are applicable to the sewage treatment process. The other parameters that comprise restrictions on chemicals are not a concern for domestic type sewage and are therefore considered. For oil and grease this requires to be controlled by fitting grease traps to the sewage outlets from the kitchens. The design load of the sewage discharge is decided to be same as the effluent discharge standard.

Table A4.3 Effluent Discharge Standard and Design Load for the Sewage Treatment Works during Operational Phase

Site	Corresponding WCZ	BOD (mg/L)	SS (mg/L)	Total Nitrogen (mg/L)	*E.Coli* (count/100mL)
South Soko	Southern	20	30	100	1,000

(1) McClellan, John N., David A. Reckhow, John E. Tobiason, James K. Edzwald: A Comprehensive Kinietic Model for Chlorine Decay and Chlorination Byproduct Formation, Department of Civil and Environmental Engineering, University of Massachusetts/Amherst, http://www.ecs.umass.edu/cee/reckhow/publ/84/acschapter.html

4.3 *MAINTENANCE DREDGING*

The study has considered the following three steps that steer sedimentation. Two types of material have been taken into account, i.e. mud (cohesive) and sand (non-cohesive). Mud is transported in suspension and sand is transported as suspended load or bed load, depending on the grain size and wave/current conditions.

1) To estimate the rate of sediment supply, data on bed composition in the vicinity of the LNG terminals (if available also sediment cores), data on suspended sediment concentration (preferably also during or just after typhoons) and data on the sediment load and the extent of the sediment transport of Pearl River has been analysed. From the mineralogical composition, sediment sources can be identified.

2) The current velocity in and around the navigation channel and the resulting bed shear stress. To this end, results from existing hydrodynamic model simulations can be used.

   - The influence of waves has been evaluated based on a combination of wave climate data analysis from measurements, existing wave model results and desk analysis.

   - An analysis of recirculation patterns by wind and tide to identify transport pathways. The tidal excursion length is also an important parameter to consider.

   - Based on available data, it has been assessed what the effect of seasonal variations is and what the importance of density-driven effects is, e.g. salinity, fluid mud, temperature.

3) From the analysis on sediment supply and transport, an estimate can be made on the sedimentation rate in the navigation channel and in the neighbourhood of the terminal. From the average and maximum shear stress in the trench induced by currents and waves, the sediment trapping efficiency can be estimated. The product of supply and trapping efficiency yields the sedimentation rate.

Following the above approach, the frequency of the maintenance dredging has been estimated. For the impact assessment of the maintenance dredging, the qualitative assessment has been conducted (discussed in the *Section 6 – Water Quality Impact Assessment*) since the scale of the maintenance dredging would be much less than the dredging works for the approach channel and turning basin during construction phase which has been modelled as described in the previous section.

4.4 ACCIDENTAL FUEL SPILLAGE

4.4.1 Locations

A release point (808503 easting, 801160 northing) is defined just in from the boundary of Hong Kong waters on the approach to the island. This point is on the potential LNG carrier route and thus chosen for the impact assessment. To be conservative, the release point is assumed to be just above the waterline.

4.4.2 Fuel Type

Based on the information, it is assumed that the fuel is Heavy Fuel Oil (HFO i.e., 100% No 6).

4.4.3 Volume to be spilled

The most conservative case scenario was modelled, i.e. the largest single HFO storage tank from a 210 km^3 SSD propulsion vessel which is 5,043 m^3. The inventory released should equate to 60% of the tank contents.

4.4.4 Discharge Rate

It is assumed the large carrier will be used and its large collision event has a release rate of 8,060 kg s^{-1}, even though the small carrier will also be adopted in reality, giving a large collision event having a lower release rate of 7,720 kg s^{-1}.

4.4.5 Model Selection

The oil spillage has been simulated using hydrodynamic and particle tracking models (oil module of Delft3D-PART) to assess the movement of the oil spill. This Delft3D-PART forms part of the well-calibrated Delft 3D suite of models, as described in *Section 1* of this Annex. This particle tracking model has been adopted in the EIA of Permanent Aviation Fuel Facility (1).

4.4.6 Key Modelling Assumptions

Fuel spill is modelled by surface particles (floating since the density of the oil is less than that of the water). The initial radius is calculated on the basis of the Fay and Hoult equation (2) that calculates the extent of the patch after gravitational spreading. This spreading occurs in a matter of minutes rather than hours. The radius is related to the density difference between the oil and the water and the volume of spilled oil). The spill as used in the present case, of heavy fuel oil would lead to an initial patch of a diameter of 440 m. This implies a thickness of about 5 mm. In addition, no evaporation rate and emulsification is assumed in the model. The wind data at Cheung Chau and Sha Chau as shown in *Annex 13A3* in *Section 13* is used in the model.

(1) Mouchel Asia Ltd (2002). EIA of Permanent Aviation Fuel Facility. For Airport Authority Hong Kong. Final Report.
(2) Fay, J. and D. Hoult, 1971. Physical processes in the spread of oil on a water surface, Report DOT-CG-01 381-A, U.S. Coast Guard, Washington, D.C.

4.4.7 *Scenarios*

The PART model has been simulated for the dry and wet seasons with typical real time wind time series. The simulations were run for periods of 5 days to capture the transport route of the oil spill in the first 24 hours to facilitate the development of an emergency contingency plan.

5 CUMULATIVE IMPACTS

At present there are no planned projects that could have cumulative impacts with the construction of the terminal at South Soko and the gas pipeline. The construction of the HK-Zhuhai-Macau Bridge and potential Western Port Development (CT10) are unlikely to be carried out concurrently with the construction works of the gas pipeline. With reference to the Project Profile for the Lantau Logistic Park (LLP), the exact layout of the proposed LLP reclamation is the subject of further study and will be confirmed by the detailed investigations which are ongoing. The way forward and construction programme of the LLP are also uncertain at this stage. No other projects are planned to be constructed in sufficient proximity to the Project to cause cumulative effects. In light of the above, cumulative impacts are not expected to occur.

6 INPUT PARAMETERS

6.1 SEDIMENT PARAMETERS

For simulating sediment impacts the following general parameters has been used:

- Settling velocity – 0.5 mm s^{-1}
- Critical shear stress for deposition – 0.2 N m^{-2}
- Critical shear stress for erosion – 0.3 N m^{-2}
- Minimum depth where deposition allowed – 1 m
- Resuspension rate – 30 g m^{-2} d^{-1}
- Wave calculation method – Tamminga
- Chezy calculation method – White/Colebrook
- Bottom roughness – 0.001 m (1)
- Fetch for wave driven erosion – 35 km
- Depth gradient effect on waves - absent

The above parameters have been used to simulate the impacts from sediment plumes in Hong Kong associated with uncontaminated mud disposal into the Brothers MBA (2) and dredging for the Permanent Aviation Fuel Facility at Sha Chau (3). The critical shear stress values for erosion and deposition were determined by laboratory testing of a large sample of marine mud from Hong Kong as part of the original WAHMO studies associated with the new airport at Chek Lap Kok.

(1) The particular formulations used express the bottom roughness by the so-called Nikuradse roughness coefficient, which has the dimension m. (Nikuradse, J., 1932: Gesetzmassigkeiten der turbulenten Stromungen in glatten Rohren. Frosch. Ver. Deutscher Ing. No. 356.)

(2) Mouchel (2002a). Environmental Assessment Study for Backfilling of Marine Borrow Pits at North of the Brothers. Environmental Assessment Report.

(3) Mouchel (2002b). Permanent Aviation Fuel Facility. EIA Report. Environmental Permit EP-139/2002.

7 *SCENARIOS*

7.1 *CONSTRUCTION PHASE*

The scenarios are constructed in accordance with the tentative construction programme (*Figure A3.9*). To simulate conservative worse cases potential concurrent activities would be simulated at the same time regardless the reality that they may not all occur simultaneously.

The proposed scenarios for the construction phase of the South Soko Option are presented in *Table A7.1*. *Table A7.2* summarises the inputs defined in the water quality model.

Table A7.1 Scenarios of the Construction Works for South Soko Option

Scenario ID	Tasks	Details of Construction Activities	No. of Plant	Plant Type	Code
Scenario 1	Seawall/Reclamation Areas	Grab Dredging underneath Seawall for Eastern Berth (Area A)	1 no.	Grab Dredger	SS 01
	Seawall/Reclamation Areas	Grab Dredging underneath Seawall for Western Berth (Area B)	1 no.	Grab Dredger	SS 02
	Seawall/Reclamation Areas	Sand filling Seawall Trench and Reclamation for the Western Berth	1 no.	Pelican Barge	SS 32
Scenario 2	Submarine Water Main	Grab Dredging at South Soko Shore Approach	1 no.	Grab Dredger	SS 06
	Submarine Water Main	Grab Dredging at Shek Pik Shore Approach	1 no.	Grab Dredger	SS 07
	Submarine Water Main	Grab Dredging Waterway Crossing Sand Borrow Area & Marine Navigation Channel	1 no.	Grab Dredger	SS 08
Scenario 3	Submarine Water Main	Post Trenching Jetting near South Soko	1 no.	Jetting Machine	SS 09
	Submarine Water Main	Post Trenching Jetting near Shek Pik	1 no.	Jetting Machine	SS 10
Scenario 4a	Jetty Box	Grab Dredging at Jetty Box	1 no.	Grab Dredger	SS 03
	Approach Channel and Turning Basin	Grab Dredging at Approach Channel & TB at Area C	1 no.	Grab Dredger	SS 04a
	Approach Channel and Turning Basin	Grab Dredging at Approach Channel & TB at Area D	1 no.	Grab Dredger	SS 05
Scenario 4b	Jetty Box	Grab Dredging at Jetty Box	1 no.	Grab Dredger	SS 03
	Approach Channel and Turning Basin	TSHD Dredging at Approach Channel & TB at Area C	1 no.	TSHD	SS 04b
	Approach Channel and Turning Basin	Grab Dredging at Approach Channel & TB at Area D	1 no.	Grab Dredger	SS 05
Scenario 5	Submarine Cable Circuit	Submarine Cable Installation by Direct Burying (Jetting)	1 no.	Jetting Machine	SS 14
	Submarine Intake	Grab Dredging under intake	1 no.	Grab Dredger	SS 15
	Cooled Water Outfall	Grab Dredging under outfall	1 no.	Grab Dredger	SS 28
Scenario 6	Gas Receiving Station	Grab Dredging at GRS	1 no.	Grab Dredger	SS 29
	Gas Receiving Station	Grab Dredging at GRS	1 no.	Grab Dredger	SS 30
	Gas Receiving Station	Sand filling Seawall Trench and Reclamation at GRS	1 no.	Pelican Barge	SS 31
Scenario 7	Submarine Gas Pipeline	Grab Dredging at South Soko Shore Approach (KP 0 - KP 1)	1 no.	Grab Dredger	SS 21
Scenario 8	Submarine Gas Pipeline	TSHD Dredging from Fan Lau Crossing to West Lantau (KP 1 - KP 24.5)	1 no.	TSHD	SS 32

Scenario ID	Tasks	Details of Construction Activities	No. of Plant	Plant Type	Code
Scenario 9	Submarine Gas Pipeline	Grab Dredging from Northwest Lantau to Urmston Road Crossing (KP 24.5 – KP 31)	3 nos.	Grab Dredger	SS 33
Scenario 10	Submarine Gas Pipeline	Grab Dredging across Urmston Road Crossing (KP31– KP 33.5)	1 no.	Grab Dredger	SS 34
Scenario 11	Submarine Gas Pipeline	Grab Dredging at West of Black Point (KP33.5 – KP 37)	3 nos.	Grab Dredger	SS 19
Scenario 12	Submarine Gas Pipeline	Grab Dredging at West of Black Point (KP 37 – KP 37.803)	1 no.	Grab Dredger	SS 35
Scenario 13	Submarine Gas Pipeline	Grab Dredging at Black Point Shore Approach (KP37.803 - KP38.303)	1 no.	Grab Dredger	SS 16

Table A7.2 Summary of Model Inputs

Code	Emission Point	No. of Working Plant	Dredging/Jetting/ Sandfilling Rate	Operation Duration	Loss Type	Loss Rate	Loss Rate	Input Layer
			m3/day/plant	hours	-	kg m^{-3}	kg s^{-1}	-
SCENARIO 1								
Dredging and Backfilling for Seawall								
SS 01	Grab Dredging underneath Seawall for Eastern Berth (Area A)	1 X Grab Dredger (e)	10,000	24	Continuous	17	1.97	whole column
SS 02	Grab Dredging underneath Seawall for Western Berth (Area B)	1 X Grab Dredger (e)	10,000	24	Continuous	17	1.97	whole column
SS 32	Sand filling Seawall Trench and Reclamation for the Western Berth	1 X Pelican Barge	70,000	24	Continuous	1%	16.8	whole column
SCENARIO 2								
Dredging for Water Main								
SS 06	South Soko Shore Approach	1 X Grab Dredger (e)	8,000	16	Continuous	17	2.36	whole column
SS 07	Shek Pik Shore Approach	1 X Grab Dredger (e)	8,000	16	Continuous	17	2.36	whole column
SS 08	Waterway Crossing Sand Borrow Area & Marine Navigation Channel	1 X Grab Dredger (e)	8,000	16	Continuous	17	2.36	whole column
SCENARIO 3								
Jetting for Water Main								
SS 09	Post Trenching Jetting near South Soko	1 X Jetting	10,400	16	Continuous	20% trench volume (b)	14.7 (1st pass) 29.5 (2nd pass) 44.2 (3rd pass)	bed layer (f)
SS 10	Post Trenching Jetting near Shek Pik	1 X Jetting	10,400	16	Continuous	20% trench volume (b)	14.7 (1st pass) 29.5 (2nd pass)	bed layer (f)

Code	Emission Point	No. of Working Plant	Dredging/Jetting/ Sandfilling Rate	Operation Duration	Loss Type	Loss Rate	Loss Rate	Input Layer
			m3/day/plant	hours	-	kg m^{-3}	kg s^{-1}	-
							44.2 (3rd pass)	
SCENARIO 4a								
Dredging for Approach Channel and Turning Basin								
SS 03	Dredging at Jetty Box	1 X Grab Dredger (e)	10,000	24	Continuous	17	1.97	whole column
SS 04a	Dredging at Approach Channel & TB at Area C	1 X Grab Dredger (e)	10,000	24	Continuous	17	1.97	whole column
SS 05	Dredging at Approach Channel & TB at Area D	1 X Grab Dredger (e)	10,000	24	Continuous	17	1.97	whole column
SCENARIO 4b								
Dredging for Approach Channel and Turning Basin								
SS 03	South Soko Jetty Box	1 X Grab Dredger (e)	10,000	24	Continuous	17	1.97	whole column
SS 04b	Dredging at Approach Channel & TB at Area C	1 X TSHD	7,200 m^3 per trip (a)	0.75	Piecewise	7	18.67	bed layer (f)
SS 05	Dredging at Approach Channel & TB at Area D	1 X Grab Dredger (e)	10,000	24	Continuous	17	1.97	whole column
SCENARIO 5								
Jetting for Submarine Cable								
SS 14	Submarine Cable Installation by Direct Burying (Jetting)	1 X Jetting	2,700	12	Continuous	20% trench volume(c)	8.75	bed layer (f)
Dredging for Submarine Intake								
SS 15	Dredging under Intake	1 X Grab Dredger (e)	10,000	24	Continuous	17	1.97	whole column
SS 28	Dredging under Outfall	1 X Grab Dredger (e)	10,000	24	Continuous	17	1.97	whole column
SCENARIO 6								
Dredging/Backfilling for Gas Receiving Station								
SS 29	Dredging for Gas Receiving Station (grab dredger 1)	1 X Grab Dredger (e)	8,000	16	Continuous	17	2.36	whole column

Code	Emission Point	No. of Working Plant	Dredging/Jetting/ Sandfilling Rate	Operation Duration	Loss Type	Loss Rate	Loss Rate	Input Layer
			m3/day/plant	hours	-	kg m^{-3}	kg s^{-1}	-
SS 30	Dredging for Gas Receiving Station (grab dredger 2)	1 X Grab Dredger (e)	8,000	16	Continuous	17	2.36	whole column
SS 31	Backfilling for Gas Receiving Station (grab dredger)	1 X Pelican Barge	50,000	16	Continuous	1%	16.8	whole column
SCENARIO 7								
Dredging for Submarine Gas Pipeline								
SS 21	Grab Dredging at South Soko Shore Approach (KP 0 - KP 1)	1 X Grab Dredger (e)	4,000	12	Continuous	17	1.6	whole column
SCENARIO 8								
Dredging for Submarine Gas Pipeline								
SS 32	TSHD Dredging at Fan Lau Crossing (KP 5 – KP 6.84)	1 X TSHD	7,200 per trip (a)	0.75	Piecewise	7	18.7	bed layer (f)
SCENARIO 9								
Dredging for Submarine Gas Pipeline								
SS 33	Grab Dredging from West Lantau to Urmston Road Crossing (KP 24.5 – KP 31)	3 X Grab Dredger (e)	4,000	12	Continuous	17	1.6	whole column
SCENARIO 10								
Dredging for Submarine Gas Pipeline								
SS 34	Grab Dredging across Urmston Road (KP 31 – KP 33.5)	1 X Grab Dredger (e)	4,000	12	Continuous	17	1.6	whole column
SCENARIO 11								
Dredging for Submarine Gas Pipeline								
SS 19	Grab Dredging at West of Black Point (KP33.5 – KP 37)	3 X Grab Dredger (e)	4,000	12	Continuous	17	1.6	whole column
SCENARIO 12								
Dredging for Submarine Gas Pipeline								
SS 35	Grab Dredging at West of Black Point (KP 37 – KP37.803)	1 X Grab Dredger (e)	4,000	12	Continuous	17	1.6	whole column
SCENARIO 13								

Code	Emission Point	No. of Working Plant	Dredging/Jetting/ Sandfilling Rate	Operation Duration	Loss Type	Loss Rate	Loss Rate	Input Layer
			m3/day/plant	hours	-	kg m^{-3}	kg s^{-1}	-
Dredging for Submarine Gas Pipeline								
SS 16	Grab Dredging at Black Point Shore Approach (KP37.803 - KP38.303)	1 X Grab Dredger (e)	4,000	12	Continuous	17	1.6	whole column

Notes:

(a) For TSHD, with hopper capacity of 11,300 m^3, the duration stated refers to the operation time per trip and each dredging event will last for around 0.8 hour.

(b) Jetting for water main, the trench cross-section area (m^2) is (5+2)x5/2 = 17.5 m^2.

(c) Jetting for cable circuit, the trench cross-section area (m^2) is 5X0.3 = 1.5 m^2.

(d) Jetting for gas pipeline, the trench cross-section area (m^2) is 5×3 = 15 m^2.

(e) Grab dredger refers to closed grab dredger with a minimum grab size of 8 m^3.

(f) Bed layer refers to the bottom 10% of the water column.

Appendix 6A

Information on the Model Inputs

CONTENTS

1 *METHODOLOGY USED FOR THE GRID REFINEMENT*

The applied grid refinements have been realised in the Delft3D-FLOW model by means of the so-called domain decomposition technique. The FLOW model grid has subsequently been adopted without further aggregation in the water quality models.

Domain decomposition is a technique in which a model domain is subdivided into several smaller model domains, which are called sub-domains. Domain decomposition allows for local grid refinement, both in horizontal direction and in vertical direction. Grid refinement in horizontal direction means that in one sub-domain smaller mesh sizes (fine grid) are used than in other sub-domains (coarse grid) (see *Figures 1.1* and *1.2*).

The FLOW computations are carried out separately on the sub-domains. The communication between the sub-domains takes place along internal open boundaries, or so-called dd-boundaries. The resulting equations are solved simultaneously for all boundaries.

In the current model, 5 horizontally refined sub-domains are distinguished. The division in sub-domains is based on the requirements for horizontal model resolution in order to represent the coastline and bathymetry near the project sites and to adequately simulate physical processes.

The domain decomposition approach implemented in Delft3D-FLOW is based on a subdivision of the domain into non-overlapping sub-domains. An efficient iterative method is used for solving the discretised equations over the sub-domains. A direct iterative solver is used for the continuity equation, which is comparable to the single domain implementation. For the momentum equations, the transport equation and the turbulence equations the so-called additive Schwarz method is used, which allows for parallelism over the sub-domains. Upon convergence, this type of iteration process is comparable to the corresponding iterative solution methods in the single domain code, and features a comparable robustness. As witnessed by numerical experiments carried out during the development of the technique, the differences introduced by separating domains turn out to be of insignificance.

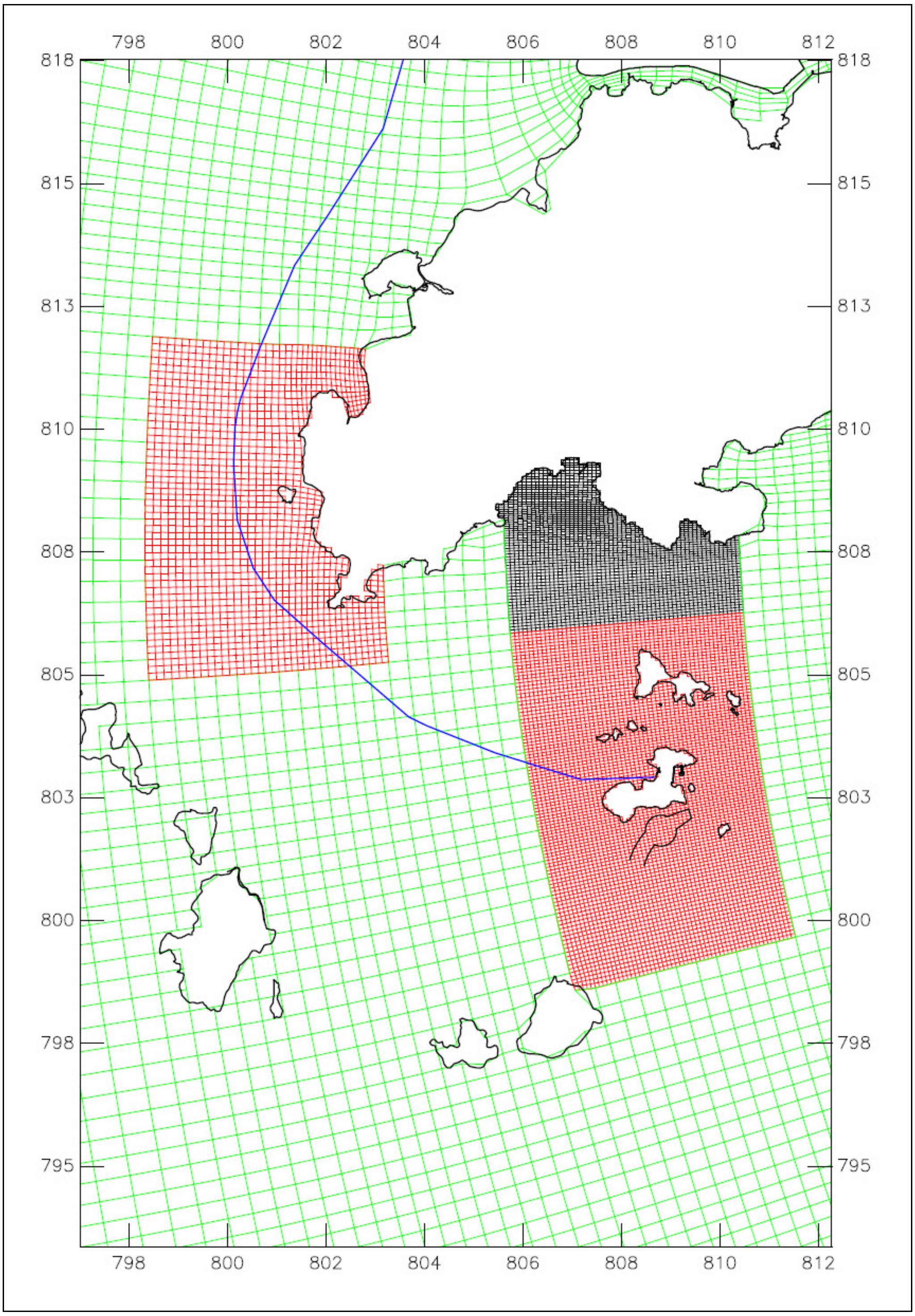


Figure 1.1 Refinement of Model Grid of the Model in the Vicinity of Soko Islands

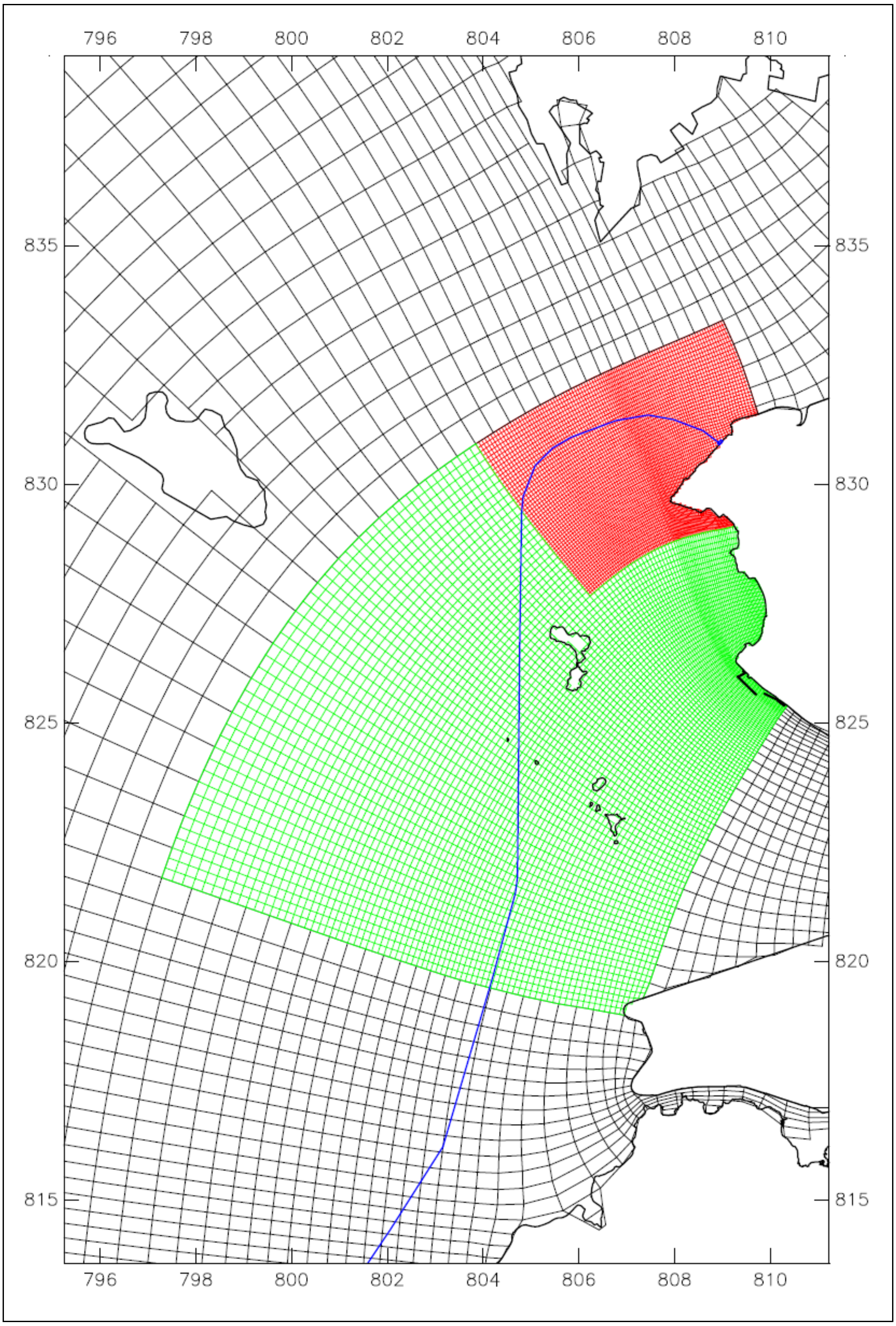


Figure 1.2 Refinement of Model Grid of the Model in the Vicinity of Black Point

2 *VERIFICATION OF THE GRID REFINEMENT*

The verification of the correct implementation of the grid refinement has been carried out by graphically comparing the results from the original, unrefined model with the refined model. This has been done for two locations:

- A location near the intake point of Black Point Power Station, inside the refined domain around the Black Point site.
- A location northwest of South Soko Island (SR26), inside the refined domain around the South Soko site.
- A location west of Lantau, inside the refined domain around the Fan Lau .

The results are shown in *Figures 1.3, 1.4, 1.5* (wet season) and *Figures 1.6, 1.7* & *1.8* (dry season). The comparison includes the water level (top graph), the current speed (second graph), the surface and bottom salinity (third graph) and the surface and bottom temperature (bottom graph). The comparison has been carried out for both the wet and the dry season simulations.

The results clearly demonstrate that the overall behaviour of both models is consistent, while the results are slightly different in the details. This is exactly as it would be expected from a locally refined model.

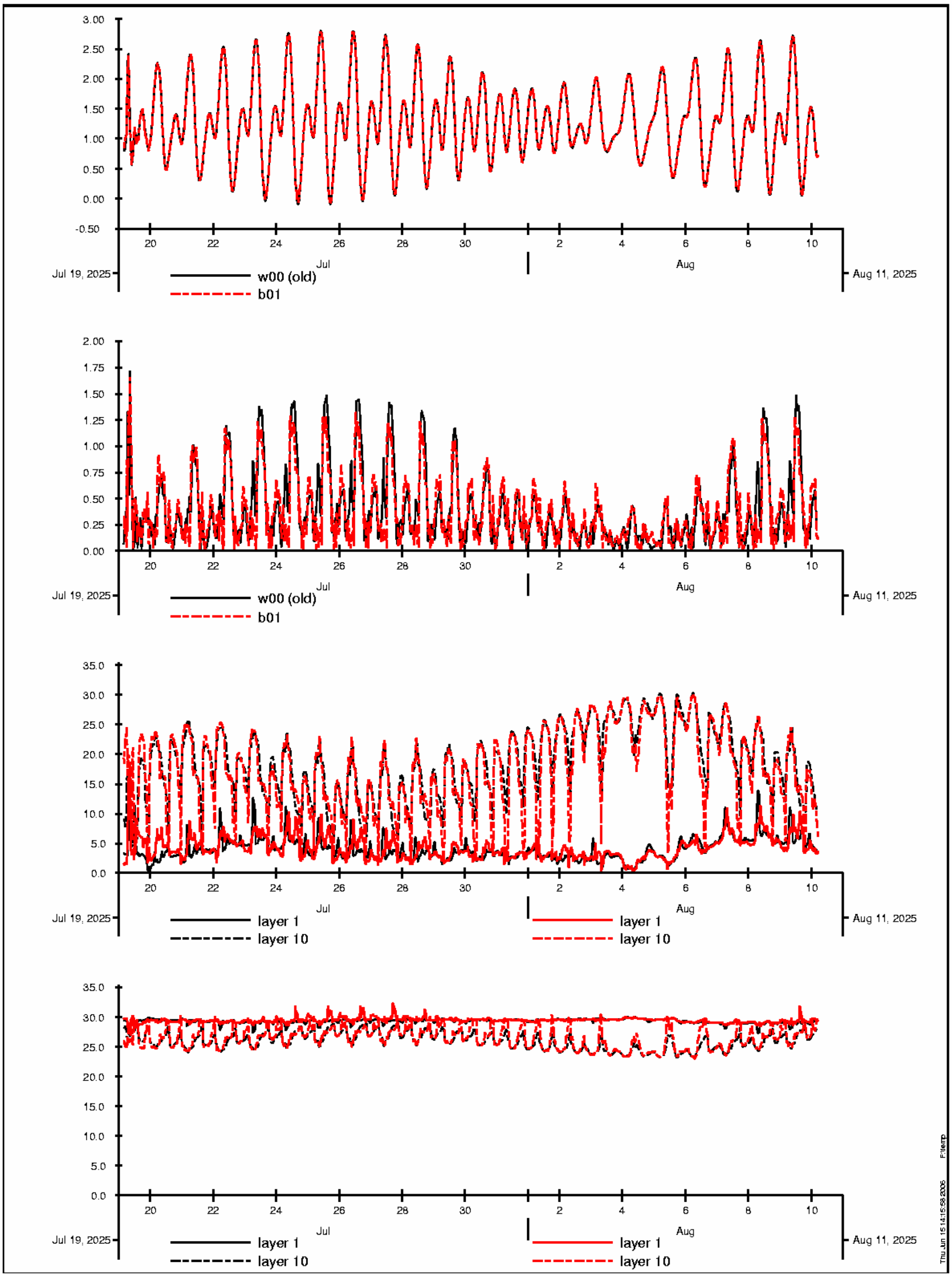


Figure 1.3 *Comparison (Wet Season) between Unrefined Model (in black) and Refined Model (in red) at the Black Point Power Station Intake in (Top graph: Water Level; Second graph: Current Speed; Third graph: Surface (layer 1) and Bottom (layer 10) Salinity; and Bottom graph: Surface (layer 1) and Bottom Temperature)*

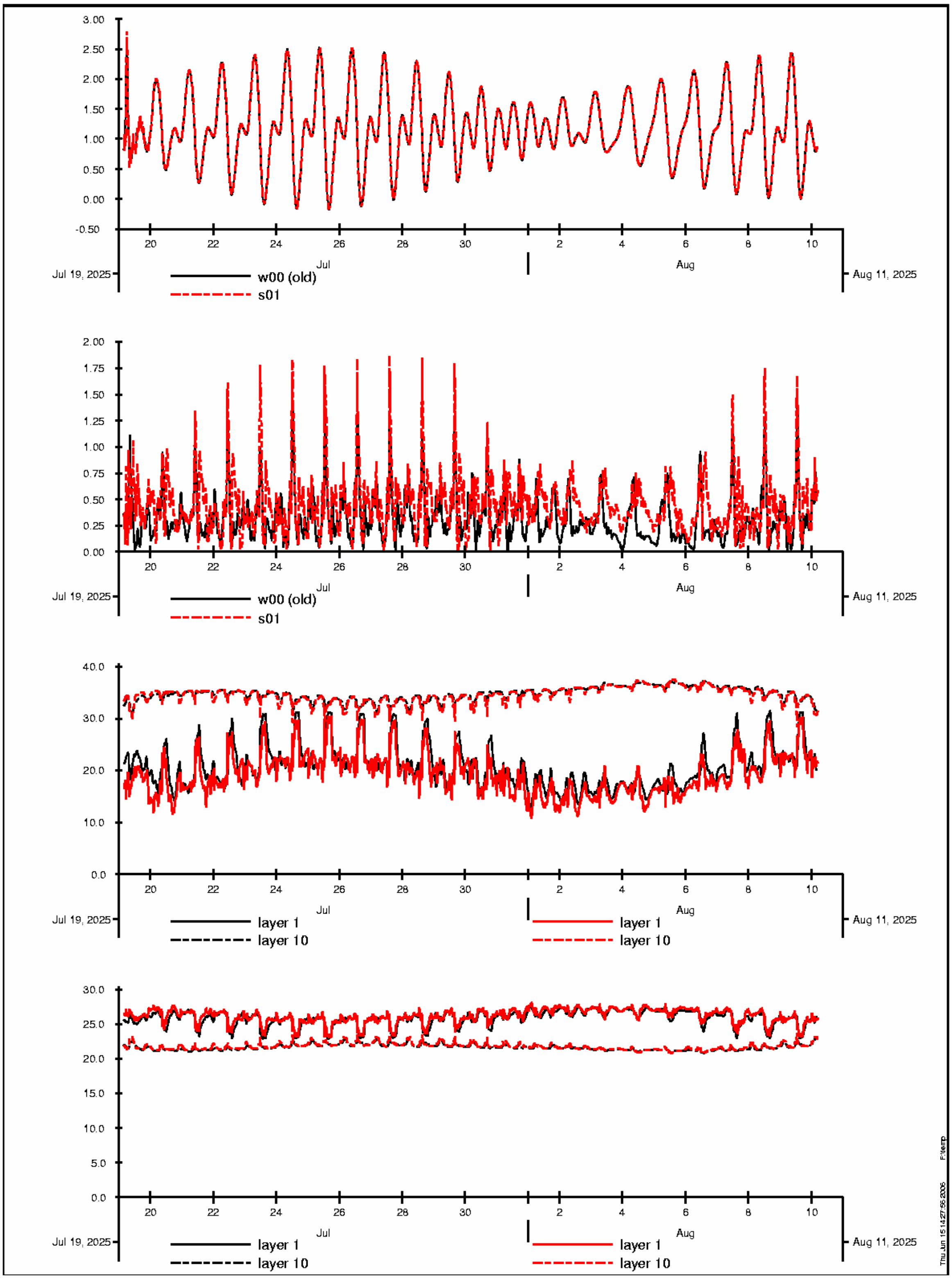


Figure 1.4 *Comparison (Wet Season) between Unrefined Model (in black) and Refined Model (in red) at North western Side of South Soko (Top graph: Water Level; Second graph: Current Speed; Third graph: Surface (layer 1) and Bottom (layer 10) Salinity; and Bottom graph: Surface (layer 1) and Bottom Temperature)*

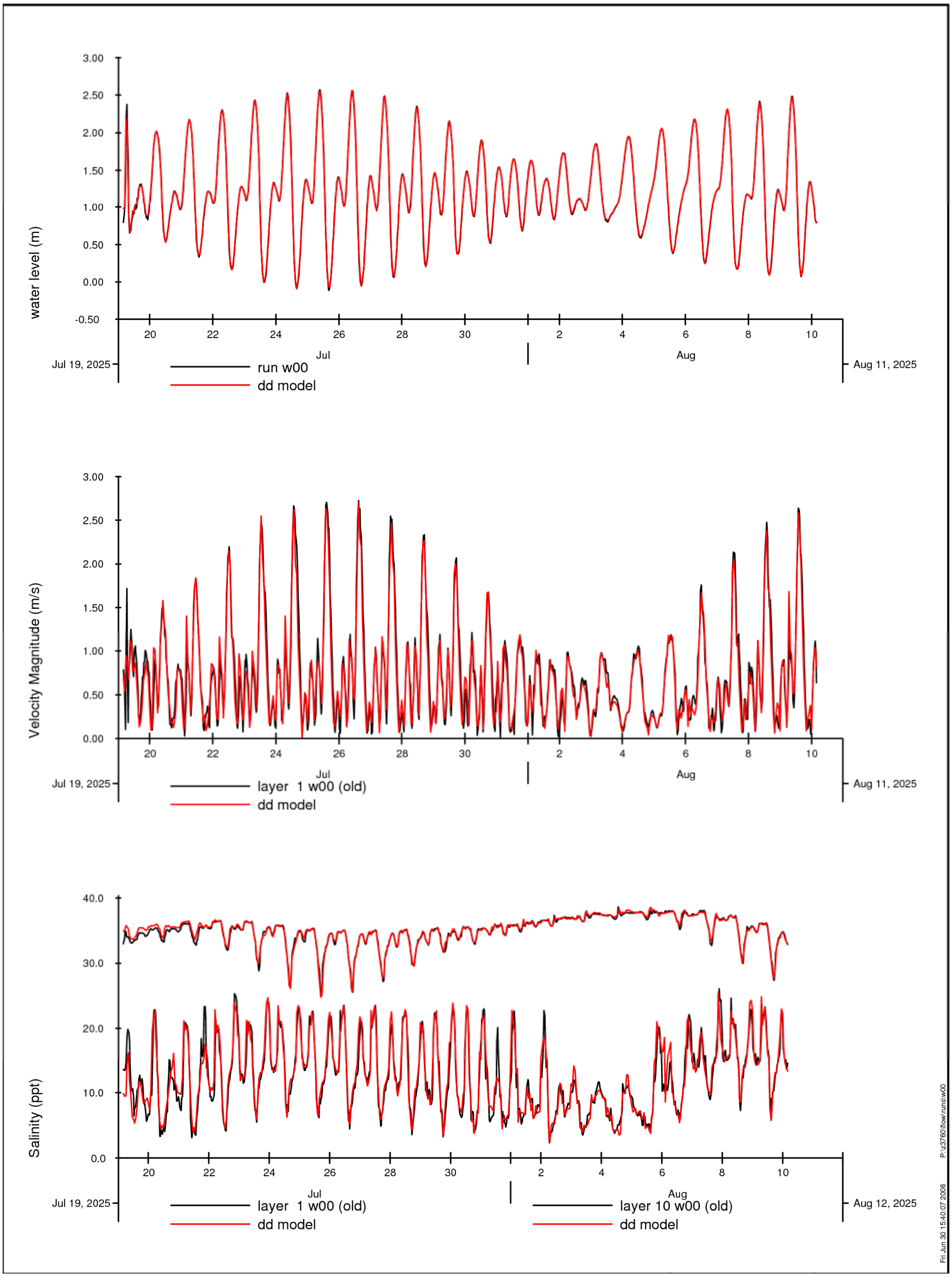


Figure 1.5 ***Comparison (Wet Season) between Unrefined Model (in black) and Refined Model (in red) at West Lantau*** *(Top graph: Water Level; Second graph: Current Speed; and Third graph: Surface (layer 1) and Bottom (layer 10) Salinity.*

