Annex A – Approved ToR from DoE

Government of the People's Republic of Bangladesh
Department of Environment
Head Office
Poribesh Bhaban, E-16, Agagaon, Sher-E-
Banglanagar, Dhaka-1207
www.doe.gov.bd

Date: 07/10/2026

Record No: 22.02.1500.161.072.028.26.4

Subject: Approval of Terms of Reference (ToR) for the EIA of the Laldia Container Terminal Limited at Patenga, Chattogram

Reference: The 543rd Meeting Minutes

With the subject mentioned above, the Department of Environment hereby gives approval of the Terms of Reference for the Environmental Impact Assessment (EIA) for the **Laldia Container Terminal Limited** at Laldiarchar, East Patenga, Chattogram subject to compliance with the following terms and conditions:

A. The project authority shall conduct a comprehensive Environmental Impact Assessment (EIA) considering the overall activity of the said project in accordance with the ToR submitted to the Department of Environment (DoE). The EIA study shall be conducted as per the provisions laid down in the Environmental Conservation Rules, 2023.

B. The EIA report shall be prepared in accordance with the guidelines provided in Schedule-11 and Rules 15 and 16 of the ECR, 2023.

C. Multidisciplinary experts are required in the study team to prepare the EIA report.

D. Consultation with Stakeholders/Public Consultation should be done in accordance with Rule 16 of the Environmental Conservation Rules, 2023.

E. As per Rule 16 of the ECR'23, a soft copy of the draft EIA report shall be sent to the DoE (mimshameem@gmail.com and nrahmanasif@gmail.com) in order to publish the report on the DoE's website for public comments.

E. Without approval of the EIA report by the Department of Environment, the project authority shall not make any land and infrastructure development.

07-10-2026
Masud Iqbal Md Shameem
Director
222218342
direc@doe.gov.bd

Mr. Khalid Mustafiz Gaffar, Director, Laldia Container Terminal Project (LCTP), Laldiar Char, East Patenga, Chattogram
01777737778, khalid.gaffar@maersk.com.

Annex B1 – Survey: Lab certificates

REPORT

DRAFT Environmental and Social Impact Assessment

Laldia Container Terminal Project

Client:	Laldia Container Terminal Ltd.
Reference:	BK4589-HAS-ES-XX-RP-EV-0001
Status:	S0/P01.01
Date:	12 October 2026

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Document title:	DRAFT Environmental and Social Impact Assessment
Subtitle:	Laldia Container Terminal Project
Reference:	BK4589-HAS-ES-XX-RP-EV-0001
Status:	S0/P01.01
Date:	12 October 2026
Project name:	ESIA Report
Project number:	BK4589
Author(s):	ESIA Team
Drafted by:	ESIA Team
Checked by:	Haskoning
Date:	22 July 2026
Approved by:	Haskoning
Date:	22 July 2026
Classification:	Project related

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Laan 1914 no 35
AMERSFOORT
Netherlands

Certificate of analysis

Date: 01/05/2026

Please find enclosed the analytical results of the test carried out for the project.

Certificate number/Version	AR-421-2026-070615-01
Project number client	-
Project name client	-
Your order number	421-2026-070615
Project Quotation Name	-
Samples received on	20/04/2026
Sample taker client	-
Start date	22/04/2026
This is last Test P Validation Ending Time	01/05/2026
Report date	01/05/2026
Appendices	A

Recognition Information:
AC: NEN EN ISO/IEC 17025: 2017, RvA L010

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We are confident that we have performed the order in accordance with your expectations. If you have any remaining questions concerning this Certificate of Analysis, please don't hesitate to contact our Customer Support.

Yours sincerely,
Eurofins Analytico (Barneveld)

Ing. A. Veldhuizen
Technical Manager

Eurofins Analytico BV
Gildeweg 42-46
3771 NB Barneveld
Netherlands
www.eurofins.nl

KvK/CoC No. 09088623

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	Parameter Name	Unit	1	2	3	4
	Characteristics					
	NEN-EN 12880					
AC	Dry matter	% w/w	65.5	80.6	67.2	88.7
	NEN 5754					
	Organic matter	% w/w DM	2.2	< 0.7	2.0	< 0.7
AC	Residue on ignition	% w/w DM	96.5	99.5	96.9	99.5
	NEN-EN 15936					
AC	Total Organic Carbon (TOC)	g/kg dm	< 5.0	< 5.0	6.8	< 5.0
	NEN 5753					
AC	Fraction < 2 µm (Clay)	% w/w DM	18.0	< 2.0	15.5	< 2.0
	Metals					
	NEN-EN-ISO 17294-2					
AC	Antimony (Sb)	mg/kg dm	< 2.0	< 2.0	< 2.0	< 2.0
AC	Arsenic (As)	mg/kg dm	< 5.0	< 5.0	5.9	< 5.0
AC	Barium (Ba)	mg/kg dm	27	< 15	31	< 15
AC	Cadmium (Cd)	mg/kg dm	< 0.40	< 0.40	< 0.40	< 0.40
AC	Chromium (Cr)	mg/kg dm	30	5.5	35	7.3
AC	Cobalt (Co)	mg/kg dm	10	< 5.0	12	< 5.0
AC	Copper (Cu)	mg/kg dm	23	< 5.0	26	< 5.0
AC	Mercury (Hg)	mg/kg dm	< 0.10	< 0.10	< 0.10	< 0.10
AC	Lead (Pb)	mg/kg dm	13	< 10	15	< 10
AC	Molybdenum (Mo)	mg/kg dm	< 1.5	< 1.5	< 1.5	< 1.5
AC	Nickel (Ni)	mg/kg dm	31	5.2	36	6.2
AC	Selenium (Se)	mg/kg dm	< 2.0	< 2.0	< 2.0	< 2.0
AC	Tin (Sn)	mg/kg dm	< 5.0	< 5.0	< 5.0	< 5.0
AC	Vanadium (V)	mg/kg dm	29	6.5	32	9.4
AC	Zinc (Zn)	mg/kg dm	52	8.4	59	8.8
AC	Beryllium (Be)	mg/kg dm	< 1.0	< 1.0	< 1.0	< 1.0
AC	Calcium (Ca)	mg/kg dm	1,800	340	2,700	310
AC	Potassium (K)	mg/kg dm	2,400	310	2,800	350
AC	Magnesium (Mg)	mg/kg dm	6,600	900	7,900	900
AC	Sodium (Na)	mg/kg dm	3,200	1,600	2,800	740

No.	Customer Reference	Sample matrix	Sampling date client	Sample Code
1	SD-01-1 SD-01(1)	Sediment	08/04/2026	421-2026-00197682
2	SD-02-1 SD-02(1)	Sediment	08/04/2026	421-2026-00197683
3	SD-03-1 SD-03(1)	Sediment	08/04/2026	421-2026-00197684
4	SD-04-1 SD-04(1)	Sediment	08/04/2026	421-2026-00197685

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	Parameter Name	Unit	1	2	3	4
	Polycyclic Aromatic Hydrocarbons, PAH					
	NEN-ISO 18287					
AC	Naphthalene	mg/kg dm	< 0.053 [1]	< 0.041 [1]	< 0.049 [1]	< 0.039 [1]
AC	Acenaphtylene	mg/kg dm	< 0.053 [1]	< 0.041 [1]	< 0.049 [1]	< 0.039 [1]
AC	Acenaphtene	mg/kg dm	< 0.053 [1]	< 0.041 [1]	< 0.049 [1]	< 0.039 [1]
AC	Fluorene	mg/kg dm	< 0.053 [1]	< 0.041 [1]	< 0.049 [1]	< 0.039 [1]
AC	Phenanthrene	mg/kg dm	< 0.053 [1]	< 0.041 [1]	< 0.049 [1]	< 0.039 [1]
AC	Anthracene	mg/kg dm	< 0.053 [1]	< 0.041 [1]	< 0.049 [1]	< 0.039 [1]
AC	Fluoranthene	mg/kg dm	< 0.053 [1]	< 0.041 [1]	0.063	< 0.039 [1]
AC	Pyrene	mg/kg dm	< 0.053 [1]	< 0.041 [1]	0.060	< 0.039 [1]
AC	Benz(a)anthracene	mg/kg dm	< 0.053 [1]	< 0.041 [1]	< 0.049 [1]	< 0.039 [1]
AC	Chrysene	mg/kg dm	< 0.053 [1]	< 0.041 [1]	< 0.049 [1]	< 0.039 [1]
AC	Benzo(b)fluoranthene	mg/kg dm	< 0.053 [1]	< 0.041 [1]	< 0.049 [1]	< 0.039 [1]
AC	Benzo(k)fluoranthene	mg/kg dm	< 0.053 [1]	< 0.041 [1]	< 0.049 [1]	< 0.039 [1]
AC	Benzo(a)pyrene	mg/kg dm	< 0.053 [1]	< 0.041 [1]	< 0.049 [1]	< 0.039 [1]
AC	Benzo(g,h,i)perylene	mg/kg dm	< 0.053 [1]	< 0.041 [1]	< 0.049 [1]	< 0.039 [1]
AC	Dibenzo(ah)anthracene	mg/kg dm	< 0.053 [1]	< 0.041 [1]	< 0.049 [1]	< 0.039 [1]
AC	Indeno(123cd)pyrene	mg/kg dm	< 0.053 [1]	< 0.041 [1]	< 0.049 [1]	< 0.039 [1]
AC	PAH 16 EPA (sum)	mg/kg dm	< 0.85 [1]	< 0.80 [1]	< 0.80 [1]	< 0.80 [1]
AC	PAH 10 VROM (sum)	mg/kg dm	< 0.53	< 0.50	< 0.50	< 0.50
	Polychlorinated Biphenyl					
	NEN 6960					
AC	PCB 28	mg/kg dm	< 0.001	< 0.001	< 0.001	< 0.001
AC	PCB 52	mg/kg dm	< 0.001	< 0.001	< 0.001	< 0.001
AC	PCB 101	mg/kg dm	< 0.001	< 0.001	< 0.001	< 0.001
AC	PCB 118	mg/kg dm	< 0.001	< 0.001	< 0.001	< 0.001
AC	PCB 138	mg/kg dm	< 0.001	< 0.001	< 0.001	< 0.001
AC	PCB 153	mg/kg dm	< 0.001	< 0.001	< 0.001	< 0.001
AC	PCB 180	mg/kg dm	< 0.001	< 0.001	< 0.001	< 0.001
AC	PCB (7) Sum)	mg/kg dm	< 0.0070	< 0.0070	< 0.0070	< 0.0070

No.	Customer Reference	Sample matrix	Sampling date client	Sample Code
1	SD-01-1 SD-01(1)	Sediment	08/04/2026	421-2026-00197682
2	SD-02-1 SD-02(1)	Sediment	08/04/2026	421-2026-00197683
3	SD-03-1 SD-03(1)	Sediment	08/04/2026	421-2026-00197684
4	SD-04-1 SD-04(1)	Sediment	08/04/2026	421-2026-00197685

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	Parameter Name	Unit	1	2	3	4
	Petroleum Hydrocarbons					
	NEN-EN-ISO 16703					
	TPH >C10-C12	mg/kg dm	< 3	< 3	< 3	< 3
	TPH >C12-C16	mg/kg dm	< 5 [4]	< 5	< 5 [4]	< 5
	TPH (>C16-C21)	mg/kg dm	< 6	< 5	10	< 6
	TPH (C21-C30)	mg/kg dm	< 13 [4]	< 12	22	< 12
	TPH (C30-C35)	mg/kg dm	12	< 5	23	< 6
	TPH (C35-C40)	mg/kg dm	< 6	< 5	< 6	< 5
A/C	TPH (sum C10-C40)	mg/kg dm	< 38	< 38	67	< 34
	Chromatogram EPH (GC)				See Appendix RA1	
	Inorganic Compounds					
	Interne Method					
	Nitrate (NO3-N)	mg/kg dm	< 2.0 [1]	< 2.0 [1]	< 2.0 [1]	< 2.0 [1]
	Nitrate (NO3)	mg/kg dm	< 9.0 [1]	< 9.0 [1]	< 9.0 [1]	< 9.0 [1]
	Ortho-phosphate (PO4-P)	mg/kg dm	0.58	0.47	0.59	0.26
	Ortho-phosphate (PO4)	mg/kg dm	2.6	1.4	1.8	0.78

No	Customer Reference	Sample matrix	Sampling date client	Sample Code
1	SD-01-1 SD-01(1)	Sediment	06/04/2026	421-2026-00197682
2	SD-02-1 SD-02(1)	Sediment	06/04/2026	421-2026-00197683
3	SD-03-1 SD-03(1)	Sediment	06/04/2026	421-2026-00197684
4	SD-04-1 SD-04(1)	Sediment	06/04/2026	421-2026-00197685

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	Parameter Name	Unit	5	6
	Characteristics			
	NEN-EN 12880			
AC	Dry matter	% w/w	77.5	77.7
	NEN 5754			
	Organic matter	% w/w DM	0.7	0.9
AC	Residue on ignition	% w/w DM	98.8	98.9
	NEN-EN 15936			
AC	Total Organic Carbon (TOC)	g/kg dm	< 5.0	< 5.0
	NEN 5753			
AC	Fraction < 2 µm (Clay)	% w/w DM	0.3	2.9
	Metals			
	NEN-EN-ISO 17294-2			
AC	Antimony (Sb)	mg/kg dm	< 2.0	< 2.0
AC	Arsenic (As)	mg/kg dm	< 5.0	< 5.0
AC	Barium (Ba)	mg/kg dm	< 15	< 15
AC	Cadmium (Cd)	mg/kg dm	< 0.40	< 0.40
AC	Chromium (Cr)	mg/kg dm	20	18
AC	Cobalt (Co)	mg/kg dm	6.9	7.7
AC	Copper (Cu)	mg/kg dm	11	5.3
AC	Mercury (Hg)	mg/kg dm	< 0.10	< 0.10
AC	Lead (Pb)	mg/kg dm	< 10	< 10
AC	Molybdenum (Mo)	mg/kg dm	< 1.5	< 1.5
AC	Nickel (Ni)	mg/kg dm	21	21
AC	Selenium (Se)	mg/kg dm	< 2.0	< 2.0
AC	Tin (Sn)	mg/kg dm	< 5.0	< 5.0
AC	Vanadium (V)	mg/kg dm	20	16
AC	Zinc (Zn)	mg/kg dm	35	24
AC	Beryllium (Be)	mg/kg dm	< 1.0	< 1.0
AC	Calcium (Ca)	mg/kg dm	1,300	670
AC	Potassium (K)	mg/kg dm	1,300	1,000
AC	Magnesium (Mg)	mg/kg dm	4,200	3,500
AC	Sodium (Na)	mg/kg dm	2,100	2,000

No.	Customer Reference	Sample matrix	Sampling date client	Sample Code
5	SD-05-1 SD-05(1)	Sediment	08/04/2026	421-2026-00197666
6	SD-06-1 SD-06(1)	Sediment	08/04/2026	421-2026-00197667

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	Parameter Name	Unit	5	6
	Polycyclic Aromatic Hydrocarbons, PAH			
	NEN-ISO 18287			
AC	Naphthalene	mg/kg dm	< 0.044 [1]	< 0.044 [1]
AC	Acenaphthylene	mg/kg dm	< 0.044 [1]	< 0.044 [1]
AC	Acenaphthene	mg/kg dm	< 0.044 [1]	< 0.044 [1]
AC	Fluorene	mg/kg dm	< 0.044 [1]	< 0.044 [1]
AC	Phenanthrene	mg/kg dm	< 0.044 [1]	< 0.044 [1]
AC	Anthracene	mg/kg dm	< 0.044 [1]	< 0.044 [1]
AC	Fluoranthene	mg/kg dm	< 0.044 [1]	< 0.044 [1]
AC	Pyrene	mg/kg dm	< 0.044 [1]	< 0.044 [1]
AC	Benz(a)anthracene	mg/kg dm	< 0.044 [1]	< 0.044 [1]
AC	Chrysene	mg/kg dm	< 0.044 [1]	< 0.044 [1]
AC	Benzo(b)fluoranthene	mg/kg dm	< 0.044 [1]	< 0.044 [1]
AC	Benzo(k)fluoranthene	mg/kg dm	< 0.044 [1]	< 0.044 [1]
AC	Benzo(a)pyrene	mg/kg dm	< 0.044 [1]	< 0.044 [1]
AC	Benzo(g,h,i)perylene	mg/kg dm	< 0.044 [1]	< 0.044 [1]
AC	Dibenzo(ah)anthracene	mg/kg dm	< 0.044 [1]	< 0.044 [1]
AC	Indeno(123cd)pyrene	mg/kg dm	< 0.044 [1]	< 0.044 [1]
AC	PAH 18 EPA (sum)	mg/kg dm	< 0.80 [1]	< 0.80 [1]
AC	PAH 10 VROM (sum)	mg/kg dm	< 0.50	< 0.50
	Polychlorinated Biphenyl			
	NEN 6880			
AC	PCB 28	mg/kg dm	< 0.001	< 0.001
AC	PCB 52	mg/kg dm	< 0.001	< 0.001
AC	PCB 101	mg/kg dm	< 0.001	< 0.001
AC	PCB 118	mg/kg dm	< 0.001	< 0.001
AC	PCB 138	mg/kg dm	< 0.001	< 0.001
AC	PCB 153	mg/kg dm	< 0.001	< 0.001
AC	PCB 180	mg/kg dm	< 0.001	< 0.001
AC	PCB (7) Sum)	mg/kg dm	< 0.0070	< 0.0070
	Petroleum Hydrocarbons			
	NEN-EN ISO 16703			
	TPH >C10-C12	mg/kg dm	< 3	< 3
	TPH >C12-C16	mg/kg dm	< 5	< 5

No.	Customer Reference	Sample matrix	Sampling date client	Sample Code
5	SD-05-1 SD-05(1)	Sediment	06/04/2026	421-2026-00197585
6	SD-06-1 SD-06(1)	Sediment	06/04/2026	421-2026-00197587

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	Parameter Name	Unit	5	6
	Petroleum Hydrocarbons			
	NEN-EN ISO 16703			
	TPH (>C16-C21)	mg/kg dm	< 6	< 6
	TPH (C21-C30)	mg/kg dm	< 12	< 12
	TPH (C30-C35)	mg/kg dm	< 6	< 6
	TPH (C35-C40)	mg/kg dm	< 6	< 6
AC	TPH (sum C10-C40)	mg/kg dm	< 36	< 36
	Inorganic Compounds			
	Internal Method			
	Nitrate (NO3-N)	mg/kg dm	< 2.0 [1]	< 2.0 [1]
	Nitrate (NO3)	mg/kg dm	< 9.0 [1]	< 9.0 [1]
	Ortho phosphate (PO4-P)	mg/kg dm	0.34	0.33
	Ortho-phosphate (PO4)	mg/kg dm	1.0	1.0

No	Customer Reference	Sample matrix	Sampling date client	Sample Code
5	SD-05-1 SD-05(1)	Sediment	08/04/2026	421-2026-00197686
6	SD-06-1 SD-06(1)	Sediment	08/04/2026	421-2026-00197687

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Comment:

1) The preservation term for this parameter has been expired.
2) The reporting limit has been increased due to low sample intake and/or low dry weight

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Appendix (A): concerning subsample information referring to certificate of analysis AR-421-2026-070615-01

Container Code	Drill nr	Depth From	Depth To	Sampling date client	Sample Container Description
Sample Code 421-2026-00197652	**Customer Reference**	SD-01-1	SD-01(1)		
0520469026	SD-01	0	800	06/04/2026	1
Sample Code 421-2026-00197653	**Customer Reference**	SD-02-1	SD-02(1)		
0520468024	SD-02	0	800	06/04/2026	1
Sample Code 421-2026-00197654	**Customer Reference**	SD-03-1	SD-03(1)		
0520469009	SD-03	0	800	06/04/2026	1
Sample Code 421-2026-00197655	**Customer Reference**	SD-04-1	SD-04(1)		
0520468516	SD-04	0	805	06/04/2026	1
Sample Code 421-2026-00197656	**Customer Reference**	SD-05-1	SD-05(1)		
0520468514	SD-05	0	900	06/04/2026	1
Sample Code 421-2026-00197657	**Customer Reference**	SD-06-1	SD-06(1)		
0520468521	SD-06	0	500	06/04/2026	1

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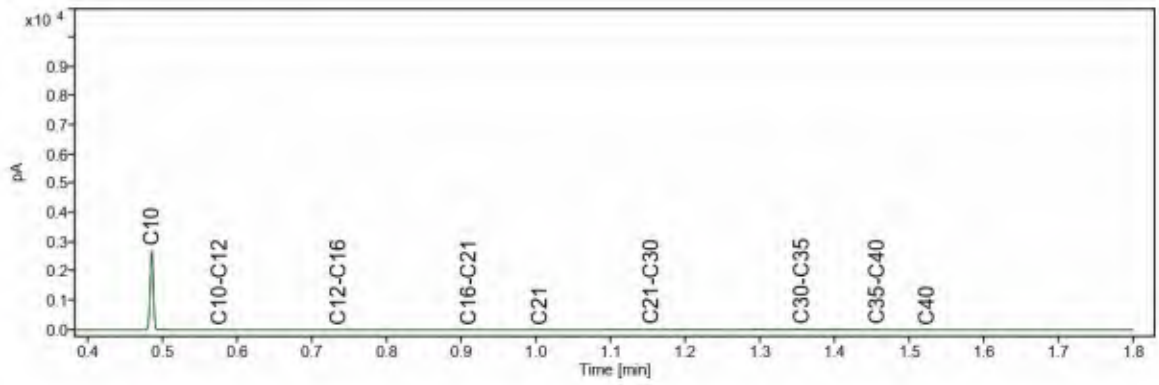
AR-421-2026-070615-01
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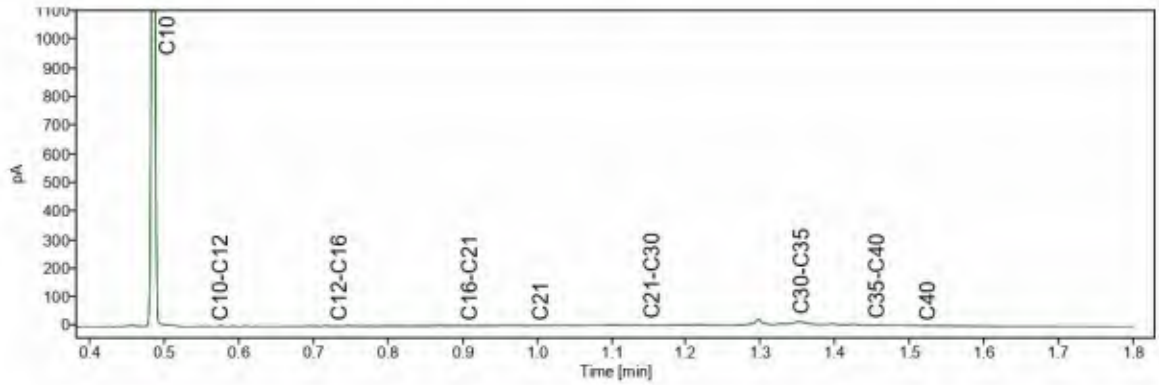
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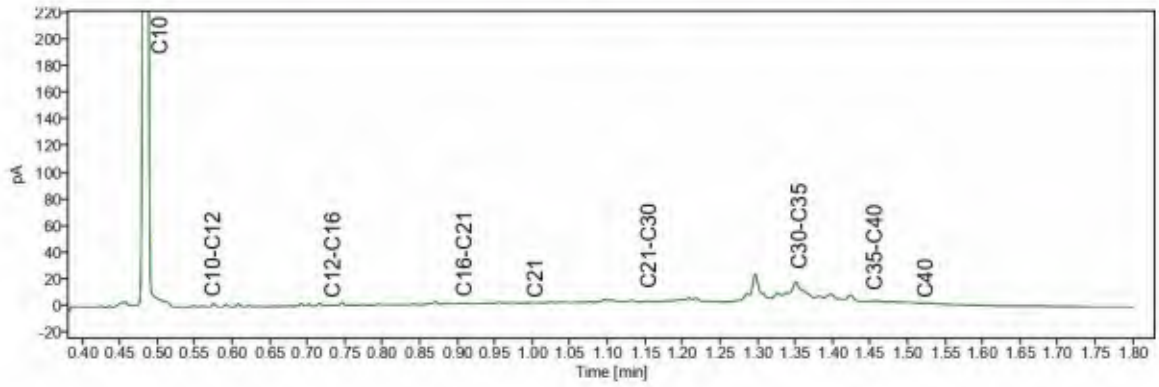
Chromatogram TPH/ Mineral Oil

Sample ID.: L02584832
Certificate no.: 421-2026-070615
Sample description.: SD-03-1

V







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Haskoning Nederland B.V.
Dhr. Jan Jurjen Schiphuis
Laan 1914 no 35
AMERSFOORT
Netherlands

Certificate of analysis

Date 19/05/2026

Please find enclosed the analytical results of the test carried out for the project

Certificate number/Version	AR-421-2026-076231-01
Project number client	-
Project name client	-
Your order number	421-2026-076231
Project Quotation Name	-
Samples received on	04/05/2026
Sample taker client	-
Start date	05/05/2026
This is last Test P Validation Ending Time	19/05/2026
Report date	19/05/2026
Appendices	A

Recognition information
AC- NEN EN ISO/IEC 17025:2017, RvA L040

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We are confident that we have performed the order in accordance with your expectations. If you have any remaining questions concerning this Certificate of Analysis, please don't hesitate to contact our Customer Support

Yours sincerely,
Eurofins Analytico (Barneveld)

Ing. A. Veldhuizen
Technical Manager

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	Parameter Name	Unit	1	2	3	4
	Characteristics					
	NEN-EN 12880					
AC	Dry matter	% w/w	84.2	75.8	72.4	74.1
	NEN 5754					
	Organic matter	% w/w DM	1.3	1.8	2.1	2.0
AC	Residue on ignition	% w/w DM	98.0	97.0	96.1	96.8
	NEN-EN 15936					
AC	Total Organic Carbon (TOC)	g/kg dm	< 5.0	< 5.0	5.8	5.6
	NEN 5753					
AC	Fraction < 2 µm (Clay)	% w/w DM	10.8	17.4	24.7	17.7
	Metals					
	NEN-EN ISO 17294-2					
AC	Antimony (Sb)	mg/kg dm	< 2.0	< 2.0	< 2.0	< 2.0
AC	Arsenic (As)	mg/kg dm	< 5.0	6.8	9.1	8.3
AC	Barium (Ba)	mg/kg dm	27	41	51	39
AC	Cadmium (Cd)	mg/kg dm	< 0.40	< 0.40	< 0.40	< 0.40
AC	Chromium (Cr)	mg/kg dm	26	42	49	41
AC	Cobalt (Co)	mg/kg dm	9.7	15	17	15
AC	Copper (Cu)	mg/kg dm	17	32	36	31
AC	Mercury (Hg)	mg/kg dm	< 0.10	< 0.10	< 0.10	< 0.10
AC	Lead (Pb)	mg/kg dm	11	19	21	18
AC	Molybdenum (Mo)	mg/kg dm	< 1.5	< 1.5	< 1.5	< 1.5
AC	Nickel (Ni)	mg/kg dm	28	45	51	44
AC	Selenium (Se)	mg/kg dm	< 2.0	< 2.0	< 2.0	< 2.0
AC	Tin (Sn)	mg/kg dm	< 5.0	< 5.0	< 5.0	< 5.0
AC	Vanadium (V)	mg/kg dm	26	40	47	41
AC	Zinc (Zn)	mg/kg dm	45	71	79	70
AC	Beryllium (Be)	mg/kg dm	< 1.0	< 1.0	1.0	< 1.0
AC	Calcium (Ca)	mg/kg dm	2,300	3,700	3,700	2,900
AC	Potassium (K)	mg/kg dm	2,200	3,700	4,100	3,500
AC	Magnesium (Mg)	mg/kg dm	5,600	10,000	10,000	9,400
AC	Sodium (Na)	mg/kg dm	1,300	2,700	3,200	2,800

No.	Customer Reference	Sample matrix	Sampling date client	Sample Code
1	MBH01-1 MBH01(1)	Sediment	21/04/2026	421-2026-00215509
2	MBH04-1 MBH04(1)	Sediment	21/04/2026	421-2026-00215510
3	MBH04-2 MBH04(3)	Sediment	21/04/2026	421-2026-00215511
4	MBH06-1 MBH06(1)	Sediment	21/04/2026	421-2026-00215512

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	Parameter Name	Unit	1	2	3	4
	Polycyclic Aromatic Hydrocarbons, PAH					
	NEN-ISO 18287					
AC	Naphthalene	mg/kg dm	< 0.039	< 0.045	< 0.048	< 0.045
AC	Acenaphthylene	mg/kg dm	< 0.039	< 0.045	< 0.048	< 0.045
AC	Acenaphthene	mg/kg dm	< 0.039	< 0.045	< 0.048	< 0.045
AC	Fluorene	mg/kg dm	< 0.039	< 0.045	< 0.048	< 0.045
AC	Phenanthrene	mg/kg dm	< 0.039	< 0.045	< 0.048	< 0.045
AC	Anthracene	mg/kg dm	< 0.039	< 0.045	< 0.048	< 0.045
AC	Fluoranthene	mg/kg dm	< 0.039	0.10	< 0.048	0.052
AC	Pyrene	mg/kg dm	0.050	0.12	< 0.048	0.060
AC	Benz(a)anthracene	mg/kg dm	< 0.039	0.065	< 0.048	0.046
AC	Chrysene	mg/kg dm	< 0.039	0.072	< 0.048	0.051
AC	Benzo(b)fluoranthene	mg/kg dm	0.048	0.12	< 0.048	0.063
AC	Benzo(k)fluoranthene	mg/kg dm	< 0.039	< 0.045	< 0.048	< 0.045
AC	Benzo(a)pyrene	mg/kg dm	0.051	0.091	< 0.048	0.053
AC	Benzo(g,h,i)perylene	mg/kg dm	0.059	0.089	< 0.048	0.059
AC	Dibenzo(ah)anthracene	mg/kg dm	< 0.039	< 0.045	< 0.048	< 0.045
AC	Indeno(1,2,3cd)pyrene	mg/kg dm	< 0.039	0.081	< 0.048	0.049
AC	PAH 16 EPA (sum)	mg/kg dm	< 0.80	< 0.80	< 0.80	< 0.80
AC	PAH 10 VROM (sum)	mg/kg dm	< 0.50	0.50	< 0.50	< 0.50
	Polychlorinated Biphenyl					
	NEN 6960					
AC	PCB 28	mg/kg dm	< 0.001	< 0.001	< 0.001	< 0.001
AC	PCB 52	mg/kg dm	< 0.001	< 0.001	< 0.001	< 0.001
AC	PCB 101	mg/kg dm	< 0.001	< 0.001	< 0.001	< 0.001
AC	PCB 118	mg/kg dm	< 0.001	< 0.001	< 0.001	< 0.001
AC	PCB 138	mg/kg dm	< 0.001	< 0.001	< 0.001	< 0.001
AC	PCB 153	mg/kg dm	< 0.001	< 0.001	< 0.001	< 0.001
AC	PCB 180	mg/kg dm	< 0.001	< 0.001	< 0.001	< 0.001
AC	PCB (7) Sum)	mg/kg dm	< 0.0070	< 0.0070	< 0.0070	< 0.0070

No	Customer Reference	Sample matrix	Sampling date client	Sample Code
1	MBH01-1 MBH01(1)	Sediment	21/04/2026	421-2026-00215509
2	MBH04-1 MBH04(1)	Sediment	21/04/2026	421-2026-00215510
3	MBH04-2 MBH04(3)	Sediment	21/04/2026	421-2026-00215511
4	MBH06-1 MBH06(1)	Sediment	21/04/2026	421-2026-00215512

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	Parameter Name	Unit	1	2	3	4
	Petroleum Hydrocarbons					
	NEN-EN ISO 16703					
	TPH >C10-C12	mg/kg dm	< 3	< 3	< 3	< 3
	TPH >C12-C16	mg/kg dm	< 5	< 5	< 5	< 5
	TPH (>C16-C21)	mg/kg dm	9	< 6	< 6	7
	TPH (C21-C30)	mg/kg dm	37	< 12	< 12	15
	TPH (C30-C35)	mg/kg dm	26	< 6	< 6	11
	TPH (C35-C40)	mg/kg dm	15	< 6	< 6	< 6
AC	TPH (sum C10-C40)	mg/kg dm	91	< 38	< 38	39
	Chromatogram EPH (GC)		See Appendix RA1			See Appendix RA2
	Inorganic Compounds					
	Internal Method					
	Nitrate (NO3-N)	mg/kg dm	< 2.0 [1]	< 2.0 [1]	< 2.0 [1]	< 2.0 [1]
	Nitrate (NO3)	mg/kg dm	< 9.0 [1]	< 9.0 [1]	< 9.0 [1]	< 9.0 [1]
	Ortho-phosphate (PO4-P)	mg/kg dm	< 0.20	< 0.20	0.20	< 0.20
	Ortho-phosphate (PO4)	mg/kg dm	< 0.60	< 0.60	0.63	< 0.60

No.	Customer Reference	Sample matrix	Sampling date client	Sample Code
1	MBH01-1 MBH01(1)	Sediment	21/04/2026	421-2026-00215509
2	MBH04-1 MBH04(1)	Sediment	21/04/2026	421-2026-00215510
3	MBH04-2 MBH04(3)	Sediment	21/04/2026	421-2026-00215511
4	MBH06-1 MBH06(1)	Sediment	21/04/2026	421-2026-00215512

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	Parameter Name	Unit	5	6	7	8
	Characteristics					
	NEN-EN 12880					
AC	Dry matter	% w/w	73.2	75.0	81.4	79.2
	NEN 5754					
	Organic matter	% w/w DM	2.5	2.3	< 0.7	1.7
AC	Residue on ignition	% w/w DM	96.5	96.1	99.3	96.1
	NEN-EN 15936					
AC	Total Organic Carbon (TOC)	g/kg dm	9.0	< 5.0	< 5.0	< 5.0
	NEN 5753					
AC	Fraction < 2 µm (Clay)	% w/w DM	14.4	22.1	2.2	31.4
	Metals					
	NEN-EN-ISO 17294-2					
AC	Antimony (Sb)	mg/kg dm	< 2.0	< 2.0	< 2.0	< 2.0
AC	Arsenic (As)	mg/kg dm	6.1	6.7	< 5.0	9.2
AC	Barium (Ba)	mg/kg dm	50	38	< 15	62
AC	Cadmium (Cd)	mg/kg dm	< 0.40	< 0.40	< 0.40	< 0.40
AC	Chromium (Cr)	mg/kg dm	41	45	9.9	58
AC	Cobalt (Co)	mg/kg dm	16	16	< 5.0	19
AC	Copper (Cu)	mg/kg dm	27	27	6.0	37
AC	Mercury (Hg)	mg/kg dm	< 0.10	< 0.10	< 0.10	< 0.10
AC	Lead (Pb)	mg/kg dm	20	21	< 10	31
AC	Molybdenum (Mo)	mg/kg dm	< 1.5	< 1.5	< 1.5	< 1.5
AC	Nickel (Ni)	mg/kg dm	47	48	9.7	56
AC	Selenium (Se)	mg/kg dm	< 2.0	< 2.0	< 2.0	< 2.0
AC	Tin (Sn)	mg/kg dm	< 5.0	< 5.0	< 5.0	< 5.0
AC	Vanadium (V)	mg/kg dm	39	43	12	55
AC	Zinc (Zn)	mg/kg dm	70	78	20	100
AC	Beryllium (Be)	mg/kg dm	< 1.0	1.0	< 1.0	1.5
AC	Calcium (Ca)	mg/kg dm	2,200	3,200	640	5,000
AC	Potassium (K)	mg/kg dm	2,700	3,400	620	4,700
AC	Magnesium (Mg)	mg/kg dm	7,600	9,600	1,700	13,000
AC	Sodium (Na)	mg/kg dm	2,600	2,300	410	1,100

No.	Customer Reference	Sample matrix	Sampling date client	Sample Code
5	MBH06-2 MBH06(3)	Sediment	21/04/2026	421-2026-00215513
6	MBH14-1 MBH14(1)	Sediment	21/04/2026	421-2026-00215514
7	MBH14-2 MBH14(3)	Sediment	21/04/2026	421-2026-00215515
8	MBH14-3 MBH14(5)	Sediment	21/04/2026	421-2026-00215516

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	Parameter Name	Unit	5	6	7	8
	Polycyclic Aromatic Hydrocarbons, PAH					
	NEN-ISO 18287					
AC	Naphthalene	mg/kg dm	< 0.046	< 0.044	< 0.041	< 0.042
AC	Acenaphthylene	mg/kg dm	< 0.046	< 0.044	< 0.041	< 0.042
AC	Acenaphthene	mg/kg dm	< 0.046	< 0.044	< 0.041	< 0.042
AC	Fluorene	mg/kg dm	< 0.046	< 0.044	< 0.041	< 0.042
AC	Phenanthrene	mg/kg dm	< 0.046	< 0.044	< 0.041	< 0.042
AC	Anthracene	mg/kg dm	< 0.046	< 0.044	< 0.041	< 0.042
AC	Fluoranthene	mg/kg dm	< 0.046	< 0.044	< 0.041	< 0.042
AC	Pyrene	mg/kg dm	< 0.046	< 0.044	< 0.041	< 0.042
AC	Benz(a)anthracene	mg/kg dm	< 0.046	< 0.044	< 0.041	< 0.042
AC	Chrysene	mg/kg dm	< 0.046	< 0.044	< 0.041	< 0.042
AC	Benzo(b)fluoranthene	mg/kg dm	< 0.046	< 0.044	< 0.041	< 0.042
AC	Benzo(k)fluoranthene	mg/kg dm	< 0.046	< 0.044	< 0.041	< 0.042
AC	Benzo(e)pyrene	mg/kg dm	< 0.046	< 0.044	< 0.041	< 0.042
AC	Benzo(g,h,i)perylene	mg/kg dm	< 0.046	< 0.044	< 0.041	< 0.042
AC	Dibenzo(ah)anthracene	mg/kg dm	< 0.046	< 0.044	< 0.041	< 0.042
AC	Indeno(123cd)pyrene	mg/kg dm	< 0.046	< 0.044	< 0.041	< 0.042
AC	PAH 16 EPA (sum)	mg/kg dm	< 0.80	< 0.80	< 0.80	< 0.80
AC	PAH 10 VROM (sum)	mg/kg dm	< 0.50	< 0.50	< 0.50	< 0.50
	Polychlorinated Biphenyl					
	NEN 6960					
AC	PCB 28	mg/kg dm	< 0.001	< 0.001	< 0.001	< 0.001
AC	PCB 52	mg/kg dm	< 0.001	< 0.001	< 0.001	< 0.001
AC	PCB 101	mg/kg dm	< 0.001	< 0.001	< 0.001	< 0.001
AC	PCB 118	mg/kg dm	< 0.001	< 0.001	< 0.001	< 0.001
AC	PCB 138	mg/kg dm	< 0.001	< 0.001	< 0.001	< 0.001
AC	PCB 153	mg/kg dm	< 0.001	< 0.001	< 0.001	< 0.001
AC	PCB 180	mg/kg dm	< 0.001	< 0.001	< 0.001	< 0.001
AC	PCB (7) Sum	mg/kg dm	< 0.0070	< 0.0070	< 0.0070	< 0.0070

No	Customer Reference	Sample matrix	Sampling date client	Sample Code
5	MBH06-2 MBH06(3)	Sediment	21/04/2026	421-2026-00215513
6	MBH14-1 MBH14(1)	Sediment	21/04/2026	421-2026-00215514
7	MBH14-2 MBH14(3)	Sediment	21/04/2026	421-2026-00215515
8	MBH14-3 MBH14(5)	Sediment	21/04/2026	421-2026-00215516

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	Parameter Name	Unit	5	6	7	8
	Petroleum Hydrocarbons					
	NEN EN ISO 16703					
	TPH >C10-C12	mg/kg dm	< 3	< 3	< 3	< 3
	TPH >C12-C16	mg/kg dm	< 5	< 5	< 5	< 5
	TPH (>C16-C21)	mg/kg dm	< 6	< 6	< 6	< 6
	TPH (C21-C30)	mg/kg dm	< 12	< 12	< 12	< 12
	TPH (C30-C35)	mg/kg dm	< 6	< 6	< 6	< 6
	TPH (C35-C40)	mg/kg dm	< 6	< 6	< 6	< 6
AC	TPH (sum C10-C40)	mg/kg dm	< 38	< 38	< 38	< 38
	Inorganic Compounds					
	Internal Method					
	Nitrate (NO3-N)	mg/kg dm	< 2.0 [1]	< 2.0 [1]	< 2.0 [1]	43 [1]
	Nitrate (NO3)	mg/kg dm	< 9.0 [1]	< 9.0 [1]	< 9.0 [1]	190 [1]
	Ortho-phosphate (PO4-P)	mg/kg dm	< 0.20	< 0.20	0.88	< 0.20
	Ortho-phosphate (PO4)	mg/kg dm	< 0.60	< 0.60	2.6	< 0.60

No.	Customer Reference	Sample matrix	Sampling date client	Sample Code
5	MBH06-2 MBH06(3)	Sediment	21/04/2026	421-2026-00215513
6	MBH14-1 MBH14(1)	Sediment	21/04/2026	421-2026-00215514
7	MBH14-2 MBH14(3)	Sediment	21/04/2026	421-2026-00215515
8	MBH14-3 MBH14(5)	Sediment	21/04/2026	421-2026-00215516

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	Parameter Name	Unit	9	10	11	12
	Characteristics					
	NEN-EN 12880					
AC	Dry matter	% w/w	78.0	79.0	73.3	81.2
	NEN 5754					
	Organic matter	% w/w DM	2.6	2.1	1.7	< 0.7
AC	Residue on ignition	% w/w DM	95.6	98.1	98.1	99.2
	NEN-EN 15936					
AC	Total Organic Carbon (TOC)	g/kg dm	6.8	< 5.0	< 5.0	< 5.0
	NEN 5753					
AC	Fraction < 2 µm (Clay)	% w/w DM	26.2	26.4	3.5	3.1
	Metals					
	NEN-EN-ISO 17294-2					
AC	Antimony (Sb)	mg/kg dm	< 2.0	< 2.0	< 2.0	< 2.0
AC	Arsenic (As)	mg/kg dm	65	10	7.4	< 5.0
AC	Barium (Ba)	mg/kg dm	48	51	82	< 15
AC	Cadmium (Cd)	mg/kg dm	< 0.40	< 0.40	< 0.40	< 0.40
AC	Chromium (Cr)	mg/kg dm	56	57	44	8.4
AC	Cobalt (Co)	mg/kg dm	19	20	21	< 5.0
AC	Copper (Cu)	mg/kg dm	37	39	20	< 5.0
AC	Mercury (Hg)	mg/kg dm	< 0.10	< 0.10	< 0.10	< 0.10
AC	Lead (Pb)	mg/kg dm	28	30	17	< 10
AC	Molybdenum (Mo)	mg/kg dm	< 1.5	< 1.5	< 1.5	< 1.5
AC	Nickel (Ni)	mg/kg dm	49	56	43	8.1
AC	Selenium (Se)	mg/kg dm	< 2.0	< 2.0	< 2.0	< 2.0
AC	Tin (Sn)	mg/kg dm	< 5.0	< 5.0	< 5.0	< 5.0
AC	Vanadium (V)	mg/kg dm	54	56	61	15
AC	Zinc (Zn)	mg/kg dm	87	100	110	17
AC	Beryllium (Be)	mg/kg dm	1.4	1.5	1.1	< 1.0
AC	Calcium (Ca)	mg/kg dm	9,500	5,200	460	520
AC	Potassium (K)	mg/kg dm	4,000	4,600	8,400	810
AC	Magnesium (Mg)	mg/kg dm	12,000	14,000	10,000	1,700
AC	Sodium (Na)	mg/kg dm	2,100	1,700	920	730

No.	Customer Reference	Sample matrix	Sampling date client	Sample Code
9	MBH15-1 MBH15(1)	Sediment	21/04/2026	421-2026-00215517
10	MBH15-2 MBH15(3)	Sediment	21/04/2026	421-2026-00215518
11	MBH17-1 MBH17(1)	Sediment	21/04/2026	421-2026-00215519
12	MBH17-2 MBH17(3)	Sediment	21/04/2026	421-2026-00215520

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	Parameter Name	Unit	9	10	11	12
	Polycyclic Aromatic Hydrocarbons, PAH					
	MEV-SD 18287					
AC	Naphthalene	mg/kg dm	< 0.042	< 0.041	< 0.047	< 0.040
AC	Acenaphtylene	mg/kg dm	< 0.042	< 0.041	< 0.047	< 0.040
AC	Acenaphtene	mg/kg dm	< 0.042	< 0.041	< 0.047	< 0.040
AC	Fluorene	mg/kg dm	< 0.042	< 0.041	< 0.047	< 0.040
AC	Phenanthrene	mg/kg dm	< 0.042	< 0.041	< 0.047	< 0.040
AC	Anthracene	mg/kg dm	< 0.042	< 0.041	< 0.047	< 0.040
AC	Fluoranthene	mg/kg dm	< 0.042	< 0.041	< 0.047	< 0.040
AC	Pyrene	mg/kg dm	< 0.042	< 0.041	< 0.047	< 0.040
AC	Benz(a)anthracene	mg/kg dm	< 0.042	< 0.041	< 0.047	< 0.040
AC	Chrysene	mg/kg dm	< 0.042	< 0.041	< 0.047	< 0.040
AC	Benzo(b)fluoranthene	mg/kg dm	< 0.042	< 0.041	< 0.047	< 0.040
AC	Benzo(k)fluoranthene	mg/kg dm	< 0.042	< 0.041	< 0.047	< 0.040
AC	Benzo(a)pyrene	mg/kg dm	< 0.042	< 0.041	< 0.047	< 0.040
AC	Benzo(g,h,i)perylene	mg/kg dm	< 0.042	< 0.041	< 0.047	< 0.040
AC	Dibenzo(ah)anthracene	mg/kg dm	< 0.042	< 0.041	< 0.047	< 0.040
AC	Indeno(123cd)pyrene	mg/kg dm	< 0.042	< 0.041	< 0.047	< 0.040
AC	PAH 18 EPA (sum)	mg/kg dm	< 0.80	< 0.80	< 0.80	< 0.80
AC	PAH 10 VROM (sum)	mg/kg dm	< 0.50	< 0.50	< 0.50	< 0.50
	Polychlorinated Biphenyl					
	MEV 6380					
AC	PCB 28	mg/kg dm	< 0.001	< 0.001	< 0.001	< 0.001
AC	PCB 52	mg/kg dm	< 0.001	< 0.001	< 0.001	< 0.001
AC	PCB 101	mg/kg dm	< 0.001	< 0.001	< 0.001	< 0.001
AC	PCB 118	mg/kg dm	< 0.001	< 0.001	< 0.001	< 0.001
AC	PCB 138	mg/kg dm	< 0.001	< 0.001	< 0.001	< 0.001
AC	PCB 153	mg/kg dm	< 0.001	< 0.001	< 0.001	< 0.001
AC	PCB 180	mg/kg dm	< 0.001	< 0.001	< 0.001	< 0.001
AC	PCB (7) Sum)	mg/kg dm	< 0.0070	< 0.0070	< 0.0070	< 0.0070

No.	Customer Reference	Sample matrix	Sampling date client	Sample Code
9	MBH15-1 MBH15(1)	Sediment	21/04/2026	421-2026-00215517
10	MBH15-2 MBH15(3)	Sediment	21/04/2026	421-2026-00215518
11	MBH17-1 MBH17(1)	Sediment	21/04/2026	421-2026-00215519
12	MBH17-2 MBH17(3)	Sediment	21/04/2026	421-2026-00215520

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	Parameter Name	Unit	9	10	11	12
	Petroleum Hydrocarbons					
	NEN-EN ISO 16703					
	TPH >C10-C12	mg/kg dm	< 3	< 3	< 3	< 3
	TPH >C12-C16	mg/kg dm	< 5	< 5	< 5	< 5
	TPH (>C16-C21)	mg/kg dm	< 6	6	< 6	< 6
	TPH (C21-C30)	mg/kg dm	< 12	< 12	< 12	< 12
	TPH (C30-C35)	mg/kg dm	10	8	< 6	< 6
	TPH (C35-C40)	mg/kg dm	< 6	< 6	< 6	< 6
AC	TPH (sum C10-C40)	mg/kg dm	< 38	< 38	< 38	< 38
	Inorganic Compounds					
	Internal Method					
	Nitrite (NO3-N)	mg/kg dm	4.4 [1]	2.3 [1]	< 2.0 [1]	4.1 [1]
	Nitrate (NO3)	mg/kg dm	19 [1]	10 [1]	< 9.0 [1]	18 [1]
	Ortho-phosphate (PO4-P)	mg/kg dm	< 0.20	< 0.20	1.6	3.5
	Ortho-phosphate (PO4)	mg/kg dm	< 0.60	< 0.60	5.0	11

No.	Customer Reference	Sample matrix	Sampling date client	Sample Code
9	MBH15-1 MBH15(1)	Sediment	21/04/2026	421-2026-00215517
10	MBH15-2 MBH15(3)	Sediment	21/04/2026	421-2026-00215518
11	MBH17-1 MBH17(1)	Sediment	21/04/2026	421-2026-00215519
12	MBH17-2 MBH17(3)	Sediment	21/04/2026	421-2026-00215520

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	Parameter Name	Unit	13
	Characteristics		
	NEN-EN 12880		
AC	Dry matter	% w/w	80.3
	NEN 5754		
	Organic matter	% w/w DM	1.4
AC	Residue on ignition	% w/w DM	97.7
	NEN-EN 15936		
AC	Total Organic Carbon (TOC)	g/kg dm	< 5.0
	NEN 5753		
AC	Fraction < 2 µm (Clay)	% w/w DM	11.7
	Metals		
	NEN-EN-ISO 17294-2		
AC	Antimony (Sb)	mg/kg dm	< 2.0
AC	Arsenic (As)	mg/kg dm	5.7
AC	Barium (Ba)	mg/kg dm	37
AC	Cadmium (Cd)	mg/kg dm	< 0.40
AC	Chromium (Cr)	mg/kg dm	34
AC	Cobalt (Co)	mg/kg dm	13
AC	Copper (Cu)	mg/kg dm	20
AC	Mercury (Hg)	mg/kg dm	< 0.10
AC	Lead (Pb)	mg/kg dm	13
AC	Molybdenum (Mo)	mg/kg dm	< 1.5
AC	Nickel (Ni)	mg/kg dm	36
AC	Selenium (Se)	mg/kg dm	< 2.0
AC	Tin (Sn)	mg/kg dm	< 5.0
AC	Vanadium (V)	mg/kg dm	35
AC	Zinc (Zn)	mg/kg dm	69
AC	Beryllium (Be)	mg/kg dm	< 1.0
AC	Calcium (Ca)	mg/kg dm	2,500
AC	Potassium (K)	mg/kg dm	3,600
AC	Magnesium (Mg)	mg/kg dm	8,900
AC	Sodium (Na)	mg/kg dm	370

No.	Customer Reference	Sample matrix	Sampling date client	Sample Code
13	MBH17-3 MBH17(5)	Sediment	21/04/2026	421-2026-00215521

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	Parameter Name	Unit	13	
	Polycyclic Aromatic Hydrocarbons, PAH			
	NEN-ISO 18287			
AC	Naphthalene	mg/kg dm	< 0.040	b
AC	Acenaphthylene	mg/kg dm	< 0.040	b
AC	Acenaphthene	mg/kg dm	< 0.040	b
AC	Fluorene	mg/kg dm	< 0.040	b
AC	Phenanthrene	mg/kg dm	< 0.040	b
AC	Anthracene	mg/kg dm	< 0.040	b
AC	Fluoranthene	mg/kg dm	< 0.040	b
AC	Pyrene	mg/kg dm	< 0.040	b
AC	Benz(a)anthracene	mg/kg dm	< 0.040	b
AC	Chrysene	mg/kg dm	< 0.040	b
AC	Benzo(b)fluoranthene	mg/kg dm	< 0.040	b
AC	Benzo(k)fluoranthene	mg/kg dm	< 0.040	b
AC	Benzo(a)pyrene	mg/kg dm	< 0.040	b
AC	Benzo(g,h,i)perylene	mg/kg dm	< 0.040	b
AC	Dibenzo(ah)anthracene	mg/kg dm	< 0.040	b
AC	Indeno(123cd)pyrene	mg/kg dm	< 0.040	b
AC	PAH 16 EPA (sum)	mg/kg dm	< 0.60	
AC	PAH 10 VROM (sum)	mg/kg dm	< 0.50	
	Polychlorinated Biphenyl			
	NEN 6960			
AC	PCB 28	mg/kg dm	< 0.001	
AC	PCB 52	mg/kg dm	< 0.001	
AC	PCB 101	mg/kg dm	< 0.001	
AC	PCB 118	mg/kg dm	< 0.001	
AC	PCB 138	mg/kg dm	< 0.001	
AC	PCB 153	mg/kg dm	< 0.001	
AC	PCB 180	mg/kg dm	< 0.001	
AC	PCB (7) Sum	mg/kg dm	< 0.0070	
	Petroleum Hydrocarbons			
	NEN-EN-ISO 16703			
	TPH >C10-C12	mg/kg dm	< 3	
	TPH >C12-C16	mg/kg dm	< 5	
	TPH (>C16-C21)	mg/kg dm	< 6	

No	Customer Reference	Sample matrix	Sampling date client	Sample Code
13	MBH17-3 MBH17(5)	Sediment	21/04/2026	421-2026 00215521

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	Parameter Name	Unit	13
	Petroleum Hydrocarbons		
	NEN-EN ISO 16703		
	TPH (C21-C30)	mg/kg dm	< 12
	TPH (C30-C35)	mg/kg dm	< 6
	TPH (C35-C40)	mg/kg dm	< 6
AC	TPH (sum C10-C40)	mg/kg dm	< 36
	Inorganic Compounds		
	Internal Method		
	Nitrate (NO3-N)	mg/kg dm	< 2.0 ▼
	Nitrate (NO3)	mg/kg dm	< 8.0 ▼
	Ortho-phosphate (PO4-P)	mg/kg dm	< 0.20
	Ortho-phosphate (PO4)	mg/kg dm	< 0.60

No.	Customer Reference	Sample matrix	Sampling date client	Sample Code
13	MRH17-3 MRH17(5)	Sediment	21/04/2026	421-2026-00215521

Released by: NFZI

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ISO 17025

Comment:

1) The preservation term for this parameter has been expired.
2) The reporting limit has been increased due to low sample intake and/or low dry weight.
3) Benzo(b)fluoranthene could be affected by Benzo(j)fluoranthene.

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Appendix (A): concerning subsample information referring to certificate of analysis AR-421-2026-076231-01

Container Code	Drill nr	Depth From	Depth To	Sampling date client	Sample Container Description
Sample Code: 421-2026-00215508	Customer Reference: MBH01-1		MBH01(1)		
0520468314	MBH01	150	255	21/04/2026	1
Sample Code: 421-2026-00215510	Customer Reference: MBH04-1		MBH04(1)		
0520468004	MBH04	0	105	21/04/2026	1
Sample Code: 421-2026-00215511	Customer Reference: MBH04-2		MBH04(3)		
0520468003	MBH04	150	255	21/04/2026	3
Sample Code: 421-2026-00215512	Customer Reference: MBH06-1		MBH06(1)		
0520468027	MBH06	0	105	21/04/2026	1
Sample Code: 421-2026-00215513	Customer Reference: MBH06-2		MBH06(3)		
0520468004	MBH06	300	405	21/04/2026	3
Sample Code: 421-2026-00215514	Customer Reference: MBH14-1		MBH14(1)		
0520468067	MBH14	0	105	21/04/2026	1
Sample Code: 421-2026-00215515	Customer Reference: MBH14-2		MBH14(3)		
0520468027	MBH14	300	405	21/04/2026	3
Sample Code: 421-2026-00215516	Customer Reference: MBH14-3		MBH14(5)		
0520468009	MBH14	900	1005	21/04/2026	5
Sample Code: 421-2026-00215517	Customer Reference: MBH15-1		MBH15(1)		
0520468044	MBH15	150	255	21/04/2026	1
Sample Code: 421-2026-00215518	Customer Reference: MBH15-2		MBH15(3)		
0520468048	MBH15	600	705	21/04/2026	3
Sample Code: 421-2026-00215519	Customer Reference: MBH17-1		MBH17(1)		
0520468074	MBH17	0	105	21/04/2026	1
Sample Code: 421-2026-00215520	Customer Reference: MBH17-2		MBH17(3)		
0520468087	MBH17	300	405	21/04/2026	3
Sample Code: 421-2026-00215521	Customer Reference: MBH17-3		MBH17(5)		
0520468029	MBH17	900	1005	21/04/2026	5

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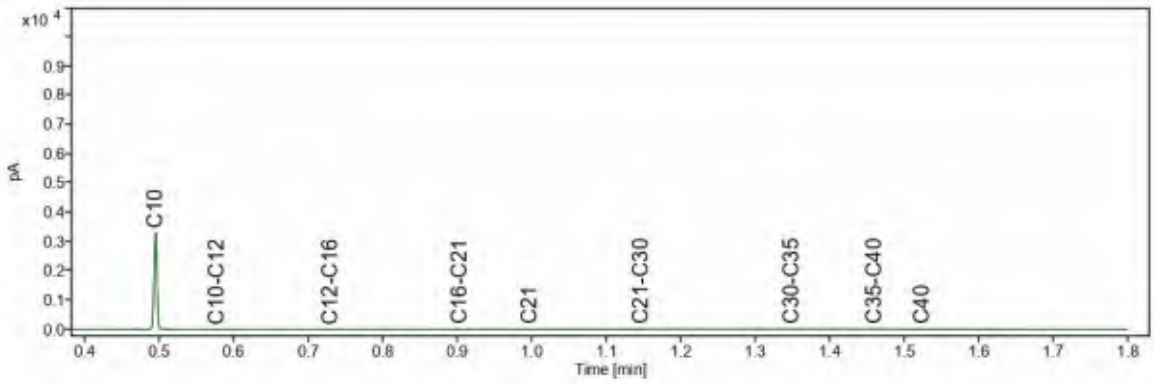
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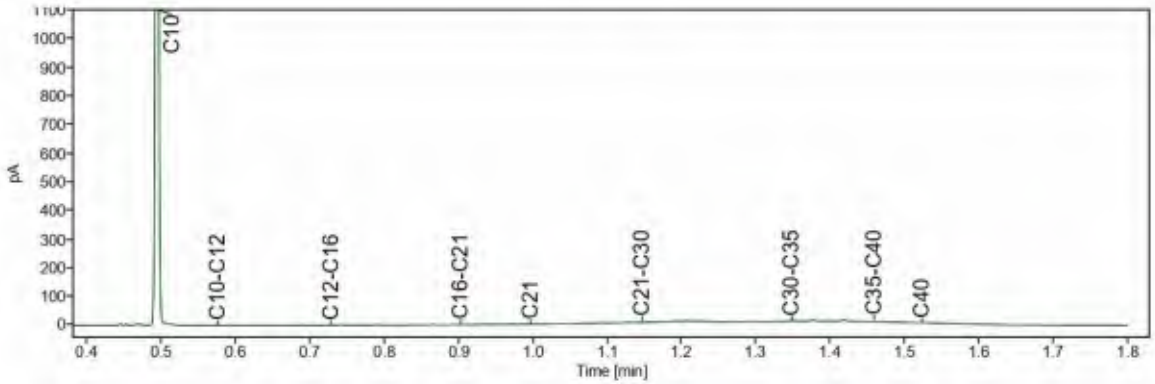
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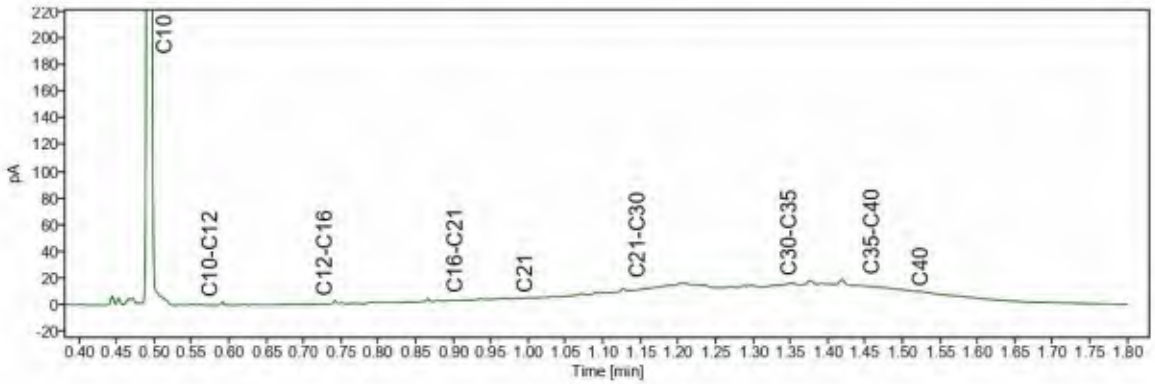
Chromatogram TPH/ Mineral Oil

Sample ID.: L02685179
Certificate no.: 421-2026-076231
Sample description.: MBH01-1

V



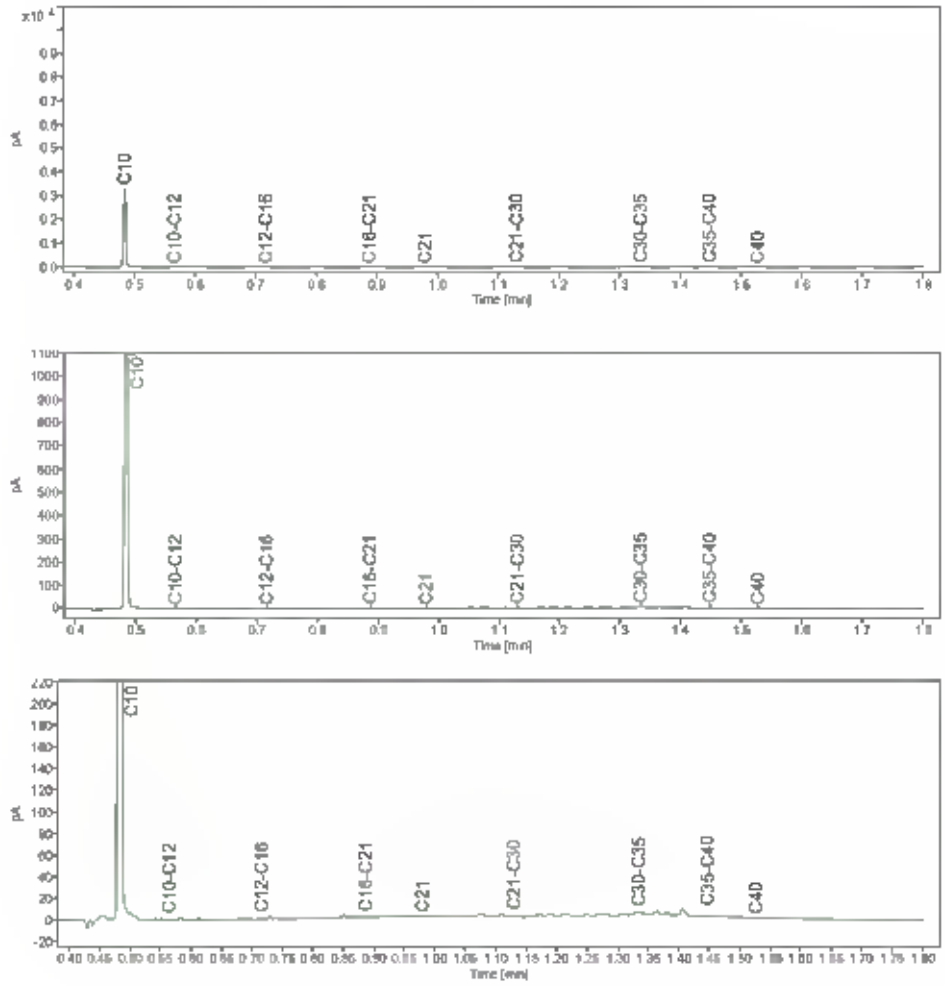




Result Attachment RA2 AR-421-2026-076231-01 - 421-2026-00215512 17/17

Chromatogram TPH/ Mineral Oil

Sample ID.: L02731390
Certificate no 421-2026-076231
Sample description : MBH06-1 MBH06(1)



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14 May 2026

Project Director
Institute of Water Modelling (IWM)
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Bangladesh

Benthic Organism Analysis Report

Sample ID	Group Name	Species Name	Number of organisms
BN_SD_03_1	Black fly larvae (Simulidae, Diptera)	*Simulium* sp.	6
	Crane fly larvae (Tipulidae, Diptera)	*Tipula* sp.	15
	Chironomid larvae (Chironomidae, Diptera)	*Chironomus* sp.	12
	Blood worm (Tubificidae, Oligochaeta)	*Tubifex* sp.	6
	Gastropoda (Mollusca)	*Corbicula* sp.	3
BN_SD_03_2	Chironomid larvae (Chironomidae, Diptera)	*Chironomus* sp.	8
	Blood worm (Tubificidae, Oligochaeta)	*Tubifex* sp.	9
	Hover fly larvae (Syrphidae, Diptera)	*Eristalis* sp.	4
	Gastropoda (Mollusca)	*Corbicula* sp.	3
BN_SD_03_3	Blood worm (Tubificidae, Oligochaeta)	*Tubifex* sp.	6
	Hover fly larvae (Syrphidae, Diptera)	*Eristalis* sp.	6
BN_SD_06_1	Crane fly larvae (Tipulidae, Diptera)	*Tipula* sp.	3
	Chironomid larvae (Chironomidae, Diptera)	*Chironomus* sp.	6
BN_SD_06_2	Gastropoda (Mollusca)	*Corbicula* sp.	7
	Chironomid larvae (Chironomidae, Diptera)	*Chironomus* sp.	5
BN_SD_06_3	Crane fly larvae (Tipulidae, Diptera)	*Tipula* sp.	2
	Gastropoda (Mollusca)	*Corbicula* sp.	4
BN_SD_04_1	Gastropoda (Mollusca)	*Corbicula* sp.	3
BN_SD_04_2	Gastropoda (Mollusca)	*Corbicula* sp.	5
BN_SD_04_3	Gastropoda (Mollusca)	*Corbicula* sp.	6

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ঢাকা ১০০০, বাংলাদেশ
ফোন: ৮৮০-২-৯৬৬১৯০০-৭৩
এক্স ৭৫৮০, ৭৫৮১, ফ্যাক্স: ৮৮০-২-৯৬৬৭২২২

07 June 2026

Project Director
Institute of Water Modelling (IWM)
IWM Bhaban, House-06, Road# 3C,
Block-H, Sector-15, Uttara, Dhaka-1230
Bangladesh

Benthic Organism Analysis Report

Sample ID	Group Name	Species Name	Number of organisms
Karnaphuli River Soil_1	Sand worms (Nephtyidae, Polychaeta)	*Nepthys* sp.	11
	Polychaete worms (Capitellidae, Polychaeta)	*Capitella* sp,	5
	Bristle worms (Nereididae, Polychaeta)	*Namalycastis* sp.	9
	Asian Clam (Gastropoda, Mollusca)	*Corbicula* sp.	6
Karnaphuli River soil_2	Polychaete worms (Capitellidae, Polychaeta)	*Capitella* sp.	6
	Bristle worms (Nereididae, Polychaeta)	*Namalycastis* sp.	8
	Estuarine isopods (Isopoda, Crustacea)	Isopod sp	3

Md. Mizanur Rahman PhD
Associate Professor
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Surface Water Quality

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Haskoning Nederland B V
Dhr Jan Jurjen Schiphuis
Laan 1914 no 35
AMERSFOORT
Netherlands

Certificate of analysis

Date 19/05/2026

Please find enclosed the analytical results of the test carried out for the project.

Certificate number/Version	AR-421-2026-070629-01
Project number client	-
Project name client	-
Your order number	421-2026-070629
Project Quotation Name	-
Samples received on	29/04/2026
Sample taker client	-
Start date	29/04/2026
This is last Test IP Validation Ending Time	19/05/2026
Report date	19/05/2026
Appendices	A

Recognition Information
AC NEN EN ISO/IEC 17025 2017, RvA L010

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We are confident that we have performed the order in accordance with your expectations. If you have any remaining questions concerning this Certificate of Analysis please don't hesitate to contact our Customer Support.

Yours sincerely,
Eurofins Analytico (Barneveld)

Ing. A. Veldhuizen
Technical Manager

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KvK/CoC No. 09088523

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	Parameter Name	Unit	1	2	3	4
	Metals					
	NEN-EN-ISO 17294-2					
AC	Arsenic (As)	µg/l	< 3.0 [1]	< 3.0 [1]	< 3.0 [1]	3.0 [1]
AC	Antimony (Sb)	µg/l	< 5.0 [1]	< 5.0 [1]	< 5.0 [1]	< 5.0 [1]
AC	Barium (Ba)	µg/l	18 [1]	26 [1]	31 [1]	35 [1]
AC	Beryllium (Be)	µg/l	< 1.0 [1]	< 1.0 [1]	< 1.0 [1]	< 1.0 [1]
AC	Cadmium (Cd)	µg/l	< 0.40 [1]	< 0.40 [1]	< 0.40 [1]	< 0.40 [1]
AC	Chromium (Cr)	µg/l	2.0 [1]	3.5 [1]	5.0 [1]	5.0 [1]
AC	Cobalt (Co)	µg/l	1.2 [1]	2.6 [1]	2.8 [1]	3.2 [1]
AC	Copper (Cu)	µg/l	4.9 [1]	9.1 [1]	10 [1]	11 [1]
AC	Mercury (Hg)	µg/l	< 0.04 [1]	< 0.04 [1]	< 0.04 [1]	< 0.04 [1]
AC	Lead (Pb)	µg/l	< 3.0 [1]	6.2 [1]	7.1 [1]	7.1 [1]
AC	Molybdenum (Mo)	µg/l	< 2.0 [1]	< 2.0 [1]	< 2.0 [1]	< 2.0 [1]
AC	Nickel (Ni)	µg/l	2.9 [1]	5.1 [1]	6.4 [1]	6.7 [1]
AC	Selenium (Se)	µg/l	< 5.0 [1]	< 5.0 [1]	< 5.0 [1]	< 5.0 [1]
AC	Tin (Sn)	µg/l	< 5.0 [1]	< 5.0 [1]	< 5.0 [1]	< 5.0 [1]
AC	Vanadium (V)	µg/l	3.9 [1]	6.6 [1]	6.8 [1]	7.7 [1]
AC	Zinc (Zn)	µg/l	6.3 [1]	12 [1]	19 [1]	12 [1]
AC	Calcium (Ca)	mg/l	60	80	99	110
	Iron (Fe)	mg/l	0.37	0.50	0.57	0.87
	Potassium (K)	mg/l	48	67	85	95
AC	Magnesium (Mg)	mg/l	150	230	290	350
AC	Manganese (Mn)	mg/l	0.046	0.079	0.075	0.12
	Sodium (Na)	mg/l	1,300	1,800	2,200	2,700
	Mono Aromatic Hydrocarbons					
	NEN-EN-ISO 20595					
AC	Benzene	µg/l	< 0.2 [1]	< 0.2 [1]	< 0.2 [1]	< 0.2 [1]
AC	Toluene	µg/l	< 0.2 [1]	< 0.2 [1]	< 0.2 [1]	< 0.2 [1]
AC	Ethylbenzene	µg/l	< 0.2 [1]	< 0.2 [1]	< 0.2 [1]	< 0.2 [1]
AC	o-Xylene	µg/l	< 0.2 [1]	< 0.2 [1]	< 0.2 [1]	< 0.2 [1]
AC	m,p-Xylene	µg/l	< 0.2 [1]	< 0.2 [1]	< 0.2 [1]	< 0.2 [1]
AC	BTEX (sum)	µg/l	< 1.0 [1]	< 1.0 [1]	< 1.0 [1]	< 1.0 [1]
AC	Xylenes (sum)	µg/l	< 0.3	< 0.3	< 0.3	< 0.3

No.	Customer Reference	Sample matrix	Sampling date client	Sample Code
1	SW-01-1 SW-01	Surface water	08/04/2026	421-2026-00197708
2	SW-02-1 SW-02	Surface water	08/04/2026	421-2026-00197709
3	SW-03-1 SW-03	Surface water	08/04/2026	421-2026-00197710
4	SW-04-1 SW-04	Surface water	08/04/2026	421-2026-00197711

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	Parameter Name	Unit	1	2	3	4
	Mono Aromatic Hydrocarbons					
	ISO 11423-1 & GM/GC					
AC	Naphtalene	µg/l	< 0.2	< 0.2	< 0.2	< 0.2
	Volatile halogenated Hydrocarbons					
	EN-ISO 10301 & GM/MS					
	Trichloromethane	µg/l	< 0.1	< 0.1	< 0.1	< 0.1
	Tetrachloromethane	µg/l	< 0.1	< 0.1	< 0.1	< 0.1
	Trichloroethene	µg/l	< 0.1	< 0.1	< 0.1	0.1
	Tetrachloroethene	µg/l	< 0.1	< 0.1	< 0.1	< 0.1
	1,2-Dichloroethane	µg/l	< 0.1	< 0.1	< 0.1	< 0.1
	1,1,1-Trichloroethane	µg/l	< 0.1	< 0.1	< 0.1	< 0.1
	1,1,2-Trichloroethane	µg/l	< 0.1	< 0.1	< 0.1	< 0.1
	cis-1,2-Dichloroethene	µg/l	< 0.1	< 0.1	< 0.1	< 0.1
	Monochlorobenzene	µg/l	< 0.1	< 0.1	< 0.1	< 0.1
	1,2-Dichlorobenzene	µg/l	< 0.1	< 0.1	< 0.1	< 0.1
	1,3-Dichlorobenzene	µg/l	< 0.1	< 0.1	< 0.1	< 0.1
	1,4-Dichlorobenzene	µg/l	< 0.1	< 0.1	< 0.1	< 0.1
	Dichlorobenzenes (sum 3)	µg/l	< 0.3	< 0.3	< 0.3	< 0.3
	Chlorobenzenes (sum 4)	µg/l	< 0.4	< 0.4	< 0.4	< 0.4
	Chlorinated Hydrocarbons (sum)	µg/l	< 0.8	< 0.8	< 0.8	< 0.8
	Petroleum Hydrocarbons					
	NEN-EN-ISO 9377-2					
	TPH (C10-C12)	µg/l	< 10	< 10	< 10	< 10
	TPH (C12-C16)	µg/l	< 10	< 10	< 10	< 10
	TPH (C16-C21)	µg/l	< 10	< 10	< 10	< 10
	TPH (C21-C30)	µg/l	< 15	< 15	< 15	< 15
	TPH (C30-C35)	µg/l	< 10	< 10	< 10	< 10
	TPH (C35-C40)	µg/l	< 10	< 10	< 10	< 10
AC	TPH Sum (C10-C40)	µg/l	< 38	< 38	< 38	< 38

No.	Customer Reference	Sample matrix	Sampling date client	Sample Code
1	SW-01-1 SW 01	Surface water	08/04/2026	421-2026-00197708
2	SW-02-1 SW 02	Surface water	08/04/2026	421-2026-00197709
3	SW-03-1 SW 03	Surface water	08/04/2026	421-2026-00197710
4	SW-04-1 SW 04	Surface water	08/04/2026	421-2026-00197711

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	Parameter Name	Unit	1	2	3	4
	Inorganic Compounds					
	NEN-EN-ISO 10304-1					
AC	Bromide	mg/l	7.1	13	14	17
AC	Chloride	mg/l	2,200	3,800	4,200	5,300
AC	Sulphate	mg SO4/l	300	530	590	700
	Fluoride	mg/l	< 0.50 3)	< 5.0 3)	< 5.0 3)	< 5.0 3)

No.	Customer Reference	Sample matrix	Sampling date client	Sample Code
1	SW-01-1 SW-01	Surface water	08/04/2026	421-2026-00197708
2	SW-02-1 SW-02	Surface water	08/04/2026	421-2026-00197709
3	SW-03-1 SW-03	Surface water	08/04/2026	421-2026-00197710
4	SW-04-1 SW-04	Surface water	08/04/2026	421-2026-00197711

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	Parameter Name	Unit	5	6
	Metals			
	NEN-EN-ISO 17294-2			
AC	Arsenic (As)	µg/l	< 3.0	3.3
AC	Antimony (Sb)	µg/l	< 5.0	< 5.0
AC	Barium (Ba)	µg/l	40	57
AC	Beryllium (Be)	µg/l	< 1.0	< 1.0
AC	Cadmium (Cd)	µg/l	< 0.40	< 0.40
AC	Chromium (Cr)	µg/l	4.0	5.2
AC	Cobalt (Co)	µg/l	2.6	3.6
AC	Copper (Cu)	µg/l	8.9	11
AC	Mercury (Hg)	µg/l	< 0.04	< 0.04
AC	Lead (Pb)	µg/l	5.8	7.1
AC	Molybdenum (Mo)	µg/l	2.3	2.5
AC	Nickel (Ni)	µg/l	5.5	7.3
AC	Selenium (Se)	µg/l	< 5.0	< 5.0
AC	Tin (Sn)	µg/l	< 5.0	< 5.0
AC	Vanadium (V)	µg/l	6.8	8.4
AC	Zinc (Zn)	µg/l	13	14
AC	Calcium (Ca)	mg/l	130	170
	Iron (Fe)	mg/l	0.67	0.97
	Potassium (K)	mg/l	120	150
AC	Magnesium (Mg)	mg/l	380	500
AC	Manganese (Mn)	mg/l	0.10	0.12
	Sodium (Na)	mg/l	3,000	3,800
	Mono Aromatic Hydrocarbons			
	NEN-EN-ISO 20595			
AC	Benzene	µg/l	0.3	< 0.2
AC	Toluene	µg/l	0.4	< 0.2
AC	Ethylbenzene	µg/l	< 0.2	< 0.2
AC	o-Xylene	µg/l	< 0.2	< 0.2
AC	m,p Xylene	µg/l	0.2	< 0.2
AC	BTEX (sum)	µg/l	< 1.0	< 1.0
AC	Xylenes (sum)	µg/l	< 0.3	< 0.3
	ISO 11423-1 & CMA/3/E			
AC	Naphthalene	µg/l	< 0.2	< 0.2

No	Customer Reference	Sample matrix	Sampling date client	Sample Code
5	SW-05-1 SW-05	Surface water	08/04/2026	421-2026-00197712
6	SW 06-1 SW-06	Surface water	08/04/2026	421-2026-00197713

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	Parameter Name	Unit	5	6
	Volatile halogenated Hydrocarbons			
	EN-ISO 10301 & CMA/5E			
	Trichloromethane	µg/l	< 0.1	< 0.1
	Tetrachloromethene	µg/l	< 0.1	< 0.1
	Trichloroethene	µg/l	< 0.1	< 0.1
	Tetrachloroethene	µg/l	< 0.1	< 0.1
	1,2-Dichloromethane	µg/l	< 0.1	< 0.1
	1,1,1-Trichloroethane	µg/l	< 0.1	< 0.1
	1,1,2-Trichloroethane	µg/l	< 0.1	< 0.1
	cis-1,2-Dichloroethene	µg/l	< 0.1	< 0.1
	Monochlorobenzene	µg/l	< 0.1	< 0.1
	1,2-Dichlorobenzene	µg/l	< 0.1	< 0.1
	1,3-Dichlorobenzene	µg/l	< 0.1	< 0.1
	1,4-Dichlorobenzene	µg/l	< 0.1	< 0.1
	Dichlorobenzenes (sum 3)	µg/l	< 0.3	< 0.3
	Chlorobenzenes (sum 4)	µg/l	< 0.4	< 0.4
	Chlorinated Hydrocarbons (sum)	µg/l	< 0.8	< 0.8
	Petroleum Hydrocarbons			
	NEN-EN-ISO 9377-2			
	TPH (C10-C12)	µg/l	< 10	< 10
	TPH (C12-C16)	µg/l	< 10	< 10
	TPH (C16-C21)	µg/l	< 10	< 10
	TPH (C21-C30)	µg/l	< 15	< 15
	TPH (C30-C35)	µg/l	< 10	< 10
	TPH (C35-C40)	µg/l	< 10	< 10
AC	TPH Sum (C10-C40)	µg/l	< 35	< 35
	Inorganic Compounds			
	NEN-EN-ISO 10304-1			
AC	Bromide	mg/l	22	26
AC	Chloride	mg/l	5,400	7,500
AC	Sulphate	mg SO4/l	900	1,100
	Fluoride	mg/l	< 5.0	< 5.0

No.	Customer Reference	Sample matrix	Sampling date client	Sample Code
5	SW-05-1 SW-05	Surface water	06/04/2026	421-2026-00197712
6	SW-06-1 SW-06	Surface water	06/04/2026	421-2026-00197713

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Comment:

1) The preservation term for this parameter has been expired.
2) The reporting limit has been increased due to low sample intake and/or low dry weight.

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Appendix (A): concerning subsample information referring to certificate of analysis AR-421-2026-070629-01

Container Code	Drill nr	Depth From	Depth To	Sampling date client	Sample Container Description
Sample Code	421-2026-00197708 **Customer Reference**	SW-01-1 SW-01			
0625078805	SW-01			08/04/2026	2
0675401147	SW-01			08/04/2026	4
0695318286	SW-01			08/04/2026	1
0905231437	SW-01			08/04/2026	3
Sample Code	421-2026-00197709 **Customer Reference**	SW-02-1 SW-02			
0625078818	SW-02			08/04/2026	2
0675401151	SW-02			08/04/2026	4
0695318303	SW-02			08/04/2026	1
0905231514	SW-02			08/04/2026	3
Sample Code	421-2026-00197710 **Customer Reference**	SW-03-1 SW-03			
0625078791	SW-03			08/04/2026	2
0675401124	SW-03			08/04/2026	4
0695318287	SW-03			08/04/2026	1
0905231642	SW-03			08/04/2026	3
Sample Code	421-2026-00197711 **Customer Reference**	SW-04-1 SW-04			
0625078800	SW-04			08/04/2026	2
0675401146	SW-04			08/04/2026	4
0695318296	SW-04			08/04/2026	1
0905231507	SW-04			08/04/2026	3
Sample Code	421-2026-00197712 **Customer Reference**	SW-05-1 SW-05			
0625078779	SW-05			08/04/2026	2
0675401160	SW-05			08/04/2026	4
0695318295	SW-05			08/04/2026	1
0905231420	SW-05			08/04/2026	3
Sample Code	421-2026-00197713 **Customer Reference**	SW-06-1 SW-06			
0625078783	SW-06			08/04/2026	2
0675401162	SW-06			08/04/2026	4
0695318294	SW-06			08/04/2026	1
0905231442	SW-06			08/04/2026	3

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Bangladesh Council of Scientific and Industrial Research (BCSIR)
Ministry of Science and Technology (MoST)
Dr Qudrat-e-Khuda Road, Dhanmondi, Dhaka-1205, Bangladesh

TRACKING NO.: **2026045759** REFERENCE/BATCH NO.: **A-304-309** DATE: **07-05-2026**

ANALYSIS/TEST REPORT · SAMPLE ANALYSIS (INARS)

SAMPLE INFORMATION
Description: Sample-1 SW-1, Sample- SW-2, Sample-3 SW-3, Sample-4 SW-4, Sample-5 SW-5, Sample-6 SW-6.
Receive Date: 09-04-2026
Analysis Date: 07-05-2026
Report Delivery Date 11-05-2026

APPLICANT
Nafi Naib
JR. Engineer
Institute of Water Modelling
House-06, Road-3C, Block H, Sector 15.
nafinaibmon660012@gmail.com
01732335155

Lab ID	Particulars of supplied sample	Parameters	Results	Test Method (APHA)
A-304	Surface Water (SW-01)	BOD (Biological Oxygen Demand)	< 0.2 mg/L	5210.B
A-305	Surface Water (SW-02)	BOD (Biological Oxygen Demand)	< 0.2 mg/L	5210.B
A-306	Surface Water (SW-03)	BOD (Biological Oxygen Demand)	< 0.2 mg/L	5210.B
A-307	Surface Water (SW-04)	BOD (Biological Oxygen Demand)	< 0.2 mg/L	5210.B
A-308	Surface Water (SW-05)	BOD (Biological Oxygen Demand)	< 0.2 mg/L	5210.B
A-309	Surface Water (SW-06)	BOD (Biological Oxygen Demand)	< 0.2 mg/L	5210.B

Note. a. The results reported here pertained to the sample received in this laboratory only
b. Complain and/or query regarding delivered test report should be lodged within one month of report delivery date.
c. The laboratory is not responsible for the date quality affected due to sampling, transporting and storage conditions of the sample(s) maintained before received in the laboratory
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QR CODE

10-05-2026	10-05-2026	10-05-2026
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(Sharmin Ahmed)	[Dr Muhammad Abdullah Al-Mansur]	(Dr. Md. Salim Khan)
Scientific Officer	Principal Scientific Officer	Director
Institute of National Analytical Research & Services (INARS)	Institute of National Analytical Research & Services (INARS)	Institute of National Analytical Research & Services (INARS)

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Institute of National Analytical Research & Services (INARS)
Bangladesh Council of Scientific and Industrial Research (BCSIR)
Ministry of Science and Technology (MoST)
Dr. Qudrat-e Khuda Road, Dhanmondi, Dhaka-1205, Bangladesh

TRACKING NO.: **2026045760** REFERENCE/BATCH NO : **A-310-315** DATE: **07-05-2026**

ANALYSIS/TEST REPORT : SAMPLE ANALYSIS (INARS)

SAMPLE INFORMATION
Description: Sample-1 SW-01, Sample-2 SW-02, Sample-3 SW-03, Sample-4 SW-04, Sample-5 SW-05, Sample-6 SW-06
Receive Date: 09-04-2026
Analysis Date: 07-05-2026
Report Delivery Date: 11-05-2026

APPLICANT
Nafi Naib
JR Engineer
Institute of Water Modelling
House-06, Road-3C, Block H, Sector 15.
nafinaibmon660012@gmail com
01732335155

Lab ID	Particulars of supplied sample	Parameters	Results	Test Method (APHA)
A-310	**Surface Water (SW-01)**	COD (Chemical Oxygen Demand)	2 82 mg/L	5220.B
		TOC (Total Organic Carbon)	2.92 mg/L	5310.B
		TDS (Total dissolved solids)	4232 mg/L	2540 C
		TSS (Total Suspended Solids)	176 mg/L	2540.D
		Sulphate (SO_4^{2-})	310 mg/L	4110.B
		Nitrate (NO_3^-)	< 3 0 mg/L	4110 B
		Phosphate (PO_4^{3-})	< 0 5 mg/L	4500/P C

Lab ID	Particulars of supplied sample	Parameters	Results	Test Method (APHA)

10-05-2026	10-05-2026	10-05-2026
Analyst	Section/Division In-Charge	In-Charge/ Director
(Sharmin Ahmed)	(Dr. Muhammad Abdullah Al-Mansur)	(Dr. Md. Salim Khan)
Scientific Officer	Principal Scientific Officer	Director
Institute of National Analytical Research & Services (INARS)	Institute of National Analytical Research & Services (INARS)	Institute of National Analytical Research & Services (INARS)

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A-311	**Surface Water (SW-02)**	COD (Chemical Oxygen Demand)	1.88 mg/L	5220.B
		TOC (Total Organic Carbon)	3.68 mg/L	5310.B
		TDS (Total dissolved solids)	6632 mg/L	2540.C
		TSS (Total Suspended Solids)	302 mg/L	2540.D
		Sulphate (SO_4^{2-})	449 mg/L	4110.B
		Nitrate (NO_3^-)	3.11 mg/L	4110.B
		Phosphate (PO_4^{3-})	< 0.5 mg/L	4500/P.C

Lab ID	Particulars of supplied sample	Parameters	Results	Test Method (APHA)
A-312	**Surface Water (SW-03)**	COD (Chemical Oxygen Demand)	1.95 mg/L	5220.B
		TOC (Total Organic Carbon)	2.04 mg/L	5310.B
		TDS (Total dissolved solids)	7492 mg/L	2540.C
		TSS (Total Suspended Solids)	550 mg/L	2540.D
		Sulphate (SO_4^{2-})	493 mg/L	4110.B
		Nitrate (NO_3^-)	< 3.0 mg/L	4110.B
		Phosphate (PO_4^{3-})	< 0.5 mg/L	4500/P.C

Lab ID	Particulars of supplied sample	Parameters	Results	Test Method (APHA)

10-05-2026
Analyst
(Sharmin Ahmed)
Scientific Officer
Institute of National Analytical Research & Services (INARS)

10-05-2026
Section/Division In-Charge
(Dr. Muhammad Abdullah Al-Mansur)
Principal Scientific Officer
Institute of National Analytical Research & Services (INARS)

10-05-2026
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(Dr. Md. Salim Khan)
Director
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A-313	Surface Water (SW-04)	COD (Chemical Oxygen Demand)	2.92 mg/L	5220.B
		TOC (Total Organic Carbon)	3.96 mg/L	5310.B
		TDS (Total dissolved solids)	8750 mg/L	2540.C
		TSS (Total Suspended Solids)	572 mg/L	2540.D
		Sulphate (SO_4^{2-})	531 mg/L	4110.B
		Nitrate (NO_3^-)	5.45 mg/L	4110.B
		Phosphate (PO_4^{3-})	< 0.5 mg/L	4500/P.C

Lab ID	Particulars of supplied sample	Parameters	Results	Test Method (APHA)
A-314	Surface Water (SW-05)	COD (Chemical Oxygen Demand)	3.92 mg/L	5220.B
		TOC (Total Organic Carbon)	4.80 mg/L	5310.B
		TDS (Total dissolved solids)	10388 mg/L	2540.C
		TSS (Total Suspended Solids)	698 mg/L	2540.D
		Sulphate (SO_4^{2-})	547 mg/L	4110.B
		Nitrate (NO_3^-)	7.68 mg/L	4110.B
		Phosphate (PO_4^{3-})	< 0.5 mg/L	4500/P.C

Lab ID	Particulars of supplied sample	Parameters	Results	Test Method (APHA)

10-05-2026
Analyst
(Sharmin Ahmed)
Scientific Officer
Institute of National Analytical Research & Services (INARS)

10-05-2026
Section/Division In-Charge
(Dr. Muhammad Abdullah Al-Mansur)
Principal Scientific Officer
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10-05-2026
In-Charge/ Director
(Dr. Md Salim Khan)
Director
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A-315	Surface Water (SW-06)	COD (Chemical Oxygen Demand)	2.94 mg/L	5220.B
		TOC (Total Organic Carbon)	5.99 mg/L	5310.B
		TDS (Total dissolved solids)	12856 mg/L	2540.C
		TSS (Total Suspended Solids)	706 mg/L	2540.D
		Sulphate (SO_4^{2-})	534 mg/L	4110.B
		Nitrate (NO_3^-)	12.1 mg/L	4110.B
		Phosphate (PO_4^{3-})	< 0.5 mg/L	4500/P.C

Note: a. The results reported here pertained to the sample received in this laboratory only.
b. Complain and/or query regarding delivered test report should be lodged within one month of report delivery date
c. The laboratory is not responsible for the date quality affected due to sampling, transporting and storage conditions of the sample(s) maintained before received in the laboratory.
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Dhr. Jan Jurjen Schiphuis
Laan 1914 no 35
AMERSFOORT
Netherlands

Certificate of analysis

Date 13/05/2026

Please find enclosed the analytical results of the test carried out for the project

Certificate number/Version	AR-421-2026-076232-01
Project number client	-
Project name client	-
Your order number	421-2026-076232
Project Quotation Name	-
Samples received on	01/05/2026
Sample taker client	-
Start date	05/05/2026
This is test Test P Validation Ending Time	12/05/2026
Report date	13/05/2026
Appendices	A

Recognition Information
AC. NEN EN ISO/IEC 17025 2017, RvA L010

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We are confident that we have performed the order in accordance with your expectations. If you have any remaining questions concerning this Certificate of Analysis, please don't hesitate to contact our Customer Support.

Yours sincerely,
Eurofins Analytico (Barneveld)

Ing. A. Veldhuizen
Technical Manager

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	Parameter Name	Unit	1	2	3	4
	Characteristics					
	MEN-EN 15934					
AC	Dry matter	% w/w	47.2	99.2	93.5	94.8
	MEN 5754					
AC	Organic matter	% w/w DM	1.6 [3]	< 0.7 [3]	1.2 [3]	0.9
AC	Residue on ignition	% w/w DM	97.5 [3]	99.4 [3]	98.5 [3]	98.9
	MEN 5763					
AC	Fraction < 2 µm (Clay)	% w/w DM	12.4	2.2	5.0	2.4
	Metals					
	MEN-EN-ISO 17294-2					
AC	Antimony (Sb)	mg/kg dm	< 2.0 [3]	< 2.0 [3]	< 2.0 [3]	< 2.0 [3]
AC	Arsenic (As)	mg/kg dm	< 5.0 [3]	< 5.0 [3]	5.3 [3]	< 5.0 [3]
AC	Barium (Ba)	mg/kg dm	34 [3]	< 15 [3]	15 [3]	< 15 [3]
AC	Cadmium (Cd)	mg/kg dm	< 0.40 [3]	< 0.40 [3]	< 0.40 [3]	< 0.40 [3]
AC	Chromium (Cr)	mg/kg dm	26 [3]	10 [3]	18 [3]	12 [3]
AC	Cobalt (Co)	mg/kg dm	8.4 [3]	< 5.0 [3]	7.0 [3]	5.2 [3]
AC	Copper (Cu)	mg/kg dm	53 [3]	< 5.0 [3]	8.6 [3]	< 5.0 [3]
AC	Mercury (Hg)	mg/kg dm	< 0.10 [3]	< 0.10 [3]	< 0.10 [3]	< 0.10 [3]
AC	Lead (Pb)	mg/kg dm	12 [3]	< 10 [3]	13 [3]	< 10 [3]
AC	Molybdenum (Mo)	mg/kg dm	< 1.5 [3]	< 1.5 [3]	< 1.5 [3]	< 1.5 [3]
AC	Nickel (Ni)	mg/kg dm	25 [3]	12 [3]	18 [3]	13 [3]
AC	Selenium (Se)	mg/kg dm	< 2.0 [3]	< 2.0 [3]	< 2.0 [3]	< 2.0 [3]
AC	Tin (Sn)	mg/kg dm	< 5.0 [3]	< 5.0 [3]	< 5.0 [3]	< 5.0 [3]
AC	Vanadium (V)	mg/kg dm	24 [3]	11 [3]	17 [3]	13 [3]
AC	Zinc (Zn)	mg/kg dm	59 [3]	15 [3]	30 [3]	29 [3]
AC	Beryllium (Be)	mg/kg dm	< 1.0 [3]	< 1.0 [3]	< 1.0 [3]	< 1.0 [3]
	Polycyclic Aromatic Hydrocarbons, PAH					
	MEN-ISO 18287					
AC	Naphthalene	mg/kg dm	< 0.040 [LOQ] [3]	< 0.035 [1] [3]	< 0.036 [1] [3]	< 0.035 [1] [3]
AC	Acenaphtylene	mg/kg dm	< 0.040 [LOQ] [3]	< 0.035 [1] [3]	< 0.036 [1] [3]	< 0.035 [1] [3]
AC	Acenaphtene	mg/kg dm	< 0.040 [LOQ] [3]	< 0.035 [1] [3]	< 0.036 [1] [3]	< 0.035 [1] [3]
AC	Fluorene	mg/kg dm	< 0.040 [LOQ] [3]	< 0.035 [1] [3]	< 0.036 [1] [3]	< 0.035 [1] [3]

No.	Customer Reference	Sample matrix	Sampling date client	Sample Code
1	BHA1-1 BHA1(1)	Soil	08/04/2026	421-2026-00215522
2	BHC1-1 BHC1(1)	Soil	08/04/2026	421-2026-00215523
3	BHC1-2 BHC1(3)	Soil	08/04/2026	421-2026-00215524
4	BHC2-1 BHC2(1)	Soil	08/04/2026	421-2026-00215525

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	Parameter Name	Unit	1	2	3	4
	Polycyclic Aromatic Hydrocarbons, PAH					
	NEN-ISO 18287					
AC	Phenanthrene	mg/kg dm	< 0.040 [1,2]	< 0.035 [1,2]	< 0.036 [1,2]	< 0.035 [1,2]
AC	Anthracene	mg/kg dm	< 0.040 [1,2]	< 0.035 [1,2]	< 0.036 [1,2]	< 0.035 [1,2]
AC	Fluoranthene	mg/kg dm	< 0.040 [1,2]	< 0.035 [1,2]	< 0.036 [1,2]	< 0.035 [1,2]
AC	Pyrene	mg/kg dm	< 0.040 [1,2]	< 0.035 [1,2]	< 0.036 [1,2]	< 0.035 [1,2]
AC	Benz(a)anthracene	mg/kg dm	< 0.040 [1,2]	< 0.035 [1,2]	< 0.036 [1,2]	< 0.035 [1,2]
AC	Chrysene	mg/kg dm	< 0.040 [1,2]	< 0.035 [1,2]	< 0.036 [1,2]	< 0.035 [1,2]
AC	Benzo(b)fluoranthene	mg/kg dm	< 0.040 [1,2]	< 0.035 [1,2]	< 0.036 [1,2]	< 0.035 [1,2]
AC	Benzo(k)fluoranthene	mg/kg dm	< 0.040 [1,2]	< 0.035 [1,2]	< 0.036 [1,2]	< 0.035 [1,2]
AC	Benzo(a)pyrene	mg/kg dm	< 0.040 [1,2]	< 0.035 [1,2]	< 0.036 [1,2]	< 0.035 [1,2]
AC	Benzo(g,h,i)perylene	mg/kg dm	< 0.040 [1,2]	< 0.035 [1,2]	< 0.036 [1,2]	< 0.035 [1,2]
AC	Dibenzo(ah)anthracene	mg/kg dm	< 0.040 [1,2]	< 0.035 [1,2]	< 0.036 [1,2]	< 0.035 [1,2]
AC	Indeno(123cd)pyrene	mg/kg dm	< 0.040 [1,2]	< 0.035 [1,2]	< 0.036 [1,2]	< 0.035 [1,2]
AC	PAH 18 EPA (sum)	mg/kg dm	< 0.84 [1,2]	< 0.56 [1,2]	< 0.56 [1,2]	< 0.56 [1,2]
AC	PAH 10 VROM (sum)	mg/kg dm	< 0.50	< 0.50	< 0.50	< 0.50
	Polychlorinated Biphenyl					
	NEN 6960					
AC	PCB 28	mg/kg dm	< 0.0010 [2]	< 0.0010 [2]	< 0.0010 [2]	< 0.0010
AC	PCB 52	mg/kg dm	< 0.0010 [2]	< 0.0010 [2]	< 0.0010 [2]	< 0.0010
AC	PCB 101	mg/kg dm	< 0.0010 [2]	< 0.0010 [2]	< 0.0010 [2]	< 0.0010
AC	PCB 118	mg/kg dm	< 0.0010 [2]	< 0.0010 [2]	< 0.0010 [2]	< 0.0010
AC	PCB 138	mg/kg dm	< 0.0010 [2]	< 0.0010 [2]	< 0.0010 [2]	< 0.0010
AC	PCB 153	mg/kg dm	< 0.0010 [2]	< 0.0010 [2]	< 0.0010 [2]	< 0.0010
AC	PCB 180	mg/kg dm	< 0.0010 [2]	< 0.0010 [2]	< 0.0010 [2]	< 0.0010
AC	PCB (7) Sum)	mg/kg dm	< 0.0070	< 0.0070	< 0.0070	< 0.0070
	Petroleum Hydrocarbons					
	NEN-EN ISO 16703					
	TPH >C10-C12	mg/kg dm	< 3 [2]	< 3 [2]	< 3 [2]	< 3 [2]
	TPH >C12-C16	mg/kg dm	< 5 [2]	< 5 [2]	< 5 [2]	< 5 [2]
	TPH (>C16-C21)	mg/kg dm	< 6 [2]	< 6 [2]	< 6 [2]	< 6 [2]
	TPH (C21-C30)	mg/kg dm	23 [2]	< 12 [2]	< 12 [2]	< 12 [2]

No.	Customer Reference	Sample matrix	Sampling date client	Sample Code
1	BHA1-1 BHA1(1)	Soil	08/04/2026	421-2026-00215522
2	BHC1-1 BHC1(1)	Soil	08/04/2026	421-2026-00215523
3	BHC1-2 BHC1(3)	Soil	08/04/2026	421-2026-00215524
4	BHC2-1 BHC2(1)	Soil	08/04/2026	421-2026-00215525

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	Parameter Name	Unit	1	2	3	4
	Petroleum Hydrocarbons					
	NEN-EN ISO 16703					
	TPH (C30-C35)	mg/kg dm	13 [1]	< 6 [1]	< 6 [1]	< 6 [1]
	TPH (C35-C40)	mg/kg dm	7 [1]	< 6 [1]	< 6 [1]	< 6 [1]
AC	TPH (sum C10-C40)	mg/kg dm	51 [1]	< 38 [1]	< 38 [1]	< 38 [1]
	Chromatogram EPH (GC)		See Appendix RA1			

No.	Customer Reference	Sample matrix	Sampling date client	Sample Code
1	BHA1-1 BHA1(1)	Soil	08/04/2026	421-2026-00215522
2	BHC1-1 BHC1(1)	Soil	08/04/2026	421-2026-00215523
3	BHC1-2 BHC1(3)	Soil	08/04/2026	421-2026-00215524
4	BHC2-1 BHC2(1)	Soil	08/04/2026	421-2026-00215525

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	Parameter Name	Unit	5	6	7	8
	Characteristics					
	NEN-EN 15934					
AC	Dry matter	% w/w	99.3	94.8	97.2	97.3
	NEN 5754					
AC	Organic matter	% w/w DM	< 0.7	< 0.7 [1]	< 0.7	< 0.7
AC	Residue on ignition	% w/w DM	99.4	99.3 [1]	99.4	99.5
	NEN 5753					
AC	Fraction < 2 µm (Clay)	% w/w DM	< 2.0	2.7	2.7	< 2.0
	Metals					
	NEN-EN-ISO 17294-2					
AC	Antimony (Sb)	mg/kg dm	< 2.0	< 2.0 [1]	< 2.0 [a]	< 2.0
AC	Arsenic (As)	mg/kg dm	< 5.0	< 5.0 [1]	< 5.0 [a]	< 5.0
AC	Barium (Ba)	mg/kg dm	< 15	15 [1]	< 15 [a]	< 15
AC	Cadmium (Cd)	mg/kg dm	< 0.40	< 0.40 [1]	< 0.40 [a]	< 0.40
AC	Chromium (Cr)	mg/kg dm	9.7	11 [1]	10 [a]	8.9
AC	Cobalt (Co)	mg/kg dm	< 5.0	< 5.0 [1]	< 5.0 [a]	< 5.0
AC	Copper (Cu)	mg/kg dm	< 5.0	< 5.0 [1]	< 5.0 [a]	< 5.0
AC	Mercury (Hg)	mg/kg dm	< 0.10	< 0.10 [1]	< 0.10 [a]	< 0.10
AC	Lead (Pb)	mg/kg dm	< 10	< 10 [1]	< 10 [a]	< 10
AC	Molybdenum (Mo)	mg/kg dm	< 1.5	< 1.5 [1]	< 1.5 [a]	< 1.5
AC	Nickel (Ni)	mg/kg dm	9.5	9.4 [1]	12 [a]	8.6
AC	Selenium (Se)	mg/kg dm	< 2.0	< 2.0 [1]	< 2.0 [a]	< 2.0
AC	Tin (Sn)	mg/kg dm	< 5.0	< 5.0 [1]	< 5.0 [a]	< 5.0
AC	Vanadium (V)	mg/kg dm	10	16 [1]	12 [a]	9.8
AC	Zinc (Zn)	mg/kg dm	12	20 [1]	15 [a]	12
AC	Beryllium (Be)	mg/kg dm	< 1.0	< 1.0 [1]	< 1.0 [a]	< 1.0
	Polycyclic Aromatic Hydrocarbons, PAH					
	NEN-ISO 18287					
AC	Naphthalene	mg/kg dm	< 0.033 [1,h]	< 0.035 [1,a]	< 0.034 [1,a]	< 0.035 [1,a]
AC	Acenaphthylene	mg/kg dm	< 0.033 [1,h]	< 0.035 [1,a]	< 0.034 [1,a]	< 0.035 [1,a]
AC	Acenaphthene	mg/kg dm	< 0.033 [1,a]	< 0.035 [1,a]	< 0.034 [1,a]	< 0.035 [1,a]
AC	Fluorene	mg/kg dm	< 0.033 [1,h]	< 0.035 [1,a]	< 0.034 [1,a]	< 0.035 [1,a]

No.	Customer Reference	Sample matrix	Sampling date client	Sample Code
5	BHC3-1 BHC3(1)	Soil	06/04/2026	421-2026-00215526
6	BHC4-1 BHC4(1)	Soil	06/04/2026	421-2026-00215527
7	BHC5-1 BHC5(1)	Soil	06/04/2026	421-2026-00215528
8	BHC6-1 BHC6(1)	Soil	06/04/2026	421-2026-00215529

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	Parameter Name	Unit	5	6	7	8
	Polycyclic Aromatic Hydrocarbons, PAH					
	NEN-ISO 18287					
AC	Phenanthrene	mg/kg dm	< 0.033 [4,9]	< 0.035 [1,3]	< 0.034 [4,9]	< 0.035 [1,3]
AC	Anthracene	mg/kg dm	< 0.033 [4,9]	< 0.035 [1,3]	< 0.034 [4,9]	< 0.035 [1,3]
AC	Fluoranthene	mg/kg dm	< 0.033 [4,9]	< 0.035 [1,3]	< 0.034 [4,9]	< 0.035 [1,3]
AC	Pyrene	mg/kg dm	< 0.033 [4,9]	< 0.035 [1,3]	< 0.034 [4,9]	< 0.035 [1,3]
AC	Benz(a)anthracene	mg/kg dm	< 0.033 [4,9]	< 0.035 [1,3]	< 0.034 [4,9]	< 0.035 [1,3]
AC	Chrysene	mg/kg dm	< 0.033 [4,9]	< 0.035 [1,3]	< 0.034 [4,9]	< 0.035 [1,3]
AC	Benzo(b)fluoranthene	mg/kg dm	< 0.033 [4,9]	< 0.035 [1,3]	< 0.034 [4,9]	< 0.035 [1,3]
AC	Benzo(k)fluoranthene	mg/kg dm	< 0.033 [4,9]	< 0.035 [1,3]	< 0.034 [4,9]	< 0.035 [1,3]
AC	Benzo(a)pyrene	mg/kg dm	< 0.033 [4,9]	< 0.035 [1,3]	< 0.034 [4,9]	< 0.035 [1,3]
AC	Benzo(g,h,i)perylene	mg/kg dm	< 0.033 [4,9]	< 0.035 [1,3]	< 0.034 [4,9]	< 0.035 [1,3]
AC	Dibenzo(ah)anthracene	mg/kg dm	< 0.033 [4,9]	< 0.035 [1,3]	< 0.034 [4,9]	< 0.035 [1,3]
AC	Indeno(123cd)pyrene	mg/kg dm	< 0.033 [4,9]	< 0.035 [1,3]	< 0.034 [4,9]	< 0.035 [1,3]
AC	PAH 18 EPA (sum)	mg/kg dm	< 0.53 [4,9]	< 0.56 [1,3]	< 0.54 [4,9]	< 0.56 [1,3]
AC	PAH 10 VROM (sum)	mg/kg dm	< 0.50	< 0.50	< 0.50	< 0.50
	Polychlorinated Biphenyl					
	NEN 6960					
AC	PCB 28	mg/kg dm	< 0.0010	< 0.0010 [1]	< 0.0010	< 0.0010
AC	PCB 52	mg/kg dm	< 0.0010	< 0.0010 [1]	< 0.0010	< 0.0010
AC	PCB 101	mg/kg dm	< 0.0010	< 0.0010 [1]	< 0.0010	< 0.0010
AC	PCB 118	mg/kg dm	< 0.0010	< 0.0010 [1]	< 0.0010	< 0.0010
AC	PCB 138	mg/kg dm	< 0.0010	< 0.0010 [1]	< 0.0010	< 0.0010
AC	PCB 153	mg/kg dm	< 0.0010	< 0.0010 [1]	< 0.0010	< 0.0010
AC	PCB 180	mg/kg dm	< 0.0010	< 0.0010 [1]	< 0.0010	< 0.0010
AC	PCB (7) Sum)	mg/kg dm	< 0.0070	< 0.0070	< 0.0070	< 0.0070
	Petroleum Hydrocarbons					
	NEN-EN ISO 16703					
	TPH >C10-C12	mg/kg dm	< 3 [4]	< 3 [1]	< 3 [4]	< 3 [1]
	TPH >C12-C16	mg/kg dm	< 5 [4]	< 5 [1]	< 5 [4]	< 5 [1]
	TPH (>C16-C21)	mg/kg dm	< 6 [4]	< 6 [1]	< 6 [4]	< 6 [1]
	TPH (C21-C30)	mg/kg dm	< 12 [4]	< 12 [1]	< 12 [4]	< 12 [1]

No	Customer Reference	Sample matrix	Sampling date client	Sample Code
5	BHC3-1 BHC3(1)	Soil	06/04/2026	421-2026-00215526
6	BHC4-1 BHC4(1)	Soil	06/04/2026	421-2026-00215527
7	BHC5-1 BHC5(1)	Soil	06/04/2026	421-2026-00215528
8	BHC6-1 BHC6(1)	Soil	06/04/2026	421-2026-00215529

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	Parameter Name	Unit	5	6	7	8
	Petroleum Hydrocarbons					
	NEN-EN ISO 16703					
	TPH (C30-C35)	mg/kg dm	< 6 1)	< 6 1)	< 6 1)	< 6 1)
	TPH (C35-C40)	mg/kg dm	< 6 1)	< 6 1)	< 6 1)	< 6 1)
AC	TPH (sum C10-C40)	mg/kg dm	< 38 1)	< 38 1)	< 38 1)	< 38 1)

No.	Customer Reference	Sample matrix	Sampling date client	Sample Code
5	BHC3-1 BHC3(1)	Soil	09/04/2026	421-2026-00215526
6	BHC4-1 BHC4(1)	Soil	06/04/2026	421-2026-00215527
7	BHC5-1 BHC5(1)	Soil	09/04/2026	421-2026-00215528
8	BHC6-1 BHC6(1)	Soil	09/04/2026	421-2026-00215529

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	Parameter Name	Unit	9	10	11	12
	Characteristics					
	NEN EN 15934					
AC	Dry matter	% w/w	85.3	94.6	96.7	88.3
	NEN 5754					
AC	Organic matter	% wW DM	1.2	< 0.7	< 0.7	1.7
AC	Residue on ignition	% wW DM	97.8	99.3	99.3	97.9
	NEN 5753					
AC	Fraction < 2 µm (Clay)	% wW DM	13.6	2.2	3.1	5.1
	Metals					
	NEN-EN-ISO 17294-2					
AC	Antimony (Sb)	mg/kg dm	< 2.0 [n]	< 2.0	< 2.0 [n]	< 2.0
AC	Arsenic (As)	mg/kg dm	< 5.0 [n]	< 5.0	< 5.0 [n]	< 5.0
AC	Barium (Ba)	mg/kg dm	25 [n]	< 15	< 15 [n]	< 15
AC	Cadmium (Cd)	mg/kg dm	< 0.40 [n]	< 0.40	< 0.40 [n]	< 0.40
AC	Chromium (Cr)	mg/kg dm	24 [n]	11	12 [n]	14
AC	Cobalt (Co)	mg/kg dm	8.6 [n]	< 5.0	5.4 [n]	5.5
AC	Copper (Cu)	mg/kg dm	17 [n]	< 5.0	< 5.0 [n]	8.6
AC	Mercury (Hg)	mg/kg dm	< 0.10 [n]	< 0.10	< 0.10 [n]	< 0.10
AC	Lead (Pb)	mg/kg dm	12 [n]	< 10	< 10 [n]	< 10
AC	Molybdenum (Mo)	mg/kg dm	< 1.5 [n]	< 1.5	< 1.5 [n]	< 1.5
AC	Nickel (Ni)	mg/kg dm	26 [n]	11	14 [n]	15
AC	Selenium (Se)	mg/kg dm	< 2.0 [n]	< 2.0	< 2.0 [n]	< 2.0
AC	Tin (Sn)	mg/kg dm	< 5.0 [n]	< 5.0	< 5.0 [n]	< 5.0
AC	Vanadium (V)	mg/kg dm	24 [n]	12	12 [n]	14
AC	Zinc (Zn)	mg/kg dm	47 [n]	50	21 [n]	30
AC	Beryllium (Be)	mg/kg dm	< 1.0 [n]	< 1.0	< 1.0 [n]	< 1.0
	Polycyclic Aromatic Hydrocarbons, PAH					
	NEN-ISO 18287					
AC	Naphthalene	mg/kg dm	< 0.039 [n,f]	< 0.035 [f,h]	< 0.035 [f,h]	< 0.036 [f,h]
AC	Acenaphtylene	mg/kg dm	< 0.039 [n,f]	< 0.035 [f,h]	< 0.035 [f,h]	< 0.036 [f,h]
AC	Acenaphtene	mg/kg dm	< 0.039 [n,f]	< 0.035 [f,h]	< 0.035 [f,h]	< 0.036 [f,h]
AC	Fluorene	mg/kg dm	< 0.039 [n,f]	< 0.035 [f,h]	< 0.035 [f,h]	< 0.036 [f,h]

No.	Customer Reference	Sample matrix	Sampling date client	Sample Code
9	BHC7-1 BHC7(1)	Soil	09/04/2026	421-2026-00215530
10	BHC8-1 BHC8(1)	Soil	09/04/2026	421-2026-00215531
11	BHC9-1 BHC9(1)	Soil	09/04/2026	421-2026-00215532
12	BHC10-1 BHC10(1)	Soil	10/04/2026	421-2026-00215533

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	Parameter Name	Unit	9	10	11	12
	Polycyclic Aromatic Hydrocarbons, PAH					
	NEN-ISO 18287					
AC	Phenanthrene	mg/kg dm	< 0.038 [3,7]	< 0.035 [3,8]	< 0.035 [1,8]	< 0.038 [1,8]
AC	Anthracene	mg/kg dm	< 0.038 [3,8]	< 0.035 [1,8]	< 0.035 [1,8]	< 0.038 [1,8]
AC	Fluoranthene	mg/kg dm	< 0.038 [3,7]	< 0.035 [3,8]	< 0.035 [1,8]	< 0.038 [1,8]
AC	Pyrene	mg/kg dm	< 0.038 [3,7]	< 0.035 [1,8]	< 0.035 [1,8]	< 0.038 [1,8]
AC	Benz(a)anthracene	mg/kg dm	< 0.038 [3,8]	< 0.035 [3,8]	< 0.035 [1,8]	< 0.038 [1,8]
AC	Chrysene	mg/kg dm	< 0.038 [3,7]	< 0.035 [1,8]	< 0.035 [1,8]	< 0.038 [1,8]
AC	Benzo(b)fluoranthene	mg/kg dm	< 0.038 [3,8]	< 0.035 [3,8]	< 0.035 [1,8]	< 0.038 [1,8]
AC	Benzo(k)fluoranthene	mg/kg dm	< 0.038 [3,7]	< 0.035 [1,8]	< 0.035 [1,8]	< 0.038 [1,8]
AC	Benzo(a)pyrene	mg/kg dm	< 0.038 [3,8]	< 0.035 [3,8]	< 0.035 [1,8]	< 0.038 [1,8]
AC	Benzo(g,h,i)perylene	mg/kg dm	< 0.038 [3,7]	< 0.035 [1,8]	< 0.035 [1,8]	< 0.038 [1,8]
AC	Dibenzo(ah)anthracene	mg/kg dm	< 0.038 [3,8]	< 0.035 [3,8]	< 0.035 [1,8]	< 0.038 [1,8]
AC	Indeno(123cd)pyrene	mg/kg dm	< 0.038 [3,7]	< 0.035 [1,8]	< 0.035 [1,8]	< 0.038 [1,8]
AC	PAH 16 EPA (sum)	mg/kg dm	< 0.61 [3,8]	< 0.56 [3,8]	< 0.56 [1,8]	< 0.59 [1,8]
AC	PAH 10 VROM (sum)	mg/kg dm	< 0.50	< 0.50	< 0.50	< 0.50
	Polychlorinated Biphenyl					
	NEN 6960					
AC	PCB 28	mg/kg dm	< 0.0010	< 0.0010	< 0.0010	< 0.0010
AC	PCB 52	mg/kg dm	< 0.0010	< 0.0010	< 0.0010	< 0.0010
AC	PCB 101	mg/kg dm	< 0.0010	< 0.0010	< 0.0010	< 0.0010
AC	PCB 118	mg/kg dm	< 0.0010	< 0.0010	< 0.0010	< 0.0010
AC	PCB 138	mg/kg dm	< 0.0010	< 0.0010	< 0.0010	< 0.0010
AC	PCB 153	mg/kg dm	< 0.0010	< 0.0010	< 0.0010	< 0.0010
AC	PCB 180	mg/kg dm	< 0.0010	< 0.0010	< 0.0010	< 0.0010
AC	PCB (7) Sum)	mg/kg dm	< 0.0070	< 0.0070	< 0.0070	< 0.0070
	Petroleum Hydrocarbons					
	NEN-EN ISO 16703					
	TPH >C10-C12	mg/kg dm	< 3 [1]	< 3 [1]	< 3 [1]	< 3 [1]
	TPH >C12-C16	mg/kg dm	< 5 [1]	< 5 [1]	< 5 [1]	< 5 [1]
	TPH (>C16-C21)	mg/kg dm	< 6 [1]	< 6 [1]	< 6 [1]	< 6 [1]
	TPH (C21-C30)	mg/kg dm	< 12 [1]	< 12 [1]	< 12 [1]	< 12 [1]

No.	Customer Reference	Sample matrix	Sampling date client	Sample Code
9	BHC7-1 BHC7(1)	Soil	08/04/2026	421-2026-00215530
10	BHC8-1 BHC8(1)	Soil	09/04/2026	421-2026-00215531
11	BHC9-1 BHC9(1)	Soil	08/04/2026	421-2026-00215532
12	BHC10-1 BHC10(1)	Soil	10/04/2026	421-2026-00215533

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	Parameter Name	Unit	9	10	11	12
	Petroleum Hydrocarbons					
	NEN-EN ISO 16703					
	TPH (C30-C35)	mg/kg dm	< 6	< 6	< 6	< 6
	TPH (C35-C40)	mg/kg dm	< 6	< 6	< 6	< 6
AC	TPH (sum C10-C40)	mg/kg dm	< 36	< 36	< 36	< 36

No.	Customer Reference	Sample matrix	Sampling date client	Sample Code
9	BHC7-1 BHC7(1)	Soil	09/04/2026	421-2026-00215530
10	BHC8-1 BHC8(1)	Soil	09/04/2026	421-2026-00215531
11	BHC9-1 BHC9(1)	Soil	09/04/2026	421-2026-00215532
12	BHC10-1 BHC10(1)	Soil	10/04/2026	421-2026-00215533

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	Parameter Name	Unit	13	14	15	16
	Characteristics					
	NEN-EN 15934					
AC	Dry matter	% w/w	97.9	89.4	88.1	79.1
	NEN 3754					
AC	Organic matter	% w/w DM	< 0.7	< 0.7	1.4 [3]	1.6 [3]
AC	Residue on ignition	% w/w DM	99.4	99.2	97.6 [3]	96.9 [3]
	NEN 5753					
AC	Fraction < 2 µm (Clay)	% w/w DM	< 2.0	2.8	15.0	16.6
	Metals					
	NEN-EN ISO 17294-2					
AC	Antimony (Sb)	mg/kg dm	< 2.0	< 2.0	< 2.0 [3]	< 2.0 [3]
AC	Arsenic (As)	mg/kg dm	< 5.0	< 5.0	5.6 [3]	5.7 [3]
AC	Barium (Ba)	mg/kg dm	< 15	< 15	39 [3]	46 [3]
AC	Cadmium (Cd)	mg/kg dm	< 0.40	< 0.40	< 0.40 [3]	< 0.40 [3]
AC	Chromium (Cr)	mg/kg dm	8.9	8.8	31 [4]	35 [3]
AC	Cobalt (Co)	mg/kg dm	< 5.0	< 5.0	11 [4]	12 [3]
AC	Copper (Cu)	mg/kg dm	< 5.0	< 5.0	33 [4]	29 [3]
AC	Mercury (Hg)	mg/kg dm	< 0.10	< 0.10	< 0.10 [4]	< 0.10 [3]
AC	Lead (Pb)	mg/kg dm	< 10	< 10	20 [4]	15 [3]
AC	Molybdenum (Mo)	mg/kg dm	< 1.5	< 1.5	< 1.5 [3]	< 1.5 [3]
AC	Nickel (Ni)	mg/kg dm	11	12	33 [3]	37 [3]
AC	Selenium (Se)	mg/kg dm	< 2.0	< 2.0	< 2.0 [3]	< 2.0 [3]
AC	Tin (Sn)	mg/kg dm	< 5.0	< 5.0	< 5.0 [4]	< 5.0 [3]
AC	Vanadium (V)	mg/kg dm	11	12	30 [4]	34 [3]
AC	Zinc (Zn)	mg/kg dm	14	16	90 [4]	74 [3]
AC	Beryllium (Be)	mg/kg dm	< 1.0	< 1.0	< 1.0 [4]	< 1.0 [3]
	Polycyclic Aromatic Hydrocarbons, PAH					
	NEN-ISO 18287					
AC	Naphthalene	mg/kg dm	< 0.034 [1,5]	< 0.037 [1,3]	< 0.037 [1,3]	< 0.043 [1,3]
AC	Acenaphthylene	mg/kg dm	< 0.034 [1,5]	< 0.037 [1,3]	< 0.037 [1,3]	< 0.043 [1,3]
AC	Acenaphthene	mg/kg dm	< 0.034 [1,5]	< 0.037 [1,3]	< 0.037 [1,3]	< 0.043 [1,3]
AC	Fluorene	mg/kg dm	< 0.034 [1,5]	< 0.037 [1,3]	< 0.037 [1,3]	< 0.043 [1,3]

No.	Customer Reference	Sample matrix	Sampling date client	Sample Code
13	BHC11-1 BHC11(1)	Soil	10/04/2026	421-2026-00215534
14	BHC11-2 BHC11(3)	Soil	10/04/2026	421-2026-00215535
15	GW-A1-1 GW-A1(1)	Soil	09/04/2026	421-2026-00215536
16	GW-B1-1 GW-B1(1)	Soil	09/04/2026	421-2026-00215537

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	Parameter Name	Unit	13	14	15	16
	Polycyclic Aromatic Hydrocarbons, PAH					
	NEN-ISO 18287					
AC	Phenanthrene	mg/kg dm	< 0.034 [1,3]	< 0.037 [1,3]	< 0.037 [1,3]	< 0.043 [1,3]
AC	Anthracene	mg/kg dm	< 0.034 [1,3]	< 0.037 [1,3]	< 0.037 [1,3]	< 0.043 [1,3]
AC	Fluoranthene	mg/kg dm	< 0.034 [1,3]	< 0.037 [1,3]	< 0.037 [1,3]	< 0.043 [1,3]
AC	Pyrene	mg/kg dm	< 0.034 [1,3]	< 0.037 [1,3]	< 0.037 [1,3]	< 0.043 [1,3]
AC	Benz(a)anthracene	mg/kg dm	< 0.034 [1,3]	< 0.037 [1,3]	< 0.037 [1,3]	< 0.043 [1,3]
AC	Chrysene	mg/kg dm	< 0.034 [1,3]	< 0.037 [1,3]	< 0.037 [1,3]	< 0.043 [1,3]
AC	Benzo(b)fluoranthene	mg/kg dm	< 0.034 [1,3]	< 0.037 [1,3]	< 0.037 [1,3]	< 0.043 [1,3]
AC	Benzo(k)fluoranthene	mg/kg dm	< 0.034 [1,3]	< 0.037 [1,3]	< 0.037 [1,3]	< 0.043 [1,3]
AC	Benzo(a)pyrene	mg/kg dm	< 0.034 [1,3]	< 0.037 [1,3]	< 0.037 [1,3]	< 0.043 [1,3]
AC	Benzo(g,h,i)perylene	mg/kg dm	< 0.034 [1,3]	< 0.037 [1,3]	< 0.037 [1,3]	< 0.043 [1,3]
AC	Dibenzo(ah)anthracene	mg/kg dm	< 0.034 [1,3]	< 0.037 [1,3]	< 0.037 [1,3]	< 0.043 [1,3]
AC	Indeno(123cd)pyrene	mg/kg dm	< 0.034 [1,3]	< 0.037 [1,3]	< 0.037 [1,3]	< 0.043 [1,3]
AC	PAH 16 EPA (sum)	mg/kg dm	< 0.54 [1,3]	< 0.59 [1,3]	< 0.59 [1,3]	< 0.69 [1,3]
AC	PAH 10 VROM (sum)	mg/kg dm	< 0.50	< 0.50	< 0.50	< 0.50
	Polychlorinated Biphenyl					
	NEN 6960					
AC	PCB 28	mg/kg dm	< 0.0010	< 0.0010	< 0.0010 [3]	< 0.0010 [3]
AC	PCB 52	mg/kg dm	< 0.0010	< 0.0010	0.0019 [3]	< 0.0010 [3]
AC	PCB 101	mg/kg dm	< 0.0010	< 0.0010	0.013 [3]	< 0.0010 [3]
AC	PCB 118	mg/kg dm	< 0.0010	< 0.0010	0.013 [3]	< 0.0010 [3]
AC	PCB 138	mg/kg dm	< 0.0010	< 0.0010	0.018 [2,4]	< 0.0010 [3]
AC	PCB 153	mg/kg dm	< 0.0010	< 0.0010	0.019 [2,3]	< 0.0010 [3]
AC	PCB 180	mg/kg dm	< 0.0010	< 0.0010	0.011 [3]	< 0.0010 [3]
AC	PCB (7) Sum)	mg/kg dm	< 0.0070	< 0.0070	0.076	< 0.0070
	Petroleum Hydrocarbons					
	NEN-EN ISO 16703					
	TPH >C10-C12	mg/kg dm	< 3 [1]	< 3 [1]	< 3 [1]	< 3 [1]
	TPH >C12-C16	mg/kg dm	< 5 [1]	< 5 [1]	< 5 [1]	< 5 [1]
	TPH (>C16-C21)	mg/kg dm	< 6 [1]	< 6 [1]	< 6 [1]	8 [1]
	TPH (C21-C30)	mg/kg dm	< 12 [1]	< 12 [1]	< 12 [1]	37 [1]

No.	Customer Reference	Sample matrix	Sampling date client	Sample Code
13	BHC11-1 BHC11(1)	Soil	10/04/2026	421-2026-00215534
14	BHC11-2 BHC11(3)	Soil	10/04/2026	421-2026-00215535
15	GW-A1-1 GW-A1(1)	Soil	08/04/2026	421-2026-00215536
16	GW-B1-1 GW-B1(1)	Soil	08/04/2026	421-2026-00215537

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	Parameter Name	Unit	13	14	15	16
	Petroleum Hydrocarbons					
	NEN-EN ISO 16703					
	TPH (C30-C35)	mg/kg dm	< 6 ▽	< 6 ▽	6 ▽	22 ▽
	TPH (C35-C40)	mg/kg dm	< 6 ▽	< 6 ▽	< 6 ▽	12 ▽
AC	TPH (sum C10-C40)	mg/kg dm	< 36 ▽	< 36 ▽	< 36 ▽	84 ▽
	Chromatogram EPH (GC)					See Appendix RAZ

No.	Customer Reference	Sample matrix	Sampling date client	Sample Code
13	BHC11-1 BHC11(1)	Soil	10/04/2026	421-2026-00215534
14	BHC11-2 BHC11(3)	Soil	10/04/2026	421-2026-00215535
15	GW A1-1 GW A1(1)	Soil	08/04/2026	421-2026-00215536
16	GW-B1-1 GW B1(1)	Soil	08/04/2026	421-2026-00215537

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	Parameter Name	Unit	17	18	19	20
	Characteristics					
	NEN-EN 16934					
AC	Dry matter	% w/w	72.3	72.6	71.7	82.2
	NEN 3754					
AC	Organic matter	% w/w DM	1.6	1.9	1.8	2.0
AC	Residue on ignition	% w/w DM	97.2	96.3	96.4	96.8
	NEN 5753					
AC	Fraction < 2 µm (Clay)	% w/w DM	16.8	25.2	25.1	19.8
	Metals					
	NEN-EN-ISO 17294-2					
AC	Antimony (Sb)	mg/kg dm	< 2.0	< 2.0	< 2.0	< 2.0
AC	Arsenic (As)	mg/kg dm	< 5.0	7.9	7.6	5.0
AC	Barium (Ba)	mg/kg dm	41	46	42	60
AC	Cadmium (Cd)	mg/kg dm	< 0.40	< 0.40	< 0.40	< 0.40
AC	Chromium (Cr)	mg/kg dm	40	47	45	30
AC	Cobalt (Co)	mg/kg dm	15	18	16	12
AC	Copper (Cu)	mg/kg dm	28	37	36	28
AC	Mercury (Hg)	mg/kg dm	< 0.10	< 0.10	< 0.10	< 0.10
AC	Lead (Pb)	mg/kg dm	15	18	19	17
AC	Molybdenum (Mo)	mg/kg dm	< 1.5	< 1.5	< 1.5	< 1.5
AC	Nickel (Ni)	mg/kg dm	42	52	50	38
AC	Selenium (Se)	mg/kg dm	< 2.0	< 2.0	< 2.0	< 2.0
AC	Tin (Sn)	mg/kg dm	< 5.0	< 5.0	< 5.0	< 5.0
AC	Vanadium (V)	mg/kg dm	36	45	43	30
AC	Zinc (Zn)	mg/kg dm	66	80	79	72
AC	Beryllium (Be)	mg/kg dm	< 1.0	< 1.0	1.1	< 1.0
	Polycyclic Aromatic Hydrocarbons, PAH					
	NEN-ISO 18287					
AC	Naphthalene	mg/kg dm	< 0.045 [L3]	< 0.045 [L3]	< 0.047 [L3]	< 0.038 [L3]
AC	Acenaphthylene	mg/kg dm	< 0.045 [L3]	< 0.045 [L3]	< 0.047 [L3]	< 0.038 [L3]
AC	Acenaphthene	mg/kg dm	< 0.045 [L3]	< 0.045 [L3]	< 0.047 [L3]	< 0.038 [L3]
AC	Fluorene	mg/kg dm	< 0.045 [L3]	< 0.045 [L3]	< 0.047 [L3]	< 0.038 [L3]

No.	Customer Reference	Sample matrix	Sampling date client	Sample Code
17	LBH02-1 LBH02(1)	Soil	21/04/2026	421-2026-00215536
18	LBH09-1 LBH09(1)	Soil	21/04/2026	421-2026-00215539
19	LBH10-1 LBH10(1)	Soil	21/04/2026	421-2026-00215540
20	Soil-ACH-2-1 Soil-ACH-2(1)	Soil	10/04/2026	421-2026-00215542

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Appendix (A): concerning subsample information referring to certificate of analysis AR-421-2026-076232-01

Container Code	Drill nr	Depth From	Depth To	Sampling date client	Sample Container Description
Sample Code 421-2026-00215522	**Customer Reference** BHA1-1 BHA1(1)				
0520468531	BHA1	0	50	08/04/2026	1
Sample Code 421-2026-00215523	**Customer Reference** BHC1-1 BHC1(1)				
0520468985	BHC1	0	50	08/04/2026	1
Sample Code 421-2026-00215524	**Customer Reference** BHC1-2 BHC1(3)				
0520468984	BHC1	100	150	08/04/2026	3
Sample Code 421-2026-00215525	**Customer Reference** BHC2-1 BHC2(1)				
0520468990	BHC2	0	150	08/04/2026	1
Sample Code 421-2026-00215526	**Customer Reference** BHC3-1 BHC3(1)				
0520468512	BHC3	0	50	09/04/2026	1
Sample Code 421-2026-00215527	**Customer Reference** BHC4-1 BHC4(1)				
0520468468	BHC4	0	150	06/04/2026	1
Sample Code 421-2026-00215528	**Customer Reference** BHC5-1 BHC5(1)				
0520468455	BHC5	0	50	09/04/2026	1
Sample Code 421-2026-00215529	**Customer Reference** BHC6-1 BHC6(1)				
0520468511	BHC6	0	50	09/04/2026	1
Sample Code 421-2026-00215530	**Customer Reference** BHC7-1 BHC7(1)				
0520468513	BHC7	0	150	09/04/2026	1
Sample Code 421-2026-00215531	**Customer Reference** BHC8-1 BHC8(1)				
0520469054	BHC8	0	150	09/04/2026	1
Sample Code 421-2026-00215532	**Customer Reference** BHC9-1 BHC9(1)				
0520469032	BHC9	0	50	09/04/2026	1
Sample Code 421-2026-00215533	**Customer Reference** BHC10-1 BHC10(1)				
0520468524	BHC10	0	150	10/04/2026	1
Sample Code 421-2026-00215534	**Customer Reference** BHC11-1 BHC11(1)				
0520468989	BHC11	0	50	10/04/2026	1
Sample Code 421-2026-00215535	**Customer Reference** BHC11-2 BHC11(3)				
0520468983	BHC11	100	150	10/04/2026	3
Sample Code 421-2026-00215536	**Customer Reference** GW-A1-1 GW-A1(1)				
0520468528	GW-A1	0	105	08/04/2026	1

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Comment:

1) The preservation term for this parameter has been expired.
2) The preservation term for this parameter has been expired.
3) The reporting limit has been increased due to low sample intake and/or low dry weight.
4) PCB 138 can be positively influenced by PCB 163.
5) PCB 153 could be affected by PCB 132.

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	Parameter Name	Unit	21
	Polycyclic Aromatic Hydrocarbons, PAH		
	NEN-ISO 18287		
AC	Pyrene	mg/kg dm	< 0.035 [1,3]
AC	Benz(a)anthracene	mg/kg dm	< 0.035 [1,3]
AC	Chrysene	mg/kg dm	< 0.035 [1,3]
AC	Benzo(b)fluoranthene	mg/kg dm	< 0.035 [1,3]
AC	Benzo(k)fluoranthene	mg/kg dm	< 0.035 [1,3]
AC	Benzo(a)pyrene	mg/kg dm	< 0.035 [1,3]
AC	Benzo(g,h,i)perylene	mg/kg dm	< 0.035 [1,3]
AC	Dibenzo(ah)anthracene	mg/kg dm	< 0.035 [1,3]
AC	Indeno(123cd)pyrene	mg/kg dm	< 0.035 [1,3]
AC	PAH 16 EPA (sum)	mg/kg dm	< 0.56 [1,3]
AC	PAH 10 VROM (sum)	mg/kg dm	< 0.50
	Polychlorinated Biphenyl		
	NEN 6960		
AC	PCB 28	mg/kg dm	< 0.0010
AC	PCB 52	mg/kg dm	< 0.0010
AC	PCB 101	mg/kg dm	< 0.0010
AC	PCB 118	mg/kg dm	< 0.0010
AC	PCB 138	mg/kg dm	< 0.0010
AC	PCB 153	mg/kg dm	< 0.0010
AC	PCB 180	mg/kg dm	< 0.0010
AC	PCB (7) Sum)	mg/kg dm	< 0.0070
	Petroleum Hydrocarbons		
	NEN-EN ISO 16703		
	TPH >C10-C12	mg/kg dm	< 3 [1]
	TPH >C12-C16	mg/kg dm	< 5 [1]
	TPH (>C16-C21)	mg/kg dm	< 6 [1]
	TPH (C21-C30)	mg/kg dm	< 12 [1]
	TPH (C30-C35)	mg/kg dm	< 6 [1]
	TPH (C35-C40)	mg/kg dm	< 6 [1]
AC	TPH (sum C10-C40)	mg/kg dm	< 38 [1]

No.	Customer Reference	Sample matrix	Sampling date client	Sample Code
21	Soil-AOI-3-1 Soil-AOI-3(1)	Soil	10/04/2026	421-2026-00215543

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	Parameter Name	Unit	21
	Characteristics		
	NEN-EN 15934		
AC	Dry matter	% w/w	97.4
	NEN 5754		
AC	Organic matter	% w/w DM	0.7
AC	Residue on ignition	% w/w DM	99.0
	NEN 5753		
AC	Fraction < 2 µm (Clay)	% w/w DM	3.0
	Metals		
	NEN-EN-ISO 17294-2		
AC	Antimony (Sb)	mg/kg dm	< 2.0
AC	Arsenic (As)	mg/kg dm	< 5.0
AC	Barium (Ba)	mg/kg dm	< 15
AC	Cadmium (Cd)	mg/kg dm	< 0.40
AC	Chromium (Cr)	mg/kg dm	14
AC	Cobalt (Co)	mg/kg dm	5.5
AC	Copper (Cu)	mg/kg dm	< 5.0
AC	Mercury (Hg)	mg/kg dm	< 0.10
AC	Lead (Pb)	mg/kg dm	< 10
AC	Molybdenum (Mo)	mg/kg dm	< 1.5
AC	Nickel (Ni)	mg/kg dm	25
AC	Selenium (Se)	mg/kg dm	< 2.0
AC	Tin (Sn)	mg/kg dm	< 5.0
AC	Vanadium (V)	mg/kg dm	13
AC	Zinc (Zn)	mg/kg dm	25
AC	Beryllium (Be)	mg/kg dm	< 1.0
	Polycyclic Aromatic Hydrocarbons, PAH		
	NEN-ISO 18287		
AC	Naphthalene	mg/kg dm	< 0.035 [1,3]
AC	Acenaphtylene	mg/kg dm	< 0.035 [1,3]
AC	Acenaphtene	mg/kg dm	< 0.035 [1,3]
AC	Fluorene	mg/kg dm	< 0.035 [1,3]
AC	Phenanthrene	mg/kg dm	< 0.035 [1,3]
AC	Anthracene	mg/kg dm	< 0.035 [1,3]
AC	Fluoranthene	mg/kg dm	< 0.035 [1,3]

No.	Customer Reference	Sample matrix	Sampling date client	Sample Code
21	Soil-AOI-3-1 Soil-AOI-3(1)	Soil	10/04/2026	421-2026-00215543

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	Parameter Name	Unit	17	18	19	20
	Petroleum Hydrocarbons					
	NEN-EN ISO 16703					
	TPH (C30-C35)	mg/kg dm	< 6 [1]	6 [1]	< 6 [1]	12 [1]
	TPH (C35-C40)	mg/kg dm	< 6 [1]	< 6 [1]	< 6 [1]	7 [1]
AC	TPH (sum C10-C40)	mg/kg dm	< 38 [1]	< 38 [1]	< 38 [1]	< 38 [1]

No.	Customer Reference	Sample matrix	Sampling date client	Sample Code
17	LBH02-1 LBH02(1)	Soil	21/04/2026	421-2026-00215538
18	LBH06-1 LBH06(1)	Soil	21/04/2026	421-2026-00215539
19	LBH10-1 LBH10(1)	Soil	21/04/2026	421-2026-00215540
20	Soil-AOI-2-1 Soil-AOI-2(1)	Soil	10/04/2026	421-2026-00215542

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	Parameter Name	Unit	17	18	19	20
	Polycyclic Aromatic Hydrocarbons, PAH					
	NEN-ISO 18287					
AC	Phenanthrene	mg/kg dm	< 0.045 [1,3]	< 0.045 [1,3]	< 0.047 [1,3]	< 0.039 [1,3]
AC	Anthracene	mg/kg dm	< 0.045 [1,3]	< 0.045 [1,3]	< 0.047 [1,3]	< 0.039 [1,3]
AC	Fluoranthene	mg/kg dm	< 0.045 [1,3]	< 0.045 [1,3]	< 0.047 [1,3]	< 0.039 [1,3]
AC	Pyrene	mg/kg dm	< 0.045 [1,3]	< 0.045 [1,3]	< 0.047 [1,3]	< 0.039 [1,3]
AC	Benz(a)anthracene	mg/kg dm	< 0.045 [1,3]	< 0.045 [1,3]	< 0.047 [1,3]	< 0.039 [1,3]
AC	Chrysene	mg/kg dm	< 0.045 [1,3]	< 0.045 [1,3]	< 0.047 [1,3]	< 0.039 [1,3]
AC	Benzo(b)fluoranthene	mg/kg dm	< 0.045 [1,3]	< 0.045 [1,3]	< 0.047 [1,3]	< 0.039 [1,3]
AC	Benzo(k)fluoranthene	mg/kg dm	< 0.045 [1,3]	< 0.045 [1,3]	< 0.047 [1,3]	< 0.039 [1,3]
AC	Benzo(a)pyrene	mg/kg dm	< 0.045 [1,3]	< 0.045 [1,3]	< 0.047 [1,3]	< 0.039 [1,3]
AC	Benzo(g,h,i)perylene	mg/kg dm	< 0.045 [1,3]	< 0.045 [1,3]	< 0.047 [1,3]	< 0.039 [1,3]
AC	Dibenzo(ah)anthracene	mg/kg dm	< 0.045 [1,3]	< 0.045 [1,3]	< 0.047 [1,3]	< 0.039 [1,3]
AC	Indeno(123cd)pyrene	mg/kg dm	< 0.045 [1,3]	< 0.045 [1,3]	< 0.047 [1,3]	< 0.039 [1,3]
AC	PAH 16 EPA (sum)	mg/kg dm	< 0.72 [1,3]	< 0.72 [1,3]	< 0.75 [1,3]	< 0.62 [1,3]
AC	PAH 10 VROM (sum)	mg/kg dm	< 0.50	< 0.50	< 0.50	< 0.50
	Polychlorinated Biphenyl					
	NEN 6960					
AC	PCB 28	mg/kg dm	< 0.0010	< 0.0010	< 0.0011 [3]	< 0.0010
AC	PCB 52	mg/kg dm	< 0.0010	< 0.0010	< 0.0011 [3]	< 0.0010
AC	PCB 101	mg/kg dm	< 0.0011 [3]	< 0.0011 [3]	< 0.0011 [3]	< 0.0010
AC	PCB 118	mg/kg dm	< 0.0010	< 0.0010	< 0.0011 [3]	< 0.0010
AC	PCB 138	mg/kg dm	< 0.0010	< 0.0010	< 0.0011 [3]	< 0.0010
AC	PCB 153	mg/kg dm	< 0.0011 [3]	< 0.0011 [3]	< 0.0011 [3]	< 0.0010
AC	PCB 180	mg/kg dm	< 0.0010	< 0.0010	< 0.0011 [3]	< 0.0010
AC	PCB (7) Sum)	mg/kg dm	< 0.0072	< 0.0072	< 0.0077	< 0.0070
	Petroleum Hydrocarbons					
	NEN-EN ISO 16703					
	TPH >C10-C12	mg/kg dm	< 3 [1]	< 3 [1]	< 3 [1]	< 3 [1]
	TPH >C12-C16	mg/kg dm	< 5 [1]	< 5 [1]	< 5 [1]	< 5 [1]
	TPH (>C16-C21)	mg/kg dm	< 6 [1]	< 6 [1]	< 6 [1]	< 6 [1]
	TPH (C21-C30)	mg/kg dm	< 12 [1]	< 12 [1]	< 12 [1]	15 [1]

No.	Customer Reference	Sample matrix	Sampling date client	Sample Code
17	LBH02-1 LBH02(1)	Soil	21/04/2026	421-2026-00215538
18	LBH06-1 LBH06(1)	Soil	21/04/2026	421-2026-00215539
19	LBH10-1 LBH10(1)	Soil	21/04/2026	421-2026-00215540
20	Soil-AOI-2-1 Soil-AOI-2(1)	Soil	10/04/2026	421-2026-00215542

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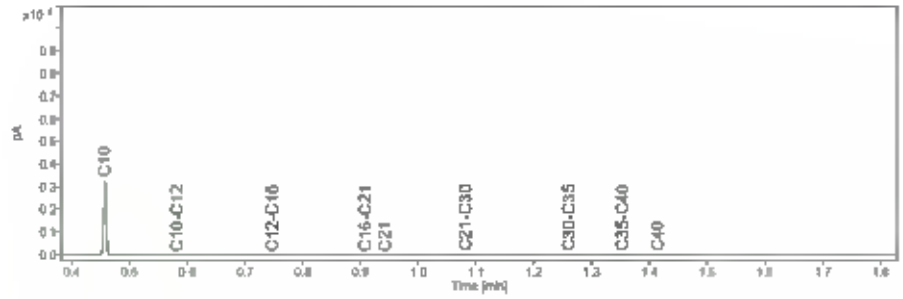
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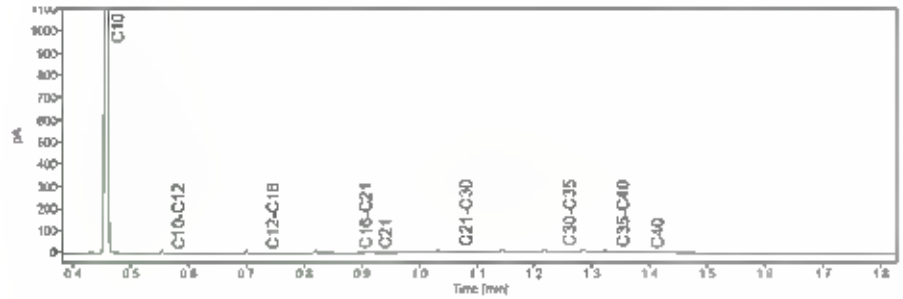
Container Code	Drill nr	Depth From	Depth To	Sampling date client	Sample Container Description
Sample Code 421-2026-00215537	**Customer Reference** GW-B1-1 GW-B1(1)				
0520468532	GW-B1	0	105	08/04/2026	1
Sample Code 421-2026-00215538	**Customer Reference** LBH02-1 LBH02(1)				
0520468451	LBH02	450	555	21/04/2026	1
Sample Code 421-2026-00215539	**Customer Reference** LBH06-1 LBH06(1)				
0520468520	LBH06	300	405	21/04/2026	1
Sample Code 421-2026-00215540	**Customer Reference** LBH10-1 LBH10(1)				
0520469053	LBH10	450	555	21/04/2026	1
Sample Code 421-2026-00215542	**Customer Reference** Soil-AOI-2-1 Soil-AOI-2(1)				
0520468510	Soil-AOI-2	0	50	10/04/2026	1
Sample Code 421-2026-00215543	**Customer Reference** Soil-AOI-3-1 Soil-AOI-3(1)				
0520468509	Soil-AOI-3	0	50	10/04/2026	1

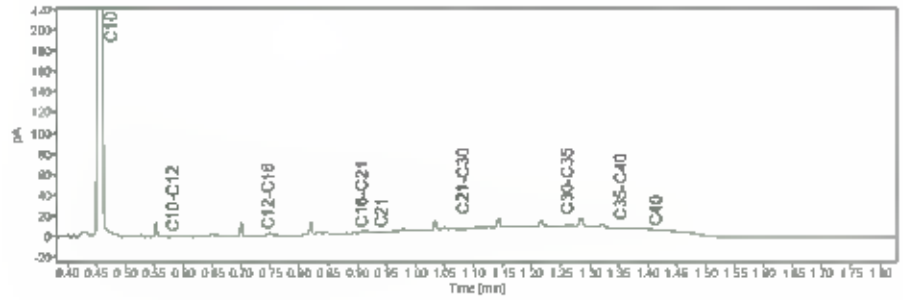
Result Attachment RA1 AR-421-2026-076232-01 - 421-2026-00215522 22/23

Chromatogram TPH/ Mineral Oil

Sample ID : L02585588
Certificate no : 421-2026-076232
Sample description : BHA1-1
V





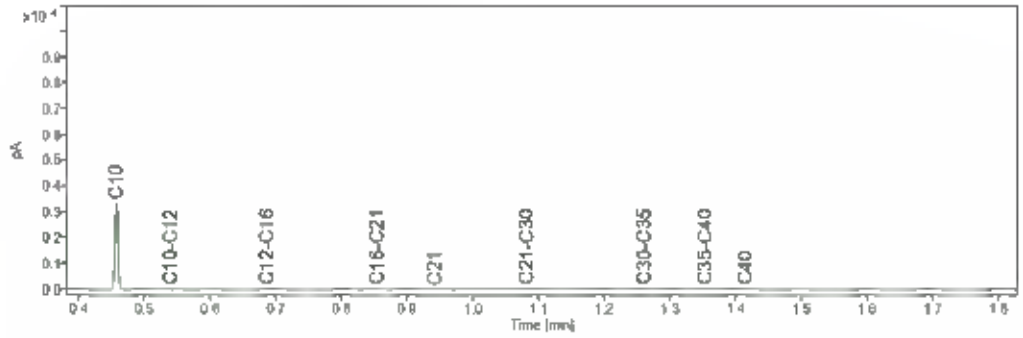


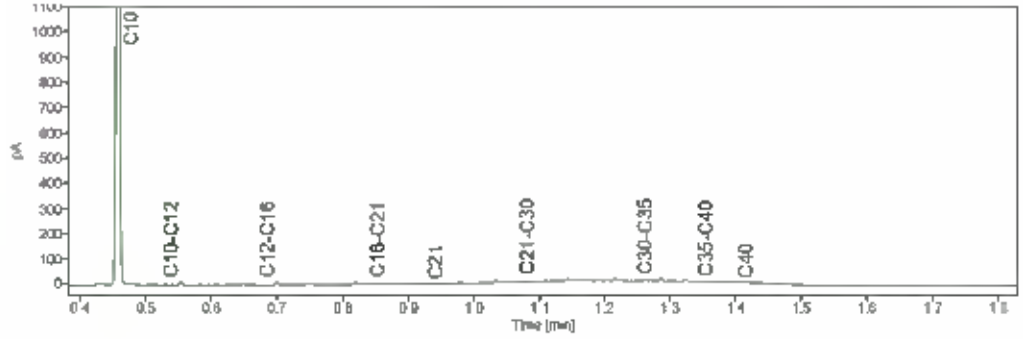
Result Attachment RA2 AR-421-2026-076232-01 - 421-2026-00215537 23/23

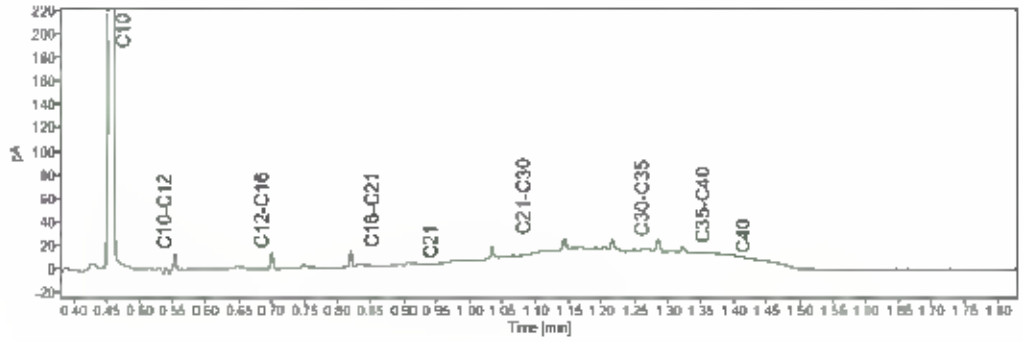
Chromatogram TPH/ Mineral Oil

Sample ID.: L02685674
Certificate no.: 421-2026-076232
Sample description.: GW-B1-1

V







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Haskoning Nederland B.V.
Dhr. Jan Jurgen Schaftum
Laan 1914 no 35
AMERSFOORT
Netherlands

Certificate of analysis

Date 11/05/2026

Please find enclosed the analytical results of the test carried out for the project

Certificate number/Version	AR-421-2026-076233-01
Project number client	-
Project name client	-
Your order number	421-2026-076233
Project Quotation Name	-
Samples received on	04/05/2026
Sample taker client	-
Start date	05/05/2026
This is last Test P Validation Ending Time	11/05/2026
Report date	11/05/2026
Appendices	A

Recognition Information
AC- nEN EN ISO/IEC 17025 2017 RvA L010

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We are confident that we have performed the order in accordance with your expectations. If you have any remaining questions concerning this Certificate of Analysis, please don't hesitate to contact our Customer Support.

Yours sincerely,
Eurofins Analytico (Barneveld)

Ing. A. Veldhuizen
Technical Manager

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Certificate number/Version: AR-421-2026-076233-01

	Parameter Name	Unit	1	2	3	4
	Metals					
	NEN-EN-ISO 17294-2					
AC	Arsenic (As)	µg/l	< 3.0	41	< 3.0	99
AC	Antimony (Sb)	µg/l	< 5.0	< 5.0	< 5.0	< 5.0
AC	Barium (Ba)	µg/l	32	30	67	180
AC	Beryllium (Be)	µg/l	< 1.0	< 1.0	< 1.0	< 1.0
AC	Cadmium (Cd)	µg/l	< 0.40	< 0.40	< 0.40	< 0.40
AC	Chromium (Cr)	µg/l	< 2.0	< 2.0	< 2.0	< 2.0
AC	Cobalt (Co)	µg/l	< 1.0	< 1.0	< 1.0	1.4
AC	Copper (Cu)	µg/l	< 3.0	< 3.0	< 3.0	< 3.0
AC	Mercury (Hg)	µg/l	< 0.04	< 0.04	< 0.04	< 0.04
AC	Lead (Pb)	µg/l	< 3.0	< 3.0	< 3.0	< 3.0
AC	Molybdenum (Mo)	µg/l	< 2.0	< 2.0	< 2.0	< 2.0
AC	Nickel (Ni)	µg/l	< 2.0	< 2.0	< 2.0	< 2.0
AC	Selenium (Se)	µg/l	< 5.0	< 5.0	< 5.0	< 5.0
AC	Tin (Sn)	µg/l	< 5.0	< 5.0	< 5.0	< 5.0
AC	Vanadium (V)	µg/l	< 2.0	< 2.0	< 2.0	2.0
AC	Zinc (Zn)	µg/l	18	< 5.0	< 5.0	< 5.0
AC	Calcium (Ca)	mg/l	88	19	53	63
AC	Iron (Fe)	mg/l	4.3	2.3	8.6	6.9
AC	Potassium (K)	mg/l	30	32	12	49
AC	Magnesium (Mg)	mg/l	97	75	65	160
AC	Manganese (Mn)	mg/l	1.7	0.070	1.1	0.30
AC	Sodium (Na)	mg/l	260	530	170	2,100
	Mono Aromatic Hydrocarbons					
	NEN-EN-ISO 20595					
AC	Benzene	µg/l	2.7 1)	1.1 1)	0.8 1)	2.7 1)
AC	Toluene	µg/l	4.7 1)	5.9 1)	4.9 1)	9.9 1)
AC	Ethylbenzene	µg/l	0.3 1)	0.8 1)	0.7 1)	1.0 1)
AC	o-Xylene	µg/l	1.1 1)	2.0 1)	1.8 1)	2.4 1)
AC	m,p-Xylene	µg/l	1.8 1)	4.0 1)	3.4 1)	5.1 1)
AC	BTEX (sum)	µg/l	11 1)	14 1)	12 1)	21 1)
AC	Xylenes (sum)	µg/l	2.9	6.0	5.2	7.5

No.	Customer Reference	Sample matrix	Sampling date client	Sample Code
1	GW-A1-1 GW-A1	Ground water	11/04/2026	421-2026-00215544
2	GW-AOI-1-1 GW-AOI-1	Ground water	11/04/2026	421-2026-00215545
3	GW-AOI-2-1 GW-AOI-2	Ground water	11/04/2026	421-2026-00215546
4	GW-B1-1 GW-B1	Ground water	10/04/2026	421-2026-00215547

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	Parameter Name	Unit	1	2	3	4
	Mono Aromatic Hydrocarbons					
	ISO 11423-1					
AC	Naphtalene	µg/l	0.3 II	0.9 I	0.8 I	0.6 I
	Volatile halogenated Hydrocarbons					
	NEN EN-ISO 20595					
AC	cis+trans 1,2-Dichloroethenes (sum)	µg/l	< 0.2	< 0.2	< 0.2	< 0.2
AC	Dichloromethane	µg/l	< 0.1 II	< 0.1 I	< 0.1 I	< 0.1 I
AC	Trichloromethane	µg/l	1.7 II	2.7 I	2.3 I	4.8 I
AC	Tetrachloromethane	µg/l	< 0.1 II	< 0.1 I	< 0.1 I	< 0.1 I
AC	Trichloroethene	µg/l	< 0.1 II	< 0.1 I	< 0.1 I	< 0.1 I
AC	Tetrachloroethene	µg/l	< 0.1 II	< 0.1 I	< 0.1 I	< 0.1 I
AC	1,1-Dichloroethene	µg/l	< 0.1 II	< 0.1 I	< 0.1 I	< 0.1 I
AC	1,2-Dichloroethene	µg/l	< 0.1 II	0.1 I	< 0.1 I	< 0.1 I
AC	1,1,1-Trichloroethane	µg/l	< 0.1 II	< 0.1 I	< 0.1 I	< 0.1 I
AC	1,1,2-Trichloroethane	µg/l	< 0.1 II	< 0.1 I	< 0.1 I	< 0.1 I
AC	cis1,2-Dichloroethene	µg/l	< 0.1 II	< 0.1 I	< 0.1 I	< 0.1 I
AC	trans 1,2-Dichloroethene	µg/l	< 0.1 II	< 0.1 I	< 0.1 I	< 0.1 I
AC	Chlorinated Hydrocarbons (sum)	µg/l	1.7 II	2.8 I	2.3 I	4.8 I
	Petroleum Hydrocarbons					
	NEN EN-ISO 9377-2					
	TPH (C10-C12)	µg/l	< 10	< 10	< 10	< 10
	TPH (C12-C16)	µg/l	< 10	< 10	< 10	< 10
	TPH (C16-C21)	µg/l	< 10	< 10	< 10	< 10
	TPH (C21-C30)	µg/l	< 15	< 15	< 15	< 15
	TPH (C30-C35)	µg/l	< 10	< 10	< 10	< 10
	TPH (C35-C40)	µg/l	< 10	< 10	< 10	< 10
AC	TPH Sum (C10-C40)	µg/l	< 38	< 38	< 38	< 38
	Inorganic Compounds					
	NEN-EN-ISO 10304-1					
AC	Bromide	mg/l	1.7	2.1	1.7	1.3

No	Customer Reference	Sample matrix	Sampling date client	Sample Code
1	GW-A1-1 GW-A1	Ground water	11/04/2026	421-2026-00215544
2	GW-AOI-1-1 GW-AOI-1	Ground water	11/04/2026	421-2026-00215545
3	GW-AOI-2-1 GW-AOI-2	Ground water	11/04/2026	421-2026-00215546
4	GW-B1-1 GW-B1	Ground water	10/04/2026	421-2026-00215547

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	Parameter Name	Unit	1	2	3	4
	Inorganic Compounds					
	NEN-EN-ISO 10304-1					
AC	Chloride	mg/l	400	600	490	3,600
AC	Sulphate	mg/l	27	< 2.0 [3]	42	35
AC	Fluoride	mg/l	< 0.50 [3]	0.58	< 0.50 [3]	< 5.0 [4]

No	Customer Reference	Sample matrix	Sampling date client	Sample Code
1	GW-A1-1 GW-A1	Ground water	11/04/2026	421-2026-00215544
2	GW-AOI-1-1 GW-AOI-1	Ground water	11/04/2026	421-2026-00215545
3	GW-AOI 2-1 GW AOI-2	Ground water	11/04/2026	421-2026-00215546
4	GW-B1-1 GW-B1	Ground water	10/04/2026	421-2026-00215547

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	Parameter Name	Unit	5	6	7	8
	Metals					
	NEN-EN-ISO 17294-2					
AC	Arsenic (As)	µg/l	< 3.0	< 3.0	14	< 3.0
AC	Antimony (Sb)	µg/l	< 5.0	< 5.0	< 5.0	5.0
AC	Barium (Ba)	µg/l	320	58	250	210
AC	Beryllium (Be)	µg/l	< 1.0	< 1.0	< 1.0	< 1.0
AC	Cadmium (Cd)	µg/l	< 0.40	< 0.40	< 0.40	< 0.40
AC	Chromium (Cr)	µg/l	< 2.0	< 2.0	< 10 [4]	< 2.0
AC	Cobalt (Co)	µg/l	< 1.0	< 1.0	< 1.0	< 1.0
AC	Copper (Cu)	µg/l	< 3.0	< 3.0	< 3.0	< 3.0
AC	Mercury (Hg)	µg/l	< 0.04	< 0.04	< 0.04	< 0.04
AC	Lead (Pb)	µg/l	< 3.0	< 3.0	< 10 [5]	< 3.0
AC	Molybdenum (Mo)	µg/l	< 2.0	< 2.0	4.5	5.1
AC	Nickel (Ni)	µg/l	< 2.0	< 2.0	< 2.0	< 2.0
AC	Selenium (Se)	µg/l	< 5.0	< 5.0	< 7.0 [6]	< 5.0
AC	Tin (Sn)	µg/l	< 5.0	< 5.0	< 5.0	< 5.0
AC	Vanadium (V)	µg/l	< 2.0	< 2.0	< 10 [7]	< 2.0
AC	Zinc (Zn)	µg/l	5.0	52	8.4	12
AC	Calcium (Ca)	mg/l	320	58	150	160
AC	Iron (Fe)	mg/l	11	3.9	3.7	8.8
AC	Potassium (K)	mg/l	110	44	79	91
AC	Magnesium (Mg)	mg/l	600	99	360	520
AC	Manganese (Mn)	mg/l	3.3	0.82	0.28	1.2
AC	Sodium (Na)	mg/l	1,400	300	2,800	3,500
	Mono Aromatic Hydrocarbons					
	NEN-EN ISO 20595					
AC	Benzene	µg/l	13 [9]	2.8 [9]	1.7 [1]	3.5 [1]
AC	Toluene	µg/l	9.4 [9]	4.5 [9]	2.3 [1]	3.0 [1]
AC	Ethylbenzene	µg/l	0.3 [1]	0.3 [1]	< 0.2 [1]	< 0.2 [1]
AC	o-Xylene	µg/l	1.0 [1]	1.2 [1]	0.8 [1]	0.5 [1]
AC	m,p-Xylene	µg/l	1.3 [1]	1.9 [1]	0.9 [1]	0.8 [1]
AC	BTEX (sum)	µg/l	25 [1]	11 [1]	5.5 [1]	7.8 [1]
AC	Xylenes (sum)	µg/l	2.3	3.1	1.5	1.0

No.	Customer Reference	Sample matrix	Sampling date client	Sample Code
5	GW-C1-1 GW-C1	Ground water	11/04/2026	421-2026-00215548
6	GW-C2-1 GW-C2	Ground water	11/04/2026	421-2026-00215549
7	GW-C3-1 GW-C3	Ground water	12/04/2026	421-2026-00215550
8	GW-C4-1 GW-C4	Ground water	12/04/2026	421-2026-00215551

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	Parameter Name	Unit	5	6	7	8
	Mono Aromatic Hydrocarbons					
	ISO 11423-1					
AC	Naphtalene	µg/l	< 0.2 [1]	0.3 [1]	< 0.2 [1]	< 0.2 [1]
	Volatile halogenated Hydrocarbons					
	NEN-EN-ISO 20595					
AC	cis+trans 1,2-Dichloroethenes (sum)	µg/l	< 0.2	< 0.2	< 0.2	< 0.2
AC	Dichloromethane	µg/l	< 0.1 [1]	< 0.1 [1]	< 0.1 [1]	< 0.1 [1]
AC	Trichloromethane	µg/l	3.0 [1]	1.8 [1]	0.9 [1]	1.1 [1]
AC	Tetrachloromethane	µg/l	< 0.1 [1]	< 0.1 [1]	< 0.1 [1]	< 0.1 [1]
AC	Trichloroethene	µg/l	< 0.1 [1]	< 0.1 [1]	< 0.1 [1]	< 0.1 [1]
AC	Tetrachloroethene	µg/l	< 0.1 [1]	< 0.1 [1]	< 0.1 [1]	< 0.1 [1]
AC	1,1-Dichloroethane	µg/l	< 0.1 [1]	< 0.1 [1]	< 0.1 [1]	< 0.1 [1]
AC	1,2-Dichloroethane	µg/l	< 0.1 [1]	< 0.1 [1]	< 0.1 [1]	< 0.1 [1]
AC	1,1,1-Trichloroethane	µg/l	< 0.1 [1]	< 0.1 [1]	< 0.1 [1]	< 0.1 [1]
AC	1,1,2-Trichloroethane	µg/l	< 0.1 [1]	< 0.1 [1]	< 0.1 [1]	< 0.1 [1]
AC	cis1,2-Dichloroethene	µg/l	< 0.1 [1]	< 0.1 [1]	< 0.1 [1]	< 0.1 [1]
AC	trans 1,2-Dichloroethene	µg/l	< 0.1 [1]	< 0.1 [1]	< 0.1 [1]	< 0.1 [1]
AC	Chlorinated Hydrocarbons (sum)	µg/l	3.0 [1]	1.8 [1]	< 1.1 [1]	< 1.1 [1]
	Petroleum Hydrocarbons					
	NEN-EN-ISO 9377-2					
	TPH (C10-C12)	µg/l	< 10	< 10	< 10	< 10
	TPH (C12-C16)	µg/l	< 10	< 10	15	16
	TPH (C16-C21)	µg/l	< 10	< 10	< 10	< 10
	TPH (C21-C30)	µg/l	< 15	< 15	< 15	< 15
	TPH (C30-C35)	µg/l	< 10	< 10	< 10	< 10
	TPH (C35-C40)	µg/l	< 10	< 10	< 10	< 10
AC	TPH Sum (C10-C40)	µg/l	< 38	< 38	< 38	< 38
	Inorganic Compounds					
	NEN-EN-ISO 10304-1					
AC	Bromide	mg/l	17	4.8	18	23

No.	Customer Reference	Sample matrix	Sampling date client	Sample Code
5	GW-C1-1 GW-C1	Ground water	11/04/2026	421-2026-00215548
6	GW-C2-1 GW-C2	Ground water	11/04/2026	421-2026-00215549
7	GW-C3-1 GW-C3	Ground water	12/04/2026	421-2026-00215550
8	GW-C4-1 GW-C4	Ground water	12/04/2026	421-2026-00215551

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	Parameter Name	Unit	5	6	7	8
	Inorganic Compounds					
	NEN-EN-ISO 10304-1					
AC	Chloride	mg/l	4,800	1,300	5,700	5,800
AC	Sulphate	mg/l	510	190	480	530
AC	Fluoride	mg/l	<5.0 [3]	<0.50 [4]	<5.0 [4]	<5.0 [4]

No.	Customer Reference	Sample matrix	Sampling date client	Sample Code
5	GW-C1-1 GW-C1	Ground water	11/04/2026	421-2026-00215548
6	GW-C2-1 GW-C2	Ground water	11/04/2026	421-2026-00215549
7	GW-C3-1 GW-C3	Ground water	12/04/2026	421-2026-00215550
8	GW-C4-1 GW-C4	Ground water	12/04/2026	421-2026-00215551

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AR-421-2026-076233-01
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Comment:

1) The preservation term for this parameter has been expired.
2) The reporting limit has been increased due to low sample intake and/or low dry weight.

