CARNIVAL GRAND BAHAMA INVESTMENTS LIMITED

Addendum # 2

ENVIRONMENTAL MANAGEMENT PLAN

FOR

"GRAND PORT"

Freeport, Grand Bahama Island
The Bahamas

Submitted to:

Department of Environmental Planning and Protection

And

Grand Bahama Port Authority

Prepared by

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1.0 INTRODUCTION

This addendum, identified as Addendum # 2, is submitted to the Department of Environmental Planning and Protection (DEPP) of the Bahamas Government and the Building and Development Services Department (BDS) of the Grand Bahama Port Authority (GBPA) to inform both departments of the changes to the Carnival "Grand Port". Project Environmental Management Plan (EMP).

This addendum also includes information regarding dredging activities which were not available during the preparation of the EMP, as the Dredging contractor had not been selected. Carnival Grand Bahama Investments Ltd. (CGBIL) has since selected Jan De Nul as the dredging contractor. Therefore, the following documents have been included with this submission.

- **Method Statement Dredging and Reclamation**
- **Environmental Management Plan**
- **Turbidity Control Plan**

2.0 CLARIFICATIONS TO EMP

1. **Hours of Nighttime Operation during Construction of the Facility**

EMP Section 10.4.2 Night Operations (p.44) and 10.10 Management of Turtle Nesting Habitat "(p.59)

"Night operations shall be limited to hydraulic dredging operations only. All other construction shall occur during daylight hours only."

And

"A long-term sea turtle nesting management and monitoring plan is proposed as a mitigative measure for marine project impacts. The turtle nesting management plan will adaptively manage the beach resource and may include marking/avoidance of nesting areas, restrictions on nighttime activities on the beach, and other reasonable management actions to encourage successful nesting."

CHANGE:

CGBIL would like to clarify that nighttime operations are not meant to preclude operations during the construction phase of the pier and land side facility since there will be safety precautions for night work taken by the contractors, and the work is sufficiently distant from any residences and/or commercial facilities to not pose a disturbance. In addition, this work will not be conducted on the beach.

The working lights associated with the pier construction and land side development will be pointed away from the beach to avoid potential impacts to nesting. Should turtle nesting on the beach become an issue, additional measures will be put in place including nighttime restrictions to avoid disturbance to nesting.

2. Temporary Reverse Osmosis Plant

While the EIA and EMP discuss the provision of a seawater reverse osmosis system and associated wells, which has already been permitted by the GBPA, a smaller temporary unit is required to provide potable water to the site during the construction phase. The potable water produced by the temporary unit will be used for irrigation of transplanted vegetation, concrete mixing as well as other uses during the construction phase until the permanent unit is designed and installed. This temporary unit is necessary since the final design of the facility which includes the back of house operations is still in progress. This temporary reverse osmosis unit will be permitted through the BDS of the GBPA.

ATTACHMENT 1
Method Statement Dredging and Reclamation

Owner:

CARNIVAL GRAND BAHAMA INVESTMENTS

Engineer:

MOFFAT & NICHOL

Contractor:

JAN DE NUL CENTRAL AMERICA LTD. (MEMBER OF JAN DE NUL GROUP)

Project:

BAHAMAS – GRAND BAHAMA – DREDGING WORKS FOR THE GRAND PORT CRUISE CENTER

Document title:

METHOD STATEMENT DREDGING AND RECLAMATION

Document no.:	JDN.BSGRCC.011
Prepared by:	Tender and Procurement Department of Jan De Nul

Rev.	Date	Description of revision	Prepared	Checked	Approved
			Contractor		
01	17.11.2022	Issued for Approval	MIVL	HEH	HEH
00	11.11.2022	Issued for Review	MIVL	HEH	HEH
T.01	14.08.2022	Tender - First Revision	GUL	TVC	YVA
T.00	22.07.2022	Tender - Issued for tender	GUL	TVC	YVA

REVISION CHANGE DETAILS

Revision	Location	Brief description of change
T.00	-	Tender - Initial Revision – issued for RFP use
T.01	-	Tender - First revision based on input received
00	-	Revision based on detailed analysis project team – Issued for Approval
01		Update of Annex 2 after review from Carnival

TABLE OF CONTENTS

1 INTRODUCTION

This Method Statement includes a synopsis of the methods, operations and sequences by which Jan De Nul Central America Ltd. aims to complete the construction of the dredging works required to provide safe navigation for the user fleet at the facility at Grand Bahama, the Bahamas.

2 SCOPE OF WORK

Carnival Grand Bahama Investments, Limited plans to create a new cruise terminal on the island of Grand Bahama. This island is located on the Bahama Islands and subject to the governance of the country of the Bahamas.

The Project will be specifically located on Grand Bahama, on the mid southern shore of the island at a location called Sharp Rock. The Project will consist of dredging to provide for cruise ship maneuvering and berthing on both sides of the proposed new cruise ship pier. The berths will be capable of accommodating the largest cruise ships of any class during a transit port call, which ships have a maximum length of approximately 1130 feet (345m).

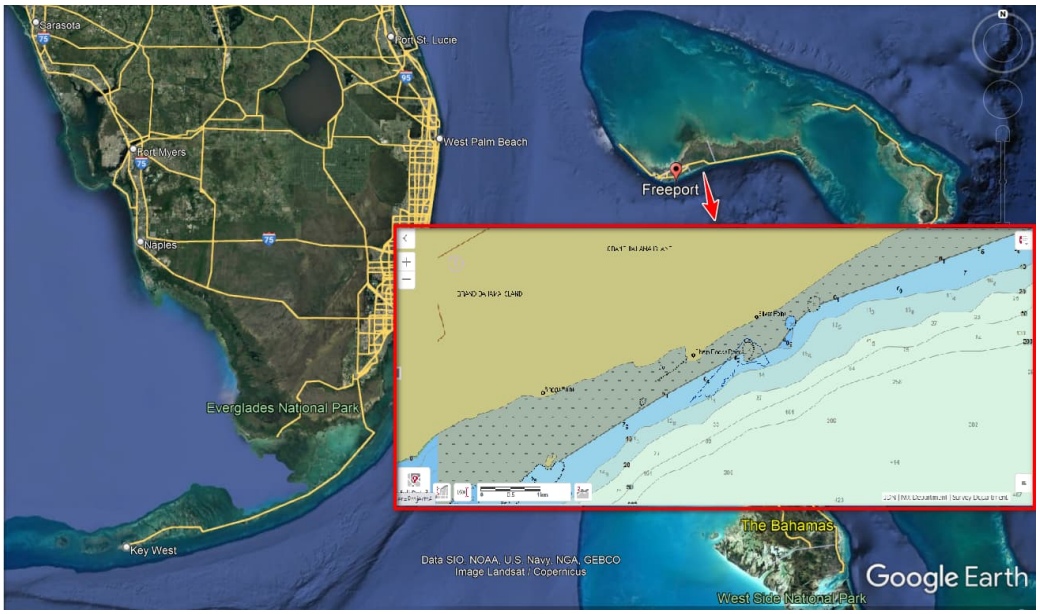


Figure 2-1: Location of the project site

The works to be executed under this contract include:

- Mobilization of dredger, auxiliary equipment, pipes, sandfield equipment and silt curtains
- Preparation of fill placement area and settlement ponds
- Dredging berth pocket for future cruise pier

- Discharging of the dredged volume on the proposed upland placement area (incl. management of the placement area and maintenance of the containment bunds)
- Environmental mitigation and monitoring: deployment of silt curtains at the dredge area and upland placement area outfall and turbidity monitoring
- Demobilization of plant

2.1 DREDGE DESIGN

The dredging area will be dredged up to -36.0 ft (-10.97m) Mean Low Water (MLW) resulting in 826,554m³ (= 1,081,092 yd³) of dredge volume within the net design profile plus 1.0 ft. (0.3m) of payable over dredge. Volumes will be confirmed during project insurvey. No areas shall be above these specified dredge levels.

Additionally the Owner requires to remove boulders or other loose material that may be left within the dredge footprint from the dredging operations to ensure the dredge depth is achieved as measured by multi-beam hydrographic survey.

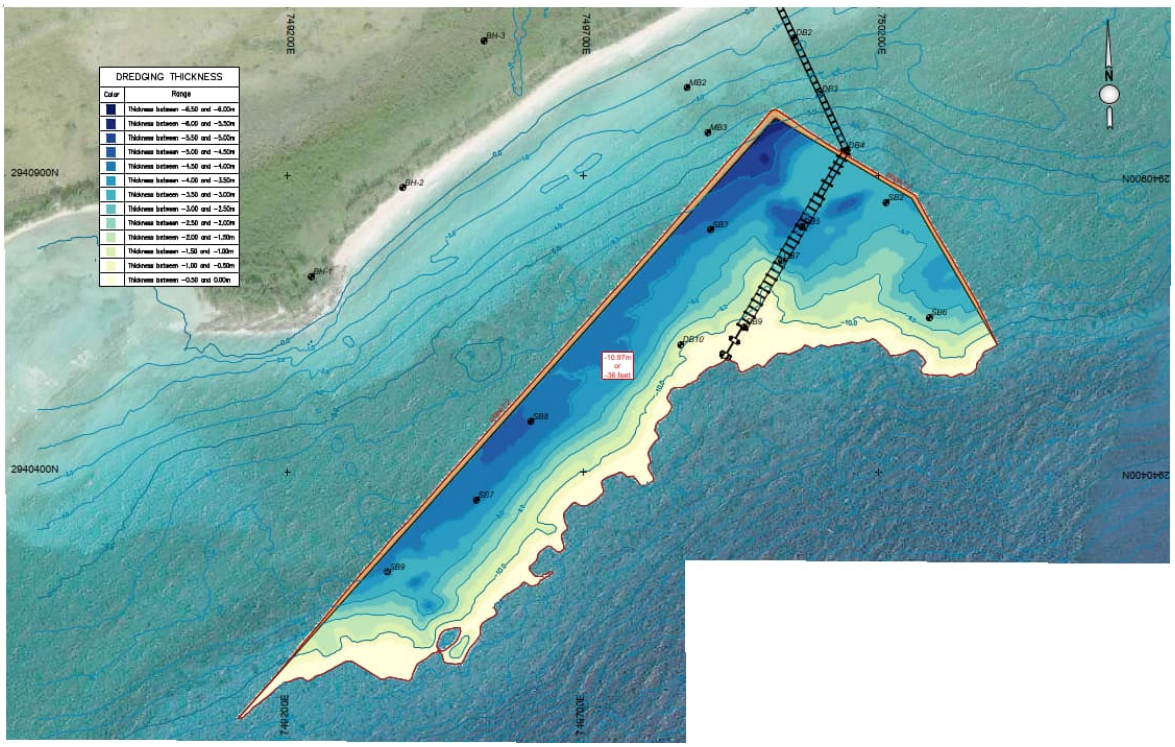


Figure 2-2: Scope of Works

The upland placement area as provided on the Owner's Mass Grading plans are shown below. The area that can be practically used for placement of the material is marked with the blue boundary.

The Mass Grading Drawings depict the fill placement and upland development programming. Based on limitations of hydraulic placement of dredged material, the fill shall be placed, practically possible, in layers

not to exceed 3 feet (1m) to the proposed grades with a tolerance of +/- 3 feet (1m) in areas where the mass grading plan shows fill. The fill shall be placed within the areas of the proposed upland development to the practical extent possible, realizing the limitations of pipeline placement and the need to maintain the efficient production of the Cutter Suction Dredger (CSD) that will be excavating the material and pumping the slurry to the placement area.

The remainder of the material will be pumped onto a stockpile in the East of the property.

The dredger will pump the slurry through a floating pipeline connecting to shoreline. A sinker pipe is not foreseen for the dredger's side.

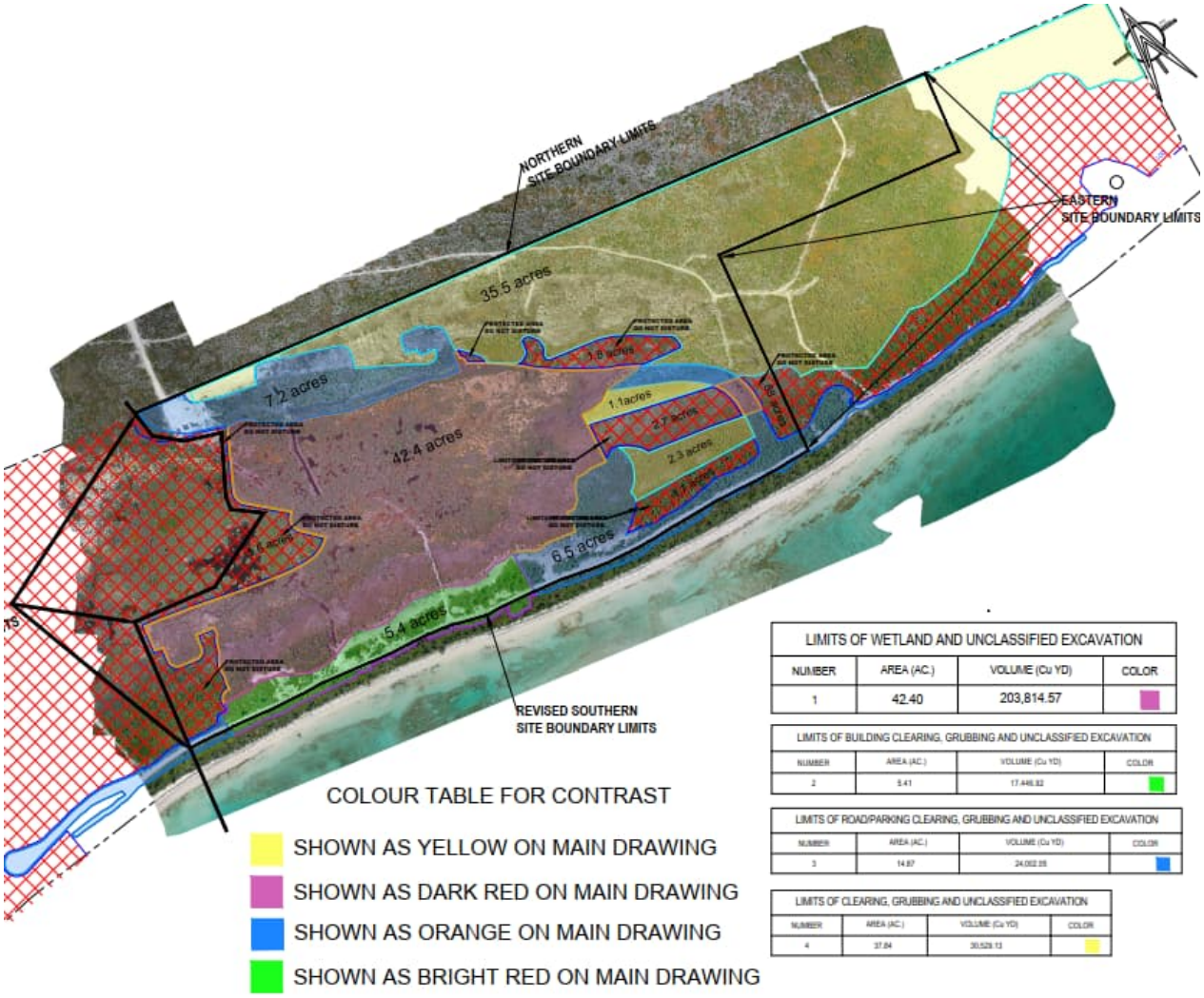


Figure 2-3: Location of the upland placement area (Mass Grading Drawing)

2.2 TOLERANCES

The following paid overdredge tolerances are applicable:

- Vertical tolerance : 1 ft
- Horizontal tolerance : 2.00m

There are no technical tolerances applicable on the design of the dredging works. In general an overdredge of 2ft is considered standard for a CSD dredging in limestone.