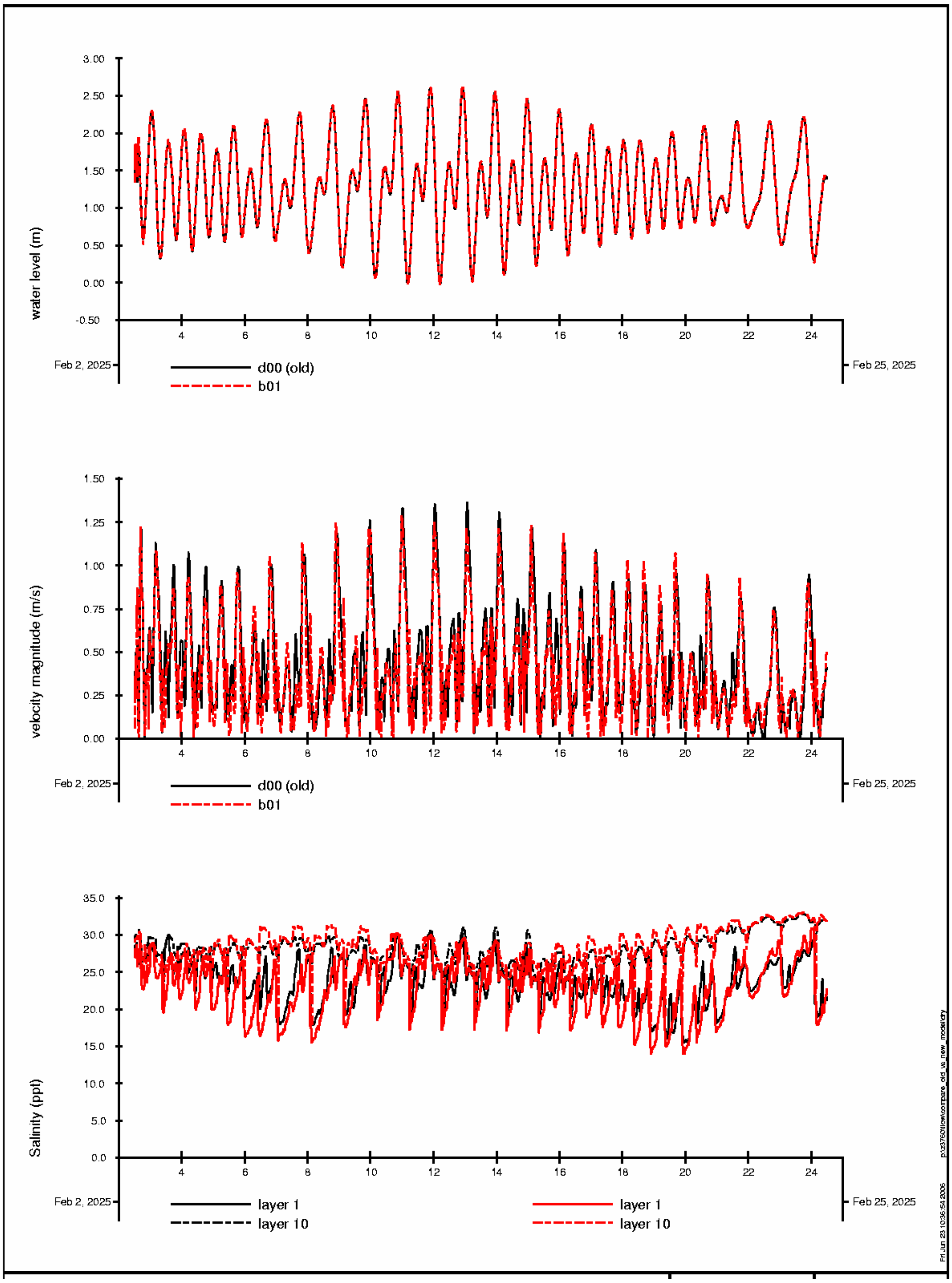


Figure 1.6 *Comparison (Dry Season) between Unrefined Model (in black) and Refined Model (in red) at the Black Point Power Station Intake in (Top graph: Water Level; Second graph: Current Speed; and Third graph: Surface (layer 1) and Bottom (layer 10) Salinity.*

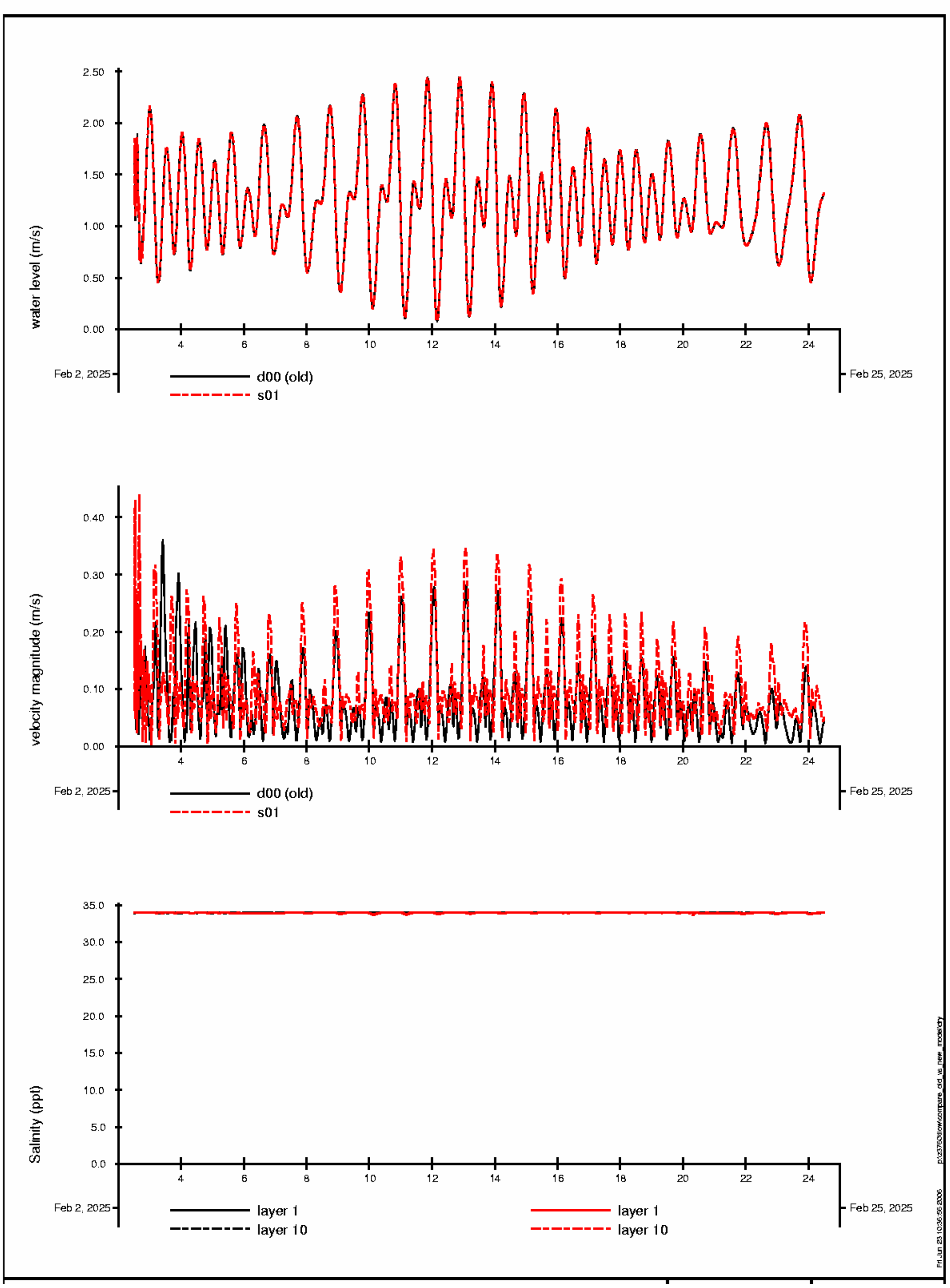


Figure 1.7 *Comparison (Dry Season) between Unrefined Model (in black) and Refined Model (in red) at North western Side of South Soko (Top graph: Water Level; Second graph: Current Speed; and Third graph: Surface (layer 1) and Bottom (layer 10) Salinity.*

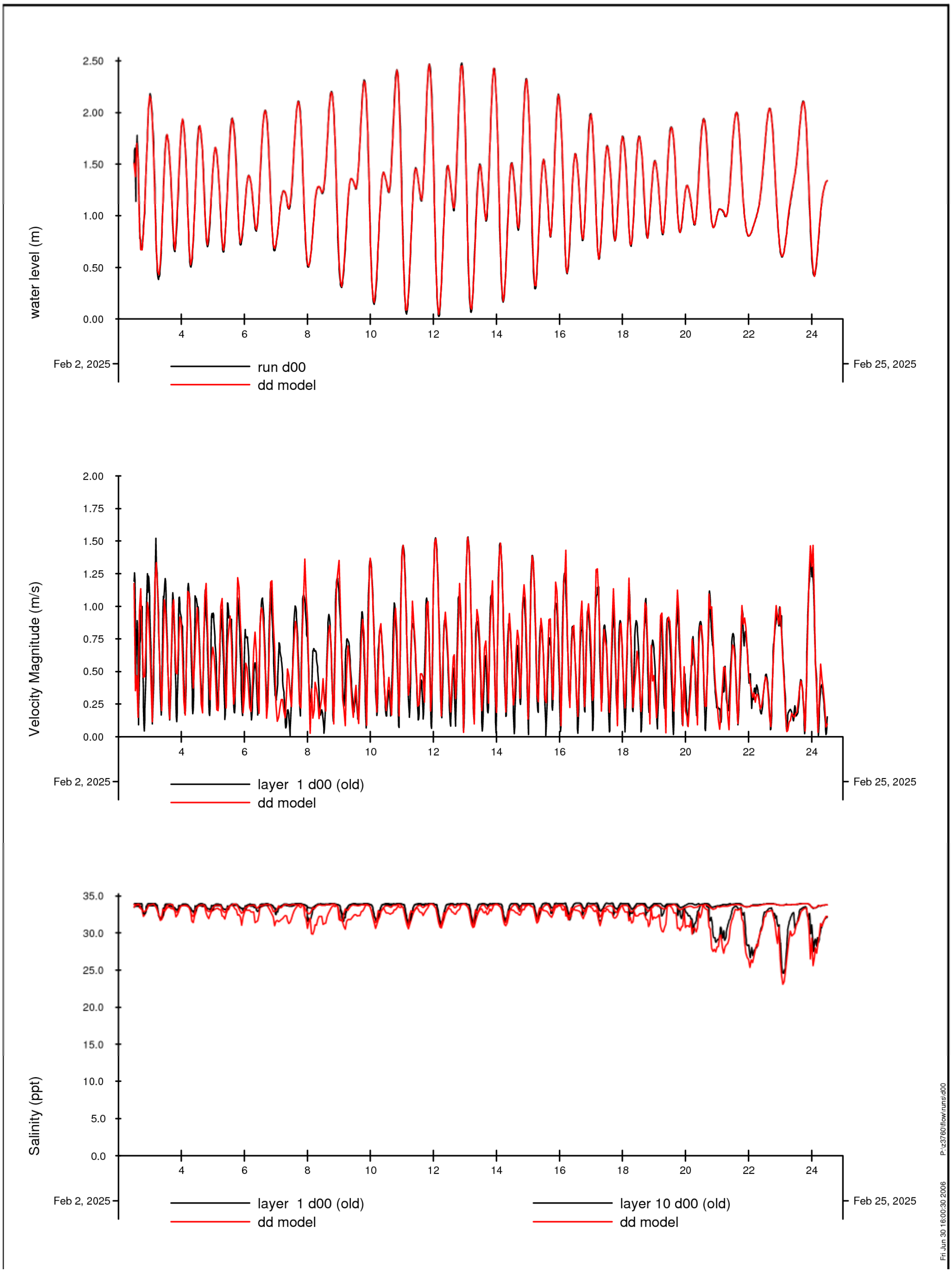


Figure 1.8 ***Comparison (Dry Season) between Unrefined Model (in black) and Refined Model (in red) at West Lantau** (Top graph: Water Level; Second graph: Current Speed; and Third graph: Surface (layer 1) and Bottom (layer 10) Salinity.*

3 DETAILS OF HYDRODYNAMIC SIMULATIONS

All hydrodynamic scenarios are simulated for a spring-neap-cycle during the dry season and a spring-neap-cycle during the wet season. The simulated periods are:

- Dry season: simulation period from 2 February 12:00h to 22 February 12:00h, simulation period 20 days, time step 30 seconds.
- Wet season: simulation period from 19 July 04:00h to 10 August 04:00h, simulation period 22 days, time step 30 seconds.

Adequate spin-up has been provided for salinity and temperature by means of initial conditions files (as shown by verification results). The first 5 days of both simulation periods are also used as spin-up, and are not used for the assessments purpose.

The wind has been set to typical seasonally averaged values:

- Dry season: northeast, 5 m s^{-1}.
- Wet season: southwest, 5 m s^{-1}.

The rivers have been set to typical seasonal values:

	Dry ($m^3 s^{-1}$)	Wet ($m^3 s^{-1}$)
Humen	1248	7442
Jiaomen	527	4732
Hongqili	128	1535
Hengmen	136	2805
Deep Bay	2.5	16

Appendix 6B

Information on CORMIX Model

CONTENTS

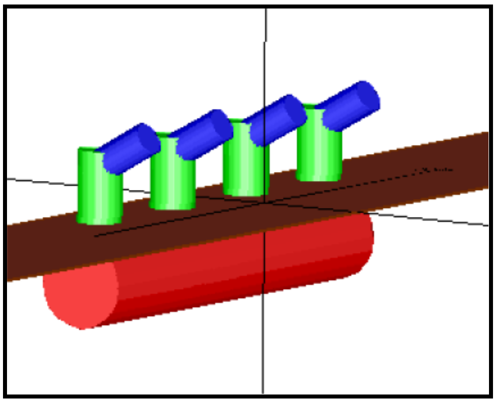
1 CORMIX SIMULATIONS

1.1 INTRODUCTION

The effluent from the LNG terminal will be discharged through the outfall located at south of South Soko Island.

The outfall has the following characteristics:

- Discharge via an outfall and diffuser with four nozzles each at a horizontal angle of approximately 30° (upwards). The nozzles have a diameter of 0.75 m. The schematic design is shown below.



The aim of the CORMIX modelling is here to determine the near field mixing characteristics. These characteristics will be used to set the manner in which the discharge is introduced in the 3D hydrodynamic model.

1.2 *CONDITIONS AROUND THE OUTFALL LOCATIONS*

From the information that was provided is derived that the outfall is located at (809056, 802436) (Hong Kong 1980 coordinate system). To determine the local hydrodynamic conditions that is used for the CORMIX calculations, model output from the indicated grid (in red as shown in the figure below) cell is used. The cell nearest to the outfall is not appropriate because the hydrodynamic conditions in this cell cannot include the alongshore currents. Hence one grid cell further off-shore is used to determine the conditions.

The hydrodynamic conditions were determined for the wet and dry seasons. These conditions were taken from existing baseline computation (*Tables 1.1* and *1.2*).

Table 1.1 Wet Season Conditions

Bottom -10.7 m

	Neap tide			**Spring tide**		
	HW (d)	**LW**	**Mid**	**HW** (d)	**LW** (d)	**Mid** (d)
Depth (m)	12.7	11.2	12	13.2	10.6	12
T_{bot} (°C)	21.2	21.1	20.8	21.7	21.8	21.6
S_{bot} (ppt)	35.1	35.6	36.2	34.7	34.2	34.9
ρ_{bot} (kg m^{-3})	1024.6	1025.0	1025.6	1024.2	1023.8	1024.4
T_{surf} (°C)	26.6	26.4	26.3	26	25.1	25.1
S_{surf} (ppt)	18	20.4	20.8	20.7	25.7	25.1
ρ_{surf} (kg m^{-3})	1010.2	1012.0	1012.4	1012.4	1016.4	1016.0
V_{bot} (m s^{-1})	0.05	0.05	0.1	0.05	0.05	0.1
V_{surf} (m s^{-1})	0.05	0.05	0.4	0.05	0.05	0.4
T_{out} (°C)	15.4	15.25	15.05	15.35	14.95	14.85
S_{out} (ppt)	26.55	28	28.5	27.7	29.95	30
ρ_{out} (kg m^{-3})	1019.3	1020.5	1020.9	1020.2	1022.0	1022.1

Notes:

(a) "bot" denotes the bed

(b) "surf" denotes the surface

(c) "out" denotes the effluent characteristics

(d) The model results are shown in *Appendix 6B-1*.

Table 1.2 *Dry Season Conditions*

Bottom (from model)	-10.7 m PD					
	Neap tide			**Spring tide**		
	HW	**LW**	**Mid**	**HW**	**LW** (d)	**Mid** (d)
Depth (m)	12.3	11.4	11.9	13.1	10.9	11.9
T_{bot} (°C)	23	23	23	23	23	23
S_{bot} (ppt)	34	34	34	34	34	34
ρ_{bot} (kg m^{-3})	1023.3	1023.3	1023.3	1023.3	1023.3	1023.3
T_{surf} (°C)	23	23	23	23	23	23
S_{surf} (ppt)	34	34	34	34	34	34
ρ_{surf} (kg m^{-3})	1023.3	1023.3	1023.3	1023.3	1023.3	1023.3
V_{bot} (m s^{-1})	0.03	0.03	0.18	0.03	0.03	0.18
V_{surf} (m s^{-1})	0.03	0.03	0.29	0.03	0.03	0.29
T_{out} (°C)	14.5	14.5	14.5	14.5	14.5	14.5
S_{out} (ppt)	34	34	34	34	34	34
ρ_{out} (kg m^{-3})	1025.3	1025.3	1025.3	1025.3	1025.3	1025.3

Notes:

(a) "bot" denotes the bed
(b) "surf" denotes the surface
(c) "out" denotes the effluent characteristics
(d) The model results are shown in *Appendix 6B-1*.

The conditions in the area around and south of the discharge are during the dry season tide related, although there is no significant difference in current speed or direction between spring and neap tides. The current direction is mainly from the west and there is no stratification. During the wet season, stratification is significant. The density difference between the surface and bed is generally between 5 and 15 kg m^{-3}. Currents are more chaotic than during the dry season. The influence of the tide on currents is small. In general the current is directed towards the west in contrast to the dry season conditions.

The effluent characteristics are based on the vertically averaged [1] ambient temperature and salinity with the temperature reduced by 8.5 °C. Note that the CORMIX model results were used in the far-field Delft hydrodynamic

(1) In considering that the hydrodynamic model has simulated one condition (with averaged forcing), effects of varying wind, stormy conditions etc, are not taken into account in the model results. Hence actual conditions will vary compared with the conditions in the model, and to use the vertically averaged conditions is more likely to represent the characteristics of the water that is drawn in at the intake.

model to simulate cooling water discharge of 12.5 °C reduction. This increase of the temperature difference increases the density of the discharge by approximately 0.7-0.8 kg m^{-3}, compared to a density difference between discharge and ambient of about 2-6 kg m^{-3}. The CORMIX results (the results for both temperature reduction are enclosed in *Appendix 6B – 1*) show that the difference due to the change in the discharge density is not significant. The dilution factors are the same to the nearest tenth. There is a small difference in the size of the plume, the thickness of the plume reduces by around 20 cm after a travelling distance of over 3 km, well beyond the near field. At the edge of the near field, there are no significant differences in the CORMIX results. This means that there is no consequence in terms of defining the discharge into the far-field model and that the manner in which the discharge is introduced into the Delft3D model remains correct.

Appendix 6B - 1

Results of CORMIX Model

Temperature Difference of 8.5 °C

```
CORMIX2 PREDICTION FILE:
22222222222222222222222222222222222222222222222222222222222222222222222222222222
                       CORMIX MIXING ZONE EXPERT SYSTEM
         Subsystem CORMIX2:  Submerged Multiport Diffuser Discharges
                         CORMIX-GI Version 4.2G
                      HYDRO2 Version 4.2 August 2002
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
CASE DESCRIPTION
 Site name/label:   SOKO
 Design case:       dry season, low water at Soko island
 FILE NAME:         D:\...-station\additional_CORMIX\south-soko-d-sp-lw.prd
 Time stamp:        Wed Jan  4 14:13:13 2006

ENVIRONMENT PARAMETERS (metric units)
 Unbounded section
 HA    =     12.00  HD    =     10.90
 UA    =      0.030 F     =      0.031 USTAR =0.1863E-02
 UW    =      7.500 UWSTAR=0.9300E-02
 Uniform density environment
 STRCND=  U         RHOAM = 1023.3000

DIFFUSER DISCHARGE PARAMETERS (metric units)
 Diffuser type:     DITYPE= unidirectional_parallel
 BANK  =  LEFT      DISTB =    420.00  YB1   =    420.00  YB2   =    420.00
 LD    =     16.00  NOPEN =    4       SPAC  =      5.33
 D0    =      0.750 A0    =      0.442 H0    =      2.00
 Nozzle/port arrangement:   unidirectional_without_fanning
 GAMMA =      0.00  THETA =     30.00  SIGMA =    270.00  BETA  =     90.00
 U0    =      2.829 Q0    =      5.000       =0.5000E+01
 RHO0  = 1025.3000  DRHO0 =-.2000E+01  GP0   =-.1917E-01
 C0    =0.8500E+01  CUNITS=  deg.C
 IPOLL =  3         KS    =0.8359E-05  KD    =0.0000E+00

FLUX VARIABLES - PER UNIT DIFFUSER LENGTH (metric units)
 q0    =0.3125E+00  m0    =0.8842E+00  j0    =-.5990E-02  SIGNJ0=     -1.0
 Associated 2-d length scales (meters)
 lQ=B  =      0.110 lM    =     26.72  lm    =    982.44
 lmp   =  99999.00  lbp   =  99999.00  la    =  99999.00

FLUX VARIABLES - ENTIRE DIFFUSER (metric units)
 Q0    =0.5000E+01  M0    =0.1415E+02  J0    =-.9584E-01
 Associated 3-d length scales (meters)
 LQ    =      1.33  LM    =     23.56  Lm    =    125.38  Lb    =   3549.39
                                       Lmp   =  99999.00  Lbp   =  99999.00

NON-DIMENSIONAL PARAMETERS
 FR0   =     61.50  FRD0  =     23.60  R     =     94.31
 (slot)             (port/nozzle)

FLOW CLASSIFICATION
 222222222222222222222222222222222222222222
 2  Flow class (CORMIX2)      =    MNU8   2
 2  Applicable layer depth HS =    10.90  2
 222222222222222222222222222222222222222222

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.8500E+01  CUNITS=  deg.C
 NTOX  =  0
 NSTD  =  1         CSTD  =0.1000E+01
 REGMZ =  0
 XINT  =  20000.00  XMAX  =  20000.00

X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the bottom and the diffuser mid-point:
       420.00 m  from the LEFT  bank/shore.
    X-axis points downstream, Y-axis points to left, Z-axis points upward.
NSTEP = 20 display intervals per module
```

NOTE on dilution/concentration values for this HEATED DISCHARGE (IPOLL=3):
S = hydrodynamic dilutions, include buoyancy (heat) loss effects, but provided plume has surface contact
C = corresponding temperature values (always in "degC"!), include heat loss, if any

---

BEGIN MOD201: DIFFUSER DISCHARGE MODULE

Due to complex near-field motions: EQUIVALENT SLOT DIFFUSER (2-D) GEOMETRY

Profile definitions:
BV = Gaussian 1/e (37%) half-width, in vertical plane normal to trajectory
BH = top-hat half-width, in horizontal plane normal to trajectory
S = hydrodynamic centerline dilution
C = centerline concentration (includes reaction effects, if any)

X	Y	Z	S	C	BV	BH
0.00	0.00	2.00	1.0	0.850E+01	0.09	8.00

END OF MOD201: DIFFUSER DISCHARGE MODULE

BEGIN MOD272: ACCELERATION ZONE OF UNIDIRECTIONAL CROSS-FLOWING DIFFUSER (TEE)

In this laterally contracting zone the diffuser plume becomes VERTICALLY FULLY MIXED over the entire layer depth (HS = 10.90m).
Full mixing is achieved after a plume distance of about five layer depths from the diffuser.

Profile definitions:
BV = layer depth (vertically mixed)
BH = top-hat half-width, in horizontal plane normal to trajectory
S = hydrodynamic average (bulk) dilution
C = average (bulk) concentration (includes reaction effects, if any)

X	Y	Z	S	C	BV	BH
0.00	0.00	2.00	1.0	0.850E+01	0.09	8.00
0.00	-0.40	2.17	2.2	0.387E+01	0.55	7.44
0.00	-0.80	2.35	2.7	0.315E+01	1.09	6.96
0.00	-1.20	2.52	3.1	0.276E+01	1.63	6.55
0.00	-1.60	2.69	3.4	0.250E+01	2.18	6.18
0.00	-2.00	2.86	3.7	0.231E+01	2.72	5.87
0.00	-2.40	3.03	3.9	0.216E+01	3.27	5.59
0.00	-2.80	3.21	4.2	0.204E+01	3.82	5.34
0.00	-3.20	3.38	4.4	0.194E+01	4.36	5.12
0.00	-3.60	3.55	4.6	0.185E+01	4.91	4.92
0.00	-4.00	3.73	4.8	0.177E+01	5.45	4.74
0.00	-4.40	3.90	5.0	0.171E+01	6.00	4.58
0.00	-4.80	4.07	5.2	0.165E+01	6.54	4.45
0.00	-5.20	4.24	5.3	0.160E+01	7.09	4.33
0.00	-5.60	4.41	5.5	0.155E+01	7.63	4.24
0.00	-6.00	4.59	5.6	0.151E+01	8.18	4.16
0.00	-6.40	4.76	5.8	0.147E+01	8.72	4.11
0.00	-6.80	4.93	5.9	0.143E+01	9.27	4.07
0.00	-7.20	5.11	6.1	0.140E+01	9.81	4.04
0.00	-7.60	5.28	6.2	0.136E+01	10.36	4.02
0.00	-8.00	5.45	6.4	0.134E+01	10.90	4.01

Cumulative travel time = 18. sec
Plume centerline may exhibit slight discontinuities in transition to subsequent far-field module.

END OF MOD272: ACCELERATION ZONE OF UNIDIRECTIONAL CROSS-FLOWING DIFFUSER (TEE

BEGIN MOD252: DIFFUSER INDUCED PLUME IN WEAK CROSS-FLOW

```
 Phase 1: Vertically mixed, Phase 2: Re-stratified

 Phase 1: The diffuser plume is VERTICALLY FULLY MIXED over the
          entire layer depth.
 This flow region is INSIGNIFICANT in spatial extent and will be by-passed.
-----------------------------------------------------------------------------
 Phase 2: The flow has RESTRATIFIED at the beginning of this zone.

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = Gaussian 1/e (37%) half-width in horizontal plane normal to trajectory
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction effects, if any)

       X        Y       Z        S       C       BV       BH
      0.00    -8.00    0.00     6.4 0.134E+01  10.90     4.18
** WATER QUALITY STANDARD OR CCC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.100E+01 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
     40.16  -114.09    0.00    12.0 0.708E+00   3.34    45.49
     99.33  -220.17    0.00    15.7 0.540E+00   2.94    85.29
    172.61  -326.26    0.00    18.7 0.453E+00   2.72   126.49
    257.68  -432.35    0.00    21.3 0.398E+00   2.57   168.86
    353.09  -538.44    0.00    23.6 0.360E+00   2.46   212.19
    457.81  -644.52    0.00    25.7 0.330E+00   2.36   256.36
    571.08  -750.61    0.00    27.7 0.307E+00   2.28   301.26
    692.30  -856.70    0.00    29.5 0.288E+00   2.21   346.80
    820.97  -962.78    0.00    31.2 0.272E+00   2.15   392.93
    956.69 -1068.87    0.00    32.8 0.259E+00   2.09   439.60
   1099.11 -1174.96    0.00    34.4 0.247E+00   2.05   486.76
   1247.93 -1281.04    0.00    35.8 0.237E+00   2.00   534.38
   1402.88 -1387.13    0.00    37.3 0.228E+00   1.96   582.44
   1563.73 -1493.22    0.00    38.6 0.220E+00   1.92   630.89
   1730.27 -1599.31    0.00    39.9 0.213E+00   1.88   679.73
   1902.31 -1705.39    0.00    41.2 0.206E+00   1.85   728.93
   2079.69 -1811.48    0.00    42.5 0.200E+00   1.82   778.48
   2262.24 -1917.57    0.00    43.7 0.195E+00   1.79   828.35
   2449.82 -2023.65    0.00    44.8 0.190E+00   1.76   878.54
   2642.31 -2129.74    0.00    46.0 0.185E+00   1.74   929.03
 Cumulative travel time =      105710. sec

END OF MOD252: DIFFUSER INDUCED PLUME IN WEAK CROSS-FLOW
-----------------------------------------------------------------------------
** End of NEAR-FIELD REGION (NFR) **

 The initial plume WIDTH values in the next far-field module will be
  CORRECTED by a factor  1.54 to conserve the mass flux in the far-field!
 The correction factor is quite large because of the small ambient velocity
   relative to the strong mixing characteristics of the discharge!
   This indicates localized RECIRCULATION REGIONS and internal hydraulic JUMPS.
   Width predictions show discontinuities, dilution values should be acceptable.
-----------------------------------------------------------------------------
BEGIN MOD241: BUOYANT AMBIENT SPREADING

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)

 Plume Stage 1 (not bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL
```

```
   2642.31 -2129.74    0.00    46.0 0.185E+00   2.68  1431.45    2.68    0.00
   2723.84 -2129.74    0.00    54.1 0.157E+00   3.11  1450.24    3.11    0.00
   2805.37 -2129.74    0.00    62.4 0.136E+00   3.54  1470.00    3.54    0.00
   2886.90 -2129.74    0.00    71.0 0.120E+00   3.97  1490.61    3.97    0.00
   2968.43 -2129.74    0.00    79.8 0.106E+00   4.40  1511.95    4.40    0.00
   3049.96 -2129.74    0.00    89.0 0.955E-01   4.83  1533.94    4.83    0.00
   3131.49 -2129.74    0.00    98.4 0.864E-01   5.27  1556.50    5.27    0.00
   3213.02 -2129.74    0.00   108.2 0.786E-01   5.71  1579.57    5.71    0.00
   3294.55 -2129.74    0.00   118.3 0.719E-01   6.15  1603.08    6.15    0.00
   3376.08 -2129.74    0.00   128.7 0.661E-01   6.59  1626.99    6.59    0.00
   3457.62 -2129.74    0.00   139.4 0.610E-01   7.03  1651.25    7.03    0.00
   3539.15 -2129.74    0.00   150.5 0.565E-01   7.48  1675.83    7.48    0.00
   3620.68 -2129.74    0.00   161.9 0.525E-01   7.93  1700.69    7.93    0.00
   3702.21 -2129.74    0.00   173.7 0.489E-01   8.39  1725.80    8.39    0.00
   3783.74 -2129.74    0.00   185.9 0.457E-01   8.85  1751.14    8.85    0.00
   3865.27 -2129.74    0.00   198.5 0.428E-01   9.31  1776.68    9.31    0.00
   3946.80 -2129.74    0.00   211.4 0.402E-01   9.77  1802.39    9.77    0.00
   4028.33 -2129.74    0.00   224.8 0.378E-01  10.24  1828.27   10.24    0.00
   4109.86 -2129.74    0.00   238.5 0.356E-01  10.72  1854.28   10.72    0.00
   4191.39 -2129.74    0.00   252.7 0.336E-01  10.90  1880.43   10.90    0.00
   4272.93 -2129.74    0.00   267.2 0.318E-01  10.90  1906.68   10.90    0.00
 Cumulative travel time =      160064. sec

END OF MOD241: BUOYANT AMBIENT SPREADING
-----------------------------------------------------------------------------
 Due to the attachment or proximity of the plume tothe bottom, the bottom
   coordinate for the FAR-FIELD differs from the ambient depth, ZFB = 0 m.
 In a subsequent analysis set "depth at discharge" equal to "ambient depth".
-----------------------------------------------------------------------------
BEGIN MOD261: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

  Vertical diffusivity (initial value)   = 0.203E-01 m^2/s
  Horizontal diffusivity (initial value) = 0.355E+02 m^2/s

 The passive diffusion plume is VERTICALLY FULLY MIXED at beginning of region.

 Profile definitions:
   BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically
      = or equal to layer depth, if fully mixed
   BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
        measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction effects, if any)

 Plume Stage 1 (not bank attached):
       X        Y       Z        S       C       BV       BH      ZU      ZL
   4272.92 -2129.74    0.00   267.2 0.318E-01  10.90  1906.68   10.90    0.00
   4304.32 -2129.74    0.00   271.5 0.313E-01  10.90  1937.34   10.90    0.00
   4335.71 -2129.74    0.00   275.9 0.308E-01  10.90  1968.15   10.90    0.00
   4367.11 -2129.74    0.00   280.2 0.303E-01  10.90  1999.13   10.90    0.00
   4398.50 -2129.74    0.00   284.6 0.299E-01  10.90  2030.28   10.90    0.00
   4429.90 -2129.74    0.00   289.0 0.294E-01  10.90  2061.58   10.90    0.00
   4461.29 -2129.74    0.00   293.4 0.290E-01  10.90  2093.04   10.90    0.00
   4492.68 -2129.74    0.00   297.8 0.285E-01  10.90  2124.66   10.90    0.00
   4524.08 -2129.74    0.00   302.3 0.281E-01  10.90  2156.43   10.90    0.00
   4555.47 -2129.74    0.00   306.7 0.277E-01  10.90  2188.37   10.90    0.00
   4586.87 -2129.74    0.00   311.2 0.273E-01  10.90  2220.46   10.90    0.00
   4618.26 -2129.74    0.00   315.7 0.269E-01  10.90  2252.70   10.90    0.00
   4649.65 -2129.74    0.00   320.3 0.265E-01  10.90  2285.10   10.90    0.00
   4681.05 -2129.74    0.00   324.9 0.262E-01  10.90  2317.66   10.90    0.00
   4712.44 -2129.74    0.00   329.4 0.258E-01  10.90  2350.36   10.90    0.00
   4743.84 -2129.74    0.00   334.0 0.254E-01  10.90  2383.22   10.90    0.00
   4775.23 -2129.74    0.00   338.7 0.251E-01  10.90  2416.23   10.90    0.00
   4806.62 -2129.74    0.00   343.3 0.248E-01  10.90  2449.39   10.90    0.00
   4838.02 -2129.74    0.00   348.0 0.244E-01  10.90  2482.71   10.90    0.00
   4869.41 -2129.74    0.00   352.7 0.241E-01  10.90  2516.17   10.90    0.00
```

```
   4900.81 -2129.74    0.00   357.4 0.238E-01  10.90  2549.78   10.90    0.00
 Cumulative travel time =      180994. sec

-----------------------------------------------------------------------------
 Plume Stage 2 (bank attached):
       X        Y       Z        S        C       BV       BH      ZU      ZL
   4900.81   420.00    0.00   357.4 0.238E-01  10.90  5099.56   10.90    0.00
   5655.77   420.00    0.00   431.2 0.197E-01  10.90  6153.49   10.90    0.00
   6410.73   420.00    0.00   509.6 0.167E-01  10.90  7271.42   10.90    0.00
   7165.69   420.00    0.00   592.2 0.144E-01  10.90  8449.90   10.90    0.00
   7920.65   420.00    0.00   678.8 0.125E-01  10.90  9685.94   10.90    0.00
   8675.61   420.00    0.00   769.3 0.110E-01  10.90 10976.99   10.90    0.00
   9430.57   420.00    0.00   863.5 0.984E-02  10.90 12320.79   10.90    0.00
  10185.53   420.00    0.00   961.2 0.884E-02  10.90 13715.35   10.90    0.00
  10940.49   420.00    0.00  1062.4 0.800E-02  10.90 15158.88   10.90    0.00
  11695.45   420.00    0.00  1166.8 0.728E-02  10.90 16649.78   10.90    0.00
  12450.41   420.00    0.00  1274.5 0.667E-02  10.90 18186.59   10.90    0.00
  13205.37   420.00    0.00  1385.4 0.614E-02  10.90 19767.97   10.90    0.00
  13960.33   420.00    0.00  1499.2 0.567E-02  10.90 21392.70   10.90    0.00
  14715.29   420.00    0.00  1616.1 0.526E-02  10.90 23059.65   10.90    0.00
  15470.25   420.00    0.00  1735.8 0.490E-02  10.90 24767.79   10.90    0.00
  16225.21   420.00    0.00  1858.3 0.457E-02  10.90 26516.13   10.90    0.00
  16980.16   420.00    0.00  1983.6 0.429E-02  10.90 28303.78   10.90    0.00
  17735.12   420.00    0.00  2111.6 0.403E-02  10.90 30129.88   10.90    0.00
  18490.08   420.00    0.00  2242.2 0.379E-02  10.90 31993.66   10.90    0.00
  19245.04   420.00    0.00  2375.4 0.358E-02  10.90 33894.35   10.90    0.00
  20000.00   420.00    0.00  2511.1 0.338E-02  10.90 35831.26   10.90    0.00
 Cumulative travel time =      684300. sec

 Simulation limit based on maximum specified distance =  20000.00 m.
   This is the REGION OF INTEREST limitation.

END OF MOD261: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
CORMIX2: Submerged Multiport Diffuser Discharges       End of Prediction File
22222222222222222222222222222222222222222222222222222222222222222222222222222
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CORMIX2 PREDICTION FILE:
22222222222222222222222222222222222222222222222222222222222222222222222222222222
                        CORMIX MIXING ZONE EXPERT SYSTEM
         Subsystem CORMIX2:  Submerged Multiport Diffuser Discharges
                          CORMIX-GI Version 4.2G
                       HYDRO2 Version 4.2 August 2002
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
CASE DESCRIPTION
 Site name/label:   SOKO
 Design case:       dry season, mid tide at Soko island
 FILE NAME:         D:\...station\additional_CORMIX\south-soko-d-sp-mid.prd
 Time stamp:        Wed Jan  4 14:15:26 2006

ENVIRONMENT PARAMETERS (metric units)
 Unbounded section
 HA    =     12.00  HD    =     11.90
 UA    =      0.240 F     =      0.031 USTAR =0.1491E-01
 UW    =      7.500 UWSTAR=0.9300E-02
 Uniform density environment
 STRCND=  U         RHOAM = 1023.3000

DIFFUSER DISCHARGE PARAMETERS (metric units)
 Diffuser type:     DITYPE= unidirectional_parallel
 BANK  =  LEFT      DISTB =    420.00  YB1   =    420.00  YB2   =    420.00
 LD    =     16.00  NOPEN =    4       SPAC  =      5.33
 D0    =      0.750 A0    =      0.442 H0    =      2.00
 Nozzle/port arrangement:   unidirectional_without_fanning
 GAMMA =      0.00  THETA =     30.00  SIGMA =    270.00  BETA  =     90.00
 U0    =      2.829 Q0    =      5.000       =0.5000E+01
 RHO0  = 1025.3000  DRHO0 =-.2000E+01  GP0   =-.1917E-01
 C0    =0.8500E+01  CUNITS=  deg.C
 IPOLL =  3         KS    =0.8359E-05  KD    =0.0000E+00

FLUX VARIABLES - PER UNIT DIFFUSER LENGTH (metric units)
 q0    =0.3125E+00  m0    =0.8842E+00  j0    =-.5990E-02  SIGNJ0=     -1.0
 Associated 2-d length scales (meters)
 lQ=B  =      0.110 lM    =     26.72  lm    =     15.35
 lmp   =  99999.00  lbp   =  99999.00  la    =  99999.00

FLUX VARIABLES - ENTIRE DIFFUSER (metric units)
 Q0    =0.5000E+01  M0    =0.1415E+02  J0    =-.9584E-01
 Associated 3-d length scales (meters)
 LQ    =      1.33  LM    =     23.56  Lm    =     15.67  Lb    =      6.93
                                       Lmp   =  99999.00  Lbp   =  99999.00

NON-DIMENSIONAL PARAMETERS
 FR0   =     61.50  FRD0  =     23.60  R     =     11.79
 (slot)             (port/nozzle)

FLOW CLASSIFICATION
 222222222222222222222222222222222222222222
 2  Flow class (CORMIX2)      =    MNU9   2
 2  Applicable layer depth HS =    11.90  2
 222222222222222222222222222222222222222222

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.8500E+01  CUNITS=  deg.C
 NTOX  =  0
 NSTD  =  1         CSTD  =0.1000E+01
 REGMZ =  0
 XINT  =  20000.00  XMAX  =  20000.00

X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the bottom and the diffuser mid-point:
       420.00 m  from the LEFT  bank/shore.
    X-axis points downstream, Y-axis points to left, Z-axis points upward.
NSTEP = 20 display intervals per module
```

NOTE on dilution/concentration values for this HEATED DISCHARGE (IPOLL=3):
S = hydrodynamic dilutions, include buoyancy (heat) loss effects, but provided plume has surface contact
C = corresponding temperature values (always in "degC"!), include heat loss, if any

---

BEGIN MOD201: DIFFUSER DISCHARGE MODULE

Due to complex near-field motions: EQUIVALENT SLOT DIFFUSER (2-D) GEOMETRY

Profile definitions:
BV = Gaussian 1/e (37%) half-width, in vertical plane normal to trajectory
BH = top-hat half-width, in horizontal plane normal to trajectory
S = hydrodynamic centerline dilution
C = centerline concentration (includes reaction effects, if any)

X	Y	Z	S	C	BV	BH
0.00	0.00	2.00	1.0	0.850E+01	0.09	8.00

END OF MOD201: DIFFUSER DISCHARGE MODULE

BEGIN MOD273: UNIDIRECTIONAL CROSS-FLOWING DIFFUSER (TEE) IN STRONG CURRENT

Because of the strong ambient current the diffuser plume of this crossflowing discharge gets RAPIDLY DEFLECTED.
A near-field zone is formed that is VERTICALLY FULLY MIXED over the entire layer depth. Full mixing is achieved at a downstream distance of about five (5) layer depths.