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Appendix (A): concerning subsample information referring to certificate of analysis AR-421-2026-076233-01

Container Code	Drill nr	Depth From	Depth To	Sampling date client	Sample Container Description
Sample Code	421-2026-00215544 **Customer Reference**	GW A1-1 GW-A1			
0625078388	GW A1	0	1056	11/04/2026	2
0675401179	GW-A1	0	1056	11/04/2026	4
0695318324	GW A1	0	1056	11/04/2026	1
0805231413	GW A1	0	1056	11/04/2026	3
Sample Code	421-2026-00215545 **Customer Reference**	GW-AOI-1-1 GW-AOI-1			
0625078359	GW-AOI-1	0	1677	11/04/2026	2
0675401149	GW-AOI-1	0	1677	11/04/2026	4
0695318318	GW-AOI-1	0	1677	11/04/2026	1
0805231579	GW-AOI-1	0	1677	11/04/2026	3
Sample Code	421-2026-00215546 **Customer Reference**	GW AOI 2-1 GW AOI-2			
0625078390	GW-AOI-2	0	1677	11/04/2026	2
0675401186	GW-AOI-2	0	1677	11/04/2026	4
0695318311	GW-AOI-2	0	1677	11/04/2026	1
0805231524	GW-AOI-2	0	1677	11/04/2026	3
Sample Code	421-2026-00215547 **Customer Reference**	GW-B1-1 GW-B1			
0625078824	GW-B1	0	1056	10/04/2026	2
0675401107	GW-B1	0	1056	10/04/2026	4
0695318377	GW-B1	0	1056	10/04/2026	1
0805231450					
Sample Code	421-2026-00215548 **Customer Reference**	GW-C1-1 GW C1			
0625078359				11/05/2026	
0675401139	GW-C1	0	1056	11/04/2026	3
0695318316	GW-C1	0	1056	11/04/2026	1
0805231555	GW-C1	0	1056	11/04/2026	2
Sample Code	421-2026-00215549 **Customer Reference**	GW-C2-1 GW-C2			
0625078379	GW-C2	0	1056	11/04/2026	2
0675401125	GW C2	0	1056	11/04/2026	4
0695318385	GW-C2	0	1056	11/04/2026	1
0805231459					
Sample Code	421-2026-00215550 **Customer Reference**	GW-C3-1 GW-C3			
0625078361	GW-C3	0	1056	12/04/2026	2
0675401150					
0695318317	GW-C3	0	1056	12/04/2026	1
0805231402	GW-C3	0	1056	12/04/2026	3

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VAT Number NL803145383B01

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Certificate number/Version: AR-421-2026-076233-01

Page: 10/10

Container Code	Drill nr	Depth From	Depth To	Sampling date client	Sample Container Description
Sample Code: 421-2026-00215551	Customer Reference: GW-C4-1 GW-C4				
0825078390	GW-C4	0	1056	12/04/2026	2
0825401161	GW-C4	0	1056	12/04/2026	4
0805318325	GW-C4	0	1056	12/04/2026	1
0805231375	GW-C4	0	1056	12/04/2026	3

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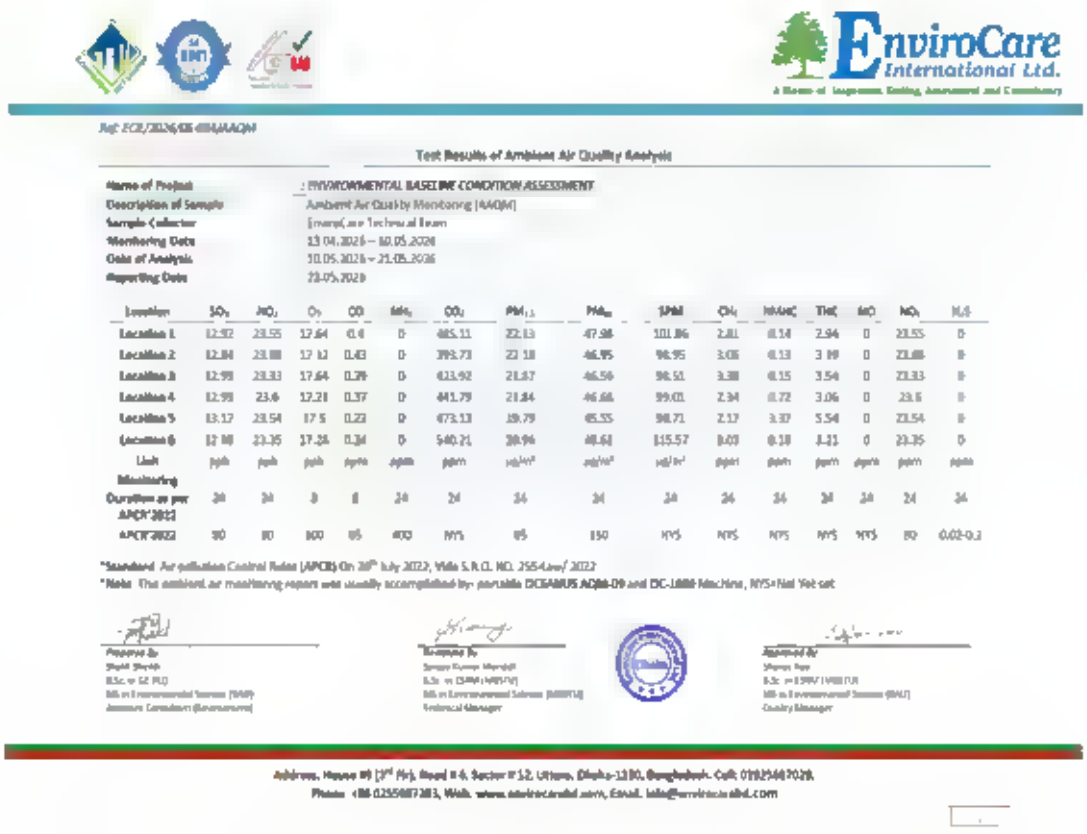
KvK/CoC No 09068523

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Annex B2 – Survey: Air / Noise quality certificates

Air Quality Survey



EnviroCare International Ltd.

Test Results of Ambient Air Quality Analysis

Name of Project	: ENVIRONMENTAL BASELINE CONDITION ASSESSMENT
Description of Sample	Ambient Air Quality Monitoring (AAQM)
Sample Collector	Envirocare Technical Team
Monitoring Date	13.04.2026 – 20.05.2026
Date of Analysis	10.05.2026 – 21.05.2026
Reporting Date	23.05.2026

Location	SO_2	NO_2	O_3	CO	NH_3	CO_2	$PM_{2.5}$	PM_{10}	SPM	CH_4	NMHC	THC	H_2S	NO	N.S
Location 1	12.92	23.55	17.64	0.4	D	485.11	22.13	47.98	101.86	2.81	0.14	2.96	D	23.55	D
Location 2	12.84	23.88	17.12	0.43	D	393.73	23.18	46.95	98.95	3.05	0.13	3.18	D	23.88	D
Location 3	12.99	23.83	17.64	0.39	D	423.92	21.87	46.56	96.51	3.38	0.15	3.54	D	23.83	D
Location 4	12.98	23.6	17.21	0.37	D	441.79	21.84	46.66	99.01	2.34	0.12	3.06	D	23.6	D
Location 5	13.17	23.54	17.5	0.23	D	473.13	19.79	45.55	98.71	2.17	3.37	5.54	D	23.54	D
Location 6	12.98	23.35	17.26	0.34	D	540.21	20.96	48.61	115.57	3.03	0.18	3.21	D	23.35	D
Unit	ppb	ppb	ppb	ppm	ppm	ppm	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	ppm	ppm	ppm	ppm	ppm	ppm
Monitoring Duration as per APCR'2022	24	24	8	8	24	24	24	24	24	24	24	24	24	24	24
APCR'2022	80	80	100	05	400	NYS	05	150	NYS	NYS	NYS	NYS	NYS	80	0.02-0.1

*Standard: Air pollution Control Rules (APCR) On 20th July 2022, Vide S.R.O. NO. 255-Law/ 2022

*Note: The ambient air monitoring report was usually accomplished by- portable DIGIARUS AQM-09 and DC-1888 Machine, NYS= Not Yet set

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Noise Quality Survey

EnviroCare International Ltd.
A House of Inspection, Testing, Assessment and Consultancy

Ref: ECIL/2026/05-035/NLM

Test Results of Ambient Air Quality Analysis

Name of Project : *ENVIRONMENTAL BASELINE CONDITION ASSESSMENT*
Description of Sample : Noise Level Monitoring (NLM)
Sample Collector : EnviroCare Technical Team
Monitoring Date : 13.04.2026 – 10.05.2026
Date of Analysis : 10.05.2026 – 21.05.2026
Reporting Date : 23.05.2026

Location	Period	Leq	Lmax	Lmin	L90	L50	L10	Category
Location 1	Day-time	72.39	84.8	44.3	54.9	66.6	77.1	Mixed
	Night-time	68.38	79.6	39.6	50	62.5	73.2	
Location 2	Day-time	67.37	81.4	40.3	49.5	60.4	71.9	Mixed
	Night-time	63.8	78.4	36.2	45.5	56.7	68.3	
Location 3	Day-time	67.57	82.9	41.6	50	60.7	71.9	Mixed
	Night-time	62.42	78.2	37.2	44.6	55.3	66.7	
Location 4	Day-time	68.68	82.1	42.3	50.6	61.7	73.3	Mixed
	Night-time	62.16	74.9	38.7	45.6	55.9	66.8	
Location 5	Day-time	65.64	78.4	42.2	49.5	59.6	70.2	Mixed
	Night-time	60.65	74.6	37.9	44.8	54.7	65.1	
Location 6	Day-time	74.92	88.5	46.4	56.2	68.2	79.4	Mixed
	Night-time	68.38	81.4	41.6	50.6	62.4	73	

Noise Pollution (Control) Rules, 2025)	Day-Time	Night-Time
Silent Zone	50	40
Residential Zone	55	45
Mixed Zone (this area is used combining residential, commercial and industrial purposes)	60	50
Commercial Zone	70	60
Industrial Zone	75	70
World Bank/IFC Standard	**Day-Time**	**Night-Time**
Industrial Area	70	70
Residential, Institutional, Educational	55	45

*Note: The day time is considered from 6 a.m. to 9 p.m. and the night time is from 9 p.m. to 6 p.m.

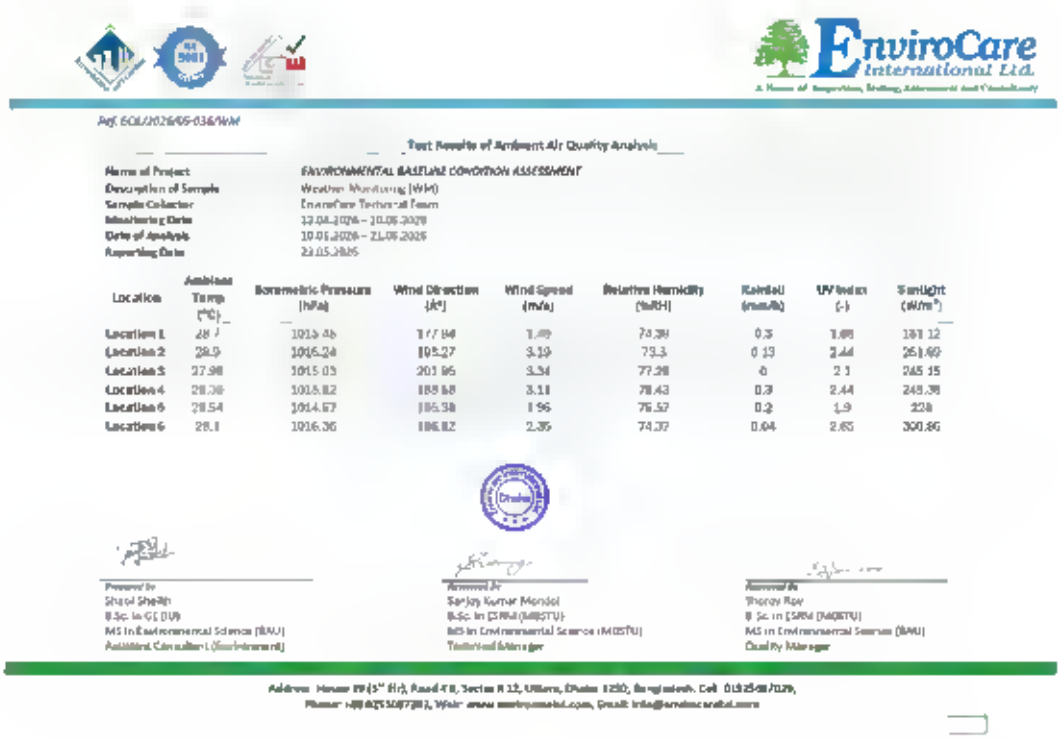
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Micrometeorology Survey



EnviroCare International Ltd.

Ref: ECIL/026/05-036/WM

Test Results of Ambient Air Quality Analysis

Name of Project	ENVIRONMENTAL BASELINE CONDITION ASSESSMENT
Description of Sample	Weather Monitoring (WM)
Sample Collector	EnviroCare Technical Team
Monitoring Date	13.04.2026 – 10.05.2026
Date of Analysis	10.05.2026 – 21.05.2026
Reporting Date	23.05.2026

Location	Ambient Temp (°C)	Barometric Pressure (hPa)	Wind Direction (d°)	Wind Speed (m/s)	Relative Humidity (%RH)	Rainfall (mm/h)	UV Index (-)	Sunlight (W/m²)
Location 1	28.7	1015.46	177.68	1.49	74.39	0.3	1.88	181.12
Location 2	28.9	1016.24	195.27	3.19	73.3	0.13	2.44	261.69
Location 3	27.98	1015.03	201.95	3.34	77.98	0	2.1	245.15
Location 4	28.36	1015.82	185.68	3.11	78.43	0.3	2.44	248.38
Location 5	28.54	1014.67	186.38	1.96	76.57	0.2	1.9	228
Location 6	28.1	1016.36	186.82	2.35	74.37	0.04	2.65	300.86

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Annex B3 – SE and social survey: List of participants in meetings / FGDs

Minutes

HASKONING NEDERLAND B.V.
WATER & MARITIME

Present:	Attendance sheets attached
Apologies:	-
From:	IWM
Date:	23 & 25 April 2026
Location:	Multiple Locations
Copy:	-
Our reference:	BK4589-HAS-ES-XX-RP-EV-0001
Classification:	Project related
Enclosures:	NA

Subject: **Minutes of Community Consultations (3)**

1st Community/Public Consultation Meeting

Date: 23 April 2026
Time: 11:00 AM – 1:00 PM
Location: Fulchori Para, Hafez Mubarak Ali Shah Government Primary School, South Patenga, Chattogram
Participants: 75 (Male: 49, Female: 26)
Participants discussed displacement, livelihood impacts, environmental degradation, labour management, and utility-related concerns based on experiences from previous development projects in the area.

Key Findings

- Participants stated that large-scale infrastructure and industrial developments could create new business opportunities, increase commercial activities and enhance livelihood opportunities for local residents, particularly youth and low-income households.
- Many stakeholders also mentioned that successful implementation of the Project may contribute positively to the economic development of Chattogram and Bangladesh as a whole

- Participants stated that previous development projects displaced many households without adequate compensation or rehabilitation and emphasized that future displacement should ensure fair compensation, proper resettlement, livelihood restoration, and continuous stakeholder engagement.
- Stakeholders highlighted that repeated infrastructure developments, including embankments, EPZ expansion, airport development, naval facilities, and elevated expressways, have created cumulative environmental and social pressure in the area. Tree plantation should be surrounding project area.
- Limited access to safe drinking water due to salinity intrusion was identified as a major concern. Participants requested improved water supply systems and regular water quality monitoring.
- Community members reported that previous projects resulted in extensive tree cutting without adequate local reforestation measures and recommended localized tree plantation and green buffer development.
- Participants expressed concern that local residents were not adequately employed in earlier infrastructure projects and requested priority employment opportunities, transparent recruitment, and technical training for local youth.
- Concerns were raised regarding labour management practices under subcontractors, including inadequate labour protection, unsafe work allocation, and poor worker treatment.
- Participants recommended implementation of traffic management measures, restriction of heavy vehicle movement during school hours, and maintenance of pedestrian and ferry access routes.
- Stakeholders also emphasized the need for community health awareness programs, improved sanitation measures, and protection of cultural and religious sites during project implementation.

Participants List:

PCM – 1

P-1

Environmental and Social Impact Assessment (ESIA) Study for the Laldia Container Terminal Project.

Attendances: FGDs/Public Consultation

Location: Date:

SL	Name of Participants	Contact	Signature
1		01713104385	
2		01816000708	
3		01812-510443	
4		01820-216703	
5		01706311480	
6	Abu Shadat Slayem	01874956773	
7		01818026674	
8		01860350 19	
9		01813922889	
10		0821-961727	
11		01819630840	
12		01823508301	
13		01823413007	
14		01862039504	
15		01825865507	
16		01822534350	
17		01822549944	
18		01829-411345	
19		01824889904	
20		01815097987	
22		01823142608	
22		01875080817	
23		01829508326	

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Environmental and Social Impact Assessment (ESIA) Study for the Laldia Container Terminal Project.

Attendances: FGDs/Public Consultation

Location: Date:

SL	Name of Participants	Contact	Signature
24	Meherun Nisa Tafad	01944-430383	Meher
25	Tahmina Akter Shoshe	01814564-386	Tahmina
26	মোঃ [illegible]		
27	মোঃ [illegible]	01[illegible]778457	Runa
		01821778457	-
28	মোছা: নাসরিন [illegible]	01819539516	নাসরিন
29	মোঃ [illegible]		[illegible]
30	মোঃ [illegible]	01752830313	[illegible]
31	মোঃ [illegible]	01944559566	[illegible]
32	মোঃ [illegible]	01845714599	[illegible]
33	মোঃ [illegible]	01838797197	Lal Akter
34	মোঃ [illegible]	01881873640	[illegible]
35	মোঃ [illegible]		[illegible]
36	মোঃ [illegible]	01882963325	[illegible]
37	মোঃ [illegible]	০১	[illegible]
38	মোঃ [illegible]	-	[illegible]
39	মোঃ [illegible]	01881606199	Rajmony
40	[illegible]	-	[illegible]
41	[illegible]	01703774983	[illegible]
42	[illegible]	-	[illegible]
43	[illegible]	01[illegible]2443586	[illegible]
44	[illegible]	01723075670	[illegible]
45	[illegible]	01723117043	[illegible]

P-3

SL	Name of Participants	Contact	Signature
46	মো: আবু বোরহ	01876997409	
47	মো: সোলায়মান মাঝি	01879198312	
48	মো: ইয়াকিব	01617841788	
49	মো: তাজু [illegible]	01862032532	
50	মো: ইমরান	01830345797	
51	মো: নাসুম [illegible]	01880186195	
52	MD. [illegible]	01886786744	
53	মো: কামেদ [illegible]	01827577285 01575109081	
54	মো: নাসির উদ্দিন	01692862078	
55	মো: মো: ইউনুস	01892788470	
56	মো: [illegible]	01617067878	
57	মো: মাইনুল ইসলাম	01976033802	
58	[illegible]	01871534357	
59	মো: জামাল	01816085532	JAMAL
60	মো: [illegible]	01790755484	
61	মো: মুনছুর [illegible]	01815107771	মো: মুনছুর [illegible]
62	মো: [illegible]	01626648672	
63	মো: [illegible]	01814027684	
64	মোছা: [illegible]	01	
65	মোছা: [illegible]	01814676873	
66	[illegible]	01	
67	মোছা: [illegible]	01845345966	
68	মোছা: [illegible]	01856685614	

P-4

SL	Name of Participants	Contact	Signature
70	শ্রী রতন কুমার বিশ্বাস	০১৭৪৭১৪০৪	
71	তিয়াউর রহমান মিয়া	01855536972	
72	আলী আকবর	০১৮১৭৩৬৫২৪	
73	মোঃ সাইফুল ইসলাম	01760756	
74	মনোমোহন	01709371[illegible]	
75	মোঃ নুরুবায়েন	01682480714	নুরুন্নাহার





2nd Community/Public Consultation Meeting

Date: 23 April 2026
Time: 3:30 PM – 5:00 PM
Location: Ward Commissioner Office, Ward No. 41, South Patenga, Chattogram
Participants: 69 (Male: 57, Female: 12)
The second consultation meeting focused on livelihood security, employment opportunities, traffic congestion, environmental management, and community safety concerns.
Key Findings

- Participants demonstrated strong interest in cooperating with project authorities and expressed willingness to support successful implementation of the Project
- Participants stated that previous development projects negatively affected local livelihoods, particularly among fishermen, labourers, and low-income households.
- Community members mentioned around 700 Households were displaced previously from the Laldia Char, they emphasized the need for fair compensation, rehabilitation support, and livelihood restoration measures for affected people.
- Stakeholders strongly recommended priority employment opportunities for local residents during both construction and operational phases of the Project.
- Participants requested transparent recruitment systems, vocational training programs, and greater involvement of local businesses in project-related activities.
- Traffic congestion and movement of heavy vehicles were identified as major concerns, and participants recommended dedicated truck parking areas and effective traffic management measures.
- Community members raised concerns regarding dust, noise, waste management, and water pollution during construction and operation phases.
- Participants also expressed concern regarding social safety issues associated with outside labourers, particularly risks related to harassment and community insecurity for women and adolescent girls.
- Stakeholders recommended strict community safety measures, and effective grievance redress systems in the project area.
- Emergency response, better treatment facilities including civic amenities should be increased in the area.

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Apem- 2

P-2

Environmental and Social Impact Assessment (ESIA) Study for the Laldia Container Terminal Project.

Attendances: FGDs/Public Consultation সময়:- 3:30pm

Location: দক্ষিন পাতেঙ্গা, ইউনিয়ন পরিষদ, ওয়ার্ড নং 41 Date: 23-04-26

SL	Name of Participants	Contact	Signature
1.	(Md. Rezwan Ahmed Chowdhury, Chairman, Union Parishad)	01731045825	
2.	Shahidul Islam	01753532602	
3.	Nazmul Huda Chy	01819170127	
4.	মো: জমিয়ত উদ্দিন মিলকী	01757799277	
5.	মো: আলী হোসেন	01819832238	
6.	মো; শাহাবুল ইসলাম	01706311480	
7.	মো: কামাল উদ্দিন	01861694135	
8.	মোছা: হাসিনা বেগম	01812098925	
9.	মোছা: নুর নাহার বেগম	01837734981	
10	মোছা: শাহিদা বেগম	01823885901	হাতেরা বেগম
11	নাহিদা আক্তার	01877197889	
12	মো: আ: কাদের	01711225993	
13	মো: আবুল কাশেম	01777477858	
14	মো: আব্দুল্লাহ রহমান	01700925700	
15	মো: আবুবক্কার রহমান	01774942065	
16	মো: নাবুল হাসেম	01715742779	
17	মো: আবদুল মান্নান	01845679887	Abdul Mannan
18	মো: নুর হোসেন	01673261598	
19	মো: নাঈম হোসেন	01827708074	
20	মো: সাইফুল ইসলাম (সিফাত)	01312038258	Sifat
21	হুমায়রা আক্তার	01712165728	
22	হাসিনা আকতার	01615561545	
23	মোছা: রোকেয়া	01844963404	রোকেয়া

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Environmental and Social Impact Assessment (ESIA) Study for the Laldia Container Terminal Project.

Attendances: FGDs/Public Consultation

সময়:— 3:30Pm

Location: দক্ষিণখোকশা, হোসেনের বাড়ি, ওয়ার্ড নং 41, Date: 23-04-26

SL	Name of Participants	Contact	Signature
24	নাসরিন আক্তার	01641561251	
25	রেকসনা বেগম	01871529229	
26	রিনাকিন বেগম	01886209959	রিনাকিন
29	মো: হোসেন	01715085517	
28	মো: মনিরুল ইসলাম	01623501741	
29	মো: আ: সাত্তার	01715731571	
30	মো: আলী আমজাদ	01635210643	
31	মো: ইকবাল বাহার	01815115321	
32	মো: রাশেদুল আমিন শিকদার	01911068164	
33	মো: নুর হোসেন	01819358876	
34	মো: বাবুল কাজল	01716804650	
35	মো: আকাশ মুরাদ	01850-379173	
36	মো: ওয়াহিদ ইসলাম	01615095872	
37	মো: জুয়েল সরদার	01840285888	
38	মুক্তার হোসেন	01731361144	
39	ইকবাল মিয়া	01791320505	
40	মো:- কাশেম	01711-038703	
41	জেরু তরফদার	01680 951228	
42	মো: আকাশ উদ্দিন	01858052739	
43	মো: রিফাত	01843666146	
44	মো: সাদেক	01834843483	
45	মো: সাদেক	01858720327	
46	মোসাঃ আকলিমা আক্তার	01403420006	

P-3

SL	Name of Participants	Contact	Signature
47	Md. Sala uddin Rubel	01813732220	
48	Md. Forkan	01821053877	
49	Md. Jahangir	01813678226	
50	[illegible]	01644060379	
51	[illegible]	01852006410	
52	[illegible]	01814306943	
53	[illegible]	01848636445	
54	[illegible]	01533620798	
55	[illegible]	01862644188	
56	[illegible]	01897090913	
57	[illegible]	01814306942	
58	[illegible]	01762443586	
59	[illegible]	01871845868	
60	Zuhayr Absor	01841104326	
61	Kayum Uddin	01832664788	
62	Nihan	01602215934	
63	Newas	01624916172	
64	Nabil	01312251835	
65	Sagar	01868036452	
66	Tohes	01622978575	
67	[illegible]	01321935679	
68	[illegible]	01865986779	
69	[illegible]	01723117043	





3rd Community/Public Consultation Meeting

Date: 25 April 2026
Time: 11:00 AM – 1:00 PM
Location: Dhakkin Patanga High School, Port Area, Karnofuli, Chattogram
Participants: 50 (Male: 43, Female: 07)
The third consultation meeting focused on employment generation, disaster vulnerability, public health, environmental management, and community participation.
Key Findings

- Participants expected the Project to generate employment opportunities and contribute to local economic development, particularly for youth and affected households.
- Stakeholders emphasized the need for technical and vocational training programs and priority employment opportunities for local communities, women, and vulnerable groups.
- Community members highlighted the area's vulnerability to cyclones, flooding, tidal surges, and waterlogging, and requested improved drainage systems, cyclone shelters, and disaster preparedness measures.
- Limited access to safe drinking water, inadequate sanitation facilities, and poor healthcare services were identified as important community concerns.
- Participants recommended strengthening environmental management measures, including dust and noise control, waste management, and protection of fisheries and aquatic ecosystems.
- Participants emphasized that existing ferry transport services should be maintained in the area, or alternative river-crossing transportation facilities should be introduced, as pedestrian movement is not permitted through the existing Karnaphuli Tunnel.
- Participants emphasized that local residents should be given priority in project-related employment opportunities during both construction and operation phases.

pem – 3

P-1

Environmental and Social Impact Assessment (ESIA) Study for the Laldia Container Terminal Project.

Attendances: FGDs/Public Consultation সময়:- 11.0Am

Location: দক্ষিণ পতেঙ্গা উচ্চ বিদ্যালয়, কর্ণফুলী, চট্টগ্রাম Date: 25.04.26

SL	Name of Participants	Contact	Signature
1	মোঃ আবুতাহের	0186-008612	
2	[illegible]	01713104925	
3	মোঃ মহিবুল ইসলাম	01706311480	
4	মোঃ সাইফুল ইসলাম	01723075670	
5	[illegible]	01712941586	
6	মোঃ নেছার আলী	01813869518	
7	মোঃ রাকিব হোসেন	01335382284	রাকিব
8	মোঃ বাবু হালিম	01319807[illegible]	মোঃ আবুতাহের
9	মো হাছান	01324301451	মোঃ হাছান
10	মোঃ হুমায়ুন চৌধুরী	01812088210	
11	[illegible]	01813417017	
12	মোঃ আবদুল্লাহ	01894158738	
13	মোঃ আলী আকবর	01818609877	
14	মোঃ-আবিউল আলম	01813-242600	
15	মোঃ আযান	01820407417	মোঃ রাশেদুল করিম
16	মোঃ হাসান	০১	হাসান
17	মোঃ কামাল	01861215208	
18	মোঃ তাহির	01787367397	
19	মোঃ আবদুর রহমান হাসান	01827401264	রহমান
20	মোঃ আবুল কাশেম	01881079789	আবুল
21	মোঃ আমিন আলম	01835097146	মোঃ আমিন
22	মোঃ হাসান	01912389510	
23	মোঃ সুমন	01836055294	

SL	Name of Participants	Contact	Signature
24	মো: আবেদিন	0179193755 2	
25	মো: [illegible]	01897202927	
26	মো: আনজারুল ইসলাম	01852953800	
27	মো: [illegible]	01749879605	
28	মো: [illegible]	01[illegible]4510153	
29	[illegible]	01835828620	
30	মো: [illegible]	01820154454	
31	মো: [illegible]	01831400 39	
32	[illegible]	01812523948	
33	মো: [illegible]	01763112753	
34	[illegible]	01812078850	—
35	মো: [illegible]		
36	[illegible]	01818318430	
37	[illegible]	01808936452	
38	[illegible]	01834-141583	
39	[illegible]	01715498986	
40	Md. Hamedul Islam	01817792256	
41	মো: [illegible]	01955195758	
42	[illegible]	01816360802	
43	[illegible]	01819975776	
44	[illegible]	01894114685	
45	[illegible]	01813343140	
46	[illegible]	01735410608	

p. 3

SL	Name of Participants	Contact	Signature
47	উর্মি আক্তার	01879309540	Urmi akter
48	[illegible]	01825418[illegible]	[illegible]
49	[illegible]	[illegible]	[illegible]
50	[illegible]	0188388[illegible]	[illegible]





Annex B4 – SE and social survey: Stakeholder Engagement Log

Minutes

HASKONING NEDERLAND B.V.
WATER & MARITIME

Present:	See attached lists
Apologies:	Click to enter "Apologies"
From:	-
Date:	8, 9, 20, 21, 22, 26 & 27 April 2026
Location:	Multiple Locations
Copy:	Click to enter "CopyTo"
Our reference:	BK4589-HAS-ES-XX-RP-EV-0001
Classification:	Project related
Enclosures:	Click to enter "Enclosures"

Subject: Minutes from Focus Group Discussions (12)

FGD with Shop Owners Potentially Impacted (Blocks A–C of the Proposed Container Terminal Area)

Date: 22 April 2026
Location: 15 No. Ghat, South Patenga, Ward No. 41
Number of Participants: 08 (Male: 08, Female: 00)
The local businessmen discussed economic opportunities, infrastructure challenges, and social concerns associated with ongoing and future development activities in the project area.

- Most businesses operating in the area are long-established family-run enterprises that have been functioning for approximately 15–20 years, mainly serving local residents, labourers, transport workers, and industrial employees.
- Participants stated that nearby industrial and infrastructure development projects have positively influenced local commercial activities by increasing worker movement, customer demand, and overall economic transactions.
- Business owners reported noticeable improvements in sales and income due to the influx of workers and increased development-related activities in surrounding areas.

- Irregular electricity supply and prolonged power outages were identified as major operational challenges affecting business productivity, preservation of goods, and routine commercial operations.
- Limited access to safe drinking water due to salinity intrusion was highlighted as a major concern. Many businesses and households depend on purchased drinking water, increasing their daily expenditure.
- Participants generally viewed future development projects positively and expected that improved infrastructure and industrial expansion would further increase employment opportunities and market demand.
- However, participants strongly emphasized the need for livelihood restoration and rehabilitation support before displacement caused by future project implementation activities.
- The participants requested alternative income-generating opportunities and priority employment support for affected local residents under the Project.
- Concerns were also raised regarding the influx of outside workers, particularly related to community security, social conflict, and women's safety if proper management and monitoring systems are not established.

Environmental and Social Impact Assessment (ESIA) Study for the Laldia Container Terminal Project.

Attendances: FGDs/Public Consultation

Location: 12 নং ঘাট, ৪১ নং ওয়ার্ড, দঃ পতেঙ্গা

Date: 22.04.2026

SL	Name of Participants	Contact	Signature
01	মোঃ [illegible]	018/870/477	MD. [illegible]
02	মোঃ [illegible]	01831714736	
03	এম, এ, বক্কর	01826025073	M.A. Bakkar
04	মোঃ [illegible]	01862403097	
05	[illegible]	01814944191	
06	মোঃ [illegible]	01629916195	
07	মোঃ [illegible]	01811817618	
08	[illegible]	01813678226	



FGD with Fishermen Groups

Date: 21 April 2026
Location: 12 No. Ghat, Ward No. 41, South Patenga
Number of Participants: 07 (Male: 07, Female: 00)
The fishermen highlighted concerns regarding declining fish availability, environmental degradation, loss of fishing grounds, and livelihood insecurity.

- Fishing has traditionally been the primary occupation of local communities in the area, with many fishermen engaged in the profession for generations. The occupation represents both an economic activity and a cultural heritage inherited from their ancestors.

- Fishing activities are mainly concentrated between Ghat No. 10 and Ghat No. 13 using traditional boats, manual nets, and small-scale fishing equipment. Most fishermen lack access to modern fishing technologies.
- Participants stated that household income is highly dependent on daily fishing activities, making their economic condition vulnerable to environmental changes and restrictions on fishing operations.
- Fishermen reported a significant decline in fish availability due to river pollution, industrial waste discharge, navigation activities, and development interventions affecting aquatic habitats and water quality.
- Traditional fishermen expressed concern over increasing competition from technologically advanced fishing operations using larger vessels and sonar systems.
- Participants feared that construction and operation of the Laldia Container Terminal may restrict access to traditional fishing areas, resulting in substantial loss of income and disruption of their livelihoods.
- Increased vessel movement after terminal operation may also create navigation difficulties and increase the risk of accidents for small fishing boats.
- Some fishermen stated that they may be forced to travel to deeper offshore areas for fishing if nearby fishing grounds become inaccessible, which would increase operational costs and safety risks.
- Participants emphasized the need for compensation, livelihood restoration programs, vocational training, and priority employment opportunities under the Project to reduce economic vulnerability.

ছেলে স্থান-2

ıvironmental and Social Impact Assessment (ESIA) Study for the Laldia Container Terminal Project.

ছেলে স্থান

Attendances: FGDs/Public Consultation

সময়:-দুপুর-১২.০০ ঘটিকা

ɔcation: ১২ নং ওয়ার্ড ৪ নং ঘাট ঃ কাতরে

Date: 21.04.2026

SL	Name of Participants	Contact	Signature
১.	কাঞ্চন মল্লদাস	01317008775	কাঞ্চন
২.	সুমন মল্লদাস	01871811655	সুমন দাস
৩.	যমিনি মল্লদাস	01891673485	
৪.	তপন মল্লদাস	01840156054	তপন দাস
৫.	রাজু মল্লদাস	01891C73485	রাজু
৬.	জানু মল্লদাস	01851C07279	[illegible]
৭.	টুলু মল্লদাস	01853116389	টুলু



FGD with Truck/Relevant Labor Unions

Date: 09 April 2026
Location: Ward Commissioner Office, 41 Ward.
Number of Participants: 15 (Male: 15, Female: 00)
The labourers associated with truck loading, unloading, and transportation activities discussed both the opportunities and operational challenges associated with the proposed Project.

- Participants believed that operation of the Laldia Container Terminal may increase labour demand and create additional employment opportunities for transport-related workers.
- Labourers emphasized the need for a transparent and fair recruitment process directly managed by authorities or transport owners rather than through brokers or middlemen.
- Participants reported that labour recruitment through brokers often results in lower wages, irregular employment, and unfair treatment of workers.
- Severe traffic congestion on the VIP Road was identified as a major operational challenge affecting transportation efficiency and labour productivity.
- Participants recommended establishment of dedicated truck parking facilities and improved traffic management systems to reduce congestion and operational delays.
- Labourers stated that prolonged traffic congestion directly affects their income because payment depends on completion of unloading activities.
- The group emphasized that improved transport management, organized labour systems, and fair employment practices would significantly benefit transport workers and associated labour communities.

Environmental and Social Impact Assessment (ESIA) Study for the Laldia Container Terminal Project

Attendances: FGDs/Public Consultation

Location: Date:

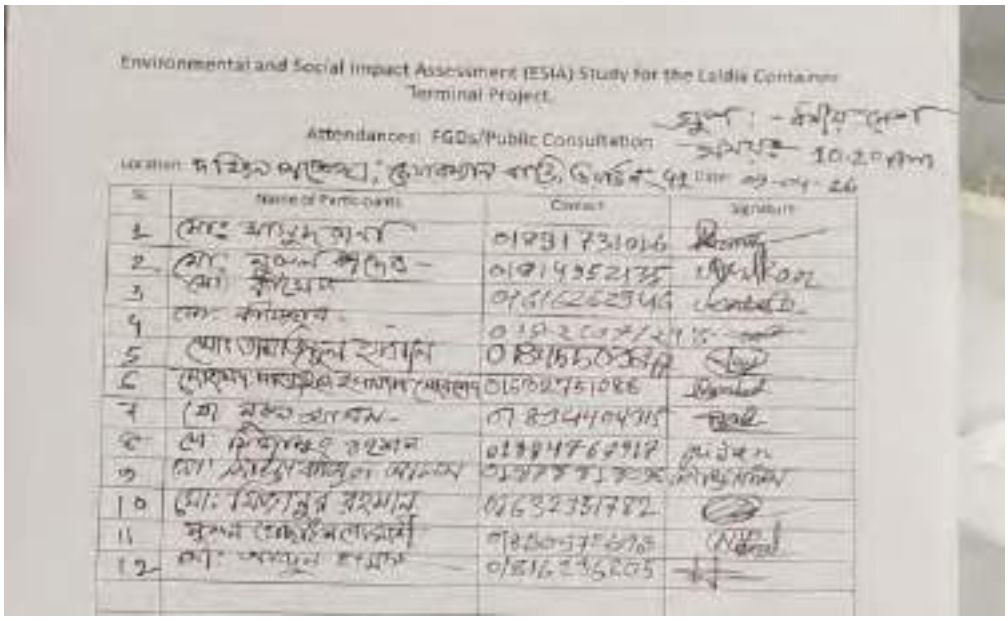
Sl.	Name of Participants	Contact	Signature
1		01623835	
2		01870216999	
		01823964690	
		01855	
		01815993863	
		01830056890	
		01816179954	
		01827576824	
		01609501054	
		01645681933	
		01824021409	
		01898929280	
		01890193765	
		01840916096	
		01843699228	



FGD with Religious Groups

Date: 09 April 2026
Location: Patenga
Number of Participants: 12 (Male: 12, Female: 00)
The religious leaders discussed employment challenges, social welfare, and expectations regarding local development associated with the Project.

- Participants reported that religious leaders and associated community members often experience financial hardship due to limited income-generating opportunities.
- The group requested that project authorities provide suitable employment opportunities for religious leaders and economically vulnerable community members.
- Religious leaders expressed willingness to cooperate fully with successful implementation of the Laldia Container Terminal Project.
- Participants believed that the Project would contribute positively to regional development, infrastructure improvement, and enhancement of local living standards.
- The group also expressed the opinion that improved infrastructure and industrial development may attract additional foreign investment and economic growth in the region.


Environmental and Social Impact Assessment (ESIA) Study for the Laldia Container Terminal Project.

Attendances: FGDs/Public Consultation

Sl.	Name of Participants	Contact	Signature
1		01931731016	
2		01914552135	
3		01616625945	
4			
5		01815503811	
6		01582751086	
7		01834404315	
8		01884766918	
9			
10		01632351782	
11			
12		01816245205	



FGD with Youth Groups

Date: 22 April 2026
Location: Dakkin Patanga, Ward No. 41
Number of Participants: 13 (Male: 13, Female: 00)
The youth participants expressed optimism regarding employment generation, economic growth, and regional development opportunities associated with the Project.

- Participants strongly emphasized the need for sustainable employment opportunities for local youth, particularly for educated but unemployed young people.
- The youth group requested that local residents should receive priority consideration in project-related employment opportunities based on qualifications and skills.
- Participants stated that development-related promises often remain unimplemented; therefore, they emphasized the need for practical and transparent employment commitments.
- According to the participants, improved employment opportunities and local economic development would contribute positively to the socio-economic advancement of Chattogram and Bangladesh as a whole.
- The youth group generally viewed the Laldia Container Terminal Project as a positive development initiative that could improve infrastructure, business opportunities, and employment conditions.
- Participants expressed their willingness to cooperate with project authorities and support successful implementation of the Project if local people are adequately included in the development process.

Haskoning
Enhancing Society Together



Environmental and Social Impact Assessment (ESIA) Study for the Laldia Container Terminal Project.

Attendances: FGDs/Public Consultation

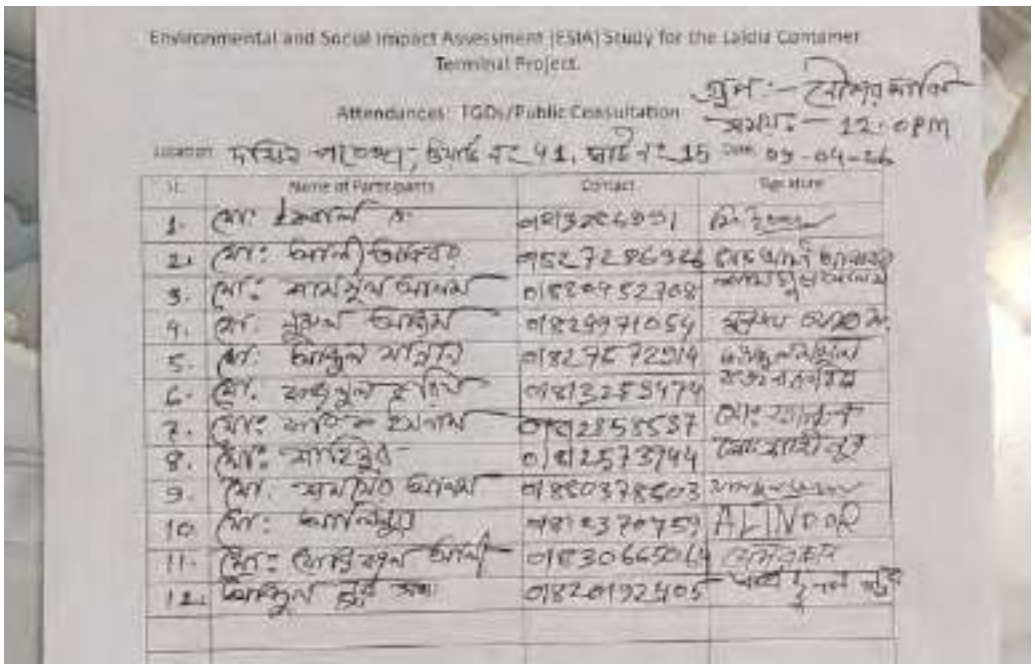
Location: Date: 22-04-2026

SL	Name of Participants	Contact	Signature
01		01533620778	
02		01602215934	
03		01684636445	
04		01756158372	
05		01763020393	
06		01882788877	
07		01312251835	Nabil
08		01811260040	
09		01736590188	
10.		01868936452	
11.		01858840485	
12		01894	
		01830	

FGD with Boatmen Groups

Date: 09 April 2026
Location: Dakkin Patanga, Ward No. 41
Number of Participants: 12 (Male: 12, Female: 00)
The boatmen expressed serious concerns regarding the potential impacts of the Project on their traditional occupation and livelihood security.

- Participants reported that boat ghats may remain temporarily or permanently closed during construction activities, disrupting transportation and income-generating activities.
- Restrictions on boat movement and reduced passenger transportation may significantly decrease their daily earnings and increase financial hardship.
- Most participants stated that they possess limited education and lack alternative vocational skills, making occupational transition difficult if their traditional livelihood is affected.
- Participants mentioned that boat operation has been their primary and hereditary occupation for generations. Therefore, loss of access to river transportation activities would threaten both their livelihood and traditional identity.
- The boatmen emphasized the need for livelihood restoration measures, vocational training programs, and inclusion of affected people in alternative employment opportunities under the Project.
- FGD with Boatmen group, at Ghat No.15, on 09 April 2026





FGD with Women Groups

Date: 21 April 2026
Location: 41 No. Ward, South Patenga
Number of Participants: 10 (Male: 00, Female: 10)
The women participants highlighted a broad range of socio-economic, environmental, healthcare, and safety-related concerns affecting community well-being.

- Women's participation in income-generating activities remains limited, with most women engaged in household responsibilities and only a few involved in NGO-related activities.
- Access to safe drinking water was identified as a major challenge due to salinity intrusion into local water sources. Many households depend on purchased water for daily use.
- Participants reported that skin diseases and other health complications are increasing due to poor water quality and environmental pollution.
- Community safety, particularly for women and adolescent girls, remains a serious concern due to eve-teasing, harassment, insecurity, and anti-social activities associated with unemployed youth and outside labourers.
- Women expressed interest in office-based, computer-related, tailoring, sewing, handicraft, and vocational jobs rather than physically demanding labour-intensive activities.
- Concerns were raised regarding trafficking of women and children, with participants mentioning incidents of missing children within the community.
- Participants also reported cases of employment-related fraud where local residents were deceived by false job promises in exchange for money.
- Gender-based violence, domestic conflicts, and social inequalities were identified as major social challenges affecting women's empowerment and well-being.
- Participants emphasized the need for awareness programs, self-defense training, and social protection initiatives to improve women's safety and confidence.
- Women reported limited involvement in household decision-making processes, particularly regarding financial and major family matters.
- Unemployment and inadequate healthcare services were identified as major concerns due to limited access to affordable and quality medical facilities.
- Participants expected the Project to improve local livelihoods through employment generation but emphasized the need for skill development programs and priority employment opportunities for local educated youth.

- Environmental issues such as reduction of agricultural land, declining fish availability, coal ash impacts, groundwater depletion, and waterlogging have negatively affected food security and livelihoods.
- Electricity supply was reported to be highly unreliable, with severe load shedding disrupting household activities and productivity.
- Maternal and child healthcare services were described as inadequate, resulting in delayed treatment and increased health risks.
- Floods, cyclones, tidal surges, and extreme weather events frequently affect the community, damaging houses, disrupting livelihoods, and increasing vulnerability.
- Due to the absence of dedicated cyclone shelters, residents often take refuge in nearby schools and colleges during disasters.
- Participants recommended pond excavation, improved drainage systems, and enhanced disaster preparedness measures to strengthen community resilience.
- Environmental and Social Impact Assessment (ESIA) Study for the Laldia Container Terminal Project.

Attendances: FGDs/Public Consultation

Location: [illegible] Date: 21.04.2026

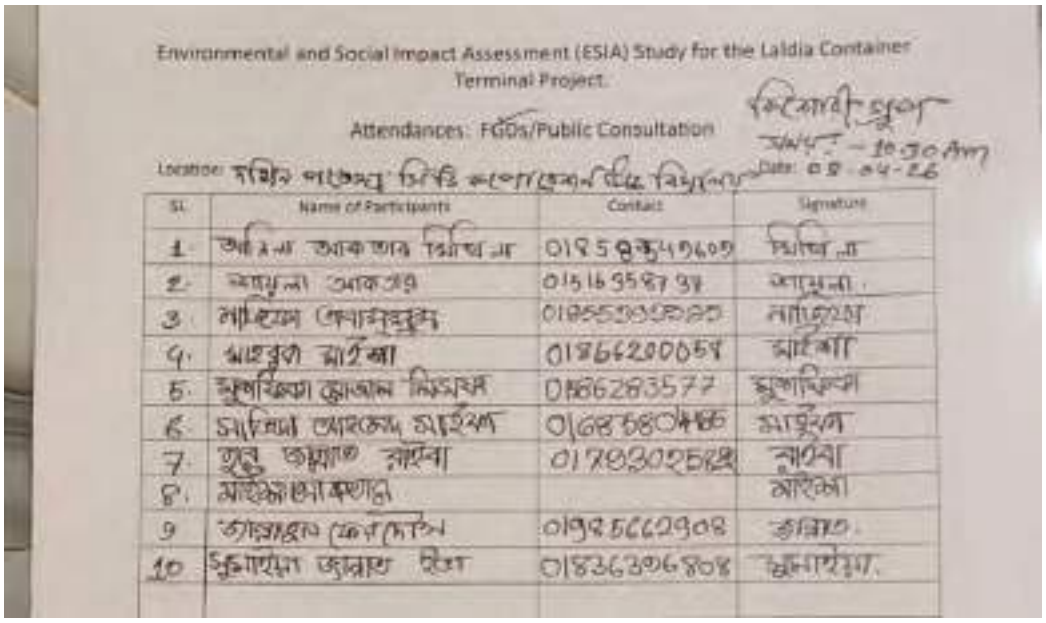
SL	Name of Participants	Contact	Signature
01.	[illegible]	01877197889	
02.	[illegible]	" (R)	
03.	[illegible]	01884619404	
04.	[illegible]	01814806614	
05.	[illegible]	01812098925	
06.	[illegible]	01866209959	
07.	[illegible]	01403420006	
08.	[illegible]	01793712480	
09.	[illegible]	" (R)	
10.	[illegible]	01877197889(R)	



FGD with Adolescent Girls

Date: 08 April 2026
Location: City Corporation High School, Dakkin Patanga
Number of Participants: 10 (Male: 00, Female: 10)
The adolescent girls highlighted concerns related to education, sanitation, safety, and transportation facilities.

- Participants reported the absence of separate and adequate toilet facilities for female students, creating discomfort and hygiene-related challenges.
- Severe traffic congestion near the airport area regularly delays their movement to and from school, affecting attendance and academic performance.
- Participants stated that there are no structured awareness programs regarding menstrual hygiene management within schools.
- Inadequate waste management systems within school premises create unhygienic conditions and potential health risks.
- The participants emphasized the need for improved educational infrastructure, gender-sensitive sanitation facilities, and safer transportation systems for students.



Environmental and Social Impact Assessment (ESIA) Study for the Laldia Container Terminal Project.

Attendances: FGDs/Public Consultation

Sl.	Name of Participants	Contact	Signature
1	[illegible]	0185[illegible]49609	[illegible]
2	[illegible]	01516959797	[illegible]
3	[illegible]	01855[illegible]	[illegible]
4	[illegible]	01866200054	[illegible]
5	[illegible]	01886283577	[illegible]
6	[illegible]	01688580466	[illegible]
7	[illegible]	01709302582	[illegible]
8	[illegible]		[illegible]
9	[illegible]	01925[illegible]908	[illegible]
10	[illegible]	01836306804	[illegible]



FGD with Landless Households

Date: 26 April 2026
Location: Miazi Para, Ward 41
Number of Participants: 16 (Male: 15, Female: 01)
The landless and displaced households discussed compensation, rehabilitation, and resettlement concerns associated with development interventions.

- Participants emphasized that affected landowners should receive fair and adequate compensation for acquired land in accordance with market value and legal procedures.
- Compensation should also be provided for damaged or demolished houses, structures, and other physical assets affected by project implementation.
- Many participants stated that families who previously lost land and housing are currently living in rented accommodations or on government land under unstable conditions.
- The participants stressed the need for proper rehabilitation and resettlement arrangements to ensure secure housing and stable living conditions for displaced households.
- Participants requested government support in identifying suitable settlement locations and providing basic services and infrastructure facilities for affected families.

- The landless households emphasized that rehabilitation support should also include livelihood restoration measures to ensure long-term socio-economic stability.

Environmental and Social Impact Assessment (ESIA) Study for the Laldia Container Terminal Project.

Attendances: FGDs/Public Consultation

Location: মিরাবী-কান্দু-দঃ পাতেহা ওয়ার্ড-নং 41 Date: 26-04-26

SL	Name of Participants	Contact	Signature
1.	মো: মুস্তাফিজুর রহমান	01714040544	
2.	মো: সাইফুল ইসলাম	01720675676	
3.	মো: জসিমুল গনি	01876812361	
4.	মো: কাশির ইকবাল	01871354822	
5.	মো: শাহিনুর	01817089956	
6.	মো: নুর হোসেন	01819358876	
7.	মো: আবুল কাশেম	01716804650	
8.	মো: বশির আহমেদ	01843582316	
9	মো: নুর আলম	01878163154	
10	মো: বাপ্পি	01823312045	
11	মো: কাশেম	01815075875	
12	মো: ইসলাম	01857271517	
13	মো: লিয়াব	01817989212	
14	মো: সেলিম	01625152312	
15	মো: জসিম	01723-117043	
16	তাসলিমা আক্তার	01762443586	



FGD with Ferry Ghat Workers and Ferry Users

Date: 20 April 2026
Location: 14 No. Ferry Ghat, Laldia
Number of Participants: 18 men, no women.
The ferry ghat workers and users discussed transportation dependency, operational challenges, and livelihood concerns related to ferry services.

- Participants stated that ferry services play an important role in local transportation and daily movement of workers, students, and residents.
- Workers expressed concern that project construction activities may temporarily disrupt ferry operations and reduce passenger movement.
- Ferry users emphasized the importance of maintaining uninterrupted transportation services during project implementation.
- Participants requested that if project interventions in Block A and Block B create movement restrictions or limit existing access routes, adequate connectivity measures should be ensured through the construction of an overpass or underpass for safe and convenient movement of workers and local people.
- Participants requested proper traffic and river transportation management to minimize disruption of commuting and economic activities.
- Workers also requested compensation and alternative livelihood support if ferry operations are affected by project activities.



FGD with Vulnerable Groups

Date: 27 April 2026
Location: Dakkin Patanga, Phulchari Para
Number of Participants: 10 (Male: 10, Female: 00)
Participants from vulnerable groups emphasized the need for social inclusion, livelihood support, and improved living conditions.

- Participants requested allocation of designated settlement areas for helpless and vulnerable individuals to ensure secure living arrangements.
- Vulnerable groups expressed the need for employment opportunities within the Project to improve economic stability and reduce dependency.
- Participants highlighted that socially marginalized and economically disadvantaged groups often face discrimination and limited opportunities.
- The group emphasized the importance of social inclusion measures that would improve dignity, identity, and community acceptance.
- Participants expressed the desire to achieve a standard of living comparable to other community members through stable employment and improved access to services.

Environmental and Social Impact Assessment (ESIA) Study for the Laldia Container Terminal Project.

Attendances: FGDs/Public Consultation

Location: ফুলছড়ি কান্দি, দক্ষিণ পতেঙ্গা, ওয়ার্ড নং 41 Date: 27-04-26

Sl.	Name of Participants	Contact	Signature
1.	মো: কামরুজ্জামান	01752550838	
2.	মো: করিম ইসলাম	01875608315	
3.	মো: বেলাল হোসেন নিশান	01767162043	
4.	মো: তালাইমিন	01625445935	
5	মো: ওয়াজি হাসান	01615095872	
6	মো: কিবরিয়া হোসেন	01814-306942	
7.	মো: কামাউজ্জামান হোসাইন	01533620798	
8.	ইলোরা মিয়া	01731920505	
9.	নুরুল ইসলাম	01731361044	
10.	আবির হোসাইন আও	01860730904	



FGD with Workers in Incontrade

Date: 27 April 2026
Location: Bijoynagar, Ward 41, Laldia
Number of Participants: 14 (Male: 14, Female: 00)
A Focus Group Discussion (FGD) was conducted with workers engaged in activities related to Incontrade. Discussions focused on employment conditions, living arrangements, labour expectations, use of surrounding spaces, and anticipated impacts of the Project.
Key Findings

- Participants were engaged in various types of work, including loading and unloading, warehouse operations, transportation support, security services, and other labour-intensive activities within the Incontrade compound.
- Some workers reported living within or near the Incontrade compound for work convenience, while onsite workers generally followed shift-based working arrangements.
- Workers commonly used the surrounding areas for daily movement, informal gatherings,
- Participants noted that vegetable cultivation occasionally takes place along sections of the drainage channel, mainly on a seasonal or temporary basis.
- Participants indicated that implementation of the Project may require additional skilled labour and technical workforce in the future.
- It was reported that there is currently no trade union or formal institution.
- Participants emphasized the need for improved access roads to facilitate worker mobility, transportation, and operational activities.
- Particularly, the inhabitants of Bojoynagar required recreation place or playing ground.
- Concerns were raised regarding occupational health and safety conditions during both construction and operational phases of the Project, including the need for proper personal protective equipment (PPE) and safer working environments.
- Participants also highlighted the importance of technical skill development and vocational training programs to enhance long-term employment opportunities, income stability, and worker capacity

Environmental and Social Impact Assessment (ESIA) Study for the Laldia Container Terminal Project.

Attendances: FGDs/Public Consultation

Location: বিক্রয়নগর; Ts: পাতেঙ্গা, ওয়ার্ড নং 41

Date: 26-04-26

SL	Name of Participants	Contact	Signature
1.	মো: মোস্তাফিজুর রহমান	01714040544	
2.	মো: নুরুল হুদা	01711735332	নুরুল হুদা
3.	মো: সাইফুল ইসলাম	01723075678	
4.	মো: আবদুল খালেক	01723-117043	
5.	মো: আসাদুজ্জামান	01866608920	Asad
6.	মো: সোহরাব হোসেন	01622978577	
7.	মো: সোবারুন হোসেন	01887885988	
8.	মো: সাজ্জাদাত হোসেন	01680858859	
9.	মো: বাহারুল আলম	01828040439	Jahangir
10	মো: তিয়ে মি সামুন	01752136638	Ramun
11.	মো: বক্কর	01580 49978	
12.	মো: আবসার	01646225377	আবির
13	মো: ওয়ালি	01788403391	মো: ওয়ালি
14	তাসলিমা খাতুন	01762449586	



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Annex B5 – SE and social survey : Social survey questionnaire

No.	Question	Answer Option
1.1	ID Interviewee	
1.2	Name Interviewee	
1.3	Project influence area	1-3 KM
		4-5 KM
		Within 1 KM
1.3.1	GPS coordinates _latitude	
1.3.2	GPS coordinates _longitude	
1.3.3	GPS coordinates _altitude	
1.3.4	GPS coordinates _precision	
1.4	Sex of Respondent	Female
		Male
1.5	Age Category	15 to 19
		20 to 24
		25 to 29
		30 to 49
		50 to 59
		60 to 64
		More than 64
1.5.1	Age	
2.1	Are you the head of the household?	No
		Yes
2.1.1	If no, what is your relationship to the head of the household?	Cousin (চাচাতো ভাই)
		In-law (শ্বশুরবাড়ির লোকজন)
		Other relative (অন্যান্য আত্মীয়)
		Parent (অভিভাবক)
		Son / Daughter (ছেলে / মেয়ে)
		Spouse / Partner (স্বামী/স্ত্রী / সঙ্গী)
2.2	Is the head of the household Male of Female	Female
		Male
2.3	Name of Neighbourhood/Ward /Upazilla (২.৩ পাড়া/ওয়ার্ড/উপজেলার নাম)	
2.3.1	Area	Anwara
		CCC
		Potiya
2.4	How many years have your HH lived at this location?	10 – 15 years
		5 – 10 years
		Less than 5 years
		More than 15 years
2.4.1	What is the main reason for living in this area?	Employment opportunities
		Affordable housing
		Proximity to workplace

No.	Question	Answer Option
		Family/ancestral residence
		Better environment
		Displaced from Laldia Char
2.5	Where did you live before you moved here?	
2.6	What ethnic group do you belong to?	
2.8	Religion	Buddhist
		Hinduism
		Muslim
2.9	How many people live in your household?	1 to 2
		3 to 5
		6 to 10
		More than 10
2.10	What is the highest level of education of the head of the household?	Below SSC
		Can only read
		Can read and write
		Graduate or equivalent
		HSC or equivalent
		No Education
		Post graduate or equivalent
		Primary Religious Education
		Religious Education non-recognized
		SSC or equivalent
		Vocational Training
2.11	What is the highest level of education of other members of the household? ২.১১ পরিবারের অন্য সদস্যের সর্বোচ্চ শিক্ষাগত যোগ্যতা	Below SSC
		Can only read
		Can read and write
		Graduate or equivalent
		HSC or equivalent
		No Education
		Post graduate or equivalent
		Primary Religious Education
		Religious Education non-recognized
		SSC or equivalent
		Vocational Training
2.12	What is the main source of income of the HH?	Agriculture related day labour
		Aquaculture
		Boat man/ Boat operator
		Business
		Carpenter
		Construction worker
		Cook
		Day laborer
		Delivery man

No.	Question	Answer Option
		Driver
		Electrician
		Farmer
		Fishermen
		Garment Worker
		Government job
		Housewife / Houseman
		Immigrant
		Maintenance Technician / Equipment Mechanic
		Medical practitioner
		Navigation (transport of people and goods)
		Plumber
		Port job
		Retired
		Security guard
		Service (private, lawyers, consultant, NGO)
		Tailor
		Teacher
		Wage labour
		lasher/stuwador
2.13	What is a secondary source of income (if any) of the HH? (২.১৩ পরিবারটির আয়ের দ্বিতীয় উৎস কী (যদি থাকে)?)	Agriculture related day labour (কৃষি সম্পর্কিত দিনমজুর)
		Aquaculture (জলজ চাষ)
		Carpenter (ছুতার)
		Construction worker (নির্মাণ শ্রমিক)
		Farmer (কৃষক)
		Fishing (মাছ ধরা)
		Government (সরকার)
		Housewife / Houseman (গৃহিণী / গৃহকর্তা)
		Maintenance Technician / Equipment Mechanic (রক্ষণাবেক্ষণ টেকনিশিয়ান / সরঞ্জাম মেকানিক)
		Navigation (transport of people and goods) (নৌচলাচল (মানুষ ও পণ্য পরিবহন))
		Other (অন্যান্য)
		Port Security (বন্দর নিরাপত্তা)
		Retired (অবসরপ্রাপ্ত)

No.	Question	Answer Option
		Service (private, lawyers, consultant, NGO) (সেবা (ব্যক্তিগত, আইনজীবী, পরামর্শক, এনজিও))
		Teacher (শিক্ষক)
		Trade/shop keeper (ব্যবসায়ী/দোকানদার)
		Truck Dispatcher, Stuffing/unstuffing of containers (ট্রাক ডিসপ্যাচার, কন্টেইনারে মালামাল ভরা ও খালি করা)
		Truck Driver (ট্রাক চালক)
2.14	What is the occupation of other adult members of the HH? ২.১৪ পরিবারের অন্য প্রাপ্ত বয়স্ক সদস্যের পেশা	Service (private, lawyers, consultant, NGO)
		Trade/shop keeper
		Farmer
		Agriculture related day labour
		Truck Driver
		Truck Dispatcher, Stuffing/unstuffing of containers
		Port Security
		Maintenance Technician / Equipment Mechanic
		Housewife / Houseman
		Aquaculture
		Navigation (transport of people and goods)
		Government
		Carpenter
		Construction worker
		lasher/stuwador
		Medical practitioner
		Fishing
		Teacher
		Retired
		Other
2.15	Are you dependent on the environment for your income or sources of food/drink?	
2.15.1	if 2.15 yes, what?	পানি আছে দেখেই জীবন কাটতেছে, আয় রোজগার আছে
		পানি, কৃষি
		পানি, চাষাবাদ
		পানি, মাছ
		পানি,দিনমজুরি
		পানির ব্যবহার

No.	Question	Answer Option
		পানীয়
		পানীয়, খামার, কৃষি
		পানীয়জল
		পানীয়জল ব্যবহার, কৃষি কাজে দিনমজুর
		বর্ষায় বাবার কাজ অফ থাকে, বন্যায় গাড়ি অফ থাকে ব্যবসায় ক্ষতি হয়।
		বৃষ্টি থাকলে গরু ঘরে বন্ধী থাকে,কেনা খাবার দেয়া লাগে
		ব্যবহারিক কাজে
		ব্যবহারিক কাজে এবং কৃষি কাজে
		মাছ কিনে বিক্রি করে।
		মাছ ধরি
		মাছ ধরে আর টিউবওয়েলের পানি ব্যবহার করি
		মাছ ধরে আর টিউবওয়েলের পানি ব্যবহার করে
		মাছ ধরে এবং টিউবওয়েলের পানি ব্যবহার করে
		মাছ ধরে নদী থেকে
		মাছের ব্যবসা আমার
		লবণাক্ত পানির কারণে খাবার পানি কিনে খেতে হয়।
2.16	How would you describe the total monthly income of your household? (Include all sources of income: wages, business, remittances, farming, etc.)	12,001 – 20,000 BDT
		20,001 – 30,000 BDT
		30,001 – 50,000+ BDT
		6001 – 12,000 BDT
		More than 50000 BDT
2.17	How would you describe the economic condition of your household?	High / Above average
		Low / Below average
		Medium / Average
		Very low / Poor
3.1	What type of house do you have?	Make-shift housing
		Semi pucca
		Stone house
		Tin-made
		Wooden house
3.2	Land ownership	Government
		Owner
		Rental
3.3	House ownership	Living with relatives
		Owner

No.	Question	Answer Option
		Rental
3.4	How much do you spend monthly on house rent?	BDT 3,000–6,000
		BDT 6,001–10,000
		Below BDT 3,000
		Not applicable (owner)
3.5a	Rent For a three-room permanent (pucca) house	Above BDT 15,000
		BDT 10,001–15,000
		BDT 5,000–10,000
		Below BDT 5,000
3.5b	Rent For a two-room house:	BDT 3,000–6,000
		BDT 6,001–10,000
		Below BDT 3,000
3.6	Are new houses being constructed regularly in this area?	No significant change
		Not sure
		Yes, but slowly
		Yes, rapidly increasing
3.7	How would you describe the pressure of new population in this area?	Low
		Moderate
		No noticeable change
		Very high
3.8	Which groups of people predominantly live in this area?	Local residents (native inhabitants)
		Migrant workers
		Mixed population
		Immigrants
		Other
4.1	Physical and Mental Condition of HH member	Chronic illness
		Disabled and chronic illness
		Mental illness
		Without disability
4.2	What diseases did your HH members suffer from in the last 6 months? Please circle all that are applicable.	Cholera
		Diarreal (other than cholera)
		Tuberculosis
		Dengue and Chikungunya
		Typhoid
		Hepetites A or E
		Malaria
		Skin infections/scabies
		Not applicable
		Other
4.4	How far are the following services from your residence?	
4.4a	What is the distance to the nearest Government hospital?	1–3 km
		3–5 km

No.	Question	Answer Option
		More than 5 km
		Within 1 km
4.4b	Nearest Private Clinic:	1–3 km
		3–5 km
		More than 5 km
		Within 1 km
4.4c	What is the distance to the nearest pharmacy?	1–3 km
		3–5 km
		Within 1 km
4.4d	Nearest Government School:	1–3 km
		Within 1 km
4.4e	Nearest Private School:	1–3 km
		3–5 km
		Within 1 km
4.4f	Nearest College	1–3 km
		3–5 km
		More than 5 km
		Within 1 km
4.4g	Nearest Market	1–3 km
		3–5 km
		Within 1 km
4.4h	Nearest Local Bus Stand	1–3 km
		3–5 km
		More than 5 km
		Within 1 km
4.4i	Nearest Inter-district Bus Terminal	1–3 km
		3–5 km
		More than 5 km
		Within 1 km
4.5	What is the name of the hospital you go to?	
4.6	What is your main source of drinking water?	Piped Water
		Tube well
		Canal
		Pond
		River
		Borehole (deep or shallow)
		Water vendor
		Water kiosk
		Rainwater
4.7	Is there sufficient drinking water available for drinking and cooking?	No
		Yes
4.7a	if 4.7 is no, describe why	Climate change
		Deforestation

No.	Question	Answer Option
		Drying if underground
		Have to purchase
		Low rainfall
		No regular source
		Poor water management
		Salinity in water
4.8	What source do you use for electricity?	Connected to the grid (গ্রিডের সাথে সংযুক্ত)
		Connected to the grid (গ্রিডের সাথে সংযুক্ত) Generator (জেনারেটর)
		Connected to the grid (গ্রিডের সাথে সংযুক্ত) Solar Panels (সৌর প্যানেল)
		Generator (জেনারেটর)
		Other (অন্যান্য)
		Solar Panels (সৌর প্যানেল) Connected to the grid (গ্রিডের সাথে সংযুক্ত)
4.9	Is there sufficient electricity available?	No
		Yes
4.9a	If 4.9 is nosufficient electricity available, please describe reason	
4.10	Are you aware of STIs and HIV	No
		Yes
4.11	Have you received any information or training on STI/HIV/AIDS	No
		Yes
5.1	Are there locations or buildings which are of cultural or religious importance?	No
		Yes
5.1.1	add location of cultural or religious importance	
5.2	Are there sacred places that you know of in the area?	No
		Yes
5.2.1	Location of sacred places	
5.3	Are there any cultural or religious activities that make use of specific locations?	No
		Yes
5.3.1	Location of cultural or religious activities	
6.1	Are there any conflicts in the area?	No
		Yes
6.2	If yes, what are the conflicts related to?	
6.3	Who do you go to if there are problems/ conflicts in the community	Family member
		Community leader
		Ward leader
		Religious leader
		Other
6.4		No

No.	Question	Answer Option
	Is there any gender-based violence or insecurity in the community?	Yes
6.4.1	If Yes add explanation	Conjugal life conflicts
		Eve teasing
		Eve teasing by local leaders
		Eve teasing, family conflicts
		eve teasing
6.5	Do you or any household members participate in resolving conflicts, mediating issues, or helping others solve problems in the community?	No
		Yes
7.1	What means of transport do you use the most?	Walking
		Public Transport
		Bus
		Riksa
		Ferry
		Bike
		Motorbike
		CNG
		Other
7.2	If you make use of the ferry, for what purpose?	Private
		Work (কাজ)
		School
		Treatment
7.2.1	Please add what purpose	
7.3	If use ferry, what Ghat do you mostly use?	12 (১২)
		12 (১২) 14 (১৪)
		14 (১৪)
		Other (অন্যান্য)
7.4	How do you reach the ghat?	15 – 30 minutes walking
		Auto rickshaw
		Bus
		CNG
		Ferry
		Less than 15 minutes walking
		Not Applicable
		Ricksha
7.5	If applicable, how do you or your children reach school?	15 – 30 minutes walking
		Auto rikshaws
		Bus
		CNG
		Cycle
		Less than 15 minutes walking
		Motor cycle

No.	Question	Answer Option
		Not Applicable
		Ricksha
8.1	What concerns do you have about the port infrastructure developments in the area?	
8.2	What effects do you experience from the existing port activities?	Noise
		Traffic intensity
		Visual
		Light in the night
		Influx of workers
		Employment
		Business
		Business for restaurants
		Community development
		Improved port efficiency
8.2.1	Other opportunities	
8.2.2	Other negative impacts	
8.3	What are your expectations about the new Laldia Container Terminal?	
8.4	What are your concerns about the new Laldia Container Terminal?	
8.5	Did or do you use the areas that are now designated for the development of the LCTP?	No
		Yes
8.6	If you use the areas that are now designated for the development of the LCTP, for what purposes?	
9.1	Do (or did) you or your household members work in the port or related to the port?	No
		Yes
9.2	Would you or your household members want to work in the construction of the new Laldia Terminal?	No
		Yes
9.3	Do you have experience in working in construction?	No
		Yes
9.4	If you have experience in working in construction, In what capacity?	Computer operator
		Construction work
		Lasher/Stuwador
		Maintenance Technician / Equipment Mechanic
		Mason
		Port Security
		Transport worker
		Trelar Driver
		Truck Dispatcher, Stuffing/unstuffing of containers
9.5	Would you or your household members want to work in the operation of the new Laldia Terminal?	No
		Yes

No.	Question	Answer Option
9.6	Do you have experience in working in operation of port facilities?	No
		Yes
9.7	If yes, in what capacity?	Cargo handling
		Dockworker (loading and unloading cargo)
		HSE Officer
		Marine Services Crew (tugboat, mooring crew)
		Port Security Officer
		Truck Driver
		Vessel traffic management
10.1	Did you experience the following climate related issues in the last year?	Cyclones
		Rainfall
		Extreme Winds
		Flooding
		Extreme Heat
10.2	Do you experience water logging near your house? How often?	Monthly
		No
		Rarely
		Weekly
10.3	How long?	1-2 weeks
		1-3 days
		2-4 weeks
		4-7 days
		Less than 1 day
		More than 1 month
11.1	What communication method is most effective for the Project to reach your household?	Direct call
		SMS/whatsapp
		Leaflets/Flyers
		Newspaper
		Website
		Radio
		Direct communication
11.2	If a community meeting about the Project is organised would you come? What would be the conditions for you to come?	Maybe
		No
		Yes
11.2.2	If no or maybe, Please describe reason	

Annex C1 – Specialist Study: Air quality

REPORT

Air Quality Assessment Report

Laldia Container Terminal Environmental and Social Impact Assessment

Client:	Laldia Container Terminal Limited
Reference:	BK4589-HAS-SP-XX-RP-EV-0005
Status:	Draft/01
Date:	27 July 2026

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Document title:	Air Quality Assessment Report
Subtitle:	Laldia Container Terminal Environmental and Social Impact Assessment
Reference:	BK4589-HAS-SP-XX-RP-EV-0005
Your reference	Click or tap here to enter text.
Status:	Draft/01
Date:	27 July 2026
Project name:	Laldia Terminal ESIA
Project number:	BK4589
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1 Introduction

1.1 Project Background

The Laldia Container Terminal Project (LCTP, or the Project) is a strategic initiative to address port congestion challenges in Chattogram by expanding container handling capacity and improving operational efficiency at the Port of Chittagong. Located at Laldia Char along the right bank of the Karnaphuli River in Chattogram, the terminal will add approximately 0.8 million Twenty-Foot Equivalent Unit (TEU) per year of new handling capacity. This will relieve pressure on existing terminals, reduce congestion and vessel waiting times, and strengthen maritime logistics performance to support Bangladesh's trade competitiveness and regional connectivity.

The terminal is being developed under a Public-Private Partnership (PPP) between the Chittagong Port Authority (CPA) and Laldia Container Terminal Ltd. (LCT Ltd.), a joint venture between APM Terminals (APMT) and QNS Container Services Ltd. (QNS Ltd.). A 30-year concession agreement (CA) for the design, financing, construction, operation, and maintenance of the terminal was signed on 17 November 2025, representing one of the largest PPP investments in Bangladesh's port sector. LCT Ltd.'s involvement brings international expertise in container-terminal management, digital optimization, energy-efficient operations, and global best practice in port safety and reliability, supporting the long-term modernization of the Port of Chittagong.

The development of LCTP will take environmental and social aspects into account and therefore an Environmental and Social Impact Assessment (ESIA) is being prepared. This ESIA is prepared for permitting purposes in Bangladesh with the Department of Environment (DoE).

1.2 Aims and Objectives

The aim of the air quality impact assessment is to:

- identify applicable standards and guidelines;
- set out the scope and relevant assessment methodology, assumptions and limitations;
- identify key sensitive receptors in the Project Area of Influence (AoI);
- identify the main sources of potential impact to air quality arising from the construction and operation phases of the Project; and
- determine whether air emissions will impact sensitive receptors.

The objective of the impact assessment is to identify, where necessary, suitable mitigation to eliminate or reduce significant effects to an acceptable level, i.e. such that once mitigation is applied, residual effects are not significant.

2 Legislation, Standards and Guidance

Legislation and Guidance

Air Quality Standards (AQS) are established to protect human health and the environment. In Bangladesh, national ambient AQS were originally set out by the Department of Environment (DoE) in the Environment Conservation Rules (1997) (DoE, 1997) and were subsequently revised in 2023 (DoE, 2023) The Air Pollution Control Rules (APCR) 2022 (DoE, 2022) established a newer framework for AQS based on World Health Organisation (WHO) Air Quality Guideline (AQG) Interim Target 1 (WHO, 2021). An overview of relevant national legislation and guidance is provided in Table 2-1 below.

Table 2-1 National Air Quality Legislation and Guidance

Instrument	Type	Year	Overview
Bangladesh Environment Conservation Act (MoEF, 1995)	Act	1995 (amended 2000, 2002, 2010)	Core environmental law establishing the DoE and enabling regulation of air pollution sources, emission limits, and enforcement powers.
Environment Conservation Rules (DoE, 2023) (DoE, 1997)	Regulation	1997 (revised 2023)	Introduced AQS and emission limits, environmental clearance procedures, and classification of industries based on pollution impact. 2023 revision updated framework with stronger monitoring, stricter pollution standards, and improved compliance mechanisms, including air emissions control.
Air Pollution Control Rules (APCR) (DoE, 2022)	Regulation	2022	Dedicated air pollution rules setting emission standards for industries, vehicles, and projects, and requiring national air quality planning.
National Air Quality Management Plan (NAQMP)	Policy / Plan	2024–2030	National strategy to monitor, manage, and reduce air pollution, including emission inventories, airshed management, and sectoral interventions.
National Environment Policy (MoEFC, 2018)	Policy	2018	Sets broad national direction for pollution control and environmental quality improvement, including air quality goals.
National Action Plan on Short-Lived Climate Pollutants (DoE, 2018)	Policy	2018	Targets reduction of pollutants like black carbon and methane, major contributors to air pollution.

Air Quality Standards and Guidelines

Bangladesh's existing national AQS as set out in the APCR 2022 and the National Air Quality Management Plan 2024-2030 (DoE, 2024) are shown in Table 2-2. National and international AQS, including the most recent WHO Air Quality Guidelines (AQGs) published in September 2021 (WHO, 2021), for SO_2, NO_2, CO, PM_{10} and $PM_{2.5}$ are provided for comparison.

Table 2-2 Air Quality Standards and Guidelines

Pollutant	Averaging period	Bangladesh APCR Standard	WHO (IFC EHS)				
			Interim Targets				AQG Level
			1	2	3	4	
SO_2	10-minute	-	-	-	-	-	500

Pollutant	Averaging period	Bangladesh APCR Standard	WHO (IFC EHS)				
			Interim Targets				AQG Level
			1	2	3	4	
	1-hour	250[(a)]	-	-	-	-	-
	24-hour	80[(a)]	125	50	-	-	40[(b)]
NO_2	1-hour	-	-	-	-	-	200
	24-hour	80[(a)]	120	50	-	-	25[(b)]
	Annual	40	40	30	20	-	10
CO	15-minute	-	-	-	-	-	100,000
	1-hour	20,000[(a)]	-	-	-	-	35,000
	8-hour	5,000[(a)]	-	-	-	-	10,000
	24-hour	-	7,000	-	-	-	4,000[(b)]
PM_{10}	24-hour	150[(a)]	150	100	75	50	45[(b)]
	Annual	50	70	50	30	20	15
$PM_{2.5}$	24-hour	65[(a)]	75	50	37.5	25	15[(b)]
	Annual	35	35	25	15	10	5

[(a)] Mean value not to exceed limit value more than once per year.
[(b)] 99th percentile (i.e. 3-4 exceedances per year).

In accordance with International Finance Corporation (IFC) guidance (IFC, 2007), the national AQS for Bangladesh were considered to be most relevant and were therefore used in the assessment. Where no national AQS are in place, WHO AQGs were assessed against.

3 Assessment Approach and Methodology

3.1 Technical Scope

Emissions to air would be generated by the Project during the construction and operation phases, as detailed in Table 3-1.

Table 3-1 Emissions Sources Identified During Each Phase of the Project

Sources	Pollutants
Construction	
Construction dust and particulate matter emissions	Dust, PM_{10}, $PM_{2.5}$
Exhaust emissions from construction phase vessels	NO_2, PM_{10}, $PM_{2.5}$, SO_2, CO
Emissions from construction phase road traffic	NO_2, PM_{10}, $PM_{2.5}$
Emissions from Non-Road Mobile Machinery (NRMM)	NO_2, PM_{10}, $PM_{2.5}$, SO_2
Operation	
Exhaust emissions from operation phase vessels	NO_2, PM_{10}, $PM_{2.5}$, SO_2, CO
Emissions from operation phase road traffic	NO_2, PM_{10}, $PM_{2.5}$
Point source releases from fuel for energy use	None (electrified)

The Project proponent has determined to use only electrical sources for energy generation throughout the operation phase. Therefore, there are not predicted to be any fixed point source emissions from fuel for energy use over the lifetime of the Project.

3.2 Area of Influence (AoI)

Construction Phase Dust Assessment

The Construction Dust Risk Assessment (CDRA) methodology as set out in the Institute of Air Quality Management (IAQM) Guidance on the assessment of dust from demolition and construction (IAQM, 2024) recommends that the potential impacts of construction dust from demolition, earthworks, construction and trackout (i.e. the transport of mud, dust and dirt from a construction site onto public roads by vehicle wheels, dust from which as it dries out, gets resuspended by other vehicles using the road) are individually assessed. The Project proponent proposes to develop Block C (32 acres), as well as partial areas of Block B (7.15 acres) and Block A (10 acres). Due to the planned construction works for each Block, construction dust emissions are expected to vary in source and magnitude.

The following construction phase activities were identified as requiring assessment in each Block:

- Block A – Trackout.
- Block B – Demolition and Trackout.
- Block C – Demolition, Earthworks, Construction and Trackout.

Emissions of dust and particulate matter generated as a result of construction works would have the greatest effect on receptors within 250 m of the site boundary (IAQM, 2024). Beyond this distance, the overall effect of impacts is anticipated to be not significant.

The AoI for construction dust is therefore 250 m around each Block for all construction phase activities that will occur in that Block. The AoI for trackout is up to 250 m from site entrance(s).

Construction and Operation Phase Vessel Emissions Assessment

The AoI with regard to emissions from vessel activity associated with the construction phase is likely to be limited to receptors within 250 m of offshore activities, and is therefore likely to be limited to workers on site.

The AoI with regard to operation phase vessel emissions is likely to be limited to workers on site as well as residential/ commercial properties located within 250 m of the proposed berth and main areas of manoeuvring.

Construction and Operation Phase Road Traffic Emissions Assessment

The AoI with regard to emissions from road traffic associated with the construction and operation phase is likely to be limited to residential/ commercial properties located within 200 m of the affected road network, which comprises Airport Road/ Patenga Road and VIP Road.

Construction and Operation Phase Plant Emissions Assessment

Construction phase plant will operate principally within Block C where the majority of construction work is scheduled to occur, as well as within Block B. The AoI with regard to emissions from construction phase plant is therefore likely to be limited to workers on site.

All operation phase plant will be fully electric. Therefore, it is expected that the Project will generate zero plant emissions at source during operation. Operation plant has therefore not been considered within this assessment.

3.3 Sensitive Receptors

The sensitive receptor locations identified within the AoI for consideration in the assessment are detailed in Table 3-2 and are shown in Figure 6-1 in the Appendix.

The sensitive receptor locations were selected based on their proximity to the proposed emission sources, where the potential impacts of Project-related emissions on local air pollution would be greatest i.e. locations of worst-case exposure to Project-related emissions. The nearest settlements/ residential properties in each direction around the Project were included, as well as places of worship and educational centres.

Table 3-2 Sensitive Receptors

Receptor ID	Receptor Description	Grid Reference		Receptor Sensitivity
		X	Y	
M1	41 No. Ward, Char Basti, South Patenga	378676	2460538	High
M2	Airport Road, North Patenga	378943	2460922	High
M6	Biman Bondor High School	378950	2461142	High
R1	Baitul Aman Jami Mosque,14 No Colony Rd	379086	2461116	Medium
R2	Chattogram Biman Bandar High School	378987	2461163	High
R3	Residential Building, Airport Road	378902	2460852	High
R4	Workers' Accommodation, Block B, Port Side	379326	2461178	Medium
R5	Coffee Shop, Near Airport Roar/VIP Road Roundabout	378203	2459926	Medium

R6	Mosque, VIP Road	378011	2459885	Medium
R7	Residential Building, VIP Road	377642	2459816	High
R8	CULF Mosque	379273	2459608	Medium
R9	Education Centre	380165	2460832	High
R10	Workers' Accommodation, Block B, Roadside	379199	2461234	Medium
R11	Residential Building, near Bangladesh Marine Academy	380130	2460608	High
R12	Office Building, Airport Road	379008	2461001	Medium
R13	Residential Building, VIP Road	376646	2459572	High
R14	Residential Building, VIP Road	377270	2459833	High
R15	Residential Building, Airport Road	378775	2460664	High
R16	Residential Building, Airport Road	378913	2460869	High
R17	South Patenga City Corporation High School	377089	2459840	High
R18	Residential Building, VIP Road	377605	2459847	High
R19	Bangladesh Marine Academy	380075	2460298	High
R20	Residential Building, VIP Road	376607	2459572	High

3.4 Construction Phase Emissions Assessment

Construction Phase Dust Emissions

Impacts may occur during construction as a result of dust generation and exhaust emissions from construction plant and vehicles. The UK IAQM guidance document (IAQM, 2024) sets out the methodology for establishing the risk of a project to generate dust, taking into account the dust emission magnitude (derived using information on the activities to be undertaken and their scale), and the proximity and number of sensitive receptors. Based on the calculated risk, commensurate mitigation measures are recommended, which, when implemented, are considered to be sufficient to conclude that no significant effects would be experienced. A qualitative dust assessment was undertaken using the IAQM methodology, the full details of the assessment steps are provided in Section 5.1.

Construction Phase Plant Emissions

The potential for impacts of exhaust emissions from construction phase plant were considered qualitatively, taking into account the number and types of plant likely to be used, the prevailing meteorological conditions, the duration of construction, the distance to receptors and the baseline air quality conditions in line with the approach set out in UK Government Department for Environment Food and Rural Affairs (Defra) Local Air Quality Management Technical Guidance (LAQM TG22) (Defra, 2025).

Construction Phase Road Traffic and Vessel Emissions

Road Traffic

As stated in the Road Traffic Impact Study (Haskoning, 2026), is not possible to accurately estimate the number of construction vehicle movements at this stage, as this will largely depend on the construction methodology and logistics strategy adopted by the contractor. However, it is expected that a significant proportion of bulk materials will be transported by water to minimise overall construction road traffic volumes. Although it is expected that slow-moving construction plant will be transported over the road network, these movements are expected to occur infrequently and are therefore unlikely to result in significant road traffic emissions.

Vessels

LAQM TG22 sets out that there is a risk of exceedance of short-term AQS for NO_2, PM_{10} and SO_2 if either of the below criteria are met:

- More than 5,000 large ship movements per year, with relevant exposure within 250 m of the berth and main areas for manoeuvring, or;
- More than 15,000 large ship movements per year, with relevant exposure within 1 km of these areas.

The total number of construction phase vessel trips is less than 5,000, therefore it is not anticipated that exceedances of the short-term AQS for NO_2, PM_{10} or SO_2 will occur. Based on this screening, it was also concluded that exceedance of the short-term AQS for CO is not likely. However, as it was not possible to quantify emissions from construction phase vessels with the information available at this stage.

Road Traffic and Vessels

Given that the bulk of materials required for construction will be transported by water, it is assumed that there will be fewer road vehicles during construction than during the operation phase. It is also assumed that construction phase vessel movements and berthing will occur at a greater distance from receptors and will be of shorter durations, and using smaller individual vessels with lower emissions. The potential impacts of operation phase road traffic and vessel emissions were quantitatively assessed by air dispersion modelling, and it is assumed that construction phase effects associated with road traffic and vessel emissions will be no worse than those assessed for the operation phase.

3.5 Operation Phase Emissions Assessment

Air Dispersion Modelling

Air dispersion (or atmospheric dispersion) modelling was undertaken to consider the impact of the operation phase of the Project.

Pollutant emissions from vessels and road traffic were modelled using the AERMOD atmospheric dispersion model version 24142. AERMOD is an advanced dispersion model based on the Gaussian theory of plume dispersion, developed by the United States Environmental Protection Agency (US EPA). It is widely used internationally for regulatory and assessment purposes and has been accepted by the Bangladesh DoE in previous air emissions impact assessment of developments in Bangladesh.

Atmospheric dispersion is determined by input data (source pollutant release parameters, hourly sequential meteorological data and time-varying emissions factors) to calculate pollutant concentrations across a selected receptor grid and at discrete receptor points.

Traffic Data

Operation phase 24-hour Annual Average Daily Traffic (AADT) flows for staff vehicles and peak day Heavy Goods Vehicles (HGVs) journeys were provided by the Road Traffic Study as part of Laldia ESIA. VIP Road and Airport Road/ Potenga Road are the main access routes to the LCTP and form the primary connection to the wider road network. To the south of the site, both roads are dual-carriageways and are connected by a roundabout approximately 1 km south-west from the proposed boundary of Block C. To the north of Block A, Airport Road/ Potenga Road merges to form a single carriageway road. Based on traffic data distribution, 80% of operation phase traffic is expected to travel down roads to the south of the LCTP and 20% to the north.

Operation phase internal HGV movements were determined from proposed Block C plans showing internal HGV routes within the new container terminal. Internal road links were connected to Airport Road/ Potenga road at the proposed locations of the gate complex entry and exit. The internal HGV daily flow was modelled as the peak day HGV arrivals (2,816 journeys) to provide a worst-case scenario estimate of the air quality impacts resulting from operation phase road traffic.

Traffic speeds were modelled at the relevant speed limit for each road. However, where appropriate, speeds were reduced to simulate queues at junctions, traffic lights and other locations where queues or slower traffic are known to be an issue, in accordance with LAQM TG22 (Defra, 2025).

Road lengths and widths were determined from satellite imagery and from the Bangladesh Road Design Standards (Planning Commission, 2004). It was assumed that internal HGV routes would be the width of a standard two-way road (7.3 m).

The road networks utilised in the air quality assessment are shown in Table 3-3 below.

Table 3-3 Road Network Model Inputs

Road Link	AADT	% HGV	Speed (kph)	Width (m)	Length (m)
VIP Road West	2,643	85.2	45	7.3	2,131.3
VIP Road East	2,643	85.2	45	7.3	2,140.6
VIP Road East (Slowdown)	2,643	85.2	35	7.3	58.4
VIP Road West (Slowdown)	2,643	85.2	35	7.3	77.0
VIP Road/Airport Road Roundabout	2,643	85.2	35	6.2	74.6
Airport Road Northeast (Slowdown)	2,643	85.2	35	7.3	50.2
Airport Road Northeast (South)	2,643	85.2	45	7.3	1,590.1
Airport Road Southwest (South)	2,643	85.2	45	7.3	1,595.3
Airport Road Southwest (Slowdown)	2,643	85.2	35	7.3	49.2
Airport Road Northeast (North)	661	85.2	45	7.3	1,115.5
Airport Road Southwest (North)	661	85.2	45	7.3	1,119.7
Airport Road/Potenga Road	1,321	85.2	45	9.8	253.7
Internal Roads	2,816	85.2	20	7.3	2,966.0

Vessel Data

The Project is expected to have a maximum annual Twenty-foot Equivalent Unit (TEU) capacity of 1,400,000 TEU and there will be an estimated 410 vessel journeys per year. This is below the 5,000 large vessel movements a year threshold set out in LAQM TG22 (Defra, 2025), and therefore modelling of vessel emissions was not required. However, vessel emissions were included within the model to determine the total effect of the operation phase of the Project on air quality.

Container Vessels

Approach and berthing simulations were run by HR Wallingford (HR Wallingford, 2024) for two types of container vessels, the Chittagong Max, a 186 m long IMO Tier III, and WAFMAX, a 250 m long IMO Tier II.

As it was assumed that each vessel journey would deliver the same TEU regardless of vessel nominal TEU, the WAFMAX was chosen for use in the air dispersion model as a worst-case scenario due to its larger size and lower IMO engine category tier. Container vessels with Tier II engines comply with less stringent emissions standards than those with Tier III engines. Therefore, assuming all journeys are undertaken by WAFMAX vessels is considered to be a conservative approach.

Speed over Ground (SoG) was obtained from the simulation report (HR Wallingford, 2024) for the 250 m vessel and the maneuvering track, which plotted vessel position every two minutes, was used to model the vessel approach. For vessel unberthing, the only simulation run available was for the 350 m container ship, which is not a consideration for this assessment. As there was no turning required on departure, it was assumed that the 250 m vessel would follow the same manoeuvre track as the larger vessel. For departure following unberthing, no simulation data was available. It was therefore assumed that following unberthing, the vessel accelerates uniformly in a straight line to reach the maximum speed recorded on its approach at the mouth of the river. Equations of motion were then applied to identify distances and speeds for each link length.

Tugboats

It was assumed that two 60tBP ASD tugboats would assist in maneuvering. The times for which the tugboats acted on the ship were determined from the 250 m vessel approach simulation report. As tugboat movements were not depicted on the simulation run for vessel unberthing, it was assumed that the tugboats would be operational only during vessel approach when assisting with container vessel berthing.

Details of the vessels used in the air dispersion modelling study are shown below in Table 3-4.

Table 3-4 Details of Vessels used in Dispersion Modelling Study

Parameter	Container Vessel	Tugboats
Vessel Type	Maersk Congo WAFMAX	2 x 60tBP ASD tugs
Engine Power (kW)	23,000	3,728
Maximum Speed (kn)	21.5	13
Stack Height (meters above waterline)	40	16
Fuel Type	Marine Diesel Oil	Marine Diesel Oil
Engine Category	C3	C1
IMO Tier	Tier II	Tier III

Emissions Factors

Operation Phase Traffic Emissions

As there are no official national emissions factors for Bangladesh, 2026 emissions factors were obtained from the Emissions Factors Toolkit (EFT) v14.1 published by Defra (Defra, 2026). Emissions factors of NO_x, PM_{10} and $PM_{2.5}$ for the Current Year (2026) were used in the assessment scenario. Emissions factors were determined using a bespoke Euro Fleet, which allows the user to specify Euro class and vehicle size distributions as detailed in the following section.

The Project is not anticipated to become operational until 2030, and it is assumed that the use of current year emissions factors and Euro class standards for vehicles is a conservative approach. The introduction

of policy focused on enforcing higher Euro class emissions standards for vehicles means that it is expected that emissions from road traffic will reduce, and therefore improve, in future years.

Operation Phase Vessel Emissions

Operation phase vessel emissions factors were derived using US EPA Port Emissions Guidance (U.S. EPA, 2022). This guidance specifies that some emissions factors require adjustment based on fuel sulphur content and Brake Specific Fuel Consumption (BSFC), which depends on the engine type and fuel used.

It was assumed that the container vessels and tugboats will both be IMO Tier II compliant and will use Marine Diesel Oil (MDO) fuel with a sulphur content of 0.5% mass by mass, which is the compulsory sulphur content cap introduced by the International Maritime Organization (IMO) in 2020 (IMO, 2018). Based on these assumptions, emissions factors for container vessel propulsion, auxiliary and boiler engines, and tugboat propulsion and auxiliary engines were determined. These are shown in Table 3-5 below.

Table 3-5 Vessel Emissions Factors by Engine Type

Vessel Type	Engine Type	Emissions Factors (g/kWh)				
		NOx	CO	PM_{10}	$PM_{2.5}$	SO_2
Container Vessel	Propulsion	14.40	1.40	0.30	0.28	1.81
	Auxiliary	10.50	1.10	0.33	0.30	2.12
	Boiler	2.00	0.20	0.39	0.36	2.93
Tugboat	Propulsion	4.81	1.10	0.07	0.07	0.01
	Auxiliary	4.89	0.90	0.08	0.08	0.01

Calculation of Emissions

Operation Phase Traffic Emissions

Euro classes for staff traffic and HGVs were determined from the Bangladesh DoE Revisions of Vehicular Emission Standards for Bangladesh (DoE, 2012) which sets out that from 2019, HGVs and commercial diesel vehicles (i.e. staff passenger buses) operating within Chittagong must be Euro class III, while all cars must be Euro class 4.

The below example HGV and passenger bus types were provided by the Haskoning transport consultants:

- HGV: Ashok Leyland 3518 IL Prime Mover Base[1]; and
- Passenger Bus: Toyota Coaster[2].

Emissions factors for each road link were determined using the EFT v14.1 with a bespoke Euro fleet, which allows the user to specify the Euro class and vehicle size distributions of the fleet. The EFT was run with the following bespoke Euro fleet inputs:

- All HGVs were Euro III compliant and greater than 32 tonnes.
- All passenger buses were Euro III compliant and less than 15 tonnes.
- All staff cars were Euro 4 compliant.

[1] *Ashok Leyland 3518 IL Prime Mover Base Specification*
[2] *Toyota Coaster Specification*

As the size distribution of staff car sizes was not known, these values were left unchanged in the EFT. Although the EFT is designed to be used for UK road traffic, the majority of cars in Bangladesh are less than 1500 cc[3], and it was therefore determined that using the default size distributions provided a conservative approach.
The emission rates determined for each modelled road link are shown below in Table 3-6.

Table 3-6 Road Traffic Emissions

Road Link	Emission Rate (g/m/s^2)		
	NO_x	PM_{10}	$PM_{2.5}$
VIP Road West	0.0000296	0.0000008	0.0000007
VIP Road East	0.0000296	0.0000008	0.0000007
VIP Road East (Slowdown)	0.0000335	0.0000009	0.0000009
VIP Road West (Slowdown)	0.0000335	0.0000009	0.0000009
VIP Road/ Airport Road Roundabout	0.0000394	0.0000011	0.0000010
Airport Road Northeast (Slowdown)	0.0000335	0.0000009	0.0000009
Airport Road Northeast (South)	0.0000296	0.0000008	0.0000007
Airport Road Southwest (South)	0.0000296	0.0000008	0.0000007
Airport Road Southwest (Slowdown)	0.0000335	0.0000009	0.0000009
Airport Road Northeast (North)	0.0000074	0.0000002	0.0000002
Airport Road Southwest (North)	0.0000074	0.0000002	0.0000002
Airport Road/ Potenga Road	0.0000110	0.0000003	0.0000003
Internal Roads	0.0000520	0.0000016	0.0000015

Operation Phase Vessel Emissions

Vessel Approach, Berthing, Unberthing and Departure

The approach and berthing simulation data was used to plot two-minute vessel links covering vessel arrival to the new quay and subsequent departure. Distances of each two-minute link were determined and speeds and operating modes were assigned.

For container vessel propulsion engine emissions, the propulsion engine load factor (LF) was calculated, and Low Load Adjustment Factors (LLAFs) were applied if the load was less than 20%. This is in line with the US EPA Port Emissions Guidance and accounts for decreased propulsion engine efficiency when a vessel operates at lower loads. For auxiliary engines and boilers, power outputs by mode were determined from Annex G of the Fourth IMO GHG Study (IMO, 2020).

Operation phase vessel emissions were calculated for each vessel and engine type and then aggregated to determine the total emissions for each link. The total estimated emissions for vessel approach, berthing, unberthing and departure are shown in Table 3-7 below.

Table 3-7 Calculated Emissions Rates for Vessel Arrival and Departure

[3] *Bangladesh Used Car Market Size & Share Analysis - Growth Trends And Forecast (2026 - 2031), Mordor Intelligence.*

Pollutant	Emission Rate (g/m²/s)			
	Approach	Berthing	Unberthing	Departure
Container Vessels				
NO_x	0.21	2.65	1.02	0.29
CO	0.04	0.28	0.11	0.05
PM_{10}	0.01	0.10	0.04	0.01
$PM_{2.5}$	0.01	0.09	0.03	0.01
SO_2	0.05	0.64	0.25	0.07
Tugboats				
NO_x	-	1.76	-	-
CO	-	0.72	-	-
PM_{10}	-	0.03	-	-
$PM_{2.5}$	-	0.02	-	-
SO_2	-	<0.01	-	-

Hotelling

During hotelling, container vessel main engines are turned off while auxiliary engines and boilers remain running. Auxiliary and boiler loads while at berth (hotelling) were determined from Annex G of the Fourth IMO GHG Study (IMO, 2020) and emissions rates in g/s were calculated for the estimated hotelling time of 28 hours. Hotelling emissions rates and stack emissions parameters used in the dispersion model are detailed in Table 3-8.

Table 3-8 Container Vessel Hotelling Emissions Rates and Parameters

Parameter	Value
Stack Emissions Parameters	
Stack Diameter (m)	0.7
Stack Height (m)	40.0
Efflux Velocity (m/s)	30.0
Temperature (°C)	250.0
Emissions Rates (g/s)	
NO_x	3.48
CO	0.36
PM_{10}	0.15
$PM_{2.5}$	0.14
SO_2	1.04

Representation of Operating Hours

Operation Phase Traffic Emissions

Traffic flows are expected to vary throughout the day, with peaks occurring at typical rush hour times (8-9 am, 5-6 pm) and between 1-2 pm. To represent hourly variations in traffic flows, baseline hourly traffic counts were used to calculate hourly time varying factors. Hourly emissions were then calculated by dividing

the calculated daily emissions by 24 and multiplying by the hourly time varying factor. The long-term time varying factors were also multiplied by 360/365 to account for the port being operational for 360 days of the year.

Operation Phase Vessel Emissions

Vessel arrival and departure was modelled from the simulation runs as separate line sources each representing two minutes of travel time (0.033 hours). Container vessels are expected to hotel for 28 hours, and there are anticipated to be 410 journeys occurring over 360 days of the year.

In order to assess worst-case concentrations against long-term (annual) and short-term (1-hour, 8-hour and 24-hour) AQS, two models were developed with different time varying factors applied to the vessel emissions sources. The long-term model spread the vessel emissions (assuming 410 journeys over 360 days) equally over 24 hours of the day. As the vessel hotelling exceeded 24 hours, the short-term model considered a worst-case scenario of both vessel arrival and departure happening each hour. The worst-case modelled results were then compared against the relevant AQS. The time varying factors applied to each vessel emissions source per model run are shown in Table 3-9 below.

Table 3-9 Dispersion Model Hourly Time Varying Factors

Model Run	Hotelling Point Source	Arrival/ Departure Line Sources
Long-Term	1.151	0.002
Short-Term	2.000	0.033

Meteorological Data

The nearest meteorological station to the Project is located at Shah Amanat International Airport, approximately 1 km southwest from the proposed boundary of Block C. However, as only three hourly meteorological data was available from the site, one year of hourly Numerical Weather Prediction (NWP) data was purchased for the most recent complete year, 2025. This was input into the dispersion model to allow for comparisons with short-term (hourly) AQS. A windrose of the NWP data is shown in Figure 6-3 and a summary is provided in Table 3-10.

Table 3-10 Summary of Numerical Weather Prediction Data

Wind Direction	N	NE	E	SE	S	SW	W	NW
Counts by Wind Direction (%)	10.2	9.9	5.9	23.2	20.2	10.0	10.0	10.5

Conversion of NO_X to NO_2

NO_x to NO_2 conversion was undertaken within AERMOD using Ambient Ratio Method 2 (ARM2) which adjusts the modelled NO_x concentrations based on an empirical relationship between NO_x and NO_2.

3.6 Assessment Significance Criteria

Construction Phase Dust and Particulate Matter Assessment

The IAQM construction dust assessment methodology (IAQM, 2024) states that the dust emission magnitude should be combined with the sensitivity of the area to determine the risk of impacts prior to mitigation. Full details are provided in Section 5.1. Once appropriate mitigation measures

have been identified, the overall effect significance of construction phase impacts can be determined. The aim is to prevent significant effects at receptors due to the implementation of effective mitigation.

With implementation of effective mitigation measures, generation of dust and particulate matter will be minimised such that the residual impacts can be considered to be not significant in accordance with guidance provided by the IAQM.

Operation Phase Emissions Assessment

Receptor Sensitivity

Receptor sensitivity is detailed in Table 3-11 below and was determined based on LAQM TG22 (Defra, 2025) and professional judgement. Locations where long-term (annual mean) AQS apply, such as residential properties and schools were classed as high sensitivity, whilst locations where long-term AQS do not apply, such as commercial properties and places of worship were classed as medium. None of the selected receptors would be classified as low sensitivity.

Table 3-11 Receptor Sensitivity

Sensitivity	Examples	Receptors
High	Residential properties	M1, M2, R3, R7, R11, R13, R14, R15, R16, R18, R20
	Schools	M6, R2, R9, R17, R19
Medium	Places of work	R4, R5, R10, R12
	Places of worship	R1, R6, R8
Low	N/A	

Impact Magnitude

The IFC General EHS Guidelines (IFC, 2007) states that projects with substantial sources of air emissions and a potential for significant effects on ambient air quality should prevent or minimise impacts by ensuring that:

> *"Emissions do not result in pollutant concentrations that reach or exceed relevant ambient quality guidelines and standards by applying national legislated standards, or in their absence, the current WHO Air Quality Guidelines, or other internationally recognised sources; and*
>
> *Emissions do not contribute a significant portion to the attainment of relevant ambient air quality guidelines or standards. As a general rule, this Guideline suggests 25% of the applicable air quality standards to allow additional, future sustainable development in the same air shed".*

In addition, for projects located within degraded airsheds and within or next to ecologically sensitive areas, a project should ensure that *"any increase in pollution levels is as small as feasible, and amounts to a fraction of the applicable short-term and annual average air quality guidelines or standards"*.

Impact magnitude can therefore be determined by a combination of:

- Any increase in air pollutant concentrations due to the Process Contribution (PC)); and
- Total air pollutant concentrations (i.e., baseline plus PC) (the Predicted Environmental Concentration (PEC)) or cumulative impacts at sensitive receptors.

The results of the air dispersion modelling are compared to the relevant ambient AQS or guidelines for human health (as detailed in Table 2-2).

Different AQS will apply depending on the pollutant of interest and the averaging period. To determine impact magnitude, the Project's PC was assessed alongside the PEC as a percentage of the AQS. The impact at a receptor is said to be large if the PC from the Project is predicted to exceed the IFC guideline value of 25% of the relevant AQS, or the relevant AQS was predicted to be exceeded. Where the PC was less than 25% and the AQS was not likely to be exceeded, impact magnitudes of medium, small and very small were assigned based on professional judgement. The magnitude criteria used in this assessment is detailed in Table 3-12 below.

Table 3-12 Impact Magnitude Criteria

Magnitude	Definition/ Example
Large	• PC is more than 25% of Ambient AQS; or • PEC is predicted to exceed Ambient AQS.
Medium	• PC is 15-25% of Ambient AQS; and • PEC is not predicted to exceed Ambient AQS.
Small	• PC is 5-15% of Ambient AQS; and • PEC is not predicted to exceed Ambient AQS.
Very Small	• PC is <5% of Ambient AQS; and • PEC is not predicted to exceed Ambient AQS.

Impact Magnitude

The impact magnitude criteria (Table 3-12) and receptor sensitivity (Table 3-11) are combined to determine the magnitude of impact. This is undertaken using the matrix presented in Table 3-13. Impacts may be classified as negligible, minor, moderate or major.

Table 3-13 Impact Descriptors for Individual Receptors

Impact Magnitude	Receptor Sensitivity		
	Low	**Medium**	**High**
Very Small	Negligible	Negligible	Minor
Small	Negligible	Minor	Moderate
Medium	Minor	Moderate	Major
Large	Moderate	Major	Major

For the purposes of this assessment, the impact descriptors were assigned to each assessed receptor, of which 23 were assessed in total. The overall significance of effect of a development, as a binary judgement (i.e. significant or not significant), was determined based on the extent of impacts (i.e. how many receptors were affected). For air quality the impact magnitude is determined based on numerical increases in pollutant concentrations in relation to the AQS and therefore professional judgement is applied to the consideration of an air quality effect across a study area.

Mitigate/ Enhance

As part of the ESIA process, when negative impacts are identified (the effects of which cannot be managed via design controls/ incorporated mitigation), additional mitigation measures are developed (including avoiding, management and monitoring actions). The process of identifying design controls and mitigation measures must follow the sequence of the mitigation hierarchy. First, efforts are made to avoid or prevent, then minimise or reduce adverse effects through the application of design controls. These efforts are supplemented by additional design controls and mitigation measures during Project construction, operation and decommissioning. For positive impacts, enhancement measures to increase the benefits generated by the Project may also be developed.

Residual Impacts

Following the identification of mitigation measures, the significance of effect of residual impacts are assessed. Any remaining significant residual effects (typically those impacts described as moderate or major) are then addressed via consideration of further mitigation measures such as offsetting and/ or compensation.

3.7 Assumptions and Limitations

In addition to the assumptions and limitations discussed throughout Section 3, the following assumptions and limitations were noted in relation to the baseline monitoring survey and the use of baseline monitoring results within the assessment.

The baseline monitoring survey was conducted at six locations within the AoI during the pre-monsoon period (April–May 2026). The selected locations are assumed to adequately represent existing environmental conditions, including residential, roadside, educational and proposed terminal areas. The survey results provide a short-term characterisation of ambient conditions during the monitoring period and may not capture seasonal variations, extreme weather events, or unusual emission episodes. Air quality may vary over time due to changes in traffic volume, port operations, vessel movement, waste management activities, and meteorological conditions.

As monitoring was only conducted for four 24-hour periods at each location, the average 24-hour mean concentrations were used as a proxy for annual mean concentrations to compare against relevant annual mean AQOs. However, the baseline monitoring period took place during pre-monsoon season (March to May), and ambient pollutant concentrations have been shown to reduce substantially during the proceeding Monsoon season (June to September) (Hoque et. al, 2022). It is therefore likely that the actual baseline annual mean concentrations are lower than those estimated from the monitoring period averages.

Notwithstanding these limitations, the monitoring programme is considered sufficient to establish a reliable baseline for the ESIA and future environmental impact assessment.

4 Baseline Conditions

4.1 Pollution Sources

The Project area is located within the coastal-port environment of South Patenga, Chattogram, where ambient air quality is influenced by road, air and river transportation, municipal activities and port operations. During the baseline survey, several local pollution sources were identified.

Local sources of air pollution include road traffic emissions, road dust, municipal waste collection activities, commercial activities, and small-scale fuel combustion sources. Potential pollution sources from Chattogram Port operations include emissions from marine vessel movements, port-related activities, cargo handling operations, and occasional maintenance or dredging activities. The wider study area is also influenced by emissions from flight and aircraft operations at Shah Amanat International Airport, which is located approximately 800 m to the southwest of the site at the nearest point.

4.2 Meteorological Conditions

The baseline survey was conducted during the pre-monsoon season, a period typically characterised by warm temperatures, elevated humidity levels, moderate coastal winds, and occasional rainfall events. Recorded meteorological conditions were generally consistent across the monitoring locations. A summary of meteorological conditions is shown in Table 4-1 below.

Table 4-1 Summary of Meteorological Conditions

Parameter	Location Wise Average
Temperature (°C)	27.99 – 29.10
Relative Humidity (%)	73.3 – 77.3
Wind Speed (m/s)	1.49 – 3.34
Barometric Pressure (hPa)	1,014.57 – 1,016.36
Rainfall (mm/h)	0.00 – 0.30

The monitoring results indicate relatively stable atmospheric conditions during the survey period. Wind directions were predominantly from the south to southwest sector (approximately 178°–202°), reflecting the influence of coastal sea-breeze circulation typical of the Patenga coastal zone. These meteorological conditions generally favour pollutant dispersion and atmospheric mixing, reducing the potential for prolonged pollutant accumulation within the study area.

4.3 Ambient Air Quality Monitoring

A baseline ambient air quality monitoring programme was undertaken to characterise existing atmospheric conditions within the AoI and to provide a benchmark against which future Project-related impacts may be assessed. Monitoring was conducted concurrently with meteorological observations and covered key pollutants associated with transportation, port operations, fuel combustion, and industrial activities.

The monitoring programme consisted of four rounds of 24-hour continuous monitoring at six strategically selected locations representing residential areas, transportation corridors, educational receptors, and proposed terminal operation zones. Real-time monitoring equipment was used to measure particulate matter (PM_{10} and $PM_{2.5}$) and gaseous pollutants (SO_2, NO_2 and CO), as presented in Section 4.2).

Monitoring Locations

The monitoring locations set out in Table 4-2 were selected based on land-use characteristics, proximity to sensitive receptors, transportation routes, proposed terminal facilities, and anticipated upwind/ downwind influences.

Table 4-2 Baseline Survey Monitoring Locations

Site ID	Location Description	Latitude	Longitude	Classification
Location 1	41 No. Ward, Char Basti, South Patenga	22.24609	91.82264	Residential / Sensitive Receptor
Location 2	Airport Road, North Patenga	22.24958	91.8252	Roadside / Transportation Corridor
Location 3	Block C, Proposed LCT Area	22.24914	91.82595	Project Area
Location 4	Block B, Proposed LCT Area	22.2534	91.83036	Project Area
Location 5	Block A, Proposed LCT Area	22.2604	91.83009	Project Area
Location 6	Biman Bondor High School	22.25157	91.82524	Educational / Sensitive Receptor

Source: Environmental Baseline Monitoring Survey, April–May 2026

Pollutants Measured

The monitoring programme included a comprehensive suite of particulate and gaseous pollutants relevant to coastal port developments. Measurements were undertaken using the OCEANUS AQM-09 Real-Time Air Quality Monitoring System. Monitoring data was recorded at 10-minute intervals and subsequently processed to derive hourly and 24-hour average concentrations for comparison with applicable Bangladesh AQS and international guideline values. The pollutants measured and the measuring techniques used are set out in Table 4-3 below.

Table 4-3 Baseline Survey Monitoring Programme Analysis Methods

Pollutants Measured	Monitoring Instrument	Measurement Technique
$PM_{2.5}$, PM_{10}	OCEANUS AQM-09	Laser Light Scattering
SO_2, NO_2, CO		Electrochemical Sensors

Sampling Survey Schedule

The ambient air quality monitoring programme was conducted over four monitoring rounds between 13 April and 10 May 2026. Each survey consisted of continuous 24-hour monitoring, allowing assessment of both day-time and night-time environmental conditions. Monitoring equipment was installed and operated continuously throughout the sampling period, with data recorded at regular intervals. The sampling survey schedule is set out in Table 4-4 below.

Table 4-4 Baseline Monitoring Survey Sampling Schedule

Location	Start Date	Start Time	End Date	End Time
Round 1				
Location 1	13-Apr-2026	08:50	14-Apr-2026	08:50
Location 2	14-Apr-2026	10:00	15-Apr-2026	10:00

Location	Start Date	Start Time	End Date	End Time
Location 3	15-Apr-2026	10:15	16-Apr-2026	10:15
Location 4	16-Apr-2026	10:30	17-Apr-2026	10:30
Location 5	18-Apr-2026	08:25	19-Apr-2026	08:25
Location 6	19-Apr-2026	08:55	20-Apr-2026	08:55
Round 2				
Location 1	20-Apr-2026	09:20	21-Apr-2026	09:20
Location 2	21-Apr-2026	09:40	22-Apr-2026	09:40
Location 3	22-Apr-2026	10:15	23-Apr-2026	10:15
Location 4	23-Apr-2026	10:25	24-Apr-2026	10:25
Location 5	25-Apr-2026	08:00	26-Apr-2026	08:00
Location 6	26-Apr-2026	08:25	27-Apr-2026	08:25
Round 3				
Location 1	27-Apr-2026	08:50	28-Apr-2026	08:50
Location 2	28-Apr-2026	09:20	29-Apr-2026	09:20
Location 3	29-Apr-2026	09:50	30-Apr-2026	09:50
Location 4	30-Apr-2026	10:05	01-May-2026	10:05
Location 5	02-May-2026	08:00	03-May-2026	08:00
Location 6	03-May-2026	08:20	04-May-2026	08:20
Round 4				
Location 1	04-May-2026	08:55	05-May-2026	08:55
Location 2	05-May-2026	09:20	06-May-2026	09:20
Location 3	06-May-2026	09:45	07-May-2026	09:45
Location 4	10-May-2026	08:40	11-May-2026	08:40
Location 5	09-May-2026	08:10	10-May-2026	08:10
Location 6	07-May-2026	10:00	08-May-2026	10:00

Baseline Monitoring Results

The baseline ambient air quality monitoring results were obtained from four monitoring rounds conducted between April and May 2026 at six monitoring locations within the AoI. The results presented below represent the average concentrations recorded during the monitoring programme and are compared with applicable Bangladesh Air Pollution Control Rules (APCR) 2022 standards (DoE, 2022) and ECR'1997 standards (DoE, 1997). Where no national AQS was set, comparisons were made to the WHO AQGs (WHO, 2021) in line with IFC guidance (IFC, 2007).

Using the 4-day monitoring data as a proxy to characterise annual mean and short-term concentrations (as set out in Section 3.7) is a limitation of the monitoring study because it presents a snapshot of data as opposed to a full annual dataset that would cover fluctuations over the course of a year.

NO_2 Monitoring Results

NO_2 baseline monitoring survey results are shown in Table 4-5 below. Mean monitoring period NO_2 concentrations exceeded the national annual mean NO_2 AQS (40 µg/m³) at all monitoring locations.

Maximum 24-hour NO_2 mean concentrations varied between 44.14 µg/m³ and 44.96 µg/m³ at Location 6 and Location 4 respectively, which is well within the national 24-hour AQS of 80 µg/m³. As no national hourly AQS exists for NO_2, maximum hourly mean concentrations were compared against the WHO AQG hourly mean of 200 µg/m³. The maximum hourly mean was 51.45 µg/m³, which was reported at Location 2 and is well within the WHO AQG value.

Table 4-5 NO_2 Baseline Monitoring Survey Results

Standard/Location	Monitoring Period Mean (µg/m³)	Maximum 24-hour Mean (µg/m³)	Maximum Hourly Mean (µg/m³)
Relevant Standard	**40[(a)]**	**80[(b)]**	**200[(c)]**
Location 1	43.84	44.29	49.78
Location 2	44.09	44.54	51.23
Location 3	43.51	44.21	49.65
Location 4	43.98	44.96	51.45
Location 5	43.81	44.39	48.25
Location 6	43.45	44.14	47.62

[(a)] Bangladesh National AQS – annual mean
[(b)] Bangladesh National AQS – 24-hour mean
[(c)] WHO/IFC AQG – hourly mean

SO_2 Monitoring Results

SO_2 baseline monitoring survey results are shown in Table 4-6 below. Maximum 24-hour mean SO_2 concentrations varied between 33.62 µg/m³ and 35.03 µg/m³ at Location 1 and Location 5 respectively, which is well within the national 24-hour AQS of 80 µg/m³. Maximum hourly means were also well within the national AQS of 250 µg/m³, with the highest reported mean being 42.88 µg/m³ recorded at Location 3.

As no national hourly AQS exists for 10-minute mean SO_2 concentrations, maximum 10-minute mean concentrations were compared to the WHO AQG value of 500 µg/m³. The maximum 10-minute mean was 51.23 µg/m³, which was reported at Location 2 and is well within the WHO AQG value.

Table 4-6 SO_2 Baseline Monitoring Survey Results

Standard/Location	Maximum 24-hour Mean (µg/m³)	Maximum Hourly Mean (µg/m³)	Maximum 10-minute Mean (µg/m³)
Relevant Standard	**80[(a)]**	**250[(b)]**	**500[(c)]**
Location 1	33.62	39.21	47.52
Location 2	33.68	41.15	51.23
Location 3	34.06	42.88	47.25
Location 4	34.63	41.89	47.38
Location 5	35.03	40.97	47.46
Location 6	34.12	40.49	46.89

Standard/Location	Maximum 24-hour Mean (µg/m³)	Maximum Hourly Mean (µg/m³)	Maximum 10-minute Mean (µg/m³)
(a) Bangladesh National AQS – 24-hour mean *(b) Bangladesh National AQS – hourly mean* *(c) WHO/IFC AQG – 10-minute mean*			

PM_{10} Monitoring Results

PM_{10} baseline monitoring survey results are shown in Table 4-7 below. The mean monitoring period PM_{10} concentrations varied from 45.55 µg/m³ to 49.61 µg/m³ at Location 5 and Location 6 respectively, and are within 10% of the national annual mean AQS (50 µg/m³). Maximum 24-hour mean PM_{10} concentrations varied between 47.25 µg/m³ and 58.16 µg/m³ at Location 3 and Location 6 respectively, which are well within the national 24-hour AQS of 150 µg/m³.

Table 4-7 PM_{10} Baseline Monitoring Survey Results

Standard/Location	Monitoring Period Mean (µg/m³)	Maximum 24-hour Mean (µg/m³)
Relevant Standard	**50[(a)]**	**150[(b)]**
Location 1	47.98	50.20
Location 2	46.95	47.57
Location 3	46.56	47.25
Location 4	46.68	48.39
Location 5	45.55	47.33
Location 6	49.61	58.16
(a) Bangladesh National AQS – annual mean *(b) Bangladesh National AQS – 24-hour mean*		

$PM_{2.5}$ Monitoring Results

$PM_{2.5}$ baseline monitoring survey results are shown in Table 4-8 below. The mean monitoring period $PM_{2.5}$ concentrations varied from 19.79 µg/m³ to 22.18 µg/m³ at Location 5 and Location 2 respectively, which are well within the annual mean AQS (35 µg/m³). Maximum 24-hour mean PM_{10} concentrations varied between 21.77 µg/m³ and 22.72 µg/m³ at Location 5 and Location 1 respectively, which are well within the national 24-hour AQS of 65 µg/m³.

Table 4-8 $PM_{2.5}$ Baseline Monitoring Survey Results

Standard/Location	Monitoring Period Mean (µg/m³)	Maximum 24-hour Mean (µg/m³)
Relevant Standard	**35[(a)]**	**65[(b)]**
Location 1	22.13	22.72
Location 2	22.18	22.47
Location 3	21.87	22.51
Location 4	21.84	22.60
Location 5	19.79	21.77
Location 6	20.96	22.56
(a) Bangladesh National AQS – annual mean		

Standard/Location	Monitoring Period Mean (µg/m³)	Maximum 24-hour Mean (µg/m³)
(b) Bangladesh National AQS – 24-hour mean		

CO Monitoring Results

CO baseline monitoring survey results are shown in Table 4-9 below. As no national AQS exists for 24-hour mean CO, maximum 24-hour mean concentrations were compared to the WHO AQG value of 4,000 µg/m Maximum 24-hour mean CO concentrations varied between 284.44 µg/m³ and 719.86 µg/m³ at Location 5 and Location 2 respectively, which are well within the WHO AQG value.
The maximum 8-hour and1-hour means were 1,323.96 µg/m³ and 1,720.00 µg/m³ at Location 2, which are well within the respective national AQS values of 5,000 µg/m³ and 20,000 µg/m³.

As data was collected over 10-minute periods, it was not possible to calculate a 15-minute mean, however the maximum 10-minute mean was compared to the WHO AQG 15-minute value to give an indication of whether this was likely to be exceeded. All locations reported maximum 10-minute mean values that were less than 5% the 15-minute mean AQG value of 100,000 µg/m³, which indicates that this value is unlikely to be exceeded.

Table 4-9 CO Baseline Monitoring Survey Results

Standard/Location	Maximum 24-hour Mean (µg/m³)	Maximum 8-hour Mean (µg/m³)	Maximum 1-hour Mean (µg/m³)	Maximum 10-minute Mean (µg/m³)
Relevant Standard	**4,000[a]**	**5,000[b]**	**20,000[c]**	**100,000[d]**
Location 1	580.69	879.58	1,521.67	3,060.00
Location 2	719.86	1,323.96	1,720.00	2,820.00
Location 3	592.29	770.83	1,306.67	2,530.00
Location 4	529.93	720.42	1,050.00	1,720.00
Location 5	284.44	720.42	810.00	1,100.00
Location 6	589.72	1,163.96	1,493.33	1,510.00

[a] WHO/IFC AQG – 24-hour mean
[b] Bangladesh National AQS –8-hour mean
[c] Bangladesh National AQS –1-hour mean
[d] WHO/IFC AQG – 15-minute mean

5 Prediction of Potential Effects During the Construction Phase

The construction works associated with the Project have the potential to impact upon local air quality conditions as follows:

- dust and PM_{10} emissions generated by demolition, excavation, construction and earthworks activities associated with the construction of the Project have the potential to cause dust soiling and/ or health impacts at sensitive receptors;
- emissions of NO_2 and PM_{10} from non-road mobile machinery (NRMM)/ plant operating within the Project site have the potential to adversely impact local air quality at sensitive receptors in close proximity to the works; and
- emissions of exhaust pollutants, especially NO_2 and PM_{10} from construction vessels and road traffic have the potential to adversely impact upon local air quality at sensitive receptors situated adjacent to the routes utilised by construction vehicles and vessels.

5.1 Construction Phase Dust and Particulate Matter Assessment

A qualitative assessment was undertaken in accordance with methodology provided in IAQM guidance (IAQM, 2024).

Step 1: Screen the Need for a Detailed Assessment

The main construction works will take place in Block C, where preparatory earthworks, land clearing and demolition will occur prior to the construction of new buildings and infrastructure. Construction of the new Quay area will require capital dredging and land reclamation using an estimated 300,000 m^3 – 400,000 m^3 of fill materials from quarries and/ or offshore borrow-areas. There are numerous residential buildings located along the stretch of Potenga Road/ Airport Road running adjacent to the boundary of Block C, which is the principal access route for construction phase vehicles.

No major construction phase activities are scheduled for Block A or Block B. Furthermore, these Blocks are located within the existing Terminal area. Therefore, there are very few sensitive human receptors (e.g. residential buildings) located in proximity to either Block. This assessment therefore considers the worst-case scenario based on the sensitive human receptors closest to the works being undertaken at Block C.

The IAQM guidance (IAQM, 2024) states that a detailed assessment is required if there are human receptors located within 250 m and/ or ecological sites located within 50 m of the site boundary. There are human receptors present within 250 m of the site boundary and a detailed assessment was undertaken for human receptors only.

Step 2A: Define the Potential Dust Emission Magnitude

The IAQM guidance (IAQM, 2024) recommends that the dust emission magnitude is determined for demolition, earthworks, construction and trackout. The dust magnitudes for these activities were determined from site plans in accordance with the IAQM methodology and are summarised in Table 5-1.

Table 5-1 Dust Emission Magnitude for the Site

Construction Activity	Dust Magnitude	Justification
Demolition	Small	Total building volume to be demolished <12,000 m^3. Demolition activities <6 m above ground.

Construction Activity	Dust Magnitude	Justification
Earthworks	Large	Total site area >110,000 m^2, potentially dusty soil type, >10 heavy earth moving vehicles active at any one time.
Construction	Medium	Total building volume 12,000 m^3 – 75,000 m^3, potentially dusty construction material (e.g. concrete).
Trackout	Large	>50 daily HGV movements, potentially dusty surface material.

Step 2B: Define the Sensitivity of the Area

Sensitivity of People to Dust Soiling:

- *Non-Trackout (Demolition, Earthworks and Construction):* There are 10-100 high sensitivity human receptors (e.g. residential buildings) located within 50 m of Block C, the majority of which are residential buildings. The sensitivity of human receptors to dust soiling from non-trackout construction phase activities is therefore considered to be medium.
- *Trackout:* There 10-100 high sensitivity residential receptors within 20 m of the access road adjacent to the proposed site boundary of Block C. The overall sensitivity of human receptors to dust soiling from trackout during the construction phase is therefore considered to be high.

Sensitivity of People to Health Effects of PM_{10}

As background PM_{10} concentrations exceed 32 µg/m^3 (see Table 4-7), long-term exposure to high concentrations of particulate matter in the local area is likely to have caused increased sensitivity of human health receptors to dust impacts. The sensitivity of people to the health effects of PM_{10} is therefore considered to be high.

The determined sensitivities of the surrounding area to the potential impacts of dust soiling and health effects of PM_{10} are shown in Table 5-2 below.

Table 5-2 Sensitivity of the Surrounding Area

Potential Impact	Sensitivity of Surrounding Area			
	Demolition	Earthworks	Construction	Trackout
Dust Soiling	Medium	Medium	Medium	High
Human Health	High	High	High	High

Step 2C: Define the Risk of Impact

Step 2C requires a combination of the dust emission magnitude and sensitivity of the area to determine the risk of dust impacts. Combining the dust emission magnitude and sensitivity of the area generates a low to high risk for dust soiling impacts and a medium to high risk for human health impacts. The risk of impacts for each construction phase activity is shown in Table 5-3 below.

Table 5-3 Risk of Construction Dust Impacts

Potential Impact	Risk of Impacts			
	Demolition	Earthworks	Construction	Trackout
Dust Soiling	Low	Medium	Medium	High
Human Health	Medium	High	Medium	High

Step 3: Site Specific Mitigation

The construction dust risk assessment determined that the highest risk of impacts was high without the implementation of mitigation measures. Guidance is provided by the IAQM in relation to dust mitigation measures. These measures are related to the site risk for each activity and are set out in Table 5-5 and Table 5-6 of Section 5.3.

Step 4: Determine Significance of Effect

With the implementation of the mitigation measures set out in Section 5.3 the overall effect of residual impacts from the construction phase of the Project are considered to be not significant, in accordance with IAQM guidance (IAQM, 2024).

5.2 Construction Phase Plant, Vessels and Vehicles

The duration of the various elements of construction and the plant required is provided in Table 5-4 below. A full list of construction plant and vessels required for each phase are provided respectively in Appendix A2 - Construction Phase Plant and Vessels
Table 6-15 and Table 6-16 of Appendix A2 - Construction Phase Plant and Vessels.

Table 5-4 Durations and Plant/ Vessel Requirements for the Construction Phase

Construction Phase/ Package	Duration (Months)	Main Plant/ Vessels Requirements
P01: Mobilisation, temporary offices/welfare, utilities and laydown, including prefabricated offices where applicable	3	Generators, mobile cranes, forklifts, lighting towers
P02: Site clearance, fencing and enabling earthworks	5	Excavators, loaders, dozers, dump trucks
P03: B-C drainage channel closure, temporary flow control and box culvert / replacement drainage	9	Excavators, sheet piling vibro rig if needed, pumps, concrete plant support
P04: Capital berth pocket dredging	6	CSD, barges, tugs, survey vessels
P05: Reclamation fill import, placement and profiling	10	Barges, excavators, dozers, dump trucks, rollers
P06: Ground improvement, drainage blankets, vertical drains and preload	11	PVD rigs, dozers, rollers, optional vibro treatment
P07: Quay/ deck-on-piles: piling, beams and deck structure	17	Marine/ land piling rigs, hammers, cranes, concrete pumps, barges
P08: Slope trimming, revetment, scour and slope protection	13	Rock barges, excavators, cranes, placement barges
P09: Block C yard formation, drainage, pavement and utility corridors, including paving block placement if selected	15	Pavers/ paving block handling plant, rollers, trenchers, concrete plant support
P10: Block B integration and lower-density container area works	12	Cutters, skid steer, loaders, utility trenching plant
P11: Block A temporary prefab/batching/storage support and later truck waiting/ processing area upgrades	12	Excavators, trenchers, mobile cranes, MEWPs, optional paving block production/ batching plant
P12: Buildings and terminal support facilities	15	Concrete plant support, mobile cranes, telehandlers, wash bay systems
P13: Mechanical, electrical and plumbing, power, ICT, gates, scanners, lighting, CCTV and systems	10	MEWPs, cable pullers, generators for testing

Construction Phase/ Package	Duration (Months)	Main Plant/ Vessels Requirements
P14: STS/ terminal equipment delivery, positioning, installation support, testing and commissioning	6	SPMT slow loaders, MEWPs, limited assist cranes, commissioning equipment
P15: Demobilisation, reinstatement, final waste clearance and handover	3	Low loaders, waste skips, road sweepers, small cranes

Construction Phase Plant

Construction of the Project would require standard construction plant such as excavators, graders, compacting rollers, concrete trucks and pumps, water tankers, diesel-powered generators and delivery trucks. The main pollutants of concern in relation to these sources are NO_2, PM_{10} and CO, with some hydrocarbon and SO_2 releases, as products of fuel combustion.

It is anticipated that the most intensive periods of plant use would be the initial site clearance and enabling earthworks, reclamation works and construction of the quay and deck structure, due to the plant required for site levelling, excavation, drilling and concrete pouring. The plant required during construction is expected to be standard construction equipment and it is unlikely that all plant will operate continuously throughout each day.

The prevailing meteorological conditions will disperse emissions from plant working at the riverside of Block C to the southeast across the Karnaphuli River and away from receptors located to the northeast of the Project site. In the short-term, the distance between sources and receptors on both sides of the river is considered to provide sufficient dispersion and dilution of pollutants. As such, the overall effect of impacts is considered to be not significant. However, LAQM TG22 recommends that good-practice fuel efficiency measures be implemented to minimise emissions from NRMM/ plant during construction (Defra, 2025) – these are set out in the proceeding Section 5.3.

Construction Phase Vessels

Barges, tugboats, survey boats and workboats will be required for capital dredging, reclamation works, construction of the quay piling and deck and slope protection works, all of which will take place at the riverside of Block C, over 250 m from the nearest sensitive receptors.

Although construction phase vessels are below the threshold for exceedances of the short-term AQS, as set out in LAQM TG22 (Defra, 2025), it was not possible to quantify emissions from construction phase vessels with the information provided at this stage. Therefore, the magnitude of impact could not be concluded.

Construction Phase Road Traffic

Construction vehicles will be required to transport plant and materials to and from site, particularly during ground reclamation works, although the bulk of materials required for construction will be transported by water, and transport of construction plant is expected to occur infrequently (Haskoning, 2026). Whilst the exact number of construction vehicles required is not known at this time, it is anticipated that there will be more than 50 daily HGV movements, but fewer than will be required during the operation phase.

Given the short-term nature of the construction phase works, and that the main method of transport of construction material will be by water, it is anticipated that the impacts from road traffic emissions during the construction phase will be no worse than during the operation phase. Therefore, emissions from construction phase road traffic is not considered further. As it was not possible to quantify emissions from construction

phase road traffic with the information provided at this stage, the magnitude of impact could not be concluded.

Given the information available, it is anticipated that the effect in relation to construction phase road traffic and vessel emissions would be no worse than for the operational phase.

5.3 Construction Phase Mitigation and Monitoring

Construction Phase Dust

A list of IAQM highly recommended and desirable mitigation measures for a high-risk site are provided in Table 5-5 and Table 5-6 below. The recommendations should be included within a Construction Environmental Management Plan (CEMP) to be prepared by the contractor to prevent or minimise the release of dust entering the atmosphere and/ or being deposited at nearby sensitive receptors. Particular attention should be paid to works which must unavoidably take place close to the site boundary. It is recognised that with the effective implementation of the CEMP any potential dust releases associated with the construction phase will be reduced and controlled to avoid significant effects arising.

Table 5-5 IAQM Highly Recommended Construction Phase Dust Mitigation Measures

Highly Recommended Mitigation Measures
Communications
• Develop and implement a stakeholder communications plan that includes community engagement before work commences on site.
• Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary. This may be the environment manager/engineer or the site manager.
• Display the head or regional office contact information.
• Develop and implement a Dust Management Plan (DMP) as part of Air Quality Management Plan, which may include measures to control other emissions, approved by the relevant authority. The level of detail will depend on the risk, and should include as a minimum the highly recommended measures in this document. The desirable measures should be included as appropriate for the site.
Construction
• Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place.
Demolition
• Ensure effective water suppression is used during demolition operations. Hand held sprays are more effective than hoses attached to equipment as the water can be directed to where it is needed. In addition high volume water suppression systems, manually controlled, can produce fine water droplets that effectively bring the dust particles to the ground.
• Avoid explosive blasting, using appropriate manual or mechanical alternatives.
Earthworks
• Bag and remove any biological debris or damp down such material before demolition.
• Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable.
• Use Hessian, mulches or tackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable.
• Only remove the cover in small areas during work and not all at once.

Highly Recommended Mitigation Measures
Trackout
• Use water-assisted dust sweeper(s) on the access and local roads, to remove, as necessary, any material tracked out of the site. This may require the sweeper being continuously in use.
• Avoid dry sweeping of large areas.
• Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.
• Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable.
• Record all inspections of haul routes and any subsequent action in a site log book.
• Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowsers and regularly cleaned.
• Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).
• Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permits.
• Access gates to be located at least 10m from receptors where possible.
Monitoring
• Undertake daily on-site and off-site inspection, where receptors (including roads) are nearby, to monitor dust, record inspection results, and make the log available to the relevant authority when asked. This should include regular dust soiling checks of surfaces such as street furniture, cars and window sills within 100m of site boundary, with cleaning to be provided if necessary.
• Carry out regular site inspections to monitor compliance with the DMP, record inspection results, and make an inspection log available to the relevant authority when asked.
• Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.
• Agree dust deposition, dust flux, or real-time PM_{10} continuous monitoring locations with the Relevant authority. Where possible commence baseline monitoring at least three months before work commences on site or, if it a large site, before work on a phase commences. Further guidance is provided by IAQM on monitoring during demolition, earthworks and construction.
Operating Vehicle/Machinery and Sustainable Travel
• Ensure all vehicles switch off engines when stationary - no idling vehicles.
• Avoid the use of diesel- or petrol-powered generators and use mains electricity or battery powered equipment where practicable.
• Impose and signpost a maximum-speed-limit of 15 mph on surfaced and 10 mph on unsurfaced haul roads and work areas (if long haul routes are required these speeds may be increased with suitable additional control measures provided, subject to the approval of the nominated undertaker and with the agreement of the relevant authority, where appropriate).
• Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials.
• Implement a Travel Plan that supports and encourages sustainable travel (public transport, cycling, walking, and car-sharing).
Operations
• Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems.
• Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate.

Highly Recommended Mitigation Measures
• Use enclosed chutes and conveyors and covered skips.
• Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate.
• Ensure equipment is readily available on site to clean any dry spillages, and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.
Preparing and Maintaining the Site
• Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible.
• Erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site.
• Fully enclose site or specific operations where there is a high potential for dust production and the site is active for an extensive period.
• Avoid site runoff of water or mud.
• Keep site fencing, barriers and scaffolding clean using wet methods.
• Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on-site cover as described below.
• Cover, seed or fence stockpiles to prevent wind whipping.
Site Management
• Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken.
• Make the complaints log available to the relevant authority when asked.
• Record any exceptional incidents that cause dust and/or air emissions, either on- or offsite, and the action taken to resolve the situation in the log book.
• Hold regular liaison meetings with other high risk construction sites within 250 m of the site boundary, to ensure plans are co-ordinated and dust and particulate matter emissions are minimised. It is important to understand the interactions of the off-site transport deliveries which might be using the same strategic road network routes.
Waste Management
• Avoid bonfires and burning of waste materials.

Table 5-6 IAQM Desirable Construction Phase Dust Mitigation Measures

Desirable Mitigation Measures
Construction
• Avoid scabbling (roughening of concrete surfaces) if possible.
• Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery.
Demolition
• For smaller supplies of fine power materials ensure bags are sealed after use and stored appropriately to prevent dust.
• Soft strip inside buildings before demolition (retaining walls and windows in the rest of the building where possible, to provide a screen against dust).

Construction Phase NRMM

LAQM TG22 recommends that the following good-practice fuel efficiency measures be implemented to minimize emissions from NRMM/ plant during construction (Defra, 2025):

- ensure all equipment complies with the appropriate NRMM standards;
- where feasible, ensure further abatement plant is installed on NRMM equipment, e.g. Diesel Particulate Filters (DPFs);
- ensure all vehicles switch off engines when stationary – no idling vehicles;
- avoid the use of diesel- or petrol-powered generators and use mains electricity or battery powered equipment where possible; and
- impose and signpost a maximum-speed-limit of 15 mph on surfaced and 10 mph on unsurfaced haul roads and work areas.

Construction Phase Road Traffic and Vessel Emissions

As it was not possible to determine the significance of effect of construction phase road traffic and vessel emissions, it is recommended that relevant mitigation measures set out for operation phase road traffic and vessel emissions in Section 6.1.1 are also implemented during the construction phase.

5.4 Residual Construction Phase Effects

With the implementation of the mitigation measures set out in Section 5.3 the overall effect of residual impacts from construction phase dust is considered to be not significant, in accordance with IAQM guidance (IAQM, 2024).

The overall effects of impacts from construction phase plant were determined to be not significant. Although the precise number of construction phase vehicles is not known, it is anticipated that the impacts of road traffic and vessel emissions during the construction phase will be no worse than the operation phase impacts, for which a detailed assessment has been undertaken.

6 Prediction of Potential Effects during the Operation Phase

6.1 Operation Phase Road Traffic and Vessel Emissions

The operation phase assessment considered the impact of vessel and road traffic emissions to consider the total impact at receptors during the operation phase. The results include the pollutant contribution from road traffic and vessel emissions and baseline concentrations determined from the baseline monitoring survey. As detailed in the assessment methodology section, emissions associated with vessels during the operation phase are considered to be conservative with regard to annual mean averaging times. Impacts were considered at locations of relevant exposure to long-term and/ or short-term AQS.

Monitoring was not conducted over the entire modelling domain, so baseline concentrations were assigned to receptors based on the nearest representative monitor for which data was available. As the majority of receptors were located along roads, baseline monitoring data from Locations 1 and 2 (roadside locations) were assigned based on receptor proximity. Location 6, located further back from main roads, was assigned to urban locations – principally those located on the southeast side of the Karnaphuli River.

As detailed in Section 3.7, average baseline concentrations recorded over the baseline survey period were used as a proxy for annual mean concentrations, which has the potential to overestimate the true annual mean. Due to the limitations associated with using short-term baseline monitoring as a proxy for the annual mean, the PC of the Project (as a % of the AQS) was used to determine the overall effect of impacts at receptors. This approach is therefore conservative with regards to determining receptor sensitivity, whilst also avoiding over-estimating the impact of the scheme by relying on potentially over-estimated total annual mean concentrations.

Isopleth (contour) plots showing predicted pollutant concentrations are presented in Figure 6-4 to Figure 6-7 in Appendix A1 - Figures.

Annual Mean Concentrations

NO_2 Annual Mean Concentrations

NO_2 annual mean results are shown in Table 6-1 below. At all but three receptors (R9, R11 and R19, all located on the eastern side of the Karnaphuli River to the LCTP), the annual mean NO_2 PC exceeded 25% of the national AQS of 40 µg/m^3. At one receptor, R3, the PC was predicted to exceed 100% of the AQS – this receptor is located along Airport Road adjacent to the entrance to Block C, and is therefore predicted to be affected by emissions from both internal site road traffic and external (public highway) road traffic.

Table 6-1 Predicted Annual Mean NO_2 Concentrations and Impact of the Project for the Operation Phase at Sensitive Receptor Locations

Receptor ID	Baseline Concentration (µg/m^3)	Project Contribution (µg/m^3)			PEC (µg/m^3)	PC as % of AQS	Magnitude of Impact
		Road Traffic	Vessels	PC (Road Traffic + Vessels)			
M1	43.84	19.94	0.97	20.91	64.75	52.27	Major
M2	44.09	36.29	0.90	37.19	81.28	92.98	Major
M6	43.45	9.26	1.04	10.30	53.75	25.76	Major
R2	43.45	9.98	1.17	11.15	54.60	27.88	Major
R3	44.09	39.35	0.89	40.24	84.33	100.61	Major

Receptor ID	Baseline Concentration (µg/m³)	Project Contribution (µg/m³)			PEC (µg/m³)	PC as % of AQS	Magnitude of Impact
		Road Traffic	Vessels	PC (Road Traffic + Vessels)			
R7	43.84	21.80	0.56	22.37	66.21	55.91	Major
R9	43.45	0.71	0.73	1.43	44.88	3.59	Minor
R11	43.45	0.68	0.70	1.39	44.84	3.47	Minor
R13	43.84	21.69	0.34	22.03	65.87	55.08	Major
R14	43.84	21.87	0.46	22.33	66.18	55.84	Major
R15	44.09	26.69	0.94	27.63	71.72	69.07	Major
R16	44.09	38.96	0.89	39.85	83.94	99.62	Major
R17	43.84	20.24	0.42	20.66	64.51	51.66	Major
R18	43.84	19.81	0.56	20.36	64.21	50.91	Major
R19	43.45	0.60	0.61	1.21	44.66	3.03	Minor
R20	43.84	22.20	0.33	22.53	66.37	56.32	Major
Bangladesh APCR AQS: 40 µg/m³							

PM_{10} and $PM_{2.5}$ Annual Mean Concentrations

PM_{10} and $PM_{2.5}$ annual mean results are shown in Table 6-2 and Table 6-3 respectively. The modelled PM_{10} PC was less than 3% of, and the PEC is not predicted to exceed, the national AQS of 50 µg/m³ at all modelled receptors. Similar results were observed for $PM_{2.5}$, with PC predicted to be less than 4% of, and the PEC is not predicted to exceed, the national AQS of 35 µg/m³ across all receptors. The magnitude of impact with respect to annual mean PM_{10} and $PM_{2.5}$ is therefore expected to be minor.

Table 6-2 Predicted Annual Mean PM_{10} Concentrations and Impact of the Project for the Operation Phase at Sensitive Receptor Locations

Receptor ID	Baseline Concentration (µg/m³)	Project Contribution (µg/m³)			PEC (µg/m³)	PC as % of AQS	Magnitude of Impact
		Road Traffic	Vessels	PC (Road Traffic + Vessels)			
M1	47.98	0.61	0.04	0.65	48.62	1.29	Minor
M2	46.95	1.19	0.04	1.22	48.18	2.44	Minor
M6	49.61	0.30	0.04	0.34	49.94	0.67	Minor
R2	49.61	0.32	0.05	0.36	49.97	0.73	Minor
R3	46.95	1.29	0.04	1.33	48.28	2.66	Minor
R7	47.98	0.65	0.02	0.68	48.65	1.35	Minor
R9	49.61	0.02	0.03	0.05	49.66	0.11	Minor
R11	49.61	0.02	0.03	0.05	49.66	0.10	Minor
R13	47.98	0.65	0.01	0.66	48.64	1.33	Minor
R14	47.98	0.65	0.02	0.67	48.65	1.34	Minor
R15	46.95	0.84	0.04	0.88	47.83	1.75	Minor

Receptor ID	Baseline Concentration (µg/m³)	Project Contribution (µg/m³)			PEC (µg/m³)	PC as % of AQS	Magnitude of Impact
		Road Traffic	Vessels	PC (Road Traffic + Vessels)			
R16	46.95	1.28	0.04	1.32	48.27	2.63	Minor
R17	47.98	0.60	0.02	0.62	48.60	1.24	Minor
R18	47.98	0.59	0.02	0.61	48.59	1.22	Minor
R19	49.61	0.02	0.02	0.04	49.65	0.09	Minor
R20	47.98	0.66	0.01	0.68	48.65	1.35	Minor
Bangladesh APCR AQS: 50 µg/m³							

Table 6-3 Predicted Annual Mean $PM_{2.5}$ Concentrations and Impact of the Project for the Operation Phase at Sensitive Receptor Locations

Receptor ID	Baseline Concentration (µg/m³)	Project Contribution (µg/m³)			PEC (µg/m³)	PC as % of AQS	Magnitude of Impact
		Road Traffic	Vessels	PC (Road Traffic + Vessels)			
M1	22.13	0.57	0.04	0.61	22.74	1.73	Minor
M2	22.18	1.12	0.03	1.15	23.34	3.29	Minor
M6	20.96	0.28	0.04	0.32	21.28	0.90	Minor
R2	20.96	0.30	0.04	0.34	21.31	0.98	Minor
R3	22.18	1.22	0.03	1.25	23.44	3.58	Minor
R7	22.13	0.61	0.02	0.64	22.77	1.82	Minor
R9	20.96	0.02	0.03	0.05	21.01	0.14	Minor
R11	20.96	0.02	0.03	0.05	21.01	0.13	Minor
R13	22.13	0.61	0.01	0.62	22.75	1.78	Minor
R14	22.13	0.61	0.02	0.63	22.76	1.81	Minor
R15	22.18	0.79	0.04	0.82	23.01	2.36	Minor
R16	22.18	1.21	0.03	1.24	23.42	3.54	Minor
R17	22.13	0.57	0.02	0.58	22.71	1.67	Minor
R18	22.13	0.55	0.02	0.58	22.71	1.65	Minor
R19	20.96	0.02	0.02	0.04	21.01	0.12	Minor
R20	22.13	0.62	0.01	0.64	22.77	1.82	Minor
Bangladesh APCR AQS: 35 µg/m³							

Short-Term Concentrations

Short-Term NO_2 Concentrations

24-hour mean and 1-hour mean NO_2 results are shown in Table 6-4 and Table 6-5 respectively. As there is no 1-hour mean national AQS for NO_2, the WHO AQG value of 200 µg/m³ was used for comparison in accordance with IFC guidance (IFC, 2007).

In both cases, the PC was predicted to exceed 25% of the relevant AQS at all receptors, meaning the magnitude of impact was major. For 24-hour NO_2, the predicted PC exceeded 100% of the national AQS of 80 µg/m^3 at 8 receptors, whilst the 1-hour mean PC exceeded 100% of the WHO AQG value at 10 receptors.

1-hour and 24-hour mean concentrations were highest at receptor R4, which is located on the façade of the existing worker's building in Block B and is close to the internal HGV route proposed for Block C.

Table 6-4 Predicted 24-hour Mean NO_2 Concentrations and Impact of the Project for the Operation Phase at Sensitive Receptor Locations

Receptor ID	Baseline Concentration (µg/m^3)	Project Contribution (µg/m^3)			PEC (µg/m^3)	PC as % of AQS	Magnitude of Impact
		Road Traffic	Vessels	Total PC (Road Traffic + Vessels)			
M1	44.29	43.09	35.59	68.18	112.47	85.23	Major
M2	44.54	66.54	40.52	88.74	133.28	110.93	Major
M6	44.14	22.71	60.64	58.50	102.63	73.12	Major
R1	44.54	63.80	65.41	91.14	135.68	113.93	Major
R2	44.14	24.10	63.76	61.12	105.26	76.40	Major
R3	44.54	71.39	36.77	92.98	137.52	116.23	Major
R4	44.96	77.76	73.47	118.32	163.28	147.90	Major
R5	44.29	54.34	28.90	72.23	116.52	90.28	Major
R6	44.29	55.70	27.44	66.29	110.58	82.86	Major
R7	44.29	61.00	22.95	75.67	119.96	94.59	Major
R8	44.14	4.21	30.02	31.15	75.29	38.94	Major
R9	44.14	4.60	43.78	42.79	86.93	53.49	Major
R10	44.96	58.11	72.03	97.10	142.06	121.38	Major
R11	44.14	4.11	36.69	36.28	80.41	45.35	Major
R12	44.54	79.71	45.92	99.99	144.52	124.98	Major
R13	44.29	63.01	16.72	67.36	111.65	84.20	Major
R14	44.29	58.56	20.77	70.57	114.86	88.21	Major
R15	44.54	56.86	35.07	81.45	125.99	101.81	Major
R16	44.54	70.86	37.74	92.53	137.07	115.66	Major
R17	44.29	47.31	19.75	54.24	98.53	67.80	Major
R18	44.29	45.61	23.32	56.27	100.56	70.33	Major
R19	44.14	3.37	27.61	23.41	67.54	29.26	Major
R20	44.29	51.31	16.31	62.52	106.81	78.15	Major
Bangladesh APCR AQS: 80 µg/m^3							

Table 6-5 Predicted 1-hour Mean NO_2 Concentrations and Impact of the Project for the Operation Phase at Sensitive Receptor Locations

Receptor ID	Baseline Concentration (µg/m³)	Project Contribution (µg/m³)			PEC (µg/m³)	PC as % of AQS	Magnitude of Impact
		Road Traffic	Vessels	PC (Road Traffic + Vessels)			
M1	49.78	173.02	134.72	240.51	290.30	120.26	Major
M2	51.23	215.18	167.64	277.70	328.93	138.85	Major
M6	47.62	111.12	167.65	178.92	226.55	89.46	Major
R1	51.23	198.84	198.22	244.32	295.55	122.16	Major
R2	47.62	117.45	170.81	192.79	240.42	96.40	Major
R3	51.23	249.78	156.15	278.27	329.50	139.14	Major
R4	51.45	186.83	256.14	341.78	393.23	170.89	Major
R5	49.78	157.57	120.58	226.52	276.30	113.26	Major
R6	49.78	166.91	117.78	142.70	192.48	71.35	Major
R7	49.78	158.56	97.68	196.76	246.54	98.38	Major
R8	47.62	37.55	137.97	127.22	174.85	63.61	Major
R9	47.62	43.27	180.27	156.93	204.55	78.46	Major
R10	51.45	196.33	216.09	279.65	331.10	139.83	Major
R11	47.62	39.86	175.09	164.86	212.48	82.43	Major
R12	51.23	235.29	185.48	300.79	352.02	150.40	Major
R13	49.78	149.00	77.62	159.05	208.84	79.53	Major
R14	49.78	151.90	88.67	151.65	201.44	75.83	Major
R15	51.23	232.97	138.39	291.06	342.29	145.53	Major
R16	51.23	244.31	157.89	277.58	328.80	138.79	Major
R17	49.78	152.24	85.92	141.03	190.81	70.51	Major
R18	49.78	159.51	103.83	137.10	186.88	68.55	Major
R19	47.62	35.52	157.00	148.30	195.93	74.15	Major
R20	49.78	139.45	73.82	158.76	208.55	79.38	Major
WHO AQG: 200 µg/m³							

Short-Term PM_{10} and $PM_{2.5}$ Concentrations

24-hour mean PM_{10} and $PM_{2.5}$ results are shown in Table 6-6 and Table 6-7 respectively. For PM_{10}, the PC was less than 5% of, and the PEC is not predicted to exceed, the national AQS at all locations, meaning that the magnitude of impact ranged from negligible to minor, depending on receptor sensitivity.

For $PM_{2.5}$, moderate impacts were predicted at two receptors: R3 and R16, both of which are located along Airport Road close to the proposed boundary of Block C. At all other receptors, the PC was below 5% of, and the PEC was not predicted to exceed, the national AQS, meaning that the magnitude of impact ranged from negligible to minor depending on receptor sensitivity.

Table 6-6 Predicted 24-Hour Mean PM_{10} Concentrations and Impact of the Project for the Operation Phase at Sensitive Receptor Locations

Receptor ID	Baseline Concentration (µg/m³)	Project Contribution (µg/m³)			PEC (µg/m³)	PC as % of AQS	Magnitude of Impact
		Road Traffic	Vessels	PC (Road Traffic + Vessels)			
M1	50.20	1.50	1.43	2.46	52.66	1.64	Minor
M2	47.57	2.44	1.50	3.44	51.00	2.29	Minor
M6	58.16	0.83	2.38	2.17	60.33	1.45	Minor
R1	47.57	2.30	2.73	3.51	51.08	2.34	Negligible
R2	58.16	0.85	2.58	2.36	60.52	1.57	Minor
R3	47.57	2.65	1.36	3.61	51.17	2.41	Minor
R4	48.39	3.15	2.62	5.06	53.45	3.38	Negligible
R5	50.20	1.79	1.13	2.45	52.65	1.63	Negligible
R6	50.20	1.69	1.02	2.17	52.37	1.45	Negligible
R7	50.20	1.99	0.84	2.60	52.80	1.73	Minor
R8	58.16	0.13	0.97	1.02	59.19	0.68	Negligible
R9	58.16	0.16	1.41	1.49	59.65	0.99	Minor
R10	48.39	2.07	2.84	3.75	52.14	2.50	Negligible
R11	58.16	0.14	1.12	1.13	59.29	0.75	Minor
R12	47.57	3.03	1.72	4.10	51.66	2.73	Negligible
R13	50.20	1.99	0.60	2.15	52.35	1.43	Minor
R14	50.20	1.81	0.76	2.37	52.57	1.58	Minor
R15	47.57	2.12	1.48	3.06	50.62	2.04	Minor
R16	47.57	2.62	1.40	3.59	51.15	2.39	Minor
R17	50.20	1.47	0.72	1.79	51.99	1.19	Minor
R18	50.20	1.36	0.83	1.79	51.99	1.19	Minor
R19	58.16	0.11	0.87	0.90	59.07	0.60	Minor
R20	50.20	1.57	0.59	2.02	52.22	1.35	Minor
Bangladesh APCR AQS: 150 µg/m³							

Table 6-7 Predicted 24-Hour Mean $PM_{2.5}$ Concentrations and Impact of the Project for the Operation Phase at Sensitive Receptor Locations

Receptor ID	Baseline Concentration (µg/m³)	Project Contribution (µg/m³)			PEC (µg/m³)	PC as % of AQS	Magnitude of Impact
		Road Traffic	Vessels	PC (Road Traffic + Vessels)			
M1	22.72	1.41	1.32	2.30	25.03	3.55	Minor
M2	22.47	2.30	1.40	3.23	25.70	4.97	Minor
M6	22.56	0.78	2.20	2.03	24.59	3.13	Minor

Receptor ID	Baseline Concentration (µg/m³)	Project Contribution (µg/m³)			PEC (µg/m³)	PC as % of AQS	Magnitude of Impact
		Road Traffic	Vessels	PC (Road Traffic + Vessels)			
R1	22.47	2.17	2.54	3.30	25.76	5.07	Minor
R2	22.56	0.80	2.39	2.20	24.76	3.39	Minor
R3	22.47	2.50	1.27	3.39	25.86	5.22	Moderate
R4	22.60	2.98	2.46	4.76	27.37	7.33	Minor
R5	22.72	1.70	1.04	2.30	25.03	3.54	Negligible
R6	22.72	1.59	0.94	2.03	24.76	3.13	Negligible
R7	22.72	1.88	0.77	2.44	25.16	3.75	Minor
R8	22.56	0.13	0.90	0.95	23.51	1.47	Negligible
R9	22.56	0.15	1.31	1.39	23.95	2.14	Minor
R10	22.60	1.95	2.65	3.52	26.12	5.41	Minor
R11	22.56	0.13	1.05	1.05	23.61	1.62	Minor
R12	22.47	2.86	1.60	3.85	26.31	5.92	Minor
R13	22.72	1.87	0.56	2.02	24.74	3.11	Minor
R14	22.72	1.71	0.71	2.22	24.95	3.42	Minor
R15	22.47	2.00	1.38	2.87	25.33	4.41	Minor
R16	22.47	2.47	1.30	3.37	25.84	5.19	Moderate
R17	22.72	1.38	0.66	1.67	24.39	2.57	Minor
R18	22.72	1.28	0.76	1.68	24.40	2.58	Minor
R19	22.56	0.11	0.81	0.84	23.40	1.29	Minor
R20	22.72	1.48	0.55	1.90	24.62	2.92	Minor
Bangladesh APCR AQS: 65 µg/m³							

Short-Term SO_2 Concentrations

Results for 24-hour and 1-hour mean SO_2 concentrations considered emissions from vessels only and are detailed in Table 6-8 and Table 6-9 respectively. For 24-hour mean SO_2, the magnitude of impact ranged from minor to moderate, with the maximum PCs predicted at R4 and R10, located on-site on the façade of an existing workers building. The highest PC at a highly sensitive receptor was 12.58% at R2, which is located on the façade of Chattogram Biman Bandor High School.

The magnitude of impact for 1-hour SO_2 was predicted to be major at 8 receptors, including Chattogram Biman Bandor High School and residential receptors on both sides of the Karnaphuli River.

Table 6-8 Predicted 24-Hour Mean SO_2 Concentrations and Impact of the Project for the Operation Phase at Sensitive Receptor Locations

Receptor ID	Baseline Concentration (µg/m³)	PC (Vessels only) (µg/m³)	PEC (µg/m³)	PC as % of AQS	Magnitude of Impact
M1	33.62	6.93	40.55	8.66	Moderate

Receptor ID	Baseline Concentration (µg/m³)	PC (Vessels only) (µg/m³)	PEC (µg/m³)	PC as % of AQS	Magnitude of Impact
M2	33.68	6.60	40.28	8.25	Moderate
M6	34.12	9.74	43.86	12.18	Moderate
R1	33.68	10.67	44.35	13.34	Minor
R2	34.12	10.07	44.19	12.58	Moderate
R3	33.68	6.34	40.02	7.93	Moderate
R4	34.63	11.59	46.21	14.48	Minor
R5	33.62	5.31	38.93	6.64	Minor
R6	33.62	5.13	38.75	6.41	Minor
R7	33.62	4.64	38.26	5.80	Moderate
R8	34.12	4.96	39.08	6.19	Minor
R9	34.12	7.09	41.21	8.86	Moderate
R10	34.63	11.10	45.73	13.87	Minor
R11	34.12	5.27	39.39	6.59	Moderate
R12	33.68	7.26	40.94	9.07	Minor
R13	33.62	3.13	36.75	3.91	Minor
R14	33.62	3.97	37.59	4.96	Minor
R15	33.68	7.39	41.07	9.23	Moderate
R16	33.68	6.16	39.84	7.70	Moderate
R17	33.62	3.73	37.35	4.67	Minor
R18	33.62	4.51	38.13	5.63	Moderate
R19	34.12	4.32	38.44	5.40	Moderate
R20	33.62	3.06	36.68	3.82	Minor
Bangladesh APCR AQS: 80 µg/m³					

Table 6-9 Predicted 1-Hour Mean SO_2 Concentrations and Impact of the Project for the Operation Phase at Sensitive Receptor Locations

Receptor ID	Baseline Concentration (µg/m³)	PC (Vessels only) (µg/m³)	PEC (µg/m³)	PC as % of AQS	Magnitude of Impact
M1	39.21	33.77	72.99	13.51	Moderate
M2	41.15	40.19	81.35	16.08	Major
M6	40.49	41.06	81.55	16.42	Major
R1	41.15	43.81	84.96	17.52	Moderate
R2	40.49	40.89	81.38	16.36	Major
R3	41.15	38.00	79.16	15.20	Major
R4	41.89	48.38	90.27	19.35	Moderate

Receptor ID	Baseline Concentration (µg/m³)	PC (Vessels only) (µg/m³)	PEC (µg/m³)	PC as % of AQS	Magnitude of Impact
R5	39.21	24.72	63.93	9.89	Minor
R6	39.21	21.43	60.64	8.57	Minor
R7	39.21	18.12	57.34	7.25	Moderate
R8	40.49	24.61	65.10	9.85	Minor
R9	40.49	40.33	80.82	16.13	Major
R10	41.89	48.11	90.00	19.25	Moderate
R11	40.49	41.54	82.03	16.61	Major
R12	41.15	43.64	84.79	17.46	Moderate
R13	39.21	13.46	52.68	5.39	Moderate
R14	39.21	16.30	55.52	6.52	Moderate
R15	41.15	35.62	76.78	14.25	Moderate
R16	41.15	37.94	79.09	15.17	Major
R17	39.21	15.30	54.51	6.12	Moderate
R18	39.21	17.91	57.13	7.17	Moderate
R19	40.49	37.68	78.17	15.07	Major
R20	39.21	13.27	52.48	5.31	Moderate
Bangladesh APCR AQS: 250 µg/m³					

Short-Term CO Concentrations

Table 6-10, Table 6-11 and Table 6-12 show the results for 24-hour, 8-hour and 1-hour mean CO concentrations. As no national standard exists for 24-hour mean CO, the PC results were compared to the WHO AQG value of 4,000 µg/m³. The PC was less than 5% of the relevant AQS for all averaging periods across all modelled receptors. The CO magnitude of impact ranged from negligible to minor, depending on receptor sensitivity.

Table 6-10 Predicted 24-Hour Mean CO Concentrations and Impact of the Project for the Operation Phase at Sensitive Receptor Locations

Receptor ID	Baseline Concentration (µg/m³)	PC (Vessels only) (µg/m³)	PEC (µg/m³)	PC as % of AQS	Magnitude of Impact
M1	580.69	6.91	587.61	0.17	Minor
M2	719.86	8.99	728.85	0.22	Minor
M6	589.72	9.70	599.42	0.24	Minor
R1	719.86	12.90	732.76	0.32	Negligible
R2	589.72	10.76	600.49	0.27	Minor
R3	719.86	8.04	727.90	0.20	Minor
R4	529.93	17.09	547.02	0.43	Negligible

Receptor ID	Baseline Concentration (µg/m³)	PC (Vessels only) (µg/m³)	PEC (µg/m³)	PC as % of AQS	Magnitude of Impact
R5	580.69	4.86	585.56	0.12	Negligible
R6	580.69	4.35	585.04	0.11	Negligible
R7	580.69	3.73	584.43	0.09	Minor
R8	589.72	5.59	595.31	0.14	Negligible
R9	589.72	8.09	597.82	0.20	Minor
R10	529.93	13.99	543.92	0.35	Negligible
R11	589.72	6.68	596.40	0.17	Minor
R12	719.86	9.69	729.55	0.24	Negligible
R13	580.69	2.48	583.18	0.06	Minor
R14	580.69	3.14	583.83	0.08	Minor
R15	719.86	7.38	727.24	0.18	Minor
R16	719.86	8.31	728.17	0.21	Minor
R17	580.69	2.95	583.65	0.07	Minor
R18	580.69	3.62	584.32	0.09	Minor
R19	589.72	4.54	594.26	0.11	Minor
R20	580.69	2.43	583.12	0.06	Minor
WHO AQG: 4,000 µg/m³					

Table 6-11 Predicted 8-Hour Mean CO Concentrations and Impact of the Project for the Operation Phase at Sensitive Receptor Locations

Receptor ID	Baseline Concentration (µg/m³)	PC (Vessels only) (µg/m³)	PEC (µg/m³)	PC as % of AQS	Magnitude of Impact
M1	879.58	17.79	897.38	0.36	Minor
M2	1,323.96	18.99	1,342.94	0.38	Minor
M6	1,163.96	22.41	1,186.37	0.45	Minor
R1	1,323.96	30.41	1,354.37	0.61	Negligible
R2	1,163.96	25.32	1,189.27	0.51	Minor
R3	1,323.96	17.96	1,341.92	0.36	Minor
R4	720.42	32.05	752.47	0.64	Negligible
R5	879.58	13.36	892.94	0.27	Negligible
R6	879.58	11.17	890.75	0.22	Negligible
R7	879.58	9.17	888.75	0.18	Minor
R8	1,163.96	10.88	1,174.84	0.22	Negligible
R9	1,163.96	17.07	1,181.03	0.34	Minor
R10	720.42	30.22	750.63	0.60	Negligible

Receptor ID	Baseline Concentration (µg/m³)	PC (Vessels only) (µg/m³)	PEC (µg/m³)	PC as % of AQS	Magnitude of Impact
R11	1,163.96	15.30	1,179.26	0.31	Minor
R12	1,323.96	18.97	1,342.93	0.38	Negligible
R13	879.58	6.31	885.90	0.13	Minor
R14	879.58	7.78	887.37	0.16	Minor
R15	1,323.96	19.16	1,343.12	0.38	Minor
R16	1,323.96	17.68	1,341.64	0.35	Minor
R17	879.58	7.15	886.73	0.14	Minor
R18	879.58	9.01	888.59	0.18	Minor
R19	1,163.96	9.79	1,173.75	0.20	Minor
R20	879.58	6.22	885.81	0.12	Minor
Bangladesh APCR AQS: 5,000 µg/m³					

Table 6-12 Predicted 1-Hour Mean CO Concentrations and Impact of the Project for the Operation Phase at Sensitive Receptor Locations

Receptor ID	Baseline Concentration (µg/m³)	PC (Vessels only) (µg/m³)	PEC (µg/m³)	PC as % of AQS	Magnitude of Impact
M1	1,521.67	35.04	1,556.70	0.18	Minor
M2	1,720.00	48.45	1,768.45	0.24	Minor
M6	1,493.33	46.15	1,539.49	0.23	Minor
R1	1,720.00	55.52	1,775.52	0.28	Negligible
R2	1,493.33	46.48	1,539.81	0.23	Minor
R3	1,720.00	43.69	1,763.69	0.22	Minor
R4	1,050.00	76.27	1,126.27	0.38	Negligible
R5	1,521.67	23.45	1,545.12	0.12	Negligible
R6	1,521.67	20.20	1,541.86	0.10	Negligible
R7	1,521.67	17.27	1,538.94	0.09	Minor
R8	1,493.33	24.78	1,518.12	0.12	Negligible
R9	1,493.33	46.46	1,539.79	0.23	Minor
R10	1,050.00	59.97	1,109.97	0.30	Negligible
R11	1,493.33	48.89	1,542.22	0.24	Minor
R12	1,720.00	53.87	1,773.87	0.27	Negligible
R13	1,521.67	12.49	1,534.15	0.06	Minor
R14	1,521.67	15.29	1,536.96	0.08	Minor
R15	1,720.00	36.32	1,756.32	0.18	Minor
R16	1,720.00	44.83	1,764.83	0.22	Minor

Receptor ID	Baseline Concentration (µg/m³)	PC (Vessels only) (µg/m³)	PEC (µg/m³)	PC as % of AQS	Magnitude of Impact
R17	1,521.67	14.18	1,535.85	0.07	Minor
R18	1,521.67	17.22	1,538.89	0.09	Minor
R19	1,493.33	40.57	1,533.90	0.20	Minor
R20	1,521.67	12.29	1,533.96	0.06	Minor
Bangladesh APCR AQS: 20,000 µg/m³					

Summary of Impacts and Overall Significance of Effects

A summary of the number of receptors impacted for each defined impact magnitude is shown in Table 6-13 below. The results indicate that contributions from the Project to short-term (24-hour mean and 1-hour mean) and long-term (annual mean) NO_2 concentrations will result in major impacts at the majority of receptors. Major impacts were also predicted at 8 receptors with respect to vessel contributions to 1-hour mean SO_2 concentrations. In addition, moderate impacts were predicted at the majority of receptors for 24-hour mean SO_2 concentrations. Based on these results and professional judgement, it is concluded that the Project will result in significant effects in relation to NO_2 and SO_2 arising from road traffic and vessel exhaust emissions.