2.3 SLOPE

Side slopes in the dredge areas within this contract will be measured and paid based on a 2 feet horizontal to 1 feet vertical ratio. The slopes will be efficiently dredging using the box-cut method. Preliminary, the box cut steps assumed height is 2m (6 ft) and will be optimized in the course of dredging works.

The volumes dredged within the boxcut design are considered as paid. Such side slopes will remain stable until the Owner accepts the site.

Figure 2-4: Preliminary design of the boxcut method

2.4 RECLAMATION VOLUME

The total volume to reclaim will include overdredge volume and bulking. The volume dredged including overdredge is estimated at the maximum 1,332,380 cubic yards. The volume will be around 1,465,600 cubic yards on the reclamation area taking into account bulking and losses.

3 EQUIPMENT

3.1 VESSEL SPECIFICATIONS

The Cutter Suction Dredger (CSD) "Zheng He" (ZH) will be used to execute the dredging and reclamation scope. See Annex 10.1 for the technical leaflet of the CSD.

Figure 3-1 CSD Zheng He

ZHENG HE - Cutter Suction Dredger	
Length o.a.	138.5 m
Breadth	26.0 m
Draught	5.5 m
Dredging depth	35.0 m
Suction pipe diameter	900 mm
Discharge pipe diameter	900 mm
Barge loading pipe diameter	900 mm
Inboard pump power	2 x 5,000 kW
Cutter power	7,000 kW
Propulsion power	2 x 3,500 kW
Total installed diesel power	23,520 kW
Speed	13 kn
Accommodation	46
Built in	2010

The following assistance equipment will be used for the period of the execution of the project. The assistance equipment will be mobilized by JDN and/or will be sourced and chartered locally.

- Multicat "DN205" for anchor handling operations, floating pipeline, sinker line operations, general support to the CSD and siltscreen operations

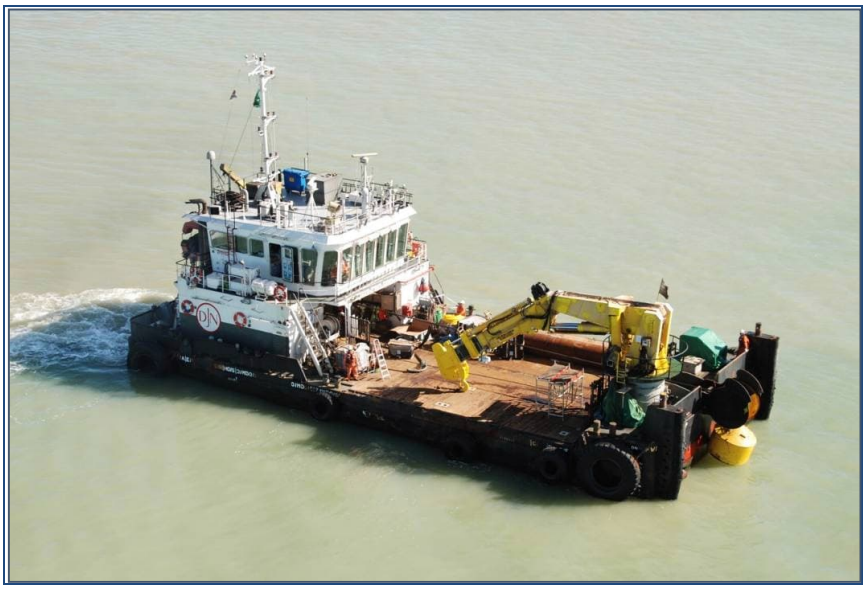


Figure 3-2 Large Sea-going Multicat

DN205 - Multicat	
Deadweight	360 ton
Propulsion	2x540 kW
Hydraulic Crane	260 tm
Winch	200 ton at 2.5 m/min
Bunker Capacity (Fuel)	250 m³
Built in	2010

- Local Survey Vessel/workboat "El Fuego"

Figure 3-3: El Fuego

- Local small launch for siltscreen installation operations

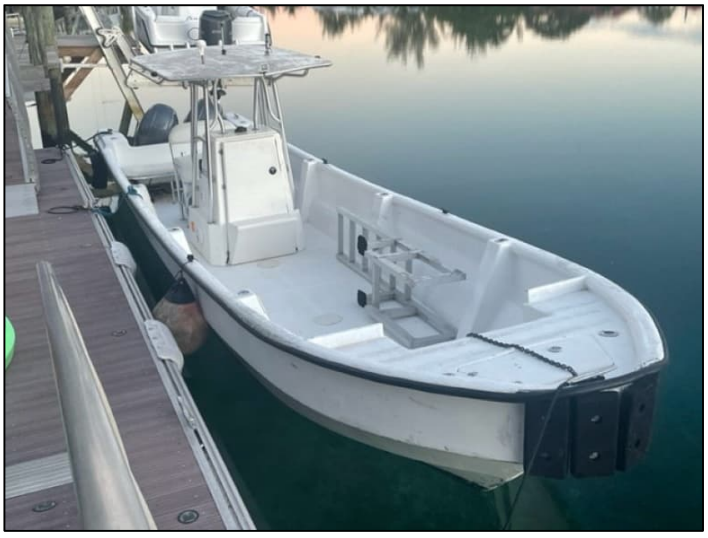


Figure 3-4: Fiberglass launch boat

3.2 GENERAL LAYOUT OF A CUTTER SUCTION DREDGER (CSD)

See Annex 10.2.

3.3 WORKING PRINCIPLES OF A CSD

See Annex 10.2.

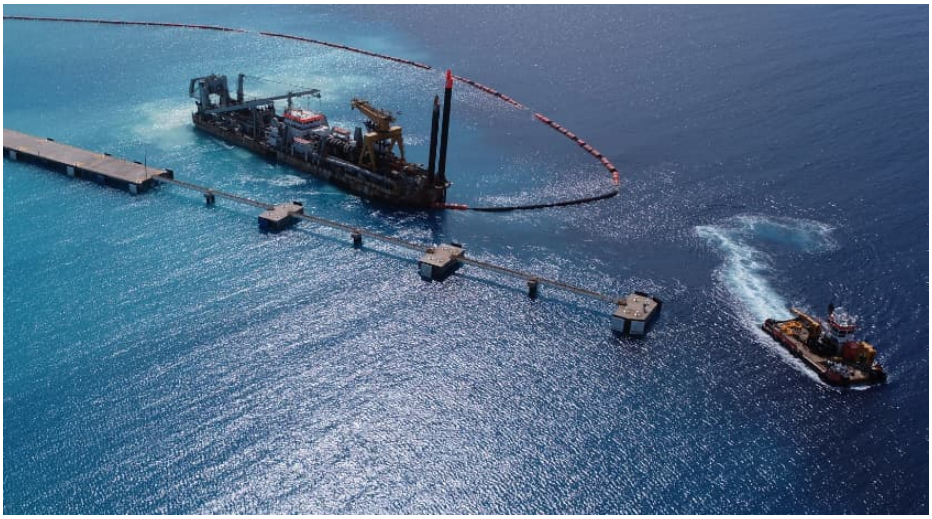


Figure 3-5: CSD and pipeline works

3.3.1 Other CSD activities

Typical activities on board of a Cutter Suction Dredger, such as changing pick points, changing cutter head, replacing support ring of cutter shaft and anchor handling with the multicat are being controlled via Safe Work Practices (SWP's). SWP's describe how these activities are being executed in a safe, environmental friendly and correct way. These SWP's are available on board and all crew involved in the activities have to sign off on the procedure.

3.3.2 Dredging Control CSD

Dredging control for the CSD is maintained by means of the following systems and equipment:

- Positioning System
- Cutter Operating System

Dredging control is based upon the dredger's positioning system. For this purpose, several systems including the DGPS/RTK system, Gyro compass and tide updates are used to determine the actual vessel and cutter-head positions.

These results are displayed, relative to the area to be dredged, on navigational displays to monitor the movements of the dredger.

The information displayed on the screen includes:

- Position of vessel and cutter head relative to the dredge area and dredge profile;
- Bathymetric data;
- Differential chart showing the layer thickness still to be dredged;
- Longitudinal and cross profiles of the dredge area marking the original seabed level and the design level;

The cutter operating system is a system containing angle transducers, which determines the cutter-head position relative to the vessel. This provides relative X, Y and Z coordinates of the cutter head available to the positioning system and dredging control computers.

The dredging control computer controls multiple dredging processes including dredging level of the cutter head and pump settings. The interface between the positioning computer and the dredging control computer enables control of the dredging process to pre-defined levels put into the system from pre-dredge survey information and design requirements.

3.3.3 Operating Times

The vessels and land equipment will work 24 hours per day and 7 days a week during the execution of the project. All crew on board and supervisors and operators for the discharge area are working 12 hours a day and are working on a fly-in fly-out regime.

3.3.4 Crew

Below an estimation of the crew:

Cutter Suction Dredger:	40 persons
DN 205:	8 persons
Reclamation area:	10 persons (excl. operators)
Workboat:	2 persons

The crew members of CSD are accommodated on board during the term of the project. A procedure for on-signing and off-signing crew has been agreed with the maritime agent. Crew on board of DN205 will also sleep on board of the CSD. Crew on the sand field and from the local vessels will be accommodated on shore. All crew working on the shore will be provided with a short or long term working permit.

3.3.5 Scheduled Maintenance

The CSD will have a scheduled pause for maintenance on a regular base. Scheduled maintenance activities will broadly include the following, but is subject to change as required and to Master's decision:

- Routine repairs and maintenance;
- Routine scheduled preventive maintenance works in engine and pump room;
- Inspection and maintenance of main vessel components;
- Required oiling and greasing procedure;
- General welding works;
- Bringing on board of stores and spare parts etc.
- Bunkering of Fuel

4 MOBILIZATION, LOGISTICS & PREPARATION

4.1 MOBILIZATION

4.1.1 Vessels

CSD Zheng He will sail on her own keel to the Bahamas.

The CSD needs approximately 3 days upon arrival in quiet water conditions to be prepared for dredging operations, mainly for putting the spuds in vertical position, assembling the side wire anchors and connecting the floating pipeline to the dredger.

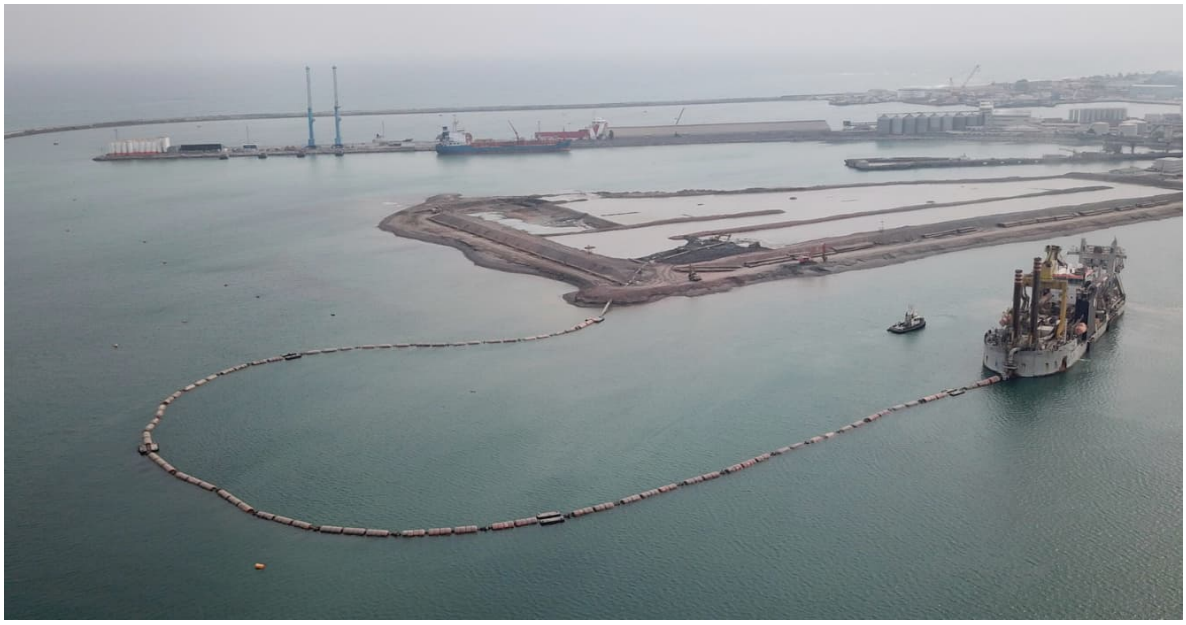


Figure 4-1: CSD, pipeline and reclamation area example

The clearances for Customs Authorities and Immigration can be done directly upon arrival at site.

4.1.2 Auxiliary floating equipment

4.1.2.1 Multicat DN205

DN205 will also sail on its own keel to the site.

4.1.2.2 Survey vessel/workboat

Local vessels as described in 3.1 will be hired as survey vessel, workboat and crew transport vessel.

