



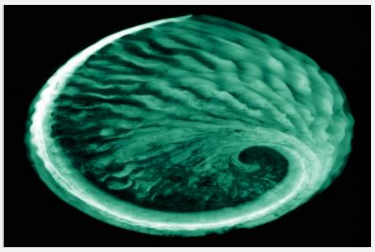

Capco 青山發電有限公司 Castle Peak Power Co. Ltd.

Hong Kong Offshore LNG Terminal - Works associated with the subsea gas pipeline for Black Point Power Station (BPPS) and the associated Gas Receiving Station (GRS) in BPPS

Pipeline Construction Plan

6 January 2021

Project No.: 0505354

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ERM

Document details	
Document title	Hong Kong Offshore LNG Terminal - Works associated with the subsea gas pipeline for Black Point Power Station (BPPS) and the associated Gas Receiving Station (GRS) in BPPS
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Signature Page

6 January 2021

Hong Kong Offshore LNG Terminal - Works associated with the subsea gas pipeline for Black Point Power Station (BPPS) and the associated Gas Receiving Station (GRS) in BPPS

Pipeline Construction Plan

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Hong Kong Offshore LNG Terminal - Works associated with the subsea gas pipeline for Black Point Power Station (BPPS) and the associated Gas Receiving Station (GRS) in BPPS

Environmental Certification Sheet

FEP-03/558/2018

Reference Document/Plan

Document/~~Plan~~ to be Certified/ Verified:	Pipeline Construction Plan
Date of Report:	6 January 2021
Date received by ET:	6 January 2021
Date received by IEC:	14 January 2021

Reference EP Requirement

EP Condition: Condition No. 2.8 of FEP-03/558/2018

Content: *Pipeline Construction Plan*

The Permit Holder shall, no later than 1 month before the commencement of construction of the Project, submit 3 hard copies and 1 electronic copy of a pipeline construction plan of the Project to the Director for approval. The pipeline construction plan shall include but not limited to a detailed schedule, sequence and programme of different work fronts for carrying out the dredging and jetting works and cofferdam construction works for laying the subsea gas pipeline of the Project. The programming of the dredging and jetting works shall take into account the peak calving season of Chinese White Dolphin and peak occurrence season of Finless Porpoise, with a view to minimizing the impacts to marine ecology as far as practicable. The dredging and jetting works shall be carried out in accordance with the information as contained in the approved pipeline construction plan.

ET Certification

I hereby certify that the above referenced document/~~plan~~ complies with the above referenced condition of FEP-03/558/2018.

Mr Raymond Chow,
Environmental Team Leader:  Date: 6 January 2021

IEC Verification

I hereby verify that the above referenced document/~~plan~~ complies with the above referenced condition of FEP-03/558/2018.

Mr Arthur Lo,
Independent Environmental Checker:  Date: 19 January 2021

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1. INTRODUCTION

1.1 Background

To support the increased use of natural gas in Hong Kong from 2020 onwards, Castle Peak Power Company Limited (CAPCO) and The Hongkong Electric Co., Ltd. (HK Electric) have identified that the development of an offshore liquefied natural gas (LNG) receiving terminal in Hong Kong using Floating Storage and Regasification Unit (FSRU) technology ('the Hong Kong Offshore LNG Terminal Project') presents a viable additional gas supply option that will provide energy security through access to competitive gas supplies from world markets. The Hong Kong Offshore LNG Terminal Project will involve the construction and operation of an offshore LNG import facility to be located in the southern waters of Hong Kong, a double berth jetty, and subsea pipelines that connect to the gas receiving stations (GRS) at the Black Point Power Station (BPPS) and the Lamma Power Station (LPS).

The Environmental Impact Assessment (EIA) Report for the Hong Kong Offshore LNG Terminal Project was submitted to the Environmental Protection Department (EPD) of the Hong Kong Special Administrative Region Government in May 2018. The EIA Report (EIAO Register No. AEIAR-218/2018) was approved by EPD and the associated Environmental Permit (EP) (EP-558/2018) was issued in October 2018. An application for Further Environmental Permits (FEP) was made on 24 December 2019 to demarcate the works between the different parties. The following FEPs were issued on 17 January 2020 and the EP under EP-558/2018 was surrendered on 5 March 2020:

- the double berth jetty at LNG Terminal under the Hong Kong LNG Terminal Limited, joint venture between CAPCO and HK Electric (FEP-01/558/2018/A) (1);
- the subsea gas pipeline for the BPPS and the associated GRS in the BPPS under CAPCO (FEP-03/558/2018); and
- the subsea gas pipeline for the LPS and the associated GRS in the LPS under HK Electric (FEP-02/558/2018/A) (2).

The location plan for the works associated with the subsea gas pipeline for the BPPS and the associated GRS in the BPPS ('the Project') is provided in ***Figure 1.1***. As the BPPS Pipeline design progresses and in further discussion with relevant Subsea Cable Owners on subsea pipeline / cable crossings as mentioned in Section 2.3.3 and Section 3.4.3 of the approved EIA Report, the construction methods of the BPPS Pipeline have been reviewed and an environmental review has been carried out to assess the potential environmental impacts associated with the latest construction options of selected sections of the BPPS Pipeline to confirm the environmental acceptability of these options making reference to the approved EIA Report (see ***Annex A*** for details). The latest construction methods at different sections of the BPPS pipeline route is shown in ***Figure 1.2***.

1.2 Objectives of the Pipeline Construction Plan

This *Pipeline Construction Plan* for the Project has been prepared in accordance with Condition 2.8 of the Further Environmental Permit FEP-03/558/2018.

(1) Application for variation of an environmental permit for FEP-01/558/2018 was undertaken and the latest FEP (FEP-01/558/2018/A) was issued on 6 November 2020.

(2) Application for variation of an environmental permit for FEP-02/558/2018 was undertaken and the latest FEP (FEP-02/558/2018/A) was issued on 22 December 2020.

FEP No. FEP-03/558/2018, Condition 2.8:

"The Permit Holder shall, no later than 1 month before the commencement of construction of the Project, submit 3 hard copies and 1 electronic copy of a pipeline construction plan of the Project to the Director for approval. The pipeline construction plan shall include but not limited to a detailed schedule, sequence and programme of different work fronts for carrying out the dredging and jetting works and cofferdam construction works for laying the subsea gas pipeline of the Project. The programming of the dredging and jetting works shall take into account the peak calving season of Chinese White Dolphin and peak occurrence season of Finless Porpoise, with a view to minimizing the impacts to marine ecology as far as practicable. The dredging and jetting works shall be carried out in accordance with the information as contained in the approved pipeline construction plan."

The key objective of this *Pipeline Construction Plan* is to include a detailed schedule, sequence and programme of different work fronts for carrying out the dredging and jetting works and cofferdam construction works for laying the subsea gas pipeline of the Project.

The *Pipeline Construction Plan* will be reviewed and updated as appropriate, throughout the course of the construction works to confirm that it remains current with the latest detailed information.

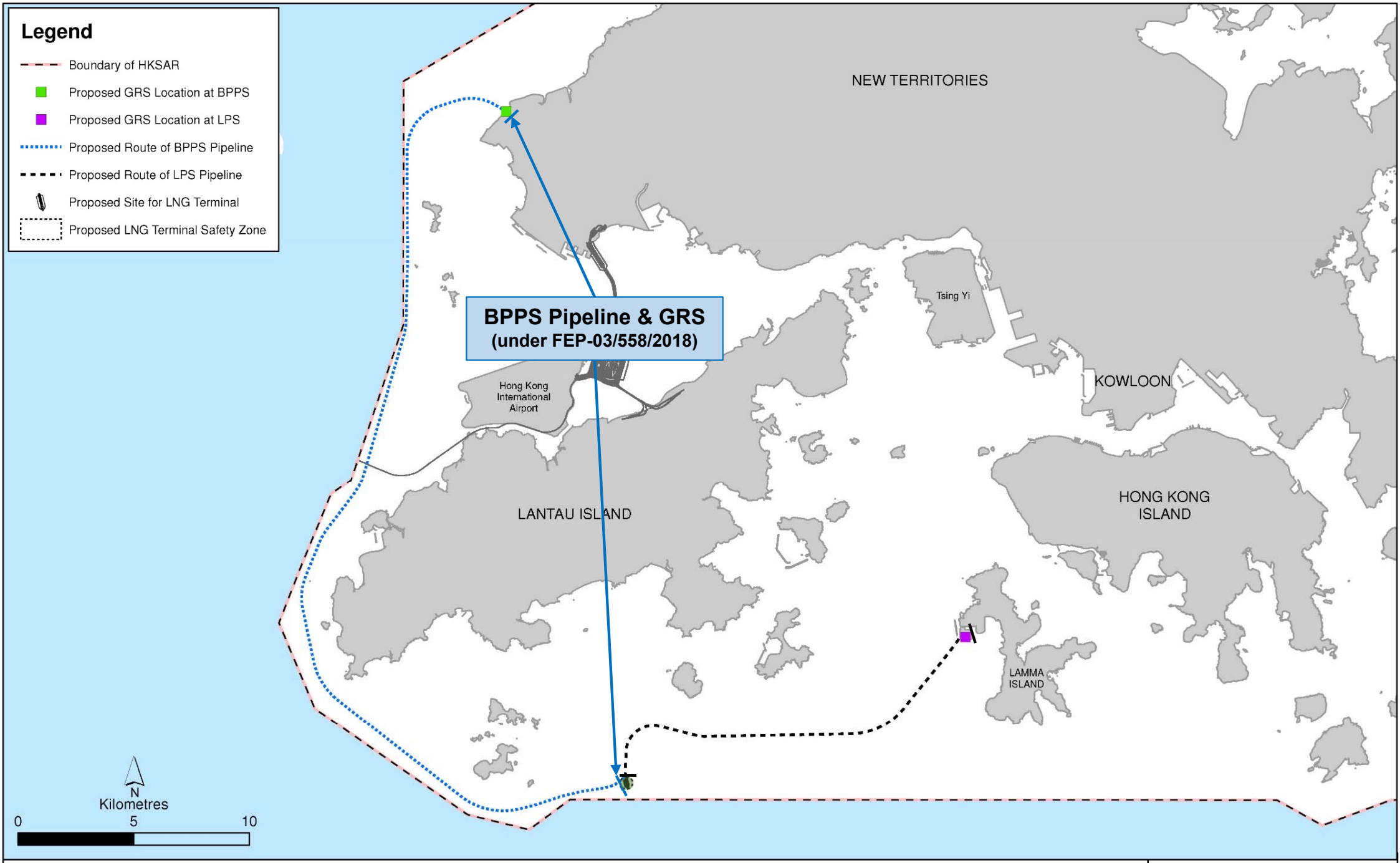

Figure 1.1

Indicative Location of Key Project Components

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Date: March 2020

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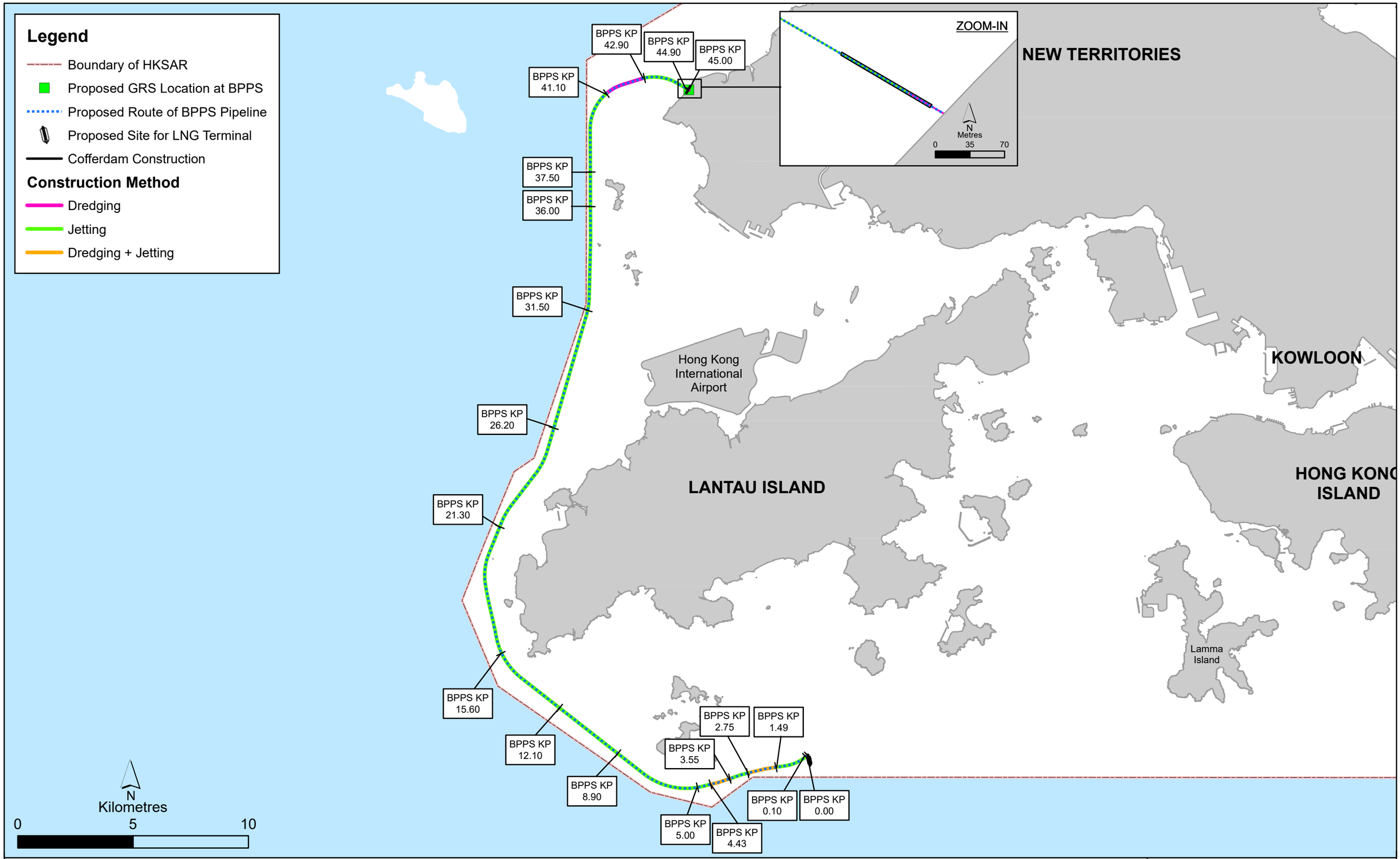

Figure 1.2

BPPS Pipeline Route and the Indicative Location of the Cofferdam

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Date: 27/10/2020

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2. SEQUENCE AND PROGRAMME AND DETAILED SCHEDULE FOR BPPS PIPELINE AND COFFERDAM CONSTRUCTION WORKS

2.1 Overall Approach for Minimising Impact to Marine Ecology

In developing the sequence and programme for the dredging and jetting works of the BPPS Pipeline as presented in *Figure 2.1*, EIA recommendations, conditions of the FEP, the peak calving season of Chinese White Dolphin (CWD) and peak occurrence season of Finless Porpoise (FP) have been taken into account, with a view to minimizing the impacts to marine ecology, in particular marine mammals, as far as practicable. It is also important to take into account the overall construction programme of the other components of the Project, including the construction of the LPS Pipeline, GRSs at the BPPS and the LPS and the LNG Terminal, such that the connections between each component could be made at the required time for operation of the Project in 2022 to support the HKSAR Government's 2020 emission initiatives and contribute to achieving Hong Kong's commitment to improving air quality and reducing carbon emissions. The following paragraphs present the considerations made in developing the detailed schedule for the BPPS Pipeline to minimise impact to marine ecology, in particular CWD and FP.

2.1.1 Work Front Management and Sequence of Work Programme

Generally for marine construction activities, it is important to reduce the number and size of works areas and total duration of marine works to limit potential short-term behavioural disturbance and / or displacement of marine mammals. The construction of the BPPS Pipeline will involve pre-trenching, pipe-laying, post-trenching and rock armour placement. Each activity is scheduled to take place within a period of about three to nine months as presented in *Figure 2.1*. In order to minimise potential short-term behavioural disturbance and / or displacement of marine mammals, the construction works for the BPPS Pipeline is planned to work 24 hours a day in some areas of the pipeline routes to shorten the total duration of marine works, such that marine mammals that have avoided the vicinity of the works areas can return to the area sooner. Also, although some locations to be impacted may have moderate to high ecological importance (e.g. the waters at the west of Lantau Island, the waters between Soko Islands and Shek Kwu Chau), the pipeline construction works for the BPPS Pipeline are planned to be undertaken at discrete work fronts, e.g. the pre-trenching works will be conducted at Jetty Approach (KP 0.0 – 0.1), at subsea cable sterile corridors (KP 1.49 – 2.75 & KP 3.55 – 4.43) and at Urmston Road (KP 41.1 – 42.9) in Q1 to Q2 2021 while the pipeline laying works will be conducted afterwards in Q1 to Q3 2021 upon completion of the pre-trenching works at the corresponding sections of the BPPS Pipeline (see *Figure 2.1* for the detailed schedule). The work activities will also be carried out in sequence, i.e. phased. The pre-trenching works will be conducted in Q1 to Q2 2021, followed by pipeline laying works in Q1 to Q3 2021, then post-trenching works in Q2 2021 to Q3 2022 and finally rock armour placement activities in Q3 2021 to Q3 2022 (see *Figure 2.1* for the detailed schedule). These activities will generally be conducted from the direction of Hong Kong Link Road (HKLR) (i.e. KP 25.1) towards the two ends of the BPPS Pipeline (i.e. BPPS GRS and the LNG Terminal) such that discrete work fronts will be maintained throughout the construction period. Therefore, not the entire lengths of the pipeline route would be disturbed at any one time because pipeline pre-trenching, pipe-laying, post-trenching and rock armour placement activities would be undertaken in sequence. Considering the temporary nature of the disturbance and with management of work fronts/sequence and the optimised works programme, impacts on marine mammals are expected to be of minor significance, except for sections of the BPPS Pipeline (between North of Tai O to Fan Lau, and between South of Soko Islands to LNG Terminal) where impact of minor to moderate significance is expected hence requiring mitigation. Upon cessation of the disturbance, no significant long-term change in marine mammal distribution, abundance and usage pattern in the wider Hong Kong waters is expected.

2.1.2 Mitigation Measures and Precautionary Measures for Marine Mammals

Findings from the EIA and the Review Report on Finless Porpoise Peak Occurrence Season [3] showed that FP exhibited the tendency for greater activity in late hours at night and very early hours at surveyed locations compared to daylight hours. Consequently to mitigate potential disturbance to FP especially in waters of moderate ecological importance between South of Soko Islands and LNG Terminal along the BPPS Pipeline (KP 0.0 – 8.9), pipeline dredging/ jetting works are scheduled to take place for 12 hours during daytime period (0700-1900) with marine mammal exclusion zone monitoring. Furthermore, as the peak calving season of CWD is found to be in May and June, pipeline dredging/ jetting works between North of Tai O and Fan Lau (KP15.6 – 21.3) in May and June will be avoided to minimise potential disturbance to CWD. Pipeline dredging/ jetting works for the remainder of the BPPS Pipeline would proceed with marine mammal exclusion zone monitoring for 24 hours a day to minimize the total works duration. With the implementation of such work arrangement during daytime period in waters of moderate ecological importance between South of Soko Islands and LNG Terminal along the BPPS Pipeline (KP 0.0 – 8.9), avoidance of pipeline dredging/ jetting works between North of Tai O and Fan Lau (KP15.6 – 21.3) in May and June and the effective implementation of marine mammal exclusion zone monitoring as precautionary measure over the duration of dredging / jetting works, no unacceptable impact to FP and CWD is expected.

The following mitigation measures have been considered in the development of sequence and programme for the BPPS Pipeline and will be implemented during the construction of the BPPS Pipeline to minimise impacts to marine ecology, in particular marine mammals.

- Pipeline dredging/ jetting works between North of Tai O and Fan Lau (KP15.6 – 21.3) will avoid the peak months of CWD calving (May and June);
- Pipeline dredging/ jetting works between South of Soko Islands and the LNG Terminal (KP0.0 – 8.9) will be restricted to a daily maximum of 12 hours with daytime (0700 – 1900) operations;
- The vessel operators of this Project will be required to use predefined and regular routes (that do not encroach into existing and proposed marine parks), make use of designated fairways to access the works areas, and would avoid traversing sensitive habitats such as existing and proposed marine parks. Predefined and regular routes will become known to FP and CWD using these waters. This measure will further serve to minimise disturbance to marine mammals due to vessel movements;
- Any anchoring/ anchor spread requirements during Project construction will avoid encroachment into the existing and proposed marine parks, unless otherwise agreed by the Director of Environmental Protection;
- Silt curtain deployment during Project construction will avoid encroachment into the existing and proposed marine park;
- No stopping over or anchoring activity of vessels related to the Project should be conducted within existing and proposed marine parks even before, during and after typhoon, unless otherwise agreed by the Director of Environmental Protection;
- Use of appropriate dredging and jetting rates with the use of silt curtain where needed as recommended in the Pipeline Laying Method Plan [4] to reduce potential water quality impacts from elevated SS due to the proposed marine works; and
- Silt curtain will be checked and maintained to ensure its effectiveness in mitigating water quality impacts on existing, planned and potential marine parks.

(3) ERM (2020) Review Report on Finless Porpoise Peak Occurrence Season. Submitted under FEP-01/558/2018/A.

(4) ERM (2020) Pipeline Laying Method Plan. Submitted under FEP-03/558/2018.

Apart from the mitigation measures above, the following precautionary measures have been considered in the development of sequence and programme for the BPPS Pipeline and will be implemented during the construction of the BPPS Pipeline to further reduce potential impacts on marine mammals:

- All vessel operators working on the Project will be given a briefing, alerting them to the possible presence of dolphins and porpoises in the marine works areas, and the guidelines for safe vessel operation in the presence of these animals. The vessels will avoid using high speed as far as possible. By observing the guidelines, vessels will be operated in an appropriate manner so that marine mammals will not be subject to undue disturbance or harassment;
- All vessels used in this Project will be required to slow down to 10 knots around the Project's marine works areas and areas with high dolphin and porpoise usage, including existing and proposed marine parks. With implementation of this measure, the chance of vessel strike resulting in physical injury or mortality of marine mammals will be extremely unlikely; and
- During marine dredging or jetting operations, a marine mammal exclusion zone within a radius of 250m from dredger or jetting machine will be implemented. Qualified observer(s) will scan an exclusion zone of 250m radius around the work area for at least 30 minutes prior to the start of dredging or jetting. If cetaceans or other megafauna are observed in the exclusion zone, dredging or jetting will be delayed until they have left the area. This measure will ensure the area in the vicinity of the dredging or jetting work is clear of marine mammals prior to the commencement of works and will serve to reduce any disturbance to marine mammals. When a marine mammal is spotted by qualified personnel within the exclusion zone, dredging or jetting works will cease and will not resume until the observer confirms that the zone has been continuously clear of the marine mammal for a period of 30 minutes. This measure will ensure the area in the vicinity of the works is clear of the marine mammal during works and will serve to reduce any disturbance to marine mammals. If necessary, for night-time works, exclusion zone monitoring for FP by underwater acoustic means would be explored to supplement the exclusion zone monitoring by trained observers. A site trial will be conducted to demonstrate its practicability/ effectiveness before actual implementation during the night-time works.

Marine mammal exclusion zone monitoring has been demonstrated to be effective in reducing disturbance to marine mammals and has been adopted in marine construction activities in Hong Kong. It is considered that the implementation of marine mammal exclusion zone monitoring will be effective in further reducing the disturbance of marine mammals during construction works at both daytime and night-time. Marine mammal exclusion zone monitoring has been adopted in marine construction activities in Hong Kong during both daytime and night-time, in particular the north Lantau waters where CWD is more abundant [5] [6] [7] [8]. Marine mammal exclusion zone monitoring has been demonstrated to be technically feasible, and also effective in reducing disturbance to marine mammals and there is no reported case of marine mammal injury / behavioural change due to marine construction works with the implementation of marine mammal exclusion zone monitoring.

It is important to note that in Hong Kong, many similar subsea pipelines and cables have been installed or permitted in marine mammal habitats. There is no evidence of significant residual impacts on marine mammals due to pipeline installation activities. This Project has adopted similar construction methodology and mitigation measures and with appropriate mitigation, potential impacts to marine mammals are deemed environmentally acceptable.

(5) Arup (2009) EIA Report for the Hong Kong - Zhuhai - Macao Bridge Hong Kong Boundary Crossing Facilities (Register No.: AEIAR-145/2009)

(6) AECOM (2009) EIA Report for the Tuen Mun - Chek Lap Kok Link (Register No.: AEIAR-146/2009)

(7) AECOM (2012) EIA Report for the Tung Chung New Town Extension (Register No.: AEIAR-196/2016)

(8) Mott MacDonald (2014) EIA Report for the Expansion of Hong Kong International Airport into a Three-Runway System (Register No.: AEIAR-185/2014).

2.1.3 Considerations to Minimise Impact to Chinese White Dolphins (CWD)

CWD generally sighted in West Lantau waters, especially the waters between Tai O and Fan Lau [9][10] and the peak calving season of CWD is found to be in May and June. In developing the detailed schedule for the BPPS Pipeline, such considerations of the avoidance of pipeline dredging/ jetting works between North of Tai O and Fan Lau (KP15.6 – 21.3) in May and June and reducing overall duration of exposure to marine construction works by marine mammals have been applied to effectively minimize impacts on marine mammals. As presented in the detailed schedule (*Figure 2.1*), dredging works at North of Tai O and Fan Lau (KP15.6 – 21.3) are not required for the BPPS Pipeline while jetting works at North of Tai O and Fan Lau (KP15.6 – 21.3) will be conducted in Q4 2021 to Q1 2022, avoiding the peak calving season of CWD in May and June. The pipeline construction works will be conducted in Q1 2021 for completion by Q4 2022 following the construction sequence and discrete work fronts as discussed in *Section 2.1.1* to limit potential short-term behavioural disturbance and / or displacement of marine mammals. The construction works for the BPPS Pipeline is planned to work 24 hours a day in some areas of the pipeline routes to shorten the total duration of marine works, such that marine mammals that have avoided the vicinity of the works areas can return to the area sooner. In addition, marine mammal exclusion zone monitoring will be implemented over the duration of dredging / jetting works to further reduce the disturbance of CWD, including the period of CWD peak calving season in May and June, during construction works at both daytime and night-time. Given the work activities are scheduled to avoid pipeline dredging/ jetting works between North of Tai O and Fan Lau (KP15.6 – 21.3) in May and June and they will be conducted in discrete work fronts and in sequence as discussed in *Section 2.1.1* with the implementation of the mitigation measures and precautionary measures as discussed in *Section 2.1.2*, including marine mammal exclusion zone monitoring, unacceptable impacts to CWD, including the period of CWD peak calving season in May and June, are not anticipated. Thus, potential impacts to CWD are deemed environmentally acceptable.

2.1.4 Considerations to Minimise Impact to Finless Porpoises (FP)

FP generally sighted in South Lantau and western Lamma waters around the Project area [11][12] and the peak occurrence season of FP has been reviewed and the period between January and June appears to be the peak months of porpoise occurrences for the waters in the vicinity of the LNG Terminal site [13]. In order to match with the overall construction programme with all the other components of the Project, it is unavoidable to carry out pipeline construction activities at the areas frequented by FP between South of Soko Islands and the proposed Jetty (i.e. KP0.0 – 8.9) during the FP peak occurrence season. In developing the detailed schedule for the BPPS Pipeline, the consideration reducing overall duration of exposure to marine construction works by marine mammals have been applied to effectively minimize impacts on marine mammals. As presented in the detailed schedule (*Figure 2.1*), the pipeline construction works will be conducted in Q1 2021 for completion by Q4 2022 following the construction sequence and discrete work fronts as discussed in *Section 2.1.1* to limit potential short-term behavioural disturbance and / or displacement of marine mammals. In addition, the construction programme for the BPPS Pipeline has been carefully considered to reduce the number and size of works areas by having discrete work fronts and phased work activities, optimised works programme by working 24 hours a day in some areas of the pipeline routes, as well as limiting pipeline dredging/ jetting works to take place for 12 hours during daytime period (0700-1900) at areas frequented by FP between South of Soko

(9) AFCD (2020) Monitoring of Marine Mammals in Hong Kong Waters (2019-2020). Prepared by Hong Kong Cetacean Research Project.

(10) ERM (2018) EIA Report for the Hong Kong Offshore LNG Terminal (Register No.: AEIAR-218/2018).

(11) AFCD (2020) *Op cit.*

(12) ERM (2018) *Op cit.*

(13) ERM (2020) *Op cit.*

Islands and the proposed Jetty (i.e. KP0.0 – 8.9) and the implementation of marine mammal exclusion zone monitoring as explained in *Section 2.1.1* and *Section 2.1.2*. Thus, potential impacts to FP are deemed environmentally acceptable.

2.1.5 Summary

Overall, reducing the overall duration of exposure to marine construction works by marine mammals is an effective approach to minimize impacts on these animals. Scheduling construction programme with the consideration of the peak calving season of CWD in May and June and peak season of FP, restricting the daily maximum working hours, and implementation of a marine mammal exclusion zone by which marine works would cease temporarily whenever a marine mammal is sighted inside the zone are appropriate measures for the BPPS Pipeline to achieve the purpose of impact avoidance and minimization. The detailed schedule for the construction of the BPPS Pipeline has been developed based on the above considerations, as well as the overall construction programme of the other components of the Project to support the HKSAR Government's 2020 emission initiatives and contribute to achieving Hong Kong's commitment to improving air quality and reducing carbon emissions.

2.2 Detailed Schedule

Taking into account the considerations as discussed in *Section 2.1*, the BPPS Pipeline and cofferdam will be constructed based on the sequences and procedures below for both preparation and construction phases. The detailed schedule is outlined in ***Figure 2.1***. Key mitigation measures and working rates for construction of the BPPS Pipeline are summarized in ***Table 2.1***.

2.2.1 Preparation Phase

- Pre-survey;
- Geological investigation works; and
- Removal of obstructions.