Table 6-13 Summary of Operation Phase Impacts

Pollutant	Magnitude of Impact and Number of Receptors			
	Major	Moderate	Minor	Negligible
Annual Mean				
NO_2	10	0	1	0
PM_{10}	0	0	11	0
$PM_{2.5}$	0	0	11	0
24-Hour Mean				
NO_2	23	0	0	0
PM_{10}	0	0	15	7
$PM_{2.5}$	0	2	17	3
CO	0	0	16	7
SO_2	0	12	11	0
1-Hour Mean				
NO_2	23	0	0	0
CO	0	0	16	7
SO_2	8	12	3	0
8-Hour Mean				
CO	0	0	16	7

6.1.1 Operation Phase Mitigation and Monitoring

Potential mitigation measures to reduce operation phase contributions to long- and short-term NO_2 and short-term SO_2 impacts are set out for road traffic and vessels emissions below. Where possible, the potential reduction in emissions was quantified by comparing the emissions rates calculated with the proposed mitigation measure in place with those used in the model.

Operation Road Traffic Emissions

- Heavy Goods Vehicles (HGVs) associated with port operations should be compliant with Euro VI standards (the assessment assumed Euro III standards) – this is estimated to reduce road traffic emissions by at least 85%.
- Rerouting of HGVs away from sensitive receptors (i.e. the majority of HGVs should arrive and depart to the north of the site to minimise traffic along Airport Road and VIP Road).
- Installation of road barriers to prevent dispersion of road traffic emissions.

Operation Vessel Emissions

- Container vessels should be IMO Tier III compliant – this is estimated to reduce NO_x emissions by approximately 75%.
- The Project is not located within an Emission Control Area (ECA). Therefore, the 0.1% sulphur fuel cap does not apply. However, it is recommended that the use of Ultra-Low Sulphur Fuel (ULSF) for tugboats operating within the port is enforced, and that container vessels must either use ULSF or be fitted with exhaust gas cleaning systems (scrubbers) that demonstrate equivalent sulphur oxides (SO_x) reduction to be equivalent to compliant ULSF use.
- To reduce the likelihood of 1-hour mean exceedances of SO_2 and NO_2, arrivals and departures should be staggered to avoid them occurring within the same hour.
- Use of on-shore electric power for hotelling vessels.

6.2 Residual Operation Phase Effects

There are a number of potential mitigation measures that could be expected to reduce impact magnitudes through the reduction of emissions from both operation road traffic and vessels. However, the emissions reduction of the proposed measures has not been quantitatively assessed and therefore the residual effect remains significant.

A full quantitative assessment of the proposed mitigation measures would be required in order to determine the effectiveness of proposed mitigation and whether they would sufficiently reduce impacts such that the residual effects are not significant.

6.3 Summary of Residual Effects

Table 6-14 Summary of provides a summary of the residual effects relating to the construction and operation phases of the Project with regard to air quality receptors.

Table 6-14 Summary of Residual Air Quality Effects

Impact	Receptor	Residual Effects	
		Construction	Operation
Construction Dust	Human receptors within 250 m of the site boundary (and/ or within 50 m of HGV routes up to 250 m from site entrances).	Not significant	Scoped out

NRMM emissions	Human receptors within 200 m of the plant – limited to on-site workers.	Not significant	Scoped out
Road traffic and Vessel emissions	Human receptors within 200 m of the affected road network and human receptors within 1 km of the berths and/ or main areas of vessel manoeuvring.	Significant (worst-case)	Significant

Mitigation for construction phase NRMM and dust is set out in Section 5.3. With implementation of the recommended mitigation measures, the residual effects from construction phase dust and NRMM are not significant.

Given it has not been possible to determine the significance of effect for construction phase road traffic and vessel emissions, a worst-case assumption has been applied based on the findings of the operational assessment, i.e. that the effect will be significant. Therefore, the operational phase mitigation measures presented in Section 6.1.1 to reduce potential impacts from emissions associated with road traffic and vessels should also be applied to the construction phase as a precautionary approach.

Although the proposed mitigation measures for operation phase set out in Section 6.1.1 would reduce emissions from road traffic and vessels, a full quantitative assessment of the emissions reduction was not undertaken and therefore the residual effect remains significant.

Appendix A1 - Figures

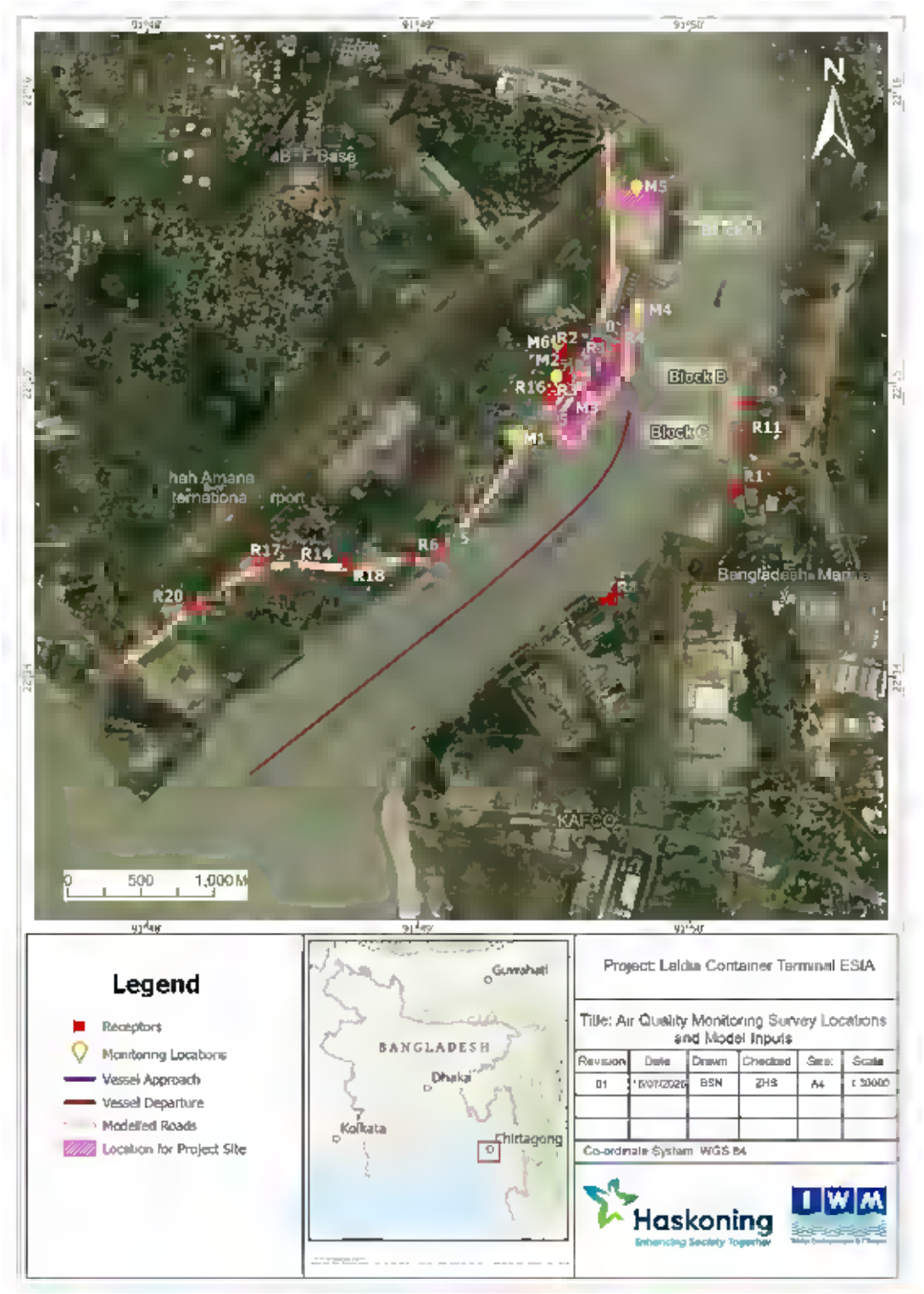


Figure 6-1 Air Quality Monitoring Survey Locations and Model Inputs

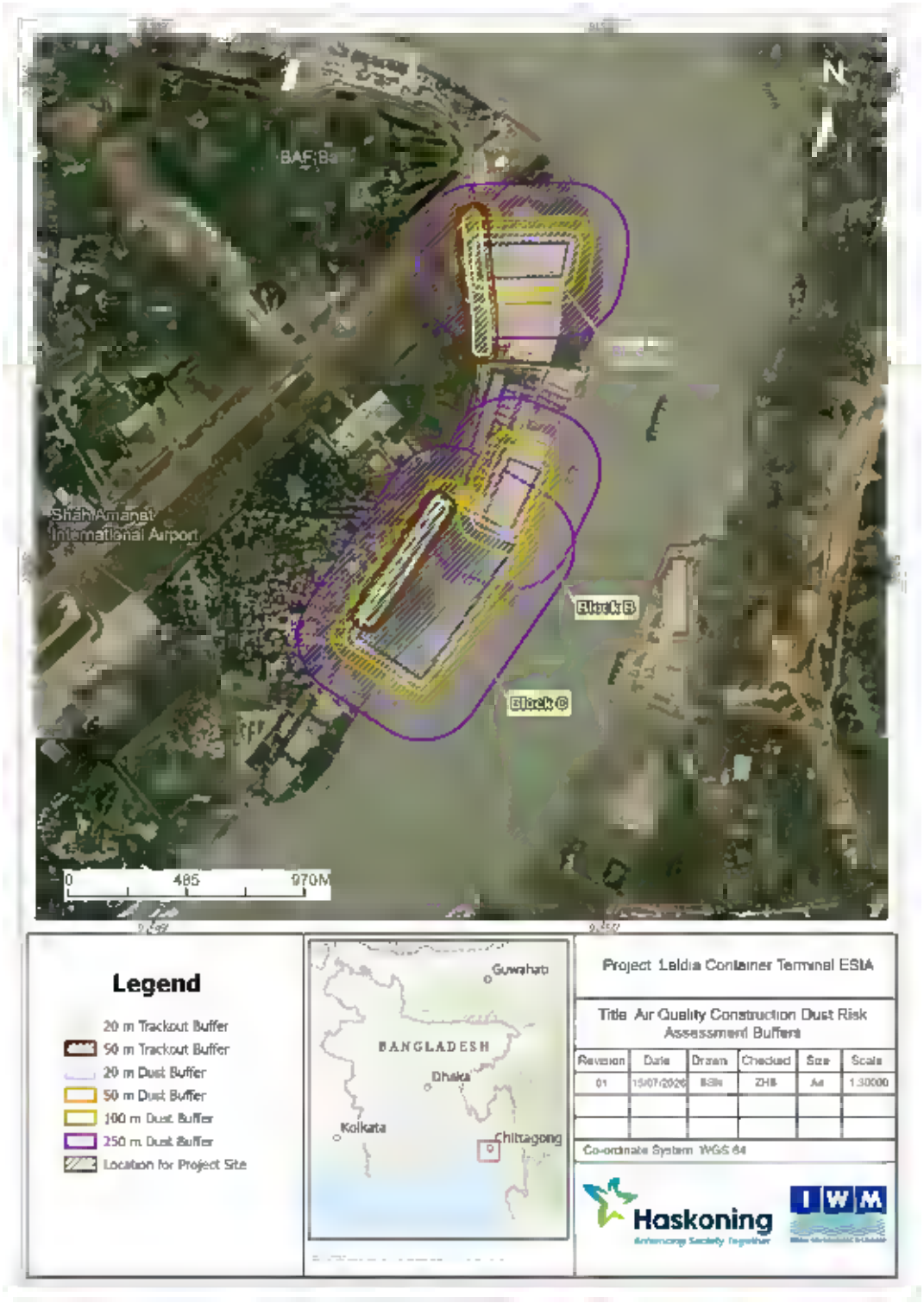


Figure 6-2 Air Quality Construction Dust Risk Assessment Buffers

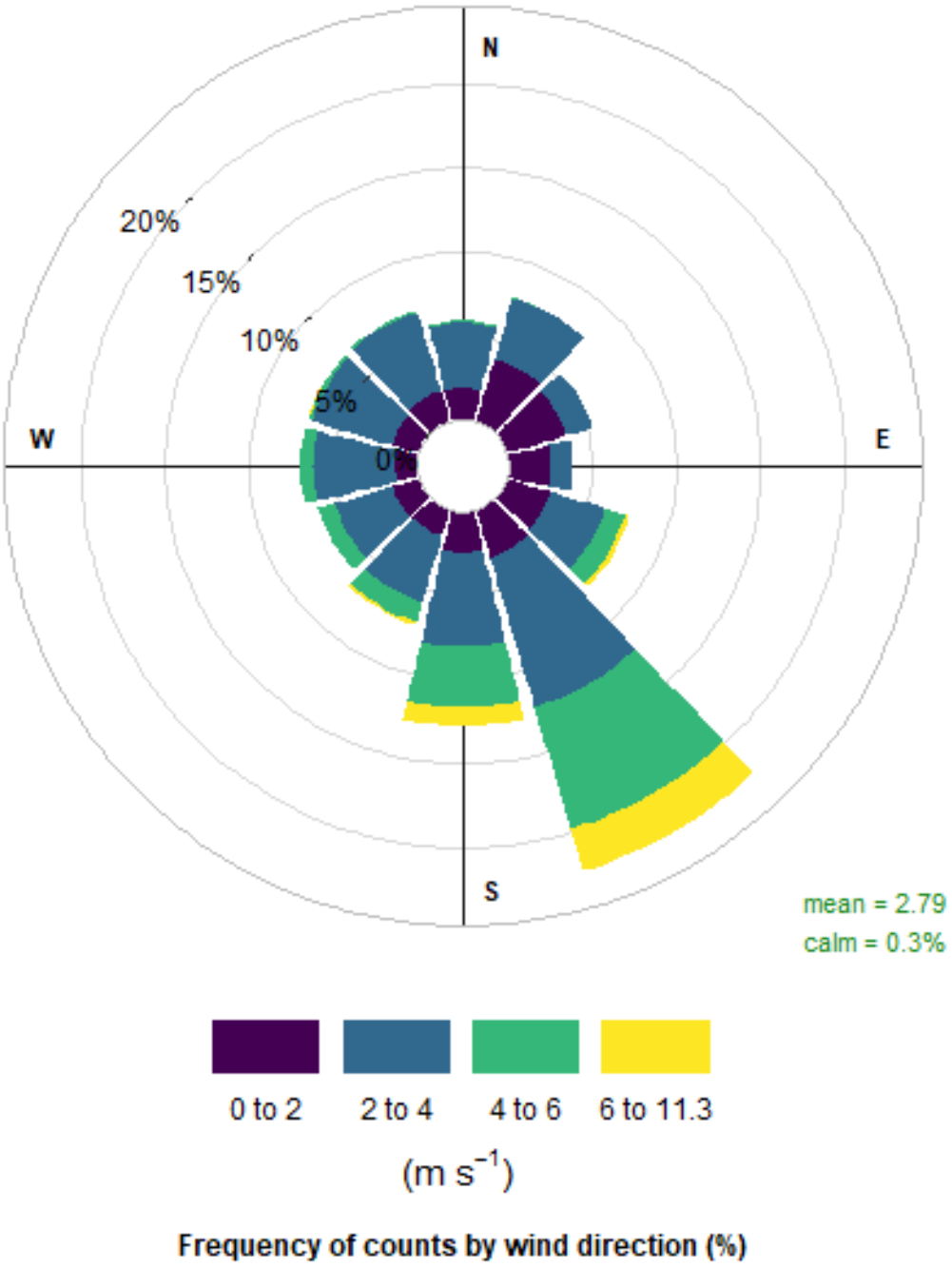


Figure 6-3 Windrose of 2025 Numerical Weather Prediction Data

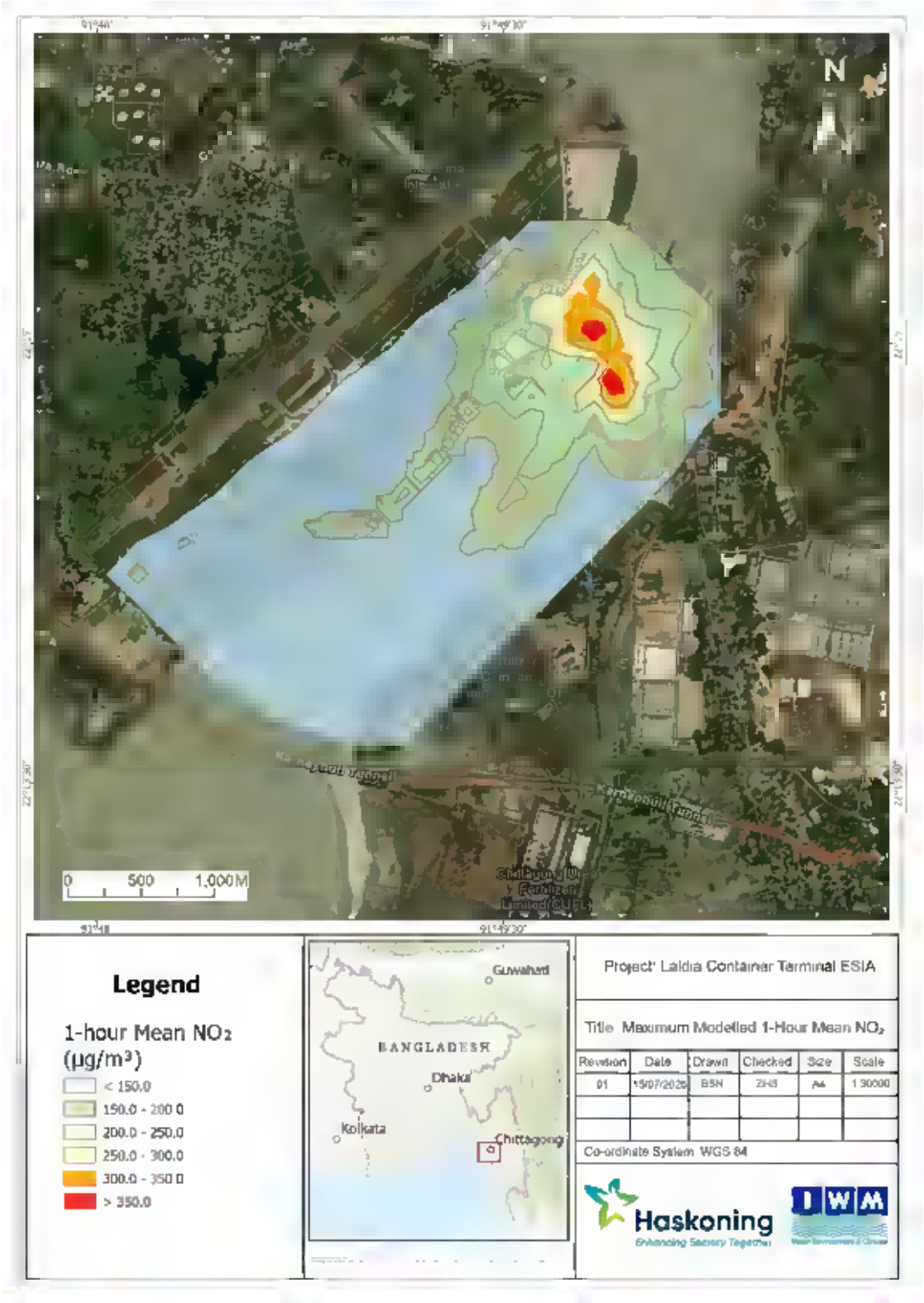


Figure 6-4 Maximum Modelled 1-hour Mean NO_2

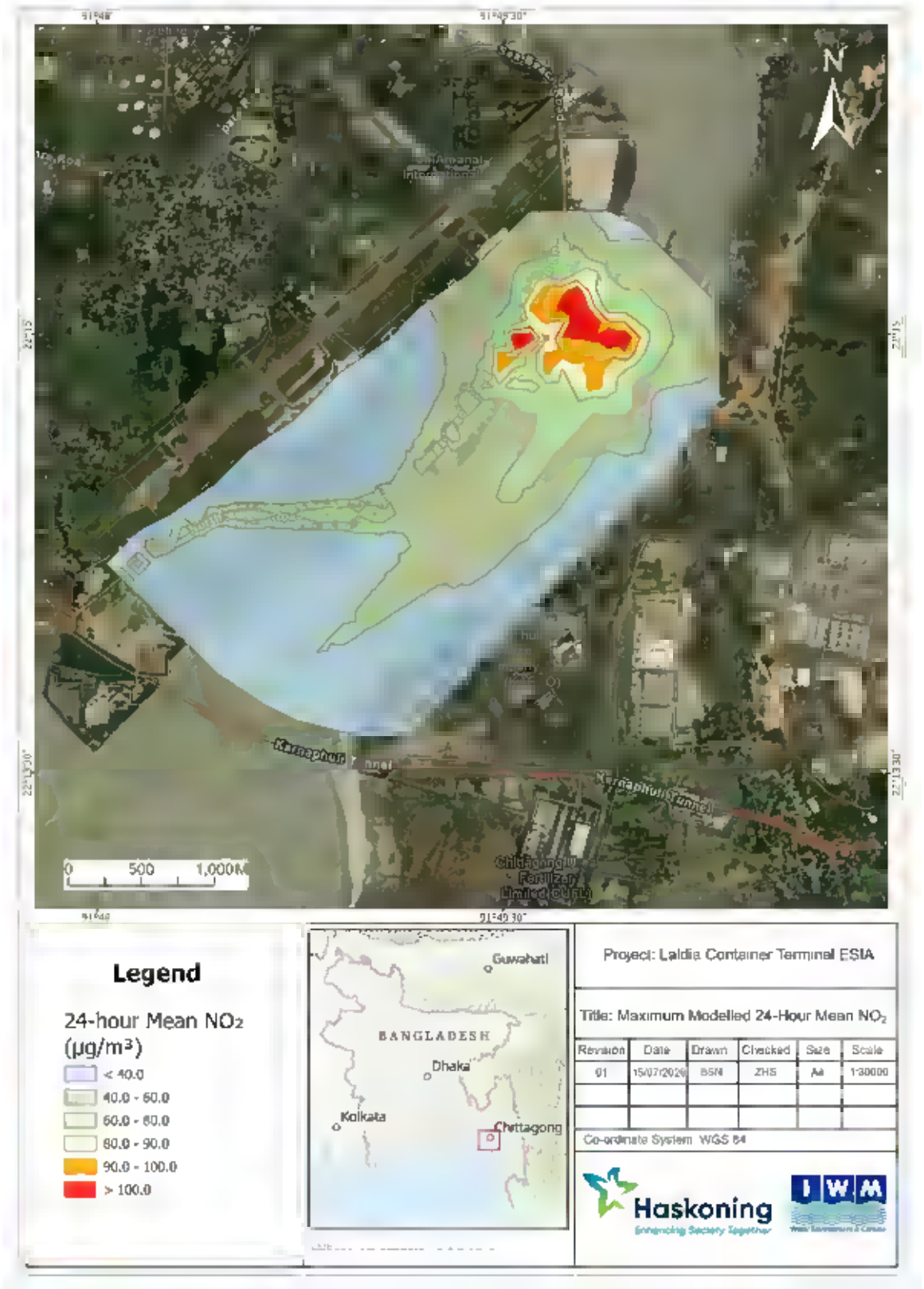


Figure 6-5 Maximum Modelled 24-hour Mean NO_2

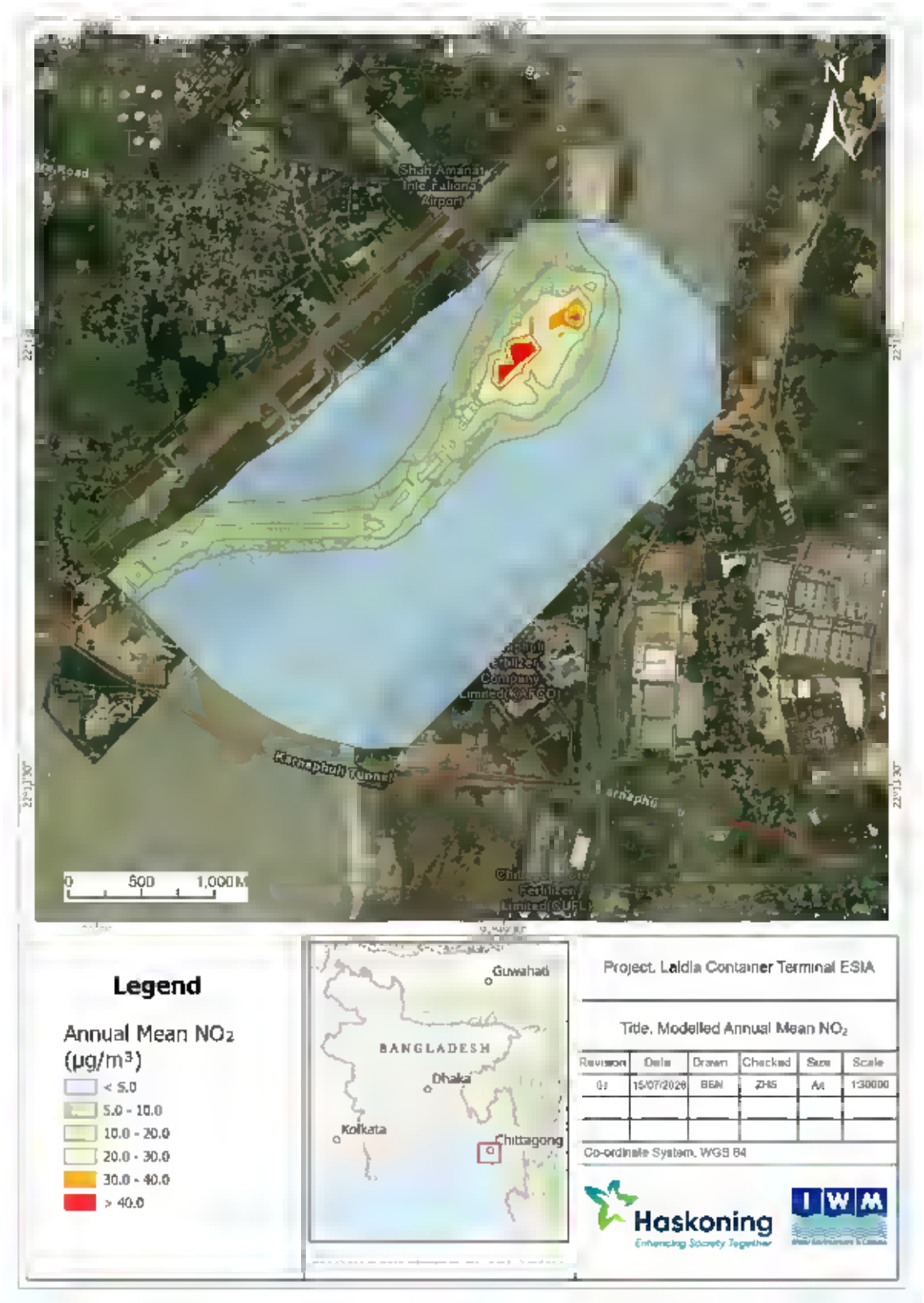


Figure 6-6 Modelled Annual Mean NO_2

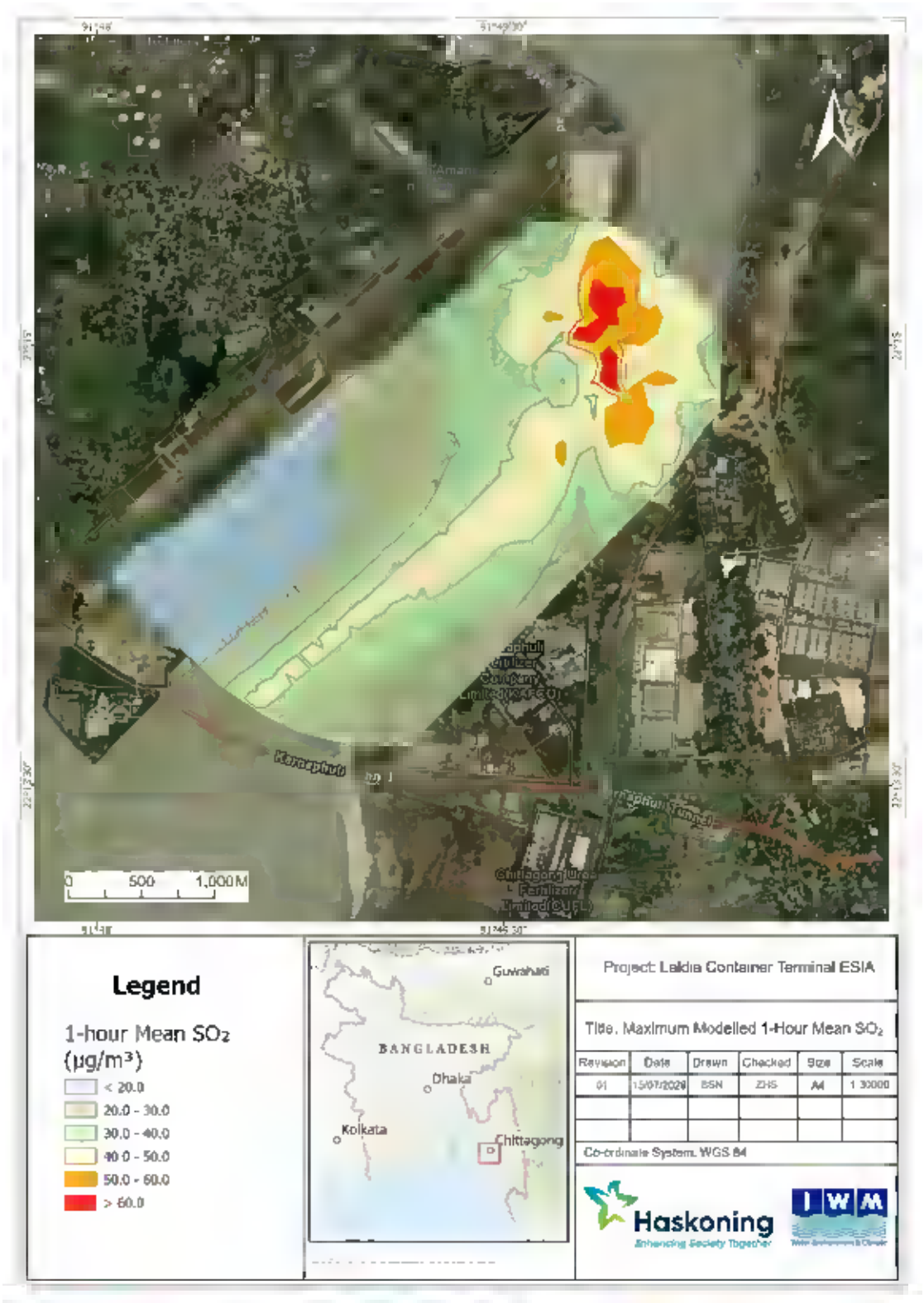


Figure 6-7 Maximum Modelled 1-hour Mean SO_2

Appendix A2 - Construction Phase Plant and Vessels

Table 6-15 Construction Phase Plant

Construction Phase	Area	Plant
Mobilisation & site establishment	Project-wide / temporary compounds	• 4 x Mobile diesel generator set (250-500 kVA) • 4 x Small diesel generator set (60-125 kVA) • 3 x Water bowser / tanker (Diesel, capacity 8-12 m3) • 2 x Fuel bowser with spill kit (Diesel, capacity 8-15 m3) • 3 x Telehandler (Diesel, capacity 3-5 t, 7-14 m reach) • 3 x Air compressor (Diesel, capacity 185-375 cfm) • 2 x Mobile crane (Diesel, capacity 50-100 t)
Site clearance & enabling	Blocks B/C, local interfaces	• 6 x Tracked excavator (Diesel, capacity 20-35 t) • 4 x Backhoe loader (Diesel, Standard construction class) • 2 x Long-reach excavator (Diesel, capacity 25-40 t, extended reach) • 4 x Bulldozer (Diesel, capacity D6-D8 equivalent) • 4 x Wheel loader (Diesel, capacity 3-5 m3 bucket) • 20 x Dump truck / tipper (Diesel, capacity 16-25 m3) • 2 x Motor grader (Diesel, 140-200 hp) • 4 x Vibratory roller (Diesel, capacity 10-20 t)
B-C channel closure & culvert	Between Blocks B and C	• 4 x Tracked excavator (Diesel, capacity 20-35 t) • 2 x Long-reach excavator (Diesel, capacity 25-40 t, extended reach) • 1 x Vibratory sheet pile hammer with leader rig (Diesel, Medium-heavy construction class) • 2 x Crawler crane (Diesel, capacity 100-150 t) • 2 x Concrete pump (Diesel, capacity 36-52 m boom equivalent) • 8 x Transit mixer (Diesel, capacity 6-10 m3)
Reclamation fill import and placement	Block C and adjacent riverbank	• 3 x Excavator / grab unloading plant (Diesel, 30-45 t class) • 5 x Bulldozer (Diesel, capacity D6-D8 equivalent) • 24 x Articulated dump truck / tipper (Diesel, capacity 20-30 t payload) • 6 x Vibratory roller (Diesel, capacity 10-20 t) • 2 x Motor grader (Diesel, 140-200 hp class)
Ground improvement	Block C reclamation and weak subsoil zones	• 3 x PVD installation rig (Diesel, capacity Project-specific) • 4 x Bulldozer / loader support (Diesel, capacity D6-D8 / loader mix) • 2 x Monitoring drilling / CPT support rig (Diesel, capacity Small rig)
Quay, piling and deck	Riverside Block C	• 1 x Land-based piling rig (Diesel, capacity Project-specific) • 2 x Impact hammer (Diesel / hydraulic, capacity Hammer energy TBC) • 2 x Vibratory hammer (Diesel / hydraulic, capacity TBC) • 1 x Drilling rig / rotary bored piling unit (Diesel, capacity TBC) • 4 x Crawler crane (Diesel, capacity 150-250 t) • 4 x Concrete pump (Diesel, capacity 36-60 m boom equivalent) • 18 x Transit mixer (Diesel, capacity 6-10 m3) • 4 x Hydraulic breaker / pile cutter set (Diesel / hydraulic, capacity TBC)
Slope protection and scour	Riverside Block C	• 3 x Long-reach excavator / rock placer (Diesel, capacity 30-50 t)

Construction Phase	Area	Plant
Yard, drainage and utilities	Block C	• 2 x Paver / grader spreader (Diesel, capacity Project-specific) • 6 x Tandem / pneumatic roller (Diesel, capacity 8-16 t) • 6 x Excavator / trench excavator (Diesel, capacity 15-25 t) • 3 x Mobile crane (Diesel, capacity 50-100 t)
Block B integration	Block B	• 4 x Skid steer loader (Diesel, Small construction class)
Block A temporary support and truck area works	Block A	• 3 x Tracked excavator (Diesel, capacity 15-25 t)
Buildings and facilities	Roadside buildings / project-wide	• 4 x Mobile crane (Diesel, capacity 50-150 t) • 3 x Concrete pump (Diesel, capacity 36-52 m boom equivalent) • 4 x Telehandler (Diesel, capacity 3-5 t)
MEP, ICT and systems	Terminal-wide	• 2 x Mobile crane (Diesel, capacity 100-200 t)
Crane delivery and commissioning	Quay and yard	• 2 x Mobile assist crane (Diesel, capacity 100-250 t assist crane or project-specific) • 4 x SPMT / heavy low-loader / quay transfer transporter (Diesel, capacity Project-specific)
Demobilisation and handover	Project-wide	• 12 x Low-loader / plant transport (Diesel, Heavy transport class) • 3 x Road sweeper / water tanker (Diesel, Municipal / industrial class)

Table 6-16 Construction Phase Vessels

Construction Phase	Area	Construction Vessels
Capital dredging	Riverfront / berth pocket	• 1 x Cutter Suction Dredger (CSD) (Marine fuel, capacity Screening basis only, production TBC) • 6 x Spoil barge / split hopper barge equivalent (Marine fuel, capacity 1,000-2,500 m^3) • 3 x Tugboat (Marine fuel, capacity 1,000-2,000 hp) • 2 x Survey / monitoring boat (Marine fuel, capacity Small survey craft) • 2 x Workboat / crew boat (Marine fuel, capacity Small harbour craft)
Reclamation fill import and placement	Block C and adjacent riverbank	• 6 x Fill barge / hopper barge equivalent (Marine fuel, capacity 1,000-2,500 m^3)
Quay, piling and deck	Riverside Block C	• 2 x Marine piling rig on spud barge / jack-up equivalent (Marine fuel, capacity Project-specific) • 4 x Material barge (Marine fuel, Deck / beam supply barge)
Slope protection and scour	Riverside Block C	• 4 x Rock barge (Marine fuel, capacity 1,000-2,500 t) • 2 x Grab crane / floating crane (Marine fuel, capacity 80-150 t equivalent) • 2 x Workboat / small crane support (Marine fuel, capacity Small support craft)

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Annex C2 – Specialist Study: Ambient noise

REPORT

Ambient Noise Assessment Report

Laldia Container Terminal Environmental and Social Impact Assessment

Client:	Laldia Container Terminal Limited
Reference:	BK4589-HAS-SP-XX-RP-EV-0006
Status:	Draft/01
Date:	20 August 2026

IWM Water Environment, Climate & ICT

Haskoning Enhancing Society Together

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Appendices

A1 Appendix A

1 Introduction

1.1 Project Background

The Laldia Container Terminal Project (LCTP, or the Project) is a strategic initiative to address port congestion challenges in Chattogram by expanding container-handling capacity and improving operational efficiency at the Port of Chattogram. Located at Laldia Char along the west bank of the Karnaphuli River in Chattogram, the terminal will add approximately 0.8 million Twenty-Foot Equivalent Unit (TEU) per year of new handling capacity. This will relieve pressure on existing terminals, reduce congestion and vessel waiting times, and strengthen maritime logistics performance to support Bangladesh's trade competitiveness and regional connectivity.

The terminal is being developed under a Public-Private Partnership (PPP) between the Chittagong Port Authority (CPA) and Laldia Container Terminal Ltd. (LCT Ltd.), a joint venture between APM Terminals (APMT) and QNS Container Services Ltd. (QNS Ltd.). A 30-year concession agreement (CA) for the design, financing, construction, operation and maintenance of the terminal was signed on 17 November 2025, representing one of the largest PPP investments in Bangladesh's port sector. LCT Ltd.'s involvement brings international expertise in container-terminal management, digital optimization, energy-efficient operations and global best practice in port safety and reliability, supporting the long-term modernization of the Port of Chattogram.

The development of LCTP will take environmental and social aspects into account and therefore an Environmental and Social Impact Assessment (ESIA) is being prepared. This ESIA is prepared for permitting purposes in Bangladesh with the Department of Environment (DoE).

1.2 Overview

As part of the ESIA for the proposed LCTP, a comprehensive noise assessment has been undertaken to evaluate the existing acoustic environment and the potential noise impacts associated with both the construction and operational phases of the project. The assessment aims to identify potential changes in ambient noise levels at nearby sensitive receptors and to determine compliance with applicable national and international noise standards.

The noise assessment comprises two key components: (i) baseline noise monitoring to establish existing ambient noise conditions within the project influence area, and (ii) predictive noise modelling to estimate future noise levels resulting from project activities. Baseline noise measurements were conducted at selected representative locations surrounding the project site to characterize the prevailing noise environment. Figure 1-1shows the proposed receptor location within the model domain/study area.

The findings of this assessment provide the basis for evaluating potential noise impacts, identifying affected receptors, and recommending appropriate mitigation measures and environmental management strategies to minimize adverse noise effects during both construction and operation of the proposed LCTP.

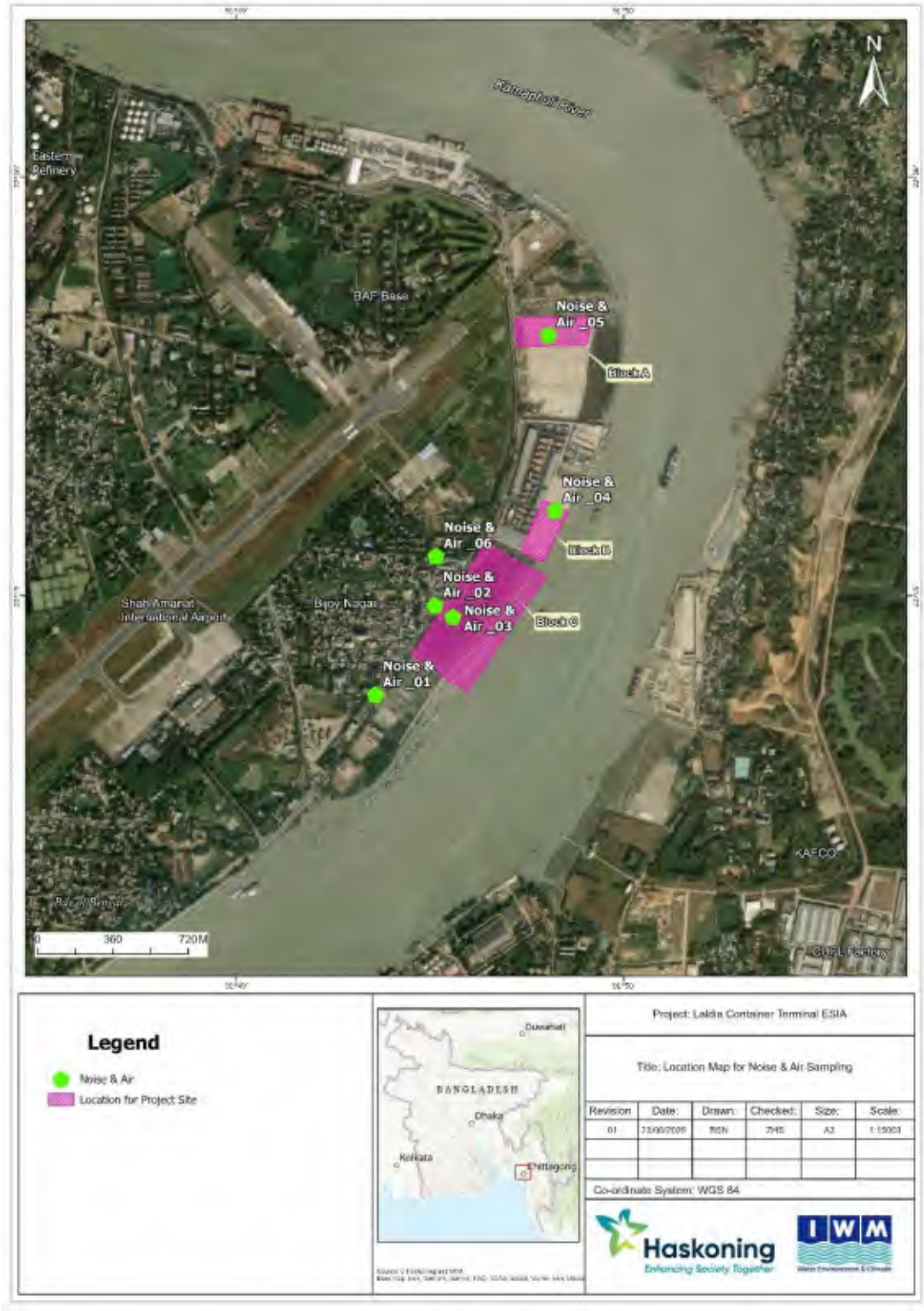


Figure 1-1: Proposed noise receptor and baseline measurement locations within the model domain

1.3 Objective of Ambient Noise Assessment

The objectives of this Ambient Noise Assessment are:

- To measure the baseline ambient noise levels in the study area;
- To evaluate the potential noise impacts associated with the proposed project intervention;
- To assess noise impacts at selected sensitive receptors in relation to applicable standards;
- To assess cumulative impacts of noise in the study area considering both baseline and future project contributions during construction & operation phase; and
- To identify and recommend appropriate mitigation measures to minimize any adverse noise related impacts where necessary.

2 Regulatory Framework

The regulatory framework for noise is a critical component of environmental assessments, essential for safeguarding public health and environmental quality. In Bangladesh, the Department of Environment (DoE) Noise Pollution (Control) Rules, alongside international frameworks such as the IFC Environmental, Health, and Safety (EHS) Guidelines, which are broadly aligned with WHO Noise Guidelines, provide the key regulatory benchmarks. These standards, which are regarded as applicable standards for this assessment, collectively define acceptable noise limits and guide the assessment and mitigation of noise impacts, as outlined below. Also, human response to noise is discussed at the end of this section.

The noise criteria presented in Table 1 are based on internationally recognised good practice, including guidance from the World Health Organization (WHO) and international environmental and social standards for the protection of human health and amenity. These criteria consider both absolute noise levels and changes relative to baseline conditions, with particular attention given to noise-sensitive receptors such as residential areas, schools and healthcare facilities.

Accordingly, the noise levels should not exceed the identified levels presented or result in a maximum increase in current background levels of 3 dB at the nearest receptor location off-site. Whilst it is not specifically stated in the guidelines, the limit of a 3 dB change at the nearest off-site receptor is considered to relate to a change in L_{Aeq} from the baseline, and is only applicable to residential or other highly sensitive receptor types, not to industrial or commercial areas due to their low sensitivity to noise level change.

As national regulation, the Noise Pollution (Control) Rules, 2025 (NPCR-2025), issued by the DoE, Bangladesh, establish permissible ambient noise limits for different land use zones, including residential, mixed, commercial, and industrial areas, with separate day and night standards. The Rules also regulate noise-generating activities such as vehicular horn use, construction works, and industrial operations, particularly in and around sensitive receptors like hospitals, educational institutions, and residential areas. Furthermore, they empower regulatory authorities to designate silent zones, monitor compliance, and enforce corrective measures to control excessive noise pollution and safeguard public health.

The standard limits set by DoE and IFC-EHS Guidelines are presented in the table below;

Table 2-1: Noise Level Standards

Area Type	Noise Pollution (Control) Rules, 2025, L_{eq} (dBA)		IFC-EHS Guidelines, 2007[1] L_{eq} (dBA)	
	Daytime (6:00-21:00)	Nighttime (21:00-6:00)	Daytime (7:00-22:00)	Nighttime (22:00-7:00)
Silent Area	50	40	-	-
Residential Area	55	45	55	45
Mixed Area	60	50	-	-
Commercial Area	70	60	70	70
Industrial Area	75	70	70	70

Human Response to Noise: The human ear does not perceive sound in absolute terms but rather in relation to differences in intensity, effectively sensing how much greater one sound is compared to another. The decibel (dB) is the fundamental unit used to express sound level, representing a logarithmic

[1] *https://documents1.worldbank.org/curated/en/157871484635724258/pdf/112110-WP-Final-General-EHS-Guidelines.pdf*

ratio of sound intensity relative to a reference value. The typical range of audible sound for humans extends from 0 to 140 dB. For reference, a whisper is approximately 30 dB, normal conversational speech is around 60 dB, and exposure to 130 dB approaches the threshold of physical pain. In terms of perceptibility, changes of around 3 dB in the ambient environment are generally considered barely noticeable, a 5 dB increase is readily perceptible, and a 10 dB increase is commonly perceived as approximately twice as loud.

3 Methodology

For the cumulative impact of ambient noise assessment, both baseline noise measurements and noise modelling are required. Baseline noise monitoring is conducted to establish existing ambient noise conditions, while noise modelling is performed to estimate the project-specific noise contribution (predicted noise levels). The methodology for baseline noise measurement is presented in a subsequent section; therefore, only the noise modelling methodology is described in this section.

The noise model is developed using SoundPLAN essential software, which provides multiple standards for noise propagation calculations. In this study, the RLS-90 and ISO 9613-2 standards are applied for modelling road traffic noise and industrial noise respectively. These standards have been selected as they are well established and have been extensively validated within the SoundPLAN environment. They are also more optimized in SoundPLAN compared to the other standards and require less simulation time. For example, the simulation using RLS-90 is 75% faster than NMPB-96 (Noise Study, Port of Long Beach, USA). This industry-standard software has been frequently employed in various development projects for the assessment of noise impacts.

The methodology involves detailed documentation of both inputs and outputs. Noise sources (e.g. container trucks, ships and cargo handling equipment including STS & RTG cranes, reach stacker, empty handler, and terminal tractors etc.) within the terminal are identified, and their noise levels are mapped to accurately represent the real-world scenario. The noise contributions from individual sources are then aggregated by the software to determine their combined impact on designated receptors. The spatial distribution of noise propagation is also shown using contour maps which helps to identify the extent of the noise impact zone. The predicted noise levels are compared against the levels given in the NPCR-2025, and the IFC EHS Guidelines, 2007 and as shown in Table 2-1. Finally, based on the model's findings, appropriate mitigation measures are proposed to ensure that the project adheres to noise regulations and minimizes environmental impact. A simplified representation of the modelling process is provided in Figure 3-1.

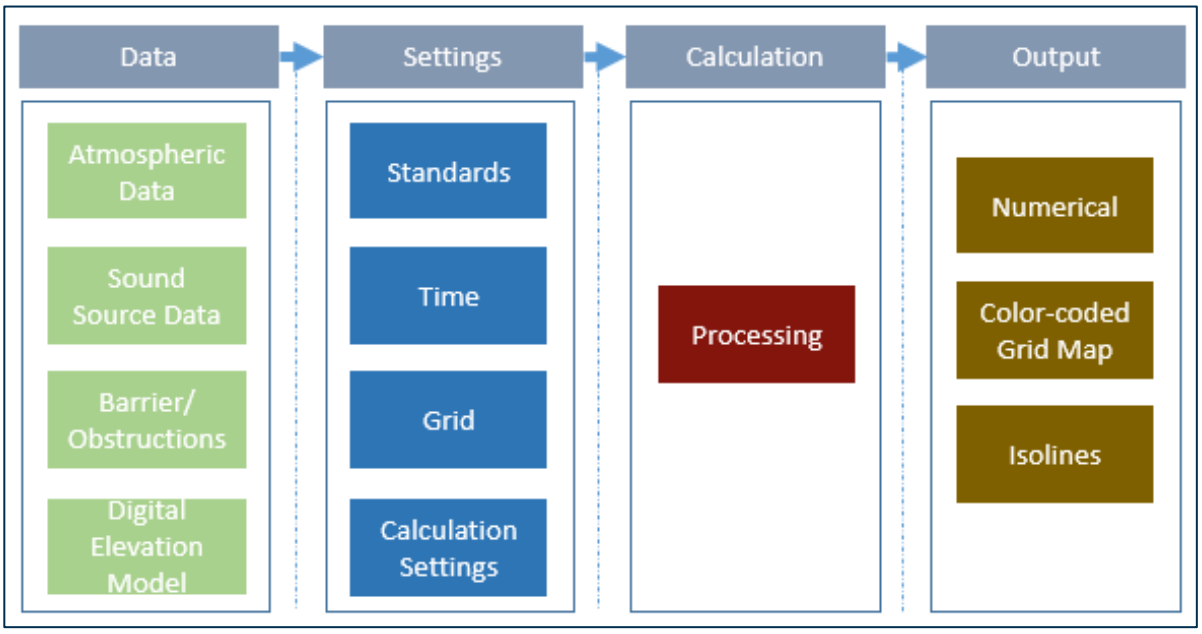


Figure 3-1: Simplified representation of modelling process

To get the cumulative noise level from the baseline and predicted noise levels at a selected receptor, the following formula is used in this study.

$$L_{\text{cumulative}} = 10 \log_{10} \left(10^{\frac{L_{\text{background}}}{10}} + 10^{\frac{L_{\text{predicted}}}{10}} \right)$$

Where:

- $L_{\text{cumulative}}$= Cumulative noise level (dB(A))
- $L_{\text{background}}$= Baseline noise level (dB(A))
- $L_{\text{predicted}}$= Predicted noise level due to the proposed project (dB(A))

4 Survey Implementation

Environmental baseline monitoring was conducted through a comprehensive field campaign covering six (06) monitoring locations distributed throughout the project influence area. Monitoring activities were performed over four (04) rounds conducted once every week. Each monitoring event consisted of continuous 24-hour observation periods to capture both daytime and night-time environmental variations. Monitoring locations and schedules are presented in Table 4-1.

Table 4-1: Environmental Monitoring Locations, Coordinates and Schedule

SN	Location ID	GPS Coordinates	Monitoring Date	Location Description
1	Location–1	22.24608919°N, 91.82263907°E	13, 20, 27 April and 4 May 2026	41 No Ward, Chorbasti, South Patenga, Chattogram
2	Location–2	22.24957979°N, 91.82519995°E	14, 21, 28 April and 5 May 2026	41 No Ward, Airport Road, North Patenga
3	Location–3	22.24914062°N, 91.82595096°E	15, 22, 29 April and 6 May 2026	Block C Laldia Container Terminal, South Patenga, Chattogram
4	Location–4	22.25339990°N, 91.83035540°E	16, 23, 30 April and 10 May 2026	Block B Laldia Container Terminal, South Patenga, Chattogram
5	Location–5	22.26040213°N, 91.83009451°E	18, 25 April and 2, 9 May 2026	Block A Laldia Container Terminal, South Patenga, Chattogram
6	Location–6	22.25156608°N, 91.82524358°E	19, 26 April and 3, 7 May 2026	Biman Bondor High School, Chattogram

Noise level monitoring was carried out to get the parameters e.g. L_{max}, L_{min}, L_{eq}-day, L_{eq}-night, L_{90}, L_{50}, L_{10} in dBA unit. Measurements were taken at 1-sec intervals over the period. The following table mentions the instrument details that was used for noise level monitoring and method of measurement. The device recorded the data throughout the monitoring period. After getting the raw data from the device, descriptive statistical analysis was applied to calculate L_{eq} & other parameter for every monitoring location.

Table 4-2: Analysis Methods of Noise Level Monitoring

Parameters	Device Name	Laboratory	Analysis Method
L_{max}, L_{min}, $L_{eq\text{-}day}$, $L_{eq\text{-}night}$, L_{90}, L_{50}, L_{10}	Lutron SL- 4033SD	In House	Descriptive Statistical Analysis by Python and MS Excel.

More details on the Sound level meter & calibrator are given in calibration certificate attached in Annex-A. Sound levels presented in this report are expressed in A-weighted decibels, dB(A), which apply a frequency weighting to measured sound pressure levels to reflect the sensitivity of human hearing. This weighting reduces the influence of very low and very high frequencies while emphasising the mid-frequency range to which the human ear is most responsive, thereby providing a measure that more accurately represents perceived noise levels and potential disturbance.

The principal acoustic descriptors adopted in this assessment are as follows:

- **L_{eq} (dBA)**: the equivalent continuous A-weighted sound level, representing the constant sound level that contains the same acoustic energy as the actual fluctuating noise over a specified

period (daytime or night-time). This parameter serves as the primary metric for both measured baseline conditions and modelled project-related noise levels.

- **L_{max}** and **L_{min}**: the maximum and minimum instantaneous sound levels recorded during the monitoring period, used to identify short-duration, high-intensity noise events and the lowest prevailing sound levels, respectively.
- **L_{10}**, **L_{50}**, and **L_{90}**: the sound levels exceeded for 10%, 50%, and 90% of the monitoring period, respectively. These statistical descriptors provide an indication of the variability of the acoustic environment, with L_{10} generally characterising intermittent peak events, L_{50} representing the median sound level, and L_{90} commonly used as an indicator of background noise conditions.

For the purposes of this report, **baseline noise** refers to the existing acoustic environment at each receptor location prior to implementation of the proposed development. Baseline noise levels are represented by measured Leq (dBA) values obtained during the survey programme described earlier. These measured baseline conditions have been combined with the model-predicted project noise levels to determine the cumulative noise levels presented in Section 6.

Data processing and descriptive statistical analysis were carried out using Python and Microsoft Excel following the processing workflow applied to the monitoring dataset.

Results were analyzed separately for daytime and nighttime periods and compared with Bangladesh Noise Pollution Control Rules (NPCR, 2025) and IFC noise guidelines.



Figure 4-1: Noise Level Monitoring Equipment (Lutron SL-4033SD)

5 Survey Results and Interpretation

Based on field measurement, the noise levels measured at the 6 selected locations are illustrated in **Figure 5-1** and summarized in **Table 5-1** which also provides a comparison with the good industry standards & Bangladesh noise standards. These data represent the baseline noise level which will be required in estimating cumulative noise levels after getting the predicted noise level from the model.

Table 5-1: Noise Level Monitoring Result and Applicable Limits from NPCR-2025 and EHS Guidelines

Location	Period	L_{eq} (dBA)	L_{max} (dBA)	L_{min} (dBA)	L_{90} (dBA)	L_{50} (dBA)	L_{10} (dBA)	Category	Noise Pollution (Control) Rules, 2025, L_{eq} (dBA)	IFC-EHS Guidelines, 2007[2] L_{eq} (dBA)
Location 1	Daytime	72.4	84.8	44.3	54.9	66.6	77.1	Residential	55	55
	Night-time	68.4	79.6	39.6	50.0	62.3	73.2		45	45
Location 2	Daytime	67.4	81.4	40.3	49.5	60.4	71.9	Residential	55	55
	Night-time	63.8	78.4	36.2	45.5	56.7	68.3		45	45
Location 3	Daytime	67.6	82.9	41.6	50.0	60.7	71.9	Industrial	75	70
	Night-time	62.4	78.2	37.2	44.6	55.3	66.7		70	70
Location 4	Daytime	68.7	82.1	42.3	50.6	61.7	73.3	Industrial	75	70
	Night-time	62.2	74.9	38.7	45.6	55.9	66.8		70	70
Location 5	Daytime	65.6	78.4	42.2	49.5	59.6	70.2	Industrial	75	70
	Night-time	60.7	74.6	37.9	44.8	54.7	65.1		70	70
Location 6	Daytime	74.9	88.5	46.4	56.2	68.2	79.4	Educational /Silent Zone	50	-
	Night-time	68.4	81.4	41.6	50.6	62.4	73.0		40	-

[2] *https://documents1.worldbank.org/curated/en/157871484635724258/pdf/112110-WP-Final-General-EHS-Guidelines.pdf*

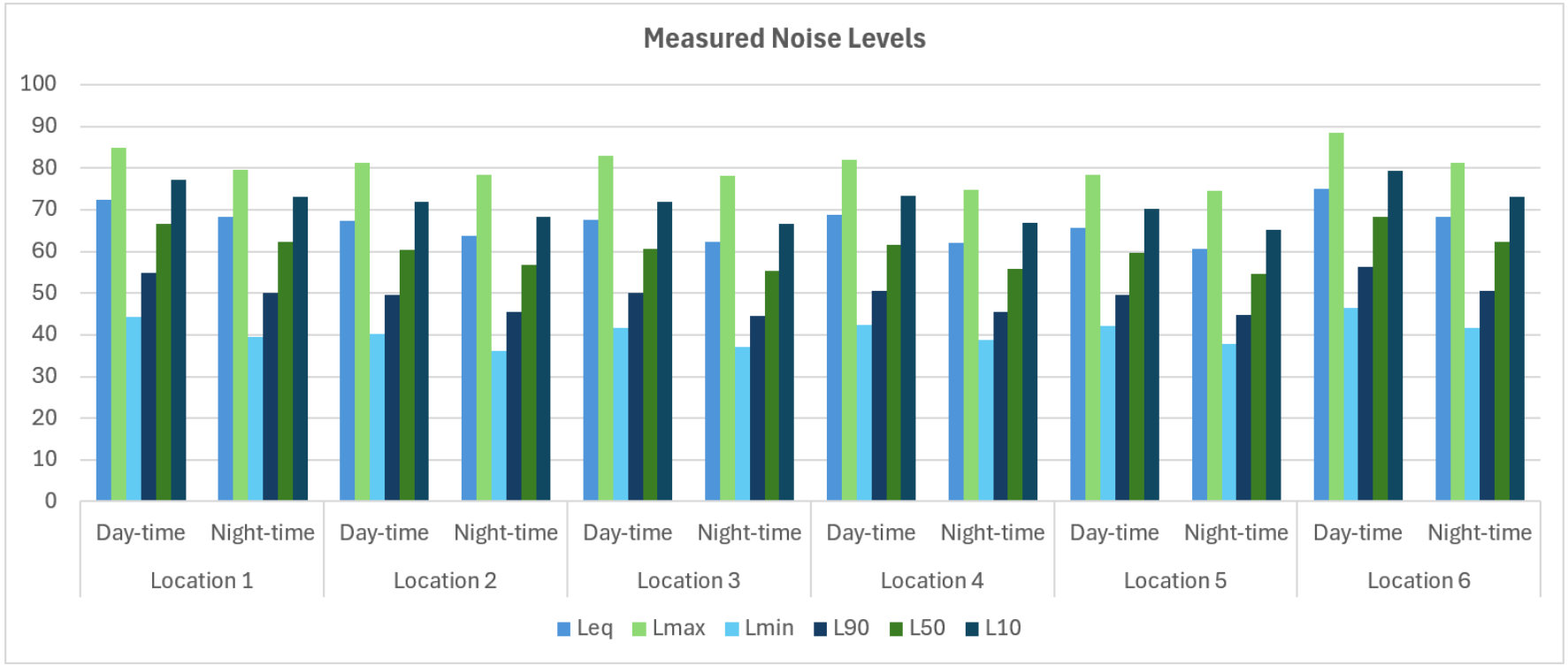


Figure 5-1: Comparison of Measured Noise Levels

The analysis revealed that equivalent noise levels (L_{eq}) at 3 residential locations exceeded the residential standard specified in NPCR'2025 during both periods while the other 3 industrial locations are within industrial limit . Daytime L_{eq} values ranged from 65.6–74.9 dB(A), while night-time levels ranged from 60.6–68.4 dB(A).

The highest noise levels were recorded at Location–6 with 74.9 dB(A) during daytime and 68.4 dB(A) during night-time, whereas the lowest levels were observed at Location–5, recording 65.6 dB(A) and 60.7 dB(A) respectively. Maximum noise levels (L_{max}) reached up to 88.5 dB(A), indicating intermittent high-intensity sound events.

The elevated baseline noise levels with respect to typical residential area are primarily associated with road traffic movement, transportation activities, nearby port operations, commercial activities, airport and other anthropogenic sources within South Patenga. In addition, the coastal setting and sea wind conditions may contribute to the existing acoustic environment through wind-induced ambient sounds, wave action, and enhanced sound propagation characteristics.

Overall, the study area exhibits a relatively elevated acoustic environment compared to mixed area standards, indicating current baseline influence from the coastal setting and sea wind conditions as well as surrounding urban and transportation activities.

6 Ambient Noise Modelling

6.1 Modelling Considerations

The general noise modelling approach described in Section 3 (Methodology) is applied to develop noise maps for container terminal environments. Accurate prediction of port-related noise is achievable provided that the necessary input data are appropriately defined. The three primary inputs required are: (i) Ground Topography & Atmospheric Data, (ii) Receiver Details, (iii) Noise Generating activities and Source Noise Spectrum (construction & operation scenario).

(i) Ground Topography & Atmospheric Data: Accurate representation of ground conditions, including terrain contours, boundary walls, and buildings, as well as atmospheric parameters such as temperature, relative humidity, and air pressure, is essential for reliable noise modelling. Sound propagation is significantly influenced by topography, atmospheric conditions, and the presence of intervening structures between noise sources and receptors. Therefore, contour data obtained from the Topographic & Conduit Survey Report of LCT, February 2026 were used to develop the Digital Ground Model (DGM) within the modelling software, while the required atmospheric data were collected from the Bangladesh Meteorological Department (BMD).

In general, the topographic data required for the model includes the following:

- Elevation data and spot heights;
- Locations of noise sources, including industrial facilities, roads, and railways;
- Residential and industrial buildings, including their heights and dimensions;
- Other physical obstacles within the study area that may affect sound propagation; and
- Identification and characterization of ground surface condition for ground absorption factor

All relevant features have been digitized from the Terminal Layout Drawing "**APM-056-01A-10"** and incorporated into the model accordingly. The proposed future formation level of the terminal blocks has been considered as +8 m ISWL (equivalent to 5.66 m MSL), while for Patenga Road it has been taken as +7 m ISWL (4.66 m MSL), based on the survey report as mentioned above. The high-water level has been assumed as 3.66 m MSL, i.e., 2 m below the terminal formation level, as required for ship noise modelling inputs. All other areas within the domain have been assumed to be relatively flat, with an approximate elevation variation of 1 m. It should be noted that elevation data imported from Google Maps into SoundPLAN has not been used, as they are based on 90 m SRTM data, which is not sufficiently accurate for this small riverine study area.

(ii) Receiver Details: Based on careful expert judgement, six locations have been selected for baseline noise measurements and incorporated as free field receivers in the model. These locations are selected considering the nearby sensitive receptors (educational & residential) and within the LCTP boundary (3 blocks). Furthermore, for the development of a grid-based noise map, the entire domain has been divided into a uniformly spaced 10m grid, assigned a height of 1.5 m to represent the average human ear level.

For the modelling domain, an area of 5 km × 3.5 km has been considered as the calculation extent.

Table 6-1: List of Receptor

Sl No.	Location	Receptor name	X	Y	Ground RL (m MSL)
1	Location-1	R-1	378676.00	2460537.00	4.53
2	Location-2	R-2	378943.00	2460922.00	4.55
3	Location-3	R-3	379020.00	2460873.00	5.66

4	Location-4	R-4	379477.00	2461340.00	5.66
5	Location-5	R-5	379457.00	2462115.00	5.66
6	Location-6	R-6	378949.00	2461142.00	4.62

(iii) Noise Generating activities and Source Noise Spectrum: Detailed information on both construction and operational activities is required to estimate overall noise levels and define noise boundaries for the project. This includes data on construction equipment (e.g. excavators, piling rigs, generators, and dump trucks) as well as operational sources such as ships, cranes, terminal tractors, trucks, and other handling equipment. Information on source locations, movement patterns, and operating durations is essential. Construction scenarios are typically based on planned work schedules and activity phasing, while operational scenarios are projected for future conditions, including estimates of ship arrivals, cargo volumes (e.g., number of containers handled), and associated equipment and transport requirements. Reliable estimation of these parameters is critical to ensure accurate noise modelling and impact assessment. Based on expert judgment and several consultations with relevant experts, it has been finalized that one (1) operational and three (3) construction scenarios will be developed for the noise modelling assessment. These scenarios are described in detail in the below sections.

6.1.1 Construction Scenario

The construction of the proposed terminal is expected to generate noise from various activities, including the use of heavy machinery and vehicular movements. These increased noise levels may temporarily disturb nearby communities as well as adjacent wildlife habitats during the construction period. However, it is important to note that construction-related noise impacts are inherently short-term and will occur in phases throughout the project implementation. Based on the provided construction schedule, and considering overlapping multiple construction stages, major noise-generating activities, more simultaneous equipment operating phases, and duration of activities, three (3) construction scenarios have been defined. These scenarios collectively represent all the key noise-generating construction phases with equipment and are shown in Figure 6-1.

Phase ID	Phase / Package	Indicative Start Month	Indicative End Month
P00	Pre-construction approvals and surveys	0	0
P01	Mobilisation, temporary offices/welfare, utilities and laydown, including prefabricated offices where applicable	1	4
P02	Site clearance, fencing and enabling earthworks	1	6
P03	B-C drainage channel closure, temporary flow control and box culvert / replacement drainage	3	12
P04	Capital berth pocket dredging	4	10
P05	Reclamation fill import, placement and profiling	4	14
P06	Ground improvement, drainage blankets, vertical drains and preload	7	18
P07	Quay / deck-on-piles: piling, beams and deck structure	8	25
P08	Slope trimming, revetment, scour and slope protection	10	23
P09	Block C yard formation, drainage, pavement and utility corridors, including paving block placement if selected	15	30
P10	Block B integration and lower-density container area works	16	28
P11	Block A temporary prefab/batching/storage support and later truck waiting / processing area upgrades	18	30
P12	Buildings and terminal support facilities	14	29
P13	MEP, power, ICT, gates, scanners, lighting, CCTV and systems	22	32
P14	STS / terminal equipment delivery, positioning, installation support, testing and commissioning	28	34
P15	Demobilisation, reinstatement, final waste clearance and handover	33	36

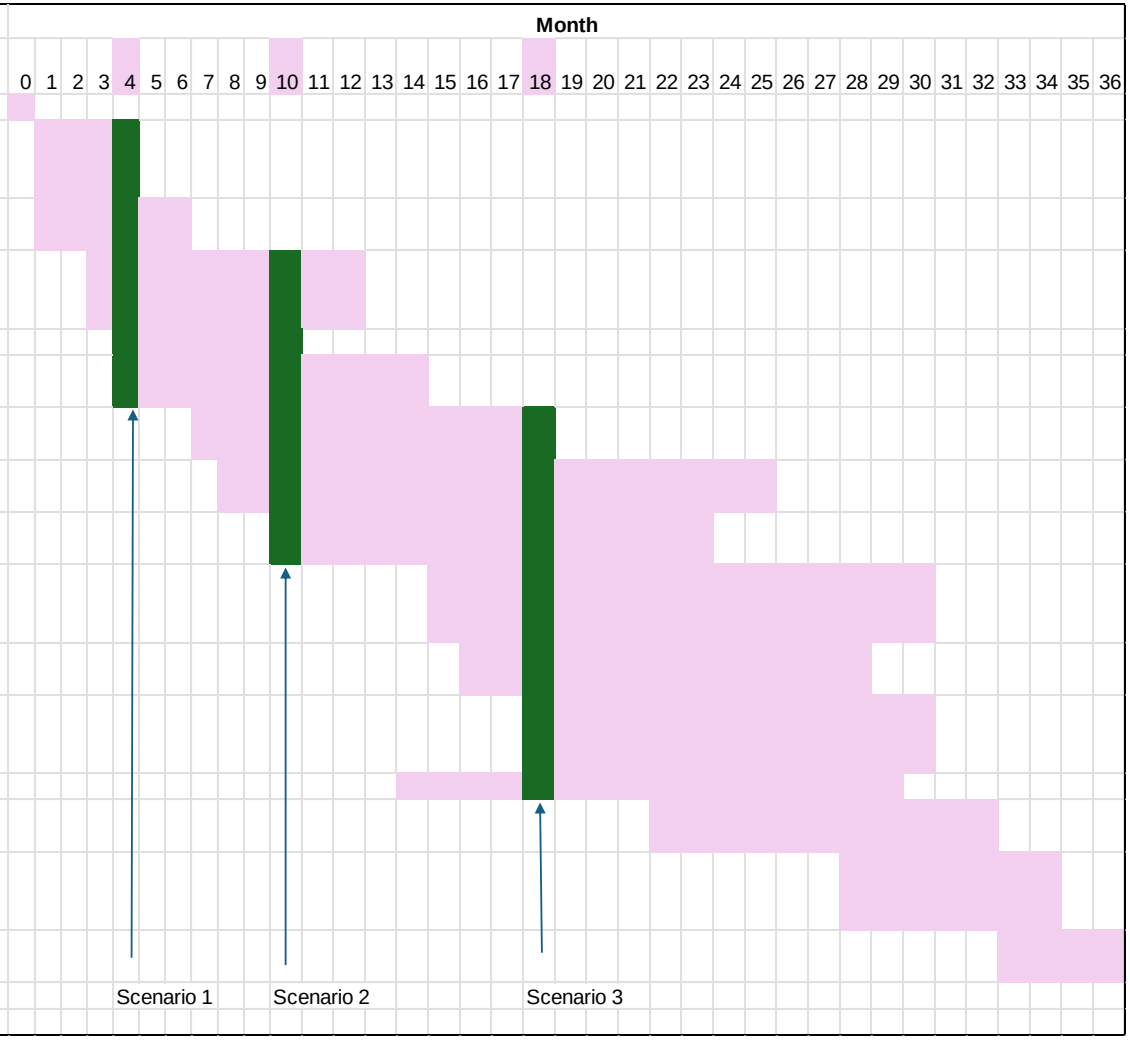


Figure 6-1: Construction schedule & scenario development

The noise sources of construction activities in the LCT areas can be broadly grouped into two major categories: stationary equipment and moving/traffic related activities.

The data required for modelling stationary noise sources include:

- Sound power level of each stationary source (Excavator, Crawler crane, Generator, Piling Rig, Dewatering Pump, Concrete pump, Batching plant etc.); and
- Location, number & operating hours of each equipment for different time periods (day, night).

The data required for modelling moving noise sources include:

- Sound power level of each moving source (Dump Truck, Transit Mixer, Material carrying external truck, forklift, water bowser etc.) and average vehicle speed; and
- Location, number & operating hours of each equipment for different time periods (day, night).

It should be noted that existing traffic on Patenga Road has not been included in the noise model, as its contribution is already represented in the measured baseline noise levels.

The operating hour of each equipment with their duty cycle as well as the peak simultaneous quantity are given in Table 6-2.

Table 6-2: Preliminary Construction Equipment and Assumptions Register

Construction Scenario-1								
Equip. ID	**Work Package**	**Plant / Equipment / Vessel**	**Unit**	**Indicative Capacity / Rating**	**Peak Simultaneous Qty**	**Operating Window**	**Active Hours / Day**	**Duty Cycle / Utilization Factor**
P01 - MOBILISATION, TEMPORARY FACILITIES AND GENERAL SUPPORT PLANT								
E001	Mobilisation & site establishment	Mobile diesel generator set	No.	250-500 kVA	3	24/7 peak period	24.00	0.60
E002		Small diesel generator set	No.	60-125 kVA	2	24/7 peak period	24.00	0.45
E003		Water bowser	No.	8-12 m³	2	Extended day	12.00	0.50
E005		Forklift	No.	3-5 t	2	Extended day	12.00	0.35
E009		Mobile crane	No.	50-100 t	1	Extended day	10.00	0.30
P02 - SITE CLEARANCE, ENABLING WORKS AND TEMPORARY ACCESS								
E011	Site clearance & enabling	Tracked excavator	No.	20-35 t	4	Extended day	12.00	0.55
E012		Backhoe loader	No.	Standard constr. class	3	Extended day	12.00	0.45
E013		Long-reach excavator	No.	25-40 t	1	Extend day	12.00	0.45

E014		Bulldozer	No.	D6-D8 equivalent	3	Extended day	12.00	0.55
E015		Wheel loader	No.	3-5 m³ bucket	3	Extended day	12.00	0.55
E016		Dump truck / tipper	No.	16-25 m³	12	Extended day	12.00	0.55
E017		Motor grader	No.	140-200 hp class	1	Extended day	12.00	0.45
E018		Vibratory roller	No.	10-20 t	3	Extended day	12.00	0.50
E019		Plate compactor	No.	Light construction	4	Day only	10.00	0.35
P03 - B-C DRAINAGE CHANNEL CLOSURE, BOX CULVERT AND TEMPORARY FLOW MANAGEMENT								
E020	B-C channel closure & culvert	Tracked excavator	No.	20-35 t	3	Extended day	12.00	0.55
E021		Long-reach excavator	No.	25-40 t, ext. reach	1	Extended day	12.00	0.45
E022		Vibratory sheet pile hammer with leader rig	No.	Medium-heavy construction class	1	Extended day	10.00	0.35
E023		Crawler crane	No.	100-150 t	1	Extended day	10.00	0.35
E024		Dewatering pump	No.	100-300 m³/h	4	24/7 peak period	24.00	0.60
E025		Concrete pump	No.	36-52 m boom equivalent	1	Extended day	10.00	0.35
E026		Transit mixer	No.	6-10 m³	4	Ext day	10.00	0.50
P05 - RECLAMATION FILL IMPORT, PLACEMENT AND FORMATION								
E034	Reclamation fill import and placement	Excavator	No.	30-45 t class	2	Extended day	12.00	0.55
E035		Bulldozer	No.	D6-D8 eqv.	4	Extended day	12.00	0.60
E036		Articulated dump truck	No.	20-30 t payload	16	Extended day	12.00	0.60
E037		Vibratory roller	No.	10-20 t	4	Extended day	12.00	0.55
E038		Motor grader	No.	140-200 hp	2	Extended day	12.00	0.45

Construction Scenario-2								
Equip ID	**Work Package**	**Plant / Equipment / Vessel**	**Unit**	**Indicative Capacity / Rating**	**Peak Simultaneous Qty**	**Operating Window**	**Active Hours / Day**	**Duty Cycle / Utilization Factor**
P03 - B-C DRAINAGE CHANNEL CLOSURE, BOX CULVERT AND TEMPORARY FLOW MANAGEMENT								
E020	B-C channel closure & culvert	Tracked excavator	No.	20-35 t	3	Extended day	12.00	0.55
E021		Long-reach excavator	No.	25-40 t, extended reach	1	Extended day	12.00	0.45
E022		Vibratory sheet pile hammer with leader rig	No.	Medium-heavy construction class	1	Extended day	10.00	0.35
E023		Crawler crane	No.	100-150 t	1	Extended day	10.00	0.35
E024		Diesel / electric dewatering pump	No.	100-300 m³/h	4	24/7 peak period	24.00	0.60
E025		Concrete pump	No.	36-52 m boom equivalent	1	Extended day	10.00	0.35
E026		Transit mixer	No.	6-10 m³	4	Extended day	10.00	0.50
P05 - RECLAMATION FILL IMPORT, PLACEMENT AND FORMATION								
E034	Reclamation fill import and placement	Excavator / grab unloading plant	No.	30-45 t class	2	Extended day	12.00	0.55
E035		Bulldozer	No.	D6-D8 equivalent	4	Extended day	12.00	0.60
E036		Articulated dump truck / tipper	No.	20-30 t payload	16	Extended day	12.00	0.60
E037		Vibratory roller	No.	10-20 t	4	Extended day	12.00	0.55
E038		Motor grader	No.	140-200 hp class	2	Extended day	12.00	0.45
P06 - GROUND IMPROVEMENT AND PLATFORM PREPARATION								
E040	Ground improvement	PVD installation rig	No.	Project-specific	2	Extended day	12.00	0.55
E041		Bulldozer / loader support	No.	D6-D8 / loader mix	3	Extended day	12.00	0.55
E042		Vibroflot / sand-column rig	No.	Project-specific	1	Extended day	12.00	0.45
P07 - QUAY STRUCTURE / DECK-ON-PILES, PILING AND MARINE APPURTENANCES								
E049	Quay, piling and deck	Crawler crane	No.	150-250 t	3	Extended day	12.00	0.50
E051		Concrete batching plant	No.	60-120 m³/h	1	Extended day	12.00	0.60

E052		Concrete pump	No.	36-60 m boom equivalent	2	Extended day	12.00	0.50
E053		Transit mixer	No.	6-10 m³	10	Extended day	12.00	0.55
E054		Welding generator / rebar processing set	Set	Multiple small sets	4	Extended day	12.00	0.45
E055		Hydraulic breaker / pile cutter set	No.	TBC	2	Extended day	10.00	0.35
P08 - SLOPE PROTECTION, REVETMENT AND SCOUR PROTECTION								
E056	Slope protection and scour	Long-reach excavator / rock placer	No.	30-50 t	2	Extended day	12.00	0.50

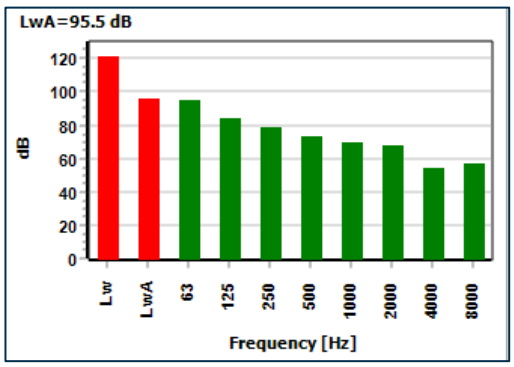
Construction Scenario-3

Equip ID	Work Package	Plant / Equipment / Vessel	Unit	Indicative Capacity / Rating	Peak Simultaneous Qty	Operating Window	Active Hours / Day	Duty Cycle / Utilization Factor
P06 - GROUND IMPROVEMENT AND PLATFORM PREPARATION								
E040	Ground improvement	PVD installation rig	No.	Project-specific	2	Extended day	12.00	0.55
E041		Bulldozer / loader support	No.	D6-D8 / loader mix	3	Extended day	12.00	0.55
E042		Vibroflot / sand-column rig	No.	Project-specific	1	Extended day	12.00	0.45
P07 - QUAY STRUCTURE / DECK-ON-PILES, PILING AND MARINE APPURTENANCES								
E049	Quay, piling and deck	Crawler crane	No.	150-250 t	3	Extended day	12.00	0.50
E051		Concrete batching plant	No.	60-120 m³/h	1	Extended day	12.00	0.60
E052		Concrete pump	No.	36-60 m boom equivalent	2	Extended day	12.00	0.50
E053		Transit mixer	No.	6-10 m³	10	Extended day	12.00	0.55
E054		Welding generator / rebar processing set	Set	Multiple small sets	4	Extended day	12.00	0.45
E055		Hydraulic breaker / pile cutter set	No.	TBC	2	Extended day	10.00	0.35
P08 - SLOPE PROTECTION, REVETMENT AND SCOUR PROTECTION								
E056	Slope protection and scour	Long-reach excavator / rock placer	No.	30-50 t	2	Extended day	12.00	0.50
P09 - BLOCK C TERMINAL YARD, PAVEMENT, DRAINAGE AND UNDERGROUND UTILITIES								
E060	Yard, drainage and utilities	Paver / grader spreader	No.	Project-specific	1	Extended day	12.00	0.50

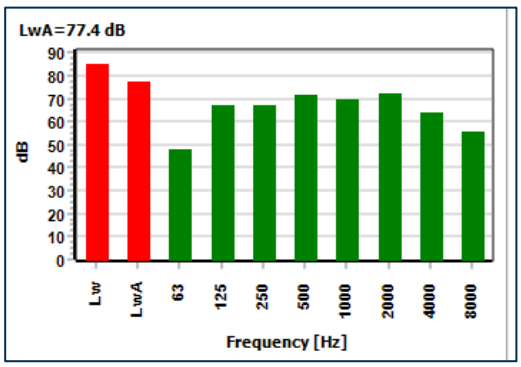
E061		Tandem / pneumatic roller	No.	8-16 t	4	Extended day	12.00	0.50
E062		Excavator / trench excavator	No.	15-25 t	4	Extended day	12.00	0.50
E063		Dewatering pump	No.	50-150 m³/h	3	Extended day	12.00	0.40
E064		Mobile crane	No.	50-100 t	2	Extended day	10.00	0.35
P11 - BLOCK A TEMPORARY PREFAB / BATCHING / STORAGE SUPPORT AND TRUCK WAITING / PROCESSING AREA WORKS								
E067A	Block A temporary support and truck area works	Concrete paving block production plant / batching and moulding line	Set	TBC by final pavement type and production method	1	Day only / extended day	10.00	0.35
E067		Tracked excavator	No.	15-25 t	2	Extended day	12.00	0.45
P12 - BUILDINGS, WORKSHOPS, SUBSTATIONS AND FACILITY WORKS								
E070	Buildings and facilities	Mobile crane	No.	50-150 t	2	Extended day	12	0.45
E071		Concrete pump	No.	36-52 m boom equivalent	2	Extended day	10	0.45
E073		Welding generator / workshop set	Set	Multiple small sets	3	Extended day	12	0.4

ISO 9613-2 is applied to estimate noise emissions from Construction Equipment. As this is a general prediction standard, it requires detailed input data, including source sound power levels, frequency spectra, and operational characteristics.

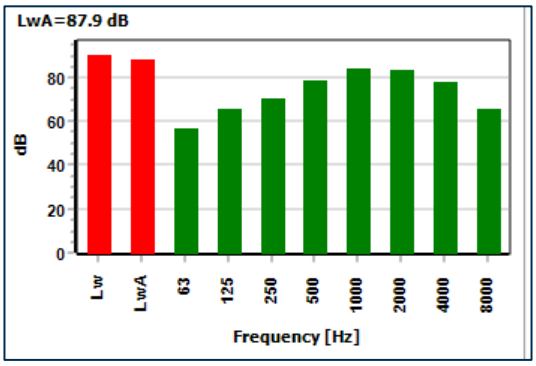
Due to limitations in data availability, both from field measurements of noise characteristics and from equipment manufacturers, the SoundPLAN library has been adopted for this study. It is a comprehensive noise database containing acoustic characteristics of approximately 1,000 sources across around 50 industries, including those relevant to construction activities. The remaining noise data are taken from SourceDB, another very comprehensive database which was developed under the EU IMAGINE (Improved Methods for the Assessment of the Generic Impact of Noise in the Environment) project which has been widely applied in the NoMEPorts (Noise Management in European Ports) noise mapping initiative, which is comparable in scope to the present study. The sound spectra are provided in 1/3 octave bands ranging from 25 Hz to 10 kHz. The following Figure 6-2 presents the sound power levels and spectral characteristics of the construction noise sources.



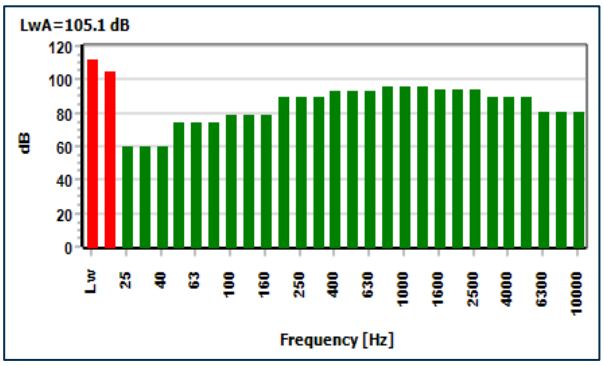
Sound Power & Spectrum of Tracked Excavator



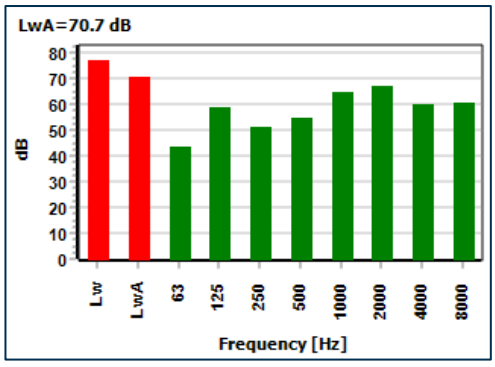
Sound Power & Spectrum of Long-reach Excavator



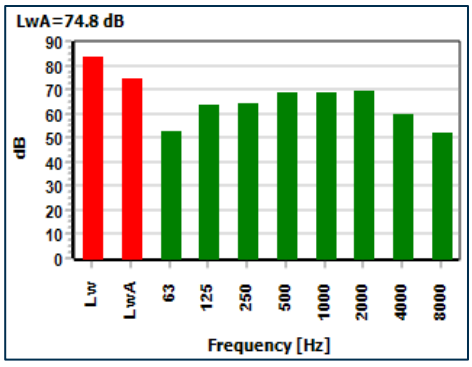
Sound Power & Spectrum of Sheet Pile Rig



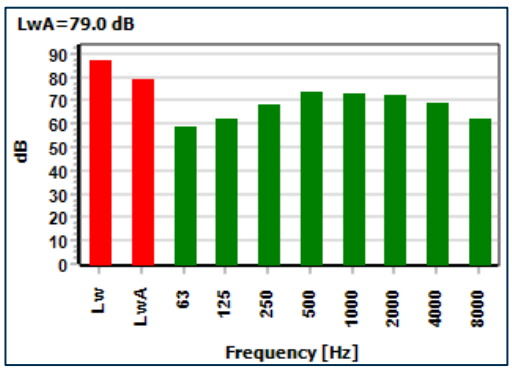
Sound Power & Spectrum of Crawler Crane



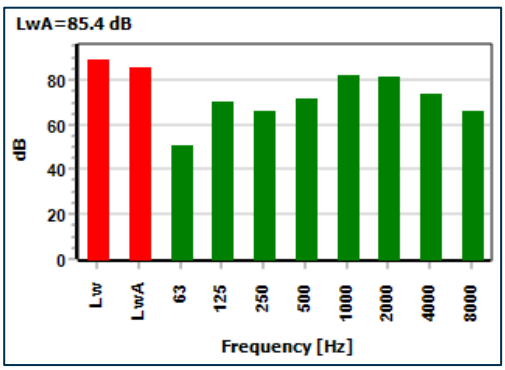
Sound Power & Spectrum of Dewatering Pump



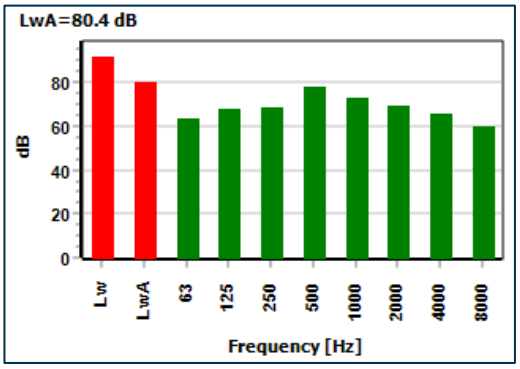
Sound Power & Spectrum of Concrete Pump



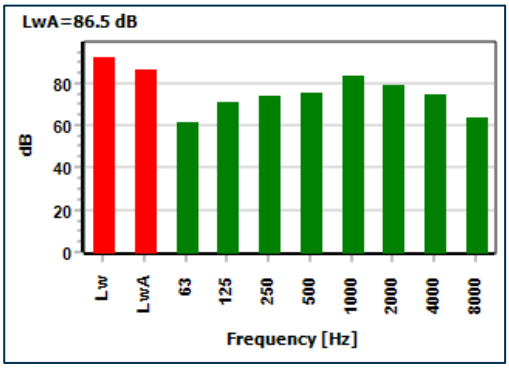
Sound Power & Spectrum of Excavator



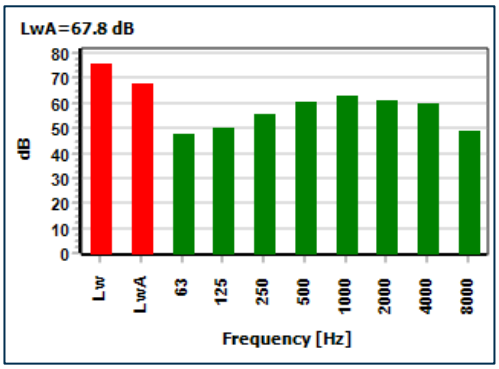
Sound Power & Spectrum of Bulldozer



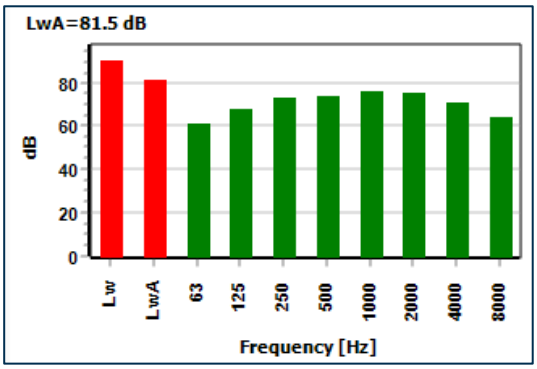
Sound Power & Spectrum of Vibratory Roller



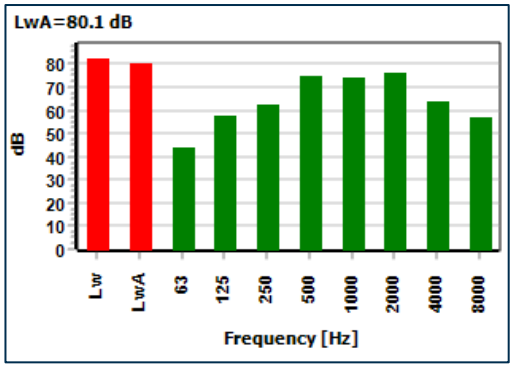
Sound Power & Spectrum of Grader



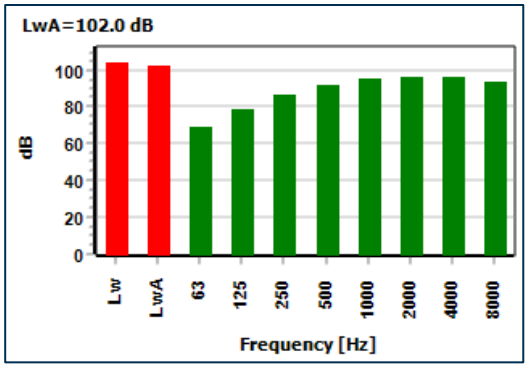
Sound Power & Spectrum of Backhoe Loader



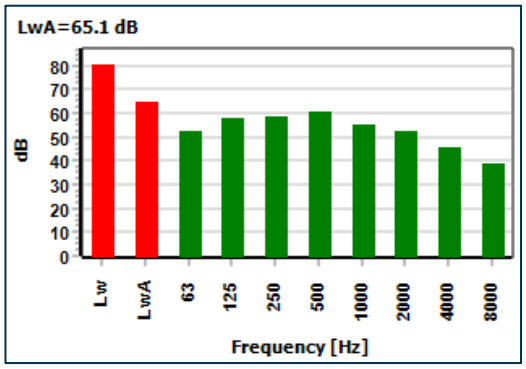
Sound Power & Spectrum of Wheel Loader



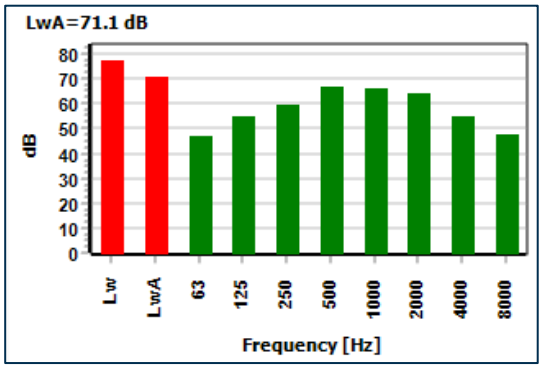
Sound Power & Spectrum of Plate Compactor



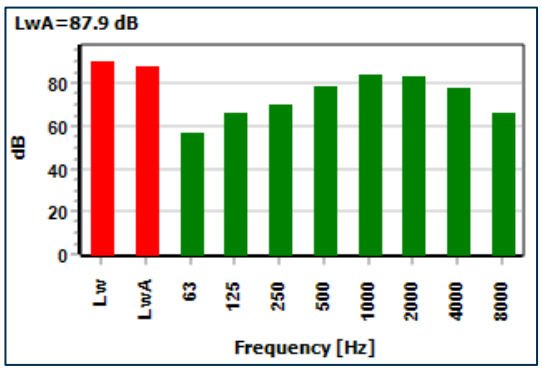
Sound Power & Spectrum of Generator (250-500kw)



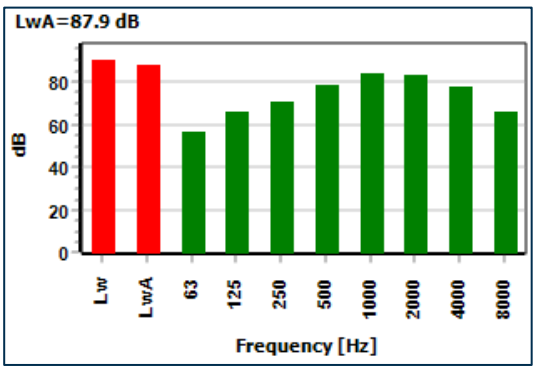
Sound Power & Spectrum of Generator (125kw)



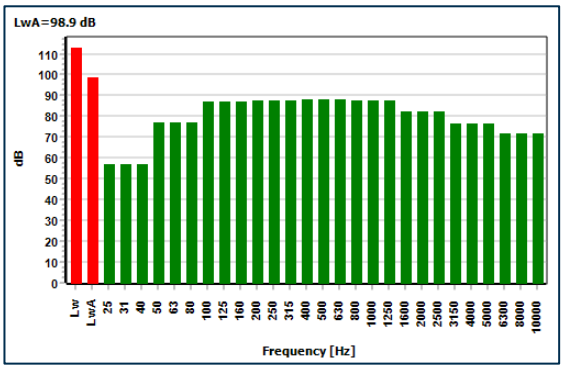
Sound Power & Spectrum of Mobile Crane



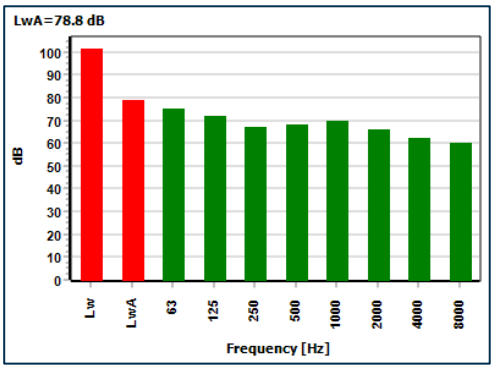
Sound Power & Spectrum of PVD Rig



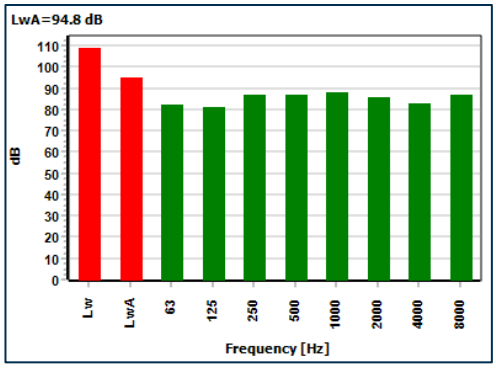
Sound Power & Spectrum of Sand-column Rig



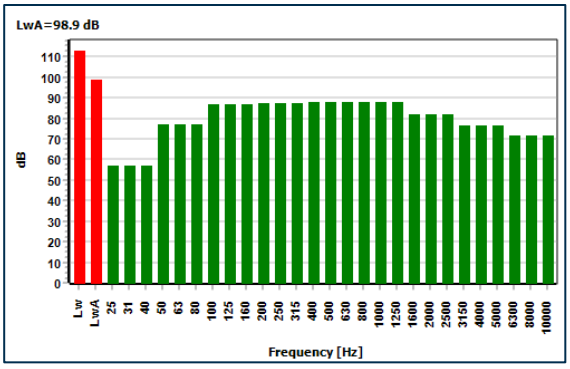
Sound Power & Spectrum of Concrete Batching Plant



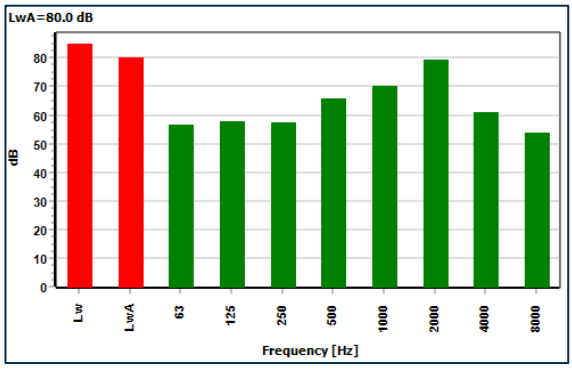
Sound Power & Spectrum of Welding Generator



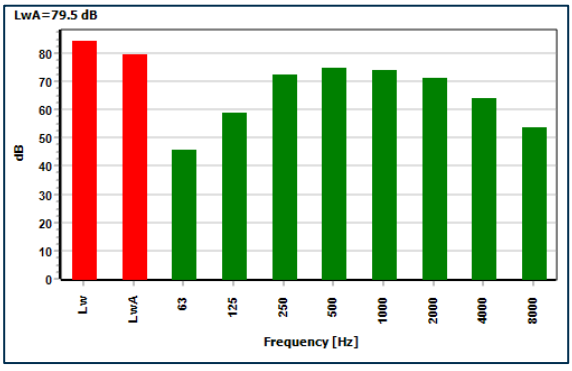
Sound Power & Spectrum of hydraulic breaker



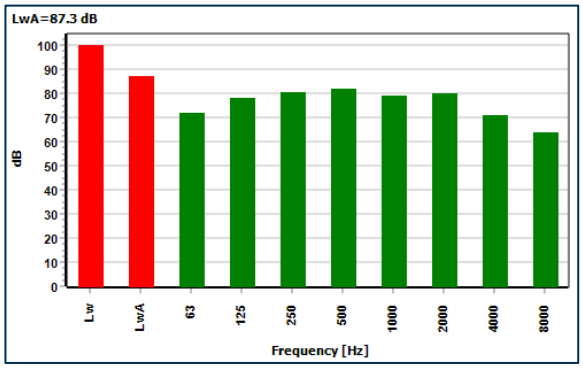
Sound Power & Spectrum of Paving Block Plant



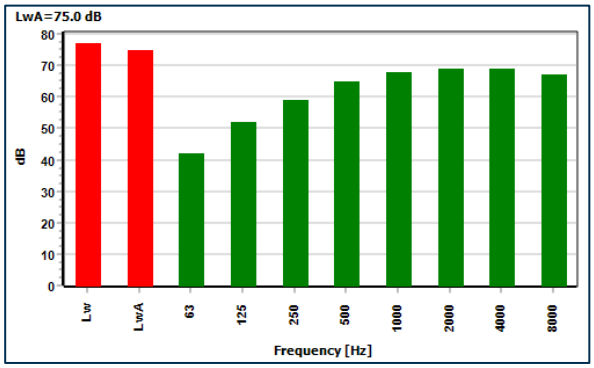
Sound Power & Spectrum of Transit Mixer



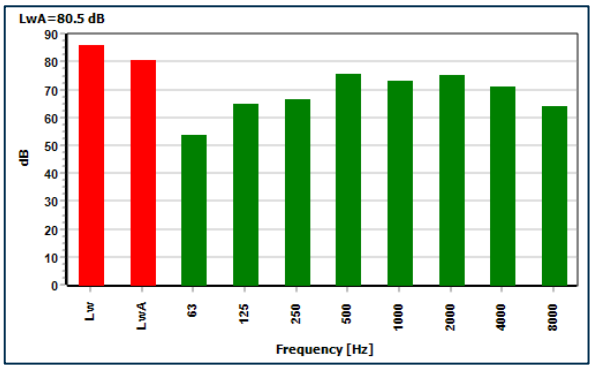
Sound Power & Spectrum of Tandem Roller



Sound Power & Spectrum of Dump Truck



Sound Power & Spectrum of Forklift



Sound Power & Spectrum of Water Bowser

Figure 6-2: Sound power and spectrum of the Construction Noise Sources

6.1.2 Operational scenario

Areas surrounding a container terminal are typically subject to high traffic volumes due to terminal operations and adjacent industrial activities, resulting in elevated ambient noise levels at nearby locations. Consequently, noise impacts associated with terminal activities are often significant, necessitating comprehensive noise assessment. Noise levels generated during container terminal operations vary depending on the type of equipment and the nature of activities undertaken. Broadly, noise from port operations can be categorized into two principal types:

i. **Specific intermittent noise sources**: These include intermittent sounds such as ship horns during departure, and train crossing alarms (if relevant). Although these sources are of short duration and occur intermittently and therefore contribute less to overall equivalent noise levels (L_{eq}) and are not explicitly represented in noise models, they are frequently perceived as highly intrusive and are a major source of concern for nearby residents.
ii. **General terminal noise sources**: Continuous operational noise is generated by the primary cargo handling equipment used in container terminal operations, including Ship-to-Shore (STS) cranes, Rubber-Tyred Gantry (RTG) cranes, Empty Container Handlers (ECHs), road trucks, terminal tractors, and other associated equipment.

The noise sources of operational activities in the port areas can be broadly grouped into two major categories: industrial activities and traffic related activities (NoMEPort, 2008).

The data required for modelling industrial noise sources include:

- Sound power level of each relevant industrial source (Ship & container handling equipment, reach stacker, empty handler, yard tractors, STS & RTG cranes, etc.);
- Location of noise sources and their movement patterns; and
- Operating hours of each source for different time periods (day, evening, night).

The data required for modelling traffic-related noise sources include:

- Road traffic data: vehicle types (trucks & cars as per RLS-90), traffic volume per hour for each time period (day, night), and average vehicle speed; and
- Location of roads and type of road surface (e.g., asphalt, concrete, etc.).

Regarding operational scenario development, TEU throughput is a critical sensitivity factor for ESIA because it directly influences the scale and intensity of operational impacts across multiple environmental domains. As defined in Chapter 3, the three throughput scenarios have been defined for use in impact assessment and modelling. However, analysis of operational data indicates that the operating hours of each cargo-handling equipment remain nearly identical during peak ship-unloading periods across all three scenarios although the vessel call per year is different. Therefore, there is no significant variation in operational activity among the defined scenarios when the peak activity is considered. In view of this, modelling of all three scenarios is not required. Accordingly, only the upper-bound scenario has been considered for assessment, as it represents the worst-case condition.

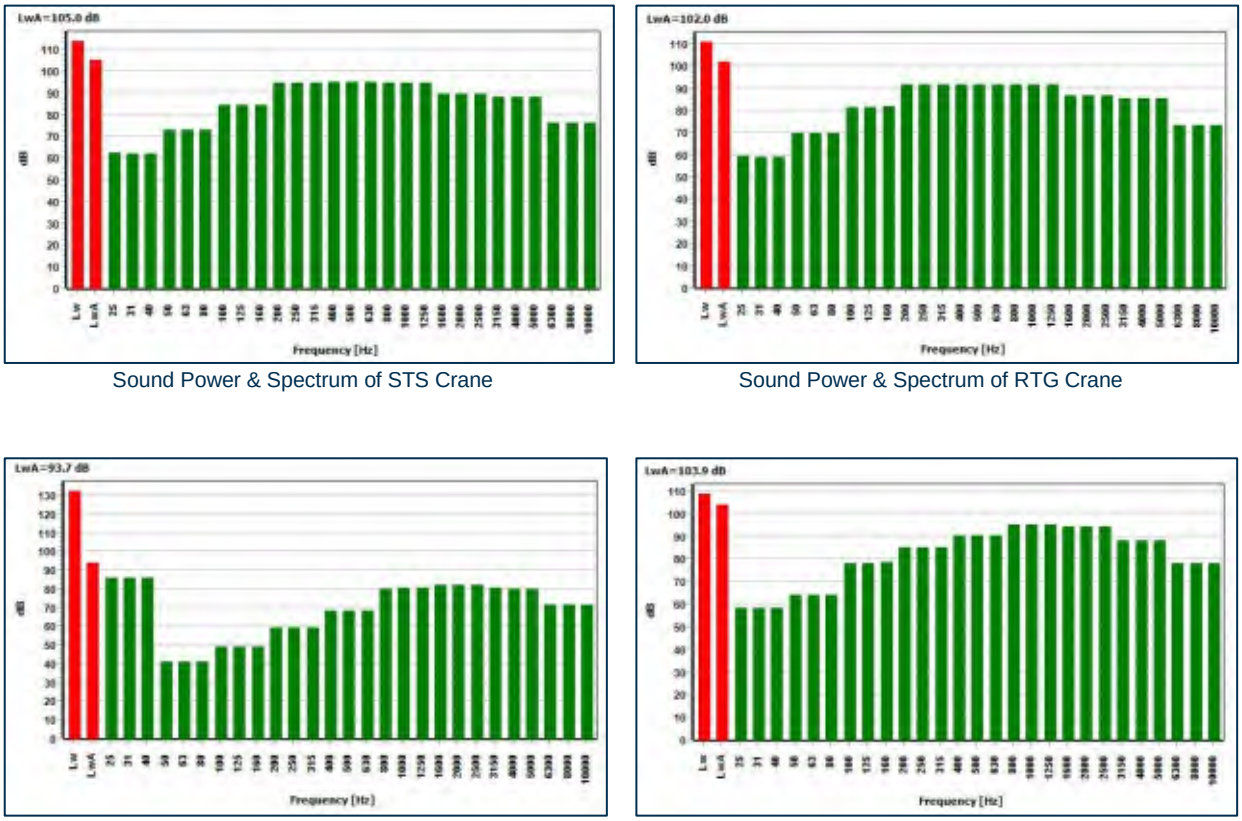
The following sections describe the modelling approach for noise emissions from cargo handling equipment and traffic noise.

Cargo Handling Equipment (CHE): The ISO 9613-2 is applied to calculate and predict the attenuation of sound as it propagates from cargo handling equipment. As this is a general prediction standard, it requires detailed input data, including source sound power levels, frequency spectra, and operational characteristics.

Due to limitations in data availability, both from field measurements of noise characteristics and from equipment manufacturers, the SourceDB database has been adopted for this study. SourceDB is a comprehensive industrial noise database containing acoustic characteristics of approximately 1,100 sources across more than 70 industries, including those relevant to port operations. The database was developed under the EU IMAGINE (Improved Methods for the Assessment of the Generic Impact of Noise in the Environment) project and has been widely applied in the NoMEPorts (Noise Management in European Ports) noise mapping initiative, which is comparable in scope to the present study.

The required acoustic data for all relevant sources, such as dockside cranes (STS), RTG cranes, empty container handler (ECH), reach stackers (RS), and terminal tractors (TT) are available within the database. The sound spectra are provided in 1/3 octave bands ranging from 25 Hz to 10 kHz. For computational efficiency, similar equipment types (RS & ECH) have been grouped together.

The following figure presents the sound power levels and spectral characteristics of the identified noise sources.



Sound Power & Spectrum of STS Crane

Sound Power & Spectrum of RTG Crane

Sound Power & Spectrum of ECH/RS

Sound Power & Spectrum of TT

Figure 6-3: Sound power and spectrum of the Operational Noise Sources

The quantities of Cargo Handling Equipment (CHE) and their corresponding operating hours, as presented in Table 6-3, have been used as inputs for the operation scenario (Upper Scenario) model. The velocities considered (for moving source) are: RTG- 3.5 km/h; TT- 12 km/h and ECH/RS- 12 km/h.

Table** 6-3**: Modelling consideration for CHE

Equipment	**No of Unit** *(Model Input)*	**Source Type** *(Model input)*	**Hour/time slice /unit**	**Equipment** *Drive type*	**Sum** *dB(A)/unit*	**Remarks**
STS	7 nos. (d) 7 nos. (n)	Point	15hr day 9hr night	Electric	105.0	Day and nighttime operations are continuous when the terminal is working (=when the berth is occupied by one or more vessels and all equipment are working), so there is no difference between the day and night. This applies to a peak day where all 7 cranes are operating during the day and night. There will be other days and nights without vessels, where zero cranes will be working.
e-RTG	32 nos. (d) 26 nos. (n)	Line	15hr day 9hr night	Electric	102.0	Fewer RTGs working during the night, as reduced number of external trucks entering the terminal during the night, and

						therefore fewer landside RTG moves during the night.
TT	42 nos. (d) 42 nos. (n)	Line	15hr day 9hr night	Diesel	103.9	Working full time when a vessel is there, as they are connected to STS operations
ECH	6 nos. (d) 5 nos. (n)	Line	15hr day 9hr night	Diesel	93.8	Fewer ECH working during the night, for the same reason as less RTGs
RS	2 nos. (d) 0 nos. (n)	Line	15hr day 0 hr night	Electric	93.8	No RS operations seem to be required - 2 Reach Stackers might be used at the terminal for Out of Gauge containers and other auxiliary works. Only daytime operations

Traffic (Truck & Others): For traffic noise assessment, the adopted calculation standards incorporate built-in assumptions regarding vehicle noise emission characteristics; therefore, only traffic count data with velocity are required as model inputs. The RLS-90 standard has been applied to estimate noise from road traffic, enabling simulation based on typical vehicle categories such as cars and trucks.

In the operational scenario, the focus is mainly on container handling operations; therefore only terminal generated trucks, staff bus and cars are considered in this model. In the internal haul roads only the container carrying trucks are considered in this model. However, for outer roadways (e.g., Patenga Road), trucks, buses and cars have been considered in the noise assessment. The key input parameters for the model include the number of trucks per hour and their operating speeds for each road segment used in container transport within the terminal. It is noted that, the upper scenario generates approximately 40 company bus, 391 cars and 5632 external truck movements per day at peak for both ways. These values have subsequently been converted into vehicles per hour (veh/hr), assuming a distribution of 80% of the movements are realized during daytime and the remaining 20% during nighttime periods. The estimated traffic volumes for different time periods are presented in Table 6-4. The truck routes have been derived through digitization of the terminal layout. The corresponding data have subsequently been compiled for each road segment and incorporated into the model.

Table 6-4: Modelling consideration for Internal & Outer Patenga road

Vehicle Type	Veh/hr. (daytime)	Veh/hr. (night-time)	Speed (daytime) km/h	Speed (night-time) km/h
Terminal Internal Road				
Truck	150	63	15	15
Terminal entry & exit road segment			5	5
Terminal Outer Road				
Truck (which includes buses)	304	130	30	35
Cars	22	10	30	35

6.2 Model Output

The model outputs present the spatial distribution of predicted noise levels across the study area based on the defined input data and assessment scenarios. The results are expressed through noise contour maps and receptor-specific noise levels, representing the combined contribution of all identified noise

sources. These outputs provide a clear basis for evaluating noise propagation patterns, identifying sensitive receptors and potential noise hotspots, and assessing the need for mitigation measures where applicable.

The following sections present the cumulative noise levels at the selected receptor locations along with the applicable zone-specific NPCR-2025 values. In addition, day and nighttime grid noise maps are provided for both the construction and operational scenarios.

6.2.1 Operational Scenario

The following table presents the baseline noise levels, model-predicted noise levels, and cumulative noise levels at each receptor location, together with the applicable zone-specific standard limits.

Table 6-5: Receiver Noise level Output

Receptor	Period	Baseline L_{eq} (dBA)	Predicted L_{eq} (dBA)	Cumulative L_{eq} (dBA)	NPCR-2025 L_{eq} (dBA)	Category	Remarks
R-1	Daytime	72.4	64.1	73.0	55	Residential	Baseline level already exceeded limit
	Night-time	68.4	61.8	69.2	45		
R-2	Daytime	67.4	67.0	70.2	55	Residential	Same as R-1
	Night-time	63.8	64.8	67.3	45		
R-3	Daytime	67.6	72.7	73.9	75	Industrial	Within limit (day) Exceeded limit (night)
	Night-time	62.4	71.2	71.7	70		
R-4	Daytime	68.7	63.7	69.9	75	Industrial	Within limit
	Night-time	62.2	62.6	65.4	70		
R-5	Daytime	65.6	54.4	65.9	75	Industrial	Within limit
	Night-time	60.7	51.9	61.2	70		
R-6	Daytime	74.9	60.5	75.1	50	Educational /Silent Zone	Same as R-1
	Night-time	68.4	59.0	68.9	40		

From the above table, it can be interpreted that receptors R-3, R-4, and R-5 are located within the industrial zone, and the cumulative noise levels at these locations remain within the applicable standard limits or slightly exceed the limit but remains very close to it. Receptor R-2, although situated near the residential area, is located directly opposite the LCT boundary and that's why the cumulative noise level at this receptor exceeds the residential limit.

The remaining receptors, R-1 and R-6, exhibit relatively high cumulative noise levels during both daytime and nighttime periods. However, the baseline noise levels at these receptors are already substantially elevated; therefore, the added contribution from the operation of proposed project is relatively small/negligible.

Assessment against the IFC noise criteria shows that cumulative noise levels at receptors R-3, R-4, and R-5 are either compliant with or very close to the applicable limits for industrial areas. However, cumulative noise levels at the remaining receptors exceed the IFC limits and also fail to meet the allowable 3 dB increase over baseline ambient noise levels. Receptors R-2, R-3, and R-4, in particular, demonstrate increases exceeding 3 dB relative to baseline conditions. However, as these receptors are all industrial, the impact of this noise level change is considered to be relatively small.

The following figures show the single point map as well as grid noise map of both day & night-time for the operational scenario.



Figure 6-4: Single Point Noise Level Map (in L_{eq} dBA)

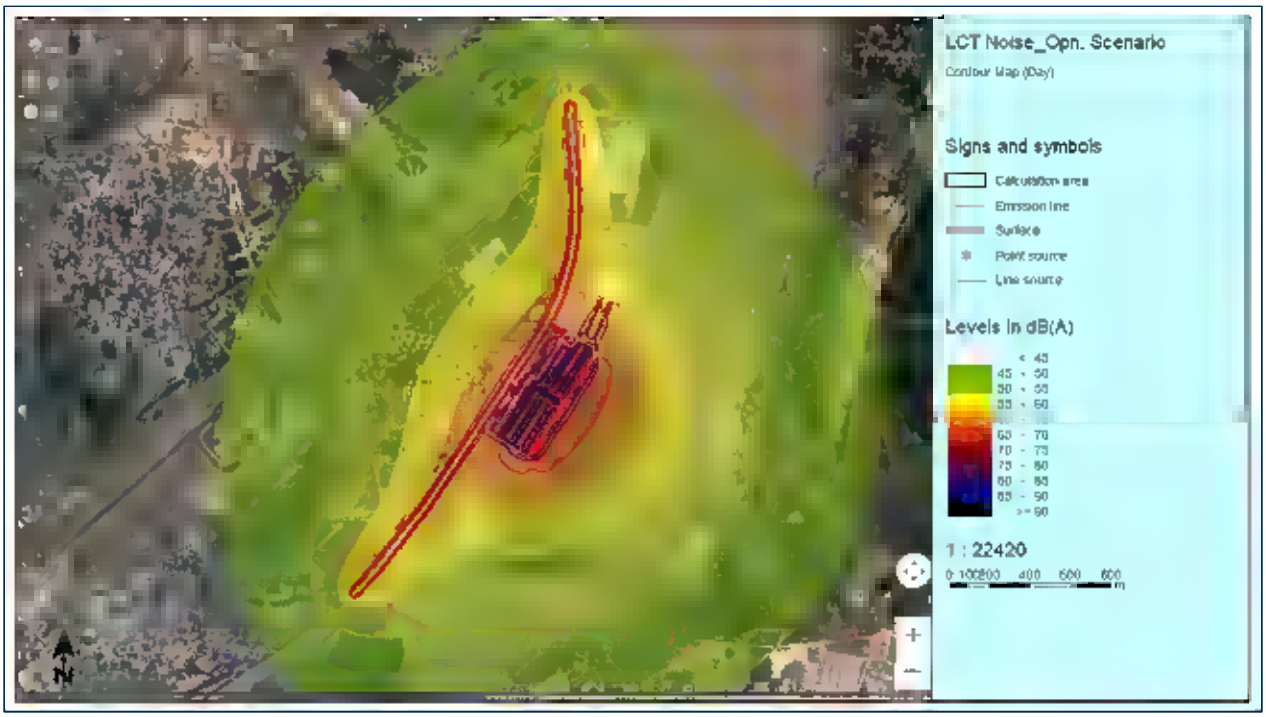


Figure 6-5: Noise Contour Map Daytime (7-22)

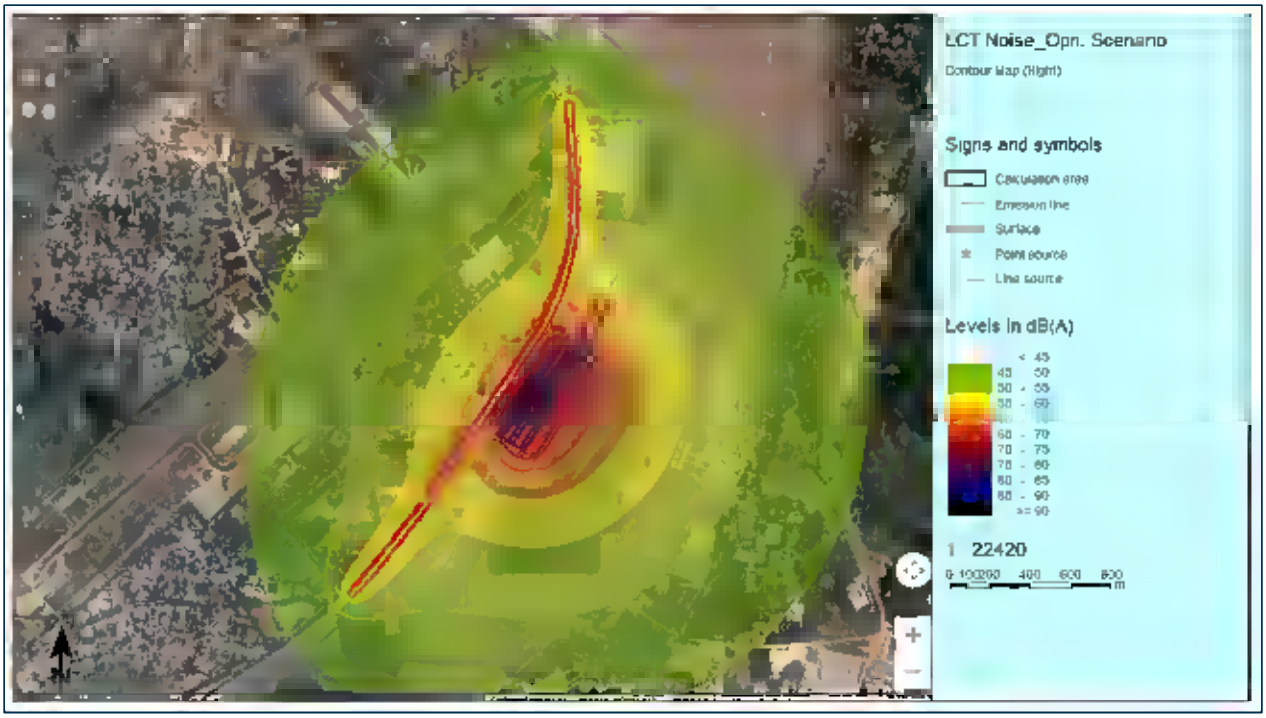


Figure 6-6: Noise Contour Map Night-time (22-7)

Figures 6-5 and 6-6 present the noise contour maps for daytime and nighttime conditions, respectively, illustrating the spatial distribution of predicted noise levels in the surrounding areas influenced by LCTP operations. The contour maps are developed using 5 dB intervals and are presented through a color-coded classification system.

The analysis indicates that a significant portion of the LCTP area, extending in some areas beyond the site boundary, falls within the 60–80 dB range (dark red zone) during both daytime and nighttime conditions. Localized zones within the site boundary exhibit higher noise levels, reaching up to 89.5 dB, which exceed the limits specified in the Noise Pollution (Control) Rules, 2025 (75 dB) as well as the IFC guideline value (70 dB).

During daytime, the 55 dB contour (IFC residential daytime limit) extends into a substantial portion of the nearby Bijoy Nagar residential area. During nighttime, the 45 dB contour (IFC residential night-time limit) covers the entire residential area and extends further, reaching the airport runway and beyond.

6.2.2 Construction Scenario-1

The following table presents the baseline noise levels, model-predicted noise levels, and cumulative noise levels at each receptor location, together with the applicable zone-specific standard limits.

Table 6-6: Receiver Noise level Output

Receptor	Period	Background L_{eq} (dBA)	Predicted L_{eq} (dBA)	Cumulative L_{eq} (dBA)	NPCR-2025 L_{eq} (dBA)	Category	Remarks
R-1	Daytime	72.4	42.2	72.4	55	Residential	Baseline level already exceeded limit
	Night-time	68.4	35.6	68.4	45		
R-2	Daytime	67.4	53.3	68.3	55	Residential	Same as R-1
	Night-time	63.8	51.0	64.6	45		
R-3	Daytime	67.6	56.9	69.3	75	Industrial	Within Limit
	Night-time	62.4	51.5	63.8	70		
R-4	Daytime	68.7	48.8	69.0	75	Industrial	Within Limit
	Night-time	62.2	40.4	62.5	70		
R-5	Daytime	65.7	37.0	65.7	75	Industrial	Within Limit
	Night-time	60.7	28.8	60.8	70		
R-6	Daytime	74.9	51.6	75.1	50	Educational /Silent Zone	Same as R-1
	Night-time	68.4	49.5	68.7	40		

From the above table, it can be interpreted that receptors R-3, R-4, and R-5 are located within the industrial zone, and the cumulative noise levels at these locations remain within the applicable standard limits. Receptor R-2, although situated near the residential area, is located directly opposite the LCTP boundary and that's why the cumulative noise level at this receptor significantly exceeds the residential limit.

The remaining receptors (R-1 and R-6), although closer to residential areas, are also located near the boundary of the industrial zone, approximately 150–200 m from the LCT boundary. They show high noise levels if compared with residential & educational limit. Although they exhibit relatively high cumulative noise

levels during both daytime and nighttime periods the baseline noise levels at these receptors are already substantially elevated; therefore, the added contribution from the construction is comparatively minor.

Evaluation against the IFC noise criteria shows that cumulative noise levels at receptors R-3, R-4, and R-5 are either compliant with or very close to the applicable limits for industrial areas. However, cumulative noise levels at the remaining receptors exceed the IFC limits.

The following figures show the single point map as well as grid noise map of both day & night-time for construction scenario-1.



Figure 6-7: Single Point Noise Level Map (in L_{eq} dBA)

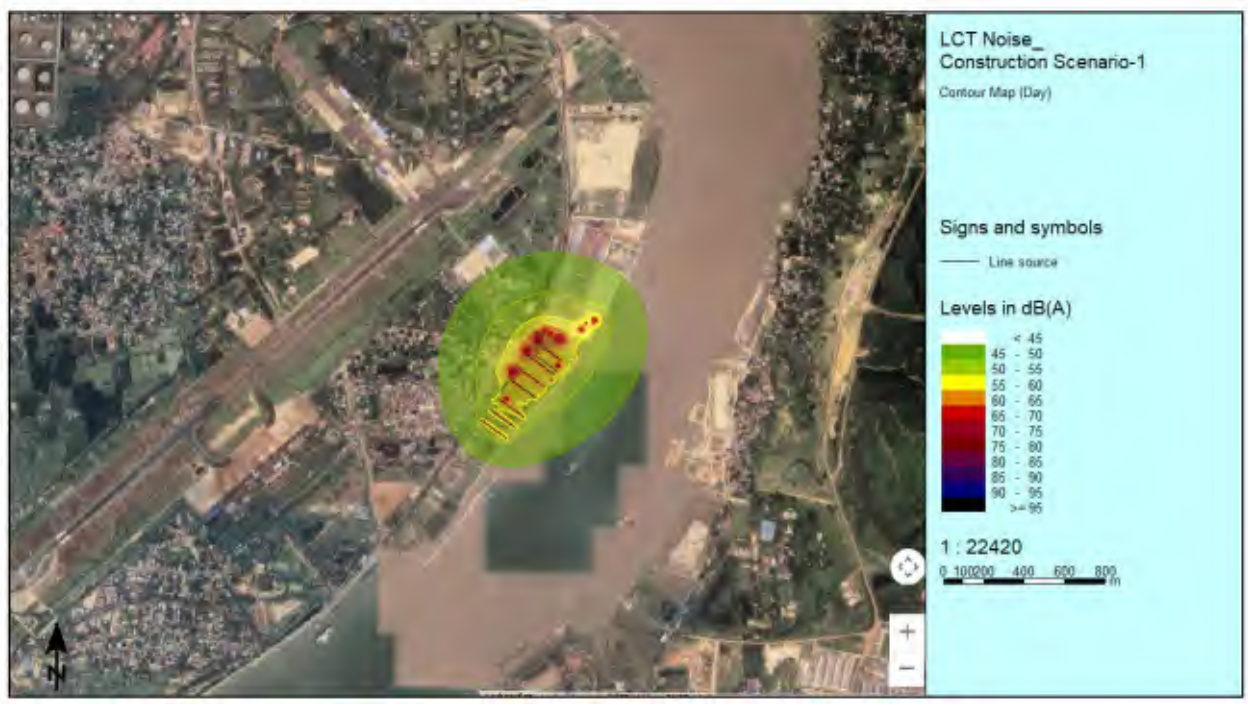


Figure 6-8: Noise Contour Map Daytime (7-22)

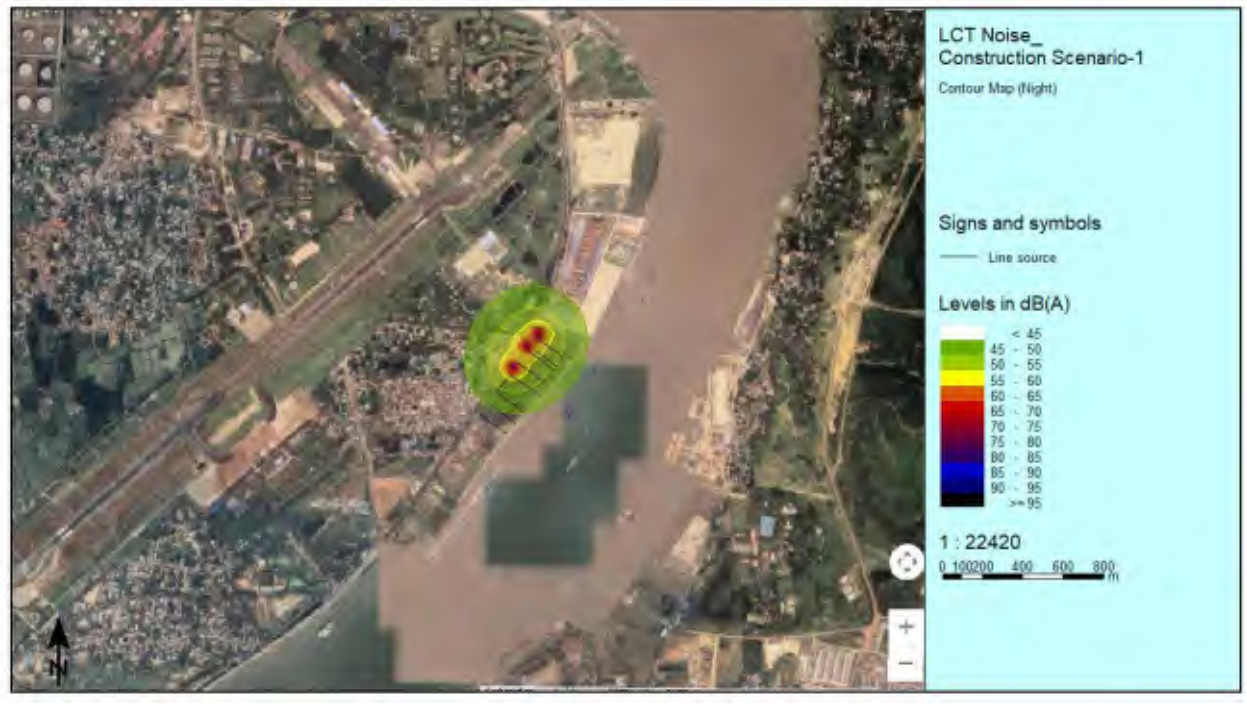


Figure 6-9: Noise Contour Map Night-time (22-7)

The above Figures 6-8 and 6-9 present the noise contour maps for daytime and night-time, respectively, illustrating the spatial distribution of predicted noise levels in the surrounding areas influenced by LCT construction scenario-1. It is observed that during daytime, the noise contour extends beyond the Block B and C boundary, as most construction activities are carried out during extended daytime hours. This is represented by the 55–65 dB contour range (yellow to red zone).

Localized areas within the boundary, particularly at several work zones, exhibit higher noise levels reaching up to 75–80 dB range, which exceed the limits specified in the noise standards.

During nighttime, noise is generated only from diesel generators and dewatering pumps, resulting in a 45 dB contour covering a small portion of the nearby residential area. However, the overall impact remains comparatively lower than that observed under the operational nighttime scenario.

6.2.3 Construction Scenario-2

The following table presents the baseline noise levels, model-predicted noise levels, and cumulative noise levels at each receptor location, together with the applicable zone-specific standard limits.

Table 6-7: Receiver Noise level Output

Receptor	Period	Background L_{eq} (dBA)	Predicted L_{eq} (dBA)	Cumulative L_{eq} (dBA)	NPCR-2025 L_{eq} (dBA)	Category	Remarks
R-1	Daytime	72.4	42.6	72.4	55	Residential	Baseline level already exceeded the limit
	Night-time	68.4	3.4	68.4	45		
R-2	Daytime	67.4	50.8	67.7	55	Residential	Same as R-1
	Night-time	63.8	13.2	63.8	45		
R-3	Daytime	67.6	56.5	68.2	75	Industrial	Within limit
	Night-time	62.4	13.9	62.4	70		
R-4	Daytime	68.7	47.8	68.9	75	Industrial	Within limit
	Night-time	62.2	14.8	62.2	70		
R-5	Daytime	65.6	36.6	65.7	75	Industrial	Within limit
	Night-time	60.7	0.9	60.7	70		
R-6	Daytime	74.9	49.2	74.9	50	Educational /Silent Zone	Same as R-1
	Night-time	68.4	15.7	68.4	40		

From the above table, it can be interpreted that receptors R-3, R-4, and R-5 are located within the industrial zone, and the cumulative noise levels at these locations remain within the applicable standard limits. Receptor R-2, although situated near the residential area, is located directly opposite the LCTP boundary and hence shows high cumulative noise level. The remaining receptors (R-1 and R-6), although closer to residential areas, are also located near the boundary of the industrial zone, approximately 150–200 m from the LCT boundary, and show high noise levels if compared with residential & educational limit. Although these receptors exhibit relatively high cumulative noise levels during both daytime and nighttime periods the baseline noise levels at these receptors are already substantially elevated; therefore, the added contribution from the construction is comparatively minor.

Comparison with the IFC noise criteria shows that the cumulative noise levels at receptors R-3, R-4, and R-5 are either compliant with or very close to the applicable limits for industrial areas. However, cumulative noise levels at the remaining receptors exceed the IFC limits.

The following figures show the single point map as well as grid noise map of both day & night-time for construction scenario-2.

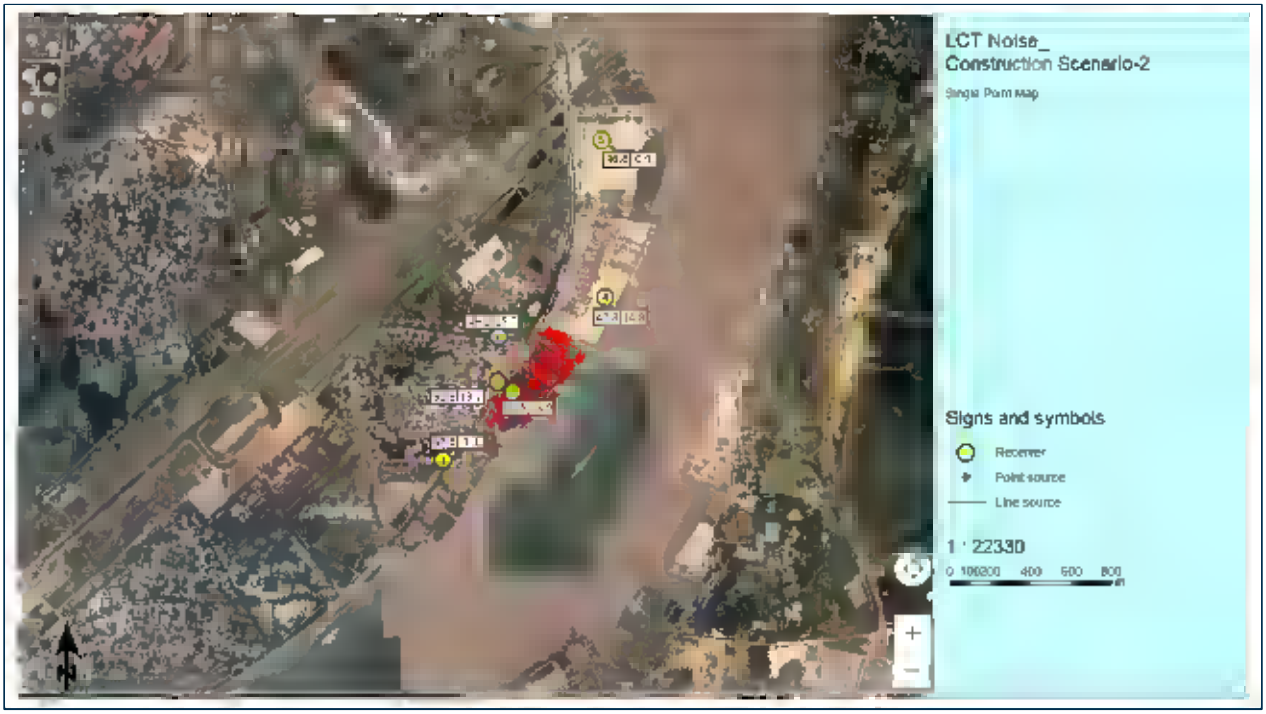


Figure 6-10: Single Point Noise Level Map (in L_{eq} dBA)

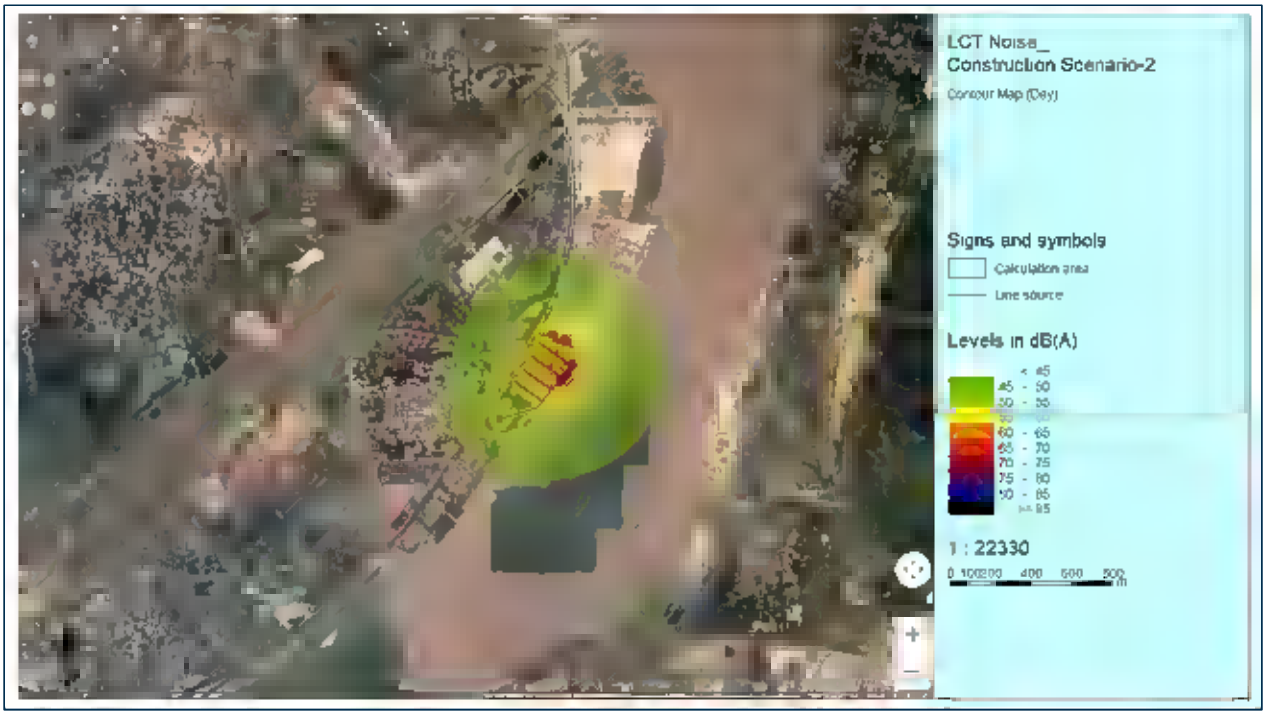


Figure 6-11: Noise Contour Map Daytime (7-22)



Figure 6-12: Noise Contour Map Night-time (22-7)

The above Figures 6-11 and 6-12 present the noise contour maps for daytime and night-time, respectively, illustrating the spatial distribution of predicted noise levels in the surrounding areas influenced by LCTP construction scenario-2. It is observed that during daytime, the noise contour extends beyond the Block B and C boundary, as most construction activities are carried out during extended daytime hours. This is represented by the 55–65 dB contour range (yellow to red zone).

Localized areas within the boundary, particularly at several work zones, exhibit higher noise levels reaching up to 65–75 dB range, which exceed the limits specified in the noise standards.
During nighttime, noise is generated only from dewatering pumps which has a negligible impact on selected receptors.

6.2.4 Construction Scenario-3

The following table presents the baseline noise levels, model-predicted noise levels, and cumulative noise levels at each receptor location, together with the applicable zone-specific standard limits.

Table 6-8: Receiver Noise level Output

Receptor	Period	Background L_{eq} (dBA)	Predicted L_{eq} (dBA)	Cumulative L_{eq} (dBA)	NPCR-2025 L_{eq} (dBA)	Category	Remarks
R-1	Daytime	72.4	41.4	72.4	55	Residential	Baseline level already exceeded limit
	Night-time	68.4	-	68.4	45		
R-2	Daytime	67.4	49.2	67.5	55	Residential	Same as R-1
	Night-time	63.8	-	63.8	45		
R-3	Daytime	67.6	55.7	68.0	75	Industrial	Within limit
	Night-time	62.4	-	62.4	70		
R-4	Daytime	68.7	45.3	68.8	75	Industrial	Within limit
	Night-time	62.2	-	62.2	70		
R-5	Daytime	65.6	51.4	66.2	75	Industrial	Within limit
	Night-time	60.7	-	60.7	70		
R-6	Daytime	74.9	46.8	75.0	50	Educational /Silent Zone	Same as R-1
	Night-time	68.4	-	68.4	40		

From the above table, it can be interpreted that receptors R-3, R-4, and R-5 are located within the industrial zone, and the cumulative noise levels at these locations remain within the applicable standard limits. Receptor R-2, although situated near the residential area, is located directly opposite the LCT boundary and the cumulative noise level at this receptor exceeds the limit. The receptors (R-1 and R-6), although closer to residential areas, are also located near the boundary of the industrial zone, approximately 150–200 m from the LCT boundary. They show high noise levels if compared with the residential & educational limits.

Although this scenario exhibits relatively high cumulative noise levels during both daytime and nighttime periods, the baseline noise levels at these receptors are already substantially elevated; therefore, the added contribution from the construction is comparatively minor.

As per IFC noise criteria it shows that cumulative noise levels at receptors R-3, R-4, and R-5 are either compliant with or very close to the applicable limits for industrial areas. However, cumulative noise levels at the remaining receptors exceed the IFC limits.

The following figures show the single point map as well as grid noise map of both day & night-time for construction scenario-3.



Figure 6-13: Single Point Noise Level Map (in L_{eq} dBA)

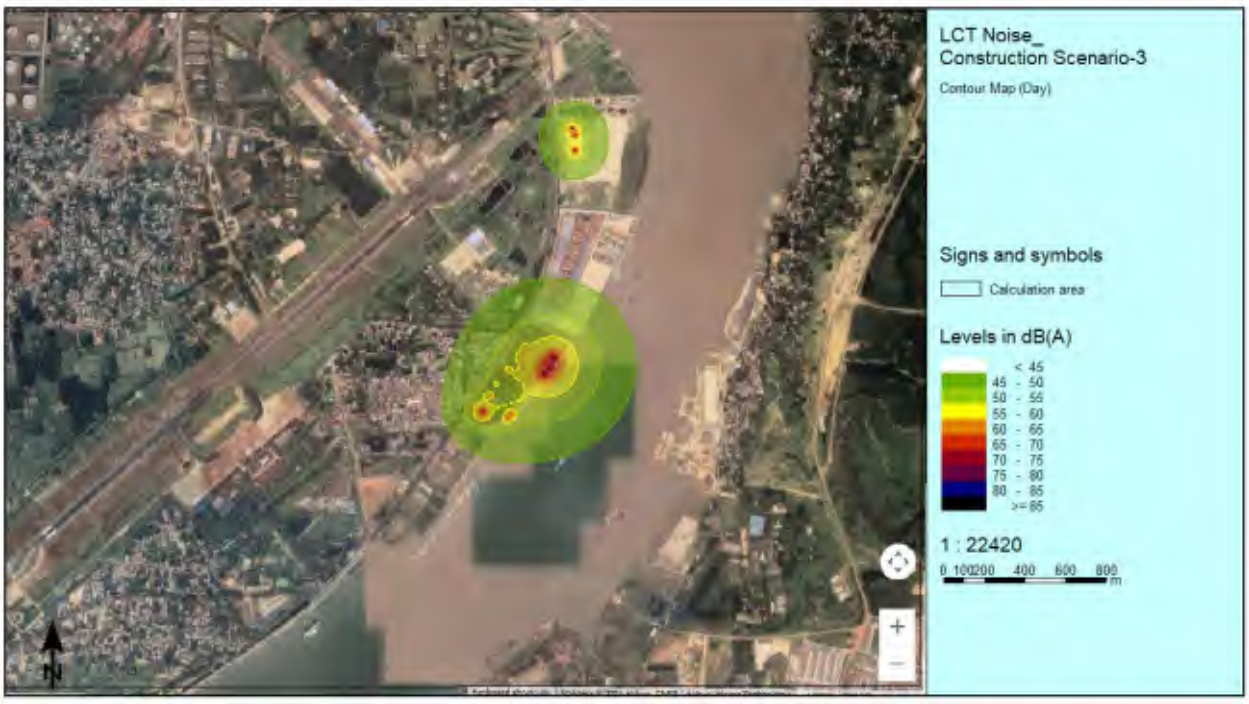


Figure 6-14: Noise Contour Map Daytime (7-22)

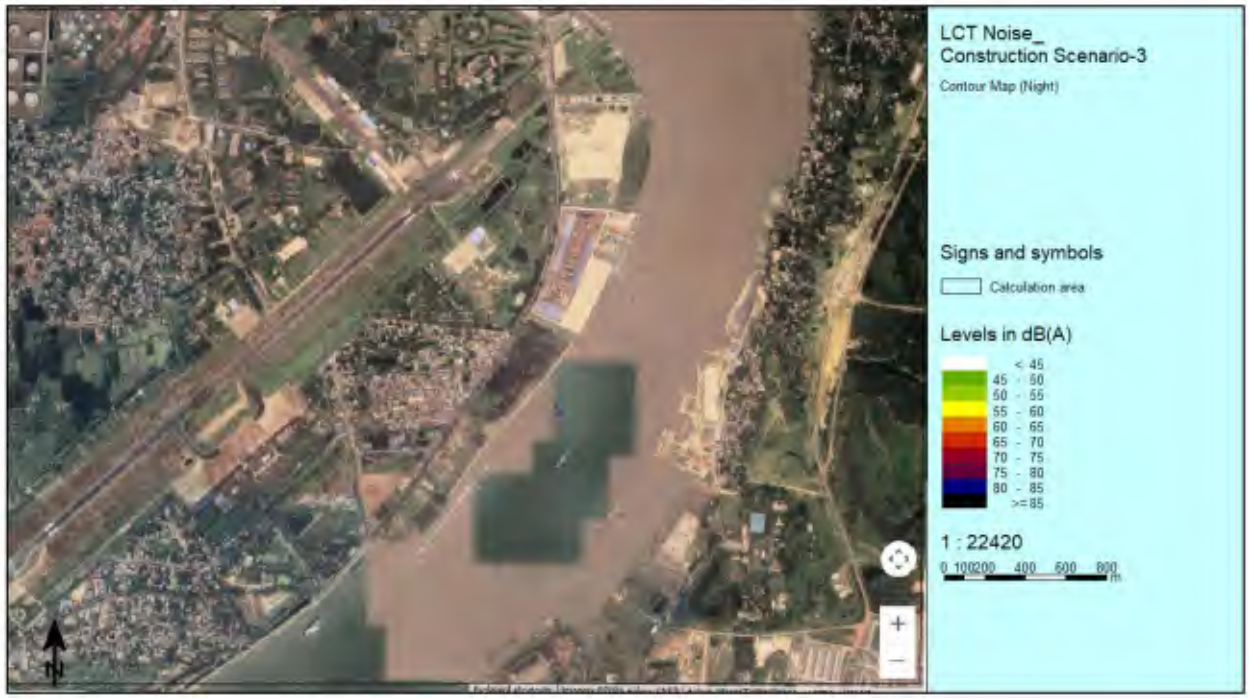


Figure 6-15: Noise Contour Map Night-time (22-7)

The above Figures 6-14 and 6-15 present the noise contour maps for daytime and night-time, respectively, illustrating the spatial distribution of predicted noise levels in the surrounding areas influenced by LCTP construction scenario-3. It is observed that during daytime, the noise contour extends beyond the Block B and C boundary, as most construction activities are carried out during extended daytime hours. This is represented by the 55–65 dB contour range (yellow to red zone).

Localized areas within the boundary, particularly at several work zones, exhibit higher noise levels reaching up to 75–80 dB range, which exceed the limits specified in the noise standards.

During nighttime, no equipment will be in operation; therefore, no noise contour map is shown.

7 Conclusions for the ESIA

7.1 Potential Impacts

Based on the predicted noise modelling results and the measured baseline noise levels, cumulative noise levels were estimated for both the construction and operational phases of the proposed LCTP. The assessment indicates that the operational phase represents the primary source of noise impact, with the potential to affect nearby residential areas and educational institutions during both daytime and night-time. For the construction phase, Scenario 1, where the maximum number of equipment operates simultaneously, produces the highest cumulative noise levels among the assessed scenarios. Although Scenarios 2 and 3 also generate noise impacts during the daytime, their nighttime contribution is minimal or absent due to limited or no construction activities.

The assessment further indicates that cumulative nighttime noise levels remain relatively high even when construction activities are absent or insignificant. This is attributed to the elevated baseline ambient noise generated by the adjacent airport rather than the proposed project itself.

Although construction-related noise impacts are temporary and localized, appropriate mitigation measures should be implemented to minimize disturbance to nearby sensitive receptors. Greater attention, however, should be given to the operational phase, particularly under the worst-case condition where all Cargo Handling Equipment (CHE) operates simultaneously during ship unloading operations.

The grid noise maps for both the construction and operational phases show that the highest predicted noise levels are concentrated within the LCTP boundary. As these levels may exceed acceptable occupational exposure limits, the implementation of appropriate Occupational Health and Safety (OHS) measures, including hearing protection and noise exposure management for on-site personnel, is essential.

In summary, while both the construction and operational phases have the potential to generate noise impacts, the baseline noise is already elevated due to the existing noise sources. However, the operational phase is identified as the principal concern for nearby residential areas and educational institutions. The construction phase, despite being temporary, also requires effective noise management. Furthermore, workers within the LCTP boundary are expected to experience the highest noise exposure and should therefore receive priority consideration in the implementation of occupational noise control measures.

7.2 Proposed Mitigation Measures

Based on the calculated cumulative noise levels, the following mitigation measures are recommended to minimize adverse impacts during both the construction and operational phases and to protect on-site personnel.

Construction Phase

- Schedule high-noise construction activities during daytime as far as practicable and avoid unnecessary nighttime operations.
- Limit the simultaneous operation of multiple high-noise equipment to reduce cumulative noise levels, particularly near sensitive receptors i.e. Bijoy Nagar residential area & nearby Schools.
- Ensure that all construction equipment and vehicles are regularly inspected and maintained to minimize excessive noise caused by mechanical defects.
- Install temporary noise barriers or acoustic screens around stationary high-noise equipment, such as generators and compressors, where feasible.

- Locate temporary facilities, including generators and batching or fabrication areas, as far as practicable from nearby residential areas and educational institutions.
- Prohibit unnecessary idling of construction vehicles and equipment when not in active use.
- Establish designated haul routes and enforce speed limits for construction vehicles within the project area.
- Inform nearby communities and educational institutions in advance about planned high-noise construction activities whenever practicable.

Operational Phase

- Maintain ground to be used by the container terminal vehicles so it is flat and smooth to minimize clatter of vehicles travelling over deviations in the surface.
- Implement good practice operational procedures to minimize the use of reversing warning sirens and use broadband sirens rather than tonal where possible.
- Create noise barriers on the site boundary to block line of sight to receptors, for example using stacked containers.
- Select and operate low-noise Cargo Handling Equipment (CHE) and ensure compliance with applicable manufacturer noise specifications.
- Select electric equipment instead of using diesel/internal combustion equipment. Using shore power instead of using auxiliary ship engines will reduce noise level significantly.
- Implement a preventive maintenance programme for cranes, mobile equipment, generators, conveyors, and other mechanical systems to maintain optimum operating conditions.
- Minimize simultaneous operation of multiple high-noise equipment where operationally feasible, especially during nighttime.
- Install acoustic enclosures or noise attenuation devices for fixed noise sources, such as generators and other auxiliary equipment.
- Conduct periodic environmental noise monitoring at project boundaries and nearby sensitive receptors to verify compliance and evaluate the effectiveness of mitigation measures.
- Provide training to workers on best practice techniques for cargo handling to minimize impulsive noise from container impacts
- Establish a grievance redress mechanism to address noise-related complaints from surrounding communities promptly.

Occupational Health and Safety Measures for On-site Workers

- Identify high-noise work zones and clearly mark them with appropriate warning signage based on assessment output.
- Provide suitable hearing protection devices (earplugs or earmuffs) to all personnel working in areas where noise exposure may exceed occupational limits and ensure their mandatory use.
- Implement job rotation and administrative controls to reduce individual exposure duration in high-noise areas.
- Conduct periodic occupational noise exposure assessments and audiometric (hearing) testing for workers routinely exposed to elevated noise levels.
- Provide training and awareness programmes on noise hazards, proper use of hearing protection, and safe work practices.
- Restrict unauthorized personnel from entering high-noise operational areas and maintain controlled access where necessary.
- Regularly review and update the occupational noise management plan based on monitoring results and operational changes.

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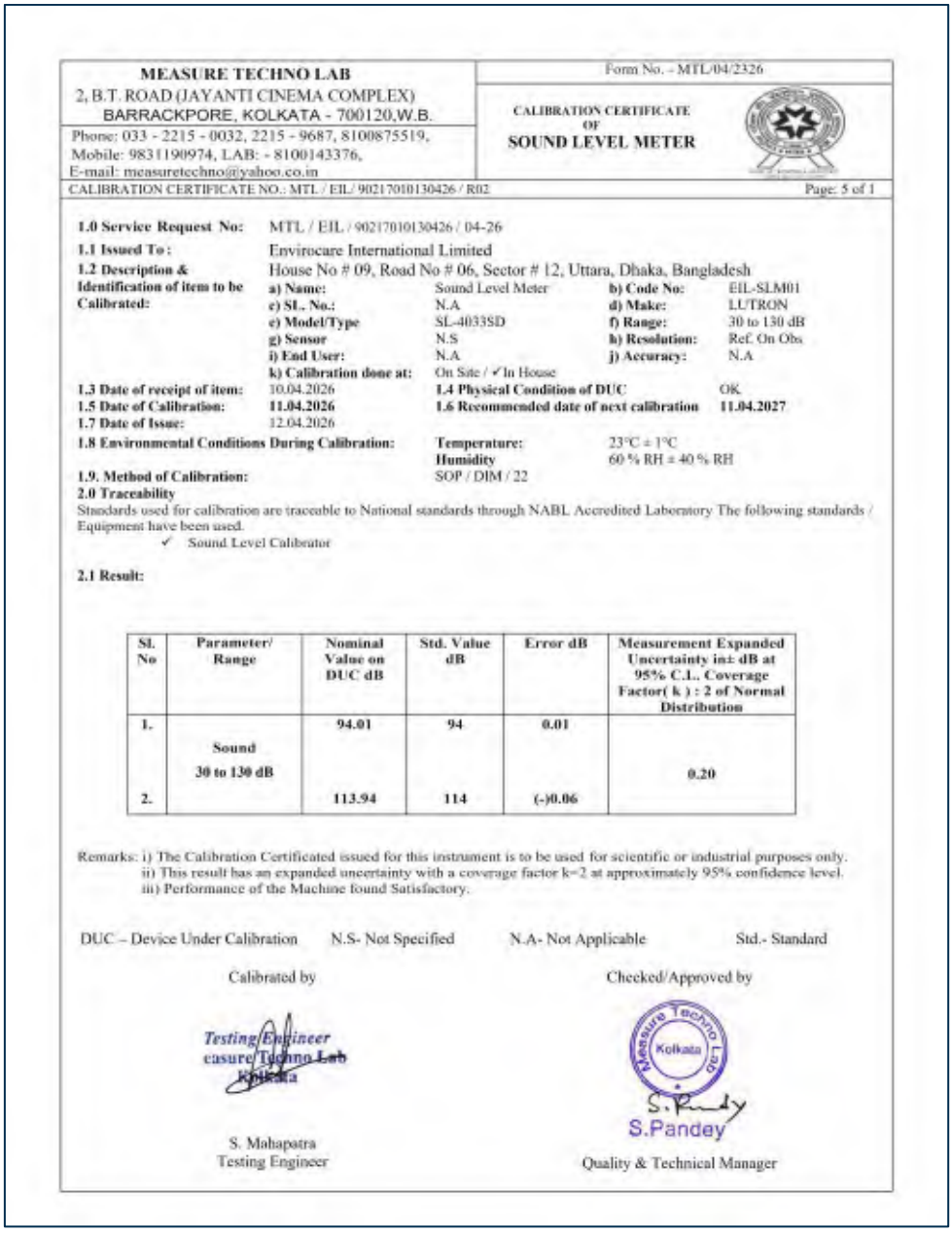
Topographic & Conduit Survey Report of LCT, February 2026

“Laldia_ESIA_Preliminary_Construction_Equipment_Assumptions_Final (1)” approved by APMT

“BK4589_Laldia_Port planning calcs_Operation phase_final” approved by APMT

“BK4589-HAS-PM-XX-IE-Z-0001_S1P02_Request for Information_20052026” shared RfI.

A1 Appendix A



MEASURE TECHNO LAB
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Phone: 033 - 2215 - 0032, 2215 - 9687, 8100875519,
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E-mail: measuretechno@yahoo.co.in

Form No. - MTL/04/2326

CALIBRATION CERTIFICATE OF SOUND LEVEL METER

CALIBRATION CERTIFICATE NO.: MTL / EIL/ 90217010130426 / R02 Page: 5 of 1

1.0 Service Request No: MTL / EIL / 90217010130426 / 04-26
1.1 Issued To : Envirocare International Limited
1.2 Description & Identification of item to be Calibrated: House No # 09, Road No # 06, Sector # 12, Uttara, Dhaka, Bangladesh

a) Name:	Sound Level Meter	**b) Code No:**	EIL-SLM01
c) Sl. No.:	N.A	**d) Make:**	LUTRON
e) Model/Type	SL-4033SD	**f) Range:**	30 to 130 dB
g) Sensor	N.S	**h) Resolution:**	Ref. On Obs.
i) End User:	N.A	**j) Accuracy:**	N.A
k) Calibration done at:	On Site / ✓In House		

1.3 Date of receipt of item: 10.04.2026 **1.4 Physical Condition of DUC** OK
1.5 Date of Calibration: **11.04.2026** **1.6 Recommended date of next calibration** **11.04.2027**
1.7 Date of Issue: 12.04.2026
1.8 Environmental Conditions During Calibration: **Temperature:** 23°C ± 1°C; **Humidity** 60 % RH ± 40 % RH
1.9. Method of Calibration: SOP / DIM / 22
2.0 Traceability
Standards used for calibration are traceable to National standards through NABL Accredited Laboratory The following standards / Equipment have been used.
✓ Sound Level Calibrator

2.1 Result:

Sl. No	Parameter/ Range	Nominal Value on DUC dB	Std. Value dB	Error dB	Measurement Expanded Uncertainty in± dB at 95% C.L. Coverage Factor(k) : 2 of Normal Distribution
1.	Sound 30 to 130 dB	94.01	94	0.01	0.20
2.		113.94	114	(-)0.06	

Remarks: i) The Calibration Certificated issued for this instrument is to be used for scientific or industrial purposes only.
ii) This result has an expanded uncertainty with a coverage factor k=2 at approximately 95% confidence level.
iii) Performance of the Machine found Satisfactory.

DUC – Device Under Calibration N.S- Not Specified N.A- Not Applicable Std.- Standard

Calibrated by
Testing Engineer
Measure Techno Lab Kolkata
S. Mahapatra
Testing Engineer

Checked/Approved by
Measure Techno Lab Kolkata
S.Pandey
Quality & Technical Manager

Annex C3 – Specialist Study: Flood model set-up

REPORT

Flood Model Set-up

Laldia Container Terminal ESIA

Client:	LCT Ltd.
Reference:	BK4589
Status:	S5/P02
Date:	30 July 2026

Haskoning
Enhancing Society Together

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Document title:	Flood Model Set-up
Reference:	BK4589
Status:	S5/P02
Date:	30 July 2026
Project name:	Click to enter "ProjectName"
Project number:	BK4589
Author(s):	IWM
Drafted by:	IWM
Checked by:	Haskoning
Date:	15/07/2026
Approved by:	Haskoning
Date:	21/07/2026
Classification:	Project related

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1 Introduction and scope

1.1 Purpose of this report

This appendix documents the technical set-up of the pluvial flood model developed for the Laldia Container Terminal Project (LCTP) and its surrounding project influence area in Chattogram, Bangladesh. It describes the input data, data pre-processing, model architecture, hydrological and hydraulic schematisation, boundary conditions, climate and project scenarios, model checking, assumptions and limitations.

The appendix is intended to provide a transparent technical record of how rainfall, runoff, the khal[1] drainage network, receiving-water levels and two-dimensional surface flow were represented. Interpretation of the resulting flood-hazard maps and assessment of project impacts are provided in the main impact report and are outside the scope of this appendix.

1.2 Modelling objectives

The coupled modelling system was developed to reproduce the principal processes controlling drainage and surface-water accumulation within the project influence area. The technical objectives were to:

- Represent rainfall-runoff generation for the local drainage catchments;
- Represent flow conveyance through the principal khals, regulators, pumps and proposed culverts;
- Represent the interaction between the local drainage network and the Karnaphuli River under tidally varying downstream water levels;
- Simulate two-dimensional overland flow and temporary storage across in the relevant catchment areas within the project influence area; and
- Provide a consistent basis for comparing without-project and with-project conditions for the selected 2030 and 2050 scenarios.

1.3 Scope boundary

The modelling system combines a regional river model, local rainfall-runoff and drainage-channel models, and a two-dimensional surface-flow model. The documented network includes the regional Karnaphuli-Halda river system (up to the Kaptai Dam), the principal local khals and hydraulic structures, and the project influence area. The available model does not contain a detailed representation of the underground sewer network or minor roadside drains. It therefore represents the dominant surface-water and open-channel drainage processes at the adopted study scale. The figure below shows the catchment boundary on the local rainfall-runoff and drainage-channel models.

[1] *Khal means "channel" in Bengali and refers to the network of channels that are developed to steer the stormwater towards the river in Chattogram*



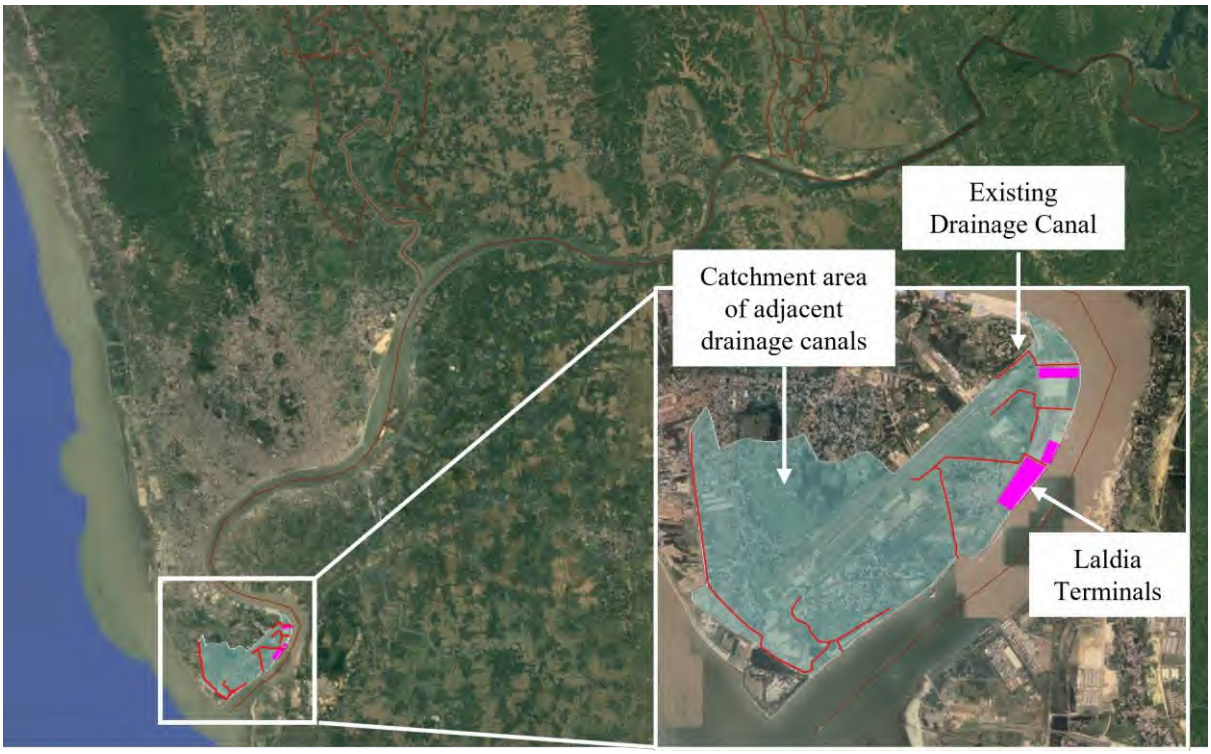


Figure 1-1. Pluvial flood model Boundary

2 Project setting

2.1 Hydrological characteristics

Chattogram has a humid subtropical monsoon climate, with most annual rainfall occurring between June and September. Rainfall intensities and totals increase markedly during the monsoon, while the dry season generally extends from December to February. The seasonal pattern recorded at Patenga station is shown in Figure 2-1. See Figure 2-2 for the location of the Patenga station.