Profile definitions:
BV = layer depth (vertically mixed)
BH = top-hat half-width, measured horizontally in Y-direction
S = hydrodynamic average (bulk) dilution
C = average (bulk) concentration (includes reaction effects, if any)

X	Y	Z	S	C	BV	BH
0.00	0.00	2.00	1.0	0.850E+01	0.09	8.00
3.38	-0.52	1.90	1.6	0.523E+01	0.68	7.77
6.75	-1.03	1.80	1.9	0.451E+01	1.27	7.53
10.12	-1.55	1.70	2.1	0.408E+01	1.86	7.30
13.50	-2.06	1.60	2.2	0.378E+01	2.45	7.06
16.88	-2.58	1.50	2.4	0.355E+01	3.04	6.83
20.25	-3.10	1.40	2.5	0.336E+01	3.63	6.60
23.62	-3.61	1.30	2.7	0.320E+01	4.22	6.36
27.00	-4.13	1.20	2.8	0.307E+01	4.81	6.13
30.38	-4.64	1.10	2.9	0.296E+01	5.40	5.89
33.75	-5.16	1.00	3.0	0.286E+01	5.99	5.66
37.12	-5.68	0.90	3.1	0.277E+01	6.58	5.43
40.50	-6.19	0.80	3.2	0.269E+01	7.18	5.19
43.88	-6.71	0.70	3.3	0.261E+01	7.77	4.96
47.25	-7.22	0.60	3.3	0.255E+01	8.36	4.73
50.62	-7.74	0.50	3.4	0.249E+01	8.95	4.49
54.00	-8.26	0.40	3.5	0.243E+01	9.54	4.26
57.38	-8.77	0.30	3.6	0.238E+01	10.13	4.02
60.75	-9.29	0.20	3.7	0.233E+01	10.72	3.79
64.12	-9.80	0.10	3.7	0.228E+01	11.31	3.56
67.50	-10.32	0.00	3.8	0.224E+01	11.90	3.32

Cumulative travel time = 281. sec
Plume centerline may exhibit slight discontinuities in transition to subsequent far-field module.

END OF MOD273: UNIDIRECTIONAL CROSS-FLOWING DIFFUSER (TEE) IN STRONG CURRENT

** End of NEAR-FIELD REGION (NFR) **

BEGIN MOD241: BUOYANT AMBIENT SPREADING

Profile definitions:
BV = top-hat thickness, measured vertically
BH = top-hat half-width, measured horizontally in y-direction
ZU = upper plume boundary (Z-coordinate)
ZL = lower plume boundary (Z-coordinate)
S = hydrodynamic average (bulk) dilution
C = average (bulk) concentration (includes reaction effects, if any)

Plume Stage 1 (not bank attached):

X	Y	Z	S	C	BV	BH	ZU	ZL
70.88	-10.32	0.00	3.8	0.224E+01	11.90	3.32	11.90	0.00
264.81	-10.32	0.00	7.9	0.108E+01	1.68	48.96	1.68	0.00

** WATER QUALITY STANDARD OR CCC HAS BEEN FOUND **
The pollutant concentration in the plume falls below water quality standard or CCC value of 0.100E+01 in the current prediction interval.
This is the spatial extent of concentrations exceeding the water quality standard or CCC value.

458.74	-10.32	0.00	10.2	0.835E+00	1.45	72.93	1.45	0.00
652.68	-10.32	0.00	13.4	0.634E+00	1.52	91.86	1.52	0.00
846.61	-10.32	0.00	17.8	0.477E+00	1.71	108.48	1.71	0.00
1040.55	-10.32	0.00	23.6	0.361E+00	1.98	123.82	1.98	0.00
1234.48	-10.32	0.00	30.8	0.276E+00	2.32	138.37	2.32	0.00
1428.42	-10.32	0.00	39.6	0.214E+00	2.71	152.38	2.71	0.00
1622.35	-10.32	0.00	50.2	0.169E+00	3.15	165.97	3.15	0.00
1816.29	-10.32	0.00	62.6	0.136E+00	3.64	179.25	3.64	0.00
2010.22	-10.32	0.00	76.9	0.111E+00	4.17	192.25	4.17	0.00
2204.16	-10.32	0.00	93.3	0.911E-01	4.74	205.02	4.74	0.00
2398.09	-10.32	0.00	111.9	0.760E-01	5.35	217.58	5.35	0.00
2592.03	-10.32	0.00	132.7	0.641E-01	6.01	229.95	6.01	0.00
2785.96	-10.32	0.00	155.8	0.546E-01	6.70	242.15	6.70	0.00
2979.90	-10.32	0.00	181.4	0.469E-01	7.43	254.19	7.43	0.00
3173.83	-10.32	0.00	209.6	0.406E-01	8.20	266.07	8.20	0.00
3367.77	-10.32	0.00	240.3	0.354E-01	9.01	277.81	9.01	0.00
3561.70	-10.32	0.00	273.8	0.310E-01	9.85	289.42	9.85	0.00
3755.64	-10.32	0.00	310.1	0.274E-01	10.73	300.90	10.73	0.00
3949.57	-10.32	0.00	349.2	0.243E-01	11.65	312.26	11.65	0.00

Cumulative travel time = 16442. sec

END OF MOD241: BUOYANT AMBIENT SPREADING

Due to the attachment or proximity of the plume tothe bottom, the bottom coordinate for the FAR-FIELD differs from the ambient depth, ZFB = 0 m.
In a subsequent analysis set "depth at discharge" equal to "ambient depth".

BEGIN MOD261: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

Vertical diffusivity (initial value) = 0.382E-01 m^2/s
Horizontal diffusivity (initial value) = 0.318E+01 m^2/s

Profile definitions:
BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically
= or equal to layer depth, if fully mixed
BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
measured horizontally in Y-direction
ZU = upper plume boundary (Z-coordinate)
ZL = lower plume boundary (Z-coordinate)
S = hydrodynamic centerline dilution
C = centerline concentration (includes reaction effects, if any)

Plume Stage 1 (not bank attached):

X	Y	Z	S	C	BV	BH	ZU	ZL
3949.57	-10.32	0.00	349.2	0.243E-01	11.65	312.26	11.65	0.00
4033.39	-10.32	0.00	363.1	0.234E-01	11.90	317.86	11.90	0.00
4117.21	-10.32	0.00	369.6	0.230E-01	11.90	323.49	11.90	0.00
4201.03	-10.32	0.00	376.0	0.226E-01	11.90	329.16	11.90	0.00
4284.85	-10.32	0.00	382.5	0.222E-01	11.90	334.85	11.90	0.00

4368.67	-10.32	0.00	389.1	0.218E-01	11.90	340.58	11.90	0.00
4452.49	-10.32	0.00	395.7	0.215E-01	11.90	346.35	11.90	0.00
4536.31	-10.32	0.00	402.3	0.211E-01	11.90	352.14	11.90	0.00
4620.13	-10.32	0.00	408.9	0.208E-01	11.90	357.97	11.90	0.00
4703.95	-10.32	0.00	415.6	0.205E-01	11.90	363.83	11.90	0.00
4787.77	-10.32	0.00	422.4	0.201E-01	11.90	369.72	11.90	0.00
4871.59	-10.32	0.00	429.1	0.198E-01	11.90	375.64	11.90	0.00
4955.41	-10.32	0.00	435.9	0.195E-01	11.90	381.59	11.90	0.00
5039.23	-10.32	0.00	442.8	0.192E-01	11.90	387.58	11.90	0.00
5123.05	-10.32	0.00	449.6	0.189E-01	11.90	393.59	11.90	0.00
5206.87	-10.32	0.00	456.5	0.186E-01	11.90	399.64	11.90	0.00
5290.69	-10.32	0.00	463.5	0.183E-01	11.90	405.72	11.90	0.00
5374.52	-10.32	0.00	470.5	0.181E-01	11.90	411.82	11.90	0.00
5458.34	-10.32	0.00	477.5	0.178E-01	11.90	417.96	11.90	0.00
5542.16	-10.32	0.00	484.5	0.175E-01	11.90	424.13	11.90	0.00
5625.98	-10.32	0.00	491.6	0.173E-01	11.90	430.33	11.90	0.00

Cumulative travel time = 23428. sec

Plume Stage 2 (bank attached):

X	Y	Z	S	C	BV	BH	ZU	ZL
5625.98	420.00	0.00	491.6	0.173E-01	11.90	860.65	11.90	0.00
6344.68	420.00	0.00	530.4	0.160E-01	11.90	928.63	11.90	0.00
7063.38	420.00	0.00	570.2	0.149E-01	11.90	998.32	11.90	0.00
7782.08	420.00	0.00	611.0	0.139E-01	11.90	1069.66	11.90	0.00
8500.78	420.00	0.00	652.7	0.130E-01	11.90	1142.62	11.90	0.00
9219.48	420.00	0.00	695.3	0.122E-01	11.90	1217.18	11.90	0.00
9938.18	420.00	0.00	738.7	0.115E-01	11.90	1293.28	11.90	0.00
10656.88	420.00	0.00	783.1	0.109E-01	11.90	1370.91	11.90	0.00
11375.59	420.00	0.00	828.3	0.103E-01	11.90	1450.04	11.90	0.00
12094.29	420.00	0.00	874.3	0.972E-02	11.90	1530.63	11.90	0.00
12812.99	420.00	0.00	921.2	0.923E-02	11.90	1612.66	11.90	0.00
13531.69	420.00	0.00	968.8	0.877E-02	11.90	1696.11	11.90	0.00
14250.39	420.00	0.00	1017.3	0.836E-02	11.90	1780.94	11.90	0.00
14969.09	420.00	0.00	1066.5	0.797E-02	11.90	1867.15	11.90	0.00
15687.79	420.00	0.00	1116.5	0.761E-02	11.90	1954.71	11.90	0.00
16406.49	420.00	0.00	1167.3	0.728E-02	11.90	2043.59	11.90	0.00
17125.20	420.00	0.00	1218.8	0.697E-02	11.90	2133.78	11.90	0.00
17843.90	420.00	0.00	1271.1	0.669E-02	11.90	2225.26	11.90	0.00
18562.60	420.00	0.00	1324.0	0.642E-02	11.90	2318.01	11.90	0.00
19281.30	420.00	0.00	1377.7	0.617E-02	11.90	2412.01	11.90	0.00
20000.00	420.00	0.00	1432.1	0.594E-02	11.90	2507.25	11.90	0.00

Cumulative travel time = 83319. sec

Simulation limit based on maximum specified distance = 20000.00 m.
This is the REGION OF INTEREST limitation.

END OF MOD261: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

CORMIX2: Submerged Multiport Diffuser Discharges End of Prediction File

2222222222222222222222222222222222222222222222222222222222222222222222222222

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CORMIX2 PREDICTION FILE:
222222222222222222222222222222222222222222222222222222222222222222222222222222
                       CORMIX MIXING ZONE EXPERT SYSTEM
         Subsystem CORMIX2:  Submerged Multiport Diffuser Discharges
                         CORMIX-GI Version 4.2G
                      HYDRO2 Version 4.2 August 2002
------------------------------------------------------------------------------
------------------------------------------------------------------------------
CASE DESCRIPTION
 Site name/label:   SOKO
 Design case:       Wet season, neap tide, high water
 FILE NAME:         D:\...-station\additional_CORMIX\south-soko-w-np-hw.prd
 Time stamp:        Wed Jan  4 14:17:30 2006

ENVIRONMENT PARAMETERS (metric units)
 Unbounded section
 HA    =     12.00  HD    =     12.70
 UA    =      0.050 F     =      0.031 USTAR =0.3106E-02
 UW    =      7.500 UWSTAR=0.9300E-02
 Density stratified environment
 STRCND=  A         RHOAM = 1017.4000
 RHOAS = 1010.2000  RHOAB = 1024.6000  RHOAH0= 1017.4000  E     =0.1085E-01

DIFFUSER DISCHARGE PARAMETERS (metric units)
 Diffuser type:     DITYPE= unidirectional_parallel
 BANK  =  LEFT      DISTB =    420.00  YB1   =    420.00  YB2   =    420.00
 LD    =     16.00  NOPEN =    4       SPAC  =      5.33
 D0    =      0.750 A0    =      0.442 H0    =      2.00
 Nozzle/port arrangement:   unidirectional_without_fanning
 GAMMA =      0.00  THETA =     30.00  SIGMA =    270.00  BETA  =     90.00
 U0    =      2.829 Q0    =      5.000       =0.5000E+01
 RHO0  = 1019.3000  DRHO0 =-.1900E+01  GP0   =-.1831E-01
 C0    =0.8500E+01  CUNITS=  deg.C
 IPOLL =  3         KS    =0.8359E-05  KD    =0.0000E+00

FLUX VARIABLES - PER UNIT DIFFUSER LENGTH (metric units)
 q0    =0.3125E+00  m0    =0.8842E+00  j0    =-.5723E-02  SIGNJ0=     -1.0
 Associated 2-d length scales (meters)
 lQ=B  =      0.110 lM    =     27.68  lm    =    353.68
 lmp   =  99999.00  lbp   =  99999.00  la    =  99999.00

FLUX VARIABLES - ENTIRE DIFFUSER (metric units)
 Q0    =0.5000E+01  M0    =0.1415E+02  J0    =-.9157E-01
 Associated 3-d length scales (meters)
 LQ    =      1.33  LM    =     24.11  Lm    =     75.23  Lb    =    732.56
                                       Lmp   =  99999.00  Lbp   =  99999.00

NON-DIMENSIONAL PARAMETERS
 FR0   =     62.91  FRD0  =     24.14  R     =     56.59
 (slot)             (port/nozzle)

FLOW CLASSIFICATION
 222222222222222222222222222222222222222222
 2  Flow class (CORMIX2)      =    MNU8   2
 2  Applicable layer depth HS =    12.70  2
 222222222222222222222222222222222222222222

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.8500E+01  CUNITS=  deg.C
 NTOX  =  0
 NSTD  =  1         CSTD  =0.1000E+01
 REGMZ =  0
 XINT  =  20000.00  XMAX  =  20000.00

X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the bottom and the diffuser mid-point:
       420.00 m  from the LEFT  bank/shore.
    X-axis points downstream, Y-axis points to left, Z-axis points upward.
```

NSTEP = 20 display intervals per module

NOTE on dilution/concentration values for this HEATED DISCHARGE (IPOLL=3):
S = hydrodynamic dilutions, include buoyancy (heat) loss effects, but provided plume has surface contact
C = corresponding temperature values (always in "degC"!), include heat loss, if any

---

BEGIN MOD201: DIFFUSER DISCHARGE MODULE

Due to complex near-field motions: EQUIVALENT SLOT DIFFUSER (2-D) GEOMETRY

Profile definitions:
BV = Gaussian 1/e (37%) half-width, in vertical plane normal to trajectory
BH = top-hat half-width, in horizontal plane normal to trajectory
S = hydrodynamic centerline dilution
C = centerline concentration (includes reaction effects, if any)

X	Y	Z	S	C	BV	BH
0.00	0.00	2.00	1.0	0.850E+01	0.09	8.00

END OF MOD201: DIFFUSER DISCHARGE MODULE

BEGIN MOD272: ACCELERATION ZONE OF UNIDIRECTIONAL CROSS-FLOWING DIFFUSER (TEE)

In this laterally contracting zone the diffuser plume becomes VERTICALLY FULLY MIXED over the entire layer depth (HS = 12.70m).
Full mixing is achieved after a plume distance of about five layer depths from the diffuser.

Profile definitions:
BV = layer depth (vertically mixed)
BH = top-hat half-width, in horizontal plane normal to trajectory
S = hydrodynamic average (bulk) dilution
C = average (bulk) concentration (includes reaction effects, if any)

X	Y	Z	S	C	BV	BH
0.00	0.00	2.00	1.0	0.850E+01	0.09	8.00
0.00	-0.40	2.22	2.2	0.381E+01	0.63	7.44
0.00	-0.80	2.43	2.7	0.310E+01	1.27	6.96
0.00	-1.20	2.65	3.1	0.272E+01	1.91	6.55
0.00	-1.60	2.87	3.5	0.246E+01	2.54	6.18
0.00	-2.00	3.09	3.7	0.227E+01	3.17	5.87
0.00	-2.40	3.31	4.0	0.212E+01	3.81	5.59
0.00	-2.80	3.52	4.3	0.200E+01	4.45	5.34
0.00	-3.20	3.74	4.5	0.190E+01	5.08	5.12
0.00	-3.60	3.96	4.7	0.181E+01	5.72	4.92
0.00	-4.00	4.18	4.9	0.174E+01	6.35	4.74
0.00	-4.40	4.39	5.1	0.167E+01	6.99	4.58
0.00	-4.80	4.61	5.3	0.162E+01	7.62	4.45
0.00	-5.20	4.83	5.4	0.156E+01	8.26	4.33
0.00	-5.60	5.05	5.6	0.152E+01	8.89	4.24
0.00	-6.00	5.26	5.8	0.148E+01	9.53	4.16
0.00	-6.40	5.48	5.9	0.144E+01	10.16	4.11
0.00	-6.80	5.70	6.1	0.140E+01	10.80	4.07
0.00	-7.20	5.92	6.2	0.137E+01	11.43	4.04
0.00	-7.60	6.13	6.4	0.134E+01	12.07	4.02
0.00	-8.00	6.35	6.5	0.131E+01	12.70	4.01

Cumulative travel time = 18. sec
Plume centerline may exhibit slight discontinuities in transition to subsequent far-field module.

END OF MOD272: ACCELERATION ZONE OF UNIDIRECTIONAL CROSS-FLOWING DIFFUSER (TEE

BEGIN MOD252: DIFFUSER INDUCED PLUME IN WEAK CROSS-FLOW

```
 Phase 1: Vertically mixed, Phase 2: Re-stratified

 Phase 1: The diffuser plume is VERTICALLY FULLY MIXED over the
          entire layer depth.
 This flow region is INSIGNIFICANT in spatial extent and will be by-passed.
-----------------------------------------------------------------------------
 Phase 2: The flow has RESTRATIFIED at the beginning of this zone.

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = Gaussian 1/e (37%) half-width in horizontal plane normal to trajectory
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction effects, if any)

       X        Y       Z        S       C       BV       BH
      0.00    -8.00    0.00     6.5 0.131E+01  12.70     3.91
** WATER QUALITY STANDARD OR CCC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.100E+01 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
     16.78   -39.35    0.00     8.6 0.987E+00   4.59    18.21
     37.70   -70.69    0.00    10.3 0.825E+00   3.87    29.90
     62.06  -102.04    0.00    11.7 0.723E+00   3.53    41.50
     89.44  -133.39    0.00    13.0 0.652E+00   3.31    53.18
    119.52  -164.74    0.00    14.2 0.598E+00   3.15    64.99
    152.08  -196.08    0.00    15.3 0.556E+00   3.02    76.92
    186.96  -227.43    0.00    16.3 0.521E+00   2.92    88.97
    224.00  -258.78    0.00    17.3 0.493E+00   2.83   101.15
    263.08  -290.12    0.00    18.2 0.468E+00   2.75   113.44
    304.10  -321.47    0.00    19.0 0.447E+00   2.68   125.84
    346.98  -352.82    0.00    19.8 0.428E+00   2.62   138.34
    391.63  -384.17    0.00    20.6 0.412E+00   2.56   150.94
    438.00  -415.51    0.00    21.4 0.397E+00   2.51   163.64
    486.01  -446.86    0.00    22.1 0.384E+00   2.46   176.42
    535.61  -478.21    0.00    22.8 0.372E+00   2.42   189.28
    586.76  -509.55    0.00    23.5 0.361E+00   2.38   202.23
    639.41  -540.90    0.00    24.2 0.351E+00   2.34   215.26
    693.52  -572.25    0.00    24.8 0.342E+00   2.30   228.36
    749.04  -603.60    0.00    25.5 0.334E+00   2.27   241.53
    805.95  -634.94    0.00    26.1 0.326E+00   2.23   254.77
 Cumulative travel time =       19361. sec

END OF MOD252: DIFFUSER INDUCED PLUME IN WEAK CROSS-FLOW
-----------------------------------------------------------------------------
** End of NEAR-FIELD REGION (NFR) **

 The initial plume WIDTH values in the next far-field module will be
  CORRECTED by a factor  1.51 to conserve the mass flux in the far-field!
 The correction factor is quite large because of the small ambient velocity
   relative to the strong mixing characteristics of the discharge!
   This indicates localized RECIRCULATION REGIONS and internal hydraulic JUMPS.
   Width predictions show discontinuities, dilution values should be acceptable.
-----------------------------------------------------------------------------
BEGIN MOD241: BUOYANT AMBIENT SPREADING

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)

 Plume Stage 1 (not bank attached):
```

X	Y	Z	S	C	BV	BH	ZU	ZL
805.95	-634.94	0.00	26.1	0.326E+00	3.38	385.84	3.38	0.00
939.38	-634.94	0.00	28.8	0.295E+00	3.32	432.87	3.32	0.00
1072.82	-634.94	0.00	31.8	0.267E+00	3.34	475.77	3.34	0.00
1206.25	-634.94	0.00	35.2	0.241E+00	3.42	515.72	3.42	0.00
1339.68	-634.94	0.00	39.1	0.217E+00	3.53	553.50	3.53	0.00
1473.12	-634.94	0.00	43.4	0.196E+00	3.68	589.64	3.68	0.00
1606.55	-634.94	0.00	48.2	0.176E+00	3.86	624.48	3.86	0.00
1739.99	-634.94	0.00	53.5	0.159E+00	4.06	658.31	4.06	0.00
1873.42	-634.94	0.00	59.3	0.143E+00	4.29	691.31	4.29	0.00
2006.85	-634.94	0.00	65.6	0.130E+00	4.53	723.64	4.53	0.00
2140.29	-634.94	0.00	72.5	0.117E+00	4.80	755.41	4.80	0.00
2273.72	-634.94	0.00	79.9	0.106E+00	5.08	786.70	5.08	0.00
2407.16	-634.94	0.00	87.9	0.967E-01	5.38	817.58	5.38	0.00
2540.59	-634.94	0.00	96.5	0.881E-01	5.69	848.12	5.69	0.00
2674.02	-634.94	0.00	105.8	0.804E-01	6.02	878.35	6.02	0.00
2807.46	-634.94	0.00	115.6	0.735E-01	6.36	908.31	6.36	0.00
2940.89	-634.94	0.00	126.1	0.674E-01	6.72	938.04	6.72	0.00
3074.32	-634.94	0.00	137.3	0.619E-01	7.10	967.55	7.10	0.00
3207.76	-634.94	0.00	149.2	0.570E-01	7.48	996.86	7.48	0.00
3341.19	-634.94	0.00	161.8	0.525E-01	7.88	1026.00	7.88	0.00
3474.63	-634.94	0.00	175.1	0.485E-01	8.30	1054.98	8.30	0.00

Cumulative travel time = 72735. sec

Plume is ATTACHED to LEFT bank/shore.
Plume width is now determined from LEFT bank/shore.

Plume Stage 2 (bank attached):

X	Y	Z	S	C	BV	BH	ZU	ZL
3474.63	420.00	0.00	175.1	0.485E-01	8.30	2109.88	8.30	0.00
3539.66	420.00	0.00	181.4	0.469E-01	8.56	2118.95	8.56	0.00
3604.70	420.00	0.00	187.7	0.453E-01	8.82	2128.11	8.82	0.00
3669.74	420.00	0.00	194.2	0.438E-01	9.08	2137.34	9.08	0.00
3734.77	420.00	0.00	200.6	0.424E-01	9.35	2146.66	9.35	0.00
3799.81	420.00	0.00	207.2	0.410E-01	9.61	2156.06	9.61	0.00
3864.85	420.00	0.00	213.8	0.398E-01	9.87	2165.53	9.87	0.00
3929.88	420.00	0.00	220.4	0.386E-01	10.13	2175.07	10.13	0.00
3994.92	420.00	0.00	227.2	0.374E-01	10.40	2184.68	10.40	0.00
4059.96	420.00	0.00	234.0	0.363E-01	10.66	2194.35	10.66	0.00
4124.99	420.00	0.00	240.8	0.353E-01	10.93	2204.09	10.93	0.00
4190.03	420.00	0.00	247.8	0.343E-01	11.19	2213.90	11.19	0.00
4255.07	420.00	0.00	254.8	0.334E-01	11.46	2223.76	11.46	0.00
4320.10	420.00	0.00	261.8	0.325E-01	11.72	2233.68	11.72	0.00
4385.14	420.00	0.00	269.0	0.316E-01	11.99	2243.65	11.99	0.00
4450.18	420.00	0.00	276.2	0.308E-01	12.25	2253.68	12.25	0.00
4515.21	420.00	0.00	283.4	0.300E-01	12.52	2263.76	12.52	0.00
4580.25	420.00	0.00	290.8	0.292E-01	12.70	2273.89	12.70	0.00
4645.29	420.00	0.00	298.2	0.285E-01	12.70	2284.07	12.70	0.00
4710.32	420.00	0.00	305.7	0.278E-01	12.70	2294.29	12.70	0.00
4775.36	420.00	0.00	313.3	0.271E-01	12.70	2304.55	12.70	0.00

Cumulative travel time = 98749. sec

END OF MOD241: BUOYANT AMBIENT SPREADING

Due to the attachment or proximity of the plume tothe bottom, the bottom
coordinate for the FAR-FIELD differs from the ambient depth, ZFB = 0 m.
In a subsequent analysis set "depth at discharge" equal to "ambient depth".

BEGIN MOD262: PASSIVE AMBIENT MIXING IN STRATIFIED AMBIENT

Vertical diffusivity (initial value) = 0.263E-07 m^2/s
Horizontal diffusivity (initial value) = 0.457E+02 m^2/s

The passive diffusion plume is VERTICALLY FULLY MIXED at beginning of region.

Profile definitions:
BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically

```
      = or equal to layer depth, if fully mixed
   BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
        measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction effects, if any)
```

Plume Stage 2 (bank attached):

X	Y	Z	S	C	BV	BH	ZU	ZL
4775.36	420.00	0.00	313.3	0.271E-01	12.70	2304.55	12.70	0.00
5536.59	420.00	0.00	379.9	0.224E-01	12.70	2794.26	12.70	0.00
6297.82	420.00	0.00	450.6	0.189E-01	12.70	3314.45	12.70	0.00
7059.05	420.00	0.00	525.2	0.162E-01	12.70	3863.43	12.70	0.00
7820.29	420.00	0.00	603.6	0.141E-01	12.70	4439.77	12.70	0.00
8581.52	420.00	0.00	685.5	0.124E-01	12.70	5042.21	12.70	0.00
9342.75	420.00	0.00	770.8	0.110E-01	12.70	5669.68	12.70	0.00
10103.98	420.00	0.00	859.3	0.989E-02	12.70	6321.22	12.70	0.00
10865.22	420.00	0.00	951.1	0.894E-02	12.70	6995.96	12.70	0.00
11626.45	420.00	0.00	1045.8	0.813E-02	12.70	7693.13	12.70	0.00
12387.68	420.00	0.00	1143.6	0.743E-02	12.70	8412.04	12.70	0.00
13148.91	420.00	0.00	1244.2	0.683E-02	12.70	9152.04	12.70	0.00
13910.15	420.00	0.00	1347.6	0.631E-02	12.70	9912.55	12.70	0.00
14671.38	420.00	0.00	1453.7	0.585E-02	12.70	10693.04	12.70	0.00
15432.61	420.00	0.00	1562.4	0.544E-02	12.70	11493.00	12.70	0.00
16193.84	420.00	0.00	1673.7	0.508E-02	12.70	12311.96	12.70	0.00
16955.07	420.00	0.00	1787.6	0.475E-02	12.70	13149.51	12.70	0.00
17716.31	420.00	0.00	1903.9	0.446E-02	12.70	14005.23	12.70	0.00
18477.54	420.00	0.00	2022.7	0.420E-02	12.70	14878.74	12.70	0.00
19238.77	420.00	0.00	2143.8	0.396E-02	12.70	15769.70	12.70	0.00
20000.00	420.00	0.00	2267.2	0.375E-02	12.70	16677.77	12.70	0.00

Cumulative travel time = 403242. sec

Simulation limit based on maximum specified distance = 20000.00 m.
This is the REGION OF INTEREST limitation.

```
END OF MOD262: PASSIVE AMBIENT MIXING IN STRATIFIED AMBIENT
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
CORMIX2: Submerged Multiport Diffuser Discharges       End of Prediction File
22222222222222222222222222222222222222222222222222222222222222222222222222222
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CORMIX2 PREDICTION FILE:
222222222222222222222222222222222222222222222222222222222222222222222222222222
                       CORMIX MIXING ZONE EXPERT SYSTEM
         Subsystem CORMIX2:  Submerged Multiport Diffuser Discharges
                         CORMIX-GI Version 4.2G
                      HYDRO2 Version 4.2 August 2002
------------------------------------------------------------------------------
------------------------------------------------------------------------------
CASE DESCRIPTION
 Site name/label:   SOKO
 Design case:       wet season, high water at Soko island
 FILE NAME:         D:\...-station\additional_CORMIX\south-soko-w-sp-hw.prd
 Time stamp:        Wed Jan  4 14:22:17 2006

ENVIRONMENT PARAMETERS (metric units)
 Unbounded section
 HA    =     12.00  HD    =     13.20
 UA    =      0.050 F     =      0.031 USTAR =0.3106E-02
 UW    =      7.500 UWSTAR=0.9300E-02
 Density stratified environment
 STRCND=  A         RHOAM = 1018.3000
 RHOAS = 1012.4000  RHOAB = 1024.2000  RHOAH0= 1018.3000  E     =0.8559E-02

DIFFUSER DISCHARGE PARAMETERS (metric units)
 Diffuser type:     DITYPE= unidirectional_parallel
 BANK  =  LEFT      DISTB =    420.00  YB1   =    420.00  YB2   =    420.00
 LD    =     16.00  NOPEN =    4       SPAC  =      5.33
 D0    =      0.750 A0    =      0.442 H0    =      2.00
 Nozzle/port arrangement:   unidirectional_without_fanning
 GAMMA =      0.00  THETA =     30.00  SIGMA =    270.00  BETA  =     90.00
 U0    =      2.829 Q0    =      5.000       =0.5000E+01
 RHO0  = 1020.2000  DRHO0 =-.1900E+01  GP0   =-.1830E-01
 C0    =0.8500E+01  CUNITS=  deg.C
 IPOLL =  3         KS    =0.8359E-05  KD    =0.0000E+00

FLUX VARIABLES - PER UNIT DIFFUSER LENGTH (metric units)
 q0    =0.3125E+00  m0    =0.8842E+00  j0    =-.5718E-02  SIGNJ0=     -1.0
 Associated 2-d length scales (meters)
 lQ=B  =      0.110 lM    =     27.70  lm    =    353.68
 lmp   =  99999.00  lbp   =  99999.00  la    =  99999.00

FLUX VARIABLES - ENTIRE DIFFUSER (metric units)
 Q0    =0.5000E+01  M0    =0.1415E+02  J0    =-.9149E-01
 Associated 3-d length scales (meters)
 LQ    =      1.33  LM    =     24.12  Lm    =     75.23  Lb    =    731.91
                                       Lmp   =  99999.00  Lbp   =  99999.00

NON-DIMENSIONAL PARAMETERS
 FR0   =     62.94  FRD0  =     24.15  R     =     56.59
 (slot)             (port/nozzle)

FLOW CLASSIFICATION
 222222222222222222222222222222222222222222
 2  Flow class (CORMIX2)      =    MNU8   2
 2  Applicable layer depth HS =    13.20  2
 222222222222222222222222222222222222222222

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.8500E+01  CUNITS=  deg.C
 NTOX  =  0
 NSTD  =  1         CSTD  =0.1000E+01
 REGMZ =  0
 XINT  =  20000.00  XMAX  =  20000.00

X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the bottom and the diffuser mid-point:
       420.00 m  from the LEFT  bank/shore.
    X-axis points downstream, Y-axis points to left, Z-axis points upward.
```

NSTEP = 20 display intervals per module

NOTE on dilution/concentration values for this HEATED DISCHARGE (IPOLL=3):
S = hydrodynamic dilutions, include buoyancy (heat) loss effects, but provided plume has surface contact
C = corresponding temperature values (always in "degC"!), include heat loss, if any

---

BEGIN MOD201: DIFFUSER DISCHARGE MODULE

Due to complex near-field motions: EQUIVALENT SLOT DIFFUSER (2-D) GEOMETRY

Profile definitions:
BV = Gaussian 1/e (37%) half-width, in vertical plane normal to trajectory
BH = top-hat half-width, in horizontal plane normal to trajectory
S = hydrodynamic centerline dilution
C = centerline concentration (includes reaction effects, if any)

X	Y	Z	S	C	BV	BH
0.00	0.00	2.00	1.0	0.850E+01	0.09	8.00

END OF MOD201: DIFFUSER DISCHARGE MODULE

BEGIN MOD272: ACCELERATION ZONE OF UNIDIRECTIONAL CROSS-FLOWING DIFFUSER (TEE)

In this laterally contracting zone the diffuser plume becomes VERTICALLY FULLY MIXED over the entire layer depth (HS = 13.20m).
Full mixing is achieved after a plume distance of about five layer depths from the diffuser.

Profile definitions:
BV = layer depth (vertically mixed)
BH = top-hat half-width, in horizontal plane normal to trajectory
S = hydrodynamic average (bulk) dilution
C = average (bulk) concentration (includes reaction effects, if any)

X	Y	Z	S	C	BV	BH
0.00	0.00	2.00	1.0	0.850E+01	0.09	8.00
0.00	-0.40	2.23	2.3	0.377E+01	0.66	7.44
0.00	-0.80	2.46	2.8	0.307E+01	1.32	6.96
0.00	-1.20	2.69	3.2	0.268E+01	1.98	6.55
0.00	-1.60	2.92	3.5	0.242E+01	2.64	6.18
0.00	-2.00	3.15	3.8	0.224E+01	3.30	5.87
0.00	-2.40	3.38	4.1	0.209E+01	3.96	5.59
0.00	-2.80	3.61	4.3	0.197E+01	4.62	5.34
0.00	-3.20	3.84	4.5	0.187E+01	5.28	5.12
0.00	-3.60	4.07	4.8	0.179E+01	5.94	4.92
0.00	-4.00	4.30	5.0	0.171E+01	6.60	4.74
0.00	-4.40	4.53	5.2	0.165E+01	7.26	4.58
0.00	-4.80	4.76	5.3	0.159E+01	7.92	4.45
0.00	-5.20	4.99	5.5	0.154E+01	8.58	4.33
0.00	-5.60	5.22	5.7	0.149E+01	9.24	4.24
0.00	-6.00	5.45	5.9	0.145E+01	9.90	4.16
0.00	-6.40	5.68	6.0	0.141E+01	10.56	4.11
0.00	-6.80	5.91	6.2	0.138E+01	11.22	4.07
0.00	-7.20	6.14	6.3	0.135E+01	11.88	4.04
0.00	-7.60	6.37	6.5	0.132E+01	12.54	4.02
0.00	-8.00	6.60	6.6	0.129E+01	13.20	4.01

Cumulative travel time = 19. sec
Plume centerline may exhibit slight discontinuities in transition to subsequent far-field module.

END OF MOD272: ACCELERATION ZONE OF UNIDIRECTIONAL CROSS-FLOWING DIFFUSER (TEE

BEGIN MOD252: DIFFUSER INDUCED PLUME IN WEAK CROSS-FLOW

```
 Phase 1: Vertically mixed, Phase 2: Re-stratified

 Phase 1: The diffuser plume is VERTICALLY FULLY MIXED over the
          entire layer depth.
 This flow region is INSIGNIFICANT in spatial extent and will be by-passed.
-----------------------------------------------------------------------------
 Phase 2: The flow has RESTRATIFIED at the beginning of this zone.