2.2.2 Construction Phase

- Pre-trenching, including deployment of silt curtain and pilot test to be conducted during the early stage of pre-trenching works – pre-trenching works will be conducted by grab dredger with the following planned sequences:
    1. Urmston Road (KP41.1 – 42.9);
    2. Subsea Cable Sterile Corridors (KP1.49 – 2.75 & KP3.55 – 4.43);
    3. Pipeline Riser (KP0.0 – 0.1);
- Cofferdam and sheet pile construction – cofferdam will be constructed by inserting sheet piles to the seabed near the pipeline shore approach at BPPS as shown in ***Figure 1.2***, grab dredging for pipeline shore approach at BPPS (KP44.9 – 45.0) will then be carried out;
- Pipeline laying – pipeline laying will be conducted using two pipeline laying vessels. One vessel will conduct pipeline laying from Hong Kong Link Road (HKLR) towards BPPS (KP 25.1 – 44.9) while the other vessel will conduct pipeline laying from HKLR towards the Jetty (KP25.1 – 0.0). Riser installation at the Jetty will then be conducted;
- Post-trenching, including deployment of silt curtain and pilot test to be conducted during the early stage of post-trenching works – post-trenching works will be conducted by jetting machine with the following planned sequences:
    1. HKLR to West of HKIA (KP25.1-31.5);
    2. Sha Chau to Lung Kwu Chau (KP31.5 – 37.5);

Figure 2.1 Detailed Schedule of Pipeline Construction Works

Node	WORK	Q3 2020	Q4 2020	Q1 2021	Q2 2021	Q3 2021	Q4 2021	Q1 2022	Q2 2022	Q3 2022	Q4 2022
Preparation Phase											
1	Pre-survey										
2	Geological investigation works										
3	Removal of obstructions										
Construction Phase											
	Pre-trenching including Deployment of Silt Curtain and Pilot Test										
4	Urmston Road (KP41.1 – 42.9)										
5	Subsea Cable Sterile Corridors (KP1.49 – 2.75 & KP3.55 – 4.43)										
6	Pipeline Riser (KP0.0 – 0.1)										
7	**Cofferdam and Sheet Pile Construction**										
	Pipeline Laying										
8	Shallow water pipeline laying from Hong Kong Link Road (HKLR) towards BPPS (KP 25.1 – 44.9)										
9	Deep water pipeline laying from Hong Kong Link Road (HKLR) towards Jetty (KP25.1 – 0)										
10	Riser installation (Stalk on)										
	Post-trenching including Deployment of Silt Curtain and Pilot Test										
11	HKLR to West of HKIA (KP25.1-31.5)										
12	Sha Chau to Lung Kwu Chau (KP31.5 – 37.5)										
13	Lung Kwu Chau to Urmston Anchorage (KP37.5 – 41.1)										
14	West of BPPS (KP42.9 – 44.9)										
15	HKLR to Southwest Lantau (KP25.1 – 15.6)										
16	Adamasta Channel to Southwest of Soko Islands (KP15.6 – 8.9)										
17	South of Soko Islands (KP5.0 – 8.9)										
18	Subsea Cable Sterile Corridors (KP1.49 – 2.75 & KP3.55 – 4.43)										
19	Jetty Approach (KP0.1 – 5.0), excluding Subsea Cable Sterile Corridors										
	Rock Armour Placement										
20	Shallow water rock armour from Hong Kong Link Road (HKLR) towards BPPS (KP 25.1 – 44.9)										
21	Deep water rock armour from Hong Kong Link Road (HKLR) towards Jetty (KP25.1 – 0)										
22	**Intermediate and Final Hydrotesting for Pipeline**										

Remarks:
1. No construction works for the section of subsea gas pipeline between North of Tai O and Fan Lau shall be carried out in the months of May and June (to avoid the peak calving season of Chinese White Dolphin).
2. No construction works for the section of subsea gas pipeline between South of Soko Islands and the jetty shall be carried out from 1900 hours to 0700 hours of the following day (to avoid construction works at night-time when Finless Porpoise exhibits tendency for greater activity).
3. A marine mammal exclusion zone of not less than 250m radius from the dredging and jetting works shall be implemented during the construction work for the subsea gas pipeline. No dredging or jetting works shall be carried until the marine mammal exclusion zone is confirmed by an experienced marine mammal observer as clear of marine mammals for 30 minutes continuously.
4. Pilot tests on the efficiency of silt curtain system shall be conducted during the early stage of construction to confirm the removal efficiency of the silt curtains.

3. Lung Kwu Chau to Urmston Anchorage (KP37.5 – 41.1);
4. West of BPPS (KP42.9 – 44.9);
5. HKLR to Southwest Lantau (KP25.1 – 15.6);
6. Adamasta Channel to Southwest of Soko Islands (KP15.6 – 8.9);
7. South of Soko Islands (KP5.0 – 8.9);
8. Subsea Cable Sterile Corridors (KP1.49 – 2.75 & KP3.55 – 4.43);
9. Jetty Approach (KP0.1 – 5.0), excluding Subsea Cable Sterile Corridors;

- Rock armour placement – rock armour placement will be conducted using two vessels (derrick lighter or equivalent). One vessel will place rock armour from HKLR towards BPPS (KP 25.1 – 44.9) while the other vessel will conduct pipeline laying from HKLR towards the Jetty (KP25.1 – 0.0); and
- Pipeline hydrotesting – hydrotesting will be conducted at two stages:
  1. intermediate hydrotesting will be conducted and the hydrotest water will remain in the pipeline until completion of final hydrotesting;
  2. final hydrotesting to be conducted upon completion of rock armour placement and the hydrotest water will be discharged at the end of pipe at the Jetty (KP 0.0).

Table 2.1 Mitigation Measures for the BPPS Pipeline Construction Works

Work Location	Types and No. of Plant Involved	Allowed Maximum Work Rate	Silt Curtain at Plants	Silt Curtain at Water Sensitive Receivers (WSRs)	Other Measures
Pipeline Riser (KP0.0 – 0.1)	1 Grab Dredger	8,000m^3 day^{-1} for 24 hours each day	Yes	Not required	Daily maximum of 12 hours with daylight (0700 – 1900)
Jetty Approach (KP0.1 – 5.0), excluding Subsea Cable Sterile Corridors	1 Jetting Machine	1,000m day^{-1} for 24 hours each day	Yes	Not required for grab dredging; Two layers at Southern Boundary of the proposed South Lantau Marine Park (KP0.1 – 8.9) for jetting	Daily maximum of 12 hours with daylight (0700 – 1900)
Subsea Cable Sterile Corridors (KP1.49 – 2.75 & KP3.55 – 4.43)	2 Grab Dredgers, followed by 1 Jetting Machine	8,000m^3 day^{-1} for 24 hours each day for each dredger 720m day^{-1} for 24 hours each day for jetting machine	Yes		
South of Soko Islands (KP5.0 – 8.9)	1 Jetting Machine	1,000m day^{-1} for 24 hours each day	Yes		
Southwest of Soko Islands (KP8.9 – 12.1)	1 Jetting Machine	1,000m day^{-1} for 24 hours each day	Yes	Not required	
Adamasta Channel (KP12.1 – 15.6)	1 Jetting Machine	1,000m day^{-1} for 24 hours each day	Yes	Not required	

Work Location	Types and No. of Plant Involved	Allowed Maximum Work Rate	Silt Curtain at Plants	Silt Curtain at Water Sensitive Receivers (WSRs)	Other Measures
Southwest Lantau (KP15.6 – 21.3)	1 Jetting Machine	1,500m day^{-1} for 24 hours each day	Yes	Not required	Avoid the peak months of Chinese White Dolphin (CWD) calving (May and June)
West of Tai O to West of HKIA (KP21.3 – 31.5)	1 Jetting Machine	1,500m day^{-1} for 24 hours each day from KP26.2 to 21.3 720m day^{-1} for 24 hours each day from KP31.5 to 26.2	Yes	Not required	
Sha Chau to Lung Kwu Chau (KP31.5 – 36.0)	1 Jetting Machine	720m day^{-1} for 24 hours each day	Yes	Two layers at Western Boundary of the Sha Chau and Lung Kwu Chau Marine Park (KP31.5 – 36.0)	
Sha Chau to Lung Kwu Chau (KP36.0 – 37.5)	1 Jetting Machine	720m day^{-1} for 24 hours each day	Yes	Two layers at Western Boundary of Sha Chau and Lung Kwu Chau Marine Park (KP36.0 – 37.5)	
Lung Kwu Chau to Urmston Anchorage (KP37.5 – 41.1)	1 Jetting Machine	1,000m day^{-1} for 24 hours each day	Yes	Two layers at NW corner of Sha Chau and Lung Kwu Chau Marine Park (KP37.5 – 41.1)	
Urmston Road (KP41.1 – 42.9)	1 Grab Dredger	8,000m^3 day^{-1} for 24 hours each day	Yes	Not required	
West of BPPS (KP42.9 – 44.9)	1 Jetting Machine	1,000m day^{-1} for 24 hours each day	Yes	Two layers at CR1, CR2 (Note 1)	
Pipeline shore approach at BPPS (KP44.9 – 45.0)	1 Grab Dredger	1,500m^3 day^{-1} for 24 hours each day	Yes	Two layers at CR1, CR2 (Note 1)	

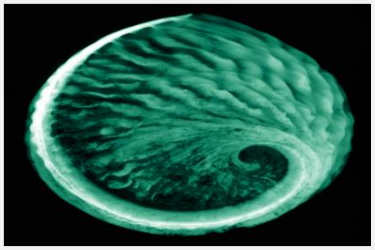
Note: (1) CR1 and CR2 denote the coral colonies identified at the artificial seawall at BPPS.

ANNEX A

ENVIRONMENTAL REVIEW REPORT FOR THE BPPS PIPELINE CONSTRUCTION OPTIONS







Capco 青山發電有限公司 Castle Peak Power Co. Ltd.

Hong Kong Offshore LNG Terminal Project

Environmental Review Report for the BPPS Pipeline Construction Options

27 July 2020

Project No.: 0505354

The business of sustainability

ERM

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27 July 2020

Hong Kong Offshore LNG Terminal Project

Environmental Review Report for the BPPS Pipeline Construction Options

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1. INTRODUCTION

1.1 Background

To support the increased use of natural gas in Hong Kong from 2020 onwards, CLP Power Hong Kong Limited (CLP) and The Hongkong Electric Co., Ltd. (HK Electric) have identified that the development of an offshore liquefied natural gas (LNG) receiving terminal in Hong Kong using Floating Storage and Regasification Unit (FSRU) technology ('the Project') presents a viable additional gas supply option that can access competitive gas supplies from world markets. The Project will involve the construction and operation of an offshore LNG import facility to be located in the southern waters of Hong Kong, a double berth jetty, and subsea pipelines that connect to the gas receiving stations (GRS) at the Black Point Power Station (BPPS) and the Lamma Power Station (LPS).

According to the approved Environmental Impact Assessment (EIA) Report (EIAO Register No. AEIAR-218/2018), the installation of subsea gas pipeline will involve primarily jetting, supplemented by dredging with grab dredgers and potentially trailing suction dredger hopper (TSHD). The jetting and dredging areas of the BPPS Pipeline and LPS Pipeline proposed in the approved EIA Report are shown in *Figure 1.1*. Sediment dispersion modelling study and assessments were conducted in the EIA to evaluate the potential environmental impact as a result of subsea pipeline installation. With the implementation of proposed mitigation measures, no unacceptable residual environmental impact from subsea pipeline installation works is expected.

As the BPPS Pipeline design progresses and in further discussion with relevant Subsea Cable Owners on subsea pipeline / cable crossings as mentioned in Section 2.3.3 and Section 3.4.3 of the approved EIA Report, the construction methods of the BPPS Pipeline have been reviewed and the latest construction methods at different sections of the BPPS pipeline route is shown in *Figure 1.2*. Some potential options of BPPS Pipeline construction methods have been proposed:

- Jetting at Sha Chau to Lung Kwu Chau (KP36.0 - 37.5);
- Jetting at Southwest Lantau (KP15.6 - 21.3); and
- Dredging and/or jetting two segments ("subsea cable sterile corridors") within the Jetty Approach (KP1.49 to KP2.75 and KP3.55 to KP4.43) (*Figure 1.3*).

The above construction options are not covered in the assessments and water quality modelling scenarios included in the approved EIA Report. Therefore quantitative modelling have been completed and supplementary assessments conducted to confirm the environmental acceptability of these options making reference to the approved EIA Report.

1.2 Purpose of this Report

This *Environmental Review Report* (ERR) is prepared to provide the details for the above options of BPPS Pipeline construction methods, and review the likely environmental impacts assessed in the approved EIA Report based on these options. In particular, it outlines the corresponding water quality modelling scenarios and assumptions to assess water quality impacts, as well as the results of the modelling assessment. Unless otherwise specified, the water quality model, modelling assumptions, water quality sensitive receivers and assessment criteria adopted in the approved EIA Report are followed. This ERR also provides recommendations as to whether any modification and/or refinement of proposed mitigation measures and monitoring and audit requirements is needed.

1.3 Structure of this Report

Following this introductory section, the remainder of this ERR is organized as follows:

- Section 2 describes the BPPS Pipeline construction methods proposed in the approved EIA Report, and the corresponding modelling assumptions and scenarios adopted;

- Section 3 presents the proposed construction options for selected sections of the BPPS Pipeline, and the modelling assumptions and scenarios for these proposed construction options;
- Section 4 describes the potential impacts associated with the proposed construction options, presents the results of water quality modelling, and provides the results of supplementary environmental assessments;
- Section 5 includes a review of the environmental monitoring and audit requirements for the construction of the BPPS Pipeline; and
- Section 6 provides the conclusions of this environmental review.

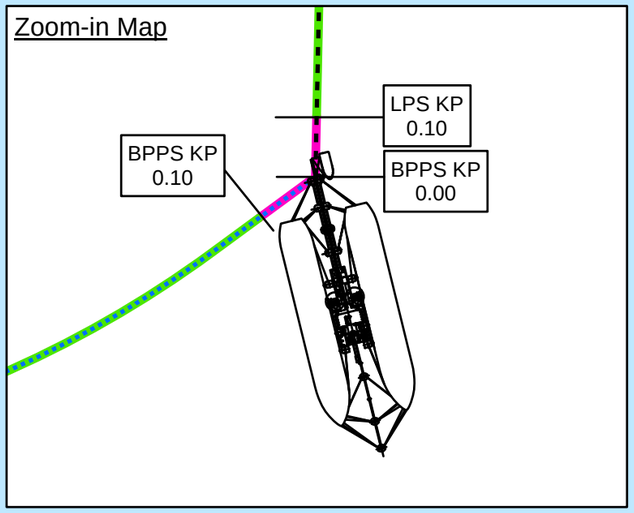
Legend

- Boundary of HKSAR
- Proposed GRS Location at BPPS
- Proposed GRS Location at LPS
- Proposed Route of BPPS Pipeline
- Proposed Route of LPS Pipeline
- Proposed Site for LNG Terminal

Construction Method

- Dredging
- Jetting

Zoom-in Map



NEW TERRITORIES

KOWLOON

HONG KONG ISLAND

LANTAU ISLAND

Hong Kong International Airport

Lamma Island

BPPS KP 42.90
BPPS KP 44.90
BPPS KP 45.00
BPPS KP 41.10
BPPS KP 39.50
BPPS KP 37.50
BPPS KP 36.00
BPPS KP 31.50
BPPS KP 26.20
BPPS KP 21.30
BPPS KP 15.60
BPPS KP 12.10
BPPS KP 8.90
BPPS KP 5.00
BPPS KP 0.10
BPPS KP 0.00
LPS KP 0.10
LPS KP 5.00
LPS KP 14.60
LPS KP 17.40

N

Kilometres

0 5 10

Figure 1.1

Overview of Project Pipeline Construction Methods proposed in the Approved EIA Report

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Date: 31/1/2019

Environmental Resources Management

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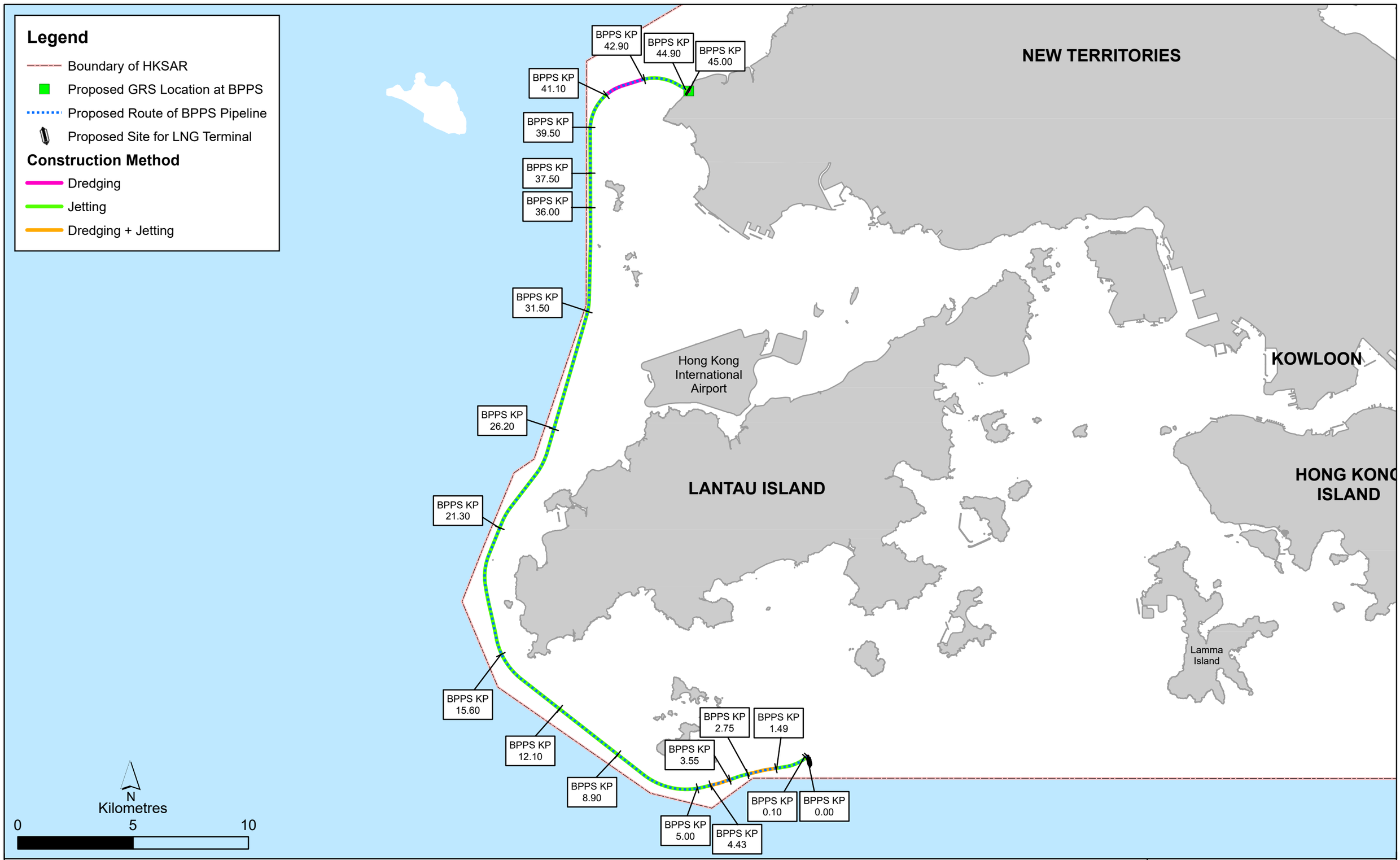

Figure 1.2

Latest Construction Methods for the BPPS Pipeline Route

File: T:\GIS\CONTRACT\0505354\mxd\0505354_BBPS_Pipeline_v2.mxd
Date: 17/6/2020

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BPPS KP 1.49

BPPS KP 2.75

BPPS KP 3.55

BPPS KP 4.43

Potential Dredging Extent

Potential Dredging Extent

Legend

- Boundary of HKSAR
- Proposed Site for LNG Terminal
- Proposed Route of BPPS Pipeline
- Proposed Route of LPS Pipeline

Construction Method

- Potential Dredging
- Jetting
- Submarine Cables

N

Metres

0 500 1,000

Figure 1.3

Location of Potential Dredging Extent at the Subsea Cable Sterile Corridors

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Date: 1/11/2019

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2. BPPS PIPELINE CONSTRUCTION METHODS IN THE APPROVED EIA REPORT

2.1 Introduction

Major water quality modelling scenarios and assumptions adopted in the EIA study were provided in *Annex 7B* of the approved EIA Report. The following sections highlight the key assumptions adopted and modelling scenarios assessed for the construction of the BPPS Pipeline.

2.2 Proposed Construction Methods

In the approved EIA Report, marine construction works for the installation of the BPPS Pipeline was assumed to be conducted using jetting, grab dredging as well as TSHD dredging. The use of different construction methods are summarized in *Table 3.3* of the *Annex 7B* of the approved EIA Report and the relevant information for the BPPS Pipeline is recapped in *Table 2.1*.

Table 2.1 Works Programme at Different Sections of the BPPS Pipeline

Location (Kilometer Point)	Plant Used	Work Rate (m^3/day) (1)	Working Hours per Day assumed for modelling
Pipeline Riser Sections at Double Berth Jetty			
Pipeline Riser (KP0.0 – 0.1 for both pipelines)	1 Grab Dredger	8,000	24
From Double Berth Jetty to BPPS			
Jetty Approach (KP0.1 – 5.0)	1 Jetting Machine	1,000m/day	24
South of Soko Islands (KP5.0 – 8.9)	1 Jetting Machine	1,000m/day	24
Southwest of Soko Islands (KP8.9 - 12.1)	1 Jetting Machine	1,000m/day	24
Adamasta Channel (KP12.1 - 15.6)	1 Jetting Machine	1,000m/day	24
Southwest Lantau (KP15.6 - 21.3)	2 Grab Dredgers OR 1 TSHD (2)	Total 16,000 OR 57,600	24
West of Tai O to West of HKIA (KP21.3 – 31.5)	1 Jetting Machine	1,500m/day	24
Sha Chau to Lung Kwu Chau (KP31.5 - 36.0)	1 Jetting Machine	720m/day	24
Sha Chau to Lung Kwu Chau (KP36.0 – 37.5)	1 Grab Dredger	8,000	24
Lung Kwu Chau to Urmston Anchorage (37.5 - 41.1)	1 Jetting Machine	1,000m/day	24
Urmston Road (KP41.1 – 42.9)	1 Grab Dredger OR 1 TSHD (2)	8,000 OR 64,800	24
West of BPPS (KP42.9 - 44.9)	1 Jetting Machine	1,000m/day	24
Pipeline shore approach at BPPS (KP44.9 - 45.0)	1 Grab Dredger	1,500	24

Note:
(1) For jetting, the values provided are in m/day.
(2) TSHD: trailing suction hopper dredger

2.3 Modelling Assumptions and Scenario Adopted

Sediment loss rate and discharge behaviour for sediment dispersion modelling were determined based on the proposed construction methods and plants used. Major modelling assumptions adopted for modelling scenarios are summarized in *Table 3.5* of the *Annex 7B* of the approved EIA Report and the relevant information for the BPPS Pipeline is recapped in *Table 2.2*.

Table 2.2 Summary of Modelling Sediment Sources for the BPPS Pipeline – Unmitigated Scenarios of the Approved EIA Report

Sediment Source ID	Location (Kilometer Point)	Plant Used	Work Rate (m^3/day) (1)	Sediment Loss Rate (kg/s) (2)
	Pipeline Riser Sections at Double Berth Jetty			
03_G	Pipeline Riser (KP0.0 – 0.1 for both pipelines)	Grab Dredger	8,000	1.8519
	From Double Berth Jetty to BPPS			
04_J_A	Jetty Approach (KP0.1 - 5.0)	Jetting Machine	1,000m/day	25.9259
04_J_B	South of Soko Islands (KP5.0 - 8.9)	Jetting Machine	1,000m/day	25.9259
04_J_C	Southwest of Soko Islands (KP8.9 - 12.1)	Jetting Machine	1,000m/day	25.9259
04_J_D	Adamasta Channel (KP12.1 - 15.6)	Jetting Machine	1,000m/day	25.9259
05_G	Southwest Lantau (KP15.6 - 21.3) – Location 1	Grab Dredger	8,000	1.8519
06_G	Southwest Lantau (KP15.6 - 21.3) – Location 2	Grab Dredger	8,000	1.8519
05_T	Southwest Lantau (KP15.6 - 21.3)	TSHD	57,600	10.6667
07_J	West of Tai O to West of HKIA (KP21.3 – 31.5)	Jetting Machine	1,500m/day	38.8889
08_J	Sha Chau to Lung Kwu Chau (KP31.5 - 36.0)	Jetting Machine	720m/day	18.6667
09_G	Sha Chau to Lung Kwu Chau (KP36.0 - 37.5)	Grab Dredger	8,000	1.8519
10_J	Lung Kwu Chau to Urmston Anchorage (KP37.5 - 41.1)	Jetting Machine	1,000m/day	25.9259
11_G	Urmston Road (KP41.1 – 42.9)	Grab Dredger	8,000	1.8519
11_T	Urmston Road (KP41.1 – 42.9)	TSHD	64,800	10.6667
12_J	West of BPPS (KP42.9 - 44.9)	Jetting Machine	1,000m/day	25.9259
13_G	Pipeline landing at BPPS (KP44.9 - 45.0)	Grab Dredger	1,500	0.3472

Note:
(1) For jetting, the values provided are in m/day.
(2) Effect of mitigation measures not taken into account.

Water quality modelling predicted that, without mitigation, dredging and jetting works of the BPPS Pipeline would result in suspended solids (SS) level that would exceed the corresponding assessment criterion based on the Water Quality Objectives (WQO) at certain water sensitive receivers (WSRs). Mitigation measures, such as work rate reduction, provision of silt curtain at sediment sources and WSRs are recommended to manage water quality impacts to within acceptable levels. In addition, to mitigate potential impacts on marine mammals/ marine parks, pipeline dredging/ jetting works between North of Tai O and Fan Lau will avoid the peak months of Chinese White Dolphin (CWD) calving (May and June), and pipeline dredging / jetting works between South of Soko Islands and the Offshore LNG Terminal will be restricted to a daily maximum of 12 hours with daytime (0700 – 1900) operations. Key mitigation measures as well as working rates are summarized in *Table 7.18* of the approved EIA Report and the relevant information for the BPPS Pipeline is recapped in *Table 2.3*.

Table 2.3 Mitigation Measures for the BPPS Pipeline Construction Works

Work Location	Plants Involved	Allowed Maximum Work Rate	Silt Curtain at Plants	Silt Curtain at WSRs	Other Measures
Pipeline Riser (KP0.0 – 0.1)	1 Grab Dredger	8,000 m^3 day^{-1} for 24 hours each day	Yes	Not required	Daily maximum of 12 hours with daylight (0700 – 1900)
Jetty Approach (KP0.1 – 5.0)	1 Jetting Machine	1,000 m day^{-1} for 24 hours each day	Yes	Two layers at Southern Boundary of the Proposed South Lantau MP (KP0.1-8.9)	Daily maximum of 12 hours with daylight (0700 – 1900)
South of Soko Islands (KP5.0 – 8.9)	1 Jetting Machine	1,000 m day^{-1} for 24 hours each day	Yes		
Southwest of Soko Islands (KP8.9 - 12.1)	1 Jetting Machine	1,000 m day^{-1} for 24 hours each day	Yes	Not required	
Adamasta Channel (KP12.1 - 15.6)	1 Jetting Machine	1,000 m day^{-1} for 24 hours each day	Yes	Not required	
Southwest Lantau (KP15.6 - 21.3)	2 Grab Dredgers	Total 16,000 m^3 day^{-1} for 24 hours each day 8,000 m^3 day^{-1} for each plant	Yes	Not required	Avoid the peak months of CWD calving (May and June)
	1 TSHD (Alternative)	57,600 m^3 day^{-1} for 24 hours each day	Not required	Not required	
West of Tai O to West of HKIA (KP21.3 – 31.5)	1 Jetting Machine	1,500 m day^{-1} for 24 hours each day from KP KP26.2 to 21.3 720 m day^{-1} for 24 hours each day from KP31.5 to 26.2	Yes	Not required	
Sha Chau to Lung Kwu Chau (KP31.5 – 36.0)	1 Jetting Machine	720 m day^{-1} for 24 hours each day	Yes	Two layers at Western Boundary of the Sha Chau and Lung Kwu Chau MP (KP31.5-36.0)	
Sha Chau to Lung Kwu Chau (KP36.0 - 37.5)	1 Grab Dredger	8,000 m^3 day^{-1} for 24 hours each day	Yes	Not required	
Lung Kwu Chau to Urmston Anchorage (37.5 - 41.1)	1 Jetting Machine	1,000 m day^{-1} for 24 hours each day	Yes	Two layers at NW corner of Sha Chau and Lung Kwu Chau MP (KP37.5-41.1)	
Urmston Road (KP41.1 – 42.9)	1 Grab Dredger	8,000 m^3 day^{-1} for 24 hours each day	Yes	Not required	
	1 TSHD (Alternative)	64,800 m^3 day^{-1} for 24 hours each day	Not required	Not required *	
West of BPPS (KP42.9 - 44.9)	1 Jetting Machine	1,000 m day^{-1} for 24 hours each day	Yes	Two layers at CR1, CR2	
Pipeline shore approach at BPPS (KP44.9 - 45.0)	1 Grab Dredger	1,500 m^3 day^{-1} for 24 hours each day	Yes	Two layers at CR1, CR2	

* The predicted sediment plume from grab dredging/ TSHD at this section would not reach CR1 and CR2 at the BPPS seawall, therefore additional silt curtain at CR1 and CR2 is not required.

3. PROPOSED CONSTRUCTION OPTIONS FOR SELECTED SECTIONS OF THE BPPS PIPELINE

3.1 Subsea Cable Sterile Corridors

In further discussion with relevant Subsea Cable Owners on subsea pipeline / cable crossings as mentioned in Section 2.3.3 and Section 3.4.3 of the approved EIA Report, two segments (KP1.49 to KP2.75 and KP3.55 to KP4.43) within the Jetty Approach Section of the BPPS Pipeline are proposed to be provided as "subsea cable sterile corridors" to cater for installation of future new subsea telecommunications cables. It is understood that future cables shall be buried at about 5m below the existing seabed level. Consequently along the subsea cable sterile corridors the BPPS Pipeline is required to be buried at about 8m (bottom of pipe) below the existing seabed level.

A number of construction options have been proposed to achieve the required burial depth at the subsea cable sterile corridors (*Table 3.1*):

- Option 1 involves jetting only to bury the pipeline to the required burial depth (about 8 m below seabed level); and
- Option 2 involves grab dredging to remove the sediment near the seabed (down to 1.5 m below seabed level), followed by jetting to install the pipeline to the required burial depth (about 8.5 m below seabed level).