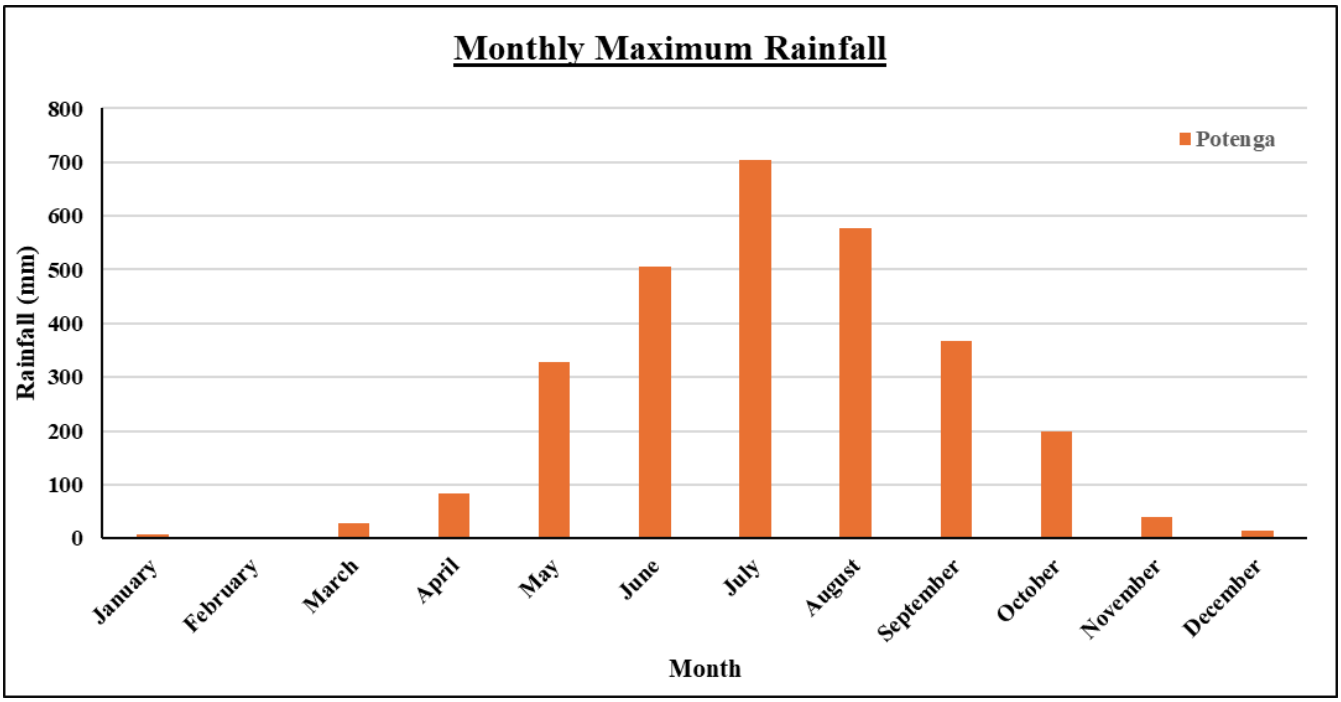


Figure 2-1. Monthly maximum rainfall at Patenga station (2016-2025)

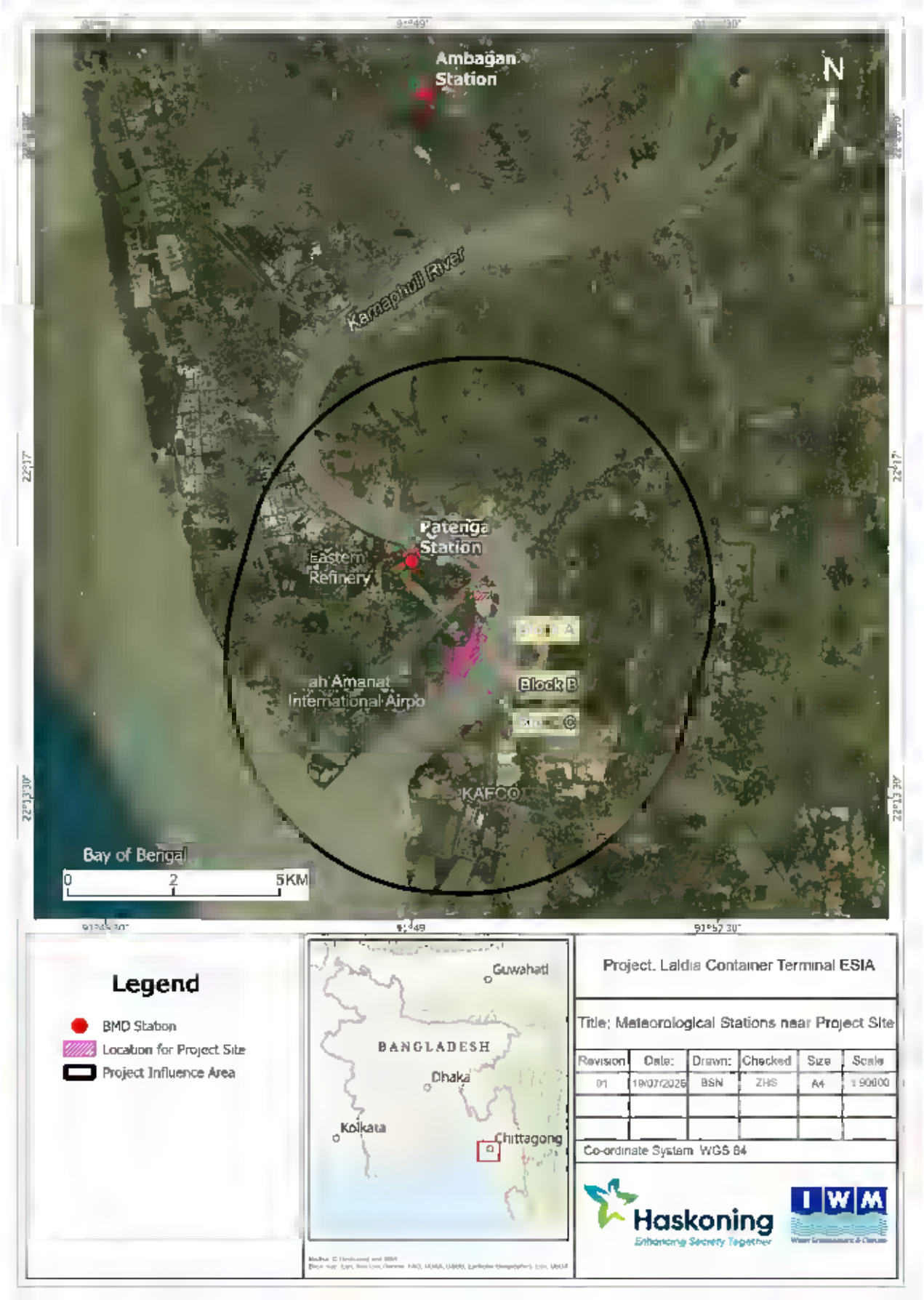


Figure 2-2: Location of BMD weather stations

2.2 Flood-generating mechanisms

Pluvial flooding in the project influence area occurs when rainfall generates runoff more rapidly than it can be conveyed or discharged by the local drainage system. Water can accumulate in low-lying areas when the storage and conveyance capacity of the khal network is exceeded, when local flow paths are obstructed, or when downstream water levels restrict gravity drainage.

The khals ultimately discharge to the Karnaphuli River. When river levels are lower than water levels in the khals, the regulators can open and gravity drainage can occur. When river levels are higher, the regulators close to prevent reverse tidal inflow. During these periods, local runoff is temporarily stored in the drainage network and low-lying areas unless it can be removed by pumping. The model therefore represents the combined influence of rainfall-runoff generation, local drainage capacity, regulator and pump operation, and time-varying receiving-water levels.

3 Flood model input data and pre-processing

3.1 Data inventory

The modelling system was assembled from open-source elevation data, field surveys, governmental sources, archived hydrometric and meteorological records, an existing regional river model, and terminal design information. Table 3-1 summarises the principal inputs, their resolution or level of detail, and their stated source. The following sections describe how these data were prepared before use in the model.

Table 3-1. Primary model data sources

Data input	Resolution / level of detail	Source
Base Elevation	FABDEM, nominal 30 m grid	FABDEM V1-2 / University of Bristol
Local topographic levels	Spot levels and terminal block surveys	IWM field survey (April 2026) and Survey 2000 data
Regional river cross-sections	Surveyed sections along the regional river network	IWM survey archive (2020)
Local khal cross-sections	Surveyed sections along the local drainage network	IWM field survey (2026)
Regulators and drainage structures	Openings, sill levels and dimensions	IWM field survey and available BWDB records
Pump information	Number of pumps and nominal installed capacity	BWDB / IWM field inventory
Kaptai Dam releases	Daily discharge series	Bangladesh Power Development Board (BPDB)

Data input	Resolution / level of detail	Source
Downstream tidal water levels	2022 water-level series at Khal-18	IWM regional model archive; originating authority to be confirmed
Receiving-water levels	Measured tidal levels at Khal-15	IWM measurements (2020)
Rainfall and evaporation	Hourly, 3-hourly and daily observations	BMD and BWDB
Climate-change projections	Return-period rainfall changes and sea-level-rise allowances	Haskoning climate analysis
Terminal project design	Formation levels and proposed interventions	APMT / Asset Design Drawings APM-056-01A-14 (February 2026), APM-056-01A-12-3 (landfill and culvert layout), APM-056-01A-13 rev. 2 (drainage cross-sections) and APM-056-06B-01 rev. 3 (drainage layout plan)

3.2 Elevation and project levels

3.2.1 Elevation and vertical datum alignment

The base elevation input was prepared from the Forest and Buildings removed Copernicus DEM (FABDEM). FABDEM provides a nominal 30 m bare-earth grid derived from the Copernicus GLO-30 dataset. The source grid was clipped to the project influence area and compared with spot levels collected by IWM in April 2026 at open locations considered to have remained unchanged.

The comparison indicated that the FABDEM elevations were, on average, 0.84 m above the local survey levels. A uniform correction was therefore applied across the model domain: model elevation in

$$mMSL = FABDEM\ elevation - 0.84\,m.$$

The corrected grid was subsequently merged with the available local survey data.

3.2.2 Terminal block levels

Blocks A and B were represented using available Survey 2000 elevation data because these areas had already been constructed at the time of the survey. For Block C, the without-project terrain uses the IWM survey levels and FABDEM, while the with-project terrain uses the proposed terminal formation levels. The proposed terminal platform in Block C was represented at +8.0 m ISLWL, corresponding to approximately +5.66 m mMSL based on the adopted datum conversion. All elevations in the hydraulic model are reported relative to mean sea level (mMSL).

Table 3-2. Topographic data inputs and vertical datum transformations

Dataset	Use	Source	Original vertical reference	Transformation / treatment
FABDEM V1-2	Base terrain across the project influence area	FABDEM / University of Bristol	EGM2008, as stated in the source material	Uniform correction: model mMSL = FABDEM - 0.84 m
IWM spot-level survey, April 2026	Local datum check and surveyed terrain points	Primary field survey	Mean sea level established by the Survey of Bangladesh	Used directly in mMSL
Survey 2000 data for Blocks A and B	Representation of constructed terminal blocks	Project survey data, April 2025 and January 2026	Project survey datum	Used after alignment to the model datum
Terminal design levels for Block C	With-project terminal level	Drawing APM-056-01A-14, February 2026	Chart datum / ISLWL, as stated in the source material	mMSL = ISLWL - 2.34 m

The corrected terrain shown in Figure 3-1 represents the without-project condition. Across much of the surrounding area, terrain levels are approximately 2 to 3 mMSL, while the existing terminal blocks are generally higher. The proposed raising of Block C is introduced only in the with-project terrain used for the scenario simulations.

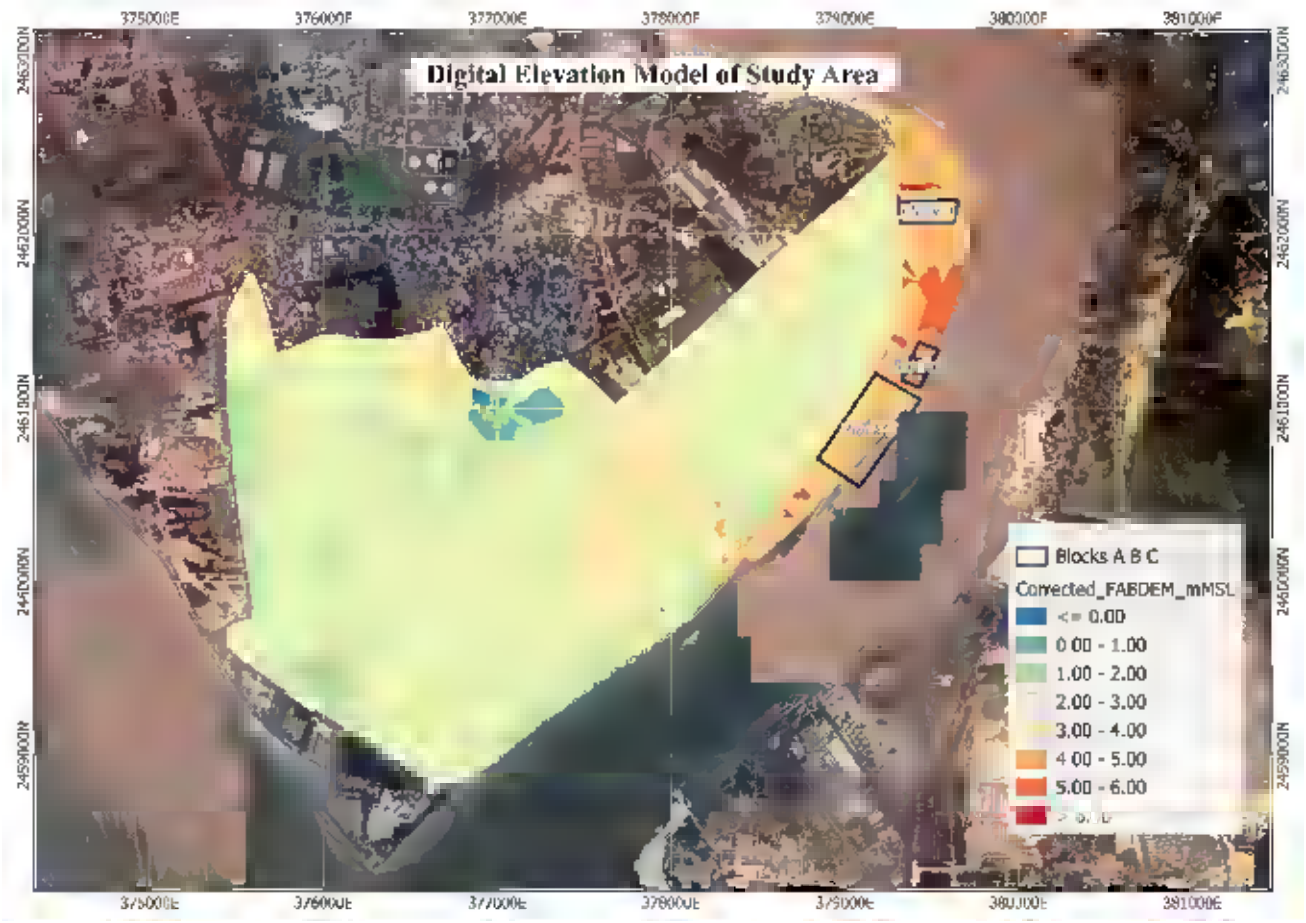


Figure 3-1. Corrected digital elevation model of the project influence area

3.3 Rainfall, evaporation and climate-change inputs

3.3.1 Observed rainfall and evaporation

3-hourly Observed rainfall and evaporation data between 2016 and 2025 were obtained from Bangladesh Meteorological Department (BMD) and Bangladesh Water Development Board (BWDB) stations were obtain in the regional and local hydrological models.

The continuous 2023 rainfall series at Patenga station, shown in Figure 3-2, was used as a diagnostic input for checking the hydrological response of the configured catchment model. The design simulations use return-period rainfall inputs rather than the 2023 historical sequence.

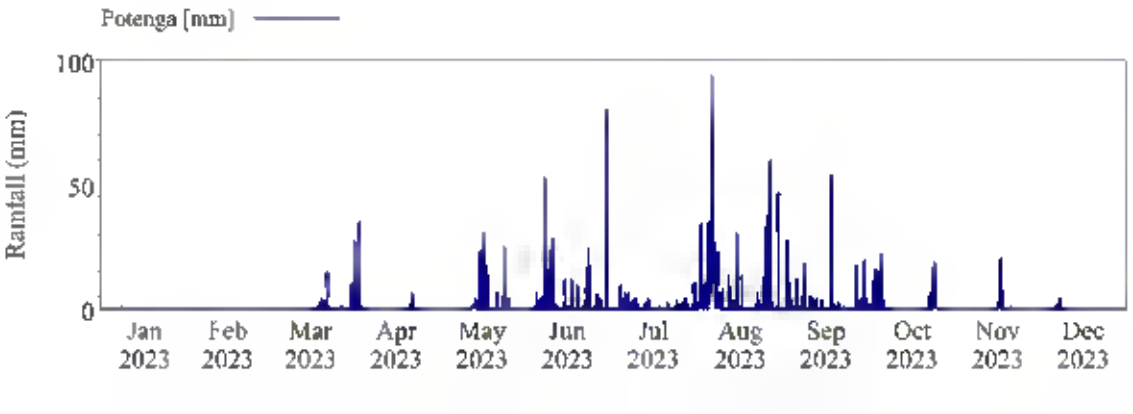


Figure 3-2. Observed hourly rainfall at Patenga station for 2023

3.3.2 Rainfall climate-change adjustment

Projected return-period rainfall totals for baseline and future climate conditions were provided by Haskoning. For this study, the projected change between the climate-model baseline and each selected future time horizon was applied to the historical 1-day maximum rainfall total for the 1-in-25-year return period. This follows the delta-change method, whereby the projected climate-change signal is applied to an observed historical design-rainfall value rather than using the raw climate-model rainfall totals directly. This method is commonly applied in climate-impact assessments because it retains the characteristics of the observed historical rainfall baseline while incorporating the projected change for the selected future period. The scenario simulations therefore represent the historical 1-in-25-year rainfall event adjusted for the projected climate conditions in 2030 and 2050.

3.4 Data specific to the River Model

3.4.1 Kaptai Dam release data

Daily discharge releases from Kaptai Dam were obtained from the Bangladesh Power Development Board (BPDB) and supplied through the regional model dataset. These records provide the upstream flow input for the regional Karnaphuli River model.

3.4.2 River cross-sections

The regional river geometry is based on surveyed cross-sections from the IWM archive. The cross-sections used for the Karnaphuli River were surveyed in 2020. Figure 3-3 provides a representative example of the available river geometry.

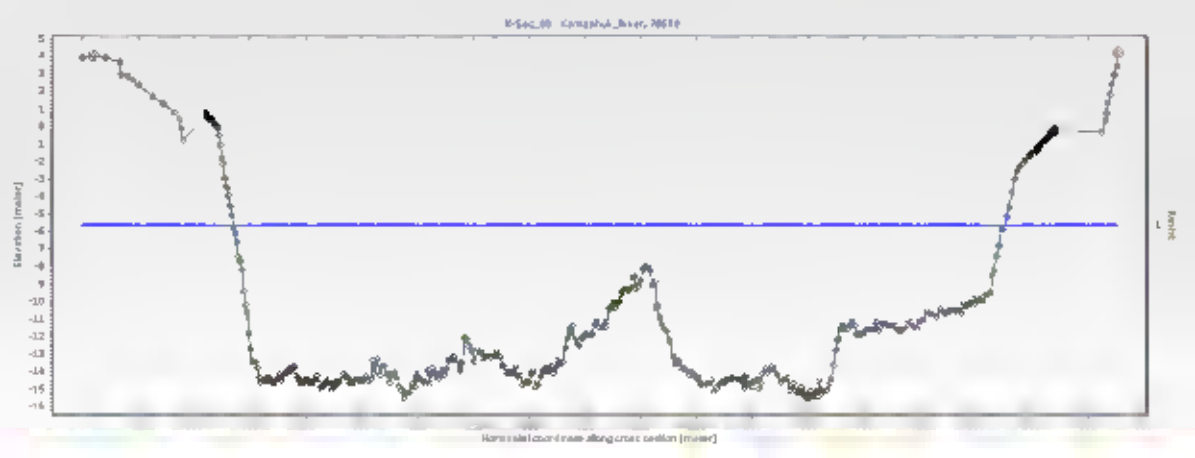


Figure 3-3. Representative surveyed cross-section of the Karnaphuli River

3.4.3 Downstream tidal water-level data

The downstream water-level input is a measured 2022 tidal series at Khal-18 in the lower Karnaphuli River (see Figure 3-4). The series was supplied through IWM's regional model archive and captures spring-neap tidal variability. The data inventory in the supplied material refers to BIWTA/SOB, while the original modelling draft refers to Chittagong Port Authority (CPA) as the originating authority. The final controlled data register should confirm the originating organisation; the model uses the same 2022 water-level series irrespective of this attribution.

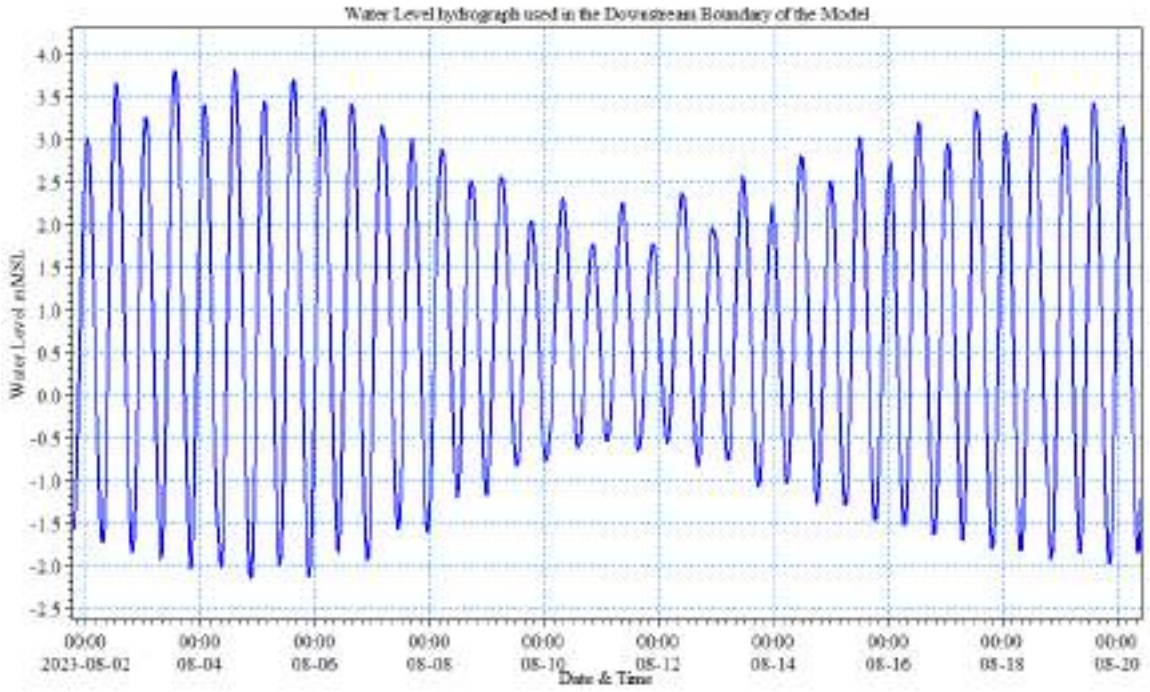


Figure 3-4. Observed tidal water-level series at Khal-18

3.4.4 Additional water level data

Additional water-level measurements at the outfall of Khal-15 were collected by IWM in 2020 as part of the feasibility study for development and management of the Karnaphuli-Halda river basin. These measurements provide supporting information on the range of tidal levels experienced near the local

drainage outfalls. The reported seasonal spring and neap water levels are summarised in Table 3-3. Tidal water levels at the outfall of Khal-15, mMSL

Table 3-3. Tidal water levels at the outfall of Khal-15, mMSL

Parameter	Dry season	Wet season
High water, spring tide	1.76	3.67
Low water, spring tide	-2.35	-2.41
High water, neap tide	1.11	2.10
Low water, neap tide	-1.40	-1.39
Maximum tidal range	4.13	5.73

3.4.5 Sea-level-rise input

Sea-level-rise allowances were provided as part of the climate inputs. The values used in the source scenario definition are 0.07 m for 2022, 0.12 m for 2030 and 0.28 m for 2050. The scenario implementation is described in Chapter 7.

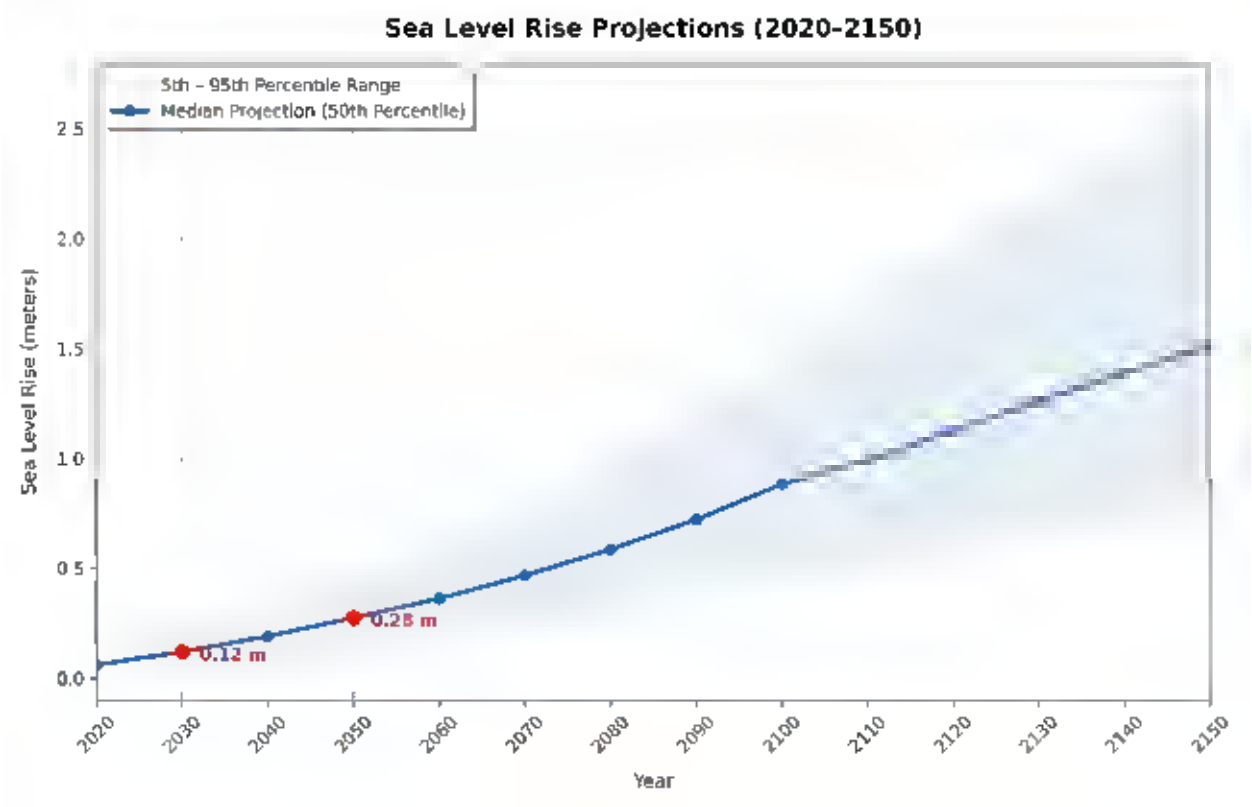


Figure 3-5. Sea-level-rise projection used in the scenario definition

3.5 Local drainage and hydraulic-structure data

3.5.1 Drainage network and surveyed geometry

The local larger drainage inventory contains nine principal khals with a combined surveyed length of approximately 13 km. The local khal cross-sections were surveyed by IWM in 2026. The khals,

drainage outfalls, regulators and terminal blocks are shown in Figure 3-6. The drainage branches and catchment delineation used in the model are described in Chapter 6.



Figure 3-6. Drainage khals and regulator locations within the project influence area

3.5.2 Existing regulators and pumps

Structure information, including the number and dimensions of regulator openings, sill levels, number of pumps and nominal pump capacities, was compiled from the field inventory and available BWDB information. The adopted input values are summarised in Table 3-4. Detailed operating rules are described in Section 6.6.

Table 3-4. Existing regulators and drainage pumps

No.	Structure	Khal	Vents	Vent height (m)	Vent width (m)	Sill (mMSL)	Pumps	Capacity per pump
1	Regulator / sluice	No. 12 Boat Club Khal	2	1.5	1.5	-0.96	2	10 cusec (0.283 m³/s)
2	Regulator / sluice	No. 14 Laldiar Char 1 Khal	2	1.5	1.5	-0.96	2	10 cusec (0.283 m³/s)
3	Regulator / sluice	No. 15 Airport Khal	4	1.5	1.5	-0.96	4	10 cusec (0.283 m³/s)
4	Regulator / sluice	No. 17 Nizam Market Khal	4	1.8	1.8	-0.96	4	10 cusec (0.283 m³/s)
5	Regulator / sluice	Gullakhali Khal	2	1.5	1.5	-0.96	-	Not stated

3.6 Terminal project design data

- The with-project model uses the terminal design levels for Block C (+8 m ISLWL)
- The LCTP introduces two proposed box culverts on Khal-14, one upstream and one downstream of the existing regulator. The geometry documented in the current model set-up is listed in Table 3-5. The dimensions of the proposed culverts are aligned with the opening in the sluice gate.
- The terminal area drains toward Khal-14 downstream of the regulator in both with and without project conditions.

Table 3-5. Proposed Khal-14 culvert data used in the model set-up

Structure	Khal	Location	L (m)	W (m)	H (m)	Modelled invert level
Culvert 1	Khal-14	Upstream of the existing regulator	60	3.0	1.5	Same as regulator sill level
Culvert 2	Khal-14	Downstream of the existing regulator	100	3.0	1.5	

4 Modelling framework

4.1 Overall architecture

The modelling system was developed in the MIKE FLOOD environment. Rainfall-runoff generation is represented with MIKE NAM. Regional river and local drainage-channel hydraulics are represented in the one-dimensional MIKE 11 model, while surface flow across the project influence area is represented in MIKE 21 Flexible Mesh. MIKE FLOOD links the one-dimensional and two-dimensional components into a coupled simulation. The model architecture is shown in the figure below.

The component models were prepared and tested individually before coupling. The regional river model provides time-varying receiving-water levels at the local khal outfalls. The local NAM models generate catchment runoff, which enters the one-dimensional drainage network. Lateral links between the khal branches and the two-dimensional domain allow water to spill onto and return from the floodplain.

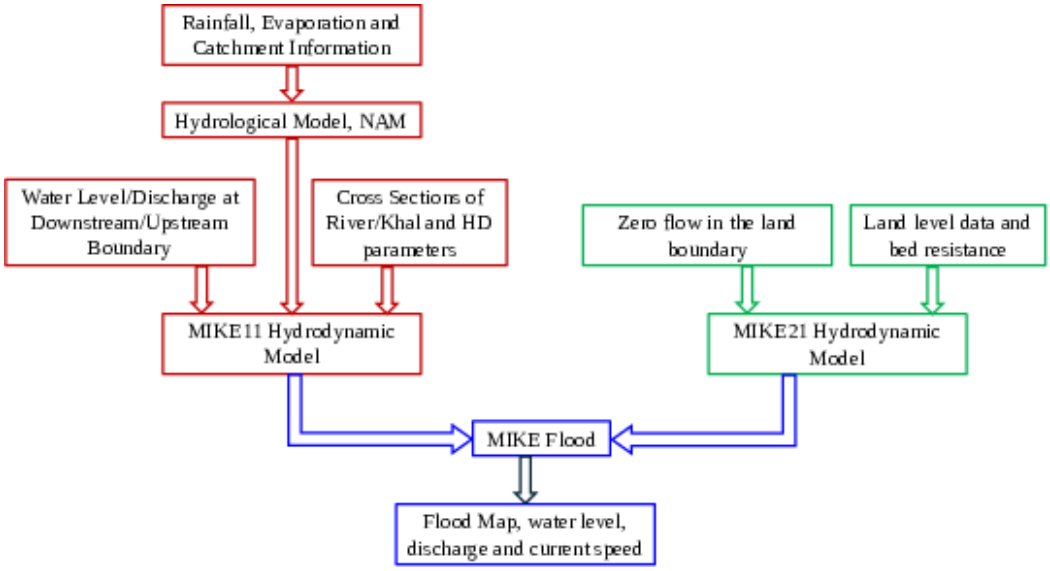


Figure 4-1. Integrated MIKE FLOOD modelling architecture

4.2 Model components and data exchange

The modelling system contains three linked spatial scales: the regional Karnaphuli-Halda river network; the local rainfall-runoff and khal drainage network; and the two-dimensional project influence area. The regional and local model set-ups are described separately in Chapters 5 and 6.

5 Regional fluvial model set-up

5.1 Model domain and schematisation

The regional hydrodynamic model covers the major river system downstream of Kaptai Dam. The represented network comprises approximately 81 km of the Karnaphuli River, 93.9 km of the Halda River, 37.1 km of the Ichamati River, 50.96 km of the Dhurang River and 46 km of the Sarta River (see Figure 5-1. Regional Karnaphuli-Halda model catchments downstream of Kaptai Dam. Link channels

are included where required by the existing model schematisation to represent floodplain storage and hydraulic connectivity.

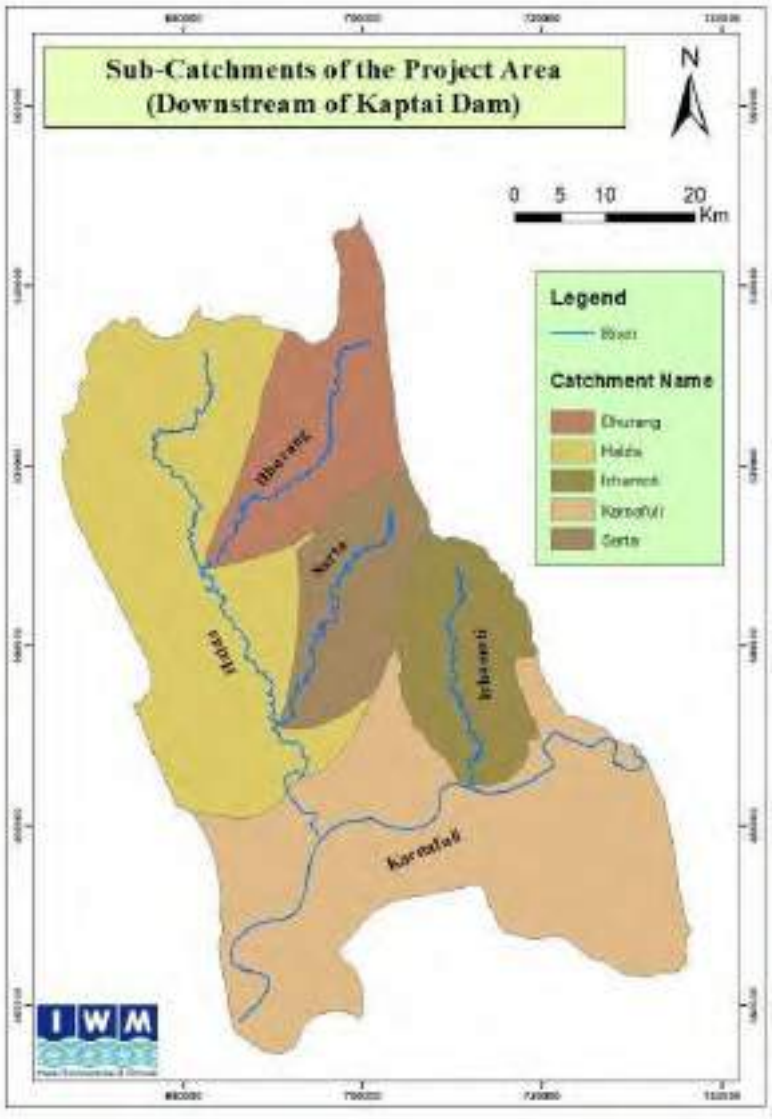


Figure 5-1. Regional Karnaphuli-Halda model catchments downstream of Kaptai Dam

5.2 Catchment runoff representation

Rainfall-runoff generation for the regional catchments is represented using the existing MIKE NAM hydrological model. Observed rainfall and evaporation series are assigned to the catchments using the Thiessen weights listed in Table 5-1 The resulting runoff hydrographs are connected to the corresponding river branches in the regional one-dimensional model.

Table 5-1. Thiessen weights for regional river-model catchments

Catchment	Amtali	Manikchari	Chattogram	Fatikchari	Sitakunda	Patiya	Anwara	Bandarban	Satkania	Potenga
CA-01	0.60	0.40	-	-	-	-	-	-	-	-
CA-02	-	-	0.34	0.36	0.30	-	-	-	-	-
CA-03	-	0.77	-	0.23	-	-	-	-	-	-
CA-04	-	0.05	-	0.95	-	-	-	-	-	-

CA-05	-	-	-	1.00	-	-	-	-	-	-
CA-06	-	-	-	0.59	-	0.41	-	-	-	-
CA-07	-	-	0.09	-	-	0.47	0.05	0.32	0.07	-
CA-08	-	-	-	-	-	-	-	-	-	1.00

5.3 Upstream and downstream boundary conditions

The upstream flow boundary is prescribed using the daily Kaptai Dam release series described in Section 3.4.1. The downstream boundary is prescribed as the measured time-varying water-level series at Khal-18 described in 3.4.3. For future scenarios, the applicable sea-level-rise increment is added to the downstream water-level series as described in Section 7.3.

5.4 Hydraulic resistance

Hydraulic resistance in the Karnaphuli River is represented using Manning's M values in the range 35 to 40, equivalent to Manning's n values of approximately 0.029 to 0.025. These values were inherited from the existing calibrated regional Karnaphuli-Halda hydrodynamic model and were retained unchanged in the current modelling framework.

5.5 Connection to the local pluvial model

The downstream ends of the local khal branches are connected to the regional Karnaphuli River model at the appropriate river chainages. The regional model therefore supplies a time-varying receiving-water level at each local drainage outfall, allowing tidal and river-level conditions to influence gravity drainage and regulator operation. See Figure 5-2 for the connection points between the river (blue line) and the Khals ends, represented by the green lines.

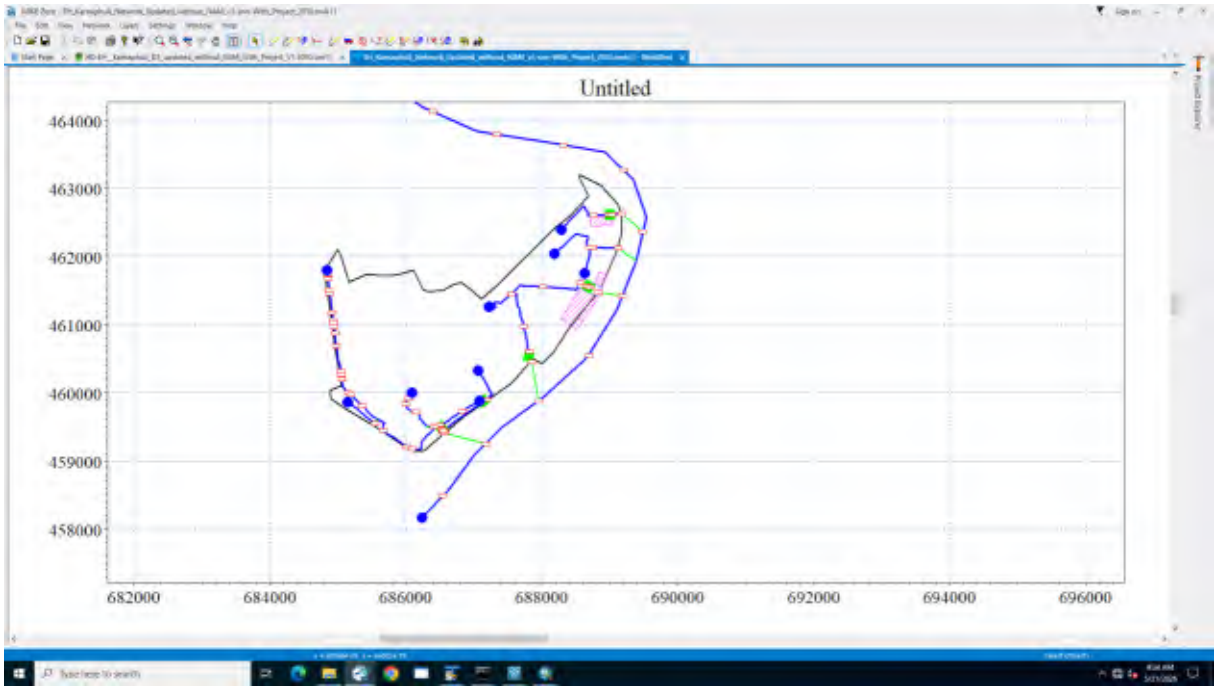


Figure 5-2. Connection between the regional river model and the local pluvial model

6 Local pluvial model set-up

6.1 Model domain and schematisation

The local two-dimensional model domain covers approximately 8 km² and includes the relevant catchment in project influence area. The domain contains the existing terminal blocks, adjacent low-lying urban areas, the airport corridor, main roads and embankments, and the principal drainage khals. The one-dimensional drainage network and two-dimensional model extent are shown in Figure 6-1.

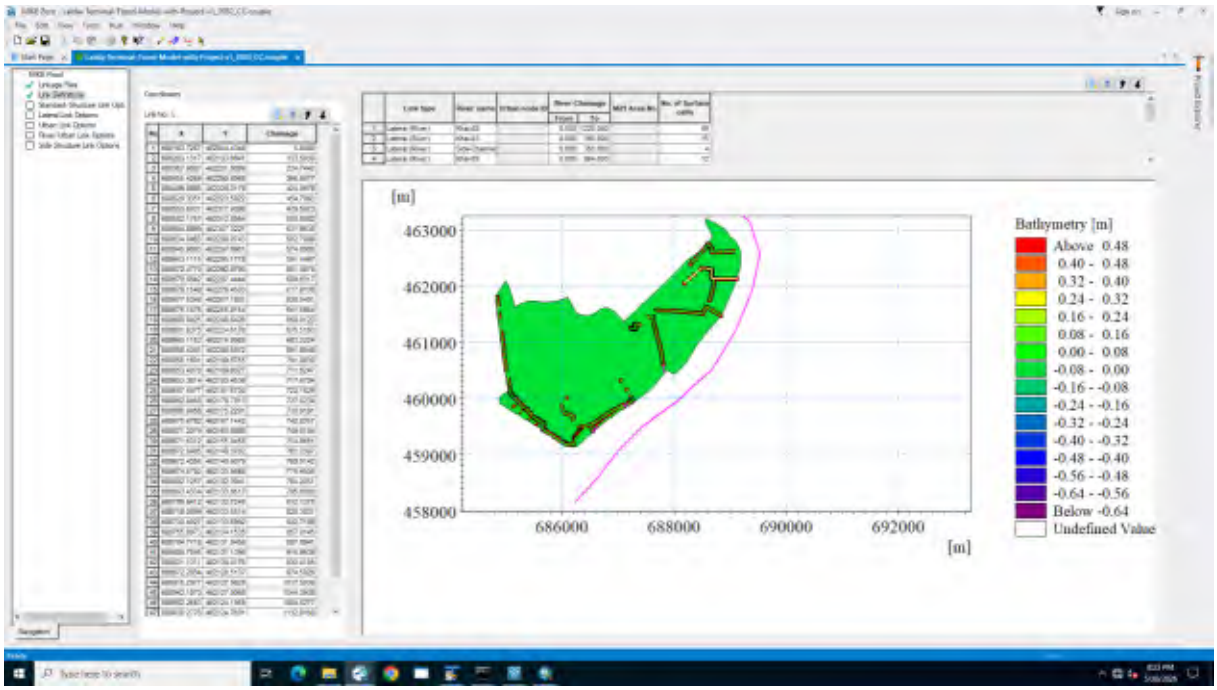


Figure 6-1. Local one-dimensional and two-dimensional model domain

6.2 One-dimensional drainage network

Nine one-dimensional branches were defined from the surveyed khal network. Catchment boundaries were delineated using the terrain, road network and observed drainage connectivity. Runoff from each local catchment is introduced to the corresponding branch. The adopted branch lengths and catchment areas are listed in Table 6-1. Local drainage catchments and one-dimensional branches

Table 6-1. Local drainage catchments and one-dimensional branches

No.	Branch	Upstream chainage (m)	Downstream chainage (m)	Catchment area (km²)
1	Khal-14	0	1,930	0.80
2	Khal-15	0	1,110	1.32
3	Khal-02	0	1,220	0.48
4	Khal-01	0	1,172	0.27
5	Khal-03	0	390	0.21
6	Khal-04	0	831	0.60
7	Khal-05	0	864	3.10
8	Khal-06	0	3,730	1.08

9	Side channel	0	350	0.14
	Total			8.00

The surveyed local cross-sections were incorporated along the one-dimensional branches. Figure 6-2 the surveyed section of Khal-14 near the outfall as an example of the geometry represented in the model.

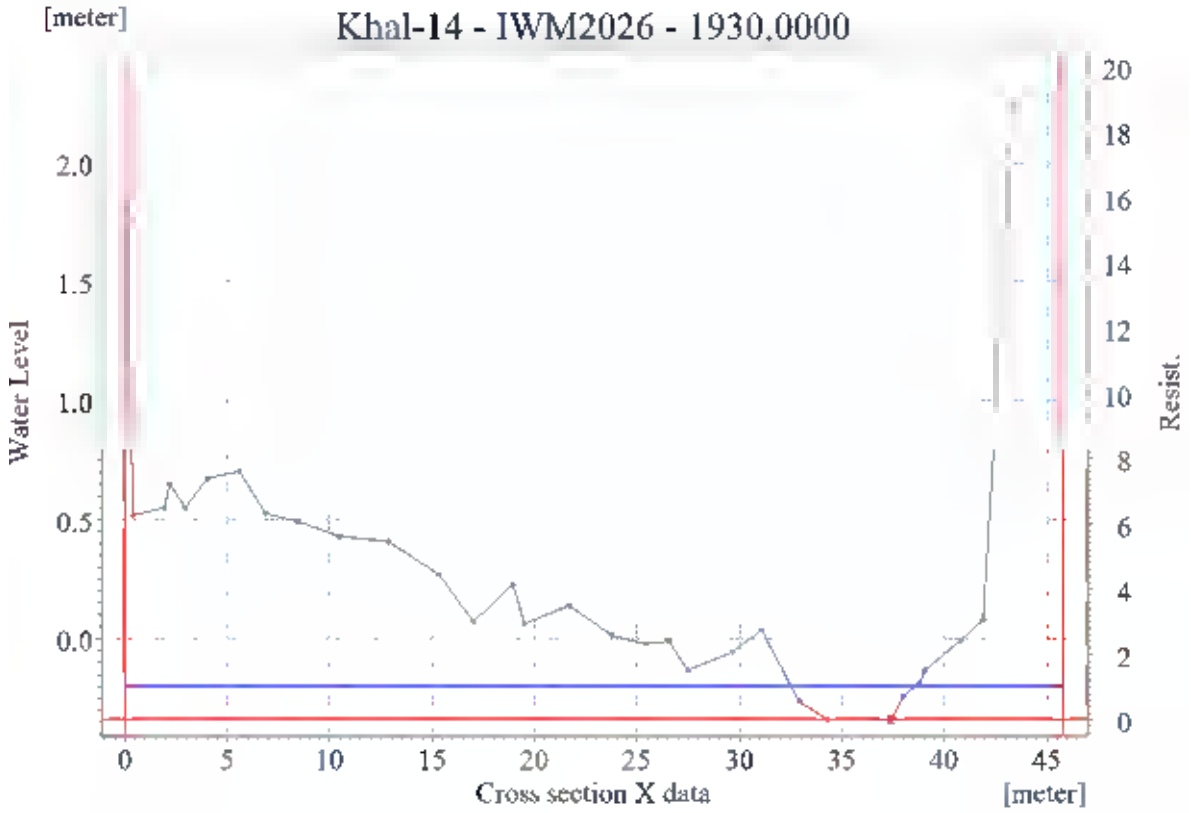


Figure 6-2. Surveyed cross-section of Khal-14 near the outfall

6.3 Two-dimensional terrain and computational mesh

The two-dimensional bed levels are based on the corrected and merged terrain described in Section 3.2. Roads and embankments were incorporated as hydraulic controls in the surface model. Open drainage channels were represented in the one-dimensional network and connected to the two-dimensional domain through the MIKE FLOOD coupling links.

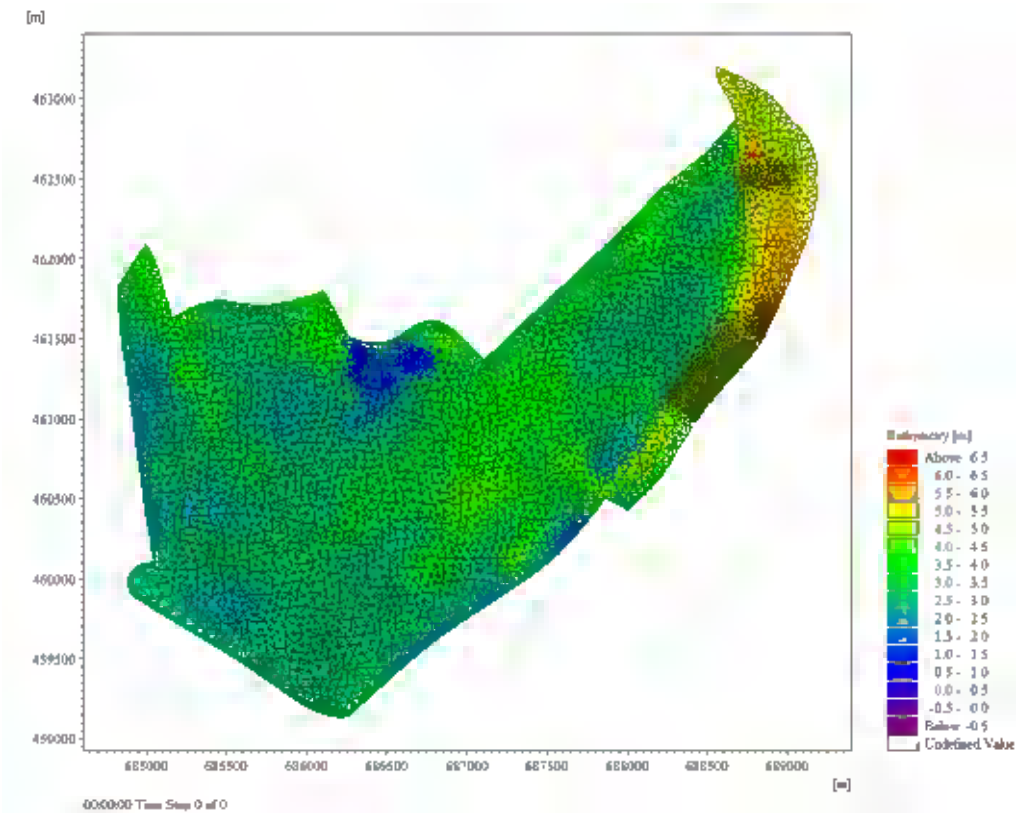


Figure 6-3. Two-dimensional model bathymetry

The MIKE 21 Flexible Mesh domain uses an unstructured triangular mesh. Average element sizes are approximately 40 to 100 m across the general floodplain, see Figure 6-4. The mesh is refined to approximately 20 m within the terminal blocks and other locations where additional spatial detail is required. This variable resolution retains computational efficiency while providing finer representation around the project footprint and key hydraulic controls.

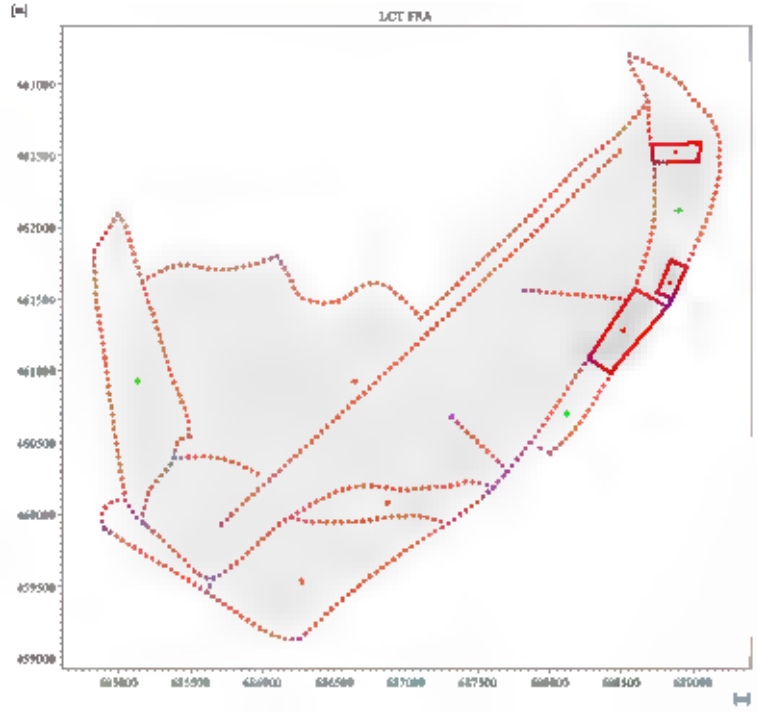


Figure 6-4. Unstructured computational mesh for the local model domain

6.4 Hydrological model set-up

Rainfall-runoff generation for the local catchments is represented using the NAM conceptual hydrological model. NAM represents surface storage, root-zone storage, overland flow, interflow, groundwater recharge and baseflow routing. The parameters used in the supplied local model are listed in Table 6-2.

Table 6-2. Local NAM hydrological parameters

Group	Parameter	Description	Unit	Value
Surface-root zone	Umax	Maximum water content in surface storage	mm	20
Surface-root zone	Lmax	Maximum water content in root-zone storage	mm	80
Surface-root zone	CQOF	Overland-flow runoff coefficient	-	0.70
Surface-root zone	CKIF	Interflow time constant	h	200
Surface-root zone	CK1,2	Overland-flow routing time constants	h	1
Surface-root zone	TOF	Root-zone threshold for overland flow	-	0
Surface-root zone	TIF	Root-zone threshold for interflow	-	0
Groundwater	TG	Root-zone threshold for groundwater recharge	-	0.50
Groundwater	CKBF	Baseflow routing time constant	h	2,000
Groundwater	GWLBF0	Lower groundwater level for baseflow	m	2
Groundwater	GWLBF1	Upper groundwater level for baseflow	-	0

The continuous 2023 rainfall and simulated runoff series were used as a diagnostic check of the configured hydrological response. Figure 15 shows the resulting runoff for a representative local catchment. These plots are model diagnostics and are not design-event hazard results.

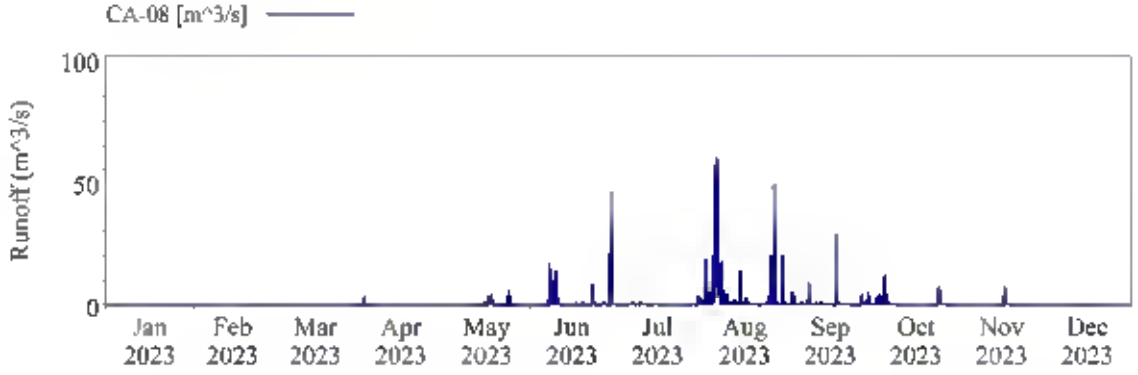


Figure 6-5. Simulated local catchment runoff for 2023

6.5 Hydraulic roughness

Hydraulic resistance is represented using Manning's M formulation, where M is the reciprocal of Manning's n. A constant M value of 20 was applied across the two-dimensional floodplain, equivalent to n = 0.05. A constant M value of 30 was applied to the local khals, equivalent to n = 0.033.

The constant floodplain resistance reflects the simplified representation adopted for the relatively compact and predominantly urban model domain. The principal hydraulic variability is represented

through the terrain, roads, embankments, open channels and hydraulic structures rather than through a spatially variable roughness map.

6.6 Regulators, pumps and culverts

Regulator operation is controlled by the water-level difference between the upstream khal and the downstream river. When the river level exceeds the khal level, the gate closes to prevent reverse tidal inflow. When the khal level exceeds the river level, the gate opens and permits gravity drainage.

Pumps are represented at the locations and nominal capacities listed in Table 3-4. Detailed pump curves, start and stop levels, availability factors and failure assumptions are not documented in the supplied report material. According to BWDB, the pumps have only been operated a few times by the contractor since installation, and no official operation records are available. In view of this, and because the installed pumping capacity is very small relative to the regulator, pump operation was not explicitly included in the modelling setup. The report therefore records the nominal installed capacities, while the controlled model files remain the source for the implemented operating rules. The figure below shows an example of how a regulator is included in the model.

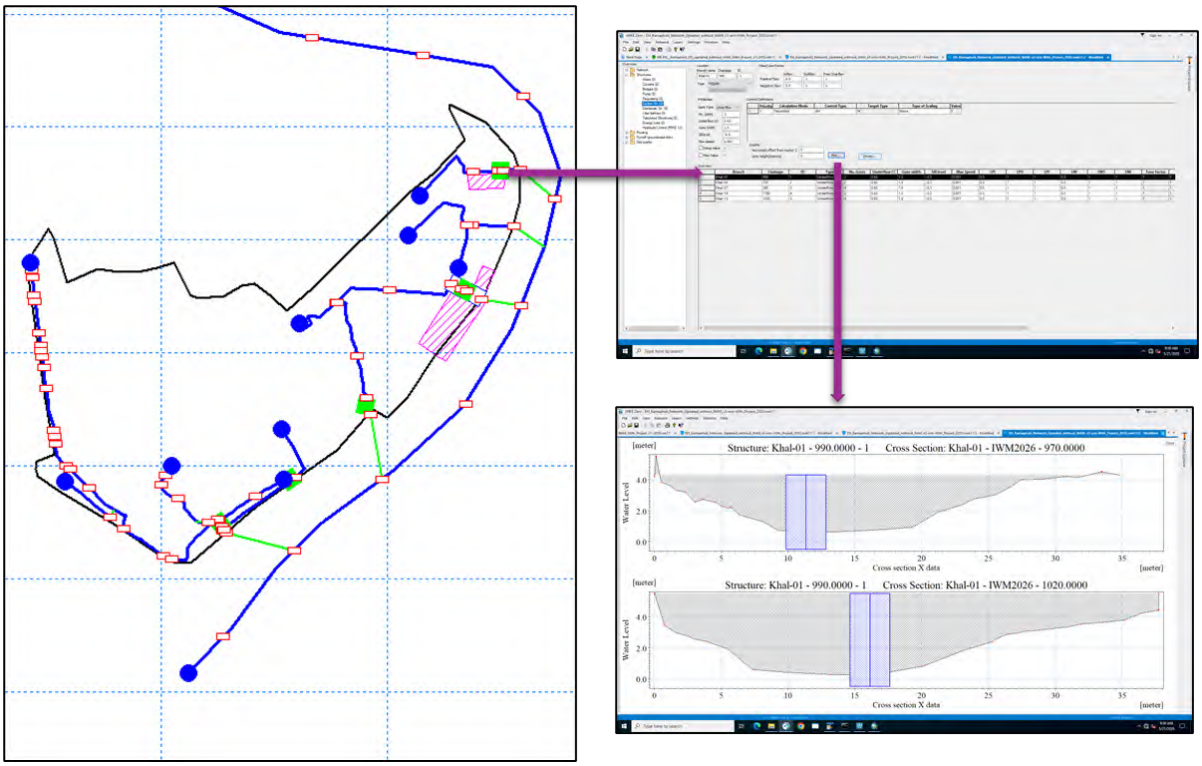


Figure 6-6. Regulator representation in the one-dimensional model

For the with-project condition, the two proposed box culverts listed in Table 3-5 are added to Khal-14. Flow through the culverts is calculated from the upstream and downstream water levels using the MIKE structure equations for free and submerged flow.

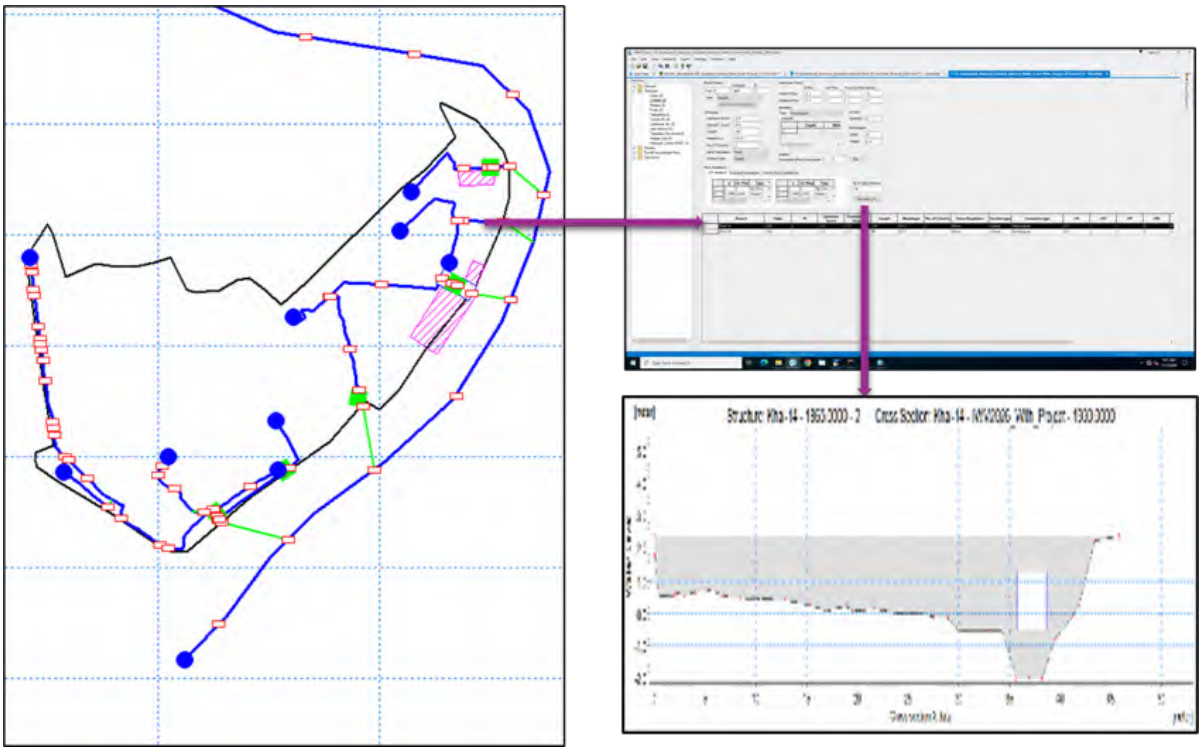


Figure 6-7. Culvert representation in the one-dimensional model

6.7 Initial and boundary conditions

The drainage canals included in the model setup is not connected to any upstream canals/rivers. Therefore, there is no upstream flow to the drainage canals from the upstream area. The local khal system does not receive significant upstream inflows from external rivers outside the model domain. Runoff enters the drainage system through the rainfall-runoff model catchments represented in the NAM model. Therefore, the upstream ends of the local one-dimensional branches are represented as zero-discharge boundaries. Catchment inflows are introduced along the network from the NAM runoff hydrographs. The downstream ends are connected to the regional Karnaphuli River model, which provides the time-varying receiving-water levels. The external boundary of the two-dimensional surface domain is represented as a closed land boundary, except where water is exchanged with the one-dimensional network through the defined coupling links.

The combined river-water-level and local-runoff series shown in Figure 6-8 was reviewed to identify periods when high runoff coincides with elevated river stage. This coincidence controls the duration for which gravity drainage is restricted.

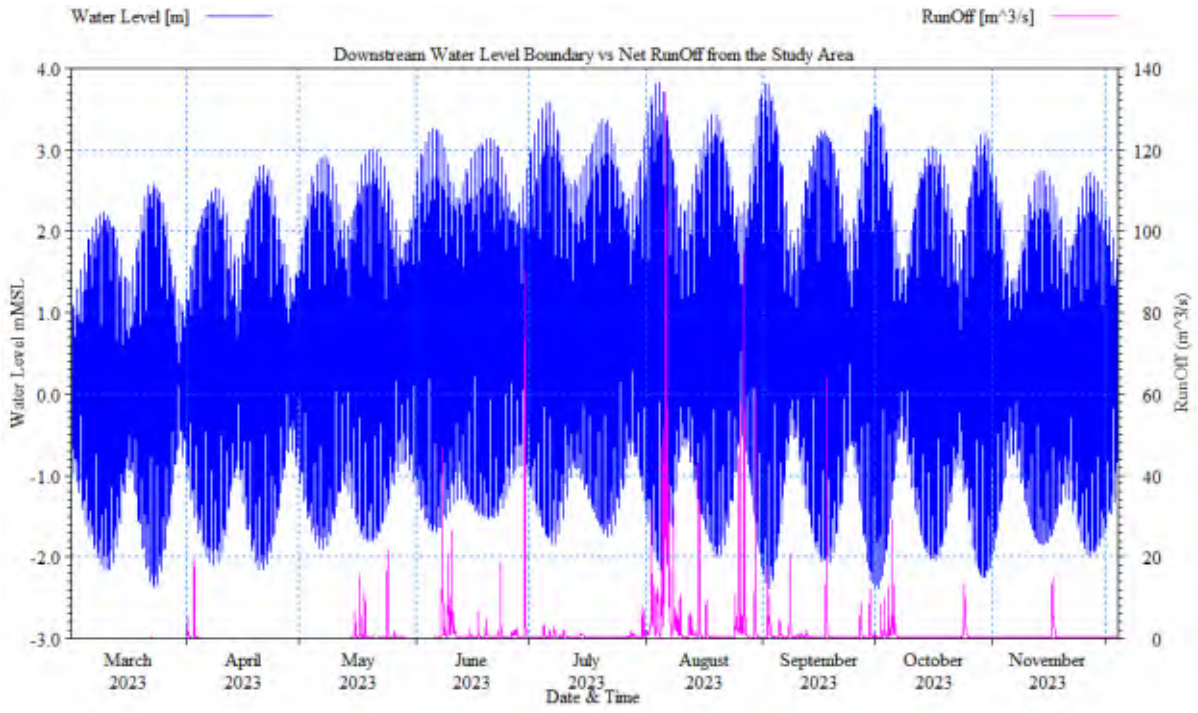


Figure 6-8. River water level and local runoff hydrographs used to assess boundary coincidence

6.8 One-dimensional and two-dimensional coupling

Lateral links connect the one-dimensional khal branches to adjacent two-dimensional mesh elements. Flow across these links is calculated from the local water-level difference and the applicable link formulation. This configuration allows water to spill from the khals to the surrounding surface and to return to the drainage network when the hydraulic gradient reverses.

6.9 Numerical controls and model outputs

The one-dimensional and two-dimensional components were tested independently before the coupled MIKE FLOOD simulations were run. This staged approach allows instabilities in the component models to be identified before water is exchanged through the coupling links.

The coupled model produces time-varying water levels, discharges and velocities in the one-dimensional network and water levels, depths and current speeds in the two-dimensional domain. Maximum and time-specific fields are exported for mapping and use in the main impact assessment. Interpretation of the mapped flood hazard is not included in this appendix.

7 Model scenarios

7.1 Scenario basis

Four coupled scenarios were simulated. Each scenario applies the 1-in-25-year rainfall event and compares without-project and with-project conditions. The selected time horizons are 2030 and 2050. The scenario definition combines the adjusted design rainfall with a time-varying Karnaphuli River boundary and, for 2050, an additional sea-level-rise allowance.

7.2 Rainfall scenarios

The 2030 and 2050 rainfall inputs were derived by applying the projected climate-model change to the historical 1-in-25-year 1-day maximum rainfall total, as described in Section 3.3.2.

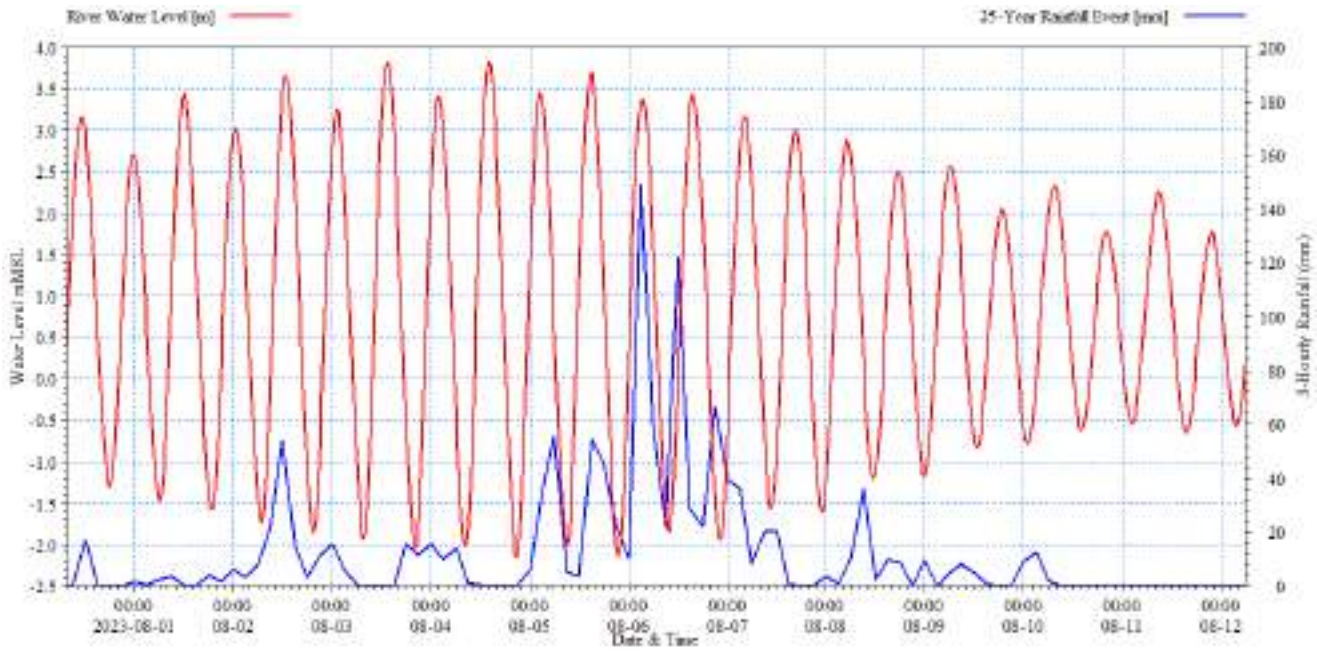


Figure 7-1. River water level and rainfall hyetographs for 25-year rainfall event

7.3 River levels and sea-level rise

The 2030 scenarios use the measured 2022 tidal series without application of the additional 0.05 m sea-level-rise increment implied by the climate projections. This difference was considered negligible relative to the tidal range observed in the lower Karnaphuli River and therefore was not incorporated in the 2030 simulations. For the 2050 scenarios, a sea-level-rise increment of 0.21 m was added to the measured tidal series, representing the difference between the adopted 2050 allowance (0.28 m) and the baseline 2022 allowance (0.07 m)..

7.4 Representation of the terminal project

Two model changes distinguish the with-project condition from the without-project condition. First, the terrain within Block C is raised to the proposed formation level. Blocks A and B are represented at their existing constructed levels in both conditions. Second, the two proposed box culverts are added to Khal-14 upstream and downstream of the existing regulator. All other hydrological and boundary inputs are kept consistent between paired without-project and with-project simulations.

7.5 Scenario matrix

Table 7-1. Pluvial flood-model scenario matrix

Scenario	Rainfall	River boundary	Horizon	Climate label	Project condition

1	1-in-25-year event scaled to 2030 projection	Measured 2022 tidal series; no additional SLR	2030	RCP8.5	Without project
2	1-in-25-year event scaled to 2030 projection	Measured 2022 tidal series; no additional SLR	2030	RCP8.5	With project
3	1-in-25-year event scaled to 2050 projection	Measured tidal series + 0.21 m	2050	RCP8.5 / SSP5-8.5 SLR	Without project
4	1-in-25-year event scaled to 2050 projection	Measured tidal series + 0.21 m	2050	RCP8.5 / SSP5-8.5 SLR	With project

8 Model checking, validation and quality assurance

8.1 Available validation evidence

Available validation evidence is limited. The source material documents a field visit and community consultation at No. 14 Colony Road, where residents reported recurring waterlogging approximately 0.15 to 0.30 m above the road surface. The corresponding model simulation produced approximately 0.60 m of water above the surrounding ground level at the location.

8.2 Qualitative model check

The field evidence was used as a qualitative plausibility check rather than as a formal calibration dataset. After accounting for the elevation difference between the road and adjacent ground, the simulated water level was considered broadly consistent with the reported waterlogging. Figure 8-1 shows the field-check location and the corresponding simulated inundation area.

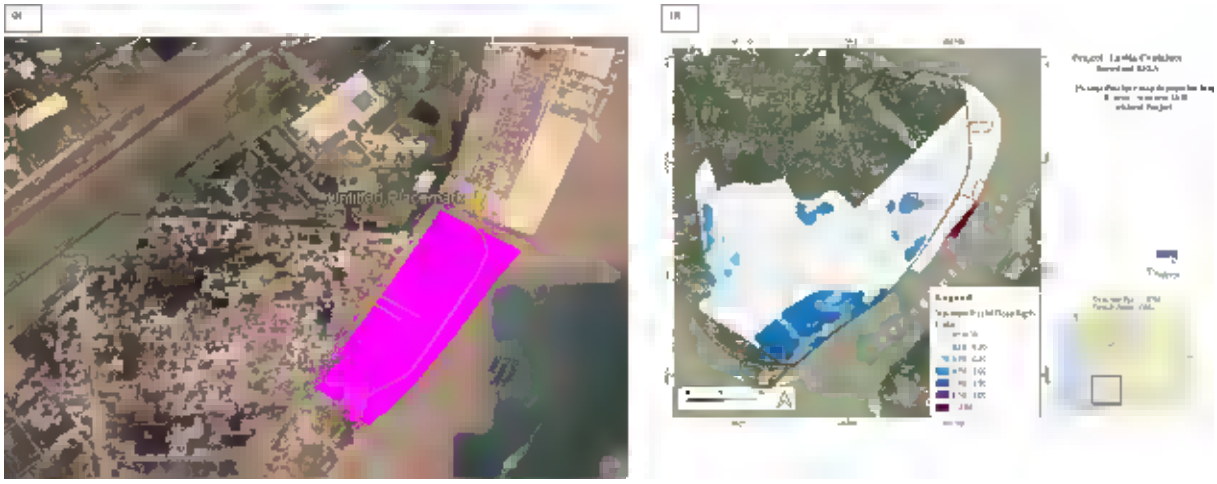


Figure 8-1. Field-check location and corresponding simulated inundation depth

No continuous local water-level, discharge or flood-depth observations are documented. Consequently, no quantitative goodness-of-fit statistics are reported. The available evidence supports a broad check of local plausibility but does not constitute a full event-based calibration of the coupled model.

9 Assumptions and limitations

9.1 Principal assumptions

- A uniform vertical correction of -0.84 m is applied to the FABDEM terrain dataset across the model domain to align the digital elevation model with locally surveyed ground levels.
- Blocks A and B are represented using their surveyed as-built elevations (Survey 2000 data), while Block C is represented at existing ground levels in the without-project condition and at the proposed terminal formation level in the with-project condition.
- Sluice gates and regulators are represented as automated hydraulic structures that operate in response to the water-level difference between the upstream drainage channel and the downstream river. The structures close when river water levels exceed upstream water levels to prevent tidal backflow.
- Pumps are represented using the installed capacities and operational settings contained in the model files.
- The proposed Khal-14 drainage modification is represented through two replacement box culverts located upstream and downstream of the existing sluice gate. For modelling purposes, both culverts are 3.0 m wide and 1.5 m high, matching the sluice gate dimensions.
- The existing culvert beneath Airport Road is represented using dimensions derived from field observations. The model assumes a culvert width of 1.2 m, a height of 1.5 m, and an invert level located approximately 2.5 m below road level.
- The selected rainfall events and downstream river water-level boundary conditions provide the intended coincidence of high local runoff and elevated receiving-water levels, representing a conservative flood-risk assessment scenario.

9.2 Limitations

- The base floodplain terrain is derived primarily from a global 30 m resolution digital elevation model (following the Concession Agreement requirements). Small-scale features such as kerbs, shallow depressions, local drainage pathways and other fine-scale topographic controls may not be fully represented.
- The model represents the principal khals and listed structures but does not document detailed representation of minor drains, underground sewers, local blockages or temporary obstructions.
- A single floodplain roughness value is used across the two-dimensional domain. Local variations in buildings, paved surfaces, vegetation and storage are represented only indirectly through the terrain and mesh.
- The model assumes that drainage channels and hydraulic structures remain free of significant sediment accumulation, solid waste and debris. In practice, waste deposition and sediment build-up occur in parts of the drainage network and may locally reduce conveyance capacity and increase flood risk.

- The available validation evidence is qualitative and is limited to one reported waterlogging location. Quantitative calibration against observed water levels, depths, discharges or flood extents has not been documented. Consequently, model outputs are most suitable for assessing the relative differences between with-project and without-project conditions rather than predicting exact flood depths or flood extents at individual locations.

Annex C4 – Specialist Study: Sediment plume model

REPORT

Sediment Plume Modelling Report

Laldia Container Terminal ESIA

Client:	Laldia Container Terminal Limited
Reference:	BK4589-HAS-SP-XX-RP-EV-0003
Status:	Draft/02
Date:	20 August 2026

Haskoning
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1 Introduction

1.1 Project background

The Laldia Container Terminal Project (LCTP, or the Project) is a strategic initiative to address port congestion challenges in Chattogram by expanding container-handling capacity and improving operational efficiency at the Port of Chattogram. Located at Laldia Char along the right bank of the Karnaphuli River in Chattogram, the terminal will add approximately 0.8 million Twenty-Foot Equivalent Unit (TEU) per year of new handling capacity. This will relieve pressure on existing terminals, reduce congestion and vessel waiting times, and strengthen maritime logistics performance to support Bangladesh's trade competitiveness and regional connectivity.

The terminal is being developed under a Public-Private Partnership (PPP) between the Chittagong Port Authority (CPA) and Laldia Container Terminal Ltd. (LCT Ltd.), a joint venture between APM Terminals (APMT) and QNS Container Services Ltd. (QNS Ltd.). A 30-year concession agreement (CA) for the design, financing, construction, operation, and maintenance of the terminal was signed on 17 November 2025, representing one of the largest PPP investments in Bangladesh's port sector. LCT Ltd.'s involvement brings international expertise in container-terminal management, digital optimization, energy-efficient operations, and global best practice in port safety and reliability, supporting the long-term modernization of the Port of Chattogram.

The development of LCTP will take environmental and social aspects into account and therefore an Environmental and Social Impact Assessment (ESIA) is being prepared. This ESIA is prepared for permitting purposes in Bangladesh with the Department of Environment (DoE).

1.2 Objectives of Sediment Plume Modelling Report

As part of the ESIA study, dredge plume modelling study is conducted to determine the increase in suspended sediment concentration due to the dredging activities.

1.3 General approach

Basis of the sediment plume modelling is a hydrodynamic model describing the tidal and river currents in Karnaphuli River (Haskoning, 2026a). This model is developed in MIKE 3 Flexible Mesh (FM) model software and includes the downstream section of the Karnaphuli River, including the Laldia Container Terminal, and part of the Bay of Bengal around the river mouth. The model schematisation was calibrated based on measured water levels.

In the sediment plume modelling, the dispersion and deposition of dredged fine bed material is modelled for a set of hydrodynamic conditions.

2 Methodology for dredging

In this chapter, the assumed dredging methodology for the construction of Laldia Container Terminal is presented. This methodology is focussed on the capital dredging, as capital dredging rates and sediment source terms are expected to be larger than the maintenance dredging rates and sediment source terms. More details about the dredging methodology can be found in the Dredging Management Plan (Haskoning, 2026e).

2.1 Block C dredging pocket in Concept Design

Following the Asset Design Drawings of the Concept Design, the design parameters for the dredging depth are the following:

- Design vessel draught is 10.5 meters
- Under-keel clearance is 0.5 m
- Sedimentation buffer is 1.0 m
- Resulting dredging design depth of the berth pocket is -12.0 m CD, which is equal to -12.0 m ISLWL and -14.6 m MSL.

The plan view of the dredging pocket of the mooring area is shown in Figure 2-1 and the cross-sectional profile is shown in Figure 2-2. Without side slopes, the dredging pocket has a length of 723 m and width of 50 m.

The dredging pocket has four side slopes, with assumed slopes of 1:2 to 1:3:

- One slope underneath the deck on piles. Deck on piles level is +8.0 m CD.
- Three slopes towards the riverbed.

Estimated total capital dredging volume is 400,000 m³, which is the upper bound of the estimated volume to be dredged.



Figure 2-1: Plan view of Blocks B and C with dredging, deck on piles and land reclamation areas along Block C. Source: APM-056-01A-12-3 (top) and APM-056-01A-08-2 (bottom).

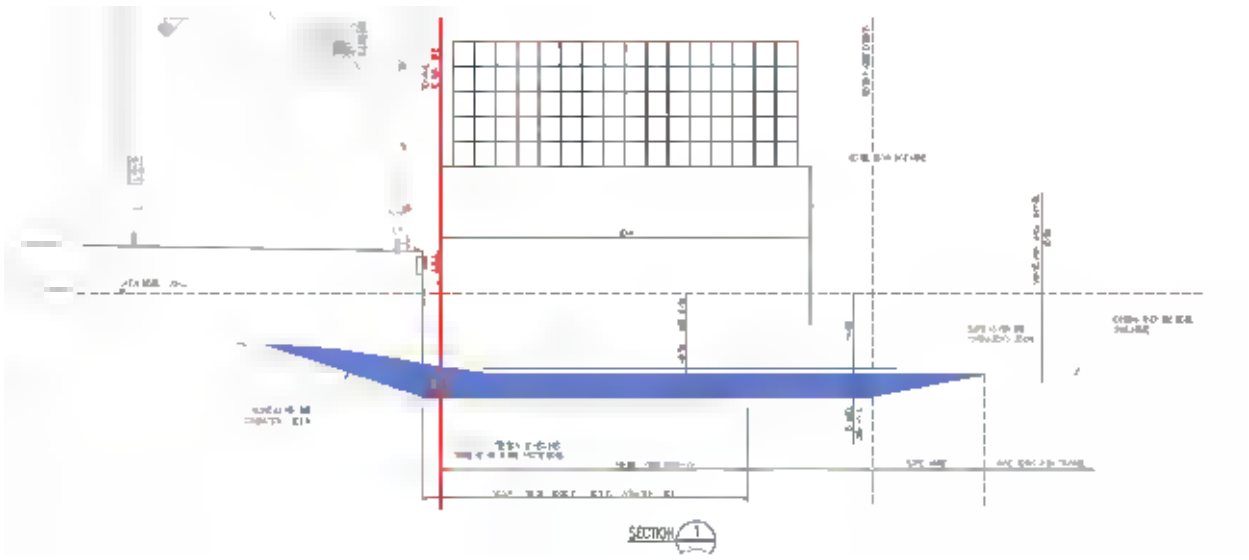


Figure 2-2: Dredging design cross section (source: Asset Design Drawings APM-056-03A-02 rev. 4)

2.2 Soil conditions

2.2.1 Land-side boreholes

Land-side boreholes are available for the Block-C area (APMT, 2026a). From these boreholes (Figure 2-3), the boreholes LBH-09, LBH-10 and LBH-11 are the closest to the water edge. The land boreholes are included in this assessment to verify consistency with the marine boreholes.

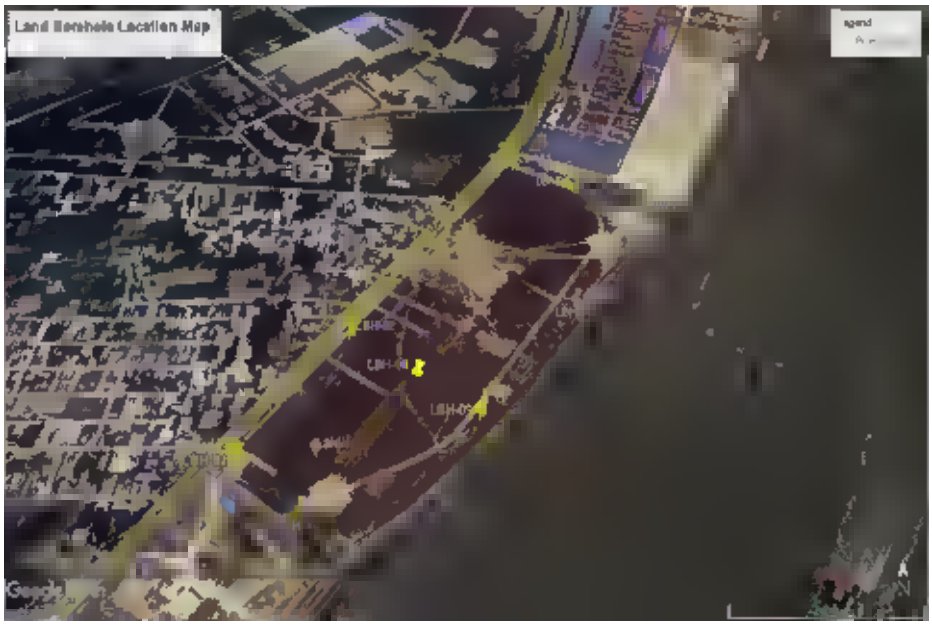


Figure 2-3: Location of land-based boreholes (APMT, 2026a).

The geological profile along the boreholes LBH-09, LBH-10 and LBH-11 is provided in Figure 2-4 below. The layers hatched in blue colours represent fine to medium sand layers. The layers in purple, pink, grey and orange represent layers that are predominately silty and clayey. The red box indicatively shows the depth levels where dredging will take place, which is from around -9 m CD to -12 m CD.

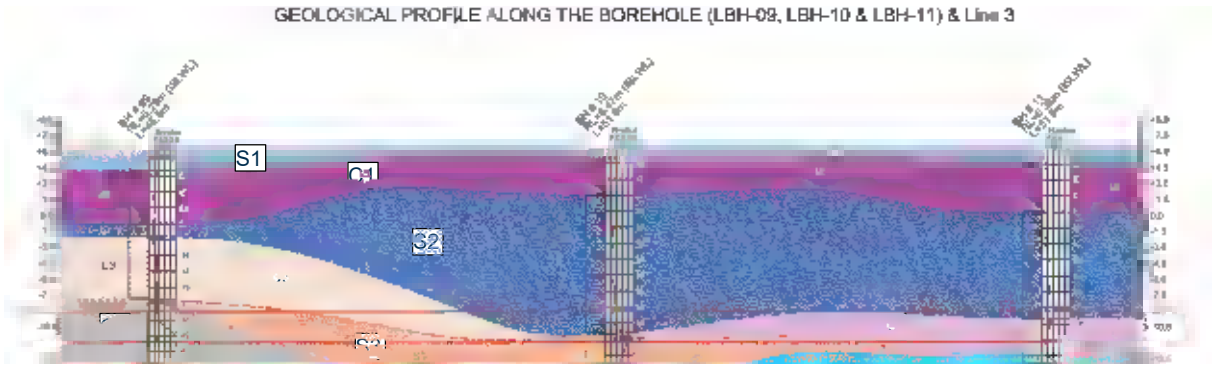


Figure 2-4: Geological profile along Borehole LBH-09. LBH-10 and LBH-11) the red box indicatively shows the dredging scope (APMT, 2026a).

Layer ID	Lithology Description
S0	Loose brown silty fine SAND (Filling SAND) (1<N≤9)
S1	Very loose to medium dense light gray to brown silty fine to medium SAND (2<N≤12)
C1	Very soft to stiff grey clayey SILT (1<N≤15)
S2	Loose to dense grey medium to fine SAND (4<N≤50)
C2	Soft to stiff grey clayey SILT (3<N≤25)
S3	Loose to dense grey silty fine to medium SAND (5<N≤50)
C3	Stiff to hard grey clayey SILT (9<N≤37)
S4	Very dense grey to brown fine to medium SAND (N≥50)
C4	Very stiff to hard grey clayey silt (18<N≥50)
C5	Hard grey clayey SILT (N≥50)

Figure 2-5: Lithology Description (APMT, 2026a).

2.2.2 Marine boreholes

Marine-side boreholes are available for the area in front of Block-C (APMT, 2026b). The boreholes along Block C inside the Karnaphuli River are shown in Figure 2-6. It can be concluded that the line 2-2', which includes the boreholes MBH-07, MBH-08, MBH-09, MBH-10, MBH-11 and MBH-12 are most relevant for the dredging scope. Lines 1-1' and 3-3' are used to validate the consistency over the line 2-2'.

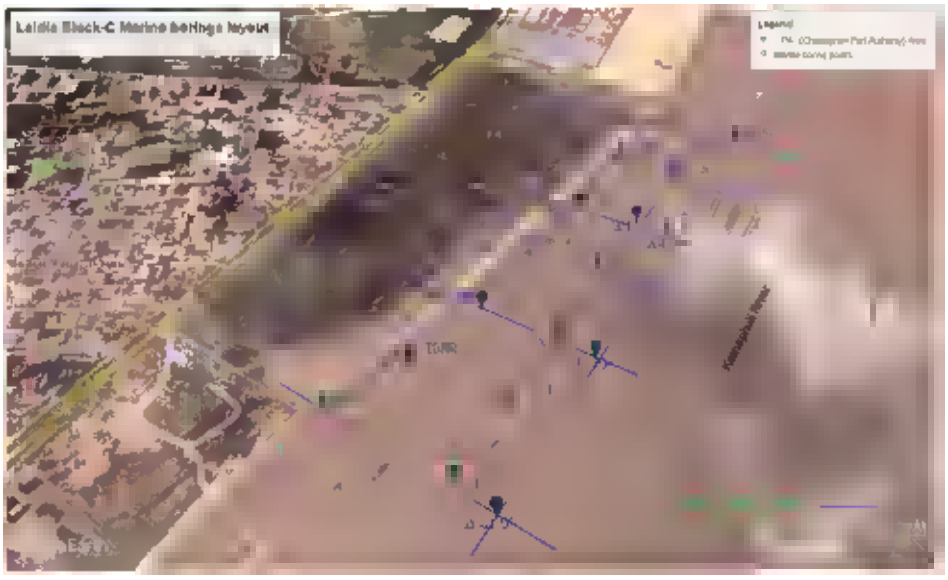


Figure 2-6: Location of boreholes along Block C in Karnaphuli River (APMT, 2026b).

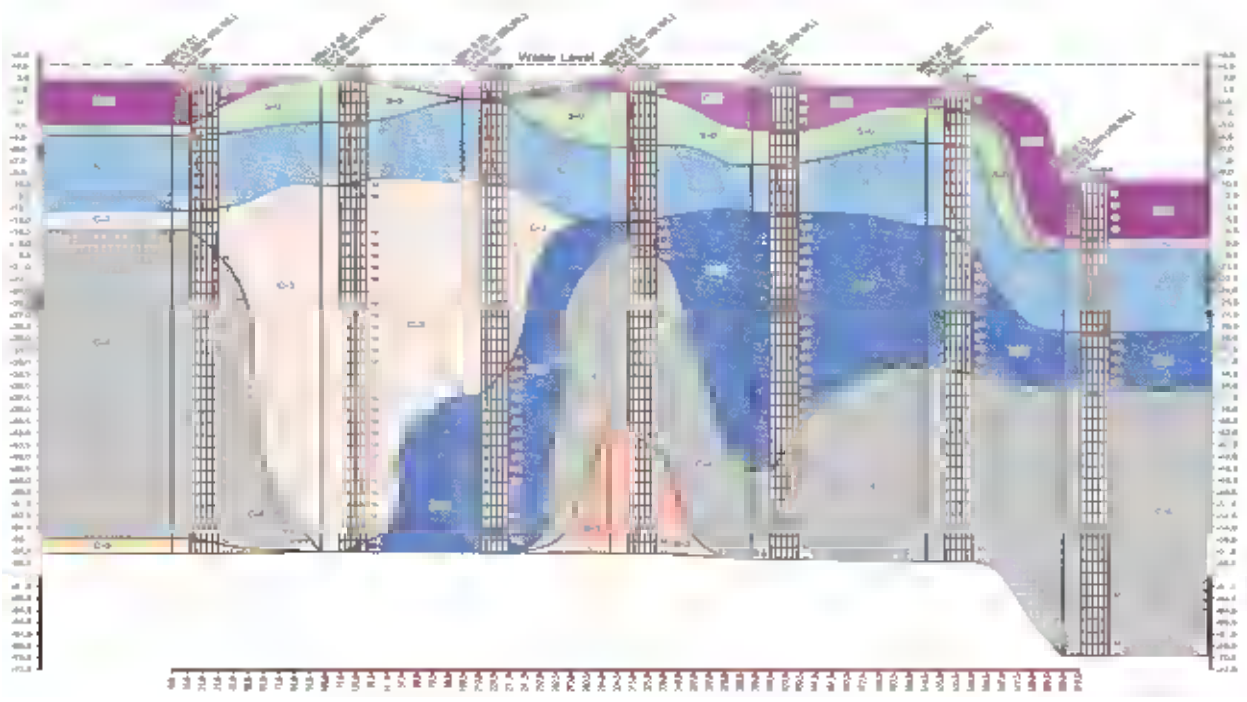


Figure 2-7: Lithology Description of profile 1-1' (APMT, 2026b).

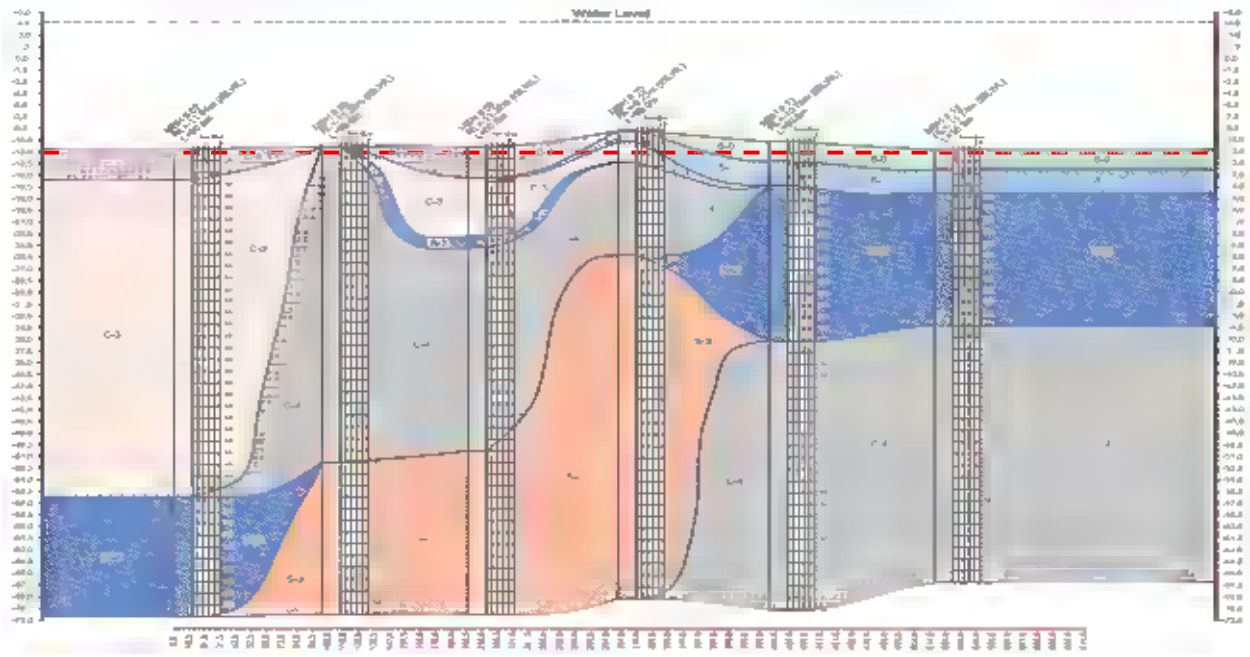


Figure 2-8: Lithology Description of profile 2-2' (APMT, 2026b).

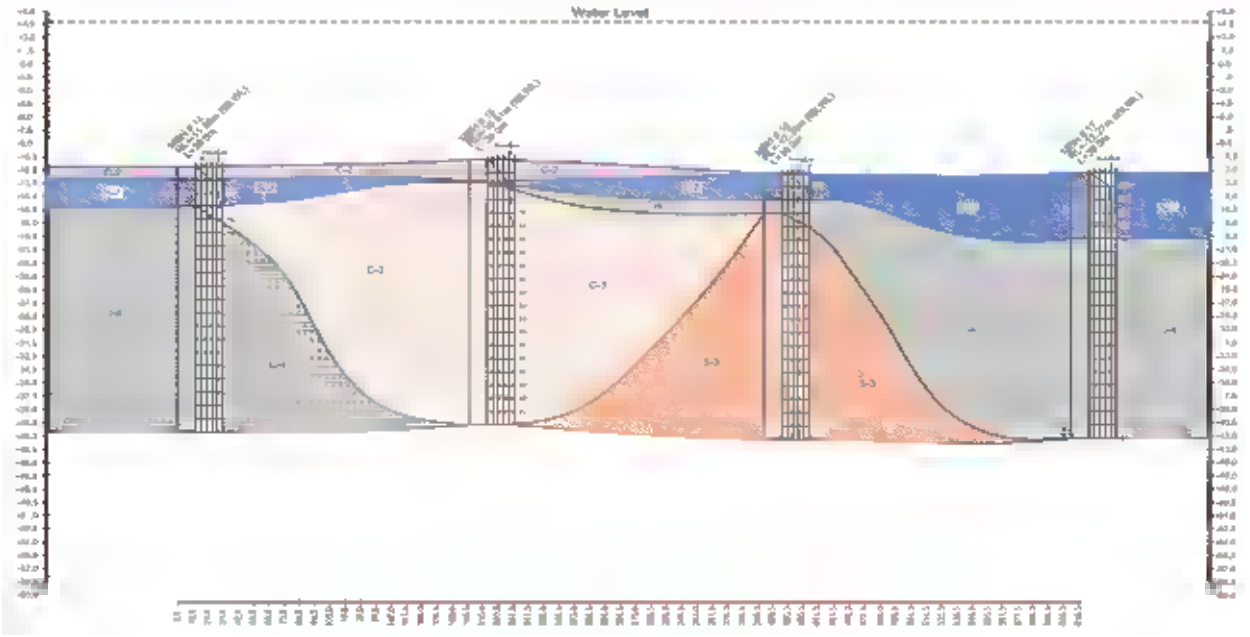


Figure 2-9: Lithology Description of profile 3-3' (APMT, 2026b).

Layer ID	USCS Classification
C-1	Lean clay CL / Lean clay with sand CL / Clayey sand, SC / Sandy silt, ML
C-2	Lean clay CL / Lean clay with sand CL / Fat clay CH
S-0	Poorly graded sand, SP / Silty sand SM / Poorly Graded Sand with Silty Clay SP-SC / Silty clayey sand SC-SM
S-1	Poorly graded sand, SP / Poorly graded sand with clay SP-SC / Clayey sand SC / Silty sand SM / Silt with sand ML / Silty clayey sand SC-SM
C-3	Lean Clay, CL / Fat clay CH
S-2	Poorly graded sand, SP / Poorly Graded Sand with Silty Clay, SP-SC / Silty sand, SM / Silty clayey sand SC-SM
C-4	Lean clay, CL / Silt, ML / Fat clay CH / Sandy lean clay CL / Lean clay with sand CL
S-3	Poorly graded Sand SP / Poorly Graded sand with silty clay SP-SC
C-5	Lean Clay, CL

Figure 2-10: Lithography description (APMT, 2026b)

Reference is made to Figure 2-8 where the lithography of the dredging scope is provided. The red dashed line represents the dredging level of -12.0 mCD (CD = ISLWL).

Table 2-1 provides an estimate of the distribution of soil types to be encountered for the dredging scope, reference is also made to Figure 2-4 and Figure 2-5 where the lithology and legend are provided.

Table 2-1: Estimate of soil types to be encountered for the Dredging Works

Layer (from left to right)	Amount (estimate)	material
C2	~50%	Lean clay, CL/ Lean clay with sand, CL/ Fat clay, CH
C4	~ 3%	Lean clay, CL/ Silt, ML/ Fat clay, CH/ Sandy lean clay, CL/ Lean clay with sand, CL
S2	~ 2%	Poorly graded sand, SP/ Poorly graded sand with silty clay, SP-SC/ Silty sand, SM/ Silty, clayey sand, SC-SM
C3	~ 5%	Lean Clay, CL/ Fat clay, CH
S1	~10%	Poorly graded sand, SP/ Poorly graded sand with clay, SP-SC, Clayey sand, SC/ Silty sand, SM/ Silt with sand, ML/ Silty, Clayey sand, SC-SM
S0	~30%	Poorly graded sand, SP/ Silty Sand, SM/ Poorly graded sand with silty clay, SP-SC/ Silty, clayey sand, SC-SM

Based on the assessment above, ~40% of the material to be dredged is poorly graded sand and ~60% of the material to be dredged is predominantly silt and clay.

2.2.3 Fine contents

As informed in Section 2.2.2, the relevant boreholes are provided in the Table 2-2 below. Reference is made to the Marine Boreholes report (APMT, 2026b), where a summary table and (some) particle size distributions (PSD) are provided.

Table 2-2: fine contents per borehole

Borehole	RL (m ISLWL)	BH Depth to dredge level (m)	Relevant PSD's	PSD
MBH-07_C1	-11.64 m ISLWL	0.36 m	Depth 0.00-1.05m	Sand: 3% Silt: 93% Clay: 4%
*MBH-08_C2**	-11.23 m ISLWL	0.77 m	*Depth 1.50- 2.55m*	*Sand: 0%* *Silt: 98%*

Borehole	RL (m ISLWL)	BH Depth to dredge level (m)	Relevant PSD's	PSD
				Clay: 2%
*MBH-09_C2**	-11.32 m ISLWL	0.68 m	*Depth 1.50- 2.55m*	*Sand: 6%* *Silt: 92%* *Clay: 2%*
MBH-10_C1 *MBH-10_C3**	-9.23 m ISLWL	2.77 m	Depth 0.00- 1.05m *Depth 3.00- 4.05m*	Sand: 95% Silt and clay: 5% *Sand: 0%* *Silt: 98%* *Clay: 2%*
*MBH-11_C1**	-10.7 m ISLWL	1.3 m	*Depth 0.00- 1.05m*	*Sand: 97%* *Silt and clay: 3%*
*MBH-12_C2**	-11.74 m ISLWL	0.26 m	*Depth 1.50- 2.55m*	*Sand: 94%* *Silt and clay: 6%*
(MBH-13)**	-10.20 m ISLWL	1.8 m	Depth 1.05-1.50m	Sand: 19% Silt: 77% Clay: 4%
**depth at which PSD is taken is slightly above/below the dredging scope*				
***MBH is part of section 1-1', but is relevant*				

Figure 2-11, Figure 2-12 and Figure 2-13 provide PSD's extracted from the survey report (APMT, 2026b).

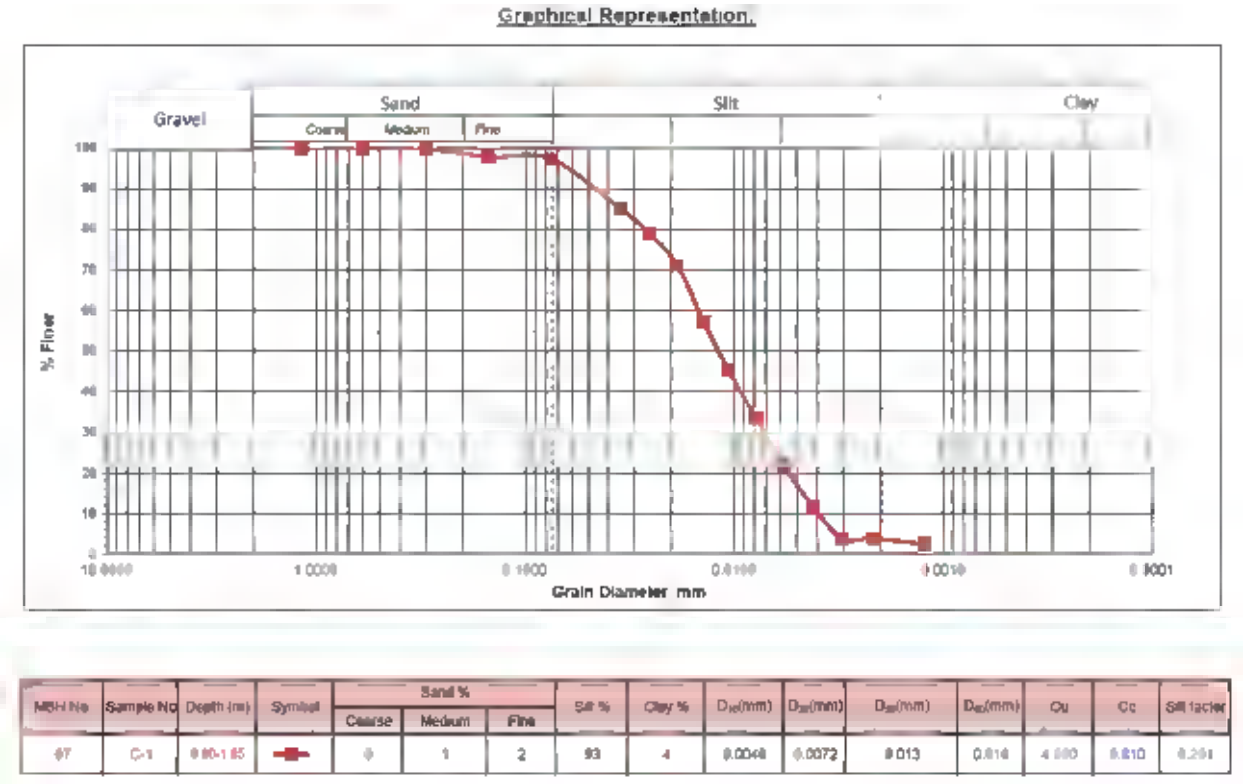
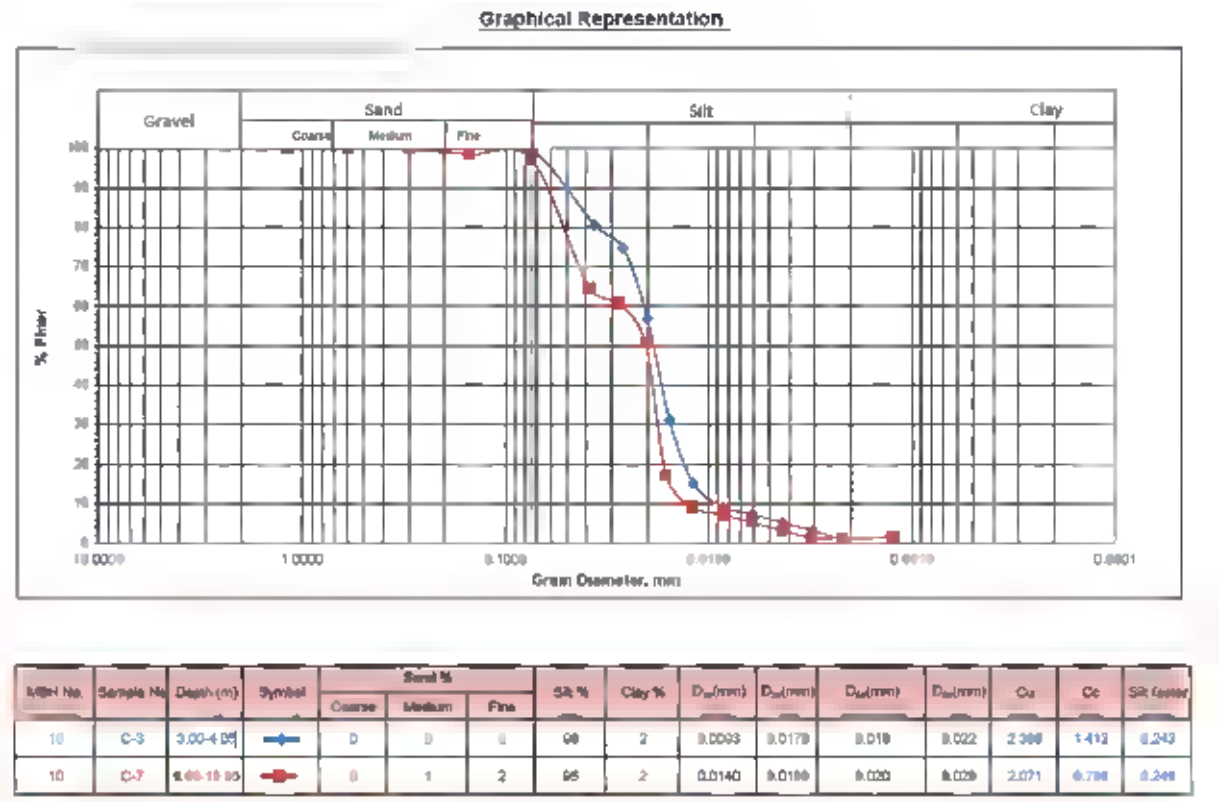
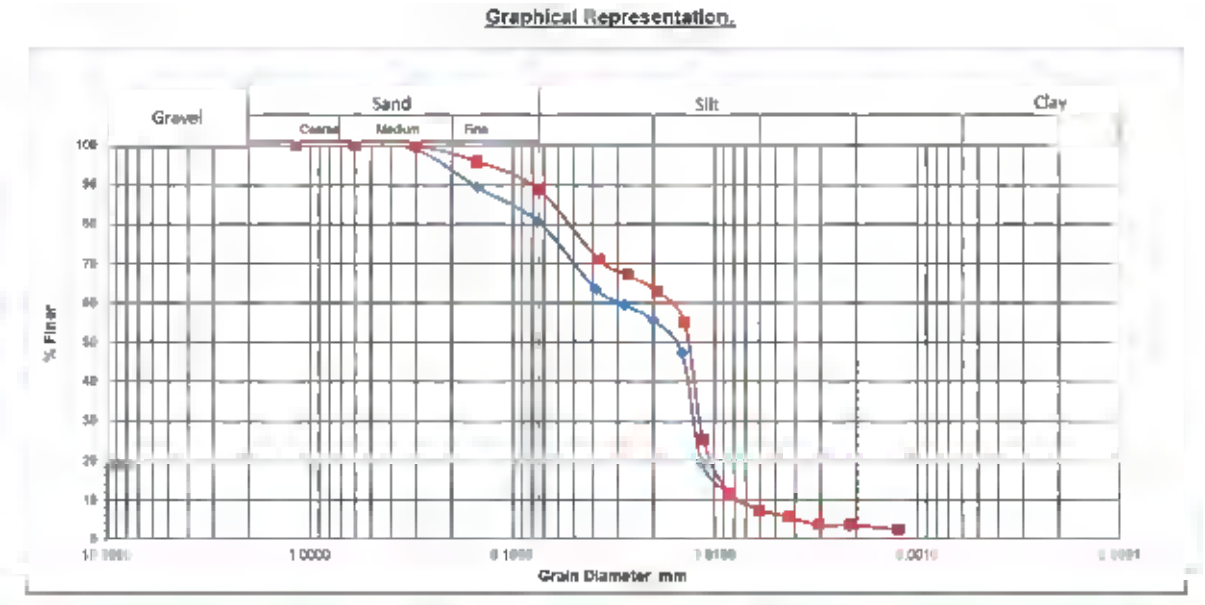


Figure 2-11: PSD MBH-07 0-1.05 m (APMT, 2026b)



MBH No.	Sample No.	Depth (m)	Symbol	Sand %			Silt %	Clay %	D_{10}(mm)	D_{30}(mm)	D_{50}(mm)	D_{60}(mm)	Cu	Cc	Silt factor
				Coarse	Medium	Fine									
10	C-3	3.00-4.05		0	0	0	98	2	0.0093	0.0179	0.019	0.022	2.366	1.412	0.243
10	C-7	5.45-15.95		0	1	2	95	2	0.0140	0.0189	0.020	0.029	2.071	0.798	0.248

Figure 2-12: PSD MBH-10 3-4.05 m (APMT, 2026b)



MBH No	Sample No	Depth (m)	Symbol	Sand %			Silt %	Clay %	D_{10}(mm)	D_{30}(mm)	D_{50}(mm)	D_{60}(mm)	Cu	Cc	Silt factor
				Coarse	Medium	Fine									
13	D-1	1.05-1.50		0	7	12	77	4	0.0079	0.014	0.0179	0.030	3.797	0.827	0.229
13	D-4	5.55-6.00		0	0	11	85	4	0.0078	0.013	0.0149	0.017	2.152	1.258	0.206

Figure 2-13: PSD MBH-13 1.05-1.50 m (APMT, 2026b)

Based on the provided information, an average fine content of ~80% is assumed, which primarily consists of silt particles. For the far-field dredge plume modelling, it is the fine sediment that is brought into suspension, remains in suspension over relatively large distances and thus forms the far-field dredge plume. Considering the clay percentage in the bed samples is small (about 2-4%) and the coarse part of the silt is deposited within short distance from the spill, it is the fine part of the silt that forms the far-field dredge plume. A grain size of in the order of 15 µm can be considered the dominant particle size for the far-field dredge plume.

2.3 Capital dredging volumes

It is informed in the documentation of LCT Ltd. that the dredging volume in the berth pocket is in the range of 300,000 – 400,000 m^3. Dredging of a turning circle and access channel, if required, is not part of the scope of works for LCT Ltd.

Based on the plan view in the Asset Design Drawing, on average the existing current bed level in the berth pocket is at around -9.0 m CD. A high-level cross check of dredging volumes results in (723 x 50 x (12-9) x 1.5=) <200,000 m^3 of material to be removed in the pocket. The slopes are assumed to be <50% of the berth pocket volume. With the current information available, the 300,000-400,000 m^3 of dredging of berth pocket and slopes and as informed by LCT Ltd., seems to be on the high side.

For this assessment it is assumed that the dredging material will be re-used and therefore not disposed at an offsite location. Reuse options of the material will be assessed in the ESIA. There are currently ongoing sand mining activities in the river, which pose an opportunity for reuse of the dredged material (see section 3.3).

2.4 Assumed dredging methods

The actual choice of dredging equipment is part of work method of the Contractor. The Contractor will determine, based on the different criteria, what the Contractor's work method will be. The Dredging Management Plan of the ESIA (Haskoning, 2026e) presents the most likely dredge method.

Bangladesh has a rich history of capital and maintenance dredging projects ranging from very small projects to multimillion m^3 of dredging projects. In Bangladesh there is quite some experience with dredging, especially dredging by Cutter Suction Dredger (CSD) and barge loading. Dredged material is almost always re-used.

Figure 2-14 and Figure 2-15 shows local dredging practices in the Karnaphuli river. Barges are typically loaded by a CSD (or another suction dredger, such as a plain suction dredger). Suction dredgers in Bangladesh are typically equipped with a barge loading pipe. Dredged material is disposed in the barge where the majority of the solids settles. Process water leaves the barge by flowing over the coaming of the barge. With this process, parts of the finer material (silt and clay) flows with the process water back into the water column. Figure 2-15 clearly shows the dredge spill, particularly caused by the overflowing.



Figure 2-14: CSD at Karnaphuli river (photo taken at site visit spring 2026)



Figure 2-15: Barge loading at Karnaphuli River (photo taken at site visit spring 2026)- process water is overflowing over the coaming

The most likely working method for undertaking the dredging works of the berth pocket at the Laldia Container Terminal, and thus assumed in the dredge plume modelling study, is dredging by a Cutter Suction Dredger (CSD) with barge loading.

Dredging of the slope in between the piles is more challenging and requires special care and attention of the dredging contractor. It might be that for this scope a small backhoe will be mobilised. Dredging by CSD in between the piles is still possible, but this requires lots of care. Production rates of dredging between the piles will in any case be lower than during bulk dredging, no matter if this is done by CSD or BHD, so this dredging scope will not be leading for dredge plume modelling.

Typically, dredging by CSD is the conservative upper bound approach in terms of dredge spill produced compared to mechanical dredging by BHD. The method selected in this note serves therefore as upper bound.

Working is assumed to be foreseen only at daytime, say 10 hours per day.

The production of the CSD is estimated by multiplying the situ riverbed density with the velocity and the cross-sectional area of the suction pipe. A diameter of the suction pipe of 500 mm is assumed. The velocity of the mixture is around 5 m/s, to prevent that particles will settle in the suction and delivery pipe. The situ density is typically 10% of the mixture density.

The operating efficiency includes repositioning of the CSD, mooring of the barge alongside, etc. Maintenance of the dredger is foreseen to be done outside of the working hours. The ratios solid and voids are standard ratios. The fine content is estimated based on the land bore holes, refer to Section 2.2.

Table 2-3: Production estimate of the CSD

Parameter	Quantity	unit
diameter	500	mm
velocity suction pipe	5	m/s
mixture density	10%	
solid particle/ insitu	60%	
voids/insitu	40%	
operating efficiency	80%	
density water	1025	kg/m³
density soil particle	2650	kg/m³
fine content	80%	
working hours	10	hrs/day
dredging volume	400,000	m³
production slurry	2827	m³/hr
production in-situ	283	m³/hr
production in-situ	0.08	m^3/s
production in-situ	2827	m^3/day
production dry matter	439	t/hr
production dry matter	0.12	t/s
production dry matter (fines)	97	kg/s
production dry matter (fines) day-averaged	41	kg/s
est time req. for dredging work	141	days

2.5 Spill source terms

Part of input for plume modelling is the spill source term which is a factor which depends on the dredging working method and the soil type. Figure 2-16 indicatively shows the spill generated by a CSD, which is typically only near the cutterhead. Figure 2-17 shows a TSHD while dredging and overflowing. Although the TSHD is not directly foreseen on the project, the overflowing aspect (“2”) of the TSHD is similar as the barge loading alongside the CSD.

The amount of spill (represented by the spill source term) will be an important factor in the size and concentration of the plume.

Spill source terms are basically factors (in '%') which are multiplied with the dredgers production and with the fine content, to come to the sediment release per time.

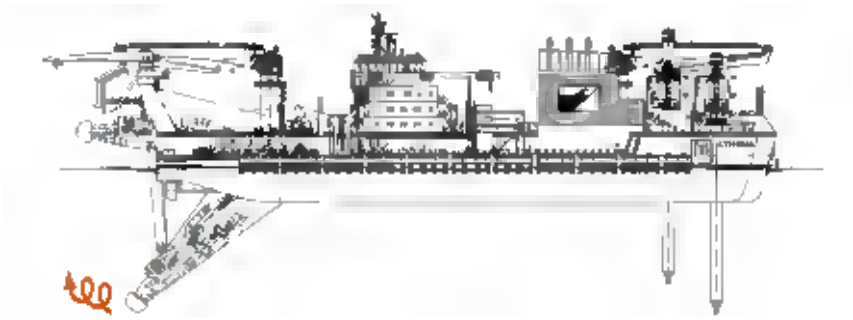


Figure 2-16: Sources of a dredge plume for a Cutter Suction Dredger (CSD). Source: Becker, 2014



Figure 2-17: Sources of a dredge plume for a TSHD while overflowing ('2') source: Becker, 2014

The dredge spill source terms are part of extensive research. Literature provides ranges of reasonable spill source terms for dredging and disposal options, refer to Figure 2-18 (Becker, 2015).

Plume source	Symbol	Fraction
Draghead	σ_d	0–0.03
Overflow ratio	R_o	0–1
In-hopper settlement	f_{sett}	0–1
In-matrix fixation	f_{mip}	0.01–0.05
Overflow	σ_o	0–0.2
Cutterhead	σ_c	0.01–0.05
Bucket drip	σ_b	0–0.04
Bottom door (hydraulic)	σ_p	0–0.1
Bottom door (mechanic)	σ_p	0.0–0.05

Figure 2-18: Reasonable ranges for (empirical) source term fractions (Becker, 2015)

For this project, the factor on the cutterhead (0-0.05) and the in-hopper settlement (0-1) are of relevance. Based on these numbers it can be observed that the spill source terms are in a wide range.

More detailed spill source terms are elaborated in "Dredging for Sustainable Infrastructure" (Aarninkhof, Laboyrie, & Koningsveld, 2018) of which an extract is provided in Figure 2-19. The third column in this extract indicates reference to spill source terms of previous literature and the column on the far right provides spill source terms as assessed in this book.

Also in this instance, the factors for 'Cutter Suction Dredger (CSD)' and 'TSHD overflow discharge' are relevant.

Plume source	Literature value ranges for source terms (as fraction of available fines)		Comments	Realistic ranges initial estimate for common project
	Becker et al (2015)	Other literature		
Trailing Suction Hopper Dredger (TSHD) draghead	σ_d	0-0 03	No directly comparable formulations John et al (2000) Penneka mp et al. (1996) HR Wallingford and Dredging Research (2005)	-	σ_d = 0 01-0 03 Initial estimate 0.015
TSHD overflow discharge	R_o	0-1	0 5-1 of incoming fines overflow Application of in-hopper settlement model Van Rhee (2002) Spearman et al (2011) Boone and De Nijs (2017)	Part of the overflow discharge will end up in the passive plume and is available for spreading in the environment the other part will descend towards the bed (dynamic plume) to deposit on the bed or form a near-bed benthic layer where it can be resuspended/dispersed by currents and waves	A simple initial estimate for the overflown discharge is to assume that 0.5-1 of the fines that enter the hopper during overflow leave the hopper via the overflow discharge.
	f_{settr}	0-1			
	f_{resp}	0 01-0 05			
TSHD initial overflow release (as a proportion of the overflow discharge)	σ_o	0-0.2	Initial loss to water column 0 15-0.8 Spearman et al (2011) De Wit (2014)	The higher values of release into water column occur under influence of limited water depth and direct interaction with propeller wash The remainder of the overflow discharge will deposit on the bed or form a near-bed benthic layer where it can be resuspended/dispersed by currents and waves	σ_o = 0.05-0 20 Initial estimate 0 15 (larger in limited water depth)
Cutter Suction Dredger (CSD)	σ_c	0 01-0 05	Spill up to 0 30 of cutter production (Vlasblom, 2007) Immediate loss to water column 0.25-0.50 of fines in cutter spill Loss onto bed 0.25-0.75 of fines in cutter spill	The suction pipe of a cutterhead will typically retain 70% of the material dredged The rest of the material termed spill', is either released immediately into the water column falls back onto the bed (where it may be resuspended later) or is re-dredged	σ_c = 0 01-0 08 Initial estimate 0.05
Backhoe Dredger (BHD)/Grab Dregder (GD)	σ_b	0-0 01	BHD Penneka mp et al. (1996) John et al (2000) GD Depending on leakage 0 03-0 10 (Burt et al 2007) 0 05-0.07 (Land et al , 2007) 0 01-0.05 (Sato et al , 2011)	There can be enhanced losses for grab dredging due to leakage (not fully closing) of the grabs caused by rocks, wood etc in the sediment	σ_b = 0 01-0 05 (up to 0 10 in case of issues with bucket closing). Initial estimate 0 035
Bottom door (hydraulically dredged material)	σ_y	0-0.1	Similar values Land and Bray (1998)	In deeper water sometimes higher percentages	σ_y = 0 01-0 10 Initial estimate 0 06
Bottom door (mechanically dredged material)	σ_y	0-0 05	Similar values Land and Bray (1998)	In deeper water sometimes higher percentages	σ_y = 0 01-0 05 Initial estimate 0 04

Figure 2-19: Spill source terms (Aarninkhof, Laboyrie, & Koningsveld, 2018)

For the Cutterhead, a spill source factor of 0.05 of the fine content is advised to be used for the passive plume. A conservative value for the spill source factor of the cutterhead is 8% of the fines. For the overflow, literature provides a wide range of factors, basically between 0.5 and 1 of the fines that enter the hopper during overflowing leave the barge via the overflow discharge. Since the incoming flow is quite low in relation to the typical size of barges used in Bangladesh, some material will be able to settle in the barge, also the

barges don't typically have an overflow system, but the process water will flow out of the barge via the coaming, making the outflow velocities of the process water low, enabling the particles to settle. For dredge plume modelling, a factor of 0.5 of the fine content is therefore advised to be used for the passive plume. A conservative upper bound would be to use a spill source factor of 1.0 of the fines (actually 0.95 to take the source of the cutterhead into consideration), this will basically result in a form of agitation dredging, where all (fine) material is suspended in the water column.

As a summary, dredging work method used in the dredge plume modelling is a cutter dredger in combination with an overflow barge. We believe this is a very likely and realistic work method to be applied, whilst at the same time creating a significant spill. We can therefore consider this scenario conservative (in terms of plume development), as other dredging methods exist (e.g. grab or backhoe in combination with barges) which will generate a smaller plume.

The spill source factors for the dredging activity at the berth pocket to be used in our assessments are summarised in Table 2-4.

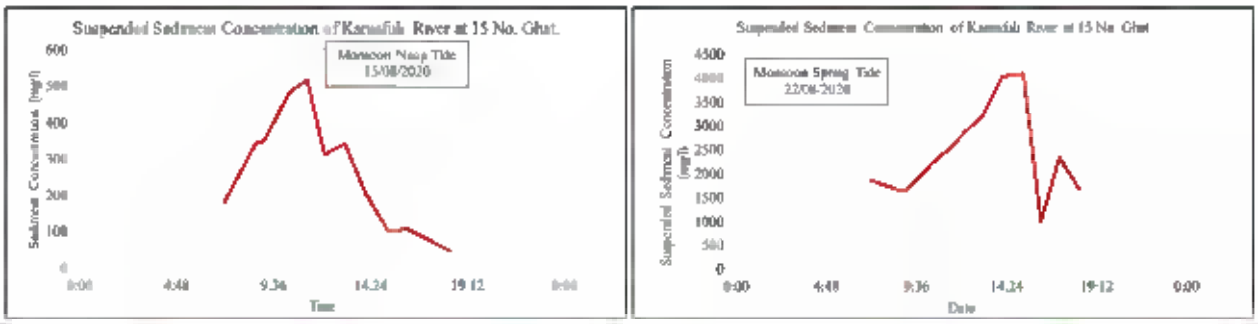
Table 2-4: Spill source factors

Source	Realistic spill source factor	Conservative spill source factor
Cutter head	5% of the fines	8% of the fines
Overflow barge	50% of the fines	92% of the fines
Total	~55% of the fines	100% of the fines

It should be noted that plumes from the disposal of the dredged material are not taken into account at this stage, as it is not known if and where disposal would take place. Also plumes from dredging at borrow areas for reclamation are not covered in this scope.

2.6 Background sediment concentration

Measured suspended sediment concentrations (SSC) in the Karnaphuli River are available from earlier studies (IWM, 2021). Figure 2-20 shows the depth-averaged SSC measured in Karnaphuli River at the project site. The effect of tide on the SSC is clear, with higher concentrations during spring tide. Also, for spring tide conditions, the SSC in the monsoon period is much higher than in the dry period. Overall, the observations show that the suspended sediment concentrations can be extremely high, with SSC well above several 1000's mg/l. The lowest observed SSC is about 50 mg/l.



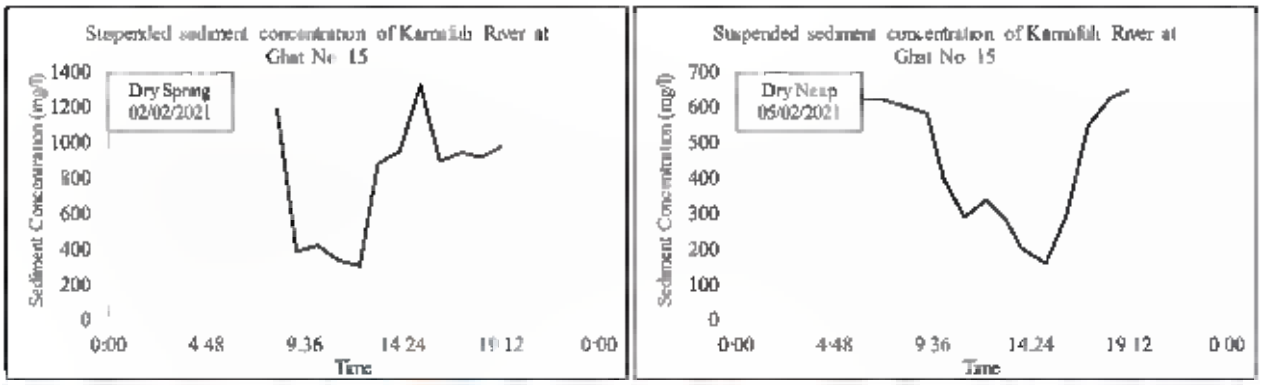


Figure 2-20: Observed suspended sediment concentrations in Karnaphuli River at Ghat No. 15, close to the project site during monsoon neap tide (top left), monsoon spring tide (top right), dry period spring tide (bottom left) and dry period neap tide (bottom right). (IWM, 2021).

Furthermore, surface water samples were taken in the Karnaphuli River for this ESIA, in April 2026 (Haskoning, 2026f). The locations of these samples are shown in Figure 2-21. From these water samples, the concentration of Total Suspended Solids (TSS) was determined in the laboratory. Although the definition and analysis for determining the TSS and SSC are different, both parameters describe the sediment concentration in the water. Overall, TSS is in the same order of magnitude as the SSC found in 2020, with suspended sediment concentrations well over 100 mg/L, up to 700 mg/L.

Table 2-5: Analytical results surface water laboratory Bangladesh (Haskoning, 2026f).

Parameter	Unit	SW1	SW2	SW3	SW4	SW5	SW6
TSS (Total Suspended Solids)	mg/L	176	302	550	572	698	706

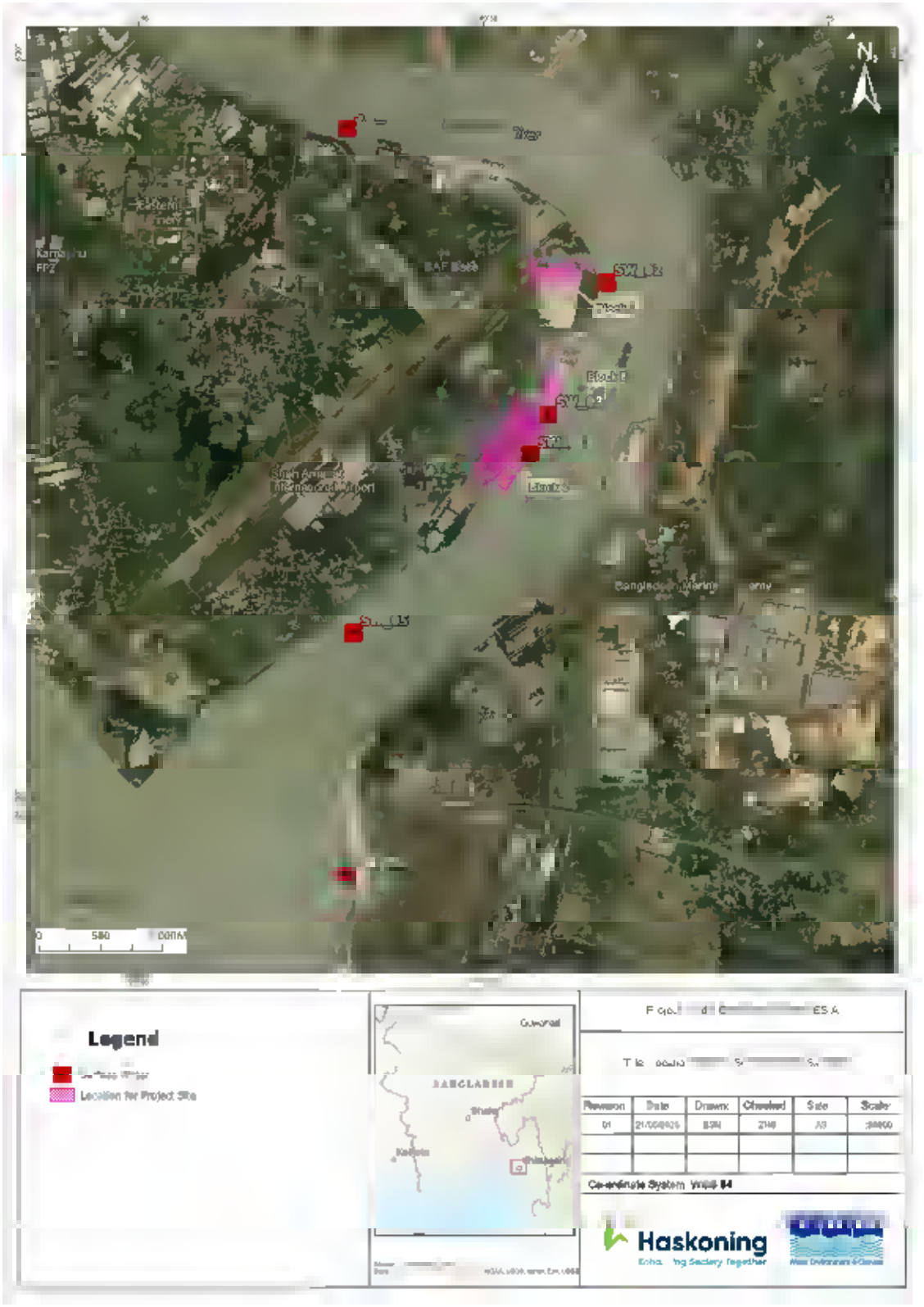


Figure 2-21: Surface water sampling location (Haskoning, 2026f)

3 Methodology for modelling

In this chapter, the set-up of the 3D hydrodynamic model is described.

3.1 Modelling software

The well-established hydrodynamic modelling software MIKE 3 Flexible Mesh (FM) is used in this study. MIKE 3 FM is developed by DHI and widely used to simulate hydrodynamics in river, coastal and estuarine environments. MIKE 3 FM is a three-dimensional model, with multiple layers over the vertical to account for vertical variation in currents, salinity and sediment concentration.

3.2 Computational grid and bathymetry

The computational grid of the Karnaphuli river and Bay of Bengal is shown in Figure 3-1. The computational grid is rectangular and curvilinear. The minimum dimension of the rectangular grid across the width of the channel is 30 meter and along the length it is 30 meter. In the outlet of the Karnaphuli river into the Bay of Bengal, the grid is triangular and the area of the minimum size of the triangle is 11250 m². The grid of the sea is also triangular and its minimum size is 45000 m².

Three bathymetric datasets are available:

- Year 2020 data, collected corresponds to (IWM, 2021) project. In this dataset, the data was collected at 500 m center to center spacing.
- Year 2021 data, which covers the region from the Kalurghat bridge to the outfall of the river. The spacing of the river cross section is 100 meter center to center. The dataset is collected from (IWM, 2021b)
- Year 2025 data, which is measured by LCT Ltd. during the project period just foreshore of the Laldia Container Terminal area.

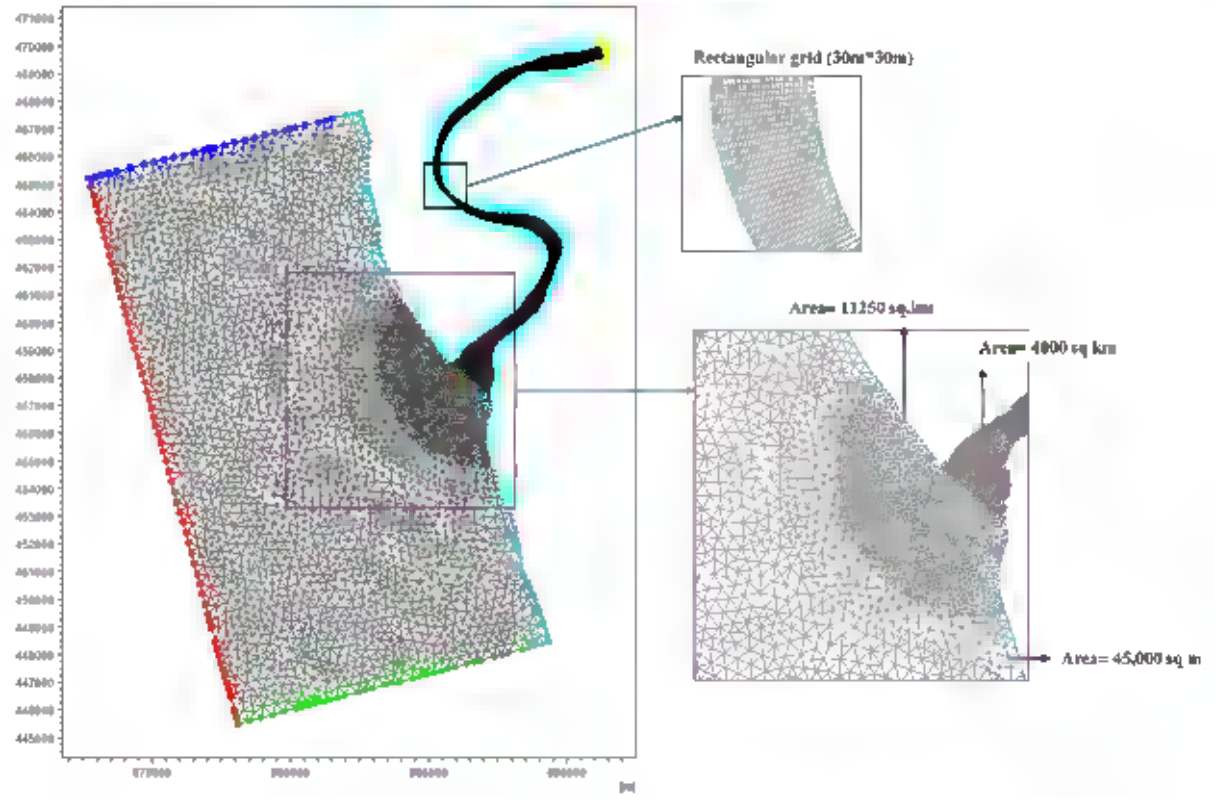


Figure 3-1: Computational grid of the Karnaphuli River model domain

3.3 Model scenarios for sediment plume modelling

In the dredge plume modelling, spill source terms are based on the dredging methodology presented in Sections 2.3 and 2.5:

- For a 10-hours work shift, the production rate within these 10 hours is estimated at 97 kg/s.
- 80% of the bed material consists of fine sediment.
- The realistic estimation is 5% spill source term at the cutter head and 50% due to overflow.

Resulting source terms for the modelling during the 10-hours work shift are:

- Cutter head: 97 x 80% x 5% = 3.88 kg/s
- Overflow: 97 x 80% x 50% = 38.80 kg/s

The source term for the cutter head is imposed in the bottom layer of the model, while the overflow source term is imposed in the top layer.

For the dredged bed material, a representative grain size of 15 µm for the fine fraction is applied, based on the grainsize distribution of the top layer in front of Block C (Section 2.2.3). Settling velocity of such grain size is 0.2 mm/s.

Considering the hydraulic and weather conditions, two scenarios are devised for the plume dispersion modelling:

1) High river discharge with calm wind conditions (High Flow Calm Wind)
2) Low river discharge with calm wind conditions (Low Flow Calm Wind)

1st July to 31st July is the simulation period representing the High Flow Calm Wind simulation and 22nd February to 22nd March period represents the low flow calm wind condition. After the model simulation, plume dispersion will be observed for the flood tide and ebb tide conditions.

3.4 Hydraulic boundary conditions

3.4.1 Upstream boundary

The upstream boundary of the hydrodynamic model is located at the Kalurghat Bridge (Figure 3-3). At this upstream boundary, a discharge timeseries is imposed. The discharge at the bridge is a combination of fresh-water discharge from the upstream river catchment and tidal water exchange with the Bay of Bengal. The discharge at the upstream model boundary was obtained from the one-dimensional hydrodynamic model developed in an earlier study (IWM, 2021). The domain of the model (shown in Figure 3-2) comprises the major rivers like Karnafuli river (downstream of Kaptai dam), Halda, Ichamati, Dhurang and Sarta river. The resulting discharge at the upstream boundary is shown in Figure 3-4.

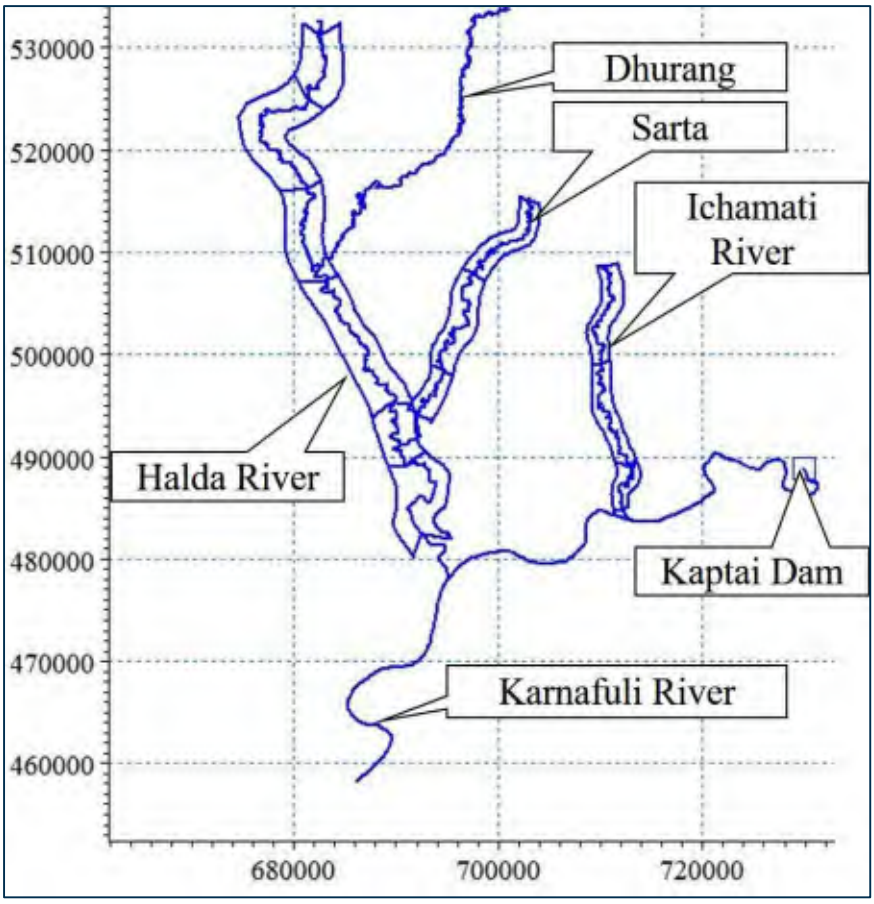


Figure 3-2: Domain of Karnaphuli river basin model.



Figure 3-3: Boundaries of the model.

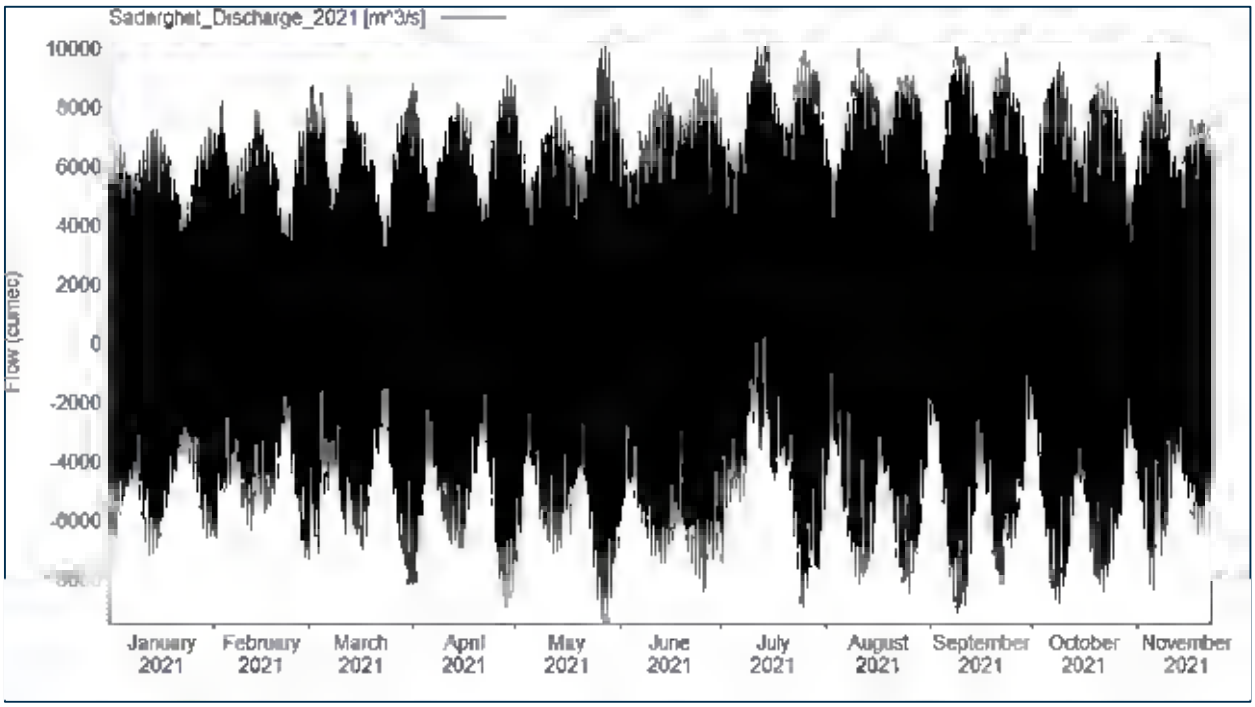


Figure 3-4: Upstream discharge boundary at Kalurghat Bridge

3.4.2 Downstream boundary

The downstream model boundary is located in the Bay of Bengal (Figure 3-3). The hydrodynamics at this model boundary are based mainly on tidal water level variation, tidal currents and wind-driven currents.

At the downstream model boundaries water level timeseries is imposed (see Figure 3-5 for the monsoon period). The water level timeseries was obtained from the regional Meghna Estuary model. The description of Meghna River estuary model is elaborated in (IWM, 2022)

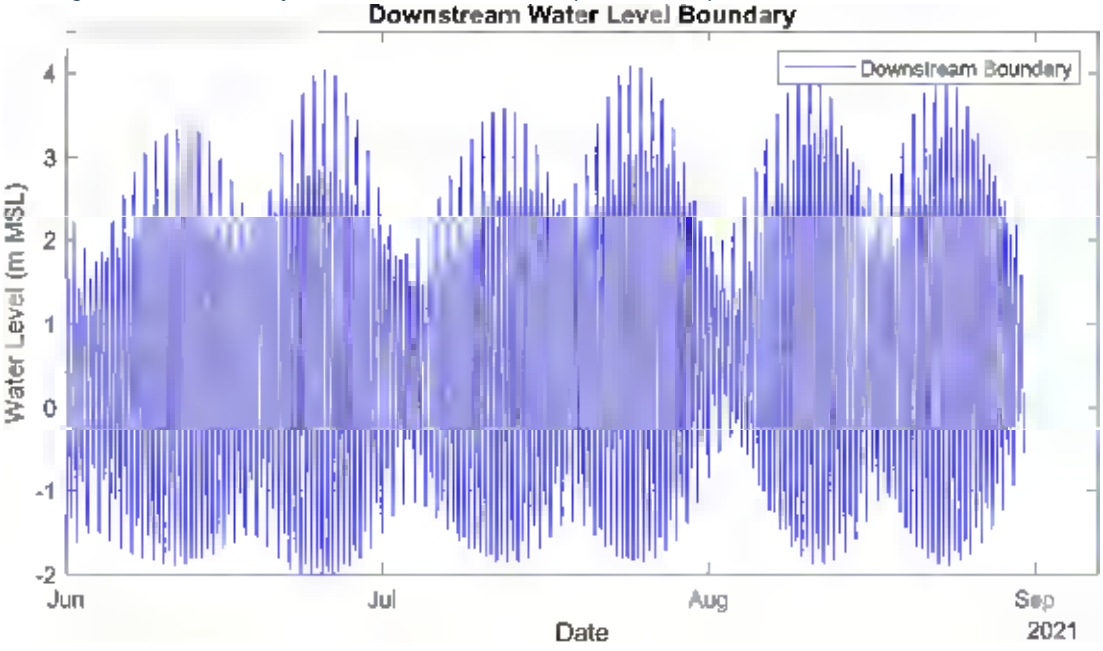


Figure 3-5: Plot of downstream water Level Boundary during monsoon

3.5 Other model settings

Figure 3-6 shows the operation of a cutter suction dredger. The operation of the dredger is periodic. The dredger operates 10 hours a day. And it starts operation in the morning and continues in the afternoon. In this simulation only one dredger is considered to operate. Multiple dredgers can operate. However, the rate of dredging can also be changed, depending on the availability of dredger type.

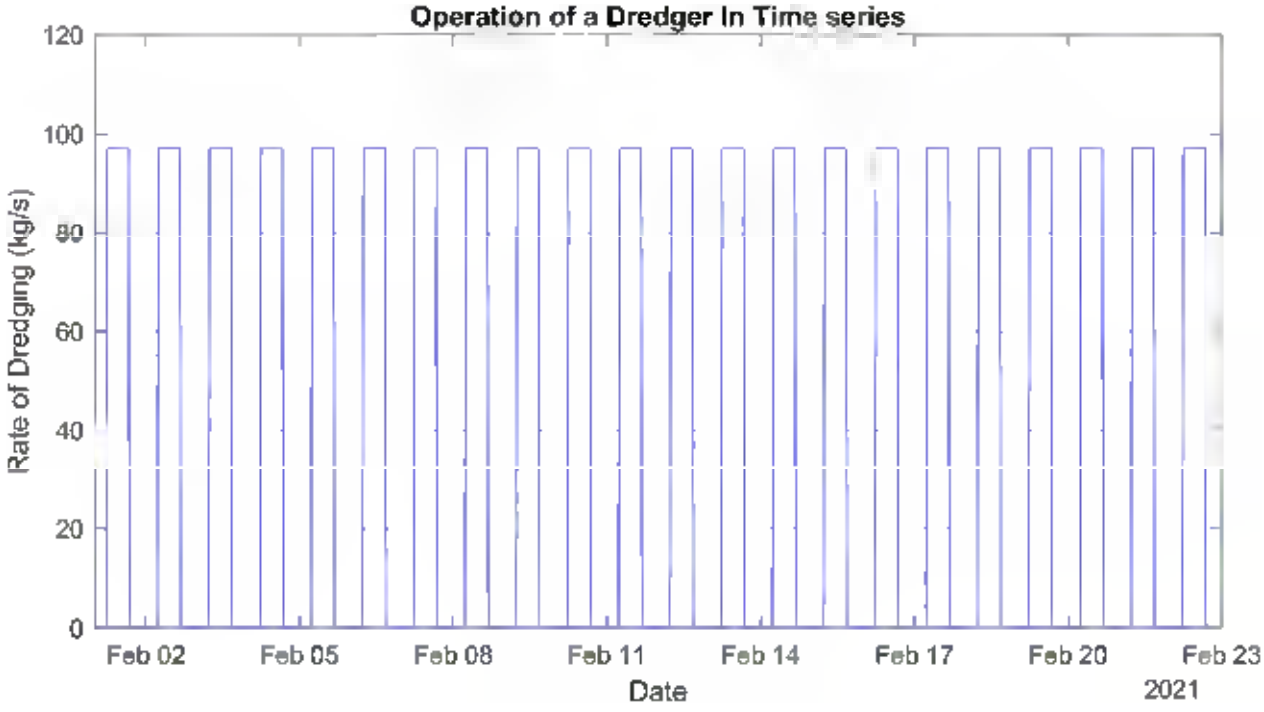


Figure 3-6: Operational graph of a cutter suction dredger.

4 Results

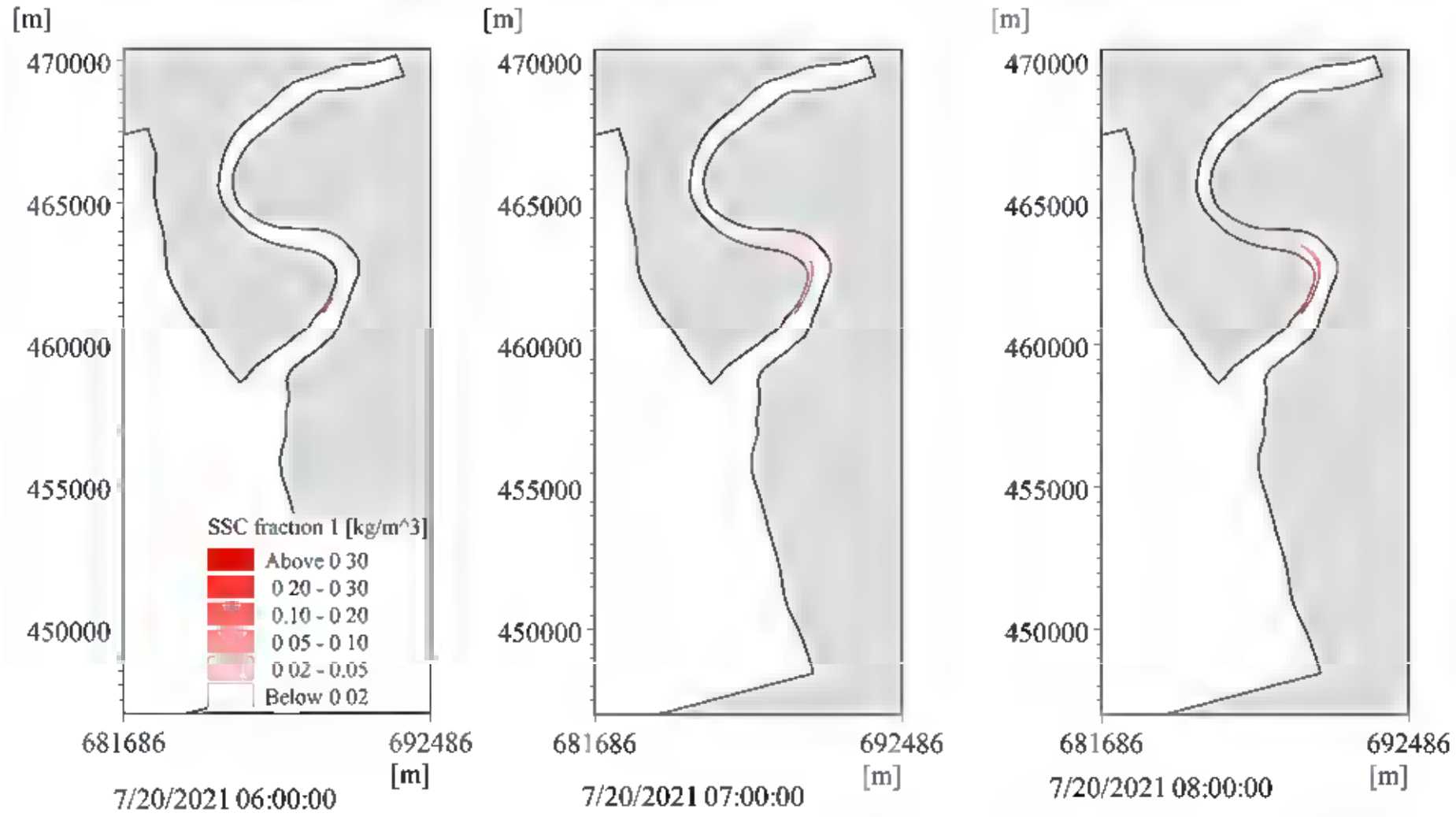
4.1 High river discharge with calm wind conditions

This section presents the simulated sediment plume dispersion under varying tidal and hydrodynamic conditions, together with the approximate spatial extent of plume propagation observed in each scenario. Figure 4-1 illustrates the development of the suspended sediment plume during the flood tide condition in the top water layer between 06:00 and 10:00 on 20 July 2021. During the initial stage, the plume remains concentrated close to the dredging or discharge location and gradually spreads along the tidal flow direction. The plume dispersion length during this stage is relatively limited, extending approximately 8 km from the source (0.5 kg/m^3 to 0.02 kg/m^3) due to the moderate hydrodynamic forcing and the early stage of tidal transport.

Figure 4-2 shows the sediment plume behaviour during ebb tide conditions between 10:30 and 12:30 on 20 July 2021. Following the reversal of tidal currents, the suspended sediments are transported in the opposite direction associated with the ebb flow. The plume becomes more elongated under the stronger directional current and spreads over a larger area. The approximate plume dispersion (0.5 kg/m^3 to 0.02 kg/m^3) length of about 6.5 km from the source location, indicating enhanced sediment transport due to the prevailing hydrodynamic conditions.

Figure 4-3 illustrates the vertical distribution of sediment plume dispersion throughout the water column under low flow and calm wind conditions. Because of the relatively weak hydrodynamic energy and limited vertical turbulence, the sediment plume remains largely confined near the source area. The horizontal dispersion length under this condition is comparatively short, approximately 300–500 m, while higher sediment concentrations remain concentrated near the lower layers of the water column due to gravitational settling and limited vertical mixing.

Figure 4-4 presents the statistical maximum extent of the dredge plume in the monsoon season, with high river discharge and calm wind conditions. This figure represents the maximum concentration envelope obtained during the one-month simulation period and highlights the farthest reach of the dredge plume. Owing to the higher river discharge conditions, the plume spreads significantly farther downstream in the monsoon period than in the dry season scenario. Upstream of the terminal location, the plume extent is approximately equal for both seasons. The figure therefore represents the maximum potential impact zone of the dredge plume within the study area under the simulated hydrodynamic conditions.


[m]
470000
465000
460000
455000
450000
SSC fraction 1 [kg/m^3]
Above 0 30
0 20 - 0 30
0.10 - 0 20
0 05 - 0 10
0 02 - 0.05
Below 0 02
681686
692486
[m]
7/20/2021 06:00:00
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470000
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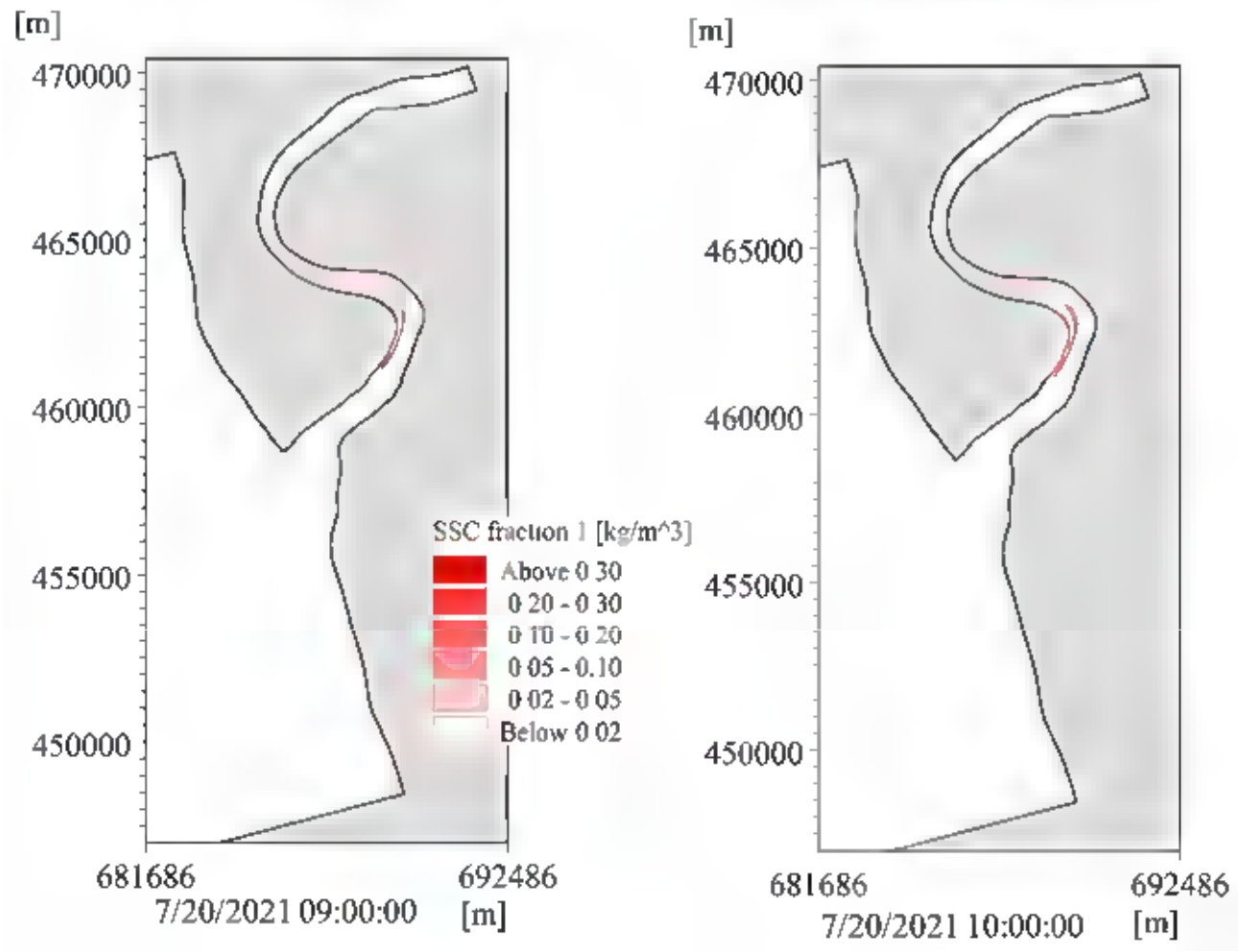


Figure 4-1: Plume dispersion during flood tide conditions (Top Layer)

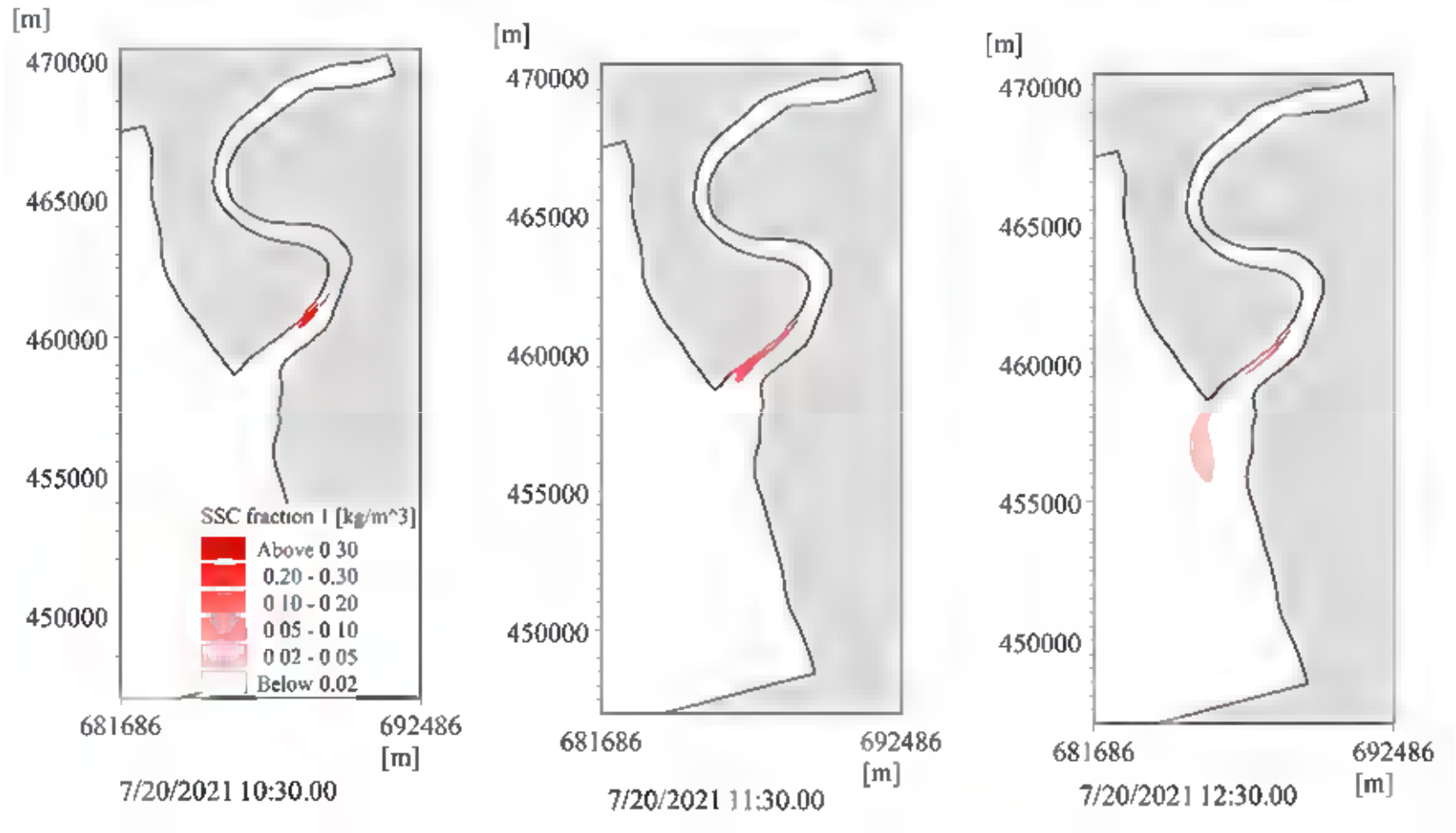


Figure 4-2: Plume dispersion during ebb tide conditions (Top Layer)

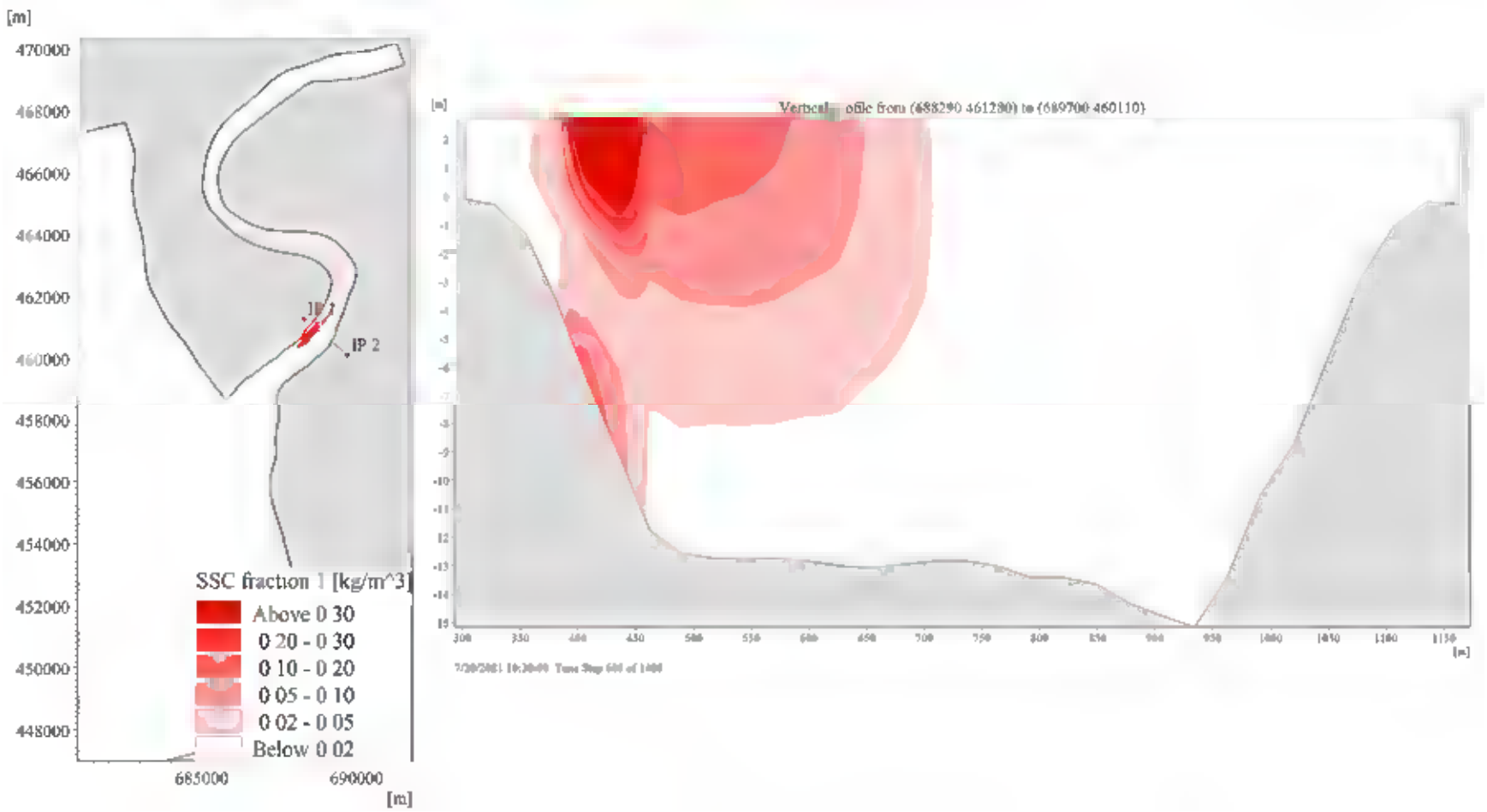


Figure 4-3: *Plume dispersion across the depth during high river discharge and calm wind conditions.*

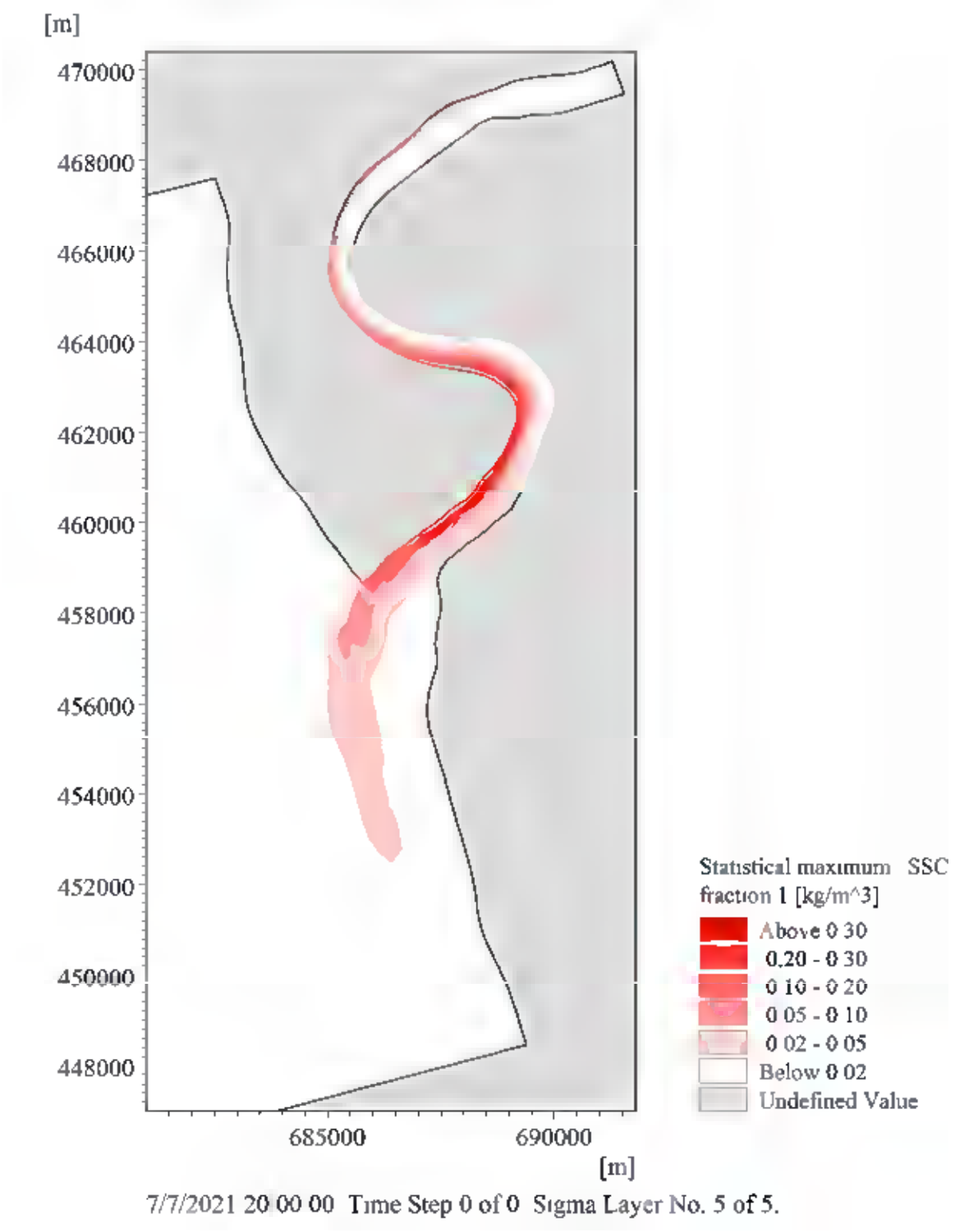


Figure 4-4: Statistical maximum plume concentration during high river discharge and calm wind conditions.