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = Gaussian 1/e (37%) half-width in horizontal plane normal to trajectory
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction effects, if any)

       X        Y       Z        S       C       BV       BH
      0.00    -8.00    0.00     6.6 0.129E+01  13.20     3.90
** WATER QUALITY STANDARD OR CCC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.100E+01 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
     16.33   -38.08    0.00     8.7 0.980E+00   4.75    17.92
     36.57   -68.16    0.00    10.3 0.822E+00   3.99    29.31
     60.09   -98.24    0.00    11.8 0.722E+00   3.64    40.59
     86.48  -128.33    0.00    13.0 0.651E+00   3.41    51.94
    115.45  -158.41    0.00    14.2 0.598E+00   3.24    63.40
    146.78  -188.49    0.00    15.3 0.556E+00   3.11    74.99
    180.32  -218.57    0.00    16.3 0.522E+00   3.00    86.69
    215.93  -248.65    0.00    17.2 0.493E+00   2.91    98.51
    253.49  -278.73    0.00    18.1 0.469E+00   2.83   110.43
    292.91  -308.81    0.00    19.0 0.448E+00   2.76   122.47
    334.10  -338.89    0.00    19.8 0.429E+00   2.69   134.60
    376.98  -368.98    0.00    20.6 0.413E+00   2.64   146.82
    421.51  -399.06    0.00    21.3 0.398E+00   2.58   159.14
    467.61  -429.14    0.00    22.1 0.385E+00   2.53   171.54
    515.23  -459.22    0.00    22.8 0.373E+00   2.49   184.02
    564.33  -489.30    0.00    23.5 0.362E+00   2.44   196.58
    614.87  -519.38    0.00    24.1 0.352E+00   2.40   209.22
    666.80  -549.46    0.00    24.8 0.343E+00   2.36   221.93
    720.08  -579.54    0.00    25.4 0.335E+00   2.33   234.70
    774.70  -609.63    0.00    26.0 0.327E+00   2.30   247.55
 Cumulative travel time =       18611. sec

END OF MOD252: DIFFUSER INDUCED PLUME IN WEAK CROSS-FLOW
-----------------------------------------------------------------------------
** End of NEAR-FIELD REGION (NFR) **

 The initial plume WIDTH values in the next far-field module will be
  CORRECTED by a factor  1.51 to conserve the mass flux in the far-field!
 The correction factor is quite large because of the small ambient velocity
   relative to the strong mixing characteristics of the discharge!
   This indicates localized RECIRCULATION REGIONS and internal hydraulic JUMPS.
   Width predictions show discontinuities, dilution values should be acceptable.
-----------------------------------------------------------------------------
BEGIN MOD241: BUOYANT AMBIENT SPREADING

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)

 Plume Stage 1 (not bank attached):
```

X	Y	Z	S	C	BV	BH	ZU	ZL
774.70	-609.63	0.00	26.0	0.327E+00	3.47	374.56	3.47	0.00
903.46	-609.63	0.00	28.5	0.298E+00	3.39	421.42	3.39	0.00
1032.22	-609.63	0.00	31.4	0.271E+00	3.38	463.98	3.38	0.00
1160.98	-609.63	0.00	34.6	0.246E+00	3.44	503.49	3.44	0.00
1289.74	-609.63	0.00	38.2	0.223E+00	3.53	540.74	3.53	0.00
1418.50	-609.63	0.00	42.2	0.201E+00	3.66	576.28	3.66	0.00
1547.26	-609.63	0.00	46.7	0.182E+00	3.82	610.48	3.82	0.00
1676.02	-609.63	0.00	51.6	0.165E+00	4.01	643.62	4.01	0.00
1804.78	-609.63	0.00	56.9	0.149E+00	4.21	675.90	4.21	0.00
1933.54	-609.63	0.00	62.8	0.135E+00	4.44	707.48	4.44	0.00
2062.30	-609.63	0.00	69.2	0.123E+00	4.68	738.47	4.68	0.00
2191.06	-609.63	0.00	76.1	0.112E+00	4.94	768.97	4.94	0.00
2319.82	-609.63	0.00	83.5	0.102E+00	5.22	799.05	5.22	0.00
2448.58	-609.63	0.00	91.4	0.930E-01	5.52	828.76	5.52	0.00
2577.34	-609.63	0.00	100.0	0.850E-01	5.82	858.16	5.82	0.00
2706.10	-609.63	0.00	109.1	0.779E-01	6.15	887.29	6.15	0.00
2834.86	-609.63	0.00	118.8	0.716E-01	6.48	916.16	6.48	0.00
2963.62	-609.63	0.00	129.1	0.658E-01	6.83	944.82	6.83	0.00
3092.38	-609.63	0.00	140.1	0.607E-01	7.20	973.28	7.20	0.00
3221.15	-609.63	0.00	151.7	0.560E-01	7.57	1001.56	7.57	0.00
3349.91	-609.63	0.00	163.9	0.519E-01	7.96	1029.67	7.96	0.00

Cumulative travel time = 70116. sec

Plume is ATTACHED to LEFT bank/shore.
Plume width is now determined from LEFT bank/shore.

Plume Stage 2 (bank attached):

X	Y	Z	S	C	BV	BH	ZU	ZL
3349.91	420.00	0.00	163.9	0.519E-01	7.96	2059.25	7.96	0.00
3419.52	420.00	0.00	170.3	0.499E-01	8.23	2069.00	8.23	0.00
3489.13	420.00	0.00	176.8	0.481E-01	8.51	2078.85	8.51	0.00
3558.74	420.00	0.00	183.4	0.463E-01	8.78	2088.79	8.78	0.00
3628.35	420.00	0.00	190.0	0.447E-01	9.05	2098.83	9.05	0.00
3697.96	420.00	0.00	196.7	0.432E-01	9.33	2108.96	9.33	0.00
3767.57	420.00	0.00	203.5	0.418E-01	9.60	2119.17	9.60	0.00
3837.18	420.00	0.00	210.4	0.404E-01	9.88	2129.46	9.88	0.00
3906.79	420.00	0.00	217.3	0.391E-01	10.15	2139.84	10.15	0.00
3976.40	420.00	0.00	224.3	0.379E-01	10.43	2150.29	10.43	0.00
4046.01	420.00	0.00	231.3	0.367E-01	10.71	2160.81	10.71	0.00
4115.62	420.00	0.00	238.5	0.356E-01	10.98	2171.40	10.98	0.00
4185.23	420.00	0.00	245.7	0.346E-01	11.26	2182.05	11.26	0.00
4254.84	420.00	0.00	253.0	0.336E-01	11.54	2192.78	11.54	0.00
4324.45	420.00	0.00	260.4	0.326E-01	11.82	2203.56	11.82	0.00
4394.06	420.00	0.00	267.9	0.317E-01	12.10	2214.41	12.10	0.00
4463.67	420.00	0.00	275.4	0.309E-01	12.37	2225.31	12.37	0.00
4533.28	420.00	0.00	283.0	0.300E-01	12.65	2236.26	12.65	0.00
4602.89	420.00	0.00	290.7	0.292E-01	12.94	2247.27	12.94	0.00
4672.50	420.00	0.00	298.5	0.285E-01	13.20	2258.34	13.20	0.00
4742.11	420.00	0.00	306.4	0.277E-01	13.20	2269.44	13.20	0.00

Cumulative travel time = 97960. sec

END OF MOD241: BUOYANT AMBIENT SPREADING

Due to the attachment or proximity of the plume tothe bottom, the bottom
coordinate for the FAR-FIELD differs from the ambient depth, ZFB = 0 m.
In a subsequent analysis set "depth at discharge" equal to "ambient depth".

BEGIN MOD262: PASSIVE AMBIENT MIXING IN STRATIFIED AMBIENT

Vertical diffusivity (initial value) = 0.390E-07 m^2/s
Horizontal diffusivity (initial value) = 0.447E+02 m^2/s

The passive diffusion plume is VERTICALLY FULLY MIXED at beginning of region.

Profile definitions:
BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically

```
      = or equal to layer depth, if fully mixed
   BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
        measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction effects, if any)

 Plume Stage 2 (bank attached):
```

X	Y	Z	S	C	BV	BH	ZU	ZL
4742.11	420.00	0.00	306.4	0.277E-01	13.20	2269.44	13.20	0.00
5505.01	420.00	0.00	372.3	0.228E-01	13.20	2757.91	13.20	0.00
6267.90	420.00	0.00	442.4	0.192E-01	13.20	3277.13	13.20	0.00
7030.80	420.00	0.00	516.4	0.165E-01	13.20	3825.38	13.20	0.00
7793.69	420.00	0.00	594.1	0.143E-01	13.20	4401.19	13.20	0.00
8556.59	420.00	0.00	675.4	0.126E-01	13.20	5003.29	13.20	0.00
9319.48	420.00	0.00	760.1	0.112E-01	13.20	5630.60	13.20	0.00
10082.38	420.00	0.00	848.1	0.100E-01	13.20	6282.14	13.20	0.00
10845.27	420.00	0.00	939.2	0.905E-02	13.20	6957.03	13.20	0.00
11608.17	420.00	0.00	1033.3	0.823E-02	13.20	7654.49	13.20	0.00
12371.06	420.00	0.00	1130.4	0.752E-02	13.20	8373.82	13.20	0.00
13133.95	420.00	0.00	1230.4	0.691E-02	13.20	9114.36	13.20	0.00
13896.85	420.00	0.00	1333.1	0.638E-02	13.20	9875.54	13.20	0.00
14659.74	420.00	0.00	1438.6	0.591E-02	13.20	10656.80	13.20	0.00
15422.64	420.00	0.00	1546.7	0.550E-02	13.20	11457.64	13.20	0.00
16185.53	420.00	0.00	1657.4	0.513E-02	13.20	12277.59	13.20	0.00
16948.43	420.00	0.00	1770.6	0.480E-02	13.20	13116.22	13.20	0.00
17711.32	420.00	0.00	1886.3	0.451E-02	13.20	13973.12	13.20	0.00
18474.21	420.00	0.00	2004.4	0.424E-02	13.20	14847.91	13.20	0.00
19237.11	420.00	0.00	2124.8	0.400E-02	13.20	15740.22	13.20	0.00
20000.00	420.00	0.00	2247.6	0.378E-02	13.20	16649.73	13.20	0.00

```
 Cumulative travel time =      403117. sec

 Simulation limit based on maximum specified distance =  20000.00 m.
   This is the REGION OF INTEREST limitation.

END OF MOD262: PASSIVE AMBIENT MIXING IN STRATIFIED AMBIENT
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
CORMIX2: Submerged Multiport Diffuser Discharges       End of Prediction File
2222222222222222222222222222222222222222222222222222222222222222222222222222222
```

```
CORMIX2 PREDICTION FILE:
2222222222222222222222222222222222222222222222222222222222222222222222222222222
                       CORMIX MIXING ZONE EXPERT SYSTEM
         Subsystem CORMIX2:  Submerged Multiport Diffuser Discharges
                         CORMIX-GI Version 4.2G
                      HYDRO2 Version 4.2 August 2002
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
CASE DESCRIPTION
 Site name/label:   SOKO
 Design case:       wet season, lw water at Soko island
 FILE NAME:         D:\...-station\additional_CORMIX\south-soko-w-sp-lw.prd
 Time stamp:        Wed Jan  4 14:23:47 2006

ENVIRONMENT PARAMETERS (metric units)
 Unbounded section
 HA    =     12.00  HD    =     10.60
 UA    =      0.050 F     =      0.031 USTAR =0.3106E-02
 UW    =      7.500 UWSTAR=0.9300E-02
 Density stratified environment
 STRCND=  A         RHOAM = 1020.1000
 RHOAS = 1016.4000  RHOAB = 1023.8000  RHOAH0= 1020.1000  E     =0.6687E-02

DIFFUSER DISCHARGE PARAMETERS (metric units)
 Diffuser type:     DITYPE= unidirectional_parallel
 BANK  =  LEFT      DISTB =    420.00  YB1   =    420.00  YB2   =    420.00
 LD    =     16.00  NOPEN =    4       SPAC  =      5.33
 D0    =      0.750 A0    =      0.442 H0    =      2.00
 Nozzle/port arrangement:   unidirectional_without_fanning
 GAMMA =      0.00  THETA =     30.00  SIGMA =    270.00  BETA  =     90.00
 U0    =      2.829 Q0    =      5.000       =0.5000E+01
 RHO0  = 1022.0000  DRHO0 =-.1900E+01  GP0   =-.1827E-01
 C0    =0.8500E+01  CUNITS=  deg.C
 IPOLL =  3         KS    =0.8359E-05  KD    =0.0000E+00

FLUX VARIABLES - PER UNIT DIFFUSER LENGTH (metric units)
 q0    =0.3125E+00  m0    =0.8842E+00  j0    =-.5708E-02  SIGNJ0=     -1.0
 Associated 2-d length scales (meters)
 lQ=B  =      0.110 lM    =     27.73  lm    =    353.68
 lmp   =  99999.00  lbp   =  99999.00  la    =  99999.00

FLUX VARIABLES - ENTIRE DIFFUSER (metric units)
 Q0    =0.5000E+01  M0    =0.1415E+02  J0    =-.9133E-01
 Associated 3-d length scales (meters)
 LQ    =      1.33  LM    =     24.14  Lm    =     75.23  Lb    =    730.62
                                       Lmp   =  99999.00  Lbp   =  99999.00

NON-DIMENSIONAL PARAMETERS
 FR0   =     62.99  FRD0  =     24.17  R     =     56.59
 (slot)             (port/nozzle)

FLOW CLASSIFICATION
 222222222222222222222222222222222222222222
 2  Flow class (CORMIX2)      =    MNU8   2
 2  Applicable layer depth HS =    10.60  2
 222222222222222222222222222222222222222222

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.8500E+01  CUNITS=  deg.C
 NTOX  =  0
 NSTD  =  1         CSTD  =0.1000E+01
 REGMZ =  0
 XINT  =  20000.00  XMAX  =  20000.00

X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the bottom and the diffuser mid-point:
       420.00 m  from the LEFT  bank/shore.
    X-axis points downstream, Y-axis points to left, Z-axis points upward.
```

NSTEP = 20 display intervals per module

NOTE on dilution/concentration values for this HEATED DISCHARGE (IPOLL=3):
   S = hydrodynamic dilutions, include buoyancy (heat) loss effects, but
        provided plume has surface contact
   C = corresponding temperature values (always in "degC"!),
        include heat loss, if any

BEGIN MOD201: DIFFUSER DISCHARGE MODULE

Due to complex near-field motions: EQUIVALENT SLOT DIFFUSER (2-D) GEOMETRY

Profile definitions:
   BV = Gaussian 1/e (37%) half-width, in vertical plane normal to trajectory
   BH = top-hat half-width, in horizontal plane normal to trajectory
   S = hydrodynamic centerline dilution
   C = centerline concentration (includes reaction effects, if any)

X	Y	Z	S	C	BV	BH
0.00	0.00	2.00	1.0	0.850E+01	0.09	8.00

END OF MOD201: DIFFUSER DISCHARGE MODULE

BEGIN MOD272: ACCELERATION ZONE OF UNIDIRECTIONAL CROSS-FLOWING DIFFUSER (TEE)

In this laterally contracting zone the diffuser plume becomes VERTICALLY FULLY
 MIXED over the entire layer depth (HS =   10.60m).
  Full mixing is achieved after a plume distance of about five
  layer depths from the diffuser.

Profile definitions:
   BV = layer depth (vertically mixed)
   BH = top-hat half-width, in horizontal plane normal to trajectory
   S = hydrodynamic average (bulk) dilution
   C = average (bulk) concentration (includes reaction effects, if any)

X	Y	Z	S	C	BV	BH
0.00	0.00	2.00	1.0	0.850E+01	0.09	8.00
0.00	-0.40	2.16	2.1	0.401E+01	0.53	7.44
0.00	-0.80	2.33	2.6	0.329E+01	1.06	6.96
0.00	-1.20	2.50	2.9	0.289E+01	1.59	6.55
0.00	-1.60	2.66	3.2	0.262E+01	2.12	6.18
0.00	-2.00	2.83	3.5	0.242E+01	2.65	5.87
0.00	-2.40	2.99	3.7	0.227E+01	3.18	5.59
0.00	-2.80	3.16	4.0	0.214E+01	3.71	5.34
0.00	-3.20	3.32	4.2	0.204E+01	4.24	5.12
0.00	-3.60	3.49	4.4	0.195E+01	4.77	4.92
0.00	-4.00	3.65	4.5	0.187E+01	5.30	4.74
0.00	-4.40	3.82	4.7	0.180E+01	5.83	4.58
0.00	-4.80	3.98	4.9	0.174E+01	6.36	4.45
0.00	-5.20	4.15	5.0	0.169E+01	6.89	4.33
0.00	-5.60	4.31	5.2	0.164E+01	7.42	4.24
0.00	-6.00	4.48	5.3	0.159E+01	7.95	4.16
0.00	-6.40	4.64	5.5	0.155E+01	8.48	4.11
0.00	-6.80	4.81	5.6	0.151E+01	9.01	4.07
0.00	-7.20	4.97	5.8	0.148E+01	9.54	4.04
0.00	-7.60	5.14	5.9	0.144E+01	10.07	4.02
0.00	-8.00	5.30	6.0	0.141E+01	10.60	4.01

Cumulative travel time =   17. sec
  Plume centerline may exhibit slight discontinuities in transition
    to subsequent far-field module.

END OF MOD272: ACCELERATION ZONE OF UNIDIRECTIONAL CROSS-FLOWING DIFFUSER (TEE

BEGIN MOD252: DIFFUSER INDUCED PLUME IN WEAK CROSS-FLOW

```
 Phase 1: Vertically mixed, Phase 2: Re-stratified

 Phase 1: The diffuser plume is VERTICALLY FULLY MIXED over the
          entire layer depth.
 This flow region is INSIGNIFICANT in spatial extent and will be by-passed.
-----------------------------------------------------------------------------
 Phase 2: The flow has RESTRATIFIED at the beginning of this zone.

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = Gaussian 1/e (37%) half-width in horizontal plane normal to trajectory
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction effects, if any)

       X        Y       Z        S       C       BV       BH
      0.00    -8.00    0.00     6.0 0.141E+01  10.60     3.96
     19.08   -45.97    0.00     8.3 0.102E+01   3.91    19.65
** WATER QUALITY STANDARD OR CCC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.100E+01 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
     43.49   -83.94    0.00    10.1 0.840E+00   3.34    32.86
     72.25  -121.90    0.00    11.6 0.730E+00   3.06    46.06
    104.77  -159.87    0.00    13.0 0.655E+00   2.89    59.41
    140.67  -197.84    0.00    14.2 0.598E+00   2.75    72.93
    179.66  -235.81    0.00    15.3 0.555E+00   2.65    86.61
    221.49  -273.77    0.00    16.4 0.519E+00   2.56   100.44
    266.01  -311.74    0.00    17.4 0.490E+00   2.48   114.42
    313.04  -349.71    0.00    18.3 0.465E+00   2.41   128.54
    362.46  -387.68    0.00    19.2 0.443E+00   2.35   142.78
    414.16  -425.65    0.00    20.0 0.425E+00   2.30   157.15
    468.05  -463.61    0.00    20.8 0.408E+00   2.25   171.62
    524.04  -501.58    0.00    21.6 0.393E+00   2.21   186.21
    582.06  -539.55    0.00    22.4 0.380E+00   2.16   200.90
    642.02  -577.52    0.00    23.1 0.368E+00   2.13   215.68
    703.89  -615.48    0.00    23.8 0.357E+00   2.09   230.56
    767.59  -653.45    0.00    24.5 0.347E+00   2.06   245.52
    833.07  -691.42    0.00    25.1 0.338E+00   2.02   260.57
    900.29  -729.39    0.00    25.8 0.329E+00   1.99   275.71
    969.21  -767.35    0.00    26.4 0.322E+00   1.97   290.92
 Cumulative travel time =       23278. sec

END OF MOD252: DIFFUSER INDUCED PLUME IN WEAK CROSS-FLOW
-----------------------------------------------------------------------------
** End of NEAR-FIELD REGION (NFR) **

 The initial plume WIDTH values in the next far-field module will be
  CORRECTED by a factor  1.52 to conserve the mass flux in the far-field!
 The correction factor is quite large because of the small ambient velocity
   relative to the strong mixing characteristics of the discharge!
   This indicates localized RECIRCULATION REGIONS and internal hydraulic JUMPS.
   Width predictions show discontinuities, dilution values should be acceptable.
-----------------------------------------------------------------------------
BEGIN MOD241: BUOYANT AMBIENT SPREADING

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)

 Plume Stage 1 (not bank attached):
```

X	Y	Z	S	C	BV	BH	ZU	ZL
969.21	-767.35	0.00	26.4	0.322E+00	2.99	442.32	2.99	0.00
1127.64	-767.35	0.00	30.1	0.283E+00	3.07	490.26	3.07	0.00
1286.08	-767.35	0.00	34.3	0.248E+00	3.20	534.95	3.20	0.00
1444.51	-767.35	0.00	39.1	0.217E+00	3.39	577.33	3.39	0.00
1602.94	-767.35	0.00	44.6	0.191E+00	3.61	618.01	3.61	0.00
1761.38	-767.35	0.00	50.7	0.168E+00	3.86	657.41	3.86	0.00
1919.81	-767.35	0.00	57.6	0.148E+00	4.14	695.81	4.14	0.00
2078.24	-767.35	0.00	65.2	0.130E+00	4.45	733.41	4.45	0.00
2236.68	-767.35	0.00	73.6	0.115E+00	4.78	770.37	4.78	0.00
2395.11	-767.35	0.00	82.8	0.103E+00	5.13	806.79	5.13	0.00
2553.54	-767.35	0.00	92.9	0.915E-01	5.51	842.77	5.51	0.00
2711.97	-767.35	0.00	103.8	0.819E-01	5.91	878.37	5.91	0.00
2870.41	-767.35	0.00	115.5	0.736E-01	6.32	913.63	6.32	0.00
3028.84	-767.35	0.00	128.2	0.663E-01	6.76	948.61	6.76	0.00
3187.27	-767.35	0.00	141.9	0.599E-01	7.22	983.33	7.22	0.00
3345.71	-767.35	0.00	156.5	0.543E-01	7.69	1017.81	7.69	0.00
3504.14	-767.35	0.00	172.2	0.494E-01	8.18	1052.09	8.18	0.00
3662.57	-767.35	0.00	188.9	0.450E-01	8.69	1086.17	8.69	0.00
3821.01	-767.35	0.00	206.6	0.411E-01	9.22	1120.07	9.22	0.00
3979.44	-767.35	0.00	225.5	0.377E-01	9.77	1153.80	9.77	0.00
4137.87	-767.35	0.00	245.4	0.346E-01	10.33	1187.38	10.33	0.00

Cumulative travel time = 86651. sec

Plume is ATTACHED to LEFT bank/shore.
Plume width is now determined from LEFT bank/shore.

Plume Stage 2 (bank attached):

X	Y	Z	S	C	BV	BH	ZU	ZL
4137.87	420.00	0.00	245.4	0.346E-01	10.33	2374.71	10.33	0.00
4140.79	420.00	0.00	245.8	0.346E-01	10.35	2375.11	10.35	0.00
4143.70	420.00	0.00	246.1	0.345E-01	10.36	2375.51	10.36	0.00
4146.62	420.00	0.00	246.5	0.345E-01	10.37	2375.90	10.37	0.00
4149.53	420.00	0.00	246.8	0.344E-01	10.39	2376.30	10.39	0.00
4152.44	420.00	0.00	247.2	0.344E-01	10.40	2376.70	10.40	0.00
4155.36	420.00	0.00	247.6	0.343E-01	10.41	2377.10	10.41	0.00
4158.27	420.00	0.00	247.9	0.343E-01	10.43	2377.50	10.43	0.00
4161.19	420.00	0.00	248.3	0.342E-01	10.44	2377.90	10.44	0.00
4164.10	420.00	0.00	248.6	0.342E-01	10.45	2378.30	10.45	0.00
4167.02	420.00	0.00	249.0	0.341E-01	10.47	2378.70	10.47	0.00
4169.93	420.00	0.00	249.3	0.341E-01	10.48	2379.10	10.48	0.00
4172.85	420.00	0.00	249.7	0.340E-01	10.49	2379.50	10.49	0.00
4175.76	420.00	0.00	250.1	0.340E-01	10.51	2379.90	10.51	0.00
4178.68	420.00	0.00	250.4	0.339E-01	10.52	2380.30	10.52	0.00
4181.59	420.00	0.00	250.8	0.339E-01	10.53	2380.70	10.53	0.00
4184.50	420.00	0.00	251.1	0.338E-01	10.55	2381.10	10.55	0.00
4187.42	420.00	0.00	251.5	0.338E-01	10.56	2381.50	10.56	0.00
4190.33	420.00	0.00	251.9	0.337E-01	10.57	2381.90	10.57	0.00
4193.25	420.00	0.00	252.2	0.337E-01	10.59	2382.30	10.59	0.00
4196.16	420.00	0.00	252.6	0.337E-01	10.60	2382.70	10.60	0.00

Cumulative travel time = 87817. sec

END OF MOD241: BUOYANT AMBIENT SPREADING

Due to the attachment or proximity of the plume tothe bottom, the bottom
coordinate for the FAR-FIELD differs from the ambient depth, ZFB = 0 m.
In a subsequent analysis set "depth at discharge" equal to "ambient depth".

BEGIN MOD262: PASSIVE AMBIENT MIXING IN STRATIFIED AMBIENT

Vertical diffusivity (initial value) = 0.454E-07 m^2/s
Horizontal diffusivity (initial value) = 0.477E+02 m^2/s

Profile definitions:
BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically
= or equal to layer depth, if fully mixed
BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,

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        measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction effects, if any)

 Plume Stage 2 (bank attached):
       X         Y        Z        S        C       BV       BH      ZU      ZL
   4196.16   420.00    0.00   252.6 0.337E-01  10.60  2382.70   10.60    0.00
 Plume interacts with SURFACE.
 The passive diffusion plume becomes VERTICALLY FULLY MIXED within this
   prediction interval.
   4986.35   420.00    0.00   307.1 0.277E-01  10.60  2896.98   10.60    0.00
   5776.55   420.00    0.00   365.0 0.233E-01  10.60  3443.70   10.60    0.00
   6566.74   420.00    0.00   426.2 0.199E-01  10.60  4021.06   10.60    0.00
   7356.93   420.00    0.00   490.5 0.173E-01  10.60  4627.50   10.60    0.00
   8147.12   420.00    0.00   557.7 0.152E-01  10.60  5261.68   10.60    0.00
   8937.31   420.00    0.00   627.8 0.135E-01  10.60  5922.46   10.60    0.00
   9727.51   420.00    0.00   700.5 0.121E-01  10.60  6608.78   10.60    0.00
  10517.70   420.00    0.00   775.9 0.110E-01  10.60  7319.75   10.60    0.00
  11307.89   420.00    0.00   853.8 0.996E-02  10.60  8054.53   10.60    0.00
  12098.08   420.00    0.00   934.1 0.910E-02  10.60  8812.36   10.60    0.00
  12888.27   420.00    0.00  1016.8 0.836E-02  10.60  9592.58   10.60    0.00
  13678.46   420.00    0.00  1101.8 0.771E-02  10.60 10394.56   10.60    0.00
  14468.65   420.00    0.00  1189.1 0.715E-02  10.60 11217.72   10.60    0.00
  15258.85   420.00    0.00  1278.5 0.665E-02  10.60 12061.53   10.60    0.00
  16049.04   420.00    0.00  1370.1 0.620E-02  10.60 12925.50   10.60    0.00
  16839.23   420.00    0.00  1463.8 0.581E-02  10.60 13809.16   10.60    0.00
  17629.42   420.00    0.00  1559.5 0.545E-02  10.60 14712.09   10.60    0.00
  18419.61   420.00    0.00  1657.2 0.513E-02  10.60 15633.88   10.60    0.00
  19209.80   420.00    0.00  1756.9 0.484E-02  10.60 16574.17   10.60    0.00
  19999.99   420.00    0.00  1858.5 0.457E-02  10.60 17532.58   10.60    0.00
 Cumulative travel time =      403894. sec

 Simulation limit based on maximum specified distance =  20000.00 m.
   This is the REGION OF INTEREST limitation.

END OF MOD262: PASSIVE AMBIENT MIXING IN STRATIFIED AMBIENT
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
CORMIX2: Submerged Multiport Diffuser Discharges       End of Prediction File
22222222222222222222222222222222222222222222222222222222222222222222222222222
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CORMIX2 PREDICTION FILE:
222222222222222222222222222222222222222222222222222222222222222222222222222222
                       CORMIX MIXING ZONE EXPERT SYSTEM
         Subsystem CORMIX2:  Submerged Multiport Diffuser Discharges
                         CORMIX-GI Version 4.2G
                      HYDRO2 Version 4.2 August 2002
------------------------------------------------------------------------------
------------------------------------------------------------------------------
CASE DESCRIPTION
 Site name/label:   SOKO
 Design case:       wet season, mid tide at Soko island
 FILE NAME:         D:\...station\additional_CORMIX\south-soko-w-sp-mid.prd
 Time stamp:        Wed Jan  4 14:25:16 2006

ENVIRONMENT PARAMETERS (metric units)
 Unbounded section
 HA    =     12.00  HD    =     12.00
 UA    =      0.300 F     =      0.031 USTAR =0.1863E-01
 UW    =      7.500 UWSTAR=0.9300E-02
 Density stratified environment
 STRCND=  A         RHOAM = 1020.2000
 RHOAS = 1016.0000  RHOAB = 1024.4000  RHOAH0= 1020.2000  E     =0.6701E-02

DIFFUSER DISCHARGE PARAMETERS (metric units)
 Diffuser type:     DITYPE= unidirectional_parallel
 BANK  =  LEFT      DISTB =    420.00  YB1   =    420.00  YB2   =    420.00
 LD    =     16.00  NOPEN =    4       SPAC  =      5.33
 D0    =      0.750 A0    =      0.442 H0    =      2.00
 Nozzle/port arrangement:   unidirectional_without_fanning
 GAMMA =      0.00  THETA =     30.00  SIGMA =    270.00  BETA  =     90.00
 U0    =      2.829 Q0    =      5.000       =0.5000E+01
 RHO0  = 1022.1000  DRHO0 =-.1900E+01  GP0   =-.1826E-01
 C0    =0.8500E+01  CUNITS=  deg.C
 IPOLL =  3         KS    =0.8359E-05  KD    =0.0000E+00

FLUX VARIABLES - PER UNIT DIFFUSER LENGTH (metric units)
 q0    =0.3125E+00  m0    =0.8842E+00  j0    =-.5707E-02  SIGNJ0=     -1.0
 Associated 2-d length scales (meters)
 lQ=B  =      0.110 lM    =     27.73  lm    =      9.82
 lmp   =  99999.00  lbp   =  99999.00  la    =  99999.00

FLUX VARIABLES - ENTIRE DIFFUSER (metric units)
 Q0    =0.5000E+01  M0    =0.1415E+02  J0    =-.9132E-01
 Associated 3-d length scales (meters)
 LQ    =      1.33  LM    =     24.14  Lm    =     12.54  Lb    =      3.38
                                       Lmp   =  99999.00  Lbp   =  99999.00

NON-DIMENSIONAL PARAMETERS
 FR0   =     63.00  FRD0  =     24.18  R     =      9.43
 (slot)             (port/nozzle)

FLOW CLASSIFICATION
 222222222222222222222222222222222222222222
 2  Flow class (CORMIX2)      =    MNU9   2
 2  Applicable layer depth HS =    12.00  2
 222222222222222222222222222222222222222222

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.8500E+01  CUNITS=  deg.C
 NTOX  =  0
 NSTD  =  1         CSTD  =0.1000E+01
 REGMZ =  0
 XINT  =  20000.00  XMAX  =  20000.00

X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the bottom and the diffuser mid-point:
       420.00 m  from the LEFT  bank/shore.
    X-axis points downstream, Y-axis points to left, Z-axis points upward.
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NSTEP = 20 display intervals per module

NOTE on dilution/concentration values for this HEATED DISCHARGE (IPOLL=3):
   S  = hydrodynamic dilutions, include buoyancy (heat) loss effects, but
        provided plume has surface contact
   C  = corresponding temperature values (always in "degC"!),
        include heat loss, if any
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
BEGIN MOD201: DIFFUSER DISCHARGE MODULE

 Due to complex near-field motions:  EQUIVALENT SLOT DIFFUSER (2-D) GEOMETRY

 Profile definitions:
   BV = Gaussian 1/e (37%) half-width, in vertical plane normal to trajectory
   BH = top-hat half-width, in horizontal plane normal to trajectory
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction effects, if any)

        X        Y       Z        S       C        BV       BH
       0.00     0.00    2.00     1.0 0.850E+01   0.09     8.00

END OF MOD201: DIFFUSER DISCHARGE MODULE
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
BEGIN MOD273: UNIDIRECTIONAL CROSS-FLOWING DIFFUSER (TEE) IN STRONG CURRENT

 Because of the strong ambient current the diffuser plume of this crossflowing
   discharge gets RAPIDLY DEFLECTED.
 A near-field zone is formed that is VERTICALLY FULLY MIXED over the entire
   layer depth.  Full mixing is achieved at a downstream distance of about
   five (5) layer depths.

 Profile definitions:
   BV = layer depth (vertically mixed)
   BH = top-hat half-width, measured horizontally in Y-direction
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)

        X        Y       Z        S       C        BV       BH
       0.00     0.00    2.00     1.0 0.850E+01   0.09     8.00
       3.40    -0.33    1.90     1.6 0.522E+01   0.68     7.73
       6.80    -0.65    1.80     1.9 0.450E+01   1.28     7.46
      10.20    -0.98    1.70     2.1 0.407E+01   1.87     7.20
      13.60    -1.31    1.60     2.3 0.377E+01   2.47     6.93
      17.00    -1.64    1.50     2.4 0.353E+01   3.07     6.66
      20.40    -1.96    1.40     2.5 0.335E+01   3.66     6.39
      23.80    -2.29    1.30     2.7 0.319E+01   4.26     6.13
      27.20    -2.62    1.20     2.8 0.306E+01   4.85     5.86
      30.60    -2.95    1.10     2.9 0.295E+01   5.45     5.59
      34.00    -3.27    1.00     3.0 0.285E+01   6.04     5.32
      37.40    -3.60    0.90     3.1 0.276E+01   6.64     5.06
      40.80    -3.93    0.80     3.2 0.268E+01   7.24     4.79
      44.20    -4.26    0.70     3.3 0.260E+01   7.83     4.52
      47.60    -4.58    0.60     3.4 0.254E+01   8.43     4.25
      51.00    -4.91    0.50     3.4 0.248E+01   9.02     3.98
      54.40    -5.24    0.40     3.5 0.242E+01   9.62     3.72
      57.80    -5.57    0.30     3.6 0.237E+01  10.21     3.45
      61.20    -5.89    0.20     3.7 0.232E+01  10.81     3.18
      64.60    -6.22    0.10     3.7 0.227E+01  11.40     2.91
      68.00    -6.55    0.00     3.8 0.223E+01  12.00     2.65
 Cumulative travel time =         227. sec
   Plume centerline may exhibit slight discontinuities in transition
     to subsequent far-field module.

END OF MOD273: UNIDIRECTIONAL CROSS-FLOWING DIFFUSER (TEE) IN STRONG CURRENT
-----------------------------------------------------------------------------
** End of NEAR-FIELD REGION (NFR) **
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BEGIN MOD241: BUOYANT AMBIENT SPREADING

Profile definitions:
BV = top-hat thickness, measured vertically
BH = top-hat half-width, measured horizontally in y-direction
ZU = upper plume boundary (Z-coordinate)
ZL = lower plume boundary (Z-coordinate)
S = hydrodynamic average (bulk) dilution
C = average (bulk) concentration (includes reaction effects, if any)

Plume Stage 1 (not bank attached):

X	Y	Z	S	C	BV	BH	ZU	ZL
71.40	-6.55	0.00	3.8	0.223E+01	12.00	2.65	12.00	0.00
220.11	-6.55	0.00	7.5	0.113E+01	1.88	33.40	1.88	0.00

** WATER QUALITY STANDARD OR CCC HAS BEEN FOUND **
The pollutant concentration in the plume falls below water quality standard or CCC value of 0.100E+01 in the current prediction interval.
This is the spatial extent of concentrations exceeding the water quality standard or CCC value.

X	Y	Z	S	C	BV	BH	ZU	ZL
368.81	-6.55	0.00	9.6	0.885E+00	1.59	50.46	1.59	0.00
517.52	-6.55	0.00	12.4	0.684E+00	1.62	64.03	1.62	0.00
666.23	-6.55	0.00	16.3	0.522E+00	1.79	75.91	1.79	0.00
814.93	-6.55	0.00	21.3	0.399E+00	2.04	86.84	2.04	0.00
963.64	-6.55	0.00	27.6	0.308E+00	2.37	97.15	2.37	0.00
1112.35	-6.55	0.00	35.3	0.241E+00	2.75	107.03	2.75	0.00
1261.05	-6.55	0.00	44.5	0.191E+00	3.18	116.59	3.18	0.00
1409.76	-6.55	0.00	55.2	0.154E+00	3.66	125.88	3.66	0.00
1558.47	-6.55	0.00	67.6	0.126E+00	4.18	134.96	4.18	0.00
1707.17	-6.55	0.00	81.8	0.104E+00	4.74	143.85	4.74	0.00
1855.88	-6.55	0.00	97.8	0.869E-01	5.34	152.58	5.34	0.00
2004.59	-6.55	0.00	115.7	0.735E-01	5.98	161.15	5.98	0.00
2153.29	-6.55	0.00	135.6	0.627E-01	6.66	169.58	6.66	0.00
2302.00	-6.55	0.00	157.6	0.539E-01	7.38	177.89	7.38	0.00
2450.70	-6.55	0.00	181.7	0.468E-01	8.14	186.08	8.14	0.00
2599.41	-6.55	0.00	208.0	0.409E-01	8.93	194.15	8.93	0.00
2748.12	-6.55	0.00	236.5	0.359E-01	9.75	202.12	9.75	0.00
2896.82	-6.55	0.00	267.4	0.318E-01	10.61	209.99	10.61	0.00
3045.53	-6.55	0.00	300.7	0.283E-01	11.51	217.77	11.51	0.00

Cumulative travel time = 10140. sec

END OF MOD241: BUOYANT AMBIENT SPREADING

BEGIN MOD262: PASSIVE AMBIENT MIXING IN STRATIFIED AMBIENT

Vertical diffusivity (initial value) = 0.918E-06 m^2/s
Horizontal diffusivity (initial value) = 0.197E+01 m^2/s

Profile definitions:
BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically
= or equal to layer depth, if fully mixed
BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
measured horizontally in Y-direction
ZU = upper plume boundary (Z-coordinate)
ZL = lower plume boundary (Z-coordinate)
S = hydrodynamic centerline dilution
C = centerline concentration (includes reaction effects, if any)

Plume Stage 1 (not bank attached):

X	Y	Z	S	C	BV	BH	ZU	ZL
3045.53	-6.55	0.00	300.7	0.283E-01	11.51	217.77	11.51	0.00
3241.00	-6.55	0.00	313.5	0.271E-01	11.51	227.07	11.51	0.00
3436.47	-6.55	0.00	326.5	0.260E-01	11.51	236.50	11.51	0.00
3631.94	-6.55	0.00	339.7	0.250E-01	11.51	246.06	11.51	0.00
3827.41	-6.55	0.00	353.1	0.241E-01	11.51	255.74	11.51	0.00
4022.88	-6.55	0.00	366.7	0.232E-01	11.51	265.55	11.51	0.00
4218.35	-6.55	0.00	380.4	0.223E-01	11.51	275.48	11.51	0.00

4413.82	-6.55	0.00	394.2	0.216E-01	11.51	285.53	11.51	0.00
4609.29	-6.55	0.00	408.3	0.208E-01	11.51	295.69	11.51	0.00
4804.76	-6.55	0.00	422.5	0.201E-01	11.51	305.98	11.51	0.00
5000.23	-6.55	0.00	436.9	0.195E-01	11.51	316.38	11.51	0.00
5195.70	-6.55	0.00	451.4	0.188E-01	11.51	326.90	11.51	0.00
5391.17	-6.55	0.00	466.1	0.182E-01	11.51	337.54	11.51	0.00
5586.64	-6.55	0.00	480.9	0.177E-01	11.51	348.28	11.51	0.00
5782.11	-6.55	0.00	495.9	0.171E-01	11.51	359.14	11.51	0.00
5977.58	-6.55	0.00	511.1	0.166E-01	11.51	370.11	11.51	0.00
6173.05	-6.55	0.00	526.4	0.161E-01	11.51	381.18	11.51	0.00
6368.52	-6.55	0.00	541.8	0.157E-01	11.51	392.37	11.51	0.00
6563.99	-6.55	0.00	557.4	0.152E-01	11.51	403.66	11.51	0.00
6759.46	-6.55	0.00	573.2	0.148E-01	11.51	415.06	11.51	0.00
6954.93	-6.55	0.00	589.0	0.144E-01	11.51	426.56	11.51	0.00

Cumulative travel time = 23172. sec

Plume Stage 2 (bank attached):

X	Y	Z	S	C	BV	BH	ZU	ZL
6954.93	420.00	0.00	589.0	0.144E-01	11.51	853.13	11.51	0.00
7607.18	420.00	0.00	622.9	0.136E-01	11.51	902.17	11.51	0.00
8259.43	420.00	0.00	657.4	0.129E-01	11.51	952.12	11.51	0.00
8911.69	420.00	0.00	692.5	0.123E-01	11.51	1002.96	11.51	0.00
9563.94	420.00	0.00	728.3	0.117E-01	11.51	1054.67	11.51	0.00
10216.19	420.00	0.00	764.6	0.111E-01	11.51	1107.25	11.51	0.00
10868.45	420.00	0.00	801.5	0.106E-01	11.51	1160.66	11.51	0.00
11520.70	420.00	0.00	839.0	0.101E-01	11.51	1214.91	11.51	0.00
12172.96	420.00	0.00	877.0	0.969E-02	11.51	1269.98	11.51	0.00
12825.21	420.00	0.00	915.6	0.928E-02	11.51	1325.86	11.51	0.00
13477.46	420.00	0.00	954.8	0.890E-02	11.51	1382.54	11.51	0.00
14129.72	420.00	0.00	994.5	0.855E-02	11.51	1440.00	11.51	0.00
14781.97	420.00	0.00	1034.8	0.821E-02	11.51	1498.23	11.51	0.00
15434.23	420.00	0.00	1075.5	0.790E-02	11.51	1557.23	11.51	0.00
16086.48	420.00	0.00	1116.8	0.761E-02	11.51	1616.98	11.51	0.00
16738.73	420.00	0.00	1158.6	0.734E-02	11.51	1677.48	11.51	0.00
17390.99	420.00	0.00	1201.0	0.708E-02	11.51	1738.72	11.51	0.00
18043.24	420.00	0.00	1243.8	0.683E-02	11.51	1800.68	11.51	0.00
18695.49	420.00	0.00	1287.1	0.660E-02	11.51	1863.36	11.51	0.00
19347.75	420.00	0.00	1330.9	0.639E-02	11.51	1926.75	11.51	0.00
20000.00	420.00	0.00	1375.2	0.618E-02	11.51	1990.85	11.51	0.00

Cumulative travel time = 66655. sec

Simulation limit based on maximum specified distance = 20000.00 m.
This is the REGION OF INTEREST limitation.

END OF MOD262: PASSIVE AMBIENT MIXING IN STRATIFIED AMBIENT

CORMIX2: Submerged Multiport Diffuser Discharges End of Prediction File
2222222222222222222222222222222222222222222222222222222222222222222222222222

Temperature Difference
of 12.5 °C

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CORMIX2 PREDICTION FILE:
22222222222222222222222222222222222222222222222222222222222222222222222222222
                       CORMIX MIXING ZONE EXPERT SYSTEM
         Subsystem CORMIX2:  Submerged Multiport Diffuser Discharges
                         CORMIX-GI Version 4.2G
                      HYDRO2 Version 4.2 August 2002
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
CASE DESCRIPTION
 Site name/label:   SOKO
 Design case:       dry season, low water at Soko island
 FILE NAME:         D:\...60-HK\CORMIX\deltat12_5\south-soko-d-sp-lw125.prd
 Time stamp:        Mon Nov 27 15:49:33 2006

ENVIRONMENT PARAMETERS (metric units)
 Unbounded section
 HA    =     12.00  HD    =     10.90
 UA    =      0.030 F     =      0.031 USTAR =0.1863E-02
 UW    =      7.500 UWSTAR=0.9300E-02
 Uniform density environment
 STRCND=  U         RHOAM = 1023.3000

DIFFUSER DISCHARGE PARAMETERS (metric units)
 Diffuser type:     DITYPE= unidirectional_parallel
 BANK  =  LEFT      DISTB =    420.00  YB1   =    420.00  YB2   =    420.00
 LD    =     16.00  NOPEN =    4        SPAC  =      5.33
 D0    =      0.750 A0    =      0.442 H0    =      2.00
 Nozzle/port arrangement:   unidirectional_without_fanning
 GAMMA =      0.00  THETA =     30.00  SIGMA =    270.00  BETA  =     90.00
 U0    =      2.829 Q0    =      5.000       =0.5000E+01
 RHO0  = 1026.0000  DRHO0 =-.2700E+01  GP0   =-.2588E-01
 C0    =0.1250E+02  CUNITS=  deg.C
 IPOLL =  3         KS    =0.8359E-05  KD    =0.0000E+00

FLUX VARIABLES - PER UNIT DIFFUSER LENGTH (metric units)
 q0    =0.3125E+00  m0    =0.8842E+00  j0    =-.8086E-02  SIGNJ0=     -1.0
 Associated 2-d length scales (meters)
 lQ=B  =      0.110 lM    =     21.88  lm    =    982.44
 lmp   =  99999.00  lbp   =  99999.00  la    =  99999.00

FLUX VARIABLES - ENTIRE DIFFUSER (metric units)
 Q0    =0.5000E+01  M0    =0.1415E+02  J0    =-.1294E+00
 Associated 3-d length scales (meters)
 LQ    =      1.33  LM    =     20.28  Lm    =    125.38  Lb    =   4791.68
                                       Lmp   =  99999.00  Lbp   =  99999.00

NON-DIMENSIONAL PARAMETERS
 FR0   =     52.93  FRD0  =     20.31  R     =     94.31
 (slot)             (port/nozzle)

FLOW CLASSIFICATION
 222222222222222222222222222222222222222222
 2  Flow class (CORMIX2)      =    MNU8   2
 2  Applicable layer depth HS =    10.90  2
 222222222222222222222222222222222222222222

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.1250E+02  CUNITS=  deg.C
 NTOX  =  0
 NSTD  =  1         CSTD  =0.1000E+01
 REGMZ =  0
 XINT  =  20000.00  XMAX  =  20000.00

X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the bottom and the diffuser mid-point:
       420.00 m  from the LEFT  bank/shore.
    X-axis points downstream, Y-axis points to left, Z-axis points upward.
NSTEP = 20 display intervals per module
```

```
NOTE on dilution/concentration values for this HEATED DISCHARGE (IPOLL=3):
   S  = hydrodynamic dilutions, include buoyancy (heat) loss effects, but
        provided plume has surface contact
   C  = corresponding temperature values (always in "degC"!),
        include heat loss, if any
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
BEGIN MOD201: DIFFUSER DISCHARGE MODULE

 Due to complex near-field motions:  EQUIVALENT SLOT DIFFUSER (2-D) GEOMETRY

 Profile definitions:
   BV = Gaussian 1/e (37%) half-width, in vertical plane normal to trajectory
   BH = top-hat half-width, in horizontal plane normal to trajectory
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction effects, if any)

       X        Y       Z        S       C        BV       BH
      0.00     0.00    2.00     1.0 0.125E+02   0.09     8.00

END OF MOD201: DIFFUSER DISCHARGE MODULE
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
BEGIN MOD272: ACCELERATION ZONE OF UNIDIRECTIONAL CROSS-FLOWING DIFFUSER (TEE)

 In this laterally contracting zone the diffuser plume becomes VERTICALLY FULLY
  MIXED over the entire layer depth (HS =   10.90m).
   Full mixing is achieved after a plume distance of about five
   layer depths from the diffuser.

 Profile definitions:
   BV = layer depth (vertically mixed)
   BH = top-hat half-width, in horizontal plane normal to trajectory
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)

       X        Y       Z        S       C        BV       BH
      0.00     0.00    2.00     1.0 0.125E+02   0.09     8.00
      0.00    -0.40    2.17     2.2 0.568E+01   0.55     7.44
      0.00    -0.80    2.35     2.7 0.464E+01   1.09     6.96
      0.00    -1.20    2.52     3.1 0.406E+01   1.63     6.55
      0.00    -1.60    2.69     3.4 0.368E+01   2.18     6.18
      0.00    -2.00    2.86     3.7 0.340E+01   2.72     5.87
      0.00    -2.40    3.03     3.9 0.317E+01   3.27     5.59
      0.00    -2.80    3.21     4.2 0.300E+01   3.82     5.34
      0.00    -3.20    3.38     4.4 0.285E+01   4.36     5.12
      0.00    -3.60    3.55     4.6 0.272E+01   4.91     4.92
      0.00    -4.00    3.73     4.8 0.261E+01   5.45     4.74
      0.00    -4.40    3.90     5.0 0.251E+01   6.00     4.58
      0.00    -4.80    4.07     5.2 0.243E+01   6.54     4.45
      0.00    -5.20    4.24     5.3 0.235E+01   7.09     4.33
      0.00    -5.60    4.41     5.5 0.228E+01   7.63     4.24
      0.00    -6.00    4.59     5.6 0.221E+01   8.18     4.16
      0.00    -6.40    4.76     5.8 0.216E+01   8.72     4.11
      0.00    -6.80    4.93     5.9 0.210E+01   9.27     4.07
      0.00    -7.20    5.11     6.1 0.205E+01   9.81     4.04
      0.00    -7.60    5.28     6.2 0.201E+01  10.36     4.02
      0.00    -8.00    5.45     6.4 0.196E+01  10.90     4.01
 Cumulative travel time =          18. sec
   Plume centerline may exhibit slight discontinuities in transition
     to subsequent far-field module.

END OF MOD272: ACCELERATION ZONE OF UNIDIRECTIONAL CROSS-FLOWING DIFFUSER (TEE
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
BEGIN MOD252: DIFFUSER INDUCED PLUME IN WEAK CROSS-FLOW
```

```
 Phase 1: Vertically mixed, Phase 2: Re-stratified

 Phase 1: The diffuser plume is VERTICALLY FULLY MIXED over the
          entire layer depth.
 This flow region is INSIGNIFICANT in spatial extent and will be by-passed.
-----------------------------------------------------------------------------
 Phase 2: The flow has RESTRATIFIED at the beginning of this zone.

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = Gaussian 1/e (37%) half-width in horizontal plane normal to trajectory
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction effects, if any)

       X        Y        Z        S        C       BV       BH
      0.00    -8.00    0.00      6.4 0.196E+01  10.90     4.18
     40.16  -114.09    0.00     12.0 0.104E+01   3.11    48.81
** WATER QUALITY STANDARD OR CCC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.100E+01 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
     99.33  -220.17    0.00     15.7 0.794E+00   2.73    91.84
    172.61  -326.26    0.00     18.7 0.667E+00   2.52   136.47
    257.68  -432.35    0.00     21.3 0.586E+00   2.38   182.43
    353.09  -538.44    0.00     23.6 0.529E+00   2.27   229.49
    457.81  -644.52    0.00     25.7 0.486E+00   2.18   277.49
    571.08  -750.61    0.00     27.7 0.452E+00   2.11   326.32
    692.30  -856.70    0.00     29.5 0.424E+00   2.04   375.89
    820.97  -962.78    0.00     31.2 0.401E+00   1.98   426.12
    956.69 -1068.87    0.00     32.8 0.381E+00   1.93   476.96
   1099.11 -1174.96    0.00     34.4 0.364E+00   1.88   528.37
   1247.93 -1281.04    0.00     35.8 0.349E+00   1.84   580.29
   1402.88 -1387.13    0.00     37.3 0.335E+00   1.80   632.71
   1563.73 -1493.22    0.00     38.6 0.324E+00   1.77   685.58
   1730.27 -1599.31    0.00     39.9 0.313E+00   1.73   738.89
   1902.31 -1705.39    0.00     41.2 0.303E+00   1.70   792.60
   2079.69 -1811.48    0.00     42.5 0.294E+00   1.67   846.71
   2262.24 -1917.57    0.00     43.7 0.286E+00   1.65   901.19
   2449.82 -2023.65    0.00     44.8 0.279E+00   1.62   956.02
   2642.31 -2129.74    0.00     46.0 0.272E+00   1.60  1011.20
 Cumulative travel time =      105710. sec

END OF MOD252: DIFFUSER INDUCED PLUME IN WEAK CROSS-FLOW
-----------------------------------------------------------------------------
** End of NEAR-FIELD REGION (NFR) **

 The initial plume WIDTH values in the next far-field module will be
  CORRECTED by a factor  1.54 to conserve the mass flux in the far-field!
 The correction factor is quite large because of the small ambient velocity
   relative to the strong mixing characteristics of the discharge!
   This indicates localized RECIRCULATION REGIONS and internal hydraulic JUMPS.
   Width predictions show discontinuities, dilution values should be acceptable.
-----------------------------------------------------------------------------
BEGIN MOD241: BUOYANT AMBIENT SPREADING

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)

 Plume Stage 1 (not bank attached):
       X        Y        Z        S        C       BV       BH      ZU      ZL
```