Table 3.1 Works Programme at Selected Sections of the BPPS Pipeline

Location (Kilometer Point)	Plant Used	Work Rate (m^3/day) (1)	Working Hours per Day assumed for modelling
Subsea Cable Sterile Corridors			
Jetty Approach (KP0.1 - 1.49, KP2.75 - 3.55 and KP4.43 - 5.0)	1 Jetting Machine	1,000m/day	24
Cable sterile corridors (KP1.49 - 2.75 and KP3.55 - 4.43)	Option 1: 1 Jetting Machine OR	720m/day	24
	Option 2: 2 Grab Dredgers, followed by 1 Jetting Machine	8,000 for each dredger; 720m/day for jetting machine	
South of Soko Islands (KP5.0 – 8.9)	1 Jetting Machine	1,000m/day	24
Southwest of Soko Islands (KP8.9 - 12.1)	1 Jetting Machine	1,000m/day	24
Adamasta Channel (KP12.1 - 15.6)	1 Jetting Machine	1,000m/day	24
Alternative Construction Method			
Southwest Lantau (KP15.6 - 21.3)	1 Jetting Machine	1,500m/day	24
Sha Chau to Lung Kwu Chau (KP36.0 - 37.5)	1 Jetting Machine	720m/day	24

Note:
(1) For jetting, the values provided are in m/day.

Based on the results of the pipeline bending stress analysis, the maximum burial depth for a single jetting pass is limited to 3m. It is not possible to achieve the required pipeline burial depth (~ 8m

bottom of pipe) with a single jetting pass. Hence, multiple passes of jetting will be necessary to bury the pipeline to 8m and each jetting pass will be kept within the limits of pipeline bending stress to protect the pipeline from breakage. Considering the maximum jetting depth for a single pass due to pipeline stress:

- Option 1 involves five (Option 1a) to seven (Option 1b) jetting passes to achieve the proposed pipeline burial depth; and
- The jetting portion of Option 2 involves seven passes to achieve the proposed pipeline burial depth.

The proposed trench configuration for each jetting pass has also been developed for the potential construction options. This is to allow for a more realistic presentation of sediment loss among successive jetting passes. For water quality modelling, the sediment loss rates associated with jetting along the subsea cable sterile corridors are calculated based on successive increase in trench cross section area per pass, assuming 100% fluidization of the trench per pass. Jetting cross-section areas and the sediment loss rates for modelling are listed in *Table 3.2*. Based on the modelling results from the approved EIA Report, mitigation measures in form of silt curtain at the jetting machine would be required to manage water quality impacts. The same sediment removal efficiency as the approved EIA Report (85% removal) has been adopted for the calculation in *Table 3.2*.

Table 3.2 Jetting Trench Cross-sectional Area and Associated Sediment Loss Rate at the Subsea Cable Sterile Corridors

Option	Data	Jetting Pass #						
		1	2	3	4	5	6	7
Option 1a (Jetting only, 5 passes)	Cross-sectional Area (m^2)	13.5	27.0	40.3	52.3	64.0	N/A	N/A
	Sediment Loss Rate (kg/s)	2.363	4.725	7.053	9.153	11.200	N/A	N/A
Option 1b (Jetting only, 7 passes)	Cross-sectional Area (m^2)	8.0	17.5	30.0	43.4	52.1	57.8	64.0
	Sediment Loss Rate (kg/s)	1.400	3.063	5.250	7.595	9.118	10.115	11.200
Option 2 (Grab Dredging followed by Jetting)	Cross-sectional Area (m^2)	7.0 (1)	15.5	23.3	30.7	38.1	44.9	50.8
	Sediment Loss Rate (kg/s)	1.225 (1)	2.713	4.078	5.373	6.668	7.858	8.890

Note:

(1) Sample calculation for sediment loss rate: Jetting Rate (m/s) × Cross Section of Jetting Trench (m^3/m) × % Mud Entrained × Dry Mud Density (kg/m^3) × (1 - Silt Curtain Efficiency) = 0.00833 m/s × 7 m^3/m × 20% × 700 (kg/m^3) × (1 – 85%) = 1.225 kg/s

(2) Design drawings showing the trench designs of Options 1a, 1b and 2 are provided in *Appendix C*.

3.2 Alternative Construction Method

Further engineering study of the BPPS Pipeline has identified that along the West of Lung Kwu Chau and Southwest Lantau pipeline segments, besides dredging, the use of jetting is also considered

feasible from engineering perspective [(1)]. The use of jetting along these two segments can further reduce the dredged sediment volumes associated with the construction of the Project, and may be preferred where allowable in the context of WQO compliance. The proposed jetting rates for pipeline installation in these two segments are summarised in *Table 3.1.*

3.3 Proposed Modelling Assumptions and Scenarios

The assumptions and scenarios for water quality modelling related to the subsea cable sterile corridors and alternative construction method of the BPPS Pipeline are summarized in *Table 3.3*. The locations of these pipeline segments for modelling are presented in *Figures 3.1* to *3.4*.

Table 3.3 Summary of Modelling Sediment Sources *

Sediment Source ID	Location (Kilometer Point)	Plant Used	Work Rate (m^3/day) [(1)]	Sediment Loss Rate (kg/s)
	Scenario C05G Option 1a (with Silt Curtain at jetting machine)			
04_J_A	Jetty Approach (KP0.1 – 5.0) excluding Subsea Cable Sterile Corridors	Jetting Machine	1,000m/day	3.889
	Subsea Cable Sterile Corridors (KP1.49 - 2.75 and KP3.55 - 4.43)	Jetting Machine	720m/day	See Table 3.2
04_J_B	South of Soko Islands (KP5.0 – 8.9)	Jetting Machine	1,000m/day	3.889
04_J_C	Southwest of Soko Islands (KP8.9 – 12.1)	Jetting Machine	1,000m/day	3.889
04_J_D	Adamasta Channel (KP12.1 – 15.6)	Jetting Machine	1,000m/day	3.889
	Scenario C05F Option 1b (with Silt Curtain at jetting machine)			
04_J_A	Jetty Approach (KP0.1 – 5.0) excluding Subsea Cable Sterile Corridors	Jetting Machine	1,000m/day	3.889
	Subsea Cable Sterile Corridors (KP1.49 - 2.75 and KP3.55 - 4.43)	Jetting Machine	720m/day	See Table 3.2
04_J_B	South of Soko Islands (KP5.0 – 8.9)	Jetting Machine	1,000m/day	3.889
04_J_C	Southwest of Soko Islands (KP8.9 – 12.1)	Jetting Machine	1,000m/day	3.889
04_J_D	Adamasta Channel (KP12.1 – 15.6)	Jetting Machine	1,000m/day	3.889
	Scenario C01D Option 2 – Dredging (with Silt Curtain) #			
04_G_A	Subsea Cable Sterile Corridor 1 (KP1.49 – 2.75)	Grab Dredger	8,000	0.463 [(2)]
04_G_B	Subsea Cable Sterile Corridor 2 (KP3.55 – 4.43)	Grab Dredger	8,000	0.463
	Scenario C05E Option 2 – Jetting (with Silt Curtain at jetting machine)			
04_J_A	Jetty Approach (KP0.1 – 5.0) excluding Subsea Cable Sterile Corridors	Jetting Machine	1,000m/day	3.889 [(3)]
	Subsea Cable Sterile Corridors (KP1.49 - 2.75 and KP3.55 - 4.43)	Jetting Machine	720m/day	See Table 3.2
04_J_B	South of Soko Islands (KP5.0 – 8.9)	Jetting Machine	1,000m/day	3.889
04_J_C	Southwest of Soko Islands (KP8.9 – 12.1)	Jetting Machine	1,000m/day	3.889
04_J_D	Adamasta Channel (KP12.1 – 15.6)	Jetting Machine	1,000m/day	3.889

(1) As the Project progressed to Front End Engineering Design (FEED), further information has been gathered for optimization of the BPPS Pipeline trench design. The information includes latest marine traffic consideration to confirm pipeline protection design requirement, further Site Investigation (Vibrocoring) to identify soil characteristic, Finite Element Analysis on proposed trench designs and results of anchor model test, dredging volume reduction and pipeline burial depth requirements as indicated by local authorities (Marine Department and CEDD). The outcome from FEED is that the trench design for the West of Lung Kwu Chau and Southwest Lantau segments of the BPPS Pipeline can be optimized such that jetting is also an engineering feasible option besides dredging.

Sediment Source ID	Location (Kilometer Point)	Plant Used	Work Rate (m^3/day) (1)	Sediment Loss Rate (kg/s)
	Scenario C09A Southwest Lantau (with Silt Curtain at jetting machine)			
05_J	Southwest Lantau (KP15.6 – 21.3)	Jetting Machine	1,500m/day	5.833 (4)
	Scenario C08 Sha Chau to Lung Kwu Chau (with Silt Curtain at jetting machine)			
09_J	Sha Chau to Lung Kwu Chau (KP36.0 - 37.5)	Jetting Machine	720m/day	2.800 (5)

Note:

(1) For jetting, the values provided are in m/day.

(2) Sample calculation for sediment loss rate: Dredging Rate (m^3/s) × Loss Rate (kg/m^3) × (1 - Silt Curtain Efficiency) = 0.09259 m^3/s × 20 kg/m^3 × (1 – 75%) = 0.463 kg/s

(3) Sample calculation for sediment loss rate: Jetting Rate (m/s) × Cross Section of Jetting Trench (m3/m) × % Mud Entrained × Dry Mud Density (kg/m3) × (1 - Silt Curtain Efficiency) = 0.01157 m/s × 16 m3/m × 20% × 700 (kg/m3) × (1 – 75%) = 3.889 kg/s

(4) Sample calculation for sediment loss rate: Jetting Rate (m/s) × Cross Section of Jetting Trench (m3/m) × % Mud Entrained × Dry Mud Density (kg/m3) × (1 - Silt Curtain Efficiency) = 0.01736 m/s × 16 m3/m × 20% × 700 (kg/m3) × (1 – 85%) = 5.833 kg/s

(5) Sample calculation for sediment loss rate: Jetting Rate (m/s) × Cross Section of Jetting Trench (m3/m) × % Mud Entrained × Dry Mud Density (kg/m3) × (1 - Silt Curtain Efficiency) = 0.00833 m/s × 16 m3/m × 20% × 700 (kg/m3) × (1 – 85%) = 2.800 kg/s

* For jetting along non-subsea cable sterile corridors, a total of three passes would be modelled, and the sediment loss rate would remain to be the highest loss rate calculated based on the entire cross-section (16m^2).

For grab dredging under Option 2, all other concurrent grab dredging activities assessed in scenario C01A of the approved EIA Report were also included in the modelling exercise for cumulative impact assessment.

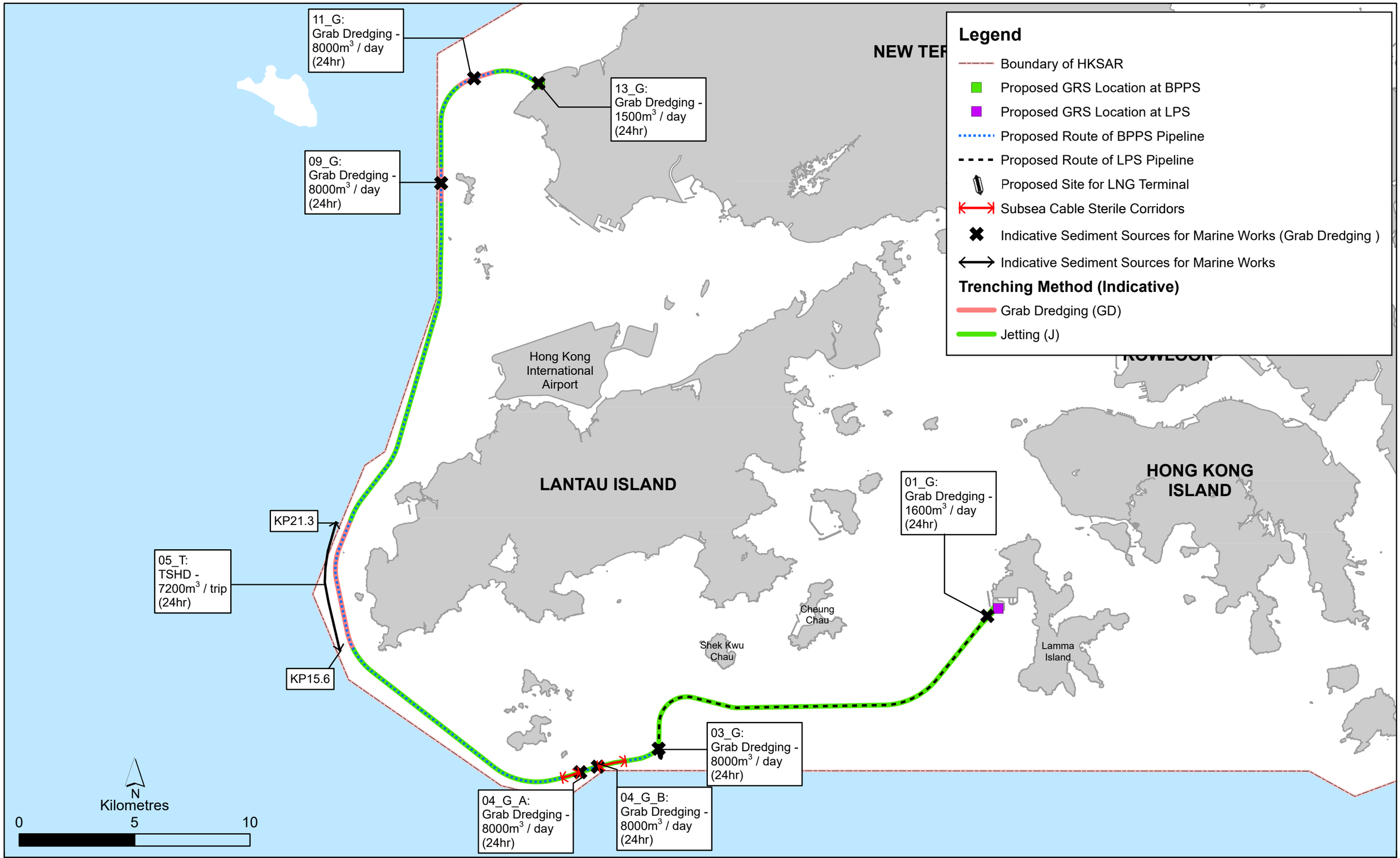

Figure 3.1

Indicative Sediment Sources for Marine Works to be Modelled - Scenario 1D

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Date: 16/12/2019

Environmental Resources Management

ERM

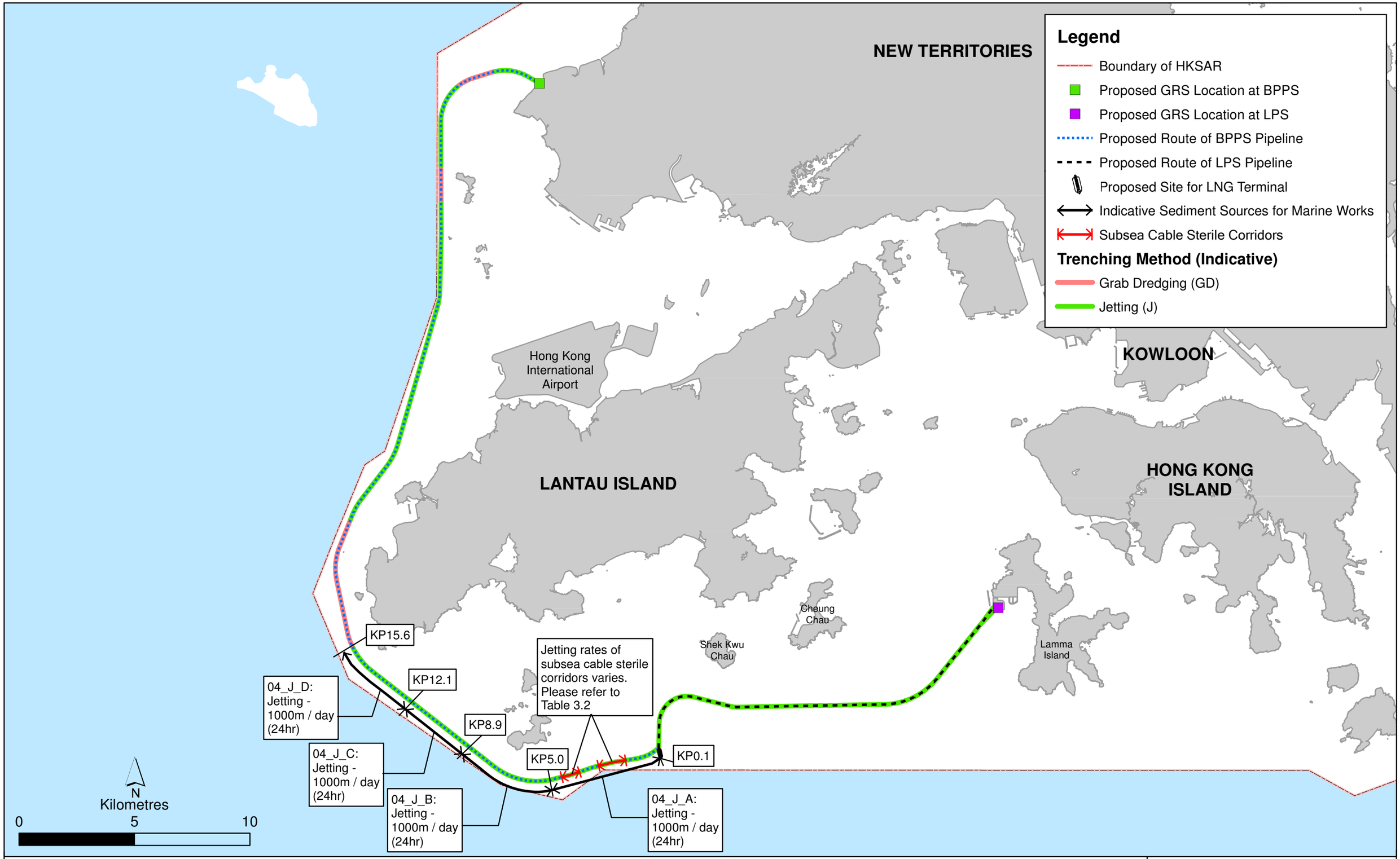

Figure 3.2

Indicative Sediment Sources for Marine Works to be Modelled - Scenario 5E / 5F / 5G

File: T:\GIS\CONTRACT\0505354\mxd\0505354_Sediment_Marine_Work_Scn_5_v2.mxd
Date: 20/11/2019

Environmental Resources Management

ERM

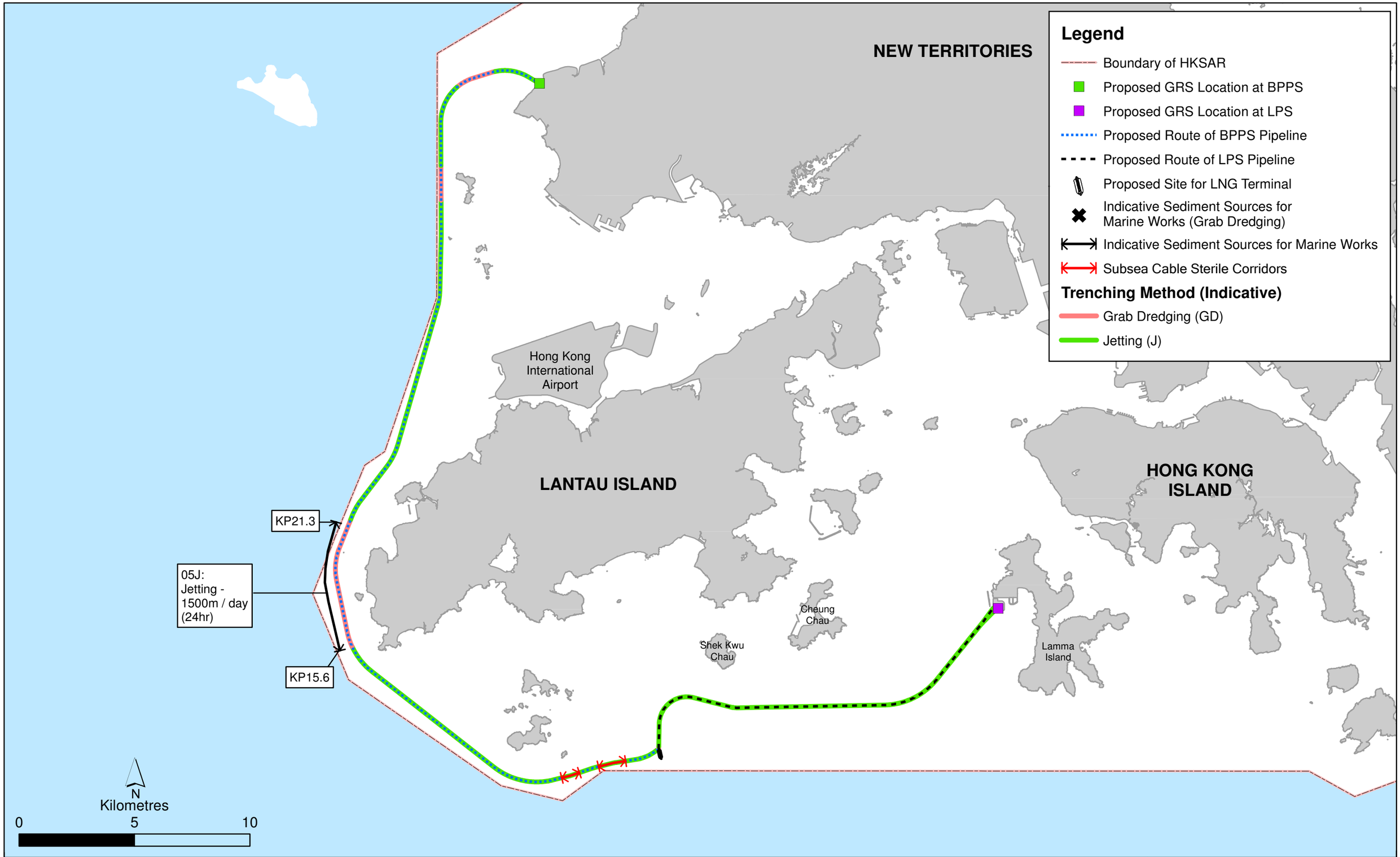

Figure 3.3

Indicative Sediment Sources for Marine Works to be Modelled - Scenario 9A

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Date: 19/11/2019

Environmental Resources Management

ERM

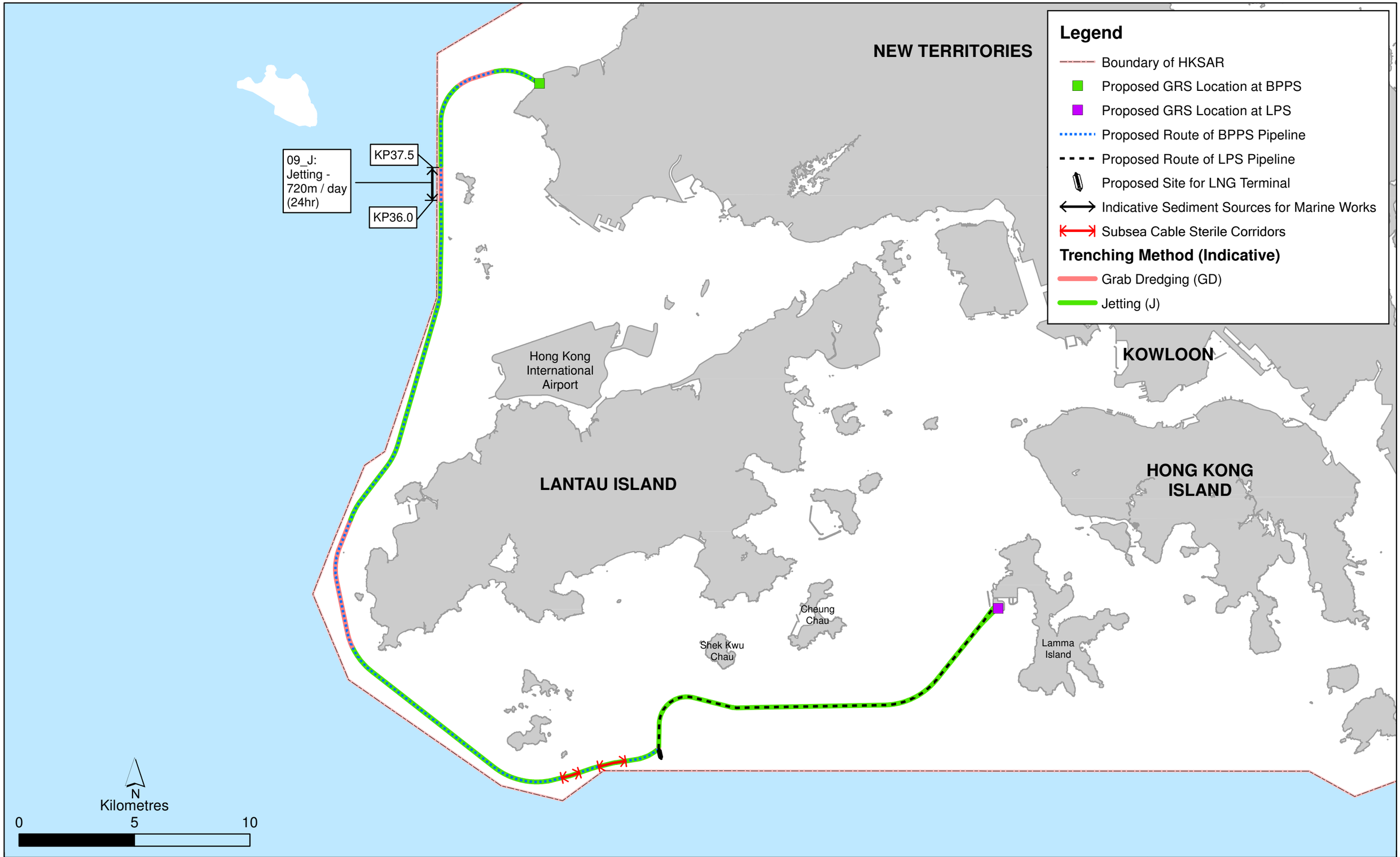

Figure 3.4

Indicative Sediment Sources for Marine Works to be Modelled - Scenario 8

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Date: 20/11/2019

Environmental Resources Management

ERM

4. POTENTIAL IMPACTS ON THE ENVIRONMENT

4.1 Key Environmental Issues Associated with the Proposed BPPS Pipeline Construction Options

Table 4.1 identifies the potential environmental impacts associated with the proposed construction options for selected sections of the BPPS Pipeline. It should be noted that the proposed construction options will not affect the operation of the pipeline, and hence no operation phase impact is anticipated.

Table 4.1 Potential Environmental Issues for Construction Phase

Aspect	Any Potential Impact?	Remarks
Air Quality	×	Pipeline dredging/ jetting works are not expected to generate fugitive dust given the marine nature of these activities. As discussed in Sections 4.6 and 4.8 of the approved EIA Report, in view of the marine nature of pipeline construction works and as there is no air sensitive receivers (ASR) within 500m along the subsea pipeline route, no adverse dust impact is anticipated and no unacceptable impact on air quality is expected.
Hazard to Life	×	For the subsea pipeline construction, LNG, natural gas and other dangerous goods will not be present; therefore, as discussed in Section 5.3 of the approved EIA Report, no hazard to life is expected during the construction of the subsea gas pipeline.
Noise	×	Potential noise sources during pipeline construction will mainly arise from Powered Mechanical Equipment (PME) operating at the marine barges. No noise sensitive receivers (NSRs) were identified within the 300m Assessment Area along the subsea pipeline route; therefore, as discussed in Sections 6.5 and 6.6 of the approved EIA Report, unacceptable adverse noise impacts due to the pipeline construction activities are not anticipated.
Water Quality	✓	
Waste Management Implications	✓	
Ecology	✓	As discussed in Section 9.9.1 of the approved EIA Report, unacceptable impacts on avifauna due to noise and light emissions from construction activities are also not expected.
Fisheries	✓	
Visual	×	According to Section 11.6 of the approved EIA report, the construction of subsea pipeline is not identified as one of the construction visual impacts of the Project.
Cultural and Heritage	×	As discussed in Section 12.4 of the approved EIA Report, the Marine Archaeological Investigation (MAI) concluded that there are no potential archaeological materials within the proposed pipeline dredging/ jetting areas, therefore no marine archaeological impact is expected to occur during the Project construction.

Notes:
(a) '✓'=Possible, '×' = Not Expected

A description and evaluation, where appropriate, of potential impacts on water quality, waste management implications, marine ecology and fisheries, the environmental changes arising from the proposed variations, and how the environment and the community might be affected by the proposed variations, are provided in the following sections.

4.2 Water Quality

Based on the construction options for the subsea cable sterile corridors, as well as the pipeline segments along Southwest Lantau and West of Lung Kwu Chau, a total of six sediment dispersion modelling scenarios were conducted. Results of the modelling exercise are discussed below. Statistics of modelling results are presented in *Tables 4.2* to *4.7* and contour plots of the modelling results are presented in Appendices A and B. It should be noted that the key WSRs that would be affected by the proposed pipeline construction works are identified in Table 7C.10 to 7C.18 of Annex 7C of the approved EIA Report. WSRs which are far away from these pipeline segments are minimally affected and hence are not included in *Tables 4.2* to *4.7*.

4.2.1 Suspended Solids (SS) Dispersion and Sedimentation

4.2.1.1 Subsea Cable Sterile Corridors – Option 1a

This scenario assesses the proposed five passes of jetting operation at the subsea cable sterile corridors (720 m/day, with silt curtain), together with the jetting for the rest of the BPPS Pipeline in South Lantau (1,000 m/day, with silt curtain). It is assumed silt curtain would be implemented at the southern boundary of the proposed South Lantau Marine Park. Results of this scenario are shown in *Table 4.2*. Contour plots of maximum SS elevation are provided in Appendix A-4 and A-10. Full compliance with the applicable WQO suspended solids (SS) criteria is predicted at all WSRs. No unacceptable water quality impact from the proposed jetting operation for construction of the subsea cable sterile corridors under Option 1a is expected.