4.1.3 Pipeline, ancillary equipment and silt curtains

For the purpose of discharging the dredged material into the fill placement areas, the following equipment will be mobilized by cargo vessel from our storage yards directly to the site:

- Floating pipeline: 883 m of floating pipeline, consisting of both steel floating pipeline and rubber floating pipeline. The majority of the floating pipeline (775m) consists of pipe section of 12m and 18m steel pipes with floating bodies. The inner diameter of these pipes is 900m. Apart from that, 108m of rubber floating pipeline of inner diameter 1000mm will be used. Some of the steel floating pipe sections are supported by narrow body pontoons.
- Shore pipeline: almost 4,000m of shore pipeline will be mobilised, consisting of 12m and 6m pipe sections that are bolted to each other
- Hydraulic valves, power packs, generators, weir boxes, bends, etc. for construction of the different branches of the shore pipeline in the discharge area

Figure 4-2: Floating pipeline layout

Several containers are part of the mobilization:

- Spare dredging equipment parts
- Pickpoints and cutterheads
- Turbidity curtains (almost 4,000m) with mooring and markers

Figure 4-3: overview of equipment and pipes during mobilization

4.1.4 Land equipment

The land-based heavy equipment will be hired from a nominated subcontractor. Required equipment for hydraulic fill:

- 2 x Bulldozer CAT D6 type or similar
- 1 x Bulldozer CAT D8 type or similar
- 1 x Excavator CAT336 type or similar, to be used as earthmoving and lifting plant
- 1 x Wheel loader CAT972 or CAT966, to be used for transport and connection of shore pipelines
- Spare equipment: 1 additional excavator and 1 bulldozer as backup

Proper communication means will be foreseen (VHF and UHF radio). Communication between vessel and sandfield (master) is done by means of VHF, while communication between sandfield master and sandfield operators is done by means of UHF radios.

The construction of the bunds will be done with the same equipment assisted with extra equipment for hauling, which is up to consideration by subcontractor and subject to approval from Contractor.

JDN Standard Daily checklists for heavy equipment will be in place. Special attention will be paid to availability of spares, state of equipment and backup equipment.

4.2 SITE PREPARATIONS

4.2.1 Site office and storage area

Site offices will be installed at the project site and a storage/laydown area will be prepared as well to locate the containers filled with equipment for the reclamation works.

On the figure below the layout of the site offices and the storage areas is presented. The office area and the area surrounded by the JDN containers will be flattened and levelled.

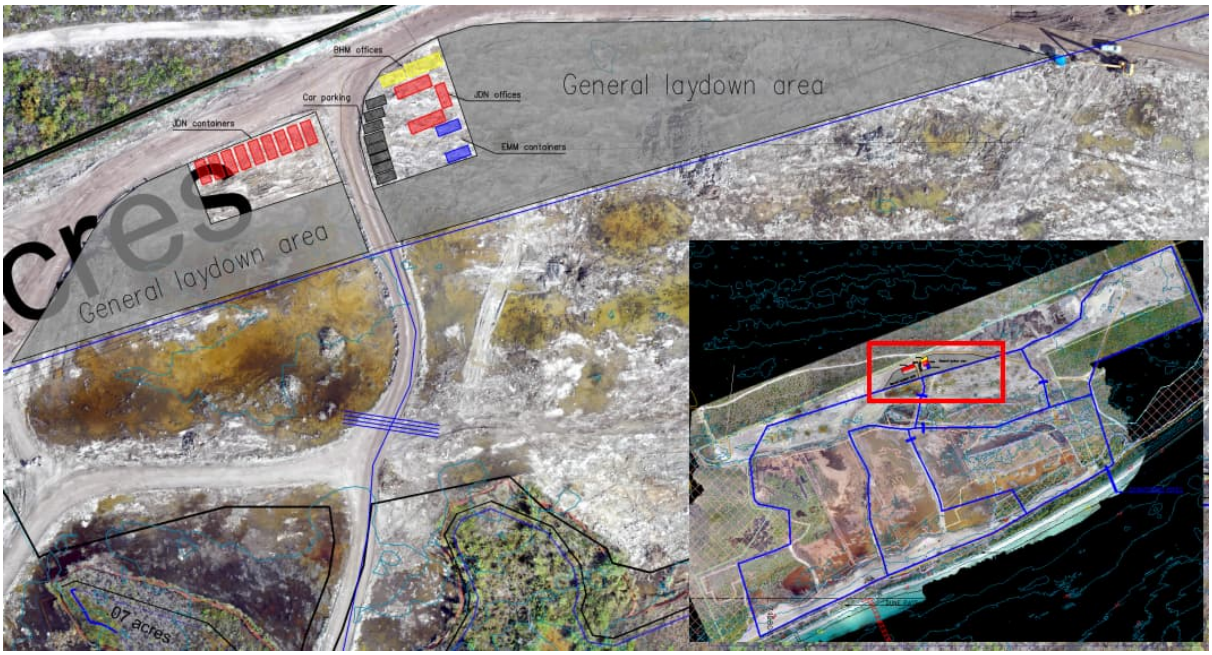


Figure 4-4: Site office and storage area layout

4.2.2 Shore pipeline route

Before the reclamation works can start, the initial shore pipeline lay-out needs to be installed on site. Two shore connections will be constructed. From shore connection 1, Terminal Area A and the Stockpile Area can be reclaimed, as well as Terminal Area B. From shore connection 2, Terminal Area B can be reclaimed. Y-pieces with hydraulic valves will be installed at strategic locations (near settlement ponds to divert water, backup branch in case of problems on discharge locations,...).

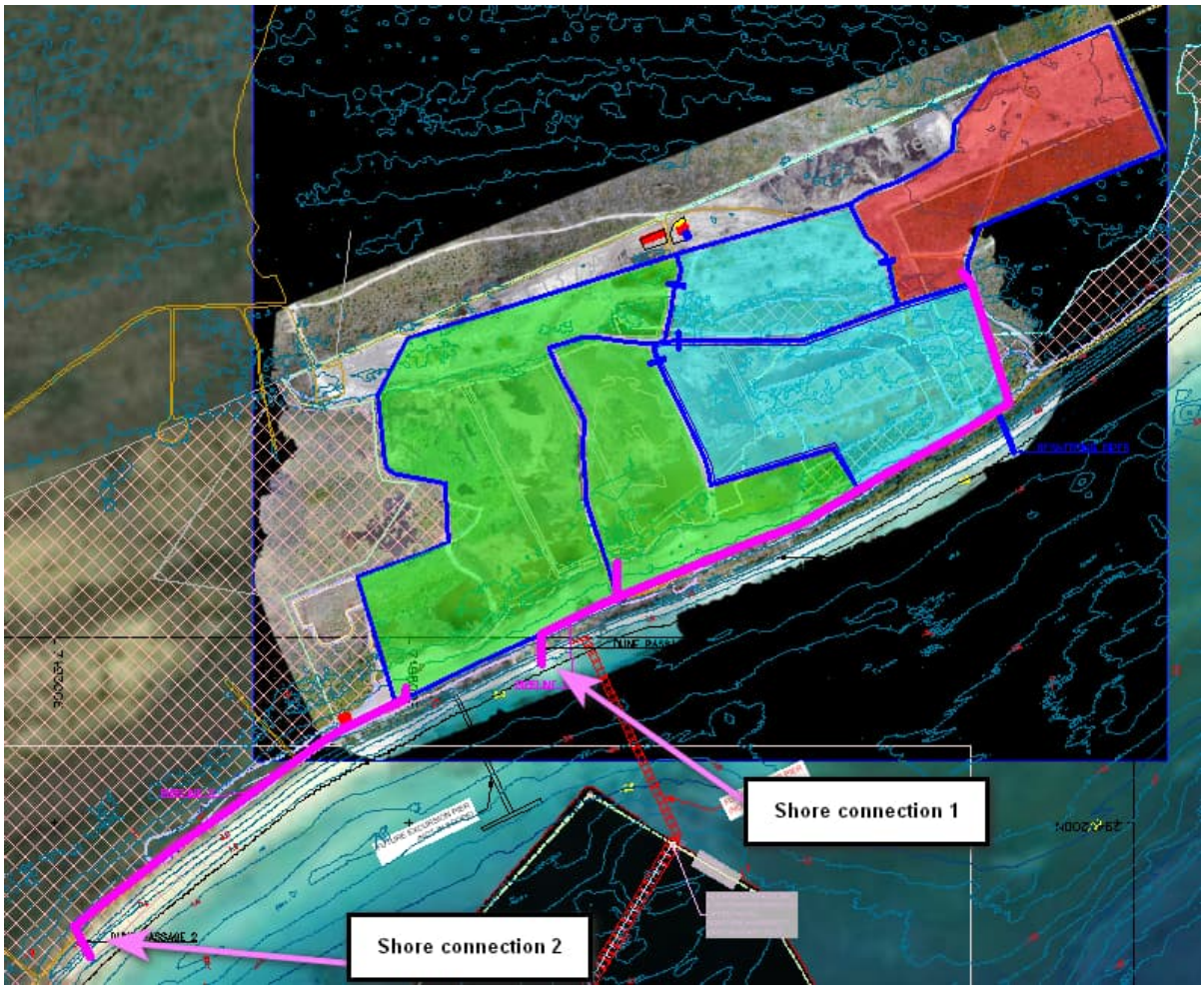


Figure 4-5: Initial shore pipeline layout

4.2.3 Floating pipeline assembly and tow

The floating pipeline will be assembled in Freeport harbor by multicat DN205.

Figure 4-6: Multicat coupling floating line

Below picture shows how the multicat, by using her winch and crane, makes the connection between two floating pipes.

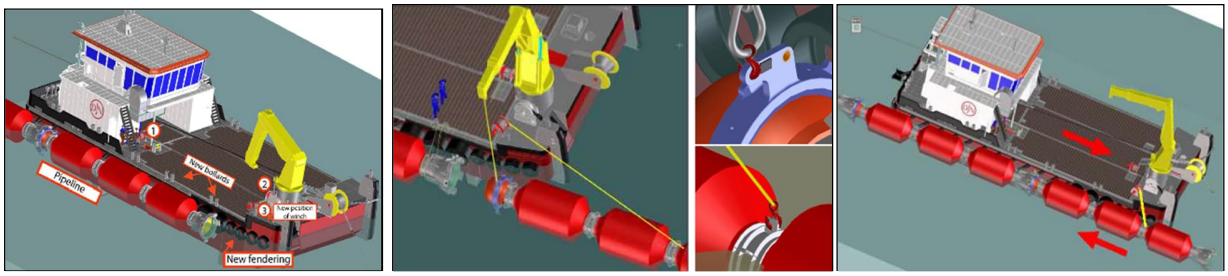


Figure 4-7: Floating pipeline coupling by multicat

When the floating pipeline is assembled into section of approximately 300m, the floating pipeline is towed to the project site by a tugboat.

5 DREDGING WORKS

General working principles of a Cutter Suction Dredger (CSD) can be found in annex 10.2.

5.1 SEQUENCE OF WORKS

The CSD will start dredging the pier area first. This area contains most of the dredge volume and will generate more bulk material that can be used to reinforce the bunds.

The majority of the cuts will be pumped via shore connection 1 (the eastern one) to the reclamation area. Part of cuts 5 and 6 will be pumped via shore connection 2 (located more towards the west) to the reclamation area.

The sequence is shown below with numbered cuts as per anticipated sequence. Note that this sequence will change after the bathymetric survey and that some cuts might be dredged differently due to for example weather conditions.

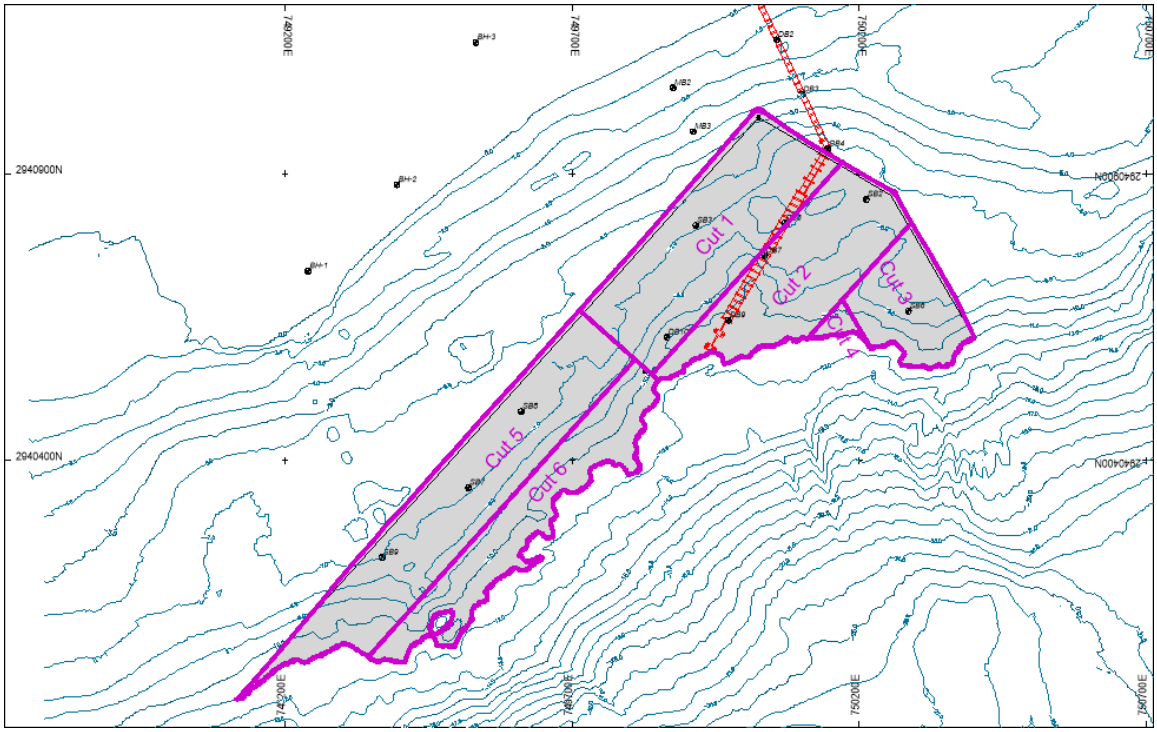


Figure 5-1: Preliminary cut plan and sequence

Based on the available floating pipeline length and considering accessibility on the shore, two locations are foreseen to be used as shore connection. The 600m extent is shown together with various locations during execution.