4.2 Low river discharge with calm wind conditions

This section presents the simulated behaviour of sediment plume dispersion under low flow and calm wind conditions for different tidal phases and vertical layers within the water column. Figure 4-5 presents the plume dispersion during flood tide conditions in the top water layer between 09:30 and 11:30 on 11 February 2021. During the flood tide phase, the suspended sediment plume gradually propagates in the direction of the incoming tidal current while remaining relatively confined around the source area due to the low flow environment. The plume becomes elongated as tidal transport increases with time, although the concentration decreases progressively away from the discharge location because of dilution and turbulent diffusion. Under these hydrodynamic conditions, the approximate horizontal plume dispersion length reaches about 6.3 km upstream from the source region.

Figure 4-6 illustrates the sediment plume behaviour during ebb tide conditions in the top water layer between 14:30 and 16:00 on 11 February 2021. With the reversal of tidal currents during the ebb phase, the plume transport direction also changes accordingly. The suspended sediment cloud becomes stretched downstream along the ebb flow direction and covers a larger spatial extent than during the flood phase. The plume dispersion is influenced primarily by the prevailing tidal currents, while calm wind conditions minimize additional surface-driven mixing effects. The approximate plume dispersion length during the ebb tide condition extends to nearly 3.8 km downstream from the source location.

Figure 4-7 presents the vertical distribution of the sediment plume across the water depth under low flow and calm wind conditions along Section IP1–IP2. The figure demonstrates that suspended sediment concentrations are generally higher in the lower and middle portions of the water column due to gravitational settling and relatively weak vertical turbulence. Because of the low hydrodynamic energy, vertical mixing remains limited, resulting in a comparatively confined plume structure near the source area. The overall horizontal extent of the plume across the depth is approximately 400–600 m, while the vertical distribution indicates gradual attenuation of sediment concentration toward the upper layers.

Figure 4-8 shows the statistical maximum extent of plume dispersion simulated for the dry season, with low river discharge and calm wind conditions. This figure represents the maximum envelope of suspended sediment concentrations obtained during the entire simulation period and identifies the farthest area affected by the dredge plume. Due to the relatively low current velocities associated with low river discharge conditions, the plume remains comparatively localized around the discharge point, in particular around the slack tide period.

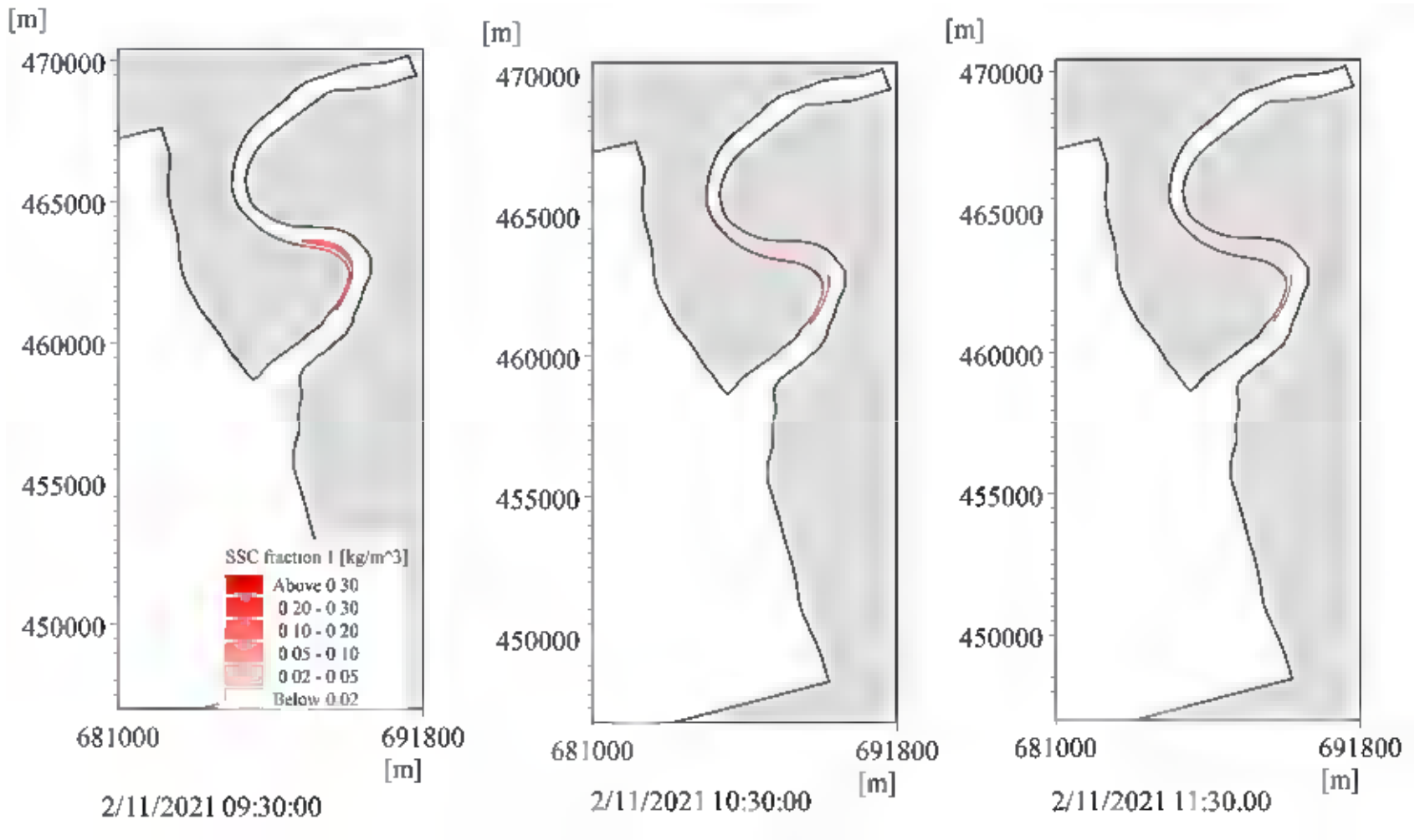


Figure 4-5: Plume dispersion during flood tide conditions (top layer).

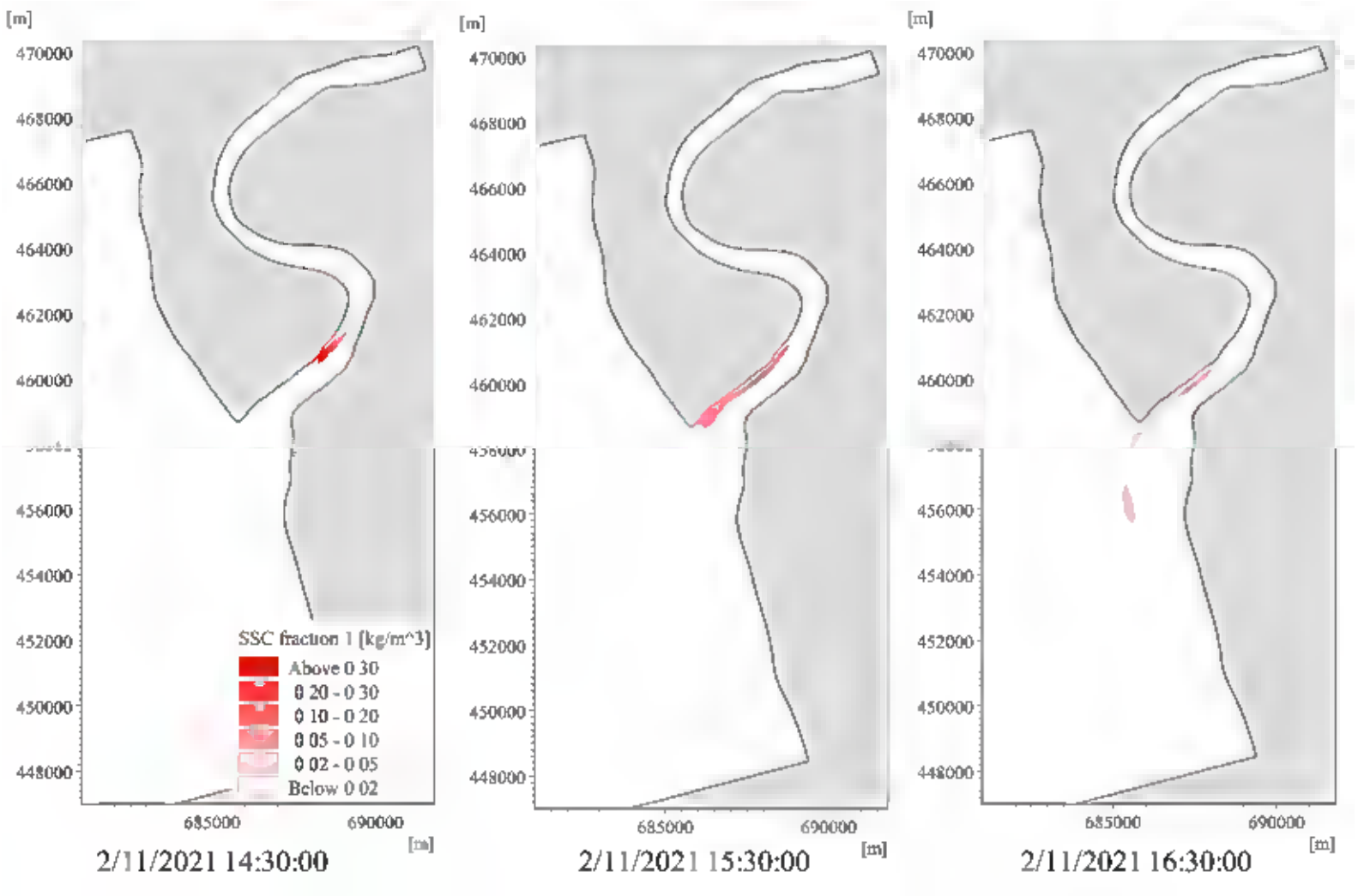


Figure 4-6: Plume dispersion during ebb tide conditions (top layer)

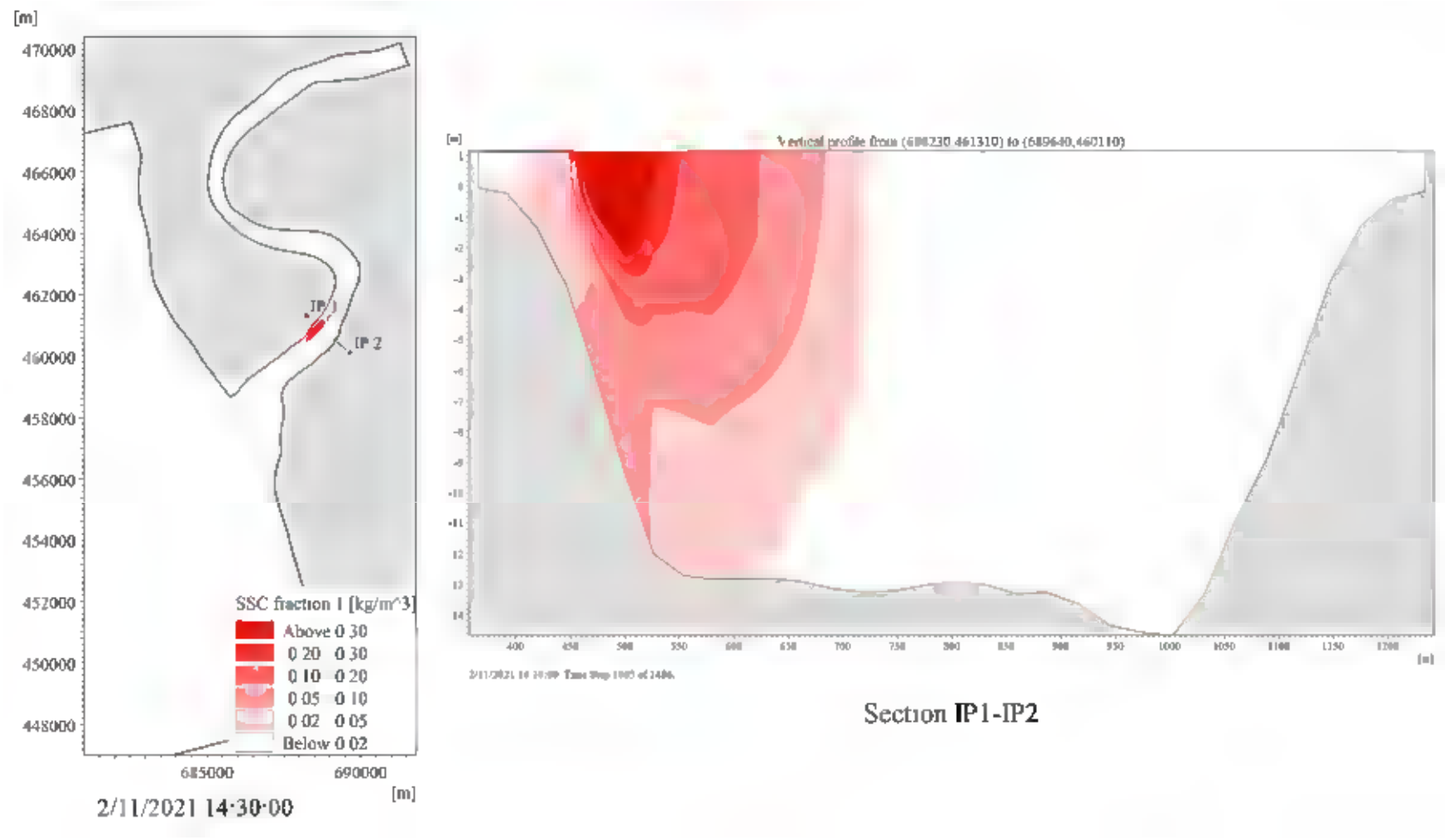


Figure 4-7: *Plume dispersion across the depth during low river discharge and calm wind conditions.*

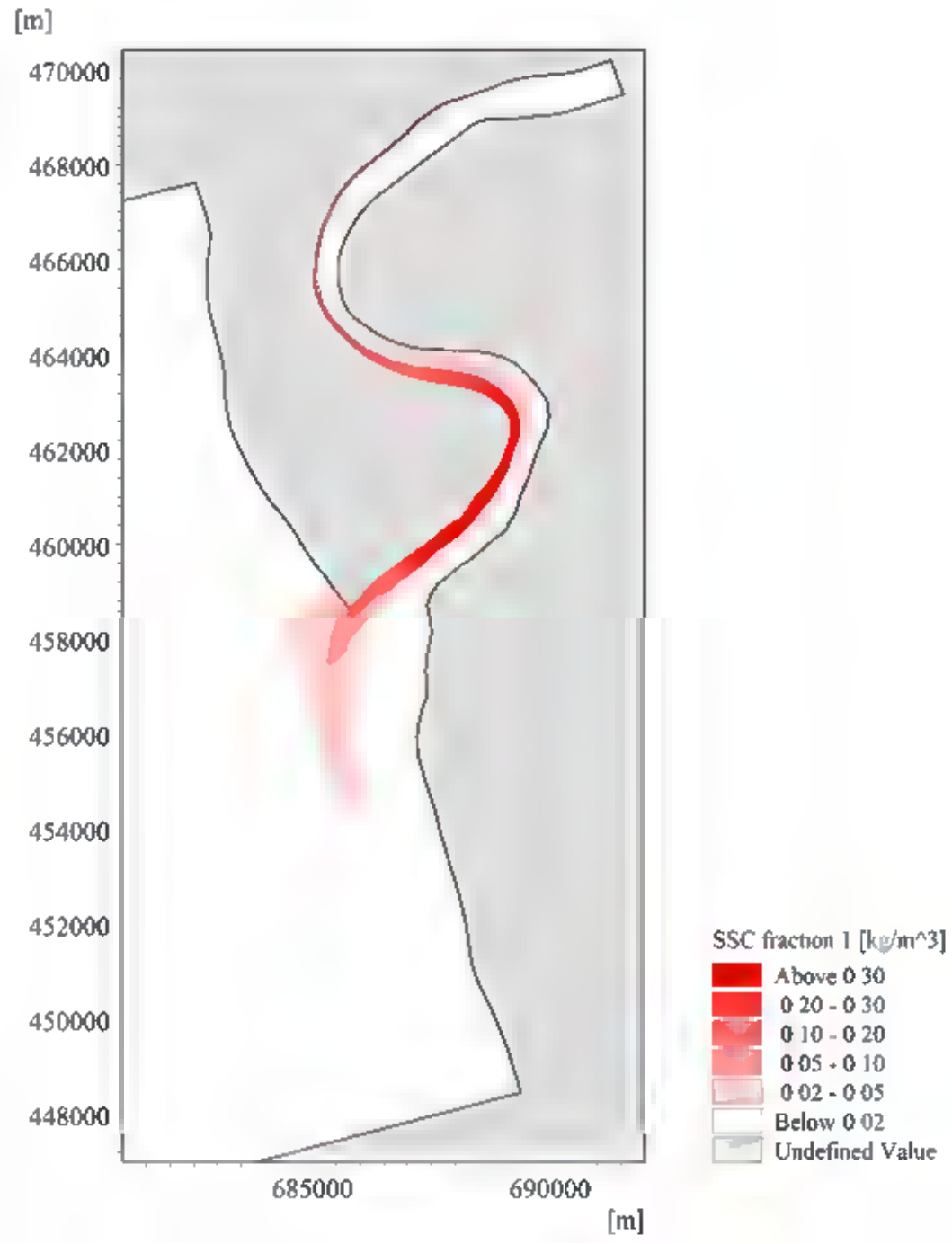


Figure 4-8: Statistical maximum plume concentration during low discharge and calm wind conditions

The comparison between the simulated plume dispersion results for the monsoon and dry seasons indicates a significant influence of hydrodynamic flow intensity on the dredge plume extent.

Under the dry season conditions, the dredge plume remains comparatively less dispersed around the dredging or discharge source. During both flood and ebb tide conditions, the plume propagation is relatively smaller due to weaker hydrodynamic forcing. The suspended sediment concentrations remain higher near the source area, while the horizontal spreading remains limited. In contrast, the results of the monsoon condition demonstrates substantially greater plume transport and dispersion due to the stronger currents and increased hydrodynamic energy.

5 Assessment of impact

The assessment of the environmental impact of the dredge plumes can be based on two different approaches:

- Pre-defined thresholds for maximum increase in SSC or maximum total SSC. The total SSC is the sum of the background SSC plus the additional SSC from the dredging. The thresholds are commonly determined based on the affected sensitive receptors.
- Comparison between the additional SSC and the background SSC, based on the assumption that sensitive receptors in an environment with high background SSC are more resilient, as they are used to high SSC and typically larger natural variation in SSC (e.g. high SSC in monsoon season). In contrast, sensitive receptors in environments with low background SSC (for example coral reefs) are typically highly sensitive to any increase in SSC.

No threshold for the maximum increase in SSC is defined in Bangladesh. Therefore, the below impact assessment is based on the relative increase in SSC, thus the increase due to the dredging relative to the background SSC.

Site measurements of the background SSC are presented in Section 2.6. The background SSC in the Karnaphuli River mouth is highly variable, among others depending on the tide and monsoon season. The background SSC is typically in the order of several hundreds of mg/l, but has peaks of 1000+ mg/l. The maximum additional SSC caused by the dredging is in the order of 300 mg/l near the dredging pocket. This means that the addition SSC caused by the dredging is well within the range of the natural background SSC in the Karnaphuli River.

The model results show that also the additional SSC in the Bay of Bengal due to the dredging activities is relatively small.

6 Conclusions

The sediment plume assessment indicates that the environmental impact of dredging activities is primarily localized and strongly controlled by the prevailing hydrodynamic conditions, tidal phases, and vertical mixing processes. Under both high-flow and low-flow calm wind conditions, suspended sediments disperse predominantly along the tidal current direction, with plume movement reversing between flood and ebb tides.

Under high river discharge and calm wind conditions, the sediment plume exhibits the greatest spatial extent due to stronger currents and enhanced hydrodynamic energy. According to the modelling results, the maximum downstream extent of the dredge plume is about 11 km in the monsoon season and 8 km in the dry season. The maximum upstream extent of the dredge plume is about 12 km, independent of the season. It is noted that, although the affected area becomes larger under high river discharge conditions, sediment concentrations decrease more rapidly away from the source due to increased turbulent diffusion and dilution. This suggests that the environmental impact is spatially wider but less concentrated.

The vertical plume distribution further indicates that suspended sediments tend to remain concentrated within the lower and middle portions of the water column because of gravitational settling and limited vertical mixing. The upper water layers experience comparatively lower concentrations, indicating that the impacts are more significant near the bed region.

Overall, the assessment demonstrates that the sediment plume impacts are temporary, dynamic, and largely confined within a limited distance from the dredging area. No evidence of excessive long-distance sediment transport is observed under the simulated scenarios. High-flow conditions increase the areal extent of influence but promote faster dilution, whereas low-flow conditions maintain more concentrated but localized plume conditions. Therefore, the potential environmental impacts are expected to remain moderate and manageable, particularly if dredging activities are conducted following appropriate operational controls and monitoring measures.

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Annex C5 – Specialist Study: Oil spill model

REPORT

Oil Spill Modelling Report

Laldia Container Terminal ESIA

Client:	Laldia Container Terminal Limited
Reference:	BK4589-HAS-SP-XX-RP-EV-0002
Status:	Draft/02
Date:	20 August 2026

Haskoning
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1 Introduction

1.1 Project background

The Laldia Container Terminal Project (LCTP, or the Project) is a strategic initiative to address port congestion challenges in Chattogram by expanding container handling capacity and improving operational efficiency at the Port of Chattogram. Located at Laldia Char along the right bank of the Karnaphuli River in Chattogram, the terminal will add approximately 0.8 million Twenty-Foot Equivalent Unit (TEU) per year of new handling capacity. This will relieve pressure on existing terminals, reduce congestion and vessel waiting times, and strengthen maritime logistics performance to support Bangladesh's trade competitiveness and regional connectivity.

The terminal is being developed under a Public-Private Partnership (PPP) between the Chittagong Port Authority (CPA) and Laldia Container Terminal Ltd. (LCT Ltd.), a joint venture between APM Terminals (APMT) and QNS Container Services Ltd. (QNS Ltd.). A 30-year concession agreement (CA) for the design, financing, construction, operation, and maintenance of the terminal was signed on 17 November 2025, representing one of the largest PPP investments in Bangladesh's port sector. LCT Ltd.'s involvement brings international expertise in container-terminal management, digital optimization, energy-efficient operations, and global best practice in port safety and reliability, supporting the long-term modernization of the Port of Chattogram.

The development of LCTP will take environmental and social aspects into account and therefore an Environmental and Social Impact Assessment (ESIA) is being prepared. This ESIA is prepared for permitting purposes in Bangladesh with the Department of Environment (DoE).

1.2 Objectives of Oil Spill Modelling Report

As part of the ESIA study, an oil spill modelling study is conducted to determine the dispersion and fate of leaked oil during the operational phase of the terminal. As the project concerns a container terminal, the main risks of oil spill are the frequent leakage of relatively small amounts of lubrication oil from the vessel machinery and the accidental release of vessel fuel in case of a leakage during bunkering.

1.3 General approach

Basis of these plume modelling studies is a MIKE 21 FM hydrodynamic model describing the tidal and river currents in Karnaphuli River (Haskoning, 2026a). This hydrodynamic model covers the downstream part of Karnaphuli River (about 18 km between Kalurghat Bridge and the river mouth) and part of the Bay of Bengal around the river mouth.

The hydrodynamics from this model is used to simulate the dispersion and settlement of leaked lubrication oil and vessel fuel. The simulations are done with the MIKE 21 FM Oil Spill Module, for low and high Karnaphuli River discharges.

2 Potential oil spill sources

2.1 Introduction

In this chapter, the potential oil spill sources are presented. The scope of this oil spill modelling study is limited to oil spills directly in the Karnaphuli River due to activities related to the Laldia Container Terminal. Reason for this scope limitation, is that spills of fuel, oil or lubrication oil on land, are expected to be intercepted by the drainage or other mitigation system, stored and properly processed. Such system, with sufficient capacity, must be present and is part of (common practice) good terminal housekeeping. Therefore, such on-land leakages are not considered in this oil spill modelling study.

Also, it is recognized that the risk of an event of vessel collision and possible fuel leakage after such event is relatively small.

In this oil spill modelling study, two types of oil spills are considered: continuous leakage of lubrication oil and an event of fuel leakage during bunkering. Details of these types of oil spills are provided in the following sections.

Together with experts from Maersk, the scenarios for possible oil spills have been developed.

2.2 Daily spills of lubricating oil

One type of oil spill is the daily leakage of lubrication oil from the stern tube, vessel deck machinery and submerged vessel machinery into the Karnaphuli River:

- Stern tube system: Based on experience of Fleet Management & Technology at Maersk, stern tube systems should not leak oil under normal operating conditions. Where stern tube lubrication oil is used, it is increasingly required to be an environmentally acceptable lubricant (EAL), specifically to minimize environmental impact in the event of incidental leakage. A worst credible incidental leakage would be in the order of 30–40 litres per month per vessel, using environmentally acceptable oil (1~1.3 litres per day per vessel). For the modelling, we assume 1.3 litres per day per vessel.
- Deck machinery: Following a study on marine inputs from lubrication oil leakages (Etkin, 2010), the estimated operational leakage of lubrication oil from deck machinery for a container vessel is on average 5.77 litres per port visit, assuming 10% of the lubrication oil from deck machinery is leaked into the water.
- Submerged machinery: Following a study on marine inputs from lubrication oil leakages (Etkin, 2010), the operational leakage of lubrication oil from submerged machinery for a container vessel is on average 10.46 litres per port visit.

It is noted that the above-mentioned lubrication oil spills from the deck and submerged machinery are considered conservative and possibly overestimated according to experts from Maersk.

Three leakage scenarios are considered to represent operational variability, based on the number of vessels using the terminal. Three scenarios for annual throughput of the terminal were defined: 640,000 TEU, 800,000 TEU and 1,400,000 TEU per year. Assuming TEU factor of 1.75 and 2000 moves per call, this would result in 183, 229 and 400 vessels per year.

Summation of the three approximately continuous lubrication oil leakages, results in daily lubrication oil leakages entering Karnaphuli River of 12, 14 and 22 litres per day per throughput scenario. The high leakage

scenario of 22 litres per day is adopted as a conservative case to represent worst-case continuous leakage conditions.



Figure 2-1: Plan view of Blocks B and C with dredging, deck on piles and land reclamation areas along Block C. Source: APM-056-01A-12-3 (top) and APM-056-01A-08-2 (bottom).

The spill location is assumed to be at the centre of the berth pocket of Block C (Figure 2-1).

As the lubrication oil spill is approximately continuous and chronic, three hydrodynamic conditions will be modelled:

- Low Karnaphuli River discharge with oil spill around neap tide (smallest plume extent).
- Low Karnaphuli River discharge with oil spill around spring tide (largest plume extent in dry period).
- High Karnaphuli River discharge with oil spill around spring tide (largest plume extent wet period).

2.3 Oil spill due to transfer failure during bunkering

Maersk's bunkering procedures require the bunker manifold to be continuously manned throughout the operation. This ensures that any disruption is identified within short timeframe, and an alarm raised, allowing for rapid shutdown and significantly limiting potential fuel spill volumes.

Assuming a bunkering rate of 100 m³/hour and an assumed terminal requirement for bunker hose monitoring at least every six minutes, a maximum credible spill volume of approximately 10,000 kg would be a realistic worst-case scenario. This means a fuel leakage of 10,000 kg in 6 minutes.

Different types of fuel can be used, depending on the vessel, such as heavy fuel oil or diesel fuel. The bunkering is assumed to occur at the berth pocket of Block C.

As a fuel spill is a relatively short event and strongly depends on the hydrodynamic conditions within this short period, the leakage during different river and tidal conditions will be modelled:

- Low Karnaphuli River discharge with fuel spill during neap slack tide (smallest plume extent).
- Low Karnaphuli River discharge with fuel spill during rising spring tide (largest plume extent in upstream direction).
- High Karnaphuli River discharge with fuel spill during falling spring tide (largest plume extent in downstream direction).

3 Model set-up

3.1 Introduction

In this chapter, the set-up of the numerical model is described. It gives a brief overview of the hydrodynamic model set-up, followed by the set-up of the oil spill module. The hydrodynamic model set-up was developed and calibrated within this project (Haskoning, 2026a).

3.2 Modelling software

The well-established hydrodynamic modelling software MIKE 21 Flexible Mesh (FM) is used in this study. MIKE 21 FM is developed by DHI and widely used to simulate hydrodynamics in river, coastal and estuarine environments. MIKE 21 FM is a depth-integrated (two-dimensional) model that represents vertically averaged conditions. It simulates horizontal variations in currents, water levels, salinity, and sediment concentration. A two-dimensional approach is considered appropriate for the present oil spill modelling because the study area is relatively shallow and well-mixed (DHI, 1993), resulting in limited vertical stratification. In addition, the simulated spills mainly involve surface transport processes driven by currents and advection-dispersion mechanisms, which can be adequately represented using depth-averaged hydrodynamics. Therefore, the MIKE 21 FM model provides a suitable balance between computational efficiency and reliable representation of the oil spill transport processes in the study area.

3.3 Computational grid and bathymetry

The two-dimensional computational grid of the Karnaphuli river is rectangular and curvilinear. The minimum dimension of the rectangular grid across the width of the channel is 30 meters and along the length it is 30 meters. In the outfall of the Karnaphuli river the grid is triangular and the minimum area of the triangle is 11,250 m². The grid of the sea is also triangular, and its minimum size is 45,000 m² (Figure 3-1).

Bathymetry of the model domain is comprised of three different datasets:

- Year 2020 data, collected in an earlier project (IWM, 2021). In this dataset, the data was collected at 500 m center to center spacing.
- Year 2021 data, which covers the region from the Kalurghat bridge to the outfall of the river. The spacing of the river cross section is 100 meter center to center. The dataset is collected in an earlier study (IWM, 2021b).
- Year 2025 data, which is measured by LCT Ltd. during the project period, and only includes the foreshore of the Laldia Container Terminal area.

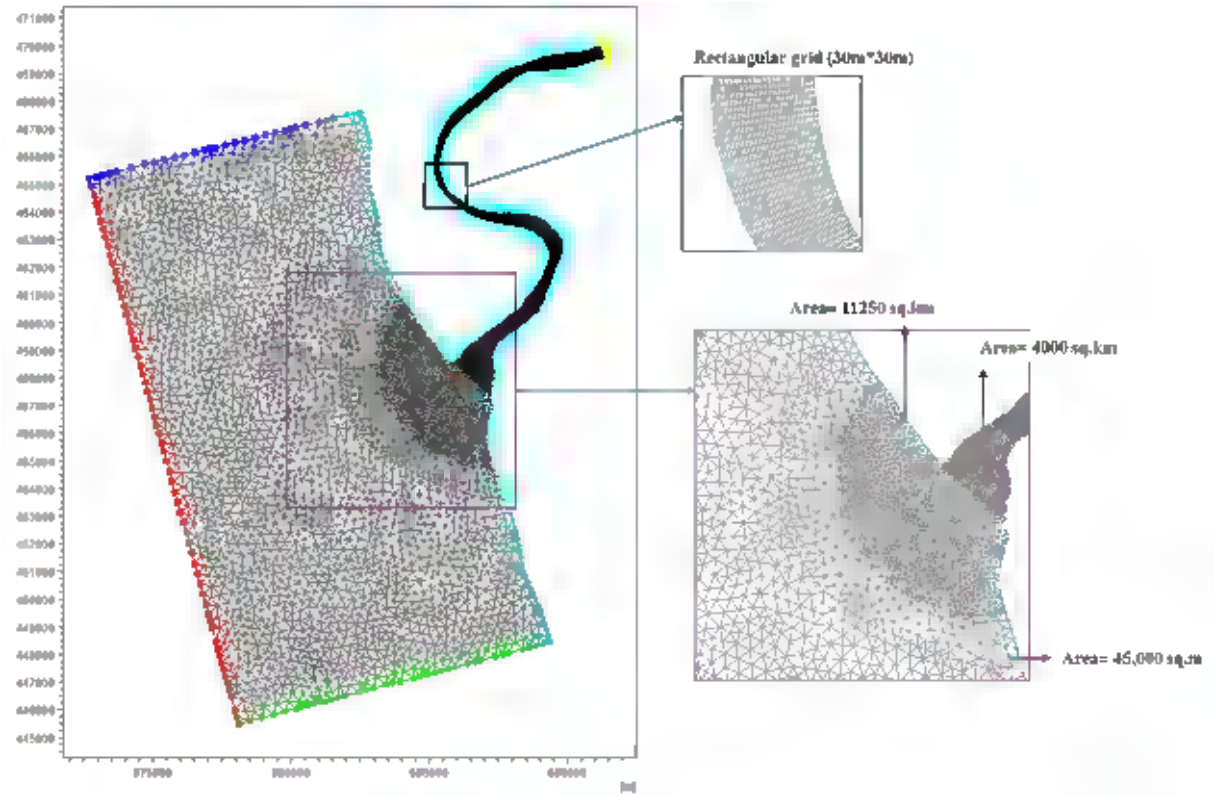


Figure 3-1: Computational grid of the Karnaphuli River model domain

3.4 Hydraulic boundary conditions

3.4.1 Upstream boundary

The upstream boundary of the hydrodynamic model is located at the Kalurghat Bridge (Figure 3-2). At this upstream boundary, a discharge timeseries is imposed. The discharge at the bridge is a combination of fresh-water discharge from the upstream river catchment and tidal water exchange with the Bay of Bengal. The discharge at the upstream model boundary was obtained from the one-dimensional hydrodynamic model developed by IWM (IWM, 2021). The resulting discharge at the upstream boundary is shown in Figure 3-3. It should be noted that upstream in the Karnaphuli River there is a hydropower dam, which regulates the flow from the river from upstream.



Figure 3-2: Boundaries of the model.

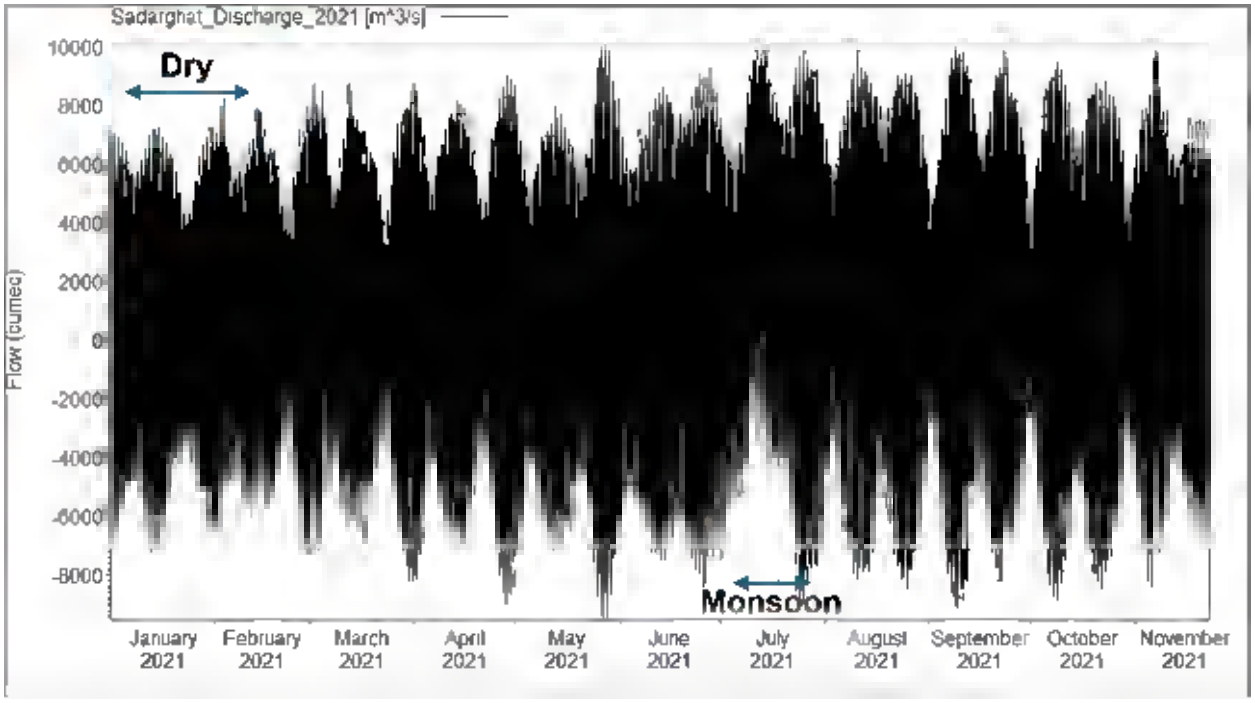


Figure 3-3: Upstream discharge boundary at Kalurghat Bridge

3.4.2 Downstream boundary

The downstream model boundary is located in the Bay of Bengal (Figure 3-2). The hydrodynamics at this model boundary are based mainly on tidal water level variation, tidal currents and wind-driven currents.

At the downstream model boundaries, water level timeseries are imposed. These water level timeseries were obtained from the regional Meghna Estuary model. The description of Meghna River estuary model is elaborated by IWM (IWM, 2022). Figure 3-4 shows the downstream boundary timeseries plot during the monsoon season.

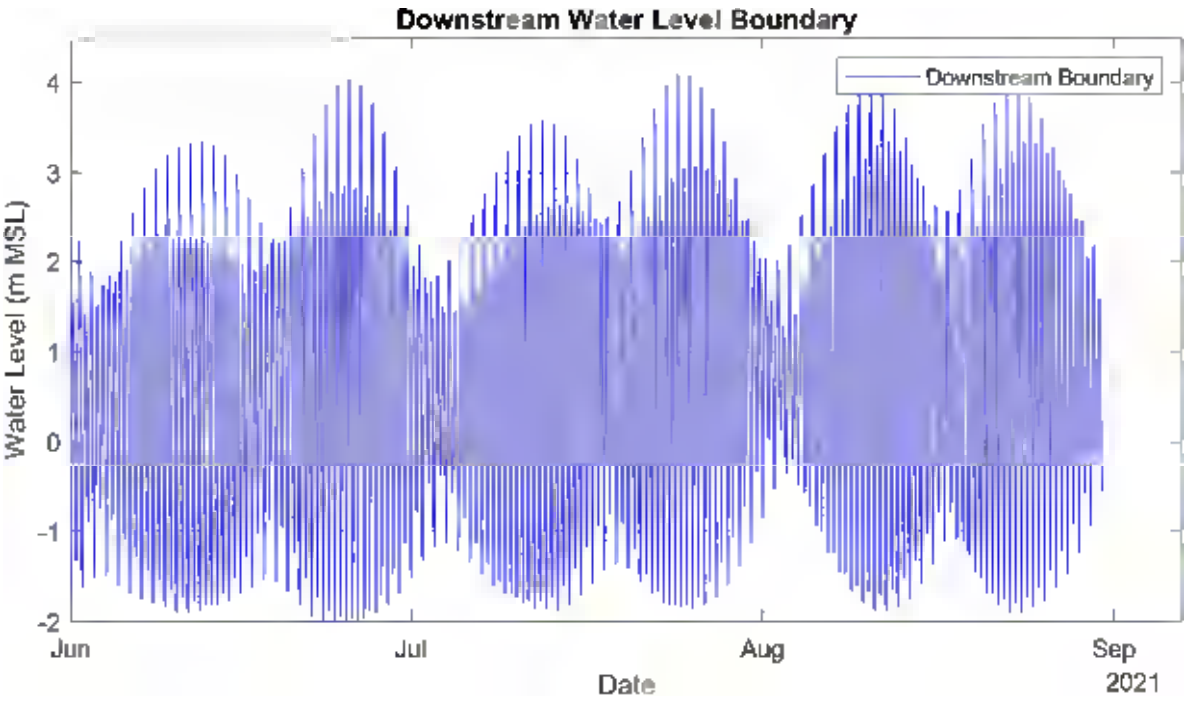


Figure 3-4: Plot of downstream water level boundary during monsoon

3.5 Oil spill model settings

For the oil dispersion modelling, MIKE 21 OS (Oil Spill) module was used, which simulates the weathering and movement of oil represented by discrete particles in a flow field using a so-called Lagrangian approach.

The different types of oil are characterised in the model through a number of key parameters including e.g. density, viscosity, pour point and maximum water content. Additionally, the composition of oil is specified by the distribution of its mass between a light volatile fraction (molecular weight below 160 g/mol and boiling point below 300°C) and a heavier oil fraction (molecular weight above 160 g/mol and boiling point above 300°C), asphaltenes and wax. Each of these components is characterised by its own key parameters and weathering constants, wax and asphaltenes components are considered as special fractions of the oil and are assumed not to degrade, evaporate and dissolve in the water.

Each oil particle in the model is described by the following 8 state variables that describe its composition and physical properties: volatile oil mass (kg), heavy oil mass (kg), amount of asphaltenes (kg), amount of wax (kg), water fraction of oil (-), droplet diameter (m), area of oil (m^2) and immersed state (logical 0/1). Each state variable in the model has an ordinary differential equation describing its rate of change due to various weathering processes. The following oil weathering processes are included in the model:

- Spreading (viscous, gravity based) – determines the change in the area of an oil particle, depends on the oil volume/density change;
- Evaporation – the dominant process in the first hours and days after the spill, affects the mass of volatile oil fraction and depends mainly on water temperature;
- Emulsification – the process describing the formation of the oil-water emulsion, which slows down subsequent weathering processes, tends to occur under conditions of strong wind and/or waves and generally not until the spill has persisted on the water for at least several hours;
- Vertical dispersion – the process of moving the oil particles from the surface into the water column facilitated by strong winds, currents, and especially breaking waves;

- Dissolution – describes the transfer of the water-soluble part of the oil from the surface slick into surrounding seawater, is affected by a range of factors, including the surface of the slick, wind and sea surface conditions, air temperature, insolation, and emulsification of the slick, which slows down the rate of evaporation;
- Biodegradation – weathering of oil by microorganisms, slows down in anaerobic environments with high petroleum contamination, but may still have a substantial cumulative impact over time;
- Photo-oxidation – a weathering process facilitated by the exposure of oil to sunlight, provides a very small contribution to the oil spill removal;
- Sedimentation – vertical movement of oil driven by buoyancy forces from differences in oil density and water density in upward and downward direction, based on Stokes Law.

3.5.1 Oil spill due to transfer failure during bunkering

Oil spill scenarios were developed to represent a bunkering transfer failure in the Karnaphuli River under varying hydrodynamic conditions. Three cases were considered: neap slack (low discharge, minimal currents, localized plume), rising spring tide (low discharge with flood currents, promoting upstream transport), and falling spring tide during monsoon (high discharge with ebb flow, resulting in strong downstream transport and maximum spreading). Table 3-1 illustrates simulation period and oil release time of each scenario. The simulations were performed using a decoupled hydrodynamic approach, where pre-computed water levels and current fields were used to drive the oil spill model. This ensures computational efficiency while accurately representing the influence of tides and river discharge on oil transport.

Table 3-1: Simulation Period and Oil Release Timing

Scenario	Condition	Simulation Period	Release Time
Neap slack	Low discharge + slack tide	21 Jan 2021, 16:00 – 04 Feb 2021, 15:00	22 Jan 2021, 14:00
Rising spring	Low discharge + flood tide	29 Jan 2021, 22:30 – 12 Feb 2021, 22:30	30 Jan 2021, 22:00
Falling spring (monsoon)	High discharge + ebb tide	07 Jul 2021, 20:00 – 22 Jul 2021, 20:00	12 Jul 2021, 15:00

A worst credible bunkering failure scenario was considered, corresponding to a total spill of 10 tons (10,000 kg) of fuel oil released over a short duration of approximately 6 minutes. The spill location was defined at the berth pocket of Block C, representing the primary operational area of the terminal. The spill was implemented as an instantaneous release using a particle-based approach to ensure precise mass control and independence from model timestep resolution. A total of 1000 particles were released, each representing 10 kg of oil, applied as an accumulated time series to simulate a single discrete spill event. Spill scenario configuration for heavy oil and diesel oil is given in the Table 3-2.

Table 3-2: Spill Scenario Configuration for heavy oil and diesel oil

Parameter	Value
Total spill mass	10,000 kg
Spill duration	6 minutes
Spill type	Instantaneous (discrete release)
Release location	Block C berth pocket
Total number of particles	1000
Mass per particle	10 kg
Release method	Accumulated time series

Heavy Fuel Oil Parameters

Heavy fuel oil was adopted as the primary spill scenario, representing the most persistent and environmentally critical condition. The oil composition follows standard DHI characterization, with a dominant heavy fraction and low volatility, resulting in slower weathering and localized accumulation.

Table 3-3: Heavy Fuel Oil Composition

Component	Percentage (%)	Mass per Particle (kg)
Volatile fraction	7.5	0.75
Heavy oil fraction	77.5	7.75
Asphaltenes	8.0	0.80
Wax	7.0	0.70

Diesel Oil Parameters

A diesel oil spill was simulated as a sensitivity scenario to represent a lighter and more volatile fuel type. The oil is classified as middle oil (low aromatics), with higher volatile content and reduced heavy components compared to heavy fuel oil.

Table 3-4: Diesel Oil Composition

Component	Percentage (%)	Mass per Particle (kg)
Volatile fraction	30.0	3.00
Heavy oil fraction	68.99	6.899
Asphaltenes	0.01	0.001
Wax	1.0	0.10

3.5.2 Daily spills of lubricating oil

Lubricating oil was simulated as a continuous leakage source representing routine vessel discharges. Three hydrodynamic conditions were considered: neap tide (dry season), spring tide (dry season), and spring tide (monsoon). The corresponding simulation periods are provided in Table 3-5. The modelling was performed using a decoupled hydrodynamic approach, where pre-computed water levels and current fields were used

to drive the oil spill model. Leakage rates were defined based on vessel activity, assuming a density of 900 kg/m³, and the high scenario (22 L/day) was adopted as a conservative case. Table 3-6 and Table 3-7 show the Leakage Scenarios and Lubricating Oil Composition respectively.

Table 3-5: Simulation Periods for Lubricant Oil under Different Hydrodynamic Scenarios

Scenario	Condition	Simulation Period
Neap tide during dry season	Low discharge	21 Jan 2021, 16:00 – 04 Feb 2021, 15:00
Spring tide during dry season	Low discharge	29 Jan 2021, 22:30 – 12 Feb 2021, 22:30
Spring tide during monsoon season	High discharge	07 Jul 2021, 20:00 – 22 Jul 2021, 20:00

Table 3-6: Leakage Scenarios

Scenario	Leakage Rate (L/day)	Mass Rate (kg/s)
Low	12	1.25×10^{-4}
Medium	14	1.46×10^{-4}
High	22	2.29×10^{-4}

Table 3-7: Lubricating Oil Composition

Component	Fraction (%)	Low Scenario Mass Rate (kg/s)	Medium Scenario Mass Rate (kg/s)	High Scenario Mass Rate (kg/s)
Volatile	2	0.000003	0.000003	0.000005
Heavy	78	0.000098	0.000114	0.000179
Wax	10	0.000013	0.000015	0.000023
Asphaltene	10	0.000013	0.000015	0.000023
Total	**100**	**0.000125**	**0.000146**	**0.000229**

3.6 Other model settings

Three representative oil types—heavy oil, diesel oil, and lubricant oil—were defined following the DHI Oil Spill modelling template to represent a range of weathering behaviours. The key process-controlling parameters are summarized in Table 3-8 to highlight differences in evaporation, spreading, and persistence characteristics.

Table 3-8 Key Parameters for Oil Types for model input

Parameter	Heavy Oil	Diesel Oil	Lubricant Oil	Unit
Vapor pressure (Pvp)	1.7×10^{-4}	5×10^{-3}	5×10^{-4}	atm
Distillation at 180°C (evap180)	5	10	2	%
Molecular weight (MW)	123	123	160	g/mol
Density (light fraction)	787	796	820	kg/m³
Density (heavy fraction)	1011	886	900	kg/m³
Max water fraction	0.85	0.50	0.60	–

Parameter	Heavy Oil	Diesel Oil	Lubricant Oil	Unit
Viscosity (T_0)	209	1.68	300	cP
Dissolution rate (light)	0.4	0.4	0.02	day^{-1}
Dissolution rate (heavy)	0.4	0.4	0.005	day^{-1}
Biodegradation (volatile)	0.005	0.005	0.002	day^{-1}
Biodegradation (heavy)	0	0	0.001	day^{-1}
Area growth rate	150	150	120	s^{-1}

The remaining model parameters were also specified based on the recommendations of the model developers (DHI), which are presented in Appendix A1.

4 Model results

4.1 Heavy oil spill during bunkering

The spatial distribution of maximum suspended heavy oil demonstrates the strong influence of tidal dynamics and river discharge on plume transport and spreading. Under neap slack conditions, the plume remains highly localized near the release point due to minimal hydrodynamic forcing, resulting in limited transport and relatively higher concentrations within a confined area. During the rising spring tide, stronger tidal currents drive the plume in the upstream direction, increasing its spatial spread while reducing peak concentrations due to enhanced mixing and dilution. The falling spring tide during monsoon conditions produces the largest plume extent, where high river discharge combined with ebb tide results in strong downstream transport and a more elongated and dispersed plume. Figure 4-1 shows the statistical maximum suspended total mass including all fractions of heavy oil plume for three (3) scenarios.

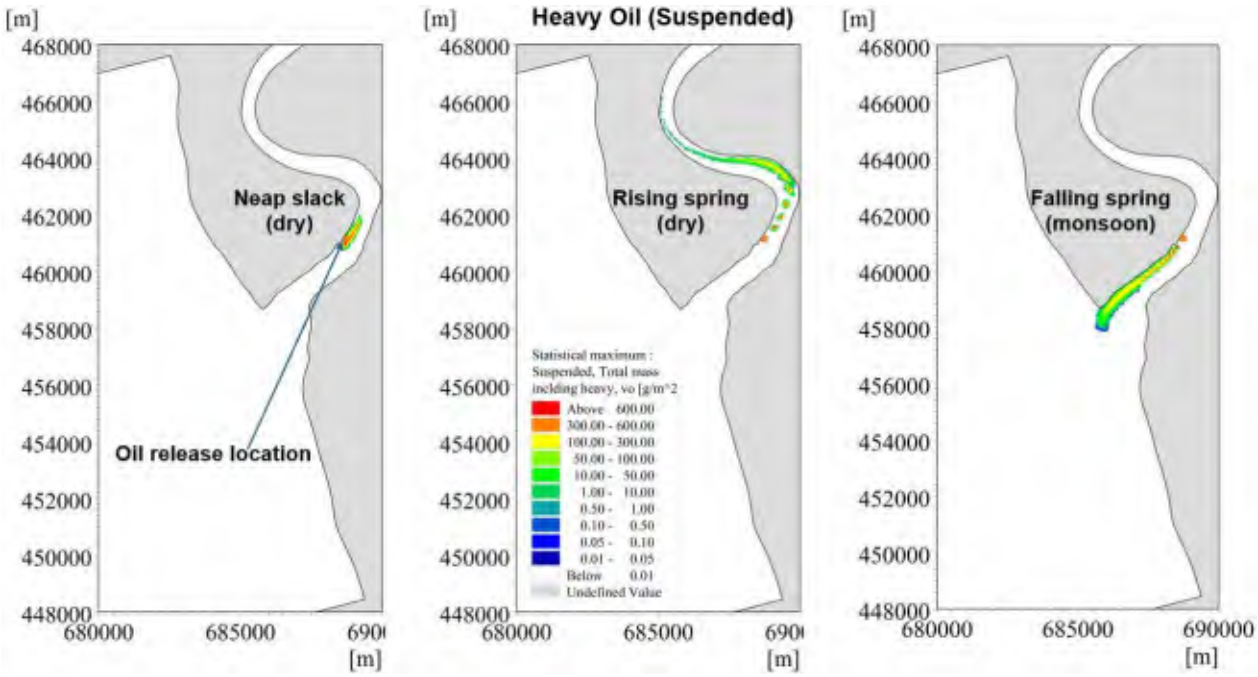


Figure 4-1: Maximum suspended total mass including all fractions of heavy oil plume for three (3) scenarios

Figure 4-2 presents the maximum sedimented heavy oil mass (all fractions) under the three hydrodynamic conditions. In contrast to the suspended oil distribution, the sedimented oil is more spatially confined and primarily distributed along the riverbanks, with little to no deposition in the main channel.

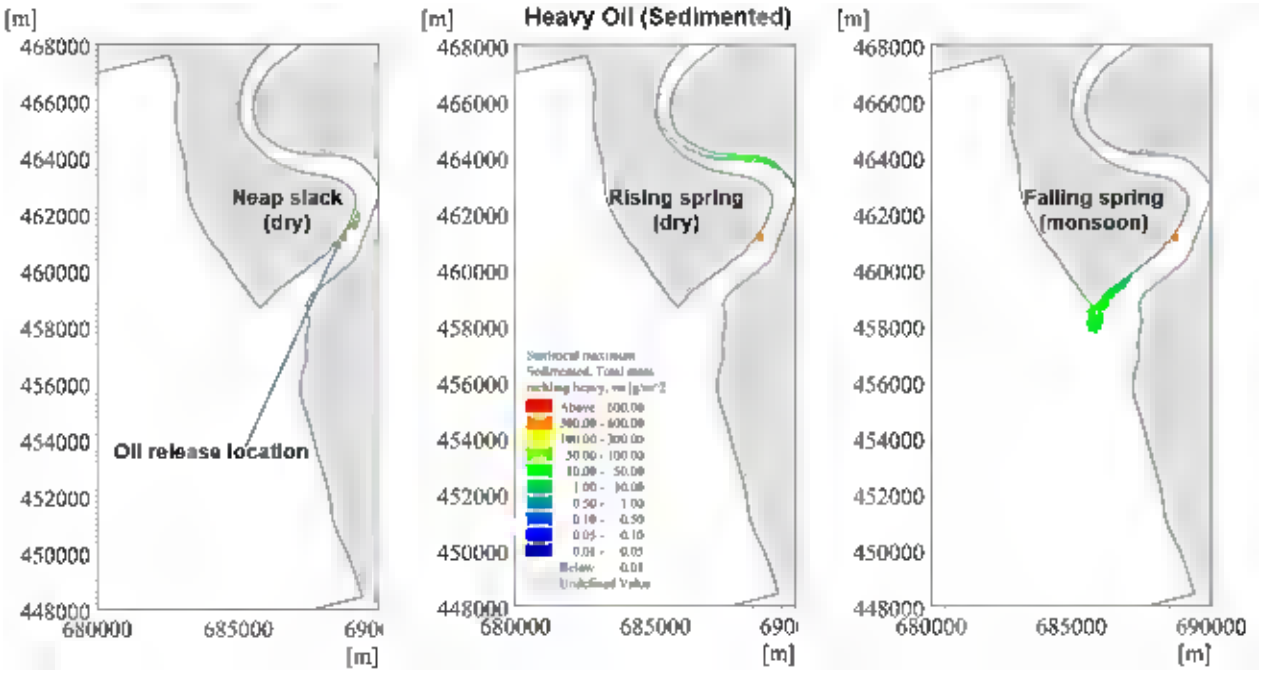


Figure 4-2: Maximum sedimented total mass including all fractions of heavy oil plume for three (3) scenarios

Figure 4-3 shows the oil plume movement after release from the source during monsoon ebbing period. After release, the heavy oil initially remains close to the source (30 minutes). At 60 minutes, the plume begins to advect downstream with slight spreading, while at 90 minutes it is transported further downstream with greater dispersion and lower concentration. After 90 minutes, the suspended plume is no longer clearly visible, indicating a significant reduction in suspended mass due to ongoing deposition.

Figure 4-4 shows the corresponding evolution of sedimented heavy oil mass. Deposition becomes noticeable after approximately 60 minutes downstream of the release point. The sedimented oil mass increases further at 90 and 120 minutes, forming a clear deposition pathway along the flow direction. This deposited oil remains until the end of the simulation.

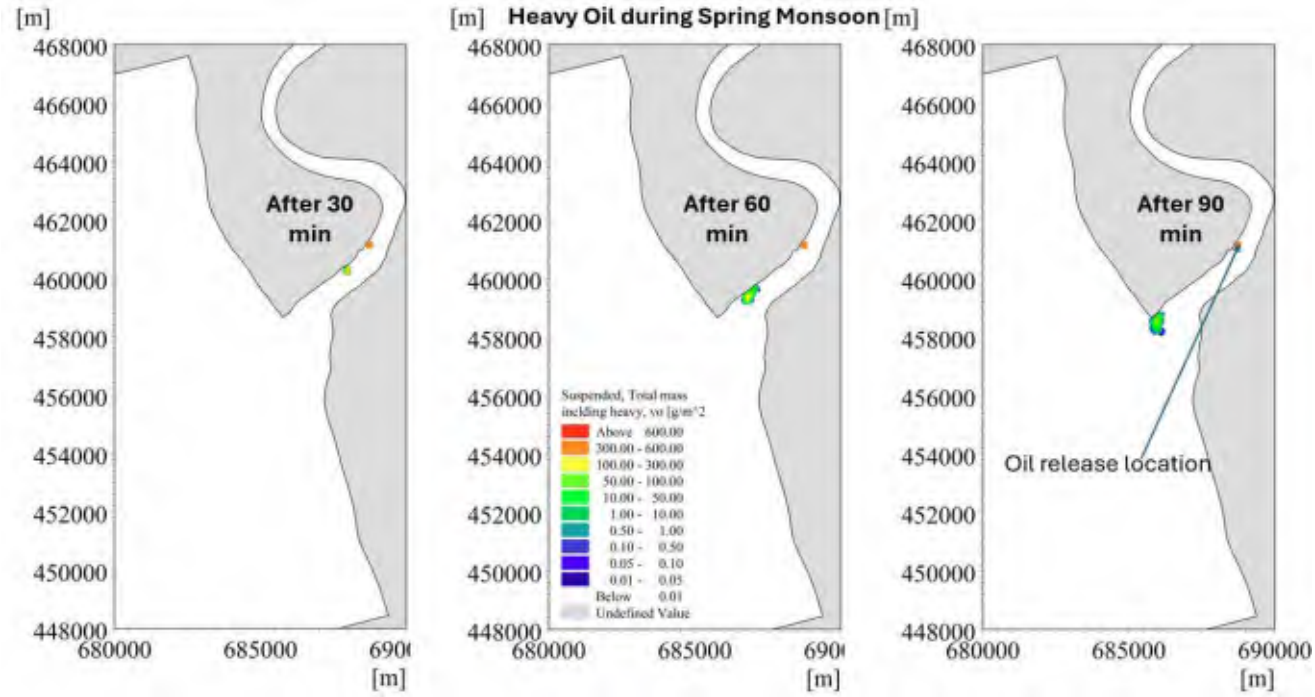


Figure 4-3: Suspended Heavy oil plume movement after release from the source during monsoon scenario.

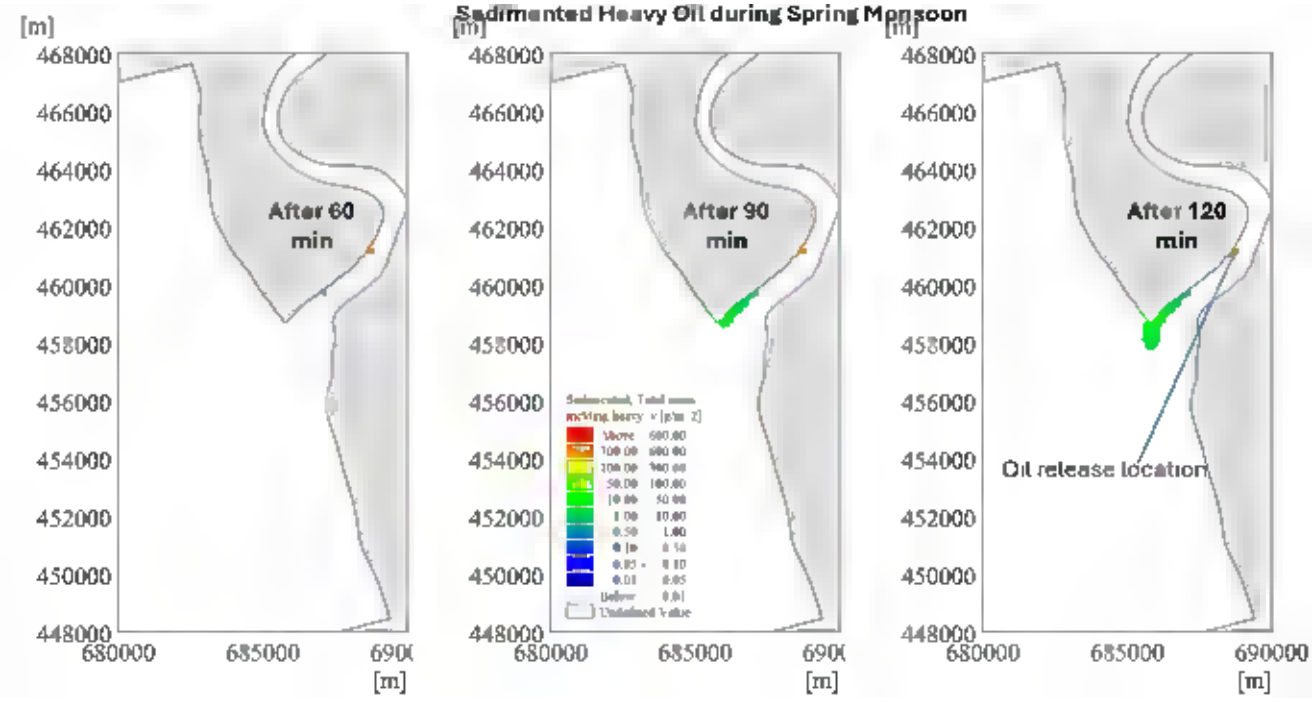


Figure 4-4: Sedimented Heavy oil plume movement after release from the source during monsoon scenario.

4.2 Diesel oil spill during bunkering

Diesel oil exhibits substantially greater spreading than heavy oil under all simulated conditions due to its relatively low viscosity and high mobility. During the neap slack condition (dry season), the suspended diesel plume remains relatively narrow and confined within the navigation channel, with transport occurring mainly in the upstream direction from the release location. Under the rising spring tide (dry season), stronger tidal currents enhance upstream advection and longitudinal spreading, producing a longer and more continuous plume along the channel. In contrast, during the falling spring tide under monsoon conditions, increased river discharge and dominant ebb flow reverse the transport direction and carry the diesel oil far downstream, resulting in a wide and elongated plume extending over a large section of the river. The monsoon condition therefore produces the largest affected area and strongest overall dispersion of suspended diesel oil. Figure 4-5 shows the statistical maximum suspended total mass including all fraction of diesel oil plume for three (3) scenarios.

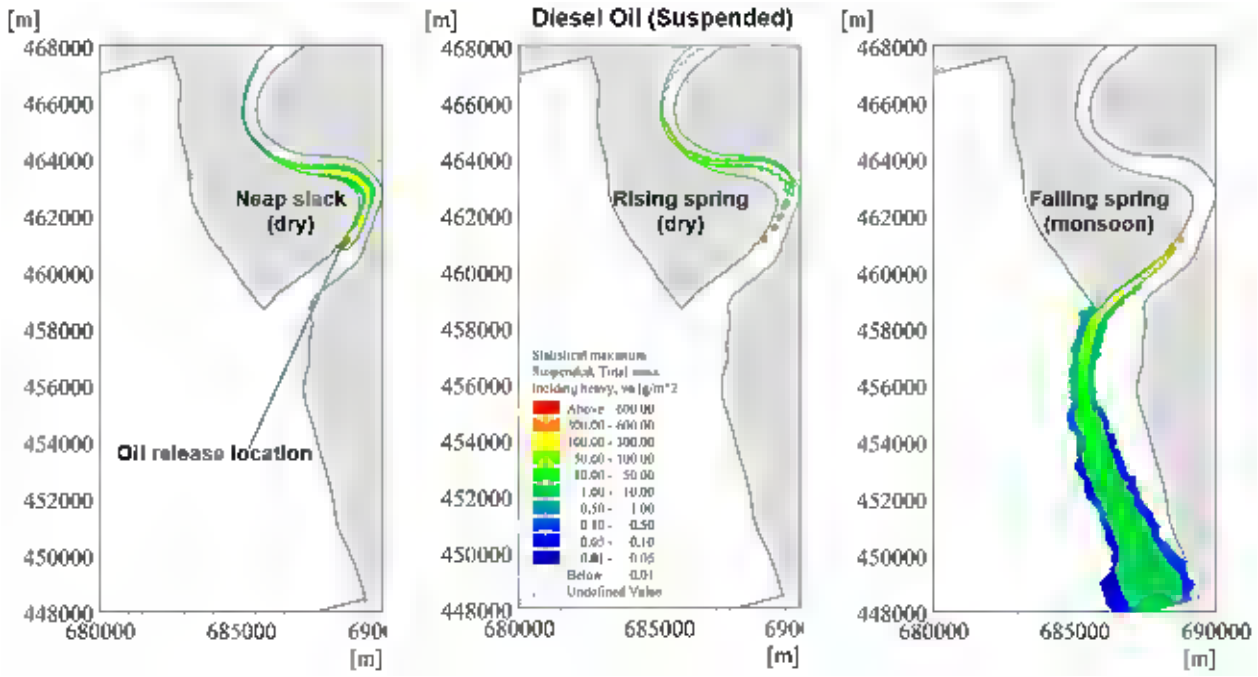


Figure 4-5: Maximum suspended total mass including all fractions of diesel oil plume for three (3) scenarios

Figure 4-6 shows the diesel oil plume movement after release from the source during monsoon ebbing period. After release, the diesel oil starts spreading downstream within 1 hour, forming a small but visible plume near the source. By 2 hours, the oil is transported further downstream, with a more dispersed and elongated plume due to strong river flow. After 3 hours, the plume has moved significantly downstream and spread over a wider area, although concentrations are lower due to dilution. Unlike heavy oil, the diesel oil remains present even after 3 hours, indicating slower dissipation and greater transport under monsoon conditions.

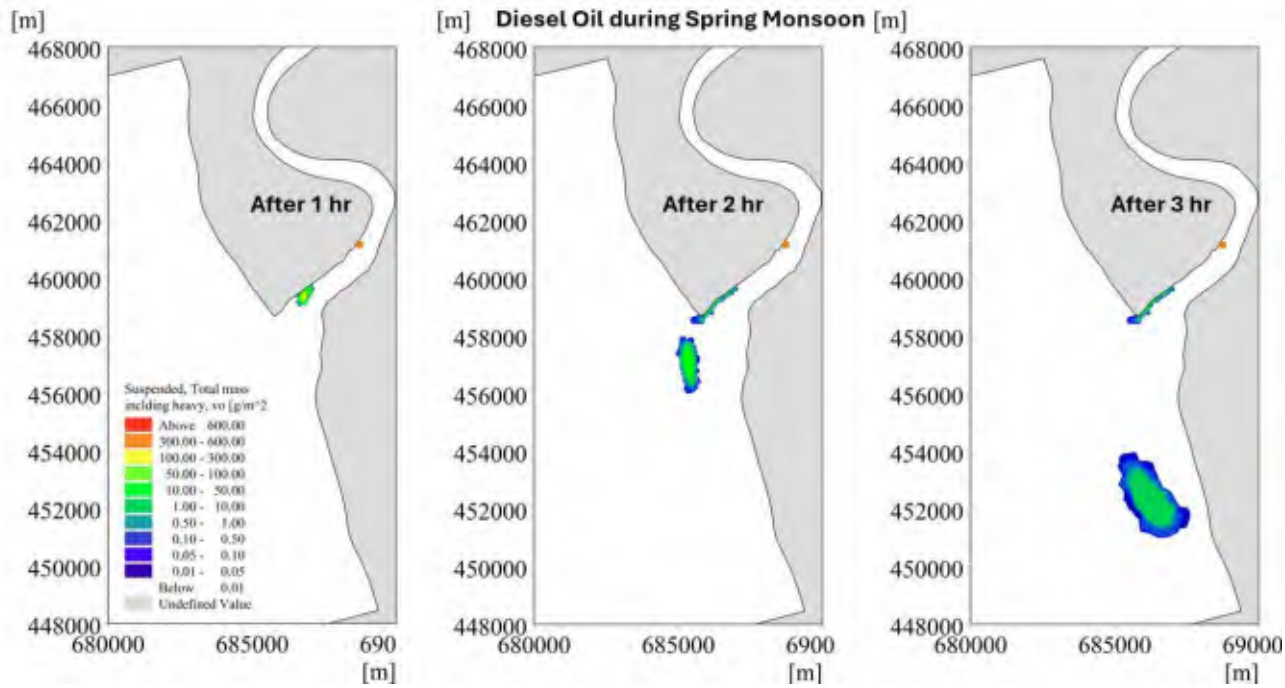


Figure 4-6: Diesel oil plume movement after release from the source during monsoon scenario

The mass balance time series under monsoon conditions (Figure 4-7) highlights the distinct transport and fate characteristics of diesel oil and heavy oil. For diesel oil, the suspended oil mass decreases rapidly after approximately 19:00, partly because part of the oil plume moves out of the model domain under strong monsoonal flow conditions. This diesel oil may transport further downstream, where it gradually will dilute and evaporate. Although the suspended mass within the model domain decreases significantly, this does not necessarily indicate complete removal of the oil from the environment, as part of the plume remains transported downstream in suspension beyond the computational boundary. In addition, evaporation contributes to the gradual reduction of diesel oil mass in the first hours after the spill due to its relatively high volatile fraction. Sedimented diesel oil mass remains negligible throughout the simulation, indicating limited deposition along the riverbed and banks.

In contrast, heavy oil exhibits minimal evaporation and a rapid transition from the suspended phase to the sedimented phase. Shortly after release, suspended heavy oil mass decreases sharply while sedimented mass increases rapidly, reaching approximately 9,000–10,000 kg. This indicates that heavy oil is primarily controlled by deposition and accumulation processes, leading to significant retention along the riverbed and nearshore areas.

Overall, the results demonstrate that diesel oil is dominated by downstream transport and evaporation processes, whereas heavy oil is governed mainly by sedimentation and long-term accumulation within the study area.

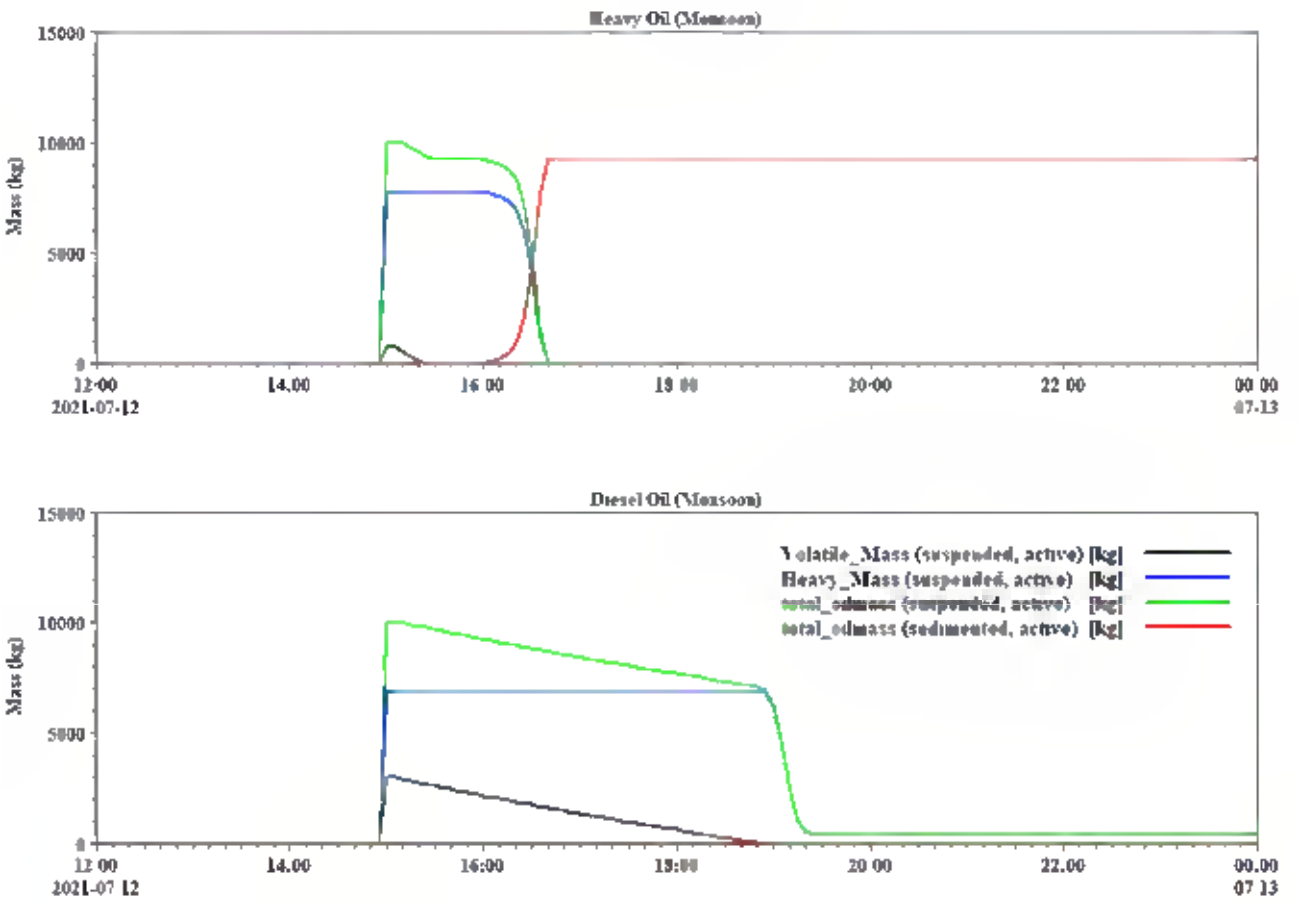


Figure 4-7: Mass balance time series of diesel and heavy oil under monsoon conditions.

4.3 Lubricant oil

The spatial distribution and mass budget timeseries plot (Figure 4-8 and Figure 4-9) indicate that lubricating oil released under the high leakage scenario is transported predominantly along the main navigation channel, with localized accumulation occurring near the riverbanks and low-flow zones. The suspended oil concentration maps (Figure 4-8) show that oil remains widely distributed within the water column under all hydrodynamic conditions, particularly along the eastern bank downstream of the release location. Comparatively, the spring monsoon condition exhibits the widest spatial spreading due to stronger hydrodynamic forcing and enhanced downstream transport.

The sedimented oil maps (Figure 4-8) indicate relatively limited but persistent deposition along the banks and nearshore areas. Sedimentation is concentrated mainly adjacent to the transport pathway, suggesting that deposition occurs preferentially in low-velocity regions where settling processes dominate. Although the sedimented concentrations are lower than suspended concentrations, the deposited oil remains persistent throughout the simulation period.

The mass budget time series (Figure 4-9) further confirms these observations. Under all scenarios, the suspended oil mass continuously increases with time and represents the dominant fraction of the released oil. The volatile fraction remains negligible, reflecting the low evaporation potential of lubricating oil. Simultaneously, the sedimented oil mass gradually increases throughout the simulation, indicating continuous deposition along the riverbanks and bed. By the end of the simulations, sedimented oil mass

reaches approximately 0.16–0.22 kg, corresponding to roughly 35–50% of the active oil mass depending on the hydrodynamic condition.

Periodic oscillations in both suspended and sedimented mass shown in Figure 4-9 are associated with tidal variations. Stronger tidal currents periodically resuspend deposited oil, while weaker flow conditions promote settling and shoreline accumulation. Among the three scenarios, the spring monsoon condition shows comparatively higher sedimented mass and wider spatial dispersion, indicating greater potential for shoreline impact under energetic hydrodynamic conditions. Overall, the results demonstrate that lubricating oil undergoes continuous transport while also exhibiting progressive long-term accumulation along the riverbanks and near-bed regions.

The lubricating oil spill model results for continuous leakage scenarios under medium (14 L/day) and low (12 L/day) discharge conditions are presented in Appendix A2.

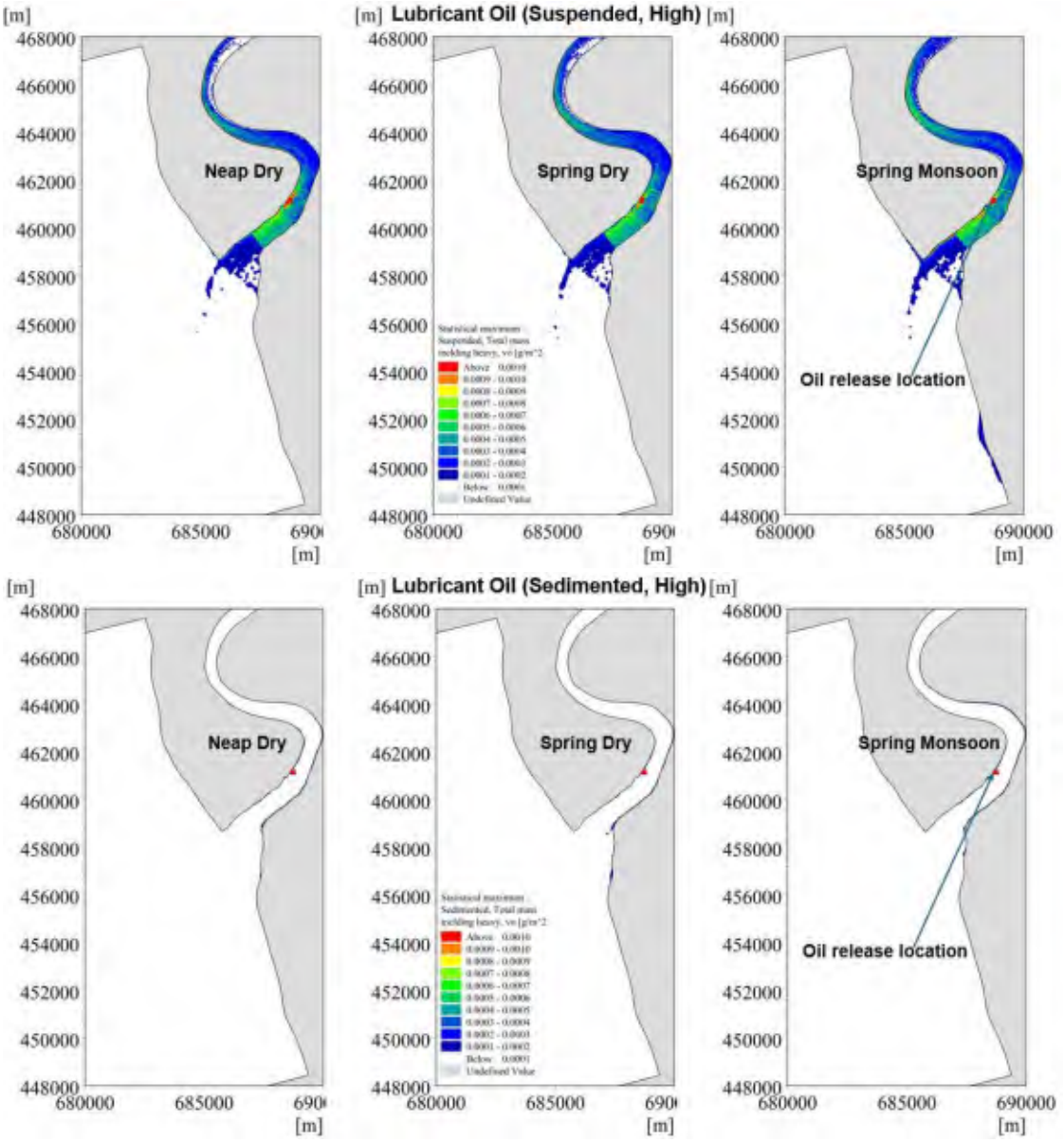


Figure 4-8: Maximum suspended (upper panel) and sedimented (lower panel) total mass including all fractions of lubricant oil plume for three (3) scenarios

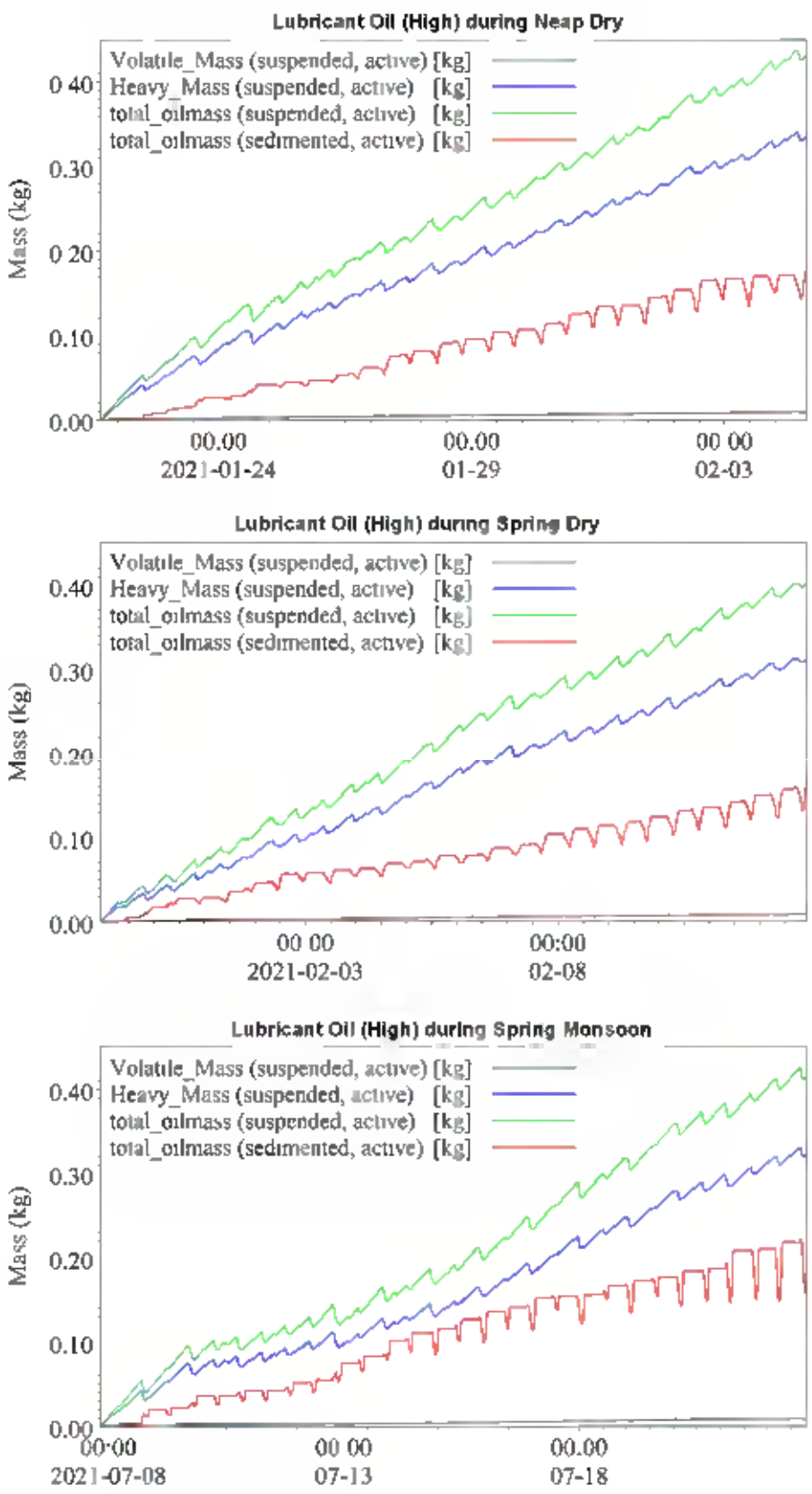


Figure 4-9: Mass balance time series of lubricant oil high plume under three (3) scenarios

5 Conclusions

As part of the ESIA for the proposed Laldia Container Terminal Project, an oil spill modelling study was conducted to assess the transport, spreading, weathering, and fate of potential oil spills in the Karnaphuli River under representative operational and hydrodynamic conditions. The simulations considered accidental spills of heavy oil and diesel oil during bunkering operations, as well as continuous low-rate leakage of lubricating oil during routine vessel activities.

The modelling results demonstrate that tidal dynamics and river discharge strongly influence oil transport and plume behaviour. Under monsoon conditions, stronger river discharge and ebb currents produce greater downstream transport and wider plume spreading, whereas neap tide conditions generally result in more localized impacts.

Heavy oil exhibits rapid deposition and accumulation near the release area and along riverbanks. Following release, the suspended plume decreases substantially within a relatively short period due to sedimentation, with a large fraction of the oil becoming deposited on the riverbed and nearshore zones. Although the simulated heavy oil spill represents a short-duration accidental event, the results indicate the potential for localized environmental impacts associated with sediment contamination and shoreline accumulation if such an incident occurs.

Diesel oil behaves differently due to its lighter and more volatile characteristics. The simulations show that diesel oil remains predominantly in suspension and is transported rapidly downstream, particularly during monsoon conditions. Evaporation contributes significantly to mass reduction, while sedimentation remains limited. Consequently, diesel oil is expected to have lower long-term accumulation potential within the study area compared to heavy oil, although temporary short-term impacts associated with plume transport and water surface contamination may occur following an accidental spill.

The continuous lubricating oil leakage scenarios represent comparatively low-magnitude releases. The modelling results indicate low suspended and sedimented oil concentrations with localized accumulation mainly near riverbanks and low-flow areas adjacent to the terminal. The spring monsoon condition produces the widest spatial spreading; however, the overall environmental impact remains limited under normal operational conditions due to the relatively small leakage volumes and low concentrations.

Overall, the study indicates that accidental heavy oil spills represent the most environmentally significant scenario because of their persistence and sedimentation potential. Diesel oil spills are characterized mainly by rapid downstream transport and evaporation, while continuous lubricating oil leakage is expected to result in comparatively minor and localized impacts. The findings highlight the importance of maintaining effective bunkering procedures, spill prevention systems, and emergency response measures to minimize the potential environmental risks associated with terminal operations.

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7 Appendixes

Appendix A1: DHI Spill Analysis Data Sheet ((DHI, 2024)

Representative oil type			Light oil	Middle oil, Low aromatics	Middle oil, High aromatics	Medium crude oil	Heavy fuel oil
Source magnitude	**State variables**	**unit**					
Weight	Volatile oil fractions	wt%	72.9	30	30	8	7.5
	Heavy oil fractions	wt%	26.09	68.99	68.99	78.3	77.5
	Asphaltene	wt%	0.01	0.01	0.01	11.5	8
	Wax	wt%	1	1	1	2.2	7
Processes	**Class constants**						
	Schmidt number		2.7	2.7	2.7	2.7	2.7
	Average molecular weight of volatile fraction	g/mol	123	123	116	121	123
	Vapore pressure of volatile fraction (atm)	atm	0.005	0.005	0.006	0.005	0.005
Simple evaporation	Distillation percentage at 180oC	%	22.5	10	10	5	5
Spreading	terminal thickness	m	0.0001	0.0001	0.0001	0.0001	0.0001
Biodegradation	Decay rate, volatile fraction	per day	0.005	0.005	0.005	0.005	0.005
	Decay rate, in-volatile fraction	per day	0	0	0	0	0
Emulsification	Maxiumum water fraction	m^3/m^3	0.5	0.5	0.5	0.85	0.85
	Kao constant		3.3	3.3	3.3	3.3	3.3
	Kaw constant		200	200	200	200	200
	Emulsion rate	s/m^2	2.00E-06	2.00E-06	2.00E-06	2.00E-06	2.00E-06
Buoyancy	Density of oil at 20oC, volatile fraction	kg/m^3	789	796	796	813	787
	Density of oil at 20oC, heavy fraction	kg/m^3	878	886	886	997	1011
Water solubility	Water solubility, volatile fraction	kg/kg	2.00E-05	2.00E-05	2.00E-05	2.00E-05	2.00E-05
	Water solubility, heavy fraction	kg/kg	2.00E-07	2.00E-07	2.00E-07	2.00E-07	2.00E-07
Volumentric temperature expansion coefficient	Volatile oil fraction	1/°C	0.0007	0.0007	0.0007	0.0007	0.0007
	In-volatile oil fraction	1/°C	0.0007	0.0007	0.0007	0.0007	0.0007
Photooxidation	Decay rate, volatile fraction	per day	0	0	0	0	0
	Decay rate, heavy fraction	per day	0	0	0	0	0
	Light extinction coefficient	1/m	1	1	1	1	1
Dissolution	Dissolution rate, Light fraction	per day	0,4	0,4	0,4	0,4	0,4
	Dissolution rate, heavy fraction	per day	0.4	0.4	0.4	0.4	0.4
Vertical dispersion	Wind speed for wave breaking	m/s	5	5	5	5	5
	Wave energy dissipation rate	$J/m^3/s$	1000	1000	1000	1000	1000
Vertical limits	Max distance below surface for surface amount	m	0.05	0.05	0.05	0.05	0.05
	Max distance above bed for bottom amount	m	0.05	0.05	0.05	0.05	0.05
Viscosity	Mooney constant		0.25	0.25	0.25	0.7	0.7
	Dynamic oil viscosity at reference temperature	cP	1.62	1.68	1.68	1283	209
	Reference temperature for dynamic oil viscosity	°C	40	40	40	40	50
	Coeff. exponential temperature dependency		-0.136	-0.136	-0.136	-0.136	-0.136
Oil_area	Oil_area growth rate constant	per sec	150	150	150	150	150

Appendix A2: Simulated results for medium and low lubricant oil leakage scenarios.

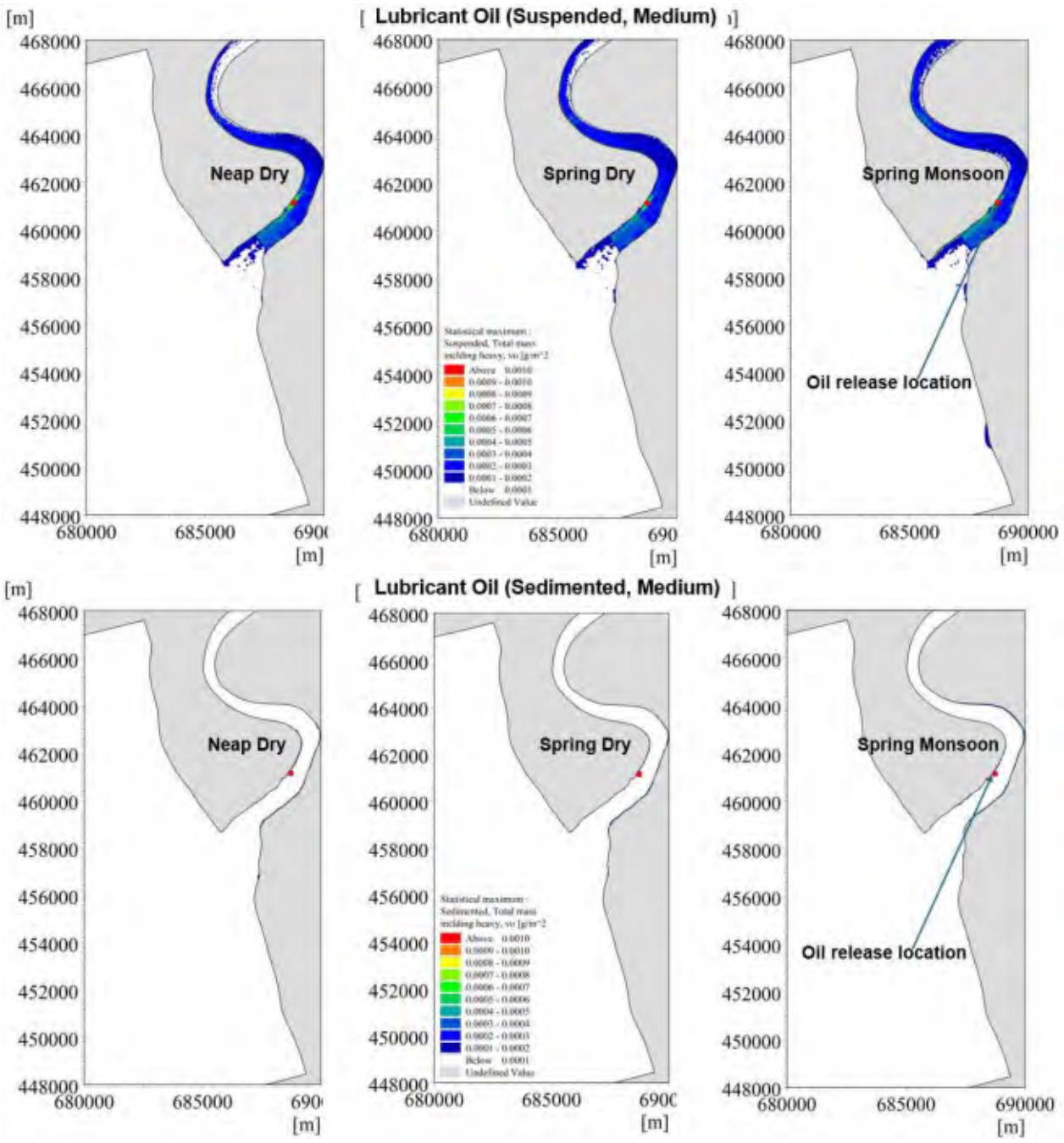


Figure 7-1: Maximum suspended (upper panel) and sedimented (lower panel) total mass including all fractions of medium lubricant oil plume for three (3) scenarios.

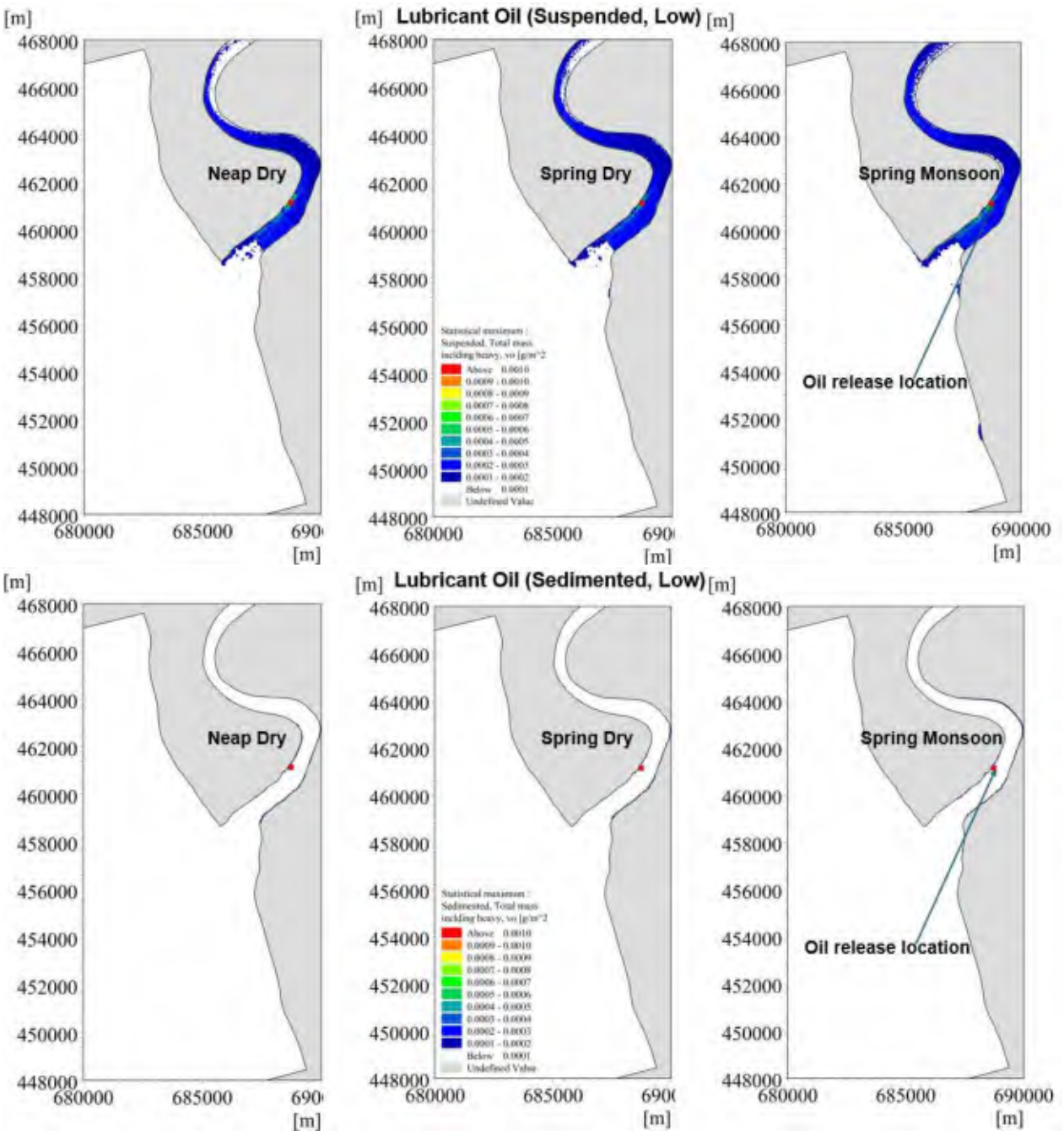


Figure 7-2: Maximum suspended (upper panel) and sedimented (lower panel) total mass including all fractions of low lubricant oil plume for three (3) scenarios.

Annex C6 – Specialist Study: Morphological changes modelling

REPORT

Morphological Modelling Report

Laldia Container Terminal ESIA

Client:	Laldia Container Terminal Limited
Reference:	BK4589-HAS-SP-XX-RP-EV-0004
Status:	S5/P02
Date:	20 August 2026

IWM Water Environment, Climate & ICT

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Subtitle:	Laldia Container Terminal ESIA
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Date:	20 August 2026
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Drafted by:	ESIA Team
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Date:	03-08-2026
Approved by:	Jurriaan de Jong
Date:	17-08-2026
Classification:	Project related

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1 Introduction

1.1 Project background

The Laldia Container Terminal Project (LCTP, or the Project) is a strategic initiative to address port congestion challenges in Chattogram by expanding container handling capacity and improving operational efficiency at the Port of Chattogram. Located at Laldia Char along the right bank of the Karnaphuli River in Chattogram, the terminal will add approximately 0.8 million Twenty-Foot Equivalent Unit (TEU) per year of new handling capacity. This will relieve pressure on existing terminals, reduce congestion and vessel waiting times and strengthen maritime logistics performance to support Bangladesh's trade competitiveness and regional connectivity.

The terminal is being developed under a Public-Private Partnership (PPP) between the Chittagong Port Authority (CPA) and Laldia Container Terminal Ltd. (LCT Ltd.), a joint venture between APM Terminals (APMT) and QNS Container Services Ltd. (QNS Ltd.). A 30-year concession agreement (CA) for the design, financing, construction, operation and maintenance of the terminal was signed on 17 November 2025, representing one of the largest PPP investments in Bangladesh's port sector. LCT Ltd.'s involvement brings international expertise in container-terminal management, digital optimization, energy-efficient operations, and global best practice in port safety and reliability, supporting the long-term modernization of the Port of Chattogram.

The development of LCTP will take environmental and social aspects into account and therefore an Environmental and Social Impact Assessment (ESIA) is being prepared. This ESIA is prepared for permitting purposes in Bangladesh with the Department of Environment (DoE).

1.2 Environmental and Social Impact Assessment (ESIA) objective

The preparation of the ESIA aims to evaluate and address all material environmental and social effects from the preparation, construction, operation, and future decommissioning of the LCTP. The goal is to enhance benefits and reduce adverse project effects. A comparative analysis of alternatives will be conducted, and the results, including enhancement and mitigation measures, will be, where possible, incorporated into the port's final design and operational management. This is intended to improve the project's environmental and social performance.

The ESIA will address not only the port itself but also all associated facilities that could have either a direct or indirect environmental impact.

The ESIA will be prepared in compliance with Bangladeshi Regulations to obtain an Site Clearance Certificate (SCC) from the DoE prior to commencement of construction, and an Environmental Clearance Certificate (ECC) prior to commencement of terminal operations.

1.3 Objectives of morphological changes modelling report

As part of the ESIA study, morphological modelling of the Karnaphuli River is conducted to determine the re-siltation rate in the dredged berth pocket of Block C and the bed level change in the Karnaphuli River

area around the proposed Laldia Container Terminal caused by the capital dredging and engineering structures inside the river.

1.4 General approach

The basis of these modelling studies is a MIKE 3 hydrodynamic model describing the tidal and river currents in Karnaphuli River (Haskoning, 2026a).

This hydrodynamic model is coupled with the MIKE 3 Sand Transport (ST) and MIKE 3 Mud Transport (MT) modules to simulate the sediment transport and associated bed level change in the downstream part of the Karnaphuli River. The ST module is used to simulate the relatively coarse part of the sediment in Karnaphuli River, while the MT module is used to simulate the relatively fine part of the sediment.

In this study, two situations are modelled:

- Present situation without Laldia Container Terminal
- Future situation with Laldia Container Terminal (see Chapter 2)

Each of these two situations are modelled for a dry season period and monsoon period.

2 Conceptual Design

2.1 Introduction

In this chapter, the components of the Conceptual Design relevant for the morphological impact modelling are described.

The project developments are separated in three areas: Block A, Block B and Block C (Figure 2-1). Blocks A and Block B are considered to be irrelevant for the morphological impact assessment, as Block A is not located along the riverbanks and Block B already is a paved area with bank protection. Only the developments along the riverside of Block C are considered to potentially affect the sediment transport and morphology in the Karnaphuli River.

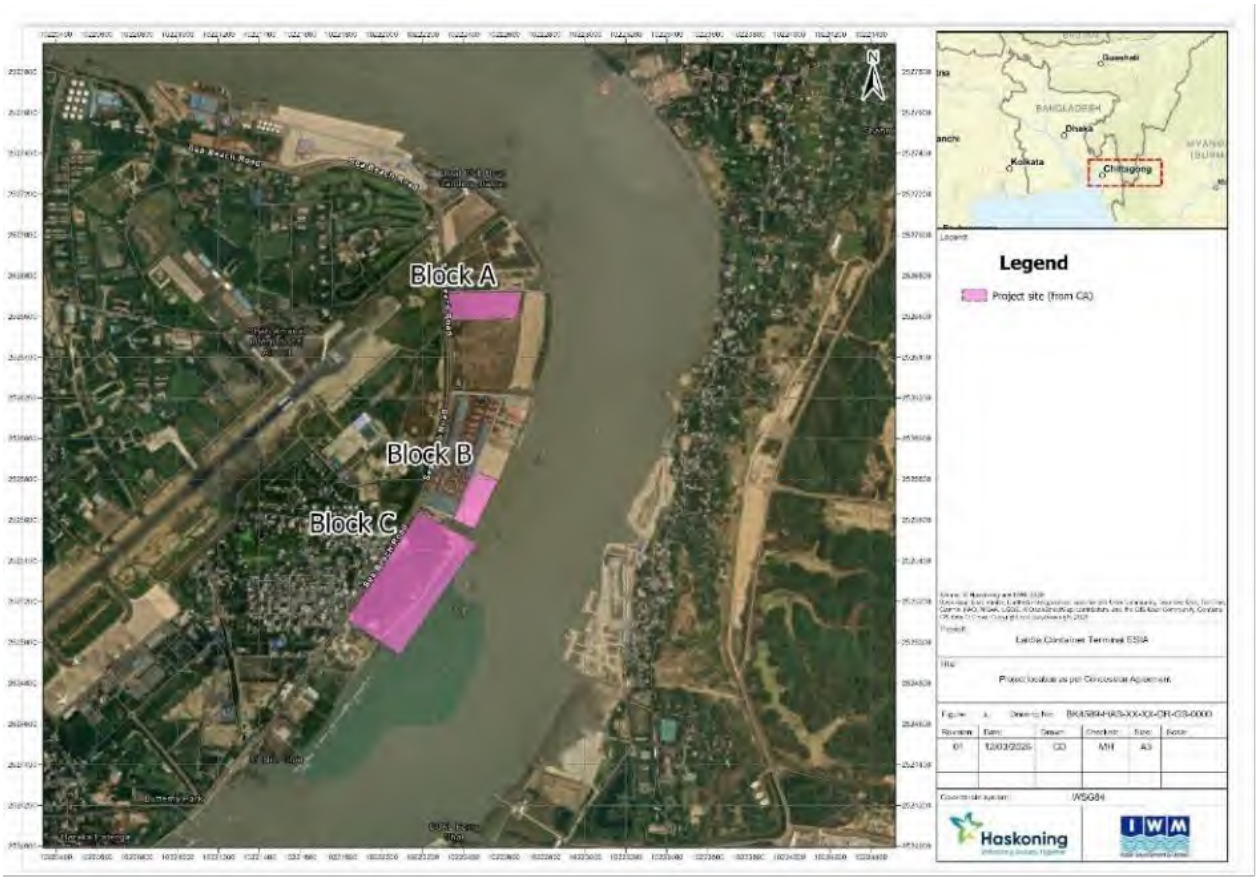


Figure 2-1: Project site layout showing Blocks A, B, and C

2.2 Riverside Developments of Block C

The riverside developments of Block C, as described in the Concept Design, are shown in the cross-sectional view of Figure 2-2 and the plan view of Figure 2-3. The riverside development consists of three main components, which are described in more detail in the following sections:

- Land reclamation (green zone in upper drawing of Figure 2-3)

- Deck on piles between the land reclamation and berth pocket (purple zone in upper drawing of Figure 2-3)
- Dredged berth pocket (hatched zone in upper drawing of Figure 2-3)

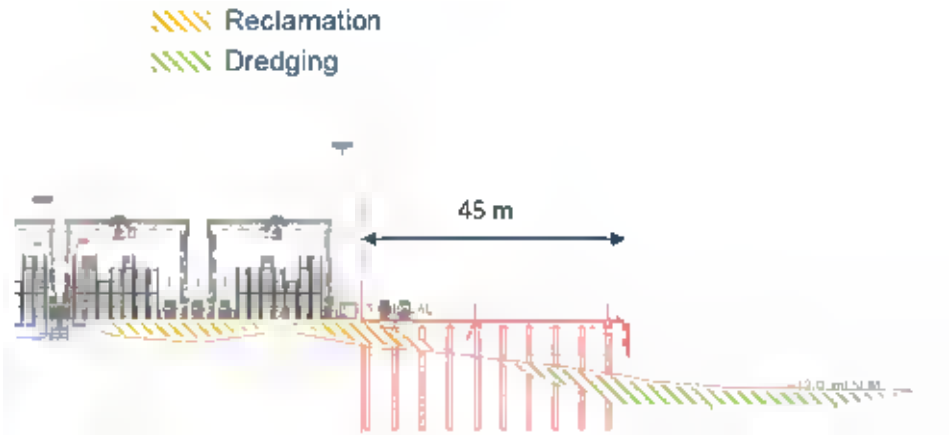


Figure 2-2: Cross-sectional view of the land reclamation, deck on piles and dredging along Block C in the Conceptual Design



Figure 2-3: Plan view of Blocks B and C with dredging, deck on piles and land reclamation areas along Block C. Source: APM-056-01A-12-3 (top) and APM-056-01A-08-2 (bottom).

2.3 Land reclamation of Block C

Following the Concept Design, the width of the land reclamation varies from nihil at the upstream end of Block C, to approximately 100 m at the downstream end of Block C. The surface level of the land reclamation is slightly less than +8 m CD. The riverside slope of the land reclamation is undefined yet but is assumed to be in the order of 1:3. No revetment along the riverside slope of the land reclamation is foreseen.

Following the Concept Design, the southern (downstream) boundary of the land reclamation is finished with a vertical wall.

2.4 Deck on piles of Block C

Following the Concept Design, the deck on piles of Block C has a width of at minimum 45 m and a length of about 613 m. Its surface level is at +8 m CD.

The deck will be supported by a set of reinforced concrete piles, see Figure 2-4 as example. The exact design of these piles is unknown at this stage. For purpose of the morphological impact modelling, a 1-m pile diameter and a 6.5-m pile spacing are assumed, equal to an earlier modelling study (HR Wallingford, 2024).

Along the riverside of the deck on piles, there will be no quay wall. This would mean free flow and sediment transport between the deck on piles zone and the Karnaphuli River (including dredged berth pocket). Depending on the contractor's design, a revetment may be placed underneath the deck on piles to prevent local erosion of the riverbank, among others due to vessel waves and turbulence from vessel propellers. For the morphological modelling study, a riverbank without revetment is assumed, which is considered a conservative approach regarding the sedimentation in the dredged berth pocket.



Figure 2-4: Example of piles under a deck on piles for a container terminal

2.5 Dredged berth pocket of Block C

Following the Concept Design, the design parameters for the berth pocket are the following:

- Design vessel draught is 10.5 meters
- Under-keel clearance is 0.5 m
- Sedimentation buffer is 1.0 m
- Resulting dredging design depth of the berth pocket is -12.0 m CD, which is equal to -12.0 m ISLWL and -14.6 m MSL.

The plan view of the dredging pocket of the mooring area is shown in Figure 2-3, and the cross-sectional profile is shown in Figure 2-5. Without side slopes, the dredging pocket has a length of 723 m and width of 50 m. The dredging pocket has four side slopes, with assumed slopes of approximately 1:2 to 1:3.

The estimated total capital dredging volume for the berth pocket, including side slopes, is ~400,000 m³.

For the morphological modelling, no scour protection on the bottom or slopes of the dredge berth pocket is assumed.

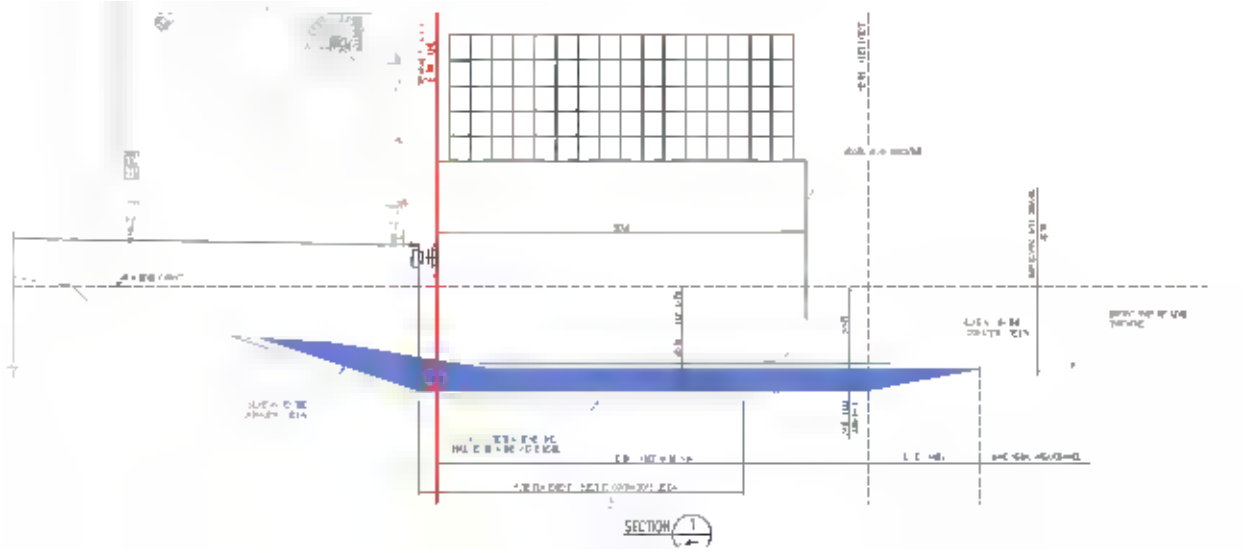


Figure 2-5: Dredging design cross section (source: Asset Design Drawings APM-056-03A-02 rev. 4)

3 Data analysis

3.1 Introduction

In this chapter, the data specifically being used for the morphological modelling are described in detail. For the hydrological and hydrodynamic data that was used for developing the hydrodynamic model, one is referred to the Hydrodynamic Modelling Report (Haskoning, 2026a).

3.2 Bathymetrical data

Three bathymetric datasets are available:

- Year 2020 data, collected in an earlier project (IWM, 2021). In this dataset, the data was collected at 500 m center to center spacing.
- Year 2021 data, which covers the region from the Kalurghat bridge to the outfall of the river. The spacing of the river cross section is 100 meter center to center. The dataset is collected in an earlier study (IWM, 2021b).
- Year 2025 data, which is measured by LCT Ltd. during the project period, and only includes the foreshore of the Laldia Container Terminal area.

These data sets and the hydrographic chart of Bangladesh Navy are composed together to make a complete dataset of model domain bathymetry, as shown in Figure 3-1.

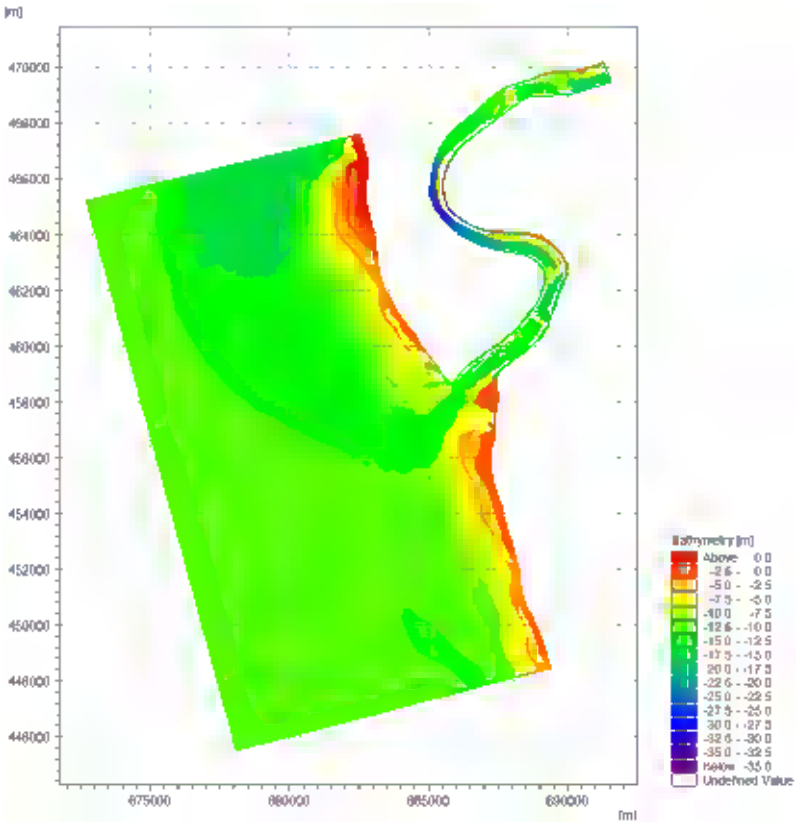


Figure 3-1: Combined bathymetry dataset.

3.3 Riverbed sediment

Some of the main morphological modelling input settings are related to the grain size distribution of the sediment comprising the Karnaphuli River bed. Grain size distributions were obtained from boreholes along Block B and Block C.

The locations of the boreholes along Block B and Block C inside the Karnaphuli River are shown in Figure 3-2. Line 2-2' along Block C, which includes the boreholes MBH-07, MBH-08, MBH-09, MBH-10, MBH-11 and MBH-12, is taken through the to-be-dredged berth pocket.



Figure 3-2: Location of boreholes along Block B (up) and Block C (bottom) in the Karnaphuli River

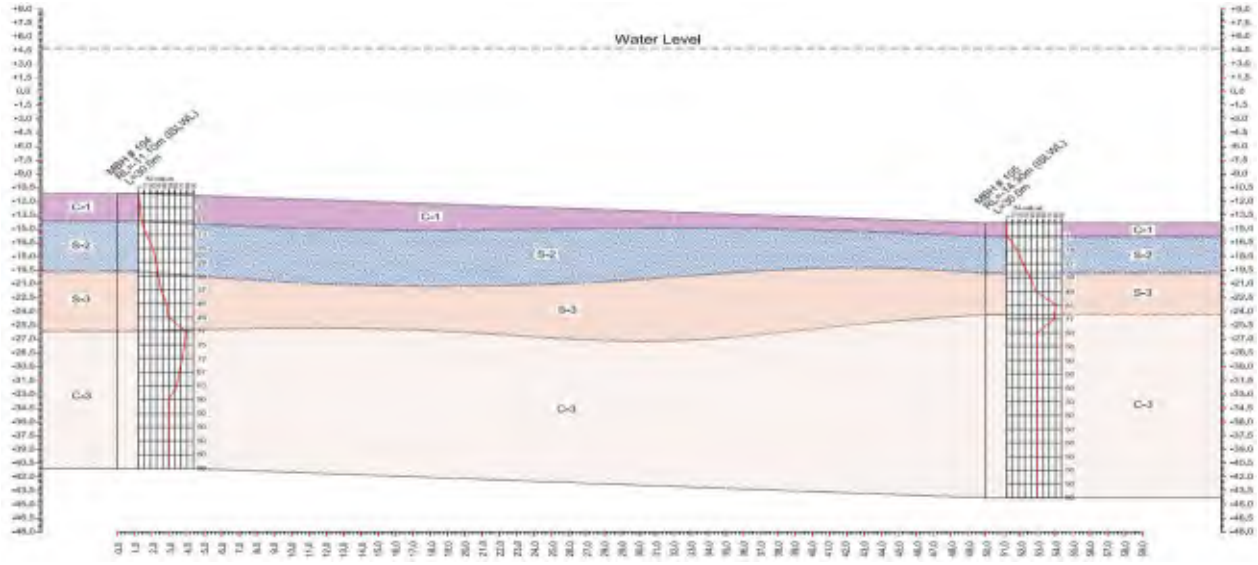


Figure 3-3: Lithology Description of cross-sectional profile 2-2' along Block B.

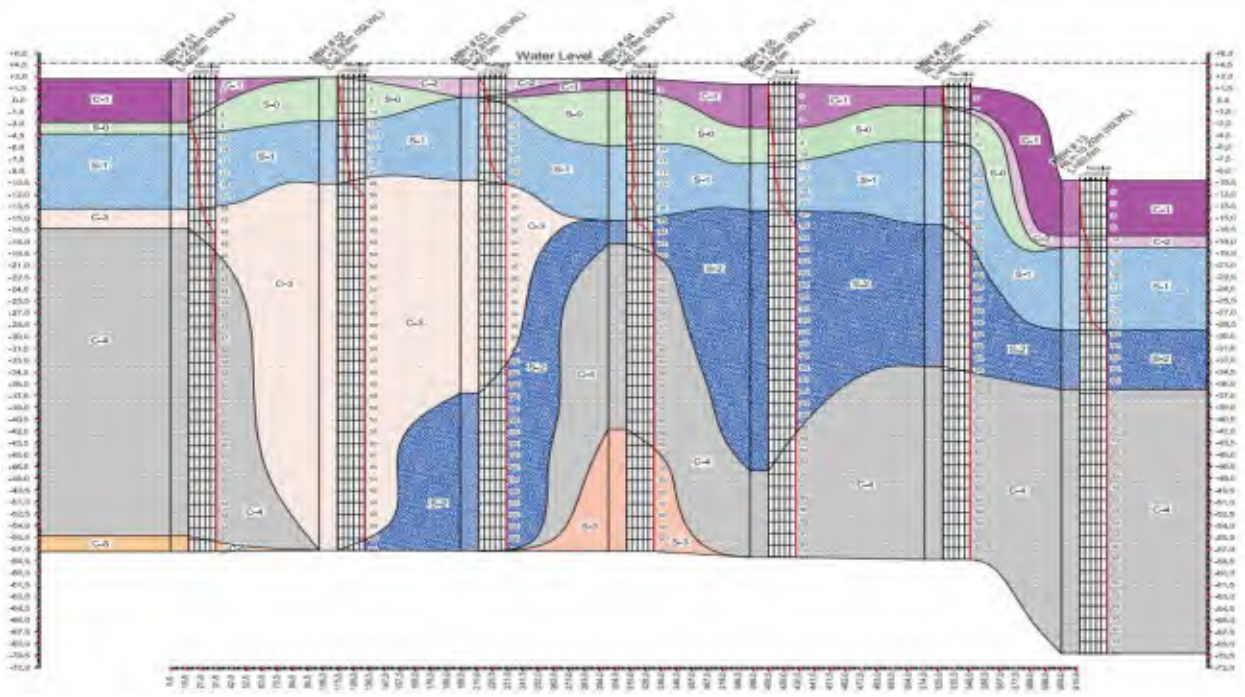


Figure 3-4: Lithology Description of profile 1-1' along Block C.

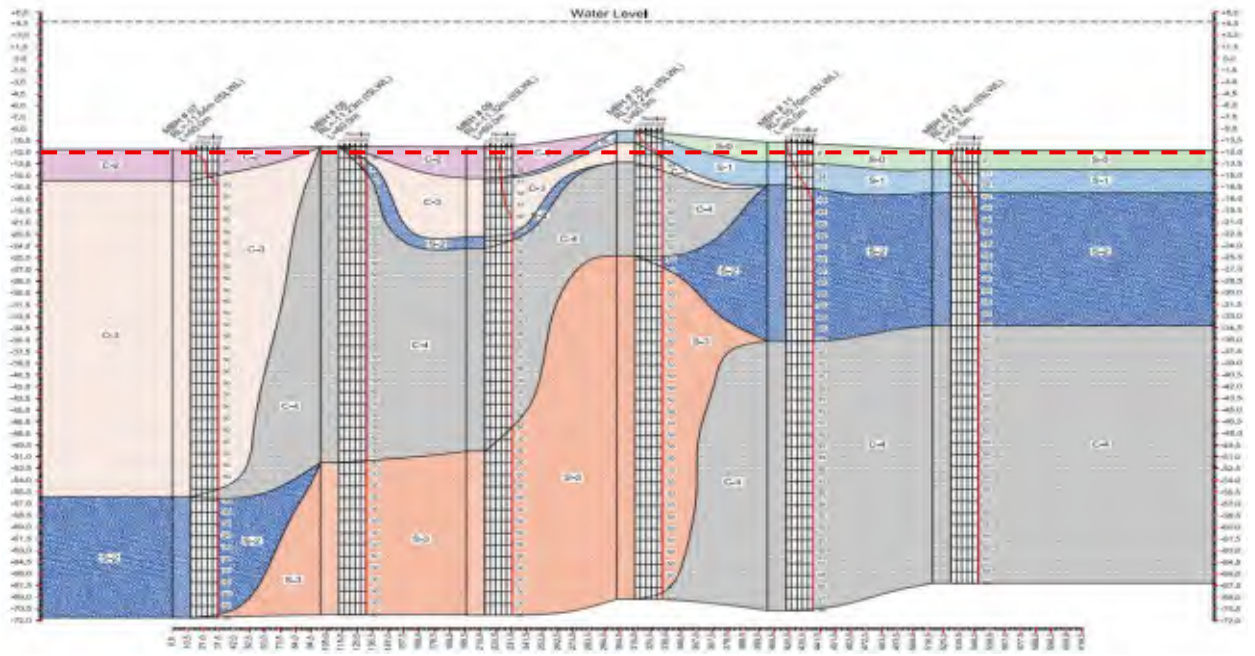


Figure 3-5: Lithology Description of profile 2-2' along Block C.

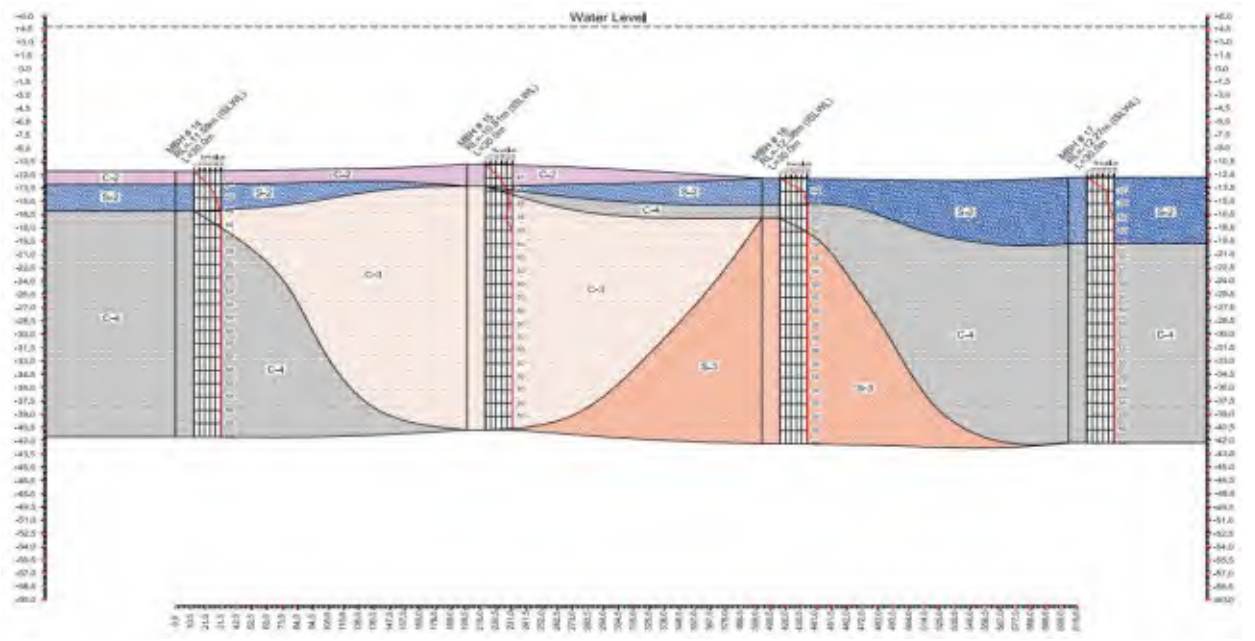


Figure 3-6: Lithology Description of profile 3-3' along Block C.

Layer ID.	USCS Classification
C-1	Lean clay, CL / Lean clay with sand, CL / Clayey sand, SC / Sandy silt, ML
C-2	Lean clay, CL / Lean clay with sand, CL / Fat clay, CH
S-0	Poorly graded sand, SP / Silty sand, SM / Poorly Graded Sand with Silty Clay, SP-SC / Silty, clayey sand, SC-SM
S-1	Poorly graded sand, SP / Poorly graded sand with clay, SP-SC / Clayey sand, SC / Silty sand, SM / Silt with sand, ML / Silty, clayey sand, SC-SM
C-3	Lean Clay, CL / Fat clay, CH
S-2	Poorly graded sand, SP / Poorly Graded Sand with Silty Clay, SP-SC / Silty sand, SM / Silty, clayey sand, SC-SM
C-4	Lean clay, CL / Silt, ML / Fat clay, CH / Sandy lean clay, CL / Lean clay with sand, CL
S-3	Poorly graded Sand, SP / Poorly Graded sand with silty clay, SP-SC
C-5	Lean Clay, CL

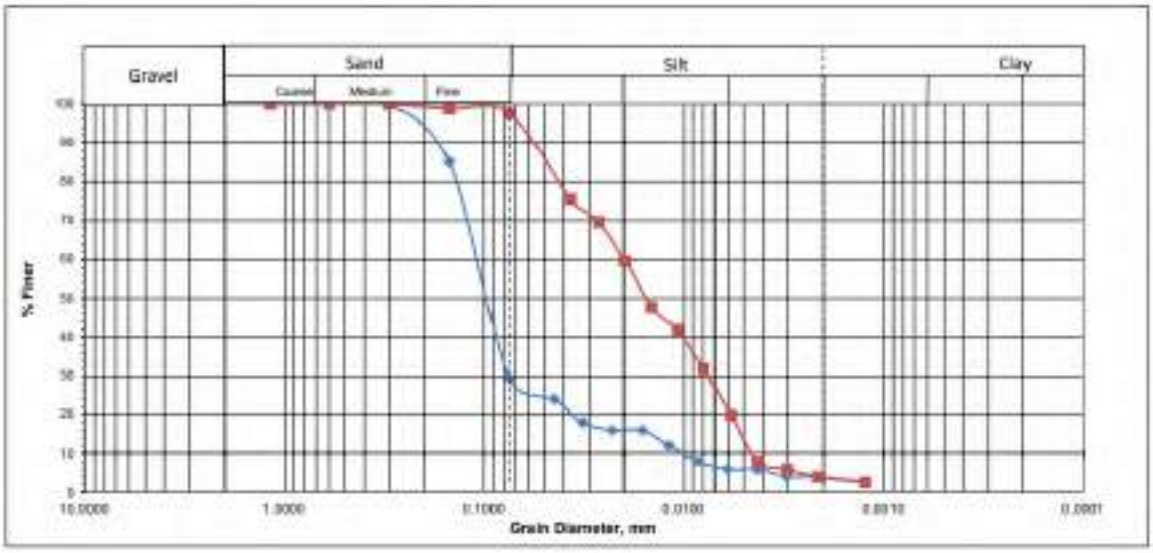
Figure 3-7: Lithography description

Reference is made to Figure 3-5 where the lithography of the dredging scope is provided. The red dashed line represents the dredging level of -12.0 m CD.

Based on the cross-sectional profiles along Block B and Block C, and taking into account that only the top sediment layer is morphologically active, the lithographic classes C1, C2, S0 and S2 are most relevant for the morphological modelling. These classes consist of relatively small amount of clay and a large amount of non-cohesive fine sediment (silt).

Figure 3-8 to Figure 3-11 provide grainsize distributions obtained from the boreholes, considered representative for the riverbed. The majority of the sediment in the upper layer of several meters is within the silt range. The grain size distributions show that both the clay and sand fraction are hardly present in the riverbed.

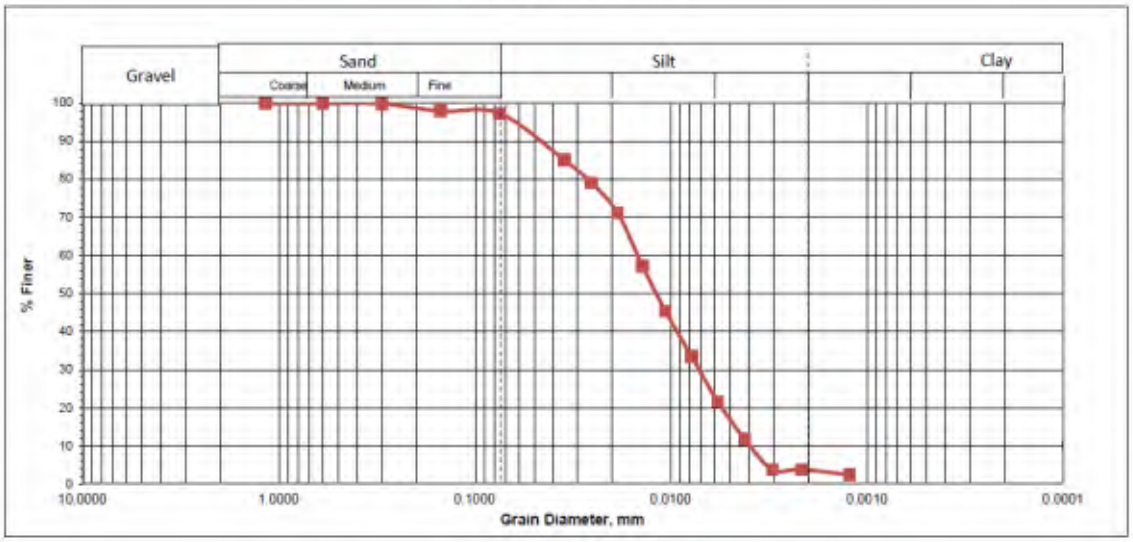
Close to the riverbank, the top layer contains a higher percentage of very fine sand and fine sand with grain sizes below 200 µm. This sand is likely a sand bar in the inner bend of the river.



MBH No.	Sample No.	Depth (m)	Symbol	Sand %			Silt %	Clay %	D_{10}(mm)	D_{30}(mm)	D_{50}(mm)	D_{60}(mm)	Cu	Cc	Silt factor
				Coarse	Medium	Fine									
[illegible]	C-1	[illegible]		0	0	88	25	4	0.0100	0.078	0.1000	0.120	12.000	4.813	0.557
[illegible]	C-3	[illegible]		0	1	1	94	4	0.0047	0.0075	0.0170	0.020	4.256	0.598	0.229

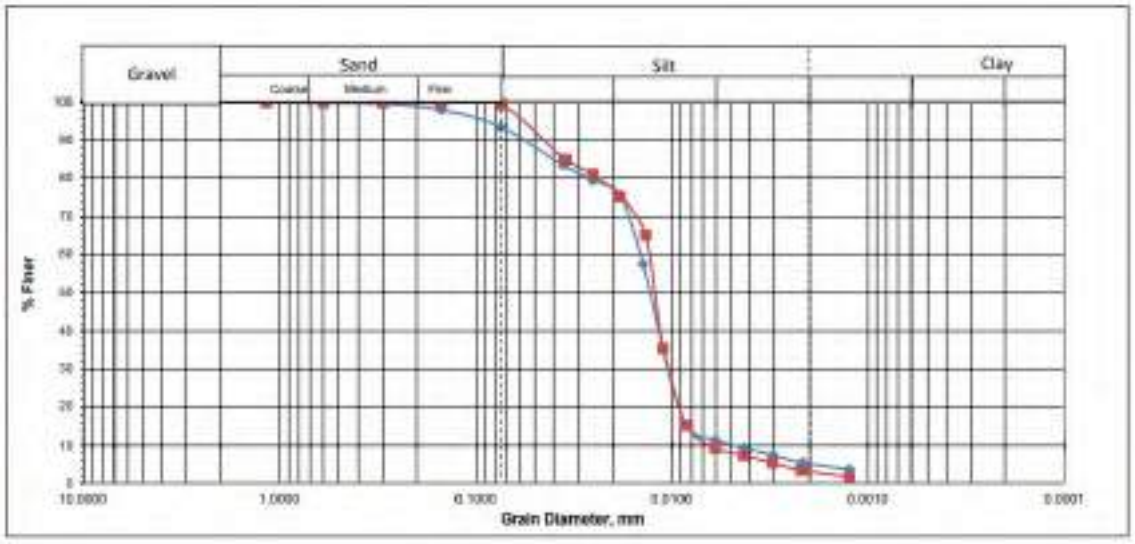
Figure 3-8: PSD MBH-05 0-1.05 and 3.00-4.05 m

Graphical Representation:



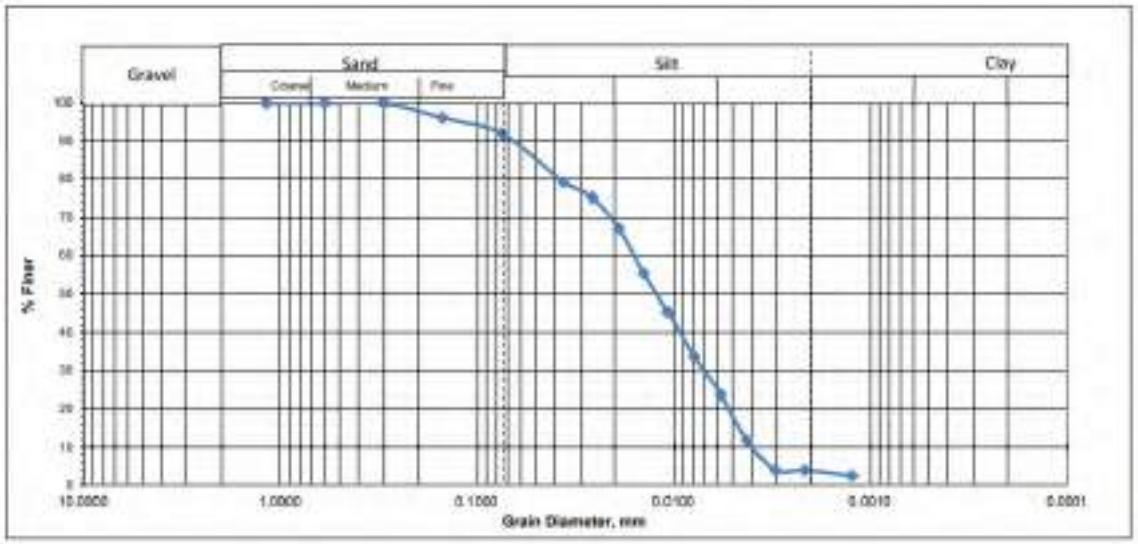
MBH No.	Sample No.	Depth (m)	Symbol	Sand %			Silt %	Clay %	D_{10}(mm)	D_{30}(mm)	D_{50}(mm)	D_{60}(mm)	Cu	Cc	Silt factor
				Coarse	Medium	Fine									
07	C-1	0.00-1.05		0	1	2	93	4	0.0040	0.0072	0.013	0.016	4.000	0.810	0.201

Figure 3-9: PSD MBH-07 0-1.05 m



MBH No.	Sample No.	Depth (m)	Symbol	Sand %			Silt %	Clay %	D_{10}(mm)	D_{30}(mm)	D_{60}(mm)	D_{90}(mm)	Cu	Cc	Silt factor
				Coarse	Medium	Fine									
14	D-1	1.05-1.50		0	2	4	89	5	0.0052	0.0110	0.014	0.019	2.600	1.551	0.208
14	C-1	4.50-5.55		0	0	1	97	3	0.0066	0.0110	0.013	0.018	3.000	1.310	0.201

Figure 3-10: PSD MBH-14 1.05-1.50 and 4.50-5.55 m



MBH No.	Sample No.	Depth (m)	Symbol	Sand %			Silt %	Clay %	D_{10}(mm)	D_{30}(mm)	D_{60}(mm)	D_{90}(mm)	Cu	Cc	Silt factor
				Coarse	Medium	Fine									
15	UD-1	0.00-1.05		0	2	8	86	4	0.0040	0.007	0.014	0.017	4.250	0.721	0.208

Figure 3-11: PSD MBH-15 0.00 -1.05 m

3.4 Riverbank material

Information about the riverbank material, which is relevant for assessing the risk of bank erosion, is obtained through boreholes in Block B and Block C. From the land-side boreholes (Figure 3-12) of Block C, the boreholes LBH-09, LBH-10 and LBH-11 are the closest to the water edge and assumed representative also for the riverbank material directly downstream of Block C and upstream of Block B.

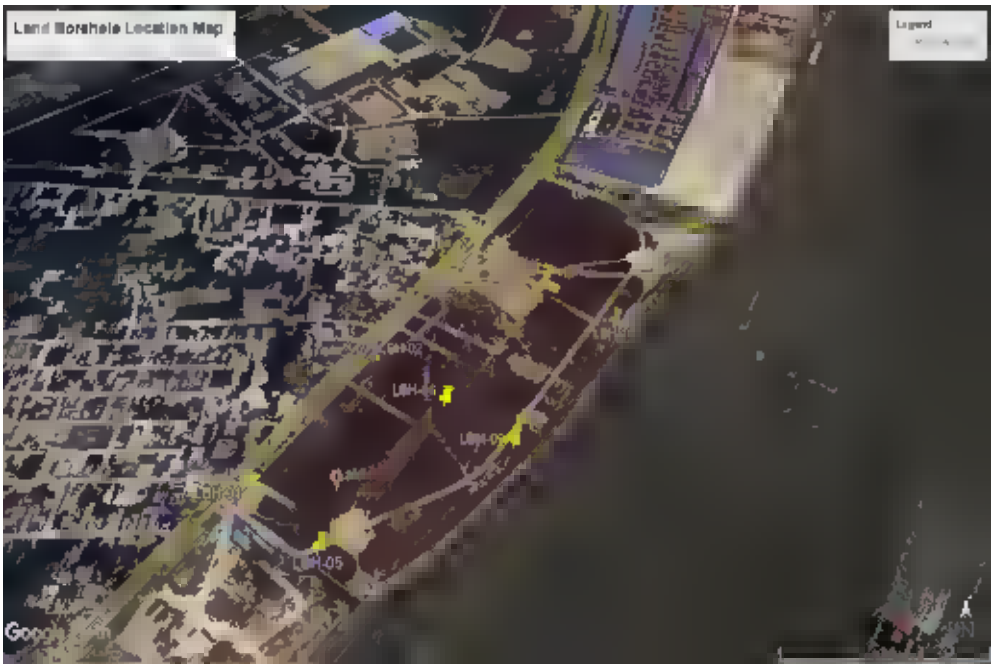


Figure 3-12: Location of land-based boreholes

The geological profile along the boreholes LBH-09, LBH-10 and LBH-11 is provided in Figure 3-13 below. The layers hatched in blue colours represent fine to medium sand layers. The layers in purple, pink, grey and orange represent layers that are predominately silty and clayey. The red box indicatively shows the depth levels where dredging will take place, which is from around -9 m CD to -12 m CD.

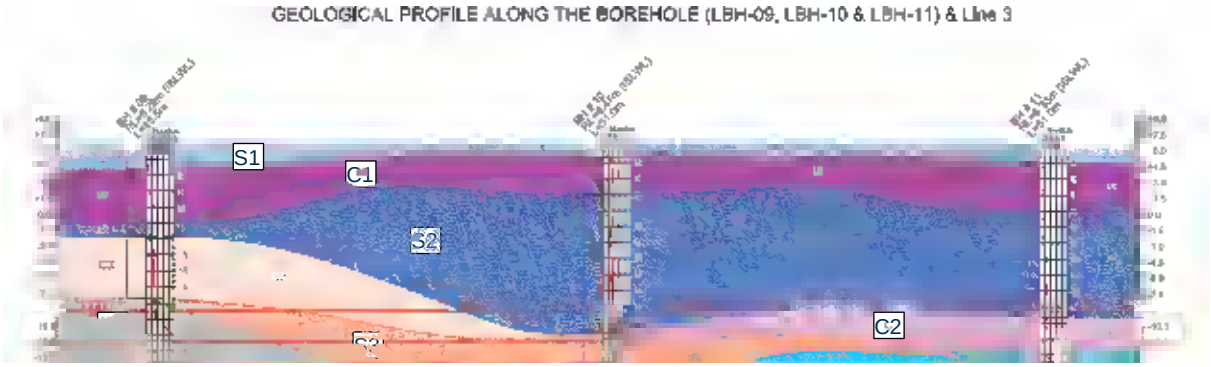


Figure 3-13: Geological profile along Borehole LBH-09. LBH-10 and LBH-11) the red box indicatively shows the dredging scope

Layer ID.	Lithology Description
S0	Loose brown silty fine SAND (Filling SAND) (1<N≤9)
S1	Very loose to medium dense light grey to brown silty fine to medium SAND (2<N≤12)
C1	Very soft to stiff grey clayey SILT (1<N≤15)
S2	Loose to dense grey medium to fine SAND (4<N≤50)
C2	Soft to stiff grey clayey SILT (3<N≤25)
S3	Loose to dense grey silty fine to medium SAND (5<N≤50)
C3	Stiff to hard grey clayey SILT (9<N≤37)
S4	Very dense grey to brown fine to medium SAND (N≥50)
C4	Very stiff to hard grey clayey silt (18<N≥50)
C5	Hard grey clayey SILT (N≥50)

Figure 3-14: Lithology Description

3.5 Suspended sediment concentrations

Measured suspended sediment concentrations (SSC) in the Karnaphuli River are available from earlier studies (IWM, 2021). Figure 3-15 shows depth-averaged SSC measured close to the project site. The effect of tide on the SSC is clear, with higher concentrations during spring tide. Also, for spring tide conditions, the SSC in the monsoon period is much higher than in the dry period.

Overall, the observations show that the suspended sediment concentrations can be extremely high, with SSC well above several 1000's mg/l. The lowest observed SSC is about 50 mg/l.

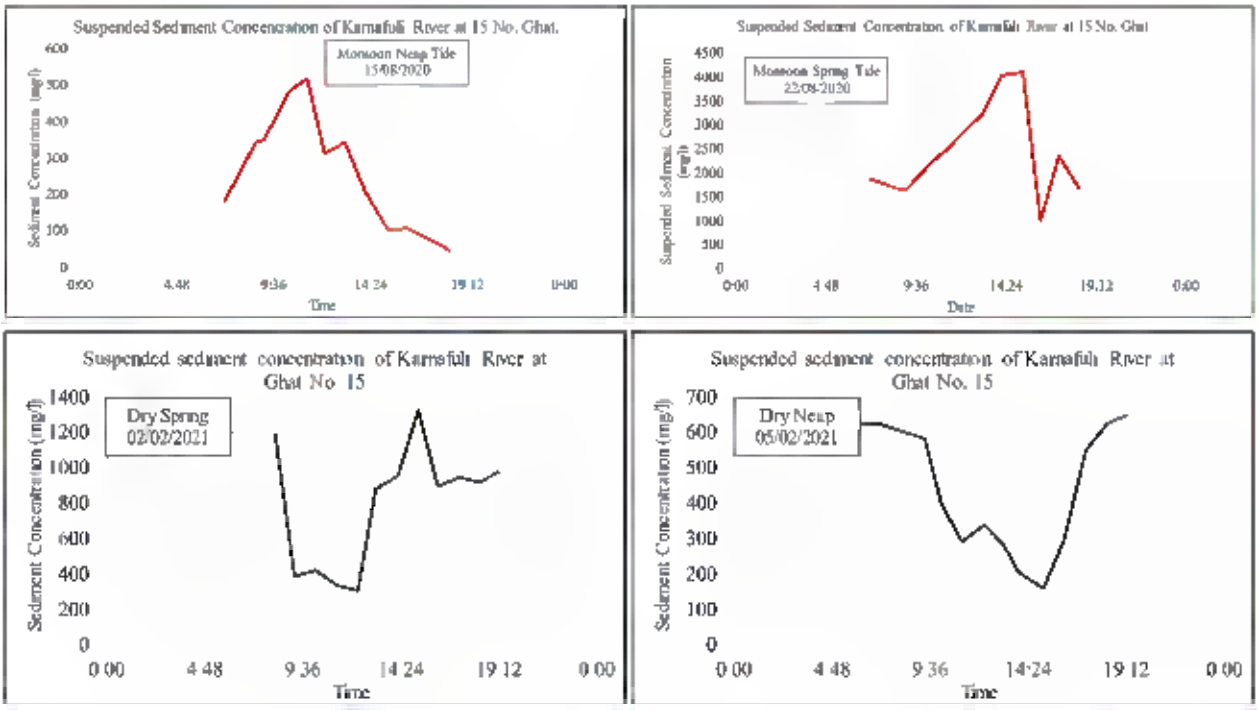


Figure 3-15: Observed suspended sediment concentrations in Karnaphuli River at Ghat No. 15, close to the project site during monsoon neap tide (top left), monsoon spring tide (top right), dry period spring tide (bottom left) and dry period neap tide (bottom right) (IWM, 2021).

Furthermore, surface water samples were taken in the Karnaphuli River for this ESIA, in April 2026 (Haskoning, 2026f). The locations of these samples are shown in Figure 3-16. From these water samples, the concentration of Total Suspended Solids (TSS) was determined in the laboratory. Although the definition and analysis for determining the TSS and SSC are different, both parameters describe the sediment concentration in the water. Overall, TSS is in the same order of magnitude as the SSC found in 2020, with suspended sediment concentrations well over 100 mg/L, up to 700 mg/L (Table 3-1).

Table 3-1: Analytical results surface water laboratory Bangladesh (Haskoning, 2026f).

Parameter	Unit	SW1	SW2	SW3	SW4	SW5	SW6
TSS (Total Suspended Solids)	mg/L	176	302	550	572	698	706



Figure 3-16: Surface water sampling location (Haskoning, 2026f)

3.6 Sediment transport and load

No information about sediment transport rates and sediment loads in Karnaphuli River are available.

4 Model set-up

4.1 Introduction

In this chapter, the main elements of the set-up of the 3D hydrodynamic model and the set-up for the sediment transport model are presented.

4.2 Modelling software

The well-established hydrodynamic modelling software MIKE 3 Flexible Mesh (FM) version 2025 is used in this study. MIKE 3 FM is developed by DHI and widely used to simulate hydrodynamics in river, coastal and estuarine environments. MIKE 3 FM accounts for variation of currents and suspended sediment transport over the water column. For simulation of sediment transport and bed level change, the hydrodynamics in the MIKE 3 FM are coupled with the Sand Transport module (ST) and Mud Transport module (MT).

4.3 Computational grid and bathymetry

The computational grid of the Karnaphuli river and Bay of Bengal is shown in Figure 4-1. Within the river section, a rectangular and curvilinear grid is applied to follow the river alignment. The grid is locally refined around Block C and the proposed dredged berth pocket. A one-step grid refinement is applied, meaning that both the length and width of the grid cells are reduced by a factor of two. The refinement improves the representation of local flow gradients, sediment transport patterns and bed level changes near the project area. The maximum dimension of the curvilinear grid across the width of the channel is 30 meters and along the length it is 40 meters. In the outlet of the Karnaphuli river into the Bay of Bengal, the computational grid is triangular and the area of the minimum size of the triangle is 11,250 m^2. The grid of the sea is also triangular, and its minimum size is 45,000 m^2.

The bathymetry data sets presented in Section 3.2 were used to generate the model bathymetry.

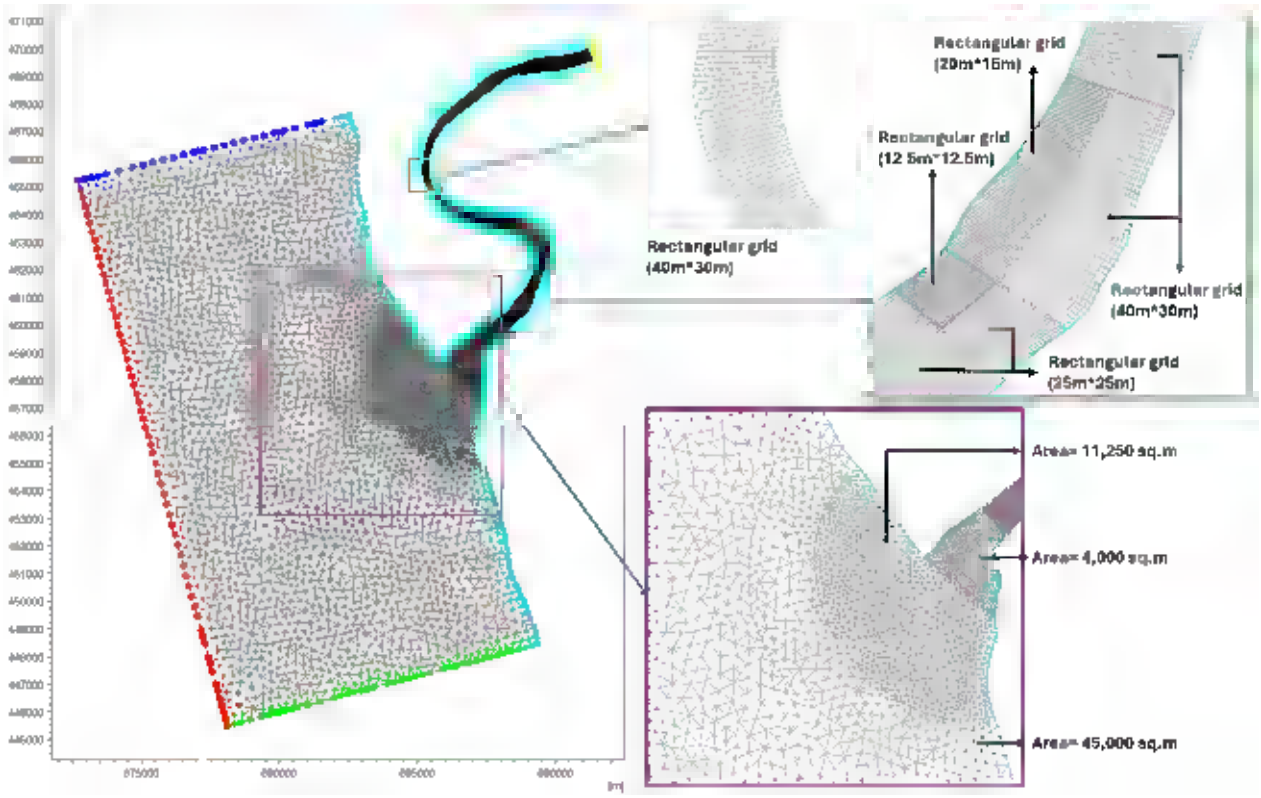


Figure 4-1: Computational grid of the Karnaphuli River model domain

4.4 Hydraulic boundary conditions

4.4.1 Upstream boundary

The upstream boundary of the hydrodynamic model is located at the Kalurghat Bridge (Figure 4-2). At this upstream boundary, a discharge timeseries is imposed. The discharge at the bridge is a combination of fresh-water discharge from the upstream river catchment and tidal water exchange with the Bay of Bengal. The discharge at the upstream model boundary was obtained from the one-dimensional hydrodynamic model developed by BWDB (2020). The resulting discharge at the upstream boundary is shown in Figure 4-3.



Figure 4-2: Boundaries of the model.

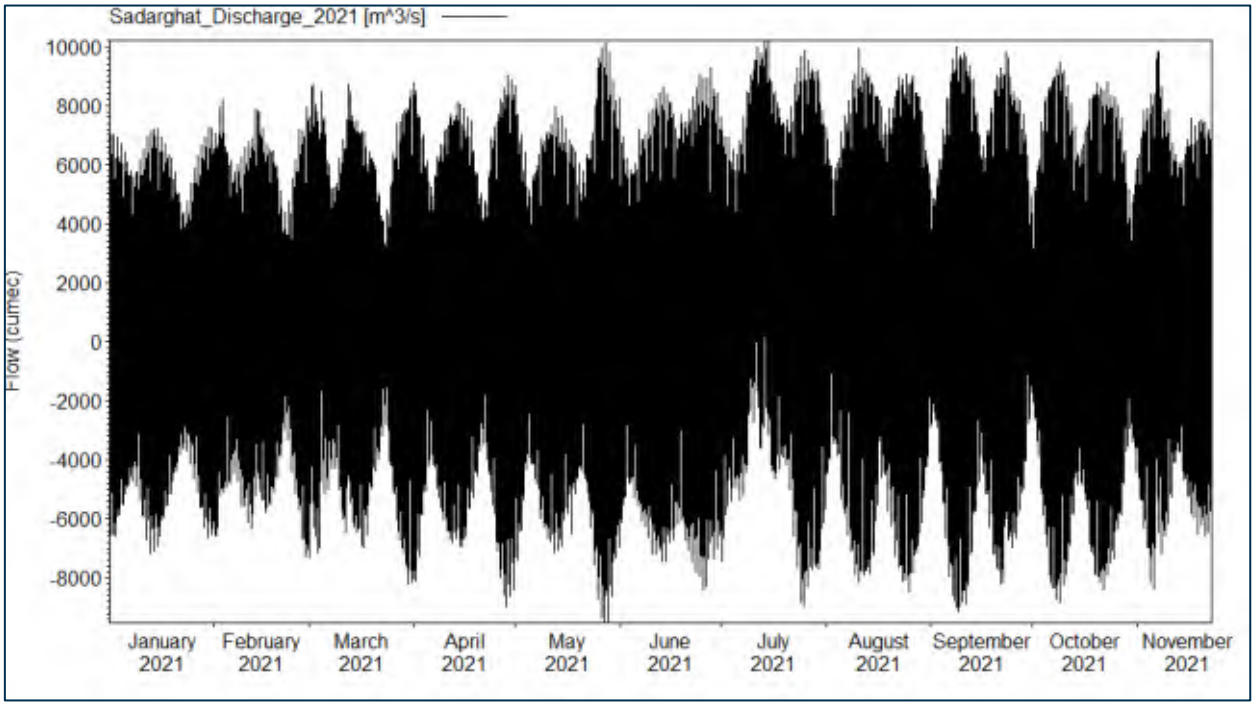


Figure 4-3: Upstream discharge boundary at Kalurghat Bridge

4.4.2 Downstream boundary

The downstream model boundary is located in the Bay of Bengal (Figure 4-2). The hydrodynamics at this model boundary are based mainly on tidal water level variation, tidal currents and wind-driven currents.

At the downstream model boundaries water level timeseries are imposed (see Figure 4-4). The water level timeseries were obtained from the regional Meghna Estuary model. The description of the Meghna River estuary model is elaborated in (IWM, 2022).

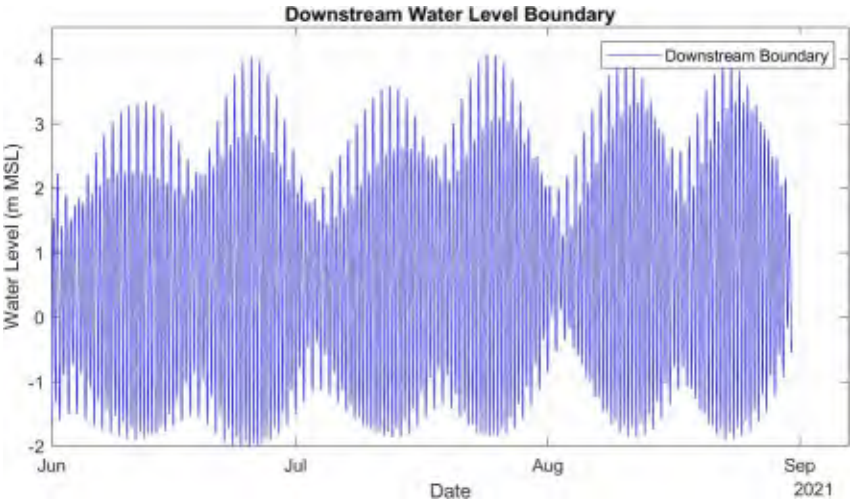


Figure 4-4: Plot of downstream water Level Boundary during monsoon

4.5 Other model settings

The hydrodynamic simulations were carried out using the MIKE 3 Flexible Mesh (FM) model. This hydrodynamic model was used as a basis for the oil spill model, sediment plume model and the morphology model. Manning's number used in the model is 0.015 to 0.025, based on calibration of the hydrodynamics (Haskoning, 2026a).

The piles of the deck on piles of Block C are modelled as individual circular 'pier' structures, with each pile having a diameter of 1 meter.

The wind forcing is applied to the model. The wind speed and direction at Chattogram, measured by BMD, is imposed on the model, see Figure 4-5.

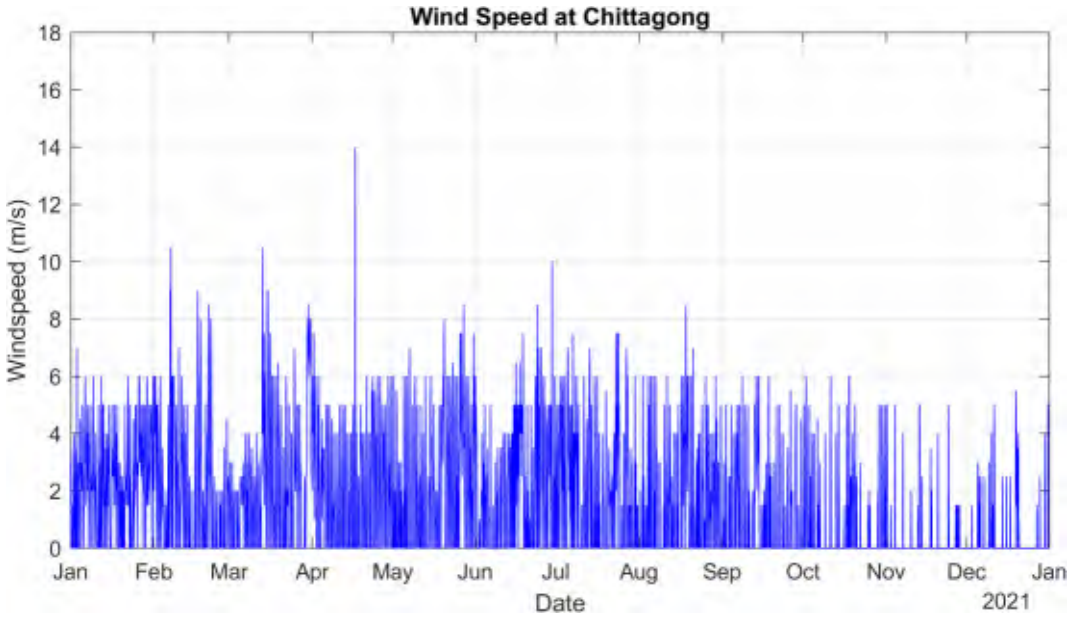


Figure 4-5: Wind Speed Plot at Chattogram (Source: Bangladesh Meteorological Department)

4.6 Sand Transport Module

The Sand Transport (ST) module in MIKE 3 FM was used to simulate the transport, erosion and deposition of fine sand and coarse silt in the Karnaphuli River. It uses the hydrodynamics from the MIKE 3 FM hydrodynamic module as input.