4.2.1.2 Subsea Cable Sterile Corridors – Option 1b

This scenario assesses the proposed seven passes of jetting operation at the subsea cable sterile corridors (720 m/day, with silt curtain), together with the jetting for the rest of the BPPS Pipeline in South Lantau (1,000 m/day, with silt curtain). It is assumed silt curtain would be implemented at the southern boundary of the proposed South Lantau Marine Park. Results of this scenario are shown in *Table 4.3*. Contour plots of maximum SS elevation are provided in Appendix A-3 and A-9. Full compliance with the applicable WQO SS criteria is predicted at all WSRs. No unacceptable water quality impact from the proposed jetting operation for construction of the subsea cable sterile corridors under Option 1b is expected.

4.2.1.3 Subsea Cable Sterile Corridors – Option 2 Dredging

This scenario assesses the use of two grab dredgers for removing the top layer of sediment at the proposed subsea cable sterile corridors, together with other concurrent grab dredging works considered in the approved EIA Report Scenario C01B. The jetting part of the marine works is assessed separately considering the sequential works nature. Results of sediment dispersion modelling are shown in *Table 4.4* and show that two grab dredgers working concurrently at the nearest point to WSRs MPD-3 and MPD-4 (with silt curtains at grab dredgers) would result in limited level of SS elevation. Predicted maximum SS elevation would be below 1 mg L^{-1} at MPD-3 and MPD-4. There is no exceedance of applicable WQO SS criteria at other WSRs as well. As shown in Appendix A-1 and A-7, the sediment plume from these two grab dredgers working at the subsea cable sterile corridors is very localized. No unacceptable water quality impact from the proposed dredging operation at the subsea cable sterile corridors under Option 2 is expected.

4.2.1.4 Subsea Cable Sterile Corridors – Option 2 Jetting

This scenario assesses the proposed seven passes of jetting operation at the subsea cable sterile corridors (720 m/day, with silt curtain), together with the jetting for the rest of the BPPS Pipeline in South Lantau (1,000 m/day, with silt curtain) after the dredging works assessed in the previous paragraph. Similar to that of the approved EIA Report, it is assumed silt curtain would be implemented at the southern boundary of the proposed South Lantau Marine Park. Results of

sediment dispersion modelling are shown in *Table 4.5*. Contour plots of maximum SS elevation are provided in Appendix A-2 and A-8. Full compliance with the applicable WQO SS criteria is predicted at all WSRs. No unacceptable water quality impact from the proposed jetting operation for construction of the subsea cable sterile corridors under Option 2 is expected.

4.2.1.5 Southwest Lantau Pipeline Section

This scenario assesses the proposed three passes of jetting operation at the pipeline segment along Southwest Lantau (1,500 m/day, with silt curtain). Maximum SS elevations of 5.2 mg L^{-1} and 4.9 mg L^{-1} were predicted at the nearest WSR (MPC-2), which are both below the corresponding WQO SS criteria. Full compliance with the applicable WQO SS criteria is predicted at all other WSRs. Results of this scenario are shown in *Table 4.6*. Contour plots of maximum SS elevation are provided in Appendix A-5 and A-11. No unacceptable water quality impact from the proposed jetting operation for the installation of the BPPS Pipeline at Southwest Lantau is expected.

4.2.1.6 Sha Chau to Lung Kwu Chau Pipeline Section

This scenario assesses the proposed three passes of jetting operation at the pipeline segment west of Lung Kwu Chau (720 m/day, with silt curtain). Maximum SS elevation of 0.3 mg L^{-1} was predicted at the few nearest WSRs, which is below the corresponding WQO SS criterion. Full compliance with the applicable WQO SS criteria is predicted at all other WSRs. Maximum sedimentation flux of 6.4 g m^{-2} day^{-1} at the nearest coral WSR CR3 was predicted, which is well below the relevant assessment criterion. Results of this scenario are shown in *Table 4.7*. Contour plots of maximum SS elevation are provided in Appendix A-6 and A-12. No unacceptable water quality impact from the proposed jetting operation for the installation of the BPPS Pipeline at Sha Chau to Lung Kwu Chau is expected.

Table 4.2 Predicted Maximum Elevation in Suspended Solid and Sediment Deposition at WSRs and Observation Points from Marine Construction of the Subsea Cable Sterile Corridors: Option 1a (Mitigated) (Scenario C05G)

Silt curtain at source (85% reduction in sediment dispersion): 04_J_A, 04_J_B, 04_J_C, 04_J_D
Two layers of silt curtain at WSRs (80% reduction in SS elevation): Southern Boundary of the Proposed South Lantau MP for MPD-2, MPD-3, MPD-4, MPD-5, MPD-9 (KP0.1-8.9)
Rate reduction: None

Sensitive Receivers	Model Output Location	SS Elevation (mg L^{-1})						Sediment Deposition (g m^{-2} day^{-1})		
		Dry Season (5 Passes)			Wet Season (5 Passes)			Criteria	Dry Season	Wet Season
		Allowable Increase	Max. Increase	Compliance Time %	Allowable Increase	Max. Increase	Compliance Time %		Max.	Max.
Observation Points (Depth-averaged) (for reference)										
Boundary of Existing & Proposed Marine Parks	MPD-2	6.0	0.8	100.0%	6.3	2.1	100.0%	-	-	-
	MPD-3	3.9	2.4	100.0%	3.1	1.0	100.0%	-	-	-
	MPD-4	3.9	0.7	100.0%	3.1	1.9	100.0%	-	-	-
	MPD-5	3.9	2.1	100.0%	3.1	1.9	100.0%	-	-	-

Table 4.3 Predicted Maximum Elevation in Suspended Solid and Sediment Deposition at WSRs and Observation Points from Marine Construction of the Subsea Cable Sterile Corridors: Option 1b (Mitigated) (Scenario C05F)

Silt curtain at source (85% reduction in sediment dispersion): 04_J_A, 04_J_B, 04_J_C, 04_J_D
Two layers of silt curtain at WSRs (80% reduction in SS elevation): Southern Boundary of the Proposed South Lantau MP for MPD-2, MPD-3, MPD-4, MPD-5, MPD-9 (KP0.1-8.9)
Rate reduction: None

Sensitive Receivers	Model Output Location	SS Elevation (mg L^{-1})						Sediment Deposition (g m^{-2} day^{-1})		
		Dry Season (7 Passes)			Wet Season (7 Passes)			Criteria	Dry Season	Wet Season
		Allowable Increase	Max. Increase	Compliance Time %	Allowable Increase	Max. Increase	Compliance Time %		Max.	Max.
Observation Points (Depth-averaged) (for reference)										
Boundary of Existing & Proposed Marine Parks	MPD-2	6.0	0.8	100.0%	6.3	2.1	100.0%	-	-	-
	MPD-3	3.9	2.3	100.0%	3.1	1.0	100.0%	-	-	-
	MPD-4	3.9	0.9	100.0%	3.1	1.5	100.0%	-	-	-
	MPD-5	3.9	2.1	100.0%	3.1	1.9	100.0%	-	-	-

Table 4.4 Predicted Maximum Elevation in Suspended Solid and Sediment Deposition at WSRs and Observation Points from Marine Construction of the Subsea Cable Sterile Corridors: Option 2 – Dredging (Mitigated) (Scenario C01D)

Silt curtain at source (75% reduction in sediment dispersion): 01_G, 03_G, 04_G_A, 04_G_B, 09_G, 13_G
Two layers of silt curtain at WSRs (80% reduction in SS elevation): None
Rate reduction: None

Sensitive Receivers	Model Output Location	SS Elevation (mg L^{-1})						Sediment Deposition (g m^{-2} day^{-1})		
		Dry Season			Wet Season			Criteria	Dry Season	Wet Season
		Allowable Increase	Max. Increase	Compliance Time %	Allowable Increase	Max. Increase	Compliance Time %		Max.	Max.
Observation Points (Depth-averaged) (for reference)										
Boundary of Existing & Proposed Marine Parks	MPD-3	3.9	0.7	100.0%	3.1	0.1	100.0%	-	-	-
	MPD-4	3.9	0.3	100.0%	3.1	0.4	100.0%	-	-	-

Table 4.5 Predicted Maximum Elevation in Suspended Solid and Sediment Deposition at WSRs and Observation Points from Marine Construction of the Subsea Cable Sterile Corridors: Option 2 – Jetting (Mitigated) (Scenario C05E)

Silt curtain at source (85% reduction in sediment dispersion): 04_J_A, 04_J_B, 04_J_C, 04_J_D
Two layers of silt curtain at WSRs (80% reduction in SS elevation): Southern Boundary of the Proposed South Lantau MP for MPD-2, MPD-3, MPD-4, MPD-5, MPD-9 (KP0.1-8.9)
Rate reduction: None

Sensitive Receivers	Model Output Location	SS Elevation (mg L^{-1})						Sediment Deposition (g m^{-2} day^{-1})		
		Dry Season (7 Passes)			Wet Season (7 Passes)			Criteria	Dry Season	Wet Season
		Allowable Increase	Max. Increase	Compliance Time %	Allowable Increase	Max. Increase	Compliance Time %		Max.	Max.
Observation Points (Depth-averaged) (for reference)										
Boundary of Existing & Proposed Marine Parks	MPD-2	6.0	0.6	100.0%	6.3	2.1	100.0%	-	-	-
	MPD-3	3.9	1.7	100.0%	3.1	0.9	100.0%	-	-	-
	MPD-4	3.9	0.8	100.0%	3.1	1.1	100.0%	-	-	-
	MPD-5	3.9	2.1	100.0%	3.1	1.9	100.0%	-	-	-

Table 4.6 Predicted Maximum Elevation in Suspended Solid and Sediment Deposition at WSRs and Observation Points from Marine Construction at Southwest Lantau (Mitigated) (Scenario C09A)

Silt curtain at source (85% reduction in sediment dispersion): 05_J
Two layers of silt curtain at WSRs (80% reduction in SS elevation): None;
Rate reduction: None

Sensitive Receivers	Model Output Location	SS Elevation (mg L^{-1})						Sediment Deposition (g m^{-2} day^{-1})		
		Dry Season			Wet Season			Criteria	Dry Season	Wet Season
		Allowable Increase	Max. Increase	Compliance Time %	Allowable Increase	Max. Increase	Compliance Time %		Max.	Max.
Observation Points (Depth-averaged) (for reference)										
Boundary of Existing & Proposed Marine Parks	MPC-1	8.5	0.9	100.0%	6.3	1.1	100.0%	-	-	-
	MPC-2	8.5	5.2	100.0%	6.3	4.9	100.0%	-	-	-
	MPC-3	6.0	2.1	100.0%	6.3	1.9	100.0%	-	-	-

Table 4.7 Predicted Maximum Elevation in Suspended Solid and Sediment Deposition at WSRs and Observation Points from Marine Construction at Sha Chau to Lung Kwu Chau (Mitigated) (Scenario C08)

Silt curtain at source (85% reduction in sediment dispersion): 09_J
Two layers of silt curtain at WSRs (80% reduction in SS elevation): Two layers at Western Boundary of the Sha Chau to Lung Kwu Chau MP for MPA-2, MPA-3, AR1, CR3 (KP36.0 – 37.5)
Rate reduction: None

Sensitive Receivers	Model Output Location	SS Elevation (mg L^{-1})						Sediment Deposition (g m^{-2} day^{-1})		
		Dry Season			Wet Season			Criteria	Dry Season	Wet Season
		Allowable Increase	Max. Increase	Compliance Time %	Allowable Increase	Max. Increase	Compliance Time %		Max.	Max.
Spawning/Nursery Grounds (Depth-averaged)										
Fisheries Spawning Ground in North Lantau	AR1	7.8	0.2	100.0%	4.3	0.1	100.0%	-	-	-
	CR3	6.6	0.2	100.0%	6.0	0.2	100.0%	-	-	-
Corals (Bottom)										
Pak Chau	CR3	10.4	0.3	100.0%	12.1	0.2	100.0%	200	6.4	5.9
Observation Points (Depth-averaged) (for reference)										
Boundary of Existing & Proposed Marine Parks	MPA-2	6.6	0.3	100.0%	6.0	0.0	100.0%	-	-	-
	MPA-3	7.8	0.1	100.0%	4.3	0.0	100.0%	-	-	-

4.2.2 Oxygen Depletion

In accordance with the approved EIA Report, potential oxygen depletion from sediment release was estimated based on maximum SS elevation and sediment oxygen demand (15,342 mg kg^{-1} adopted in the approved EIA Report). Given the maximum SS elevation predicted based on the proposed construction options is only 5.2 mg L^{-1}, the potential maximum DO depletion is calculated to be:

DO (mg O_2 L^{-1}) = DO (g O_2/m^3)

= SS (g DW/m^3) × fraction of organic matter in sediment (g C/g DW) × 2.67 (g O_2/gC)

= 5.2 (g DW/m^3) × 15,342 ÷ 1,000,000 (g C/g DW) × 2.67 (g O_2/gC)

= 0.213 mg L^{-1}

Results of DO depletion due to the proposed construction options are provided in *Table 4.8*. The predicted maximum DO depletion is only 0.2 mg L^{-1}, while the corresponding allowed DO depletion is 0.8 mg L^{-1}. No unacceptable water quality impact on oxygen depletion is predicted.

Table 4.8 Predicted Maximum Annual Dissolved Oxygen Depletion among all Modelling Scenarios

Sensitive Receivers	Model Output Location	Dissolved Oxygen (mg L^{-1})	
		Annual	
		Allowable DO Depletion	Maximum DO Depletion
Fisheries Spawning Ground in North Lantau	AR1	0.9	0.0
	CR3	0.2	0.0
Pak Chau	CR3	0.3	0.0
Boundary of Existing & Proposed Marine Parks	MPA-2	0.2	0.0
	MPA-3	0.9	0.0
	MPC-1	0.8	0.0
	MPC-2	0.8	0.2
	MPC-3	0.8	0.1
	MPD-2	0.8	0.1
	MPD-3	1.1	0.1
	MPD-4	1.1	0.1
	MPD-5	1.1	0.1

4.2.3 Release of Sediment-bounded Contaminants

Following the approach in the approved EIA Report, assessment of potential release of sediment-bounded contaminants is conducted based on conservative tracer. Contaminants of concern include total polychlorinated biphenyls (PCBs), total inorganic nitrogen (TIN) and unionized ammonia (UIA).

4.2.3.1 Total PCBs

As stated in the approved EIA Report, based on the worst case results of elutriate test of sediment, 1.0286 µg of total PCBs can be released from 1 kg of sediment. The predicted maximum tracer concentration under the modelled mitigated scenario is only 8 mg L^{-1} (shown below in *Table 4.9*), which translates to 8.23 × 10^{-6} µg L^{-1} of total PCBs. This predicted maximum total PCBs level is well below the corresponding assessment criterion of 0.03 µg L^{-1}. No unacceptable elevation of total PCBs is therefore anticipated at all WSRs in both dry and wet seasons.

Total PCBs at WSRs (µg L^{-1})= Tracer at WSRs (mg L^{-1}) [from model] ×Tracer released per unit Sediment Loss [set to 1 in model]

× Total PCBs released per unit Sediment Loss (µg kg^{-1}) [from elutriate test results]

4.2.3.2 TIN and UIA

As stated in the approved EIA Report, based on the worst case results of elutriate test of sediment, 18.1143 mg of TN can be released from 1 kg of sediment, of which 100% is assumed to be in the form of ammonia (NH_3-N, which also count as TIN) and 7.8% would be in the form of UIA. As shown in the calculation in *Table 4.9*, the estimated level of TIN and UIA are both below 0.001 mg L^{-1} (round down and shown as "0.000" in the table). No unacceptable change in water quality would be expected at all WSRs in both dry and wet seasons.

For TIN:

Total TIN at WSRs (mg L^{-1})= Tracer at WSRs (mg L^{-1}) [from model] ×Tracer released per unit Sediment Loss [set to 1 in model] ×TN released per unit Sediment Loss (mg kg^{-1}) [from elutriate test results]

For UIA:

Total UIA at WSRs (mg L^{-1})= Total TIN at WSRs (mg L^{-1}) × UIA/NH3-N ratio in marine water

Table 4.9 Predicted Maximum Nutrient Elevations (mg L^{-1}) based on Maximum Conservative Tracer Concentration at Water Quality Sensitive Receivers

Sensitive Receivers	Model Output Location	MAX Conservative Tracer Concentration		TIN Elevation		WQO Criteria for TIN	UIA		UIA WQO Allowable Elevation	
		Dry	Wet	Dry	Wet		Dry	Wet	Dry	Wet
Spawning/Nursery Grounds (Depth-averaged)										
Fisheries Spawning Ground in North Lantau	AR1	5.9	2.9	0.000	0.000	0.5	0.000	0.000	0.018	0.016
	CR3	4.7	2.5	0.000	0.000	0.5	0.000	0.000	0.016	0.015
Corals (Bottom)										
Pak Chau	CR3	4.7	2.7	0.000	0.000	0.5	0.000	0.000	0.017	0.016
Observation Points (Depth-averaged) (for reference)										
Boundary of Proposed Marine Parks	MPA-2	2.4	0.9	0.000	0.000	0.5	0.000	0.000	0.016	0.015
	MPA-3	7.6	4.4	0.000	0.000	0.5	0.000	0.000	0.016	0.015
	MPC-1	3.0	2.4	0.000	0.000	0.5	0.000	0.000	0.019	0.017
	MPC-2	2.8	2.1	0.000	0.000	0.5	0.000	0.000	0.019	0.017
	MPC-3	2.0	4.7	0.000	0.000	0.1	0.000	0.000	0.020	0.018
	MPD-2	2.3	4.8	0.000	0.000	0.1	0.000	0.000	0.020	0.018
	MPD-3	4.8	5.9	0.000	0.000	0.1	0.000	0.000	0.020	0.019
	MPD-4	4.3	7.1	0.000	0.000	0.1	0.000	0.000	0.020	0.019
	MPD-5	4.0	8.0	0.000	0.000	0.1	0.000	0.000	0.020	0.019

Note: Mitigation measures listed under *Table 4.2* to *Table 4.7* are taken into account (Same as approved EIA).

4.2.4 Summary

Additional modelling has been conducted to examine potential impact on water quality from dredging/ jetting activities associated with the construction options for the subsea cable sterile corridors, as well as the pipeline segments along Southwest Lantau and West of Lung Kwu Chau. Full compliance in terms of SS elevation and sedimentation flux, oxygen depletion and release of sediment-bound contaminants is predicted at all WSRs under the mitigated scenarios. No unacceptable water quality impact on the nearby WSRs identified, including but not limited to the existing, planned or potential Marine Parks, corals, marine mammal habitat, fisheries spawning ground, etc., is expected for all modelled scenarios. The use of silt curtain has been recommended in these pipeline construction scenarios to reduce sediment dispersion from grab dredging and jetting, as well as to protect nearby WSRs from sediment plume. Deployment of the silt curtain will be checked regularly to reduce secondary impact on water quality. Given that the forward speed for jetting machine and the associated silt curtain enclosing it is generally low near sensitive areas such as marine parks, disturbance to seabed, if any, would be very limited. As such, no unacceptable secondary water quality impact associated with the deployment of silt curtain under this Project would be anticipated.

Construction management measures will be implemented during pipeline jetting to confirm that the specific trench configuration is acceptable for each jetting pass. After each jetting pass, a sonar scanning or diver survey will be conducted to confirm the trench configuration and depth of burial and the survey result will be presented in order to ensure the trench profile and depth are achieved.

In addition, the whole segments of the subsea cable sterile corridors shall be covered by rock armour or concrete saddle to protect the pipeline from the installation of future cables. The placement of these protection measures on subsea utilities as additional protection is a common practice. Rock armour placement has been assessed in the approved in the EIA Report and no unacceptable impact is expected. The concrete saddle will be installed after the pipeline is jetted to the required burial depth, and it will be lowered down slowly to reduce disturbance to the seabed sediment. As such, no unacceptable water quality impact associated with the deployment of pipeline protection measures would be anticipated.

4.3 Waste Management

Based on the information presented in the approved EIA Report, the seabed sediments at the pipeline segments along Southwest Lantau and West of Lung Kwu Chau are category M contaminated. Consequently the use of jetting method for these pipeline segments is expected to reduce the generation of ~ 0.168 Mm^3 of dredged sediment that requires marine disposal. For the construction of the subsea cable sterile corridors under Option 2, it would generate about ~ 0.078 Mm^3 of dredged sediment (in situ volume) that are likely to be uncontaminated making reference to the sediment quality results of samples collected in the vicinity as presented in the approved EIA Report. Based on the latest engineering design information, it is expected that the overall total dredging volume for the Project would not exceed the total dredging volume presented in the approved EIA Report resulting from the proposed potential changes.

While there is the potential of a slight increase in the dredging and disposal of uncontaminated sediment should Option 2 for subsea cable sterile corridors be adopted, considering the potential reduction in the dredging and disposal of contaminated sediment from the potential change of construction method from dredging to jetting at the pipeline segments along Southwest Lantau and West of Lung Kwu Chau, and with no increase in overall total dredging volume, no unacceptable adverse environmental impacts arising from the management and disposal of dredged sediment is anticipated.

In accordance with PNAP ADV-21, the project proponent will continue to liaise with Marine Fill Committee (MFC) and EPD as to the allocation arrangement for sediment disposal. Marine sediment sampling, testing and reporting in accordance with the requirement stated in PNAP ADV-21 for EPD approval as required under the Dumping at Sea Ordinance will be undertaken prior to the

commencement of dredging and sediment disposal. The Project Proponent will continue to liaise with the relevant authorities to ensure compliance with PNAP ADV-21.

4.4 Marine Ecology

4.4.1 Temporary Habitat Loss and Disturbance

The use of jetting for the pipeline segments along Southwest Lantau and West of Lung Kwu Chau would increase the use of narrower trenches (~ 2-8 m) for ~7.2 km of the BPPS Pipeline, which would result in a reduction in the area of seabed habitats (by ~ 8.4 ha) that will be temporarily lost or disturbed due to subsea pipeline installation activities. Conversely, the construction of the subsea cable sterile corridors would require pipeline trenches of ~ 20 m wide along ~ 2.14 km of the BPPS Pipeline, and there would be a slight increase in the area of seabed habitats (by ~ 2.6 ha) that will be temporarily lost or disturbed. Given the low ecological value of the associated benthic assemblages (EIA Report Section 9.5.1, Table 9.23), and the recolonization of similar organisms following completion of the pipeline installation works, unacceptable impacts on the ecological resources are not expected.

The use of different pipeline construction options and methods is not expected to change the number and size of works areas and total duration of marine works for the construction of the BPPS Pipeline, and hence the potential impact of short-term behavioural disturbance and / or displacement of marine mammals is similar to that assessed in the approved EIA Report. It is important to note that not the entire lengths of the BPPS Pipeline route would be disturbed at any one time because pipeline dredging, pipe-laying, jetting and rock armour placement activities would be undertaken at discrete work fronts (each within a few hundred metres from the pipeline centreline), and these activities would be carried out in sequence, i.e. phased. The mitigation measures proposed in the approved EIA Report, i.e. pipeline dredging/ jetting works between North of Tai O and Fan Lau will avoid the peak months of CWD calving (May and June), and pipeline dredging / jetting works between South of Soko Islands and the Offshore LNG Terminal will be restricted to a daily maximum of 12 hours with daytime (0700 – 1900) operations, and the implementation of marine mammal exclusion zone monitoring would be effective in reducing disturbance to marine mammals to within acceptable levels.

4.4.2 Increased Marine Traffic

For the construction of the subsea cable sterile corridors, as well as the pipeline segments along Southwest Lantau and West of Lung Kwu Chau by jetting, it is expected that the same marine works vessels deployed elsewhere for the construction of other pipeline segments would be used, and similar level of marine traffic in terms of numbers of vessels, and works duration etc. would be maintained for the overall construction of the BPPS Pipeline. As recommended in the approved EIA Report, the vessel operators of this Project will be required to use predefined and regular routes (that do not encroach into existing and proposed marine parks), make use of designated fairways to access the works areas, and would avoid traversing sensitive habitats such as existing and proposed marine parks. Given the slow-moving nature of the relatively small number of works vessels involved in the construction of the Project, unacceptable adverse impacts of increased marine traffic on marine mammals and marine parks are not anticipated.

4.4.3 Underwater Sound

As discussed in Section 4.4.2, it is expected that the same marine works vessels deployed elsewhere for the construction of other pipeline segments would be used for the construction of the proposed construction options for select segments of the BPPS Pipeline. Underwater sound generated by these vessels is not expected to acoustically interfere significantly with dolphins or porpoises. Marine mammals may have short-term avoidance of the immediate works areas of sound generating activities, but are expected to return when the disturbance ceases. Unacceptable adverse impacts of increased underwater sound level on marine mammals and marine mammals are not anticipated.

4.4.4 Short-Term Changes in Water Quality

Results of the supplementary assessment on water quality (Section 4.2) indicate that with proper implementation of the proposed mitigation measures, unacceptable impacts to water quality are unlikely to occur. It is therefore predicted that there will be no unacceptable indirect impacts to marine ecological resources, marine mammals and marine parks as a result of the proposed construction options.

4.5 Fisheries

4.5.1 Habitat Disturbance & Loss of Access to Fishing Ground

As discussed in Section 4.4.1, the use of jetting for the pipeline segments along Southwest Lantau and West of Lung Kwu Chau would reduce the area of fisheries habitats and potential fishing ground (by ~ 8.4 ha) that will be temporarily disturbed due to subsea pipeline installation activities, and the construction of the subsea cable sterile corridors would slightly increase in the area of fisheries habitats and potential fishing ground (by ~ 2.6 ha) that will be temporarily disturbed. No disturbance to the fisheries sensitive receivers and reported fish fry area at Pak Tso Wan of Tai A Chau (South Soko) is expected. Also, the use of different pipeline construction options and methods is not expected to change the number and size of works areas and total duration of marine works for the construction of the BPPS Pipeline. Not the entire lengths of the BPPS Pipeline route would be disturbed at any one time because pipeline dredging, pipe-laying, jetting and rock armour placement activities would be undertaken at discrete work fronts (each within a few hundred metres from the pipeline centreline), and these activities would be carried out in sequence, i.e. phased. Considering the temporary nature of the disturbance and with management of work fronts/sequence, no unacceptable impacts on fisheries resources, habitats and fishing activities are hence expected.

4.5.2 Underwater Sound

As discussed in Section 4.4.2, it is expected that the same marine works vessels deployed elsewhere for the construction of other pipeline segments would be used for the construction of the proposed construction options for select segments of the BPPS Pipeline. As assessed in the approved EIA report, the vessel activity associated with the construction of this Project is not anticipated to result in unacceptable impacts on fisheries resources. No unacceptable disturbance to the fisheries sensitive receivers and reported fish fry area at Pak Tso Wan of Tai A Chau (South Soko) is expected.

4.5.3 Short-Term Changes in Water Quality

Results of the supplementary assessment on water quality (Section 4.2) indicate that with proper implementation of the proposed mitigation measures, the proposed marine construction works are predicted to be compliant with the relevant WQOs for both wet and dry seasons at all fisheries sensitive receivers. As such, unacceptable impacts from such works on fisheries resources and habitats (including spawning or nursery grounds) are not expected to occur.

4.6 Assessment of the Proposed Changes against EIAO-TM Section 6

The potential options of BPPS Pipeline construction methods have been evaluated to consider whether the change in construction methods may constitute a material change to a designated project or to an environmental impact (Section 6 of the EIAO-TM refers). In accordance with Section 6.2 of the EIAO-TM, *the environmental impact of a designated project, for which an environmental permit has been issued, is considered to be materially changed if the environmental performance requirements set out in the EIA report for this project may be exceeded or violated, even with the mitigation measures in place*.

The evaluation follows the factors listed in Section 6.1 of the EIAO-TM, including:

a. a change to physical alignment, layout or design of the project causing an environmental impact likely to affect existing or planned community, ecologically important areas or sites of cultural heritage;

b. a physical change resulting in an increase in the extent of reclamation or dredging affecting water flow or quality likely to affect ecologically important areas, or disrupting sites of cultural heritage;

c. an increase in pollution emissions or discharges or waste generation likely to violate guidelines or criteria in this technical memorandum without mitigation measures in place;

d. an increase in throughput or scale of the project leading to physical additions or alterations that are likely to violate the guidelines or criteria in this technical memorandum without mitigation measures in place; or

e. a change resulting in physical works that are likely to affect rare, endangered or protected species, or an important ecological habitat, or site of cultural heritage.

Table 4.10 summarises the results of the evaluation. It is considered that the proposed options of BPPS Pipeline construction methods will not lead to a material change to the designated project, or an environmental impact in accordance with Sections 6.1 and 6.2 of the EIAO-TM, respectively. As such, the proposed changes are considered as conforming to the information and requirements set out in the approved EIA Report.

Table 4.10 Summary of Evaluation Results against Section 6 of the EIAO-TM

Item	Requirement	Evaluation	Material Change?
6.1(a)	A change to physical alignment, layout or design of the project causing an environmental impact likely to affect existing or planned community, ecologically important areas or sites of cultural heritage.	The proposed change will not result in a change to physical alignment of the project to the extent that will affect existing or planned community, ecologically important areas or sites of cultural heritage, beyond those predicted in the approved EIA Report.	No
6.1(b)	A physical change resulting in an increase in the extent of reclamation or dredging affecting water flow or quality likely to affect ecologically important areas, or disrupting sites of cultural heritage.	The proposed change will not result in an increase in dredging extent that will affect water flow or quality likely to affect ecologically important areas, or disrupting sites of cultural heritage, beyond those predicted in the approved EIA Report.	No
6.1(c)	An increase in pollution emissions or discharges or waste generation likely to violate guidelines or criteria in this technical memorandum without mitigation measures in place.	Emissions (e.g. SS elevation, release of sediment-bounded contaminants) due to the proposed options of BPPS Pipeline construction methods are expected to be within the relevant assessment criteria as assessed in Section 4.2. No impacts beyond those predicted in approved EIA report are anticipated.	No
6.1(d)	An increase in throughput or scale of the project leading to physical additions or alterations that are likely to violate the guidelines or criteria in this technical memorandum without mitigation measures in place.	The proposed options of BPPS Pipeline construction methods will not result in a change to the throughput and scale of the Project.	No

Item	Requirement	Evaluation	Material Change?
6.1(e)	A change resulting in physical works that are likely to affect a rare, endangered or protected species, or an important ecological habitat, or a site of cultural heritage.	No impacts beyond those predicted in the approved EIA Report are anticipated to occur on rare, endangered or protected species, or an important ecological habitat, or site of cultural heritage due to proposed options of BPPS Pipeline construction methods.	No
6.2	The environmental impact of a designated project, for which an environmental permit has been issued, is considered to be materially changed if the environmental performance requirements set out in the EIA report for this project may be exceeded or violated, even with the mitigation measures in place.	An assessment of the potential environmental impacts associated with the proposed options of BPPS Pipeline construction methods is provided in detail in Sections 4.1-4.5. The potential environmental impacts associated with the proposed change are not expected to exceed those predicted in the approved EIA Report. As such, it is considered that the proposed options of BPPS Pipeline construction methods will not result in a material change under the EIAO-TM.	No

5. REVIEW OF PROPOSED MITIGATION MEASURES & ENVIRONMENTAL MONITORING AND AUDIT (EM&A) REQUIREMENTS

The findings of this review of environmental impacts associated with the proposed construction options for selected sections of the BPPS Pipeline have indicated that, with proper implementation of the proposed mitigation measures, no unacceptable adverse environmental impacts would be anticipated. It is considered that the proposed mitigation measures and EM&A requirements recommended in the approved EIA Report and outlined in the Project's EM&A Manual are adequate and no additional mitigation measures and EM&A requirements will be required.