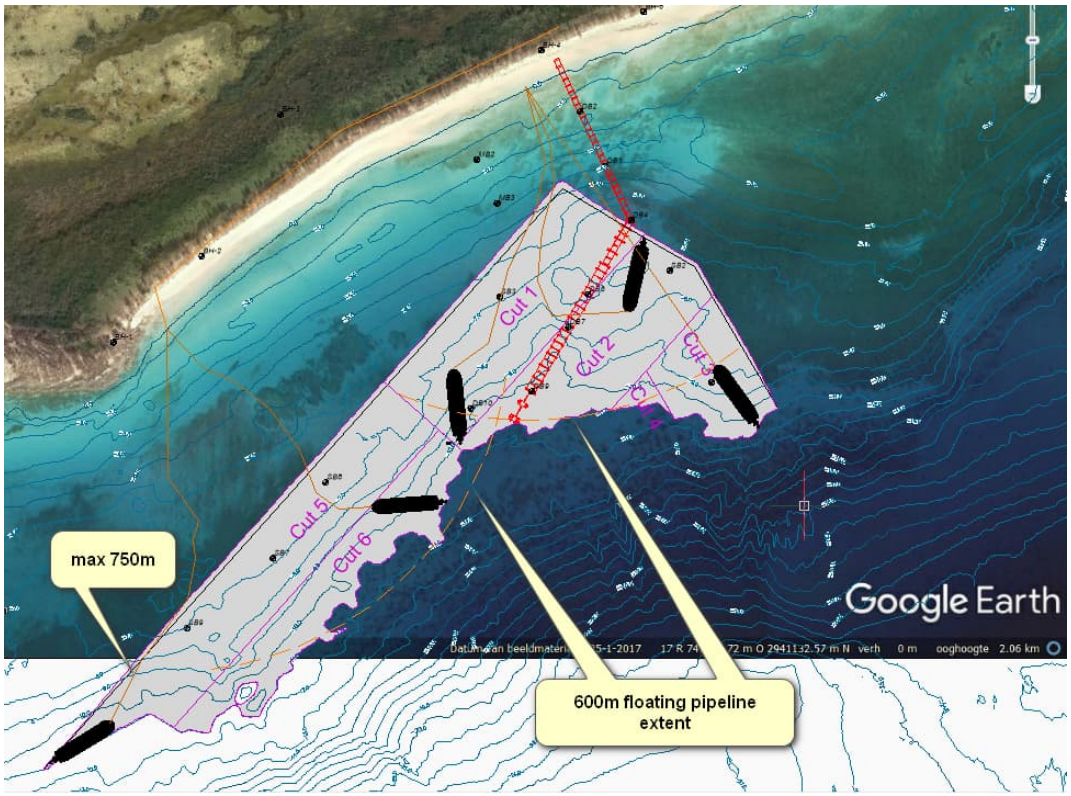


Figure 5-2: CSD with floating pipelines and shore connections

Almost 900m of floating pipeline will be mobilized to the project, which is more than sufficient to cover the entire scope.

5.2 RECORDS AND REPORTING CUTTER SUCTION DREDGER

The CSD will record and report on daily basis:

- Operating hours
- Working Area
- Estimated volume dredged
- Plan of the daily dredged section of the channel
- Delay reports for :
    - Debris and trash
    - Ship traffic
    - Delays for dredge spoil temporary storage area
    - Any adverse physical conditions or artificial obstructions or any other circumstances that may be encountered during the execution

All reports will be submitted to the Owner for comments and signature.

5.3 OPERATIONAL CONSIDERATIONS

5.3.1 Health and Safety

Specific safety measures to be followed during operations are:

- Keep a look out for other vessels to avoid collision. This includes supporting vessels and other vessels not associated with the project.
- Carry all lighting and signaling in accordance with international standards
- No persons allowed within the swinging area of the cutter and other marked no-go zones on the vessel while dredging is in progress.
- Anchor management and wire lay out
- Wear all required PPE
- Keep track and evaluate the updated weather conditions (current and forecast)
- During vessel to vessel transfers, wearing of life vests is mandatory
- Emergency Response procedures to be drafted and followed up on site
- Toolbox meetings to be followed with staff and crew

5.3.2 Dredging in proximity of existing structures

According to the tender schedule the dredging works are expected to be carried out prior to construction of the piers.
In any case, due to the considerable diameter of the cutter head (3.0 meter) and the inertia of the ship while swinging, no dredging works shall be executed closer than 5 m of existing structures.

Minimum required depths for the dredger is 6.5m.

5.3.3 Weather forecasts and Adverse Weather

Daily Weather forecasts, including wind and wave forecast for 72 hours will be obtained and evaluated by the Contractor and distributed to the vessels.

Weather limitations depend on the wave directions, the course of the vessel, tides, water depth, wind speed, wave height, currents, wave period,... The development of possible adverse weather will be closely followed up.

5.3.4 Berthing possibilities

The Contractor will arrange a berthing location with minimum 3.2m of water depth for personnel transfer and logistics.

6 DREDGED FILL PLACEMENT

The fill management will be under the supervision and instruction of 2 experienced sandfield masters. Day and night supervision is foreseen. All our sandfield masters are trained operators, if necessary they can instruct, train and guide the Bahamian operators.

The sandfield master reports to the superintendent and works/project manager. The environmental engineer and surveyor will guide and advise the operational team to execute the fill with regard to reducing the turbidity.

6.1 CONSTRUCTION OF BUNDS

Before any reclamation works can start, bunds will be installed to retain the fill and the process water, while controlling and optimizing the outflow of the water back to sea. Jointly, weir boxes will be installed to be able to dewater the reclamation areas and the silt ponds.

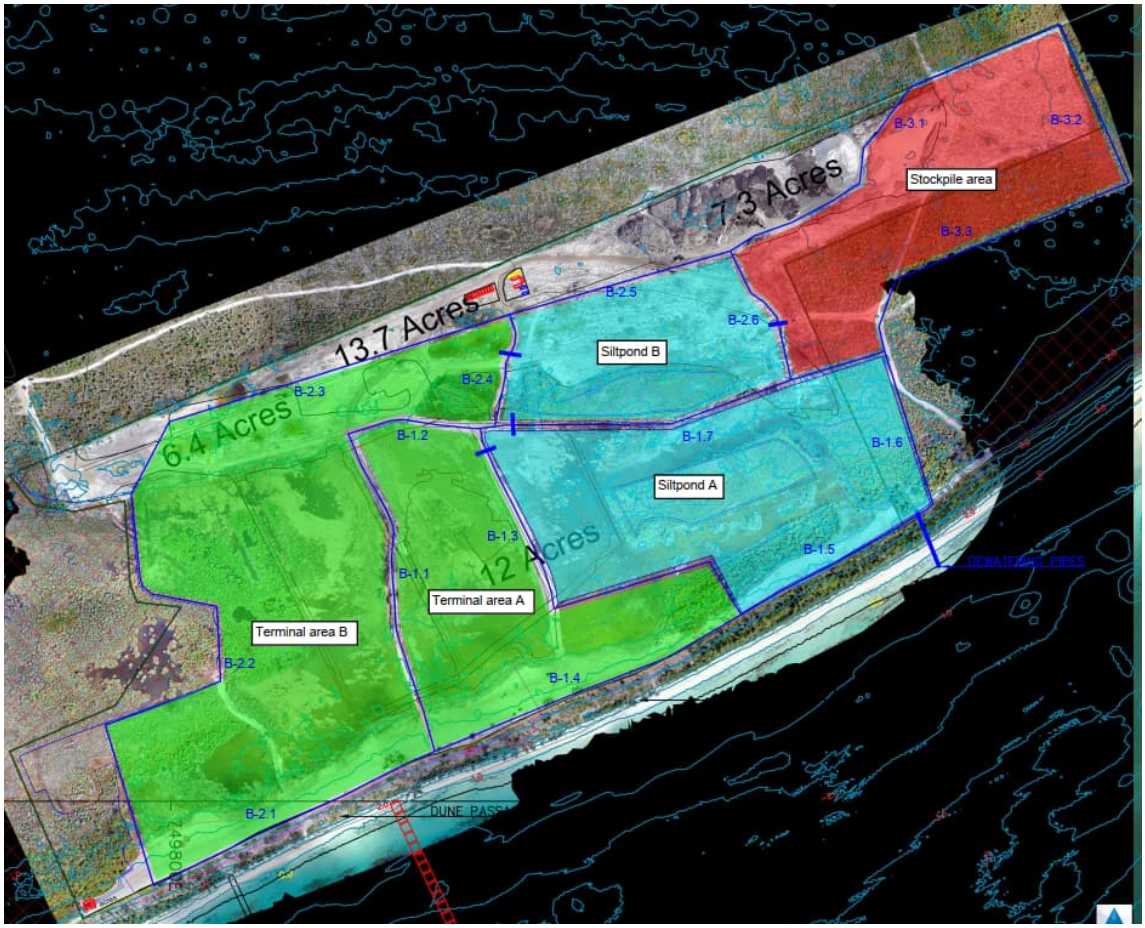


Figure 6-1: General site layout – bunds are marked with blue lines around the different subareas

Bunds around Terminal Area A and Siltpond A will be constructed with in-situ material. When this is completed, dredging and reclamation works can start. With the material that is reclaimed, bunds around Terminal Area B, Siltpond B and Stockpile area can be constructed.

The bunds are constructed by pushing material together with bulldozers and by excavating material in one location on site and transporting it by dumptrucks to another location on site.

The table below gives an overview of the bund dimensions and the required volumes to construct the bunds:

Bund Details - Start reclaiming in Terminal Area A - Phase 1							
	Bund	Length	Height	Top Width	Slope	Orig. Level	Volume
	#	(m)	(mMLW)	(m)	(-)	(mMLW)	(m³)
Phase 1	B-1.1	371	3.0	4.0	2/3	1.4	3,799
Phase 1	B-1.2	150	3.0	4.0	2/3	0.8	2,409
Phase 1	B-1.3	467	3.0	8.0	2/3	1.1	9,627
Phase 1	B-1.4	373	3.0	4.0	2/3	1.1	4,855
Phase 1	B-1.5	246	3.0	4.0	2/3	1.1	3,202
Phase 1	B-1.6	178	3.0	4.0	2/3	1.0	2,492
Phase 1	B-1.7	463	3.0	4.0	2/3	0.5	8,971
Subtotal		*2,248*					*35,354*

Bund Details - Start reclaiming in Terminal Area A - Phase 2							
	Bund	Length	Height	Top Width	Slope	Orig. Level	Volume
	#	(m)	(mMLW)	(m)	(-)	(mMLW)	(m³)
Phase 2	B-2.1	347	3.0	4	2/3	1.4	3,553
Phase 2	B-2.2	598	3.0	4	2/3	0.4	12,283
Phase 2	B-2.3	488	3.0	4	2/3	0.8	8,098
Phase 2	B-2.4	129	3.0	10	2/3	0.6	4,211
Phase 2	B-2.5	255	3.0	4	2/3	1.0	3,570
Phase 2	B-2.6	163	3.0	4	2/3	0.8	2,618
Subtotal		*1,980*					*34,332*

Bund Details - Start reclaiming in Terminal Area A - Phase 3							
	Bund	Length	Height	Top Width	Slope	Orig. Level	Volume
	#	(m)	(mMLW)	(m)	(-)	(mMLW)	(m³)
Phase 3	B-3.1	468	3.6	4	2/3	1.5	7,027
Phase 3	B-3.2	191	3.6	4	2/3	2.5	1,187
Phase 3	B-3.3	365	3.6	4	2/3	1.4	5,862
Subtotal		*1,024*					*14,076*

Figure 6-2: Construction of bunds with in-situ material

6.2 INSTALLATION OF SHORE PIPES

The pipeline corridor shall be leveled and cleared from obstructions (incl. trees) prior to installation of the pipeline.

The shore pipeline typically consists of rigid, flanged, steel elements of 12m length which are connected with bolts and nuts. Gaskets in between the flanges are guaranteeing a leak-proof connection. The diameter of the pipes will be 900 mm, a series of shorter lengths and bends are available to enable the pipeline to follow the geographic shape of the pipeline route.

During discharging, an alternative type of pipes will be utilized to extend the endpoint of the pipeline: quick fit pipes with lengths of typically 18m.

Figure 6-3: Land Pipes

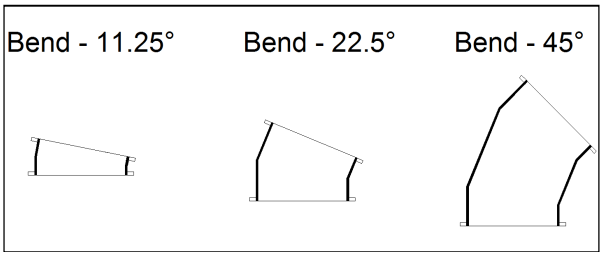


Figure 6-4: Bends

The lifting plant typically used for the connection of land pipelines are an excavator and a wheel loader. The wheel loader will pick up a pipe at the pipe lay down area and transport it to the location where the pipe needs to be connected. The wheel loader will lay down the pipe while a sling or chain is fixed to a point in the middle of the pipe. The sling or chain is attached to an excavator which lifts the free pipe and brings it in position for connection (refer to Figure below).

Figure 6-5: Lifting and positioning a shore pipe

Once the pipe is brought into position, the alignments for the bolt openings will be made.
After aligning the flanges, the pipes will be connected and the following steps must be taken:

- Insert bolts in the lower half of the flanges and screw on nuts without tightening
- Insert plastic gasket, making it rest on the inserted bolts
- Insert remaining bolts, screw on nuts without tightening.
- Tighten the bolts

Figure 6-6: Aligned flanges

Figure 6-7: Tighten the bolts

To enable the pipe fitters to easily reach the bolts at the lower part, the pipes will be positioned on heaps of gravel or alternatively on metal supports or wooden blocks, depending on the ground conditions at that location.