Based on available sediment characteristics, a median grain size (D50) of 0.06 mm was adopted for the riverbed material. Considering the silty nature of the bed and the combined influence of currents and tides, the Van Rijn sediment transport formulation was selected to estimate both bed load and suspended load transport. The Van Rijn equation is widely recognized for its applicability to non-cohesive sandy sediments and its ability to represent sediment transport under varying hydraulic conditions.

Simulated erosion and deposition patterns were compared with observed bathymetric changes to evaluate model performance. Special attention was given to the meander bend upstream of the project site and tidal transition zones, where flow acceleration, secondary circulation, and tidal asymmetry significantly influence sediment transport mechanisms.

The calibrated model was subsequently used to assess sediment dynamics, identify erosion-prone reaches, and evaluate morphological responses under different hydrological and tidal conditions. The developed model provides a robust framework for investigating channel evolution and supporting river management, navigation improvement, and bank protection planning within the Karnaphuli River system.

4.7 Mud Transport Module

The Mud Transport (MT) module in MIKE 3 FM was used to simulate the transport, erosion and deposition of fine silt in the Karnaphuli River. It uses the hydrodynamics from the MIKE 3 FM hydrodynamic module as input, similar to the ST module.

For the fine silt fraction, a characteristic grain size of 0.02 mm with a characteristic settling velocity of 0.3 mm/s was applied. The settling of the suspended particles, bed erosion and bed deposition are computed with the well-established Krone formulation (Krone, 1962). In addition to the settling velocity, the input for the formulation consists of a critical bed shear stress for deposition (0.1 N/m^2), critical bed shear stress for erosion (0.4 N/m^2) and an erosion coefficient (1E-5 $kg/m^2/s$). These parameters are based on experience with similar systems and tested on relatively stable riverbed with realistic suspended sediment concentrations. A bed density of 500 kg/m^3 was assumed, which is a typical density for an unconsolidated, but not fluffy sediment layer.

The initial sediment concentration and sediment concentration at the open sea boundaries are set at 100 mg/L, while the sediment concentration at the river boundary is set at 500 mg/L.

5 Results

5.1 Introduction

In this chapter, the model results of the riverbed level changes are assessed, both for the present situation as well as the future situation with the Laldia Container Terminal.

It should be noted that the results presented in this section, particularly the absolute values such as sedimentation rates, should be interpreted with caution. The primary reason is that the sediment transport predictions have not been calibrated or validated due to the absence of suitable field data. In addition, sediment transport computations and the resulting bed level changes are inherently associated with considerable uncertainties. Consequently, the absolute magnitudes of the predicted morphological changes should be regarded as indicative rather than definitive. However, the relative comparison between the existing situation and the design is considered to be more robust and reliable, as the same modelling approach, assumptions, and boundary conditions have been applied consistently across all scenarios.

5.2 Results for coarse silt fraction

5.2.1 Present situation

As a reference, the present situation without the Laldia Container Terminal was simulated for one dry-season month and one monsoon-season month. Figure 5-1 shows the resulting bed level changes for the original bathymetry, including the indicative locations of the project site and dredging pocket. Figure 5-2 presents the corresponding bed level change along cross-section A-B.

In general, there is a pattern of sedimentation along the western inner riverbend and erosion closer to the outer bend. The high sediment accumulation zone along the east riverbank opposite Laldia Container Terminal is attributed to a local bed depression that is filled up.

Figure 5-1 and Figure 5-2 show that the spatial distribution of erosion and deposition is broadly similar in both simulations. This indicates that the dominant bed level changes are controlled by the existing bathymetry and associated flow patterns. The monsoon simulation results in larger bed level changes, which is consistent with stronger hydraulic forcing and a higher sediment transport capacity. This indicates that seasonal variability mainly affects the magnitude of the morphological response, while the main erosion and sedimentation zones remain governed by the existing river morphology.

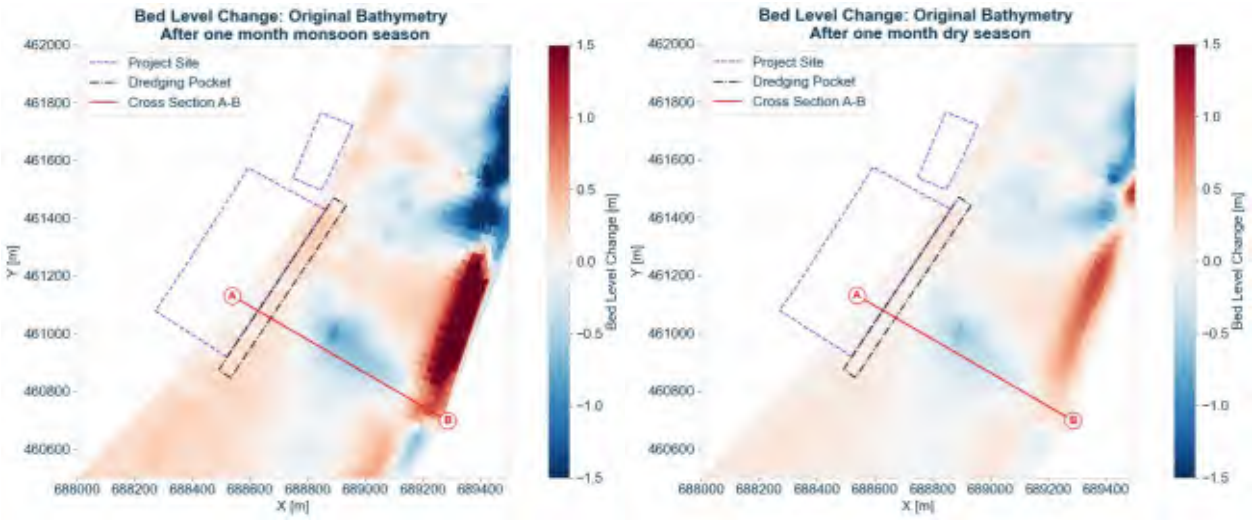


Figure 5-1 Sedimentation (red) and erosion (blue) after one month of coarse silt transport during monsoon (left) and dry (right) conditions starting with the original bathymetry.

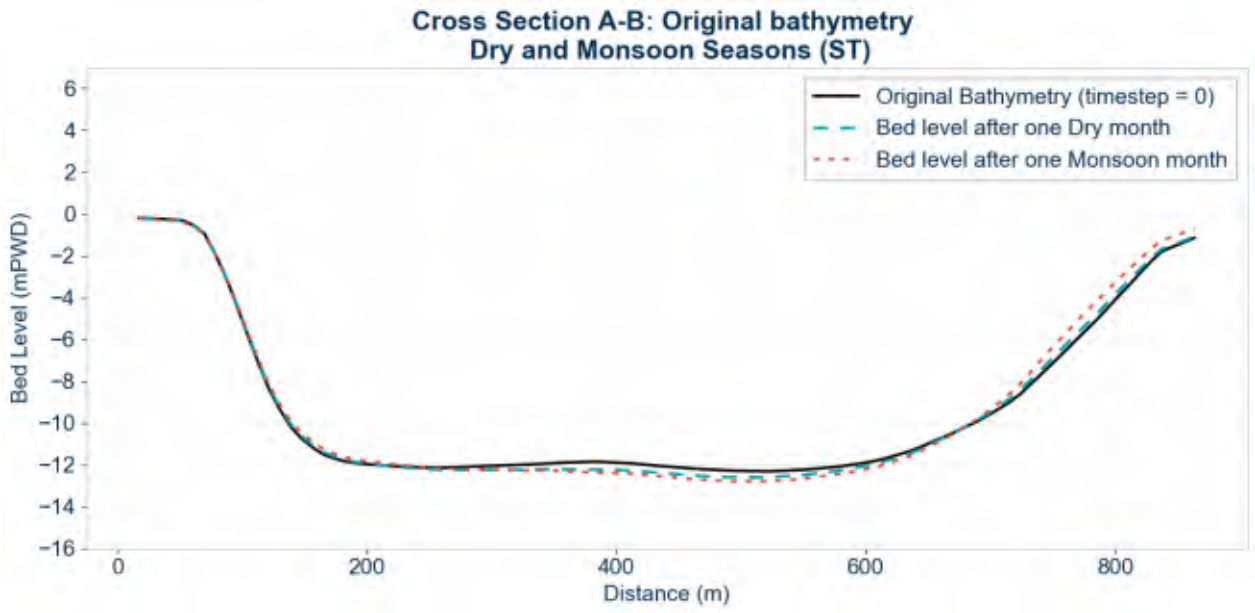


Figure 5-2 Bed level change of the original bathymetry after one month coarse silt transport during dry (blue) or monsoon (red) conditions at cross section A-B.

5.2.2 Results for proposed design

Figure 5-3 and Figure 5-4 present the bed level distribution for proposed design, at the start and after one month of coarse silt transport simulation during the monsoon and dry-season conditions, respectively. Figure 5-5 shows the resulting erosion and deposition patterns after one month of coarse silt transport for both simulations.

Compared with the simulations based on the original bathymetry under the same seasonal conditions, the main additional bed level changes are concentrated within and directly around the dredged berth pocket, while the central part of the river shows only limited change. This indicates that the proposed intervention mainly affects the local morphology near Block C, without causing substantial bed level changes across the wider river section.

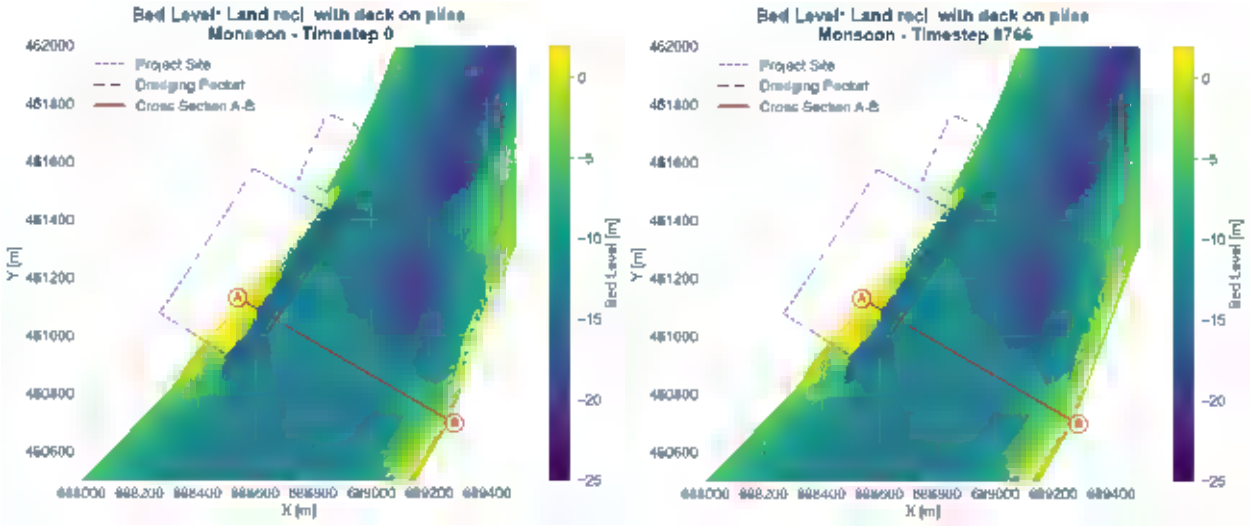


Figure 5-3 The bed level at the start (left) and end (right) with coarse silt transport during one monsoon-season month for proposed design.

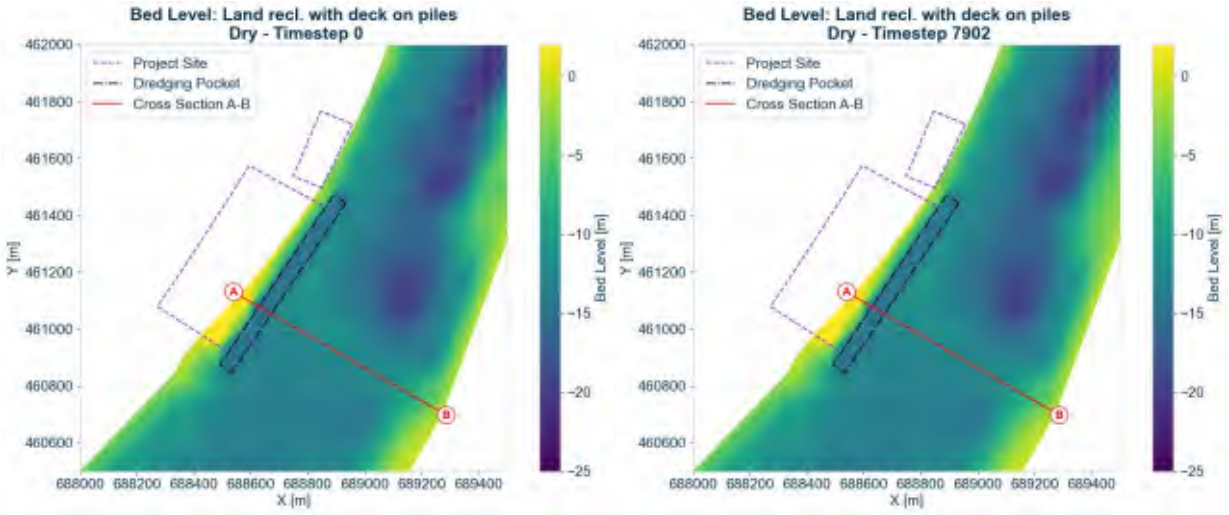


Figure 5-4 The bed level at the start (left) and end (right) with coarse silt transport during one dry-season month for proposed design.

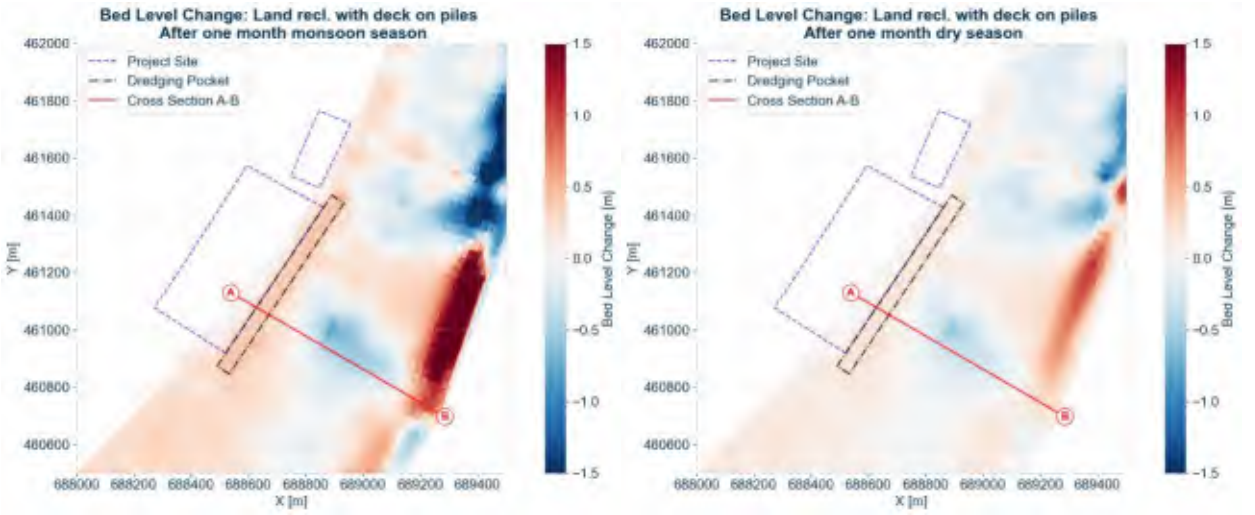


Figure 5-5 Sedimentation (red) and erosion (blue) after one month of coarse silt transport during monsoon (left) and dry (right) conditions starting for the proposed design.

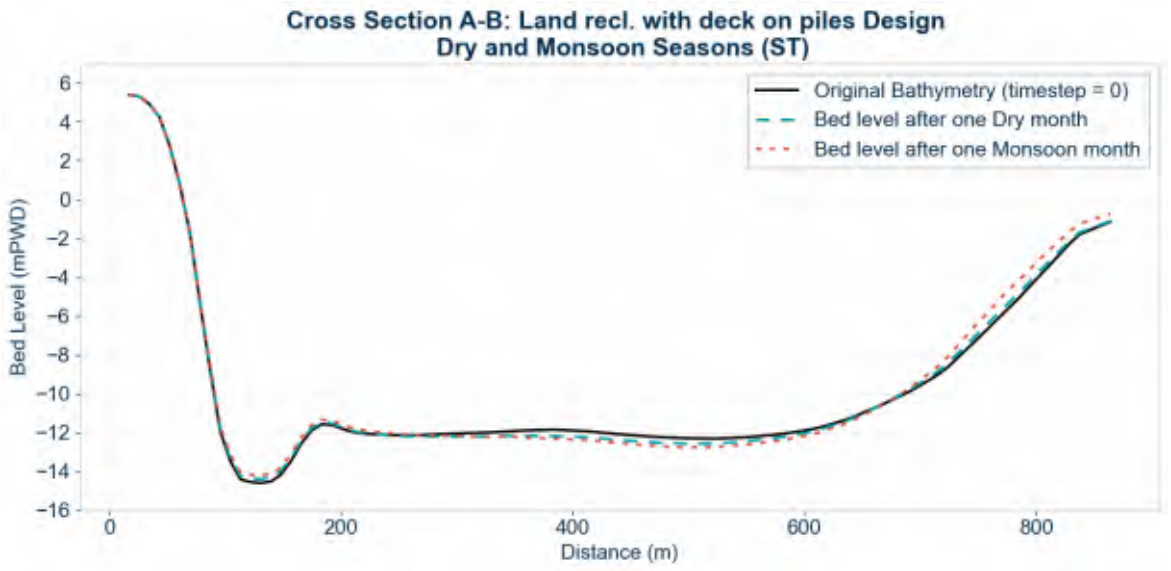


Figure 5-6 Bed level change with proposed design after one month coarse silt transport during dry (blue) or monsoon (red) conditions at cross section A-B.

The cross-sectional bed level changes in Figure 5-6 confirm that sedimentation occurs within the dredged berth pocket during both seasons, resulting in partial backfilling of the dredged profile over the one-month simulation period. The backfilling is larger during the monsoon season than during the dry season, with bed level increases of approximately 0.39 m/month and 0.19 m/month, respectively.

Outside the berth pocket, the profiles show some erosion in the centre of the river, transitioning into limited deposition near the eastern river bend. Similar to the backfilling of the dredged berth pocket, these erosion and deposition patterns are more pronounced during monsoon conditions than during the dry season. However, outside the berth pocket, the bed level changes remain comparable to those observed for the original bathymetry.

Block C Berth Pocket

Table 5-1 shows that, for the proposed design, the dredged berth pocket is expected to backfill due to the transport coarse silt. The modelled bed level increase is larger during the monsoon season than during the dry season, with 0.39 m/month and 0.19 m/month, respectively. This indicates that coarse silt-driven backfilling is most pronounced during monsoon conditions.

The modelled sedimentation volume follows the same seasonal pattern. Assuming these rates remain representative over six months for each hydrological season, the estimated annual sedimentation volume in the dredged berth pocket is approximately 124,000 m³/year. This suggests that the dredged berth pocket is the main location where maintenance dredging may be required as a result of coarse silt deposition under the proposed design.

Table 5-1 The modelled backfilling in the dredged berth pocket during coarse silt transport for the proposed design.

	Bed level change	Sedimentation volume
One monsoon-season month	0.39 [m/month]	13,974 [m³/month]
One dry-season month	0.19 [m/month]	6,688 [m³/month]
Annual estimate	3.43 [m/year]	123,975 [m³/year]

Southwest corner

Table 5-2 shows that the bed level change in the southwest corner downstream of Block C remains comparable between the proposed design and the original bathymetry. During the monsoon season, both simulations show a bed level increase of approximately 0.16 m/month. During the dry season, the proposed design results in a bed level increase of 0.06 m/month, which is slightly lower than the 0.07 m/month modelled for the original bathymetry. These small differences indicate that the proposed design does not substantially affect coarse silt sedimentation in the southwest corner downstream of the project site.

Table 5-2 The modelled bed level change in the southwest corner downstream of the project site during coarse silt transport for the present situation and proposed design.

	Proposed design	Original Bathymetry
One monsoon-season month	0.16 [m/month]	0.16 [m/month]
One dry-season month	0.06 [m/month]	0.07 [m/month]

Overall, Table 5-1 and Table 5-2 indicate that the main coarse silt transport effect of the proposed design is local backfilling of the dredged berth pocket. Bed level changes in the southwest corner downstream of the project site remain close to the response of the original bathymetry, suggesting that the proposed design has limited influence on this area.

5.3 Results for fine silt fraction

5.3.1 Present situation

For the transport of the fine silt fraction, the present situation without the Laldia Container Terminal was simulated for one dry-season month and one monsoon-season month. Figure 5-7 shows the resulting bed level changes for the original bathymetry, while Figure 5-8 presents the corresponding bed level change along cross-section A-B. Figure 5-7 and Figure 5-8 show that fine silt transport mainly results in a depositional morphological response under the original bathymetry.

Compared with the coarse silt transport simulations, the bed level changes are more directly related to the settling and deposition of suspended fine sediment, with limited erosion of the existing bed. The results in deposition of the monsoon and the dry season simulation show relatively limited differences, indicating that fine silt-driven bed level changes are less to seasonal hydraulic forcing than the coarse silt transport.

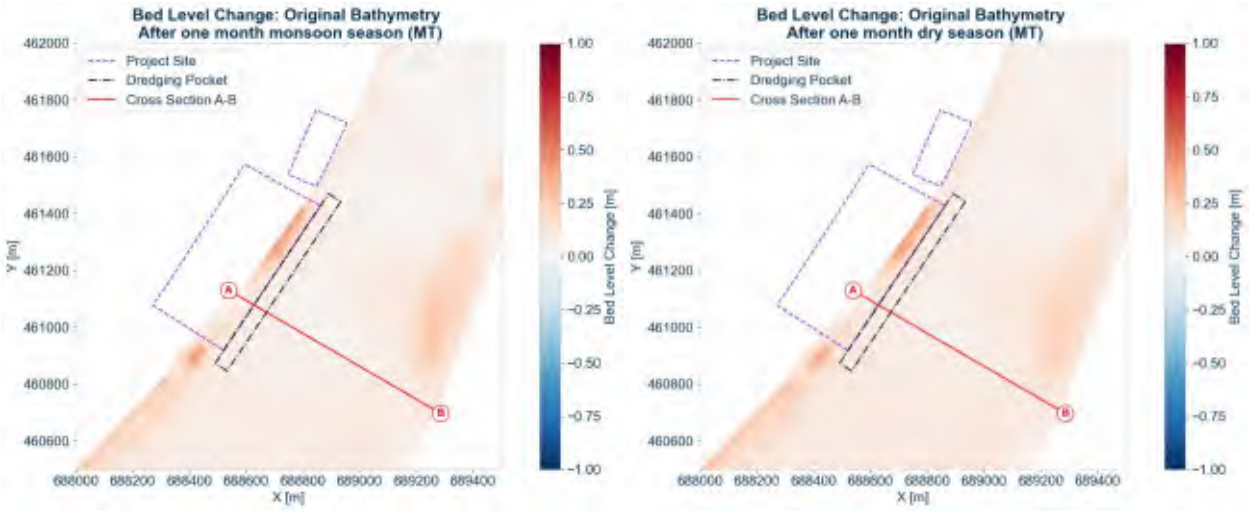


Figure 5-7 Sedimentation (red) and erosion (blue) after one month of fine silt transport during monsoon (left) and dry (right) conditions starting with the original bathymetry.

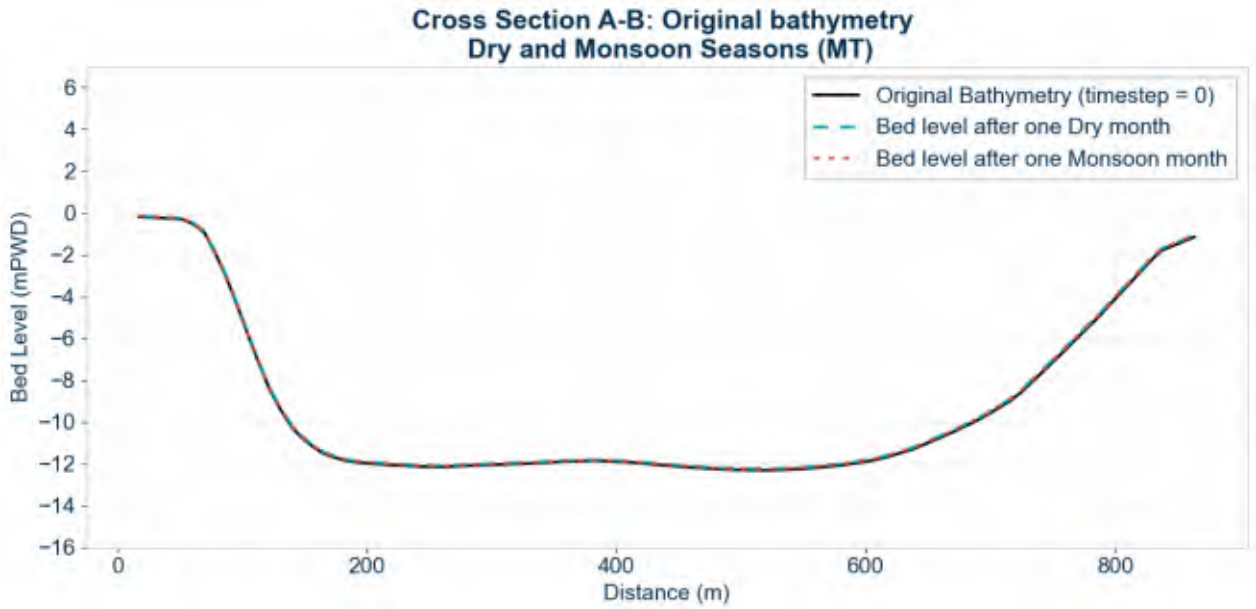


Figure 5-8 Bed level change of the original bathymetry after one month fine silt transport during dry (blue) or monsoon (red) conditions at cross section A-B.

5.3.2 Results for proposed design

Figure 5-9 and Figure 5-10 present the bed level distribution for the proposed design, at the start and after one month of fine silt transport simulation during the monsoon and dry-season conditions, respectively. Figure 5-11 shows the resulting erosion and deposition patterns after one month of fine silt transport for both simulations. Compared with the original bathymetry simulations, the main additional bed level changes are concentrated within and directly around the dredged berth pocket, while the wider river section shows only limited additional change.

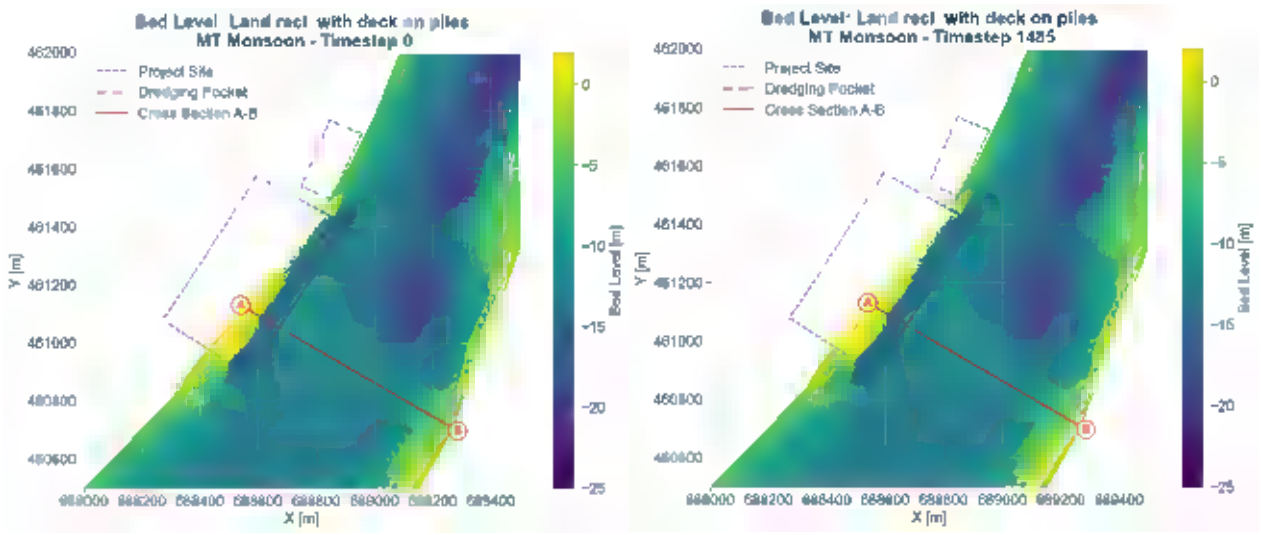


Figure 5-9 The bed level at the start (left) and end (right) with fine silt transport during one monsoon-season month for proposed design.

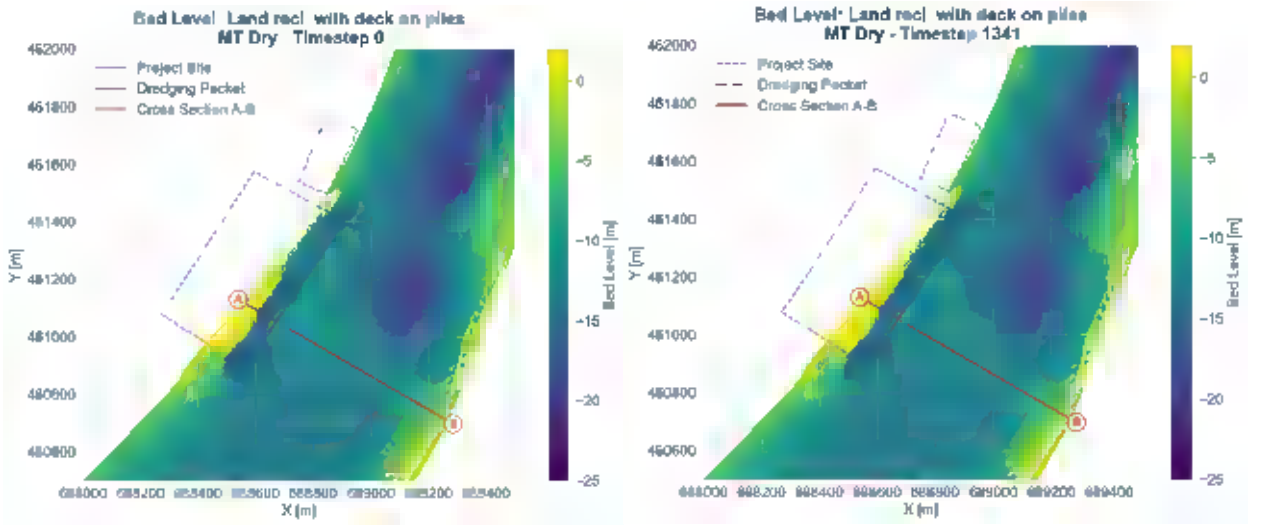


Figure 5-10 The bed level at the start (left) and end (right) with fine silt transport during one dry-season month for proposed design.

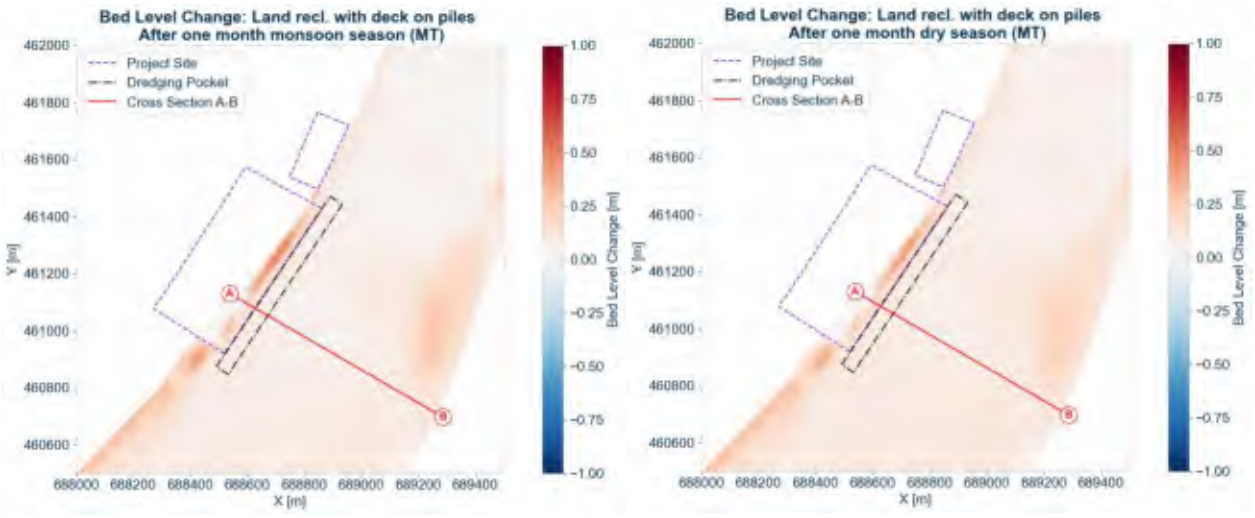


Figure 5-11 Sedimentation (red) and erosion (blue) after one month of fine silt transport during monsoon (left) and dry (right) conditions starting for the proposed design.

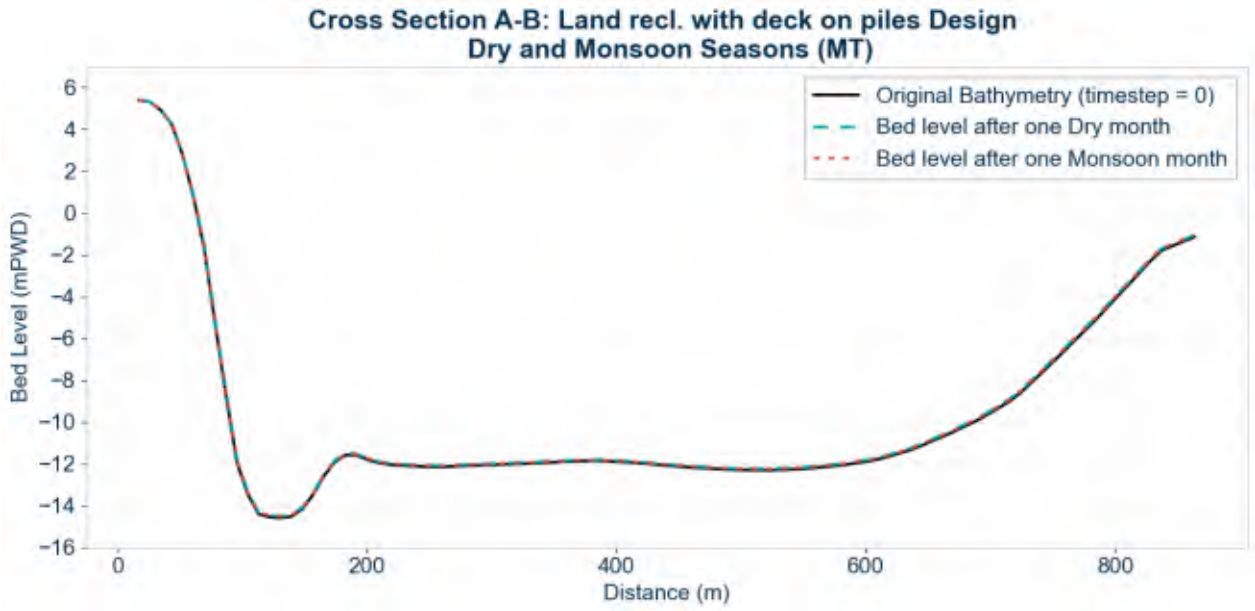


Figure 5-12 Bed level change for the proposed design after one month fine silt transport during dry (blue) or monsoon (red) conditions at cross section A-B.

The cross-sectional bed level changes in Figure 5-12 indicate that fine silt transport results in slight sedimentation within the dredged berth pocket during both seasons. The modelled backfilling is almost the same during both seasons, with bed level increases of approximately 0.09 m/month during dry season and 0.07 m/month during monsoon season. Outside the berth pocket, the bed level changes remain limited and comparable to the response of the original bathymetry.

Table 5-3 shows that fine silt transport results in limited backfilling of the dredged berth pocket. The modelled bed level increase is slightly larger during the dry season than during the monsoon season, with 0.09 m/month and 0.07 m/month, respectively. Assuming these rates remain representative over six months for each hydrological season, the estimated annual sedimentation volume is approximately 35,000 m³/year.

Table 5-3 The modelled backfilling in the dredged berth pocket during fine silt transport for the proposed design.

	Bed level change	Sedimentation volume
One monsoon-season month	0.07 [m/month]	2,684 [m³/month]
One dry-season month	0.09 [m/month]	3,188 [m³/month]
Annual estimate	0.97 [m/year]	35,233 [m³/year]

Table 5-4 The modelled bed level change in the southwest corner downstream of the project site during fine silt transport for the present situation and the proposed design.

	Proposed design	Original Bathymetry
One monsoon-season month	0.25 [m/month]	0.21 [m/month]
One dry-season month	0.22 [m/month]	0.21 [m/month]

Table 5-4 shows that the accumulation of fine silt in the southwest corner downstream of the project site remains comparable between the proposed design and the original bathymetry. During the monsoon season, the proposed design results in a bed level increase of 0.25 m/month, compared with 0.21 m/month for the original bathymetry. During the dry season, the modelled bed level increase is 0.22 m/month for the proposed design and 0.21 m/month for the original bathymetry. These small differences indicate that the proposed design has only a limited influence on fine silt accumulation in this area.

Overall, Table 5-3 and Table 5-4 indicate that fine silt transport contributes to backfilling of the dredged berth pocket under the proposed design, although the associated sedimentation volumes are considerably smaller than those modelled for coarse silt transport. In the southwest corner downstream of the project site, bed level changes remain close to the original bathymetry response, suggesting that the proposed design has limited influence on the wider fine-silt-driven deposition pattern.

5.4 Discussion on extreme events and long-term developments

The modelling results reported in the previous sections are based on one-month simulations within the dry and monsoon periods. The reported sedimentation and erosion rates, and the extrapolation to annual sedimentation volumes, are based on the current river morphology and cover the short-term morphodynamics. However, rivers are dynamic systems that also gradually change on the longer term. Considering the expected lifetime of the Laldia Container Terminal, the gradual morphological change on the scale of decades is then most relevant.

The long-term morphological change can be divided into two main components:

- Extreme events. They rarely occur and therefore not captured in a typical month, but when they occur, they have a large impact. An example is a typhoon event with extreme conditions, such as high rainfall, high river discharges, energetic waves and high water levels.
- Gradual evolution. These are slow but steady processes. A typical example is migration of a river meander bend, with erosion in the outer bend and sand accumulation in the inner bend. Another example is sea level rise.

The gradual evolution in the downstream part of the Karnaphuli River is considered to be nearly completely determined by the artificial, human-induced processes and developments. Regular maintenance dredging in the navigation channel stabilizes the thalweg, while the construction of terminals (such as Laldia Container Terminal), revetments, river training works and other engineering works reduce bank erosion and thus reduce lateral migration of the meander bends in the Karnaphuli River. In the coming decades, an increase in such artificial, human-induced processes and developments can be expected, as a more nature-based river management is not expected for this section of the river. It results in further stabilization of the Karnaphuli River morphology. Considering the relatively large (tidal) water level variation in the Karnaphuli River, it is expected that sea level rise has relatively small impact on the Karnaphuli River morphology.

The occurrence of extreme events is expected to have large temporal effects. Extreme events such as a typhoon or an extreme high river discharge are expected to result in stronger currents, and perhaps large waves propagating into the Karnaphuli River mouth. In such events, sediment concentrations and sediment transport rates are much higher than normal, resulting in:

- Increased sedimentation at the inner bend of the river, resulting in higher rates of sediment accumulation in the dredged berth pocket. In worst case, maintenance dredging will be required immediately after the event. It is noted that maintenance dredging after an extreme event will also be required for the navigation channel.
- Increased rates of sediment accumulation downstream of the Block C land reclamation and deck on piles.

Considering the highly engineered riverbanks around the project site, it is not expected that extreme events will result in severe riverbank erosion or large-scale and long-term morphological changes in the Karnaphuli River.

To summarize: extreme events are expected to result in temporally high sediment accumulation in the dredged berth pocket, which likely requires immediate maintenance dredging. On the long-term, the morphological development of the downstream part of the Karnaphuli River will be largely determined by the river training and maintenance dredging.

6 Conclusions

This chapter summarises the main findings from the morphological modelling of the Karnaphuli River for the present situation and the proposed design for Block C of the Laldia Container Terminal. The conclusions focus on the modelled bed level changes, the expected re-siltation within the dredged berth pocket, and the expected influence of the proposed design on the wider river morphology.

The modelling results indicate that the main additional morphological effect of the proposed design is local sedimentation within the dredged berth pocket. Outside the immediate project area, bed level changes remain largely comparable to the present situation, including the southwest corner downstream of Block C. This suggests that the proposed design has only a limited influence on the wider river morphology. The simulations also indicate that the dominant erosion and deposition patterns in the river remain governed by the existing bathymetry and channel geometry.

For the coarse silt fraction, the proposed design results in clear backfilling of the dredged berth pocket. The modelled bed level increase is approximately 0.39 m/month during the monsoon season and 0.19 m/month during the dry season. Assuming these rates remain representative over six months for each hydrological season, the estimated annual sedimentation volume in the dredged berth pocket is approximately 124,000 m^3/year. For the fine silt fraction, the modelled backfilling is smaller, with bed level increases of approximately 0.07 m/month during the monsoon season and 0.09 m/month during the dry season, corresponding to an estimated annual sedimentation volume in the dredged berth pocket of approximately 35,000 m^3/year. These results indicate that coarse silt transport contributes substantially more to berth pocket backfilling than the fine silt transport. The combined annual sedimentation volume in the dredged berth pocket is approximately 159,000 m^3/year.

In the southwest corner directly downstream of Block C, the model results show accumulation of both coarse and fine silt. For coarse silt, the proposed design results in bed level changes that are almost equal to the original bathymetry, with approximately 0.16 m/month during the monsoon season and 0.06 m/month during the dry season. For fine silt, the modelled bed level increase is approximately 0.25 m/month during the monsoon season and 0.22 m/month during the dry season, which is only slightly higher than for the original bathymetry. These results indicate that the proposed design has limited influence on sediment accumulation in the southwest corner downstream of the project site.

The absolute sedimentation rates should be considered indicative, as the sediment transport modelling could not be calibrated against observed sedimentation data. Nevertheless, the results show that the proposed design mainly causes local sedimentation within the dredged berth pocket, which will require periodic maintenance dredging. Bed level changes outside the berth pocket remain close to the present situation, and no significant impacts on the overall channel stability or navigational conditions are expected.

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Annex D – Dredging Management Plan

REPORT

Dredging Management Plan

Laldia Container Terminal Environmental and Social Impact Assessment

Client:	LCT Ltd.
Reference:	BK4589-HAS-MP-XX-RP-EV-0001
Status:	S5/P01
Date:	20 August 2026

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Status:	S5/P01
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Drafted by:	ESIA Team
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Classification:	Project related

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1 Introduction

1.1 Background and Project Rationale

The Laldia Container Terminal Project (LCTP, or the Project) is a strategic initiative to address port congestion challenges in Chattogram by expanding container-handling capacity and improving operational efficiency at the Port of Chattogram. Located at Laldia Char along the right bank of the Karnaphuli River in Chattogram, the terminal will add approximately 0.8 million Twenty-Foot Equivalent Unit (TEU) per year of new handling capacity. This will relieve pressure on existing terminals, reduce congestion and vessel waiting times, and strengthen maritime logistics performance to support Bangladesh's trade competitiveness and regional connectivity.

The terminal is being developed under a Public-Private Partnership (PPP) between the Chittagong Port Authority (CPA) and Laldia Container Terminal Ltd. (LCT Ltd.), a joint venture between APM Terminals (APMT) and QNS Container Services Ltd. (QNS Ltd.). A 30-year concession agreement (CA) for the design, financing, construction, operation, and maintenance of the terminal was signed on 17 November 2025, representing one of the largest PPP investments in Bangladesh's port sector. LCT Ltd.'s involvement brings international expertise in container-terminal management, digital optimization, energy-efficient operations, and global best practice in port safety and reliability, supporting the long-term modernization of the Port of Chattogram.

The development of LCTP will take environmental and social aspects into account and therefore an Environmental and Social Impact Assessment (ESIA) is being prepared. This Dredging Management Plan (DMP) forms part of the ESIA, which is prepared for permitting purposes in Bangladesh with the Department of Environment (DoE).

1.2 Objectives of the Dredging Management Plan (DMP)

This DMP outlines the dredging scope for the LCTP, what dredging methods are foreseen to be used and how they will be monitored and controlled to ensure they are safe, efficient, and environmentally responsible.

In this Plan assumptions have been made about the dredging scope and methods, which are realistic, but also on the conservative side, using the precautionary principle.

2 Project Description

2.1 Project location

The LCTP is located on the west bank of the Karnaphuli River in Bangladesh, approximately 9 km downstream from the existing Port of Chattogram and 3.5 km from the Bay of Bengal (see Figure 2-1).



Figure 2-1: Location of the Laldia Container Terminal Project (LCTP) as well as the other container terminals, within Bangladesh (left) and the Port of Chattogram (right).

The project spans three blocks, Blocks A, B, and C (see Figure 2-2) in the Laldia Char.

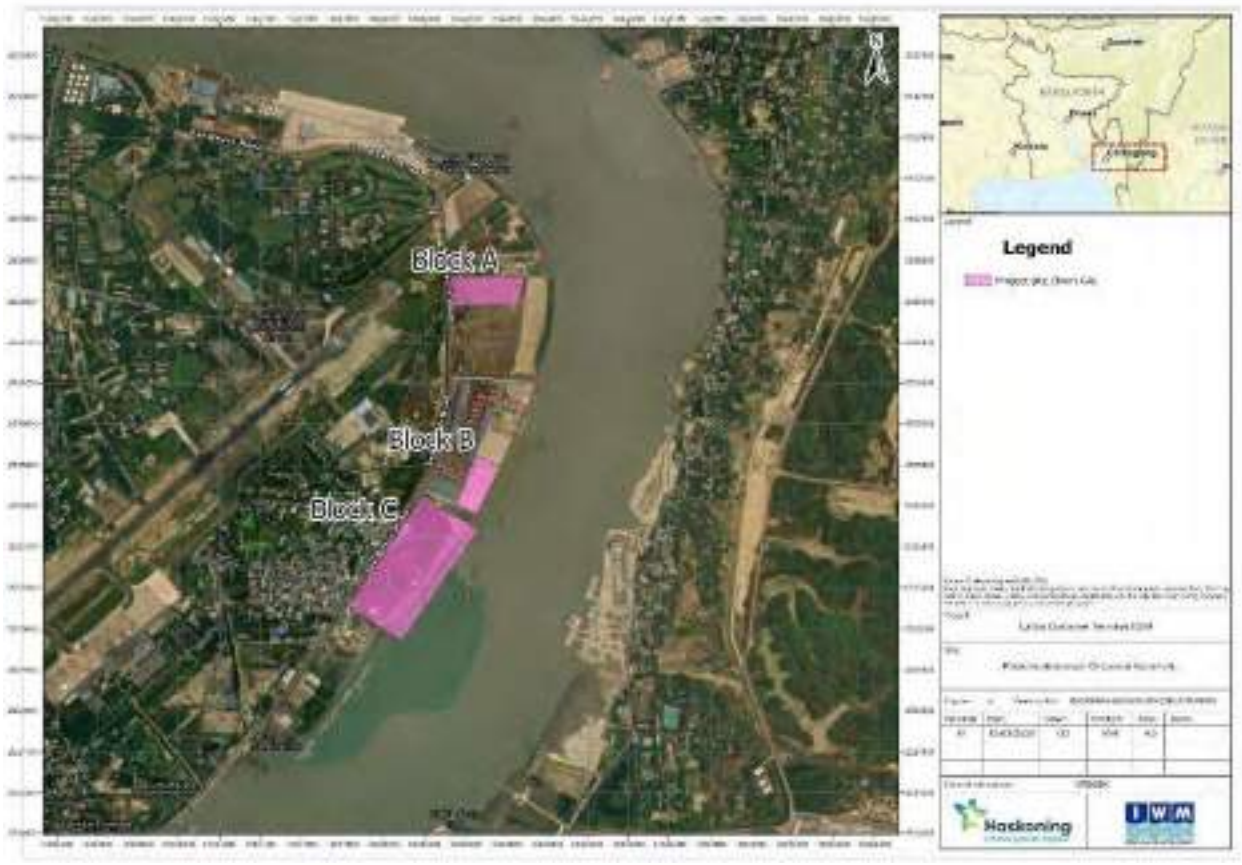


Figure 2-2: Project site layout showing Blocks A, B, and C of the LCTP

2.2 Project Design

The LCTP will utilize Blocks B and C of the Laldia Char site, with Block A serving a supporting role for truck parking and processing. The terminal shall be developed as an International Ship and Port Facility Security (ISPS) compliant operational zone. The functionality of the Blocks is as follows:

- Block C (12.95 ha) forms the core of main terminal operations due to its suitability for large-scale infrastructure.
- Block B (2.89 ha) supports the temporary storage of empty containers and is located adjacent to Block C. Block C and B will be connected for the transfer of containers. The area of the drainage channel will be filled and a culvert.
- Block A (4.05 ha) will be used as waiting and processing area for trucks before entering the actual container terminal. It has space for parking more than 240 trucks.

The terminal is designed for an annual capacity of 1.4 million TEU (standard size where one 40-ft container = 2 TEU), which is approximately 820,000 container boxes (with an estimated 1.71 TEU per move). LCTP will be equipped with seven (7) ship-to-shore (STS) cranes, 32 electrically powered remote-controlled rail-mounted gantry cranes (eRTG), and six (6) empty container handlers (ECH).

3 Soil conditions

Reference is made to the Geotechnical reports:

- Report on APMT Laldia Terminal for Ground Investigation at Laldia Chattogram in Bangladesh, Survey 2000, December 2025
- Report on APMT Laldia Terminal for Ground Investigation at Laldia Marine Side Chattogram in Bangladesh, Marine Side Works Block-C, Survey 2000, February 2026

3.1 Land-side boreholes

From the land-side boreholes (Figure 3-1), the boreholes LBH-09, LBH-10 and LBH-11 are the closest to the water edge. Land boreholes are included in this assessment to verify consistency with Marine boreholes.



Figure 3-1: Location of land-based boreholes

The geological profile along the boreholes LBH-09, LBH-10 and LBH-11 is provided in Figure 3-2. The layers hatched in blue colours represent fine to medium sand layers. The layers in purple, pink, grey and orange represent layers that are predominately silty and clayey. The red box indicatively shows the depth levels where dredging will take place, which is from around -9 m CD to -12 m CD.

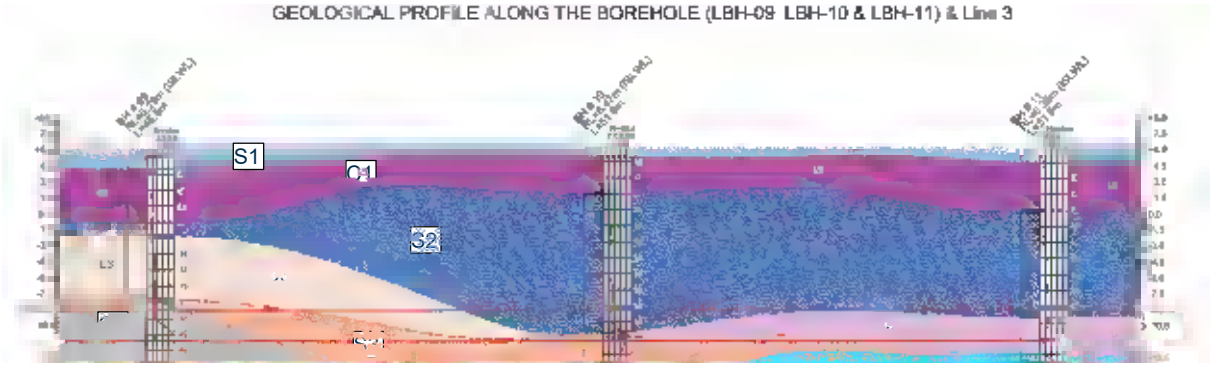


Figure 3-2: Geological profile along Borehole LBH-09. LBH-10 and LBH-11) the red box indicatively shows the dredging scope

Layer ID	Lithology Description
S0	Loose brown silty fine SAND (Filling SAND) (1<N≤9)
S1	Very loose to medium dense light gray to brown silty fine to medium SAND (2<N≤12)
C1	Very soft to stiff grey clayey SILT (1<N≤15)
S2	Loose to dense gray medium to fine SAND (4<N≤50)
C2	Soft to stiff gray clayey SILT (3<N≤25)
S3	Loose to dense gray silty fine to medium SAND (5<N≤50)
C3	Stiff to hard gray clayey SILT (9<N≤37)
S4	Very dense gray to brown fine to medium SAND (N≥50)
C4	Very stiff to hard grey clayey silt (18<N≥50)
C5	Hard grey clayey SILT (N≥50)

Figure 3-3: Lithology Description

3.2 Marine boreholes

The boreholes along Block C inside the Karnaphuli River are shown in Figure 3-4. Reference is made to Figure 3-4 where the location of the marine boreholes are plotted with reference to the dredging scope. It can be concluded that the line 2-2', which includes the boreholes MBH-07, MBH-08, MBH-09, MBH-10, MBH-11 and MBH-12 are most relevant for the dredging scope. Lines 1-1' and 3-3' are used to validate the consistency over the line 2-2'.

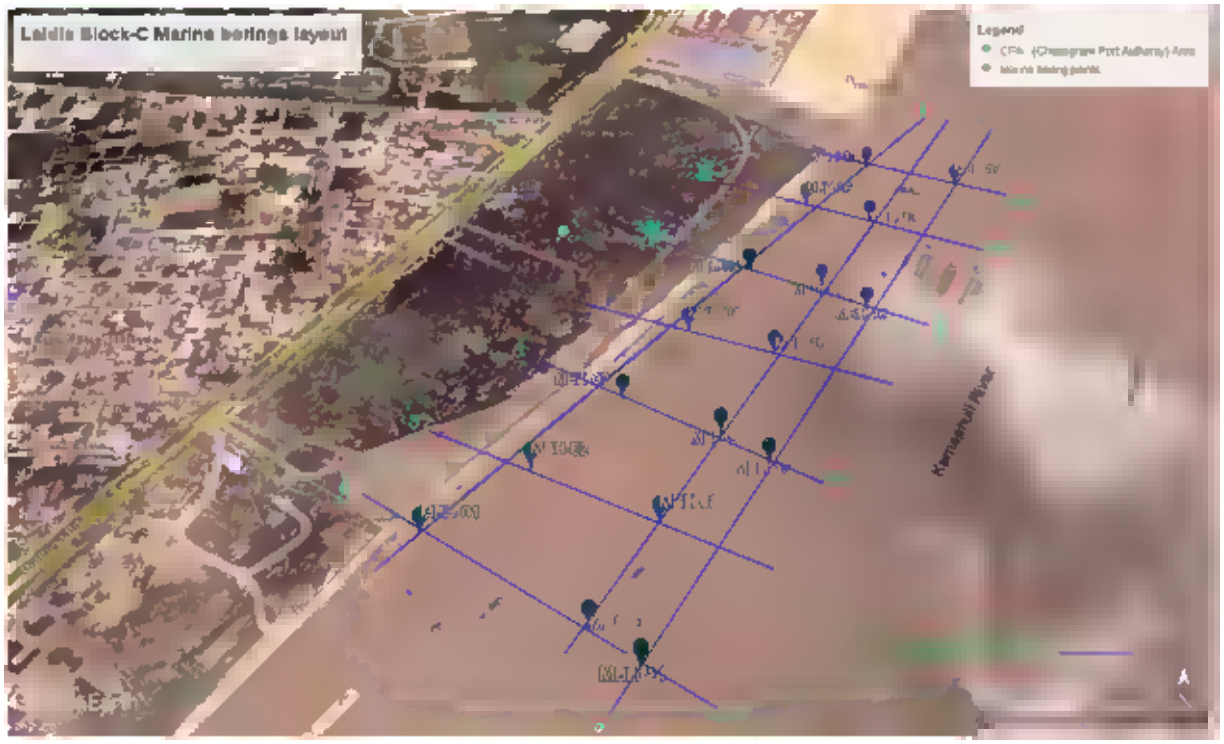


Figure 3-4: Location of boreholes along Block C in Karnaphuli River

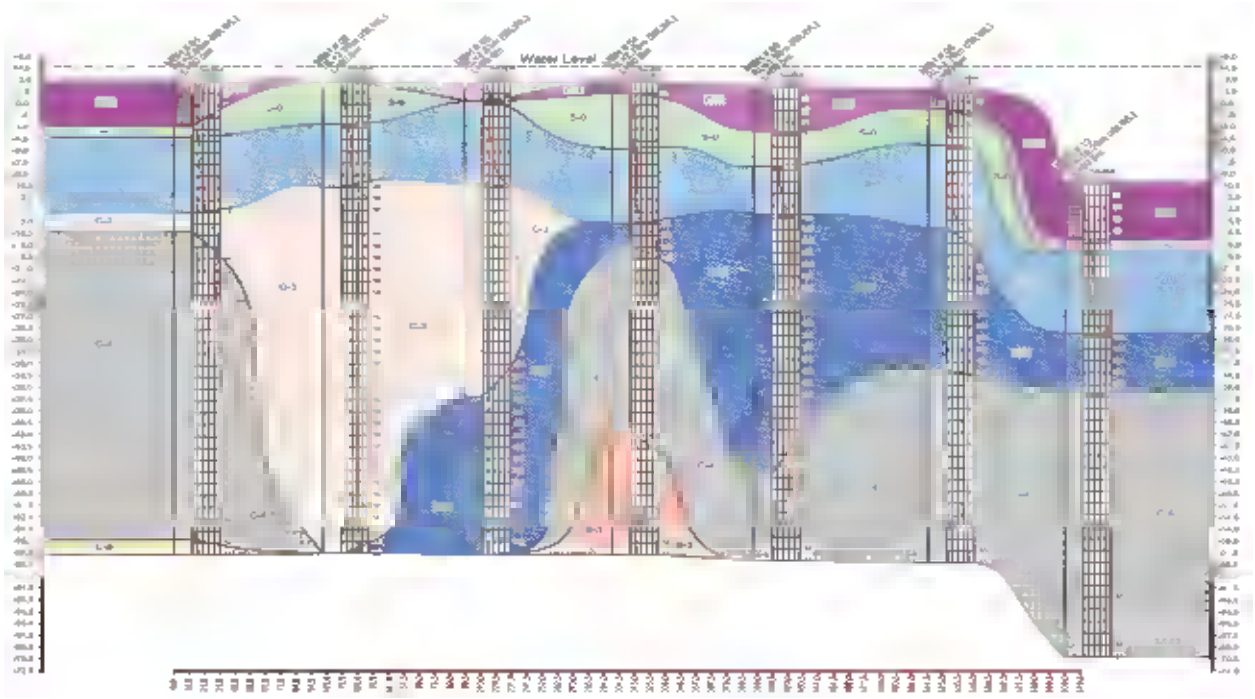


Figure 3-5: Lithology Description of profile 1-1'

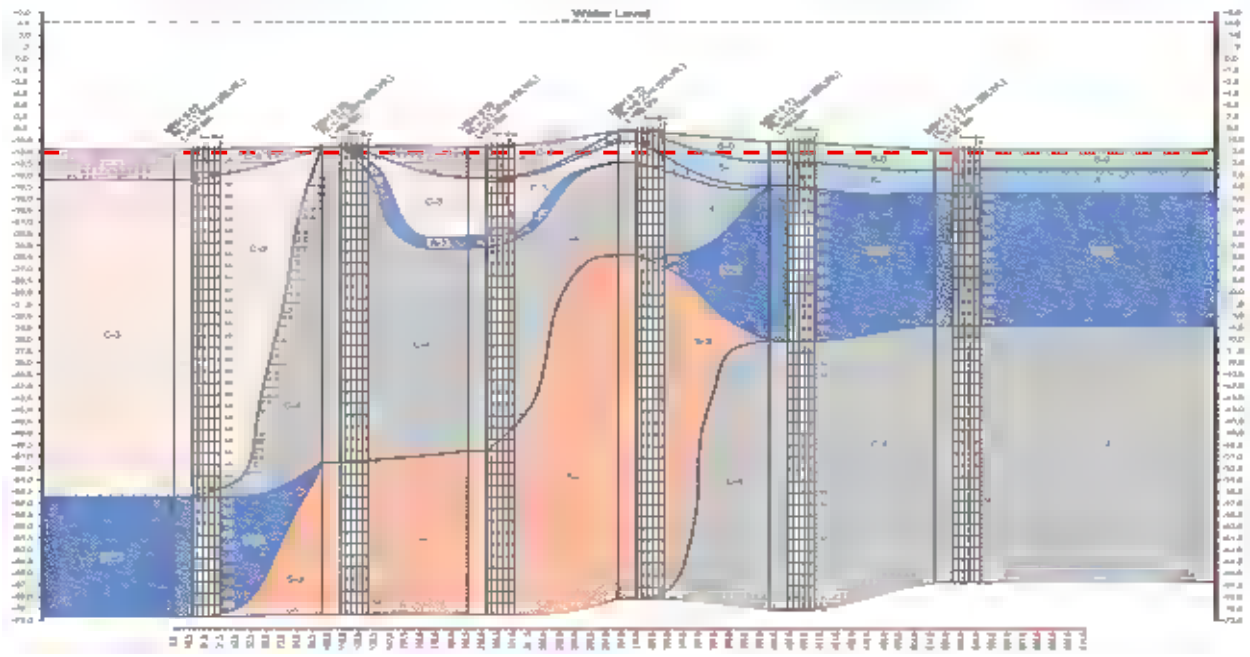


Figure 3-6: Lithology Description of profile 2-2'

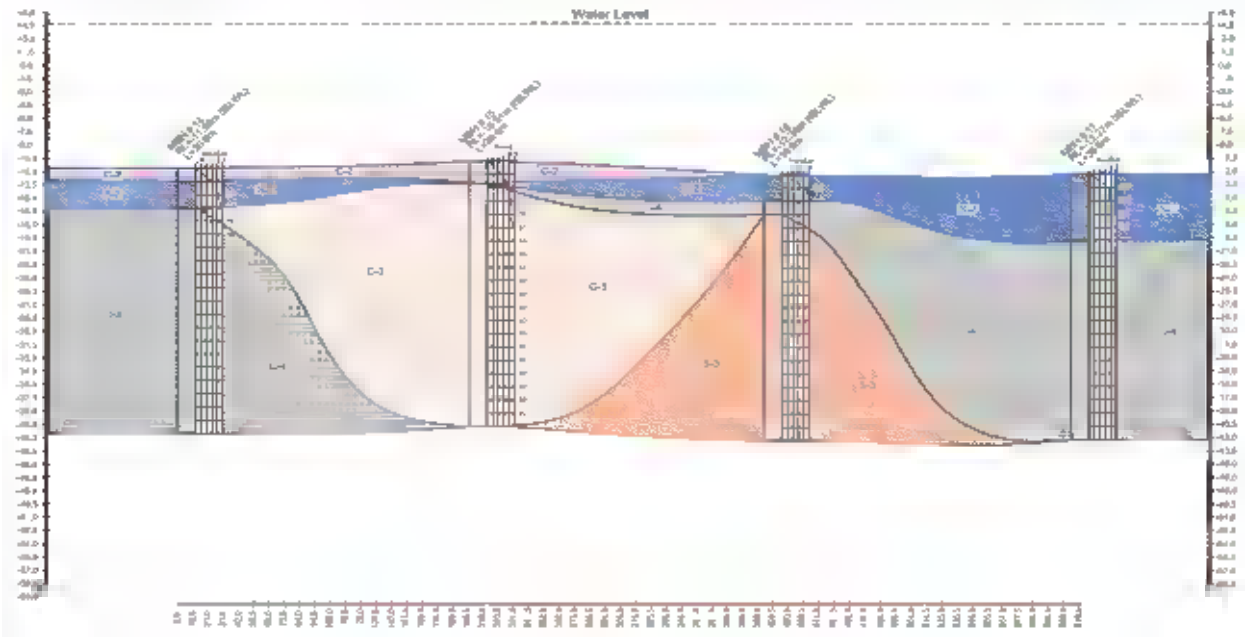


Figure 3-7: Lithology Description of profile 3-3'



Layer ID	USCS Classification
C-1	Lean clay CL / Lean clay with sand CL / Clayey sand, SC / Sandy silt, ML
C-2	Lean clay CL / Lean clay with sand CL / Fat clay CH
S-0	Poorly graded sand, SP / Silty sand SM / Poorly Graded Sand with Silty Clay SP-SC / Silty clayey sand SC-SM
S-1	Poorly graded sand, SP / Poorly graded sand with clay SP-SC / Clayey sand SC / Silty sand SM / Silt with sand ML / Silty clayey sand SC-SM
C-3	Lean Clay, CL / Fat clay CH
S-2	Poorly graded sand, SP / Poorly Graded Sand with Silty Clay, SP-SC / Silty sand, SM / Silty clayey sand SC-SM
C-4	Lean clay, CL / Silt, ML / Fat clay CH / Sandy lean clay CL / Lean clay with sand CL
S-3	Poorly graded Sand SP / Poorly Graded sand with silty clay SP-SC
C-5	Lean Clay, CL

Figure 3-8: Lithography description

Reference is made to Figure 3-3 where the lithography of the dredging scope is provided. The red dashed line represents the dredging level of -12.0 mCD (CD = ISLWL), refer to the design asset drawing in Section 4.

Table 3-1 provides an estimate of the distribution of soil types to be encountered for the dredging scope, reference is also made to Figure 3-5 and Figure 3-6 where the lithology and legend is provided.

Table 3-1: Estimate of soil types to be encountered for the Dredging Works

Layer (from left to right)	Amount (estimate)	material
C2	~50%	Lean clay, CL/ Lean clay with sand, CL/ Fat clay, CH
C4	~ 3%	Lean clay, CL/ Silt, ML/ Fat clay, CH/ Sandy lean clay, CL/ Lean clay with sand, CL
S2	~ 2%	Poorly graded sand, SP/ Poorly graded sand with silty clay, SP-SC/ Silty sand, SM/ Silty, clayey sand, SC-SM
C3	~ 5%	Lean Clay, CL/ Fat clay, CH
S1	~10%	Poorly graded sand, SP/ Poorly graded sand with clay, SP-SC, Clayey sand, SC/ Silty sand, SM/ Silt with sand, ML/ Silty, Clayey sand, SC-SM
S0	~30%	Poorly graded sand, SP/ Silty Sand, SM/ Poorly graded sand with silty clay, SP-SC/ Silty, clayey sand, SC-SM

Based on the assessment above, ~40% of the material to be dredged is poorly graded Sand and ~60% of the material to be dredged is predominantly silt and clay. The material seems therefore not suitable as fill material for the container terminal. If used as fill material, the expected high fine content (fines are defined as material with a d < 0.063 mm, being silt and clay) of the dredged material will make compaction very challenging.

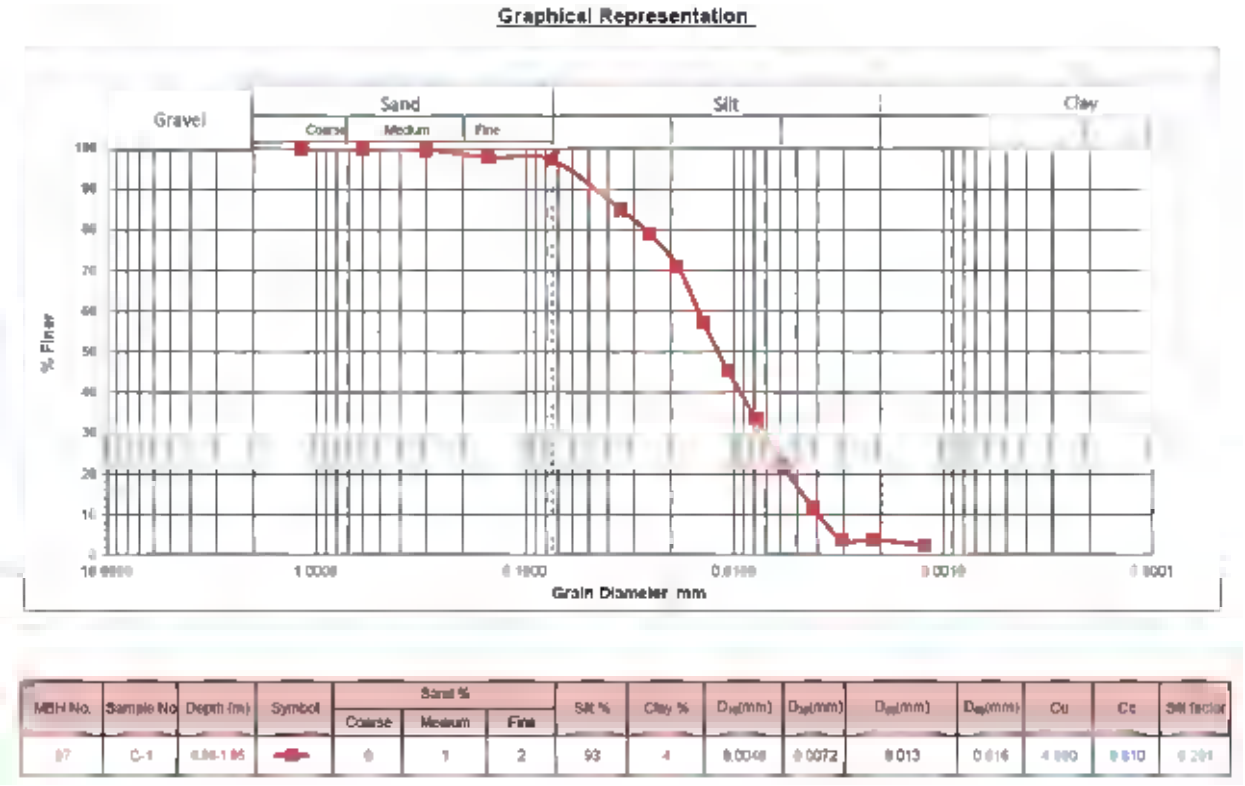
3.3 Fine contents

As informed in Section 3.2, the relevant boreholes are provided in the Table 3-2. Reference is made to the Marine Boreholes report of Survey 2000 where a summary table and (some) particle size distributions (PSD) are provided.

Table 3-2: Fine contents per borehole

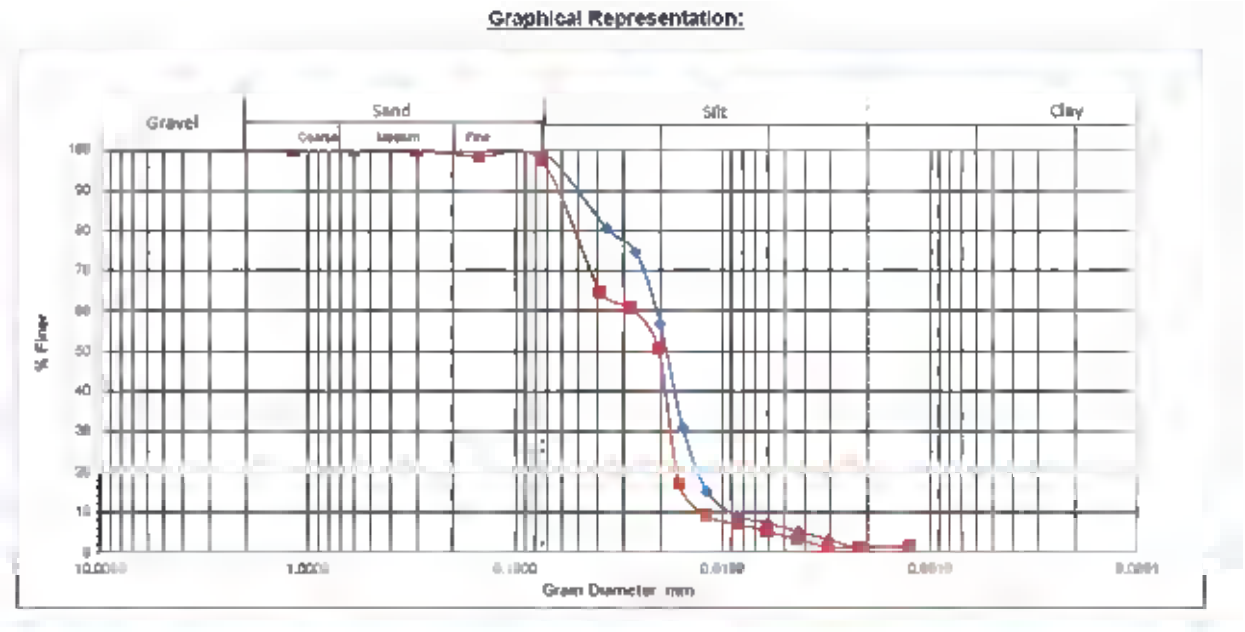
Borehole	RL (m ISLWL)	BH Depth to dredge level (m)	Relevant PSD's	PSD
MBH-07_C1	-11.64 m ISLWL	0.36 m	Depth 0.00-1.05m	Sand: 3% Silt: 93% Clay: 4%
*MBH-08_C2**	-11.23 m ISLWL	0.77 m	*Depth 1.50- 2.55m*	*Sand: 0%* *Silt: 98%* *Clay: 2%*
*MBH-09_C2**	-11.32 m ISLWL	0.68 m	*Depth 1.50- 2.55m*	*Sand: 6%* *Silt: 92%* *Clay: 2%*
MBH-10_C1 *MBH-10_C3**	-9.23 m ISLWL	2.77 m	Depth 0.00- 1.05m *Depth 3.00- 4.05m*	Sand: 95% Silt and clay: 5% *Sand: 0%* *Silt: 98%* *Clay: 2%*
*MBH-11_C1**	-10.7 m ISLWL	1.3 m	*Depth 0.00- 1.05m*	*Sand: 97%* *Silt and clay: 3%*
*MBH-12_C2**	-11.74 m ISLWL	0.26 m	*Depth 1.50- 2.55m*	*Sand: 94%* *Silt and clay: 6%*
(MBH-13)**	-10.20 m ISLWL	1.8 m	Depth 1.05-1.50m	Sand: 19% Silt: 77% Clay: 4%
**depth at which PSD is taken is slightly above/below the dredging scope*				
***MBH is part of section 1-1', but is relevant*				

Figure 3-9, Figure 3-10 and Figure 3-11 provide PSD's extracted from the Survey 2020 report.



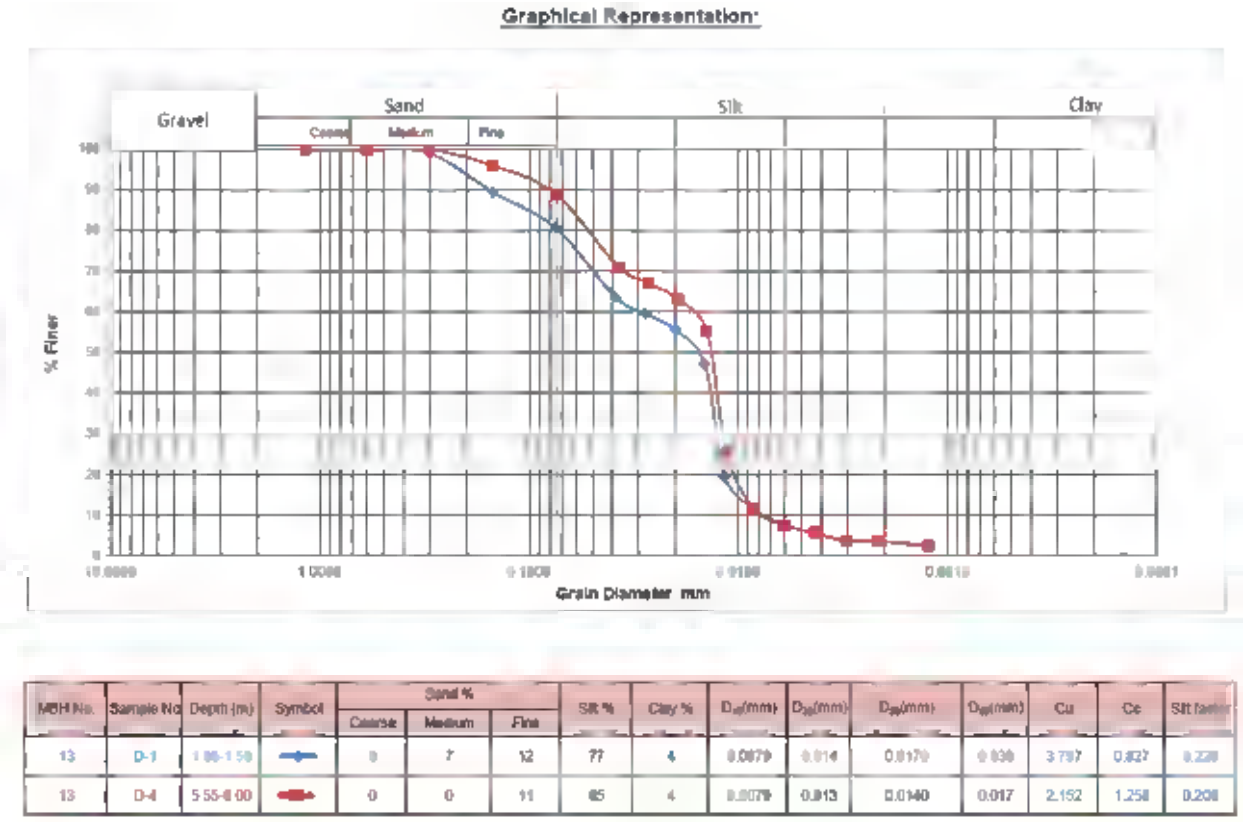
MBH No.	Sample No.	Depth (m)	Symbol	Sand %			Silt %	Clay %	D_{10}(mm)	D_{30}(mm)	D_{50}(mm)	D_{60}(mm)	Cu	Cc	Silt factor
				Coarse	Medium	Fine									
07	C-1	0.00-1.05		0	1	2	93	4	0.0048	0.0072	0.013	0.016	4.000	0.810	0.291

Figure 3-9: PSD MBH-07 0-1.05 m



MBH No.	Sample No.	Depth (m)	Symbol	Sand %			Silt %	Clay %	D_{10}(mm)	D_{30}(mm)	D_{50}(mm)	D_{60}(mm)	Cu	Cc	Silt factor
				Coarse	Medium	Fine									
10	C-3	3.00-4.05		0	0	0	98	2	0.0083	0.0179	0.019	0.022	2.366	1.413	0.243
10	C-7	9.00-10.05		0	1	2	95	2	0.0140	0.0186	0.028	0.029	2.071	0.796	0.248

Figure 3-10: PSD MBH-10 3-4.05 m



MBH No.	Sample No.	Depth (m)	Symbol	Sand %			Silt %	Clay %	D_{60}(mm)	D_{30}(mm)	D_{10}(mm)	D_{05}(mm)	Cu	Cc	Silt factor
				Coarse	Medium	Fine									
13	D-1	1.05-1.50		0	7	12	77	4	0.0079	0.014	0.0170	0.030	3.797	0.827	0.228
13	D-4	5.55-6.00		0	0	11	85	4	0.0079	0.013	0.0140	0.017	2.152	1.258	0.208

Figure 3-11: PSD MBH-13 1.05-1.50 m

Based on the provided information, an average fine content of ~80% is assumed, which primarily consists of silt particles. The dominant grain size of the silt fraction is about 15 µm, which could be considered the representative sediment size for the suspended sediment brought into suspension by the dredging activities and reaching the far-field dredge plume.

4 Dredging Scope

4.1 Dredging scope overview

Dredging scope within the project comprises the following elements:

- Capital and maintenance dredging of the berth pocket
- Dredging of the mudflats under the future reclamation area in front of Block C
- Removal of topsoil at Block C (i.e. the first 20-50 cm) before levelling can start with reclamation material.

Any dredging required to keep the access channel and turning circle to the required depth will be performed by Chittagong Port Authority (CPA) as part of the Concession Agreement. Volumes, frequencies and dredging methods are not known for the access channel and turning circle dredging. This component is not covered in this DMP. However, LCT Ltd. will request CPA to also adhere to the environmental and social requirements outlined in this DMP.

4.2 Capital Dredging Volumes

Based on the plan view in the Asset Design Drawing (see Figure 4-1, Figure 4-2 and Figure 4-3), on average the existing current bed level in the berth pocket is at around -9.0 m CD. The berthing pocket will reach -12 m ISLWL (including a 1 m sedimentation buffer), accommodating vessel drafts of 10.5 m under all tidal conditions.

A high-level cross check of dredging volumes results in (723 x 50 x (12-9) x 1.5=) <200,000 m^3 of material to be removed in the pocket. The slopes are assumed to be <50% of the berth pocket volume.

With the current information available, the 300,000-400,000 m^3 of dredging of berth pocket and slopes and as informed by LCT Ltd., seems to be the cap of dredging works.

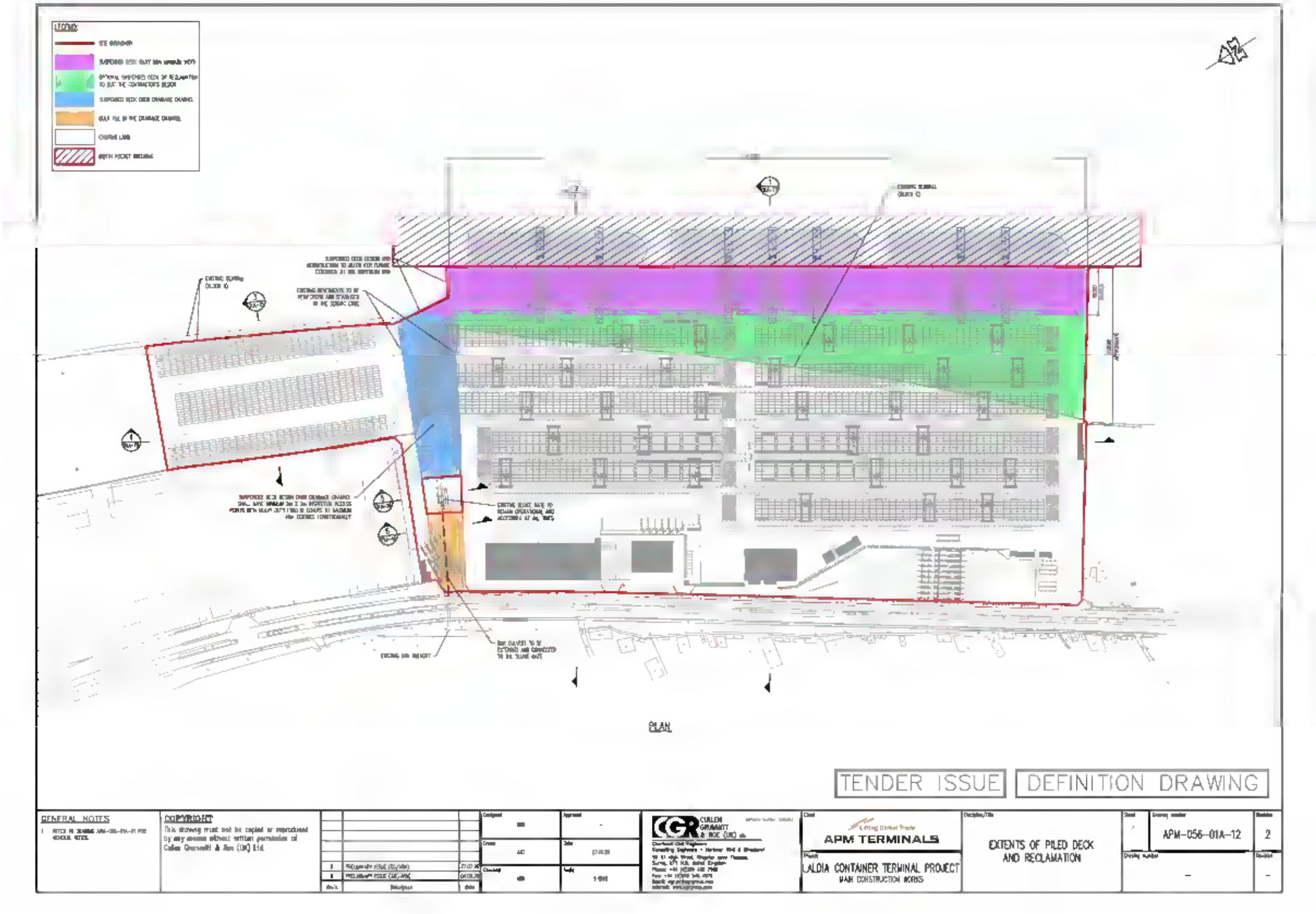


Figure 4-1: Terminal layout indicating deck-on-piles and area for reclamation (source: Asset Design Drawings APM-056-01A-12 rev. 2

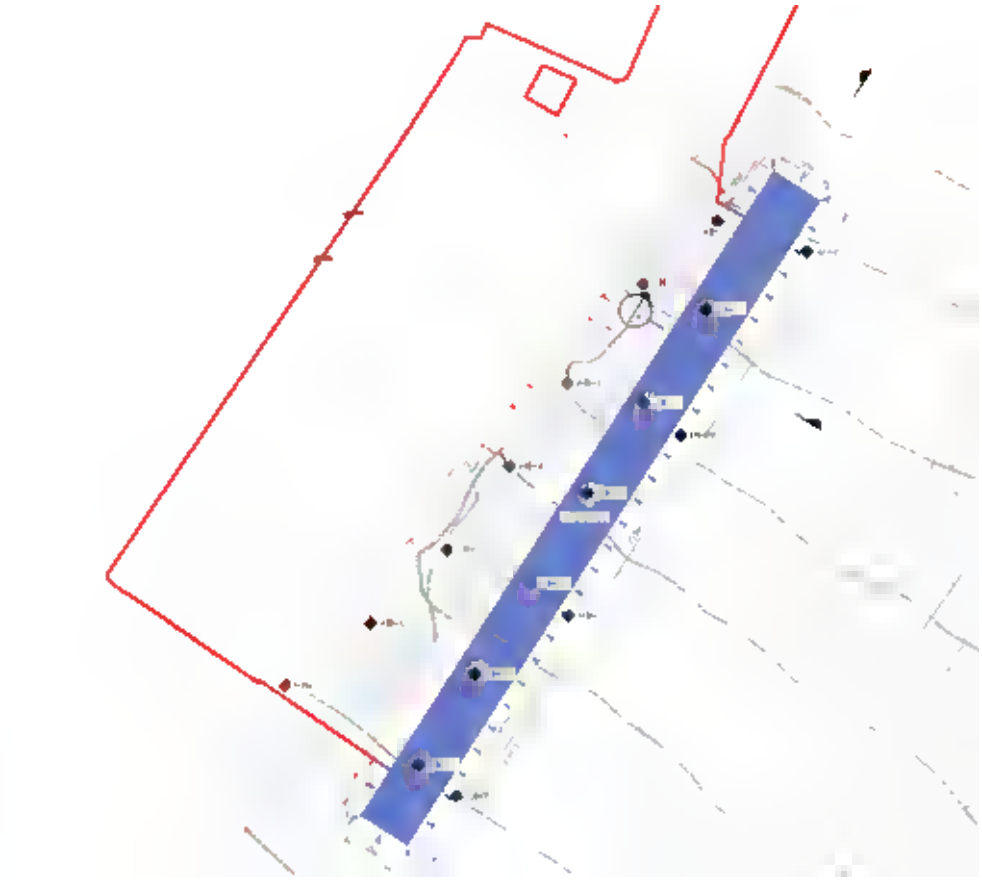


Figure 4-2: Dredging design plan view. Red line indicates the suggested project boundary (source: Asset Design Drawings APM-056-03A-01 rev. 2)

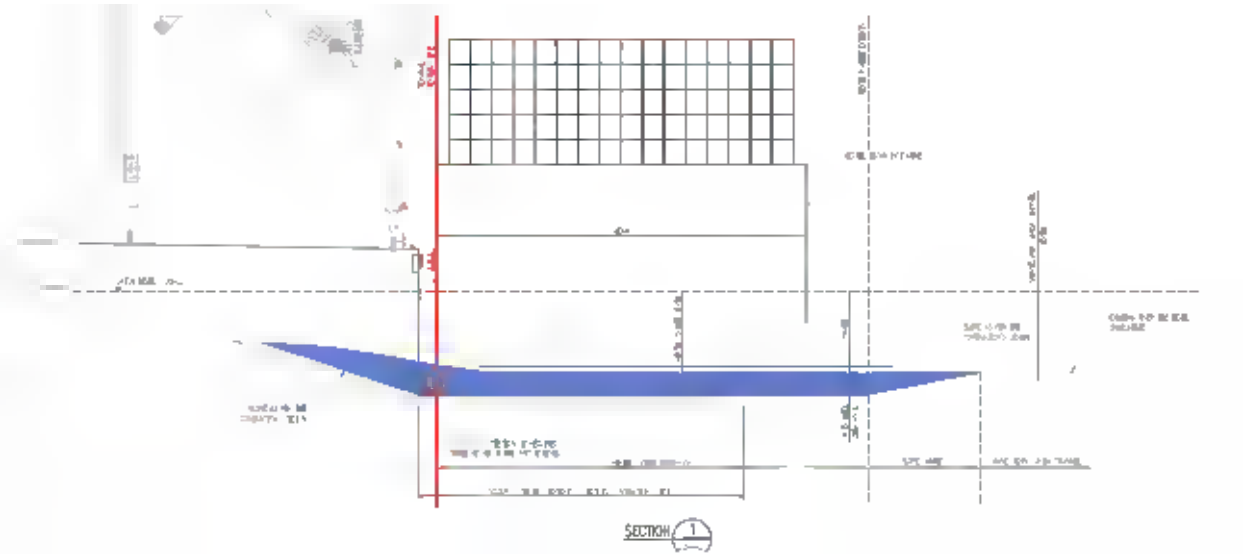


Figure 4-3: Dredging design cross section (source: Asset Design Drawings APM-056-03A-02 rev. 4)

4.3 Maintenance Dredging Volumes

Maintenance dredging shall be required during the operational phase. A morphological model is developed to assess patterns of sediment transport, changes of erosion and deposition as the hydrodynamics of the Karnaphuli River is altered by the construction of the proposed terminal at Laldia. The dredged berth pocket is expected to experience sedimentation, with backfilling rates of approximately 0.39 m/month during the monsoon and 0.19 m/month during the dry season. As a result, maintenance dredging will be required to maintain navigational depths and support terminal operations, with an estimated dredging volume of around 159,000 m³ per year.

4.4 Dredging of mudflats under reclamation area in front of Block C

Prior to the placement of suitable fill material in Block C, the removal of existing mudflats within the reclamation footprint shall be carried out to ensure a stable and uniform foundation for the reclaimed land. Mudflats typically consist of soft, highly compressible sediments with high water content, which are unsuitable to support fill loads without prior treatment or removal.
The removal process generally involves dredging or excavation of the unconsolidated sediments, using appropriate equipment such as excavators, cutter suction dredgers, or backhoe dredgers. This activity eliminates weak surface layers, reduces the risk of excessive settlement, and provides a controlled subgrade for subsequent filling operations.

Based on the current design, approximately 31,650 m² of intertidal mudflat located along the river side of Block C will be cleared. The ESIA base case takes into account an average depth of approximately 3.0 m, generating an estimated 94,950 m³ of excavated material (as a conservative estimation). This material will be transported by barge to the Char Bakalia area for temporary disposal and storage to be reused in other locations.

4.5 Removal of topsoil at Block C

The topsoil of the area in Block C contains roots of vegetation and possibly some solid waste. The vegetation has been removed and burned, however there are still remains of vegetation on-site. Prior to the commencement of levelling works, the removal of topsoil forms a preparatory activity to ensure the long-term stability of the container terminal.

Topsoil, typically defined as the uppermost organic-rich layer of soil, contains vegetation, root systems, microorganisms and nutrients essential for plant growth. The vegetation has already been removed from the site. However, there are some remaining leftovers of vegetation and associated root systems.

The topsoil layer is carefully stripped using appropriate earthmoving equipment. The stripping depth is determined based on site-specific soil conditions and is typically limited to the humic (organic) horizon to avoid mixing with underlying subsoil. The removed topsoil is segregated from other materials and needs to be disposed of.

Based on the current design, approximately 131,000 m² of land within Block C will be cleared to an average depth of approximately 0.5 m, generating an estimated 65,500 m³ of clearance material. This material will also be transported by barge to the Char Bakalia area to be temporarily disposed for further beneficial reuse.

4.6 Overview of dredging and reclamation volumes for construction

The volumes that are required to be dredged or as fill material are presented in Table 4-1. This represents the current design basis and forms the basis for the impact assessment. Maintenance dredging will be undertaken by CPA and the volume expected is given in Section 4.3.

Table 4-1: Overview of sediment material volumes required for LCTP

#	Transport of materials in and out of the LCTP	Surface (m2)	Depth (m)	Volume (m3)	Import / Export	Destination/ Source	Distance by river
1	Ground clearance in the container yard area (Block C)	131,000	0.5	65,500	Export	Char Bakalia	17 km
2	Ground clearance in the tidal zones (river side of Block C)	31,650	3.0	94,950	Export	Char Bakalia	17 km
3	Ground clearance in the drainage channel (between Block B & C)	8,890	3.0	26,670	Export	Char Bakalia	17 km
4	Dredging berth pocket			400,000	Export	Char Bakalia	17 km
5	Land levelling Block C to ISLWL+8.0m	131,000	1.5	196,500	Import	Raozan	25-35 km
6	Additional levelling for removal of topsoil, to fill from removal item no. 1	131,000	0.5	65,500	Import	Raozan	25-35 km
7	Reclamation area into the river to ISLWL+8.0m			400,000	Import	Raozan	25-35 km
8	Fill in the drainage channel (between Block B & C)	8,890	5.0	44,450	Import	Raozan	25-35 km
9	Surcharge (import)			299,000	Import	Raozan	25-35 km
10	Surcharge (excess material)			243.000	Export	Char Bakalia	18 km
	TOTAL EXPORT			**830.120 m³**			
	TOTAL IMPORT			**1,005,450 m³**			

5 Dredging Operation

5.1 General description of main dredging equipment

Dredging methods are generally split into two categories, the first category are the hydraulic dredging methods, the second category are the mechanical dredging methods.

- Hydraulic dredging includes cutting and suction of material via a suction pipe which is subsequently either loaded in a hopper (TSHD) or barge or directly pumped ashore (CSD).
  Hydraulic dredging also includes the use of a Water Injection Dredger (WID) where a beam with water nozzles is pulled over the bottom to bring the material into suspension. WID relies on a current, for example river flow or tide that will transport the suspended material from the project area.
- Mechanical dredging does not include dredging by means of pumping of material, but by mechanical means. Grab dredgers (GD) and backhoe dredgers (BHD) are among the most well-known types of dredging equipment within the mechanical dredgers category. Mechanical dredging requires barges to transport and dispose the dredged material.

Most commonly used equipment for large amounts of dredging are the following (a brief description is presented below):

- Trailing Suction Hopper Dredger (TSHD)
- Cutter Suction Dredger (CSD)
- Backhoe Dredger (BHD)
- Grab Dredger (GD)

Trailing Suction Hopper Dredger (hydraulic dredger)

A trailing suction hopper dredger is usually a sea-going dredging vessel and has large, powerful pumps and engines that enables the vessel, via a drag head and suction pipe, to suck up sand, clay, sludge and even gravel from ocean or riverbeds. One or two suction pipes run from the vessel to the bed. A drag-head is attached to the end of the pipe and lowered to just above the bed, making it possible to regulate the mixture of sand and water that it takes in. A trailing suction hopper dredger generally stores the dredged material in its own hopper and discharges the left-over water overboard.

A trailing suction hopper dredger can empty its hopper in a variety of different ways:

- Depositing – Opening doors or valves in the bottom of the vessel so that the hopper contents drop out.
- Pumping – Using jet pumps or water jets to pump water into the hopper at high pressure so that the sand becomes ‘fluid’ again. The dredge pumps can then pump the resulting mixture through a dredge pipe or pipeline which is connected to the vessel.

- Rainbowing – Rainbowing involves the discharge of dredged material from a trailer suction hopper dredger (TSHD) through a bow-mounted nozzle, creating an arc of sediment slurry that deposits material directly within the designated placement area.

TSHDs require sufficient water depth (say at least 5 meter for smaller dredgers and more than 10 meter for the largest dredgers) to work efficiently. TSHDs are self-propelled vessels capable of transporting dredged material over both short and long distances, making them suitable for maintenance dredging, capital dredging, beach nourishment, reclamation works, and offshore disposal.



Figure 5-1: Trailing Suction Hopper Dredger (TSHD)

Cutter suction dredger (hydraulic dredger)

The Cutter Suction Dredger (CSD) is very suitable for dredging cohesive soils and rock, but can also dredge sand and stiff clay very well. Moreover, smaller CSD's can operate in shallow water depths of <4 m and can dredge around the water line. CSDs can also cut their own path into shallow areas.

The CSD is equipped with a cutter head, which cuts loose the seabed material at the suction inlet and transports it to the suction mouth. The dredged material is discharged through a (long) pipeline to shore or to a barge. The typical pumping distance is around 2-3 km, depending on the pump capacity installed, and may be extended further if booster stations are added. The CSD is a stationary dredger, this means that the CSD will dredge when anchored at a position, contrary to a TSHD which dredges during sailing.

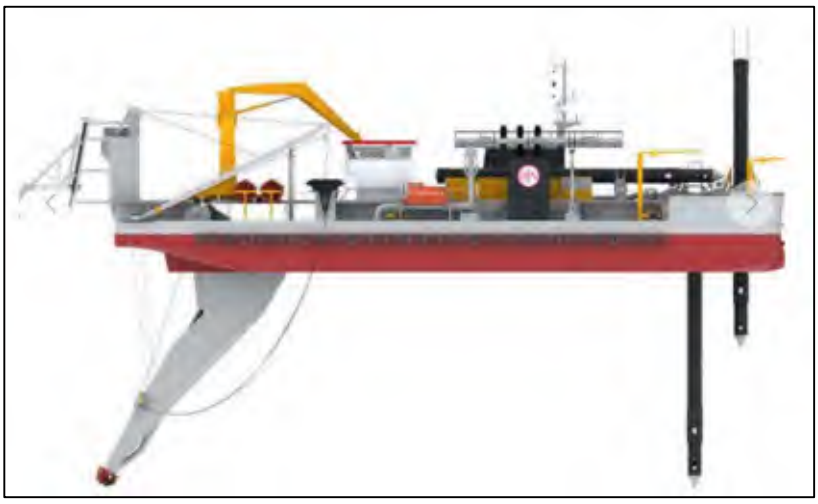


Figure 5-2: Cutter Suction Dredger (CSD)

Backhoe Dredger (mechanical dredger)

The backhoe dredger (BHD) is basically a backhoe excavator mounted on a pontoon equipped with spuds, which anchor the vessel and may also be used for repositioning.. The backhoe dredger is generally stationary during dredging and is usually non-propelled in operation.

The dredged material is brought to the surface and then typically loaded into barges for transport to a disposal or beneficial reuse site where unloading can take place. The unloading is possible via a barge unloader or disposal through a split hopper barge. The backhoe dredger is a versatile type of equipment because it can excavate a range of different materials such as sand, clay, gravel, cobbles, and weathered rock. Further, it can operate in confined areas, not accessible for many other types of dredgers. Productivity depends strongly on the soil type, excavation conditions, and project setup, and can be high under suitable conditions.



Figure 5-3: Backhoe dredger (BHD)

Water Injection Dredgers (hydraulic dredger)

Water Injection Dredger (WID) is a specialised dredging vessel typically for maintenance dredging in ports and navigation channels. Unlike conventional dredgers, which excavate or pump the material in its hull, a barge or directly onshore, a WID works by injecting water into the seabed. This process fluidises the sediment, creating a slurry layer that remains close to the bed. Under the influence of gravity, tidal currents and river flows, the fluidised sediment is transported naturally away from the dredging area towards deeper water or locations where it no longer affects navigation.

Water Injection Dredging is particularly effective for deposited fine sediments. Water Injection Dredging is regarded as a cost-effective dredging method because it makes use of natural hydrodynamic processes rather than mechanical excavation and transportation. In addition, WID vessels are highly manoeuvrable and can operate very close to quay walls, embankments and other port structures, making them well suited for confined areas where traditional dredging equipment may be less effective.

Although Water Injection Dredging offers advantages, its use is limited to suitable soil types and environmental conditions. The method is generally not effective in hard materials, and it requires sufficient currents or seabed gradients to transport the fluidised material away from the work area. When applied under the appropriate conditions, a Water Injection Dredger provides an efficient method of maintaining navigable water depths while minimising dredging costs, equipment requirements and environmental disturbance. Furthermore, as the dredged material is transported by natural hydrodynamic processes, the exact location where the suspended material is ultimately deposited cannot be completely controlled.



Figure 5-4: Water Injection dredger (WID)

Grab Dredgers (mechanical dredger)

Grab dredgers have either rotating cabs or fixed A-frame type barge-mounted equipment. They have hoisting and control systems and use clamshell digging devices or buckets rigged on cables to excavate the material from the bottom and transport it vertically out of the water and into barges for subsequent transport to the placement area. Grab dredgers can be used in sands, some types of clay, gravel, cobbles and occasionally broken rock.

Grab dredgers are not particularly effective in fine silts, which have a tendency to run out of the clamshell. However, when equipped with sealed environmental buckets, grab dredgers can be an effective and often preferred method for dredging fine contaminated sediments, as they minimise sediment loss and turbidity. Similar for Backhoe Dredgers, dredged material is typically loaded in barges, which will transport the dredged material to reclamation area or disposal location.



Figure 5-5: Grab Dredger (GD)

5.2 Evaluation criteria of possible work methods

The actual choice of dredging equipment is part of work method of the Contractor. The Contractor will determine, based on the different criteria, what the Contractor's work method will be. As an example: in case the dredged material is very hard, certain dredging equipment cannot be used. The contractor will evaluate all those aspects and come to his work method, and deployment of the most suitable equipment. The following aspects will play a role in the selection of equipment by the Contractor:

- Geotechnical characteristics
- (maximum) Required Dredging depth
- Hydrographic conditions
- Volumes
- Disposal options and distance
- Shipping / hindrance in the basin (for example a floating pipeline)
- Cost considerations

- Spill/ environmental considerations
- Availability of equipment within the fleet
- Mobilisation/ demobilisation (availability in the nearby region)
- Specific regulations (per country)
- Client / project requirements
- Interfaces with other project components
- Required tolerances and accuracy

Some more consideration related to the above-mentioned bullets is given below;

Geotechnical characteristics

Geotechnical conditions will impact the work method as different soil types require different dredging forces and equipment. For example, the suitability and efficiency of dredging equipment may vary depending on whether the material consists predominantly of soft sediments, sand, clay, gravel, cobbles, or rock.

Required dredging depth

The reach of different dredging equipment (dimensions of the cutter ladder, the size of the boom and stick of backhoes, the length of suction pipe of the TSHD, etc.) is limited, each dredger has its specific reach. The Grab Dredge can dredge to large dredge depths, as dredging depth is related to the length of the wire between grab and crane. Depth limitations do not only impact the choice of type of equipment but is also a factor of the size of the proposed equipment (i.e. smaller TSHD in shallow water and larger TSHD in deeper water).

Hydrographic conditions

The hydrographic conditions on site (waves, currents, tidal flows) can negatively impact the use and productivity of certain dredging equipment. In the case of LCTP it is expected that waves generated by passing vessels and high tidal and river currents could negatively impact dredging operations. However these risks can be well mitigated by selecting appropriate equipment and adjusting the work methods to the expected hydrographic conditions.

Volumes

Some dredging equipment have low production rates. If the dredged volumes are significant or dredged volumes require to be removed in a short period of time, the total time required to finish the works may not fit the required programme.

Existing shipping/ port operations

Shipping and/or port operations in the basin can impact the dredging method. Stationary dredging vessels have limited manoeuvrability and could hinder other shipping and/or port

operations when being for example positioned in an approach channel. TSHD's are non-stationary and are in general more suitable to interact with other shipping.
A floating pipeline of a CSD, or as shore connection of a TSHD, might also hinder the shipping activities. Regulatory requirements and approval conditions may influence the final dredging methodology and equipment selection.

Cost considerations

Economic considerations, meaning low costs per dredged m3 will be an important factor of choice of dredging equipment. Especially if one of the main award criteria will be the total contract price. Generally, the cost of dredging is determined by the cost of keeping a certain dredging vessel (and auxiliaries) in operation (say cost per week) as a function of the total volume and productivity it can achieve. This will ultimately determine the duration (i.e. in weeks) and thus the overall costs. A major factor in the operational costs of dredging equipment is fuel costs (which may determine up to 40% of the operational costs of a dredger).

Spill/ environmental considerations

Generated spill per dredging equipment and/or reclamation/disposal options differ. Some dredging equipment generate more spill and dredging plumes with higher turbidity during the dredging process compared to others. When sensitive receptors could be affected and environmental limits are very strict, special techniques can be applied, such as special 'environmental grab' for the grab dredge. Mitigation and protection measures as bubble screens also exist. Environmental restrictions may rule out certain equipment choices.

Availability of equipment within the fleet

Dredging contractors have various project commitments and main equipment within the fleet has to be reserved to a project in advance. High-profile projects, technically complex projects or projects with high risks have planned the utilisation of certain equipment well in advance. This could result in non-availability of that specific dredging vessel on certain projects.

Mobilisation/ demobilisation

When a specific dredging vessel would already be close to the project location, it might be interesting to utilise that vessel on the project in view of the lower mobilisation cost. Some dredging vessels are not self-propelled, for which additional vessels are required for towing or transport vessels, which is another element impacting the potentially very significant mob / demob costs.

Client / project requirements

Specific project requirements or preferences could impact the choice of dredging equipment.

Tolerances and accuracy

Some dredging equipment can realise very accurate dredging levels. Modern TSHD's are usually equipped with modern heave compensation systems, able to reach higher accuracies compared to TSHD's not equipped with such a system.
Furthermore, dredging operations under different hydrographic conditions (waves, currents, tidal flows) can impact the realised results; a BHD positioned on its spud poles eliminates the wave impact, in combination with accurate positioning systems, the BHD is able to reach high level of accuracies.

5.3 Local working methods

Bangladesh has a rich history of capital and maintenance dredging projects ranging from very small projects to multimillion m^3 of dredging projects. In Bangladesh there is quite some experience with dredging, especially dredging by Cutter Suction Dredger (CSD) and barge loading. Dredged material is almost always re-used. Well-graded sand fractions have the highest value and can be used as aggregates for making of concrete. Poor-graded or material with higher fine contents have less value, but are typically still used for general fill purposes, for example raising flatlands, or raising riverbanks to improve the safety against flooding.

Along the shore of the Karnaphuli river, several reclamation areas are reported to be used for disposal of dredged material.

Figure 5-6 and Figure 5-7 shows local dredging practices in the Karnaphuli river. Barges are typically loaded by a CSD (or another suction dredger, such as a plain suction dredger). Suction dredgers in Bangladesh are typically equipped with a barge loading pipe. Dredged material is disposed in the barge where the majority of the solids settles. Process water leaves the barge by flowing over the coming of the barge. With this process, parts of the finer material (silt and clay) flows with the process water back into the water column. Figure 5-7 clearly shows the dredge spill, particularly caused by the overflowing.



Figure 5-6: CSD at Karnaphuli river (photo taken spring 2026)



Figure 5-7: Barge loading at Kharnapuli river (photo taken spring 2026)- process water is overflowing over the coaming

5.4 Assessment of work method

Having assessed all considerations, the most likely working method for undertaking the dredging works of the berth pocket at the Laldia Container Terminal is dredging by a Cutter Suction Dredger (CSD) with barge loading and dispose at an offsite reclamation area, which is defined as being Char Bakalia.

A Backhoe Dredge (BHD) is also an option, but due to limited availability in Bangladesh. mobilising a BHD could result in excessive mobilisation costs.

Dredged material is likely not suitable for incorporating in the fill that is required to form the Laldia Container Terminal due to the assumed high fine content of the material. The geotechnical data suggest that around ~75% of the material will be silt, and 25% is fine to medium sand. These characteristics are typically challenging for ground improvement works, especially compaction of fine material is extremely difficult and requires a large effort. It is therefore not likely that the material will be (directly) pumped in the Laldia Container Terminal reclamation area, but instead in a barge and disposed elsewhere. The material can be used at an offsite area as general fill material.

Dredging of the slope in between the piles requires special care and attention of the dredging contractor. It might be that for this scope a small backhoe will be mobilised. Production rates of dredging between the piles will in any case be lower than during bulk dredging, no matter if this is done by CSD or backhoe, so this dredging scope will not be leading for dredge plume modelling.

Ultimately, the dredging contractor is responsible for selecting the dredging method and assess all the considerations above. Important aspects to consider, next to the technical characteristics of the material, are the environmental considerations and also the disposal options, which could dictate the dredging method.

6 Reuse and Disposal options for dredged material

In general, the following disposal options for the dredged material are identified. The final disposal option will be selected in consultation with CPA and with its approval.

1. Building in of dredged material in the work
2. Disposal in a riverbank / a char and
3. Stockpile at an off-site stockyard, where the material is traded for fill or other purposes
4. Use as a fill material for flood protection/ raising of land
5. Disposal in an offshore disposal area.

6.1 Building in of dredged material in the fill

This option refers to the direct reuse of dredged material within the same project footprint. Dredged sediments (typically sand or silt fractions) are hydraulically or mechanically placed in designated areas of the works, such as reclamation zones. In riverine environments like the Karnaphuli, this is often applied for land formation behind containment bunds or for filling low-lying areas required for port or other infrastructure development.

The main advantage is that it minimizes transport and disposal requirements, thereby reducing costs and environmental footprint. It is generally considered a beneficial use, as dredged material is treated as a resource rather than waste.

The Laldia Container Terminal Project requires substantial quantities of fill material for reclamation, land levelling and ground improvement. Based on the current design, approximately 1,005,450 m³ of fill and surcharge material will be imported to the site (see Section 0). This includes land levelling of Block C, reclamation of the river-side area, backfilling of the drainage channel, and temporary surcharge loading required for ground improvement works. The capital dredging volume associated with development of the berth pocket is estimated at approximately 400,000 m³.
The material dredged from the berth pocket is expected not be suitable for land reclamation, because of the high fines content. Typically, an engineered fill is therefore used on container terminals to meet the performance requirements which includes strict settlement requirements. Alternatively, when fill material with high fine contents is used, it will be likely that soil improvement measures have to be adopted, but the effort to make the poor fill suitable by means of soil improvement can be excessive. In such cases it will typically be preferred to bring in an engineered fill and dispose the dredged material.
Nevertheless, the Dredging Contractor is encouraged to build-in as much as possible of reuse of the dredged material into the Works.

Key considerations include:

- Striving for a closed cycle in soil materials extracted and used in a work will reduce costs and environmental/social impacts by reducing handling, extraction, transporting and disposing materials, as well as associated road and marine traffic movements. This also reduces interaction with various stakeholders, permits and risks of delays and liabilities.
- Suitability of the material, such as grain size, contamination, and consolidation behaviour for the operation of a container terminal.
- Need for containment (bunds/geotextiles) to prevent washout of sediments into the river.
- Settlement and stability of the reclaimed area for container terminal operations, requiring specific ground improvement techniques.
- Interaction with river hydrodynamics, erosion or re-suspension risk

This will result in a reduced volume of external fill material required to be sourced and transported to the site for the levelling and reclamation, reducing costs, road and marine traffic movements associated with material transport, and environmental and social impacts.

6.2 Disposal in a riverbank / a char

In Bangladesh, a “char” refers to an sediment deposit or sandbar within a river system emerging from the water. Disposal on chars or riverbanks involves placing dredged material in these naturally occurring or engineered depositional areas.
This option effectively keeps the sediment within the fluvial system, which can be beneficial in sediment-rich rivers like the Karnaphuli, where continuous sediment transport and redistribution occur. It may also support char stabilization or land development, depending on placement strategy.
However, this option requires careful planning because:

- Riverbanks in Bangladesh are often unstable and prone to erosion
- Improper placement may lead to re-entry of material into the channel, reducing dredging effectiveness.
- Potential impacts on local communities, agriculture, and fisheries if char land is already in use

This option is typically considered a transitional or semi-beneficial use, depending on whether it contributes to long-term land formation.

Also, the closest by char is the ‘Bakalia char’, which is located upstream of the LCTP (see Figure 6-1). Dredged material would typically be transported to the disposal site by dredger or barge, and placed directly on the char. There is a risk that the disposed material will be resuspended and will be deposited in the river channel and therewith increasing the dredging effort in the main river channel of the Port. To reach the char, the Shah Amanat bridge must be crossed.

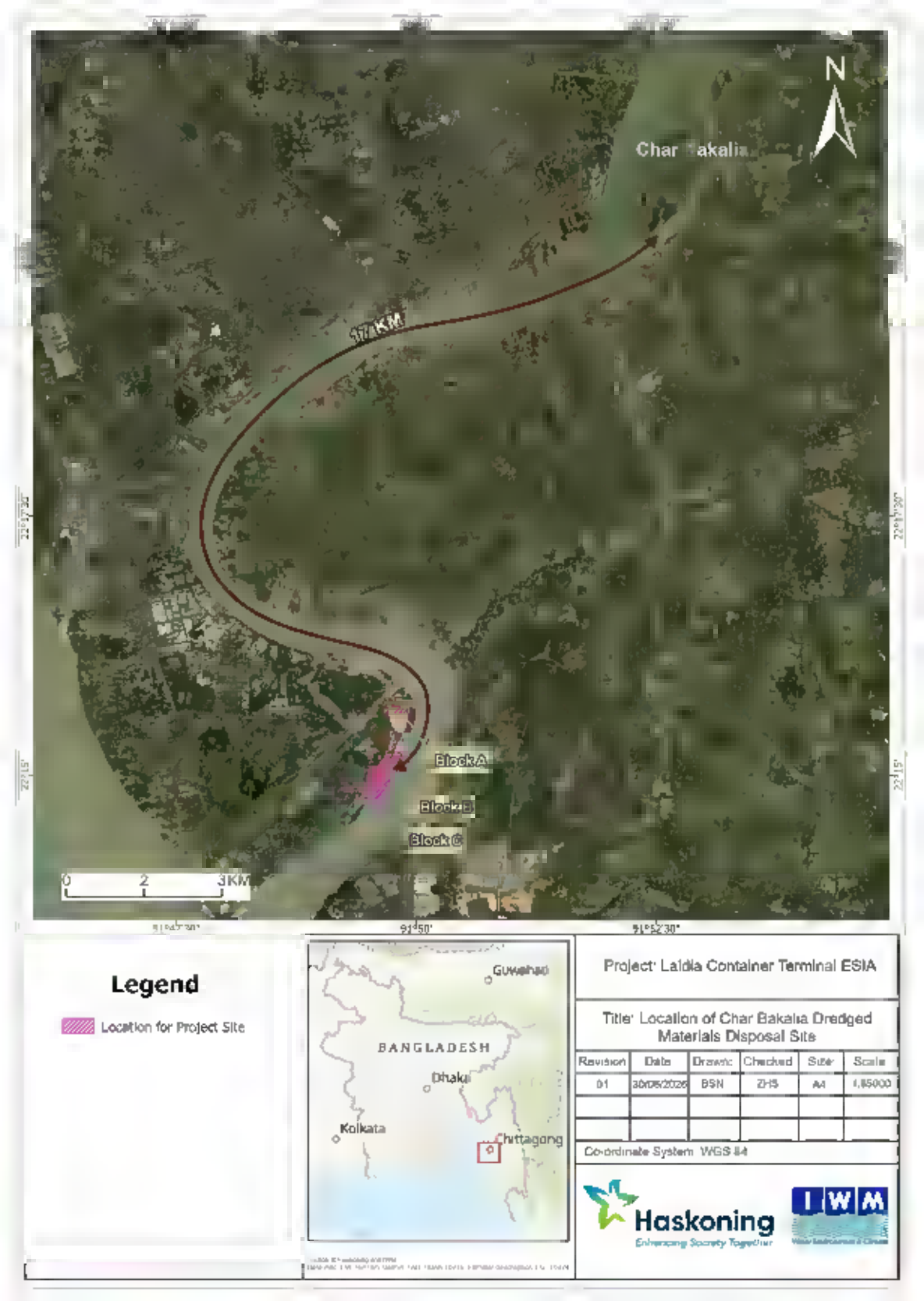


Figure 6-1: Location of Char Bakalia dredged material disposal site

6.3 Sell material to sand traders offsite

Dredged material is sold and transported to a designated stockpile area, where it is temporarily stored, dewatered, and subsequently sold or used as construction fill.
Given that river dredged material in Bangladesh is often composed of fine to medium sand suitable for land development or construction applications, this option can provide direct economic value.

Typical applications include:

- Road embankments
- Site preparation and land (char) development
- Construction fill for private developments

Key advantages:

- Generates revenue or offsets project costs
- Reduces pressure on disposal sites
- Turns the dredged material from a waste into a source material.
- There is no need for disposal of material affecting potentially marine habitats and socio-economic resources.

Key challenges:

- Need for suitable trader, who has the proper licenses and environmental and social management practices.
- Handling and drying requirements for high water content sediments
- Market demand and logistics, such as transport distances, buyers

6.4 Use as a fill material for flood protection/ raising of land

This is a targeted beneficial use, where dredged material is used for raising low-lying land or constructing flood protection works, such as embankments or polder improvements.
In Bangladesh, where flood risk and land subsidence are critical issues, this option is highly relevant. Dredged sediments can contribute to:

- Elevation of flood-prone areas
- Strengthening or widening of existing embankments
- Climate adaptation measures

It aligns strongly with recognized beneficial use categories such as flood risk reduction and land development.
Important considerations:

- Geotechnical suitability, such as strength and settlement behaviour
- Compaction and drainage requirements

- Environmental acceptability, especially if material is fine or contaminated
- Integration with existing flood protection systems

This is generally one of the most sustainable options if logistically feasible. It is most likely that the material will be supplied to a sand trader, who then may provide the material to projects in flood protection and /or raising of land for various purposes.

6.5 Disposal in an offshore disposal area

This option involves transporting dredged material to a designated offshore disposal site and releasing it in open water.

Such sites are usually selected based on environmental and social assessments to ensure:

- Limited impact on marine ecosystems
- Adequate depth and hydrodynamic conditions to retain material

Typical considerations:

- Transport distance and associated costs
- Suitability of material for marine disposal, contamination limits
- Dispersion and sediment plume impacts
- Regulatory approval and monitoring requirements
- It should be noted there is no designated disposal site for dredged material currently available in the offshore area near Chattogram.

Offshore disposal is widely practiced in many countries in the world, where beneficial use is not feasible. It is a pure disposal option (i.e., no direct reuse benefit) and is regulated to minimize environmental impacts. As mentioned earlier in Bangladesh nearly all dredged material is beneficially reused in different type of works.
While technically straightforward, it is generally less preferred compared to beneficial use options, as it does not create additional value and may impact marine environments, including fishery resources, if not properly managed.

6.6 Opportunity for reuse in a Nature-based Solution

Nature-based Solutions using dredged material are increasingly applied in delta and estuarine environments to enhance different ecosystem services. In the context of the Karnaphuli River, dredged sediments may potentially be beneficially reused to support the creation or enhancement of intertidal habitats (e.g. mudflats), stabilization and accretion of chars (riverine floodplains and islands), and restoration of mangroves.

Such approaches have been successfully applied in comparable environments in Bangladesh and the wider Ganges–Brahmaputra–Meghna delta, where controlled sediment placement has

contributed to land accretion, erosion control, and habitat development (Brammer, 2014). At the time of preparation of this DMP, no specific NbS opportunities have been identified yet for LCTP. However, this option remains open and should be further explored, in coordination with relevant stakeholders and authorities.

6.7 Reuse/Disposal preference

In general, disposal options which will make re-use of the dredged material are preferred and the Contractor is encouraged to make use as much as possible use of the dredged material in the works, given the technical constraints and conditions of the material.

In more detail, the preferred hierarchy for this project, from a technical and sustainability perspective, is typically:

1. Beneficial reuse within the works
2. Land development / flood protection uses
3. Commercial reuse (stockpiling and sale)
4. Controlled river/char placement
5. Opportunities for reuse in a Nature-based Solutions (NbS)
6. Offshore disposal (last resort)

7 Policy, Standards and Regulatory Framework

7.1 Dredging and Dredged Material Management Policy, 2025

The Dredging and Dredged Material Management Policy, 2025[1] establishes the principal regulatory framework governing dredging activities and the management of dredged materials in Bangladesh. The Policy aims to ensure that dredging is planned and implemented in a technically sound and environmentally sustainable manner while safeguarding river systems, wetlands, aquatic ecosystems, biodiversity and other environmentally sensitive resources. The Policy further provide guidance on the beneficial use, disposal, monitoring and institutional oversight of dredged materials generated through dredging operations.

Prior to undertaking dredging operations, project proponents are required to conduct comprehensive surveys, including topographic, bathymetric and hydrographic investigations. These surveys are intended to establish baseline information on landform characteristics, riverbed morphology, water depths, flow conditions, hydrodynamic processes, and other physical characteristics necessary for planning dredging activities.

For capital dredging projects, the Policy require detailed technical and feasibility assessments. Where applicable under environmental legislation, Environmental Impact Assessments (EIA) and Environmental Management Plans (EMP) must be prepared. Project assessments are required to evaluate river morphology, sediment transport processes, navigation requirements, characteristics of dredged materials, disposal alternatives, ecological impacts and long-term sustainability considerations. Particular attention must be given to the protection of fisheries, aquatic biodiversity, wetlands, river ecology and environmental flow requirements.
The Policy impose restrictions on dredging activities in environmentally sensitive locations. Dredging is generally prohibited or strictly controlled within Ecologically Critical Areas (ECAs), protected areas, forests, wetlands, wildlife habitats and other environmentally significant ecosystems unless appropriate authorization is obtained. Dredging operations must not adversely affect riverbank stability, damage embankments or river protection structures, threaten nearby infrastructure, or obstruct natural drainage patterns and environmental flows.

Environmental protection constitutes a central requirement of the Policy. Dredging operations must be designed and implemented to minimize water quality degradation, turbidity, sediment suspension and pollution. Measures are required to protect aquatic habitats, biodiversity and ecological integrity, ensuring that both biotic and abiotic components of riverine and aquatic ecosystems are maintained.

[1] *https://en.bwdb.gov.bd/archive/pdf/18405.pdf*

The Policy establishes detailed provisions for dredged material management. Dredged materials must be handled, transported, reused or disposed of in a manner that prevents environmental degradation and avoids the re-entry of excavated materials into water bodies. Disposal site selection must consider environmental sensitivity, hydrological conditions, flood risk, land use patterns, ecological significance and potential community impacts. Disposal activities must not obstruct waterways, increase flood hazards, damage wetlands, harm biodiversity or cause secondary erosion and sedimentation problems.

The Policy encourage the beneficial use of dredged materials wherever feasible. Suitable dredged materials may be utilized for infrastructure development, including road construction, embankment strengthening, land development and public facilities. They may also be used for land reclamation, filling of low-lying areas, government development projects, public-interest works, riverbank protection, erosion control and land stabilization, provided environmental safeguards are maintained.

To ensure compliance, the Policy requires regular monitoring of dredging activities, environmental conditions, disposal sites, and ecological impacts throughout the project lifecycle. Project proponents are required to maintain records relating to dredging volumes, disposal locations, monitoring results, and compliance measures. These records facilitate regulatory oversight and accountability.

The Policy also establish a National Dredging and Dredged Material Management Committee comprising representatives from key government agencies, including the Ministry of Water Resources, Bangladesh Water Development Board (BWDB), Department of Environment (DoE), Ministry of Shipping, Bangladesh Inland Water Transport Authority (BIWTA), Department of Fisheries and other relevant institutions. The Committee is responsible for coordination, oversight, monitoring of implementation, and providing policy and technical guidance on dredging and dredged material management. However, if the dredging and dredged materials disposal areas fall within a port limit, the port authority acts will be applicable.

From an environmental and social impact assessment perspective, compliance with the Policy requires the completion of appropriate baseline surveys, assessment of impacts on river morphology and sediment dynamics, protection of aquatic ecosystems and biodiversity, identification and approval of disposal or reuse sites, prevention of adverse impacts on riverbanks and hydraulic structures, implementation of environmental monitoring programmes, and maintenance of comprehensive project records. Accordingly, the Dredging and Dredged Material Management Policy, 2025 serve as the primary national regulatory instrument governing dredging activities and dredged material management in Bangladesh.

7.2 Chittagong Port Authority Act, 2022

The Chittagong Port Authority Act, 2022 provides the primary legal framework for the administration, development, expansion, and modernization of Bangladesh's principal seaport. The Act defines the powers and responsibilities of the Chittagong Port Authority in relation to port management, navigation, infrastructure development, dredging, environmental protection, and land administration within the port limits. It defines the legal limits of the Port and empowers the Government to alter or extend these limits through notification in the official Gazette. The port jurisdiction may include shipping channels, outer anchorages, adjacent rivers, banks, shores, and land, as well as docks, piers, navigation infrastructure, and other facilities necessary for port operations and maintenance. This ensures that land created through dredging and associated river engineering activities remains under the Authority's ownership and control, enabling its management and utilization for port development and operational purposes.

7.3 Environment Conservation Rules (ECR) 2023

Under the Environment Conservation Rules (ECR) 2023, projects are classified into Green, Yellow, Orange, and Red categories based on their nature and the extent of their environmental impact. Dredging activities undertaken in rivers, khals, and beels (wetlands) for stretches exceeding 5 km are classified under the Red Category, owing to their significant potential environmental impact. Similarly, the construction of ports and harbours with an annual cargo handling capacity exceeding 30 lakh metric tons is also classified under the Red Category. Red Category projects are required to obtain two sequential clearances from the Department of Environment (DOE), in accordance with the procedure prescribed under ECR 2023. The first requirement is a Site Clearance Certificate (SCC), which must be obtained prior to the commencement of land development, infrastructure construction, and related works. Subsequently, prior to the commencement of project operations, an Environmental Clearance Certificate (ECC) must be obtained.

8 Roles and Responsibilities

8.1 Introduction

This chapter defines the roles, responsibilities, and lines of accountability for all parties involved in the planning, execution, monitoring, and oversight of dredging works. Clear allocation of responsibilities is essential to ensure compliance with the Environmental and Social Impact Assessment (ESIA), national regulations of Bangladesh, and to effectively manage environmental, health, safety, and social risks associated with dredging activities.

8.2 Overview of Key Organisations & Roles

The following key organisations and roles are identified for the dredging works:

- Project Company (LCT Ltd.)
- Dredging Contractor
- Chittagong Port Authority (CPA)
- Environmental Consultant / ESIA Specialist
- Environmental Manager (Project-level)
- Health, Safety and Environment (HSE) Officers
- Marine / Dredging Superintendent
- Sand Traders / Material Transporters
- Vessel Masters and Crew
- Independent Monitoring / Audit Party (if applicable)
- Local Authorities and Regulators (oversight role)

8.3 Roles and Responsibilities

8.3.1 LCT Ltd.

The Project Company is ultimately responsible for ensuring that the dredging works are implemented in accordance with the approved ESIA and relevant permits.

Key responsibilities include:

- Overall accountability for environmental and social compliance of the project.
- Ensuring that Dredging Management Plan (DMP) requirements are incorporated into contracts and technical specifications.
- Provision of adequate financial and organizational resources to implement mitigation and monitoring measures.
- Appointment of qualified contractors and consultants with demonstrated dredging and E&S management experience.
- Liaison with relevant authorities, including the Department of Environment (DoE) and CPA.

- Review and approval of monitoring reports and corrective action plans.
- Ensuring that the agreement with the contractor includes legal and physical access to the project site along the river and work areas is unobstructed.
- Provide accurate pre-dredging bathymetric surveys, soil composition data, and geotechnical reports, so contractors can appropriately calculate sediment volumes and dredging depths.
- The selected locations of the dredged material disposal area, including access and approval for disposal, are to be included in the contract.

8.3.2 Dredging Contractor

The Contractor is responsible for execution of dredging works in compliance with the DMP, ESIA commitments, and permit conditions.

Key responsibilities include:

- Preparation of method statements consistent with the approved DMP.
- Execution of dredging works in an environmentally controlled manner.
- Implementation of all mitigation measures related to turbidity, sediment handling, noise, spill prevention, and waste management.
- Provision of trained personnel and suitably maintained dredging equipment.
- Maintaining records of dredged volumes, dredging locations, and material disposal or reuse.
- Immediate reporting of incidents, non-compliances, and near misses.
- Strictly adhere to Bangladesh's environmental frameworks, including standards set by the ECR 2023 and Dredging and Dredged Materials Management Policy 2025, to protect the surrounding ecosystem and riverside communities.

8.3.3 Chittagong Port Authority (CPA)

CPA acts as both a regulatory authority and operational stakeholder within the port area.

Key responsibilities include:

- Issuance of navigational, safety, and operational permissions related to dredging.
- Coordination of dredging activities to avoid interference with port operations.
- Enforcement of port rules, marine safety regulations, and navigation requirements.
- Review of dredging schedules and vessel movements.
- Oversight of compliance within designated port jurisdiction.

8.3.4 Environmental Consultant / ESIA Specialist

The Environmental Consultant supports the Client and Contractor during implementation of ESIA commitments.

Key responsibilities include:

- Interpretation of ESIA findings and translation into practical mitigation measures.
- Technical support for environmental monitoring programs (e.g. turbidity, sediment quality).
- Review of Contractor's environmental documentation and reports.
- Support during regulatory inspections and audits.
- Advice on corrective actions in case of non-compliance.

8.3.5 Environmental Manager (Project Level)

The Environmental Manager coordinates day-to-day environmental management on behalf of the Client or Contractor.

Key responsibilities include:

- Overall implementation of the DMP on site.
- Coordination between Contractor, HSE officers, CPA, and Client.
- Review and validation of environmental monitoring results.
- Management of environmental records and reporting.
- Verification of compliance with permit limits and ESIA commitments.

8.3.6 Health, Safety and Environment (HSE) Officers

HSE Officers provide on-site supervision and enforcement of safety and environmental requirements.

Key responsibilities include:

- Daily inspection of dredging operations, vessels, and material handling areas.
- Monitoring occupational health and marine safety risks.
- Ensuring proper use of personal protective equipment (PPE).
- Implementation of spill prevention and emergency response procedures.
- Conducting toolbox talks and safety briefings.
- Reporting incidents and enforcing corrective actions.

8.3.7 Marine / Dredging Superintendent

The Marine Superintendent manages operational control of maritime dredging activities. The Marine / Dredging Superintendent role is typically filled by the dredging contractor.

Key responsibilities include:

- Planning and coordination of dredging operations and vessel movements.
- Ensuring dredging activities comply with navigational and safety restrictions.
- Coordination with CPA vessel traffic services.

- Optimization of dredging methodology to minimize environmental impacts.
- Supervision of Vessel Masters and dredging crews.

8.3.8 Sand Traders / Material Transporters

Sand traders are responsible for transport, handling, and further use or sale of dredged material where reuse is permitted.

Key responsibilities include:

- Transport of dredged material only to approved destinations.
- Compliance with agreed routes, loading limits, and handling procedures.
- Prevention of spillage, dust, and secondary pollution during transport.
- Maintenance of documentation related to volumes and destinations.
- Compliance with contractual, environmental, and safety requirements.

8.3.9 Vessel Masters and Crew

Vessel Masters and crew ensure safe operation of dredging and transport vessels.

Key responsibilities include:

- Safe navigation and compliance with maritime rules.
- Execution of dredging or transport duties per approved procedures.
- Immediate reporting of hazards, spills, or operational deviations.
- Participation in safety drills and environmental awareness training.

8.3.10 Independent Monitoring or Audit Party (if applicable)

An independent party may be appointed to provide assurance to the Client, authorities, or lenders.

Key responsibilities include:

- Independent verification of environmental performance.
- Periodic audits of compliance with the DMP and ESIA.
- Verification of monitoring data and reporting practices.
- Provision of recommendations for improvement.

8.3.11 Local Authorities and Regulators (Oversight Role)

Relevant authorities (e.g. Department of Environment, maritime agencies) provide regulatory oversight.

Key responsibilities include:

- Review and approval of permits and licenses.
- Regulatory inspections and enforcement actions.
- Review of monitoring reports and compliance submissions.
- Approval of corrective actions where required.

9 Chemical quality of Dredged Materials

As part of the ESIA, sediments to be dredged in the area of the future berthing pocket, have been sampled and analysed in the laboratory. The full results can be seen in Chapter 8 of the ESIA Report.

Based on the obtained analytical results from the Sediment samples from 2026, the following can be concluded:

- Nickel (Ni): The background value is marginally exceeded in 1 out of 6 samples (SD-03, between block B and C), while all other samples remain below; concentrations across the dataset are otherwise relatively low and consistent. Possibly, the somewhat higher concentration is due to (waste) water coming from the village, which is discharged in the river in this area.
- All other metals: No exceedances of background or intervention values are observed across all 6 samples for all other analysed metals; concentrations are generally low and frequently below detection limits.
- Total Petroleum Hydrocarbons (TPH): All samples remain below the background value for all samples, with only minor detections in higher fractions (notably at SD-03).
- PCBs: All analysed congeners and the PCB (7) sum are below detection limits in all samples.
- PAHs: Individual compounds are only detected at low concentrations in a single sample (SD-03); however, the PAH (16 EPA) sum remains below the background value in all samples.
- Inorganic nutrients (nitrate, phosphate): Nitrate concentrations are consistently below detection limits, while phosphate concentrations show some variability between samples; no formal comparison to background or intervention values applies.

Overall, based on the analytical results and the limited and localised nature of the observed concentrations, there is no indication of risks to human health, the environment, or the intended use of the sediment.

It should be noted that based on the results of the sediment analysis, Dutch regulatory thresholds for the application of dredged material in saline surface waters (marine disposal standards as defined under the Dutch soil quality decree) are not exceeded.

10 Sediment Plume

10.1 Model and input parameters

As part of the ESIA study, dredge plume modelling study is conducted to determine the increase in suspended sediment concentration due to the dredging activities (Haskoning, 2026). The three-dimensional hydrodynamic modelling software MIKE 3 Flexible Mesh (FM) is used in this study.

The input parameters for the model are based on the above descriptions in the dredging scope, dredging operation and the reuse of the dredged material in other works and therewith no disposal of dredged material offshore or in the riverbed:

- Estimated total capital dredging volume is 400,000 m³.
- Based on the assessment above, ~40% of the material to be dredged is poorly graded Sand and ~60% of the material to be dredged is predominantly silt and clay.
- An average fine content of ~80% is assumed, which primarily consists of silt particles.
- The dominant grain size of the silt fraction is about 15 µm, which could be considered the representative sediment size for the suspended sediment brought into suspension by the dredging activities and reaching the far-field dredge plume.
- The most likely working method, and thus assumed in the dredge plume modelling study, is dredging by a Cutter Suction Dredger (CSD) with barge loading and dispose at an offsite area. Typically, dredging by CSD is the conservative upper bound approach in terms of dredge spill produced compared to mechanical dredging by BHD. The method selected in this note serves therefore as upper bound.
- Dredging of the slope in between the piles is more challenging and requires special care and attention of the dredging contractor. It might be that for this scope a small backhoe will be mobilised. Dredging by CSD in between the piles is still possible, but this requires lots of care. Production rates of dredging between the piles will in any case be lower than during bulk dredging, no matter if this is done by CSD or BHD, so this dredging scope will not be leading for dredge plume modelling.
- Working is assumed to be foreseen only at daytime, say 10 hours per day with one dredger.
- The production in-situ is 283 m³/hr for 141 days.

The spill source factors for the dredging activity at the berth pocket to be used in our assessments are summarised in Table 10-1.

Table 10-1: Spill source factors

Source	Realistic spill source factor	Conservative spill source factor
Cutter head	5% of the fines	8% of the fines
Overflow barge	50% of the fines	92% of the fines
Total	~55% of the fines	100% of the fines

10.2 Results

Figure 10-1 presents the statistical maximum extent of sediment plume dispersion under high flow and calm wind conditions. This figure represents the maximum concentration envelope obtained during the entire simulation period of 1 month and highlights the farthest reach of suspended sediment transport, which represents the worst-case. Owing to the stronger flow conditions, the plume spreads significantly farther than in the low flow scenario, with the maximum plume dispersion length extending approximately 11 km from the source area in the upstream side and 8 km in the downstream side.

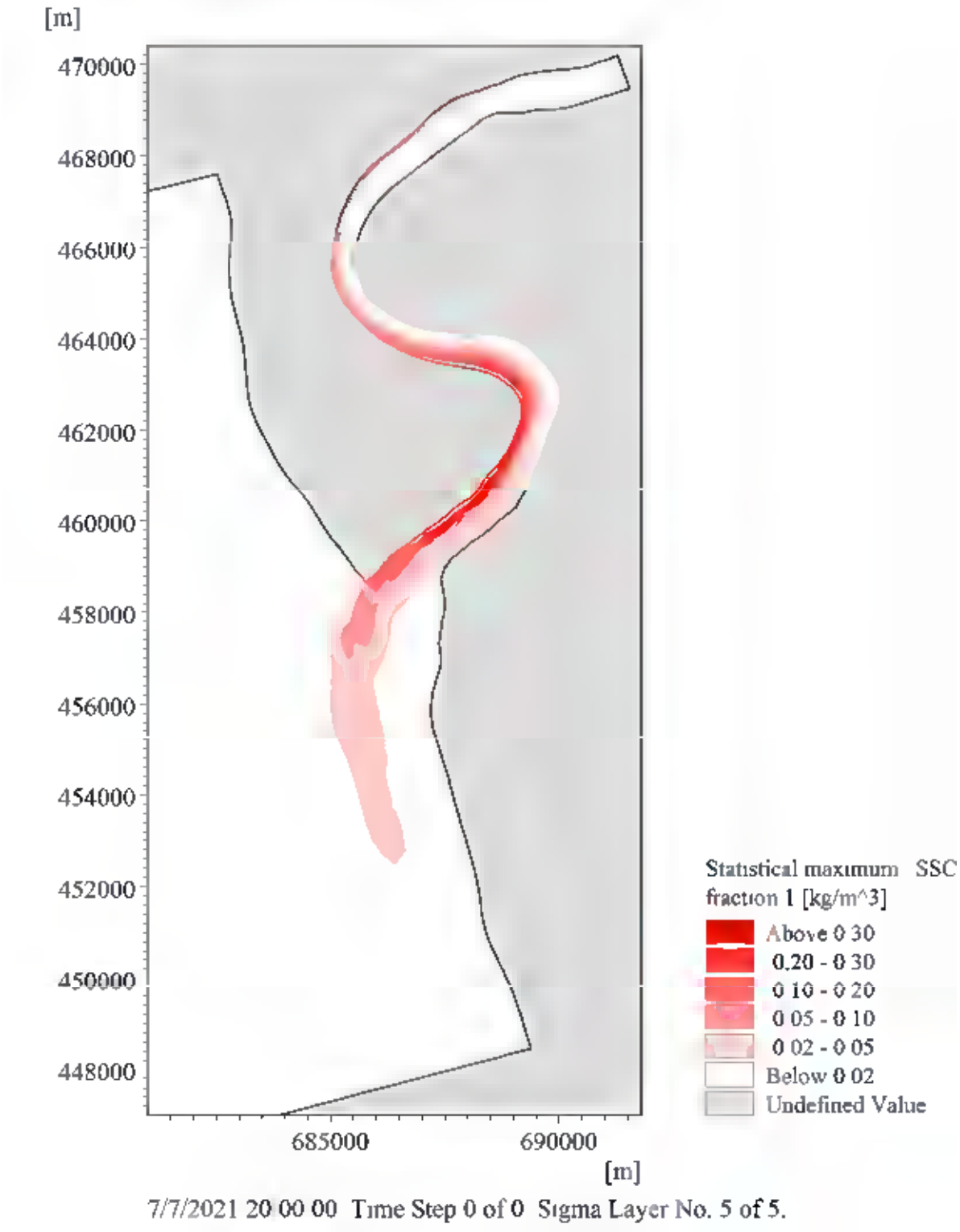


Figure 10-1: Statistical Maximum of Plume Dispersion in High Flow Calm Wind Condition

10.3 Background sediment concentrations

Measured suspended sediment concentrations (SSC) in the Karnaphuli River are available from earlier studies (IWM, 2021). Figure 10-2 shows depth-averaged SSC measured in Karnaphuli River at the project site. The effect of tide on the SSC is clear, with higher concentrations during spring tide. Also, for spring tide conditions, the SSC in the monsoon period is much higher than in the dry period.

Overall, the observations show that the suspended sediment concentrations can be extremely high, with SSC well above several 1000's mg/l. The lowest observed SSC is about 50 mg/l.

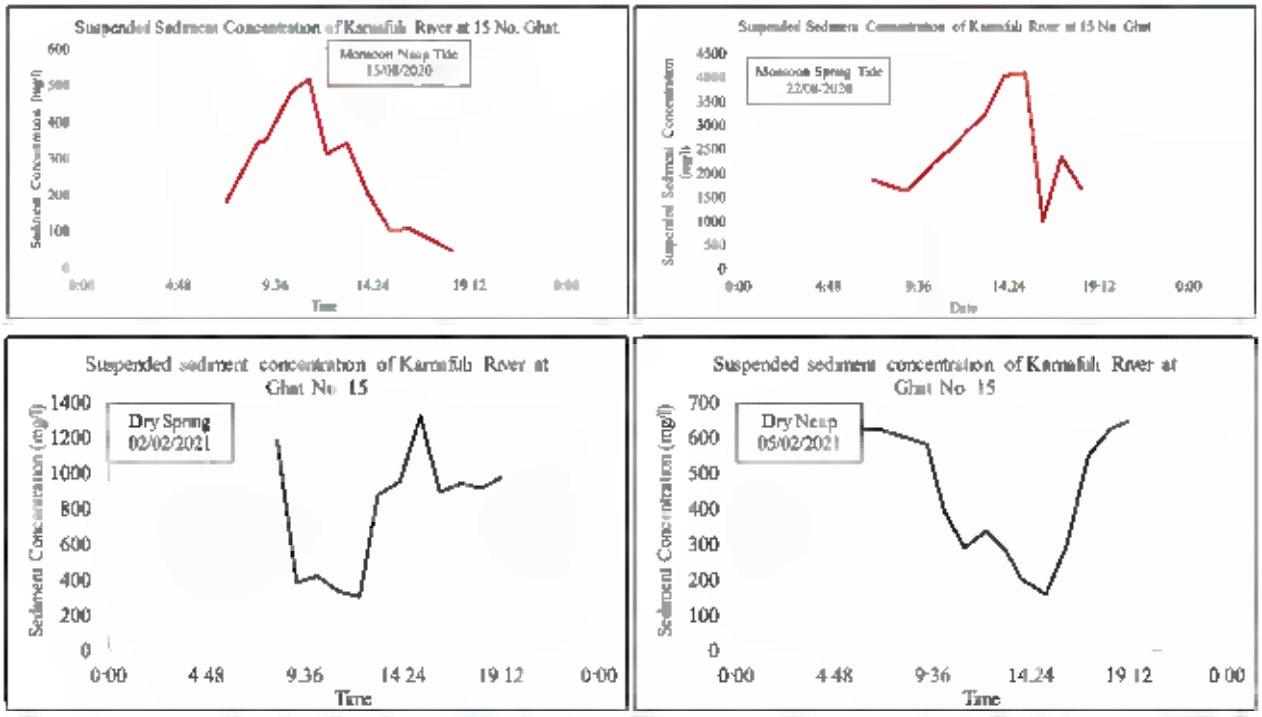


Figure 10-2: Observed suspended sediment concentrations in Karnaphuli River at Ghat No. 15, close to the project site during monsoon neap tide (top left), monsoon spring tide (top right), dry period spring tide (bottom left) and dry period neap tide (bottom right). (IWM, 2021).

11 Impacts and Risks

In the ESIA the impacts and risks of the dredging and the management of the dredged material have been determined. The key impacts are described below:

Impact on water and sediment quality:

- Effect on water and sediment quality, light intrusion and sedimentation from sediment plumes from dredging and reclamation or levelling when sediments enter the river.

Impact on river morphology

- Potential change in morphological processes (erosion / sedimentation) and slope failure, potentially affecting the shoreline and mangrove.

Capital dredging during construction and maintenance dredging during operation are expected to affect water and sediment quality primarily through the resuspension of riverbed sediments. This will increase turbidity and suspended sediment concentrations, reduce light penetration, and may release nutrients, heavy metals and organic contaminants trapped in the sediments into the water column. Resuspended organic matter may also cause temporary reductions in dissolved oxygen and changes in water chemistry, including pH, redox conditions, salinity and temperature.

Dredging will generate a sediment plume that is dispersed by tidal currents. Modelling indicates that plume impacts are generally temporary and localised, although the area affected varies with hydrodynamic conditions. Under high-flow conditions, sediment is dispersed over a wider area but concentrations decline rapidly due to dilution, whereas under low-flow conditions, sediment remains closer to the dredging site, resulting in higher short-term concentrations near the source. Disposal of dredged material may also temporarily increase suspended sediment levels and affect water quality around the disposal site.

Overall, despite temporary increases in turbidity and sediment concentrations, the highly dynamic tidal conditions of the Karnaphuli River are expected to promote rapid dilution and dispersion of suspended materials. Consequently, no significant long-term or large-scale deterioration of water or sediment quality is anticipated, and impacts are considered moderate and manageable with appropriate dredging controls and monitoring measures.

Capital dredging during construction will locally alter the riverbed profile, flow patterns and sediment transport processes, potentially causing limited erosion and sediment deposition in the immediate project area. Morphological modelling indicates that these effects are small in spatial extent and do not significantly affect the overall stability of the Karnaphuli River, which remains primarily governed by its natural meander dynamics and seasonal flow variations.

The main long-term morphological impact relates to the dredged berth pocket, which will have ongoing sedimentation and experience substantial re-siltation. Modelling predicts sediment accumulation of approximately 2–3 m per month during the monsoon and 1–2 m per month during the dry season, requiring frequent maintenance dredging (estimated at 504,000 m³/year) to maintain navigational depth. While dredging, together with the terminal footprint and vessel movements, may cause localised changes in erosion and deposition patterns, the broader river channel morphology is expected to remain stable provided that maintenance dredging is regularly undertaken. Overall, the impact is considered negative, long-term, localised and significant before mitigation.

The impacts and their assessment are summarized in the table below.

Table 11-1: Summary of impacts from Dredging activities

VEC	Sensitivity	Impact/ risks on VEC	Temporal Aspect	Spatial Aspects	Type of Impact	Likelihood	Magnitude	Significance
River morphology	Medium	During construction dredging and land reclamation will cause localised changes to flow patterns and sediment transport, resulting in minor erosion and sedimentation in the vicinity of the project area. These changes are expected to remain limited in extent and will not affect the overall morphological stability of the Karnaphuli River.	Long term	Local	Negative	Very Likely	Minor	Minor
		During operation, the dredged berth pocket will have ongoing sedimentation, leading to ongoing sediment	Long term	Local	Negative	Likely	Major	Major

VEC	Sensitivity	Impact/ risks on VEC	Temporal Aspect	Spatial Aspects	Type of Impact	Likelihood	Magnitude	Significance
		accumulation and a gradual reduction in water depth. As a result, frequent maintenance dredging will be required throughout the operational phase to maintain safe navigation and terminal operations.						
Water and Sediment Quality	Medium	During construction, capital dredging will resuspend sediments and alter water quality parameters.	Short term	Local	Negative	Certain	Moderate	Moderate
		During construction, spills and leaks of fuel, grease, lubricants and other hazardous substances from equipment/ dredgers into surface or groundwater from construction and dredging equipment	Short term	Local	Negative	Unlikely	Moderate	Moderate
		Disposal of dredged materials may affect	Short term	Local	Negative	Likely	Moderate	Moderate

VEC	Sensitivity	Impact/ risks on VEC	Temporal Aspect	Spatial Aspects	Type of Impact	Likelihood	Magnitude	Significance
		water quality in other locations, such as Char Bakalia						

12 Mitigation and Monitoring Measures

The objective of this Dredging Management Plan is to minimise environmental and social impacts associated with the dredging, handling, reuse, transport and disposal of dredged sediments and excavated soils. The Plan establishes measures to ensure that sediment management activities are undertaken in a manner that protects aquatic and terrestrial environments, promotes the beneficial reuse of suitable materials and complies with applicable national regulatory requirements. Particular emphasis is placed on maximising resource efficiency, reducing waste generation, and avoiding adverse impacts on surrounding communities and sensitive environmental receptors.

Prior to the commencement of capital and maintenance dredging activities, the physical and chemical characteristics of the sediments to be dredged shall be assessed to determine their suitability for reuse, beneficial application or disposal. Sediment quality testing will be undertaken in accordance with applicable national requirements and relevant standards to identify any potential contamination risks and to inform the selection of appropriate management options.

Where practicable, the Project will seek to achieve a closed sediment and soil balance by maximising the beneficial reuse of dredged materials and excavated soil within the LCTP. Surplus sediments that cannot be reused within the Project will be evaluated for use in other approved construction projects, through authorised sand traders, or for suitable nature-based solutions (NBS), subject to the outcomes of environmental and social assessments. Topsoil, vegetation and debris will be separated where feasible to enable the reuse of suitable soil resources and minimise waste generation.

All sediment reuse and disposal options will be subject to environmental and social assessment, including evaluation of potential impacts on aquatic and terrestrial ecosystems, stakeholder consultation where relevant (particularly for land-based disposal sites) and the development of appropriate monitoring programmes. Monitoring of sedimentation and water quality will be undertaken during dredging and disposal activities, and adaptive management measures will be implemented where necessary to ensure compliance with national regulatory requirements and minimise adverse environmental and social impacts.

Ambient turbidity conditions shall be established at representative reference locations that are not influenced by Project-related activities. Prior to commencement of dredging, a site-specific relationship between turbidity (NTU) and Total Suspended Solids (TSS) shall be established. During dredging activities, continuous real-time turbidity monitoring shall be undertaken. Monitoring shall include ambient turbidity (NTU) at representative reference locations outside the

influence of dredging, turbidity (NTU) and estimated TSS concentrations within 100 m of the active dredging location at mid-water depth at three locations across the river width, percentage increase in turbidity relative to ambient conditions, and the width of unaffected river corridor available for fish movement.

Turbidity monitoring results shall be reviewed daily throughout active dredging activities. The spatial extent of the sediment plume shall be monitored and assessed using field measurements and available satellite imagery, where practicable and subject to image availability and cloud cover. Where turbidity exceeds 10% above ambient conditions at all monitoring stations across the width of the estuary at either the upstream or downstream monitoring locations, the cause shall be investigated. If the exceedance is attributable to Project activities, management actions shall be implemented to reduce turbidity levels. Where monitoring identifies turbidity levels exceeding 20% above ambient conditions at all monitoring stations across the width of the estuary at either the upstream or downstream monitoring locations and the exceedance is attributable to Project-related activities, additional corrective actions shall be implemented to reduce turbidity-generating activities and return turbidity levels below the threshold. Where exceedances persist, the relevant activity shall cease unless it can be demonstrated, through monitoring and consultation with local fisherfolk and the fisheries consultant, that fish migration is continuing and that the threshold is overly conservative.

Weekly consultation shall be undertaken with fishermen and fishing communities through an appropriately qualified local fisheries consultant during active dredging activities. Monitoring shall include evidence of the continued occurrence and movement of migratory fish species, reports from fishermen regarding fish migratory movements, and reports of any potential disruption to fish migration. Baseline information on migratory fish movements and other potential sources of disruption shall be established before commencement of turbidity-generating activities.

Specific mitigation measures during construction phase are listed below:

- Implement adaptive management measures if monitoring indicates unexpected changes in erosion or deposition patterns.
- Establish frequent sedimentation monitoring surveys to identify areas of accelerated infilling and optimise dredging frequency.
- Determine chemical and physical quality of sediments to be dredged before starting dredging.
- Any debris, waste materials or other non-sediment materials recovered during dredging shall be segregated and managed in accordance with the Project Waste Management Plan and applicable regulatory requirements.
- Prepare an Adaptive Dredging and Reclamation Method Statement (MS) and inform prior to start of execution in detail about work methodology, including consideration of

environmental techniques, monitoring and management measures to implement should significant effects be observed during the fisheries migration period.

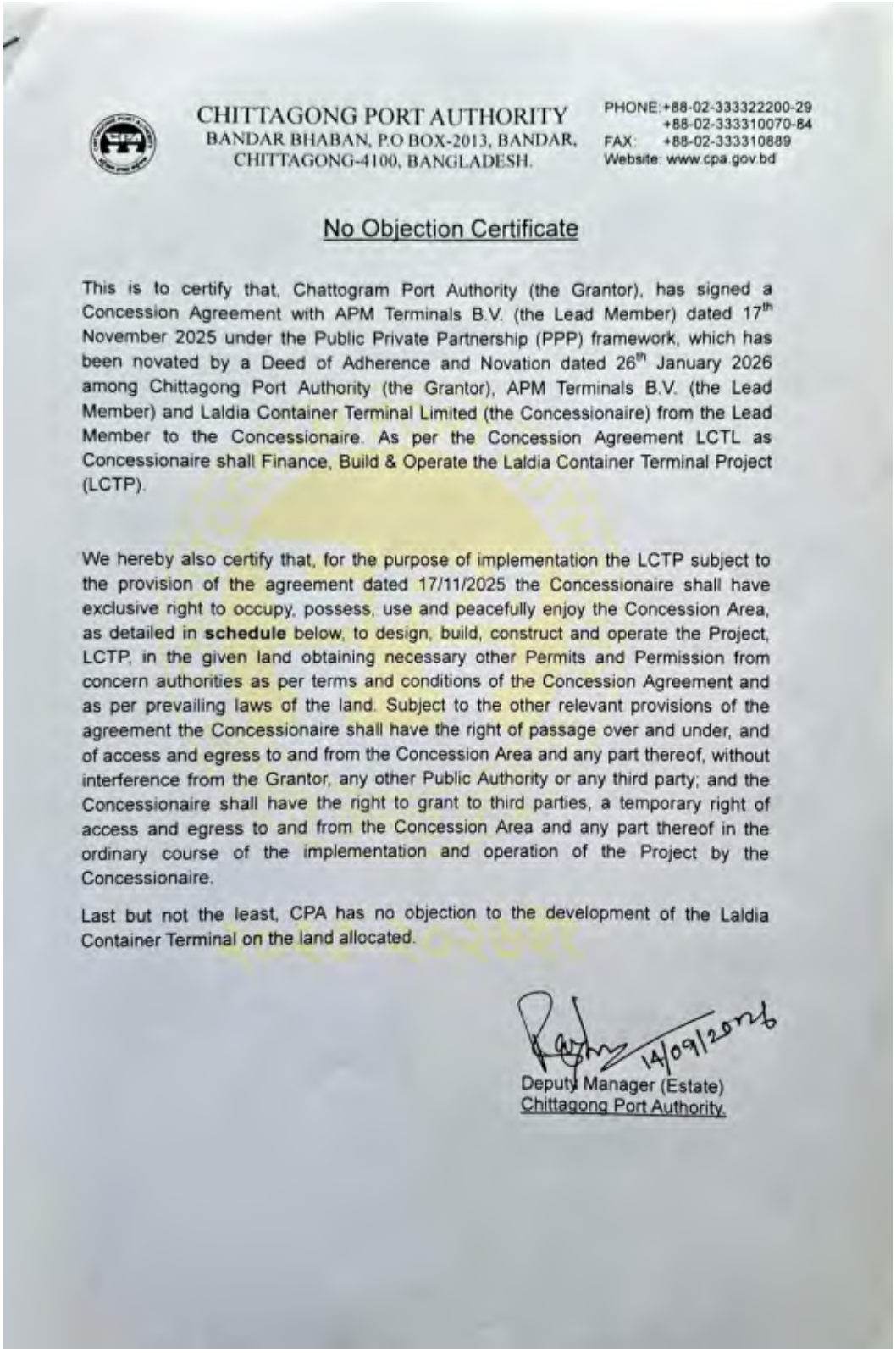
- Dredge material disposal according to the Dredging and Dredge Material Disposal Policy 2025 and in coordination with the CPA.
- Strive for closed soil balance in LCTP and reuse the dredged material as much as possible in the work. Dredged material, which cannot be reused in the works, should become available to use in other works. LCTP can provide the dredged material to sand traders, e.g. at Char Bakalia.
- Determine chemical and physical quality of sediments to be dredged before start capital dredging campaign to confirm reuse options.
- Remove vegetation and debris from topsoil of Block C and reuse soil as much as possible within LCTP or bring to sand traders.
- Disposal of sediments shall be well planned and approved by the CPA/DoE.
- Undertake daily satellite monitoring of sediment plume extent during dredging operations, with particular focus on maintaining a corridor for migratory fish during migration periods.
- In the event that unexpected objects, debris, potential wreckage, or suspected unexploded ordnance (UXO) are encountered during dredging, works shall be suspended in the immediate area and the item shall be assessed and managed in accordance with the Contractor's dredging procedures, Waste Management Plan and relevant health and safety requirements before dredging activities resume.

Specific mitigation measures during operation phase are listed below:

- Implement a frequent maintenance dredging programme together with CPA to maintain the required navigational depth.
- Investigate beneficial uses for the maintenance material elsewhere in the system, e.g. at areas where erosion is expected to occur.
- Establish frequent sedimentation monitoring surveys to identify areas of accelerated infilling and optimise dredging frequency.
- Regular monitoring of erosion and sedimentation patterns. Implement mitigating measures if the morphological changes cause issues.
- Any debris, waste materials or other non-sediment materials recovered during dredging shall be segregated and managed in accordance with the Project Waste Management Plan and applicable regulatory requirements.
- Dredge material disposal according to the Dredging and Dredge Material Disposal Policy 2025 and in coordination with the CPA.
- Dredged material, which cannot be reused in the works, should become available to use in other works. LCTP can provide the dredged material to sand traders, e.g. at Char Bakalia.

- Determine chemical and physical quality of sediments to be dredged before start maintenance dredging campaign to confirm reuse options.
- The disposal site shall have the required permits and E&S management systems. The Operator shall audit E&S performance and report this to LCT Ltd. LCT Ltd. shall perform surprise audit with key suppliers of the Operator.
- Regular monitoring of water and dredged material (sediment) quality is necessary:
    - During construction phase, surface water quality in Karnaphuli River at upstream of the site, the outfall of khal-14, in front of Block-C and downstream of the site as well as at the location where dredging materials will be disposed of for storage shall be monitored once before the capital dredging starts and every two weeks during capital dredging. Similarly, sediment quality shall be monitored once before capital dredging.
    - During operation phase, surface water quality in Karnaphuli River at the outfall of khal-14 and in front of Block-C shall be monitored twice every year; once during Feb/Mar (dry season) and once during Jul/Aug (wet season). Sediment quality shall also be monitored in Karnaphuli River in upstream of the terminal, outfall of the drainage channel, in front of Block C, and downstream of the terminal twice every year; once during Feb/Mar (dry season) and once during Jul/Aug (wet season).

Annex E – Land Possession Certificate of CPA



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No Objection Certificate

This is to certify that, Chattogram Port Authority (the Grantor), has signed a Concession Agreement with APM Terminals B.V. (the Lead Member) dated 17th November 2025 under the Public Private Partnership (PPP) framework, which has been novated by a Deed of Adherence and Novation dated 26th January 2026 among Chittagong Port Authority (the Grantor), APM Terminals B.V. (the Lead Member) and Laldia Container Terminal Limited (the Concessionaire) from the Lead Member to the Concessionaire. As per the Concession Agreement LCTL as Concessionaire shall Finance, Build & Operate the Laldia Container Terminal Project (LCTP).

We hereby also certify that, for the purpose of implementation the LCTP subject to the provision of the agreement dated 17/11/2025 the Concessionaire shall have exclusive right to occupy, possess, use and peacefully enjoy the Concession Area, as detailed in **schedule** below, to design, build, construct and operate the Project, LCTP, in the given land obtaining necessary other Permits and Permission from concern authorities as per terms and conditions of the Concession Agreement and as per prevailing laws of the land. Subject to the other relevant provisions of the agreement the Concessionaire shall have the right of passage over and under, and of access and egress to and from the Concession Area and any part thereof, without interference from the Grantor, any other Public Authority or any third party; and the Concessionaire shall have the right to grant to third parties, a temporary right of access and egress to and from the Concession Area and any part thereof in the ordinary course of the implementation and operation of the Project by the Concessionaire.

Last but not the least, CPA has no objection to the development of the Laldia Container Terminal on the land allocated.

14/09/2026

Deputy Manager (Estate)
Chittagong Port Authority.

Annex F1 – Waste Management Plan

APM Terminals – Laldia Container Terminal

Project Execution

Waste Management Plan

Version 2.0
October 2026

Classification: Internal

Uncontrolled when Printed

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Section Name	HSSE
Document Name	Laldia Container Terminal: Waste Management Plan
Document Owner	Senior QHSE Center of Excellence Manager – Environment & HSE

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Date Issued	Version	Drafted By/ Changed By	Reason for Change	Reviewed By	Approved By
10 October 2026	1.0	Nigel Rossouw	First version	Ali Adel Michiel Klaui Madhangi Kalaimani (CGR)	Marco de Castro

Sign-off Sheet

Authored By: Nigel Rossouw Senior QHSE Center of Excellence Manager Date: 11 October 2026	Reviewer Signature:
Approved By: Marco de Castro Project Director Date:	Approver Signature:

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EXECUTIVE SUMMARY

The Laldia Container Terminal (LCT) is a greenfield container terminal on Laldia Char, on the west bank of the Karnaphuli River approximately 5 km downstream of the existing Chittagong Port, Chattogram, Bangladesh. The Project is developed and operated by Laldia Container Terminal Limited (LCTL), a joint venture between APM Terminals (APMT) and QNS, under a Concession Agreement with the Chattogram Port Authority (CPA). This Waste Management Plan (WMP / "the Plan") sets out the systems, infrastructure and responsibilities required to manage all waste generated during the Pre-Construction stage (permits, surveys, procurement, detailed design and preparatory works), the Construction phase (mobilisation, dredging, civil and marine works, commissioning), the Operations phase (container handling, marine operations, maintenance and administration) and the Decommissioning stage (salvage, demolition, remediation and site closure), in full compliance with the Bangladesh Environment Conservation Act 1995 (as amended) and Environment Conservation Rules 2023 (ECR 2023), the Environmental Clearance Certificate (ECC), the Project's Environmental and Social Impact Assessment (ESIA) and Environmental and Social Management Plan (ESMP) commitments, IFC Performance Standard 3 (Resource Efficiency and Pollution Prevention), the World Bank Group EHS Guidelines and APM Terminals Standards.

Waste management at the Laldia Container Terminal (LCT) is based on the waste hierarchy, which prioritises the avoidance and reduction of waste generation at source, followed by reuse, recycling and recovery. Treatment and disposal are regarded as the least preferred management options and are only used where higher-order alternatives are not technically, environmentally or economically feasible. This approach is supported by a six-class colour-coded waste classification system consisting of Class I Hazardous Waste (Red), Class II Liquid Waste (Purple), Class III Non-Hazardous Waste (Green), Class IV Inert Waste (Yellow), Class V Electronic and Electrical Waste (Blue) and Class VI Recyclable Waste (Orange). Waste is consolidated at a central Waste Management Facility (WMF) prior to transport, by DoE-licensed contractors only, to approved destinations. Particular attention is given to dredged material management, hazardous and oily waste from workshop activities (bunded storage, full-retention oil-water separators), sewage treatment (at a Sewage Treatment Plant – STP), washdown effluent treated at the terminal's Wastewater Treatment Plant (WWTP). Recyclable waste streams with revenue generation potential, including scrap steel, aluminium and timber, shall be actively recovered, segregated and managed under defined control measures to maximise opportunities for reuse, recycling and resource recovery.

Implementation is governed by defined roles and responsibilities, a Waste Coordinator / Waste Champion network, mandatory training and a structured internal inspection programme covering solid waste and wastewater infrastructure. Performance is tracked through defined indicators and a central waste register, with routine contractor auditing to support continuous improvement. Table 1 summarises, at a high level, the key actions and mitigation measures described in detail throughout this Plan and in the Pre-Construction, Construction, Operations and Decommissioning summary tables (see Sections 14 to 17).



Table 1: High-Level Summary of Key Actions and Mitigation Measures by Waste Theme (see the Pre-Construction, Construction, Operation and Decommissioning Summary of Waste Management Actions and Mitigation Measures in Sections 14 to 17 of this Plan for full detail).