6. CONCLUSION

As the BPPS Pipeline design progresses and in further discussion with relevant Subsea Cable Owners on subsea pipeline / cable crossings as mentioned in Section 2.3.3 and Section 3.4.3 of the approved EIA Report, some potential options of BPPS Pipeline construction methods have been proposed:

- Jetting at Sha Chau to Lung Kwu Chau (KP36.0 - 37.5);
- Jetting at Southwest Lantau (KP15.6 - 21.3); and
- Dredging and/or jetting two subsea cable sterile corridors within the Jetty Approach (KP1.49 to KP2.75 and KP3.55 to KP4.43).

An environmental review has been carried out to assess the potential environmental impacts associated with the proposed construction options of selected sections of the BPPS Pipeline. Water quality modelling and assessment have been conducted to confirm the environmental acceptability of these options making reference to the approved EIA Report. A number of pipeline construction scenarios have been assessed, and appropriate mitigation measures and their effects have been taken into account in the modelling exercise. Modelling results indicated the proposed construction options for selected sections of the BPPS Pipeline would result in full compliance of the corresponding WQO SS criteria at the nearest WSRs. Also, potential maximum DO depletion, release of contaminant and nutrients have been estimated and was found to be below the corresponding allowable DO depletion limit, assessment criteria for contaminant and WQO for nutrients. Overall, with the implementation of proposed mitigation measures, no unacceptable residual water quality impact from the BPPS Pipeline installation works is expected. The review also indicates that no unacceptable adverse impacts on waste management, marine ecology and fisheries are anticipated from the proposed construction options with respect to the assessment criteria stipulated in the EIAO-TM and relevant environmental legislation, and the same environmental performance requirements set out in the approved EIA Report will apply. The proposed options of BPPS Pipeline construction methods will not result in a material change to the designated project, or an environmental impact in accordance with Section 6 of the EIAO-TM. The Project fully complies with the EIAO-TM requirements.

It is considered that the EM&A requirements recommended in the approved EIA Report are adequate and no additional EM&A requirements will be required. Key mitigation measures and working rates for construction of the BPPS Pipeline are summarized in *Table 6.1*.

Table 6.1 Mitigation Measures for the BPPS Pipeline Construction Works

Work Location	Plants Involved	Allowed Maximum Work Rate	Silt Curtain at Plants	Silt Curtain at WSRs	Other Measures
Pipeline Riser (KP0.0 – 0.1 for both pipelines)	1 Grab Dredger	8,000 m^3 day^{-1} for 24 hours each day	Yes	Not required	Daily maximum of 12 hours with daylight (0700 – 1900)
Jetty Approach (KP0.1 – 5.0) excluding Subsea Cable Sterile Corridors	1 Jetting Machine	1,000 m day^{-1} for 24 hours each day	Yes	Not required for grab dredging; Two layers at Southern Boundary of the Proposed South Lantau MP (KP0.1-8.9) for jetting	Daily maximum of 12 hours with daylight (0700 – 1900)
Subsea Cable Sterile Corridors (KP1.49 - 2.75 and KP3.55 - 4.43)	1 Jetting Machine	720 m day^{-1} for 24 hours each day	Yes		
	2 Grab Dredgers, followed by 1 Jetting Machine (Alternative)	8,000m^3 day^{-1} for 24 hours each day for each dredger 720m day^{-1} for 24 hours each day jetting machine	Yes		

Work Location	Plants Involved	Allowed Maximum Work Rate	Silt Curtain at Plants	Silt Curtain at WSRs	Other Measures
South of Soko Islands (KP5.0 – 8.9)	1 Jetting Machine	1,000 m day^{-1} for 24 hours each day	Yes		
Southwest of Soko Islands (KP8.9 - 12.1)	1 Jetting Machine	1,000 m day^{-1} for 24 hours each day	Yes	Not required	
Adamasta Channel (KP12.1 - 15.6)	1 Jetting Machine	1,000 m day^{-1} for 24 hours each day	Yes	Not required	
Southwest Lantau (KP15.6 - 21.3)	2 Grab Dredgers	Total 16,000 m^3 day^{-1} for 24 hours each day 8,000 m^3 day^{-1} for each plant	Yes	Not required	Avoid the peak months of CWD calving (May and June)
	1 TSHD (Alternative)	57,600 m^3 day^{-1} for 24 hours each day	Not required	Not required	
	1 Jetting Machine (Alternative)	1,500 m day^{-1} for 24 hours each day	Yes	Not required	
West of Tai O to West of HKIA (KP21.3 – 31.5)	1 Jetting Machine	1,500 m day^{-1} for 24 hours each day from KP KP26.2 to 21.3 720 m day^{-1} for 24 hours each day from KP31.5 to 26.2	Yes	Not required	
Sha Chau to Lung Kwu Chau (KP31.5 – 36.0)	1 Jetting Machine	720 m day^{-1} for 24 hours each day	Yes	Two layers at Western Boundary of the Sha Chau and Lung Kwu Chau MP (KP31.5-36.0)	
Sha Chau to Lung Kwu Chau (KP36.0 - 37.5)	1 Grab Dredger	8,000 m^3 day^{-1} for 24 hours each day	Yes	Not required	
	1 Jetting Machine (Alternative)	720 m day^{-1} for 24 hours each day	Yes	Two layers at Western Boundary of the Sha Chau and Lung Kwu Chau MP (KP36.0-37.5)	
Lung Kwu Chau to Urmston Anchorage (37.5 - 41.1)	1 Jetting Machine	1,000 m day^{-1} for 24 hours each day	Yes	Two layers at NW corner of Sha Chau and Lung Kwu Chau MP (KP37.5-41.1)	
Urmston Road (KP41.1 – 42.9)	1 Grab Dredger	8,000 m^3 day^{-1} for 24 hours each day	Yes	Not required	
	1 TSHD (Alternative)	64,800 m^3 day^{-1} for 24 hours each day	Not required	Not required *	
West of BPPS (KP42.9 - 44.9)	1 Jetting Machine	1,000 m day^{-1} for 24 hours each day	Yes	Two layers at CR1, CR2	
Pipeline shore approach at BPPS (KP44.9 - 45.0)	1 Grab Dredger	1,500 m^3 day^{-1} for 24 hours each day	Yes	Two layers at CR1, CR2	

* The predicted sediment plume from grab dredging/ TSHD at this section would not reach CR1 and CR2 at the BPPS seawall, therefore additional silt curtain at CR1 and CR2 is not required.

Appendix A Contour Plots for Sediment Plume Modelling - SS Elevation

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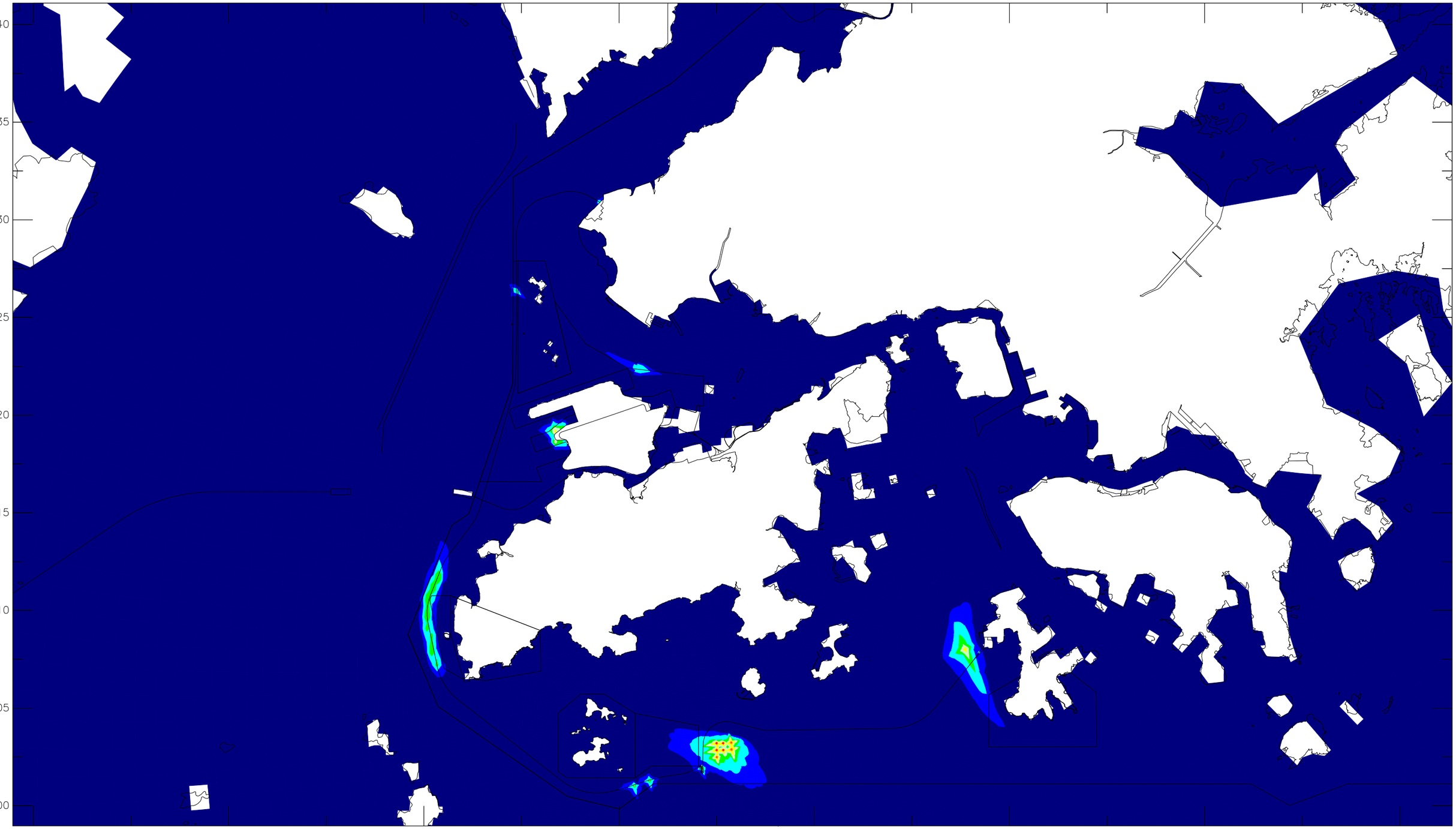
840 835 830 825 820 815 810 805 800



780 790 800 810 820 830 840 850

Offshore LNG Terminal EIA	Dry 2019
Construction Phase Sediment Plume Modelling – Scenario C01D – mitigated Maximum Depth-averaged SS Elevation (mg/L)	Appendix A-1
ERM	Appendix A.ssn

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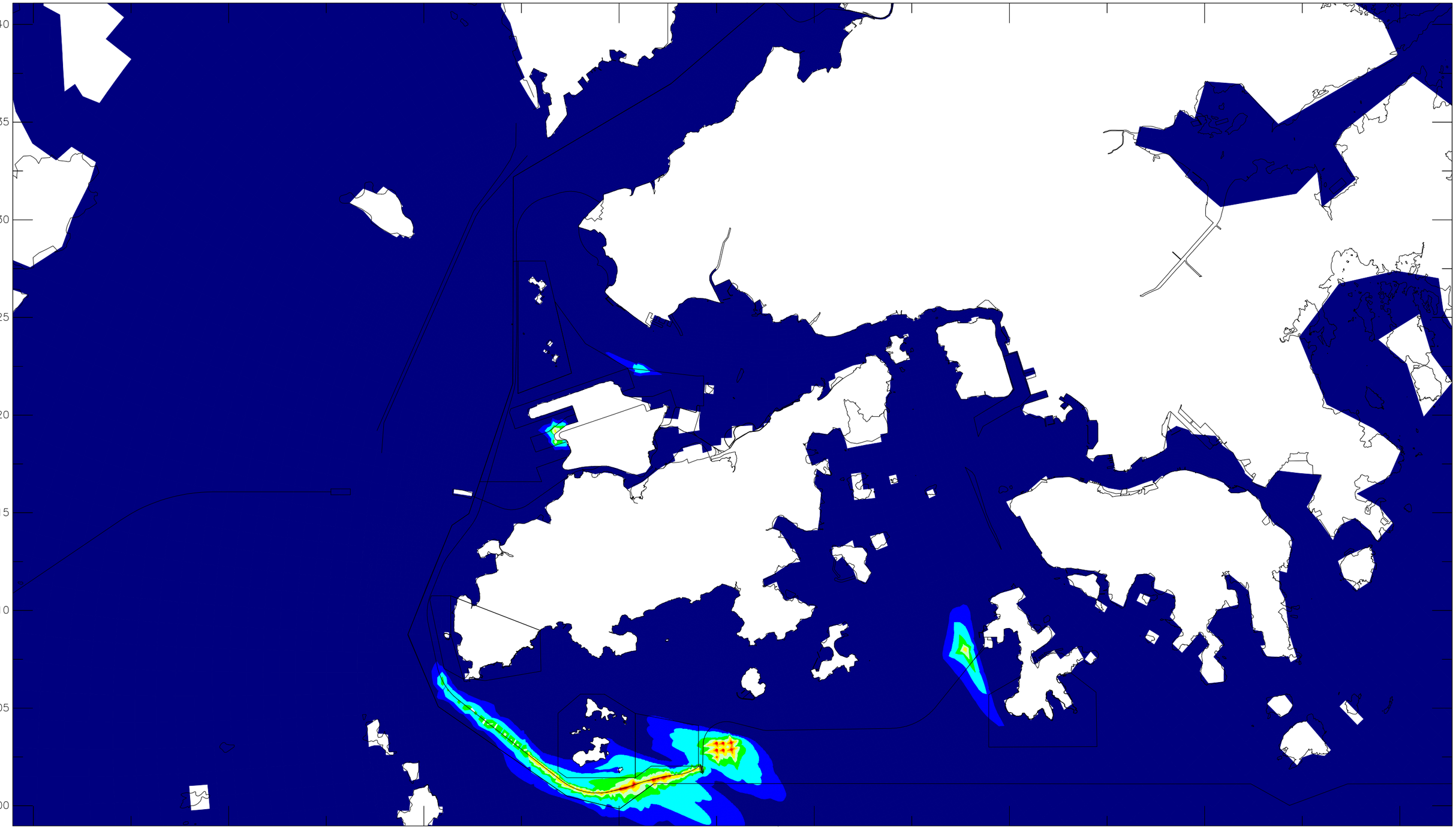

Offshore LNG Terminal EIA	Dry 2019
Construction Phase Sediment Plume Modelling – Scenario C05E – mitigated Maximum Depth-averaged SS Elevation (mg/L)	Appendix A-2
ERM	Appendix A.ssn

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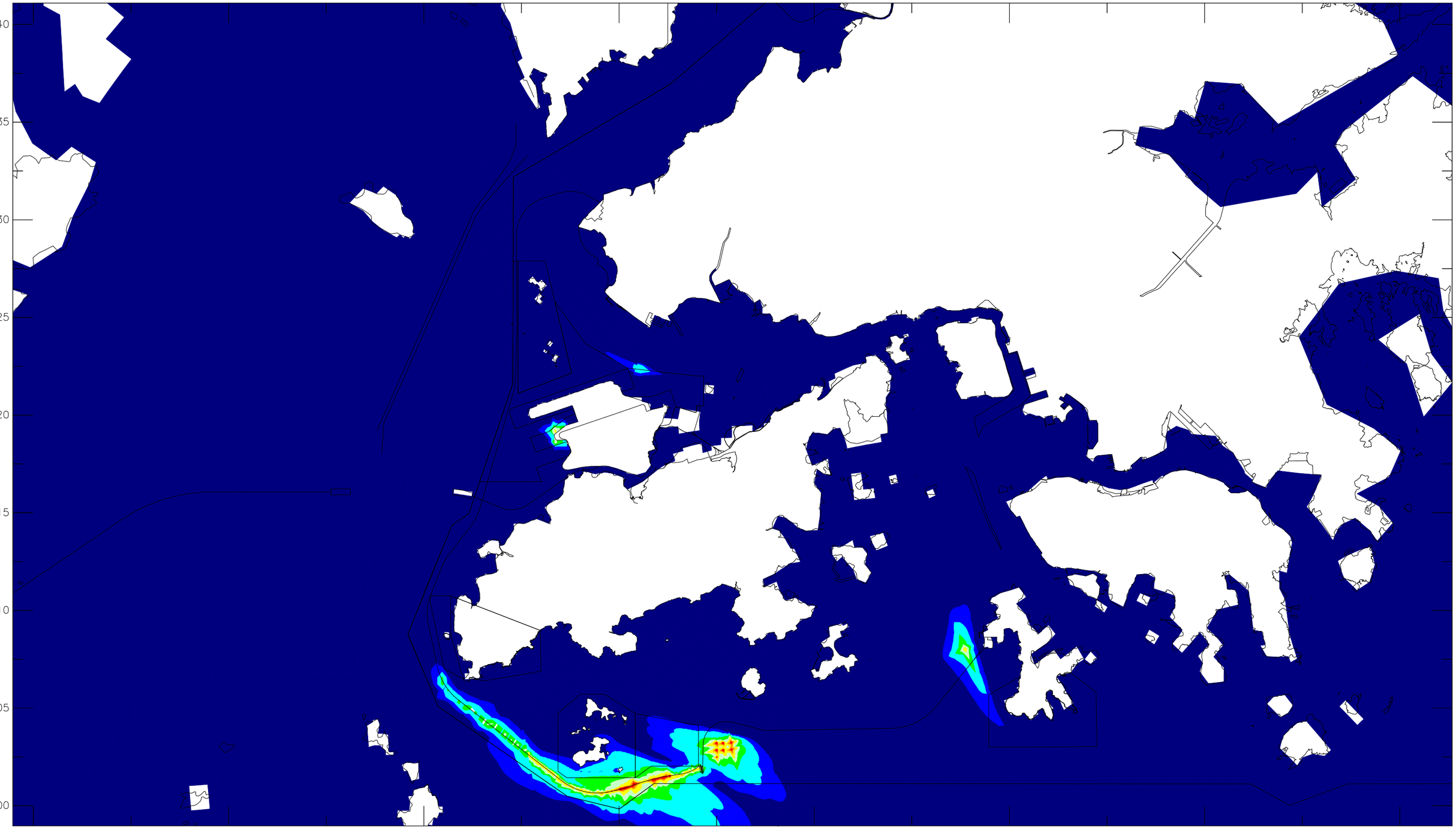

Offshore LNG Terminal EIA	Dry 2019
Construction Phase Sediment Plume Modelling – Scenario C05F – mitigated Maximum Depth-averaged SS Elevation (mg/L)	Appendix A-3
ERM	Appendix A.ssn

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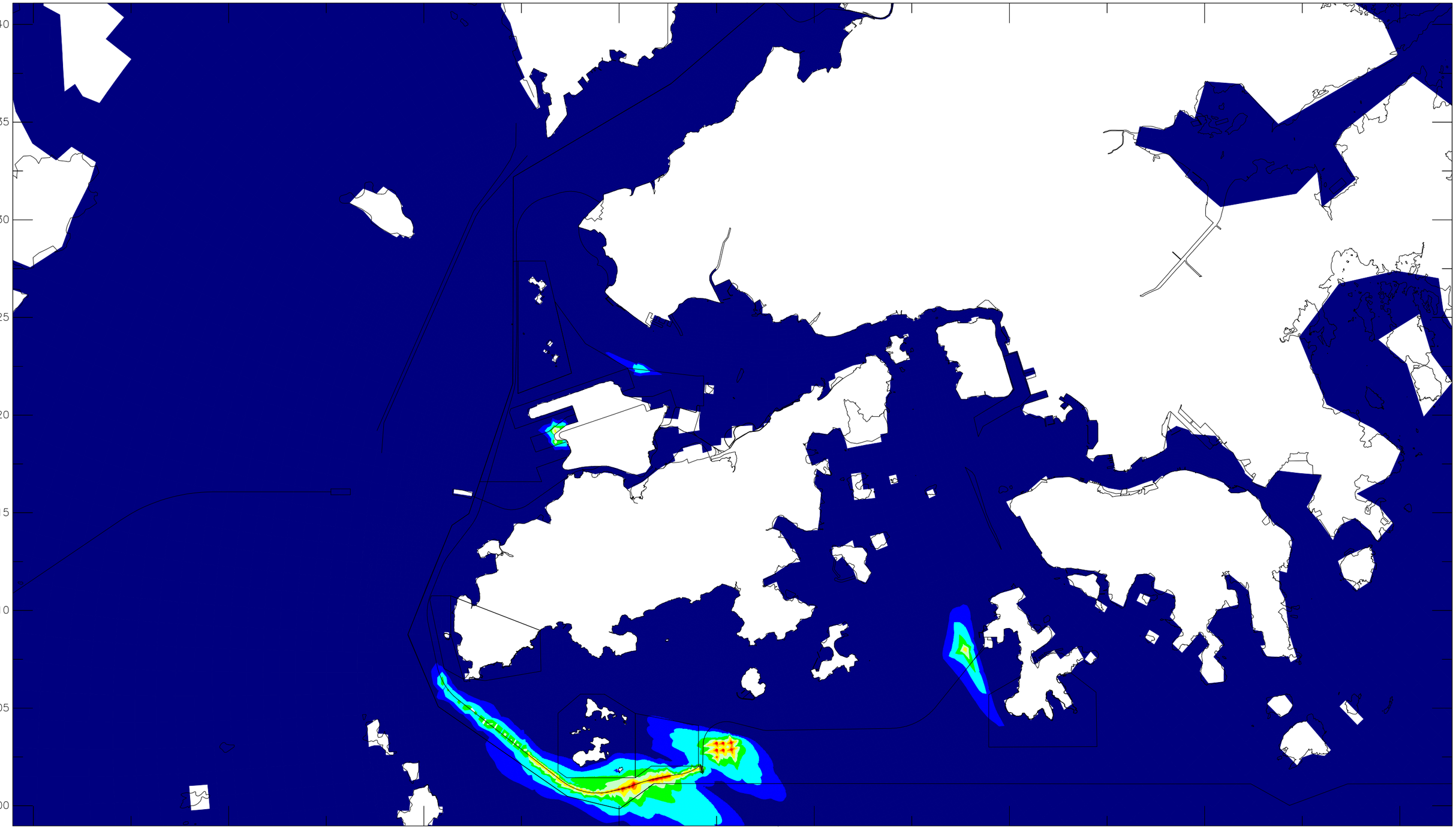

Offshore LNG Terminal EIA	Dry 2019
Construction Phase Sediment Plume Modelling – Scenario C05G – mitigated Maximum Depth-averaged SS Elevation (mg/L)	Appendix A-4
ERM	Appendix A.ssn

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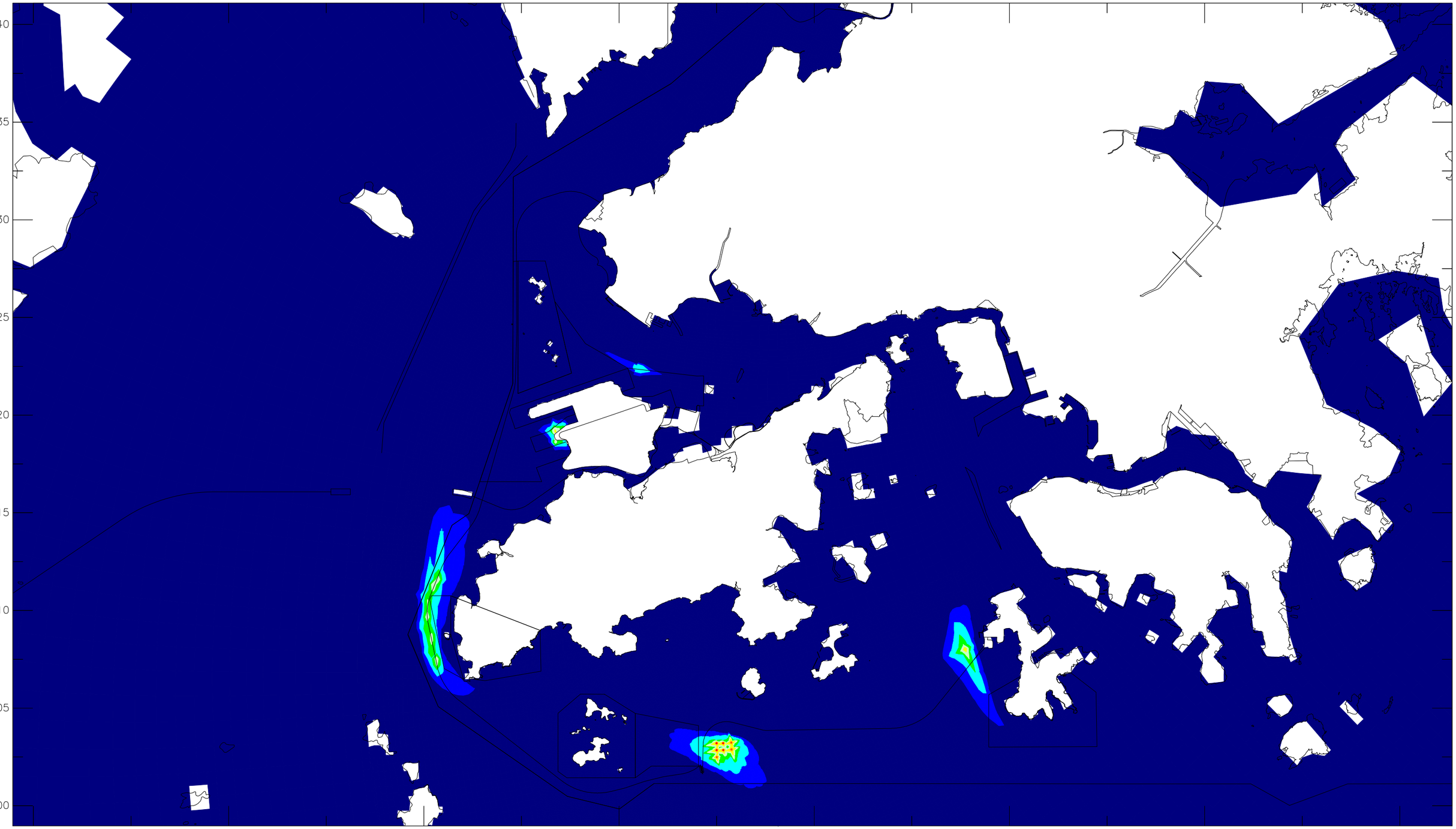

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Offshore LNG Terminal EIA	Dry 2019
Construction Phase Sediment Plume Modelling – Scenario C09A – mitigated Maximum Depth-averaged SS Elevation (mg/L)	Appendix A-5
ERM	Appendix A.ssn

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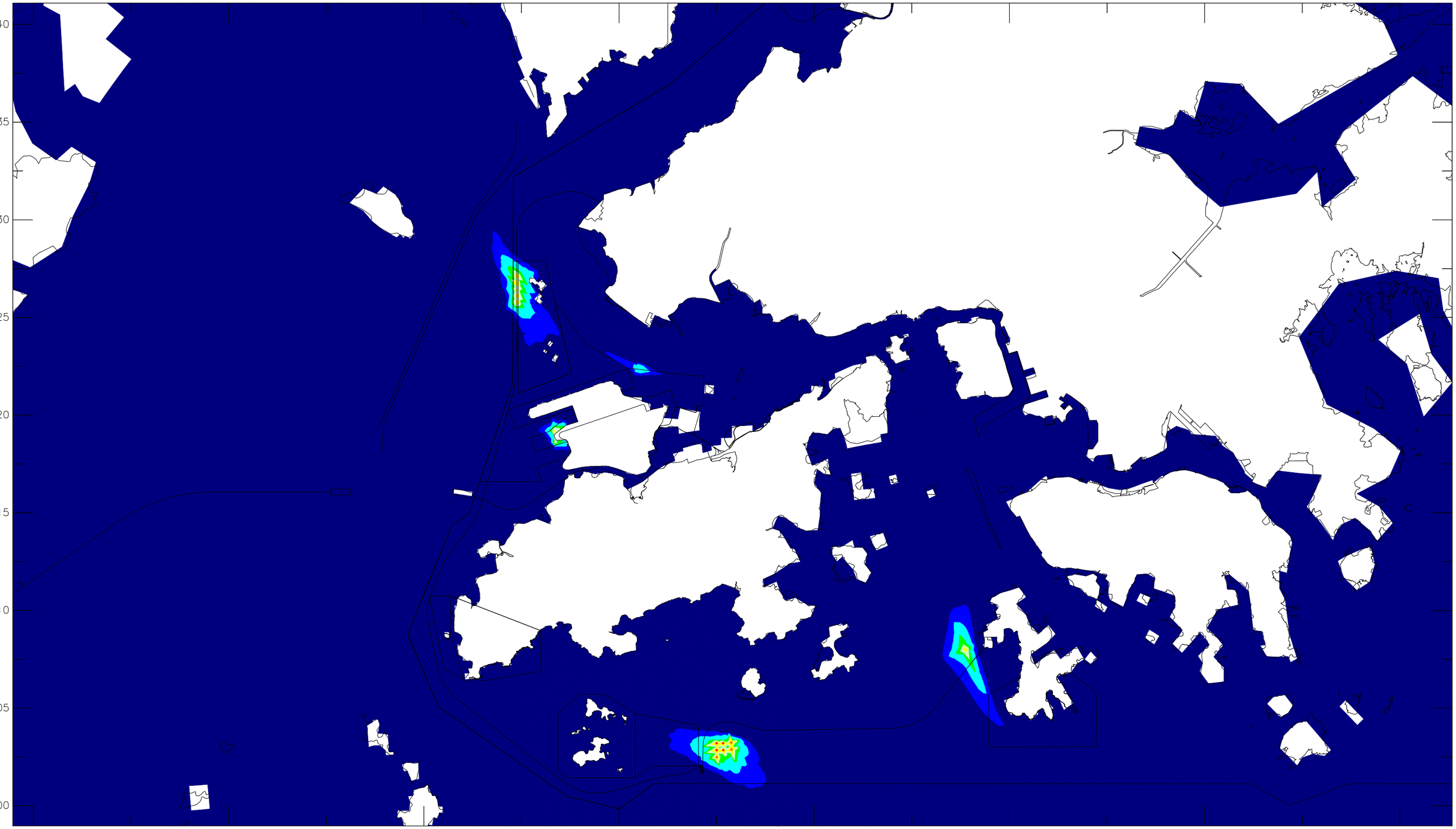