For the discharging operations and construction of the shore pipeline, the following dry equipment will typically be required:

- 2 x Bulldozer CAT D6 type or similar
- 1 x Bulldozer CAT D8 type or similar
- 1 x Excavator CAT336 type or similar, to be used as earthmoving and lifting plant
- 1 x Wheel loader CAT972 or CAT966, to be used for transport and connection of shore pipelines
- Spare equipment: 1 additional excavator and 1 bulldozer as backup

Figure 6-8: Dry Equipment on the discharging Area

6.3 INSTALLATION OF WEIR BOXES

Weir boxes or dewatering pipes will be installed at 5 locations:

1. Between Siltpond A and the sea
2. Between Terminal Area A and Siltpond A
3. Between Terminal Area B and Siltpond B
4. Between Siltpond B and Siltpond A
5. Between Stockpile area and Siltpond B

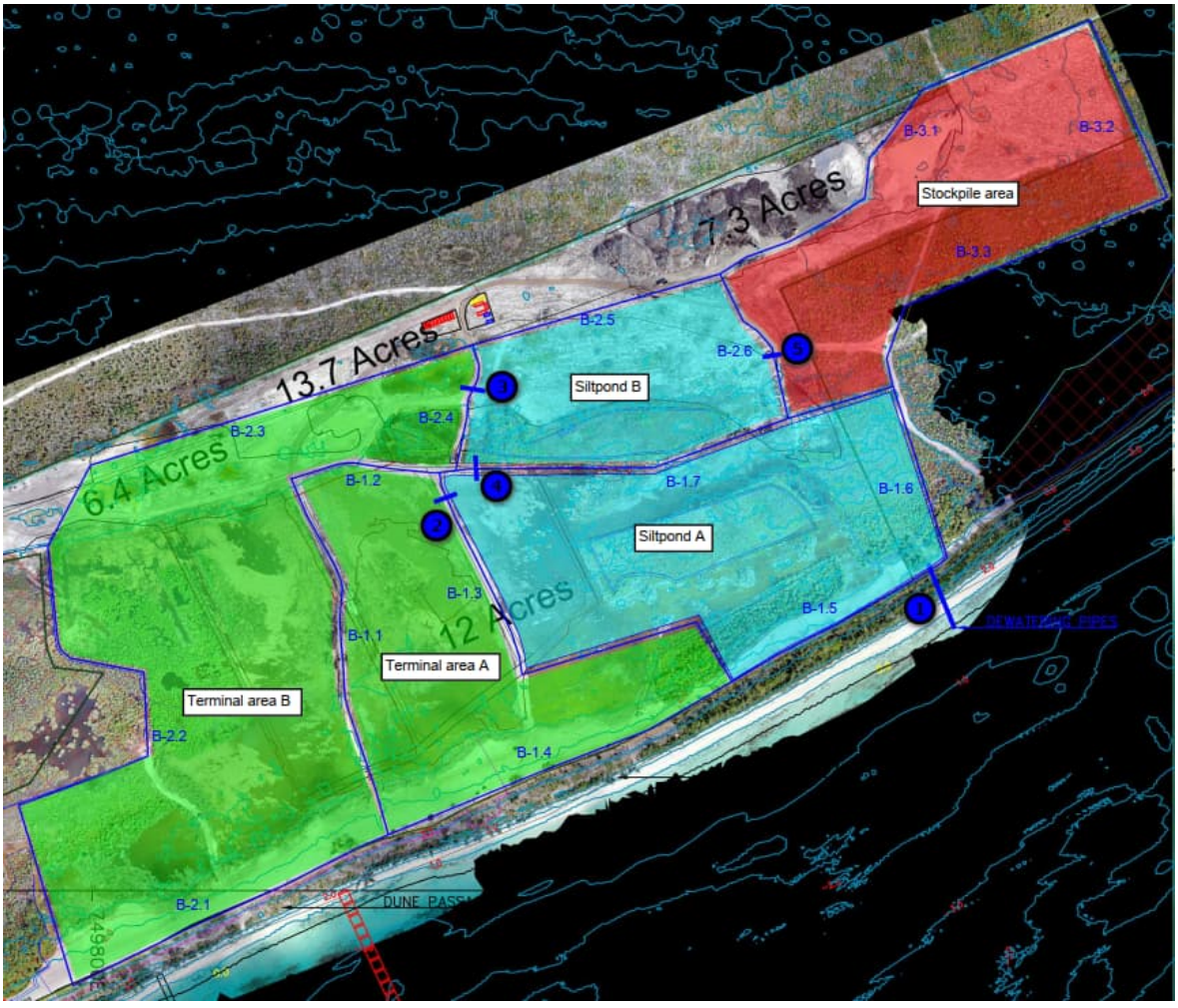


Figure 6-9: Location of weir boxes/dewatering pipes

The purpose of these weirboxes is to control the water level in the reclamation area and to control the outflow of water and fines from the reclamation area towards the sea. At the inner side of the box, inlet surface can be closed off at different levels by wooden planks, allowing to manage the water level in the reclamation area. To prevent wooden branches, floating objects,... clogging the weir box, a grid can be installed on top of

the wooden planks. On the outlet of the box, land line pipes are connected to act as a culvert under the bund and dewater towards a reservoir, pumping hole or open waters.

The number outgoing pipes to be installed is based on our internal production tool for project specific conditions (soil, cutting production, pumping distance, surface). The advantage of the custom made weir boxes are:

- Standard design (newly improved design for safety, transport and works)
- In large stock available and easy to fabricate
- Flexible design in quantity and height
- Modular length of outgoing pipes at the bottom based on site necessities
- Allows to control water levels with extra care for safety
- Outgoing designed to install 4 sets of 2 outgoing pipes diameter 900mm/ 35inch

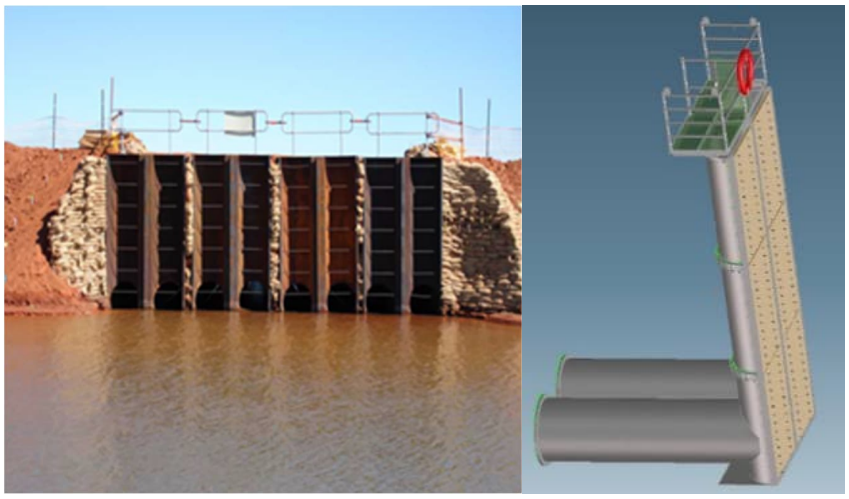


Figure 6-10 weirbox design

Figure 6-11: Installation of weirbox

6.4 CLEARING/DEGRUBBING OF AREAS

Owner's subcontractor BHM cleared and degrubbed a large part of the project area. Additionally, seven areas have to be cleared and degrubbed to allow for a sufficiently large reclamation area and sufficiently large siltponds.

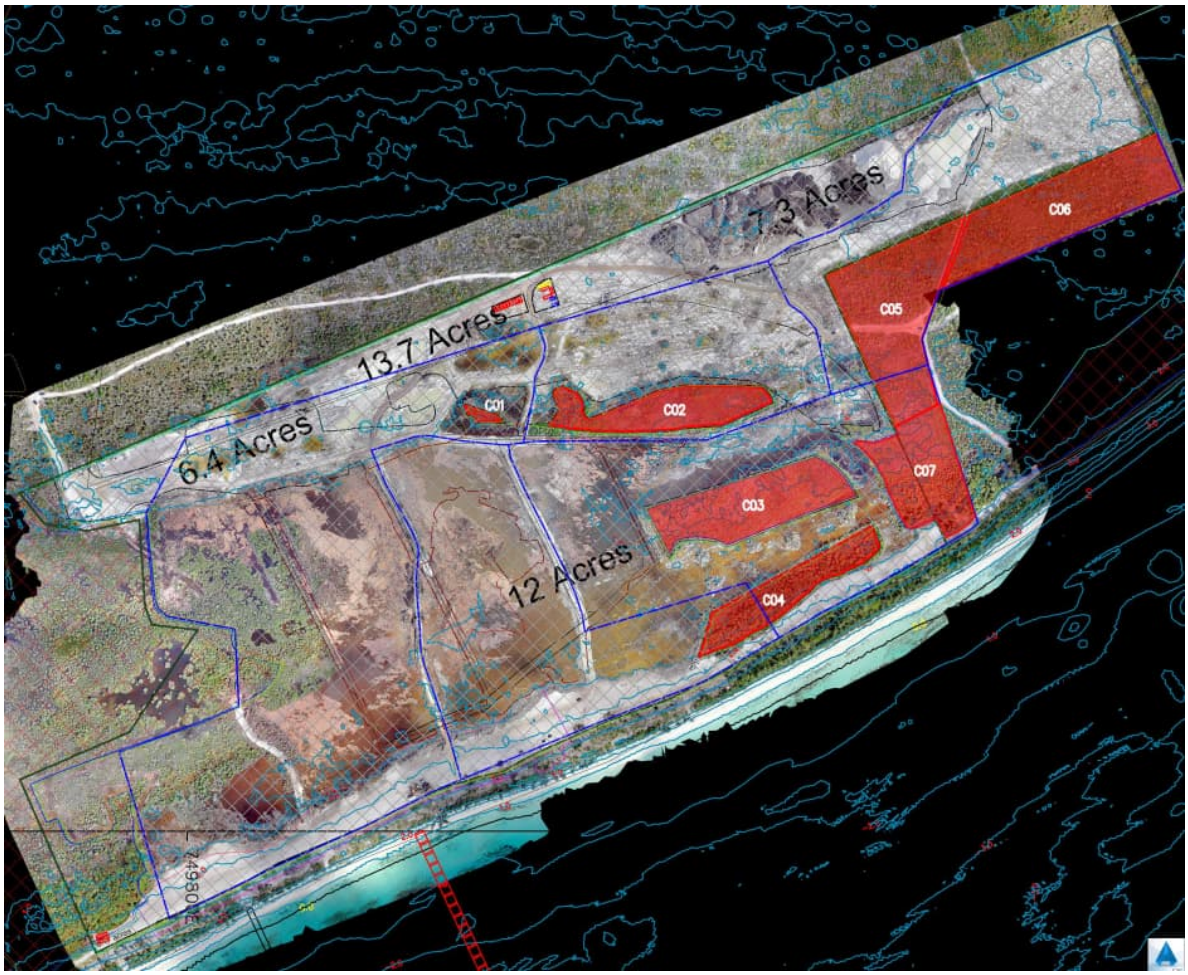


Figure 6-12: Additional clearing and degrubbing areas

Below table gives an overview of how large these areas are:

Areas for Clearing & Degrubbing			
Name	Area (m²)	Area (Acres)	Area (sqy)
	(m²)	(Acres)	(sqy)
C01	281.5	0.07	336.7
C02	7,513.3	1.86	8,985.8
C03	11,125.2	2.75	13,305.6
C04	6,909.7	1.71	8,263.9
C05	15,865.1	3.92	18,974.5
C06	15,812.3	3.91	18,911.4
C07	9,536.0	2.36	11,405.0
Total	*67,043.1*	*16.57*	*80,182.9*

6.5 FILL PLACEMENT AREAS

Below table gives an overview of the surfaces, estimated original levels, estimated design levels and corresponding capacities of each of the different areas on the project site.

Reclamation Areas					
Name	Area (m^2)	Area (Acres)	Orig. Level	Design Level	Capacity
	(m^2)	(Acres)	(mMLW)	(mMLW)	(m^3)
Terminal Area - A	64,893	16.04	0.4	3.0	168,722
Terminal Area - B	135,437	33.47	0.5	3.0	338,593
Siltpond A	81,400	20.11	0.4		
Siltpond B	39,744	9.82	0.8	4.0	127,181
Stockpile Area	66,899	16.53	1.5	5.0	234,147
Total	*388,373*	*95.97*			*868,642*

6.6 FILL STRATEGY AND SEQUENCE

The fill sequence will happen in 3 phases:

1. Reclaiming of Terminal area A and dewatering via siltpond A

The eastern section of Terminal area A will be reclaimed first, after which the area is filled up towards the north. During this filling, dry excavation of Terminal area A will take place to construct the bunds around Terminal area B and siltpond B. The complete Terminal area A will be filled from the first shore connection.