2642.31	-2129.74	0.00	46.0	0.272E+00	2.46	1558.05	2.46	0.00
2742.55	-2129.74	0.00	54.7	0.228E+00	2.88	1581.89	2.88	0.00
2842.80	-2129.74	0.00	63.8	0.196E+00	3.31	1607.03	3.31	0.00
2943.05	-2129.74	0.00	73.2	0.171E+00	3.73	1633.28	3.73	0.00
3043.29	-2129.74	0.00	82.9	0.151E+00	4.16	1660.50	4.16	0.00
3143.54	-2129.74	0.00	93.0	0.134E+00	4.59	1688.56	4.59	0.00
3243.79	-2129.74	0.00	103.5	0.121E+00	5.02	1717.35	5.02	0.00
3344.03	-2129.74	0.00	114.4	0.109E+00	5.46	1746.78	5.46	0.00
3444.28	-2129.74	0.00	125.7	0.995E-01	5.89	1776.78	5.89	0.00
3544.52	-2129.74	0.00	137.4	0.910E-01	6.34	1807.27	6.34	0.00
3644.77	-2129.74	0.00	149.5	0.836E-01	6.78	1838.19	6.78	0.00
3745.02	-2129.74	0.00	162.1	0.771E-01	7.23	1869.50	7.23	0.00
3845.26	-2129.74	0.00	175.2	0.714E-01	7.68	1901.15	7.68	0.00
3945.51	-2129.74	0.00	188.7	0.662E-01	8.14	1933.10	8.14	0.00
4045.76	-2129.74	0.00	202.7	0.617E-01	8.60	1965.32	8.60	0.00
4146.00	-2129.74	0.00	217.2	0.575E-01	9.06	1997.77	9.06	0.00
4246.25	-2129.74	0.00	232.2	0.538E-01	9.53	2030.43	9.53	0.00
4346.50	-2129.74	0.00	247.7	0.505E-01	10.01	2063.27	10.01	0.00
4446.74	-2129.74	0.00	263.8	0.474E-01	10.49	2096.28	10.49	0.00
4546.99	-2129.74	0.00	280.3	0.446E-01	10.90	2129.43	10.90	0.00
4647.24	-2129.74	0.00	297.5	0.420E-01	10.90	2162.69	10.90	0.00

Cumulative travel time = 172541. sec

END OF MOD241: BUOYANT AMBIENT SPREADING

Due to the attachment or proximity of the plume tothe bottom, the bottom coordinate for the FAR-FIELD differs from the ambient depth, ZFB = 0 m.
In a subsequent analysis set "depth at discharge" equal to "ambient depth".

BEGIN MOD261: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

Vertical diffusivity (initial value) = 0.203E-01 m^2/s
Horizontal diffusivity (initial value) = 0.420E+02 m^2/s

The passive diffusion plume is VERTICALLY FULLY MIXED at beginning of region.

Profile definitions:
BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically
= or equal to layer depth, if fully mixed
BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
measured horizontally in Y-direction
ZU = upper plume boundary (Z-coordinate)
ZL = lower plume boundary (Z-coordinate)
S = hydrodynamic centerline dilution
C = centerline concentration (includes reaction effects, if any)

Plume Stage 1 (not bank attached):

X	Y	Z	S	C	BV	BH	ZU	ZL
4647.24	-2129.74	0.00	297.5	0.420E-01	10.90	2162.69	10.90	0.00
4665.77	-2129.74	0.00	300.1	0.417E-01	10.90	2181.53	10.90	0.00
4684.29	-2129.74	0.00	302.7	0.413E-01	10.90	2200.43	10.90	0.00
4702.82	-2129.74	0.00	305.3	0.409E-01	10.90	2219.39	10.90	0.00
4721.35	-2129.74	0.00	307.9	0.406E-01	10.90	2238.40	10.90	0.00
4739.88	-2129.74	0.00	310.5	0.403E-01	10.90	2257.46	10.90	0.00
4758.40	-2129.74	0.00	313.1	0.399E-01	10.90	2276.57	10.90	0.00
4776.93	-2129.74	0.00	315.8	0.396E-01	10.90	2295.74	10.90	0.00
4795.46	-2129.74	0.00	318.4	0.393E-01	10.90	2314.97	10.90	0.00
4813.99	-2129.74	0.00	321.1	0.389E-01	10.90	2334.24	10.90	0.00
4832.52	-2129.74	0.00	323.7	0.386E-01	10.90	2353.57	10.90	0.00
4851.04	-2129.74	0.00	326.4	0.383E-01	10.90	2372.96	10.90	0.00
4869.57	-2129.74	0.00	329.1	0.380E-01	10.90	2392.39	10.90	0.00
4888.10	-2129.74	0.00	331.7	0.377E-01	10.90	2411.88	10.90	0.00
4906.63	-2129.74	0.00	334.4	0.374E-01	10.90	2431.42	10.90	0.00
4925.15	-2129.74	0.00	337.1	0.371E-01	10.90	2451.02	10.90	0.00
4943.68	-2129.74	0.00	339.8	0.368E-01	10.90	2470.66	10.90	0.00
4962.21	-2129.74	0.00	342.5	0.365E-01	10.90	2490.36	10.90	0.00
4980.74	-2129.74	0.00	345.3	0.362E-01	10.90	2510.11	10.90	0.00
4999.27	-2129.74	0.00	348.0	0.359E-01	10.90	2529.91	10.90	0.00

```
   5017.79 -2129.74    0.00   350.7 0.356E-01  10.90  2549.77   10.90    0.00
 Cumulative travel time =      184893. sec

-------------------------------------------------------------------------------
 Plume Stage 2 (bank attached):
       X        Y        Z        S        C        BV       BH       ZU       ZL
   5017.79   420.00    0.00   350.7 0.356E-01  10.90  5099.53   10.90    0.00
   5766.90   420.00    0.00   422.6 0.296E-01  10.90  6145.04   10.90    0.00
   6516.01   420.00    0.00   498.8 0.251E-01  10.90  7253.60   10.90    0.00
   7265.12   420.00    0.00   579.2 0.216E-01  10.90  8421.81   10.90    0.00
   8014.24   420.00    0.00   663.4 0.188E-01  10.90  9646.76   10.90    0.00
   8763.35   420.00    0.00   751.4 0.166E-01  10.90 10925.94   10.90    0.00
   9512.46   420.00    0.00   843.0 0.148E-01  10.90 12257.14   10.90    0.00
  10261.57   420.00    0.00   937.9 0.133E-01  10.90 13638.40   10.90    0.00
  11010.68   420.00    0.00  1036.3 0.121E-01  10.90 15067.97   10.90    0.00
  11759.79   420.00    0.00  1137.8 0.110E-01  10.90 16544.27   10.90    0.00
  12508.90   420.00    0.00  1242.4 0.101E-01  10.90 18065.86   10.90    0.00
  13258.01   420.00    0.00  1350.1 0.926E-02  10.90 19631.43   10.90    0.00
  14007.12   420.00    0.00  1460.7 0.856E-02  10.90 21239.79   10.90    0.00
  14756.23   420.00    0.00  1574.2 0.794E-02  10.90 22889.81   10.90    0.00
  15505.34   420.00    0.00  1690.5 0.739E-02  10.90 24580.48   10.90    0.00
  16254.45   420.00    0.00  1809.5 0.691E-02  10.90 26310.85   10.90    0.00
  17003.56   420.00    0.00  1931.1 0.647E-02  10.90 28080.00   10.90    0.00
  17752.67   420.00    0.00  2055.4 0.608E-02  10.90 29887.13   10.90    0.00
  18501.78   420.00    0.00  2182.2 0.573E-02  10.90 31731.44   10.90    0.00
  19250.89   420.00    0.00  2311.6 0.541E-02  10.90 33612.20   10.90    0.00
  20000.00   420.00    0.00  2443.4 0.512E-02  10.90 35528.71   10.90    0.00
 Cumulative travel time =      684300. sec

 Simulation limit based on maximum specified distance =  20000.00 m.
   This is the REGION OF INTEREST limitation.

END OF MOD261: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT
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-------------------------------------------------------------------------------
CORMIX2: Submerged Multiport Diffuser Discharges       End of Prediction File
22222222222222222222222222222222222222222222222222222222222222222222222222222
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CORMIX2 PREDICTION FILE:
22222222222222222222222222222222222222222222222222222222222222222222222222222222
                           CORMIX MIXING ZONE EXPERT SYSTEM
         Subsystem CORMIX2:  Submerged Multiport Diffuser Discharges
                             CORMIX-GI Version 4.2G
                          HYDRO2 Version 4.2 August 2002
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
CASE DESCRIPTION
 Site name/label:   SOKO
 Design case:       dry season, mid tide at Soko island
 FILE NAME:         D:\...0-HK\CORMIX\deltat12_5\south-soko-d-sp-mid125.prd
 Time stamp:        Mon Nov 27 15:49:13 2006

ENVIRONMENT PARAMETERS (metric units)
 Unbounded section
 HA    =     12.00  HD    =     11.90
 UA    =      0.240 F     =      0.031 USTAR =0.1491E-01
 UW    =      7.500 UWSTAR=0.9300E-02
 Uniform density environment
 STRCND=  U         RHOAM = 1023.3000

DIFFUSER DISCHARGE PARAMETERS (metric units)
 Diffuser type:     DITYPE= unidirectional_parallel
 BANK  =  LEFT      DISTB =    420.00  YB1   =    420.00  YB2   =    420.00
 LD    =     16.00  NOPEN =    4       SPAC  =      5.33
 D0    =      0.750 A0    =      0.442 H0    =      2.00
 Nozzle/port arrangement:   unidirectional_without_fanning
 GAMMA =      0.00  THETA =     30.00  SIGMA =    270.00  BETA  =     90.00
 U0    =      2.829 Q0    =      5.000       =0.5000E+01
 RHO0  = 1026.0000  DRHO0 =-.2700E+01  GP0   =-.2588E-01
 C0    =0.8500E+01  CUNITS=  deg.C
 IPOLL =  3         KS    =0.8359E-05  KD    =0.0000E+00

FLUX VARIABLES - PER UNIT DIFFUSER LENGTH (metric units)
 q0    =0.3125E+00  m0    =0.8842E+00  j0    =-.8086E-02  SIGNJ0=     -1.0
 Associated 2-d length scales (meters)
 lQ=B  =      0.110 lM    =     21.88  lm    =     15.35
 lmp   =  99999.00  lbp   =  99999.00  la    =  99999.00

FLUX VARIABLES - ENTIRE DIFFUSER (metric units)
 Q0    =0.5000E+01  M0    =0.1415E+02  J0    =-.1294E+00
 Associated 3-d length scales (meters)
 LQ    =      1.33  LM    =     20.28  Lm    =     15.67  Lb    =      9.36
                                       Lmp   =  99999.00  Lbp   =  99999.00

NON-DIMENSIONAL PARAMETERS
 FR0   =     52.93  FRD0  =     20.31  R     =     11.79
 (slot)             (port/nozzle)

FLOW CLASSIFICATION
 222222222222222222222222222222222222222222
 2  Flow class (CORMIX2)      =    MNU9   2
 2  Applicable layer depth HS =    11.90  2
 222222222222222222222222222222222222222222

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.8500E+01  CUNITS=  deg.C
 NTOX  =  0
 NSTD  =  1         CSTD  =0.1000E+01
 REGMZ =  0
 XINT  =  20000.00  XMAX  =  20000.00

X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the bottom and the diffuser mid-point:
       420.00 m  from the LEFT  bank/shore.
    X-axis points downstream, Y-axis points to left, Z-axis points upward.
NSTEP = 20 display intervals per module
```

NOTE on dilution/concentration values for this HEATED DISCHARGE (IPOLL=3):
S = hydrodynamic dilutions, include buoyancy (heat) loss effects, but provided plume has surface contact
C = corresponding temperature values (always in "degC"!), include heat loss, if any

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BEGIN MOD201: DIFFUSER DISCHARGE MODULE

Due to complex near-field motions: EQUIVALENT SLOT DIFFUSER (2-D) GEOMETRY

Profile definitions:
BV = Gaussian 1/e (37%) half-width, in vertical plane normal to trajectory
BH = top-hat half-width, in horizontal plane normal to trajectory
S = hydrodynamic centerline dilution
C = centerline concentration (includes reaction effects, if any)

X	Y	Z	S	C	BV	BH
0.00	0.00	2.00	1.0	0.850E+01	0.09	8.00

END OF MOD201: DIFFUSER DISCHARGE MODULE

BEGIN MOD273: UNIDIRECTIONAL CROSS-FLOWING DIFFUSER (TEE) IN STRONG CURRENT

Because of the strong ambient current the diffuser plume of this crossflowing discharge gets RAPIDLY DEFLECTED.
A near-field zone is formed that is VERTICALLY FULLY MIXED over the entire layer depth. Full mixing is achieved at a downstream distance of about five (5) layer depths.

Profile definitions:
BV = layer depth (vertically mixed)
BH = top-hat half-width, measured horizontally in Y-direction
S = hydrodynamic average (bulk) dilution
C = average (bulk) concentration (includes reaction effects, if any)

X	Y	Z	S	C	BV	BH
0.00	0.00	2.00	1.0	0.850E+01	0.09	8.00
3.38	-0.52	1.90	1.6	0.523E+01	0.68	7.77
6.75	-1.03	1.80	1.9	0.451E+01	1.27	7.53
10.12	-1.55	1.70	2.1	0.408E+01	1.86	7.30
13.50	-2.06	1.60	2.2	0.378E+01	2.45	7.06
16.88	-2.58	1.50	2.4	0.355E+01	3.04	6.83
20.25	-3.10	1.40	2.5	0.336E+01	3.63	6.60
23.62	-3.61	1.30	2.7	0.320E+01	4.22	6.36
27.00	-4.13	1.20	2.8	0.307E+01	4.81	6.13
30.38	-4.64	1.10	2.9	0.296E+01	5.40	5.89
33.75	-5.16	1.00	3.0	0.286E+01	5.99	5.66
37.12	-5.68	0.90	3.1	0.277E+01	6.58	5.43
40.50	-6.19	0.80	3.2	0.269E+01	7.18	5.19
43.88	-6.71	0.70	3.3	0.261E+01	7.77	4.96
47.25	-7.22	0.60	3.3	0.255E+01	8.36	4.73
50.62	-7.74	0.50	3.4	0.249E+01	8.95	4.49
54.00	-8.26	0.40	3.5	0.243E+01	9.54	4.26
57.38	-8.77	0.30	3.6	0.238E+01	10.13	4.02
60.75	-9.29	0.20	3.7	0.233E+01	10.72	3.79
64.12	-9.80	0.10	3.7	0.228E+01	11.31	3.56
67.50	-10.32	0.00	3.8	0.224E+01	11.90	3.32

Cumulative travel time = 281. sec
Plume centerline may exhibit slight discontinuities in transition to subsequent far-field module.

END OF MOD273: UNIDIRECTIONAL CROSS-FLOWING DIFFUSER (TEE) IN STRONG CURRENT

** End of NEAR-FIELD REGION (NFR) **

BEGIN MOD241: BUOYANT AMBIENT SPREADING

Profile definitions:
BV = top-hat thickness, measured vertically
BH = top-hat half-width, measured horizontally in y-direction
ZU = upper plume boundary (Z-coordinate)
ZL = lower plume boundary (Z-coordinate)
S = hydrodynamic average (bulk) dilution
C = average (bulk) concentration (includes reaction effects, if any)

Plume Stage 1 (not bank attached):

X	Y	Z	S	C	BV	BH	ZU	ZL
70.88	-10.32	0.00	3.8	0.224E+01	11.90	3.32	11.90	0.00
292.70	-10.32	0.00	8.3	0.103E+01	1.49	57.67	1.49	0.00

** WATER QUALITY STANDARD OR CCC HAS BEEN FOUND **
The pollutant concentration in the plume falls below water quality standard or CCC value of 0.100E+01 in the current prediction interval.
This is the spatial extent of concentrations exceeding the water quality standard or CCC value.

X	Y	Z	S	C	BV	BH	ZU	ZL
514.53	-10.32	0.00	10.8	0.784E+00	1.32	85.24	1.32	0.00
736.36	-10.32	0.00	14.5	0.586E+00	1.41	106.97	1.41	0.00
958.19	-10.32	0.00	19.5	0.435E+00	1.61	126.12	1.61	0.00
1180.02	-10.32	0.00	26.1	0.326E+00	1.89	143.88	1.89	0.00
1401.85	-10.32	0.00	34.4	0.247E+00	2.23	160.79	2.23	0.00
1623.68	-10.32	0.00	44.5	0.191E+00	2.62	177.10	2.62	0.00
1845.51	-10.32	0.00	56.7	0.150E+00	3.06	192.98	3.06	0.00
2067.33	-10.32	0.00	71.0	0.120E+00	3.54	208.52	3.54	0.00
2289.16	-10.32	0.00	87.5	0.971E-01	4.07	223.76	4.07	0.00
2510.99	-10.32	0.00	106.5	0.798E-01	4.64	238.75	4.64	0.00
2732.82	-10.32	0.00	127.9	0.664E-01	5.26	253.52	5.26	0.00
2954.65	-10.32	0.00	152.1	0.559E-01	5.91	268.09	5.91	0.00
3176.48	-10.32	0.00	178.9	0.475E-01	6.60	282.47	6.60	0.00
3398.31	-10.32	0.00	208.7	0.407E-01	7.33	296.67	7.33	0.00
3620.14	-10.32	0.00	241.5	0.352E-01	8.10	310.70	8.10	0.00
3841.97	-10.32	0.00	277.3	0.306E-01	8.90	324.58	8.90	0.00
4063.79	-10.32	0.00	316.4	0.269E-01	9.74	338.32	9.74	0.00
4285.62	-10.32	0.00	358.8	0.237E-01	10.62	351.90	10.62	0.00
4507.45	-10.32	0.00	404.6	0.210E-01	11.53	365.36	11.53	0.00

Cumulative travel time = 18767. sec

END OF MOD241: BUOYANT AMBIENT SPREADING

Due to the attachment or proximity of the plume tothe bottom, the bottom coordinate for the FAR-FIELD differs from the ambient depth, ZFB = 0 m.
In a subsequent analysis set "depth at discharge" equal to "ambient depth".

BEGIN MOD261: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

Vertical diffusivity (initial value) = 0.382E-01 m^2/s
Horizontal diffusivity (initial value) = 0.392E+01 m^2/s

Profile definitions:
BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically
= or equal to layer depth, if fully mixed
BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
measured horizontally in Y-direction
ZU = upper plume boundary (Z-coordinate)
ZL = lower plume boundary (Z-coordinate)
S = hydrodynamic centerline dilution
C = centerline concentration (includes reaction effects, if any)

Plume Stage 1 (not bank attached):

X	Y	Z	S	C	BV	BH	ZU	ZL
4507.45	-10.32	0.00	404.6	0.210E-01	11.53	365.36	11.53	0.00
4552.46	-10.32	0.00	416.1	0.204E-01	11.76	368.52	11.76	0.00
4597.47	-10.32	0.00	424.6	0.200E-01	11.90	371.69	11.90	0.00
4642.48	-10.32	0.00	428.3	0.198E-01	11.90	374.87	11.90	0.00
4687.49	-10.32	0.00	431.9	0.197E-01	11.90	378.06	11.90	0.00

4732.50	-10.32	0.00	435.6	0.195E-01	11.90	381.26	11.90	0.00
4777.51	-10.32	0.00	439.2	0.194E-01	11.90	384.47	11.90	0.00
4822.52	-10.32	0.00	442.9	0.192E-01	11.90	387.69	11.90	0.00
4867.53	-10.32	0.00	446.6	0.190E-01	11.90	390.92	11.90	0.00
4912.54	-10.32	0.00	450.3	0.189E-01	11.90	394.15	11.90	0.00
4957.56	-10.32	0.00	454.0	0.187E-01	11.90	397.40	11.90	0.00
5002.57	-10.32	0.00	457.7	0.186E-01	11.90	400.65	11.90	0.00
5047.58	-10.32	0.00	461.4	0.184E-01	11.90	403.91	11.90	0.00
5092.59	-10.32	0.00	465.2	0.183E-01	11.90	407.18	11.90	0.00
5137.60	-10.32	0.00	468.9	0.181E-01	11.90	410.46	11.90	0.00
5182.61	-10.32	0.00	472.7	0.180E-01	11.90	413.75	11.90	0.00
5227.62	-10.32	0.00	476.4	0.178E-01	11.90	417.05	11.90	0.00
5272.63	-10.32	0.00	480.2	0.177E-01	11.90	420.35	11.90	0.00
5317.64	-10.32	0.00	484.0	0.176E-01	11.90	423.67	11.90	0.00
5362.65	-10.32	0.00	487.8	0.174E-01	11.90	426.99	11.90	0.00
5407.66	-10.32	0.00	491.6	0.173E-01	11.90	430.32	11.90	0.00

Cumulative travel time = 22518. sec

Plume Stage 2 (bank attached):

X	Y	Z	S	C	BV	BH	ZU	ZL
5407.66	420.00	0.00	491.6	0.173E-01	11.90	860.65	11.90	0.00
6137.27	420.00	0.00	531.0	0.160E-01	11.90	929.67	11.90	0.00
6866.89	420.00	0.00	571.5	0.149E-01	11.90	1000.45	11.90	0.00
7596.51	420.00	0.00	612.9	0.139E-01	11.90	1072.94	11.90	0.00
8326.13	420.00	0.00	655.2	0.130E-01	11.90	1147.10	11.90	0.00
9055.74	420.00	0.00	698.5	0.122E-01	11.90	1222.89	11.90	0.00
9785.36	420.00	0.00	742.7	0.114E-01	11.90	1300.29	11.90	0.00
10514.98	420.00	0.00	787.8	0.108E-01	11.90	1379.25	11.90	0.00
11244.59	420.00	0.00	833.8	0.102E-01	11.90	1459.75	11.90	0.00
11974.21	420.00	0.00	880.6	0.965E-02	11.90	1541.75	11.90	0.00
12703.83	420.00	0.00	928.3	0.916E-02	11.90	1625.24	11.90	0.00
13433.45	420.00	0.00	976.9	0.870E-02	11.90	1710.18	11.90	0.00
14163.06	420.00	0.00	1026.2	0.828E-02	11.90	1796.55	11.90	0.00
14892.68	420.00	0.00	1076.3	0.790E-02	11.90	1884.33	11.90	0.00
15622.30	420.00	0.00	1127.3	0.754E-02	11.90	1973.49	11.90	0.00
16351.92	420.00	0.00	1179.0	0.721E-02	11.90	2064.01	11.90	0.00
17081.53	420.00	0.00	1231.4	0.690E-02	11.90	2155.88	11.90	0.00
17811.15	420.00	0.00	1284.7	0.662E-02	11.90	2249.08	11.90	0.00
18540.77	420.00	0.00	1338.6	0.635E-02	11.90	2343.57	11.90	0.00
19270.38	420.00	0.00	1393.4	0.610E-02	11.90	2439.36	11.90	0.00
20000.00	420.00	0.00	1448.8	0.587E-02	11.90	2536.42	11.90	0.00

Cumulative travel time = 83319. sec

Simulation limit based on maximum specified distance = 20000.00 m.
This is the REGION OF INTEREST limitation.

END OF MOD261: PASSIVE AMBIENT MIXING IN UNIFORM AMBIENT

CORMIX2: Submerged Multiport Diffuser Discharges End of Prediction File

2222222222222222222222222222222222222222222222222222222222222222222222222222222

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CORMIX2 PREDICTION FILE:
22222222222222222222222222222222222222222222222222222222222222222222222222222
                       CORMIX MIXING ZONE EXPERT SYSTEM
         Subsystem CORMIX2:  Submerged Multiport Diffuser Discharges
                         CORMIX-GI Version 4.2G
                      HYDRO2 Version 4.3.0.2 June 2005
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
CASE DESCRIPTION
 Site name/label:   SOKO
 Design case:       Wet season, neap tide, high water
 FILE NAME:         D:\...60-HK\CORMIX\deltat12_5\south-soko-w-np-hw125.prd
 Time stamp:        Mon Nov 27 15:12:53 2006

ENVIRONMENT PARAMETERS (metric units)
 Unbounded section
 HA    =     12.00  HD    =     12.70
 UA    =      0.050 F     =      0.031 USTAR =0.3106E-02
 UW    =      7.500 UWSTAR=0.9300E-02
 Density stratified environment
 STRCND=  A         RHOAM = 1017.4000
 RHOAS = 1010.2000  RHOAB = 1024.6000  RHOAH0= 1017.4000  E     =0.1085E-01

DIFFUSER DISCHARGE PARAMETERS (metric units)
 Diffuser type:     DITYPE= unidirectional_parallel
 BANK  =  LEFT      DISTB =    420.00  YB1   =    420.00  YB2   =    420.00
 LD    =     16.00  NOPEN =    4       SPAC  =      5.33
 D0    =      0.750 A0    =      0.442 H0    =      2.00
 Nozzle/port arrangement:   unidirectional_without_fanning
 GAMMA =      0.00  THETA =     30.00  SIGMA =    270.00  BETA  =     90.00
 U0    =      2.829 Q0    =      5.000       =0.5000E+01
 RHO0  = 1020.0000  DRHO0 =-.2600E+01  GP0   =-.2506E-01
 C0    =0.8500E+01  CUNITS=  deg.C
 IPOLL =  3         KS    =0.8359E-05  KD    =0.0000E+00

FLUX VARIABLES - PER UNIT DIFFUSER LENGTH (metric units)
 q0    =0.3125E+00  m0    =0.8842E+00  j0    =-.7832E-02  SIGNJ0=     -1.0
 Associated 2-d length scales (meters)
 lQ=B  =      0.110 lM    =     22.46  lm    =    353.68
 lmp   =  99999.00  lbp   =  99999.00  la    =  99999.00

FLUX VARIABLES - ENTIRE DIFFUSER (metric units)
 Q0    =0.5000E+01  M0    =0.1415E+02  J0    =-.1253E+00
 Associated 3-d length scales (meters)
 LQ    =      1.33  LM    =     20.61  Lm    =     75.23  Lb    =   1002.45
                                       Lmp   =  99999.00  Lbp   =  99999.00

NON-DIMENSIONAL PARAMETERS
 FR0   =     53.78  FRD0  =     20.64  R     =     56.59  PL    =    140.
 (slot)             (port/nozzle)

FLOW CLASSIFICATION
 222222222222222222222222222222222222222222
 2  Flow class (CORMIX2)      =    MNU8   2
 2  Applicable layer depth HS =    12.70  2
 222222222222222222222222222222222222222222

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.8500E+01  CUNITS=  deg.C
 NTOX  =  0
 NSTD  =  1         CSTD  =0.1000E+01
 REGMZ =  0
 XINT  =  20000.00  XMAX  =  20000.00

X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the bottom and the diffuser mid-point:
       420.00 m  from the LEFT  bank/shore.
    X-axis points downstream, Y-axis points to left, Z-axis points upward.
```

```
NSTEP =  20 display intervals per module

NOTE on dilution/concentration values for this HEATED DISCHARGE (IPOLL=3):
   S  = hydrodynamic dilutions, include buoyancy (heat) loss effects, but
        provided plume has surface contact
   C  = corresponding temperature values (always in "degC"!),
        include heat loss, if any
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
BEGIN MOD201: DIFFUSER DISCHARGE MODULE

 Due to complex near-field motions:  EQUIVALENT SLOT DIFFUSER (2-D) GEOMETRY

 Profile definitions:
   BV = Gaussian 1/e (37%) half-width, in vertical plane normal to trajectory
   BH = top-hat half-width, in horizontal plane normal to trajectory
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction effects, if any)

       X        Y       Z        S        C       BV       BH
      0.00     0.00    2.00     1.0 0.850E+01   0.09     8.00

END OF MOD201: DIFFUSER DISCHARGE MODULE
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
BEGIN MOD272: ACCELERATION ZONE OF UNIDIRECTIONAL CROSS-FLOWING DIFFUSER (TEE)

 In this laterally contracting zone the diffuser plume becomes VERTICALLY FULLY
  MIXED over the entire layer depth (HS =   12.70m).
   Full mixing is achieved after a plume distance of about five
   layer depths from the diffuser.

 Profile definitions:
   BV = layer depth (vertically mixed)
   BH = top-hat half-width, in horizontal plane normal to trajectory
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)

       X        Y       Z        S        C       BV       BH
      0.00    -0.00    2.00     1.0 0.850E+01   0.09     8.00
      0.00    -0.40    2.22     2.2 0.381E+01   0.63     7.44
      0.00    -0.80    2.43     2.7 0.310E+01   1.27     6.96
      0.00    -1.20    2.65     3.1 0.272E+01   1.91     6.55
      0.00    -1.60    2.87     3.5 0.246E+01   2.54     6.18
      0.00    -2.00    3.09     3.7 0.227E+01   3.17     5.87
      0.00    -2.40    3.31     4.0 0.212E+01   3.81     5.59
      0.00    -2.80    3.52     4.3 0.200E+01   4.45     5.34
      0.00    -3.20    3.74     4.5 0.190E+01   5.08     5.12
      0.00    -3.60    3.96     4.7 0.181E+01   5.72     4.92
      0.00    -4.00    4.18     4.9 0.174E+01   6.35     4.74
      0.00    -4.40    4.39     5.1 0.167E+01   6.99     4.58
      0.00    -4.80    4.61     5.3 0.162E+01   7.62     4.45
      0.00    -5.20    4.83     5.4 0.156E+01   8.26     4.33
      0.00    -5.60    5.05     5.6 0.152E+01   8.89     4.24
      0.00    -6.00    5.26     5.8 0.148E+01   9.53     4.16
      0.00    -6.40    5.48     5.9 0.144E+01  10.16     4.11
      0.00    -6.80    5.70     6.1 0.140E+01  10.80     4.07
      0.00    -7.20    5.92     6.2 0.137E+01  11.43     4.04
      0.00    -7.60    6.13     6.4 0.134E+01  12.07     4.02
      0.00    -8.00    6.35     6.5 0.131E+01  12.70     4.01
 Cumulative travel time =          18.3701 sec
   Plume centerline may exhibit slight discontinuities in transition
     to subsequent far-field module.

END OF MOD272: ACCELERATION ZONE OF UNIDIRECTIONAL CROSS-FLOWING DIFFUSER (TEE
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
BEGIN MOD252: DIFFUSER INDUCED PLUME IN WEAK CROSS-FLOW
```

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 Phase 1: Vertically mixed, Phase 2: Re-stratified

 Phase 1: The diffuser plume is VERTICALLY FULLY MIXED over the
          entire layer depth.
 This flow region is INSIGNIFICANT in spatial extent and will be by-passed.
-----------------------------------------------------------------------------
 Phase 2: The flow has RESTRATIFIED at the beginning of this zone.

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = Gaussian 1/e (37%) half-width in horizontal plane normal to trajectory
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction effects, if any)

       X        Y       Z        S       C        BV       BH
      0.00    -8.00    0.00     6.5 0.131E+01  12.70     3.91
** WATER QUALITY STANDARD OR CCC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.100E+01 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
     16.78   -39.35    0.00     8.6 0.987E+00   4.29    19.49
     37.70   -70.69    0.00    10.3 0.825E+00   3.59    32.19
     62.06  -102.04    0.00    11.7 0.723E+00   3.27    44.80
     89.44  -133.39    0.00    13.0 0.652E+00   3.06    57.52
    119.52  -164.74    0.00    14.2 0.598E+00   2.91    70.37
    152.08  -196.08    0.00    15.3 0.556E+00   2.79    83.38
    186.96  -227.43    0.00    16.3 0.521E+00   2.69    96.53
    224.00  -258.78    0.00    17.3 0.493E+00   2.61   109.82
    263.08  -290.12    0.00    18.2 0.468E+00   2.53   123.24
    304.10  -321.47    0.00    19.0 0.447E+00   2.47   136.78
    346.98  -352.82    0.00    19.8 0.428E+00   2.41   150.45
    391.63  -384.17    0.00    20.6 0.412E+00   2.36   164.22
    438.00  -415.51    0.00    21.4 0.397E+00   2.31   178.11
    486.01  -446.86    0.00    22.1 0.384E+00   2.26   192.09
    535.61  -478.21    0.00    22.8 0.372E+00   2.22   206.18
    586.76  -509.55    0.00    23.5 0.361E+00   2.18   220.35
    639.41  -540.90    0.00    24.2 0.351E+00   2.14   234.62
    693.52  -572.25    0.00    24.8 0.342E+00   2.11   248.97
    749.04  -603.60    0.00    25.5 0.334E+00   2.08   263.40
    805.95  -634.94    0.00    26.1 0.326E+00   2.05   277.91
 Cumulative travel time =       19361.1367 sec

END OF MOD252: DIFFUSER INDUCED PLUME IN WEAK CROSS-FLOW
-----------------------------------------------------------------------------
** End of NEAR-FIELD REGION (NFR) **

 The initial plume WIDTH values in the next far-field module will be
  CORRECTED by a factor  1.51 to conserve the mass flux in the far-field!
 The correction factor is quite large because of the small ambient velocity
   relative to the strong mixing characteristics of the discharge!
   This indicates localized RECIRCULATION REGIONS and internal hydraulic JUMPS.
   Width predictions show discontinuities, dilution values should be acceptable.
-----------------------------------------------------------------------------
BEGIN MOD241: BUOYANT AMBIENT SPREADING

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)

 Plume Stage 1 (not bank attached):
```

X	Y	Z	S	C	BV	BH	ZU	ZL
805.95	-634.94	0.00	26.1	0.326E+00	3.10	420.89	3.10	0.00
925.87	-634.94	0.00	28.2	0.301E+00	3.03	465.55	3.03	0.00
1045.80	-634.94	0.00	30.6	0.278E+00	3.02	506.52	3.02	0.00
1165.72	-634.94	0.00	33.2	0.256E+00	3.05	544.78	3.05	0.00
1285.65	-634.94	0.00	36.1	0.235E+00	3.11	580.97	3.11	0.00
1405.57	-634.94	0.00	39.3	0.216E+00	3.19	615.55	3.19	0.00
1525.50	-634.94	0.00	42.8	0.199E+00	3.30	648.84	3.30	0.00
1645.42	-634.94	0.00	46.6	0.183E+00	3.42	681.09	3.42	0.00
1765.35	-634.94	0.00	50.7	0.168E+00	3.56	712.49	3.56	0.00
1885.27	-634.94	0.00	55.1	0.154E+00	3.71	743.18	3.71	0.00
2005.20	-634.94	0.00	59.9	0.142E+00	3.88	773.28	3.88	0.00
2125.12	-634.94	0.00	65.1	0.131E+00	4.05	802.86	4.05	0.00
2245.05	-634.94	0.00	70.6	0.120E+00	4.24	832.02	4.24	0.00
2364.97	-634.94	0.00	76.5	0.111E+00	4.44	860.80	4.44	0.00
2484.90	-634.94	0.00	82.8	0.103E+00	4.66	889.26	4.66	0.00
2604.82	-634.94	0.00	89.5	0.950E-01	4.88	917.43	4.88	0.00
2724.74	-634.94	0.00	96.5	0.880E-01	5.11	945.34	5.11	0.00
2844.67	-634.94	0.00	104.0	0.817E-01	5.35	973.04	5.35	0.00
2964.59	-634.94	0.00	112.0	0.759E-01	5.59	1000.53	5.59	0.00
3084.52	-634.94	0.00	120.3	0.707E-01	5.85	1027.84	5.85	0.00
3204.44	-634.94	0.00	129.1	0.658E-01	6.12	1054.98	6.12	0.00

Cumulative travel time = 67331.0391 sec

Plume is ATTACHED to LEFT bank/shore.
Plume width is now determined from LEFT bank/shore.