Offshore LNG Terminal EIA	Dry 2019
Construction Phase Sediment Plume Modelling – Scenario C08 – mitigated Maximum Depth-averaged SS Elevation (mg/L)	Appendix A-6
ERM	Appendix A.ssn

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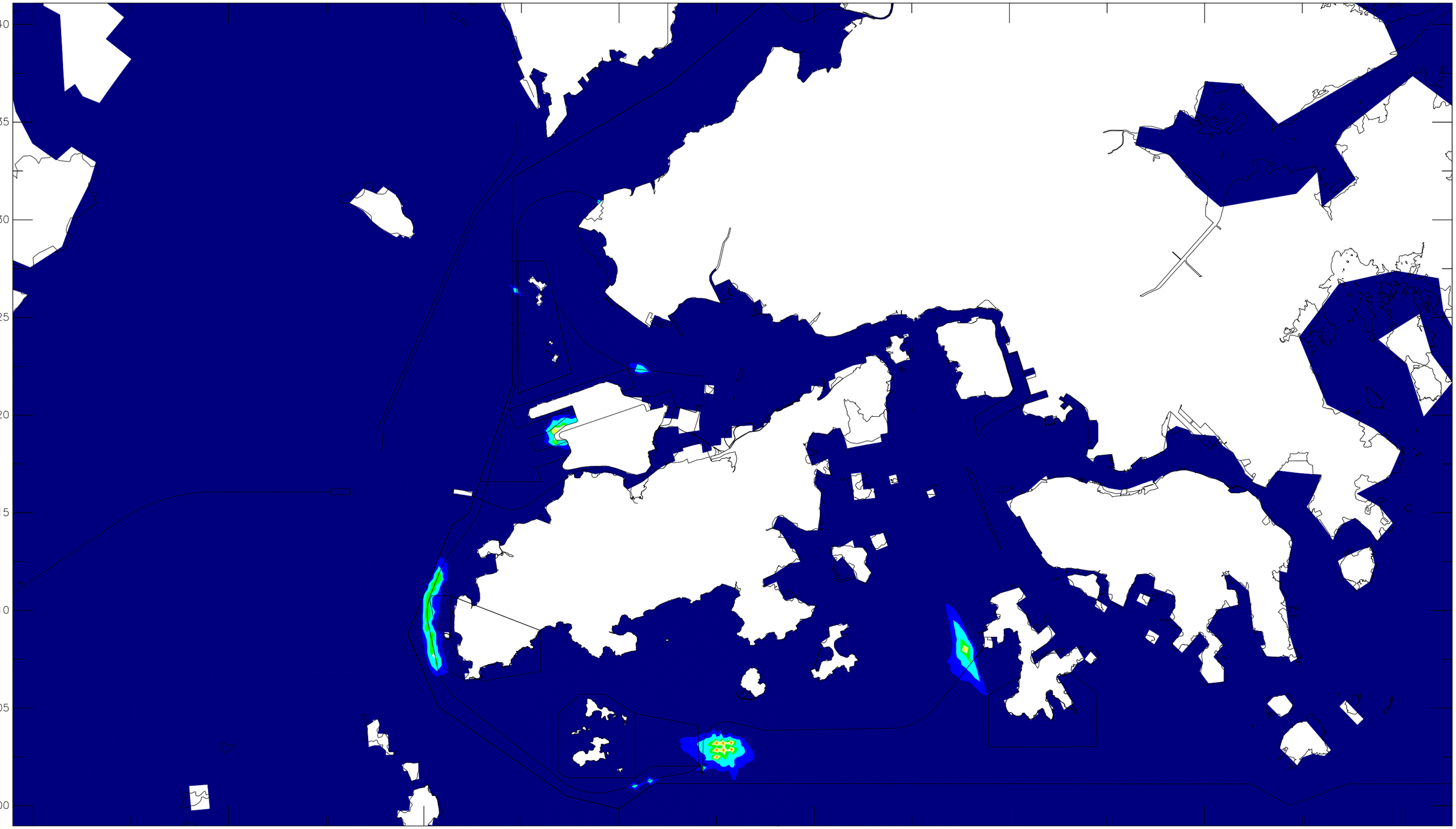

Offshore LNG Terminal EIA	Wet 2019
Construction Phase Sediment Plume Modelling – Scenario C01D – mitigated Maximum Depth-averaged SS Elevation (mg/L)	Appendix A-7
ERM	Appendix A.ssn

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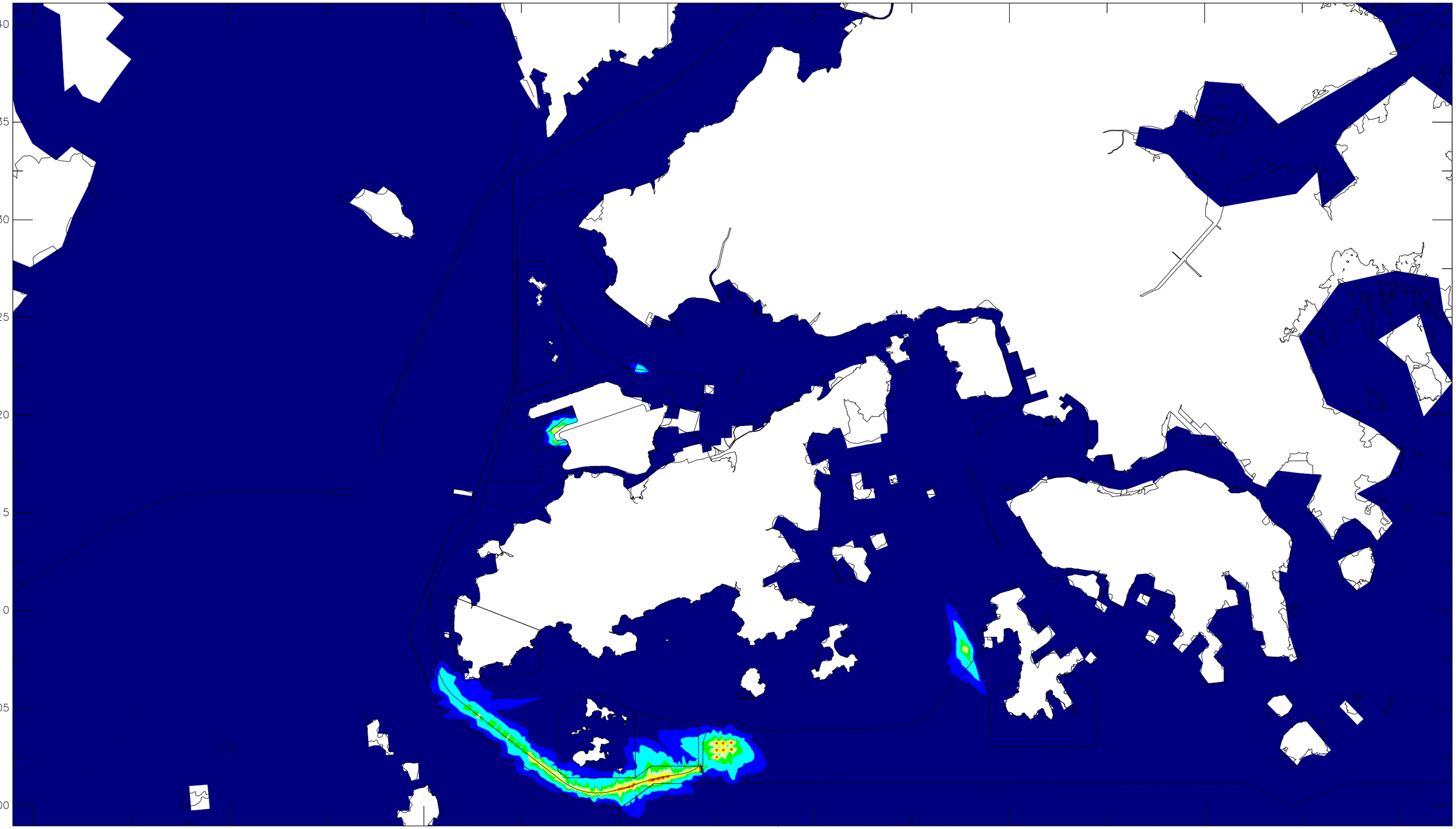

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Offshore LNG Terminal EIA	Wet 2019
Construction Phase Sediment Plume Modelling – Scenario C05E – mitigated Maximum Depth-averaged SS Elevation (mg/L)	Appendix A-8
ERM	Appendix A.ssn

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<1.0
<2.0
<5.0
<10.0
<20.0
<50.0
<100.0
>100.0

Offshore LNG Terminal EIA	Wet 2019
Construction Phase Sediment Plume Modelling – Scenario C05F – mitigated Maximum Depth-averaged SS Elevation (mg/L)	Appendix A-9
ERM	Appendix A.ssn

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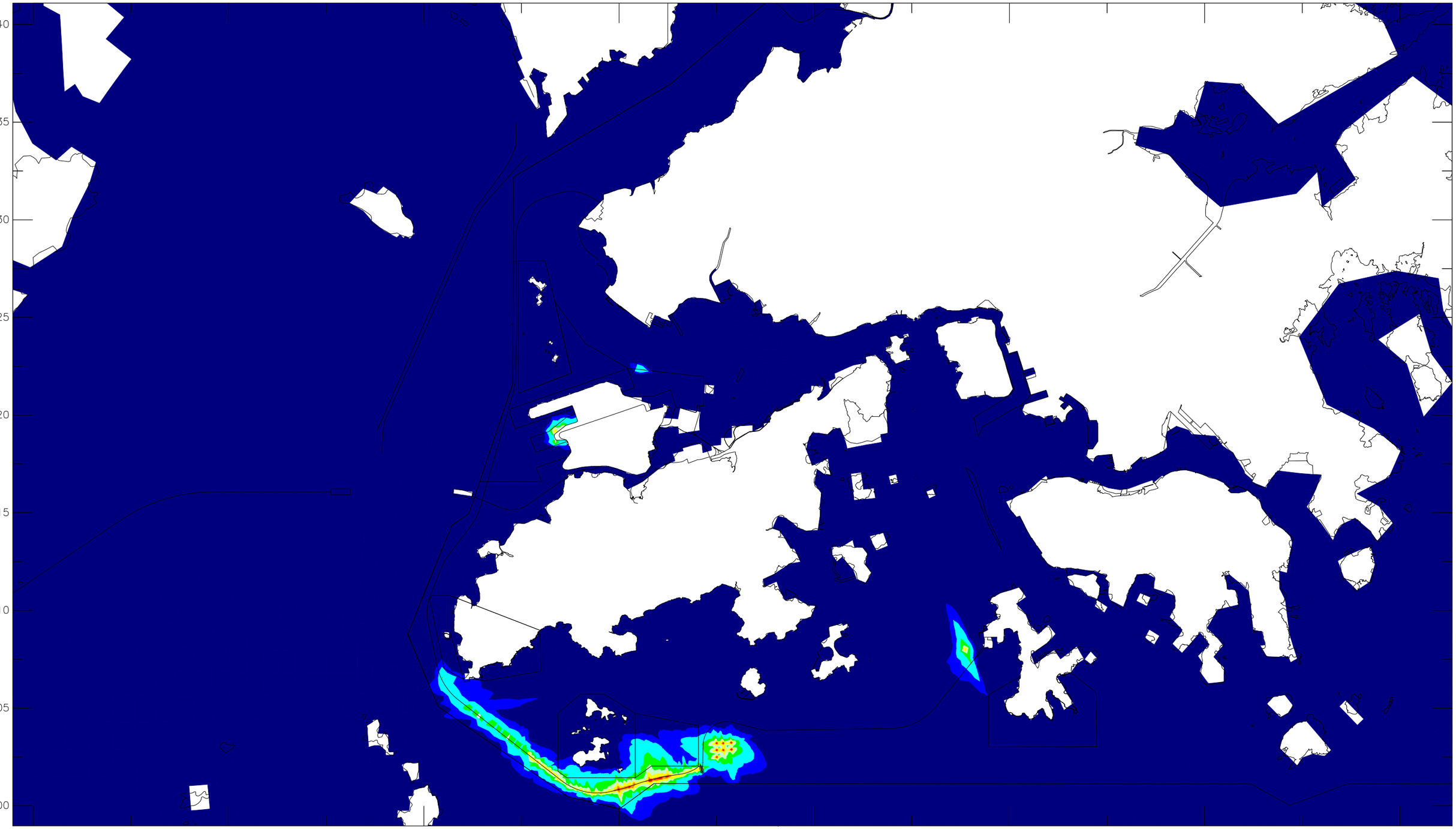

Offshore LNG Terminal EIA	Wet 2019
Construction Phase Sediment Plume Modelling – Scenario C05G – mitigated Maximum Depth-averaged SS Elevation (mg/L)	Appendix A-10
ERM	Appendix A.ssn

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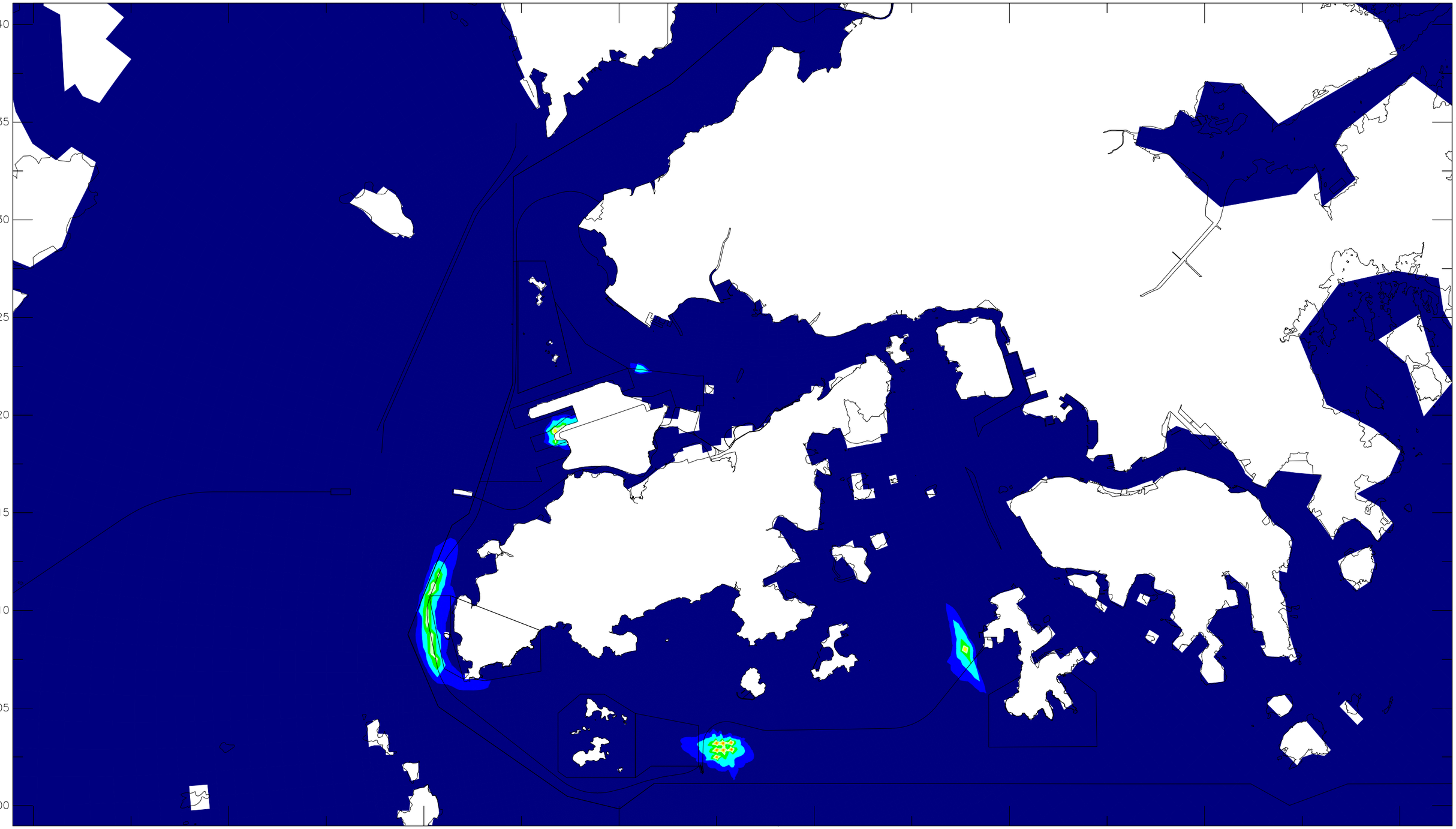
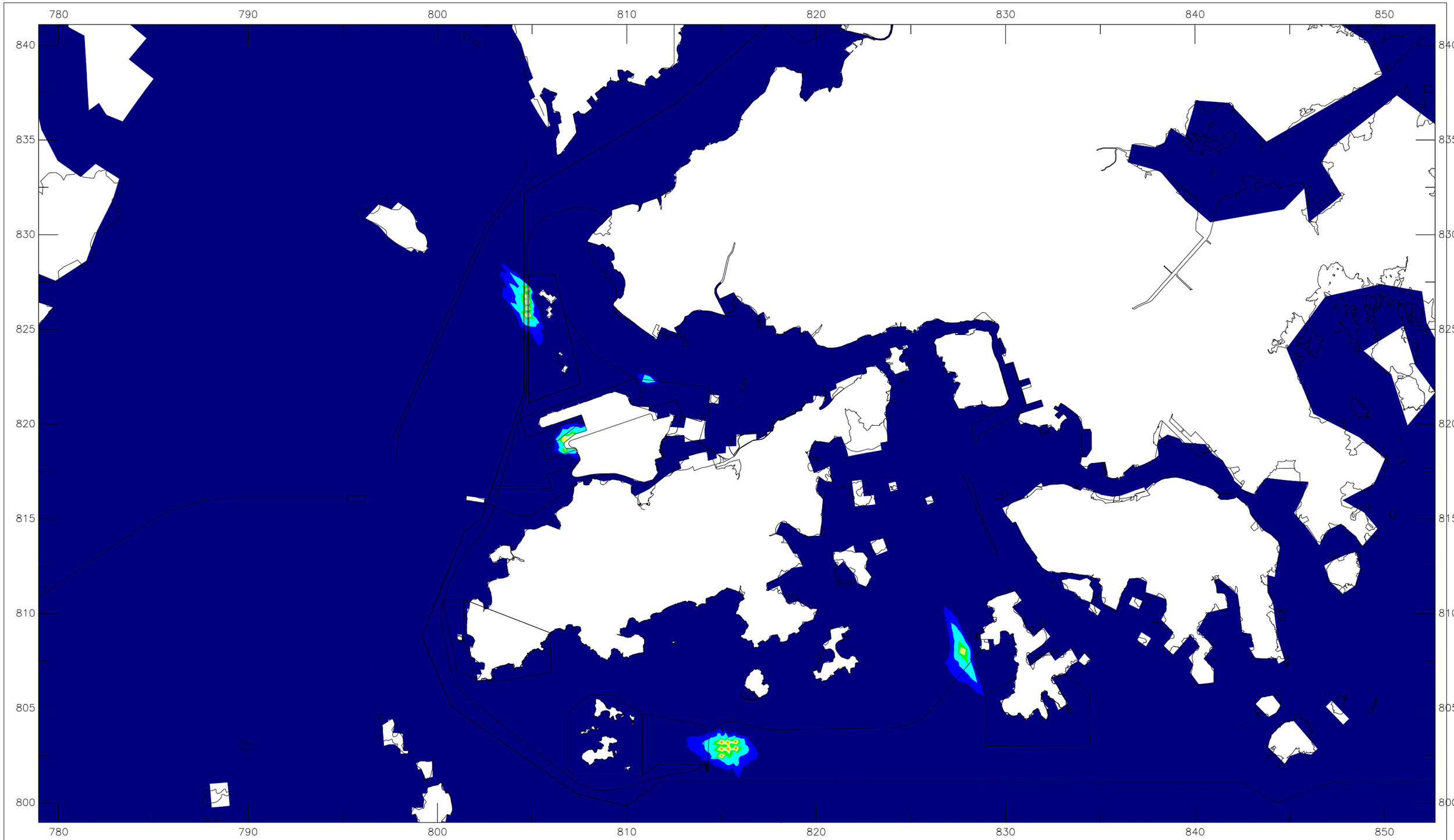


Offshore LNG Terminal EIA	Wet 2019
Construction Phase Sediment Plume Modelling – Scenario C09A – mitigated Maximum Depth-averaged SS Elevation (mg/L)	Appendix A-11
ERM	Appendix A.ssn

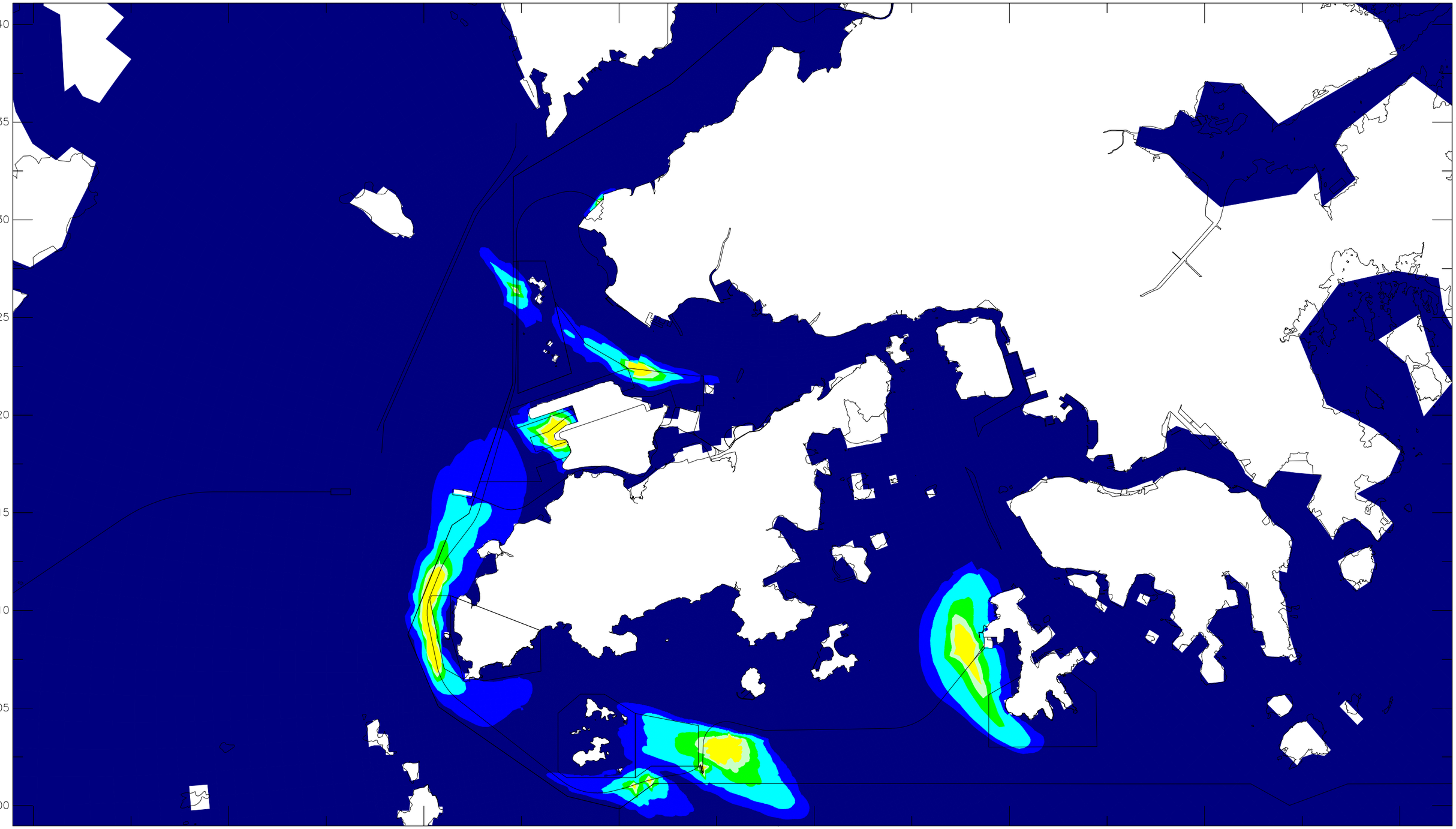


Offshore LNG Terminal EIA Construction Phase Sediment Plume Modelling – Scenario C08 – mitigated Maximum Depth-averaged SS Elevation (mg/L)	Wet 2019 Appendix A-12
ERM	Appendix A.ssn

Appendix B Contour Plots for Sediment Plume Modelling – Sedimentation Flux

780 790 800 810 820 830 840 850

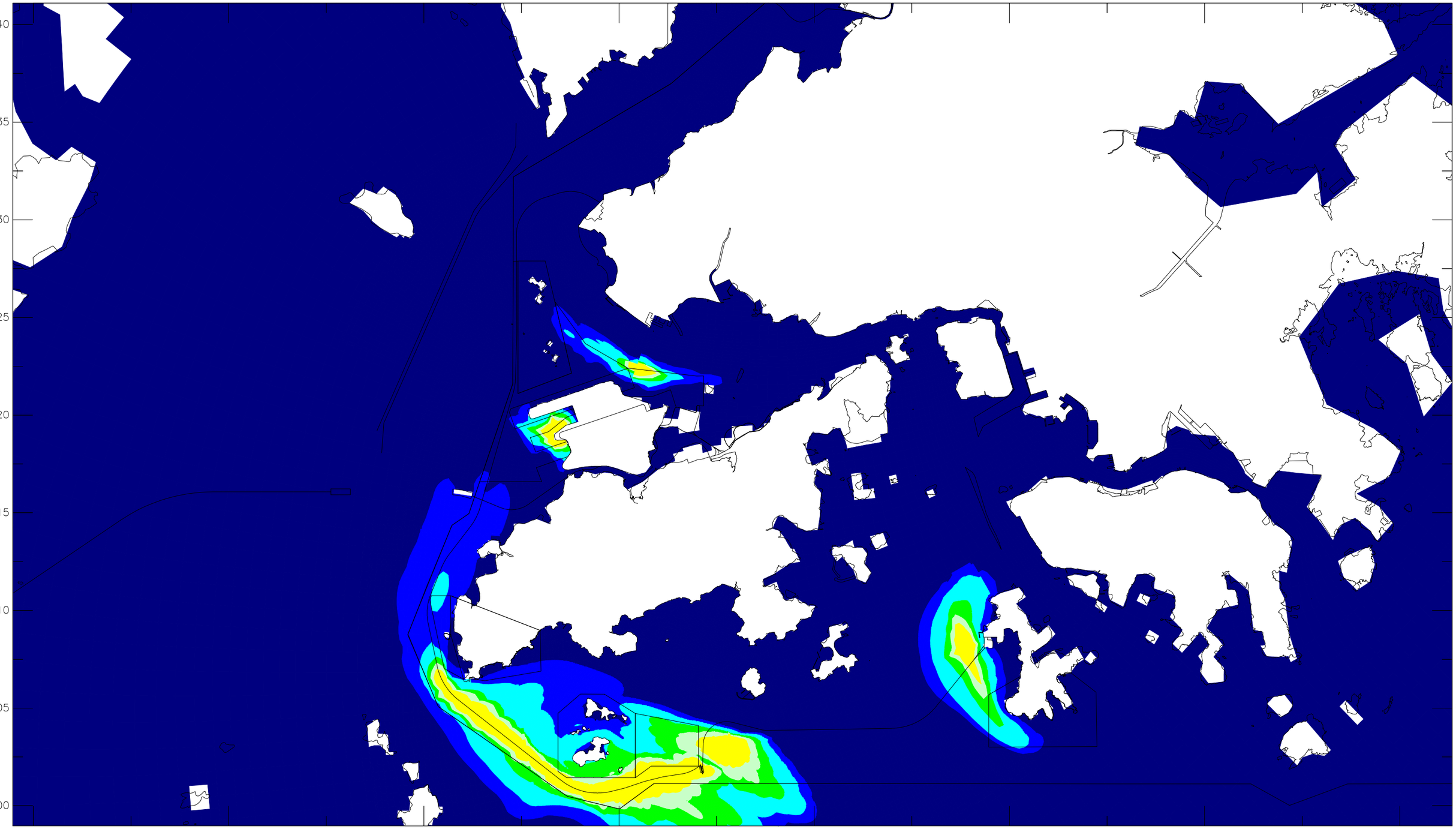
840 835 830 825 820 815 810 805 800



Offshore LNG Terminal EIA	Dry 2019
Construction Phase Sediment Plume Modelling – Scenario C01D – mitigated Maximum Sedimentation Flux (g/m2/day)	Appendix B–1
ERM	Appendix B.ssn