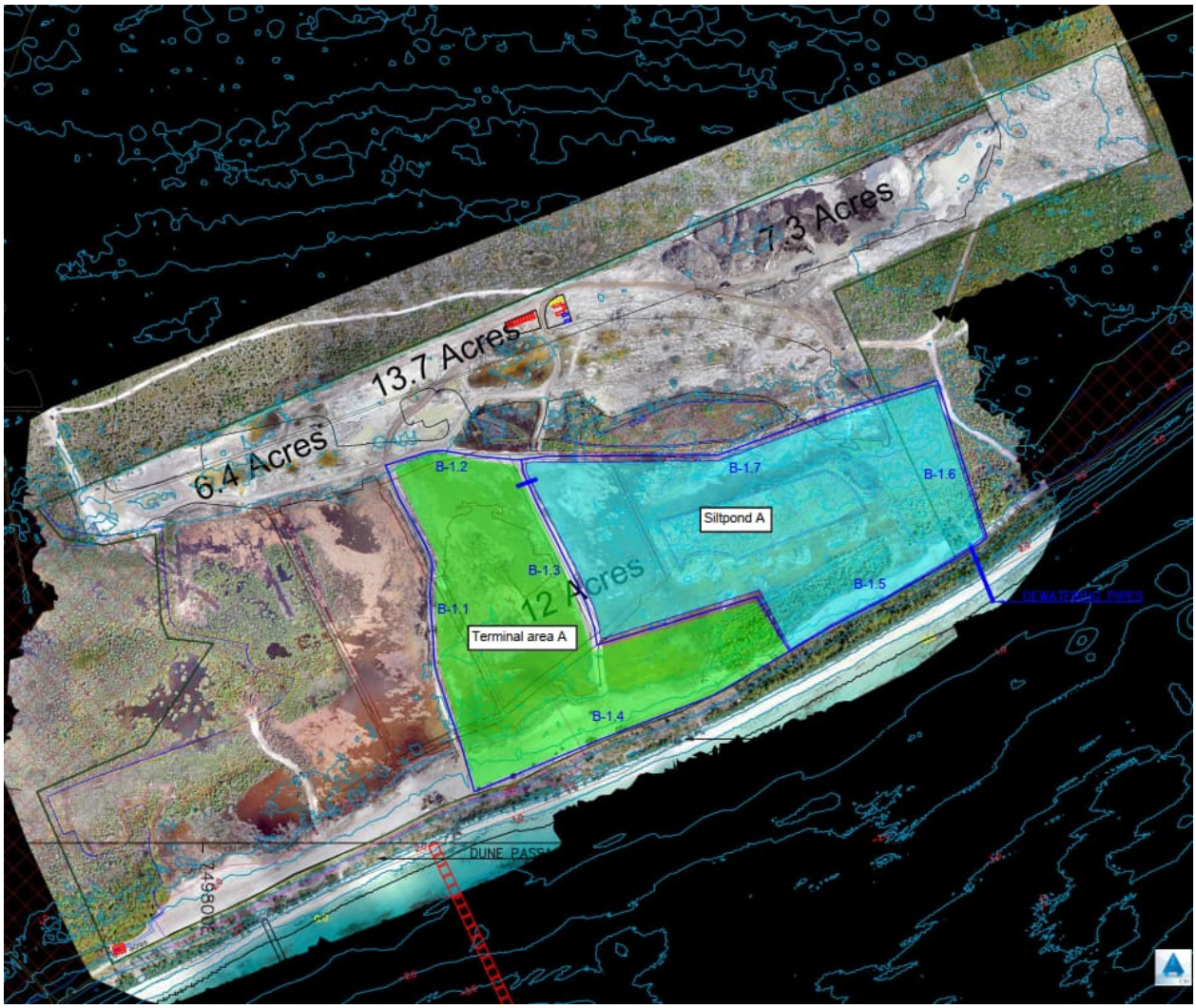


Figure 6-13: Reclamation planning – phase 1

2. Reclaiming of Terminal area B and dewatering via siltpond A through siltpond B

When Terminal area A is filled, reclamation of Terminal area B can commence. Dewatering of this area is done through 2 siltponds, to limit the fines flowing out of the reclamation area as much as possible. The southeast section of Terminal area B will be filled from the second shore connection, while the eastern and northern part of Terminal area B will be filled from the first shore connection. The pumping distance will always be minimized, as it results in higher production with less water concentrations in the slurry.

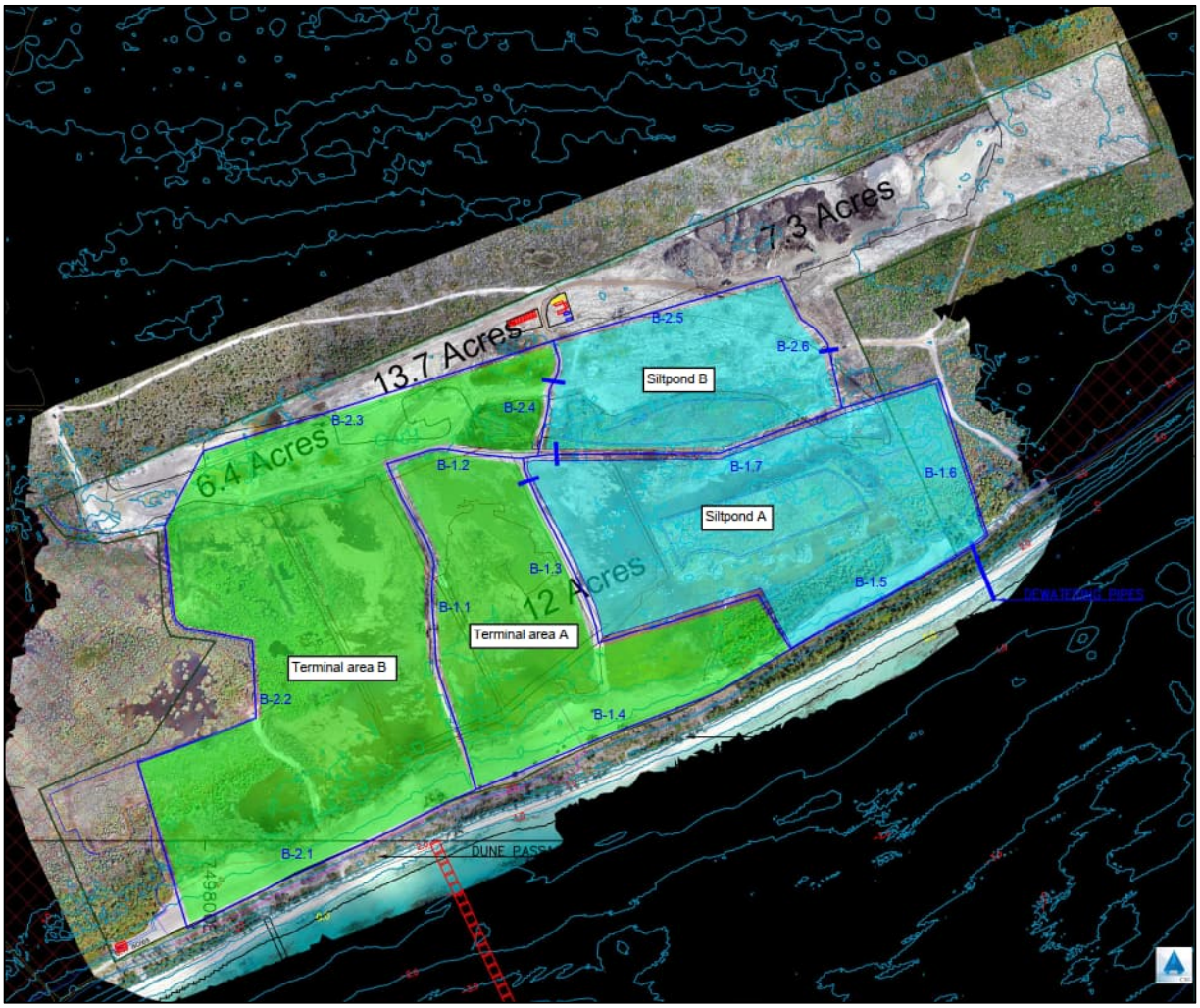


Figure 6-14: Reclamation planning – phase 2

3. Reclaiming of Stockpile area and dewatering via siltpond A through siltpond B

When Terminal area B is filled, the reclamation scope will shift to filling up of the Stockpile area. Also here the dewatering will take place through two siltponds.

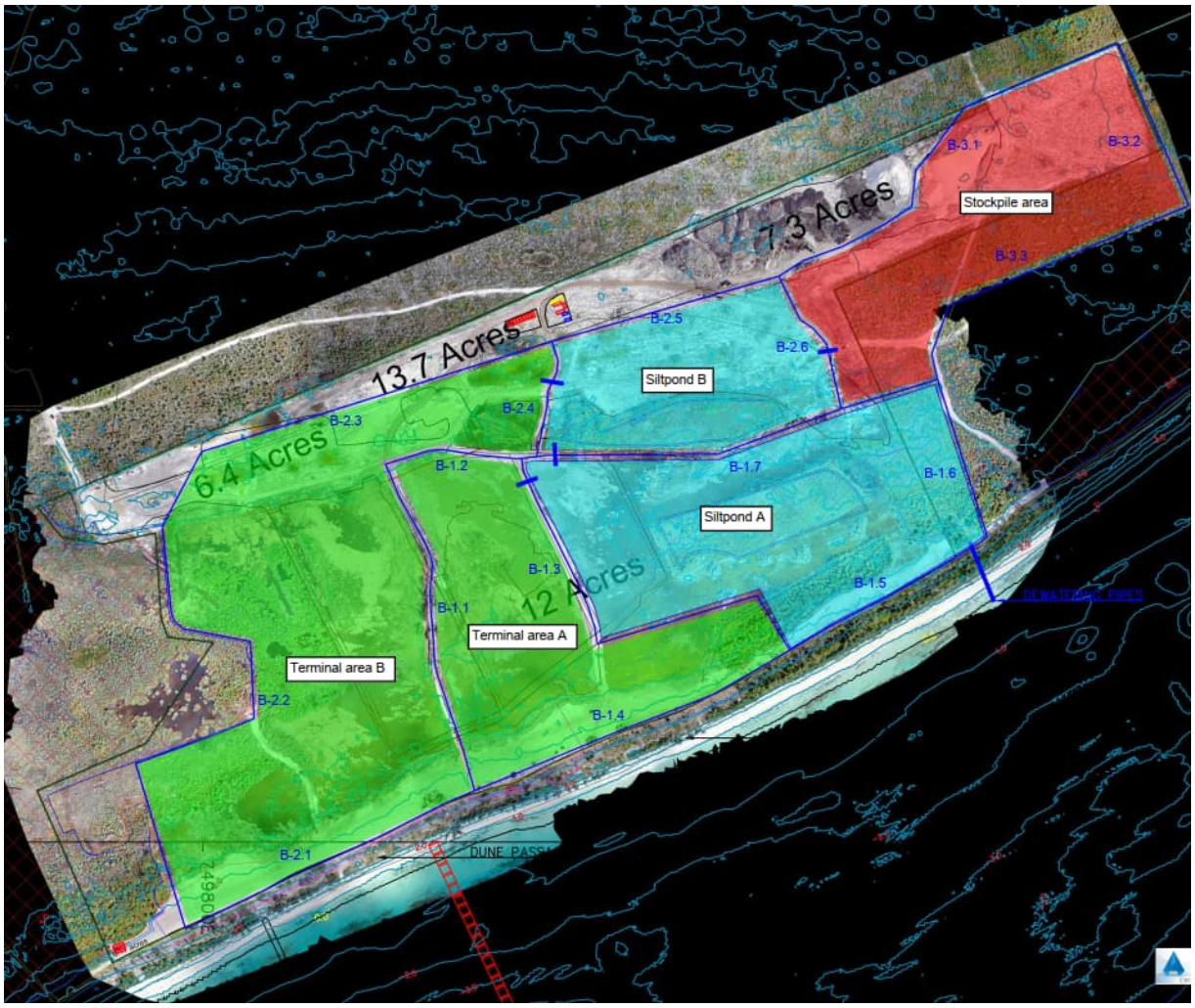


Figure 6-15: Reclamation planning – phase 3

Intermediate bunds can be made in all 3 reclamation phases to increase the distance between the discharge location and the weirbox to the sea. Silt screens can also be installed in the siltponds to reduce the amount of fines flowing towards the sea.

6.7 HYDRAULIC RECLAMATION FILL

The CSD will pump the dredged sand/limestone as a mixture of water and sand/limestone particles to the discharge area through the dredge pipelines (onboard pipeline, floating line, shore line).

The shore pipeline is always on top of the previously discharged areas and the discharging direction is towards the lower areas/outlet pipes. When leaving the pipeline, the sand/limestone particles will settle and accumulate around the discharge point and form a cone. The finer the sand, the gentler the slope of this cone will be. The water in the mixture will gravitate towards the lower areas.

Tracked land equipment (bulldozers and excavators) will be distributing the material in the discharge area during the pumping process and will construct new and higher containment dikes where necessary.

Figure 6-16: Outflow of material in discharge area

Figure 6-17: Bulldozer distributing the material in the discharge area

Figure 6-18: Outflow of material in discharge area, distributed by bulldozers

Figure 6-19: Y connection in the pipeline with hydraulic valve operation

When the section around the discharge point is discharged to the desired level, the pipeline needs to be extended with 12m or 24m sections and the just completed area will be further levelled to the required level.

During the hydraulic delivery of the dredged materials, the discharge point will have to be regularly and quickly forwarded and/or repositioned. During discharge, to avoid bolting at the discharge point, the shore pipeline is gradually extended by connecting quick fit pipes (typical 18m sections) to the existing bolted pipeline. The bulldozers will mainly be deployed for the distribution of the material in front of the discharge point. In addition the bulldozers will occasionally assist the hydraulic excavator and/or wheel loader when installing above mentioned quick fit pipes (Figure below). Wheel loaders and excavators will mainly be deployed for the extension of the pipeline including bolting up, setting up bunds and transport of pipes.

Figure 6-20: Wheel loader handling the shore pipes

Each shift the sandfield master inspects the bunds and pipeline for leakages.

Quick fit pipes allow for a fast coupling and uncoupling of pipeline and is being used primarily directly near the discharge mouth. The pipes have a male end on one side (discharge direction) and a female end on the opposite side. The female end of the pipe is connected to the male end of the pipe by pushing it onto the male end of the previous pipe. A rubber seal in the female end ensures a closed connection. The connection operation is usually done by an excavator attaching a single chain, connected to the hook of its bucket, around the female end of the pipe that needs to be connected and by positioning that end of the pipe next to the discharge mouth. A bulldozer pushes the new pipe into line with the discharge pipeline while the excavator brings the female part in front of the male end and pushes it into position.

The figure below shows a pictorial overview of the typical connection phase of a quick fit pipe during the pumping process.