Plume Stage 2 (bank attached):

X	Y	Z	S	C	BV	BH	ZU	ZL
3204.44	420.00	0.00	129.1	0.658E-01	6.12	2109.88	6.12	0.00
3318.23	420.00	0.00	137.2	0.620E-01	6.45	2126.12	6.45	0.00
3432.02	420.00	0.00	145.4	0.585E-01	6.79	2142.62	6.79	0.00
3545.80	420.00	0.00	153.8	0.553E-01	7.12	2159.36	7.12	0.00
3659.59	420.00	0.00	162.3	0.524E-01	7.46	2176.35	7.46	0.00
3773.38	420.00	0.00	170.9	0.497E-01	7.79	2193.55	7.79	0.00
3887.16	420.00	0.00	179.7	0.473E-01	8.13	2210.96	8.13	0.00
4000.95	420.00	0.00	188.7	0.450E-01	8.47	2228.56	8.47	0.00
4114.74	420.00	0.00	197.8	0.430E-01	8.81	2246.34	8.81	0.00
4228.52	420.00	0.00	207.1	0.410E-01	9.15	2264.30	9.15	0.00
4342.31	420.00	0.00	216.5	0.393E-01	9.49	2282.42	9.49	0.00
4456.10	420.00	0.00	226.2	0.376E-01	9.83	2300.69	9.83	0.00
4569.88	420.00	0.00	235.9	0.360E-01	10.17	2319.11	10.17	0.00
4683.67	420.00	0.00	245.9	0.346E-01	10.52	2337.66	10.52	0.00
4797.46	420.00	0.00	256.0	0.332E-01	10.86	2356.34	10.86	0.00
4911.24	420.00	0.00	266.3	0.319E-01	11.21	2375.14	11.21	0.00
5025.03	420.00	0.00	276.7	0.307E-01	11.56	2394.06	11.56	0.00
5138.82	420.00	0.00	287.4	0.296E-01	11.91	2413.08	11.91	0.00
5252.60	420.00	0.00	298.2	0.285E-01	12.26	2432.21	12.26	0.00
5366.39	420.00	0.00	309.2	0.275E-01	12.61	2451.43	12.61	0.00
5480.18	420.00	0.00	320.4	0.265E-01	12.70	2470.74	12.70	0.00

Cumulative travel time = 112845.7578 sec

END OF MOD241: BUOYANT AMBIENT SPREADING

Due to the attachment or proximity of the plume tothe bottom, the bottom coordinate for the FAR-FIELD differs from the ambient depth, ZFB = 0 m.
In a subsequent analysis set "depth at discharge" equal to "ambient depth".

BEGIN MOD262: PASSIVE AMBIENT MIXING IN STRATIFIED AMBIENT

Vertical diffusivity (initial value) = 0.263E-07 m^2/s
Horizontal diffusivity (initial value) = 0.501E+02 m^2/s

The passive diffusion plume is VERTICALLY FULLY MIXED at beginning of region.

Profile definitions:
BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically

```
      = or equal to layer depth, if fully mixed
   BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
        measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction effects, if any)

 Plume Stage 2 (bank attached):
        X         Y        Z         S        C         BV        BH       ZU       ZL
   5480.18    420.00    0.00    320.4 0.265E-01  12.70  2470.74   12.70     0.00
   6206.17    420.00    0.00    382.2 0.222E-01  12.70  2947.39   12.70     0.00
   6932.16    420.00    0.00    447.5 0.190E-01  12.70  3451.27   12.70     0.00
   7658.15    420.00    0.00    516.2 0.165E-01  12.70  3980.98   12.70     0.00
   8384.14    420.00    0.00    588.1 0.145E-01  12.70  4535.32   12.70     0.00
   9110.13    420.00    0.00    663.0 0.128E-01  12.70  5113.24   12.70     0.00
   9836.12    420.00    0.00    740.9 0.115E-01  12.70  5713.81   12.70     0.00
  10562.12    420.00    0.00    821.6 0.103E-01  12.70  6336.22   12.70     0.00
  11288.11    420.00    0.00    905.0 0.939E-02  12.70  6979.71   12.70     0.00
  12014.10    420.00    0.00    991.1 0.858E-02  12.70  7643.63   12.70     0.00
  12740.09    420.00    0.00   1079.8 0.787E-02  12.70  8327.35   12.70     0.00
  13466.08    420.00    0.00   1170.9 0.726E-02  12.70  9030.33   12.70     0.00
  14192.07    420.00    0.00   1264.5 0.672E-02  12.70  9752.04   12.70     0.00
  14918.06    420.00    0.00   1360.4 0.625E-02  12.70 10492.02   12.70     0.00
  15644.05    420.00    0.00   1458.7 0.583E-02  12.70 11249.82   12.70     0.00
  16370.05    420.00    0.00   1559.2 0.545E-02  12.70 12025.04   12.70     0.00
  17096.04    420.00    0.00   1661.9 0.511E-02  12.70 12817.28   12.70     0.00
  17822.03    420.00    0.00   1766.8 0.481E-02  12.70 13626.20   12.70     0.00
  18548.02    420.00    0.00   1873.8 0.454E-02  12.70 14451.46   12.70     0.00
  19274.01    420.00    0.00   1982.9 0.429E-02  12.70 15292.73   12.70     0.00
  20000.00    420.00    0.00   2094.0 0.406E-02  12.70 16149.72   12.70     0.00
 Cumulative travel time =      403242.1562 sec

 Simulation limit based on maximum specified distance =  20000.00 m.
   This is the REGION OF INTEREST limitation.

END OF MOD262: PASSIVE AMBIENT MIXING IN STRATIFIED AMBIENT
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
CORMIX2: Submerged Multiport Diffuser Discharges       End of Prediction File
22222222222222222222222222222222222222222222222222222222222222222222222222222
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CORMIX2 PREDICTION FILE:
22222222222222222222222222222222222222222222222222222222222222222222222222222
                       CORMIX MIXING ZONE EXPERT SYSTEM
         Subsystem CORMIX2:  Submerged Multiport Diffuser Discharges
                         CORMIX-GI Version 4.2G
                      HYDRO2 Version 4.3.0.2 June 2005
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
CASE DESCRIPTION
 Site name/label:   SOKO
 Design case:       wet season, high water at Soko island
 FILE NAME:         D:\...60-HK\CORMIX\deltat12_5\south-soko-w-sp-hw125.prd
 Time stamp:        Mon Nov 27 15:34:37 2006

ENVIRONMENT PARAMETERS (metric units)
 Unbounded section
 HA    =     12.00  HD    =     13.20
 UA    =      0.050 F     =      0.031 USTAR =0.3106E-02
 UW    =      7.500 UWSTAR=0.9300E-02
 Density stratified environment
 STRCND=  A         RHOAM = 1018.3000
 RHOAS = 1012.4000  RHOAB = 1024.2000  RHOAH0= 1018.3000  E     =0.8559E-02

DIFFUSER DISCHARGE PARAMETERS (metric units)
 Diffuser type:     DITYPE= unidirectional_parallel
 BANK  =  LEFT      DISTB =    420.00  YB1   =    420.00  YB2   =    420.00
 LD    =     16.00  NOPEN =    4       SPAC  =      5.33
 D0    =      0.750 A0    =      0.442 H0    =      2.00
 Nozzle/port arrangement:   unidirectional_without_fanning
 GAMMA =      0.00  THETA =     30.00  SIGMA =    270.00  BETA  =     90.00
 U0    =      2.829 Q0    =      5.000       =0.5000E+01
 RHO0  = 1020.9000  DRHO0 =-.2600E+01  GP0   =-.2504E-01
 C0    =0.1250E+02  CUNITS=  deg.C
 IPOLL =  3         KS    =0.8359E-05  KD    =0.0000E+00

FLUX VARIABLES - PER UNIT DIFFUSER LENGTH (metric units)
 q0    =0.3125E+00  m0    =0.8842E+00  j0    =-.7825E-02  SIGNJ0=     -1.0
 Associated 2-d length scales (meters)
 lQ=B  =      0.110 lM    =     22.47  lm    =    353.68
 lmp   =  99999.00  lbp   =  99999.00  la    =  99999.00

FLUX VARIABLES - ENTIRE DIFFUSER (metric units)
 Q0    =0.5000E+01  M0    =0.1415E+02  J0    =-.1252E+00
 Associated 3-d length scales (meters)
 LQ    =      1.33  LM    =     20.62  Lm    =     75.23  Lb    =   1001.56
                                       Lmp   =  99999.00  Lbp   =  99999.00

NON-DIMENSIONAL PARAMETERS
 FR0   =     53.80  FRD0  =     20.65  R     =     56.59  PL    =    140.
 (slot)             (port/nozzle)

FLOW CLASSIFICATION
 2222222222222222222222222222222222222222222
 2  Flow class (CORMIX2)      =    MNU8   2
 2  Applicable layer depth HS =    13.20  2
 2222222222222222222222222222222222222222222

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.1250E+02  CUNITS=  deg.C
 NTOX  =  0
 NSTD  =  1         CSTD  =0.1000E+01
 REGMZ =  0
 XINT  =  20000.00  XMAX  =  20000.00

X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the bottom and the diffuser mid-point:
       420.00 m  from the LEFT  bank/shore.
    X-axis points downstream, Y-axis points to left, Z-axis points upward.
```

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NSTEP =  20 display intervals per module

NOTE on dilution/concentration values for this HEATED DISCHARGE (IPOLL=3):
   S  = hydrodynamic dilutions, include buoyancy (heat) loss effects, but
        provided plume has surface contact
   C  = corresponding temperature values (always in "degC"!),
        include heat loss, if any
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
BEGIN MOD201: DIFFUSER DISCHARGE MODULE

 Due to complex near-field motions:  EQUIVALENT SLOT DIFFUSER (2-D) GEOMETRY

 Profile definitions:
   BV = Gaussian 1/e (37%) half-width, in vertical plane normal to trajectory
   BH = top-hat half-width, in horizontal plane normal to trajectory
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction effects, if any)

       X        Y       Z        S       C        BV       BH
      0.00     0.00    2.00     1.0 0.125E+02   0.09     8.00

END OF MOD201: DIFFUSER DISCHARGE MODULE
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
BEGIN MOD272: ACCELERATION ZONE OF UNIDIRECTIONAL CROSS-FLOWING DIFFUSER (TEE)

 In this laterally contracting zone the diffuser plume becomes VERTICALLY FULLY
  MIXED over the entire layer depth (HS =   13.20m).
   Full mixing is achieved after a plume distance of about five
   layer depths from the diffuser.

 Profile definitions:
   BV = layer depth (vertically mixed)
   BH = top-hat half-width, in horizontal plane normal to trajectory
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)

       X        Y       Z        S       C        BV       BH
      0.00    -0.00    2.00     1.0 0.125E+02   0.09     8.00
      0.00    -0.40    2.23     2.3 0.555E+01   0.66     7.44
      0.00    -0.80    2.46     2.8 0.451E+01   1.32     6.96
      0.00    -1.20    2.69     3.2 0.394E+01   1.98     6.55
      0.00    -1.60    2.92     3.5 0.357E+01   2.64     6.18
      0.00    -2.00    3.15     3.8 0.329E+01   3.30     5.87
      0.00    -2.40    3.38     4.1 0.307E+01   3.96     5.59
      0.00    -2.80    3.61     4.3 0.290E+01   4.62     5.34
      0.00    -3.20    3.84     4.5 0.275E+01   5.28     5.12
      0.00    -3.60    4.07     4.8 0.263E+01   5.94     4.92
      0.00    -4.00    4.30     5.0 0.252E+01   6.60     4.74
      0.00    -4.40    4.53     5.2 0.242E+01   7.26     4.58
      0.00    -4.80    4.76     5.3 0.234E+01   7.92     4.45
      0.00    -5.20    4.99     5.5 0.227E+01   8.58     4.33
      0.00    -5.60    5.22     5.7 0.220E+01   9.24     4.24
      0.00    -6.00    5.45     5.9 0.214E+01   9.90     4.16
      0.00    -6.40    5.68     6.0 0.208E+01  10.56     4.11
      0.00    -6.80    5.91     6.2 0.203E+01  11.22     4.07
      0.00    -7.20    6.14     6.3 0.198E+01  11.88     4.04
      0.00    -7.60    6.37     6.5 0.193E+01  12.54     4.02
      0.00    -8.00    6.60     6.6 0.189E+01  13.20     4.01
 Cumulative travel time =          18.6724 sec
   Plume centerline may exhibit slight discontinuities in transition
     to subsequent far-field module.

END OF MOD272: ACCELERATION ZONE OF UNIDIRECTIONAL CROSS-FLOWING DIFFUSER (TEE
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
BEGIN MOD252: DIFFUSER INDUCED PLUME IN WEAK CROSS-FLOW
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```
 Phase 1: Vertically mixed, Phase 2: Re-stratified

 Phase 1: The diffuser plume is VERTICALLY FULLY MIXED over the
          entire layer depth.
 This flow region is INSIGNIFICANT in spatial extent and will be by-passed.
-----------------------------------------------------------------------------
 Phase 2: The flow has RESTRATIFIED at the beginning of this zone.

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = Gaussian 1/e (37%) half-width in horizontal plane normal to trajectory
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction effects, if any)

       X        Y        Z        S        C        BV       BH
      0.00    -8.00     0.00      6.6 0.189E+01  13.20     3.90
     16.33   -38.08     0.00      8.7 0.144E+01   4.44    19.19
     36.57   -68.16     0.00     10.3 0.121E+01   3.71    31.56
     60.09   -98.24     0.00     11.8 0.106E+01   3.37    43.83
** WATER QUALITY STANDARD OR CCC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.100E+01 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
     86.48  -128.33     0.00     13.0 0.958E+00   3.15    56.19
    115.45  -158.41     0.00     14.2 0.880E+00   2.99    68.68
    146.78  -188.49     0.00     15.3 0.818E+00   2.87    81.30
    180.32  -218.57     0.00     16.3 0.767E+00   2.77    94.07
    215.93  -248.65     0.00     17.2 0.725E+00   2.68   106.97
    253.49  -278.73     0.00     18.1 0.690E+00   2.60   120.00
    292.91  -308.81     0.00     19.0 0.659E+00   2.54   133.14
    334.10  -338.89     0.00     19.8 0.631E+00   2.48   146.41
    376.98  -368.98     0.00     20.6 0.607E+00   2.42   159.78
    421.51  -399.06     0.00     21.3 0.586E+00   2.37   173.25
    467.61  -429.14     0.00     22.1 0.566E+00   2.32   186.82
    515.23  -459.22     0.00     22.8 0.549E+00   2.28   200.48
    564.33  -489.30     0.00     23.5 0.533E+00   2.24   214.24
    614.87  -519.38     0.00     24.1 0.518E+00   2.20   228.08
    666.80  -549.46     0.00     24.8 0.505E+00   2.17   242.00
    720.08  -579.54     0.00     25.4 0.492E+00   2.14   256.01
    774.70  -609.63     0.00     26.0 0.480E+00   2.10   270.09
 Cumulative travel time =       18611.3672 sec

END OF MOD252: DIFFUSER INDUCED PLUME IN WEAK CROSS-FLOW
-----------------------------------------------------------------------------
** End of NEAR-FIELD REGION (NFR) **

 The initial plume WIDTH values in the next far-field module will be
  CORRECTED by a factor  1.51 to conserve the mass flux in the far-field!
 The correction factor is quite large because of the small ambient velocity
   relative to the strong mixing characteristics of the discharge!
   This indicates localized RECIRCULATION REGIONS and internal hydraulic JUMPS.
   Width predictions show discontinuities, dilution values should be acceptable.
-----------------------------------------------------------------------------
BEGIN MOD241: BUOYANT AMBIENT SPREADING

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)

 Plume Stage 1 (not bank attached):
```

X	Y	Z	S	C	BV	BH	ZU	ZL
774.70	-609.63	0.00	26.0	0.480E+00	3.18	408.67	3.18	0.00
890.23	-609.63	0.00	28.0	0.446E+00	3.09	453.14	3.09	0.00
1005.76	-609.63	0.00	30.3	0.413E+00	3.06	493.79	3.06	0.00
1121.29	-609.63	0.00	32.7	0.382E+00	3.08	531.63	3.08	0.00
1236.82	-609.63	0.00	35.4	0.353E+00	3.12	567.34	3.12	0.00
1352.36	-609.63	0.00	38.4	0.326E+00	3.19	601.37	3.19	0.00
1467.89	-609.63	0.00	41.6	0.300E+00	3.28	634.08	3.28	0.00
1583.42	-609.63	0.00	45.1	0.277E+00	3.39	665.70	3.39	0.00
1698.95	-609.63	0.00	48.9	0.255E+00	3.51	696.44	3.51	0.00
1814.49	-609.63	0.00	53.1	0.236E+00	3.65	726.45	3.65	0.00
1930.02	-609.63	0.00	57.5	0.217E+00	3.81	755.83	3.81	0.00
2045.55	-609.63	0.00	62.3	0.201E+00	3.97	784.68	3.97	0.00
2161.08	-609.63	0.00	67.4	0.185E+00	4.14	813.09	4.14	0.00
2276.61	-609.63	0.00	72.8	0.172E+00	4.33	841.11	4.33	0.00
2392.15	-609.63	0.00	78.6	0.159E+00	4.53	868.79	4.53	0.00
2507.68	-609.63	0.00	84.8	0.147E+00	4.73	896.17	4.73	0.00
2623.21	-609.63	0.00	91.3	0.137E+00	4.95	923.29	4.95	0.00
2738.74	-609.63	0.00	98.2	0.127E+00	5.17	950.18	5.17	0.00
2854.28	-609.63	0.00	105.5	0.118E+00	5.40	976.86	5.40	0.00
2969.81	-609.63	0.00	113.2	0.110E+00	5.64	1003.35	5.64	0.00
3085.34	-609.63	0.00	121.3	0.103E+00	5.89	1029.67	5.89	0.00

Cumulative travel time = 64824.2656 sec

Plume is ATTACHED to LEFT bank/shore.
Plume width is now determined from LEFT bank/shore.

Plume Stage 2 (bank attached):

X	Y	Z	S	C	BV	BH	ZU	ZL
3085.34	420.00	0.00	121.3	0.103E+00	5.89	2059.25	5.89	0.00
3209.69	420.00	0.00	129.7	0.963E-01	6.25	2077.10	6.25	0.00
3334.05	420.00	0.00	138.3	0.904E-01	6.60	2095.28	6.60	0.00
3458.40	420.00	0.00	147.1	0.850E-01	6.96	2113.74	6.96	0.00
3582.76	420.00	0.00	156.0	0.801E-01	7.32	2132.49	7.32	0.00
3707.11	420.00	0.00	165.2	0.757E-01	7.68	2151.49	7.68	0.00
3831.46	420.00	0.00	174.4	0.717E-01	8.04	2170.74	8.04	0.00
3955.82	420.00	0.00	183.9	0.680E-01	8.40	2190.21	8.40	0.00
4080.17	420.00	0.00	193.6	0.646E-01	8.76	2209.89	8.76	0.00
4204.53	420.00	0.00	203.4	0.614E-01	9.12	2229.76	9.12	0.00
4328.88	420.00	0.00	213.5	0.586E-01	9.49	2249.83	9.49	0.00
4453.23	420.00	0.00	223.7	0.559E-01	9.85	2270.06	9.85	0.00
4577.59	420.00	0.00	234.1	0.534E-01	10.22	2290.46	10.22	0.00
4701.94	420.00	0.00	244.8	0.511E-01	10.59	2311.01	10.59	0.00
4826.30	420.00	0.00	255.6	0.489E-01	10.96	2331.70	10.96	0.00
4950.65	420.00	0.00	266.7	0.469E-01	11.34	2352.52	11.34	0.00
5075.00	420.00	0.00	277.9	0.450E-01	11.71	2373.47	11.71	0.00
5199.36	420.00	0.00	289.4	0.432E-01	12.09	2394.54	12.09	0.00
5323.71	420.00	0.00	301.1	0.415E-01	12.46	2415.72	12.46	0.00
5448.07	420.00	0.00	313.0	0.399E-01	12.84	2437.00	12.84	0.00
5572.42	420.00	0.00	325.2	0.384E-01	13.20	2458.38	13.20	0.00

Cumulative travel time = 114565.8438 sec

END OF MOD241: BUOYANT AMBIENT SPREADING

Due to the attachment or proximity of the plume tothe bottom, the bottom coordinate for the FAR-FIELD differs from the ambient depth, ZFB = 0 m.
In a subsequent analysis set "depth at discharge" equal to "ambient depth".

BEGIN MOD262: PASSIVE AMBIENT MIXING IN STRATIFIED AMBIENT

Vertical diffusivity (initial value) = 0.390E-07 m^2/s
Horizontal diffusivity (initial value) = 0.498E+02 m^2/s

The passive diffusion plume is VERTICALLY FULLY MIXED at beginning of region.

Profile definitions:
BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically

```
      = or equal to layer depth, if fully mixed
   BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
        measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction effects, if any)
```

Plume Stage 2 (bank attached):

X	Y	Z	S	C	BV	BH	ZU	ZL
5572.42	420.00	0.00	325.2	0.384E-01	13.20	2458.38	13.20	0.00
6293.80	420.00	0.00	387.7	0.322E-01	13.20	2931.16	13.20	0.00
7015.18	420.00	0.00	453.8	0.275E-01	13.20	3430.88	13.20	0.00
7736.56	420.00	0.00	523.3	0.239E-01	13.20	3956.16	13.20	0.00
8457.94	420.00	0.00	595.9	0.210E-01	13.20	4505.81	13.20	0.00
9179.31	420.00	0.00	671.7	0.186E-01	13.20	5078.79	13.20	0.00
9900.69	420.00	0.00	750.5	0.167E-01	13.20	5674.18	13.20	0.00
10622.07	420.00	0.00	832.1	0.150E-01	13.20	6291.18	13.20	0.00
11343.45	420.00	0.00	916.5	0.136E-01	13.20	6929.05	13.20	0.00
12064.83	420.00	0.00	1003.5	0.125E-01	13.20	7587.13	13.20	0.00
12786.21	420.00	0.00	1093.1	0.114E-01	13.20	8264.82	13.20	0.00
13507.59	420.00	0.00	1185.3	0.105E-01	13.20	8961.56	13.20	0.00
14228.97	420.00	0.00	1279.9	0.977E-02	13.20	9676.86	13.20	0.00
14950.35	420.00	0.00	1376.9	0.908E-02	13.20	10410.23	13.20	0.00
15671.72	420.00	0.00	1476.2	0.847E-02	13.20	11161.24	13.20	0.00
16393.10	420.00	0.00	1577.8	0.792E-02	13.20	11929.50	13.20	0.00
17114.48	420.00	0.00	1681.7	0.743E-02	13.20	12714.61	13.20	0.00
17835.86	420.00	0.00	1787.7	0.699E-02	13.20	13516.23	13.20	0.00
18557.24	420.00	0.00	1895.9	0.659E-02	13.20	14334.03	13.20	0.00
19278.62	420.00	0.00	2006.1	0.623E-02	13.20	15167.68	13.20	0.00
20000.00	420.00	0.00	2118.4	0.590E-02	13.20	16016.89	13.20	0.00

Cumulative travel time = 403117.4375 sec

Simulation limit based on maximum specified distance = 20000.00 m.
This is the REGION OF INTEREST limitation.

```
END OF MOD262: PASSIVE AMBIENT MIXING IN STRATIFIED AMBIENT
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
CORMIX2: Submerged Multiport Diffuser Discharges       End of Prediction File
22222222222222222222222222222222222222222222222222222222222222222222222222222
```

```
CORMIX2 PREDICTION FILE:
22222222222222222222222222222222222222222222222222222222222222222222222222222
                    CORMIX MIXING ZONE EXPERT SYSTEM
      Subsystem CORMIX2:  Submerged Multiport Diffuser Discharges
                       CORMIX-GI Version 4.2G
                    HYDRO2 Version 4.3.0.2 June 2005
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
CASE DESCRIPTION
 Site name/label:   SOKO
 Design case:       wet season, lw water at Soko island
 FILE NAME:         D:\...60-HK\CORMIX\deltat12_5\south-soko-w-sp-lw125.prd
 Time stamp:        Mon Nov 27 15:36:25 2006

ENVIRONMENT PARAMETERS (metric units)
 Unbounded section
 HA    =     12.00  HD    =     10.60
 UA    =      0.050 F     =      0.031 USTAR =0.3106E-02
 UW    =      7.500 UWSTAR=0.9300E-02
 Density stratified environment
 STRCND=  A         RHOAM = 1020.1000
 RHOAS = 1016.4000  RHOAB = 1023.8000  RHOAH0= 1020.1000  E     =0.6687E-02

DIFFUSER DISCHARGE PARAMETERS (metric units)
 Diffuser type:     DITYPE= unidirectional_parallel
 BANK  =  LEFT      DISTB =    420.00  YB1   =    420.00  YB2   =    420.00
 LD    =     16.00  NOPEN =    4       SPAC  =      5.33
 D0    =      0.750 A0    =      0.442 H0    =      2.00
 Nozzle/port arrangement:   unidirectional_without_fanning
 GAMMA =      0.00  THETA =     30.00  SIGMA =    270.00  BETA  =     90.00
 U0    =      2.829 Q0    =      5.000       =0.5000E+01
 RHO0  = 1022.8000  DRHO0 =-.2700E+01  GP0   =-.2596E-01
 C0    =0.1250E+02  CUNITS=  deg.C
 IPOLL =  3         KS    =0.8359E-05  KD    =0.0000E+00

FLUX VARIABLES - PER UNIT DIFFUSER LENGTH (metric units)
 q0    =0.3125E+00  m0    =0.8842E+00  j0    =-.8111E-02  SIGNJ0=     -1.0
 Associated 2-d length scales (meters)
 lQ=B  =      0.110 lM    =     21.94  lm    =    353.68
 lmp   =  99999.00  lbp   =  99999.00  la    =  99999.00

FLUX VARIABLES - ENTIRE DIFFUSER (metric units)
 Q0    =0.5000E+01  M0    =0.1415E+02  J0    =-.1298E+00
 Associated 3-d length scales (meters)
 LQ    =      1.33  LM    =     20.25  Lm    =     75.23  Lb    =   1038.25
                                       Lmp   =  99999.00  Lbp   =  99999.00

NON-DIMENSIONAL PARAMETERS
 FR0   =     52.84  FRD0  =     20.28  R     =     56.59  PL    =    140.
 (slot)             (port/nozzle)

FLOW CLASSIFICATION
 222222222222222222222222222222222222222222
 2  Flow class (CORMIX2)      =    MNU8   2
 2  Applicable layer depth HS =    10.60  2
 222222222222222222222222222222222222222222

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.1250E+02  CUNITS=  deg.C
 NTOX  =  0
 NSTD  =  1         CSTD  =0.1000E+01
 REGMZ =  0
 XINT  =  20000.00  XMAX  =  20000.00

X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the bottom and the diffuser mid-point:
       420.00 m  from the LEFT  bank/shore.
    X-axis points downstream, Y-axis points to left, Z-axis points upward.
```

```
NSTEP =  20 display intervals per module

NOTE on dilution/concentration values for this HEATED DISCHARGE (IPOLL=3):
   S  = hydrodynamic dilutions, include buoyancy (heat) loss effects, but
        provided plume has surface contact
   C  = corresponding temperature values (always in "degC"!),
        include heat loss, if any
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
BEGIN MOD201: DIFFUSER DISCHARGE MODULE

 Due to complex near-field motions:  EQUIVALENT SLOT DIFFUSER (2-D) GEOMETRY

 Profile definitions:
   BV = Gaussian 1/e (37%) half-width, in vertical plane normal to trajectory
   BH = top-hat half-width, in horizontal plane normal to trajectory
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction effects, if any)

       X        Y       Z        S        C        BV       BH
      0.00     0.00    2.00     1.0 0.125E+02   0.09     8.00

END OF MOD201: DIFFUSER DISCHARGE MODULE
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
BEGIN MOD272: ACCELERATION ZONE OF UNIDIRECTIONAL CROSS-FLOWING DIFFUSER (TEE)

 In this laterally contracting zone the diffuser plume becomes VERTICALLY FULLY
  MIXED over the entire layer depth (HS =   10.60m).
   Full mixing is achieved after a plume distance of about five
   layer depths from the diffuser.

 Profile definitions:
   BV = layer depth (vertically mixed)
   BH = top-hat half-width, in horizontal plane normal to trajectory
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)

       X        Y       Z        S        C        BV       BH
      0.00    -0.00    2.00     1.0 0.125E+02   0.09     8.00
      0.00    -0.40    2.16     2.1 0.589E+01   0.53     7.44
      0.00    -0.80    2.33     2.6 0.484E+01   1.06     6.96
      0.00    -1.20    2.50     2.9 0.425E+01   1.59     6.55
      0.00    -1.60    2.66     3.2 0.386E+01   2.12     6.18
      0.00    -2.00    2.83     3.5 0.357E+01   2.65     5.87
      0.00    -2.40    2.99     3.7 0.334E+01   3.18     5.59
      0.00    -2.80    3.16     4.0 0.315E+01   3.71     5.34
      0.00    -3.20    3.32     4.2 0.300E+01   4.24     5.12
      0.00    -3.60    3.49     4.4 0.287E+01   4.77     4.92
      0.00    -4.00    3.65     4.5 0.275E+01   5.30     4.74
      0.00    -4.40    3.82     4.7 0.265E+01   5.83     4.58
      0.00    -4.80    3.98     4.9 0.256E+01   6.36     4.45
      0.00    -5.20    4.15     5.0 0.248E+01   6.89     4.33
      0.00    -5.60    4.31     5.2 0.241E+01   7.42     4.24
      0.00    -6.00    4.48     5.3 0.234E+01   7.95     4.16
      0.00    -6.40    4.64     5.5 0.228E+01   8.48     4.11
      0.00    -6.80    4.81     5.6 0.222E+01   9.01     4.07
      0.00    -7.20    4.97     5.8 0.217E+01   9.54     4.04
      0.00    -7.60    5.14     5.9 0.212E+01  10.07     4.02
      0.00    -8.00    5.30     6.0 0.208E+01  10.60     4.01
 Cumulative travel time =          16.9980 sec
   Plume centerline may exhibit slight discontinuities in transition
     to subsequent far-field module.

END OF MOD272: ACCELERATION ZONE OF UNIDIRECTIONAL CROSS-FLOWING DIFFUSER (TEE
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
BEGIN MOD252: DIFFUSER INDUCED PLUME IN WEAK CROSS-FLOW
```

Phase 1: Vertically mixed, Phase 2: Re-stratified

Phase 1: The diffuser plume is VERTICALLY FULLY MIXED over the
entire layer depth.
This flow region is INSIGNIFICANT in spatial extent and will be by-passed.

Phase 2: The flow has RESTRATIFIED at the beginning of this zone.

Profile definitions:
BV = top-hat thickness, measured vertically
BH = Gaussian 1/e (37%) half-width in horizontal plane normal to trajectory
ZU = upper plume boundary (Z-coordinate)
ZL = lower plume boundary (Z-coordinate)
S = hydrodynamic centerline dilution
C = centerline concentration (includes reaction effects, if any)

X	Y	Z	S	C	BV	BH
0.00	-8.00	0.00	6.0	0.208E+01	10.60	3.96
19.08	-45.97	0.00	8.3	0.150E+01	3.63	21.19
43.49	-83.94	0.00	10.1	0.124E+01	3.08	35.66
72.25	-121.90	0.00	11.6	0.107E+01	2.82	50.13

** WATER QUALITY STANDARD OR CCC HAS BEEN FOUND **
The pollutant concentration in the plume falls below water quality standard
or CCC value of 0.100E+01 in the current prediction interval.
This is the spatial extent of concentrations exceeding the water quality
standard or CCC value.

104.77	-159.87	0.00	13.0	0.963E+00	2.65	64.79
140.67	-197.84	0.00	14.2	0.880E+00	2.52	79.64
179.66	-235.81	0.00	15.3	0.816E+00	2.42	94.69
221.49	-273.77	0.00	16.4	0.764E+00	2.34	109.92
266.01	-311.74	0.00	17.4	0.720E+00	2.26	125.32
313.04	-349.71	0.00	18.3	0.684E+00	2.20	140.88
362.46	-387.68	0.00	19.2	0.652E+00	2.15	156.59
414.16	-425.65	0.00	20.0	0.625E+00	2.10	172.44
468.05	-463.61	0.00	20.8	0.600E+00	2.05	188.42
524.04	-501.58	0.00	21.6	0.579E+00	2.01	204.54
582.06	-539.55	0.00	22.4	0.559E+00	1.97	220.77
642.02	-577.52	0.00	23.1	0.541E+00	1.93	237.11
703.89	-615.48	0.00	23.8	0.525E+00	1.90	253.56
767.59	-653.45	0.00	24.5	0.511E+00	1.87	270.12
833.07	-691.42	0.00	25.1	0.497E+00	1.84	286.77
900.29	-729.39	0.00	25.8	0.485E+00	1.81	303.53
969.21	-767.35	0.00	26.4	0.473E+00	1.78	320.37

Cumulative travel time = 23278.0703 sec

END OF MOD252: DIFFUSER INDUCED PLUME IN WEAK CROSS-FLOW

** End of NEAR-FIELD REGION (NFR) **

The initial plume WIDTH values in the next far-field module will be
CORRECTED by a factor 1.52 to conserve the mass flux in the far-field!
The correction factor is quite large because of the small ambient velocity
relative to the strong mixing characteristics of the discharge!
This indicates localized RECIRCULATION REGIONS and internal hydraulic JUMPS.
Width predictions show discontinuities, dilution values should be acceptable.

BEGIN MOD241: BUOYANT AMBIENT SPREADING

Profile definitions:
BV = top-hat thickness, measured vertically
BH = top-hat half-width, measured horizontally in y-direction
ZU = upper plume boundary (Z-coordinate)
ZL = lower plume boundary (Z-coordinate)
S = hydrodynamic average (bulk) dilution
C = average (bulk) concentration (includes reaction effects, if any)

Plume Stage 1 (not bank attached):

X	Y	Z	S	C	BV	BH	ZU	ZL
969.21	-767.35	0.00	26.4	0.473E+00	2.71	487.10	2.71	0.00
1110.90	-767.35	0.00	29.2	0.428E+00	2.75	532.43	2.75	0.00
1252.60	-767.35	0.00	32.4	0.386E+00	2.82	574.85	2.82	0.00
1394.29	-767.35	0.00	36.0	0.348E+00	2.92	615.09	2.92	0.00
1535.98	-767.35	0.00	39.9	0.313E+00	3.05	653.69	3.05	0.00
1677.67	-767.35	0.00	44.3	0.282E+00	3.20	691.00	3.20	0.00
1819.36	-767.35	0.00	49.1	0.255E+00	3.38	727.29	3.38	0.00
1961.06	-767.35	0.00	54.4	0.230E+00	3.56	762.75	3.56	0.00
2102.75	-767.35	0.00	60.1	0.208E+00	3.77	797.53	3.77	0.00
2244.44	-767.35	0.00	66.4	0.188E+00	3.99	831.75	3.99	0.00
2386.13	-767.35	0.00	73.1	0.171E+00	4.22	865.50	4.22	0.00
2527.82	-767.35	0.00	80.4	0.156E+00	4.47	898.84	4.47	0.00
2669.52	-767.35	0.00	88.2	0.142E+00	4.73	931.84	4.73	0.00
2811.21	-767.35	0.00	96.5	0.130E+00	5.00	964.54	5.00	0.00
2952.90	-767.35	0.00	105.4	0.119E+00	5.29	996.97	5.29	0.00
3094.59	-767.35	0.00	114.9	0.109E+00	5.58	1029.17	5.58	0.00
3236.29	-767.35	0.00	125.0	0.100E+00	5.89	1061.16	5.89	0.00
3377.98	-767.35	0.00	135.7	0.921E-01	6.21	1092.96	6.21	0.00
3519.67	-767.35	0.00	147.0	0.850E-01	6.54	1124.59	6.54	0.00
3661.36	-767.35	0.00	159.0	0.786E-01	6.88	1156.06	6.88	0.00
3803.05	-767.35	0.00	171.6	0.728E-01	7.23	1187.39	7.23	0.00

Cumulative travel time = 79954.9141 sec

Plume is ATTACHED to LEFT bank/shore.
Plume width is now determined from LEFT bank/shore.

Plume Stage 2 (bank attached):

X	Y	Z	S	C	BV	BH	ZU	ZL
3803.05	420.00	0.00	171.6	0.728E-01	7.23	2374.71	7.23	0.00
3860.80	420.00	0.00	176.6	0.708E-01	7.41	2382.75	7.41	0.00
3918.54	420.00	0.00	181.6	0.688E-01	7.60	2390.86	7.60	0.00
3976.29	420.00	0.00	186.7	0.670E-01	7.78	2399.03	7.78	0.00
4034.03	420.00	0.00	191.8	0.652E-01	7.97	2407.26	7.97	0.00
4091.77	420.00	0.00	196.9	0.635E-01	8.15	2415.56	8.15	0.00
4149.52	420.00	0.00	202.1	0.619E-01	8.34	2423.91	8.34	0.00
4207.26	420.00	0.00	207.3	0.603E-01	8.52	2432.32	8.52	0.00
4265.01	420.00	0.00	212.6	0.588E-01	8.71	2440.78	8.71	0.00
4322.75	420.00	0.00	217.9	0.574E-01	8.89	2449.30	8.89	0.00
4380.49	420.00	0.00	223.2	0.560E-01	9.08	2457.87	9.08	0.00
4438.24	420.00	0.00	228.6	0.547E-01	9.27	2466.49	9.27	0.00
4495.98	420.00	0.00	234.0	0.534E-01	9.45	2475.15	9.45	0.00
4553.73	420.00	0.00	239.5	0.522E-01	9.64	2483.87	9.64	0.00
4611.47	420.00	0.00	245.0	0.510E-01	9.83	2492.63	9.83	0.00
4669.22	420.00	0.00	250.5	0.499E-01	10.01	2501.44	10.01	0.00
4726.96	420.00	0.00	256.1	0.488E-01	10.20	2510.29	10.20	0.00
4784.70	420.00	0.00	261.7	0.478E-01	10.39	2519.18	10.39	0.00
4842.45	420.00	0.00	267.4	0.467E-01	10.58	2528.12	10.58	0.00
4900.19	420.00	0.00	273.2	0.458E-01	10.60	2537.09	10.60	0.00
4957.94	420.00	0.00	278.9	0.448E-01	10.60	2546.11	10.60	0.00

Cumulative travel time = 103052.5234 sec

END OF MOD241: BUOYANT AMBIENT SPREADING

Due to the attachment or proximity of the plume tothe bottom, the bottom coordinate for the FAR-FIELD differs from the ambient depth, ZFB = 0 m.
In a subsequent analysis set "depth at discharge" equal to "ambient depth".

BEGIN MOD262: PASSIVE AMBIENT MIXING IN STRATIFIED AMBIENT

Vertical diffusivity (initial value) = 0.454E-07 m^2/s
Horizontal diffusivity (initial value) = 0.522E+02 m^2/s

The passive diffusion plume is VERTICALLY FULLY MIXED at beginning of region.

Profile definitions:
BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically

```
      = or equal to layer depth, if fully mixed
   BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
        measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction effects, if any)

 Plume Stage 2 (bank attached):
```

X	Y	Z	S	C	BV	BH	ZU	ZL
4957.93	420.00	0.00	278.9	0.448E-01	10.60	2546.11	10.60	0.00
5710.04	420.00	0.00	333.6	0.375E-01	10.60	3045.09	10.60	0.00
6462.14	420.00	0.00	391.4	0.319E-01	10.60	3572.99	10.60	0.00
7214.24	420.00	0.00	452.2	0.276E-01	10.60	4128.29	10.60	0.00
7966.35	420.00	0.00	515.9	0.242E-01	10.60	4709.71	10.60	0.00
8718.45	420.00	0.00	582.4	0.215E-01	10.60	5316.11	10.60	0.00
9470.55	420.00	0.00	651.4	0.192E-01	10.60	5946.52	10.60	0.00
10222.66	420.00	0.00	723.0	0.173E-01	10.60	6600.05	10.60	0.00
10974.76	420.00	0.00	797.1	0.157E-01	10.60	7275.90	10.60	0.00
11726.87	420.00	0.00	873.5	0.143E-01	10.60	7973.37	10.60	0.00
12478.97	420.00	0.00	952.2	0.131E-01	10.60	8691.80	10.60	0.00
13231.07	420.00	0.00	1033.1	0.121E-01	10.60	9430.60	10.60	0.00
13983.18	420.00	0.00	1116.2	0.112E-01	10.60	10189.22	10.60	0.00
14735.28	420.00	0.00	1201.4	0.104E-01	10.60	10967.17	10.60	0.00
15487.38	420.00	0.00	1288.7	0.970E-02	10.60	11763.95	10.60	0.00
16239.49	420.00	0.00	1378.0	0.907E-02	10.60	12579.15	10.60	0.00
16991.59	420.00	0.00	1469.3	0.851E-02	10.60	13412.36	10.60	0.00
17743.69	420.00	0.00	1562.5	0.800E-02	10.60	14263.19	10.60	0.00
18495.80	420.00	0.00	1657.6	0.754E-02	10.60	15131.29	10.60	0.00
19247.90	420.00	0.00	1754.6	0.712E-02	10.60	16016.32	10.60	0.00
20000.00	420.00	0.00	1853.3	0.674E-02	10.60	16917.96	10.60	0.00

```
 Cumulative travel time =      403893.8438 sec

 Simulation limit based on maximum specified distance =  20000.00 m.
   This is the REGION OF INTEREST limitation.