780 790 800 810 820 830 840 850

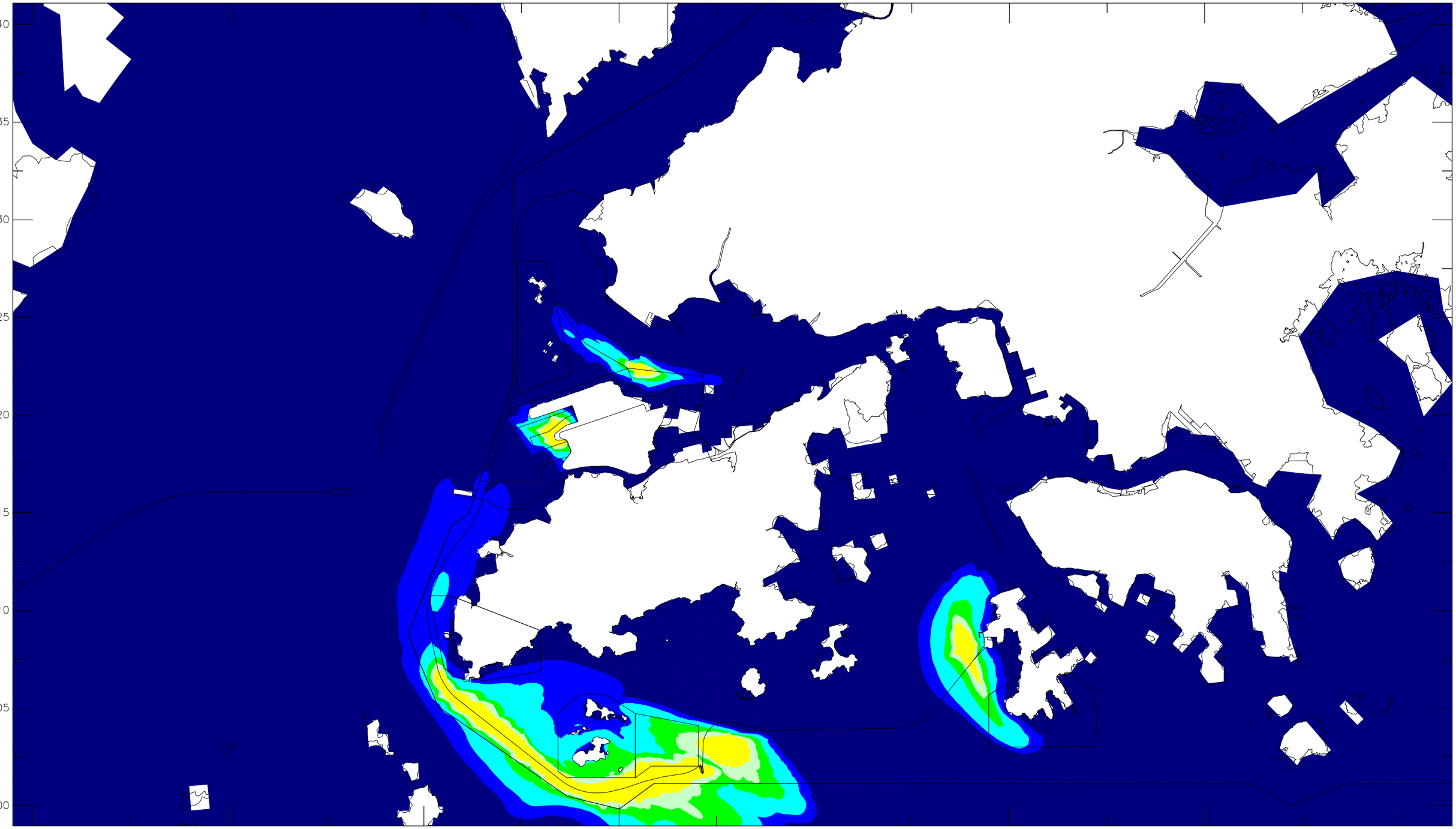
840 835 830 825 820 815 810 805 800



Offshore LNG Terminal EIA	Dry 2019
Construction Phase Sediment Plume Modelling – Scenario C05E· – mitigated Maximum Sedimentation Flux (g/m2/day)	Appendix B–2
ERM	Appendix B.ssn

780 790 800 810 820 830 840 850

840 835 830 825 820 815 810 805 800



Offshore LNG Terminal EIA	Dry 2019
Construction Phase Sediment Plume Modelling – Scenario C05F – mitigated Maximum Sedimentation Flux (g/m2/day)	Appendix B–3
ERM	Appendix B.ssn

780 790 800 810 820 830 840 850

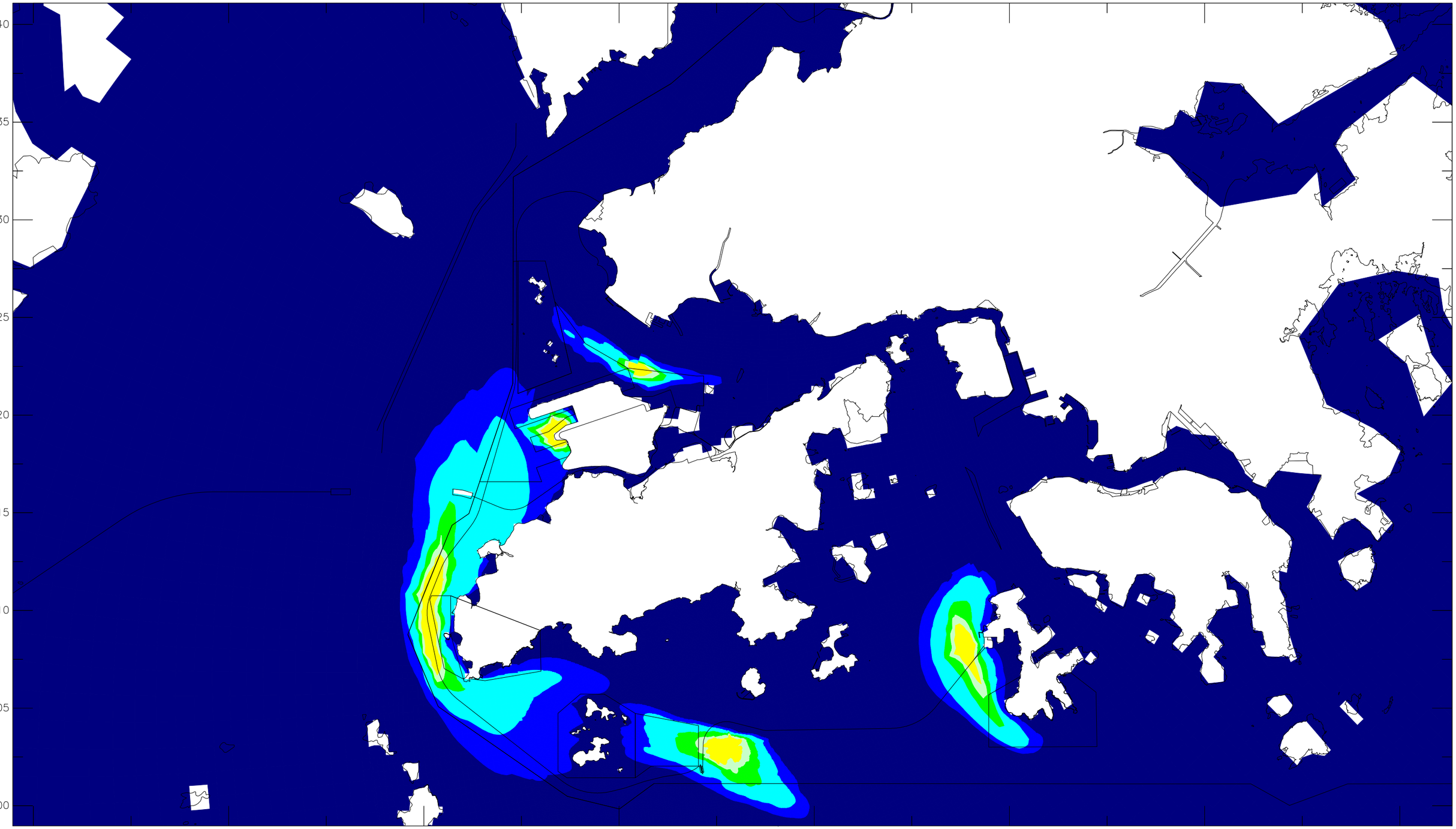
840 835 830 825 820 815 810 805 800

<10.0
<20.0
<50.0
<100.0
<200.0
>200.0

Offshore LNG Terminal EIA	Dry 2019
Construction Phase Sediment Plume Modelling – Scenario C05G – mitigated Maximum Sedimentation Flux (g/m2/day)	Appendix B–4
ERM	Appendix B.ssn

780 790 800 810 820 830 840 850

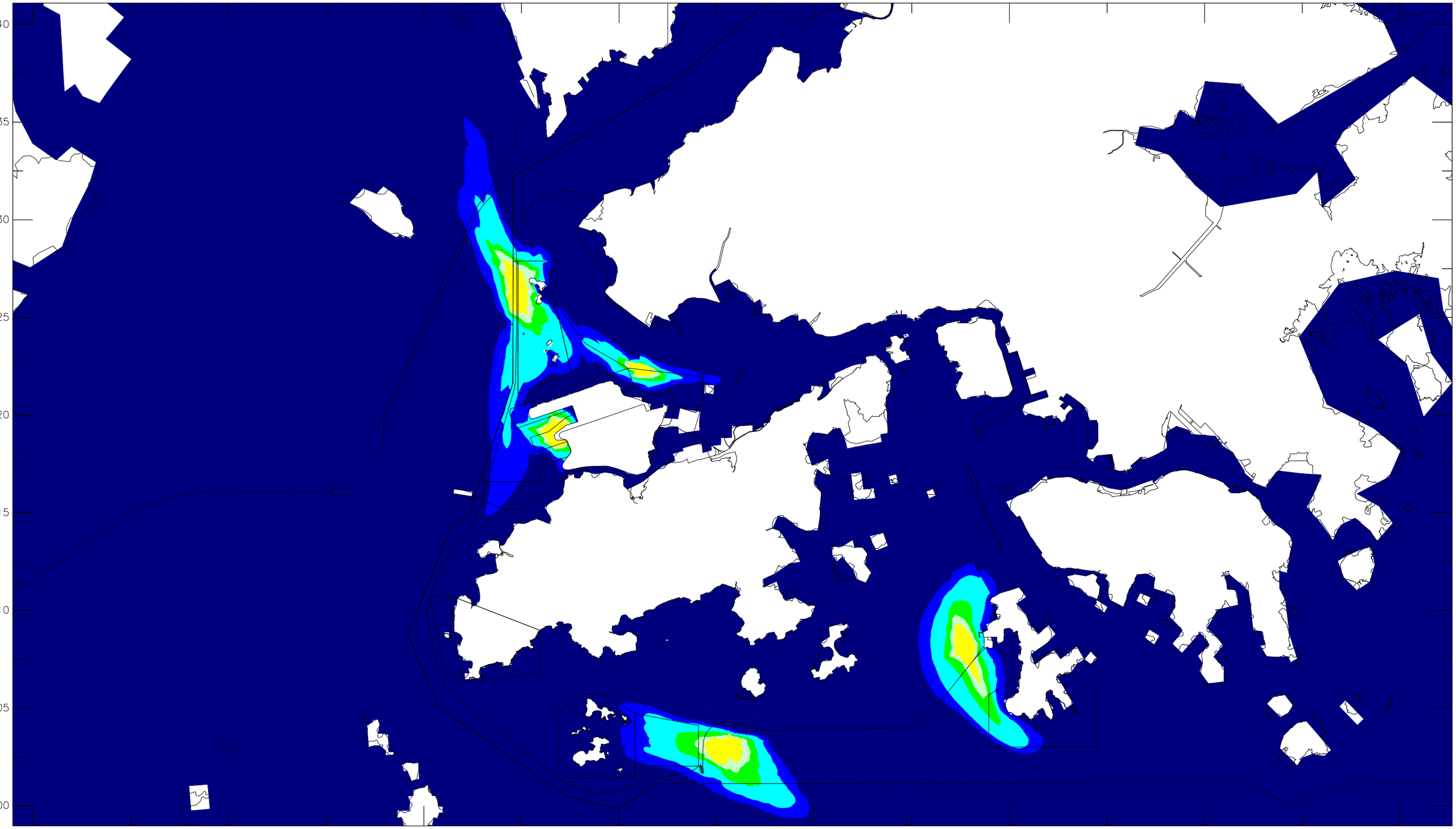
840 835 830 825 820 815 810 805 800



Offshore LNG Terminal EIA	Dry 2019
Construction Phase Sediment Plume Modelling – Scenario C09A – mitigated Maximum Sedimentation Flux (g/m2/day)	Appendix B–5
ERM	Appendix B.ssn

780 790 800 810 820 830 840 850

840 835 830 825 820 815 810 805 800



780 790 800 810 820 830 840 850

Offshore LNG Terminal EIA Construction Phase Sediment Plume Modelling – Scenario C08 – mitigated Maximum Sedimentation Flux (g/m2/day)	Dry 2019 Appendix B–6
ERM	Appendix B.ssn

780 790 800 810 820 830 840 850

840 835 830 825 820 815 810 805 800

<10.0
<20.0
<50.0
<100.0
<200.0
>200.0

Offshore LNG Terminal EIA	Wet 2019
Construction Phase Sediment Plume Modelling – Scenario C01D – mitigated Maximum Sedimentation Flux (g/m2/day)	Appendix B–7
ERM	Appendix B.ssn

780 790 800 810 820 830 840 850

840 835 830 825 820 815 810 805 800

<10.0
<20.0
<50.0
<100.0
<200.0
>200.0

Offshore LNG Terminal EIA	Wet 2019
Construction Phase Sediment Plume Modelling – Scenario C05E· – mitigated Maximum Sedimentation Flux (g/m2/day)	Appendix B–8
ERM	Appendix B.ssn

780 790 800 810 820 830 840 850

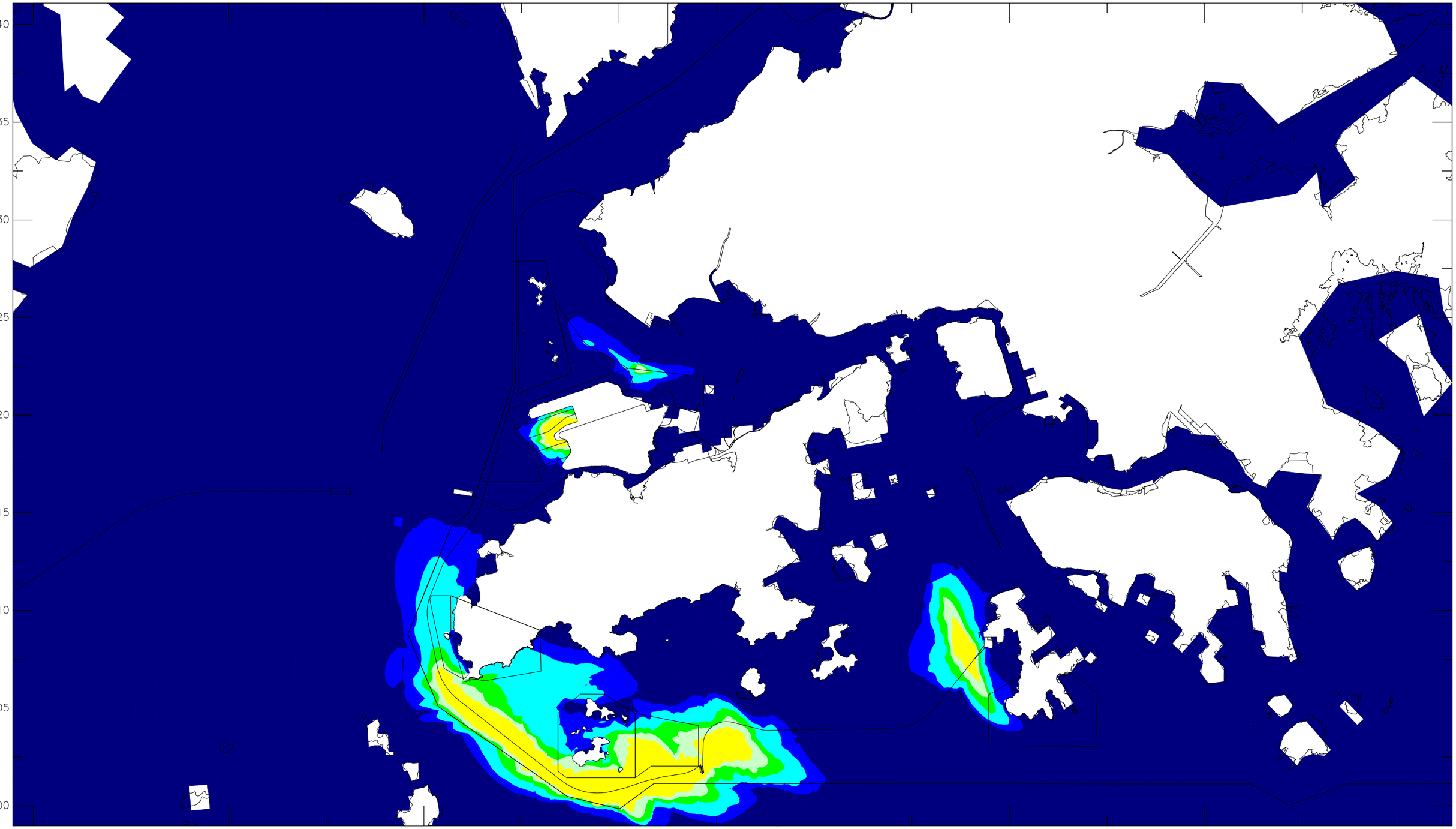
840 835 830 825 820 815 810 805 800

<10.0
<20.0
<50.0
<100.0
<200.0
>200.0

Offshore LNG Terminal EIA	Wet 2019
Construction Phase Sediment Plume Modelling – Scenario C05F – mitigated Maximum Sedimentation Flux (g/m2/day)	Appendix B–9
ERM	Appendix B.ssn

780 790 800 810 820 830 840 850

840 835 830 825 820 815 810 805 800



780 790 800 810 820 830 840 850

<10.0
<20.0
<50.0
<100.0
<200.0
>200.0

Offshore LNG Terminal EIA	Wet 2019
Construction Phase Sediment Plume Modelling – Scenario C05G – mitigated Maximum Sedimentation Flux (g/m2/day)	Appendix B–10
ERM	Appendix B.ssn

780 790 800 810 820 830 840 850

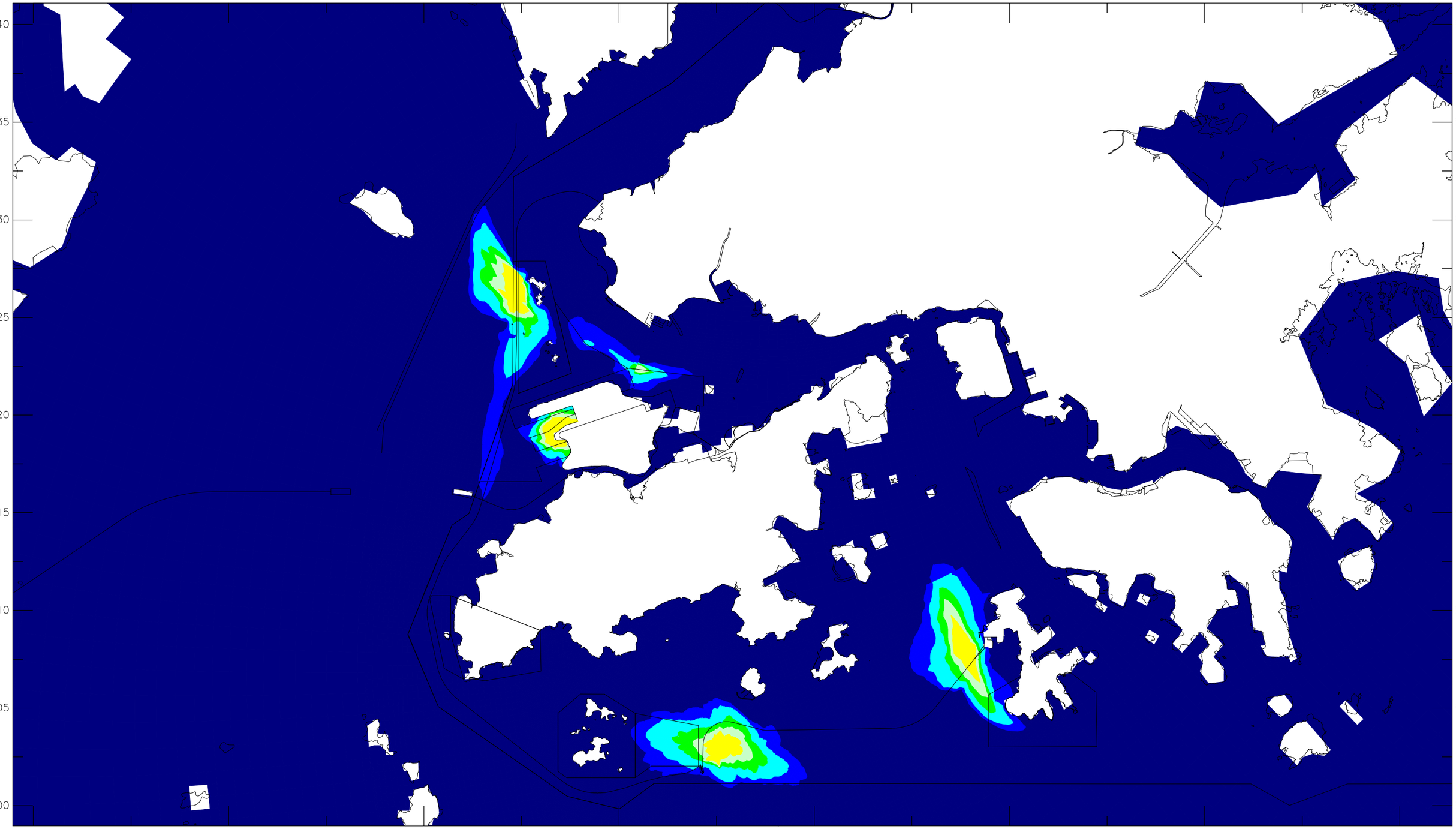
840 835 830 825 820 815 810 805 800

<10.0
<20.0
<50.0
<100.0
<200.0
>200.0

Offshore LNG Terminal EIA	Wet 2019
Construction Phase Sediment Plume Modelling – Scenario C09A – mitigated Maximum Sedimentation Flux (g/m2/day)	Appendix B–11
ERM	Appendix B.ssn

780 790 800 810 820 830 840 850

840 835 830 825 820 815 810 805 800



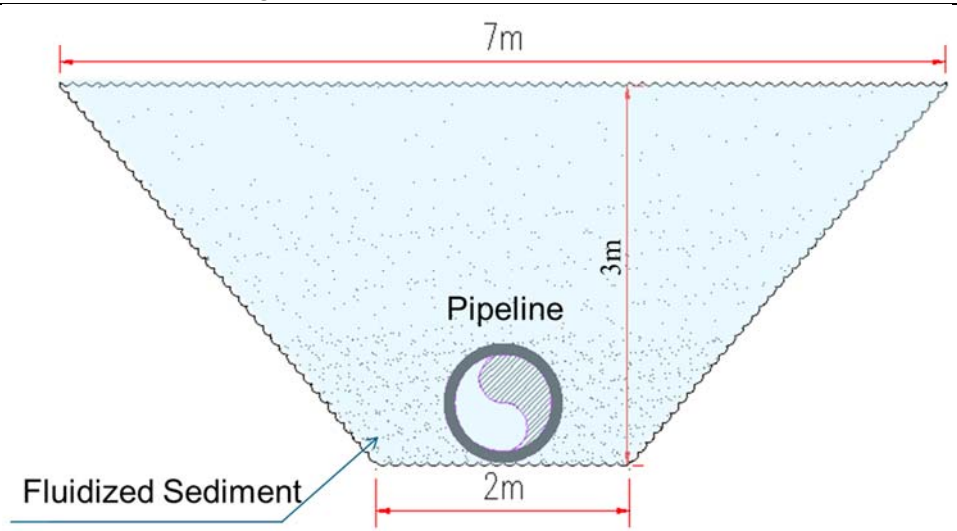
780 790 800 810 820 830 840 850

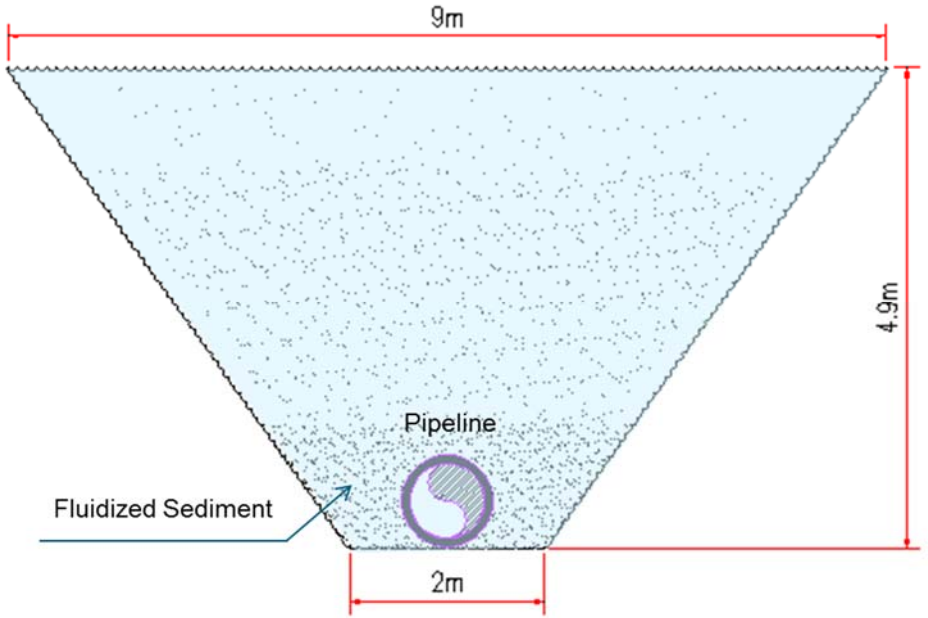
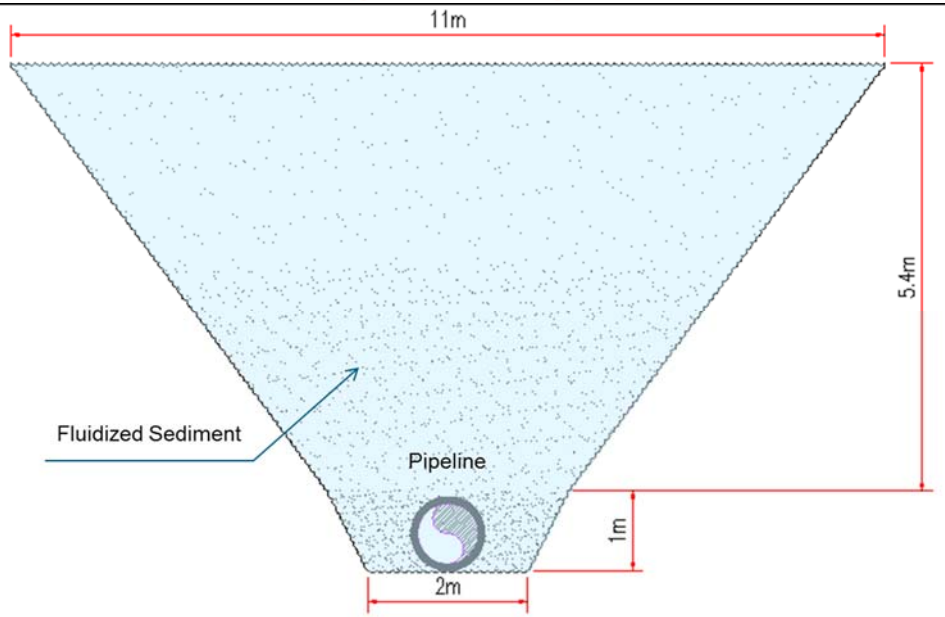
Offshore LNG Terminal EIA	Wet 2019
Construction Phase Sediment Plume Modelling – Scenario C08 – mitigated Maximum Sedimentation Flux (g/m2/day)	Appendix B–12
ERM	Appendix B.ssn

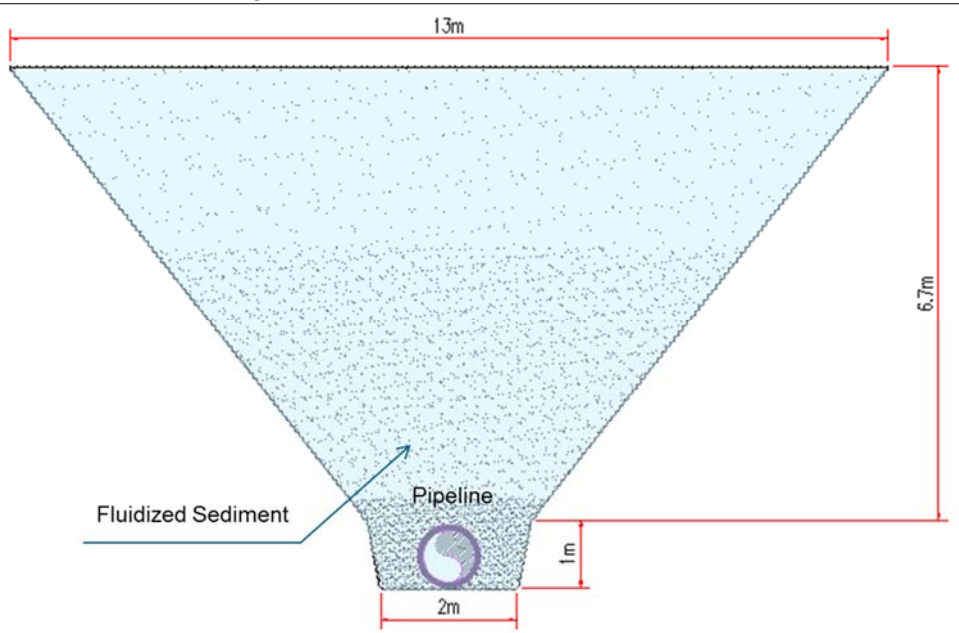
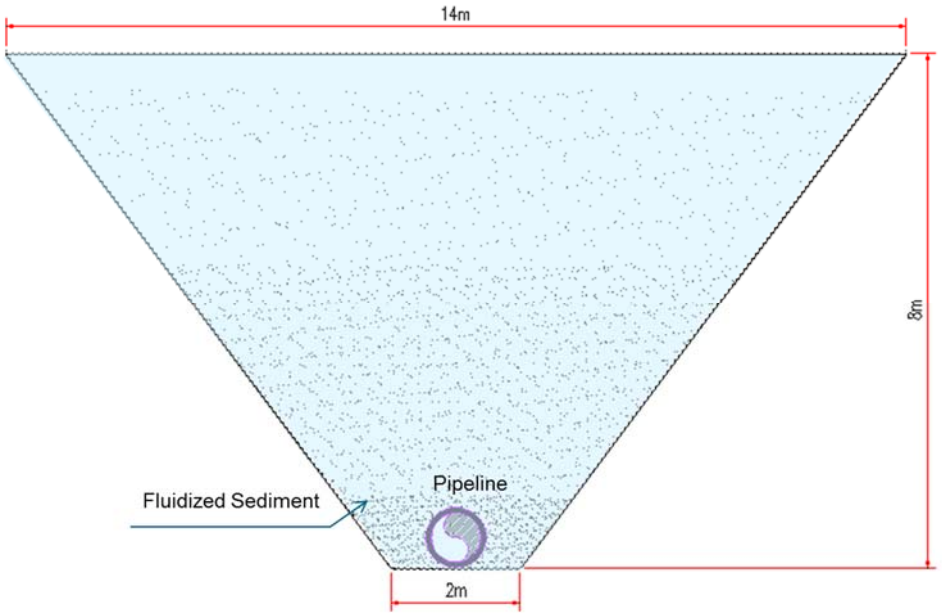
Appendix C Proposed Indicative Trench Design at Subsea Cable Sterile Corridors