Theme	Phase	Key Actions and Mitigation Measures
Framework & Governance	Both Construction and Operations	Apply the waste hierarchy and 4-class colour-coded system; Contractor/Terminal waste method statements; Waste Coordinator / Champion network.
Pre-Construction Readiness & Design	Pre-Construction	Confirm permits, ECC/ESIAR waste conditions and licensed providers before mobilisation; activity-specific WMMSs for surveys and preparatory works; contain and classify investigation wastes; embed waste requirements in tenders, contracts and detailed design; joint waste readiness inspection before construction.
Dredged Material & Marine Works	Construction	Characterise sediment; dispose only at CPA-approved sites per the DMP; turbidity monitoring and silt curtains; manage wrecks/UXO; MARPOL compliance.
C&D Waste	Construction	Segregate at source; reuse/recycle concrete, timber, metal, packaging; pre-demolition hazardous materials survey.
Hazardous & Oily Waste	Both Construction and Operations	Bunded storage (≥110% containment); full-retention oil-water separators with automatic diversion valves; licensed collection; spill kits.
Wastewater & WWTP Sludge	Both Construction and Operations	Treat effluent to Plan discharge standards; dewater sludge to DoE-approved facility; duty/standby pumps and backup power; regular sampling.
General & Domestic Waste	Both Construction and Operations	Daily collection; segregated recycling bins; food waste stored <24 hrs; approved sanitary landfill disposal only.
Batteries, E-Waste & Tyres	Both Construction and Operations	Segregate by type/chemistry; reverse logistics/take-back; licensed recyclers; fire-resistant storage for damaged batteries.
Collection, Storage & Segregation	Both Construction and Operations	Central WMF; colour-coded, correctly sized containers; weekly inspections; defined collection frequencies and storage limits.
Transport & Consignment	Both Construction and Operations	DoE-licensed transporters only; transfer note/consignment record per shipment; approved destinations only.
Minimisation & Revenue Recovery	Both Construction and Operations	Source reduction at each unit; recovery/sale of scrap steel, aluminium and timber under defined revenue controls.
Monitoring & Performance Indicators	Both Construction and Operations	Central waste register with monthly/quarterly reporting; generation, recycling and segregation indicators; non-conformance close-out.
Training, Inspection & Audit	Both Construction and Operations	Induction/refresher training; Waste Champion inspections; contractor due diligence; audits of solid waste and wastewater infrastructure.
Decommissioning & Site Closure	Decommissioning	Approved Decommissioning Waste Management Plan and asset/waste inventory; pre-demolition hazardous



Theme	Phase	Key Actions and Mitigation Measures
		materials surveys; drain and decontaminate before dismantling; prioritise salvage, reuse and recycling; close STP/WWTP, workshops and marine infrastructure without discharge; remediate contaminated land; final waste reconciliation and closure report.



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RONYMS AND ABBREVIATIONS

Waste management requirements for the Laldia Container Terminal (LCT) Project are derived from a range of legal, regulatory, operational, environmental and industry-specific documents and standards. To promote consistency and avoid ambiguity, a number of acronyms and abbreviations are used throughout this Waste Management Plan.

The Table below provides the acronyms and abbreviations referenced within this Plan, together with their corresponding meanings. These terms relate to project entities, regulatory authorities, waste management processes, environmental and social requirements, international conventions and key management systems applicable to the construction and operational phases of the Project. The Table should be used as a reference to support the consistent interpretation, implementation and communication of waste management requirements by LCT personnel, Contractors, Subcontractors, Waste Management Contractors and other stakeholders.

Acronym & Abbreviation	Meaning
APMT	APM Terminals
BC	Basel Convention
CPA	Chattogram Port Authority
C&D	Construction and Demolition (waste)
DoE	Department of Environment (Bangladesh)
ECC	Environmental Clearance Certificate
ECR 2023	Environment Conservation Rules, 2023
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
GoB	Government of Bangladesh
HSSE	Health, Safety, Security and Environment
IFC PS	IFC Performance Standards
WMF	Waste Management Facility
LCT / LCTL	Laldia Container Terminal / Laldia Container Terminal Limited
MARPOL	International Convention for the Prevention of Pollution from Ships
NORM	Naturally Occurring Radioactive Material
PPE	Personal Protective Equipment
SDS	Safety Data Sheet
WBG EHS	World Bank Group Environmental, Health and Safety Guidelines
WMC	Waste Management Contractor
WMP	Waste Management Plan
WTN	Waste Transfer Note / Consignment Note

LIST OF DEFINITIONS

The definitions provided below are intended to promote a common understanding of the terminology used throughout this Waste Management Plan. These terms establish the basis for the consistent interpretation and implementation of waste management requirements during both the pre-construction, construction, operational and decommissioning phases of the Laldia Container Terminal (LCT) Project. Where applicable, definitions are aligned with relevant Bangladesh legislation, international conventions, regulatory requirements and industry good practice.

Term	Definition
Basel Convention (BC)	The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal is a multilateral agreement, negotiated under the United Nations Environment Programme (UNEP) from 1988, governing exports and imports of hazardous waste for recovery and disposal. Bangladesh is a Party to the Basel Convention.
Client / Company	Laldia Container Terminal Limited (LCTL), the project company responsible for the development, construction, operation and maintenance of the Laldia Container Terminal (LCT) Project, including implementation of applicable environmental, social, health and safety requirements, permits, management plans and operational controls.
Competent Authority	The organisation with legally delegated authority to approve, reject, enforce or take legal action regarding environmental management applicable to the Project. In Bangladesh this is principally the Department of Environment (DoE) and for port-related matters, the Chattogram Port Authority (CPA).
Concessionaire	Laldia Container Terminal Limited (LCTL).
Consignment Note / Waste Transfer Note (WTN)	A document listing the category, quantity, origin and destination of waste, signed by the generator, transporter and receiving facility.
Contractor	Any company engaged by LCT to perform construction, maintenance or other works on the Project.
Engineered Landfill	An engineered pit in which layers of solid waste are placed, compacted and covered for final disposal, designed to minimise environmental pollution and health risks.
Environmental Clearance Certificate (ECC)	The approval issued by the Department of Environment under the Environment Conservation Rules 2023 permitting a classified activity, subject to conditions, including waste management conditions.
Hazardous Waste	Waste arising from commercial, industrial, construction or other activities which, due to its nature, composition, quantity or other characteristics, is hazardous or potentially toxic to human health, flora, fauna, air, soil or water.
Waste Management Facility (WMF)	A designated on-site staging area for waste, in particular waste streams that can be recycled or reused (e.g. wood, tyres, steel), pending removal by an approved Waste Management Contractor.
Waste Generator	Any department, Contractor, Subcontractor, Vendor, vessel or other entity within the Concession Area that produces waste.
Waste Hierarchy	The prioritised approach to waste management: avoid, reduce, reuse, recycle, recover and (as a last resort) dispose.
Waste Management Contractor (WMC)	A DoE / CPA approved and licensed contractor engaged to collect, transport, treat and/or dispose of waste on behalf of LCT or its Contractors.

1. INTRODUCTION

This Waste Management Plan (WMP / "the Plan") describes the waste management systems, controls and responsibilities applicable to the Laldia Container Terminal (LCT) Project. The Project is developed and operated by Laldia Container Terminal Limited (LCTL), a joint venture between APM Terminals (APMT) and QNS, under a Concession Agreement (CA) executed with the Chattogram Port Authority (CPA) on 17 November 2025.

This Plan covers the procedures for managing all waste streams generated during the construction phase (including mobilisation, site clearance, dredging, civil works, marine works and commissioning) and operational phase (including container handling, marine operations, terminal maintenance and administration) of the Project.

This Plan has been developed as a guidance document for LCT, its Contractors, Subcontractors, Vendors and Waste Service Providers to perform their scope of work in full compliance with applicable Bangladesh environmental and waste management requirements, including the Bangladesh Environment Conservation Act, 1995 (as amended), the Environment Conservation Rules, 2023 (ECR 2023), the conditions of the Site Clearance Certificate (SCC) and Environmental Clearance Certificate (ECC), and the waste management, pollution prevention and mitigation commitments contained in the Project's Environmental and Social Impact Assessment (ESIA) and associated Environmental and Social Management Plans (ESMPs).

The Plan is also aligned with relevant international good practice and standards applicable to port developments, including IFC Performance Standard 3: Resource Efficiency and Pollution Prevention, the World Bank Group General Environmental, Health and Safety (EHS) Guidelines, the World Bank Group EHS Guidelines for Ports, Harbors and Terminals, and other recognised Good International Industry Practice (GIIP) requirements. In addition, the Plan supports compliance with APM Terminals Standards.

1.1. Project Location and Layout

The Laldia Container Terminal (LCT) Project is a greenfield container terminal development located on Laldia Char along the west bank of the Karnaphuli River in Chattogram, Bangladesh (Figure 1). The Project is being developed by Laldia Container Terminal Limited (LCTL) under a concession agreement with the Chattogram Port Authority (CPA) to increase container handling capacity, improve cargo movement efficiency and support the continued growth of Bangladesh's international trade. The terminal is designed to handle approximately 1.4 million TEUs per year. A TEU (Twenty-foot Equivalent Unit) is the standard unit used in the shipping industry and represents one standard 20-foot shipping container. In simple terms, the terminal will be capable of handling the equivalent of around 1.4 million standard shipping containers each year, including a combination of smaller 20-foot containers and larger 40-foot containers. To put this into perspective, 1.4 million TEUs per year is equivalent to handling an average of nearly 3,850 TEUs per day, making the facility one of the major container handling terminals in the region. The terminal will operate as a facility that complies with the requirements of the International Ship and Port Facility Security (ISPS) Code, which establishes international security standards for ships and port facilities.



The land area required for the Laldia Container Terminal (LCT) Project was agreed with the Chattogram Port Authority (CPA) and allocated as three distinct concession areas, referred to as Blocks A, B and C. These blocks formed the basis of the terminal's conceptual planning and design process and were used to determine the terminal operating concept, the arrangement of key operational functions, and the overall container handling throughput capacity of the facility. Figure 1 illustrates the location and extent of these concession blocks, showing their position within the wider Chattogram Port area and their relationship to the proposed terminal development footprint.

Figure 1: Location and Overall Development Footprint of the Laldia Container Terminal Project, showing Blocks A, B and C (shaded in pink) in relation to the Chattogram Port Area.

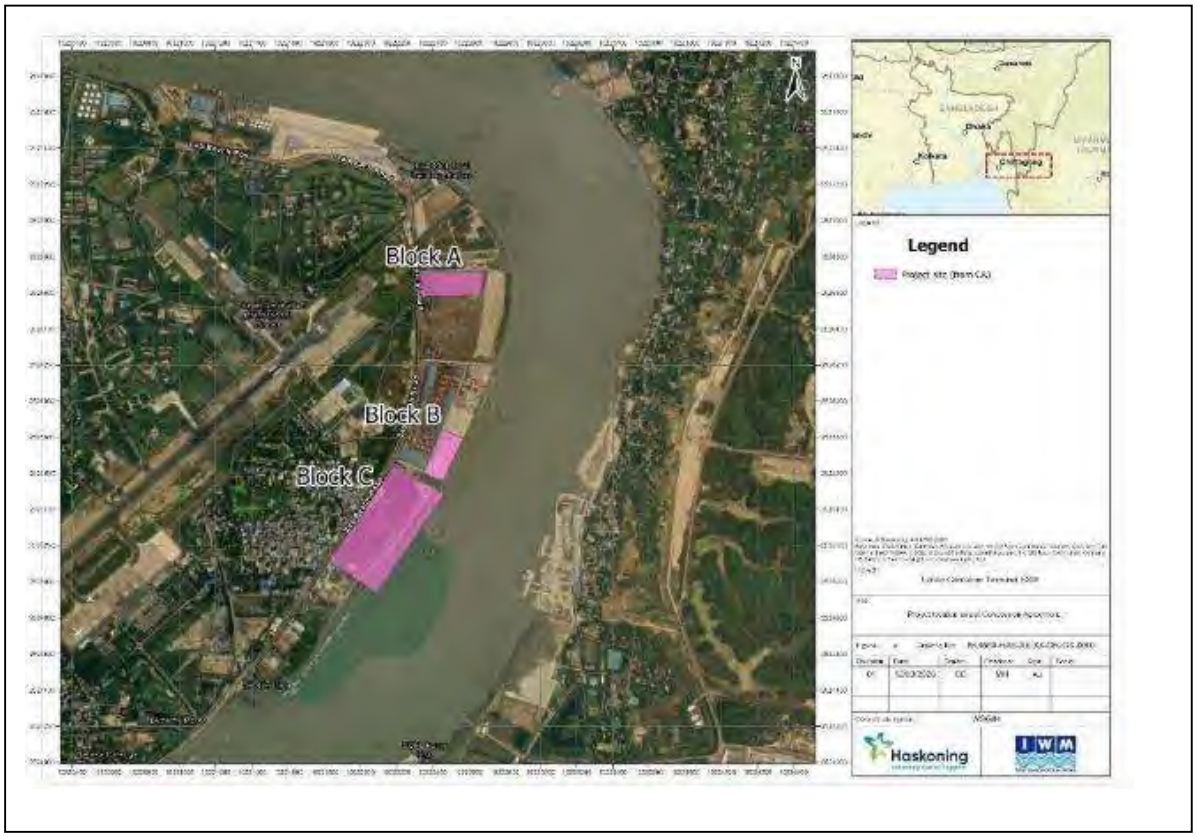


Figure 2 illustrates how the engineering design and technical planning of the Laldia Container Terminal (LCT) have progressed beyond the initial allocation of the concession area into Blocks A, B and C. While these blocks were used during the conceptual planning stage to establish land requirements, operational functions, terminal layout options and the ultimate throughput capacity of the facility, the terminal is now planned and designed as a single integrated operational system. The various functions distributed across the three concession blocks are interconnected through common infrastructure, operational processes, information systems, utilities and cargo-handling activities to achieve the intended terminal performance and capacity objectives.

Within this integrated system, Block A serves as the Truck Holding and Processing Zone, providing gate operations, truck parking, queuing and vehicle processing facilities at the

terminal entrance. Block B forms the Container Logistics Zone, accommodating customs inspection facilities, container processing activities and operational support areas. Block C comprises the Marine Operations and Container Yard Zone, incorporating vessel berthing infrastructure, quay operations, container storage yards, reefer facilities and cargo-handling operations that support the terminal's core container-handling activities. Together, these areas function as a unified terminal operation rather than as separate developments.





Figure 2: Illustrative Conceptual Layout of the Proposed Laldia Container Terminal Showing Key Operational Areas and Interfaces (Illustrative Only – Not to Scale and Not Intended as an Engineering Drawing or Site Plan).

1.2. Construction Process and Construction Equipment

This section provides a broad overview of the construction process and the typical categories of plant and equipment expected to be mobilised for the greenfield construction of the Laldia Container Terminal (LCT), including the marine dredging works described in Section 9.2 of this Plan. Construction will require significant volumes of construction materials, heavy equipment, specialised marine plant and a peak workforce of approximately 2,000 personnel. The equipment referenced below is described in broad, generic terms only; the specific plant to be deployed, including the type of dredging vessel(s), will be confirmed by the appointed Contractor(s) and set out in their Waste Management Method Statements and other approved method statements and equipment approvals prior to mobilisation.

1.2.1.Overview of the Construction Process

Construction of the LCT is expected to progress broadly through the following sequence of activities, recognising that individual work fronts may proceed concurrently:

- Site establishment and mobilisation, including fencing, signage, temporary Contractor site offices, storage and lay-down yards, and the establishment of designated waste storage and consolidation areas for the temporary segregation, accumulation and management of waste generated during construction.
- Marine and dredging works, comprising capital dredging of the Access Channel, Common Approaches, Turning Circle and berth pockets, together with land reclamation using suitable dredged or imported fill material.
- Earthworks and ground improvement, including excavation, grading, soil stabilisation and ground improvement works to prepare the terminal platform.
- Piling and marine civil works, including piling, cofferdam installation, quay wall construction and associated concrete batching and pouring.
- Building and infrastructure construction, including the administration building, workshops, customs inspection warehouse, pre-gate facilities, in-gate/out-gate complex, wastewater treatment plant and pavement works.
- Utilities, electrical and instrumentation installation, including drainage modifications, underground conduits, electrical cabling, ICT and security systems, high-mast lighting and connections to power substations.
- Equipment installation, testing and commissioning, including the assembly and deployment of the Terminal's operational container handling equipment (Table 3) ahead of handover.
- Final waste clearance and Site handover to Operations.

1.2.2.Typical Construction Equipment

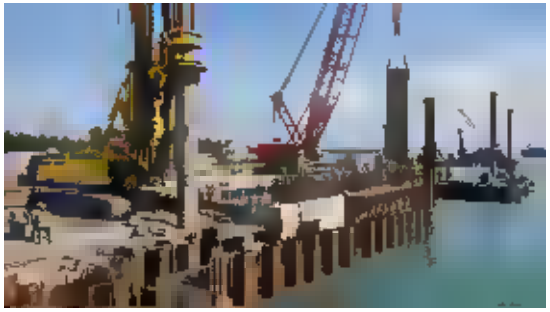
Construction of the LCT will require a range of heavy plant and equipment appropriate to marine, civil, structural and building works. The principal categories of equipment expected to be mobilised are summarised in broad terms in Table 2 and are expected to include, but are not limited to, the following:

- Earthworks and ground improvement equipment, including excavators, bulldozers, graders, compactors and rollers, together with specialist machinery used to strengthen and stabilise weak ground where necessary. These activities may include compacting the soil, removing excess water, and improving the ground so that it can safely support infrastructure such as container yards, roads, crane rails, buildings, quays and

underground services. Dewatering pumps may also be used to remove groundwater and maintain suitable working conditions during construction.

- Piling and marine civil works equipment: piling rigs, pile driving/vibratory equipment, crawler and mobile cranes, cofferdam and formwork systems, concrete batching plant and concrete pumps.
- Dredging and marine support plant: dredging vessels and associated dredging plant, together with pipelines, barges, hoppers and tug or support craft used to transport and place dredged material at approved disposal or reclamation areas in accordance with the Dredging Management Plan (DMP); the specific type of dredging vessel(s) will be confirmed by the appointed Dredging Contractor.
- Materials handling and transport equipment: dump trucks, tipper trucks, low-loaders and trailers, concrete mixer trucks and forklifts.
- Lifting equipment: mobile and crawler cranes for structural steel, precast elements and plant and equipment installation.
- Utilities and electrical/instrumentation installation equipment: trenching machines, cable-laying equipment, generators and testing/commissioning equipment.
- Support and auxiliary equipment: site generators, water trucks (dust suppression), firefighting and spill response equipment, and welfare/site accommodation facilities.

Table 2: Typical Categories of Construction Equipment needed for the Greenfield Development of the LCT.

Equipment Category	Representative Photograph	Typical Plant and Equipment	Primary Function
Earthworks and Ground Improvement		Excavators, bulldozers, graders, compactors/rollers, ground improvement rigs and dewatering pumps	Site preparation, grading, ground improvement and groundwater control
Piling and Marine Civil Works		Piling rigs, pile-driving/vibratory equipment, crawler/mobile cranes, cofferdams, formwork, concrete batching plants and concrete pumps	Foundation piling, quay wall construction and structural concrete works
Dredging and Marine Support		Dredging vessels and associated dredging plant, pipelines, barges, hoppers and tug/support craft	Capital dredging and placement of dredged material in accordance with the Dredging Management Plan

Equipment Category	Representative Photograph	Typical Plant and Equipment	Primary Function
Materials Handling and Transport		Dump trucks, tipper trucks, low-loaders/trailers, concrete mixer trucks and forklifts	Movement of fill, spoil, construction materials and equipment around the Site
Lifting Equipment		Mobile and crawler cranes	Lifting and positioning of structural steel, precast elements, plant and equipment
Utilities and E&I Installation		Trenching machines, cable-laying equipment, generators and testing/commissioning equipment	Installation of drainage, electrical, ICT and utility infrastructure

Equipment Category	Representative Photograph	Typical Plant and Equipment	Primary Function
Support and Auxiliary Equipment		Site generators, water trucks, firefighting and spill-response equipment and welfare facilities	General site support, dust suppression, emergency preparedness and workforce welfare

1.3. Terminal Operations Process and Terminal Equipment

Achieving high-throughput targets requires a robust fleet of specialized equipment engineered for seamless integration. At Laldia, the equipment selection is strategically balanced between quay-side speed and high-density yard storage. A critical feature of this fleet is the integration of electric-powered equipment, establishing Laldia as a leader in sustainable, green terminal operations.

The Terminal Operating System (TOS) is the digital control system that plans, tracks and coordinates every container, truck, crane and item of equipment within the Terminal. Acting as the operational "brain" of the Terminal, the TOS directs the container handling equipment.

1.3.1.Container Handling Equipment

The TOS directs the container handling equipment illustrated in Table 3 (Ship-to-Shore cranes, Rubber-Tyred Gantry cranes, Terminal Tractors, Reach Stackers, Empty Container Handlers, forklifts) to move containers safely and efficiently between the vessel, the container yard and the external truck gate. The equipment graphically illustrated in Table 3 below comprise the core container handling tools for the LCT:

- Ship-to-Shore (STS) Cranes (7 units) - These act as the primary interface between the vessel and the land. They utilize a specialized spreader to lift containers from the ship's hold or deck and transfer them to the quay, serving as the essential link for maritime throughput.
- Electric Rubber-Tyred Gantry (RTG) Cranes (32 units) - These electric cranes manage the container yard blocks. Because they travel on rubber tyres rather than fixed rails, they provide the operational flexibility to move between different yard areas, stacking containers several rows high to maximize storage density.
- Electric Terminal Trucks/Tractors (41 units) - These electric vehicles facilitate horizontal transport. They function as the internal logistical link, moving containers between the STS cranes at the quay and the RTG cranes in the yard blocks.
- Reach Stacker (1 unit) - A versatile, mobile crane used for flexible container handling and stacking across various terminal zones.
- Empty Container Handlers (6 units) - Specialized machinery dedicated to the high-speed stacking and management of empty containers, ensuring they do not obstruct the flow of laden units.
- Forklifts - Essential support equipment used for various utility lifting tasks and smaller cargo movements within the terminal facility.

Table 3: Photographs of the Container Handling Equipment to be used at the LCT.

Equipment	Photographs
Ship-to-Shore (STS) Cranes **7 units** These act as the primary interface between the vessel and the land. They utilise a specialised spreader to lift containers from the ship hold or deck and transfer them to the quay, serving as the essential link for maritime throughput.	
Electric Rubber-Tyred Gantry (RTG) Cranes **32 units** These electric cranes manage the container yard blocks. Because they travel on rubber tyres rather than fixed rails, they provide the operational flexibility to move between different yard areas, stacking containers several rows high to maximise storage density.	

Equipment	Photographs
Electric Terminal Trucks/Tractors **41 units** These electric vehicles facilitate horizontal transport. They function as the internal logistical link, moving containers between the STS cranes at the quay and the RTG cranes in the yard blocks.	
Empty Container Handlers **6 units** Specialised machinery dedicated to the high-speed stacking and management of empty containers, ensuring they do not obstruct the flow of laden units.	

Equipment	Photographs
Reach Stacker **1 unit** A versatile mobile crane used for flexible container handling and stacking across various terminal zones.	
Forklifts **Quantity to be confirmed** Essential support equipment used for various utility lifting tasks and smaller cargo movements within the terminal facility.	

1.3.2.Container Process Flow Journey

The movement of containers through the Laldia Container Terminal (LCT) follows a defined operational sequence coordinated by the Terminal Operating System (TOS) and supported by specialised container handling equipment. Although import and export containers move in opposite directions through the terminal, both processes involve a series of planned transfer, transport and storage activities designed to ensure the safe, efficient and timely movement of cargo between vessels, the container yard and landside transport.

Table 4 provides a simplified summary of the principal stages involved in both import and export container flows and identifies the key equipment used at each stage. The Table is intended to provide a high-level overview of terminal operations and illustrate how the STS cranes, RTG cranes, terminal tractors, gate systems and TOS interact to facilitate container movements through the Terminal.

Understanding the Terminal Operating System (TOS), container handling equipment and the operational interfaces between these systems provides important context for the waste streams, waste generation sources and waste management infrastructure requirements addressed throughout this Plan. The movement, storage and handling of containers, together with the operation and maintenance of terminal equipment and supporting infrastructure, influence both the types and quantities of waste generated across the terminal and the mitigation measures required for their effective management.

Table 4: Simplified container movement summarizing the import and export flows at the LCT.

Stages		Import Flow Activity (Ship to Truck Gate-Out)	Export Flow Activity (Truck Gate-In to Ship)	Equipment Used
1	**Arrival**	Vessel arrives and berths; TOS receives the manifest and plans discharge	Truck arrives at the gate with an export container; TOS verifies booking, weight and customs details	Terminal Operating System (TOS)
2	**First Lift**	STS Crane lifts the container from the vessel onto a Terminal Tractor	RTG Crane lifts the container from the truck	STS Crane / RTG Crane
3	**Transport**	Terminal Tractor transports the container from the quay to the assigned yard block	RTG Crane stacks the container in the export yard block to await vessel arrival	Terminal Tractor / RTG Crane
4	**Yard Storage**	RTG Crane lifts the container from the Terminal Tractor and stacks the container in the container yard	Container held in the yard pending the TOS vessel loading plan	RTG Crane / Container Yard
5	**Retrieval**	Truck arrives at the gate; TOS verifies details and issues collection instructions; RTG Crane retrieves the container from the stack	RTG Crane retrieves the container from the stack per the vessel loading plan	RTG Crane
6	**Transfer**	Container is placed directly onto the truck	RTG Crane places the container onto a	Terminal Tractor

			Terminal Tractor, which transports it to the quay	
7	**Exit / Loading**	Truck exits through the outbound gate to the customer (Truck Gate-Out)	STS Crane lifts the container from the Terminal Tractor and loads it onto the vessel	STS Crane / Gate Systems

Understanding the interaction between vessels, trucks, terminal equipment and container storage areas is important for visualising how cargo moves through the Terminal. While Table 4 provides a stage-by-stage summary of container handling activities, Figure 3 graphically illustrates the overall flow of containers and the relationship between the various operational components involved in the process.

Figure 4 presents a simplified container movement flow chart for both import and export operations. The Figure illustrates the typical movement path of a container between the vessel, Ship-to-Shore (STS) cranes, terminal tractors, Rubber-Tyred Gantry (RTG) cranes, container yard and truck gate, highlighting the principal transfer points within the terminal operating system

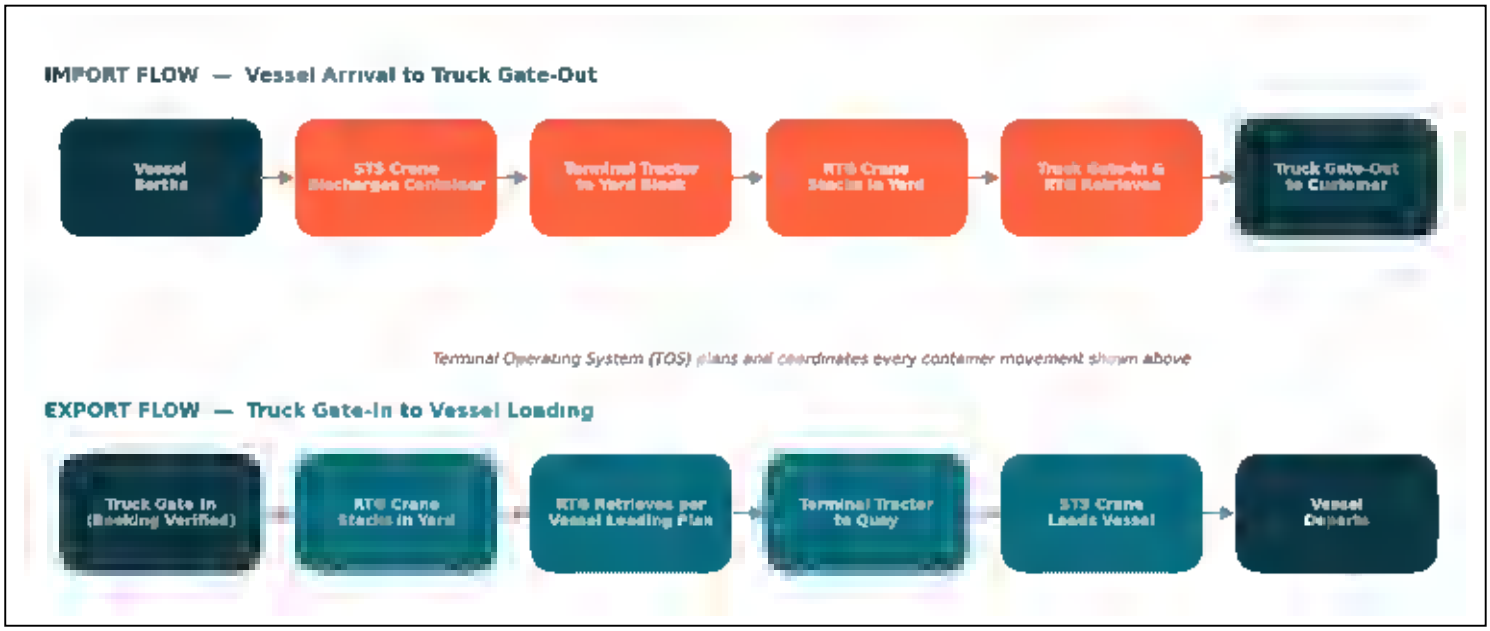


Figure 3: Container movement flow chart, illustrating the import flow (Vessel to Truck Gate-Out) and export flow (Truck Gate-In to Vessel).

1.3.2.1. Import Container Flow: Vessel Arrival and Offloading to Truck Gate-Out

In the import scenario, a container arrives by vessel and leaves the Terminal by road. Once the vessel is berthed, an STS Crane lifts the container from the ship and places it onto a waiting Terminal Tractor. The Terminal Tractor transports the container to the yard block assigned by the TOS, where an RTG Crane lifts and stacks the container in the container yard. When a customer truck subsequently arrives at the gate, the TOS verifies the driver, container and weighbridge details and issues collection instructions. The RTG Crane then retrieves the

container from the stack and places it directly onto the truck (or, where required, onto a Terminal Tractor for transfer to another loading area). Following final documentation, weight and customs checks, the truck exits through the outbound gate and the container is transported to the customer.

1.3.2.2. Export Container Flow: Truck Gate-In to Vessel Loading and Departure

In the export scenario, the sequence is reversed. An export truck arrives at the gate carrying a container; the TOS verifies the booking, weight and customs information and assigns a yard storage location. The truck proceeds to the assigned yard block, where an RTG Crane lifts the container from the truck and stacks it in the export storage area to await vessel arrival. Ahead of vessel arrival, the TOS prepares a vessel loading plan defining the sequence and position of each container. When required, the RTG Crane retrieves the container from the stack and places it onto a Terminal Tractor, which transports it to the quay; the STS Crane then lifts the container from the Terminal Tractor and loads it onto the vessel into its assigned position.

1.4. Principal Civil, Building and Waste Management Infrastructure

This section provides an overview of the principal civil structures, buildings and waste management supporting infrastructure (see list in Table 5) that make up the Laldia Container Terminal (LCT). Understanding the layout and function of these structures provides context for the waste streams, generation sources and waste management infrastructure requirements addressed throughout this Plan.

Table 5: Inventory of Key Civil Structures, Buildings and Waste Management Supporting Infrastructure at the LCT.

Facility / Structure	Type	Primary Function	Waste Management Relevance
Quay Wall & Berth Pocket	Civil / Marine Structure	Vessel berthing and cargo handling interface	Source of vessel-generated waste (MARPOL) and marine operational waste
Container Storage Yard	Civil Structure	Container stacking, handling and reefer storage	Source of sweeping waste, packaging, and occasional oil/diesel leakage waste
Gate Complex (Block A)	Civil Structure / Buildings	Truck in-gate/out-gate processing, weighing and scanning	Source of general/office waste; location of gate area waste collection points
Administration Building	Building	Terminal administration, operations control and staff welfare	Source of office, canteen, sanitary and domestic waste; houses cleaning services stores
Workshop Building	Building	Preventive and corrective maintenance of terminal equipment	Principal source of hazardous maintenance waste (oils, filters, batteries, scrap)
Customs Inspection Building	Building	Container unloading and customs inspection	Source of packaging, general and occasional Class I inspection waste
Electrical Substations	Building / Structure	Power distribution to quay, yard and buildings	Source of insulating oil waste, contaminated rags and E-Waste
Waste Management Facility (WMF)	Waste Infrastructure	Segregated temporary waste storage and consolidation	Central waste management infrastructure for the Project
Wastewater Treatment Plant (WWTP)	Waste Infrastructure	Treatment of sanitary, grey and workshop effluent	Generates WWTP sludge (Class I); manages Wastewater waste stream

Sewage Lifting Stations & Sewerage Network	Waste Infrastructure	Conveyance of sanitary effluent to the WWTP	Supports Wastewater and Sanitary Waste stream management
Equipment Washing / Wash Bays	Waste Infrastructure	Contained washdown of vehicles and equipment	Generates oily wash water managed via oil-water separators

1.4.1.Key Civil Structures

The principal marine and civil structures forming the operational core of the LCT include:

- Quay Wall and Berth Pocket: a continuous quay wall providing berthing for container vessels, with an associated dredged berth pocket (minimum design depth -12.0 m below Chart Datum, minimum width 50 m) maintained in accordance with the Project's Dredging Management Plan (DMP).
- Container Storage Yard: paved, hard-standing container stacking and handling areas served by Rubber-Tyred Gantry (RTG) cranes, including dedicated reefer container racking with electrical connection points.
- Gate Complex: automated in-gate and out-gate facilities incorporating weighbridges, Optical Character Recognition (OCR) scanning, and truck holding, parking and processing areas capable of accommodating more than 240 trucks.
- Internal Roads and Pavements: heavy-duty paved circulation roads and yard pavements designed to accommodate container handling equipment, terminal tractors and heavy vehicle traffic, incorporating surface water drainage systems.
- Stormwater Drainage Network: channels, culverts, catch pits and attenuation systems conveying surface water run-off from paved terminal areas, designed to prevent flooding and to separate clean stormwater from potentially contaminated run-off in operational areas.

1.4.2.Key Buildings

The LCT includes a range of administrative, operational and maintenance buildings, comprising:

- Administration Building: providing terminal administration, finance and operations facilities, the terminal operations room, RTG remote control room, staff welfare, canteen and changing facilities, including housekeeping stores for cleaning equipment and supplies on each floor.
- Workshop Building: providing preventive and corrective maintenance for container handling equipment and vehicles, incorporating dedicated bays for tyre, welding, hydraulic, mechanical, electrical and painting activities, an overhead gantry crane, inspection pits, a warehouse and external maintenance/washdown areas.
- Customs Inspection Building: providing sheltered container unloading and inspection facilities for customs officials, including loading docks and supporting office and welfare facilities.
- Electrical Substations: including the primary intake substation and distribution substations serving the quay, RTG fleet, reefer racks and terminal buildings.
- Gatehouse and Ancillary Buildings: including the gate office, quay office and sanitary blocks distributed across the terminal's operational areas.

1.4.3.Waste Management Supporting Infrastructure



Dedicated infrastructure is provided to support the collection, temporary storage, treatment and management of waste generated by the LCT, including:

- Waste Management Facility (WMF): a dedicated waste consolidation and temporary storage area providing segregated storage bays for recyclable, non-hazardous and hazardous waste streams (including used oil, batteries and e-waste), pending collection by licensed waste contractors.
- Wastewater Treatment Plant (WWTP): Providing treatment of workshop, equipment washdown and other oily wastewater streams through oil-water separation and associated treatment processes to achieve the Project's discharge and/or reuse standards.
- Sewage Treatment Plant (STP): Providing treatment of sanitary sewage and greywater generated from administration, welfare and operational buildings to the Project's discharge and/or reuse standards.
- Sewerage Network and Sewage Lifting Stations: conveying sanitary effluent from administration, welfare and operational buildings to the WWTP, incorporating balance tanks, duty/standby pumping and odour control measures.
- Equipment Washing and Maintenance Areas: dedicated wash bays and workshop maintenance bay drainage systems connected to full-retention oil-water separators, providing contained washdown of terminal equipment and.
- Hazardous Waste and Waste Oil Storage: bunded, ventilated storage areas within the Workshop Building and WMF providing secondary containment for waste oil, chemicals, batteries and other Class I hazardous waste streams pending collection.

2. PURPOSE AND OBJECTIVES OF THE WASTE MANAGEMENT PLAN

This Waste Management Plan (WMP) establishes the requirements and controls for the identification, segregation, handling, collection, storage, transport, recycling, recovery and disposal of wastes generated during the pre-construction, construction, operational and decommissioning phases of the Laldia Container Terminal (LCT) Project. The Plan defines the management approach for each waste stream and provides a framework to ensure that waste is managed in a safe, compliant and environmentally responsible manner throughout the Project lifecycle. It further establishes the requirements for waste minimisation, recycling and recovery, waste tracking and reporting, contractor management, employee awareness and training, and the implementation of appropriate engineering and operational controls to prevent pollution and protect human health and the environment. This Plan applies to LCT, all Contractors, Subcontractors, Vendors, Waste Service Providers and any non-routine activities undertaken within the Project area.

All personnel, departments, Contractors and other parties generating or managing waste shall take all reasonably practicable measures to:

- Prevent or minimise waste generation at source through effective planning, procurement, design and operational practices.
- Segregate, handle, collect and store waste in accordance with approved waste management procedures and designated waste classifications.
- Maximise opportunities for waste avoidance, reuse, recycling and recovery in accordance with the waste management hierarchy.



- Prevent releases of waste, contaminants or pollutants that may adversely affect soil, groundwater, surface water, the Karnaphuli River, air quality or the surrounding environment.
- Protect workers, contractors, visitors and neighbouring communities from exposure to waste-related hazards.
- Ensure that all waste is transported, treated, recycled and disposed of through approved and authorised waste management facilities and service providers.
- Comply with applicable Bangladesh legal and regulatory conditions and IFC, World Bank Group and APM Terminals Waste Management Standard.
- Maintain accurate waste records and support waste tracking, monitoring and reporting processes.
- Identify and implement continual improvement opportunities that improve resource efficiency, reduce waste generation and increase the diversion of waste from landfill through reuse, recycling and recovery initiatives.

3. LEGAL AND REGULATORY FRAMEWORK

The recommendations and control measures in this Plan are based on the national legal framework of the People's Republic of Bangladesh, and international conventions and standards applicable to waste management on port and marine construction and operations projects. Where national requirements and IFC Performance Standards / WBG EHS Guidelines differ, the more stringent requirement shall apply.

3.1. National Legal Framework of the People's Republic of Bangladesh

Waste management activities associated with the Laldia Container Terminal (LCT) Project are subject to a range of environmental, waste management, occupational health and safety, port and water resource management legislation enacted by the Government of Bangladesh. These legal requirements establish the framework for the generation, segregation, handling, storage, transportation, treatment, recycling and disposal of waste, while also defining the responsibilities of waste generators, contractors, regulators and waste management service providers. Compliance with these requirements is essential to ensure the Project protects human health and the environment, meets permitting obligations and maintains alignment with applicable regulatory approvals and concession requirements.

Table 6 summarises the principal Bangladesh legislation relevant to waste management and outlines its applicability to the construction and operational phases of the LCT Project.

Table 6: Applicable Bangladesh Legislation and Relevance to the Waste Management Plan.

Legislation	Relevance to this Plan
Bangladesh Environment Conservation Act, 1995 (as amended)	Primary environmental legislation providing the Department of Environment (DoE) with the legal framework for environmental protection, environmental clearance, pollution prevention and control and the regulation of waste management activities. The Act defines environmental pollution and provides the principal compliance and enforcement mechanisms applicable to the Project.
Environment Conservation Rules, 2023 (ECR 2023)	Implements the 1995 Act; classifies industrial and infrastructure projects into Green, Yellow, Orange and Red categories for

	environmental clearance purposes. Port/terminal projects such as LCT are categorised as "Red" (Schedule 1), requiring an Environmental Clearance Certificate (ECC) from the DoE, supported by an EIA prepared to a DoE-approved Terms of Reference. ECR 2023 sets ambient and effluent standards relevant to waste and wastewater management.
Solid Waste Management Rules, 2021	Sets out requirements for segregation, collection, transportation, treatment and disposal of solid waste (including plastics), introduces Extended Producer Responsibility (EPR) and assigns responsibilities to waste generators, local authorities and industrial facilities.
Hazardous Waste and Ship-Breaking Waste Management Rules, 2011	Regulates the generation, storage, transport, treatment and disposal of hazardous waste, including classification and manifest/consignment requirements; administered by the DoE.
Ship Breaking and Ship Recycling Rules, 2011	Relevant where any vessel recycling, dismantling or major vessel-related waste activity may interface with the Project; sets requirements for hazardous waste assessment and disposal from ship-related operations.
Ports Act, 1908 (as amended) / Chattogram Port Authority Ordinance, 1976	Establishes the legal framework for the administration and operation of the Port of Chattogram and the powers and responsibilities of the Chattogram Port Authority (CPA) as the port regulatory authority. The legislation provides CPA with authority over port operations, navigation, marine activities, safety, health, environmental protection and the management of activities conducted within port limits. Compliance with applicable CPA requirements, permits, notifications and operational controls is required for Project activities undertaken within the Port and associated marine areas.
Bangladesh Labour Act, 2006 (as amended) and Bangladesh Labour Rules, 2015	Section 54 requires effective arrangements for the disposal of waste and effluents arising from activities carried out at an establishment; sets occupational health, sanitation and welfare requirements relevant to camp, office and workshop waste.
Bangladesh Water Act, 2013 and related rules	Regulates water resource use and protection, relevant to wastewater discharge and dredging activities.
The Factories Act, 1965 (as amended) and Import Policy Order	Sets workplace sanitation/waste-disposal duties for factory-type establishments and restricts or prohibits the import of hazardous and other listed wastes into Bangladesh.

Where third-party contractors are engaged for the collection, transport, treatment, recycling or disposal of hazardous or non-hazardous waste, only appropriately licensed and authorised companies holding valid permits required under Bangladesh law shall be used. All waste management activities shall comply with applicable Department of Environment (DoE) requirements and other relevant legal and regulatory obligations.

3.2. International Conventions and Standards

The Laldia Container Terminal (LCT) Project is committed to implementing health, safety, labour, environmental and social management measures that are aligned with applicable international conventions, standards and recognised Good International Industry Practice (GIIP). In particular, this Plan has been developed with consideration of the requirements and principles set out in IFC Performance Standard 3 (Resource Efficiency and Pollution Prevention), the World Bank Group General Environmental, Health and Safety (EHS)

Guidelines, the EHS Guidelines for Ports, Harbors and Terminals, and other relevant international instruments governing pollution prevention, resource efficiency, occupational health and safety, maritime operations and waste management.

The ISO standards referenced in this Waste Management Plan are provided as sources of technical guidance and examples of recognised international good practice. They are not adopted as mandatory Project requirements, nor does their inclusion imply a commitment to certification, formal implementation or compliance with individual ISO standards unless specifically stated elsewhere in Project documentation. Rather, these standards have been considered to support the application of Good International Industry Practice (GIIP) and to inform the development of practical waste management controls, processes and performance measures throughout the Project lifecycle.

These international requirements provide the framework for managing waste generated throughout the construction and operational phases of the Project. They establish principles and expectations relating to waste minimisation, resource recovery, hazardous waste management, marine pollution prevention, dredged material management, worker protection, contractor management and environmental risk control. Compliance with these standards supports the Project's commitment to preventing adverse impacts on human health and the environment while promoting sustainable waste management practices across all Project activities.

Table 7 summarises the principal international conventions, standards and guidelines relevant to waste management at the LCT Project and describes how they have informed the development and implementation of this Waste Management Plan.

Table 7: International Conventions and Standards and their Relevance to Waste Management.

Convention & Standards	Relevance to this Plan
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (1989)	Bangladesh is a Party. Governs export/import of hazardous waste; relevant to any transboundary movement of hazardous or e-waste generated by the Project.
IFC Performance Standards 1–4 and 6	PS1 (Assessment and Management of E&S Risks), PS3 (Resource Efficiency and Pollution Prevention) and PS4 (Community Health, Safety and Security) are of particular relevance to waste management, storage, transport and disposal.
ILO Conventions (core labour standards; ILO Code of Practice for Safety and Health in Construction 2022; ILO Code of Practice for Safety and Health in Ports 2005)	International labour and occupational health and safety instruments establishing requirements for worker welfare, safe working conditions, hazard prevention, sanitation facilities, housekeeping, welfare amenities, worker training, consultation and the management of occupational health and safety risks. These standards are relevant to waste management activities by requiring the protection of workers involved in waste handling, collection, storage, transport and disposal, including the provision of appropriate hygiene facilities, personal protective equipment (PPE), training and safe systems of work.

International Maritime Organization (IMO) Ballast Water Management Convention and standards	Governs ballast water exchange, discharge records and vessel certification relevant to vessel-generated waste streams managed at the Terminal.
London Convention (1972) and 1996 Protocol on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter	International conventions regulating the disposal of wastes and other materials at sea to prevent marine pollution. The Convention and Protocol establish a framework for the assessment, management and permitting of dredged material disposal, requiring consideration of waste prevention, alternatives to disposal, material characterisation and environmental impact assessment before dredged sediments are placed in the marine environment. These requirements are particularly relevant to the Project's capital and maintenance dredging activities and the management of dredged material.
ISO 59004:2024. Circular Economy — Vocabulary, Principles and Guidance for Implementation	Establishes internationally recognised principles and guidance for circular economy implementation. Supports waste prevention, resource efficiency, reuse, recycling and recovery initiatives, promoting alignment with the waste hierarchy and Good International Industry Practice (GIIP).
ISO 24161:2022 – Environmental Management — Waste Collection and Transportation Management	Provides guidance for the environmentally sound collection, handling and transportation of waste. Relevant to waste segregation, packaging, labelling, collection, transfer, transport and contractor management arrangements associated with Project waste streams.
ISO 59020:2024 – Circular Economy — Measuring and Assessing Circularity Performance	Provides guidance on measuring and evaluating circularity performance. Relevant to monitoring waste reduction, resource recovery and recycling performance and supporting continual improvement of waste management outcomes.
ISO 14040:2006 – Environmental Management — Life Cycle Assessment — Principles and Framework	Provides principles for assessing environmental impacts across the lifecycle of products, materials and activities. Supports consideration of waste minimisation, resource efficiency and sustainable material management decisions.
MARPOL 73/78 (International Convention for the Prevention of Pollution from Ships)	Bangladesh ratified MARPOL Annexes I–VI in 2002. Governs the discharge, handling and port reception of oily waste, sewage, garbage, noxious liquid substances and ballast water from vessels calling at the Terminal.
The World Bank Group General Environmental, Health and Safety (EHS) Guidelines	Establish general international good practice requirements for environmental, health and safety management applicable across all industry sectors. The Guidelines provide requirements and guidance for waste minimisation, waste segregation, collection, storage, transport, treatment and disposal, hazardous materials management, pollution prevention, spill prevention and response, resource efficiency, worker health and safety, and environmental monitoring. These requirements underpin the Project's approach to waste management during both construction and operations.
World Bank Group EHS Guidelines for Ports, Harbors and Terminals	Provide sector-specific environmental, health and safety requirements for port and terminal developments. The Guidelines address the management of vessel-generated waste, cargo residues, dredged material, hazardous materials, wastewater,

	stormwater, oily wastes, ballast water, and marine pollution risks. They also establish requirements for port reception facilities, waste handling and storage practices, emergency preparedness and pollution prevention measures relevant to container terminal construction and operation activities.

3.3. APM Terminals Standards

In addition to compliance with applicable legal and international requirements, waste management activities undertaken during the construction and operation of the Project shall be implemented in accordance with LCT and APM Terminals HSSE policies, standards, plans and procedures. These requirements establish the Project's internal framework for environmental protection, pollution prevention, waste management, risk management and continual improvement, and shall be applied by LCT, Contractors, Subcontractors, Vendors and Waste Service Providers throughout all phases of the Project.

Contractors and Subcontractors shall develop and implement project-specific Waste Management Method Statements describing the arrangements, resources, controls and procedures that will be applied to manage waste generated by their activities. These Method Statements shall be aligned with the requirements of this Waste Management Plan, the APM Terminals HSSE Policy, applicable APM Terminals HSSE Standards, the LCT HSSE Project Specification, and all relevant Project environmental and social management plans.

The following policies, plans and management systems are particularly relevant:

- APM Terminals HSSE Policy and Standards.
- APM Terminals HSSE Project Specification and LCT HSSE Plan.
- Contractor and Subcontractor Waste Management Method Statements.
- LCT Project HSSE Plan and associated management plans (Pollution Prevention and Control Management Plan, Dredging Management Plan, Community Health and Safety Management Plan);
- This Waste Management Plan shall be reviewed and updated periodically by the LCT HSSE Department, or when there is a material change to the Project, applicable law, or other applicable Project requirements. Amendments will be notified to all relevant persons and entities and the most recent approved version shall always apply.

4. ROLES AND RESPONSIBILITIES

Effective waste management requires clear allocation of accountability, responsibility and authority throughout both the Construction and Operations phases of the Project. While some waste management responsibilities apply across the entire Project lifecycle, other responsibilities are phase-specific due to the different waste streams, operational activities, regulatory interfaces and management arrangements present during construction and operation.

4.1. Construction Phase Waste Management Responsibility Framework

During the Construction Phase, responsibility for waste management is primarily focused on the control of Contractor-generated wastes, including construction and demolition waste,



dredged material, excavation spoil, packaging materials, hazardous materials, domestic waste from temporary facilities and waste arising from commissioning activities.

All personnel generating waste are responsible for ensuring that waste is correctly identified, segregated, stored and managed in accordance with this Waste Management Plan, applicable Bangladesh regulatory requirements, Environmental and Social Impact Assessment Report (ESIAR) commitments, Environmental Clearance Certificate (ECC) conditions and applicable APM Terminals requirements. Table 8 defines the key roles, responsibilities and accountabilities for waste management during the Construction Phase to ensure that all waste streams are effectively managed and that regulatory, contractual and Project-specific requirements are consistently achieved.

Table 8: Roles and Responsibilities for Waste Management During Construction.

Role	Primary Responsibilities During Construction
Project Director (construction)	Accountable for ensuring adequate resources, organisational arrangements and contractor oversight are in place to implement this Plan. Ensures compliance with contractual requirements, ESIAR commitments, ECC conditions and Bangladesh regulatory requirements.
Construction Manager	Overall owner of waste management performance during construction. Ensures contractors prevent waste generation where practicable, implement waste segregation, maintain waste storage areas and comply with approved Waste Management Method Statements.
HSSE Manager (construction)	Leads HSSE governance and assurance activities, including inspections, audits, reporting, regulatory engagement and corrective action management.
Waste Coordinator	The HSSE Manager shall designate and appoint a resource from among the existing project execution roles to perform the day-to-day coordination of waste management activities. Maintains waste registers, manages waste consignment processes, conducts inspections, verifies compliance and coordinates waste-related reporting.
Contractors and Subcontractors	Responsible for all waste generated by their contracted activities. Ensure project-specific Waste Management Method Statements are implemented. Contractors and Subcontractors are fully responsible for managing the waste generated by their own activities, including proper waste segregation, storage, transportation and final disposal, in accordance with this Plan, the contract and Bangladesh law. Each Contractor shall appoint a person or team to coordinate HSSE and waste matters, maintain training and inspection records, and ensure its own Subcontractors comply with this Plan. Ensure contractor personnel comply with this Plan. Conduct inspections, maintain records, coordinate corrective actions and support reporting requirements.
Waste Service Providers / Waste Management Contractors	Responsible for lawful collection, transport, recycling, treatment and disposal of waste using licensed facilities and approved waste management routes in accordance with contractual and regulatory requirements. Provide delivery notes and Waste Transfer Notes (WTN) for every consignment.

All Staff, Contractors and Visitors	All personnel shall segregate waste at source, use designated waste receptacles and report any improper waste handling or disposal or waste management non-conformances.

4.2. Operation Phase Waste Management Responsibility Framework

Following the completion of construction and commissioning activities, responsibility for waste management transitions from the Project Execution organisation to the Terminal operating organisation. During the Operations Phase, waste management becomes an ongoing business process integrated into day-to-day terminal activities, including container handling operations, equipment and infrastructure maintenance, marine operations, administration, facility management, wastewater treatment and emergency response. Unlike the Construction Phase, where waste is largely generated through temporary project activities and managed through multiple contractors, operational waste management focuses on the sustained and systematic control of routine waste streams generated through terminal operations and the continual improvement of waste management performance.

The Operations Phase organisational structure establishes clear lines of accountability and responsibility for waste management at both management and operational levels. Senior management are accountable for ensuring that appropriate resources, systems and governance arrangements are in place, while operational departments are responsible for managing the waste streams generated by their respective activities. HSSE personnel provide oversight, assurance, monitoring, auditing and regulatory liaison functions, while dedicated waste management roles support the day-to-day implementation, coordination, inspection and continual improvement of waste management activities.

The responsibilities presented in Table 9 reflect the principle that waste management is not solely an HSSE function but a shared operational responsibility. Collectively, these responsibilities ensure that waste management is embedded within normal terminal operations, that regulatory and corporate requirements are consistently achieved and that opportunities to reduce waste generation, increase recycling rates and improve waste management performance are systematically identified and implemented throughout the operational life of the Terminal.

Each department generating waste remains responsible for ensuring that waste is correctly identified, segregated, stored, handled, transferred, recycled, treated or disposed of in accordance with this Waste Management Plan, the Terminal Waste Management Standard Operating Procedure (SOP), applicable Bangladesh regulatory requirements, Environmental and Social Impact Assessment Report (ESIAR) commitments, Environmental Clearance Certificate (ECC) conditions and APM Terminals requirements.

The Terminal shall appoint a Waste Coordinator and identify Waste Champions for key operational areas, including Maintenance & Repair, Yard Operations, Marine Operations, Administration, Workshops, Warehouses and Contractor-managed areas. Waste Champions shall support routine inspections, waste reduction initiatives and waste segregation compliance, while the Waste Coordinator shall maintain the Waste Register and support implementation and periodic review of this Waste Management Plan. Table 9 summarises the roles, responsibilities and accountabilities for waste management during the Operations

Phase, ensuring that waste generated through terminal activities is managed in a consistent, compliant and environmentally responsible manner throughout the life of the Terminal.

Table 9: Responsibilities for Waste Management During Operations.

Roles	Responsibilities
Managing Director	Accountable for overall terminal waste management performance and regulatory compliance. Ensures adequate resources, staffing and systems are maintained.
Terminal Chief Operations Officer	Overall owner of operational waste management performance. Ensures all operational departments comply with this Plan and the Terminal Waste Management SOP.
HSSE Manager	Maintains overall environmental governance, reporting, assurance, auditing and regulatory engagement.
Environmental Coordinator	Coordinates daily management of operational waste streams, contractor interfaces, inspections, reporting, waste registers and waste tracking systems. Develops and maintains waste registers, coordinates waste collection and disposal activities, verifies waste classification and segregation, supports contractor management, reviews waste data and supports implementation of the Waste Management Plan.
Head of Operations	Responsible for management of vessel-generated waste, MARPOL compliance, Port Waste Reception Facility arrangements and marine waste streams.
Head of Maintenance	Responsible for waste generated through maintenance activities, including oils, filters, batteries, tyres, scrap metal, chemicals, e-waste and oily wastes.
Waste Champions	Conduct routine inspections, identify improvement opportunities, support awareness campaigns and promote effective waste segregation within their operational areas.
Waste Service Providers / Waste Management Contractors	Responsible for lawful collection, transport, recycling, treatment and disposal of waste using licensed facilities and approved waste management routes in accordance with contractual and regulatory requirements. Provide delivery notes and Waste Transfer Notes (WTN) for every consignment.
All Staff, Contractors and Visitors	All personnel shall segregate waste at source, use designated waste receptacles, and report any improper waste handling or disposal or waste management non-conformances.

5. WASTE MANAGEMENT HIERARCHY AND PRINCIPLES

The waste management hierarchy provides a structured framework for prioritising waste management decisions based on environmental sustainability and resource efficiency. The hierarchy promotes the prevention and minimisation of waste generation as the preferred outcome, followed by opportunities to reuse materials, recycle wastes into new products and recover material or energy value from wastes that cannot be reused or recycled. Disposal to landfill or other authorised disposal facilities is considered the least preferred option and should only be used where higher-order waste management alternatives are not technically, environmentally or economically feasible. Application of the hierarchy supports resource conservation, reduces environmental impacts, minimises reliance on disposal facilities and

aligns with the principles of sustainable development, circular economy practices, IFC Performance Standard 3 and Good International Industry Practice (GIIP).

For the Laldia Container Terminal (LCT) Project, the waste management hierarchy shall be applied to all waste streams generated during both the Construction and Operations phases, including construction and demolition waste, dredged material, excavated spoil, packaging waste, domestic waste, hazardous waste, maintenance wastes, scrap metal, waste oils, batteries, tyres, e-waste and vessel-related wastes. During construction, emphasis shall be placed on minimising waste generation through efficient design, procurement and construction practices and maximising opportunities for the reuse and recovery of materials such as dredged material, excavated spoil and construction materials. During operations, the hierarchy shall support the ongoing reduction of waste generation through effective waste segregation, recycling programmes, resource efficiency initiatives, maintenance waste recovery and the diversion of waste from landfill. All Project personnel, Contractors, Subcontractors and Waste Management Contractors shall demonstrate that waste management decisions have considered higher-order hierarchy options before disposal is selected as the final management option.

The overall aim of this Plan is to reduce the volume of residual waste requiring final disposal at each stage of the waste cycle, applying the following hierarchy, in order of priority, to all waste streams generated during Construction and Operations.

Table 10 presents the waste management hierarchy that shall be applied to all waste streams generated by the Project, prioritising waste prevention, reuse, recycling and recovery before considering disposal as the least preferred option.

Table 10: Waste Management Hierarchy and Preferred Waste Handling Options.

Hierarchy Level		Description
1	Avoid / Reduce	Generate less waste through efficient planning, procurement, design and construction/operational practices (e.g. bulk ordering, returnable packaging, optimised material take-off).
2	Reuse	Reuse materials in their original form on-site or off-site (e.g. wooden pallets, single-sided paper, returnable drums, temporary facility materials).
3	Recycle	Convert waste back into reusable material through approved recycling contractors (e.g. scrap metal, plastics, paper/cardboard, batteries, waste oil).
4	Recover	Extract material or energy value from waste that cannot be reused or recycled (e.g. wood chipping, beneficial reuse of dredged material or surplus concrete).
5	Dispose	Safe and compliant final disposal of residual waste at a DoE / CPA approved facility, only once the above options have been exhausted.

While Table 10 presents the hierarchy in tabular form and summarises the preferred management options associated with each hierarchy level, Figure 4 provides a visual representation of how waste management decisions for the Laldia Container Terminal (LCT) Project should be progressively evaluated from the top of the hierarchy downwards.



Figure 4: Waste Management Hierarchy for Construction and Operational Activities.

Dredged material shall not automatically be regarded as a waste stream. Subject to sediment characterisation and suitability assessments, dredged material is recognised as a potentially valuable natural resource that may be beneficially reused for land reclamation, construction, habitat creation, habitat enhancement, shoreline protection, beach nourishment, beneficial fill or other approved purposes. Consistent with the waste hierarchy, beneficial use and beneficial reuse shall be evaluated before disposal is considered.

6. WASTE IDENTIFICATION AND CLASSIFICATION

6.1. Classification and Categorisation of Waste Streams by Source and Activity

Waste is defined as any substance or object which is discarded, intended to be discarded, or required to be discarded under Bangladesh law. A “waste stream” is made up of similar waste materials generated from a particular construction or operational activity for which distinct management actions apply.

Effective waste management begins with the accurate identification and classification of waste at the point of generation. Proper classification ensures that waste is segregated, stored, handled, transported and disposed of using controls appropriate to its characteristics and potential risks. The classification system adopted for the Laldia Container Terminal (LCT) Project groups wastes into broad categories based on their environmental, health and safety

risks and establishes corresponding colour codes to support consistent segregation and management across both the Construction and Operations phases.

The waste classification system presented in Table 11 establishes the primary framework for waste segregation and management based on waste characteristics and associated risks. To support effective implementation of this framework, it is also important to understand where and how different waste streams are generated across the Project. Identifying waste according to its source activity provides a practical basis for planning waste storage requirements, collection frequencies, transportation arrangements, recycling opportunities and disposal pathways. It also assists in assigning responsibilities for waste management, forecasting waste volumes and ensuring that appropriate controls are implemented at locations where specific waste streams are generated.

Table 11 presents the waste classification system applicable to the LCT Project, including the designated colour code, typical waste streams and common sources of generation. The table provides a practical framework for identifying and segregating waste generated from construction activities, container handling operations, maintenance workshops, offices, warehouses, marine operations and support facilities. These classifications shall be used throughout the Project to support waste segregation, storage, labelling, reporting, recycling and disposal activities and to minimise the risk of cross-contamination between different waste streams.

The waste colour-coding system presented in Table 11 has been developed specifically for the LCT Project to support the consistent identification, segregation, storage, handling and disposal of waste streams. While Bangladesh does not prescribe a single national colour-coding system for all waste categories, colour-coded waste segregation is recognised as Good International Industry Practice (GIIP) and is widely used internationally to improve waste management performance, reduce cross-contamination and facilitate recycling, recovery and disposal activities.

Table 11: Waste Categories, Colour Codes and Typical Sources within the LCT Project.

Waste Class	Colour Code	Typical Waste Streams	Typical Sources / Activities
Class I – Hazardous Waste	**Red**	**Any material presenting a significant risk to property, the environment and/or human health because of its physical or chemical characteristics, including:** Waste lubricating oil; hydraulic oil; oily rags and absorbents; contaminated soil; chemical containers with residues; paint and solvent waste; waste fuels; batteries; fluorescent lamps; contaminated PPE; oily sludge; laboratory waste; medical waste; asbestos-containing materials; NORM-contaminated materials.	Equipment and vehicle maintenance workshops; container handling equipment servicing; fuel storage and dispensing areas; generators; substations; paint and coating works; spill response and cleanup activities; laboratories; medical facilities; demolition and remediation works.

Waste Class	Colour Code	Typical Waste Streams	Typical Sources / Activities
Class II - Liquid Waste	**Purple**	**Liquid wastes generated by Project activities that require collection, containment, treatment and disposal to prevent pollution of soil, surface water, groundwater and the marine environment, including:** Oily water, bilge water, wastewater treatment sludge, septic waste, sewage, greywater, wash water, equipment washdown water, concrete washout water, hydrotest water, contaminated stormwater, interceptor sludge, tank cleaning residues, dredging return water and dewatering effluent.	Construction camps, sanitation facilities, wastewater treatment systems, workshops, equipment wash bays, concrete batching plants, dredging activities, fuel facilities, vessel operations and stormwater management systems.
Class III – Non-Hazardous Waste	**Green**	**Industrial and domestic waste that is not hazardous, including:** Office paper and cardboard; food and canteen waste; domestic waste; packaging materials; garden waste; toner cartridges; non-contaminated textiles; general housekeeping waste.	Administrative offices; control rooms; welfare facilities; canteens and kitchens; security posts; site accommodation camps; landscaping activities; housekeeping and cleaning operations.
Class IV – Inert (Non-Hazardous) Waste	**Yellow**	**Non-hazardous waste that is not bio-degradable or chemically active**, including: wood; scrap metal; plastic bottles; glass; construction and demolition (C&D) waste; concrete, asphalt, brick and masonry debris. Synthetic mineral fibres (insulation) and tyres fall in this class but require special handling.	Construction and demolition activities; dredging and marine works; civil works; road construction and maintenance; warehouse operations; workshop activities; container repair areas; infrastructure upgrades and maintenance projects.
Class V – Electronic and Electrical Waste (E-Waste)	**Blue**	**Waste electrical and electronic equipment at or near end-of-life,** including**:** Waste electrical and electronic equipment at or near end-of-life, including monitors, computers and accessories, office equipment, telecommunications equipment and networking equipment.	Offices; ICT rooms; terminal operating systems; gate facilities; security and surveillance systems; telecommunications infrastructure; crane and equipment control systems; automation and instrumentation upgrades.
Class VI - Recyclable Waste	Orange	**Materials that can be recovered, reused or recycled through approved waste management and resource recovery processes,**	All Project facilities and operational areas.

Waste Class	Colour Code	Typical Waste Streams	Typical Sources / Activities
		including: Segregated paper, cardboard, plastics, glass, aluminium, steel, pallets and reusable packaging materials.	

Class II Liquid Waste (Purple) - Liquid wastes requiring collection, containment, conveyance, treatment or controlled disposal, including sewage, greywater, wash water, hydrotest water, sanitary sludge and other non-hazardous liquid wastes. Liquid wastes contaminated by hydrocarbons, fuels, oils, chemicals, solvents, heavy metals or other hazardous substances shall be classified and managed as Class I Hazardous Waste:

- STP sludge = Purple (Class II)
- Sewage = Purple (Class II)
- Greywater = Purple (Class II)
- Hydrotest water = Purple (Class II)
- Oily water = Purple (Class II subtype)
- WWTP sludge = Red (Class I)
- Interceptor sludge = Red (Class I)
- Recovered hydrocarbons = Red (Class I)
- Chemical-contaminated effluent = Red (Class I)

All waste containers, skips and storage areas shall be clearly labelled according to the applicable waste class and colour code. Wastes from different classes shall not be mixed unless it is safe to do so; any unidentified waste shall be treated and managed as hazardous waste until confirmed otherwise.

Table 12 presents a source-based classification of the principal waste streams anticipated during both the Construction and Operations phases of the Laldia Container Terminal (LCT) Project. The table links typical waste-generating activities and facilities to the corresponding LCT waste classes established in Table 11 and provides an indicative alignment with the broad waste categories recognised under the Environment Conservation Rules, 2023 (ECR 2023). This cross-reference supports the consistent identification, segregation, storage, handling, transportation, treatment and disposal of waste streams while facilitating regulatory compliance and the application of Good International Industry Practice (GIIP) throughout the Project lifecycle.

Table 12: Classification of Waste Streams by Source and Activity for both the Construction and Operations Phases.

Source / Activity	Typical Waste Streams	LCT Waste Class	Broad ECR 2023 Category
Administration Building / offices	Paper, cardboard, plastics, glass, metals, organic waste, toner cartridges, batteries, computers, printers and accessories	Class III (General Waste); Class V (E-Waste); Class I (batteries, toner where	Domestic-equivalent / Hazardous / Electronic Waste

Source / Activity	Typical Waste Streams	LCT Waste Class	Broad ECR 2023 Category
		contaminated); Class VI (recyclables)	
Canteens and welfare facilities	Food waste, packaging, cooking oil, sanitary waste, sewage and greywater	Class III (General Waste); Class II (liquid waste); Class I (waste cooking oil where managed as hazardous); Class VI (recyclables)	Domestic-equivalent / Hazardous / Liquid Waste
Gate Complex and Customs Inspection Building	Paper, cardboard, plastics, packaging waste, toner cartridges, electronic equipment	Class III; Class V; Class I (toner); Class VI	Domestic-equivalent / Hazardous / Electronic Waste
Container storage yard and handling operations	Sweeping waste, damaged packaging, recyclable materials, oil-contaminated absorbents, contaminated rags, contaminated soil from spill cleanup	Class III; Class VI; Class I	Domestic-equivalent / Recyclable / Hazardous
Workshop Building (equipment and vehicle maintenance)	Waste lubricating oil, hydraulic oil, oily water, filters, batteries, tyres, paint waste, solvent waste, contaminated PPE, scrap metal, wire ropes, e-waste	Class I; Class II (oily water); Class IV (tyres, scrap metal and inert materials); Class V; Class VI	Hazardous / Liquid Waste / Inert Waste / Electronic Waste
Fuel Storage, Chemical Storage and Dispensing Areas	Fuel residues, contaminated absorbents, contaminated soil, sludge, chemical containers and spill response wastes	Class I; Class II (contaminated liquids)	Hazardous / Liquid Waste
Electrical Substations and Power Distribution Facilities	Insulating oil, contaminated absorbents, spent lamps, batteries, electrical equipment and components	Class I; Class V	Hazardous / Electronic Waste
Berth, quay and marine operations	Vessel-generated garbage, bilge water, oily water, sewage, cargo residues, packaging materials	Class II (liquid wastes); Class III; Class I (oily residues); Class VI	MARPOL Waste / Hazardous / Domestic-equivalent
Capital and maintenance dredging	Dredged sediments (for beneficial reuse, reclamation, engineering use or disposal, subject to characterisation), dewatering effluent, return water, debris, obstructions and recovered materials.	Class II (return water and dewatering effluent); Class IV (clean inert sediments and debris); Class I (contaminated sediment)	Inert, Liquid Waste or Hazardous depending on characterisation
Construction and Demolition Activities	Concrete, asphalt, masonry, timber, metal scrap,	Class IV; Class VI; Class I	Inert / Recyclable / Hazardous



Source / Activity	Typical Waste Streams	LCT Waste Class	Broad ECR 2023 Category
	packaging waste, insulation materials and demolition debris	(contaminated materials)	
Sewage Treatment Plant (STP) and Sewage Lifting Stations	Sewage screenings, grit, sludge, septic waste and other sanitary wastewater treatment residuals	Class II (liquid waste); Class I (sludge where hazardous characteristics are identified following testing)	Liquid Waste / Hazardous (subject to characterisation)
Wastewater Treatment Plant (WWTP) / Oil-Water Separation Systems	Oily sludge, interceptor sludge, oil-water separator residues, tank cleaning residues and recovered hydrocarbons	Class I; Class II	Hazardous / Liquid Waste
Medical / First Aid Facilities	Sharps, contaminated dressings, infectious waste, expired medicines	Class I	Hazardous / Clinical Waste
ICT, Telecommunications and Automation Facilities	Servers, networking equipment, telecommunications equipment, cables, control system components and electronic devices	Class V; Class VI	Electronic Waste / Recyclable
All Project Facilities and Operational Areas	Segregated recyclable paper, cardboard, plastics, glass, aluminium, steel, pallets and reusable packaging	Class VI	Recyclable Waste

This source-based classification is a practical planning tool and does not replace the formal waste class and colour-coding requirements of Table 11, which shall continue to govern labelling, segregation and storage requirements throughout the Project.

6.2. Estimated Waste Volumes by Source during Construction and Operation Phases

This section provides indicative, order-of-magnitude estimates of the solid and liquid waste expected to be generated during the Construction and Operations Phases of the LCT. As the LCT is a greenfield development without operational history, these estimates are predictive and have been derived by benchmarking against comparable APM Terminals projects and operating facilities, scaled pro rata to the LCT's maximum design throughput capacity of up to approximately 1.4 million TEU per annum, representing the upper limit of the Terminal's planned throughput capacity. This scaling approach provides a reasonable planning basis in the absence of site-specific project and operations data and should therefore be treated as indicative only. In addition to benchmarking against comparable APM Terminals projects and facilities, the waste volumes have been developed by also using professional judgement and generic industry waste-generation factors. Given that the LCT is a yet to be constructed greenfield development with no existing project and operational waste performance data, the estimates should be regarded as planning assumptions rather than definitive forecasts.



Table 13 provides indicative estimates of the waste streams expected to be generated during the Construction Phase and identifies the principal construction activities and work areas responsible for their generation. The Table has been developed to support construction waste planning, waste storage requirements, sizing of Waste Management Facilities (IWMF), wastewater treatment requirements, logistics planning and engagement of licensed waste management contractors.

Table 13 provides estimates of the quantities for peak monthly generation rates and cumulative waste volumes anticipated over the assumed construction programme of 38 months. The estimates are intended to provide a conservative planning basis pending confirmation of final construction methodologies, contractor work packages, dredging quantities, workforce levels and detailed Bills of Quantities.



Table 13: Estimated Waste Volumes Generated by Source for the LCT Construction Phase.

Construction Activity / Source	Waste Stream	Waste Class	Peak Monthly Generation (approximate)	Total Construction Period Generation (approximate)
Site Establishment & Construction Camp	Domestic/general waste, packaging, office waste other than below quantified waste	Class III	32 t/month	888 t
Construction Camp	Organic food waste	Class III	5 t/month	105 t
Construction Camp	Paper & cardboard	Class II	0.21 t/month	8 t
Construction Camp	Wood packaging/offcuts	Class VI	1.21 t/month	44t
Construction Camp	Plastics	Class VI	0.58 t/month	21 t
Construction Camp	Metals	Class VI	0.75 t/month	28 t
Capital Dredging & Marine Works	Recovered debris, wreckage, scrap metal, obstructions	Class VI	N/A	50 t
Capital Dredging & Marine Works	Contaminated dredged material/debris (if present)	Class I	TBD	TBD
Capital Dredging & Marine Works	Dredged sediment designated for beneficial reuse or reclamation	Class IV	180,000 m^3/month	180,000 m^3
Site Clearance	Vegetation and clearance waste	Class III	1894 t/month	7576 t
Land Reclamation & Earthworks	Surplus / unsuitable material	Class IV	15,000m^3/month	60,000 m^3
Earthworks & Heavy Plant Operations	Oily sludge, filters, contaminated soil	Class I	4.5 t/month	125 t
Piling & Marine Civil Works	Concrete washout, scrap steel, wire ropes	Class IV/VI/II	100 t/month	2,400 t
Piling & Marine Structures	Steel offcuts and packaging	Class VI	8.3 t/month	200 t
Structural Concrete Works	Rejected concrete, washout solids	Class II / IV	21 t/month	500 t

Building Construction	Mixed C&D waste	Class III/IV/VI	80 t/month	1440 t
Steel Fabrication Yard	Scrap steel and rebar offcuts	Class VI	10.4 t/month	250 t
Steel Fabrication Yard	Timber formwork and packaging	Class VI	6.3 t/month	150 t
Pavement & Yard Surfacing Works	Concrete/asphalt waste, aggregate rejects	Class IV	167 t/month	4,000 t
Pavement Works	Packaging, bitumen drums, cement bags	Class VI / I	3.8 t/month	90 t
Utilities Installation	Cable scrap, pipe offcuts, minor e-waste	Class Class VI / V	3 t/month	72 t
Fencing, Utilities & Landscaping	Packaging, conduit offcuts, green waste	Class Class VI / III	4.2 t/month	100 t
Vehicle & Plant Maintenance Workshop	Used oils, lubricants, oily rags	Class I	0.33 t/month	8 t
Vehicle & Plant Maintenance Workshop	Tyres	Class IV	2.5 tyres/month	60 tyres
Vehicle & Plant Maintenance Workshop	Batteries	Class I	0.08 t/month	2 t
General Site-Wide	Paint tins, solvents, contaminated packaging	Class I	0.33 t/month	8 t
Workforce Sanitary Facilities	Domestic wastewater	Class II liquid	350 m^3/month	8,400 m^3
Workforce STP	Sewage sludge	Class II (or Class I if testing indicates hazardous characteristics)	20 m^3/month	480 m^3
Construction Site Medical / First-Aid Facility	Medical and clinical waste, including sharps, contaminated dressings, disposable medical supplies, expired medicines and contaminated PPE	Class I – Hazardous Waste	0.001 t/month (1 kg/month)	0.036 t (36 kg)

Note: *Unless stated otherwise, Peak Monthly Generation reflects the highest month of activity for that source/stream, and Total Construction Programme Generation reflects the cumulative quantity across the assumed ~24-month construction programme. Figures for capital dredging represent bulk dredged material destined for disposal or beneficial reuse/reclamation and exclude material handled directly under the Dredging Management Plan (DMP).*

Dredged material volumes presented in Table 13 are based on the current estimated dredging quantities for the LCT Project and include a 20% allowance for siltation and dredging tolerances. Capital dredging is expected to be completed over an approximately one-month dredging campaign. The dredged material estimates represent material planned for beneficial reuse, reclamation and/or disposal, as applicable, and shall be verified and refined during detailed design, hydrographic survey and contractor planning activities. The figures should therefore be regarded as indicative planning estimates rather than final dredging quantities.

For site clearance: Estimated topsoil and vegetation-clearance waste is based on an affected area of 150,000 m^2, an average topsoil depth of 0.3 m, an assumed soil unit weight of 15 kN/m^3 and a 10% allowance for vegetation-clearance material. The estimated total is approximately 75,700 tonnes.

Organic food waste has been estimated based on a peak workforce of approximately 2,000 personnel, one delivered meal per person per day and an indicative food-waste generation factor of approximately 80 g per meal. Meals are assumed to be prepared off site; therefore, significant food preparation and kitchen waste is not included. The total programme estimate applies an average workforce/loading factor of approximately 55% to account for workforce mobilisation, ramp-up, peak construction and demobilisation over the 38-month construction programme. The estimate shall be reviewed against the Contractor's workforce histogram, catering arrangements and measured food waste during construction.

Building construction activities, including the administration building, workshops, customs inspection warehouse, pre-gate facilities, gate complexes and associated support infrastructure, are assumed to occur over an approximately 18-month construction period.

Main construction activities for the Laldia Container Terminal are assumed to be undertaken over an approximately 38-month construction period.

> ***IMPORTANT*: the volumes presented in Table 13 are estimates, not site-specific empirical measurements. They have been derived by benchmarking against comparable and analogous projects and third-party greenfield port/terminal projects, combined with generic industry waste-generation factors and rates. The figures are deliberately conservative and have been set at the upper end of the plausible range identified during benchmarking, so as to avoid under-estimation. Actual construction-phase waste volumes may be, and are expected to be, materially lower than the figures shown.**

Assumptions and Basis of Waste Generation Estimates for the Construction Phase

- ***Estimates are indicative**, order-of-magnitude planning figures and do not represent site-specific measured waste data.*
- ***Waste quantities have been benchmarked** against comparable APM Terminals developments and analogous greenfield port and terminal construction projects.*
- *A **construction programme duration** of approximately 38 months has been assumed.*
- *A **peak workforce** of approximately 2,000 personnel has been assumed for construction camp, sanitation and domestic waste generation estimates.*
- ***Conservative assumptions have generally been adopted** to avoid under-estimation.*
- ***Peak monthly generation** represents the highest anticipated month of activity for each waste stream.*
- ***Total programme generation** represents cumulative waste generation over the assumed construction period of 37 months, including allowance for mobilisation and demobilisation periods and assuming average monthly generation is approximately 80% of the peak monthly generation.*
- ***Capital dredging** quantities represent order-of-magnitude estimates derived from available bathymetric data and the planned dredging profile. While the dredging design requirements are defined, the Contractor is required to verify the final berth pocket geometry, dredging extents, side slopes and associated dredging requirements. As existing bathymetric conditions and final dredge surfaces have not yet been confirmed, the estimated quantities should be considered indicative only and will require validation through detailed design and hydrographic survey data. Final dredging volumes will be determined based on the difference between the existing surveyed seabed levels and the approved dredge design surface.*
- ***Land reclamation surplus/unsuitable material** quantities represent order-of-magnitude estimates derived from topographic data and concept design. While the reclamation and ground improvement design requirements are defined, the Contractor is required to verify the construction methodology, material types and fill balance. As existing these have not yet been confirmed, the estimated quantities should be considered indicative only and will require validation through detailed design and survey data.*
- ***Volumes of contaminated dredged material** remain unknown and are therefore identified as TBD pending sediment characterisation and marine debris surveys.*
- ***Construction camp waste** generation rates have been benchmarked against comparable APM Terminals construction projects and scaled to the expected workforce.*
- ***Construction and demolition (C&D) waste** quantities have been estimated using industry-standard generation factors and assumed building footprints.*
- ***Earthworks, marine works, steel fabrication, concrete works and pavement waste** estimates are based on typical waste factors associated with similar construction activities.*

- ***Wastewater and sewage sludge*** *estimates are based on anticipated workforce numbers and preliminary WWTP design assumptions.*
- ***Waste classifications*** *are based on the four-class waste management system comprising Class I (Hazardous), Class II (Non-Hazardous), Class III (Inert) and Class IV (E-Waste) adopted for this Waste Management Plan.*
- ***All estimates shall be reviewed*** *and updated once contractor methodologies, final quantities, workforce projections and actual waste generation data become available.*

Table 14 provides indicative estimates of the waste streams anticipated to be generated during routine operation of the LCT following commissioning. The estimates identify the principal operational areas and facilities that are expected to generate waste, including administrative offices, welfare facilities, customs inspection areas, workshops, container yard operations, electrical infrastructure and wastewater treatment facilities.

The purpose of these estimates is to support operational waste management planning, including waste segregation arrangements, storage capacity requirements, recycling initiatives, contractor engagement and monitoring programmes. The figures have been developed by benchmarking waste generation rates from comparable APM Terminal operations and scaling these to the anticipated throughput and operational profile of the LCT. As actual operational practices, staffing levels, cargo profiles and maintenance activities become established, the estimates should be validated and refined using site-generated waste monitoring data.

Table 14: Estimated Waste Volumes Generated by Source for the LCT Operations Phase.

Source	Typical Waste Stream	LCT Waste Class	LCT Indicative Estimate (Monthly)
Administration Building	Paper and cardboard	Class VI	≈1,400 kg
Administration Building	Glass	Class VI	≈100-200 kg/month
Administration Building	Metals	Class VI	≈350 kg
Administration Building	Office kitchen and pantry waste	Class III	50-100 kg/month
Administration Building	Plastics	Class VI	≈175 kg
Administration Building	Batteries / toner / lamps	Class I	≈42 kg combined
Administration Building	Electronic waste	Class V	≈25-50 kg/month (average)
Canteen / welfare facilities	Organic (food) waste	Class III	≈3,000 kg/month
Canteen / welfare facilities	Plastics and packaging	Class VI	≈2,500 kg/month
Canteen / welfare facilities	Paper and cardboard	Class VI	≈1,500 kg/month
Gate Complex	Paper, cardboard, plastics	Class VI	≈525 kg combined
Customs Inspection Building / warehouse	Paper, plastics, wood, packaging	Class VI	≈8,000-12,000 kg/month
Workshop Building	Used lubricating / hydraulic oils, oily effluent	Class I	≈6,650 kg / ≈5,250 L
Workshop Building	Contaminated packaging, rags, solvent and paint residues	Class I	≈825 kg combined
Workshop Building	Scrap metal	Class VI	≈1,000 kg/month
Workshop Building	Tyres	Class IV	≈17-18 tyres/month
Workshop Building	e-waste	Class V	≈35 kg/month
Container storage yard	Sweeping waste	Class III	≈7,000 kg

Source	Typical Waste Stream	LCT Waste Class	LCT Indicative Estimate (Monthly)
Container storage yard	Leaked oil/diesel, contaminated rags	Class I	≈70 L / ≈35 kg
Electrical substations	Insulating oil, contaminated rags	Class I	≈70 L / ≈35 kg
Wastewater Treatment Plant	WWTP sludge	Class II (or Class I if hazardous by testing)	≈14 m^3
Terminal Medical / First-Aid Clinic	Medical and clinical waste, including sharps, contaminated dressings, disposable medical supplies, expired medicines and contaminated PPE	Class I – Hazardous Waste	Approximately 1 kg/month

Note: *Unless stated otherwise, the estimated quantities presented in Table 14 represent indicative average monthly waste generation rates associated with routine terminal operations at the LCT under anticipated steady-state operating conditions. The estimates are intended to support operational waste management planning, including waste storage capacity, segregation arrangements, recycling initiatives, waste contractor engagement and treatment or disposal requirements. Actual waste generation rates will vary depending on terminal throughput, cargo mix, workforce levels, maintenance activities, operating practices and seasonal variations.*

E-waste is normally generated intermittently during equipment replacement cycles and not continuously each month.

Catering meals are assumed to be prepared by an offsite catering provider and delivered to the Terminal for consumption. Consequently, the canteen and welfare facilities are expected to generate food waste, food-related packaging waste and other municipal waste streams associated with meal consumption; however, significant quantities of food preparation wastes, including waste cooking oil, grease-trap residues and food-processing wastes, are not anticipated to be generated on-site. Unless limited cooking activities are undertaken within the Terminal, the estimated quantity of used cooking oil should be assumed to be negligible and excluded from operational waste forecasts.

> ***IMPORTANT*: the volumes presented in Table 14 are estimates, not site-specific empirical measurements. They have been derived by benchmarking against comparable APM Terminal operations. The figures are deliberately conservative and have been set at the upper end of the plausible range identified during benchmarking, so as to avoid under-estimation. Actual operation-phase waste volumes may be, and are expected to be, materially lower than the figures shown.**

Assumptions and Basis of Estimate for the Operations Phase

- ***Estimates are predictive*** *and represent planning-level forecasts rather than actual measured operational waste quantities.*
- ***Waste volumes have been benchmarked*** *against comparable APM Terminals operations.*

- ***Estimates have been scaled*** *to the anticipated operational profile and approved throughput capacity of approximately 1.4 million TEU per annum.*
- ***Operational waste quantities are assumed to reflect steady-state*** *terminal operations following commissioning and ramp-up.*
- ***Administrative, welfare and office waste*** *streams have been estimated using standard commercial facility generation factors and benchmark terminal data.*
- ***Canteen and welfare facility waste*** *estimates incorporate food waste, packaging waste and used cooking oil generated by the operational workforce.*
- ***Workshop waste*** *estimates are based on anticipated maintenance activities associated with container handling equipment, vehicles, mobile equipment and supporting infrastructure.*
- ***Customs inspection and cargo handling waste*** *streams include packaging materials, damaged cargo packaging and miscellaneous operational waste associated with inspection activities.*
- ***Container yard sweeping waste*** *estimates reflect routine terminal housekeeping and maintenance activities.*
- ***Hazardous waste quantities*** *are based on expected maintenance activities, lubricant consumption, battery replacement, electrical maintenance and contaminated absorbent generation.*
- ***E-waste estimates*** *reflect periodic replacement of information technology, communications and electronic equipment.*
- ***Wastewater treatment sludge*** *estimates are based on anticipated wastewater treatment system performance and operational loading assumptions.*
- ***Waste classifications*** *are based on the four-class waste management system comprising Class I (Hazardous), Class II (Non-Hazardous), Class III (Inert) and Class IV (E-Waste) adopted for this Waste Management Plan.*
- ***Actual waste generation rates will vary depending on throughput volumes****, workforce numbers, maintenance regimes, operational practices, contractor arrangements and waste minimisation initiatives.*
- ***All operational estimates should be reviewed*** *and updated periodically using actual waste management records, waste transfer documentation, contractor reports and monitoring data generated during terminal operations.*

7. WASTE COLLECTION, STORAGE AND SEGREGATION

Waste shall be segregated and containerised as they are generated to allow proper recycling, storage and disposal. Only LCT / Contractor approved waste containers suitable for temporary storage shall be used. Containers shall be positioned on paved/level surfaces, appropriately labelled and not corroded, damaged or excessively worn.

7.1. Waste Labelling and Signage Requirements

Appropriate waste labelling and signage are essential to ensuring the safe handling, segregation, storage, transport and disposal of waste generated by the Project and Terminal. Clear and consistent identification of waste containers and waste management areas assists personnel and contractors in correctly managing waste streams, reduces the risk of misclassification and cross-contamination, supports emergency response activities and facilitates compliance with applicable regulatory requirements and the requirements of this Plan.



All waste containers, bins, skips, tanks, drums and waste storage compounds shall be clearly labelled and maintained in a legible condition at all times. Labelling shall provide sufficient information to enable personnel to identify the waste type, applicable waste classification, associated hazards and handling requirements and shall support the safe collection, storage, transport and disposal of waste throughout its lifecycle.

Labels shall include, as a minimum:

- Waste type.
- Waste class.
- Hazard classification (where applicable).
- Waste generator department.
- Date waste collection commenced.
- Required PPE.
- Emergency contact details for hazardous waste areas.

Additional signage shall be provided for hazardous waste storage and handling areas to communicate site-specific hazards, emergency response requirements and access restrictions. Such signage shall be prominently displayed at all entrances and key locations within the storage area and shall be maintained in a visible and serviceable condition.

Hazardous waste storage areas shall additionally display:

- Hazard warning signage.
- No smoking signs.
- Spill response instructions.
- Emergency contact information.
- Fire-fighting equipment locations.

To ensure effective communication with all personnel, contractors, visitors and emergency responders, all waste-related labels, notices and signage shall be provided and maintained in both English and Bengali. This requirement applies to waste containers, storage areas, operational instructions, warning notices and emergency response information associated with waste management activities.

7.2. Waste Collection Requirements

Effective waste collection is essential to maintaining good housekeeping standards, preventing environmental pollution, protecting worker health and safety and ensuring that waste remains suitable for reuse, recycling, recovery or disposal. Waste collection frequencies should be based on the nature of the waste stream, the volume generated, storage capacity, potential environmental risks and operational requirements of the Laldia Container Terminal (LCT) Project.

Table 14 establishes the minimum collection frequencies for the principal waste streams expected to be generated during the Construction and Operations phases of the Project and Terminal. These frequencies are intended to minimise the accumulation of waste, prevent nuisance conditions such as odours, litter and pest attraction and ensure that waste is removed from work areas and collection points in a timely manner. More frequent collection



may be required where waste generation rates, climatic conditions, operational activities or environmental risks warrant additional controls.

Table 15: Proposed Minimum Waste Collection Frequencies for Waste Streams Generated by the LCT Project and Terminal.

Waste Type	Minimum Collection Frequency
Food waste	Daily
Domestic waste	Daily
Office waste	At least weekly
Recyclables	As required based on storage capacity, housekeeping requirements and efficient transport volumes (e.g. full truckloads)
Hazardous waste	As required based on storage capacity
Medical waste	Daily or immediately following generation
Spill cleanup waste	Immediately following incident response

Recyclable materials such as scrap metal, timber, pallets and other recoverable materials may be accumulated until sufficient quantities exist to support efficient collection, transport, recycling or resale, provided storage capacities, housekeeping standards, fire prevention measures and environmental controls are maintained

To maintain good housekeeping standards and ensure the safe and efficient collection of waste throughout the Terminal, waste collection arrangements shall be implemented in a manner that minimises disruption to operational activities while maintaining unrestricted access for emergency response vehicles and personnel. Waste collection routes shall therefore be planned and managed to avoid interference with operational traffic, pedestrian movements and designated emergency access routes.

Waste generators shall ensure that all waste is placed only in designated waste collection containers and approved collection points appropriate to the waste type and segregation requirements specified in this Plan. Waste shall not be deposited outside designated containers or in unauthorised locations.

Waste collection frequencies and container capacities shall be managed to prevent the accumulation of waste and avoid nuisance conditions. Overflowing containers shall not be permitted and waste shall be removed, replaced or transferred as necessary to ensure all containers remain within their designated storage capacity limits.

7.2.1.Design Requirements for Waste Collection

Waste collection facilities provide the interface between waste generation and the subsequent collection, transportation, recycling, treatment and disposal of waste streams. Appropriately designed collection facilities are essential to ensure waste is collected safely and efficiently, supports effective waste segregation practices, minimises housekeeping issues and prevents adverse impacts on workers, terminal operations and the surrounding environment. The following requirements shall be applied to all permanent and temporary waste collection facilities established during the Construction and Operations phases of the Laldia Container Terminal (LCT) Project.

Waste collection facilities shall be designed, located and maintained to support effective waste collection and minimise risks to workers and prevent pollution of soil, groundwater, stormwater systems and the Karnaphuli River. The facilities shall:

i. Be located close to waste generation sources to encourage proper disposal and segregation of waste.
ii. Be readily accessible to waste collection vehicles and personnel while maintaining safe pedestrian and vehicle movements.
iii. Be located away from flood-prone areas, stormwater drainage channels and environmentally sensitive receptors where practicable.
iv. Be constructed on a level, hard-surfaced and impermeable area to facilitate waste handling and housekeeping.
v. Include adequate waste collection and segregation infrastructure appropriate to the waste streams generated.
vi. Incorporate drainage controls to prevent the release of litter, contaminated runoff or waste materials into stormwater systems and surrounding areas.
vii. Be equipped with clear waste signage, colour coding and waste identification markings.
viii. Include adequate lighting to enable safe operation, inspection and collection activities during hours of darkness.
ix. Include litter containment measures to prevent windblown waste and maintain good housekeeping standards.
x. Provide sufficient space for the safe placement, handling and removal of waste containers without obstructing operational activities or emergency access routes.
xi. Be maintained in a clean, orderly and serviceable condition at all times.
xii. Display emergency contact and spill reporting information where wastes with the potential to cause environmental pollution may be collected.

7.2.2.Operational Requirements for Waste Collection

Effective operation of waste collection facilities is necessary to ensure that waste is removed from work areas in a timely manner, housekeeping standards are maintained, environmental pollution is prevented and waste collection activities do not adversely affect terminal operations. Waste collection processes shall be planned, monitored and implemented to ensure waste remains contained, collection infrastructure remains fit for purpose and waste is transferred safely to designated storage, treatment, recycling or disposal facilities. The following operational requirements shall apply to all waste collection facilities and activities during the Construction and Operations phases of the Laldia Container Terminal (LCT) Project.

The following minimum operational requirements shall apply:

i. Waste shall be collected according to defined schedules.
ii. Overflowing containers shall be addressed immediately.
iii. Collection routes shall be inspected regularly.
iv. Windblown litter shall be recovered promptly.
v. Waste transfer records shall be maintained.
vi. Containers shall be inspected during collection.
vii. Damaged containers shall be replaced immediately.
viii. Contractors shall only use approved collection points.

7.3. Waste Storage Requirements

The temporary storage of waste is an essential component of the waste management process, providing a controlled location where waste can be accumulated safely prior to collection, recycling, treatment or final disposal. Improper waste storage can result in environmental pollution, nuisance conditions, pest infestation, odour generation, increased fire risk, worker exposure and the contamination of recyclable materials. Accordingly, all waste generated during the Construction and Operations phases of the Laldia Container Terminal (LCT) Project shall be stored in a manner that protects human health and the environment, prevents the release of contaminants to soil, groundwater, stormwater systems and the Karnaphuli River and supports compliance with applicable legal, regulatory and Project requirements.

Waste storage facilities shall be designed, operated and maintained according to the nature, quantity and characteristics of the waste being stored. Particular attention shall be given to hazardous wastes, liquid wastes and recyclable materials to prevent spills, leaks, cross-contamination and deterioration of material quality. Storage arrangements shall support effective waste segregation, facilitate safe access for inspection and collection activities and ensure wastes are removed within established storage time limits.

The requirements contained in this section establish the minimum controls applicable to waste storage activities across the Project, including storage duration limits, facility design requirements, operational management controls and specific requirements for hazardous and non-hazardous waste storage. These requirements apply to all temporary waste storage locations, waste accumulation points, collection centres and a designated Waste Management Facility (WMF) established by LCT, Contractors and Subcontractors.

7.3.1. Waste Storage Limits

Waste storage limits are established to prevent excessive accumulation of waste, reduce the risk of environmental pollution, odour generation, pest infestation, fire hazards and deterioration of recyclable materials, and to ensure the timely removal of waste from the project (during construction) and operational site. All waste generators shall monitor waste volumes and storage durations to ensure waste remains within the approved capacity and retention limits of designated storage facilities.

Waste shall not be accumulated beyond the storage capacities of designated facilities. As a minimum:

i. Food waste shall not be stored for more than 24 hours.
ii. Medical waste shall not be stored for more than 24 hours unless refrigerated.
iii. Hazardous waste shall not remain within terminal storage facilities for more than 90 days.
iv. Recyclable waste shall be removed whenever storage capacity reaches 80%.
v. Waste oil shall be removed before storage exceeds 80% capacity.

The Waste Coordinator shall maintain records demonstrating compliance with storage limits.

7.3.2. Design Requirements for Waste Storage

Waste storage facilities shall be designed to safely contain waste, prevent pollution of the surrounding environment, protect human health, minimise fire and spill risks and facilitate the efficient inspection, handling, collection and removal of waste. The design of storage facilities shall be commensurate with the type, quantity and characteristics of the waste being stored and shall incorporate appropriate controls to prevent unauthorised access, releases to the environment, cross-contamination between waste streams and exposure to adverse weather conditions.

As a minimum, waste storage facilities shall meet the following requirements:

i. Be fenced and secured.
ii. Be located outside flood-prone areas where practicable.
iii. Have impermeable flooring.
iv. Include secondary containment for liquid wastes.
v. Include roofing for susceptible waste streams.
vi. Include emergency wash-down and spill containment equipment.
vii. Provide separation between incompatible waste types.
viii. Include firefighting equipment.
ix. Include adequate ventilation.
x. Include inspection access and traffic circulation space.

7.3.3.Operational Requirements for Waste Storage

Waste storage facilities shall be operated and maintained in a manner that preserves the integrity of storage systems, prevents environmental pollution, minimises fire and safety risks, and ensures waste remains properly contained pending collection, treatment, recycling or disposal. Routine inspection, maintenance and housekeeping activities shall be undertaken to verify that storage facilities remain fit for purpose and that waste is managed in accordance with the requirements of this Waste Management Plan.

At a minimum, the following operational requirements shall apply:

i. Storage areas shall be inspected weekly.
ii. Hazardous waste inventories shall be maintained.
iii. Spill kits shall be fully stocked at all times.
iv. Secondary containment systems shall remain empty of rainwater and debris.
v. Waste shall be removed before storage capacity exceeds 80%.
vi. Storage areas shall be kept clean and free of windblown litter.
vii. Damaged, leaking or otherwise defective containers shall be isolated and stored in a bunded location prior to being repaired, overpacked or replaced immediately.
viii. Housekeeping inspections shall be undertaken routinely.
ix. Emergency response equipment shall be maintained and inspected.

7.3.4.Non-Hazardous Waste Storage

Non-hazardous waste shall be stored in designated areas that prevent littering, nuisance conditions and environmental pollution, while facilitating efficient collection, recycling and disposal activities. Storage arrangements shall ensure that wastes remain contained, accessible for collection and clearly identifiable and that storage areas are maintained in a clean, safe and orderly condition.

The following requirements shall apply to the storage of non-hazardous waste generated during the Construction and Operations phases of the Laldia Container Terminal (LCT):

i. Temporary (daily) storage and collection points shall be located away from main construction / operational activities and ignition sources.
ii. The storage area shall be readily accessible to collection vehicles, of adequate size and capacity, and cleaned regularly.
iii. Waste accumulation points shall be paved/levelled, well maintained, kept clean and litter-free and clearly marked.
iv. Firefighting equipment shall be provided in close proximity to storage/collection areas.
v. Records of waste generated, stored and transported shall be maintained by the waste generator.

7.3.5.Hazardous Waste Storage

Hazardous waste presents a greater risk to human health, property and the environment due to its physical, chemical or biological characteristics and therefore requires additional controls beyond those applicable to non-hazardous waste. Hazardous waste shall be stored in designated, secure and appropriately engineered facilities that prevent spills, leaks, fire, incompatible material interactions and releases to soil, groundwater, stormwater systems and the Karnaphuli River. Storage arrangements shall ensure that hazardous wastes remain clearly identified, segregated, inspected and managed in accordance with applicable legal requirements and recognised international good practice.

At a minimum, the following requirements shall apply:

i. Hazardous waste storage/collection centres shall be located away from main activities to prevent ignition or fire, with appropriate warning signage.
ii. Storage areas shall have spill containment systems (bunding to at least 110% of stored volume), perimeter cut-off drainage where relevant and be protected from run-off.
iii. Chemical/hydrocarbon absorbent materials and firefighting equipment shall be provided nearby.
iv. Containers and storage tanks shall be constructed of suitable, compatible material, labelled and inspected regularly for leaks and structural integrity.
v. The storage period for solid hazardous waste shall not exceed 90 days from the last collection date, after which it shall be transferred to a DoE-approved treatment or storage facility.
vi. Storage areas shall be paved/levelled, fenced, signposted and illuminated after daylight hours.
vii. No burning or incineration of waste on-site is permitted; no camp incinerator shall be installed or licensed for waste disposal.

LCT / the Contractor shall dedicate an area as a Waste Management Facility (WMF) to act as a staging point for waste that can be recycled or reused (e.g. wood, tyres, steel). Suitable fencing/barricading shall be provided and this area shall also be used to inspect and sign waste manifests for all waste transported off-site.

7.3.6.Waste Containers and Colour Coding



Waste containers used at the LCT shall be selected, sized and colour-coded to support effective segregation at source, consistent with the six-class waste classification and colour-coding system set out in Table 11 of this Plan (Class I – Hazardous Waste / Red; Class II – Liquid Waste / Purple; Class III – Non-Hazardous Waste / Green; Class IV – Inert Waste / Yellow; Class V – Electronic and Electrical Waste (E-Waste) / Blue; and Class VI – Recyclable Waste / Orange).

Containers shall be selected according to the volume and nature of waste generated at each location, generally ranging from 50 L, 120 L and 240 L containers in internal areas (offices, welfare facilities, control rooms) to larger-capacity skips and bins in external operational areas (container yard, quay, workshop, gate). In internal areas, priority shall be given to pedal-operated, lidded containers to minimise manual contact and reduce contamination risk, particularly in washrooms, canteens and welfare facilities. In external areas, higher-capacity, weather-resistant containers manufactured from high-density plastic or metal, fitted with lids and clear identification, shall be used. Class I Hazardous Waste (e.g. waste oil, batteries, chemicals, contaminated PPE and fluorescent lamps) shall be stored only in containers compatible with the physical and chemical characteristics of the waste, positioned within designated bunded hazardous waste storage areas and kept segregated from all other waste classes (Class II Liquid Waste, Class III Non-Hazardous Waste, Class IV Inert Waste, Class V Electronic and Electrical Waste (E-Waste) and Class VI Recyclable Waste) at all times.

The waste classification system presented in Table 11 establishes the primary framework for waste segregation at source; however, effective implementation of this system requires the provision of appropriately sized, colour-coded, and clearly identified waste containers throughout the LCT. Container type, capacity, and placement shall be matched to the nature and volume of waste generated at each location to facilitate segregation, minimise contamination between waste streams, improve collection efficiency, and support safe handling and storage. Table 16 presents the standard waste container colour-coding requirements and indicative container specifications for the principal waste streams expected during terminal operations, consistent with the four-class waste classification system adopted in this Waste Management Plan.

Table 16: Waste Container Specification and Colour Coding by Waste Stream.

Typical Waste Stream	LCT Waste Class (Table 11)	Container Colour	Indicative Container Type / Capacity
Paper and cardboard	Class VI - Recyclable Waste	ORANGE	120 L / 240 L lidded bin or baled skip
Plastics (packaging, bottles, pipes)	Class VI - Recyclable Waste	ORANGE	120 L / 240 L lidded bin
Metal scrap (cans, wire, steel)	Class VI - Recyclable Waste	ORANGE	Open-top skip / dedicated scrap bay
Glass	Class VI - Recyclable Waste	ORANGE	120 L lidded bin
Food and organic / canteen waste	Class III - Non-Hazardous Waste	GREEN	50 L / 120 L pedal-operated lidded bin
Wood (pallets, dunnage, timber)	Class VI - Recyclable Waste	ORANGE	Open-top skip / dedicated laydown area
General / domestic waste, sweepings	Class III - Non-Hazardous Waste	GREEN	120 L / 240 L lidded bin
Tyres	Class IV - Inert (Non-Hazardous) Waste (special handling)	YELLOW	Dedicated tyre storage rack / bay
Liquid wastes (sewage, greywater)	Class IIA – Sanitary Wastewater	PURPLE	Sewerage network and STP

Typical Waste Stream	LCT Waste Class (Table 11)	Container Colour	Indicative Container Type / Capacity
Liquid wastes (Oily water, wash bay wastewater and oil-water separator influent)	Class IIB – Oily Wastewater	PURPLE	WWTP / oil-water separator system
Liquid wastes (Equipment washdown water, hydrotest water and non-contaminated process water)	Class IIC – Non-Hazardous Process Water	PURPLE	WWTP, reuse or authorised discharge
Liquid wastes (STP sludge and dewatered biosolids)	Class IID – Sanitary Sludge and Residuals	PURPLE	Dewatering and authorised disposal or approved beneficial reuse
Liquid wastes (Chemical wash water, contaminated stormwater)	lass IIE – Contaminated Liquid Waste	PURPLE	Containment, treatment and assessment. Reclassify as Class I Hazardous Waste where hazardous characteristics are confirmed
Liquid wastes (Contaminated liquid effluent containing hydrocarbons, chemicals, solvents, fuels or hazardous substances)	Class I – Hazardous Waste	RED	Bunded storage, treatment and disposal through authorised hazardous waste contractor
Liquid wastes (WWTP sludge, interceptor sludge, oil-water separator sludge and recovered hydrocarbons)	Class I – Hazardous Waste	RED	Dewatering and disposal through authorised hazardous waste treatment and disposal facility
Batteries	Class I - Hazardous Waste	RED	Rigid, acid-resistant container, segregated by chemistry
Fluorescent lamps, contaminated PPE	Class I - Hazardous Waste	RED	Rigid, labelled hazardous waste container
Electronic and electrical waste (E-Waste)	Class V - Electronic and Electrical Waste (E-Waste)	BLUE	Dedicated lidded bin / rigid container

The location of waste containers shall be determined to ensure easy access for users, minimise unnecessary waste movement and support proper segregation at the point of generation, with hazardous waste containers positioned in clearly marked, covered or protected locations close to their generating source (e.g. workshops, substations) and segregated from non-hazardous waste containers to prevent cross-contamination. The number, capacity and location of containers shall be reviewed periodically and adjusted as operational needs change, as part of the continuous improvement process for this Plan.

7.4. Waste Segregation Requirements

Effective waste segregation is fundamental to achieving the objectives of the waste management hierarchy and ensuring that waste streams are managed safely, efficiently and in a manner that maximises opportunities for reuse, recycling and recovery. Segregation at the point of generation reduces cross-contamination between waste streams, improves resource recovery rates, reduces disposal costs and assists in ensuring compliance with applicable legal, regulatory and Project requirements. All personnel generating waste shall segregate waste in accordance with the waste categories and collection systems established in this Waste Management Plan.

7.4.1.Design Requirements for Waste Segregation

Waste segregation facilities shall be designed to support the consistent identification, separation and collection of different waste streams generated during the Construction and Operations phases of the Project. The design of segregation facilities shall promote segregation at source, facilitate safe waste handling and collection and minimise the potential for cross-contamination, accidental mixing and misclassification of waste streams.

Waste segregation facilities shall:

i. Provide segregated waste storage bins, containers or designated storage areas for recyclable, non-hazardous, hazardous and operational waste streams to facilitate waste segregation, recycling, resource recovery and controlled disposal and to prevent the mixing or cross-contamination of different waste types.
ii. Be designed and maintained to provide clearly identified and segregated storage areas for recyclable, non-hazardous, hazardous and operational waste streams generated from offices, workshops, warehouses, canteens, welfare facilities and other activities.
iii. Include dedicated and clearly labelled storage areas or containers for each waste stream to prevent cross-contamination and facilitate waste segregation, reuse, recycling, recovery and disposal activities.
iv. Ensure that external waste storage areas serving workshops, maintenance facilities and operational areas provide separate storage arrangements for different waste types, including scrap metal, waste oil used parts, packaging materials, batteries, general waste, recyclable materials and hazardous wastes, as applicable.
v. Be arranged to support efficient waste collection, resource recovery, recycling and controlled disposal in accordance with the waste management hierarchy and applicable regulatory requirements.
vi. Be located as close as reasonably practicable to waste generation sources to encourage segregation at the point of generation.
vii. Provide clearly designated collection areas or containers for each approved waste stream.
viii. Include sufficient capacity to accommodate anticipated waste volumes without overflow or mixing of waste streams.
ix. Use a standardised colour-coding system to enable easy identification of different waste categories.
x. Display clear, durable and weather-resistant signage identifying each waste stream and the types of waste permitted within each container.
xi. Include visual aids, photographs or examples of acceptable and prohibited waste types where appropriate.
xii. Physically separate hazardous and non-hazardous waste streams to prevent cross-contamination.
xiii. Provide dedicated and clearly marked containers for recyclable materials, including paper, cardboard, plastics, metals, glass and e-waste where applicable.
xiv. Provide adequate space between containers to allow safe access, inspection, waste handling and collection.
xv. Be accessible to all personnel generating waste, including employees, contractors and visitors where applicable.
xvi. Be positioned to avoid obstruction of pedestrian walkways, traffic routes, emergency equipment and emergency access routes.



xvii. Enable inspection of waste containers and segregation performance without requiring movement of containers.
xviii. Be maintained in a clean and orderly condition to ensure waste stream identification remains visible and effective.
xix. Be periodically reviewed and updated where changes in operations, waste streams or recycling opportunities require additional segregation arrangements.

For operational consistency, waste segregation facilities should, as a minimum, provide dedicated collection arrangements for municipal waste, recyclables, construction and demolition waste, scrap metal, timber, e-waste, batteries, hazardous waste, waste oils, contaminated absorbents and other significant waste streams generated by terminal activities.

7.4.2.Operational Requirements for Waste Segregation

Waste segregation systems shall be operated and maintained to ensure that waste streams remain separated and identifiable from the point of generation through to collection, storage, recycling, treatment or disposal. Personnel shall comply with established segregation requirements and waste handling procedures to prevent contamination of recyclable materials, reduce the volume of waste requiring disposal and support continual improvement in waste management performance.

Operational requirements for waste segregation shall ensure that:
i. Segregation shall occur at source.
ii. Hazardous and non-hazardous waste shall not be mixed.
iii. Recyclable materials shall be protected from contamination.
iv. Waste streams shall remain identifiable from generation to disposal.
v. Segregation performance shall be inspected monthly.
vi. Non-conformances shall trigger corrective actions.
vii. Waste Champions are appointed and shall monitor compliance.

7.5. Solid Waste Management Process Flow and Handling Requirements

Solid waste management at the LCT follows a continuous operational flow from generation through to environmentally sound final disposal, designed to ensure proper segregation, waste traceability and compliance with applicable Bangladesh environmental legislation. Figure 5 illustrates this flow for solid waste management.

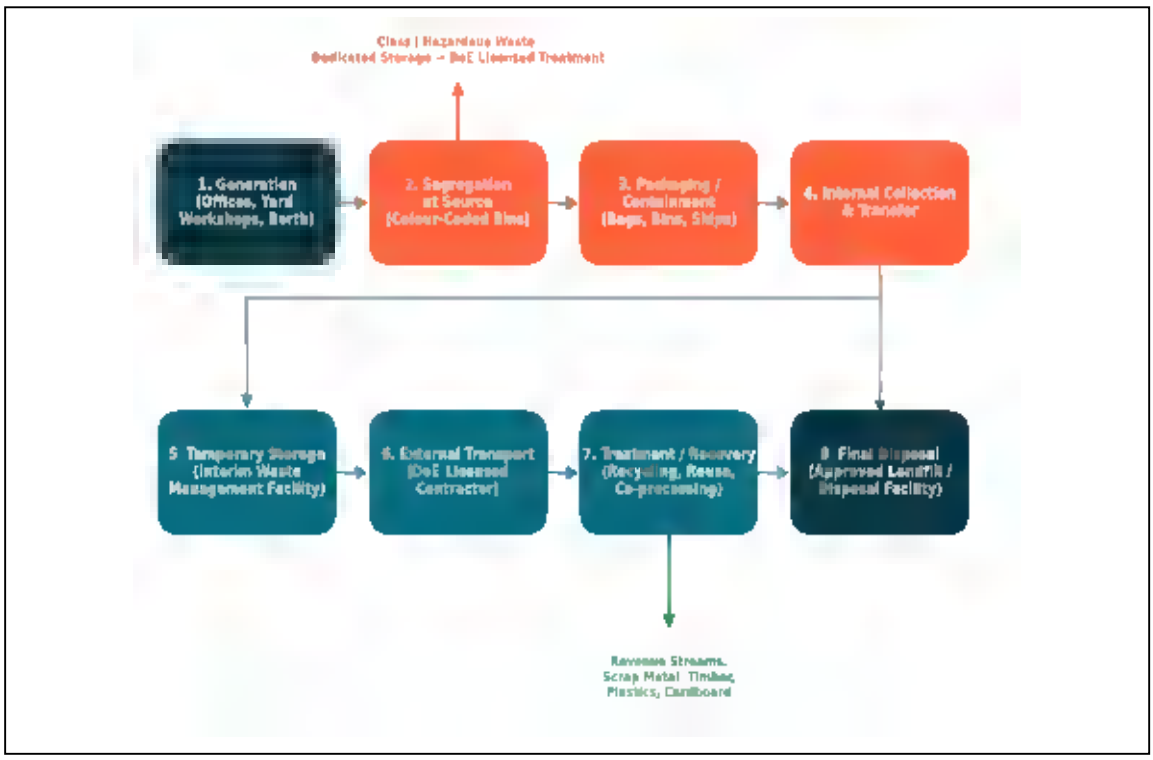


Figure 5: Solid Waste Management Flow at the Laldia Container Terminal.

7.5.1. Waste Handling Stages

Waste handling shall follow a controlled and documented process from the point of generation through to final treatment, recycling, recovery, or disposal. Each stage of the waste handling process shall be implemented in a manner that protects human health and the environment, prevents pollution, supports compliance with applicable regulatory requirements and ensures traceability of waste movements and management activities. The key stages of waste handling are outlined below:

i. **Packaging (containment):** waste shall be packaged in materials compatible with its typology, classification and quantity, using tear and leak-resistant bags, rigid washable bins or dedicated skips/tanks as appropriate. Bags shall be replaced at approximately two-thirds capacity or at least once daily to prevent overflow.
ii. **Waste movement logistics:** internal waste movement shall follow pre-defined, shortest and safest routes that minimise interference with terminal operations, vehicle traffic and pedestrian circulation and shall prevent the crossing of incompatible waste streams.
iii. **Internal collection and transport:** collection shall be carried out by trained personnel using equipment compatible with the waste type, wearing PPE appropriate to the risks involved (Table 17), following the collection frequencies set out in Table 15 of this Plan.
iv. **External collection and transport:** external transportation shall be carried out exclusively by DoE-licensed waste contractors using vehicles compatible with the waste type, with waste remaining packaged, identified and protected throughout

transport and accompanied by a waste transfer note / consignment record for each shipment.

v. **Temporary storage:** waste shall be held only within a designated Waste Management Facility (WMF) or other designated, permitted storage areas, for the minimum period necessary prior to collection.

vi. **Treatment and final disposal:** waste shall be directed to treatment, recycling, recovery or disposal facilities in accordance with the waste management hierarchy, using only DoE-licensed and Project/Terminal-approved facilities.

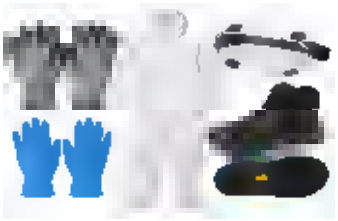
vii. **Data and document control:** records of waste generation, collection, transfer, treatment and disposal shall be maintained in a central waste register, consistent with the monitoring and record-keeping requirements of this Plan.

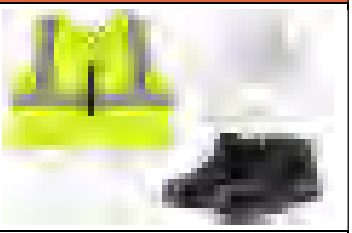
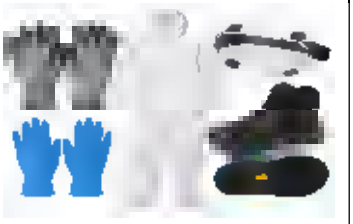
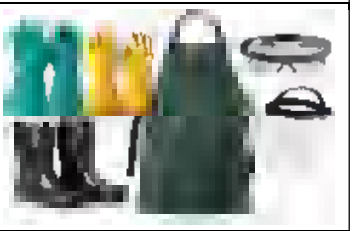
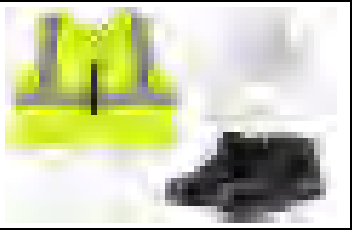
7.5.2.Personal Protective Equipment for Waste Collection and Handling

Personnel involved in waste collection, segregation, handling, temporary storage and transport activities shall be provided with and shall use appropriate Personal Protective Equipment (PPE) commensurate with the nature of the waste being managed and the associated health, safety and environmental risks. PPE requirements shall be determined through risk assessment and shall take account of potential exposure to physical hazards, biological agents, hazardous chemicals, contaminated materials, sharp objects, dust, vapours and ergonomic risks. The minimum PPE requirements specified below shall be supplemented where necessary by additional controls identified through task-specific risk assessments, Material Safety Data Sheets (MSDS), permit conditions, manufacturer recommendations, or Project-specific procedures. Table 17 sets out the minimum mandatory PPE requirements applicable to the principal waste handling, collection, transport and storage activities undertaken during Project construction and operation.

Table 17: Personal Protective Equipment (PPE) for Waste Collection and Handling.

Activity / Waste Type	Waste Class	Predominant Risks	Minimum Mandatory PPE	Representative PPE
General / non-hazardous waste	**Class III**	Cuts, punctures, strain	General-purpose or cut-resistant gloves; toe-, puncture- and slip-resistant safety footwear; coveralls; high-visibility clothing; helmet and safety glasses in operational areas.	

Activity / Waste Type	Waste Class	Predominant Risks	Minimum Mandatory PPE	Representative PPE
Recyclable waste: paper, cardboard, plastics, metal and glass	**Class VI**	Cuts, abrasion, broken glass, sharp edges	Cut-resistant gloves; toe-, puncture- and slip-resistant safety footwear; coveralls; safety glasses or goggles; high-visibility clothing; helmet in operational areas.	
Organic / food waste	**Class III**	Biological contamination, odours, splashes	Waterproof gloves; waterproof slip-resistant safety footwear; coveralls and waterproof apron where required; splash goggles; particulate respirator only where aerosol exposure is identified.	
Hazardous chemicals, paints, solvents and waste oil	**Class I**	Toxic exposure, burns, flammability, vapours	Chemical-resistant gloves and boots selected using the SDS; chemical protective clothing; full-seal splash goggles; face shield worn with goggles; contaminant-specific respirator where required.	
Oily wastewater and oil-water separator influent	**Class II**	Hydrocarbons, splashes, slips	Chemical-resistant gloves and slip-resistant boots; chemical protective clothing or apron; full-seal goggles; face shield for significant splash; respiratory protection where required.	
Sewage and greywater	**Class II**	Pathogens, aerosols, splashes	Waterproof gloves and boots; coveralls and waterproof apron; full-seal goggles; face shield for significant splash; particulate respirator where aerosol exposure is identified.	
Washdown and non-contaminated process water	**Class II**	Slips, splashes, residues	Waterproof gloves; slip-resistant safety footwear; waterproof apron or coveralls; safety glasses or goggles; high-visibility clothing in vehicle areas.	
STP sludge and biosolids	**Class II**	Pathogens, biological contamination, aerosols	Waterproof gloves and boots; coveralls and waterproof apron; full-seal goggles; face shield; particulate respirator where aerosol exposure is identified.	

Activity / Waste Type	Waste Class	Predominant Risks	Minimum Mandatory PPE	Representative PPE
WWTP/interceptor sludge and recovered hydrocarbons	**Class I**	Hydrocarbons, chemicals, splashes, vapours	Chemical-resistant gloves and boots; chemical protective clothing; full-seal goggles; face shield worn with goggles; contaminant-specific respirator where required.	
Chemical wash water and contaminated stormwater	**Class II**	Unknown contaminants, chemicals, vapours	Chemical-resistant PPE selected after contaminant assessment; full-seal goggles; face shield; suitable respirator. Work shall not proceed until unknown hazards are characterised.	
Fluorescent lamps	**Class I**	Mercury, broken glass, cuts	Cut-resistant gloves with disposable nitrile inner gloves where required; goggles; puncture-resistant footwear; disposable coveralls for breakage clean-up; mercury-vapour protection where required.	
Batteries	**Class I**	Electrolyte, burns, electrical hazards	Chemical-resistant gloves; electrical insulating gloves where applicable; full-seal goggles and face shield; chemical-resistant boots and apron or coverall.	
Electronic and electrical waste	**Class V**	Heavy metals, sharp edges, residual energy	Cut-resistant gloves; safety glasses; toe- and puncture-resistant safety footwear; coveralls; electrical PPE where residual electrical hazards exist; high-visibility clothing.	
Wire ropes, lifting gear and scrap metal	**Class VI**	Sharp strands, pinch points, cuts	Cut- and impact-resistant gloves; toe- and puncture-resistant footwear; coveralls; safety glasses or goggles; helmet; high-visibility clothing.	
Temporary storage and transfer of hazardous waste	**Class I**	Chemicals, spills, leaks, incompatibility	Chemical-resistant gloves, boots and protective clothing selected for the waste and SDS; full-seal goggles; face shield; respiratory protection where required; helmet and high-visibility clothing.	

Activity / Waste Type	Waste Class	Predominant Risks	Minimum Mandatory PPE	Representative PPE
Internal waste transport using carts, forklifts or containers	**All Classes**	Collision, dropped loads, impact, waste exposure	High-visibility clothing; safety footwear; helmet; task-appropriate gloves; safety glasses; hearing protection where required; additional waste-specific PPE.	

8. WASTE TRANSPORTATON AND CONSIGNMENT

The transportation of waste is a critical stage in the waste management process and shall be undertaken in a manner that protects human health, prevents environmental pollution and ensures full traceability of waste from generation through to recycling, treatment or final disposal. Waste transportation activities shall be conducted only by suitably licensed and authorised waste contractors using appropriate vehicles, equipment and documentation. Robust waste tracking and consignment procedures shall be maintained to demonstrate regulatory compliance, verify the authorised transfer of waste and provide an auditable record of waste movements both within and beyond the Project/Terminal boundary.

All waste transport contractors shall hold a valid DoE permit / licence to transport the relevant waste category. Transport vehicles shall have all loads covered before leaving the Site to prevent accidental discharge or wind-blow of waste materials and shall not track debris or mud onto public roads.

The following requirements shall apply to the transportation, consignment, tracking and transfer of waste generated during the Construction and Operations phases:

i. Every waste consignment leaving the Concession Area shall be accompanied by a Waste Consignment Note / Waste Transfer Note (WTN) recording the waste generator, contact details, waste type, quantity (kg or m^3), origin and destination facility.
ii. Hazardous waste consignments require correct labelling and an accompanying Material Safety Data Sheet (MSDS), whether transported on-site or off-site.
iii. All waste transported off-site shall be weighed and the weight recorded on the consignment note.
iv. Three copies of each consignment note shall be retained: one by the waste generator, one by the HSSE Department and one accompanying the waste to the disposal facility (to be countersigned and returned as evidence of receipt).
v. Hazardous waste shall not be exported outside the Project/Terminal area without prior approval and shall not be transported other than in compliance with DoE protocols, the Basel Convention and where applicable, the London Convention.
vi. No waste shall be removed from the Concession Area without the knowledge and approval of the HSSE Department.
vii. A monthly summary of all waste consignments shall be compiled and reported to LCT management and as required by permit conditions.

8.1. Recommended Waste Disposal Destinations

This section identifies the recommended treatment, recovery, recycling and disposal pathways for the principal waste streams expected to be generated during the construction and operation of the Laldia Container Terminal (LCT). Waste management options have been selected in accordance with the waste management hierarchy, prioritising waste prevention, reduction, reuse and recycling ahead of treatment and final disposal wherever technically feasible and environmentally appropriate. The recommended destinations reflect the waste management infrastructure currently available within the Chattogram region and are intended to support compliance with applicable Bangladesh regulatory requirements and Department of Environment (DoE) licensing requirements. Only waste management facilities, contractors and service providers that are appropriately licensed, authorised or otherwise approved by the relevant regulatory authorities shall be used for the transport, treatment, recovery and disposal of waste streams. Table 18 presents the recommended treatment, recovery and disposal methods for each principal waste stream together with indicative off-site waste management destinations currently available within the Chattogram area.

Table 18: Recommended Treatment and Disposal Destinations by Waste Type.

Waste Type	LCT Waste Class	Recommended Treatment / Disposal	Indicative Destination (Chattogram Area)
Paper and cardboard	Class VI - Recyclable Waste	Recycling	Licensed paper/cardboard recyclers, Chattogram
Plastics	Class VI - Recyclable Waste	Recycling	Licensed plastics recyclers, Chattogram
Metal scrap / scrap steel	Class VI - Recyclable Waste	Recycling / revenue recovery	Scrap metal dealers and Sitakunda ship-recycling / scrap steel yards
Glass	Class VI - Recyclable Waste	Recycling where available, otherwise disposal	Licensed recyclers, or approved sanitary landfill
Wood / timber pallets	Class VI - Recyclable Waste	Reuse, recycling or co-processing	Licensed timber recyclers / co-processing facility
Construction and demolition waste (concrete, brick, asphalt)	Class IV – Inert Waste	Reuse, crushing or disposal	Approved inert waste recovery or disposal facility
Food and organic waste	Class III - Non-Hazardous Waste	Composting where available, otherwise disposal	Approved composting facility, or approved sanitary landfill
General / domestic waste	Class III - Non-Hazardous Waste	Sanitary landfill	Chattogram City Corporation (CCC) approved landfill (e.g. Arefin Nagar, Pahartali)
Chemicals, paints, solvents	Class I - Hazardous Waste	Treatment per Safety Data Sheet (SDS) / co-processing	DoE-licensed hazardous waste treatment or cement kiln co-processing facility
Oily water, wash bay wastewater and oil-water separator influent	Class I - Hazardous Waste	Treatment through WWTP and oil-water separator system	DoE-licensed used-oil recovery / re-refining contractor
Sewage and greywater	Class IIA - Liquid Waste; Class I where hazardous characteristics are confirmed by testing	Treatment through STP	On-site STP
Equipment washdown water and non-contaminated process water	Class IIC – Non-Hazardous Process Water	Treatment, reuse or compliant discharge	WWTP / reuse system



Waste Type	LCT Waste Class	Recommended Treatment / Disposal	Indicative Destination (Chattogram Area)
STP sludge and dewatered biosolids	Class IID – Sanitary Sludge and Residuals	Dewatering and authorised disposal or approved beneficial reuse	DoE-approved sludge disposal or reuse facility
Chemical wash water and contaminated stormwater	Class IIE – Contaminated Liquid Waste	Treatment and assessment. Manage as hazardous waste where hazardous characteristics are confirmed	DoE-approved treatment facility
Chemical wash water and contaminated stormwater	Class IIE – Contaminated Liquid Waste	Treatment and assessment. Manage as hazardous waste where hazardous characteristics are confirmed	DoE-approved treatment facility
Contaminated liquid effluent containing hydrocarbons, fuels, oils, solvents or chemicals	Class I – Hazardous Waste	Treatment and disposal through authorised hazardous waste facility	DoE-approved hazardous waste treatment facility
Batteries	Class I - Hazardous Waste	Reverse logistics / licensed recycling	Manufacturer take-back or DoE-licensed battery recycler
Fluorescent lamps	Class I - Hazardous Waste	Specialist licensed treatment (mercury recovery)	DoE-licensed specialist lamp recycler
Electronic waste (E-Waste)	Class V - Electronic and Electrical Waste	Reverse logistics / licensed e-waste recycling	DoE-licensed e-waste recycler
Tyres	Class IV - Inert (Non-Hazardous) Waste (special handling)	Retreading, reuse or licensed recycling	Licensed tyre recycler / retreader
Medical / clinical waste	Class I - Hazardous Waste	Licensed incineration	CCC medical waste incinerator, Anandabazar / Halishahar, or licensed contractor
Dredged sediment (uncontaminated)	Class IV - Inert (Non-Hazardous) Waste, subject to characterisation	Beneficial reuse or approved disposal	CPA-designated and approved dredged material disposal ground, per the DMP
Dredged sediment (contaminated)	Class I – Hazardous Waste	Specialised treatment and disposal	Approved hazardous waste facility

The recommended waste management destinations identified in Table 18 are distributed across the wider Chattogram region and may vary over time depending on facility capacity, licensing status, operational availability and regulatory approvals. To assist in illustrating the general location and distribution of these facilities relative to the Project/Terminal site, Figure 6 provides an indicative regional overview of the principal waste treatment, recycling, recovery and disposal destinations that may be utilised by the Project/Terminal. The Figure is intended for illustrative and planning purposes only and does not represent actual transport routes, travel distances, facility boundaries or the precise geographical location of individual facilities. Figure 6 illustrates the general direction and relative location of the principal off-site waste management facilities and disposal destinations that may be used for the management of LCT waste streams within the Chattogram region.

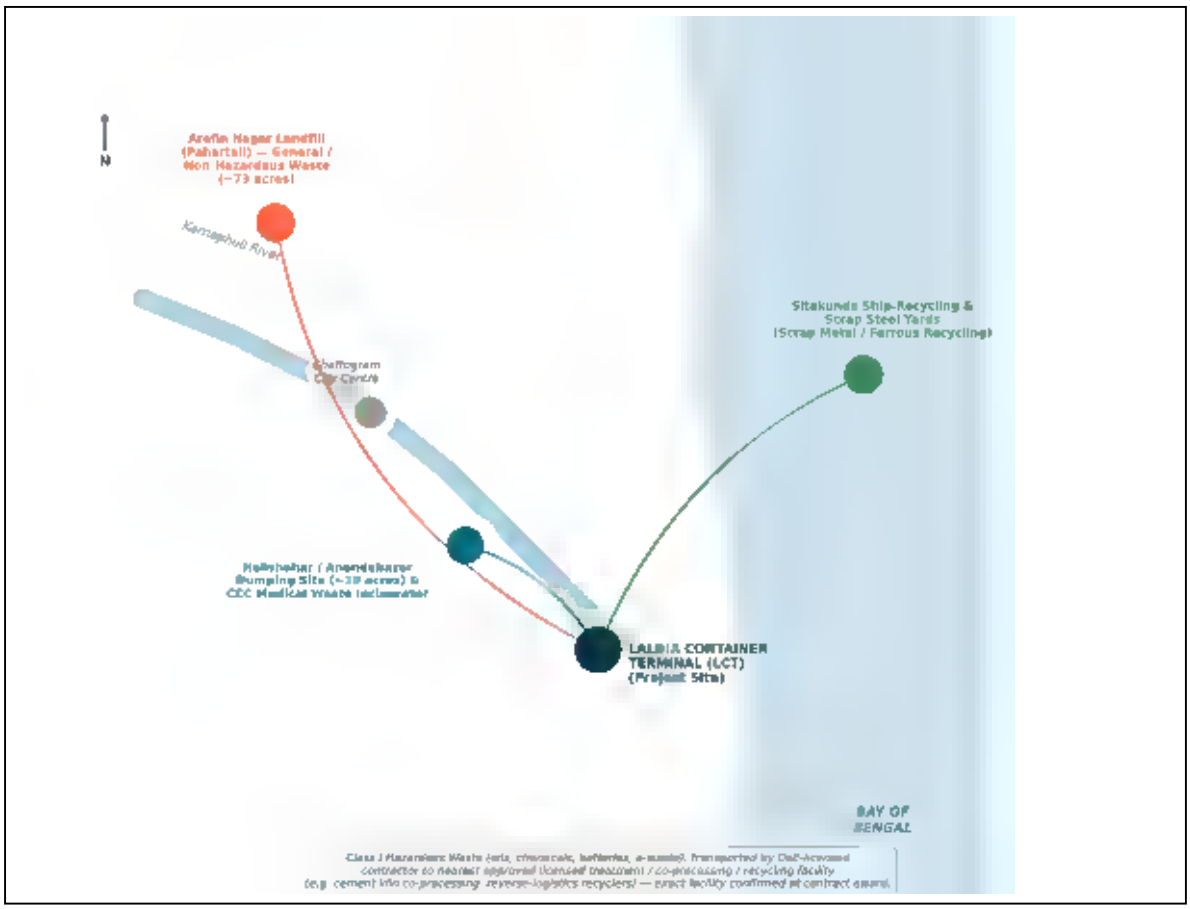


Figure 6: Indicative regional waste disposal destinations for the Chattogram Area, showing the general direction and relative location of recommended off-site waste management destinations relative to the LCT Project site.

It is noted that both existing Chattogram City Corporation dumping sites (Halishahar / Anandabazar and Arefin Nagar) have been reported to be operating at or near capacity and do not currently provide engineered sanitary landfill containment (e.g. leachate collection). The availability, capacity and environmental status of these and any alternative or future licensed disposal sites shall be confirmed with the Chattogram City Corporation (CCC) and the Department of Environment (DoE) prior to and throughout the Operations phase and this section of the Plan shall be updated accordingly as part of the periodic review of this Plan.

9. WASTE STREAMS AND MANAGEMENT MEASURES

The waste streams generated during the Construction and Operations phases of the Laldia Container Terminal (LCT) vary significantly in their composition, quantity, handling requirements and potential environmental impacts. Accordingly, each waste stream shall be managed using controls and procedures appropriate to its characteristics and associated risks. The requirements set out in this section establish the minimum waste management measures applicable to the principal waste streams anticipated and are intended to support effective waste segregation, storage, transportation, recycling, treatment and disposal in accordance

with the waste management hierarchy, applicable legal requirements and Good International Industry Practice (GIIP).

The following subsections describe the specific management requirements applicable to each waste stream generated by the Project/Terminal. Where practicable, waste shall be avoided, reduced, reused, recycled or recovered before disposal is considered, and all waste management activities shall be undertaken in a manner that protects human health, prevents pollution and minimises adverse impacts on the surrounding environment.

9.1. Construction and Demolition (C&D) Waste

Construction and demolition (C&D) waste is generated during site preparation, earthworks, demolition, dredging support activities and the construction of terminal infrastructure and facilities and typically includes concrete, wood, asphalt, gypsum, metals, bricks, glass, unwanted soil, plastics and salvaged building components. Effective management of C&D waste is essential to maximise opportunities for reuse and recycling, minimise waste requiring disposal and prevent adverse environmental impacts.

The following requirements shall apply to the management of C&D waste generated by the Project:

i. C&D waste shall be stored at or near the point of generation, segregated into different waste streams to facilitate reuse and recycling and removed from the Site before close-out of the relevant work area / permit-to-work.
ii. Non-reinforced concrete, cement blocks and similar inert C&D material may, subject to LCT/CPA approval, be reused in land reclamation, filling or levelling within the Concession Area;
iii. Asphalt and concrete shall be recycled into aggregate where practicable; wood recycled into engineered wood products, mulch or compost; plastics, glass and metals recycled through approved vendors.
iv. Potentially contaminated demolition debris (e.g. from existing structures) shall be assessed for asbestos or lead prior to demolition and managed as hazardous waste if contaminated.
v. Residual C&D waste shall be disposed of at a DoE / CPA approved landfill or disposal site, with segregation of any hazardous fractions prior to disposal.

9.2. Dredged Material Management

Capital and maintenance dredging associated with the Access Channel, Common Approaches, Turning Circle and berth pockets will generate dredged material requiring management in accordance with the Project Dredging Management Plan (DMP), the approved Environmental and Social Impact Assessment Report (ESIAR), Environmental Clearance Certificate (ECC), applicable Bangladesh regulatory requirements, the London Convention 1972 and 1996 Protocol and Good International Industry Practice (GIIP). Dredged material shall, where suitable, be regarded as a resource rather than a waste and opportunities for beneficial reuse shall be prioritised before disposal is considered. Potential beneficial uses may include land reclamation, engineering fill, habitat creation or restoration, shoreline protection, beach nourishment and other approved uses consistent with Project requirements and applicable regulatory approvals. The management objective is to minimise environmental impacts associated with dredging, transport and disposal activities, including impacts on water quality,



aquatic habitats, fisheries, navigation and other users of the Karnaphuli River and surrounding marine environment.

Dredging and disposal activities shall be undertaken using an adaptive management approach supported by monitoring, inspection and operational controls. The Dredging Contractor shall be responsible for planning, permitting, monitoring and executing dredged material management activities and shall demonstrate compliance with all permit conditions, ESIAR commitments, ECC conditions, approved disposal requirements and monitoring obligations throughout the dredging campaign.

The following waste management requirements shall apply to dredged material generated by the Project:

i. Dredged Material Balance Register: The Contractor shall develop, maintain and keep current a Dredged Material Balance Register for the duration of all dredging activities. As a minimum, the register shall identify the source dredging area, sediment type, sediment quality classification, analytical test results, contamination status, volume dredged, date dredged, designated beneficial reuse, placement or disposal location, volume placed at each location and the cumulative balance of material handled. The register shall demonstrate that dredged material has been assigned to reuse, placement or disposal locations consistent with its sediment quality classification and approved management requirements. The register shall provide full traceability and reconciliation of all dredged material from excavation through to final beneficial use, placement or disposal and shall be made available for inspection upon request.
ii. Dredged sediments shall be characterised and tested prior to dredging to determine their physical, chemical and contamination characteristics and to establish appropriate reuse, recovery, treatment or disposal requirements.
iii. Dredged material suitable for beneficial reuse shall be prioritised for reclamation, engineering fill, habitat enhancement or other approved beneficial uses before disposal is considered.
iv. Dredged material designated for disposal shall only be disposed of at approved disposal locations.
v. Dredged material shall be classified and managed according to its contamination status. Contaminated dredged material shall be managed as hazardous waste where required by applicable regulatory requirements.
vi. Dredging-derived liquid wastes, including return water and dewatering effluent, shall be managed as Class II Liquid Waste in accordance with this Plan.
vii. Records of dredged material volumes, reuse quantities, recovery quantities and disposal quantities shall be maintained.
viii. Dredged material shall be managed in accordance with the waste management hierarchy, prioritising beneficial reuse and recovery before disposal.

9.3. Dredging-Derived Debris, Obstructions and Recovered Materials

Dredging, hydrographic surveys, seabed investigations, clearance activities and dredged material disposal operations may result in the recovery of debris, wreckage, marine scrap, construction materials, abandoned equipment, obstructions, unexploded ordnance (UXO) and other foreign materials from the riverbed or disposal areas. These materials may present



environmental, navigational, operational and safety risks and may require specialised handling, storage, transportation and disposal controls depending on their nature and condition. The management objective is to ensure that all recovered materials are identified, classified, segregated and managed in a manner that protects personnel, prevents pollution, maintains navigational safety and maximises opportunities for reuse, recycling and recovery in accordance with the waste management hierarchy.

Recovered materials shall be managed using a risk-based approach that considers their origin, composition, contamination status, potential hazards and reuse or recycling potential. The Dredging Contractor shall be responsible for the identification, recovery, handling, temporary storage, transportation and final management of all debris, obstructions and recovered materials encountered during dredging and associated marine activities and shall demonstrate compliance with all applicable regulatory requirements, permit conditions, ESIAR commitments, ECC conditions and approved management procedures throughout the dredging campaign.

The following requirements shall apply to the management of dredging-derived debris, obstructions and recovered materials:

i. All debris, obstructions, wreckage, marine scrap, abandoned equipment, construction debris and other materials recovered during dredging, hydrographic surveys, seabed investigations or clearance activities shall be inspected, characterised and classified prior to reuse, recycling, treatment or disposal.
ii. Recovered materials shall be segregated into hazardous and non-hazardous waste streams and further separated, where practicable, to maximise opportunities for reuse, recycling and recovery.
iii. Wreckage, scrap metal, steel, cables, chains, anchors and other recoverable materials shall be segregated and directed to authorised reuse, recycling or recovery facilities wherever practicable.
iv. Recovered debris contaminated with oils, fuels, chemicals, heavy metals, asbestos or other hazardous substances shall be managed as hazardous waste in accordance with this Plan and applicable regulatory requirements.
v. Any wrecks, rocks, boulders, debris, abandoned structures, marine scrap or other obstructions identified within approved dredging areas shall be investigated and removed where necessary to ensure safe dredging operations and achievement of the approved dredged profile.
vi. Recovered materials shall be handled, loaded, transported and stored in a manner that prevents the release of contaminants, litter, sediments or debris into the Karnaphuli River, disposal areas or surrounding environment.
vii. Temporary storage areas for recovered materials shall be located within approved areas, clearly identified and managed to prevent pollution, unauthorised access and interference with construction or navigation activities.
viii. Any potentially contaminated materials recovered during dredging activities shall be isolated pending assessment and classification to determine appropriate handling and disposal requirements.
ix. Recovered materials shall not be disposed of at sea, within dredging areas or within dredged material disposal sites unless specifically authorised by the relevant authorities and approved permits.



x. Records shall be maintained of all significant debris, obstructions, wreckage, marine scrap and other materials recovered during dredging activities, including descriptions, quantities, locations, dates of recovery and final management or disposal routes.
xi. Recovered marine debris, obstructions, wreckage and dredging-derived waste shall only be transported by authorised contractors and shall be recycled, recovered, treated or disposed of at approved facilities authorised to receive the relevant waste stream.
xii. Dredging-derived debris, obstructions and recovered materials shall be managed in accordance with the approved Dredging Management Plan, Environmental and Social Impact Assessment Report (ESIAR), Environmental Clearance Certificate (ECC), permit conditions, applicable regulatory requirements and Good International Industry Practice (GIIP).

9.4. Office and General Waste

Office and general waste generated during the Construction and Operations phases of the Project/Terminal shall be managed to prevent littering, minimise waste requiring disposal and maximise opportunities for waste segregation, recycling and recovery. Office and general waste may include paper, cardboard, plastics, metals, glass, food waste, packaging materials and other wastes similar to municipal waste generated from offices, welfare facilities, canteens, control rooms, gate facilities, workshops and worker accommodation. Waste shall be segregated at source wherever practicable and transferred to designated waste collection and storage areas for recycling, collection or disposal through approved waste management contractors.

The following requirements shall apply:

i. Office and general waste shall be segregated into recyclable and non-recyclable waste streams at the point of generation wherever practicable.
ii. Separate, clearly labelled containers shall be provided for paper, cardboard, plastics, metals, glass, food waste and mixed waste in offices, welfare facilities, canteens and operational areas, as appropriate.
iii. Waste bins and containers shall be located within work areas to encourage proper waste segregation and disposal.
iv. Domestic waste from site offices, field offices, canteens and worker accommodation facilities shall be collected routinely and removed before nuisance conditions, odours or pest infestations develop.
v. Office and general waste shall be accumulated only within designated waste collection and storage areas and shall be segregated from construction waste and hazardous waste.
vi. Paper recycling programmes shall be implemented within office areas. Sensitive or confidential documents shall be shredded or otherwise rendered unreadable prior to recycling or disposal.
vii. Recyclable materials shall be protected from contamination and transferred to authorised recycling facilities or approved waste contractors.
viii. Any additional municipal-type waste streams generated by the Project/Terminal shall be segregated and managed separately where recycling, recovery or specialised treatment options are available.



ix. Waste containers shall be maintained in a clean and serviceable condition and shall be covered where necessary to prevent littering, windblown waste and pest attraction.
x. Quantities of office and general waste generated, recycled, recovered and disposed of shall be recorded and reported as part of the Project waste monitoring and reporting programme.
xi. Office and general waste shall only be transferred to authorised waste collectors, recycling contractors or disposal facilities approved by the relevant authorities.

9.5. Food Waste

Food waste generated during the Construction and Operations phases of the Project/Terminal has the potential to cause odour, pest infestation, littering, public health impacts and nuisance conditions if not properly managed. Food waste shall therefore be collected, stored, transported, treated and disposed of in a manner that prevents contamination of soil, groundwater, stormwater systems and the Karnaphuli River, while promoting recovery and recycling opportunities in accordance with the waste management hierarchy, applicable legal requirements, the Environmental and Social Impact Assessment Report (ESIAR), Environmental Clearance Certificate (ECC) conditions and Good International Industry Practice (GIIP).

The following requirements shall apply:

i. Food storage, preparation, serving, dishwashing and waste handling areas within kitchens, canteens and food preparation facilities shall be maintained in a clean and hygienic condition to prevent food contamination, nuisance conditions, odours and pest infestations.
ii. Food waste generated from food preparation, serving areas, dining facilities and dishwashing activities shall be collected and managed in a manner that does not adversely affect kitchen operations, food hygiene standards or worker welfare facilities.
iii. Storerooms designated for food storage and waste collection within kitchen and canteen facilities shall be organised and managed to prevent cross-contamination between food products and waste materials.
iv. Food waste handling, storage and collection arrangements shall be coordinated with kitchen, servery and dishwashing operations to ensure timely removal of waste and maintain hygienic conditions at all times.
v. Food waste shall be segregated from recyclable waste streams, including paper, cardboard, plastics, glass and metals, at the point of generation.
vi. Dedicated, clearly labelled and leak-proof containers shall be provided for the collection of food waste in kitchens, canteens, mess halls, welfare facilities and worker accommodation areas.
vii. Food waste containers shall remain covered at all times except during waste disposal and collection activities.
viii. Food waste shall be collected daily and shall not be stored on-site for more than 24 hours.
ix. Food waste storage and collection areas shall be maintained in a clean, sanitary and pest-free condition.

x. Any spills, leaks or litter arising from food waste handling or collection activities shall be cleaned up immediately.
xi. Food waste shall be transported only by authorised waste contractors and disposed of at approved composting, organic recovery, anaerobic digestion or disposal facilities.
xii. Open dumping, burial, feeding of food waste to animals and open burning of food waste shall be prohibited.
xiii. Adequate controls shall be implemented to prevent the attraction of birds, rodents, insects and other pests to food waste storage and collection areas.
xiv. Food waste management activities shall be undertaken in accordance with the Project Waste Management Plan, ESIAR commitments, ECC conditions and applicable regulatory requirements.

9.6. Sanitary Waste

Sanitary waste, sewage and faecal waste generated by offices, welfare facilities, worker accommodation camps, canteens and sanitary facilities have the potential to create significant public health, odour and environmental risks if improperly managed. Sanitary waste shall therefore be collected, contained, conveyed, treated and disposed of through approved sewerage and sewage treatment systems designed to prevent contamination of soil, groundwater, stormwater systems, surface water bodies and the Karnaphuli River, while ensuring compliance with applicable legal requirements, ESIAR commitments, ECC conditions and Good International Industry Practice (GIIP).

The following requirements shall apply:

i. Sanitary waste, sewage and wastewater generated by offices, welfare facilities, worker accommodation camps, canteens and sanitary facilities shall be collected, contained and managed through approved wastewater collection, treatment and disposal systems.
ii. Untreated sewage, sanitary wastewater or sludge shall not be discharged to land, stormwater systems, surface water bodies, the Karnaphuli River or the marine environment.
iii. Sewerage systems shall be designed considering Bangladesh climatic conditions, including monsoon rainfall, high groundwater levels, flood susceptibility and saline coastal conditions where applicable.
iv. Sewer lines shall maintain adequate horizontal and vertical separation from potable water pipelines and potable water pipelines shall be installed above sewerage lines at crossing points.
v. Sewage lifting stations shall be provided with a minimum of one duty and one standby pump, automatic level control, high-level alarms, wet well ventilation and odour control systems.
vi. Screens shall be provided at sewage lifting stations and pump stations to prevent blockage and damage to pumps and shall be readily accessible for inspection, removal and cleaning.
vii. Adequate ventilation shall be provided throughout the sewerage system to prevent the accumulation of toxic, flammable or explosive gases. Vent stacks shall terminate away from occupied areas and air intakes.



viii. Manholes shall be of watertight construction and flood-prone locations shall be provided with watertight covers and flood protection measures.
ix. Allowance shall be made for groundwater infiltration and stormwater ingress into the sewerage network, particularly during monsoon conditions.
x. Backflow prevention devices or check valves shall be installed where sewage surcharge risks have been identified.
xi. Sewage lifting systems shall be operated automatically, with manual override capability, and shall be connected to backup power supplies to maintain operation during power outages.
xii. Emergency response procedures shall be established and implemented for sewage spills, sewage overflows, equipment failures and unauthorised discharges.
xiii. Sludge generated from sewage treatment systems shall be stabilised, dewatered, collected, stored, transported and disposed of in accordance with applicable legal requirements and Department of Environment (DoE) requirements.
xiv. Sludge drying beds, where used, shall incorporate drainage and leachate collection systems.
xv. Sludge proposed for beneficial reuse, land application or soil conditioning shall be tested and demonstrated to be suitable for its intended use prior to reuse.
xvi. Records of sewage generation, treatment, sludge management, off-site disposal and monitoring activities shall be maintained and made available for inspection.
xvii. Sanitary waste management activities shall be undertaken in accordance with the Project Waste Management Plan, ESIAR commitments, ECC conditions and applicable regulatory requirements.

9.7. Wastewater

Wastewater generated during the Construction and Operations phases of the Project/Terminal may include domestic wastewater, sanitary wastewater, equipment washdown water, workshop wastewater, oily wastewater, wastewater from waste storage areas and other contaminated liquid effluents. Improper management of wastewater has the potential to cause pollution of soil, groundwater, stormwater systems, the Karnaphuli River and the marine environment. Wastewater shall therefore be collected, conveyed, treated, recycled, re-used and discharged in a manner that prevents pollution, protects human health and achieves compliance with applicable legal requirements, ESIAR commitments, ECC conditions and Good International Industry Practice (GIIP).

The following requirements shall apply:

i. Treated wastewater, greywater and harvested rainwater shall be reused, where practicable and subject to applicable water quality requirements, for non-potable applications such as landscape irrigation, toilet flushing, equipment washdown and other approved operational uses.
ii. Workshop floor drainage systems and inspection pits shall discharge to an appropriately sized oil-water separator and wastewater treatment system to ensure the collection and treatment of oils, fuels, lubricants, sediments and other contaminants prior to discharge, reuse or disposal, and shall not discharge directly to stormwater drainage systems or the environment.
iii. Greywater recycling and reuse opportunities shall be evaluated and implemented where practicable to reduce potable water consumption and support the Project/Terminal's resource efficiency objectives.

iv. Where treated wastewater is reused, reuse applications may include toilet flushing, landscape irrigation, equipment washdown and other approved non-potable uses, subject to compliance with applicable water quality requirements.
v. Rainwater harvesting, rainwater recycling and other water conservation measures shall be considered and implemented where practicable to minimise wastewater generation and support sustainable water management.
vi. Treated wastewater and recycled water systems shall support the Project/Terminal's sustainability objectives and applicable green-building certification requirements where relevant.
vii. Wastewater treatment facilities shall be designed, operated and maintained to ensure treatment performance is consistent with approved design criteria and applicable regulatory requirements.
viii. Treated effluent shall comply with the discharge standards specified in the Environmental Conservation Rules (ECR), 2023, the ESIAR and ECC, prior to any authorised discharge.
ix. Wastewater treatment systems, pumps, pipelines, tanks, septic systems and associated infrastructure shall be routinely inspected, maintained and repaired as necessary to prevent leaks, failures and unauthorised discharges.
x. Wastewater treatment systems shall incorporate a balance tank or equivalent flow attenuation measure to manage peak flows and provide storage capacity during periods of power failure, maintenance or plant downtime.
xi. Wastewater treatment systems shall be designed to remain operational during and after periods of low flow and peak flow conditions.
xii. Package treatment systems and wastewater treatment facilities shall be designed to permit future expansion and modular capacity increases where required.
xiii. Full retention separators shall be provided for equipment washdown areas, maintenance bays, waste storage areas and bunded areas where hydrocarbons or contaminated runoff may be present.
xiv. Oil separator, interceptor and wastewater treatment systems shall be sized to accommodate both operational flows and peak rainfall events where applicable.
xv. Odour control systems, including vent filters, activated carbon filters, biofilters or chemical treatment systems, shall be provided where necessary to minimise nuisance impacts.
xvi. Electrical panels, motor control centres (MCCs), pumps, blowers and control systems associated with wastewater treatment infrastructure shall be installed above the design flood level.
xvii. Underground chambers, tanks and treatment units shall be protected against stormwater ingress and flooding.
xviii. Wastewater treatment and sewage lifting systems shall be operated automatically, with manual override capability, and shall be connected to backup generators or uninterruptible power supplies (UPS) to maintain continuous operation during power outages.
xix. Treatment equipment critical to continuous operation, including pumps, blowers and other essential process equipment, shall be provided with redundancy or standby capacity.
xx. Wastewater treatment residues, screenings, grit and other treatment wastes shall be managed as separate waste streams and disposed of through authorised facilities.



xxi. Stabilised sludge shall be dewatered prior to disposal and shall not be openly dumped within the Project/Terminal area.

xxii. Measurement and sampling points shall be provided upstream and downstream of treatment facilities to enable routine monitoring of treatment performance and regulatory compliance.

xxiii. Wastewater treatment plant performance shall be verified through sampling upstream and downstream of the treatment system at a minimum frequency of every three months or following any system failure.

xxiv. Records of wastewater generation, treatment, monitoring, sludge management, off-site disposal and effluent quality monitoring results shall be maintained and made available for inspection.

xxv. Where practicable, treated effluent shall be reused for landscaping irrigation, toilet flushing, equipment washdown or other approved uses before discharge is considered.

xxvi. Where recycled water is used, the recycled water network shall be completely separated from the potable water network with no cross-connection and all outlets shall be clearly labelled and colour-coded.

xxvii. Recycled water storage tanks shall be provided where necessary to support reuse applications and ensure continuity of supply.

xxviii. Additional potable water supply shall be available for washdown facilities where recycled water supplies are insufficient to meet operational demand.

xxix. Excess treated wastewater may be discharged into the stormwater drainage system only after treatment to the required standard and verification of compliance with applicable discharge criteria.

xxx. Emergency bypass arrangements shall only be utilised during maintenance or emergency conditions and shall be subject to approval. Untreated wastewater or sewage discharge to stormwater drainage systems shall not be permitted.

xxxi. A minimum 72-hour continuous operational trial shall be completed for wastewater treatment facilities prior to acceptance and commissioning.

xxxii. Wastewater management activities shall be undertaken in accordance with the Project Waste Management Plan, ESIAR commitments, ECC conditions and applicable regulatory requirements.

9.8. Medical / Clinical Waste

Medical and clinical waste generated during the Construction and Operations phases of the Project/Terminal may contain infectious, hazardous or potentially harmful materials that require specialised handling, storage, transportation and disposal. Improper management of medical waste can create risks to human health, safety and the environment through the spread of infection, injury from sharps, contamination of waste streams and pollution of soil and water resources. Medical and clinical waste shall therefore be managed in accordance the Bangladesh Medical Waste (Management and Processing) Rules, 2008, the Bangladesh Environment Conservation Act, 1995, the Environment Conservation Rules, 2023, applicable Department of Environment (DoE) requirements, Ministry of Health and Family Welfare requirements, the Environmental and Social Impact Assessment Report (ESIAR), Environmental Clearance Certificate (ECC) conditions, and Good International Industry Practice (GIIP).

The following requirements shall apply:

i. Medical and clinical waste shall be segregated from all other waste streams at the point of generation.
ii. Clinical waste shall be classified according to its characteristics and potential risks, including infectious waste, sharps, pathological waste, pharmaceutical waste, laboratory waste, contaminated PPE and other healthcare-related waste.
iii. Colour-coded and clearly labelled containers shall be used for the collection and storage of medical waste, including yellow bags or containers for infectious waste and approved puncture-resistant containers for sharps.
iv. Sharps, including needles, syringes, scalpels and other sharp objects, shall be placed directly into approved sharps containers immediately after use and shall not be mixed with other waste streams.
v. Medical and clinical waste shall be collected daily and shall not be permitted to accumulate at points of generation.
vi. Medical waste shall not be stored on-site for more than 24 hours unless stored in a dedicated refrigerated facility designed for medical waste storage.
vii. Medical waste storage areas shall be secure, access-controlled, weatherproof, clearly signposted and accessible only to authorised personnel.
viii. Medical waste containers shall remain sealed when not in use and shall be inspected regularly for damage, leakage or overfilling.
ix. Medical and clinical waste shall be handled only by trained personnel using appropriate personal protective equipment (PPE).
x. Personnel involved in the handling, storage, transportation or management of medical waste shall receive appropriate training in infection prevention, waste handling procedures, spill response and emergency requirements.
xi. Medical waste shall be transported only by Ministry of Health, Department of Environment and/or other authorised medical waste transporters, as applicable.
xii. Medical and clinical waste shall be transferred only to authorised treatment, disposal or recovery facilities approved by the relevant authorities.
xiii. Medical waste shall be treated or disposed of by incineration or other approved treatment technologies appropriate to the waste type and applicable regulatory requirements.
xiv. Medical waste shall not be disposed of with general waste, recyclable waste, construction waste or hazardous industrial waste streams.
xv. Any spill, leak, damage to containers or accidental exposure associated with medical waste shall be reported immediately and managed in accordance with approved emergency response and infection control procedures.
xvi. Records of medical waste generation, storage, collection, transportation, treatment and disposal shall be maintained and made available for inspection.
xvii. Medical and clinical waste management activities shall be undertaken in accordance with the Waste Management Plan, ESIAR commitments, ECC conditions, Ministry of Health requirements and applicable regulatory requirements.

9.9. Hazardous Waste (Chemicals, Paints, Solvents, Waste Oil)

Hazardous waste generated during the Construction and Operations phases of the Project/Terminal may present significant risks to human health, safety and the environment due to its physical, chemical or toxic characteristics. Hazardous waste shall be identified,

segregated, labelled, stored, transported, treated and disposed of in a manner that prevents spills, leaks, fire, incompatible material reactions and contamination of soil, groundwater, surface water, stormwater systems and the Karnaphuli River. Hazardous waste management activities shall be undertaken in accordance with this Plan, applicable regulatory requirements, the Environmental and Social Impact Assessment Report (ESIAR), Environmental Clearance Certificate (ECC) conditions and Good International Industry Practice (GIIP).

The following requirements shall apply:

i. Dedicated waste oil collection and storage systems shall be provided to ensure the safe collection, segregation, temporary storage and management of waste oils generated from equipment maintenance, servicing and workshop activities and to prevent spills, leaks and contamination of soil, stormwater and the surrounding environment.
ii. Workshop facilities shall be provided with dedicated waste oil collection and storage systems, and waste oil shall be collected, stored, transported and disposed of in accordance with applicable hazardous waste requirements.
iii. Waste lubricants, hydraulic oils, fuels and other maintenance fluids generated during equipment servicing and workshop activities shall be collected separately from other waste streams and directed to approved recycling, recovery or disposal facilities.
iv. Paint wastes, paint-contaminated materials and residues generated from painting operations shall be managed as hazardous waste and stored separately from non-hazardous waste streams.
v. Hazardous waste shall be identified, classified, labelled and managed from the point of generation through to final treatment, recycling or disposal in accordance with this Plan and applicable regulatory requirements.
vi. Hazardous waste shall be segregated from non-hazardous waste and from incompatible hazardous waste streams at all times.
vii. Hazardous waste containers shall be clearly labelled with the waste type, hazard classification, date of generation and responsible department or waste generator.
viii. Hazardous waste shall be stored only within designated hazardous waste storage areas meeting the requirements of of this Plan.
ix. Waste oils, oily water, oily sludge and used oil filters shall be stored in compatible, sealed and clearly labelled containers or tanks provided with secondary containment capable of containing at least 110% of the volume of the largest container or tank.
x. Waste oil storage areas shall be located away from drainage systems, watercourses, flood-prone areas and environmentally sensitive receptors.
xi. Different waste oil types shall be segregated and shall not be mixed unless authorised and managed as part of an approved recycling or recovery process.
xii. Used oil filters shall be drained, where practicable, prior to storage and managed as hazardous waste.
xiii. Waste paints, solvents, chemical residues, contaminated absorbents, contaminated PPE, laboratory chemicals, batteries, fluorescent lamps and other hazardous waste streams shall be stored separately and managed according to their specific hazards.
xiv. Empty chemical, lubricant and oil drums shall be completely emptied, securely closed using fitted closure caps and stored in designated areas pending recycling, recovery or disposal.



xv. Quantities of hazardous waste generated, stored, transported, recycled, treated and disposed of shall be recorded and maintained by the responsible department.
xvi. Hazardous waste shall only be transported by authorised and appropriately licensed waste contractors using approved transport and consignment procedures.
xvii. Hazardous waste shall be accompanied by appropriate waste transfer documentation and records shall be maintained in accordance with this Plan.
xviii. Hazardous waste shall be preferentially managed in accordance with the waste management hierarchy, with reuse, recycling, recovery, treatment or detoxification considered before disposal.
xix. Landfilling of hazardous waste shall not be the preferred disposal option and shall only be undertaken where recycling, recovery, treatment or other environmentally preferable alternatives are not technically or economically feasible and where disposal is undertaken at an approved facility.
xx. Hazardous waste treatment, recycling and disposal facilities shall be appropriately authorised and approved by the relevant regulatory authorities.
xxi. Spill kits, fire-fighting equipment and emergency response equipment appropriate to the hazards present shall be provided and maintained at all hazardous waste storage and handling areas.
xxii. Hazardous waste storage areas, containers and secondary containment systems shall be inspected routinely for leaks, damage, deterioration and housekeeping deficiencies.
xxiii. Any spills, leaks, container failures or unauthorised releases associated with hazardous waste shall be reported immediately and managed in accordance with approved emergency response procedures.
xxiv. Personnel involved in the handling, storage, transportation or management of hazardous waste shall receive appropriate training and be provided with suitable personal protective equipment (PPE).
xxv. Hazardous waste storage areas shall be provided with adequate ventilation to prevent the accumulation of hazardous or flammable vapours and shall be constructed with impermeable flooring and containment walls or bunding to contain spills.
xxvi. Hazardous waste management activities shall be undertaken in accordance with this Waste Management Plan, ESIAR commitments, ECC conditions and applicable regulatory requirements.

9.10. Batteries

Batteries contain hazardous substances that may pose risks to human health and the environment if damaged, improperly stored or incorrectly disposed of. Battery waste shall be managed to prevent leaks, fires, short circuits, chemical releases and contamination of soil, groundwater, surface water and stormwater systems. Batteries shall be managed in accordance with the waste management hierarchy, with recycling and recovery preferred wherever practicable and facilities are available.

The following requirements shall apply:

i. Battery waste generated from battery charging, storage, maintenance and replacement activities shall be collected separately from other waste streams and stored in designated areas with appropriate containment measures to prevent the release of electrolytes, acids, heavy metals or other contaminants, and shall be

recycled or disposed of through authorised facilities in accordance with applicable regulatory requirements.

ii. Waste batteries arising from battery storage, charging and maintenance facilities shall be collected separately from other waste streams and managed through approved recycling or recovery programmes.

iii. Battery charging, storage and maintenance areas shall be maintained to prevent releases of electrolytes, contaminated wash water and battery residues to the environment.

iv. Waste batteries shall be segregated from other waste streams at the point of generation and stored in designated battery collection and storage areas.

v. Lead-acid, lithium-ion, nickel-cadmium (Ni-Cad), nickel-metal hydride (NiMH), alkaline and other battery types shall be segregated according to battery chemistry and recycling requirements.

vi. Lead-acid batteries and large wet-type lithium-ion or Ni-Cad batteries shall be stored in a secure, covered area with impermeable flooring and secondary containment capable of containing any electrolyte leaks or spills.

vii. Battery storage areas shall be protected from physical damage, excessive heat, ignition sources, direct sunlight and moisture.

viii. Damaged, leaking, swollen or defective batteries shall be isolated immediately and managed using appropriate containment and safety controls.

ix. Battery terminals shall be protected or insulated where necessary to prevent short-circuiting during storage and transportation.

x. Lead-acid batteries and other recyclable battery types shall be returned to the manufacturer, supplier or authorised recycling contractor whenever practicable.

xi. Lead-acid and large wet-type lithium-ion or Ni-Cad batteries may be accumulated within designated storage areas until sufficient quantities are available for collection and recycling by an authorised contractor.

xii. Small sealed batteries, including dry-cell and consumer lithium batteries, shall be collected separately and managed as hazardous waste or e-waste through authorised collection, recycling or disposal programmes.

xiii. Batteries shall not be disposed of with general waste, recyclable waste, construction waste or municipal waste streams.

xiv. Batteries shall never be opened, dismantled, crushed, punctured, incinerated, short-circuited or otherwise deliberately damaged.

xv. Any battery electrolyte, residue, contaminated absorbent materials or battery-related spill cleanup materials shall be managed as hazardous waste.

xvi. Battery storage areas shall be equipped with suitable spill response materials and fire-fighting equipment appropriate to the battery types being stored.

xvii. Personnel involved in the handling, storage, transportation or management of batteries shall receive appropriate training and be provided with suitable personal protective equipment (PPE).

xviii. Records of battery waste generated, stored, recycled, recovered, transported and disposed of shall be maintained and made available for inspection.

xix. Battery waste shall only be transferred to authorised recycling, recovery, treatment or disposal facilities approved by the relevant authorities.

xx. Battery management activities shall be undertaken in accordance with this Waste Management Plan, ESIAR commitments, ECC conditions and applicable regulatory requirements.



9.11. Industrial Waste and Scrap Metal

Industrial waste and scrap metal generated during the Construction and Operations phases of the Project/Terminal shall be managed to maximise opportunities for reuse and recycling, prevent contamination of recyclable materials and minimise the volume of waste requiring disposal. Industrial waste may include packaging materials, pallets, cartons, plastics, containers, damaged components, consumables, spare parts and other operational wastes that are not classified as hazardous waste. Scrap metal shall be managed as a separate recyclable waste stream and shall not be mixed with general waste, hazardous waste or other waste materials.

The following requirements shall apply:

i. Industrial waste shall be segregated from scrap metal, hazardous waste, e-waste, waste oil and other waste streams at the point of generation.
ii. Separate, clearly labelled containers, skips or collection areas shall be provided for industrial waste and scrap metal.
iii. Industrial waste shall be collected and stored within designated approved waste collection and storage areas located as close as reasonably practicable to the point of generation.
iv. Recyclable industrial waste materials, including paper, cardboard, plastics, timber, pallets, packaging materials and suitable spare parts, shall be separated and directed to authorised recycling or recovery facilities wherever practicable.
v. Industrial waste storage areas shall be maintained in a clean, orderly and safe condition and shall be protected from littering, wind dispersal and unauthorised access.
vi. Scrap metal shall be stored separately from all other waste streams and accumulated in designated scrap metal storage areas.
vii. Ferrous and non-ferrous metals shall be segregated where practicable to maximise recycling and recovery opportunities.
viii. Scrap metal contaminated with oil, chemicals, paints, asbestos or other hazardous substances shall be managed as hazardous waste until appropriately decontaminated or treated.
ix. Large metal components, cables, structural steel, machinery parts and other recoverable metal materials shall be evaluated for reuse or recycling before disposal is considered.
x. Scrap metal shall not be disposed of with general waste and shall not be sent to landfill except where recycling or recovery is demonstrated to be technically impracticable.
xi. Open burning, burial or unauthorised disposal of industrial waste or scrap metal shall be prohibited.
xii. Industrial waste and scrap metal shall only be transferred to authorised recycling contractors, recovery facilities or disposal facilities approved by the relevant authorities.
xiii. Quantities of industrial waste and scrap metal generated, recycled, recovered, transported and disposed of shall be recorded and reported as part of the Project waste monitoring and reporting programme.



xiv. Industrial waste and scrap metal management activities shall be undertaken in accordance with this Waste Management Plan, ESIAR commitments, ECC conditions and applicable regulatory requirements.

9.12. Electronic and Electrical Waste (E-Waste)

Electronic and electrical waste (e-waste) may contain hazardous substances including heavy metals, batteries, mercury-containing components, flame retardants and other materials that can cause environmental pollution if improperly managed. E-waste shall therefore be segregated, stored, handled, transported and disposed of in a manner that prevents damage to equipment, uncontrolled releases of hazardous substances and contamination of soil, groundwater, surface water and stormwater systems. Wherever practicable, e-waste shall be prioritised for reuse, refurbishment, component recovery and recycling in accordance with the waste management hierarchy.