END OF MOD262: PASSIVE AMBIENT MIXING IN STRATIFIED AMBIENT
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
CORMIX2: Submerged Multiport Diffuser Discharges       End of Prediction File
22222222222222222222222222222222222222222222222222222222222222222222222222222
```

```
CORMIX2 PREDICTION FILE:
22222222222222222222222222222222222222222222222222222222222222222222222222222
                       CORMIX MIXING ZONE EXPERT SYSTEM
         Subsystem CORMIX2:  Submerged Multiport Diffuser Discharges
                         CORMIX-GI Version 4.2G
                      HYDRO2 Version 4.2 August 2002
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
CASE DESCRIPTION
 Site name/label:   SOKO
 Design case:       wet season, mid tide at Soko island
 FILE NAME:         D:\...0-HK\CORMIX\deltat12_5\south-soko-w-sp-mid125.prd
 Time stamp:        Mon Nov 27 15:48:07 2006

ENVIRONMENT PARAMETERS (metric units)
 Unbounded section
 HA    =     12.00  HD    =     12.00
 UA    =      0.300 F     =      0.031 USTAR =0.1863E-01
 UW    =      7.500 UWSTAR=0.9300E-02
 Density stratified environment
 STRCND=  A         RHOAM = 1020.2000
 RHOAS = 1016.0000  RHOAB = 1024.4000  RHOAH0= 1020.2000  E     =0.6701E-02

DIFFUSER DISCHARGE PARAMETERS (metric units)
 Diffuser type:     DITYPE= unidirectional_parallel
 BANK  =  LEFT      DISTB =    420.00  YB1   =    420.00  YB2   =    420.00
 LD    =     16.00  NOPEN =    4       SPAC  =      5.33
 D0    =      0.750 A0    =      0.442 H0    =      2.00
 Nozzle/port arrangement:   unidirectional_without_fanning
 GAMMA =      0.00  THETA =     30.00  SIGMA =    270.00  BETA  =     90.00
 U0    =      2.829 Q0    =      5.000        =0.5000E+01
 RHO0  = 1022.8000  DRHO0 =-.2600E+01  GP0   =-.2499E-01
 C0    =0.1250E+02  CUNITS=  deg.C
 IPOLL =  3         KS    =0.8359E-05  KD    =0.0000E+00

FLUX VARIABLES - PER UNIT DIFFUSER LENGTH (metric units)
 q0    =0.3125E+00  m0    =0.8842E+00  j0    =-.7810E-02  SIGNJ0=     -1.0
 Associated 2-d length scales (meters)
 lQ=B  =      0.110 lM    =     22.50  lm    =      9.82
 lmp   =  99999.00  lbp   =  99999.00  la    =  99999.00

FLUX VARIABLES - ENTIRE DIFFUSER (metric units)
 Q0    =0.5000E+01  M0    =0.1415E+02  J0    =-.1250E+00
 Associated 3-d length scales (meters)
 LQ    =      1.33  LM    =     20.64  Lm    =     12.54  Lb    =      4.63
                                       Lmp   =  99999.00  Lbp   =  99999.00

NON-DIMENSIONAL PARAMETERS
 FR0   =     53.85  FRD0  =     20.67  R     =      9.43
 (slot)             (port/nozzle)

FLOW CLASSIFICATION
 222222222222222222222222222222222222222222
 2  Flow class (CORMIX2)      =    MNU9   2
 2  Applicable layer depth HS =    12.00  2
 222222222222222222222222222222222222222222

MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
 C0    =0.1250E+02  CUNITS=  deg.C
 NTOX  =  0
 NSTD  =  1         CSTD  =0.1000E+01
 REGMZ =  0
 XINT  =  20000.00  XMAX  =  20000.00

X-Y-Z COORDINATE SYSTEM:
    ORIGIN is located at the bottom and the diffuser mid-point:
       420.00 m  from the LEFT  bank/shore.
    X-axis points downstream, Y-axis points to left, Z-axis points upward.
```

NSTEP = 20 display intervals per module

NOTE on dilution/concentration values for this HEATED DISCHARGE (IPOLL=3):
S = hydrodynamic dilutions, include buoyancy (heat) loss effects, but provided plume has surface contact
C = corresponding temperature values (always in "degC"!), include heat loss, if any

---

BEGIN MOD201: DIFFUSER DISCHARGE MODULE

Due to complex near-field motions: EQUIVALENT SLOT DIFFUSER (2-D) GEOMETRY

Profile definitions:
BV = Gaussian 1/e (37%) half-width, in vertical plane normal to trajectory
BH = top-hat half-width, in horizontal plane normal to trajectory
S = hydrodynamic centerline dilution
C = centerline concentration (includes reaction effects, if any)

X	Y	Z	S	C	BV	BH
0.00	0.00	2.00	1.0	0.125E+02	0.09	8.00

END OF MOD201: DIFFUSER DISCHARGE MODULE

BEGIN MOD273: UNIDIRECTIONAL CROSS-FLOWING DIFFUSER (TEE) IN STRONG CURRENT

Because of the strong ambient current the diffuser plume of this crossflowing discharge gets RAPIDLY DEFLECTED.
A near-field zone is formed that is VERTICALLY FULLY MIXED over the entire layer depth. Full mixing is achieved at a downstream distance of about five (5) layer depths.

Profile definitions:
BV = layer depth (vertically mixed)
BH = top-hat half-width, measured horizontally in Y-direction
S = hydrodynamic average (bulk) dilution
C = average (bulk) concentration (includes reaction effects, if any)

X	Y	Z	S	C	BV	BH
0.00	0.00	2.00	1.0	0.125E+02	0.09	8.00
3.40	-0.33	1.90	1.6	0.768E+01	0.68	7.73
6.80	-0.65	1.80	1.9	0.662E+01	1.28	7.46
10.20	-0.98	1.70	2.1	0.599E+01	1.87	7.20
13.60	-1.31	1.60	2.3	0.554E+01	2.47	6.93
17.00	-1.64	1.50	2.4	0.520E+01	3.07	6.66
20.40	-1.96	1.40	2.5	0.492E+01	3.66	6.39
23.80	-2.29	1.30	2.7	0.469E+01	4.26	6.13
27.20	-2.62	1.20	2.8	0.450E+01	4.85	5.86
30.60	-2.95	1.10	2.9	0.433E+01	5.45	5.59
34.00	-3.27	1.00	3.0	0.418E+01	6.04	5.32
37.40	-3.60	0.90	3.1	0.405E+01	6.64	5.06
40.80	-3.93	0.80	3.2	0.393E+01	7.24	4.79
44.20	-4.26	0.70	3.3	0.383E+01	7.83	4.52
47.60	-4.58	0.60	3.4	0.373E+01	8.43	4.25
51.00	-4.91	0.50	3.4	0.364E+01	9.02	3.98
54.40	-5.24	0.40	3.5	0.356E+01	9.62	3.72
57.80	-5.57	0.30	3.6	0.348E+01	10.21	3.45
61.20	-5.89	0.20	3.7	0.341E+01	10.81	3.18
64.60	-6.22	0.10	3.7	0.334E+01	11.40	2.91
68.00	-6.55	0.00	3.8	0.328E+01	12.00	2.65

Cumulative travel time = 227. sec
Plume centerline may exhibit slight discontinuities in transition to subsequent far-field module.

END OF MOD273: UNIDIRECTIONAL CROSS-FLOWING DIFFUSER (TEE) IN STRONG CURRENT

** End of NEAR-FIELD REGION (NFR) **

```
-----------------------------------------------------------------------------
BEGIN MOD241: BUOYANT AMBIENT SPREADING

 Profile definitions:
   BV = top-hat thickness, measured vertically
   BH = top-hat half-width, measured horizontally in y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic average (bulk) dilution
   C  = average (bulk) concentration (includes reaction effects, if any)

 Plume Stage 1 (not bank attached):
        X         Y       Z        S       C        BV       BH       ZU       ZL
      71.40    -6.55    0.00     3.8 0.328E+01  12.00     2.65   12.00     0.00
     246.83    -6.55    0.00     8.0 0.156E+01   1.65    40.48    1.65     0.00
     422.25    -6.55    0.00    10.4 0.120E+01   1.43    60.68    1.43     0.00
** WATER QUALITY STANDARD OR CCC HAS BEEN FOUND **
 The pollutant concentration in the plume falls below water quality standard
   or CCC value of 0.100E+01 in the current prediction interval.
 This is the spatial extent of concentrations exceeding the water quality
   standard or CCC value.
     597.68    -6.55    0.00    13.8 0.905E+00   1.50    76.70    1.50     0.00
     773.11    -6.55    0.00    18.5 0.675E+00   1.70    90.80    1.70     0.00
     948.53    -6.55    0.00    24.7 0.507E+00   1.98   103.83    1.98     0.00
    1123.96    -6.55    0.00    32.4 0.386E+00   2.32   116.18    2.32     0.00
    1299.39    -6.55    0.00    41.9 0.298E+00   2.73   128.06    2.73     0.00
    1474.81    -6.55    0.00    53.2 0.235E+00   3.18   139.58    3.18     0.00
    1650.24    -6.55    0.00    66.6 0.188E+00   3.68   150.82    3.68     0.00
    1825.67    -6.55    0.00    82.0 0.152E+00   4.22   161.81    4.22     0.00
    2001.09    -6.55    0.00    99.6 0.126E+00   4.81   172.60    4.81     0.00
    2176.52    -6.55    0.00   119.6 0.105E+00   5.44   183.20    5.44     0.00
    2351.95    -6.55    0.00   141.9 0.881E-01   6.11   193.63    6.11     0.00
    2527.37    -6.55    0.00   166.8 0.749E-01   6.82   203.90    6.82     0.00
    2702.80    -6.55    0.00   194.3 0.643E-01   7.57   214.02    7.57     0.00
    2878.23    -6.55    0.00   224.6 0.557E-01   8.35   224.01    8.35     0.00
    3053.65    -6.55    0.00   257.6 0.485E-01   9.18   233.87    9.18     0.00
    3229.08    -6.55    0.00   293.5 0.426E-01  10.04   243.61   10.04     0.00
    3404.51    -6.55    0.00   332.5 0.376E-01  10.94   253.23   10.94     0.00
    3579.93    -6.55    0.00   374.4 0.334E-01  11.88   262.75   11.88     0.00
 Cumulative travel time =       11922. sec

END OF MOD241: BUOYANT AMBIENT SPREADING
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
BEGIN MOD262: PASSIVE AMBIENT MIXING IN STRATIFIED AMBIENT

  Vertical diffusivity (initial value)   = 0.918E-06 m^2/s
  Horizontal diffusivity (initial value) = 0.252E+01 m^2/s

 Profile definitions:
   BV = Gaussian s.d.*sqrt(pi/2) (46%) thickness, measured vertically
      = or equal to layer depth, if fully mixed
   BH = Gaussian s.d.*sqrt(pi/2) (46%) half-width,
        measured horizontally in Y-direction
   ZU = upper plume boundary (Z-coordinate)
   ZL = lower plume boundary (Z-coordinate)
   S  = hydrodynamic centerline dilution
   C  = centerline concentration (includes reaction effects, if any)