1. Preparation of discharging area, bulldozer pushing front bund for pipeline installation and to prevent backflow;
2-3. Preparation of discharging area, bulldozer pushing guidance bund near the discharging area boundary to prevent sand or water flow out of design;
3. Attaching new pipe segment (bolted);
4. Discharging area ready for discharging, quick fit pipe on standby;
5. Start discharging;
6. Bulldozer leveling discharged material in front of the pipeline;
7. Formation of crater and erosion channels near the outlet of the pipe;
8-9. Bulldozer and excavator installing quick fit pipe in front of the active discharge line;
10-11. Quick fit pipe installed, leveling of discharged area by bulldozer;
12-13. Discharging completed. Removal of quick fit pipe;
14. Quick fit pipe is being replaced by bolted shore pipes;
15-16. Reshaping bunds for continuous discharging;

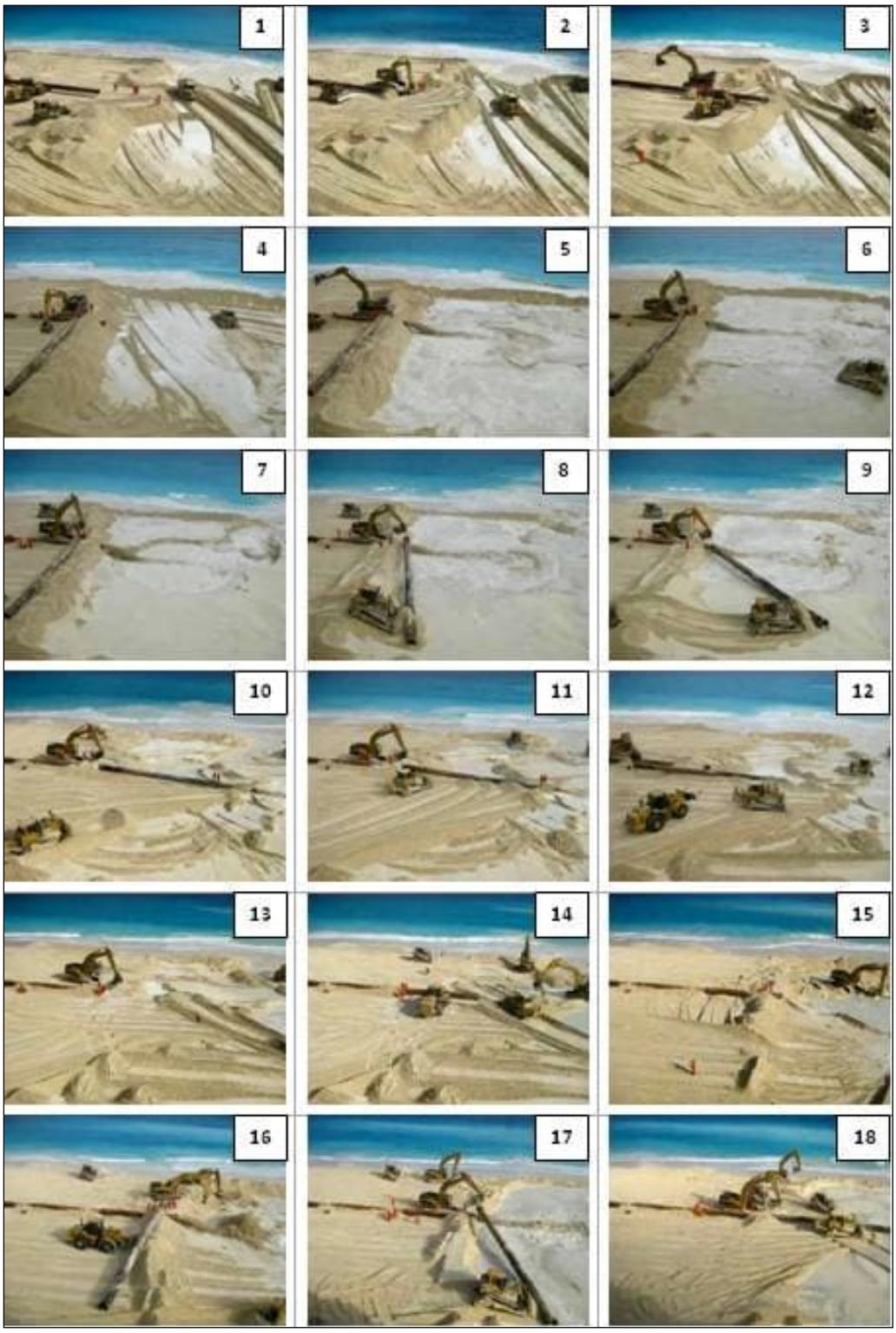


Figure 6-21: Progress of discharging works – connecting quick fit pipes

7 ENVIRONMENTAL CONSIDERATIONS

Reference is made to the Contractor's EMP to be read in conjunction with this chapter.

7.1 ENVIRONMENTAL PERMIT

Environmental permitting will be arranged through the Bahamas Department of Environmental Planning and Protection (DEPP) by the Owner.

7.2 TURBIDITY CONTROL - SILT CURTAINS

As detailed in the section on mobilization, the Contractor will mobilize almost 4,000m of turbidity curtains and accesories.

Turbidity curtains shall be installed and maintained near active excavation, construction and discharge locations including both dredge operations and reclamation works. Curtains shall be in good working order and inspected on a daily basis, with documentation of function provided within the daily report by the Contractor. The Contractor shall maintain on-site sufficient curtain length in reserve to replace worn or damaged curtain sections.

Appropriate removable living organisms, such as anemones and urchins, from areas where the turbidity curtains are to be maintained. A sweep prior to the installation of the curtains and a final sweep once the curtains are in place will be undertaken.

Upland containment including settling ponds, diking and water control structures shall be implemented to minimize the potential for discharge of coral fragments into the marine environment. Turbidity curtains will be deployed around the return water discharge from upland disposal to minimize the potential for discharge of coral fragments (which may contain SCTLD) into the broader marine environment.

In order to minimize the dispersion of sediment and elevated turbidity levels created at the outflow of dredge spoil temporary storage area on the marine environment, a silt curtain is proposed to be installed around the outflow. An anti-turbidity barrier or silt curtain is a floating barrier that allows the suspended sediment more time to settle and consequently reduces its dispersion in the surrounding environment. Typically it guides the suspended sediment to the deeper part of the water column where it will settle, as is shown in figure below. However, the efficiency in containing silt and reducing its impact on the surrounding environment highly depends on the prevailing hydrodynamic conditions on site.

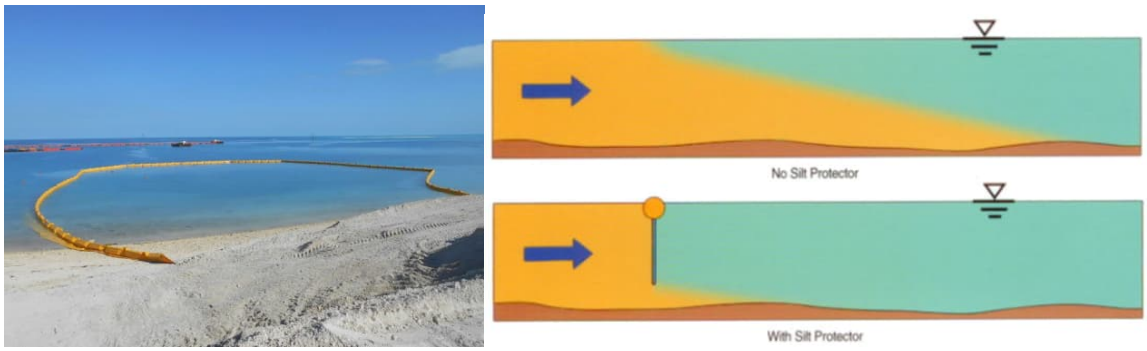
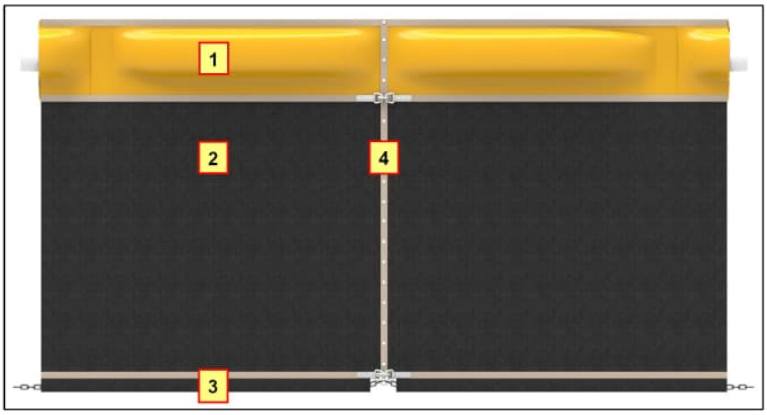


Figure 7-1: Silt Curtain (left) and its working principle (right)

A silt curtain consists of 4 major components as is shown in figure below:



1. Floating pocket containing several pieces of styrofoam to provide buoyance as well as flexibility
2. Geotextile curtain which acts as the silt barrier
3. Ballast chain at the bottom of the curtain to keep it in a vertical position
4. Connections between 2 sections of silt curtain using shackles to create a continuous barrier

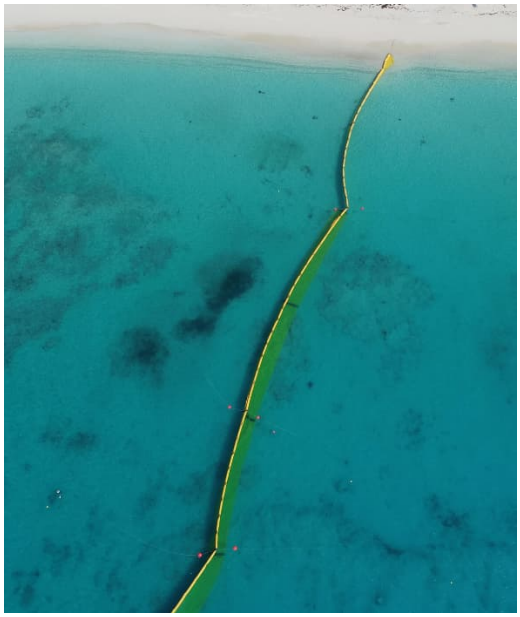


Figure 7-2: silt curtain along shoreline

It is considered no sensitive areas are nearby, requiring the installation of additional silt curtains. It is considered no siltscreens should be installed around the coral relocation sites. Turbidity curtains near the dredger will be installed in shallow water.

The silt curtains will be installed taking into consideration prevailing (tidal) currents. A sweep prior to installation of living organism is considered.

7.3 TURBIDITY CONTROL

Reference is made to JDN.BSGRCC.009 - Turbidity Control Plan.

7.4 TURBIDITY MONITORING

Reference is made to JDN.BSGRCC.009 - Turbidity Control Plan.

7.5 FAUNA MANAGEMENT

All personnel will receive an environmental induction to raise awareness regarding the importance of the marine animals, plants and avian fauna around the site and their vulnerability.
Crew members onboard of the dredgers will be trained to be aware of marine animals in the vicinity of the works, to keep sufficient distance and to implement proper response measures as required. Sightings of turtles and marine mammals will be recorded. If animals in distress are observed, the Environmental Representative will be informed in order to take the necessary actions. Any incident involving marine animals and avian fauna will be notified and reported to Owner.

7.6 HYDRAULIC FILL TURBIDITY CONTROL CONSIDERATIONS

Special attention will be paid to the following in order to control and reduce turbidity resulting from fines in suspension.

- Control erosion of fines by reclamation area management
- Use quick fit pipes, which avoids pumping extra water to switch valves
- Maximize flow distance to weirbox by reclaiming intermediate bunds first
- Maximize surface in use on the reclamation area
- Maximize water height in ponds
- Seen limited available in-situ material: maximal use of dredged material for bunds
- Mobilize Sufficient length of shoreline and number of valves for increased flexibibility during fill, which ensures backup options are availble
- Reduce pumping distance and maximize CSD production to avoid pumping extra water to the reclamation area
- Install silt curtains in front and after weirboxes
- Regular inspections of weirboxes, bunds and curtains

8 ORGANISATION AND RESPONSIBILITIES

8.1 ORGANISATION CHART FOR A CSD

The organization chart for work scope with a CSD indicates the area of responsibilities and the reporting lines for the relevant project personnel involved in this activity.

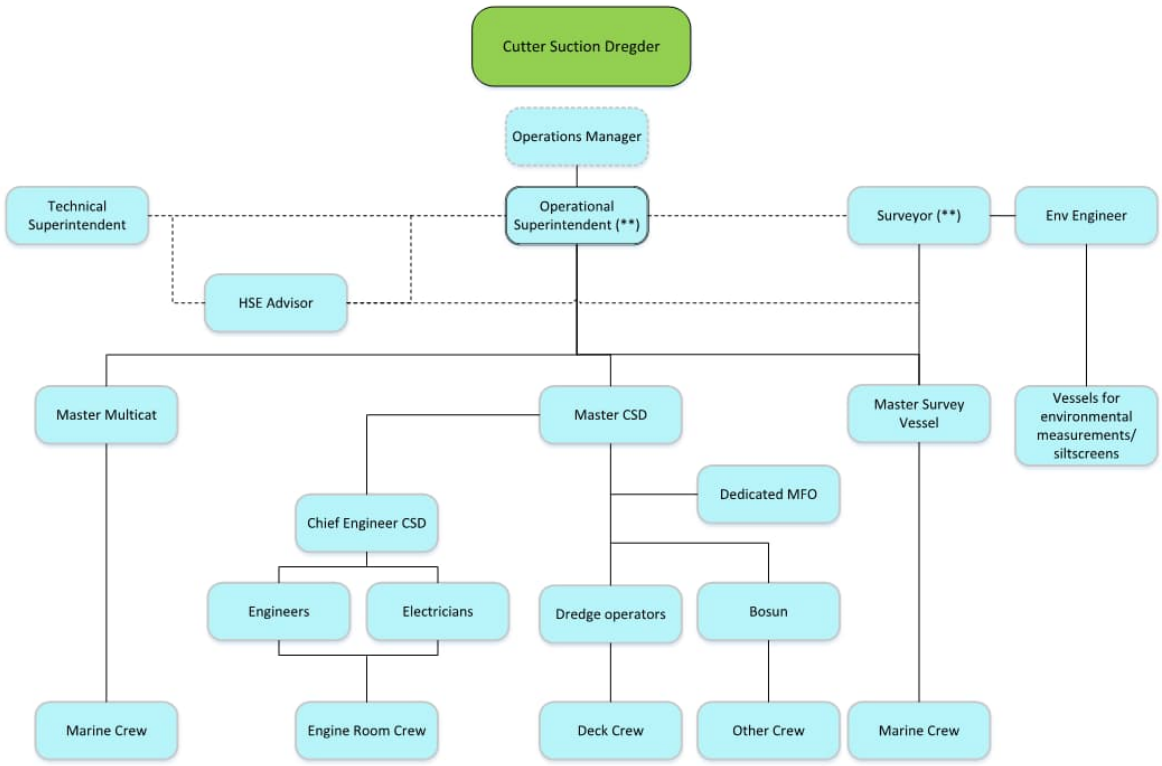


Figure 8-1: Organisation chart for CSD

8.2 RESPONSIBILITIES

Personnel shall ensure that they are aware of their duties and authorities at all times during the project. Project personnel are accountable for the activities within their area of responsibility.

The overall responsibility for the Project's activities remains with the Project Manager. The Project Manager shall evaluate and approve key personnel required for employment on the project. Special attention will be paid to the environmental staff, being experienced and familiar with the area and particulars of the project.