The following requirements shall apply:

i. Electronic and electrical waste shall be segregated from general waste, industrial waste, scrap metal and hazardous waste at the point of generation.
ii. E-waste shall include, but not be limited to, computers, servers, printers, photocopiers, monitors, televisions, telecommunications equipment, networking equipment, cables, electronic control systems, sensors, circuit boards, batteries and associated accessories.
iii. E-waste shall be collected and stored in designated, secure and weather-protected storage areas to prevent damage, deterioration and unauthorised access.
iv. E-waste storage areas shall have impermeable flooring and be maintained in a manner that prevents the release of hazardous substances to the environment.
v. Equipment containing batteries, mercury lamps, toner cartridges, capacitors or other hazardous components shall be managed to prevent leakage, breakage or contamination.
vi. E-waste shall not be dismantled, crushed, burned or disposed of with general waste unless undertaken by an authorised recycling or waste management facility.
vii. Functional electronic and electrical equipment shall be considered for reuse, redeployment or refurbishment before recycling or disposal is considered.
viii. Data-bearing devices, including computers, servers, storage devices and telecommunications equipment, shall be securely erased, destroyed or managed in accordance with applicable company information security requirements prior to disposal or recycling.
ix. E-waste shall be transferred only to suppliers, manufacturers, authorised recycling contractors or environmental service providers specialising in electronic waste recovery, recycling or disposal.
x. Fluorescent lamps, mercury-containing devices, batteries and other hazardous electronic components shall be removed and managed as separate waste streams where required by the receiving recycling or treatment facility.
xi. Records of e-waste generation, storage, transfer, recycling, recovery and disposal shall be maintained and made available for inspection.
xii. Quantities of e-waste recycled, recovered and disposed of shall be included in the Project/Terminal waste monitoring and reporting programme.

xiii. E-waste management activities shall be undertaken in accordance with this Waste Management Plan, ESIAR commitments, ECC conditions and applicable regulatory requirements.

9.13. Tyre Waste

Waste tyres generated during the Construction and Operations phases of the Project/Terminal shall be managed to prevent fire risks, pest breeding, uncontrolled accumulation and environmental pollution. Tyres represent a valuable recyclable resource and shall be managed in accordance with the waste management hierarchy, giving preference to reuse, retreading, recycling and recovery before disposal. Tyre waste shall be stored, transported and managed in a manner that protects human health and the environment and complies with applicable legal requirements.

The following requirements shall apply:

i. Waste tyres shall be segregated from other waste streams at the point of generation and stored in designated tyre storage areas.
ii. Tyres suitable for continued use, retreading or reuse shall be identified and recovered where practicable before recycling or disposal is considered.
iii. Waste tyres shall be stored in a clean, secure and clearly designated area that does not obstruct operations, emergency access routes or fire-fighting equipment.
iv. Tyre storage areas shall be located away from ignition sources, hazardous materials, drains, watercourses and environmentally sensitive receptors.
v. Tyres shall be stacked safely and managed to minimise fire hazards, water accumulation and the attraction of pests or disease vectors.
vi. Waste tyres shall not be stockpiled for extended periods and shall be removed routinely to prevent excessive accumulation.
vii. Open burning, burial or disposal of tyres with general waste shall be prohibited.
viii. Waste tyres shall be transferred only to authorised recycling, recovery, retreading or waste management facilities approved by the relevant authorities.
ix. Where recycling facilities are not available locally, waste tyres may be re-exported or transferred under the relevant permits and approvals issued by the competent authorities.
x. Records of tyre generation, storage, transfer, recycling, recovery and disposal shall be maintained and made available for inspection.
xi. Quantities of waste tyres recycled, recovered, re-used, re-exported or disposed of shall be included in the Project/Terminal waste monitoring and reporting programme.
xii. Tyre waste management activities shall be undertaken in accordance with this Waste Management Plan, ESIAR commitments, ECC conditions and applicable regulatory requirements.

9.14. Vessel-Generated Waste (MARPOL)

Waste generated by vessels calling at the Terminal may include garbage, food waste, plastics, oily waste, bilge water, sludge, sewage, cargo residues, waste chemicals, ballast water residues and other regulated waste streams. Vessel-generated waste shall be managed in a manner that prevents pollution of the marine environment, protects human health and safety, and ensures compliance with MARPOL requirements, Bangladesh regulatory requirements, the Environmental and Social Impact Assessment Report (ESIAR),

Environmental Clearance Certificate (ECC) conditions and applicable port waste management arrangements.

The following requirements shall apply:

i. Vessel-generated waste shall be managed in accordance with the requirements of MARPOL Annexes I, II, III, IV, V and VI, as applicable.
ii. Vessel operators, Masters and agents shall comply with all applicable port waste reception facility requirements and waste notification procedures before discharging waste at the Terminal.
iii. Agents shall submit waste declarations and waste reception requests to the HSSE Department and Terminal management in advance of vessel arrival where hazardous, unusual or significant quantities of waste are proposed for discharge.
iv. Vessel-generated waste shall be segregated by waste type prior to discharge and shall not be mixed in a manner that prevents appropriate treatment, recycling, recovery or disposal.
v. Waste reception facilities shall be provided, maintained and operated to safely receive approved vessel-generated waste streams without causing pollution, nuisance conditions or operational disruptions.
vi. Garbage, food waste and other non-hazardous vessel-generated waste accepted by the Terminal shall be transferred to authorised waste management facilities for recycling, recovery or disposal.
vii. Only non-hazardous vessel-generated waste meeting applicable local waste acceptance criteria shall be accepted as general waste.
viii. Hazardous vessel-generated waste, including oily waste, sludge, contaminated absorbents, chemicals, paint waste, contaminated cargo residues and other regulated waste streams, shall be managed as hazardous waste in accordance with this Plan.
ix. Hazardous vessel-generated waste shall only be transported, treated and disposed of by authorised and appropriately licensed waste contractors.
x. Bilge water, oily water, waste oils and sludge shall be collected, transferred and managed in a manner that prevents spills, leaks or unauthorised discharges to the environment.
xi. Sewage and wastewater delivered from vessels shall be discharged only to approved reception, collection, treatment or disposal facilities.
xii. Cargo residues and cargo hold washings shall be managed in accordance with MARPOL requirements, cargo-specific handling requirements and applicable regulatory requirements.
xiii. Ballast water management shall be undertaken in accordance with the International Convention for the Control and Management of Ships' Ballast Water and Sediments and applicable national requirements.
xiv. No untreated sewage, oily waste, cargo residues, garbage, ballast water residues or other vessel-generated waste shall be discharged into the Karnaphuli River, harbour waters or the marine environment from Terminal-operated facilities.
xv. Waste transfer documentation, consignment records, reception receipts and other required records shall be maintained for all vessel-generated waste received, transported, treated or disposed of.
xvi. Quantities and types of vessel-generated waste received at the Terminal shall be recorded and included in the waste monitoring and reporting programme.



xvii. Any spills, leaks, unauthorised discharges or non-compliance associated with vessel-generated waste management shall be reported immediately and managed in accordance with approved emergency response procedures.

xviii. Personnel involved in the receipt, handling, storage, transportation or management of vessel-generated waste shall receive appropriate training and be provided with suitable personal protective equipment (PPE).

xix. Vessel-generated waste management activities shall be undertaken in accordance with this Waste Management Plan, the Terminal Port Waste Reception Facility arrangements, ESIAR commitments, ECC conditions, MARPOL requirements and applicable regulatory requirements.

9.15. Yard Cleaning, Wash Bays and Equipment Washdown

Waste generated from the cleaning of container yards, quays, roads, drainage systems, workshops, wash bays, storage areas, administrative facilities, public areas and other operational facilities shall be managed in a manner that maintains good housekeeping standards, prevents environmental pollution and ensures that wastes are properly segregated, collected and disposed of according to their classification. Cleaning activities shall be planned and implemented to prevent the discharge of solid waste, sediments, contaminated wash water, oils, chemicals or other pollutants to soil, stormwater systems, the Karnaphuli River or the marine environment. Vehicle, equipment and machinery washing activities shall be undertaken only within designated wash bays designed to contain, collect and treat wash water prior to discharge, reuse or disposal.

The following requirements shall apply:

i. Equipment washdown and maintenance facilities shall be located adjacent to workshop or maintenance areas and shall have sufficient capacity to accommodate the largest equipment routinely serviced or cleaned at the Terminal.

ii. Wash bays and equipment washdown areas shall be provided with fresh water supply connections, electrical power outlets and compressed air supply connections suitable for maintenance and cleaning activities.

iii. Wash bays shall incorporate containment walls or equivalent barriers with a minimum height sufficient to prevent overspray, contaminated runoff and wash water from affecting adjacent operational areas.

iv. Wash bay containment walls and containment systems shall be maintained in good condition and inspected periodically to verify their effectiveness in preventing uncontrolled releases.

v. Water supply systems serving wash bays may utilise treated potable water, recycled rainwater and/or treated recycled wash water, provided the treated water meets the required quality standards for its intended use.

vi. Recycled water outlets shall be clearly identified as non-potable and shall be physically separated from potable water systems.

vii. Wash bay wastewater collection systems shall include settlement and solids removal facilities upstream of oil-water separators wherever necessary to improve treatment performance and facilitate sludge management.

viii. Wastewater treatment systems shall be designed and operated to ensure collected contaminants, oils, sediments and sludge are removed and transferred to authorised off-site treatment, recycling or disposal facilities.



ix. Automatic diversion systems, hydrocarbon sensors, pumps, valves, separators, collection tanks and other wastewater treatment components shall be maintained in operable condition at all times and tested periodically to verify performance.

x. Following maintenance, repair or replacement of wastewater treatment infrastructure, commissioning and operational testing shall be undertaken to verify treatment performance and system functionality prior to returning the system to service.

xi. Cleaning of yards, quays, roads, public areas, buildings and operational facilities shall be carried out routinely and as required to maintain safe, clean and environmentally acceptable conditions.

xii. Solid waste, litter, sediments, debris and other wastes generated during cleaning activities shall be collected promptly and transferred to designated waste collection facilities according to their waste classification.

xiii. Waste generated from cleaning activities shall be segregated into recyclable, non-hazardous and hazardous waste streams where applicable.

xiv. Cleaning waste containing oils, fuels, chemicals, paints, contaminated absorbents or other hazardous substances shall be classified and managed as hazardous waste in accordance with this Plan.

xv. Drainage channels, stormwater drains, catch pits and gullies shall be inspected and cleaned routinely to prevent blockages, flooding and the release of pollutants to receiving environments.

xvi. Waste collected from drainage systems shall be assessed and managed according to its characteristics and contamination status.

xvii. Washing, sweeping and cleaning activities shall be undertaken in a manner that minimises the generation of dust, litter, runoff and contaminated wash water.

xviii. Cleaning wastewater, wash water and collected residues shall not be discharged directly to soil, stormwater systems, the Karnaphuli River or the marine environment unless specifically authorised and compliant with applicable discharge requirements.

xix. Vehicle, plant, equipment and machinery washing shall only be undertaken within designated wash bays or approved wash-down areas.

xx. Wash bays shall be designed with impermeable surfaces, containment kerbs, graded drainage and collection systems to prevent uncontrolled discharges to the environment.

xxi. Wash bay drainage systems shall be connected to appropriately sized oil-water separators and, where required, wastewater treatment systems designed to treat anticipated flows and contaminant loads.

xxii. Oil-water separators shall be designed to remove free oils, greases and suspended solids from wash water prior to discharge, reuse or transfer to further treatment systems.

xxiii. Oil-water separators shall be equipped with suitable access points for inspection, cleaning, maintenance, sludge removal and oil recovery.

xxiv. Flow rates entering oil-water separators shall not exceed the design capacity of the system.

xxv. Wastewater treatment and oil-water separation systems shall be designed, operated and maintained to achieve compliance with applicable discharge standards, ESIAR commitments and ECC conditions.



xxvi. Only approved cleaning products and detergents that do not adversely affect oil-water separator performance shall be used in wash bays wherever practicable. The use of chemicals that create stable oil-water emulsions shall be minimised or avoided.

xxvii. Oil-water separators shall be inspected routinely for oil accumulation, sludge build-up, equipment condition, leaks, overflows and overall operating effectiveness.

xxviii. Accumulated oil, sludge and sediments shall be removed before storage or treatment capacities are exceeded and shall be managed as hazardous waste where applicable.

xxix. Coalescing plates, filters, sensors, pumps, valves and associated treatment components shall be inspected, cleaned, tested and maintained in accordance with manufacturer specifications and maintenance schedules.

xxx. Oil-water separator alarms, monitoring devices, automatic shut-off systems and associated controls shall be tested periodically to verify proper operation.

xxxi. Wastewater treatment systems, oil-water separators and wash bay infrastructure shall be inspected at defined intervals and records of inspections, maintenance, sludge removal, oil recovery, repairs and monitoring results shall be maintained.

xxxii. The cleaning Contractor and contract owner shall be jointly responsible for ensuring that cleaning activities, wash bay operations and wastewater treatment systems are operated and maintained in compliance with environmental requirements and that effective measures are implemented to prevent pollution from solid and liquid wastes generated during cleaning activities.

xxxiii. Personnel undertaking cleaning activities and operating wash bays, oil-water separators or wastewater treatment systems shall receive appropriate training regarding waste segregation, pollution prevention, inspection requirements, spill response and emergency procedures.

xxxiv. Any spill, leak, unauthorised discharge, treatment system malfunction, separator failure or environmental incident arising from cleaning or wash bay activities shall be reported immediately and managed in accordance with approved emergency response procedures.

xxxv. Wash bay drainage systems shall utilise an automatic, demand-driven diversion valve that defaults to stormwater and diverts flow to the oil-water separator or collection tank whenever a hose cock is operated or hydrocarbons are detected in the water; manual diversion valves shall not be used.

xxxvi. Oil-water separators serving wash bays and equipment washdown areas shall achieve a maximum residual hydrocarbon concentration of 10ppm, or such lower limit as required by local regulations, prior to discharge, reuse or transfer to further treatment.

xxxvii. Full retention separators shall be provided at equipment washdown and maintenance areas, workshop maintenance bays, surface run-off from waste storage areas and bunded areas.

xxxviii. Treated wash water shall be reused for equipment washdown operations and/or landscaping and vegetation watering wherever practicable, with any excess treated water discharged to the stormwater drainage system.

xxxix. Where recycled water is used for washdown or landscaping purposes, the recycled water network shall be entirely separate from the potable water network, with no cross-connections, and outlets shall be clearly labelled or colour-coded.

xl. Treated water quality and oil-water separator treatment performance shall be sampled and verified at a minimum frequency of once per year, in addition to routine inspections.



xli. Yard, terminal and public area cleaning activities shall be undertaken in accordance with this Waste Management Plan, ESIAR commitments, ECC conditions and applicable regulatory requirements.

9.16. Asset Maintenance Waste Management

Maintenance, inspection, servicing and repair activities associated with ship-to-shore (STS) cranes, rubber-tyred gantries (RTGs), terminal tractors, reach stackers, forklifts, generators, refrigeration equipment, electrical systems, workshops, buildings, utilities and terminal infrastructure represent a significant source of waste during terminal operations. These activities generate a diverse range of hazardous and non-hazardous waste streams that require effective segregation, storage, handling and disposal to prevent environmental pollution, minimise safety risks and maximise opportunities for recycling and recovery. Asset maintenance waste shall be managed in accordance with this Waste Management Plan, the Environmental and Social Impact Assessment Report (ESIAR), Environmental Clearance Certificate (ECC) conditions and applicable regulatory requirements.

Specific waste streams include:

- Waste lubricating oils.
- Hydraulic oils.
- Oil filters.
- Fuel filters.
- Oily water.
- Lead-acid batteries.
- Lithium-ion batteries.
- Tyres.
- Scrap metal.
- Wire ropes.
- Paint wastes.
- Solvents.
- Chemical containers.
- Contaminated absorbents.
- Oily rags.
- Electronic waste.

The following requirements shall apply:

i. Workshop activities shall incorporate designated collection systems for scrap materials, used parts, maintenance consumables and waste generated during equipment maintenance activities.
ii. Waste generated from tyre repair, welding, hydraulic, mechanical, electrical, electronics and painting workshops shall be segregated according to waste type and managed in accordance with this Plan.
iii. Drainage collected from workshop floors, maintenance bays and inspection pits shall be conveyed to the wastewater treatment system via oil-water separation systems and shall not be discharged directly to the environment
iv. Floor drainage from workshop maintenance bays, inspection pits and equipment maintenance areas shall be directed to an oil-water separator and wastewater

treatment system and shall not discharge directly to stormwater drainage systems or the environment.

v. Maintenance areas shall be provided with designated collection systems for oily wastewater, wash water, sludge and maintenance residues generated during equipment servicing activities.

vi. Wastewater generated during equipment maintenance activities shall be collected, treated, re-used or disposed of through approved wastewater treatment systems and shall not be discharged untreated.

vii. Oil, sludge and residues recovered from workshop oil-water separators, wastewater treatment systems and maintenance drainage systems shall be collected separately and managed as hazardous waste where applicable.

viii. All maintenance waste shall be segregated at the point of generation and managed according to its waste classification.

ix. Hazardous and non-hazardous maintenance waste shall be stored separately and shall not be mixed.

x. All maintenance waste containers shall be clearly labelled with the waste type and applicable hazard identification.

xi. Maintenance waste shall be stored only within designated maintenance waste storage facilities or approved waste storage areas.

xii. Waste oils, hydraulic oils, oily water and other liquid wastes shall be stored in compatible containers, tanks or vessels provided with secondary containment capable of holding at least 110% of the largest storage vessel.

xiii. Oil filters, fuel filters, contaminated absorbents, oily rags and other oil-contaminated materials shall be collected separately and managed as hazardous waste.

xiv. Waste oils shall not be mixed with chemicals, solvents, fuels, wastewater or other waste streams that may compromise recycling or recovery opportunities.

xv. Scrap metal, wire ropes and other recyclable metal components shall be segregated from other waste streams and directed to authorised recycling facilities wherever practicable.

xvi. Paint waste, solvents, chemical residues and chemical containers shall be managed as hazardous waste and stored in designated hazardous waste storage areas.

xvii. Empty chemical containers shall be inspected, capped and managed in accordance with applicable hazardous waste management requirements.

xviii. Electronic waste generated from control systems, sensors, communication systems, electrical equipment and other maintenance activities shall be managed in accordance with this Plan.

xix. Lead-acid batteries, lithium-ion batteries and other battery waste shall be managed in accordance with this Plan.

xx. Tyre waste shall be managed in accordance with this Plan.

xxi. Damaged, defective, swollen or compromised lithium-ion batteries shall be isolated immediately, protected from further damage and stored in suitable fire-resistant containers pending removal from site by an authorised contractor.

xxii. Maintenance waste storage areas shall be routinely inspected to verify container integrity, secondary containment capacity, housekeeping standards and compliance with storage requirements.

xxiii. Spill kits, fire-fighting equipment and emergency response equipment appropriate to the hazards present shall be provided and maintained within maintenance areas and maintenance waste storage facilities.



xxiv. Any spill, leak, fire, container failure or unauthorised release associated with maintenance waste shall be reported immediately and managed in accordance with approved emergency response procedures.

xxv. Personnel involved in maintenance activities and maintenance waste management shall receive appropriate training and be provided with suitable personal protective equipment (PPE).

xxvi. Records of maintenance waste generation, storage, recycling, recovery, transportation and disposal shall be maintained and included in the waste monitoring and reporting programme.

xxvii. Workshop maintenance areas shall be provided with emergency showers, eyewash stations and local smoke or exhaust extraction systems appropriate to the maintenance activities undertaken.

xxviii. Workshop facilities shall provide dedicated areas or bays for electrical, mechanical, welding, hydraulic, tyre and battery maintenance and painting activities, wherever practicable, to minimise cross-contamination between waste streams.

xxix. Workshop maintenance bays shall be provided with a dedicated waste oil collection and storage system, and floor drainage from workshop and inspection pit areas shall be connected to the wastewater treatment system oil-water separator in accordance with this Plan.

xxx. Dedicated equipment washdown areas adjacent to workshop facilities shall be provided with a containment wall or equivalent bunding to prevent uncontrolled runoff of washdown water and waste materials.

xxxi. Asset maintenance waste shall only be transferred to authorised recycling, recovery, treatment or disposal facilities approved by the relevant authorities.

10. WASTE MINIMISATION AND RECYCLING

Waste minimisation and recycling shall be implemented as fundamental components of the Waste Management Plan and shall be applied throughout the Construction and Operations phases of the Laldia Container Terminal (LCT) Project. Consistent with the waste management hierarchy, priority shall be given to avoiding waste generation at source, reducing material consumption, maximising reuse opportunities and increasing recycling and resource recovery before disposal is considered. LCT and its Contractors shall identify and implement practical measures to reduce waste generation, improve resource efficiency and minimise the environmental impacts associated with waste management activities.

The following requirements shall apply:

i. Proper planning and ordering of materials to avoid excess procurement, reduce material wastage and minimise the generation of surplus materials.

ii. Selecting materials, technologies, equipment and vendors that minimise waste generation, packaging requirements and end-of-life disposal impacts.

iii. Use of returnable, reusable or recoverable packaging systems and implementation of supplier take-back or buy-back arrangements where practicable.

iv. Procurement of non-hazardous products and substitution of hazardous materials with less hazardous alternatives wherever technically and economically feasible.

v. Use of excavated soils from earthworks as fill material where suitable and approved for reuse.

vi. Maximising opportunities for reuse and recycling of metal, glass, plastic, batteries, wood, cardboard, paper, used lubricants, waste oil and other recyclable materials through approved third-party vendors.
vii. Materials with potential for reuse shall be identified and segregated prior to disposal, including pallets, timber, steel, cables, containers, spare parts and construction materials.
viii. Waste segregation shall be undertaken at source to improve recycling efficiency and reduce contamination of recyclable materials.
ix. Recyclable materials shall be protected from contamination, excessive weather exposure and damage that may reduce their recycling value.
x. Contractors shall identify recycling and recovery opportunities applicable to their activities and incorporate these into work planning and waste management practices.
xi. Disposal of recyclable materials to landfill shall be avoided wherever recycling or recovery options are reasonably available.
xii. Dredged material suitable for beneficial reuse shall be evaluated and prioritised for reclamation, construction, habitat enhancement, shoreline protection or other approved beneficial uses before disposal is considered.
xiii. Waste generation, reuse, recycling, recovery and disposal performance shall be monitored and periodically reviewed to identify opportunities for continual improvement.
xiv. Recycling performance and waste minimisation initiatives shall be communicated to personnel through training, awareness programmes and toolbox talks as appropriate.
xv. Recording recyclable waste streams and identified recyclers in a Waste Recycling Register, updated as recycling arrangements are confirmed for the Bangladesh / Chattogram market.

A Waste Recycling Register identifying the recycler/disposal company and contact details for each recyclable stream (e.g. paper and cardboard, plastics, steel/metal/cables, wood/timber and used oil, at minimum) shall be maintained and updated by the HSSE Department as local recycling arrangements are confirmed.

The Waste Recycling Register shall, as a minimum, record the waste stream, recycler or disposal company, contact details, approval or licence status, collection arrangements, destination facility, recycling or recovery method and the quantities of waste recycled or recovered where such information is available. The Register shall be reviewed and updated periodically to identify new recycling opportunities and support continual improvement in Project waste management performance.

The following operational requirements shall apply:

i. Only recyclers, recovery facilities and disposal companies included in the Waste Recycling Register shall be used, unless otherwise approved by the HSSE Department.
ii. The HSSE Department shall verify the approval, licence or permit status of recyclers and waste management facilities prior to their inclusion in the Register and periodically thereafter.
iii. Waste generators shall segregate recyclable waste streams in accordance with the approved recycling arrangements identified in the Register.
iv. Contractors and Waste Management Contractors shall use the Register when selecting approved recycling, recovery and disposal routes for Project waste streams.



v. The Register shall be reviewed whenever new waste streams are generated, new recycling opportunities become available or existing recycling arrangements change.
vi. Quantities of waste recycled, recovered and diverted from disposal shall be recorded and reported as part of the Project waste monitoring and reporting programme.
vii. Recycling certificates, waste transfer records, weighbridge tickets and other supporting documentation shall be retained where available to demonstrate recycling and recovery performance.
viii. Opportunities to increase recycling rates, improve resource recovery and reduce disposal volumes shall be identified through periodic review of the Register.
ix. The Register shall be made available for management review, inspection, audit and regulatory compliance verification as required.
x. The HSSE Department shall periodically evaluate local recycling markets and service providers within Bangladesh to identify additional recycling and recovery opportunities for Project waste streams.
xi. Any recycler, recovery facility or waste management contractor found to be operating without the required approvals or in non-compliance with regulatory requirements shall be removed from the Register until compliance is verified.
xii. Information contained within the Register shall be used to support waste minimisation initiatives, recycling performance reporting and continual improvement of waste management practices throughout the Construction and Operations phases of the Project.

11. WASTE STREAMS WITH REVENUE GENERATION POTENTIAL

As part of the Laldia Container Terminal (LCT) resource efficiency and circular economy objectives, waste streams with demonstrable reuse, recycling or recovery value shall be identified, segregated and managed to maximise opportunities for revenue generation while reducing the volume of waste requiring disposal. LCT shall promote the sale, recovery and recycling of suitable materials through approved recyclers, recovery facilities and licensed waste management contractors, consistent with the waste management hierarchy and applicable legal requirements.

The following requirements shall apply:

i. Waste materials with recognised commercial value shall be identified, segregated, stored and managed separately from general and hazardous waste streams.
ii. Priority shall be given to the recovery, reuse, resale and recycling of waste materials before disposal is considered.
iii. Revenue-generating waste streams shall be included in the Waste Recycling Register and managed through approved recycling, recovery or resale arrangements.
iv. All sales, transfers or disposal of recyclable materials shall be supported by appropriate records, including quantities, purchaser details, transfer documentation and revenue received where applicable.
v. Quantities of recyclable materials sold, recycled or recovered shall be recorded and reported as part of the Terminal's waste performance monitoring programme.

11.1. Iron and Scrap Steel

Iron and scrap steel generated through terminal operations, equipment maintenance, infrastructure repairs and container handling activities represent a significant recyclable

waste stream with potential market value. Effective segregation and storage of ferrous metals can maximise recycling opportunities, reduce disposal costs and support resource recovery objectives.

The following requirements shall apply:

i. Iron and steel waste generated from terminal equipment, infrastructure maintenance, fabrication activities, structural components, container repairs, crane maintenance and uncontaminated wire ropes shall be collected and segregated from other waste streams.
ii. Scrap steel and iron shall be stored in designated containers or storage areas to prevent contamination and facilitate recycling.
iii. Contaminated metal waste shall be cleaned, decontaminated or managed as hazardous waste where required.
iv. Once sufficient quantities have accumulated, scrap metal shall be sold to licensed scrap metal dealers, authorised recyclers or approved recovery facilities.
v. Scrap metal shall not be disposed of to landfill except where recycling is demonstrated to be impracticable.

11.2. Aluminium Waste

Aluminium waste generated from maintenance, repair and infrastructure activities is a potential valuable recyclable material that should be segregated and managed separately to preserve its quality and maximise its recovery value. Proper handling and storage can improve recycling efficiency and support circular economy initiatives.

The following requirements shall apply:

i. Aluminium waste generated from container repairs, equipment maintenance, building maintenance and infrastructure works shall be segregated at source and stored separately from ferrous metals.
ii. Aluminium shall be protected from contamination to maximise its recycling value and marketability.
iii. Aluminium waste shall be transferred to authorised recycling facilities or sold to approved recycling contractors.
iv. Records of aluminium quantities sold, recycled or recovered shall be maintained.

11.3. Wooden Pallets and Timber

Wooden pallets and timber waste generated through cargo handling, maintenance activities and the receipt of Out-of-Gauge (OOG) and project cargo may provide opportunities for reuse, refurbishment, recycling and recovery. Where practicable, these materials should be assessed for beneficial use before being considered for disposal.

The following requirements shall apply:

i. Wooden pallets shall be inspected prior to disposal to identify opportunities for reuse, repair or refurbishment.
ii. Reusable pallets shall be returned to service wherever practicable.
iii. Damaged pallets that cannot be reused shall be segregated and stored in a designated dry area to preserve their recovery value.



iv. Waste pallets and timber may be sold for refurbishment, recycling, material recovery, biomass fuel production or other approved beneficial uses.
v. Treated, contaminated or hazardous timber shall be managed in accordance with applicable waste classification requirements and shall not be sold for reuse unless deemed suitable by an authorised recycler or recovery facility.

11.4. Revenue Management and Controls

The sale and transfer of recyclable materials shall be subject to appropriate governance, financial controls and management oversight to ensure transparency, traceability and compliance with Terminal requirements. Revenue-generating waste management activities shall be managed through approved processes and documented to support environmental and financial reporting.

The following requirements shall apply:

i. Revenue-generating waste streams shall only be sold or transferred through approved procurement, finance and asset disposal procedures.
ii. The HSSE Department shall verify that recycling and recovery facilities receiving waste materials are appropriately licensed and authorised.
iii. Revenue generated from the sale of recyclable materials shall be recorded in accordance with Terminal financial and asset management procedures.
iv. Opportunities to expand revenue-generating recycling and recovery programmes shall be periodically reviewed as part of the Terminal's waste minimisation and resource efficiency initiatives.
v. Revenue-generating waste management activities shall be undertaken in accordance with this Waste Management Plan, ESIAR commitments, ECC conditions and applicable regulatory requirements.

12. WASTE MONITORING, REPORTING AND RECORD KEEPING

Effective waste monitoring, reporting and record keeping are essential to demonstrate compliance with this Waste Management Plan, applicable legal and regulatory requirements, ESIAR commitments, ECC conditions and contractual obligations and to identify opportunities for continual improvement in waste management performance. Monitoring and reporting shall provide verifiable information on waste generation, segregation, storage, transportation, recycling, recovery, treatment and disposal activities throughout the Construction and Operations phases of the Project.

LCT shall implement a waste monitoring programme that includes, but is not limited to:

i. Monitoring and recording waste quantities, sources and destinations using a Waste Disposal Report Form, Waste Transfer Note (WTN) and/or Waste Consignment Note.
ii. Monitoring waste generation, recycling, recovery and disposal trends by waste stream, department, Contractor and operational area, where applicable.
iii. Routine review of the volumes and types of waste collected, stored, recycled, recovered, treated and disposed of as part of the overall environmental performance assessment of the Site, including investigation of any significant changes or abnormal trends.

iv. Daily site inspections of construction and operational work areas, waste collection points, waste segregation facilities and waste accumulation points to verify compliance with this Plan.
v. Weekly and monthly inspections of waste storage areas, hazardous waste facilities, recycling areas and waste management infrastructure to verify compliance with operational requirements.
vi. Verification that waste segregation, storage, transportation and disposal activities are being carried out in accordance with this Plan and approved procedures.
vii. Documentation of any deviation from this Plan's requirements, together with corrective actions, responsibilities and close-out status, in daily, weekly or monthly observation and inspection reports.
viii. Monitoring the implementation and effectiveness of waste minimisation, recycling and resource recovery initiatives.
ix. Monitoring compliance with approved waste storage time limits, waste transfer requirements and waste contractor obligations.
x. Monitoring and recording waste-related incidents, spills, complaints, non-conformances, corrective actions and environmental exceedances.
xi. Monthly and quarterly waste and environmental performance reports shall be submitted to LCT management and, where required by permit conditions, to the Chittagong Port Authority (CPA), Department of Environment (DoE) and other relevant authorities.

At a minimum, waste records shall include:

- Waste type and classification.
- Source of waste generation.
- Waste generator or responsible department.
- Quantity of waste generated, stored, recycled, recovered, treated and disposed of.
- Waste storage location and storage period.
- Date of collection, transportation and disposal.
- Waste transporter details and licence information.
- Destination facility and facility approval status.
- Recycling, recovery, treatment or disposal method.
- Waste Transfer Note (WTN), Consignment Note or manifest reference number.
- Supporting weighbridge tickets, recycling certificates, disposal receipts and other relevant documentation where available.
- Inspection, monitoring, incident and corrective action records.
- Evidence of compliance with ESIAR commitments, ECC conditions and applicable regulatory requirements where relevant.

The HSSE Department shall maintain a central waste management record system, including the Waste Register, Waste Recycling Register, hazardous waste inventories, waste transfer documentation and waste performance reports. Waste records shall be retained in accordance with applicable legal, contractual and Terminal requirements and shall be made available for inspection, audit and regulatory review upon request.

Waste management performance data shall be reviewed periodically to identify opportunities for waste reduction, increased recycling and recovery, improved resource efficiency and continual improvement of waste management practices throughout the Project lifecycle.



12.1. Solid Waste Management Performance Indicators

Performance indicators shall be adopted to enable systematic, quantitative and qualitative evaluation of the effectiveness of this Plan, to identify trends over time, and to verify the effectiveness of segregation, packaging and disposal practices implemented across the LCT. The indicators set out in Table 19 shall be reported through the waste monitoring and reporting arrangements described in this Plan.

Table 19: Solid waste management performance indicators.

Indicator	Description	Unit	Frequency
Total waste generation	Total quantity of waste generated in the reporting period	kg or tonnes / month	Monthly
Generation by waste class	Quantity generated by Class I, II, III and IV	kg / month	Monthly
Percentage of recyclables	Proportion of total waste directed to recycling or reuse	%	Monthly
Percentage of rejects	Proportion of total waste sent to final disposal	%	Monthly
Adequate segregation rate	Ratio of properly segregated waste to total waste, per inspection	%	Quarterly
Waste with complete transfer / consignment documentation	Percentage of shipments with a complete waste transfer note / consignment record	%	Monthly
Documentary compliance	Existence of valid treatment / final disposal certificates for all shipments	Yes / No	Monthly
Non-conformances identified and closed out	Number of waste-related non-conformances raised and percentage closed out within target timeframe	Number / %	Monthly
Waste management training completion	Percentage of relevant workforce completing induction and refresher waste training	%	Quarterly

Indicator results shall be tracked monthly, with a consolidated analysis conducted at least annually, in order to support continuous improvement of this Plan and to demonstrate compliance with ECR 2023, the ECC and the Project's ESIA/ESMP commitments.

13. TRAINING, COMMUNICATION, INSPECTION AND AUDIT

Effective implementation of this Waste Management Plan depends on competent personnel, clear communication, routine inspections, contractor oversight and periodic auditing. LCT and its Contractors shall ensure that personnel involved in the generation, handling, storage, transportation, inspection and management of waste are provided with appropriate training, information and resources to fulfil their responsibilities. Training, communication, inspections and audits shall be used to verify compliance with this Plan, applicable legal requirements, the Environmental and Social Impact Assessment Report (ESIAR), Environmental Clearance Certificate (ECC) conditions and Good International Industry Practice (GIIP), and to support continual improvement in waste management performance.

13.1. Training and Communication

All personnel have a responsibility to manage waste in accordance with the requirements of this Plan. Effective training and communication are essential to ensure that workers

understand waste management requirements, waste segregation procedures, environmental risks and their individual responsibilities for preventing pollution and maintaining compliance.

All LCT and Contractor/Subcontractor employees shall receive general waste management awareness as part of HSSE induction training, with task-specific refresher training at least annually, covering:

- Roles and responsibilities.
- The waste hierarchy.
- Identification and segregation of waste classes at source.
- Understanding of hazardous waste and MSDS.
- Selection and use of appropriate PPE.

Waste collection Subcontractors and their employees shall receive specific training on the requirements of this Plan.

Environmental (waste management) meetings shall be held at least monthly between the HSSE Department and Contractor/Subcontractor representatives to review requirements, new waste streams, plan amendments, environmental incidents, inspection findings, corrective actions and performance trends. Minutes shall be recorded, distributed and retained by the HSSE Department.

13.2. Waste Management Training Competency Requirements

Personnel whose duties involve waste handling, storage, transportation, supervision, inspection, auditing or contractor management shall receive competency-based training appropriate to their responsibilities. Training programmes shall ensure personnel possess the knowledge and skills necessary to perform waste management activities safely, effectively and in compliance with Project requirements.

Training programmes should address:

- Waste classification and segregation.
- Hazardous waste management.
- Waste labelling and signage.
- Spill prevention and response.
- Waste manifest and record management.
- Legal and regulatory obligations.
- ESIAR commitments and ECC requirements.
- Waste hierarchy implementation.
- Emergency response requirements.
- Contractor waste management responsibilities.

Personnel responsible for hazardous waste management shall receive periodic refresher training and competence verification. Training records, attendance registers and competency assessments shall be maintained by the responsible department and made available for inspection and audit.

13.3. Monitoring and Inspection



Routine monitoring and inspection activities shall be conducted to verify compliance with this Plan, identify actual or potential non-conformances, assess the effectiveness of waste management controls and support continual improvement. Inspection findings shall be documented, communicated to responsible personnel and tracked through to closure.

The HSSE Department shall perform daily site environmental inspections covering waste storage and collection centres, skips, bins, waste segregation facilities and waste handling areas, with outstanding issues reported. A monthly inspection of all temporary waste storage areas and waste handling/segregation facilities shall be conducted, with findings and recommendations reported to LCT management.

Inspection programmes should verify, as a minimum:

- Compliance with waste segregation requirements.
- Condition and suitability of waste containers and storage facilities.
- Waste labelling, signage and housekeeping standards.
- Compliance with waste storage limits.
- Availability of spill response and emergency equipment.
- Waste transfer documentation and records.
- Contractor compliance with waste management requirements.
- Implementation of corrective actions arising from previous inspections or audits.

13.3.1. Waste Champion Inspection Programme

The Terminal shall appoint Waste Champions for major operational areas including:

- Yard Operations.
- Marine Operations.
- Administration.
- Warehousing.
- Workshops.
- Maintenance and Repair.
- Contractor-managed facilities.

Waste Champions shall:

- Conduct monthly inspections.
- Verify waste segregation compliance.
- Verify signage and labelling.
- Verify container condition.
- Identify waste reduction opportunities.
- Report non-conformances.
- Support awareness campaigns.

Inspection results shall be reported to the Environmental Coordinator and incorporated into monthly environmental performance reporting.

13.4. Waste Contractor Due Diligence and Compliance Verification

LCT shall ensure that all Waste Management Contractors engaged in the collection, transportation, recycling, treatment or disposal of waste are competent, appropriately



licensed and capable of managing waste in accordance with Project/Terminal requirements and applicable legal obligations.

Prior to appointment and periodically thereafter, LCT shall undertake due diligence assessments of all Waste Management Contractors involved in the collection, transport, recycling, treatment or disposal of waste generated by the Project. The assessment should include, as applicable:

- Verification of business licences and registrations.
- Verification of DoE permits and authorisations.
- Verification of approved waste categories.
- Review of treatment, recycling and disposal methods.
- Verification of transportation permits and vehicle suitability.
- Review of HSSE performance history.
- Review of emergency response capability.
- Review of regulatory compliance records and enforcement actions.
- Site inspections or audits of waste management facilities.

Waste contractors shall be periodically re-evaluated to ensure continued compliance with Project/Terminal requirements, Bangladesh legislation, ESIAR commitments, ECC conditions and applicable IFC/WBG requirements.

Where deficiencies are identified, corrective actions shall be agreed and tracked to completion. LCT reserves the right to suspend or terminate the use of waste contractors that fail to demonstrate compliance with Project requirements.

13.5. Auditing

Waste management audits shall be undertaken to provide independent verification of compliance with this Plan, legal requirements, contractual obligations and environmental commitments. Audits shall evaluate the adequacy and effectiveness of waste management systems, controls, records, contractor performance and continual improvement initiatives.

Audits of all aspects of waste management, including waste transporters, recycling facilities, treatment facilities and disposal sites, shall be conducted in accordance with HSSE audit and inspection procedures and, at a minimum, consistent with ISO 14001 principles, to verify compliance with Bangladesh law, IFC Performance Standards, ESIAR commitments, ECC conditions and this Plan.

Initial audits shall be conducted for any new disposal, treatment or recycling facility prior to use, with subsequent audits undertaken at least annually.

Audit programmes should include verification of:

- Waste classification, segregation and storage practices.
- Waste transportation and consignment documentation.
- Waste recycling, recovery, treatment and disposal arrangements.
- Contractor competence and regulatory compliance.
- Monitoring, inspection and reporting records.
- Waste minimisation and recycling performance.

- Compliance with ESIAR commitments and ECC conditions.
- Closure of non-conformances and corrective actions.
- Overall implementation and effectiveness of this Waste Management Plan.

Audit findings shall be documented, reported to management and tracked through a corrective action process until satisfactory closure has been verified.

13.6. OPERATIONAL INSPECTIONS — SOLID WASTE AND WASTEWATER

This section describes the internal inspection regime to be implemented once the LCT is operational, covering both solid waste management infrastructure and the terminal's wastewater treatment and conveyance infrastructure.

Operational monitoring shall include periodic inspections at waste generating areas, packaging points, temporary storage areas and wastewater infrastructure to verify physical condition, correct segregation and operation, and compliance with the procedures set out in this Plan. Results shall be recorded and periodically analysed to support corrective and preventive actions and continuous improvement, consistent with this Plan.

13.6.1. Solid Waste Inspections

Internal inspections of solid waste collection, segregation and storage areas shall verify, as a minimum:

i. Container and storage area identification / signage, in accordance with this Plan.
ii. Correct segregation of waste by class and colour code, with no cross-contamination between Class I, II, III and IV waste streams.
iii. Container integrity (no leaks, damage or corrosion) and general housekeeping standards.
iv. Cleanliness, organisation and control of temporary storage areas.
v. Availability and completeness of required documentation, including waste transfer notes, consignment records and disposal certificates.
vi. Condition and function of secondary containment / bunding at hazardous waste storage areas.

13.6.2. Wastewater and Sewerage Infrastructure Inspections

To ensure the effective operation of wastewater management infrastructure and to minimise the risk of environmental pollution, nuisance, system failures and non-compliance with applicable discharge requirements, the Terminal shall implement a programme of routine inspections and condition assessments covering all wastewater collection, conveyance, treatment, storage and discharge systems. Inspections shall verify that wastewater treatment and associated infrastructure are functioning as designed, are being maintained in a safe and serviceable condition, and continue to meet the performance requirements of this Plan, applicable regulatory approvals, and manufacturer operating specifications. Inspection activities shall include verification of treatment performance, equipment integrity, operational controls, pollution prevention systems, flood resilience measures, sludge management practices and the condition of supporting sewerage infrastructure. As a minimum, internal inspections of the Terminal's Wastewater Treatment Plant (WWTP), sewage lifting stations, sewerage network and oil-water separators shall verify the following:



i. WWTP treatment performance, including sampling of treated effluent upstream and downstream of the treatment system to confirm compliance with the applicable discharge standards, at a minimum frequency of every three months or following any system failure.
ii. Condition and function of duty/standby pumps, automatic level controls, high-level alarms and screens at sewage lifting stations, and confirmation of backup generator / UPS operation during simulated power loss.
iii. Oil-water separator condition, oil accumulation, sludge build-up and function of automatic diversion valves at wash bays and workshop maintenance bay drainage, in accordance with this Plan.
iv. Sludge management practices, confirming stabilised sludge is dewatered and consigned only to a DoE-approved disposal facility, with no open dumping on-Site.
v. Watertightness and condition of manholes, chambers and sewerage network components, including periodic CCTV inspection of the sewerage network for cracking, damage or infiltration.
vi. Flood protection of electrical panels, control systems, pumps and blowers associated with wastewater infrastructure, confirming installation above the design flood level.
vii. Reuse water quality and separation between recycled/non-potable and potable water networks, confirming no cross-connections and correct labelling/colour-coding of outlets.

Routine inspections of waste management and wastewater infrastructure provide a key verification mechanism for confirming compliance with this Plan, identifying deterioration or operational deficiencies at an early stage and ensuring that corrective actions are implemented before environmental or operational impacts occur. Inspection requirements shall cover both solid waste management facilities and wastewater management systems, with frequencies based on the level of environmental risk and the criticality of the infrastructure being assessed. Table 20 presents the minimum inspection checklist, performance criteria and inspection frequencies applicable to solid waste management facilities, wastewater treatment systems, sewerage infrastructure and associated pollution control equipment at the Terminal.

Table 20: Internal inspection checklist for solid waste and wastewater.

Item Verified	Criteria / Standard	Frequency	Compliance
Containers identified and colour-coded	Table 16 of this Plan	Weekly	Yes / No
Proper waste segregation	Table 11 to Table 14 of this Plan; no cross-contamination	Weekly	Yes / No
Container / skip integrity	No leaks, damage or corrosion	Weekly	Yes / No
Storage area / WMF condition	Clean, organised	Weekly	Yes / No
Hazardous waste secondary containment	Bunding intact, ≥110% capacity, no leaks	Weekly	Yes / No
Waste documentation available	Waste transfer notes / consignment records / certificates	Monthly	Yes / No
WWTP effluent quality	Compliant with discharge standards	Quarterly (min.)	Yes / No
STP effluent quality	Compliant with discharge standards	Quarterly (min.)	Yes / No
Sewage lifting station pumps / alarms / backup power	Duty/standby operation, alarms and backup power functional	Monthly	Yes / No
Oil-water separator condition and diversion valve	No oil carry-over, valve defaults to stormwater correctly	Monthly	Yes / No
Sludge management and disposal	Dewatered, DoE-approved facility only, no open dumping	Per removal event	Yes / No

Item Verified	Criteria / Standard	Frequency	Compliance
Sewerage network condition	No cracking, damage or infiltration (CCTV survey)	Every 3 years	Yes / No

Non-conformances identified during inspections shall be recorded, assigned corrective actions and tracked to close-out in accordance with the monitoring, reporting and record-keeping requirements of this Plan.

14. PRE-CONSTRUCTION STAGE - SUMMARY OF WASTE MANAGEMENT ACTIONS AND MITIGATION MEASURES

14.1. Introduction

This Section defines the waste management activities, mandatory controls, responsibilities and verification requirements applicable to the Pre-Construction Stage of the Laldia Container Terminal.

The Pre-Construction Stage comprises the planning, investigative, procurement and limited physical activities undertaken before the main construction phase. The stage includes obtaining permits and approvals, conducting topographic, archaeological, geotechnical and bathymetric surveys, stakeholder engagement, preparing tender documents, selecting contractors and developing the detailed design. Preparatory physical works may also include temporary perimeter fencing, security facilities, potable water and sanitation arrangements and erection of temporary on-site project offices supplied by temporary utilities, including diesel generators.

Waste quantities during this stage are expected to be in orders of magnitude lower than during main construction. However, the stage is decisive because design, procurement and contractor-selection decisions determine the future waste profile, the ability to reuse or recycle materials and the capacity and location of waste infrastructure. Intrusive surveys and temporary facilities can also generate drill cuttings, excavated material, purge water, packaging, vegetation waste, used sampling materials, domestic waste, sewage, greywater, waste oil and contaminated spill-response materials. These wastes shall be controlled from the first physical activity on the Site.

Table 21 summarises the key Pre-Construction activities, waste streams, environmental and social aspects, performance objectives, mitigation measures, responsibilities and monitoring requirements applicable during the Pre-Construction Stage of the Project, together with the controls required for the controlled handover to the Construction Phase.

14.2. Pre-Construction Waste Management Planning and Controls

Before any physical Pre-Construction activity starts, LCT shall establish the organisational, legal and logistical arrangements required to manage waste.

i. LCT shall identify the permits, approvals, ECC conditions, ESIAR commitments and regulator notifications applicable to each Pre-Construction activity and record them in the Project permits register.

ii. Only authorised waste transporters, recyclers, treatment facilities and disposal facilities shall be used.

14.3. Permits, Approvals and Regulatory Readiness

Obtaining necessary permits and approvals is a core Pre-Construction activity. Although the administrative activity does not itself generate significant physical waste, it establishes the conditions under which survey, enabling and subsequent construction wastes may be stored, transported, treated, reused or disposed of.

i. LCT shall identify restrictions on waste storage, wastewater discharge, hazardous materials, dredged or excavated material, transport routes and receiving facilities.
ii. Waste-related conditions shall be translated into contract requirements, design criteria, method statement requirements, inspection checklists and reporting obligations.
iii. Where local treatment, recycling or disposal capacity is uncertain, LCT shall verify facility availability, acceptance criteria, capacity and licence status.
iv. No absence of local infrastructure shall justify uncontrolled storage, open dumping, burial, burning or discharge.

14.4. Field Surveys and Intrusive Investigations

Pre-Construction field surveys include topographic, geotechnical and bathymetric investigations. Non-intrusive surveying generates limited waste, whereas boreholes, cone penetration tests, trial pits, sediment sampling, groundwater sampling and equipment decontamination can generate drill cuttings, excess soil, sediment, sample containers, disposable PPE, filters, purge water and decontamination water. Marine investigations may also recover debris, abandoned materials or unidentified objects.

i. An investigation-specific waste schedule shall be prepared before fieldwork and shall distinguish clean material, potentially contaminated material, hazardous waste, liquid waste, general waste and recyclable materials.
ii. Drill cuttings, soils, sediments and groundwater shall not be classified solely by visual appearance. Where contamination is suspected, material shall be isolated and characterised before reuse, backfilling, discharge or disposal.
iii. Only clean and geotechnically suitable excavated material may be returned to a borehole or trial pit, subject to investigation requirements. Excess or contaminated material shall be removed through an approved route.
iv. Purge water, decontamination water and drilling fluids shall be captured in suitable tanks or containers and shall not be discharged to soil, drains or the Karnaphuli River without assessment and authorisation.
v. Sampling consumables, contaminated PPE, absorbents, filters and chemical containers shall be segregated at the point of generation. Unidentified or contaminated items shall be managed as hazardous waste until classification is confirmed.
vi. Marine debris or obstructions recovered during bathymetric or geotechnical work shall not be returned to the river. Recovered material shall be recorded, inspected, classified and directed to an approved reuse, recycling, treatment or disposal route.



vii. Investigation locations shall be reinstated and all temporary markers, packaging, surplus materials, containers and wastes shall be removed when the work is completed.

14.5. Tendering, Contractor Selection and Procurement

Tender preparation and contractor selection provide the principal opportunity to convert the Waste Management Plan into enforceable delivery requirements.

i. Tender documents shall require bidders to identify anticipated waste streams, waste minimisation opportunities, proposed storage arrangements, authorised contractors and receiving facilities.
ii. Contracts shall require compliance with the WMP, ESIAR, ECC and applicable legal requirements and shall define deliverables, approvals, inspection rights, reporting frequencies and corrective-action obligations.
iii. No subcontractor or waste management contractor shall be engaged until required licences and facility approvals have been verified.

14.6. Detailed Design and Waste Prevention by Design

Detailed design determines material quantities, the extent of excavation and dredging, temporary and permanent waste infrastructure, the ability to segregate waste at source and the extent to which future assets can be maintained, dismantled, reused or recycled. Waste prevention requirements shall therefore be treated as design inputs rather than operational add-ons.

i. Design teams shall apply the waste hierarchy and document significant design decisions affecting waste generation, material recovery, storage capacity and disposal demand.
ii. Material quantities and specifications shall be optimised to prevent over-ordering, unnecessary offcuts and premature replacement.
iii. Design shall provide sufficient, safely accessible and flood-resilient space for waste segregation, the Waste Management Facility, hazardous waste storage, sludge handling and collection vehicles.
iv. Hazardous liquid storage shall have impermeable surfaces and secondary containment of at least 110% of the largest container or tank.
v. Design shall keep clean stormwater separate from sewage, oily wastewater and contaminated runoff and shall provide contained drainage for workshops, wash bays, fuel areas and waste storage areas.
vi. Design shall facilitate maintenance, component replacement, future dismantling and recovery of steel, aluminium, cables, equipment, batteries and electronic systems.
vii. Design reviews shall include HSSE participation.

14.7. Temporary Fencing, Security Facilities and Site Offices

Preparatory physical works may include temporary perimeter fencing, guard posts, security facilities, sanitary facilities and site offices. These activities use prefabricated buildings, fencing, potable water, electricity, food and beverages and generator fuel. They may generate

vegetation cuttings, packaging, scrap metal, timber, office waste, food waste, sewage, greywater, waste oil and spill-clean-up materials.

i. Vegetation removal shall be limited to the approved footprint and reusable fencing, posts and prefabricated units shall be selected where practicable.
ii. Packaging, metal, timber, plastics and cable offcuts shall be segregated for reuse or recycling.
iii. General and food waste containers shall be covered, labelled and positioned to prevent windblown litter and pest access. Food waste shall be removed daily and stored for no more than 24 hours.
iv. Temporary toilets and sanitation systems shall be installed before occupancy. Untreated sewage or greywater shall not be discharged to land, stormwater systems or the river.
v. Generators and fuel containers shall be located on impermeable, bunded surfaces. Refuelling shall be controlled and spill kits shall be immediately available.
vi. Waste oil, oily rags, filters and spill-response waste shall be stored as hazardous waste and removed by an authorised contractor.
vii. All temporary collection and storage points shall be inspected at least weekly and after heavy rainfall, flooding, spills or material changes.

***IMPORTANT*: Table 21 is intended as a summary reference for Pre-Construction Stage waste management requirements and shall be read in conjunction with the detailed requirements contained in Sections 4 to 13 of this Waste Management Plan. The requirements presented in Table 21 apply specifically to the Pre-Construction Stage and do not replace, supersede, or limit any requirements specified elsewhere in this Plan. Together with the Construction, Operational and Decommissioning requirements contained in this Waste Management Plan, they form the complete set of waste management requirements applicable to the Project and Terminal.**

Table 21: Pre-Construction Stage Waste Management Framework summarizing the performance objectives, targets, Management and Mitigation Measures.

Activities	Aspects	Key Receptors	Performance Objective	Indicators	Targets	Mitigation and Management Actions	Type of Mitigation Option	Responsibility	Frequency / Timing	Monitoring and Record Keeping Requirements
P1 - Permits and approvals	Risk that waste activities proceed without approved routes, conditions or licensed providers	Regulatory compliance, soil, water, communities	Establish legal and logistical readiness before waste generation	Waste conditions identified and translated into controls	100% of applicable waste conditions captured; zero unauthorised waste movement	Maintain permit and obligations register; verify transporter and facility licences; define approval, reporting and escalation controls; confirm contingency routes before mobilisation.	Avoid / Assurance	Project Director / HSSE Manager	Before procurement and mobilisation; review upon change	Permit register; obligations matrix; licence verification; approved provider register
P2 - Topographic, geotechnical and bathymetric surveys	Drill cuttings, soil, sediment, purge and decontamination water, sampling consumables and recovered debris	Soil, groundwater, Karnaphuli River, workers	Prevent uncontrolled disposal or discharge from investigations	Waste classified; liquid waste contained; sites reinstated	100% classified and traced; zero uncontrolled discharge	Prepare investigation WMMS; segregate clean and suspect materials; capture liquids; test suspected contamination; treat unidentified material as hazardous; reinstate sites and remove residual waste.	Avoid / Contain / Dispose compliant	Investigation Contractor / Waste Coordinator	Before and throughout surveys	WMMS; field logs; analytical results; Waste Register; WTNs; reinstatement inspection
P3 - Tender documents and contractor selection	Risk of weak waste requirements and unsuitable contractors or facilities	Regulatory compliance, project performance	Embed enforceable waste controls in procurement and contracts	Waste criteria included and evaluated	100% of relevant contracts include WMP obligations and reporting requirements	Require bidder waste plans, competent resources and licensed routes; evaluate compliance history; define deliverables, inspections, records, audit rights and corrective actions.	Avoid / Assurance	Procurement Manager / HSSE Manager	During tendering and before award	Tender clauses; evaluation records; contractor due diligence; contract schedules
P4 - Detailed design	Waste generation embedded in layout, quantities and material selection	Resources, landfill capacity, soil and water	Prevent waste by design and provide adequate waste infrastructure	Waste design actions closed	100% of design reviews address waste prevention and infrastructure	Optimise quantities; specify durable and recoverable materials; provide WMF, segregated storage, bunding, contained drainage and safe access; design for maintenance and future recovery.	Avoid / Reduce	Engineering Manager / HSSE Manager	At each design review	Design review minutes; drawings; specifications; action tracker
P5 - Temporary perimeter fencing	Vegetation, packaging, metal and timber offcuts	Soil, land, local air quality	Minimise clearance and recover temporary materials	Area cleared; materials reused or recycled	Clearance limited to approved footprint; zero open burning	Use reusable fencing; segregate vegetation and materials; protect drains; remove packaging; retain recovery records.	Avoid / Reuse / Recycle	Preparatory Works Contractor	During installation and removal	Daily inspections; material register; Waste Register
P6 - Security facilities, potable water and sanitation	Domestic waste, sewage, greywater and packaging	Groundwater, surface water, communities	Provide hygienic facilities without untreated discharge	Collection and sanitation compliance	Food/general waste collected as scheduled; zero untreated discharge	Provide labelled covered bins; approved toilets and sewage collection/treatment; inspect tanks and connections; remove waste through authorised contractors.	Contain / Treat	Security Facilities Contractor / Facilities Manager	Continuous; weekly inspection	Collection logs; sanitation inspection; pump-out records; WTNs
P7 - Offices and temporary utilities	Office and food waste, sewage, greywater, fuel, waste oil, filters and spill waste	Soil, groundwater, stormwater, air quality	Operate temporary offices and generators without pollution	Waste segregation, spills, sanitary compliance	Zero uncontrolled spills or discharge; food waste less than 24 hours	Segregate office and food waste; provide appropriate sanitation; bund fuel and generators; maintain spill kits; manage oils and filters as hazardous waste; inspect weekly.	Reduce / Contain / Recycle	Project Facilities Manager / HSSE Manager	Continuous	Weekly inspection; fuel and hazardous waste inventory; collection logs; WTNs
Pre-Construction handover	Residual waste, incomplete records and unclear ownership	Construction workforce and environmental compliance	Complete controlled transition to construction	Readiness actions and inventory reconciliation	Zero unresolved critical actions; all waste and facilities assigned	Complete joint inspection; reconcile Waste Register and WTNs; remove residual waste; formally hand over retained facilities, records and open actions.	Assurance	Project Director / Construction Manager / HSSE Manager	Before main construction mobilisation	Readiness checklist; handover record; action close-out; inventory reconciliation

15. CONSTRUCTION PHASE - SUMMARY OF WASTE MANAGEMENT ACTIONS AND MITIGATION MEASURES

15.1. Introduction

Table 22 summarises the key waste-generating activities, waste streams, environmental and social aspects, performance objectives, mitigation measures, responsibilities and monitoring requirements applicable during the Construction Phase of the Project. The Table provides a summary overview of the waste management controls required across all construction-related activities, including site establishment, earthworks, dredging, civil works, marine works, building construction, electrical and instrumentation (E&I) installation, equipment assembly and commissioning. The measures presented are intended to ensure that waste generation is minimised, materials are reused or recycled where practicable, and all waste is managed, transported and disposed of in a manner that prevents adverse impacts on the environment, workers and neighbouring communities.

15.2. Relationship Between this Waste Management Plan and Contractor Method Statements

This Waste Management Plan (WMP) serves as the overarching framework for waste management across the Project and establishes the minimum standards, objectives, performance requirements and control measures that must be implemented by all contractors and subcontractors. The Plan defines the waste management hierarchy, waste segregation requirements, monitoring and reporting expectations, waste storage and handling standards and requirements for the transport and disposal of wastes through authorised facilities. In addition to complying with this WMP, all contractors and subcontractors shall comply with applicable Bangladesh environmental and waste management legislation, including but not limited to the Bangladesh Environment Conservation Act, 1995, the Environment Conservation Rules, 2023 (as amended) and any other applicable national or local regulatory requirements governing the generation, storage, transport, treatment, recycling and disposal of hazardous and non-hazardous wastes. Contractors shall also ensure that waste management activities are undertaken in accordance with the commitments, mitigation measures and management requirements contained within the approved Environmental and Social Impact Assessment Report (ESIAR) and any conditions, obligations or requirements specified in the Environmental Clearance Certificate (ECC) issued for the Project.

To support implementation of this WMP, each contractor shall develop and maintain a Waste Management Method Statement (WMMS) relevant to the scope of work under their control. These Method Statements shall translate the requirements of this WMP into detailed, task-level procedures and work instructions that describe exactly how wastes will be identified, segregated, stored, labelled, handled, reused, recycled, transported and disposed of during individual construction activities. Contractor Waste Management Method Statements shall demonstrate how compliance with both this WMP and applicable Bangladesh waste management regulatory requirements will be achieved and maintained throughout the execution of the works. The WMMSs shall additionally demonstrate alignment with the applicable commitments and requirements of the ESIAR and the conditions of the ECC relevant to the contractor's scope of work.

Contractor Waste Management Method Statements shall include, as a minimum:

i. Identification of all anticipated waste streams associated with the contracted works.
ii. Waste minimisation measures and opportunities for reuse and recycling.
iii. Waste segregation arrangements, including container types, labelling and collection frequencies.
iv. Locations of waste storage areas and transfer points.
v. Procedures for handling hazardous and non-hazardous waste streams.
vi. Waste transport, tracking and consignment procedures.
vii. Roles, responsibilities and competency requirements.
viii. Inspection, monitoring and reporting arrangements.
ix. Emergency response procedures for spills, leaks or waste management failures.
x. Interfaces with a Waste Management Facility (WMF) and approved off-site waste facilities.
xi. Applicable Bangladesh regulatory requirements, permits, approvals and authorised waste management facilities relevant to the contractor's scope of work.
xii. Applicable waste management commitments, mitigation measures and monitoring requirements contained in the ESIR and any relevant conditions of the ECC.

All contractor Method Statements shall be aligned with and shall not conflict with, the requirements of this WMP. Contractors shall demonstrate compliance through inspections, waste tracking records, waste transfer documentation, audits and reporting, ensuring that waste management is implemented consistently across all Project activities and in accordance with applicable Bangladesh regulatory requirements. Contractors shall also demonstrate compliance with applicable ESIAR commitments and ECC conditions through monitoring, inspections, audits, reporting and record keeping. This WMP therefore provides the governance framework, while contractor-specific Method Statements provide the detailed implementation procedures required to achieve compliance in the field.

During the Construction Phase, waste generation is characterised by large volumes of construction materials, dredged material, packaging waste, domestic waste and hazardous wastes arising from temporary project activities. Effective contractor management is therefore essential to ensure waste is identified, segregated, stored, transported and disposed of in compliance with Project requirements and regulatory obligations. Table 22 summarises the principal waste management requirements and mitigation measures applicable to Contractors and Subcontractors during construction, including waste minimisation, segregation, tracking, storage and disposal controls designed to prevent pollution, minimise environmental liabilities and support compliance with the Environmental Clearance Certificate (ECC), ESIA commitments and this Waste Management Plan.

> ***IMPORTANT*: Table 22 is intended as a summary reference for Construction Phase waste management requirements and shall be read in conjunction with the detailed requirements contained in Sections 4 to 13 of this Waste Management Plan. The requirements presented in Table 22 apply specifically to the Construction Phase and do not replace, supersede, or limit any requirements specified elsewhere in this Plan. Together with the Operational Phase requirements contained in this Waste Management Plan, they form the complete set of waste management requirements applicable to the Project and Terminal.**



Table 22: Construction Phase Waste Management Framework summarizing the performance objectives, targets, Management and Mitigation Measures.

Activities	Aspects	Key Receptors	Performance Objective	Indicators	Targets	Mitigation and Management Actions	Type of Mitigation Option	Responsibility	Frequency / Timing	Monitoring and Record Keeping Requirements
Site establishment, mobilisation, fencing, signage and set-up of construction site offices and lay-down yards	Vegetation clearance, excess soil, generation of general C&D and domestic waste	Soil and land, local air quality, adjacent communities	Minimise waste generation and prevent uncontrolled waste accumulation during site establishment	Volume of waste generated vs. planned; number of non-conformances	Zero uncontrolled waste disposal; 100% of skips labelled, colour-coded and segregated	Implement this WMP and approved Contractor Waste Management Method Statements prior to mobilisation; segregate waste at source using the four-class colour-coding system; establish a Waste Management Facility (WMF); apply the waste management hierarchy	Avoid / Reduce	Contractor HSSE Manager	Throughout site establishment	Daily site inspection; weekly waste log
Earthworks: excavation, grading, soil stabilisation, ground improvement	Excavated spoil (solid waste), noise and vibration	Soil, surface water, adjacent communities	Maximise beneficial reuse of excavated material and prevent erosion / sedimentation	% of excavated soil reused on Site	Define % beneficial reuse of suitable spoil	Use excavated soil as fill material where suitable and approved for reuse; segregate any contaminated soil for hazardous waste management; stockpile management and erosion/sediment controls; record reuse volumes in the Waste Register	Reuse	Civil Contractor	Daily during earthworks	Weekly stockpile inspection; monthly waste report
Capital dredging and disposal / beneficial use of dredged material (Access Channel, Common Approaches, Turning Circle)	Dredged material, turbidity plume, potential release of sediment contaminants	Karnaphuli riverine environment, aquatic biodiversity (incl. Ganges river dolphin)	Manage dredged material in accordance with the Dredging Management Plan (DMP) and the London Convention	Turbidity levels; sediment characterisation results; volumes and disposal coordinates recorded	Compliance with ECR 2023 water quality standards; no unauthorised disposal outside approved footprints	Characterise sediments prior to dredging; dispose only at CPA-designated and approved disposal sites under the approved Dredged Material Disposal Plan; monitor turbidity and suspended sediment continuously; maintain dredging equipment, pipelines and barges to prevent leakage or overflow; provide environmental awareness training to all dredging personnel; assess beneficial reuse potential of dredged material ahead of disposal; deploy physical containment measures if practical and sediment plume controls to prevent deposition outside approved footprints; undertake hydrographic in/out-surveys and bathymetric monitoring; investigate and dispose of any wrecks, obstructions or UXO via qualified specialists; manage dredging vessel oily waste, garbage, bilge and bunkering waste in accordance with MARPOL	Avoid / Minimise	Dredging Contractor	Throughout dredging campaign	Continuous turbidity monitoring; records of dredged volumes, disposal coordinates and dates; DMP compliance audit
Operation and maintenance of construction plant, equipment and vehicles	Waste oil, oily water, spent filters, chemicals, batteries, tyres, e-waste and disposables from workshops	Soil, groundwater	Prevent spills and soil / groundwater contamination from workshop and maintenance waste	Number of spills; volume of waste oil recovered and recycled	Zero uncontrolled spills; 100% of waste oil sent to a licensed recycler; waste oil removed before storage capacity falls below 20%	Bunded waste-oil storage with secondary containment of at least 110% of the largest container; licensed collection contracts for waste oil, batteries, tyres and e-waste; spill kits at workshops and fuelling points; segregate hazardous maintenance waste from non-	Reduce / Recycle	Plant / Workshop Supervisor	Continuous	Monthly hazardous waste inventory; waste consignment / transfer notes

Activities	Aspects	Key Receptors	Performance Objective	Indicators	Targets	Mitigation and Management Actions	Type of Mitigation Option	Responsibility	Frequency / Timing	Monitoring and Record Keeping Requirements
						hazardous streams; connect workshop floor and inspection pit drainage to a full-retention oil-water separator with automatic demand-driven diversion valve (manual diversion valves not permitted); provide ventilated, bunded hazardous waste storage with containment walls; provide emergency showers, eyewash stations and local smoke / exhaust extraction at workshop maintenance bays				
Demolition of any existing structures within the Concession Area	C&D waste, dust, potential asbestos / lead-containing materials	Air quality, worker health, adjacent communities	Ensure safe identification, segregation and disposal of demolition waste	Completion of pre-demolition hazardous materials survey; % of C&D waste recycled	100% pre-demolition survey completed; greater than 50% of C&D waste recycled or reused	Pre-demolition hazardous materials survey; dust suppression; segregated skips by waste class; licensed disposal of any asbestos / hazardous material as hazardous waste with storage under 90 days	Avoid / Reduce	Contractor	Prior to and during demolition works	Survey records; waste consignment notes
Concrete batching and pouring; use of temporary cofferdams and formwork	Surplus concrete, waste formwork materials, dust	Soil, air quality	Minimise surplus concrete and formwork waste	Volume of surplus concrete generated per pour	Formwork material reused / recycled; surplus concrete beneficially used (e.g. filling, paving)	Accurate batching to reduce surplus; reuse of formwork; recycling of concrete washout water and residues; recovery of surplus concrete as inert (Class III) fill material	Reduce / Reuse	Civil Works Contractor	Daily during concreting activities	Weekly waste log; site inspection
Construction of administration building, workshops, customs inspection warehouse, pre-gate facilities, in-gate / out-gate complex and wastewater treatment plant	General solid waste, packaging, dust	Soil, air quality, adjacent communities	Segregate and reduce general construction waste at each work face	Number of segregated skip types available on Site	Minimum of three waste streams segregated at each active work face	Waste segregation at source per the colour-coding system; clearly labelled and signposted collection points in English and Bengali; scheduled skip collection; Contractor waste-awareness toolbox talks	Reduce / Recycle	Contractor HSSE Team	Continuous	Weekly site inspection; monthly waste report
Installation of underground conduits, electrical cabling, ICT / security systems, high-mast lighting and connection to power substations	Cable off-cuts and packaging waste, excavation spoil	Soil, land	Minimise excavation spoil and packaging waste from electrical installation works	% of excavation spoil reused	Define % of suitable spoil reused on Site	Coordinate trenching to avoid re-opening; segregate and reuse spoil; recycle cable reels, drums and packaging through approved recycling vendors	Reduce / Reuse	E&I Contractor	Continuous during installation works	Weekly inspection; monthly waste report
Set-up and management of construction site offices, storage / lay-down yards and (where	Domestic waste, food and sanitary waste, wastewater	Adjacent communities, surface water, groundwater	Safely manage camp / office domestic waste, food waste and wastewater with no	Volume of domestic waste generated; wastewater treatment compliance rate	100% of domestic waste collected and disposed of at an approved facility; food waste stored no more than 24	Daily collection of domestic / food waste; covered, leak-proof food waste containers; septic tank / wastewater treatment and testing; segregated recycling bins in offices ; provide a balance tank or equivalent	Reduce / Recycle	Contractor Administration	Daily	Daily collection log; monthly wastewater quality testing

Activities	Aspects	Key Receptors	Performance Objective	Indicators	Targets	Mitigation and Management Actions	Type of Mitigation Option	Responsibility	Frequency / Timing	Monitoring and Record Keeping Requirements
applicable) worker accommodation			negative impact on the environment		hours; treated wastewater meets ECR 2023 standards	flow attenuation with backup generator / UPS power for continuous WWTP operation during outages; provide duty/standby pumps, high-level alarms and screens at sewage lifting stations; reuse treated effluent for landscaping / toilet flushing where practicable; dewater sludge with leachate collection and dispose only at a DoE-approved facility				
Assembly and deployment of STS cranes and major equipment; final waste clearance and Site handover to Operations	Packaging waste, hazardous waste (oils, paints, solvents), residual Site waste, recoverable scrap steel and timber	Soil, adjacent communities	Achieve full clearance of construction waste and recovery of saleable materials prior to handover / commissioning	% of Site cleared of waste at close-out; value/volume of scrap steel and timber recovered for sale	100% of waste cleared and consignment notes closed out prior to Mechanical Completion; recoverable scrap steel and timber sold through approved recyclers	Final waste walk-down and sign-off; close-out of all hazardous waste consignments; removal of WMF stockpiles; sale of recoverable scrap metal and timber via approved procurement / finance procedures	Dispose (compliant) / Recycle	Construction Manager	End of Construction Phase	Close-out audit; waste consignment reconciliation
Waste identification, classification, labelling and signage across all construction work faces	Risk of cross-contamination, mishandling and mixed-waste disposal from incorrect waste identification	Worker health and safety, soil, air quality	Ensure all waste is correctly identified, classified and labelled at the point of generation	% of containers / skips correctly labelled at inspection; number of unidentified-waste non-conformances	100% of containers labelled with waste type, class, hazard classification (where applicable), generator, date and required PPE; zero unidentified-waste incidents	Apply the four-class colour-coding system (Class I Red-Hazardous, Class II Green-Non-Hazardous, Class III Yellow-Inert, Class IV Blue-E-Waste); label all containers, skips, drums, tanks in English and Bengali; treat any unidentified waste as hazardous until confirmed otherwise	Avoid / Reduce	Contractor HSSE Team	Continuous; verified at each inspection	Weekly labelling and signage inspection; non-conformance log
Waste collection, storage and segregation across construction work areas	Potential for overflowing containers, uncontrolled storage accumulation, spillage and cross-contamination	Soil, groundwater, stormwater systems, Karnaphuli River	Maintain compliant, segregated waste collection and storage in accordance with design and operational requirements	Number of storage non-conformances; % compliance with approved storage duration limits	Zero overflowing containers; hazardous waste stored less than 90 days; food waste less than 24 hours; recyclables removed at 80% capacity; waste oil removed before capacity falls below 20%	Provide fenced, impermeable and (where required) bunded storage areas with secondary containment of at least 110% for liquid wastes; maintain the WMF as a staging point for recyclables and for inspection/sign-off of outgoing waste manifests; conduct weekly storage inspections; replace damaged or leaking containers immediately; provide ventilated hazardous waste storage areas with containment walls / bunding in addition to secondary containment requirements	Avoid / Reduce	Contractor HSSE Manager	Continuous; weekly inspections	Weekly storage area inspection; hazardous waste inventory; storage-limit compliance records
Transportation and consignment of construction waste off-site	Risk of uncontrolled or unlicensed waste transport, spillage	Public roads, adjacent communities, receiving environment	Ensure all waste transported off-site is fully traceable, licensed and compliant	% of consignments with complete Waste Transfer Note (WTN)	100% of off-site waste movements accompanied by a WTN / consignment note; zero	Use only DoE-licensed waste transport contractors; cover all loads and weigh waste prior to dispatch; retain three copies of each consignment note (generator, HSSE	Dispose (compliant)	Contractor HSSE Manager /	Per consignment; monthly reporting	Consignment note register; monthly waste transportation summary

Activities	Aspects	Key Receptors	Performance Objective	Indicators	Targets	Mitigation and Management Actions	Type of Mitigation Option	Responsibility	Frequency / Timing	Monitoring and Record Keeping Requirements
	in transit, loss of traceability			documentation; number of unauthorised waste removals	unauthorised removals from the Concession Area	Department, disposal facility); require HSSE Department / Deputy HSSE Manager approval prior to any waste leaving the Concession Area; compile a monthly consignment summary for LCT management and as required, CPA / DoE / the Independent Engineer				
Waste minimisation, recycling and revenue-generating materials recovery (scrap steel, aluminium, wooden pallets / timber) during construction	Loss of recoverable value from scrap metal, timber, packaging and surplus construction materials	Landfill capacity, resource efficiency	Maximise reuse, recycling and revenue recovery from construction waste streams ahead of disposal	% of C&D, scrap metal and timber waste recycled / reused / resold; entries maintained in the Waste Recycling Register	Greater than 50% of C&D waste recycled or reused; scrap steel, aluminium and pallets segregated and sold through approved recyclers wherever practicable	Apply the waste hierarchy to procurement, design and construction planning (Section 11); segregate scrap steel, aluminium and timber / pallets for sale to licensed recyclers via approved procurement and finance controls; maintain and update the Waste Recycling Register; record quantities and revenue from recovered materials	Reuse / Recycle	Construction Manager HSSE Department	Continuous	Waste Recycling Register; quarterly recyclables and revenue reconciliation
Waste monitoring, reporting and record-keeping for the Construction Phase	Risk of incomplete or inaccurate waste performance data undermining compliance verification	Regulatory compliance, ESIAR / ECC commitments	Maintain complete, accurate and auditable waste management records throughout construction	% completeness of waste records; number of overdue monthly / quarterly reports	100% of waste movements recorded via Waste Disposal Form / WTN; monthly and quarterly reports submitted on schedule to LCT management and, as required, the Independent Engineer, CPA and DoE	Maintain a central waste record system (Waste Register, hazardous waste inventory, WTNs); conduct daily site inspections and weekly / monthly storage and facility inspections; document deviations and corrective actions; compile monthly and quarterly waste performance reports	Dispose (compliant) / Assurance	Waste Coordinator / HSSE Manager	Daily inspection; monthly / quarterly reporting	Waste Register; inspection reports; monthly / quarterly performance reports
Training, communication, contractor due diligence, inspection and audit of construction waste management performance	Risk of non-compliance due to inadequate competence, oversight or contractor control	Workforce, regulatory compliance	Ensure personnel and contractors are competent, informed and subject to effective oversight and independent verification	% of workforce completing waste induction / refresher training; number of inspection non-conformances closed out; audit findings closed within agreed timeframe	100% of personnel receive waste management induction and annual refresher training; monthly HSSE / Contractor waste meetings held; Waste Management Contractors subject to due diligence prior to appointment and at least annual audit	Deliver induction and annual refresher training covering the waste hierarchy, segregation, hazardous waste / SDS and PPE; hold monthly environmental (waste) meetings with Contractors; verify Waste Management Contractor licences and permits prior to appointment; conduct daily HSSE inspections and at least annual ISO 14001-aligned audits of waste facilities and contractors	Avoid / Reduce (through competence and assurance)	Contractor HSSE Manager / HSSE Department	Induction plus annual refresher; monthly meetings; annual audit	Training records; meeting minutes; contractor due-diligence records; audit reports and corrective action tracking

16. OPERATION PHASE - SUMMARY OF WASTE MANAGEMENT ACTIONS AND MITIGATION MEASURES

16.1. Introduction

Table 23 summarises the principal waste-generating activities, waste streams, environmental and social risks, performance objectives, management measures, responsibilities and monitoring requirements applicable during the Operational Phase of the Terminal. The Table covers routine terminal activities, including container handling operations, equipment maintenance, marine operations, dredging activities, wastewater management, waste segregation and storage, hazardous waste management, administrative activities, industrial waste streams and emergency spill response. The measures presented are intended to ensure that waste generation is minimised, opportunities for waste reduction, reuse and recycling are maximised, and all wastes are managed, stored, transported, treated and disposed of in a manner that protects the environment, workers, neighbouring communities and the wider Karnaphuli River and marine environment.

The Table reflects the requirements of this Waste Management Plan (WMP), applicable Bangladesh regulatory requirements, relevant Environmental and Social Impact Report (ESIAR) commitments, Environmental Clearance Certificate (ECC) conditions and recognised international good practice.

16.2. Relationship Between this Waste Management Plan and the Terminal Waste Management Standard Operating Procedure

This Waste Management Plan (WMP) serves as the overarching waste management framework for the Terminal and establishes the minimum standards, objectives, performance requirements, responsibilities and control measures that must be implemented throughout the Operational Phase. The Plan defines the waste management hierarchy, waste segregation requirements, storage standards, monitoring and reporting expectations, waste contractor management requirements, waste tracking and record-keeping processes and requirements for the transport, treatment, recycling and disposal of waste through authorised facilities.

To support implementation of this WMP, the Terminal shall develop, implement and maintain a comprehensive local Waste Management Standard Operating Procedure (SOP). The SOP shall translate the requirements of this WMP into detailed, site-specific operational procedures and work instructions that describe exactly how waste management activities will be carried out on a day-to-day basis. The SOP shall be tailored to the Terminal's layout, operational activities, waste streams, equipment, infrastructure, workforce and local regulatory requirements while remaining fully aligned with this WMP.

The Terminal Waste Management SOP shall provide detailed instructions for the identification, segregation, labelling, storage, handling, movement, treatment, recycling and disposal of all waste streams generated across terminal operations. It shall also clearly define responsibilities, inspection requirements, waste storage locations, waste collection arrangements, emergency response requirements, waste contractor management processes and reporting obligations.

As a minimum, the Terminal Waste Management SOP should include:

i. Identification and classification of all operational waste streams generated at the Terminal.
ii. Waste hierarchy implementation measures, including waste avoidance, reduction, reuse and recycling initiatives.
iii. Detailed waste segregation requirements, including bin and container specifications, colour coding and labelling standards.
iv. Management procedures for municipal, industrial, recyclable, hazardous, marine and dredging-related waste streams.
v. Procedures for the operation and management of a Waste Management Facility (WMF) or equivalent waste storage and consolidation facilities.
vi. Hazardous waste handling, storage, manifesting and disposal requirements.
vii. Management of vessel-generated wastes and Port Waste Reception Facility operations.
viii. Wastewater treatment sludge management procedures.
ix. Waste transport, tracking, manifesting and record-keeping requirements.
x. Approved waste contractor selection, evaluation and auditing requirements.
xi. Inspection, monitoring, reporting and performance tracking requirements.
xii. Roles, responsibilities, competency and training requirements.
xiii. Emergency response procedures for spills, leaks, fire, illegal dumping and waste handling incidents.
xiv. Applicable Bangladesh regulatory requirements and ECC conditions relevant to waste management activities.

The SOP shall be reviewed and updated periodically to reflect changes in Terminal operations, infrastructure, regulatory requirements, waste generation profiles, contractor arrangements, lessons learned, audit findings and continuous improvement initiatives. Accordingly, this WMP provides the strategic governance framework and performance requirements for waste management, while the Terminal Waste Management SOP provides the detailed operational procedures necessary to ensure consistent and effective implementation in the field.

During the Operations Phase, waste management becomes an ongoing business process integrated into day-to-day terminal activities, including container handling, equipment maintenance, vessel services, administration and facility management. The focus shifts from managing temporary, project-generated waste streams to the systematic control of routine operational wastes, with increased emphasis on resource efficiency, recycling, recovery, MARPOL compliance and the prevention of long-term environmental liabilities.

> ***IMPORTANT*: Table 23 is intended as a summary reference for Operational Phase waste management requirements and shall be read in conjunction with the detailed requirements contained in Sections 4 to 13 of this Waste Management Plan. The requirements presented in Table 23 apply specifically to the Operations Phase and do not replace, supersede, or limit any requirements specified elsewhere in this Plan. Together with the Construction Phase requirements contained in this Waste Management Plan, they form the complete set of waste management requirements applicable to the Project and Terminal.**

Table 23: Operation Phase Waste Management Framework summarizing the performance objectives, targets, Management and Mitigation Measures.

Activities	Aspects	Key Receptors	Performance Objective	Indicators	Targets	Mitigation and Management Actions	Type of Mitigation Option	Responsibility	Frequency / Timing	Monitoring and Record Keeping Requirements
Container handling and yard operations (RTGs / RMGs, terminal tractors, stacking, gate operations)	General waste: packaging, pallets, dunnage, municipal waste	Soil, air quality, adjacent communities	Minimise general operational waste sent to landfill	kg of general waste generated per TEU handled	Year-on-year reduction in general waste to landfill	Segregated, colour-coded waste bins at operational areas; recycling of pallets, packaging and dunnage; waste hierarchy training for terminal staff	Reduce / Recycle	Terminal Operations Manager	Continuous	Monthly waste generation report
Equipment and vehicle maintenance (STS / RTG cranes, terminal tractors, reach stackers, generators, workshops)	Waste lubricating and hydraulic oils, oil and fuel filters, oily water, batteries, tyres, scrap metal, wire ropes, paint and solvent waste, contaminated absorbents and e-waste	Soil, groundwater	Prevent soil and groundwater contamination from asset maintenance waste streams	Volume of waste oil / oily water recycled; number of spills recorded	100% of waste oil and oily water sent to a licensed recycler; zero uncontrolled spills	Oil-water separators and secondary containment of at least 110% of the largest vessel at workshops; segregate hazardous maintenance waste (oils, filters, absorbents, chemicals) from non-hazardous streams; isolate damaged or swollen lithium-ion batteries in fire-resistant containers pending removal; direct scrap metal and wire ropes to authorised recyclers; licensed collection contracts for oil, batteries, tyres and e-waste; connect workshop floor and inspection pit drainage to the WWTP oil-water separator via an automatic demand-driven diversion valve (manual diversion valves not permitted); provide ventilated, bunded hazardous waste storage with containment walls; provide dedicated workshop bays for electrical, mechanical, welding, hydraulic, tyre and battery maintenance and painting to minimise cross-contamination; provide emergency showers, eyewash stations and local smoke / exhaust extraction at workshop maintenance bays	Recycle	Maintenance / Workshop Manager	Continuous	Monthly hazardous waste inventory; oil-water separator inspection; maintenance waste storage inspection
Marine operations: vessel berthing, loading / unloading, pilotage	MARPOL Annex I-VI vessel waste (garbage, oily bilge water, sewage, cargo residues), ballast water	Riverine / marine environment, aquatic biodiversity	Achieve compliant management of ship-generated waste through the port waste reception facility	Volume of vessel waste received and disposed of; number of MARPOL non-compliances	100% of vessel waste received through the approved Port Waste Reception Facility; zero illegal discharge incidents	Provision of a port waste reception facility per MARPOL Annexes I-VI; verification of ballast water management certificates against the IMO Ballast Water Management Convention; vessel waste declarations reviewed by HSSE prior to berthing; hazardous vessel waste managed only by authorised, licensed contractors	Avoid / Contain	Terminal Operations Manager	Per vessel call	Vessel waste log; MARPOL compliance audit
Maintenance dredging and disposal / beneficial use of dredged material	Dredged material, turbidity	Riverine environment, aquatic biodiversity	Maintain design channel / berth depths with minimal	Turbidity levels during dredging campaigns	Compliance with the DMP and ECR 2023 water quality standards	Scheduled maintenance dredging in accordance with the DMP; sediment and turbidity monitoring; use of approved disposal sites only; assess beneficial reuse potential of dredged	Minimise	Terminal Operations Manager	Periodic, per DMP schedule	Turbidity monitoring records; DMP audit

Activities	Aspects	Key Receptors	Performance Objective	Indicators	Targets	Mitigation and Management Actions	Type of Mitigation Option	Responsibility	Frequency / Timing	Monitoring and Record Keeping Requirements
			environmental impact			material; deploy silt curtains and sediment plume controls; undertake hydrographic in/out-surveys and bathymetric monitoring; manage any wrecks, obstructions or UXO encountered via qualified specialists; manage dredging vessel oily waste, garbage, bilge and bunkering waste per MARPOL				
Operation of the Sewage Treatment Plant (STP) serving kitchens, toilets, welfare facilities, offices and other sanitary wastewater sources	Treated effluent, sewage sludge, odour, system reliability	Surface water, groundwater, adjacent communities	Treat all sanitary wastewater to a compliant discharge standard prior to discharge	Effluent quality (BOD, COD, TSS, nutrients, faecal coliforms); sludge disposal compliance; system availability	100% compliance with ECR 2023 effluent standards; zero discharge of untreated sewage; zero uncontrolled overflows	Operate and maintain the STP in accordance with design requirements and manufacturer specifications; provide biological treatment of sewage and greywater; provide balance tanks, duty/standby pumps, automatic level controls, high-level alarms, screens and backup power; maintain odour control systems; dewater STP sludge and dispose of through authorised facilities; maintain records of sludge generation, treatment and disposal; discharge treated effluent in accordance with applicable approvals and utility requirements.	Treat / Contain	Facilities Manager	Continuous; monthly sampling and inspection	Monthly effluent laboratory testing; STP operational inspections; preventive maintenance records; sludge generation and disposal records; alarm, overflow and corrective action records
Operation of wastewater management systems serving workshops, maintenance facilities, equipment washdown areas and wash bays	Oily wastewater, hydrocarbons, separator sludge, contaminated wash water	Surface water, groundwater, stormwater network	Prevent discharge of untreated oily wastewater and achieve compliant hydrocarbon concentrations prior to discharge	Oil and grease concentration; separator performance; sludge management compliance; system availability	Maximum 10 ppm residual hydrocarbons prior to discharge; zero uncontrolled discharges; zero bypasses of treatment systems	Collect all workshop and equipment washdown wastewater through dedicated drainage systems independent of the STP; route wastewater through full-retention oil-water separators prior to discharge to the stormwater network; maintain automatic diversion valves, oil-water separators, pumps and associated treatment infrastructure; inspect and remove accumulated oil and sludge routinely; manage separator sludge, interceptor sludge and recovered hydrocarbons as Class I Hazardous Waste; provide secondary containment and spill response equipment; undertake routine inspection, maintenance and performance testing. Installation of a future municipal sewage connection shall not alter the requirement for workshop and equipment washdown wastewater to be managed through dedicated oil-water separation systems.	Treat / Contain	Facilities Manager	Continuous; monthly sampling and inspection	Monthly wastewater quality testing; oil-water separator inspection records; preventative maintenance records; separator sludge and hazardous waste disposal records; hydrocarbon monitoring records; alarm, spill and corrective action records

Activities	Aspects	Key Receptors	Performance Objective	Indicators	Targets	Mitigation and Management Actions	Type of Mitigation Option	Responsibility	Frequency / Timing	Monitoring and Record Keeping Requirements
Segregation and storage of operational waste from all terminal sources	Risk of spills, dust, cross-contamination and non-compliant storage durations	Soil, air quality, adjacent communities	Maintain effective on-site segregation and compliant storage across all waste classes	Number of segregation / storage non-conformances identified at inspection	Zero cross-contamination between waste classes; hazardous waste stored less than 90 days; food and medical waste less than 24 hours; recyclables removed at 80% capacity; waste oil removed before capacity falls below 20%	Colour-coded bins / skips by waste class; fenced, bunded and access-controlled storage facilities per design requirements; use of the WMF for recyclables; scheduled collection by a licensed Waste Management Contractor; weekly storage inspections	Reduce / Recycle	HSSE Department	Continuous; weekly inspections	Weekly waste area inspection; storage-limit compliance records
Hazardous waste handling across terminal operations (oils, paints, solvents, chemicals)	Hazardous waste	Soil, groundwater, worker health	Ensure safe storage, transport and disposal of all hazardous waste	% of hazardous waste consignments with complete Waste Transfer Note documentation	100% of consignments documented; hazardous waste storage period under 90 days; secondary containment at 110% of largest container	Bunded hazardous waste storage with 110% secondary containment; SDS management for all stored chemicals; use of DoE-licensed hazardous Waste Management Contractors only; no burning or incineration on site; provide ventilated hazardous waste storage with containment walls / bunding	Contain / Dispose (compliant)	Deputy HSSE Manager / Environmental Coordinator	Continuous	Monthly hazardous waste register audit
General terminal administration, offices and customer service areas	Packaging, pallets, municipal / office waste, e-waste	Adjacent communities, landfill capacity	Maximise recycling of general and office waste	% of office waste recycled	Greater than 40% of office waste diverted from landfill	Recycling bins in office areas; paper-reduction initiatives and shredding of sensitive documents prior to recycling; e-waste sent to a specialist recycler with data-bearing devices securely erased prior to transfer	Recycle	Administration / Facilities Manager	Continuous	Quarterly recycling report
Industrial waste and scrap metal generation from terminal infrastructure, fabrication and container repair activities	Packaging, cartons, damaged components, spare parts, ferrous and non-ferrous scrap metal	Soil, landfill capacity	Maximise reuse and recycling of industrial waste and scrap metal and prevent contamination of recyclables	% of industrial waste and scrap metal recycled or recovered vs. disposed	100% of scrap metal segregated from general waste; scrap metal sent to landfill only where recycling is demonstrated to be impracticable	Segregate industrial waste and scrap metal from hazardous waste and e-waste at source; separate ferrous and non-ferrous metals where practicable; decontaminate oil/chemical-contaminated scrap prior to recycling; direct to authorised recycling contractors	Recycle	Asset / Equipment Manager	Continuous	Quarterly waste stream reconciliation
Emergency and spill response and clean-up operations	Contaminated recovered material, spill debris	Soil, water, adjacent communities	Ensure effective containment and compliant disposal of spill-response waste	Spill response time; % of spill waste correctly classified and disposed of	Spill contained within the timeframe specified in the Emergency Response Plan; 100% of spill waste manifested	Spill kits maintained at key locations; trained spill-response team; integration with the Emergency Preparedness and Response Plan (EPRP); spill waste managed as hazardous waste	Contain / Dispose (compliant)	HSSE Department / Emergency Response Team	As needed; drills at least quarterly	Incident register; spill drill records
Operation of the terminal medical / first-aid clinic and management of clinical waste	Infectious waste, sharps, pharmaceutical and pathological waste	Worker and public health, soil and groundwater	Ensure safe segregation, storage and disposal of all medical / clinical waste	% of sharps and infectious waste correctly segregated and disposed of; medical waste storage duration compliance	100% of medical waste stored less than 24 hours unless refrigerated; zero sharps-related injury incidents	Colour-coded, puncture-resistant sharps containers and dedicated bags for infectious waste; daily collection by trained personnel using appropriate PPE; disposal only via Ministry of Health / DoE-authorised medical waste transporters and approved treatment facilities; secure,	Contain / Dispose (compliant)	HSSE Department / Clinic Supervisor	Daily	Medical waste register; monthly inspection; incident reporting

Activities	Aspects	Key Receptors	Performance Objective	Indicators	Targets	Mitigation and Management Actions	Type of Mitigation Option	Responsibility	Frequency / Timing	Monitoring and Record Keeping Requirements
						access-controlled, weatherproof storage				
Battery waste management from terminal equipment, vehicles and facilities	Lead-acid, lithium-ion, Ni-Cad / NiMH and alkaline battery waste; risk of leaks, fire and short-circuit	Soil, groundwater, worker safety (fire)	Ensure safe segregation, storage and recycling of all battery waste by chemistry type	% of batteries segregated by chemistry; number of battery-related fire or spill incidents	100% of batteries recycled through authorised contractors or manufacturer take-back; zero battery-related fire incidents	Segregate batteries by chemistry; store lead-acid and large wet-cell batteries in covered, bunded areas with secondary containment for electrolyte leaks; isolate damaged or swollen batteries in fire-resistant containers; insulate terminals; prohibit opening, crushing or incineration; return to manufacturer or authorised recycler	Recycle	Asset Maintenance Manager	Continuous	Battery waste register; quarterly reconciliation with recycler records
Tyre waste management from terminal equipment and vehicles	Waste tyres from RTGs, terminal tractors, reach stackers and vehicles; fire and pest risk from stockpiling	Air quality (fire risk), soil	Maximise reuse, retreading and recycling of waste tyres and prevent uncontrolled stockpiling	% of tyres retreaded, recycled or recovered vs. disposed of	100% of waste tyres directed to authorised recycling or retreading facilities; zero open-burning or burial incidents	Segregate and store tyres in a designated area away from ignition sources and drains; assess for retreading or reuse before recycling; remove routinely to prevent stockpiling; transfer only to authorised recycling, recovery or retreading contractors	Reuse / Recycle	Asset Maintenance Manager	Continuous	Tyre waste register; quarterly waste stream reconciliation
Yard, terminal and public area cleaning, and vehicle / equipment wash-bay operations	Sediment, litter and contaminated wash water, oils and greases from cleaning and wash-bay operations	Soil, stormwater systems, Karnaphuli River	Prevent discharge of untreated wash water, sediments or contaminants from cleaning and wash-bay operations	Oil-water separator performance at inspection; number of uncontrolled discharge incidents	Zero uncontrolled discharge of contaminated wash water; 100% of vehicle / equipment washing conducted within designated wash bays	Undertake washing only in designated wash bays with impermeable surfaces, containment kerbs and drainage to oil-water separators; inspect and maintain separators routinely, removing accumulated oil and sludge as hazardous waste; clean drainage channels and catch pits routinely; use only approved cleaning products compatible with separator performance; fit wash bay drainage with an automatic demand-driven diversion valve defaulting to stormwater and diverting to the oil-water separator when hydrocarbons are detected (manual diversion valves not permitted); achieve maximum 10ppm residual hydrocarbon concentration at oil-water separators; reuse treated wash water for washdown / landscaping where practicable via a separate, clearly labelled recycled water network; verify treatment performance through annual water quality testing in addition to routine inspections	Contain / Treat	Facilities Manager / Cleaning Contractor	Continuous; routine inspection	Oil-water separator inspection and maintenance log; drainage inspection records
Waste minimisation, recycling and revenue-generating materials	Iron / scrap steel, aluminium, wooden pallets and timber, cardboard,	Landfill capacity, resource	Maximise waste avoidance, reuse and recycling and	% of office / general waste diverted from landfill; volume and	Greater than 40% of office waste diverted from landfill; year-on-	Maintain and periodically update the Waste Recycling Register; segregate and store scrap steel, aluminium and	Reuse / Recycle	HSSE Department / Administration-Finance	Continuous; Register	Waste Recycling Register; quarterly

Activities	Aspects	Key Receptors	Performance Objective	Indicators	Targets	Mitigation and Management Actions	Type of Mitigation Option	Responsibility	Frequency / Timing	Monitoring and Record Keeping Requirements
recovery (scrap steel, aluminium, wooden pallets)	plastics and other recyclables generated through operations	efficiency, revenue	capture commercial value from recoverable waste streams	value of scrap steel, aluminium and pallets sold or recycled	year increase in tonnage recycled or resold through the Waste Recycling Register	reusable pallets separately to preserve value; sell through approved procurement, finance and asset disposal procedures to licensed recyclers only; record revenue in accordance with Terminal financial procedures			reviewed periodically	recycling and revenue report
Roles, responsibilities and Waste Coordinator / Waste Champion governance across terminal operations	Risk of unclear accountability or inconsistent waste management practices across departments	Overall terminal compliance and performance	Ensure clear accountability and active operational oversight of waste management across all terminal areas	% of designated operational areas with an appointed Waste Champion; number of Waste Champion inspections completed vs. planned	Waste Coordinator and Waste Champions appointed for all key operational areas (Yard, Marine, Administration, Warehousing, Workshops, Maintenance & Repair, Contractor-managed areas); 100% of scheduled Waste Champion inspections completed monthly	Appoint a Waste Coordinator to maintain the Waste Register and support Plan implementation; appoint Waste Champions to conduct monthly inspections, verify segregation, signage and container condition, identify reduction opportunities and report non-conformances	Avoid / Reduce (through governance)	Terminal COO / HSSE Manager / Waste Coordinator	Monthly	Waste Champion inspection reports; monthly environmental performance report
Waste monitoring, reporting and record-keeping across terminal operations	Risk of incomplete data undermining compliance verification and continual improvement	Regulatory compliance, ESIAR / ECC commitments	Maintain complete, accurate and auditable waste records and reporting throughout operations	% completeness of waste records (WTN / consignment notes); on-time submission of monthly / quarterly reports	100% of waste movements recorded via Waste Disposal Form / WTN; monthly and quarterly waste performance reports submitted on schedule to LCT management and, as required, the Independent Engineer, CPA and DoE	Maintain the central Waste Register, Waste Recycling Register and hazardous waste inventory; conduct daily HSSE site inspections and weekly / monthly storage and facility inspections; document non-conformances and corrective actions; compile monthly and quarterly performance reports	Dispose (compliant) / Assurance	Environmental Coordinator / HSSE Manager	Daily inspection; monthly / quarterly reporting	Waste Register; inspection reports; monthly / quarterly performance reports
Training, communication, contractor due diligence, inspection and audit of terminal waste management performance	Risk of non-compliance due to inadequate competence, contractor control or insufficient independent verification	Workforce, regulatory compliance, terminal reputation	Ensure personnel and Waste Management Contractors remain competent, informed and subject to effective ongoing oversight	% of workforce completing annual waste refresher training; number of Waste Management Contractors subject to due diligence / audit; audit findings closed within agreed timeframe	100% of personnel complete induction and annual refresher training; all Waste Management Contractors subject to due diligence prior to appointment and at least annual audit; monthly environmental (waste) meetings held	Deliver induction and annual refresher training on the waste hierarchy, segregation, hazardous waste / SDS and PPE; hold monthly HSSE / waste meetings; verify contractor licences, permits and compliance history prior to appointment and periodically thereafter; conduct ISO 14001-aligned audits at least annually of waste transporters, recyclers, treatment and disposal facilities	Avoid / Reduce (through competence and assurance)	HSSE Manager / Environmental Coordinator	Induction plus annual refresher; monthly meetings; annual audit	Training records; contractor due-diligence files; audit reports and corrective action tracking

17. DECOMMISSIONING STAGE - SUMMARY OF WASTE MANAGEMENT ACTIONS AND MITIGATION MEASURES

17.1. Introduction

This Section defines the waste management activities, mandatory controls, responsibilities and verification requirements applicable to the Decommissioning Stage of the Laldia Container Terminal.

The Decommissioning Stage covers the permanent shutdown, isolation, decontamination, salvage, dismantling or demolition of Terminal infrastructure and the removal of salvaged materials and debris. In practice, these activities require a controlled sequence extending from planning and inventory through make-safe, asset recovery, demolition, waste transfer, remediation and final closure.

While decommissioning has been assessed as a credible lifecycle stage for completeness and long-term environmental planning purposes, the permanent closure and decommissioning of a modern greenfield container terminal is generally considered a low-probability scenario and is not a common occurrence within the global port and terminal industry. Container terminals are typically long-lived strategic assets that continue to operate, expand, modernise or be repurposed over many decades in response to changing trade patterns and operational requirements. Nevertheless, a future decommissioning scenario remains plausible over the long term, potentially 30 to 50 years or more after commencement of operations, should container throughput demand decline materially or alternative land uses, logistics solutions, transport corridors, technological developments or commercial opportunities become demonstrably more economically viable than continued terminal operations. In such circumstances, a structured and controlled decommissioning process would be required to ensure the safe recovery of assets, responsible management of waste streams, protection of the environment and compliance with all applicable regulatory and stakeholder requirements.

Decommissioning may generate the largest one-time concentration of recoverable and waste materials in the Project lifecycle. Typical streams include structural steel, aluminium, copper cable, concrete, asphalt, masonry, timber, glass, insulation, used equipment, oils, fuels, chemicals, batteries, tyres, lamps, refrigerants, e-waste, sewage and wastewater sludge, oily residues, contaminated soil and marine debris. Material shall not be treated as waste automatically. Equipment and materials shall first be assessed for continued use, transfer, refurbishment, resale, component recovery or recycling.

Table 24 summarises the principal Decommissioning activities and the associated make-safe, salvage, demolition, closure, remediation and handover activities, together with their waste streams, environmental and social aspects, performance objectives, mitigation measures, responsibilities and monitoring requirements applicable during the Decommissioning Stage of the Terminal.

17.2. Decommissioning Planning, Permits and Waste Inventory

A project-specific Decommissioning Waste Management Plan shall be approved before physical decommissioning starts. The plan shall be proportionate to the scope, condition and

contamination status of the assets and shall establish the sequence and controls required to prevent pollution and leave the Site in the agreed closure condition.

i. The plan shall define the boundary and end-state for each asset, structure, utility, marine facility and land parcel.
ii. A detailed asset and waste inventory shall identify reusable equipment, salvageable materials, recyclable materials, hazardous substances, stored products, residual liquids, contaminated media and expected waste quantities.
iii. Pre-demolition surveys shall identify asbestos-containing materials, lead-containing coatings, mercury lamps, PCB-containing equipment where relevant, refrigerants and other hazardous components before intrusive work.
iv. The plan shall identify permits, regulator notifications, CPA requirements, approved contractors, receiving facilities, temporary storage areas, transport routes, emergency arrangements and closure criteria.
v. Reuse, recycling and recovery targets shall be established after the inventory is completed and shall reflect confirmed local or approved market capacity rather than unsupported assumptions.
vi. No asset shall be dismantled until ownership, asset disposal approval, decontamination status and the intended material route have been documented.

17.3. Shutdown, Isolation, Draining and Decontamination

Equipment, tanks, pipelines, workshops, substations, wastewater systems and fuel or chemical facilities can retain oils, fuels, chemicals, gases, refrigerants, sludge or contaminated water after operations cease. These materials shall be removed before cutting, dismantling or demolition.

i. Process, electrical, hydraulic, pneumatic, fuel, water and drainage connections shall be identified, isolated and made safe under approved isolation procedures.
ii. Fuels, oils, chemicals, coolants, refrigerants and other recoverable products shall be drained into compatible, labelled containers and directed to reuse, recovery or approved waste routes.
iii. Tank, pipeline and equipment cleaning shall use contained methods. Wash water, sludge, scale and absorbents shall be collected and characterised before treatment or disposal.
iv. Atmospheric testing and contamination verification shall be completed where confined spaces, flammable vapours or hazardous residues may be present.
v. Decontamination shall be documented through certificates or release records before equipment is classified as clean scrap or transferred for reuse.
vi. Spills, leaks or previously unidentified contamination encountered during make-safe work shall trigger immediate containment, reporting, assessment and corrective action.

17.4. Salvage, Reuse and Asset Recovery

Salvage shall precede demolition wherever safe and practicable. STS cranes, RTGs, terminal tractors, reach stackers, forklifts, workshop equipment, transformers, generators, pumps,

treatment equipment, prefabricated buildings, fencing, racking and spare parts may retain operational or material value.

i. Each major asset shall be assessed for continued use, transfer to another facility, sale, refurbishment, parts recovery or recycling before demolition.
ii. Asset transfer and sale shall follow approved finance, procurement, information security and asset disposal procedures.
iii. Fluids, batteries, lamps, refrigerants and other hazardous components shall be removed before assets are cut or processed as scrap.
iv. Recoverable items shall be stored to prevent corrosion, physical damage, theft, mixing and contamination that would reduce reuse or recycling value.
v. Ferrous metals, aluminium, copper, cables, wire ropes and other recyclable materials shall be segregated by material type where practicable.
vi. Records shall reconcile the asset inventory with items transferred, sold, reused, recycled or disposed of.

17.5. Demolition of Buildings, Pavements and Civil Infrastructure

Demolition may include administrative and welfare buildings, workshops, warehouses, gate facilities, foundations, pavements, drainage systems, underground services, substations and other civil infrastructure. Selective dismantling and source segregation are required to preserve reusable and recyclable materials and prevent hazardous fractions from contaminating inert waste.

i. Pre-demolition hazardous materials surveys shall be completed and hazardous materials shall be removed by competent personnel before general demolition.
ii. Demolition shall follow an approved sequence that separates reusable components, metals, clean concrete and masonry, timber, glass, insulation, general waste and hazardous waste.
iii. Concrete and asphalt may be crushed and reused only where technically suitable, uncontaminated and approved for the intended use.
iv. Painted, oily or chemically contaminated metals and concrete shall be assessed before recycling or reuse and shall be managed as hazardous waste where required.
v. Waste shall be removed progressively. Demolition areas shall not become uncontrolled stockpiles or mixed-waste disposal areas.
vi. Open burning, uncontrolled burial and disposal of demolition material into the river, drains or unapproved low-lying areas are prohibited.

17.6. Electrical Systems, Batteries and E-Waste

i. Electrical and electronic equipment shall be isolated and assessed for redeployment, refurbishment or supplier take-back before recycling.
ii. Batteries shall be segregated by chemistry. Damaged or swollen lithium-ion batteries shall be isolated in suitable fire-resistant containment pending specialist removal.
iii. Transformer oils and other insulating fluids shall be sampled or otherwise assessed where contamination is possible before recovery or disposal.

iv. Fluorescent lamps, mercury-containing devices, capacitors and other hazardous components shall be removed without deliberate breakage and stored in rigid containers.
v. Data-bearing equipment shall be securely erased or destroyed in accordance with company information security requirements before transfer.
vi. E-waste shall be transferred only to authorised reuse, take-back or recycling providers and shall not be mixed with general scrap.

17.7. Closure of Workshops, Fuel and Chemical Facilities

Workshops, fuelling areas, chemical stores, wash bays, oil-water separators and hazardous waste stores present an elevated contamination risk because residual liquids and historical spills may remain in tanks, bunds, drains, sumps, concrete and underlying soil.

i. All stored products and wastes shall be inventoried and removed before facility demolition.
ii. Tanks, bunds, interceptors, pits, drains and pipelines shall be drained and cleaned using contained methods.
iii. Oil-water separator oil, sludge, tank bottoms and contaminated absorbents shall be managed as hazardous waste unless characterisation demonstrates otherwise.
iv. Concrete and soil showing staining, odour or other evidence of contamination shall be assessed and segregated pending classification.
v. Former storage and handling areas shall be included in the contaminated-land assessment and closure verification programme.
vi. Containment, fire protection and spill-response systems shall remain operational until hazardous inventories and residues have been removed.

17.8. Closure of STP, WWTP, Sewerage and Drainage Systems

i. Treatment facilities shall remain operational until their contributing wastewater sources have ceased and residual flows have been managed.
ii. Sewage, greywater, oily wastewater, sludge, screenings, grit and interceptor residues shall be pumped out, contained, characterised where required and transferred to approved treatment or disposal routes.
iii. Tanks, wet wells, pipelines, separators and chambers shall be cleaned before removal, filling or abandonment.
iv. Untreated sewage, sludge, contaminated water or cleaning effluent shall not be discharged to stormwater systems, soil or the river.
v. Backup power, alarms and contingency storage shall remain available until systems are emptied and isolated.
vi. Closure records shall document the quantity and destination of residual liquids and sludge and the final condition of retained or abandoned infrastructure.

17.9. Marine Infrastructure and River Protection

Removal of quay structures, marine equipment, piles, fenders, mooring systems, pipelines or other waterfront infrastructure can release debris, coatings, oils, concrete fragments and

sediments to the Karnaphuli River. Marine decommissioning requires specific containment, retrieval and navigation controls.

i. Marine dismantling shall be covered by an approved method statement identifying waste capture, dropped-object recovery, spill control, navigation interfaces and emergency response.
ii. Demolition debris shall not be deliberately deposited into the river. Suitable containment and retrieval equipment shall be provided for the work method selected.
iii. Dredged, excavated or disturbed sediment shall be characterised and managed according to contamination status and approved beneficial use, placement or disposal requirements.
iv. Recovered chains, cables, anchors, fenders, scrap steel and other marine equipment shall be segregated for reuse or recycling where practicable.
v. Fuel, bilge, garbage and other waste from decommissioning vessels shall be managed in accordance with applicable MARPOL and port requirements.
vi. Water-quality or turbidity monitoring shall be undertaken where required by the approved decommissioning method, permits or environmental management plan.

17.10. Contaminated Land and Remediation Waste

i. A risk-based contamination assessment shall cover workshops, fuel and chemical areas, substations, waste storage areas, drainage systems, spill locations and other potential source areas.
ii. Suspected contamination shall be delineated sufficiently to select an appropriate remediation or risk-management response.
iii. Excavated clean and contaminated material shall be segregated. Contaminated soil shall not be diluted or mixed with clean material to avoid hazardous classification.
iv. Remediation waste, treatment residues and contaminated groundwater shall be recorded and transferred through approved routes.
v. Validation sampling shall demonstrate achievement of agreed closure criteria, or residual contamination and land-use controls shall be formally documented.
vi. Remediation records shall be incorporated into the final closure report and retained for regulatory and future land-management purposes.

17.11. Waste Storage, Transport, Monitoring and Final Closure

i. Temporary decommissioning waste areas shall be designed for the expected peak volumes and shall provide segregation, impermeable surfaces, drainage controls, access control, fire protection and weather protection where required.
ii. Hazardous liquids shall be stored within secondary containment of at least 110% of the largest container or tank. Incompatible wastes shall be separated.
iii. All off-site waste movements shall use authorised transporters, covered or enclosed vehicles appropriate to the waste and complete WTNs or consignment records.
iv. Waste quantities shall be weighed or otherwise measured and reconciled against the decommissioning inventory.
v. Daily work-area inspections and at least weekly waste-storage inspections shall be undertaken during active decommissioning.

vi. Before final handover, all waste, temporary containers, stockpiles and waste facilities not intended to remain shall be removed. Former waste areas shall be inspected and remediated where required.

vii. The final Decommissioning Waste and Closure Report shall reconcile waste generated, reused, sold, recycled, treated and disposed of and shall include transfer records, certificates, analytical data, remediation verification, unresolved restrictions and management sign-off.

***IMPORTANT*: Table 24 is intended as a summary reference for Decommissioning Stage waste management requirements and shall be read in conjunction with the detailed requirements contained in Sections 4 to 13 of this Waste Management Plan. The requirements presented in Table 24 apply specifically to the Decommissioning Stage and do not replace, supersede, or limit any requirements specified elsewhere in this Plan. Together with the Pre-Construction, Construction and Operational requirements contained in this Waste Management Plan, they form the complete set of waste management requirements applicable to the Project and Terminal.**

Table 24: Decommissioning Stage Waste Management Framework summarizing the performance objectives, targets, Management and Mitigation Measures.

Activities	Aspects	Key Receptors	Performance Objective	Indicators	Targets	Mitigation and Management Actions	Type of Mitigation Option	Responsibility	Frequency / Timing	Monitoring and Record Keeping Requirements
Decommissioning planning and inventory	Potential unplanned waste, inadequate capacity and unauthorised routes	Regulatory compliance, environment, workforce, communities	Establish a controlled end-state and material route before physical work	Approved plan, inventory and facility verification	Approved Decommissioning Waste Management Plan; 100% of identified streams assigned a route	Define scope and end-state; inventory assets, products, hazardous materials and wastes; confirm permits, contractors, facilities, storage, emergency controls and closure criteria.	Avoid / Reduce / Assurance	Managing Director / Decommissioning Manager / HSSE Manager	Before decommissioning and upon material change	Approved plan; asset and waste inventory; permit register; contractor due diligence; facility approvals
Shutdown, isolation and decontamination	Residual oils, fuels, chemicals, gases, refrigerants, wastewater and sludge	Workers, soil, groundwater, stormwater, river	Remove hazardous inventories before dismantling	Systems isolated and released; spills	100% of relevant systems drained and decontaminated; zero uncontrolled release	Isolate systems; drain recoverable products; contain cleaning liquids and residues; test atmospheres; document decontamination status; manage spills and unexpected contamination.	Avoid / Contain / Recover	Asset Owner / Decommissioning Contractor / HSSE Manager	Before dismantling each system	Isolation certificates; decontamination records; analytical results; hazardous waste inventory
Salvage and dismantling of terminal equipment	Reusable assets, scrap steel, aluminium, copper, wire ropes, oils, batteries, tyres and e-waste	Resources, soil, groundwater, workers	Maximise reuse and recovery without contamination	Assets reused, sold, recovered, recycled and disposed	All major assets assessed before demolition; all hazardous components routed appropriately	Prioritise transfer, sale, refurbishment and parts recovery; drain fluids; remove batteries and hazardous components; segregate metals and protect recoverable materials.	Reuse / Recycle / Contain	Decommissioning Manager / Asset Manager	Throughout dismantling	Asset disposal records; recovery register; WTNs; sales and recycler certificates
Demolition of buildings and civil infrastructure	Concrete, asphalt, masonry, metal, timber, glass, insulation and hazardous building materials	Air, soil, water, workers, adjacent communities	Maximise selective recovery and safely remove hazardous materials	Survey completion; recovery rate; incidents	100% pre-demolition hazardous materials survey; no mixing of hazardous and inert waste	Remove hazardous materials first; selectively dismantle; segregate material streams; reuse approved clean inert material; remove waste progressively; prohibit burning, burial and river disposal.	Avoid / Reuse / Recycle	Demolition Contractor / HSSE Manager	Before and throughout demolition	Survey reports; daily inspections; material records; WTNs; incident records
Electrical systems, ICT, batteries and e-waste	Batteries, lamps, transformer fluids, electronics, cables and data-bearing devices	Soil, groundwater, workers, information security	Securely recover and recycle electrical and electronic assets	Items reused or recycled; custody completeness	100% transferred through authorised routes; 100% of data-bearing devices securely managed	Assess for redeployment; segregate batteries by chemistry; remove lamps and hazardous components intact; assess oils; erase data; use approved take-back or recyclers.	Reuse / Recycle	Electrical Manager / ICT Manager / HSSE Manager	During system removal	E-waste register; battery register; data destruction certificates; WTNs
Closure of workshops, fuel, chemical and hazardous waste areas	Residual chemicals, oils, oily water, sludge, contaminated concrete and soil	Soil, groundwater, stormwater, river, workers	Remove inventories and verify contamination status	Inventory reconciliation; closure assessment	100% of stored materials and residues removed; zero uncontrolled discharge	Drain and clean tanks, bunds, separators, drains and pits; characterise residues; maintain containment; assess stained concrete and soil; retain emergency controls until removal is complete.	Contain / Treat / Dispose compliant	Facilities Manager / Specialist Contractor / HSSE Manager	During closure and before demolition	Closure checklist; analytical data; hazardous waste WTNs; remediation records
Closure of STP, WWTP, sewerage and drainage systems	Sewage, wastewater, sludge, screenings, grit and interceptor residues	Surface water, groundwater, river, workers, communities	Prevent untreated discharge during shutdown	Residual liquids and sludge removed; closure verified	Zero untreated discharge; 100% of residuals managed through approved routes	Operate until inputs cease; isolate inflows; pump out and clean systems; retain backup arrangements; characterise residuals; document final condition.	Contain / Treat	Facilities Manager / Wastewater Contractor	Throughout shutdown and before abandonment	Operational logs; pump-out records; laboratory results; WTNs; closure certificate

Activities	Aspects	Key Receptors	Performance Objective	Indicators	Targets	Mitigation and Management Actions	Type of Mitigation Option	Responsibility	Frequency / Timing	Monitoring and Record Keeping Requirements
Marine infrastructure dismantling	Marine debris, coatings, oils, concrete fragments and disturbed sediment	Karnaphuli River, aquatic biodiversity, fisheries, navigation	Prevent marine pollution and recover dismantled materials	Debris recovery; spills; water-quality compliance	Zero deliberate disposal into river; all recovered materials recorded	Use approved marine method statement; provide containment and retrieval; recover dropped objects; classify sediment and debris; segregate reusable scrap; manage vessel waste under MARPOL.	Avoid / Contain / Recover	Marine Works Contractor / HSSE Manager	Throughout marine work	Marine debris register; monitoring results; dredged material records; WTNs; incident records
Contaminated land assessment and remediation	Contaminated soil, groundwater, sediment and remediation waste	Soil, groundwater, surface water, future users	Achieve agreed closure condition and prevent legacy liability	Areas assessed; validation results; residual restrictions	All potential source areas assessed; closure criteria achieved or residual risks controlled	Assess and delineate contamination; segregate excavated materials; implement approved remediation; validate results; document residual contamination and controls.	Treat / Restore / Dispose compliant	Environmental Manager / Remediation Contractor	After source removal and before handover	Assessment reports; analytical data; remediation plan; validation report; WTNs; closure approval
Removal of salvaged materials and debris	Dust, spills, traffic risk, mixed waste and loss of traceability	Public roads, communities, receiving environment	Remove materials safely through authorised and traceable routes	Complete WTNs; covered loads; transport incidents	100% of off-site movements documented; zero unauthorised disposal	Use approved transporters; segregate and secure loads; cover vehicles; weigh or measure materials; verify destination acceptance; retain signed transfer and receipt records.	Contain / Recycle / Dispose compliant	Logistics Manager / Waste Coordinator	Per movement	WTN register; weighbridge tickets; receiving certificates; vehicle and incident inspections
Final clearance and site handover	Residual waste, temporary storage areas and incomplete records	Future users, regulatory compliance, environment	Leave no unmanaged waste or undocumented liability	Final inspection and inventory reconciliation	All waste and temporary facilities removed or formally retained; zero unresolved critical actions	Reconcile inventory; remove stockpiles and containers; inspect and remediate former waste areas; compile final closure report; obtain management and regulatory sign-off as required.	Assurance / Restore	Decommissioning Manager / HSSE Manager	Final close-out	Final waste reconciliation; closure audit; remediation verification; handover certificate

18. CONCLUSIONS

The Laldia Container Terminal (LCT) Project/Terminal will generate a diverse range of waste streams throughout its Pre-Construction, Construction, Operations and Decommissioning phases, each presenting distinct environmental, regulatory and operational management challenges. Effective waste management is therefore essential not only for maintaining compliance with applicable Bangladesh legislation, Environmental Clearance Certificate (ECC) conditions, Environmental and Social Impact Assessment (ESIA) commitments, IFC Performance Standards and World Bank Group EHS Guidelines, but also for protecting the Karnaphuli River, surrounding communities, workers and the wider environment. Where suitable, dredged material generated by the Project shall be treated as a resource and beneficially reused in accordance with the waste hierarchy, reducing disposal requirements and supporting circular economy and resource efficiency objectives.

The transition from the Construction Phase to the Operations Phase represents a fundamental shift in waste management and environmental risk management requirements. During construction, waste management is primarily event-based, focusing on the control of temporary, high-volume waste streams associated with activities such as site preparation, dredging, land reclamation, civil works and infrastructure development. The principal objective during this phase is to prevent acute pollution incidents, manage temporary waste accumulation areas and ensure the safe handling, transport and disposal of project-generated wastes. Conversely, during operations, waste management becomes a continuous business process focused on the systematic and long-term management of routine waste streams, including municipal waste, maintenance waste, hazardous wastes, vessel-generated waste, wastewater treatment residues and recyclable materials. Effective management of this transition is critical, as while construction-related incidents are typically temporary in nature, poor operational waste management can result in long-term environmental impacts and possible liabilities, including soil and groundwater contamination, reputational impacts and regulatory non-compliance.

This Waste Management Plan establishes a comprehensive framework for the identification, segregation, collection, storage, transportation, recycling, recovery and disposal of wastes generated throughout the Project/Terminal lifecycle. Through application of the waste management hierarchy, the Plan prioritises waste avoidance, reduction, reuse, recycling and recovery before disposal is considered, thereby supporting resource efficiency, circular economy principles and continual improvement in environmental performance. The Plan further establishes clear roles, responsibilities, inspection regimes, monitoring requirements, contractor management obligations and waste tracking processes to ensure that all wastes are managed in a safe, compliant and environmentally responsible manner.

Implementation of the requirements contained within this Plan will support the Project/Terminal's commitment to maintaining compliance with its environmental approvals and "Red" Category Environmental Clearance Certificate while demonstrating alignment with recognised Good International Industry Practice (GIIP). Through the combined application of the Waste Champion Inspection Programme, routine inspections, waste performance monitoring, waste tracking systems, contractor oversight and periodic audits of third-party waste facilities, LCT will move beyond regulatory compliance towards a model of evidence-based environmental stewardship and continual improvement.

Ultimately, the successful implementation of this Waste Management Plan will ensure that all waste streams generated by the Project, from dredged material and construction waste during construction, to hazardous maintenance waste, vessel-generated waste and recyclable materials during operations, are managed in a controlled, transparent and traceable manner. In doing so, LCT will minimise environmental impacts, reduce potential long-term liabilities, support sustainable terminal operations and uphold its environmental responsibilities throughout the life of the Concession.



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Annex F2 – Oil and Chemical Spillage Management Plan

APM Terminals – Laldia Container Terminal

Project Execution

Oil Spill Management Plan

Version 2.0
October 2026

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ANNEX F2 – OIL SPILLAGE MANAGEMENT PLAN



Spill Prevention, Control and Response

Global Requirement – Environment

1. Purpose and Scope

The purpose of this requirement is to provide critical controls to reduce risks associated with Spill Prevention, Control and Response and guidance to fulfill these requirements to prevent environmental impact and prevent injury and ill-health. The requirements provided in this document apply to all APMT and Mærsk controlled[1] facilities, may be used to support improvement in uncontrolled facilities and shall be used in the selection of service providers.

2. Requirements

2.1 Spill Prevention, Control and Response Plan (SPCRP)

2.1.1 Site shall have a Spill Prevention, Control and Response Plan (SPCRP) for any hazards and hazard sources identified through the risk assessment process. The SPCRP may be stand alone, or contained in chapters in another document, e.g., emergency response planning.

2.1.2 Site shall undertake risk assessments to identify the hazards and hazard sources associated with spills utilizing the Risk Management Global Process (HSSE-PRO-002).

2.1.3 The SPCRP shall identify the roles and responsibilities and appoint persons for spill response onsite – Spill Management Team.

2.1.4 The SPCRP shall contain the following information:

- Inventories of paints, chemicals, oils, and fuels that are and will be stored in the locations within the Site. The inventory list shall include location, sub-location, material type, material name, typical volume (litres), container type, and MSDS/SDS availability (see Section 0).
- Site Spill Assessment: Type of spill sources, location of spill sources, type of material that can be spilled, volume/mass spilled during a single incident. Once the assessment is completed, this information shall be used to determine what the appropriate preventative, control and response measures shall be for the site.
  Note: The **Spill Assessment Survey Template** may be used for carrying out the Site Spill Assessment if an equivalent is unavailable.
- Map showing the drainage network onsite (see 3.1),

[1] **Operational Control** is defined as the situation where APMM or one of its subsidiaries holds the governing authority and responsibility for health, safety, and environmental (HSSE) management of the people, processes, and facility either directly or indirectly via contractual arrangements.

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- Spill risk sources across site and corresponding management plans (prevention, control, and response),
- Frequency (at least annually) and criteria for at least one table-top exercise and one equipment deployment spill drill exercise,
- Specific training needs and frequency for dedicated Spill Management Team and general training needs and frequency for all personnel, including refresher trainings, and
- Information pertaining to third party spill response and control teams such as local authorities (e.g., fire service) and third-party spill response contractors.

2.1.5 The SPCRP shall be updated whenever there is a significant change to operations or if there has been a significant spill incident, in any case at intervals not exceeding one year.

2.1.6 Site shall conduct training in spill response with relevant persons and keep a record of the training, in accordance with the SPCRP.

2.1.7 Site shall develop a schedule for conducting internal and external audits to assess each site's level of conformity with the Site's SPCRP, governing regulatory requirements and the requirements of this Global Requirement.

2.1.8 Third party management: If controls are the responsibility of a third party, the risk can remain with the Manager of the Site (e.g., delayed, or ineffective spill response by the Port Authority can significantly affect operations). In this case, the Site Management should aim to influence the third party to improve procedures or have sufficient spill response management in place to the extent possible.

2.1.9 Material Safety Data Sheet (MSDS) / SDS
- Material Safety Data Sheets (MSDS) / SDS shall be available for all hazardous materials including fuels, oils, paints, and chemicals that are stored and used at the Site.
- MSDSs shall be available at the location where the materials are stored in hard copy and in waterproof sleeves or containers. MSDSs shall be available electronically on local servers.
- Where MSDSs are identified as being missing, they shall be requested from the vendor. Until MSDSs are available products shall be moved to a quarantine area and not be used until safety data is available.

The following sections provide the minimum requirements for **Spill Prevention**, **Spill Control**, **Spill Response**, **Post Spill Monitoring**, **Reporting**, and **Communication**.

2.2 Spill Prevention

Preventing spills from occurring is the most effective way of managing the environmental and compliance risk of these events onsite. The following sections outline control measures to prevent spills from occurring.

2.2.1 Site shall assess equipment that is involved in the handling or transport of hazardous substances (for example, to determine if they are 'fit for purpose'). This includes equipment such as cranes, forklifts, etc.

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2.2.2 Appropriate inspection and maintenance program for on-site equipment shall be in place.

2.2.3 Hazardous Substances storage shall be chosen to meet the requirements of the products intended to be stored.

2.2.4 Storage of Hazardous Substances: Underground Storage Tanks (USTs) are not be permitted for storage of hazardous substances.

2.2.5 Loading / unloading and fuelling shall take place in designated and purposely designed areas.

2.2.6 Storage containers shall have securely closed lids unless in use.

2.2.7 Damaged containers shall not be used.

2.2.8 Periodic inspections of containers and containment areas shall identify deficiencies that may lead to spills, e.g., leaks or drips, damaged containment, or storage containers.

2.2.9 Storage containers shall be labelled and accurate tracking of and management of containers shall be based on the Material Safety Data Sheet (MSDS) / SDS.

2.2.10 For further guidance on Spill Response, see **Guidance Document – Spill Prevention, Control and Response**.

2.3 Spill Control

Once a spill occurs onsite, there are several measures that can be in place to allow it to be effectively controlled to limit the impact.

2.3.1 Floors at transfer areas and washing bays shall be liquid tight – waterproof and chemically resistant (e.g., truck parking during loading / unloading).

2.3.2 Concrete surfaces that may be exposed to leaking liquids (including bund, any manholes, control valve pits) shall have both waterproof and chemically resistant protective coatings. The coatings shall be applied in strict accordance with the manufacturer's recommendations and details. The protective coatings applied to all exposed concrete surfaces shall be from internationally recognized supplier such as Fosroc, BASF or equivalent.

2.3.3 Drip pans / trays shall be used beneath flange / hose connections and ensure that valve manifolds are provide with adequate secondary containment.

2.3.4 Storage of hazardous Substances shall be in appropriate dedicated facilities. For liquids, this means being stored within a liquid tight containment area with a capacity of at least 110% of the volume of the liquid being stored.

2.3.5 Areas for leaking (cargo) containers shall be allocated onsite and scaled to the size of operations. Spill risk assessment shall be carried out for the leaking cargo being transported through the Site.

2.3.6 Areas to which leaking containers shall be moved shall be appropriate to the spill risk identified.

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2.3.7 For further guidance on Spill Response, see **Guidance Document – Spill Prevention, Control and Response**.

2.4 Spill Response

2.4.1 Risk appropriate Spill Response Kits shall be provided within easy reach of spill risk areas, within weatherproof and accessible containers.

2.4.2 In some cases, Spill Response Kits and Control Equipment will be provided by an offsite third party, e.g., Port Authority or Port Authority contractors. In such case, the suitability of this third-party equipment shall be reviewed, and actions taken to achieve local regulatory requirements and this Global Requirement.

2.4.3 Personal Protective Equipment (PPE) shall be made available to enable first responders to spills to be protected. PPE shall be suitable for the materials handled and may include special overalls, gloves, eye protection, face masks, etc.

2.4.4 When a container with hazardous substances is stored within a bund, a diversion valve or shut-off valves shall redirect the bund drainage into a separate containment tank or pre-treatment unit (instead of into the stormwater network).

2.4.5 If any containment onsite drains to an onsite or offsite wastewater treatment plant (WWTP), measures shall be in place to ensure that any spills would not have a negative impact on the performance of the WWTP with negative consequences for the environment.

2.4.6 Areas where washing activities are performed
- Shall not directly discharge wash water into natural water, soil, or storm water systems,
- Shall have liquid-tight floors and containments in washing bay areas and bunding to capture and collect wash water,
- Shall have sloped floors to ensure wash water collection and preventing run-off from an incident on land to water bodies and other natural areas,
- Shall be designed to discharge the wash water to the sewerage system or pre-treatment unit, as required

2.4.7 If discharge of storm water is allowed directly to surface water or other natural areas, an oil/water separator shall be installed to intercept on onsite spill. If there is a potential for a large volume spill, additional measures shall be implemented to protect the integrity and defined functionality of the oil/water separator (e.g., installing a valve-lock drainage system such that the spills are trapped/contained, but can be pumped away to a dedicated treatment installation.

2.4.8 Spills or releases of dust or solids shall be contained by wind screens or damping measures to prevent release to the air or water.

2.4.9 Waste generated during the response to a spill shall be managed as per HSSE-REQ-033 Waste Management Global Requirement and local regulatory requirements.

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2.4.10 For further guidance on Spill Response, see **Guidance Document – Spill Prevention, Control and Response**.

2.5 Post Spill Monitoring

2.5.1 In case contamination to soil or groundwater is suspected following a spill[2] (where the spill can be transported beyond the Site boundary), post spill monitoring shall be in place.

- Testing for contamination shall be carried out and appropriate containment and/or remediation steps shall be implemented.

- Risk assessment, regulatory requirements (for example, environmental permit requirements, environmental monitoring scheme) and consultation with local regulatory bodies and/or external environmental consultants (where required) shall determine if contamination testing, monitoring and remediation steps are required, and the scope and duration of post spill monitoring.

2.5.2 For further guidance on Post Spill Monitoring, see **Guidance Document – Spill Prevention, Control and Response**.

2.6 Spill Reporting

2.6.1 Spills shall be reported in Fatal5 (GIZMO).

2.6.2 An incident investigation shall be conducted, and action plan(s) shall be developed to mitigate the risk of recuring incidents as per the requirements of the Incident Investigation Global Process (HSSE-PRO-013).

2.7 Risk Communication

2.7.1 Each Site shall produce a Site Map detailing the location of:

- Fuel, chemical, paint, and oil stores
- Liquid waste stores
- Oil and hazardous materials (HazMat) spill kilts
- Leaking container drip trays
- IMP Dangerous Goods (DG) storage areas
- Compressed gas stores
- Mobile refuelling / bunkering equipment
- Any other identified potential spill source

See Section 3.2 for an example of a Site Map with the above information.

2.7.2 The Site Map shall be available

[2] Spills to underground pipe networks, e.g., storm water sewer / drainage systems shall be defined as spill to land

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- In the Site's Spill Prevention Control and Response Plan (SPCRP)
- On facility- and HSSE- notice boards
- At locations where oil, chemical, paint, and fuels are being stored
- At IMO DG storage areas
- In the facility Control Room

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3. Guidance

3.1 Surface Water Drains

3.1.1 A map showing the following information shall be available for the site:

- Location, flow direction and outfalls of the drainage network onsite
- Catchment areas of each drainage basin clearly labelled including closed systems such as those in workshops and storage areas
- Drainage systems (**Hazardous / Contaminated / Oily Water**, **Clean Surface / Storm Water**, **Sanitary Water**, **Municipal Sewerage**, etc.) shall be coloured using local standards (or where not present, use above system)
- Location of wastewater storage and treatment equipment
- Location of municipal sewers and any site connections
- Location of manholes, inspection covers, drain inlets and other accesses

Figure 1 Example of Map with Surface Water Network



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3.2 Risk Communication – Site Map

Figure 2 Example of Site Map showing locations of oil, fuel, chemicals, and paint stores; location of spill kits (by type); drip trays; and IMO DG storage areas

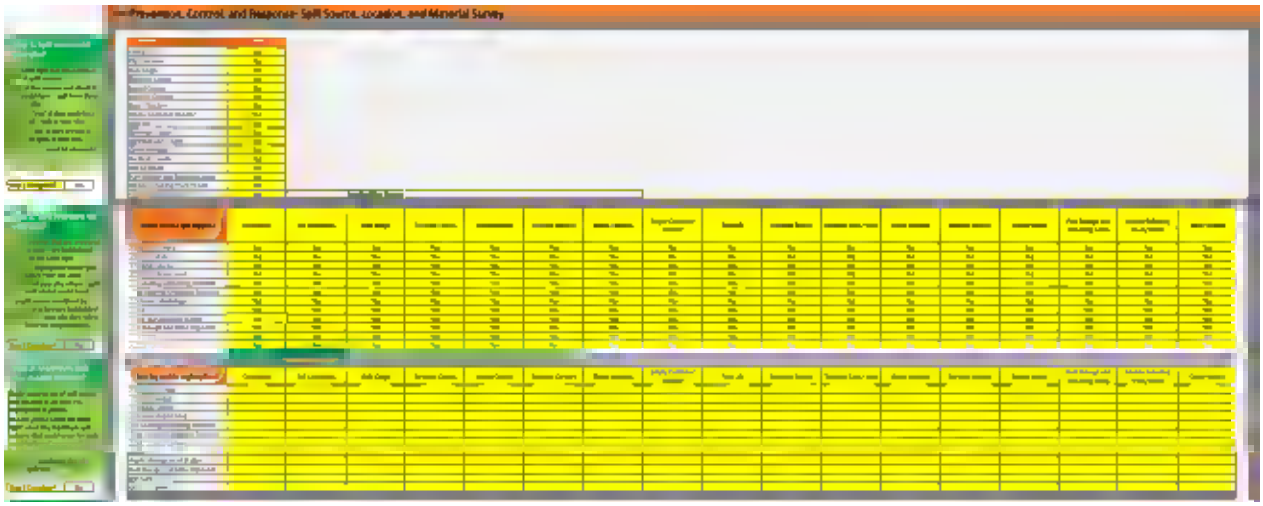


4.Related Documents and Sources

This global requirement connects or contains reference to the following:

Documents, Sources and Links
Spill Assessment Survey Template
HSSE-REQ-034 Guidance Document – Spill Prevention, Control and Response
Risk Management Global Process
How to conduct an Incident Investigation Global Process
Waste Management Global Requirement
Personal Protective Equipment Global Requirement
APM Terminals Standard Employer's Requirements (SER) #006 Yard, Civil and Structural, Part E Leaking Container Bund

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Spill Prevention, Control and Response toolkit.

Annex F3 – Ballast Water Management Plan

APM Terminals – Laldia Container Terminal

Project Execution

Ballast Water Management Plan

Version 2.0
October 2026

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1. ROLES AND RESPONSIBILITIES

1.1. Fleet Environment and Regulatory Department.

The Fleet Environment and Regulatory Department is responsible for preparing, revising, and arranging approvals of the vessel specific Ballast Water Management Plan (BWMP).

1.2. Ballast Water Management Officer (BWMO)

The Chief Officer is the Ballast Water Management Officer and is responsible for:

- The implementation of this procedure on board
- The implementation of the Ballast Water Management Plan

Detailed responsibilities of the Ballast Water Management Officer are outlined in the vessel-specific Ballast Water Management Plan.

2. BALLAST WATER MANAGEMENT STANDARDS D-1 AND D-2

There are two ballast water management standards (D-1 and D-2). All vessel under Maersk A/S DoC have been certified to comply with the D-2 standard.

2.1. Regulation D-1 – Ballast Water Exchange Standard

The D-1 Standard is only to be considered during contingency measures and with relation to challenging water quality.

The D-1 standard requires vessels to exchange their ballast water such that:

- at least 95% of water by volume is exchanged far away from the coast
- at least 200 nautical miles from land
- at least 200 metres deep waters.

2.2. Regulation D-2 – Ballast Water Performance Standard

The D-2 standard requires the availability of an IMO type-approved Ballast Water Treatment System (BWTS). The installed approved BWTS must be used in accordance with the vessel specific BWMP.

NOTE: The contingency measures are described in Section 4 of this procedure.

NOTE: The IMO Type Approval Certificate's expiration doesn't affect whether a BWTS is still valid and operational. If a BWTS was manufactured while the certificate was valid, it doesn't need renewal or replacement just because the certificate has expired. However, any modification, without approval of BWTS makers, will invalidate the existing TAC.

3. BALLAST WATER HANDLING AND BALLAST PLANS

3.1. Planning

A ballast plan must be made specific for each operation and is required every time when a ballast exchange operation is done.

The ballast plan must indicate the drafts, stability and stress values sufficient to ensure the safe limits are not exceeded.

The plan shall also take any special rules or precautions which may be applicable to certain terminals, vessel types and local / flag state regulations into consideration.
The Ballast Water Management Officer:

- Calculates which ballast tanks shall be used and to which level tanks should be transferred, filled or discharged.
- Give instructions to the OOW for transferring, ballasting or de-ballasting.

3.2. Execution

The execution of the ballast plan shall be as close as possible to the original plan drawn up. The execution shall be supplemented, if required, by daily orders. The OOW shall follow the ballast plan and line up the ballast system for the intended operation.

3.3. Monitoring

We shall continuously monitor the ballast operation in accordance with the ballast plan and that any specific terminal regulations are being observed. Should the operation deviate from the plan, the OOW shall inform the BWMO immediately.

Such monitoring shall extend to cover at least stability and stress values, tank levels, condition of ballast equipment, weather/tidal/sea conditions and moorings.

4. USE OF BALLAST WATER TREATMENT SYSTEMS (BWTS)

Where the vessel is provided with an approved BWTS, the system must be operated in accordance with the system's operating manual and the vessel's BWMP.

It must be ensured that the system is set to the correct operational mode such as ballasting, de-ballasting, stripping and by-pass mode, as applicable.

The Ballast Water Management Officer and the Chief Engineer are responsible to ensure all start up pre-checks are completed, and the system is operational.

Additionally, for BWTS based on UV technology ensure the following:

- Keep the UV-sensor housing clean as described in Maker's Instruction Manual.
- CIP cleaning to be done before and after operation if system run in turbid waters, as per maker's instructions.
- Run system Sea-to-Sea to flush the system after an operation in turbid waters.
- If BWTS has been idle for a month, run it sea-to-sea for 2 hours every month. Ensure that the system, including filter & UVR, is filled with fresh water during the idle period.

4.1. Internal transfer, intake, discharge of ballast water

Transfer, intake, discharge and mid ocean exchange of ballast shall be conducted as prescribed by the vessel's Ballast Water Management Plan, Deck Operating Manual and/or BWTS Operating Manual (if applicable), and with due regard to the considerations mentioned under Planning.

Ballast water taken under D-2 Standard, through BWTS, in one port may be discharged through D-2 Standard (through BWTS) in any port without any restrictions.

Treated ballast water which is mixed with untreated ballast water is no longer in compliance with D-2 Standard of the BWM Convention.

4.2. Mid Ocean Ballast Water Exchange (BWE)

Contact the local agent and TbM for information about local restrictions on:

- The carriage and discharge of untreated ballast
- Documentation and reporting requirements for ballast exchange

Mid Ocean Ballast Exchange are intended to protect the environment. If ballast exchange is done carelessly, it will cause extra fuel consumption, thus resulting in the contrary to environmentally protection.

An exchange must never threaten the safety of the vessel, crew or cargo.

All vessels must use the Sequential Method as the preferred exchange method in the form of an exchange plan that suits the vessels sailing and loading conditions.

BWE shall be conducted as per the requirements outlined in section 2.1.

4.3. Sediment Removal and Flushing Log

Consult the BWMP for guidance on sediment removal and flushing.

Monitor the volume of sediment in a ballast tank, during tank inspections and record it in Form 730b – Tank Condition Report.

Always consider safety and operational considerations addressed in the BWMP during any of the processes related to sediment removal.

5. CONTINGENCY MEASURES IN CASE OF MALFUNCTIONING BWTS

The safety of the vessel and crew supersedes below contingency measures. Using below contingency measures must never threaten the safety and stability of the vessel nor the safety of crew or cargo.

There are two ways to handle ballast water:

- Internal transfer of the ballast water; or
- Cleaning of ballast by means of the mid ocean exchange method.

If internal transfer is not enough or possible, the mid ocean exchange method is the best contingency. Permission from the port authority to discharge ballast water that has not been treated through the BWTS must be obtained.

Therefore, in case of a malfunctioning BWTS, below steps should be taken:

- Evaluate if internal transfer would suffice to complete the loading/unloading in the next port of call and the repair of the BWTS can be completed.
- As soon as possible inform Class, Flag and the Port Authority in the next port of call about the breakdown and advise on the plan for rectification.
- If it is required to discharge ballast water in the next port of call and if mid ocean exchange can be performed and completed, then also request permission from the port authority if they will accept discharge of untreated ballast water that has undergone mid ocean exchange before arrival.
- In the US, the USCG requires that the closest Captain of the Port (COTP) and the COTP for the intended port must be contacted immediately upon inability to operate the BWTS.
- Contact the Stowage Department (GSP) as soon as possible to have them prepare for potential changes in the stowage plan if the port authority does not agree to the discharge of untreated ballast water.
- Adequate spare parts to be available according to the critical spare part list.
- Carry out mid ocean ballast water exchange in accordance with Section 3.6

5.1. Operating in challenging water quality conditions

Vessels might experience low flow rate and low value of UV Intensity during BWTS operation in challenging water quality (CWQ) therefore vessels must consider:

Prior to arrival:
If as per the pre-arrival condition, ballasting is required in ports with challenging water quality:

- Consider taking in additional ballast in open waters, not compromising on safe navigation and vessel's stability.
- If intake of ballast with challenging water quality in port cannot be avoided, consult GSP for a revised stowage plan.

In port:

- As far as practicable, manage with internal ballast transfer in ports with turbid waters.
- Stop ballasting operations if UV Intensity Low Value alarm is active.

If it is required to ballast when the above alarm is active, below guidance can be followed to enable ballasting in port, thus the CWQ.

5.2. CWQ triggers

CWQ actions should be implemented when, the BWMS delivers a critical alarm identified in the BWMP signalling that an operational limitation has been reached or the BWMS is not meeting operational demand for D-2 compliance.

CWQ triggers consist of relevant alarms concerning matters such as:

- The required UV transmittance or UV dose of the BWMS
- The maximum allowable differential pressure across the filter to prevent permanent damage to the filter element.
- A reduction in flow rate that is below the minimum operating requirements of the BWMS.
- Monitoring data of the BWMS when the self-monitoring system indicates the BWMS is not operating normally:
  - Variation of pressure in filters, UV transmittance or dosage and/or the levels of dissolved organic carbon and/or turbidity and/or total suspended solid that triggers an alarm of the BWMS.

NOTE: At all times, alternatives should be tried before the ship bypasses a BWMS, because bypass increases the risks ballast water poses to the environment, human health, property and resources. Bypass also increases the operational workload for crew to perform alternative management methods and subsequently return of the BWMS and ship to normal operations for D-2 compliance.

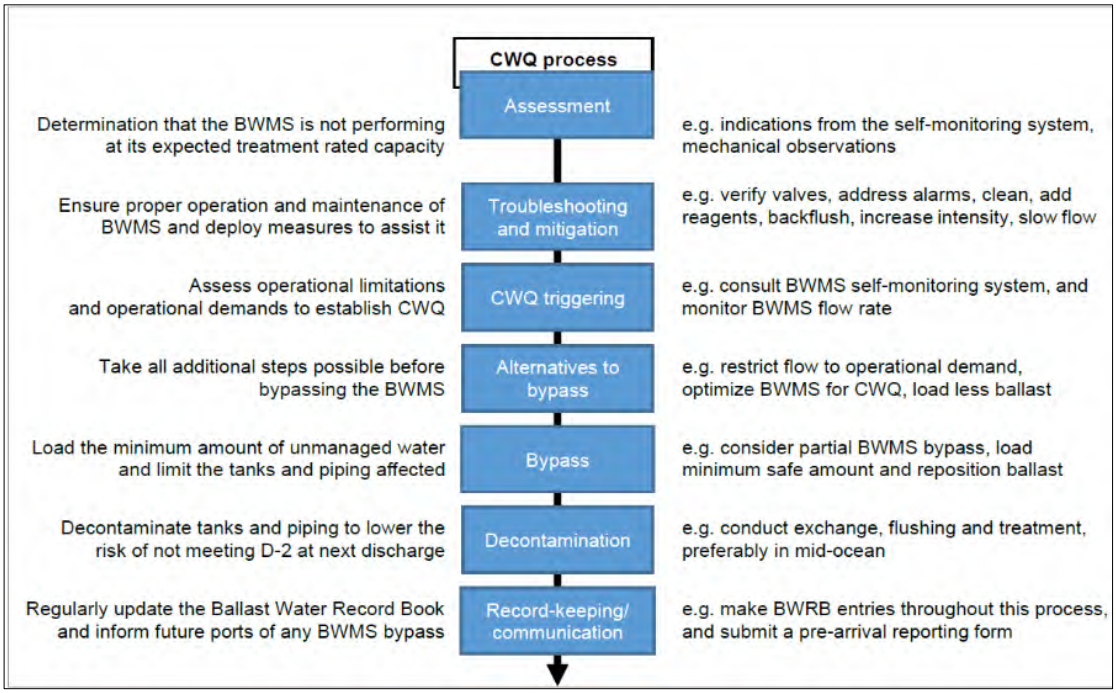


Figure 5-1: **Overview of the CWQ process**

5.3. Bypass of the BWMS

Before the BWMS is bypassed, the BWMO should:

- Ensure that any BWMS alarm that could be ascribed to CWQ is not caused by other factors such as malfunction, maintenance, crew familiarity or experience.
- Ensure that the BWMP and OMSM have been followed in troubleshooting the operation of the BWMS.
- Restrict the flow rate of the BWMS to the minimum level consistent with operational demand.
- Consider persisting with using the BWMS in the challenging area to load the minimum safe amount of ballast water and complete remaining ballasting at a nearby less challenging location at a later time.

5.4. Bypass procedure

The sequence of steps for safely bypassing the BWMS in the BWMP and OMSM should be followed. Furthermore:

- Consideration should be given to limiting the number of ballast tanks that will be exposed to partially treated or unmanaged ballast water.
- Consideration should be given to treating the minimum amount of the uptake water, by continuing to apply the BWMS to as much of the uptake water stream as practically possible.
- Only the minimum volume of ballast water should be taken on board through the bypass.

5.5. Following a bypass event in a location with CWQ

After a bypass event, decontamination must be made, to ensure that subsequent discharges meet the D-2 performance standard. This may include ballast water exchange through a BWMS (BWE+BWT). However, BWE+BWT alone may not be sufficient to meet the standard. This risk may be mitigated by conducting ballast water flushing.

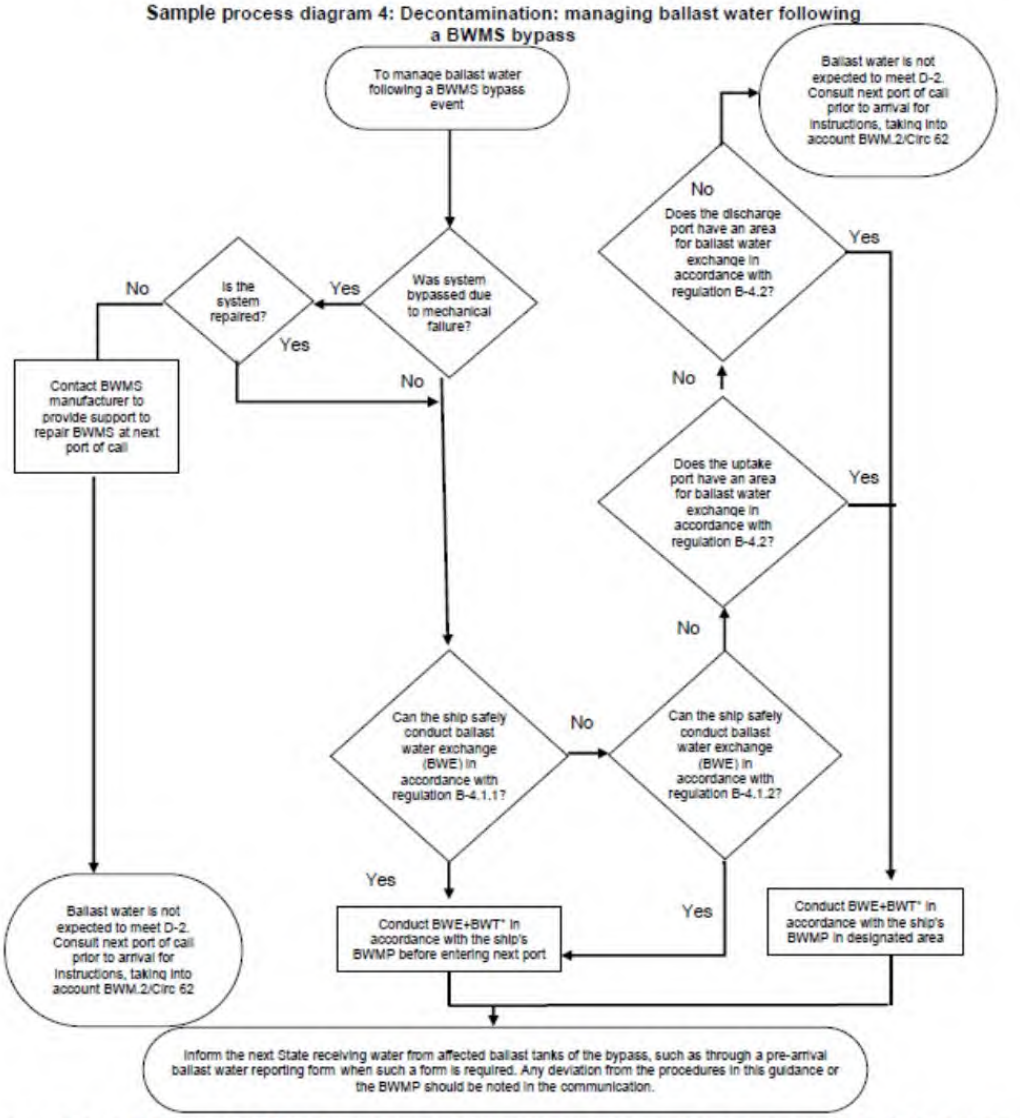
NOTE: Bypass should always be considered as the last resort and the BWMS should be used as far as practicable to treat ballast water with CWQ. Regulation B-4.3 does not apply to decontamination following a bypass of a BWMS, in order to restore compliance to regulation D-2.

5.6. Decontamination

The following steps are intended to return to compliance with regulation D-2 after a BWMS has been bypassed. Having loaded the minimum volume of ballast water, proceed to the first suitable location for the discharge of ballast water from the following list:

- Ballast water exchange to be carried out at more than 200nm from shore and at a depth of more than 200m. In cases where the ship is unable to conduct Ballast Water exchange in accordance the above, as far from the nearest land as possible, and in all cases at least 50 nautical miles from the nearest land and in water at least 200 metres in depth.
- Designated areas of the port state for ballast water exchange.
- Replace the ballast water in each contaminated tank through ballast water exchange flushing and treatment. Only sequential method must be used in the decontamination phase:
- The ballast water should be fully discharged through the treatment process for the deballasting operation of the BWMS, if technically feasible.
- The stripping pump (eductor) should be used to remove residual water from the tank.
- The concentration of organisms in remaining residual ballast water and sediments should be reduced by flushing the tank using the following sequential steps, if allowed and/or required by the receiving port State.
- The addition of treated water to the ballast tanks.
- The mixing, through the motion of the ship, of the added water with the residual ballast water and any sediments that have settled in the tanks.
- The release of the mixed water
- The tank should be refilled with treated ballast water.

Sample process diagram 4: Decontamination: managing ballast water following a BWMS bypass



* For decontamination purposes, BWE+BWT is to be done in accordance with the OMSM, approved Ballast Water Management Plan, and best practices. For the sequential method, ballast tanks should be emptied, residual ballast water and sediments should be managed (by flushing the tank with treated water, if allowed and/or required by the receiving port State), and then the tank should be refilled with treated water. For non-sequential methods, a sufficient volume of treated uptake water should be pumped through to reduce the concentration of organisms in the tank to the standard in regulation D-2, at least 1.66 times the volume specified by regulation D-1.2, if required by the receiving port State. The BWMS should be used during emptying of contaminated tanks, as well as subsequent uptakes, flushing and discharges during decontamination, if technically feasible. See appendix 1.

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6. RECORD-KEEPING FOR CWQ

In instances when the BWMS has not operated as expected owing to CWQ and may not be treating the water successfully, such circumstances carry greater environmental risk and should be recorded in the Ballast Water Record Book (see Doc ID: A040c).

The ship's Ballast Water Record Book should include a description of:

- The reason why normal ballasting operations were stopped.
- Any steps taken to optimize the treatment process and resolve BWMS technical malfunctions.
- The operational demands that were not met and/or operational limitations encountered.
- The steps that were taken prior to a bypass being initiated.

- The tanks which have received bypassed ballast water (tank ID)
- The date, time, and location where the bypass took place.
- The decontamination steps that were taken to recover from BWMS bypass as per the approved BWMP, including:
  - The start and end locations at which any exchange took place.
  - The start date and time; end date and time, the method of exchange
  - The volume exchanged.

6.1. Temporary storage of treated sewage and/or grey water in ballast tanks

There are exceptional situations where, to comply with coastal State regulations or inadequate reception facilities at ports, dry-docks and terminals, it may become necessary to store treated sewage and/or grey water in ballast water tanks.

Temporary storage of Treated sewage or greywater (TS/GW) in BW tanks should only be used as an option in extraordinary cases, where there is no other option than to store TS/GW in any other tanks, due to unforeseen operational constraints. Mixing ballast water and TS/GW in a BW tank should be avoided at all times.

NOTE: Side effects if storing TS/GW in Ballast tanks, is known to be, and not limited to: Reverse osmosis effect of the paint coating in the tank, challenges to comply to the D-2 requirements after flushing tanks several times.

6.2. Recovery to Ballast water tanks

Appropriate measures should be taken to prevent contamination of the ballast system by TS/GW and to prevent accidental discharge of TS/GW within restricted waters. (e.g. closing the valves or using blanks, spectacle flanges and pipeline blinds or using isolated pump and pipeline, and/or using a lockout/tagout).

In case a ship changes the use of a BW tank to store TS/GW, the BW tank must be fully emptied, including removal of any residual ballast water, as far as practicable, through the BWMS. The removal and disposal of sediments should be carried out as per P730 and BWMP.

In case a ship changes the use of a BW tank from TS/GW storage back to ballast water storage, the ship should follow the following procedures:

- The contents of the BW tank(s) should be discharged directly to sea. The BW tank, pipes, and dual-purpose pumps should be flushed with the normal maximum volume of the tank.
- Water used to flush the tanks should not be discharged through the BWMS to avoid residue from the TS/GW entering the BWMS as this could potentially harm the BWMS.
- Subsequent to the discharge and flushing, the ballast water tank should be reconnected to the ballast system and the tank should be flushed once more with treated ballast water to replace the residual water thus ensuring the tank is ready to return to ballast operations in accordance with the BWM Convention.

  The discharge of ballast water and TS/GW should adhere to the following principles:

- The discharge of ballast water and sediments should be in compliance with the BWM Convention; and
- The discharge of TS should be in compliance with MARPOL Annex IV where relevant. Please ref A302a Sewage non discharge zones.
- Above operation must be entered into the Ballast Water Record Book

NOTE: The Ballast Water Management Plan must include a ship-specific change-over procedure, from ballast water storage to TS/GW storage and back to ballast water storage, including pump and piping associated with the dual-purpose BW tanks, with specific details on how the flushing is conducted. Should a vessel intent to use Ballast tanks for the storage of TS/GW, send the vessel specific plan to MLFMTENV including the specific tank, to get the appendix issued for the BWMP.

6.3. Record keeping/Reporting

Record keeping, and reporting shall be in accordance with the vessel's BWMP. All records must be kept on board for a minimum period of five years from the date of last entry. The required logs are available in the company's SMS as follows:

- Form 730a – Ballast Log Book
- Form 730b – Tank Condition Report
- Form 730c – Ballast Water Reporting Form
- Form 730d – Sediment Removal Flushing Log

NOTE: The Ballast Log Book is to be maintained according to Appendix II of the BWMC (Doc ID: A730a).

When using a local Ballast Water Reporting Form which requires salinity in units of 'parts per thousand (ppt)', consult the 'NOAA - Ballast Water - Specific Gravity to Salinity Conversion Guide' (Doc ID: A730c).

6.4. Reporting

Vessel is to report to the Flag, Class and next port of call should contingency measures be triggered. Any deviation from the procedures in this Guidance or the BWMP should be noted in the communication.

Whenever a full or partial bypass of a BWMS is undertaken, the next State receiving water from affected ballast tanks should be informed of the bypass, such as through a pre-arrival ballast water reporting form, when such a form is required. Any deviation from the procedures in this Guidance or the BWMP should be noted in the communication.

6.5. Precautions

Precautions for safety and operation are outlined in the vessels Ballast Water Management Plan. For BWE operation the following shall be kept in mind:

- Empty and strip the BW tanks as much as possible before re-filling.
- Maintain adequate intact stability in accordance with an approved trim and stability booklet by use of the onboard stability software, taking into account the free surface effects.
- Keeping hull girder shear forces and bending moments within permissible seagoing strength limits as shown in the approved loading manual by use of the onboard stability software.
- Minimising hull stresses (bending moment, shear force, torsional moment)
- Manage draughts and trim to ensure adequate:
  - Bridge visibility
  - Propeller immersion to prevent temporary loss of manoeuvrability and/or ability to make headway
  - Draft forward to prevent slamming damage to ship bottom forward
- Re-secure watertight closures (e.g., open manholes) which may have been opened during ballast exchange (see Doc ID: Ref P053).
- Controlling maximum pumping/flow rates to ensure the tank is not subjected to a pressure greater than that for which it has been designed.

- Ensuring weather conditions are suitable and implementing weather routing in areas seasonably affected by heavy weather or heavy icing conditions. Potential need for greater margins on stability, strength and drafts in severe weather conditions.

6.6. Precautionary advice for planning of ballast water exchange operation

If BWE operation is performed in such a way that includes sequences which involve periods when the criteria for propeller immersion, minimum draft and/or trim, and bridge visibility cannot be met, the vessel's Master needs to assess:

- The duration(s) and time(s) during the operation that any of the criteria will not be met;
- The effects(s) on the navigation and manoeuvring capabilities of the vessel; and the manoeuvrability of the vessel will not be unduly impaired by the draft and trim and/or propeller immersion during the transitory period;
- The general weather and sea state conditions will be suitable and unlikely to deteriorate;
- The time to complete the operation.

6.7. Crew Training and Familiarization

Ballast Water Management Officer is responsible for crew training and familiarization.
Training and familiarization must be carried out in accordance with the vessel specific BWMP.
Vessels are provided with a Computer Based Environmental Training, which also covers generic training on Ballast Water Management. Vessels operating in the waters of the United States (as per VGP) are to maintain onboard a standalone training plan or other documentation. As a minimum, following trainings under Ocean Learning Platform must be carried out:

- 0465 Ballast Water Management, Compliance with the BWM Convention

6.7.1. Calibration of Sensors

UV-Sensor can be replaced by crew on-board (New UV sensor to be procured from BWTS makers, which comes with a valid calibration certificate).

OR

UV-Sensor can be calibrated only by makers/ authorized company.

6.7.2. USCG on Ballast Water Management

Vessels trading in US waters may be required to manage ballast using a treatment system at an earlier date compared to the IMO requirements, as outlined below:

Vessel Type	Ballast Capacity	Keel Laid	Compliance Date
New Vessels	All	On or after 01-DEC-2013	On delivery
	Less than 1500m³	Before 01-DEC-2013	First scheduled DD after 01-JAN-2016
Existing Vessels	1500 to 5000 m3	Before 01-DEC-2013	First scheduled DD after 01-JAN-2014
	Greater than 5000 m3		First scheduled DD after 01-JAN-2016

After the compliance dates shown above, the US regulations require vessels to comply with one of the following options:

- Use a US Coast Guard-approved BWTS;
- Use an alternate management system (AMS), i.e., an IMO approved BWTS
- Use only water from a U.S. public water system (PWS);
- Do not discharge BW into waters of the United States (includes the territorial sea as extended to 12 nautical miles from the baseline); or
- Discharge to a facility onshore or to another vessel for purposes of treatment.

All ships calling at US ports and intending to discharge ballast water must either carry out ballast water exchange or treatment, in addition to fouling and sediment management. The US has its compliance schedule determining when a vessel must begin to employ treatment instead of exchange.

The USCG regulations require the same discharge standards as the IMO regulations, but the USCG regulations also contain some additional requirements regarding a ship's operational procedures that go beyond the IMO's requirements:

- Clean ballast tanks regularly to remove sediments.
- Rinse anchors and chains when the anchor is retrieved.
- Remove fouling from the hull, piping and tanks on a regular basis.
- Maintain a BWM Plan that includes the above in addition to BWM.
- Maintain records of ballast and fouling management.
- Submit a report form (Doc ID: A730e) 24 hours before calling at a US port.

6.8. Ballast Water Sampling and Monitoring

Vessels calling US ports, that are equipped with a USCG approved Ballast Water Treatment System de-ballasting within 3 nm from the US Coast must conduct ballast water sampling and monitoring (Doc IDs: P503 and P504).

The vessels must carry out:

- monthly performance tests while in US waters and
- test for biological indicators (twice during the first year after the installation and once per year afterwards).

The vessels must arrange for the US compliant ballast water testing by contacting one of the two below listed laboratories keeping MLFMTENV@maersk.com in cc:

Laboratory	Contact Person	E-Mail
BioMarine services Ltd.	John Loaiza	john.loaiza@biomarineservices.co.uk
Maritec	Mr. Casey Phua	casey.phua@maritec.com.sg

NOTE: For UV systems, the ballast water needs to be treated twice (in-flow and out-flow) for full compliance. Hence, sampling shall be carried out while de-ballasting only after the minimum required holding time in the tank as stated on the type approval of the BWTS fitted on board is completed.

6.9. Canadian Ballast Water Reporting

All vessels calling Canada are required to submit a Ballast Water Reporting Form (BWRF) depending on when the vessel enters Canadian waters:

a. If the duration of the voyage, before entering Canadian waters, is less than 24 hours. Vessel must submit TCMSS BWRF as soon as practicable possible, but no later than the time of departure from the last port of call.
b. If the duration of the voyage, before entering Canadian waters, is less than 96 hours but more than 24 hours. At least 24 hours before entering Canadian waters.
c. At least 96 hours before entering Canadian Waters.

NOTE: Canadian waters are defined as Canadian EEZ, 200nm from shoreline. If the vessel is unable to submit the form and documents via email, please contact the agent and/or TCMSS for help. The completed Canadian BWRF form (Doc ID: A730h) should be sent to the following mail address:

- West Coast – pacballastwater@tc.gc.ca
- East Coast – atlanticballastwater@tc.gc.ca

NOTE: The email must include vessel name, IMO number, name of first port of call and the estimated date/time of arrival in the subject line.

Further, the Email must include:

- A copy of all pages of the Int. Ballast Water Management Certificate
- A copy of all pages of the Int. Oil Pollution Prevention Certificate
- Any other documents / certificates as requested by TCMSS, provided by TCMSS or the Agent.

Vessels are reminded to:

- Flush otherwise-empty ballast tanks with open ocean water in order to reduce the risk posed by residual BW and sediments.
- When entering in Canadian fresh waters & the Great Lakes, from another country, vessels will need to exchange their ballast water in mid-ocean in addition to using a ballast water management system.
- To conduct any exchange or flushing operation in waters at least 2000 meters deep.

NOTE: The Master must keep on board a copy of each BWRF for at least 24 months after it is submitted.

6.10. South Korean restriction on Ballast water intake from Japanese East Coast.

For vessels calling Korean port of Busan, the following must be considered.

d. If a vessel takes ballast waters from the East Sea of Japan, but do NOT intend to discharge ballast water from the East Sea of Japan in Busan.
a. Vessel is required to submit the evidence that vessel did NOT perform de-ballast (sourced from East Sea of Japan) during the port stay.
b. Port Clearance can only be permitted after submitted evidence is granted.
e. If a vessel takes ballast waters from East Sea of Japan and intend to discharge the water in Port of Busan.
a. Vessel is required to exchange ballast waters before entering Korea's jurisdictional waters.
b. The suggested area for ballast waters exchange is located between
i. The passage of Tsugaru Strait and longitude 135.30 E, when sailing northward such as passing Tsugaru Strait

ii. The passage between latitude 34.25 N and longitude 132.30 E when sailing southward such as passing Kanmon Strait

iii. Before discharge of exchanged water in Busan, the samples of exchanged water will be taken by Port Authority and the radioactivity concentration of samples will be promptly measured on site.

*East Sea of Japan - Aomori Prefecture, Iwate Prefecture, Fukushima Prefecture, Miyagi Prefecture, Ibaraki Prefecture, Chiba Prefecture.

Port Code	Port	Port Code	Port	Port Code	Port
JPSMA	SOUMA	JPHIC	HITACHINAKA	JPCB	CHIBA
JPONA	ONAHAMA	JPOAR	OARAI	JPKZU	KISARAZU
JPSGM	SENDAI-SHIOGAMA	JPKSM	KASHIMA(IBARAKI)	JPHHE	HACHINOHE
JPSDJ	SENDAI, MIYAGI	JPOFT	OHFUNATO	JPMUT	MUTSUOGAWARA
JPSDS	SENDAISHINKO	JPKIS	KAMAISHI	JPAOJ	AOMORI
JPISM	ISHINOMAKI	JPMYK	MIYAKI, IWATE	JPFNB	FUNABASHI
JPHTC	HITACHI	JPKJI	KUJI, IWATE	JPKMT	KIMITSU

7. REFERENCES

- A040c – Ballast Water Record Book – How to Guide
- P109 - Ballast tank - Contamination by oil
- A730a - Appendix II of BWMC, 2004
- A730c - NOAA - Ballast Water - Specific Gravity to Salinity Conversion Guide
- A730d - BWM Flowchart
- A730e – USCG Ballast Water Reporting Form
- A730h - Canadian Ballast Water Reporting Form
- Form 730b – Tank Condition Report
- Form 730c - Ballast Water Reporting Form
- Form 730d – Sediment Removal Flushing Log
- MEPC.387(81) Interim Guidance on the application of the BWM convention to ships operating in challenging water quality conditions



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