Option 1 (Pure Jetting)

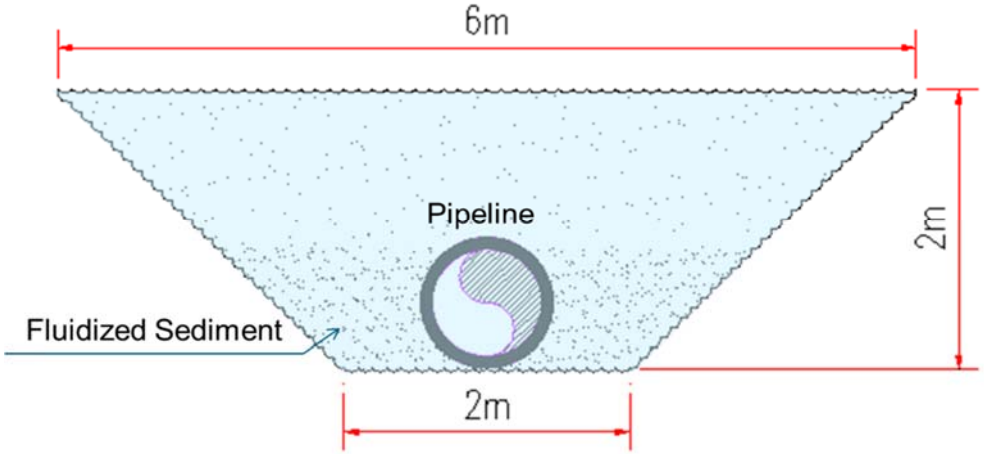
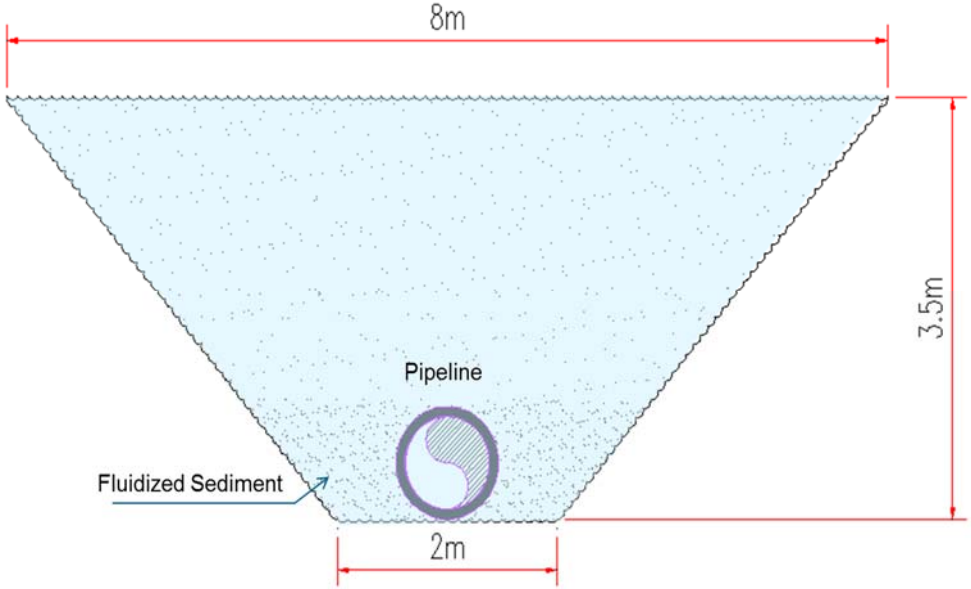
Option 1a: achieving the proposed pipeline burial depth with five jetting passes

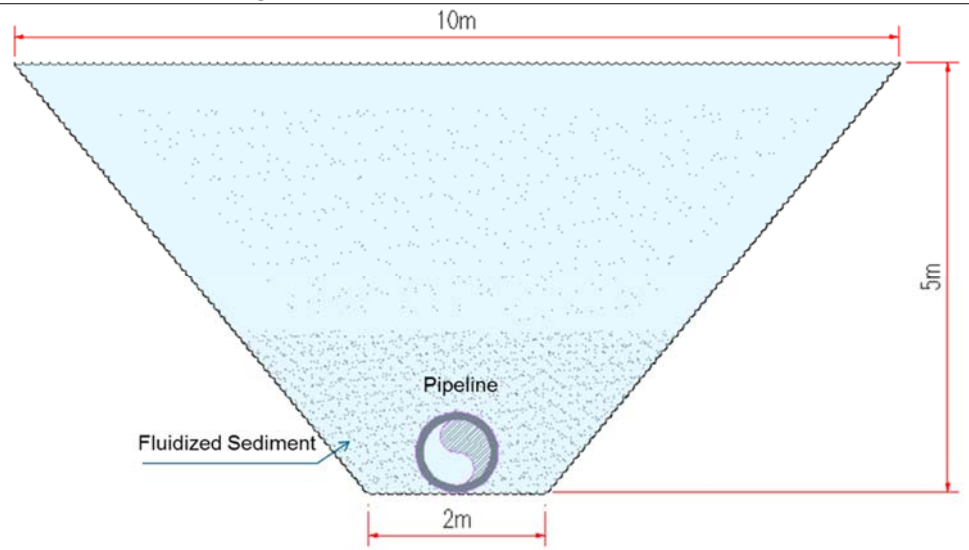
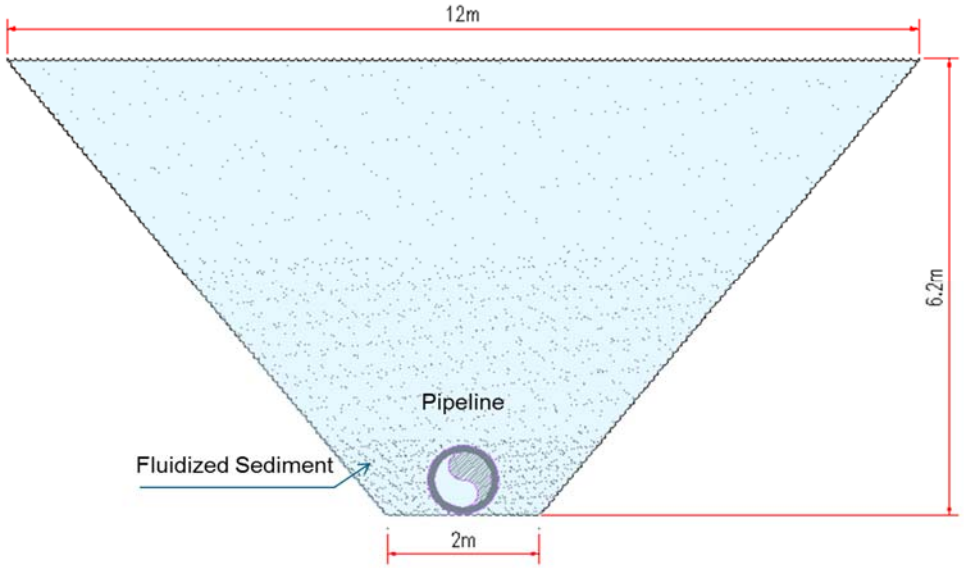
Passage number	Proposed Trench Configuration (not to scale)	Cross Section of Jetting Trench (m^2)
1		13.5

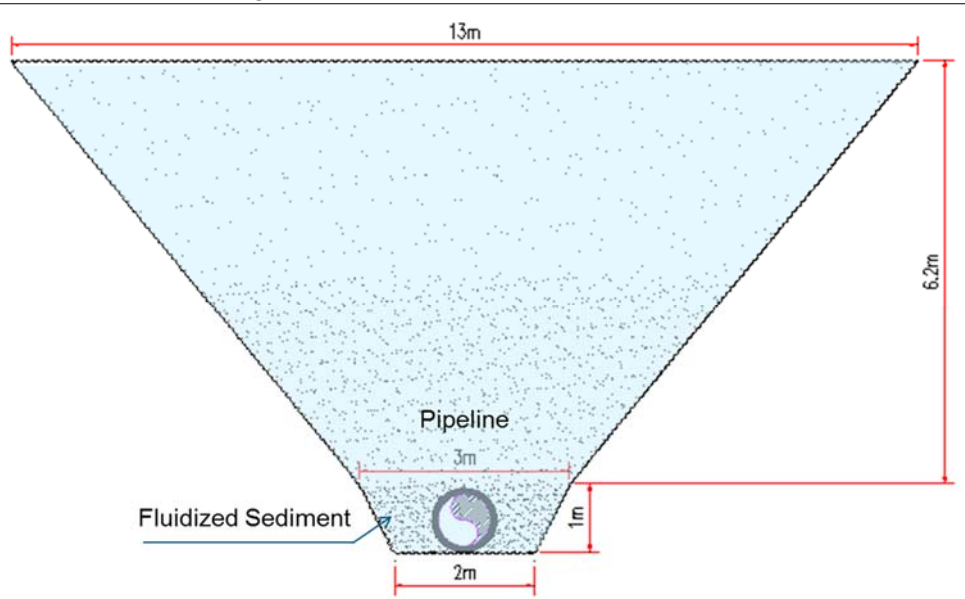
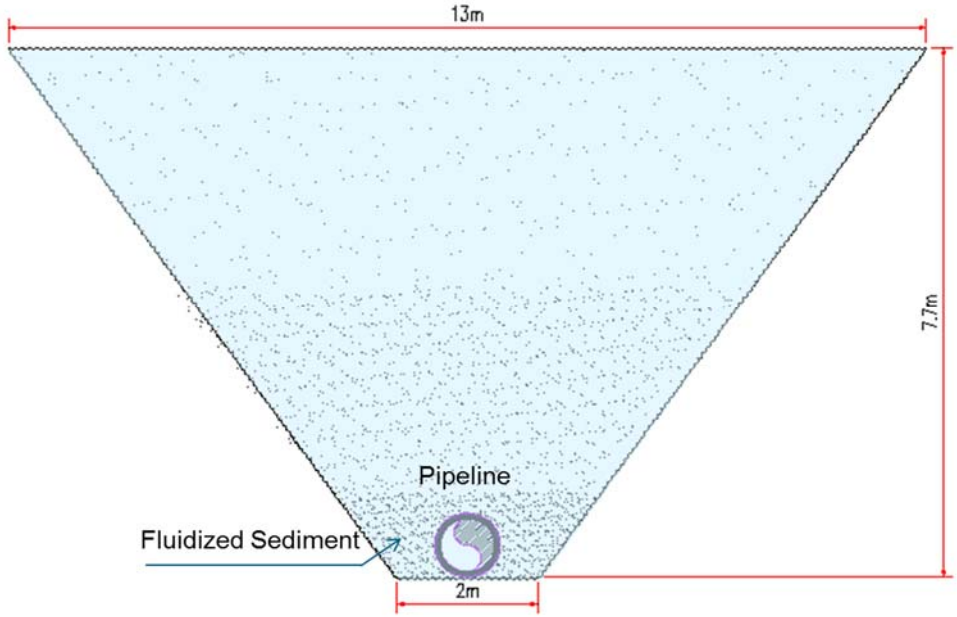
Passage number	Proposed Trench Configuration (not to scale)	Cross Section of Jetting Trench (m²)
2		27.0
3		40.3

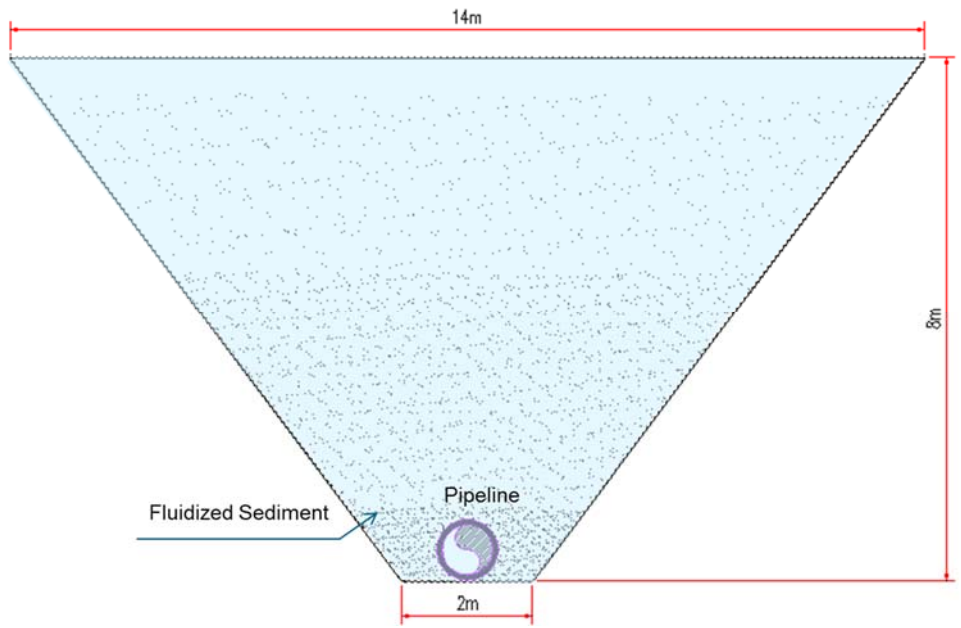
Passage number	Proposed Trench Configuration (not to scale)	Cross Section of Jetting Trench (m²)
4		52.3
5		64.0

Option 1b: achieving the proposed pipeline burial depth with seven jetting passes

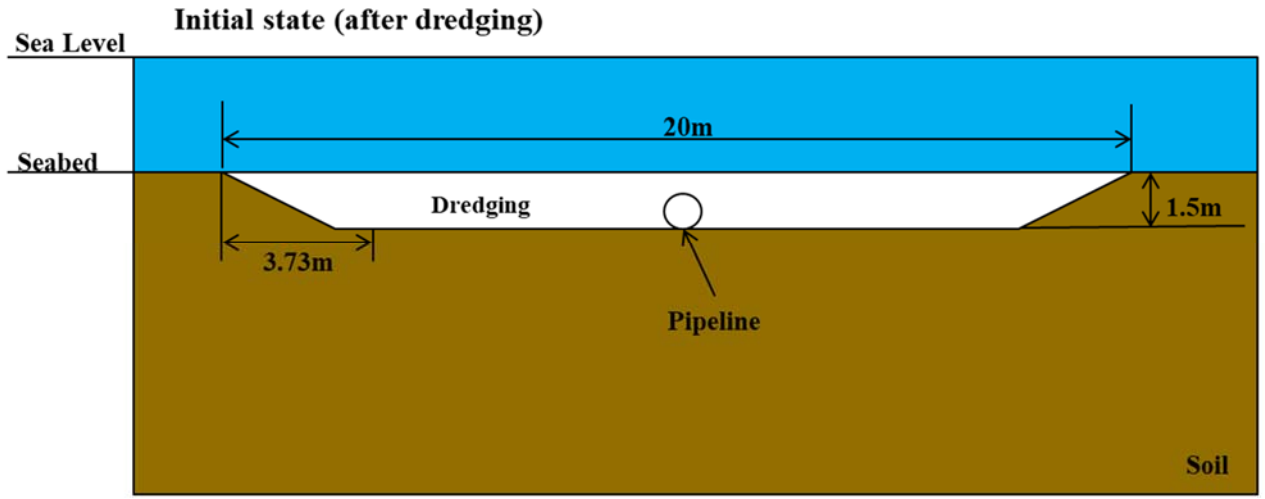
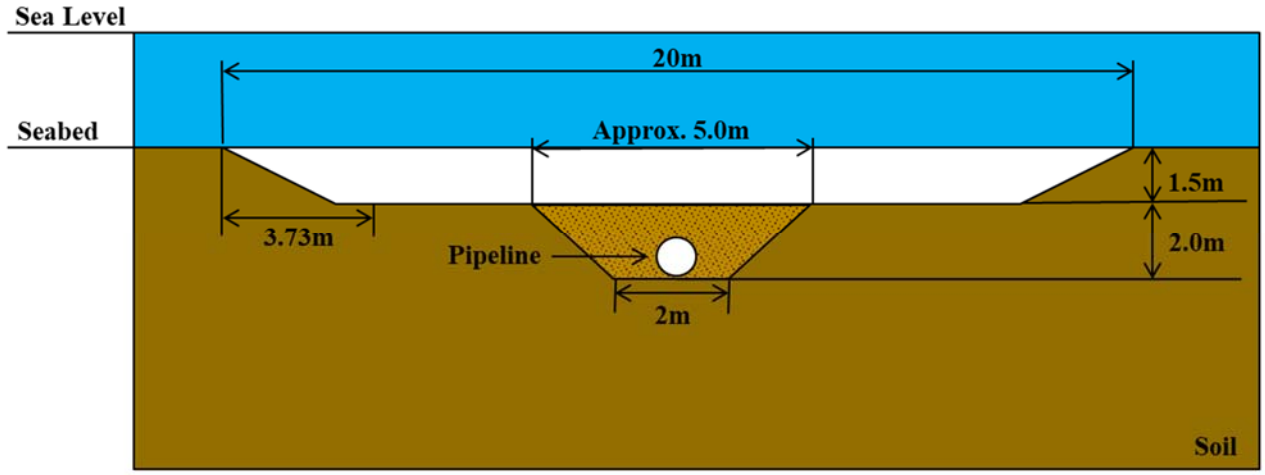
Passage number	Proposed Trench Configuration (not to scale)	Cross Section of Jetting Trench (m^2)
1		8.0
2		17.5

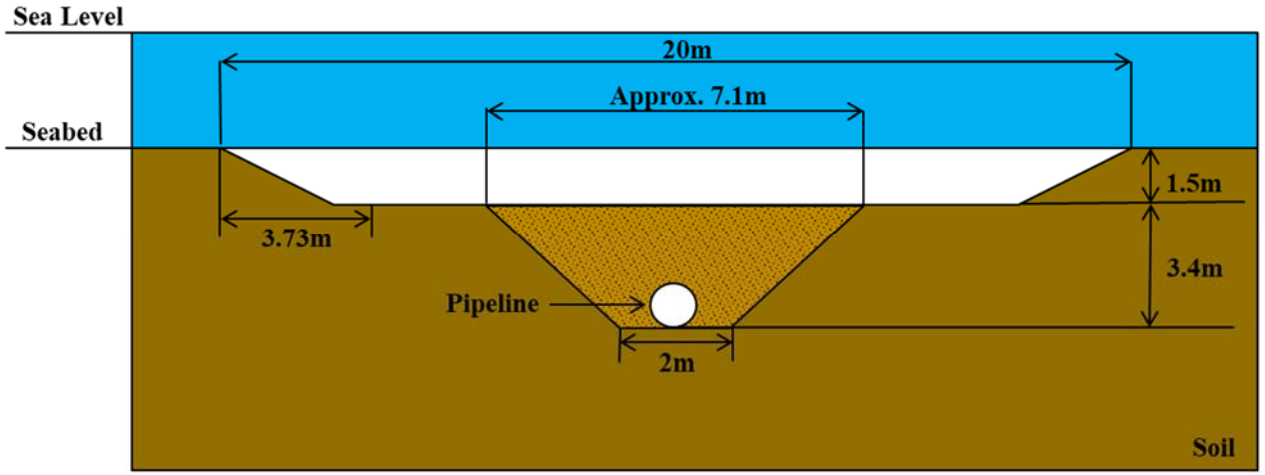
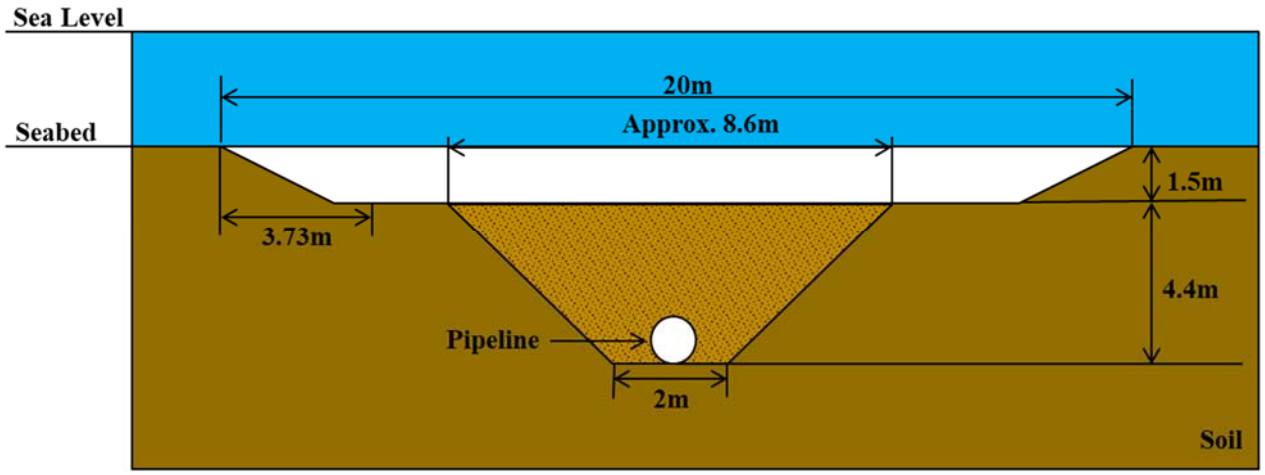
Passage number	Proposed Trench Configuration (not to scale)	Cross Section of Jetting Trench (m^2)
3		30.0
4		43.4

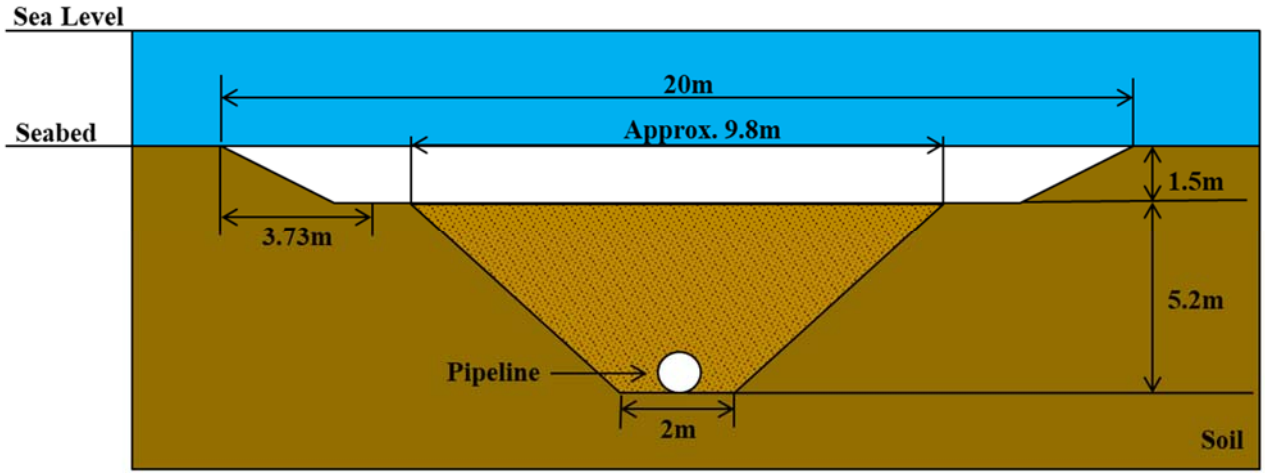
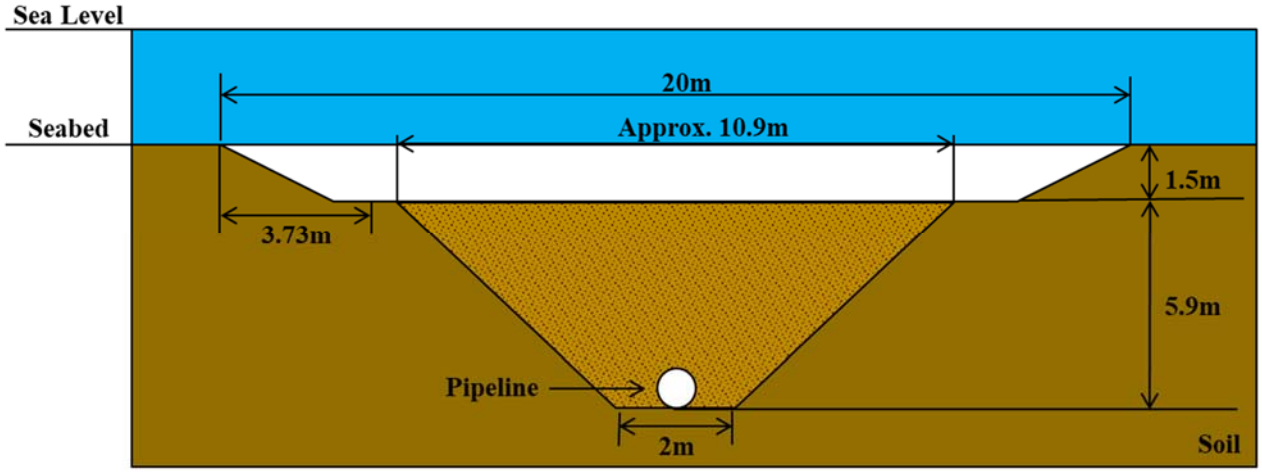
Passage number	Proposed Trench Configuration (not to scale)	Cross Section of Jetting Trench (m²)
5		52.1
6		57.8

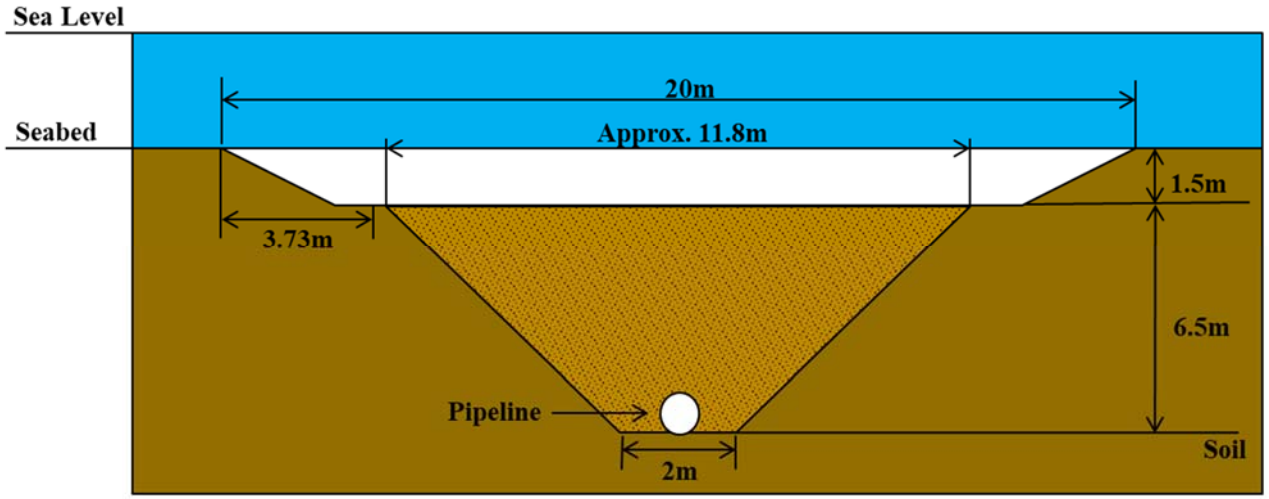
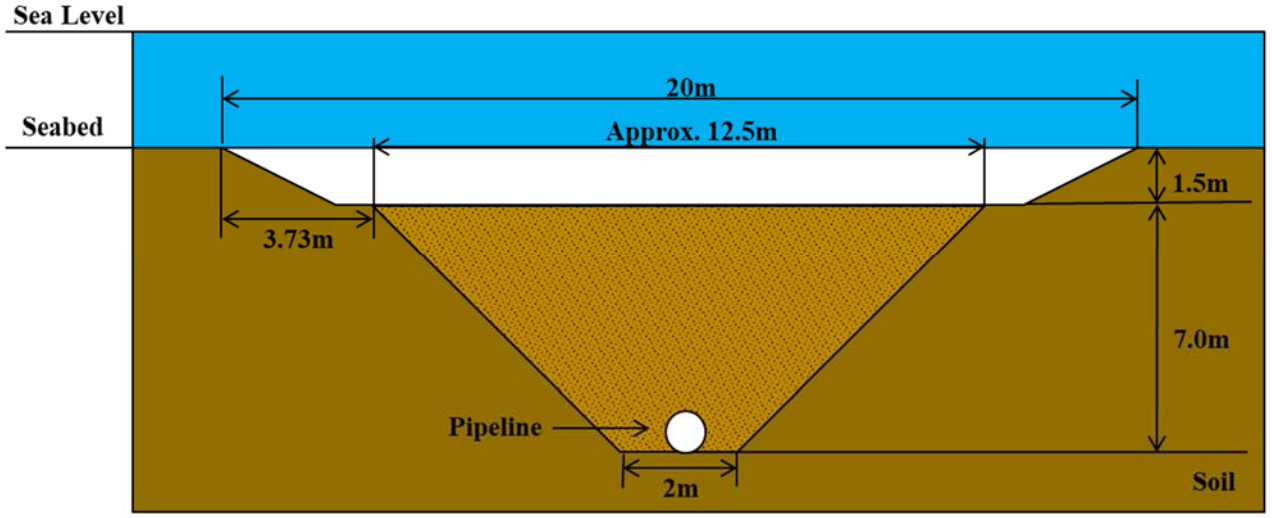
Passage number	Proposed Trench Configuration (not to scale)	Cross Section of Jetting Trench (m^2)
7		64.0

Option 2 (Dredging top 1.5m then Jetting) - achieving the proposed pipeline burial depth with seven jetting passes

Passage number	Proposed Trench Configuration (not to scale)	Cross Section of Jetting Trench (m^2)
Dredging		n/a
1		7.0

Passage number	Proposed Trench Configuration (not to scale)	Cross Section of Jetting Trench (m^2)
2		15.5
3		23.3

Passage number	Proposed Trench Configuration (not to scale)	Cross Section of Jetting Trench (m^2)
4		30.7
5		38.1

Passage number	Proposed Trench Configuration (not to scale)	Cross Section of Jetting Trench (m^2)
6		44.9
7		50.8