 Plume Stage 1 (not bank attached):
        X         Y       Z        S       C        BV       BH       ZU       ZL
    3579.93    -6.55    0.00   374.4 0.334E-01  11.88   262.75   11.88     0.00
    3729.31    -6.55    0.00   385.2 0.325E-01  11.88   270.30   11.88     0.00
    3878.69    -6.55    0.00   396.1 0.316E-01  11.88   277.92   11.88     0.00
    4028.07    -6.55    0.00   407.0 0.307E-01  11.88   285.61   11.88     0.00
    4177.45    -6.55    0.00   418.1 0.299E-01  11.88   293.37   11.88     0.00
    4326.83    -6.55    0.00   429.2 0.291E-01  11.88   301.20   11.88     0.00
    4476.21    -6.55    0.00   440.5 0.284E-01  11.88   309.10   11.88     0.00
```

4625.60	-6.55	0.00	451.9	0.277E-01	11.88	317.06	11.88	0.00
4774.98	-6.55	0.00	463.3	0.270E-01	11.88	325.10	11.88	0.00
4924.36	-6.55	0.00	474.9	0.263E-01	11.88	333.20	11.88	0.00
5073.74	-6.55	0.00	486.5	0.257E-01	11.88	341.36	11.88	0.00
5223.12	-6.55	0.00	498.2	0.251E-01	11.88	349.60	11.88	0.00
5372.50	-6.55	0.00	510.1	0.245E-01	11.88	357.89	11.88	0.00
5521.88	-6.55	0.00	522.0	0.239E-01	11.88	366.26	11.88	0.00
5671.26	-6.55	0.00	534.0	0.234E-01	11.88	374.68	11.88	0.00
5820.64	-6.55	0.00	546.1	0.229E-01	11.88	383.17	11.88	0.00
5970.02	-6.55	0.00	558.3	0.224E-01	11.88	391.73	11.88	0.00
6119.40	-6.55	0.00	570.6	0.219E-01	11.88	400.34	11.88	0.00
6268.78	-6.55	0.00	582.9	0.214E-01	11.88	409.02	11.88	0.00
6418.16	-6.55	0.00	595.4	0.210E-01	11.88	417.76	11.88	0.00
6567.54	-6.55	0.00	607.9	0.206E-01	11.88	426.56	11.88	0.00

Cumulative travel time = 21880. sec

Plume Stage 2 (bank attached):

X	Y	Z	S	C	BV	BH	ZU	ZL
6567.54	420.00	0.00	607.9	0.206E-01	11.88	853.12	11.88	0.00
7239.16	420.00	0.00	644.0	0.194E-01	11.88	903.63	11.88	0.00
7910.79	420.00	0.00	680.7	0.184E-01	11.88	955.11	11.88	0.00
8582.41	420.00	0.00	718.0	0.174E-01	11.88	1007.52	11.88	0.00
9254.03	420.00	0.00	756.1	0.165E-01	11.88	1060.87	11.88	0.00
9925.66	420.00	0.00	794.7	0.157E-01	11.88	1115.12	11.88	0.00
10597.28	420.00	0.00	834.1	0.150E-01	11.88	1170.26	11.88	0.00
11268.90	420.00	0.00	874.0	0.143E-01	11.88	1226.29	11.88	0.00
11940.52	420.00	0.00	914.6	0.137E-01	11.88	1283.18	11.88	0.00
12612.15	420.00	0.00	955.8	0.131E-01	11.88	1340.92	11.88	0.00
13283.77	420.00	0.00	997.5	0.125E-01	11.88	1399.51	11.88	0.00
13955.39	420.00	0.00	1039.9	0.120E-01	11.88	1458.93	11.88	0.00
14627.02	420.00	0.00	1082.9	0.115E-01	11.88	1519.16	11.88	0.00
15298.64	420.00	0.00	1126.4	0.111E-01	11.88	1580.20	11.88	0.00
15970.26	420.00	0.00	1170.5	0.107E-01	11.88	1642.04	11.88	0.00
16641.88	420.00	0.00	1215.2	0.103E-01	11.88	1704.66	11.88	0.00
17313.51	420.00	0.00	1260.4	0.992E-02	11.88	1768.06	11.88	0.00
17985.13	420.00	0.00	1306.2	0.957E-02	11.88	1832.22	11.88	0.00
18656.75	420.00	0.00	1352.5	0.924E-02	11.88	1897.15	11.88	0.00
19328.38	420.00	0.00	1399.3	0.893E-02	11.88	1962.82	11.88	0.00
20000.00	420.00	0.00	1446.7	0.864E-02	11.88	2029.24	11.88	0.00

Cumulative travel time = 66655. sec

Simulation limit based on maximum specified distance = 20000.00 m.
This is the REGION OF INTEREST limitation.

END OF MOD262: PASSIVE AMBIENT MIXING IN STRATIFIED AMBIENT

CORMIX2: Submerged Multiport Diffuser Discharges End of Prediction File
22222222222222222222222222222222222222222222222222222222222222222222222222222222222222222222

Appendix 6C

Model Results for the Alternative Gas Pipeline Route

CONTENTS

1 ALTERNATIVE PIPELINE ROUTE

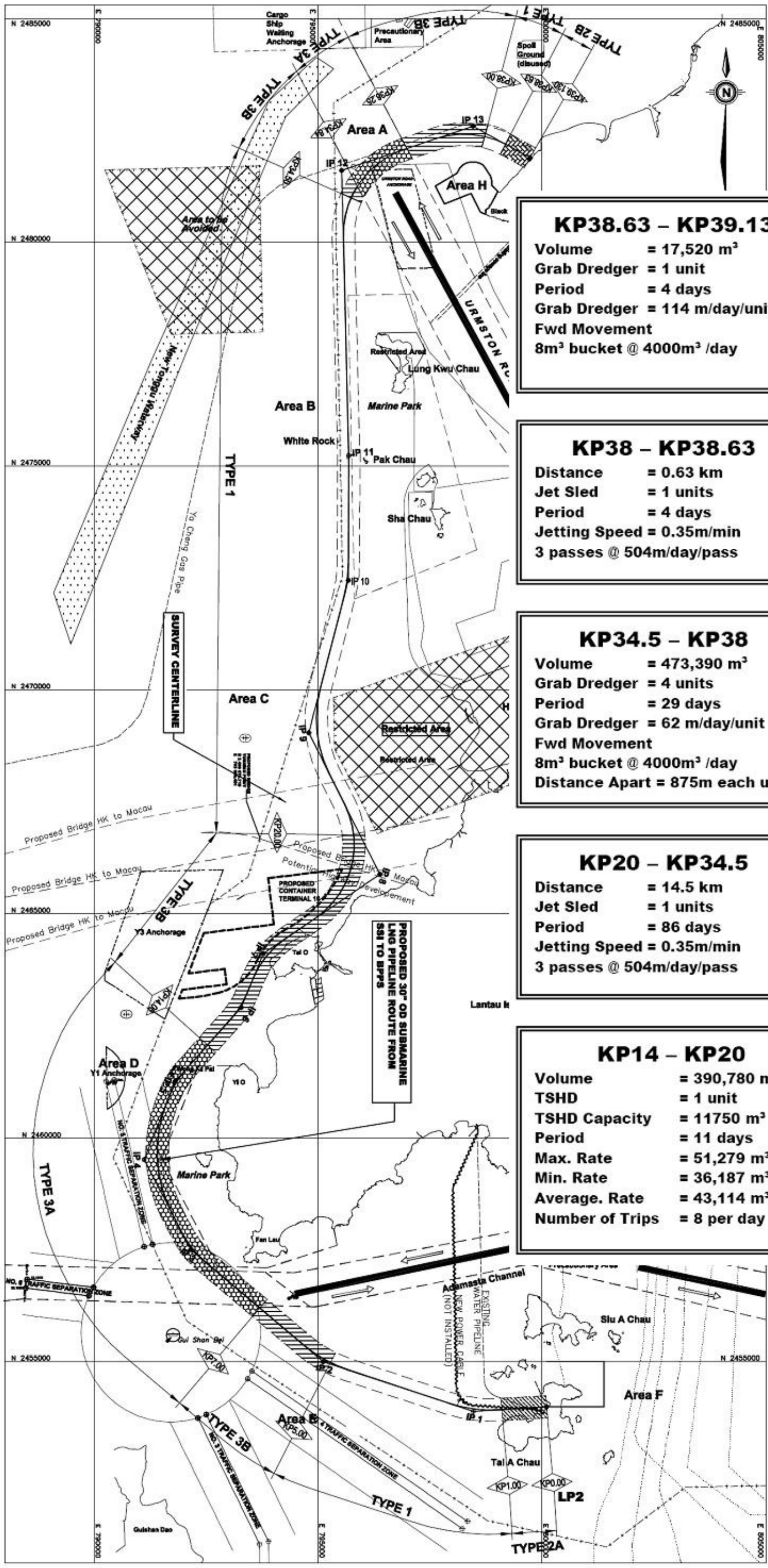
1.1 INTRODUCTION

Potentially, a container port, CT10, will be built to the west of Lantau (near Tai O). If this is the case, it will hence be necessary to alter the LNG submarine gas pipeline in order to avoid the intersection with the CT10 which may require dredging the port area to substantial depth for reclamation.

As seen from the figure below, an alternative pipeline route was designed to bypass the CT10. To assess any potential impacts due to the alternative pipeline route was thus simulated by Delft3D model.

The same modelling approach as presented in the *Section* 3 of Annex *6A* was adopted. The modelling is mainly carried out for KP7 – 14, KP14 – KP20 and KP20 – KP34.5 since the changes are mainly at these three zones. The model results are presented in the next section of this Appendix.

COMBINATION OF JETTING, GRAB DREDGE AND TSHD



KP38.63 – KP39.13

Volume = 17,520 m^3
Grab Dredger = 1 unit
Period = 4 days
Grab Dredger = 114 m/day/unit
Fwd Movement
8m^3 bucket @ 4000m^3 /day

KP38 – KP38.63

Distance = 0.63 km
Jet Sled = 1 units
Period = 4 days
Jetting Speed = 0.35m/min
3 passes @ 504m/day/pass

KP34.5 – KP38

Volume = 473,390 m^3
Grab Dredger = 4 units
Period = 29 days
Grab Dredger = 62 m/day/unit
Fwd Movement
8m^3 bucket @ 4000m^3 /day
Distance Apart = 875m each unit

KP20 – KP34.5

Distance = 14.5 km
Jet Sled = 1 units
Period = 86 days
Jetting Speed = 0.35m/min
3 passes @ 504m/day/pass

KP14 – KP20

Volume = 390,780 m^3
TSHD = 1 unit
TSHD Capacity = 11750 m^3
Period = 11 days
Max. Rate = 51,279 m^3/day
Min. Rate = 36,187 m^3/day
Average. Rate = 43,114 m^3/day
Number of Trips = 8 per day

KP7 – KP14

Volume = 787,818 m^3
TSHD = 1 unit
TSHD Capacity = 11750 m^3
Period = 19 days
Max. Rate = 51,279 m^3/day
Min. Rate = 36,187 m^3/day
Average. Rate = 43,114 m^3/day
Number of Trips = 9 per day

KP5 – KP7

Volume = 130,260 m^3
TSHD = 1 unit
TSHD Capacity = 11750 m^3
Period = 3 days
Max. Rate = 51,279 m^3/day
Min. Rate = 36,187 m^3/day
Average. Rate = 43,114 m^3/day
Number of Trips = 11 per day

KP1 - KP5

Distance = 4 km
Jet Sled = 1 units
Period = 24 days
Jetting Speed = 0.35m/min
3 passes @ 504m/day/pass

KP0 - KP1

Volume = 68,000 m^3
Grab Dredger = 1 unit
Period = 17 days
Grab Dredger = 59 m/day/unit
Fwd Movement
8m^3 bucket @ 4000m^3 /day

DRAWING NO. 8028-PLD-008 (SHT. 1 OF 2) REV. 1

1.2 MODEL RESULTS

1.2.1 *Suspended Solids*

TSHD Dredging at Lantau Channel (KP7-14)

Modelling results (*Table 1.1*) indicate that SS elevations will be compliant with the WQO and tolerance criterion at all sensitive receivers in both seasons.

TSHD Dredging at West Lantau (KP14-20)

Modelling results (*Table 1.1*) indicate that SS elevations will be compliant with the WQO at all sensitive receivers in both seasons, with the exception of SR12 (horseshoe crab habitat near Tai O). As seen from *Table 1.1*, the maximum depth-averaged SS concentrations at Pak Tso Wan would be about 52.3 and 45.7 mg L^{-1}, exceeding the WQOs of 8.9 and 5.6 mg L^{-1} in the dry and wet seasons, respectively, whereas the mean depth-averaged SS concentrations are comply with the WQO. This suggests that the exceedances are not persistent.

Jetting at the Urmston Road Crossing (KP20-34.5)

Modelling results (*Table 1.1*) indicate that SS elevations will be compliant with the WQO at all sensitive receivers in both seasons, with the exception of SR6a and 6b (boundary of Sha Chau and Lung Kwu Chau Marine Park).

The maximum depth-averaged SS elevations at SR6a and 6b will exceed the WQOs of 8.2 and 5.6 mg L^{-1} in the dry and wet seasons, respectively, whereas the mean depth-averaged SS concentrations are well below the WQO. This indicates that the exceedances are in short duration.

Figures 1.1 – 1.3 show the contour plots (mean depth-averaged) of SS elevations for the alternative gas pipeline route for the above three zones. They show that the sediment plume is in low concentrations (mean over 15 day spring-neap cycle), i.e. below 5 mg L^{-1}. This shows that there are no continually unacceptable impacts to water quality.

1.2.2 *Sediment Deposition*

The majority of SS elevations in water have been predicted to be temporary and to remain within relatively close proximity to the dredging or jetting works and, as such, the majority of sediment has been predicted to settle within relatively close proximity of the works areas.

The simulated deposition rates (1) at the artificial reefs (ARs), i.e., SR6e and SR7d during the dry and wet seasons have been assessed for the respective construction works. *Table 1.2* summarises the predicted deposition rates. No exceedance are predicted at both ARs and hence no unacceptable impacts are expected to be posed by the works.

(1) The deposition rate is simulated as the total deposition divided by the duration of complete tidal cycle.

Table 1.1 Predicted SS Elevation (mg L^{-1}) for Alternative Pipeline Route

Sensitive Receiver	Name	ID	Depth [a]	WQO Allowable Elevation		TSHD Dredging at Lantau Channel (KP7-14)				TSHD Dredging at West Lantau (KP14-20)				Jetting at the Urmston Road Crossing (KP20-34.5)			
						Max		Mean		Max		Mean		Max		Mean	
				Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
Intertidal Mudflats	Pak Nai	SR01	s	7.1	3.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Horseshoe Crab Nursery Grounds	Pak Nai	SR01	a	9.7	6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Seagrass Beds/Mangroves/Oyster Farm	Pak Nai	SR02	s	7.1	3.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Seawater Intakes	Black Point Power Station	SR04	b	700 [b]	700 [b]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Non-gazetted Beaches	Lung Kwu Sheung Tan	SR05a	a	8.2	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Non-gazetted Beaches	Lung Kwu Tan	SR05b	a	8.2	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gazetted Beaches	Butterfly Beach	SR05c	a	8.2	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Marine Park	Designated Sha Chau and Lung Kwu Chau	SR06a	a	8.2	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	44.9 [c]	79.2 [c]	1.1	0.8
Marine Park	Designated Sha Chau and Lung Kwu Chau	SR06b	a	8.2	5.6	0.2	0.0	0.0	0.0	0.2	0.0	0.0	0.0	12.8 [c]	12.1 [c]	0.8	0.2

Sensitive Receiver	Name	ID	Depth [(a)]	WQO Allowable Elevation		TSHD Dredging at Lantau Channel (KP7-14)				TSHD Dredging at West Lantau (KP14-20)				Jetting at the Urmston Road Crossing (KP20-34.5)			
						Max		Mean		Max		Mean		Max		Mean	
				Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
Marine Park	Designated Sha Chau and Lung Kwu Chau	SR06c	a	8.2	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0
Marine Park	Designated Sha Chau and Lung Kwu Chau	SR06d	a	8.2	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.3	0.0	0.0
Artificial Reef Deployment Area	Sha Chau and Lung Kwu Chau	SR06e	a	8.2	5.6	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	3.1	4.7	0.4	0.1
Seawater Intakes	Castle Peak Power Station	SR07a	b	700 [(b)]	700 [(b)]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Seawater Intakes	Tuen Mun Area 38	SR07b	b	14.2	9.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Seawater Intakes	Airport	SR07c	b	8.9	8.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Seawater Intakes	Airport	SR07d	b	8.9	8.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Artificial Reef Deployment Area	Northeast Airport	SR07d	a	4.7	5.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Seawater Intakes	Airport	SR07e	b	8.9	8.8	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.6	0.0	0.0
Seawater Intakes	Airport	SR07f	b	8.9	8.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Spawning/Nursery Grounds	Fisheries Spawning Ground in North Lantau	SR08	a	8.2	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Sensitive Receiver	Name	ID	Depth [(a)]	WQO Allowable Elevation		TSHD Dredging at Lantau Channel (KP7-14)				TSHD Dredging at West Lantau (KP14-20)				Jetting at the Urmston Road Crossing (KP20-34.5)			
						Max		Mean		Max		Mean		Max		Mean	
				Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
Horseshoe Crab Nursery Grounds	Sham Wat Wan	SR10	a	8.9	6.5	0.4	0.2	0.0	0.0	1.2	1.3	0.2	0.1	2.0	2.5	0.1	0.1
Protection Zone	Chinese White Dolphin Protection Zone in Mainland Waters	SR11	a	8.9	6.5	0.6	0.4	0.1	0.0	0.2	0.1	0.0	0.0	0.4	0.3	0.0	0.0
Protection Zone	Chinese White Dolphin Protection Zone in Mainland Waters	SR11a	a	8.9	6.5	0.6	0.7	0.1	0.1	0.2	0.2	0.0	0.0	0.3	0.2	0.0	0.0
Protection Zone	Chinese White Dolphin Protection Zone in Mainland Waters	SR11b	a	8.9	6.5	0.5	0.8	0.1	0.0	0.2	0.3	0.0	0.0	0.3	0.2	0.0	0.0
Horseshoe Crab Nursery Grounds	Tai O	SR12	a	8.9	6.5	0.7	1.1	0.1	0.1	52.3 [(c)]	45.7 [(c)]	2.4	1.9	1.3	1.3	0.1	0.1
Intertidal Mudflats	Yi O	SR14	s	6.5	3.6	0.5	0.0	0.1	0.0	2.3	1.3	0.2	0.0	0.6	0.3	0.0	0.0

Sensitive Receiver	Name	ID	Depth [(a)]	WQO Allowable Elevation		TSHD Dredging at Lantau Channel (KP7-14)				TSHD Dredging at West Lantau (KP14-20)				Jetting at the Urmston Road Crossing (KP20-34.5)			
						Max		Mean		Max		Mean		Max		Mean	
				Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
Horseshoe Crab Nursery Grounds	Yi O	SR14	a	8.9	6.5	0.7	0.9	0.2	0.1	3.1	3.9	0.4	0.2	0.7	0.4	0.1	0.0
Non-gazetted Beaches	Fan Lau Sai Wan	SR15a	a	6.9	5.5	0.7	0.8	0.2	0.1	0.4	0.4	0.1	0.0	0.2	0.1	0.0	0.0
Mangroves	Fan Lau Tung Wan	SR15b	s	4.5	3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Non-gazetted Beaches	Fan Lau Tung Wan	SR15b	a	6.9	5.5	0.1	1.3	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Non-gazetted Beaches	Tsin Yue Wan	SR15c	a	6.9	5.5	0.8	0.5	0.2	0.1	0.6	0.7	0.1	0.1	0.2	0.3	0.0	0.0
Fish Fry Habitat	Pak Tso Wan	SR16b	a	6.9	5.5	0.2	0.2	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Horseshoe Crab Nursery Grounds	Sha Lo Wan	SR18	a	7.8	4.8	0.2	0.1	0.0	0.0	0.5	0.2	0.1	0.0	0.7	1.5	0.0	0.1
Spawning/Nursery Grounds	Fisheries Spawning/Nursery Grounds in South Lantau	SR24	a	6.9	5.5	0.6	0.2	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Spawning/Nursery Grounds	Fisheries Spawning/Nursery Grounds in South Lantau	SR27	a	6.9	5.5	0.5	0.2	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Sensitive Receiver	Name	ID	Depth [a]	WQO Allowable Elevation		TSHD Dredging at Lantau Channel (KP7-14)				TSHD Dredging at West Lantau (KP14-20)				Jetting at the Urmston Road Crossing (KP20-34.5)			
						Max		Mean		Max		Mean		Max		Mean	
				Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
Subtidal Hard Bottom Habitat (coral)	Southern Side of South Soko	SR31	a	10	10	0.0	0.2	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Intertidal Mudflats	Shui Hau Wan	SR33	s	3.9	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Horseshoe Crab Nursery Grounds	Tong Fuk Miu Wan	SR33	a	4.8	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gazetted Beaches	Tong Fuk	SR34	a	4.8	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gazetted Beaches	Upper Cheung Sha Beach	SR35	a	4.8	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Seagrass Beds/Mangroves	Tung Chung Bay	SR39	s	6.5	3.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Horseshoe Crab Nursery Grounds	Tung Chung Bay	SR39	a	8.9	6.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Notes:

a. s = surface, m = middle, b = bottom, a = depth-averaged

b. The assessment criterion of 700 mg L^{-1} was adopted for these seawater intakes.

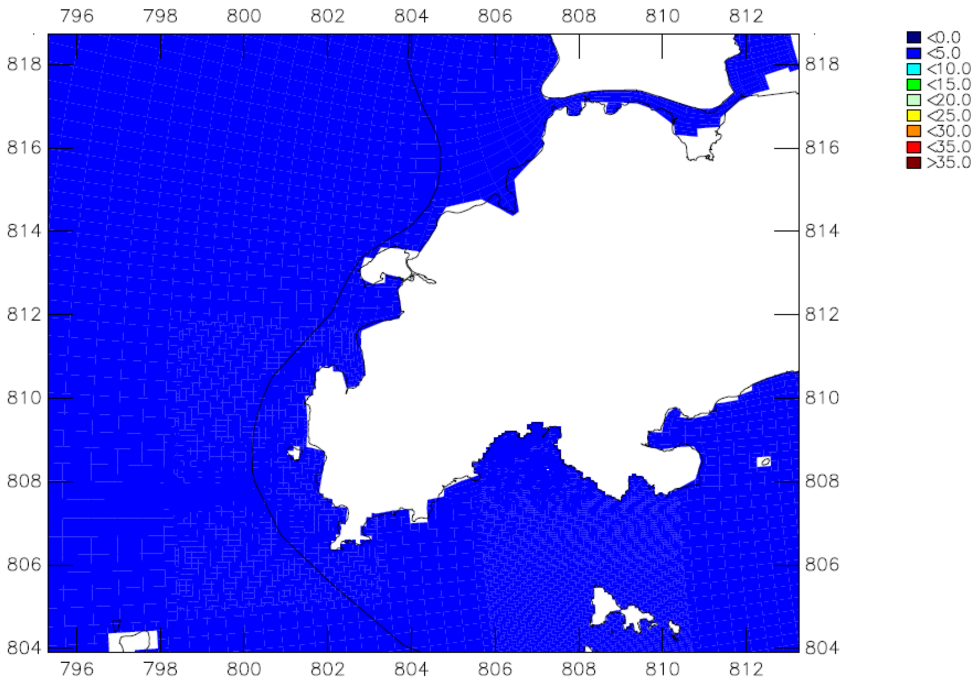
c. Shaded area indicates non-compliance with the assessment criterion.

Table 1.2 Predicted Deposition Rate (g m^{-2} day^{-1}) for the Alternative Gas Pipeline Route at the Artificial Reefs and Subtidal Hard Bottom Habitat

Sensitive Receiver	**Name**	**ID**	**Depth**	**WQO Allowable Elevation**		**TSHD Dredging at Lantau Channel (KP7-14)**		**TSHD Dredging at West Lantau (KP14-20)**		**Jetting at the Urmston Road Crossing (KP20-34.5)**	
				Dry	**Wet**	**Dry Max**	**Wet Max**	**Dry Max**	**Wet Max**	**Dry Max**	**Wet Max**
Artificial Reef Deployment Area	Sha Chau and Lung Kwu Chau	SR06e	b	200	200	0.0	0.0	0.1	0.0	15.1	3.7
Artificial Reef Deployment Area	Northeast Airport	SR07d	b	200	200	0.0	0.0	0.0	0.0	0.0	0.0

Figure 1.1 Predicted Mean Depth-Averaged SS Elevations (mg L[-1]) for TSHD Dredging at Lantau Channel (KP7-14)

Dry Season



Wet Season

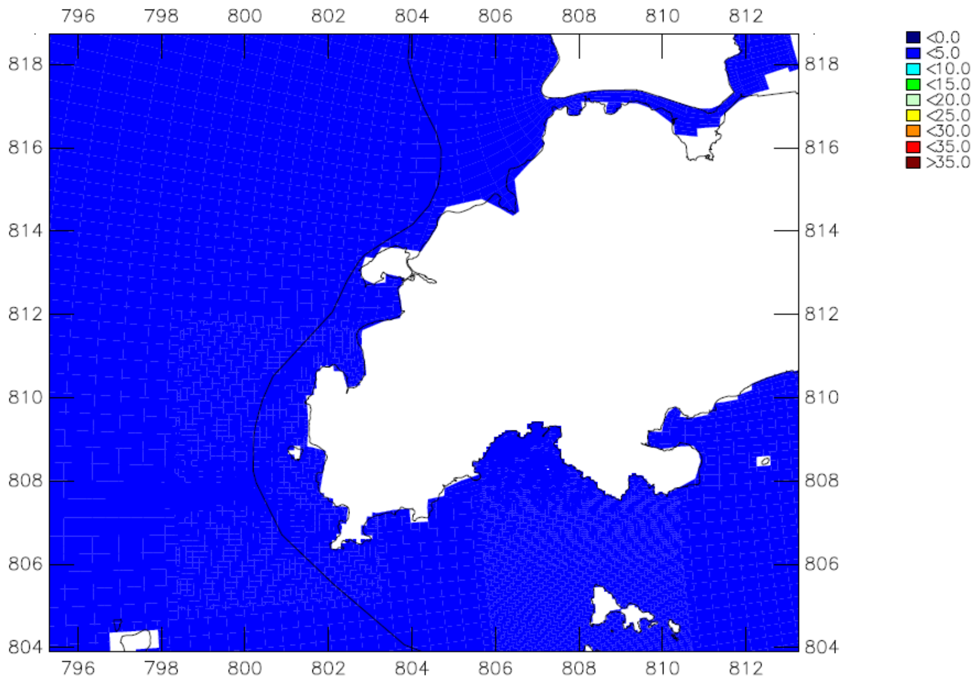
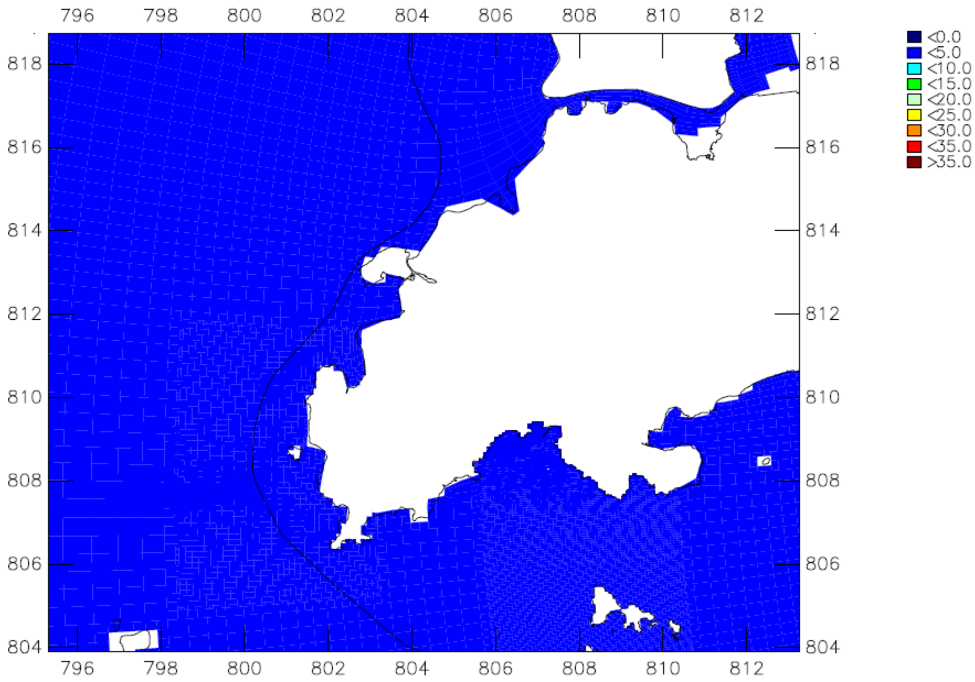


Figure 1.2 Predicted Mean Depth-Averaged SS Elevations (mg L^{-1}) for TSHD Dredging at West Lantau (KP14-20)

Dry Season



Wet Season

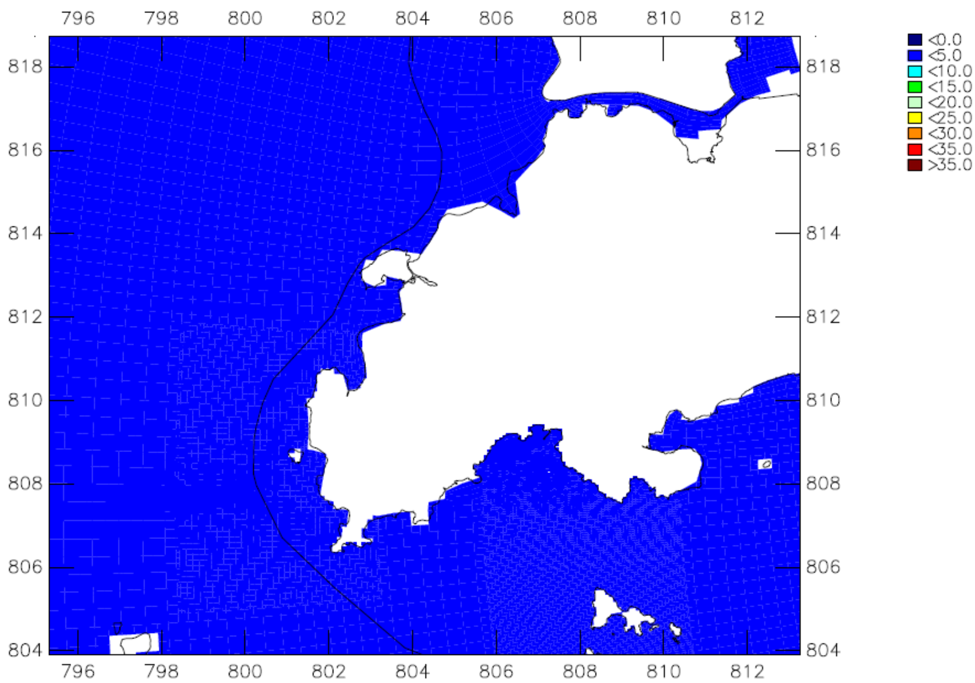
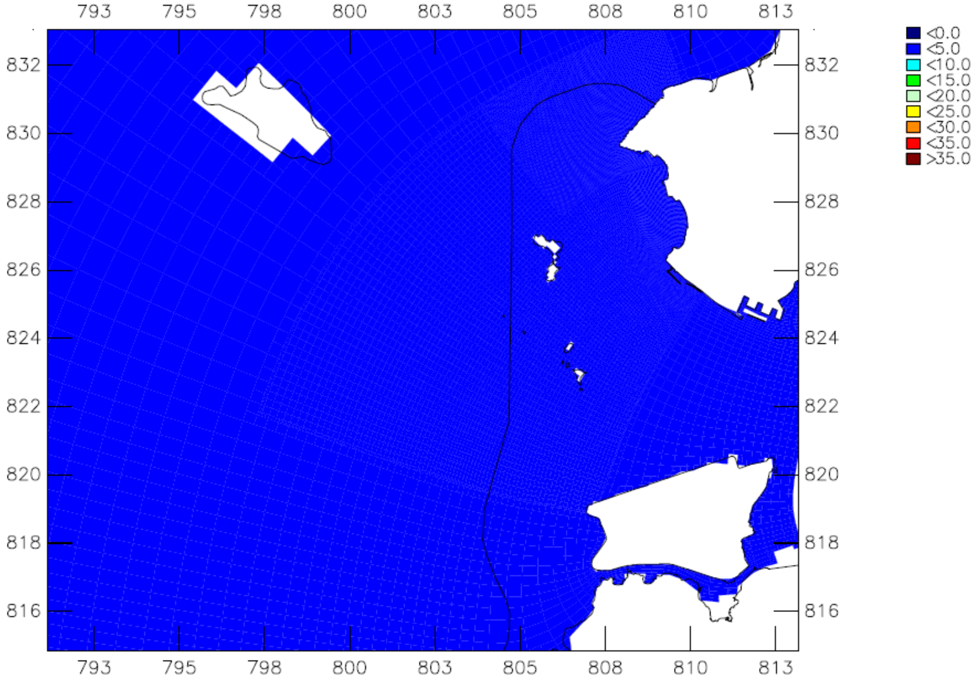
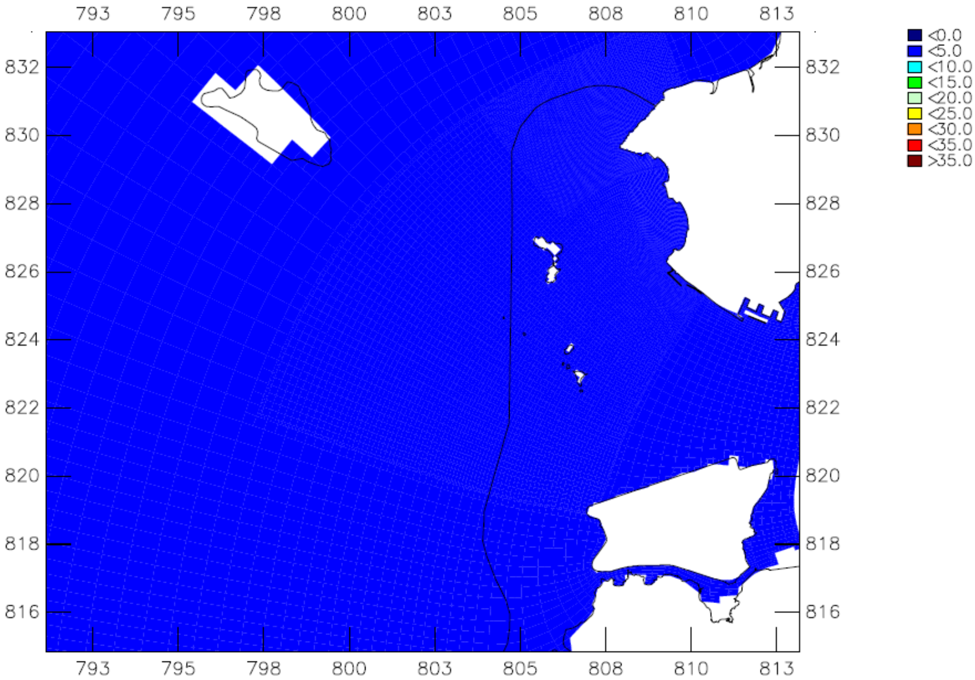


Figure 1.3 Predicted Mean Depth-Averaged SS Elevations (mg L^{-1}) for Jetting at the Urmston Road Crossing (KP20-34.5)

Dry Season



Wet Season



1.3 CONCLUSION

Installation for the alternative gas pipeline route has been simulated by water quality model using the same modelling approach as for the proposed route presented in the EIA report *Section 6*. This model results show that the SS elevations exceed the WQO at two locations whereas the SS deposition rate remain below the assessment criteria. It is expected the SS exceedances are short-term and do not have unacceptable impacts to water quality.

At the EIA stage, the alternative gas pipeline route is not considered to be a preferred option. Should the alternative gas pipeline route be selected at next stage as a result of any planning uncertainties, a further impact detailed assessment should be conducted and the following implementations should be considered:

- Jetting works next to the designated Sha Chau and Lung Kwu Chau Marine Park will be replaced by grab dredging in order to minimise the instantaneous SS elevations.

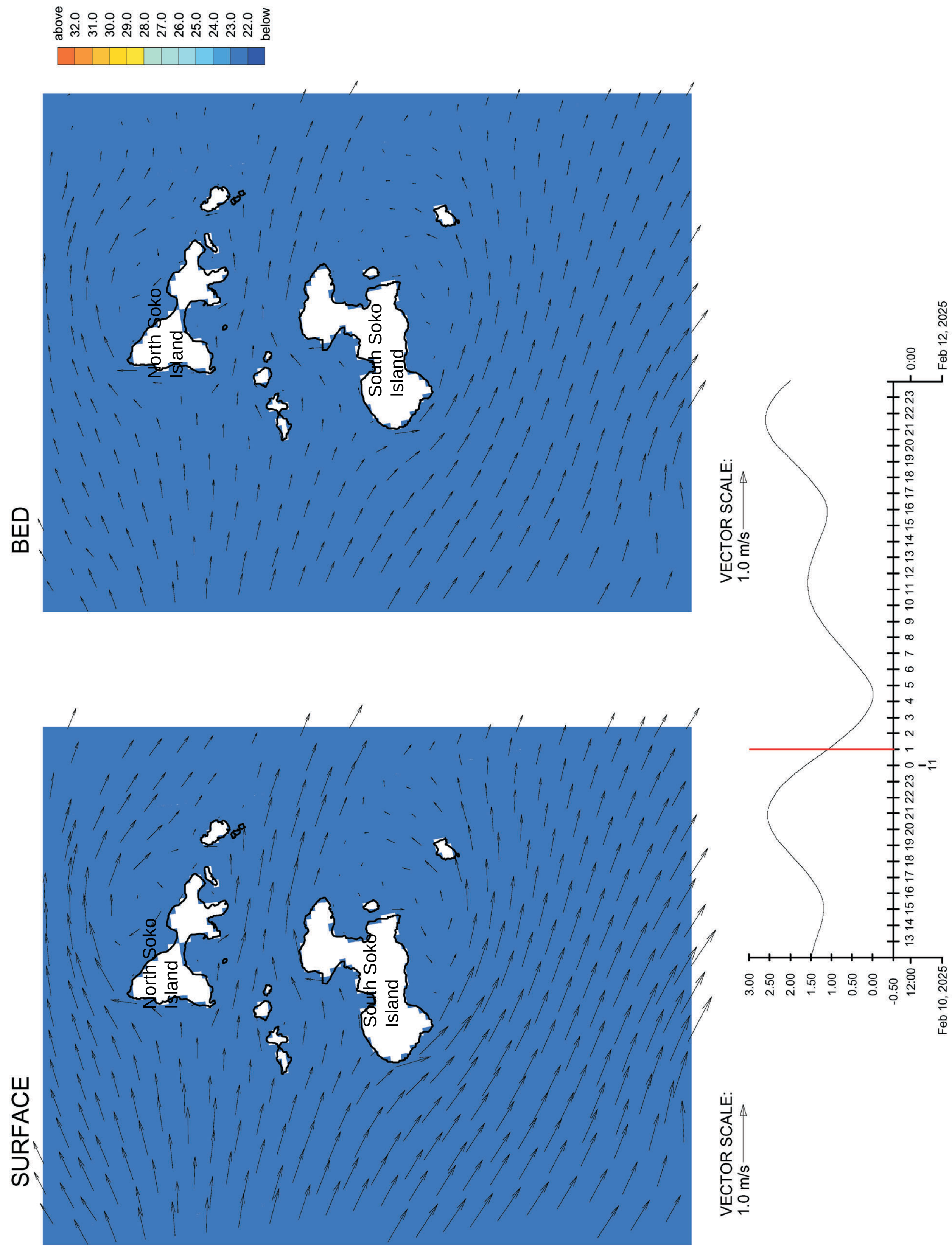
- Dredging works along the route designated Sha Chau and Lung Kwu Chau Marine Park and in West Lantau will be operated during daytime (maximum 12 hours a day) and will avoid the peak calving season of the Indo-Pacific Humpback Dolphin, i.e. March through August.

- Appropriate mitigation measures will be derived if any predicted WQO exceedances are predicted.

- The residual impacts, if any, will be assessed.

Annex 6B

Construction Phase Model Results - Hydrodynamics



Velocity Vector (m/s) and Temperature (Degree Celsius)

Dry Season, Mid-ebb, Surface (upper) & Bottom (lower)

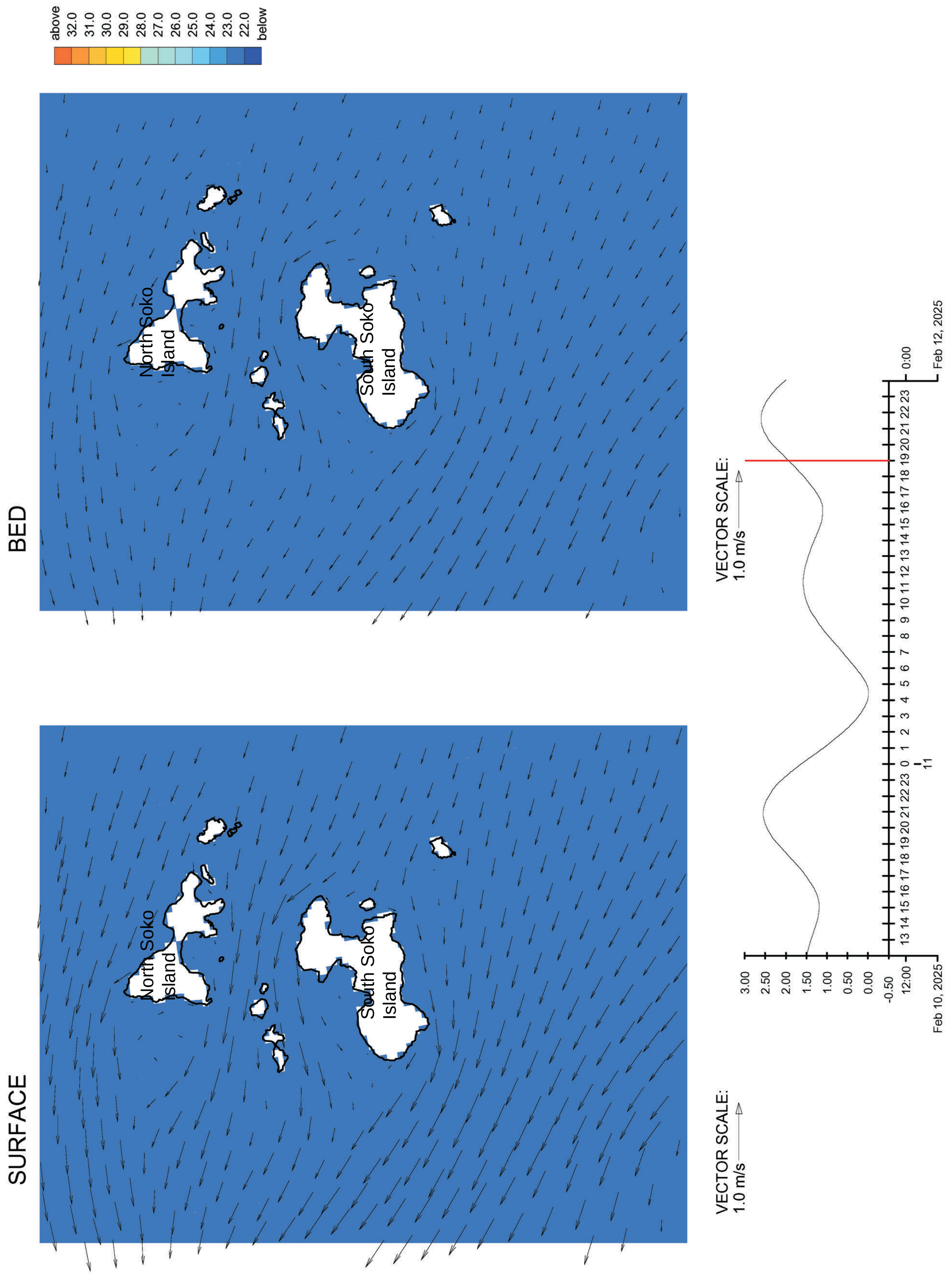
Pre-project situation, 2007

South Soko

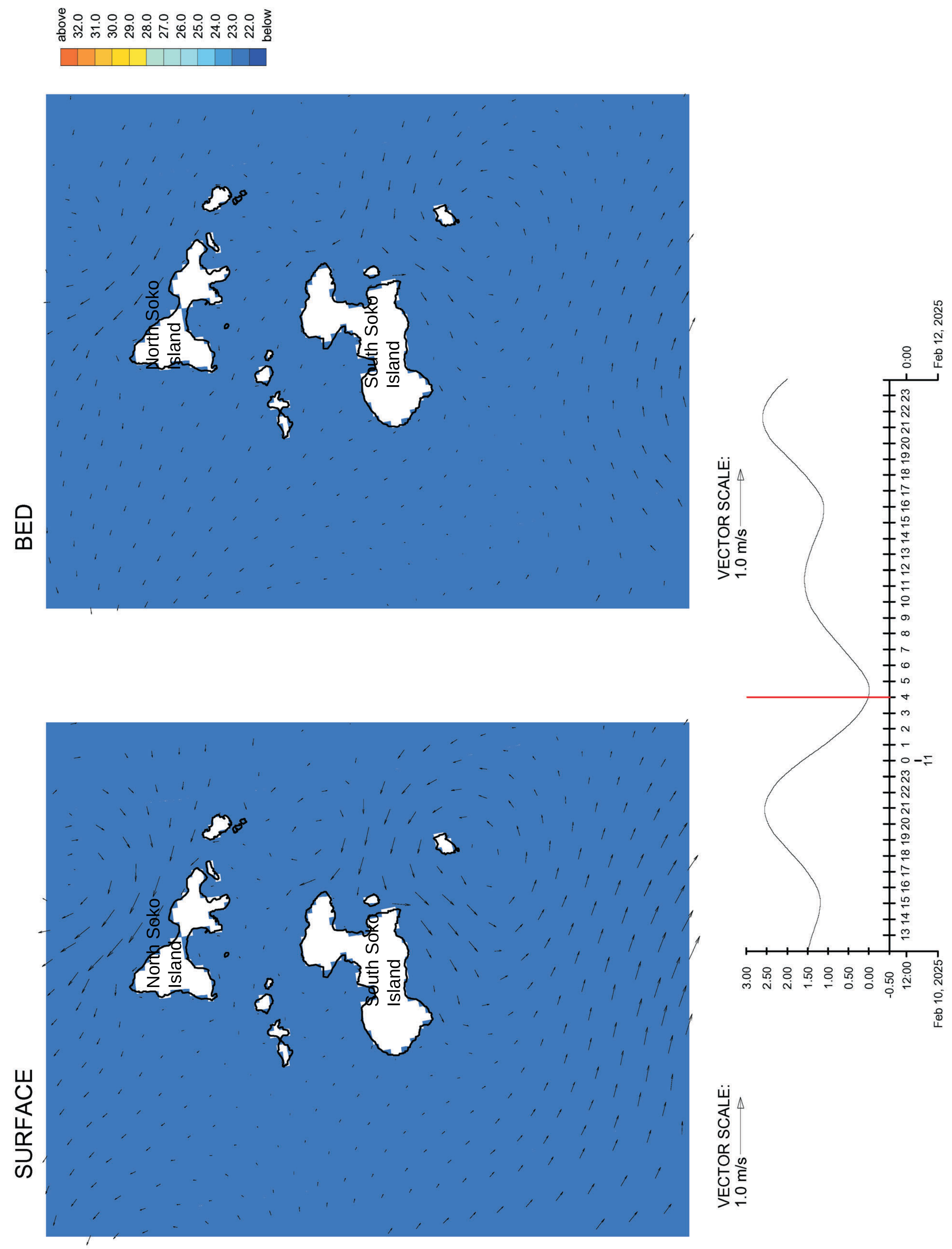
WL | delft hydraulics

0018180_eia63h

Fig. SK B01



Velocity Vector (m/s) and Temperature (Degree Celsius) Dry Season, Mid-flood, Surface (upper) & Bottom (lower) Pre-project situation, 2007		
	South Soko	
WL | delft hydraulics	0018180_eia63i	Fig. SK B02



Velocity Vector (m/s) and Temperature (Degree Celsius)

Dry Season, Low Water, Surface (upper) & Bottom (lower)

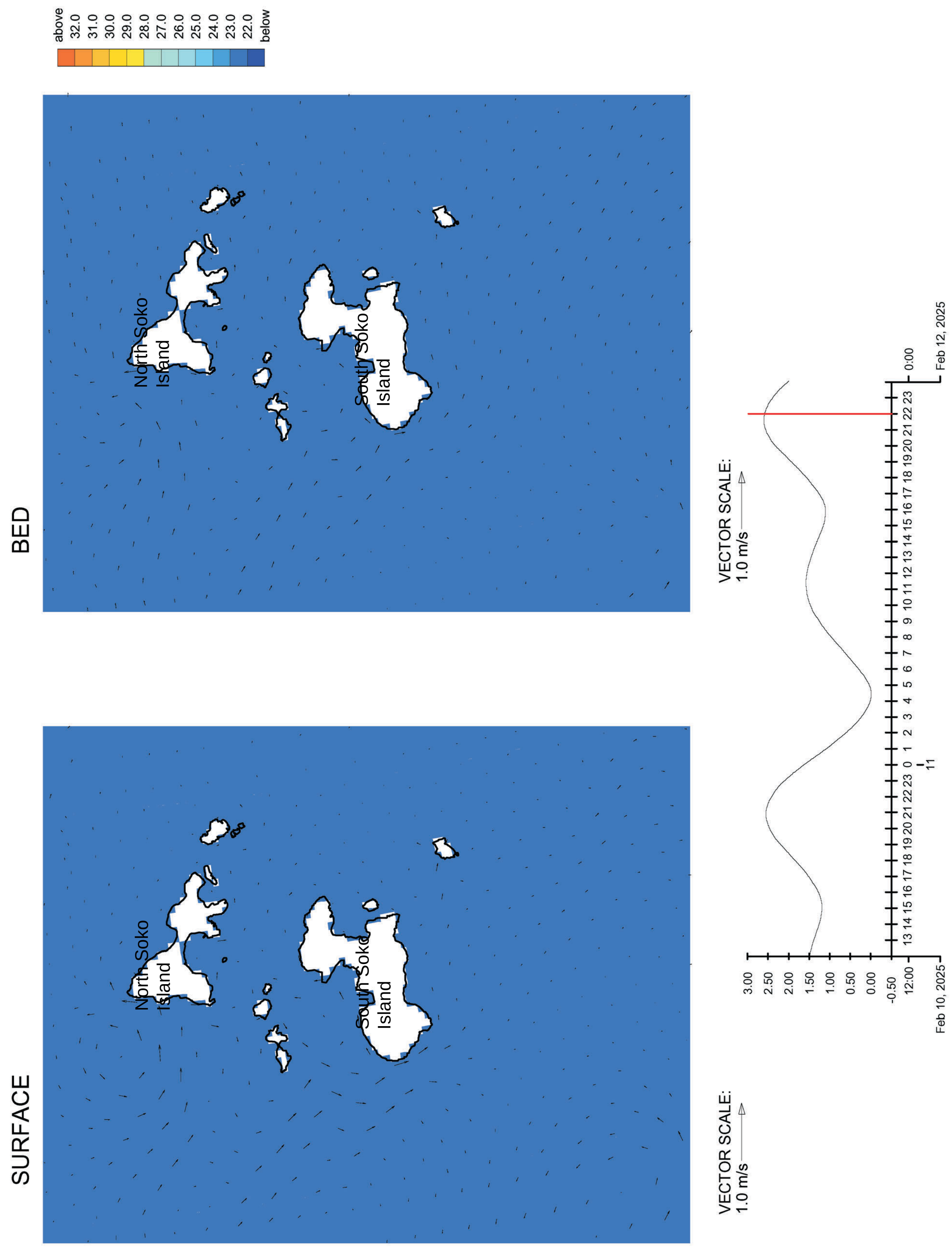
Pre-project situation, 2007

South Soko

WL | delft hydraulics

0018180_eia63j

Fig. SK B03



Velocity Vector (m/s) and Temperature (Degree Celsius)

Dry Season, High Water, Surface (upper) & Bottom (lower)

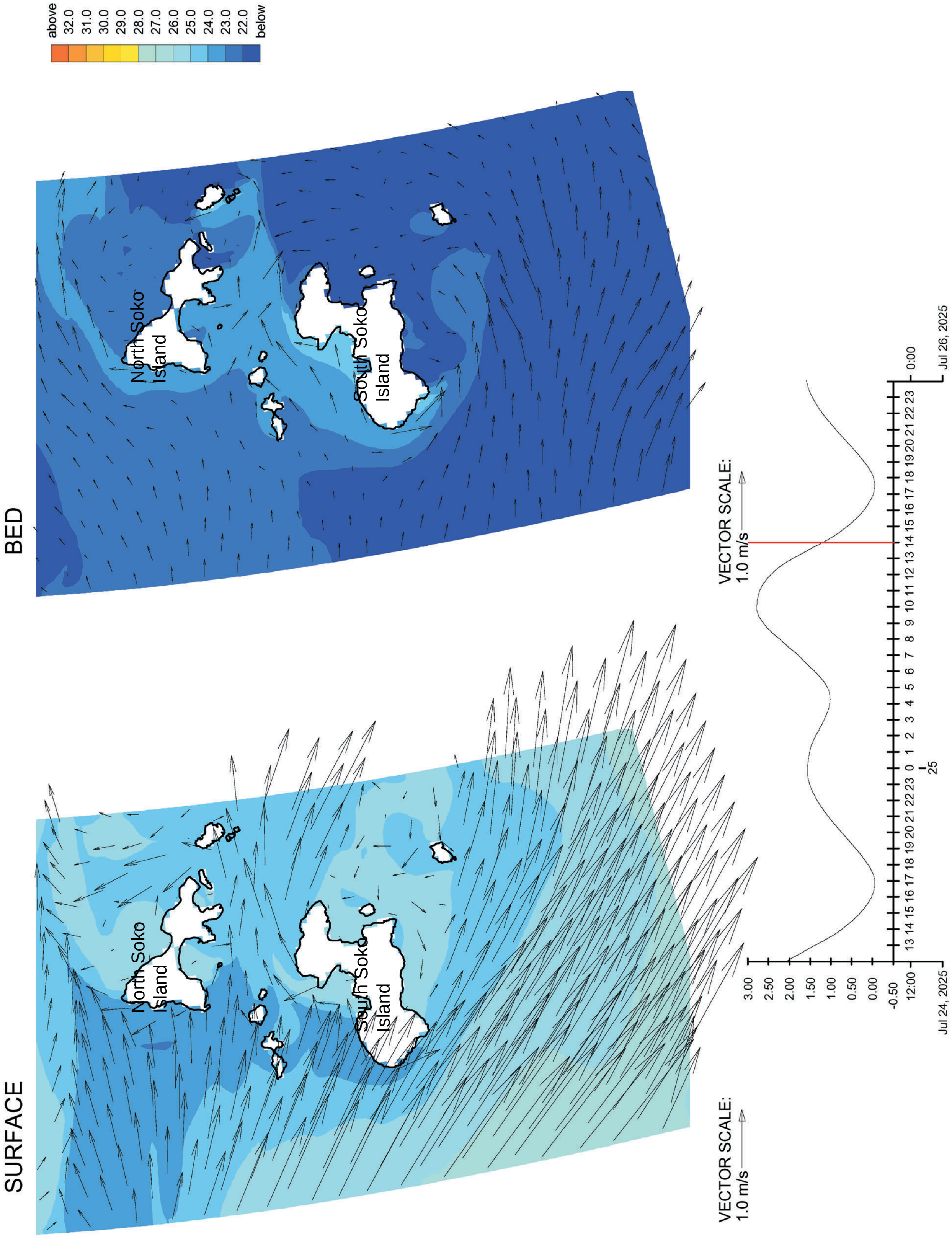
Pre-project situation, 2007

South Soko

WL | delft hydraulics

0018180_eia63k

Fig. SK B04



Velocity Vector (m/s) and Temperature (Degree Celsius)

Wet Season, Mid-ebb, Surface (upper) & Bottom (lower)

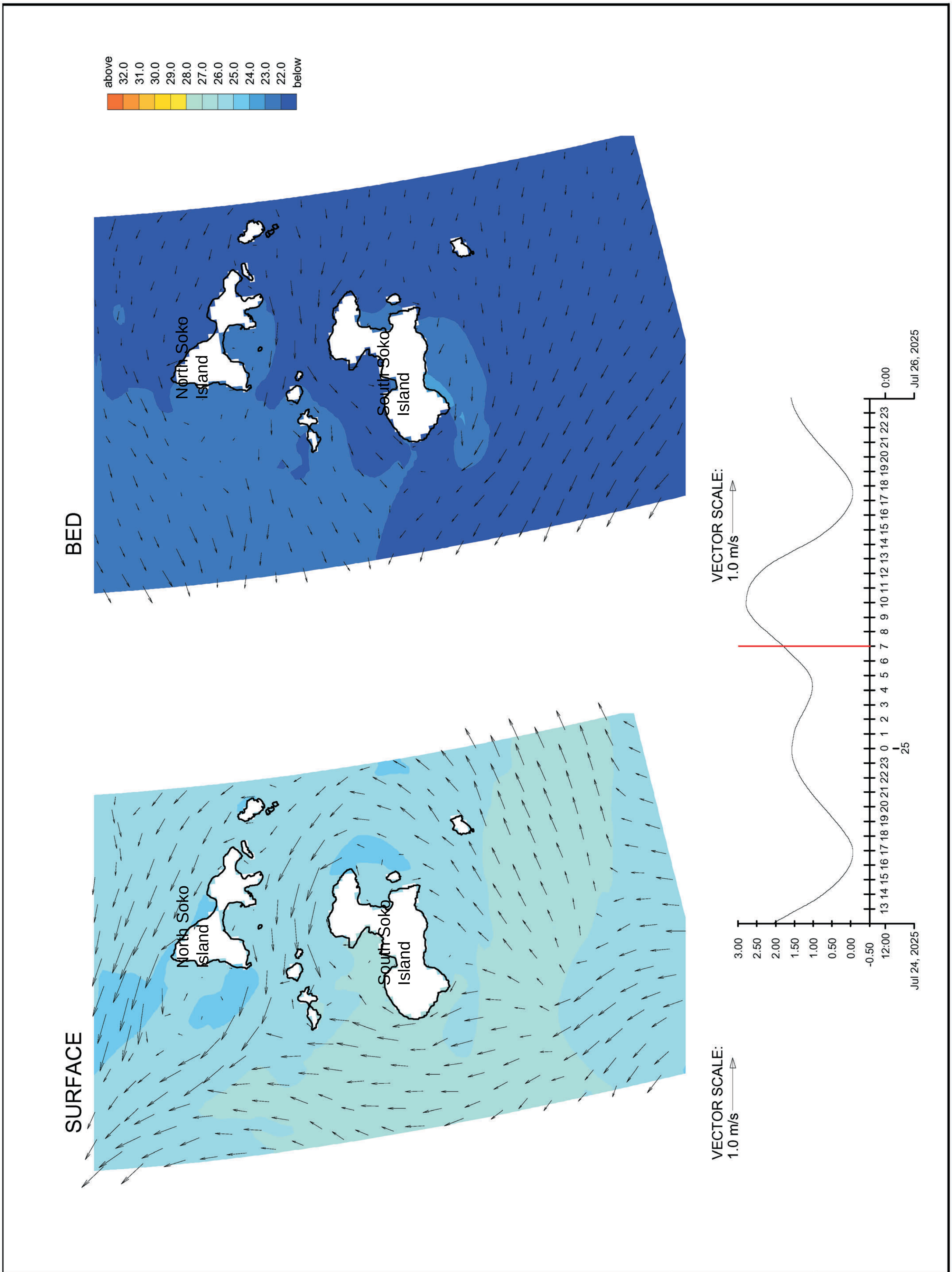
Pre-project situation, 2007

South Soko

WL | delft hydraulics

0018180_eia63l

Fig. SK B05

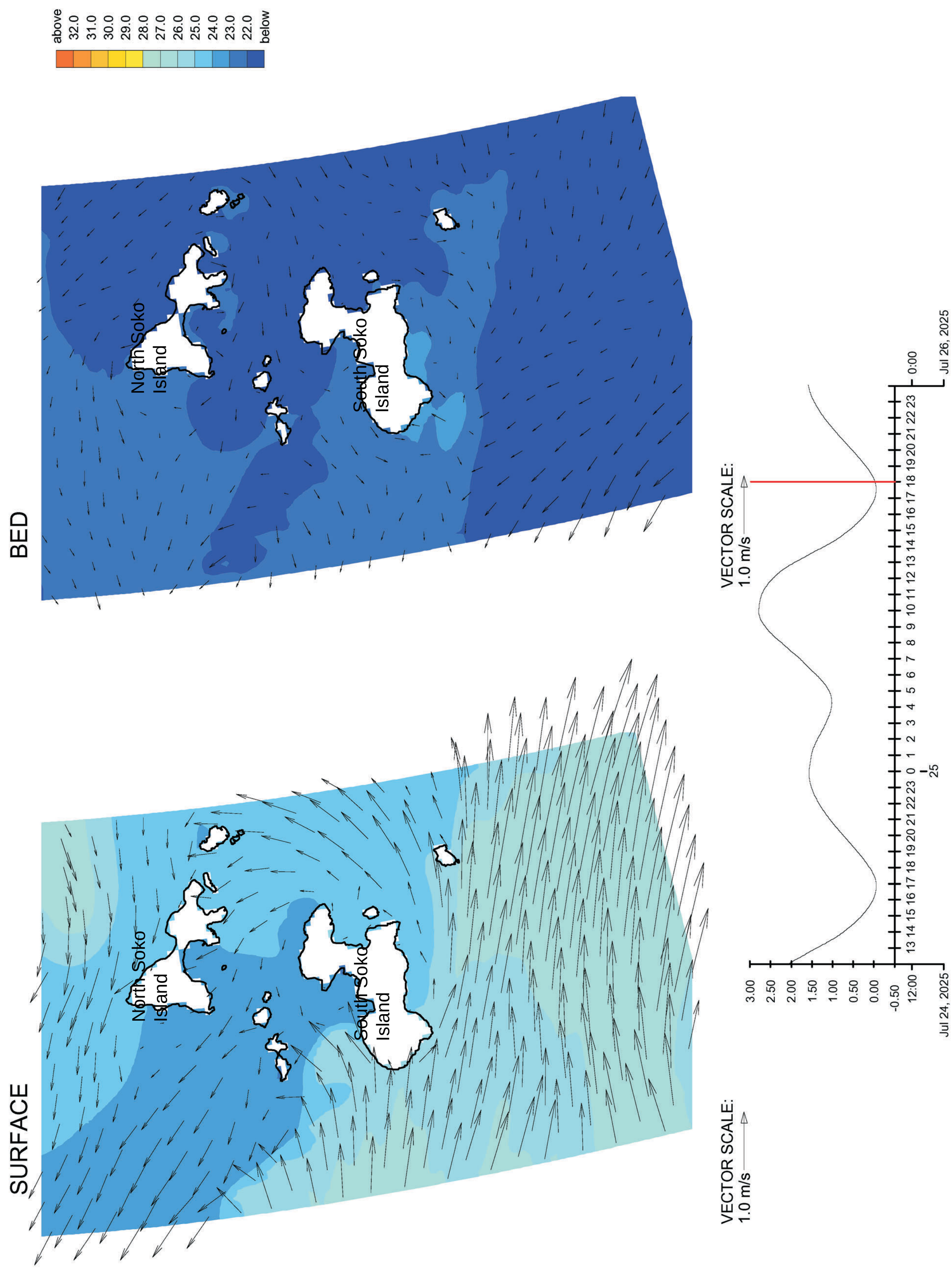


Velocity Vector (m/s) and Temperature (Degree Celsius)

Wet Season, Mid-flood, Surface (upper) & Bottom (lower)

Pre-project situation, 2007

	South Soko	
WL | delft hydraulics	0018180_eia63m	Fig. SK B06

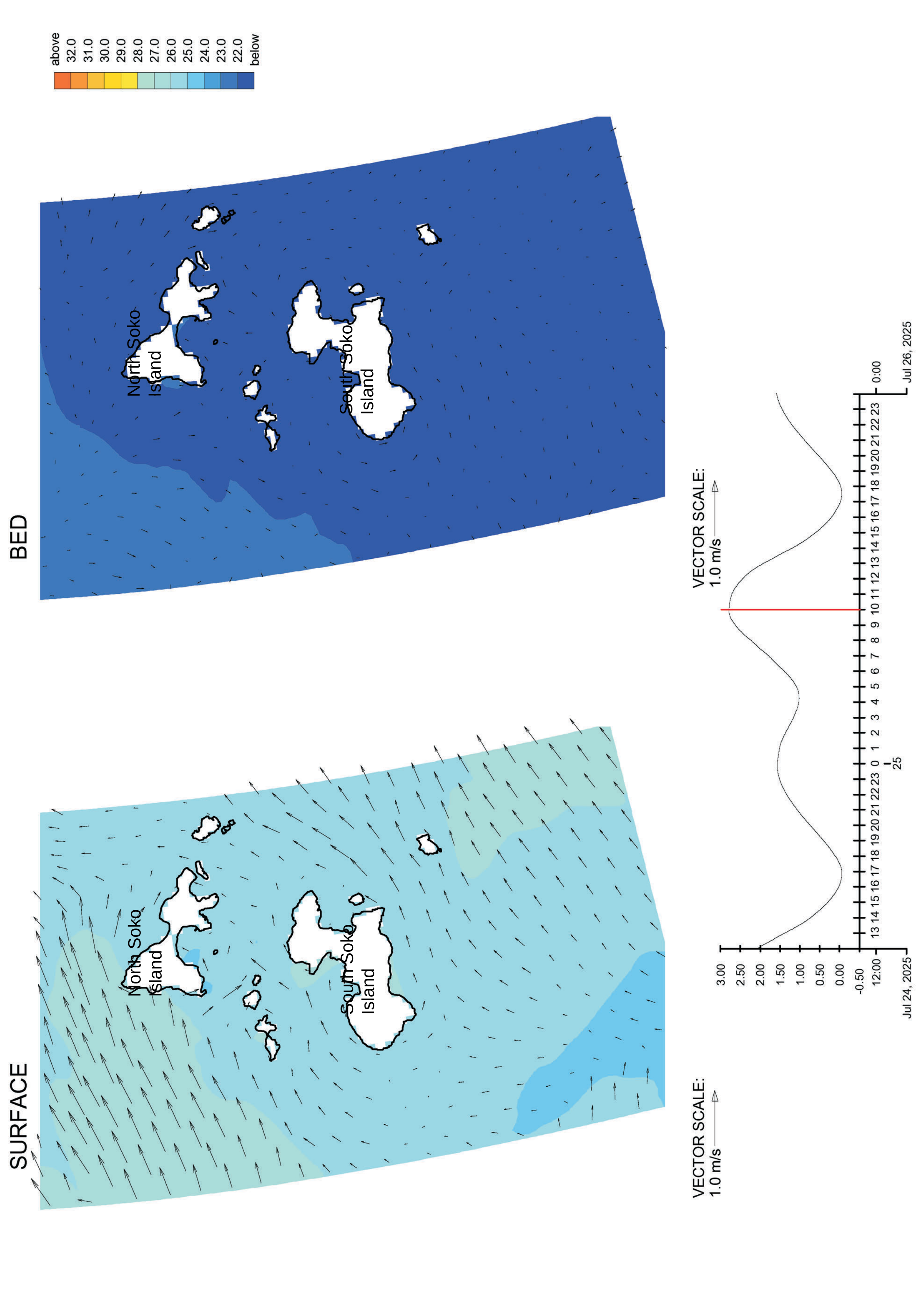


Velocity Vector (m/s) and Temperature (Degree Celsius)

Wet Season, Low Water, Surface (upper) & Bottom (lower)

Pre-project situation, 2007

	South Soko	
WL | delft hydraulics	0018180_eia63n	Fig. SK B07



Velocity Vector (m/s) and Temperature (Degree Celsius) Wet Season, High Water, Surface (upper) & Bottom (lower) Pre-project situation, 2007		
	South Soko	
WL | delft hydraulics	0018180_eia63o	Fig. SK B08