8.2.1 Project Manager

The Project Manager has the overall responsibility for control, planning and execution of the operations. He has to ensure the safe implementation of all project related procedures / method statements, and has to verify that the work is undertaken as per Company's requirement and schedule.

- Represent the Contractor during meetings with Employer and ensure they are informed of all environment related activities and events accurately and in a timely manner.
- Ensure that sufficient qualified and trained personnel are employed on the project site and on-board the vessels.
- Has the responsibility to review, approve and endorse the implementation of the contents of the EMP.

8.2.2 Operations Manager or Works Manager

- Ensure that support is provided to the Superintendents so that all works can be executed efficiently and in compliance with the Contract requirements;
- Coordinate the works to ensure the provisions contained in this document can be effectively implemented;
- Ensure that sufficient qualified and trained operators and labour are employed on the project site;
- Liaise with the Superintendents and Surveyor(s);
- Provide initial instructions and guidelines pertaining to the responsibilities and the preparation of the works;
- Liaise with third parties and stakeholders with respect to the Operations;
- Ensure compliance of Company's and Project QA/QC activities with quality assurance systems and contractual requirements;
- Ensure compliance with local regulations.
- Be fully conversant with the relevant terms and conditions of the Contract, both technically and commercially, and have complete understanding of the operational part of the Scope of Work including environmental aspects;
- Fully endorse the implementation of the EMP, where applicable to operational matters;
- Ensure that all operations are executed in accordance with the requirements of the HSSE management system.
- Ensure the turbidity control measures on the reclamation area are executed and most efficiently. Stop operations if required

8.2.3 Superintendent

- Ensure the updating, distribution and implementation of procedures;
- Report daily to the Project Manager and, when required, to the Client;
- Determine the execution of the dredging method in co-operation with the Master;
- Determine the execution of the hydraulic fill method in co-operation with the Sandfield Master;
- Determine the method of survey in close co-operation with the Chief Surveyor;
- Ensure that the required survey equipment according to the mobilization manual is available onboard.

- Monitor compliance with project HSSE requirements and communicate to the crew

8.2.4 Chief Surveyor

The Chief Surveyor maintains overall responsibility for the survey activities on the Contractor's work sites, and must:

- Ensure the quality and quantity of survey data and survey deliverables;
- Ensure the quality of the survey equipment;
- Prepare the As-Built charting and data formatting, if required;
- Communicate with the Client regarding survey related matters.
- Monitor compliance with project HSSE requirements.

8.2.5 Environmental Engineer

- Supervise preparation, implementation and communication of all environment-related documents
- Be responsible for the review of the EMP in order to ensure compliance with the latest requirements and regulations and to improve the environmental management based on project experiences.
- Set, monitor and audit the environmental performance of the project.
- Monitor compliance with all project environmental requirements
- Execute daily turbidity monitoring and related reporting
- Discuss the results of monitoring, inspections and audits with the operational department and examine opportunities for improvement
- Act as a main point of contact for all environmental aspects
- Ensure the environmental monitoring, data processing, administration and reporting are carried out correctly, quickly and effectively.
- Coordinate the environmental training and induction process
- Ensure that all project staff are fully aware of their respective environmental responsibilities
- Establish, monitor and verify the environmental performance of the project
- Coordinate installation, maintenance and performance of silt curtains

8.2.6 Master

- Ensure the proper, safe and secure functioning of the vessel and its crew;
- Implement instructions received from vessel Superintendent and perform accordingly;
- Supervise and co-ordinate all operations at sea;
- Liaise with the Superintendent and the onshore management on marine aspects of the works.
- Ensure full compliance with both international and local legislation.

8.3 MAIN ORGANIZATION

The organization chart for the Grand Port project can be found on the figure below. The on-site project team is supported by the head office throughout the complete duration of the project.

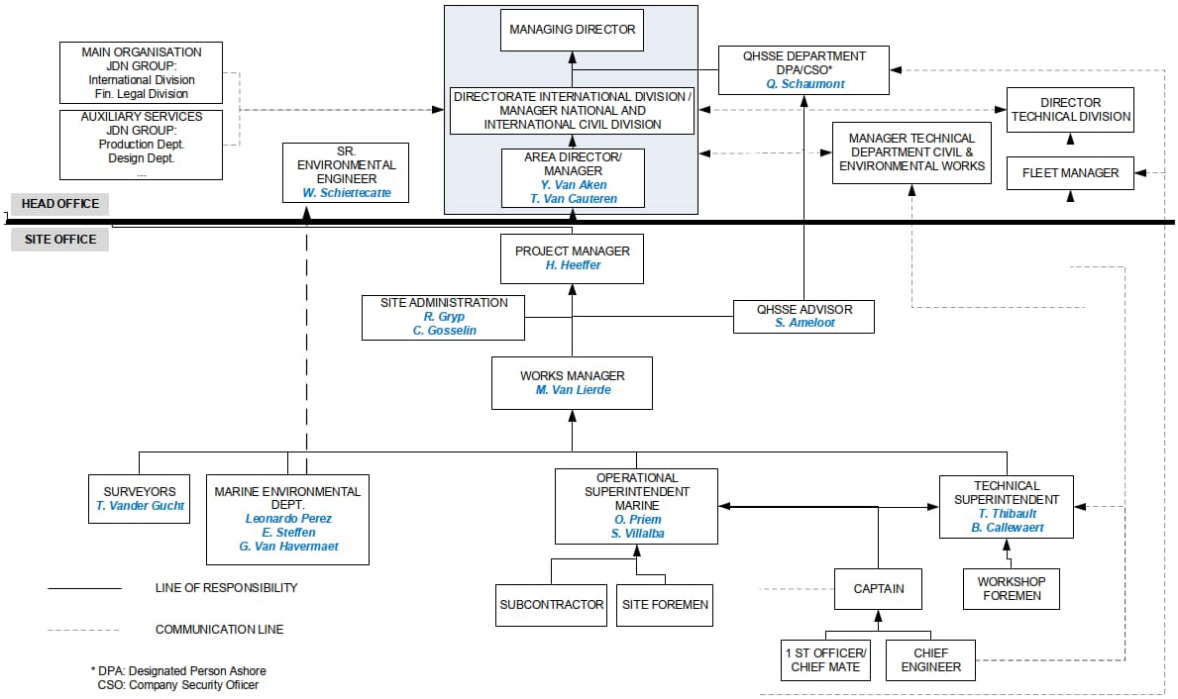


Figure 8-2: Organization Grand Port project

9 QUALITY

Quality control specific to the operations will be by regular bathymetric and topographic surveys, to ensure compliance with the horizontal and vertical tolerances, design depth and width.

A daily report containing all data of the previous 24 hours will be presented on a daily basis.

10 ANNEXES

10.1 LEAFLET DREDGER

10.2 WORKING PRINCIPLES CSD

10.3 ADDITIONAL CLEARING AND DEGRUBBING AREAS

10.4 RECLAMATION PLANNING

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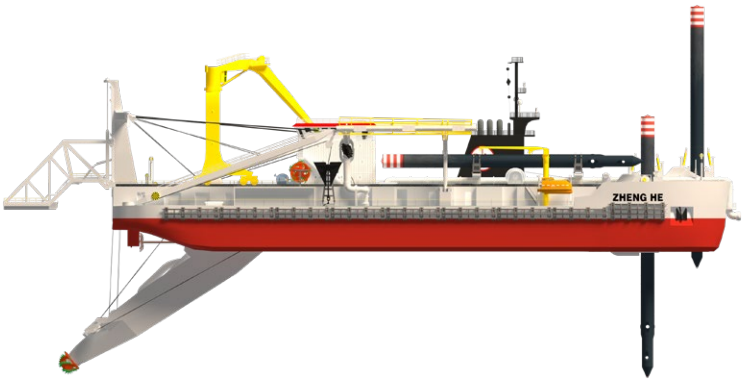
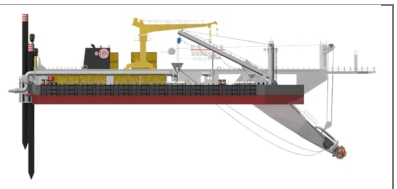


Cutter Suction Dredger

Length o.a.	**138.5 m**
Breadth	**26 m**
Draught	**5.5 m**
Dredging depth	**35 m**
Suction pipe diameter	**900 mm**
Discharge pipe diameter	**900 mm**
Barge loading pipe diameter	**900 mm**
Submerged pump power	**4,250 kW**
Inboard pump power	**2 x 5,000 kW**
Cutter power	**7,000 kW**
Propulsion power	**2 x 3,500 kW**
Total installed diesel power	**23,520 kW**
Speed	**13 kn**
Accommodation	**46**
Built in	**2010**

Jan De Nul GROUP



LAYOUT AND WORKING PRINCIPLES

CUTTER SUCTION DREDGER

1 INTRODUCTION

A Cutter Suction Dredger (CSD) is classified as a hydraulic dredger and is one of the most common used type of dredging equipment. A CSD can dredge nearly all kinds of soils and is used where the ground is too hard, or the seabed too shallow, for trailing suction hopper dredgers.

There are non-propelled CSD's, which have a pontoon hull without the means of propulsion, and self-propelled CSD's that are shaped like a ship and are sea-going.

The dredging operation takes place with the CSD in a stationary position, thus even a self-propelled CSD will be anchored to the seabed with spuds or anchors while at work. It needs to lift all dredging gear from the seabed before they can navigate freely to other sections of the project or to a next project.

Jan De Nul Group has a large fleet of CSD's, of which most are self-propelled.

The following chapters show the layout of a CSD and explain the functions of each part within the dredging process:

- Cutting
- Swinging
- Stepping and shifting spud
- Anchoring
- Pumping
- Discharging

2 CUTTING PROCESS

A CSD has a rotating cutter head, which is a mechanical device mounted at the end of the cutter shaft, in front of the suction mouth. The cutter head is able to cut hard soil or rock into fragments and rotates along the axis of the suction pipe.

The dredge pump sucks the cut soil inside suction pipe via the suction mouth, which is located inside the perimeter of the cutter head.

The Figure 2-1 below shows the general layout of a CSD.

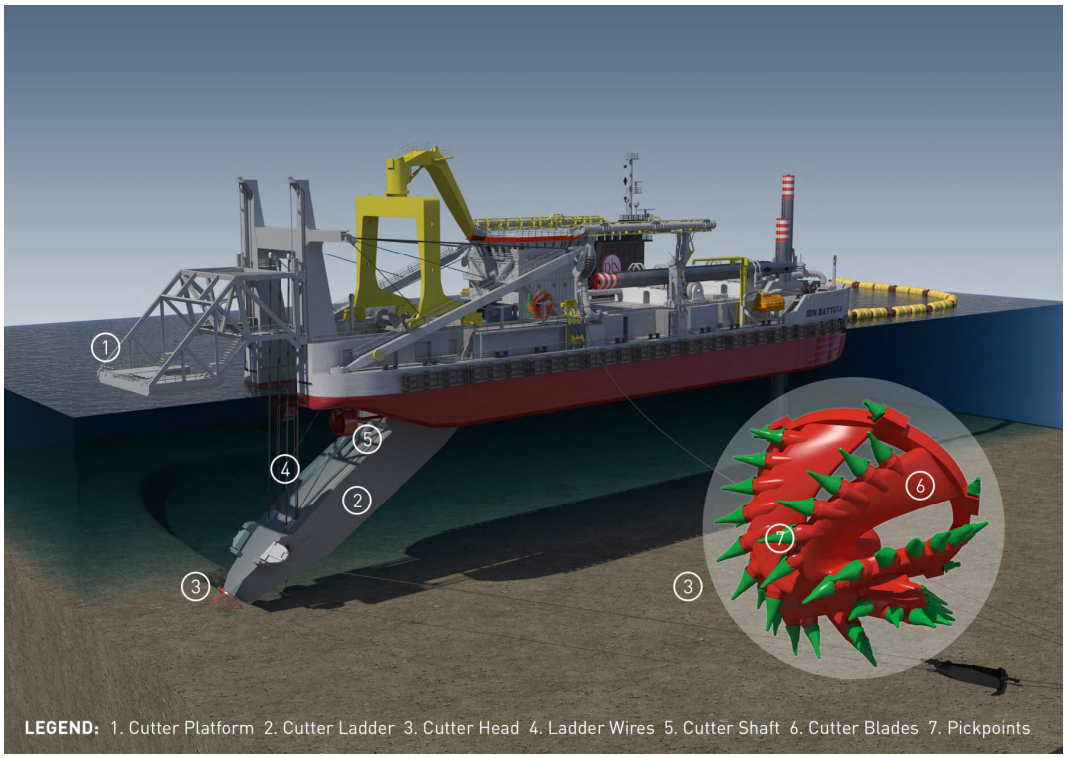
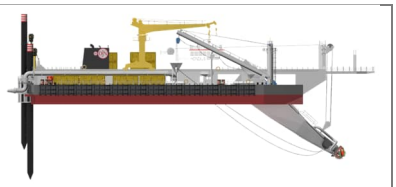


Figure 2-1: The general layout of a CSD with the cutter platform (1), cutter ladder (2), cutter head (3), ladder wires (4), cutter shaft (5) and cutter head with cutter blades (6) and pick points (7)



2.1 CUTTER HEAD

The cutter head is the rotating cutting tool mounted on the end of the cutter shaft. The rotating motion of the cutter head creates a soil-water mixture that can then be transported hydraulically.

The cutter head consists of a set of five or six blades with a half-sphere shaped form. The cutter head design is different for different types of soil material. The number of blades and thus the opening between the blades varies depending on the type of dredged soil.

For hard soils, the cutter head has to withstand the impact forces on the teeth. The cutter head design is thus heavy with a small contour and replaceable teeth to withstand the extreme wear on both the cutter head and the teeth. The teeth used are of the type pick point.

For non-cohesive soils, high production rates can be achieved through optimal mixture formation in a wide and open cutter head. Replaceable teeth such as chisels will be able to withstand the wear with lower impact forces.

For cohesive soils, the primary concern is to avoid blocking of the cutter head during dredging. The cutter head in this case should have a large and round contour with fewer blades to reduce clogging. Chisels or flared points can be used as replaceable teeth to cope with the wear.

The cutter heads are interchangeable between similar CSD's and can easily and fast be replaced during dredging if required to cope with changed soil material or for an overhaul due to wear and tear.

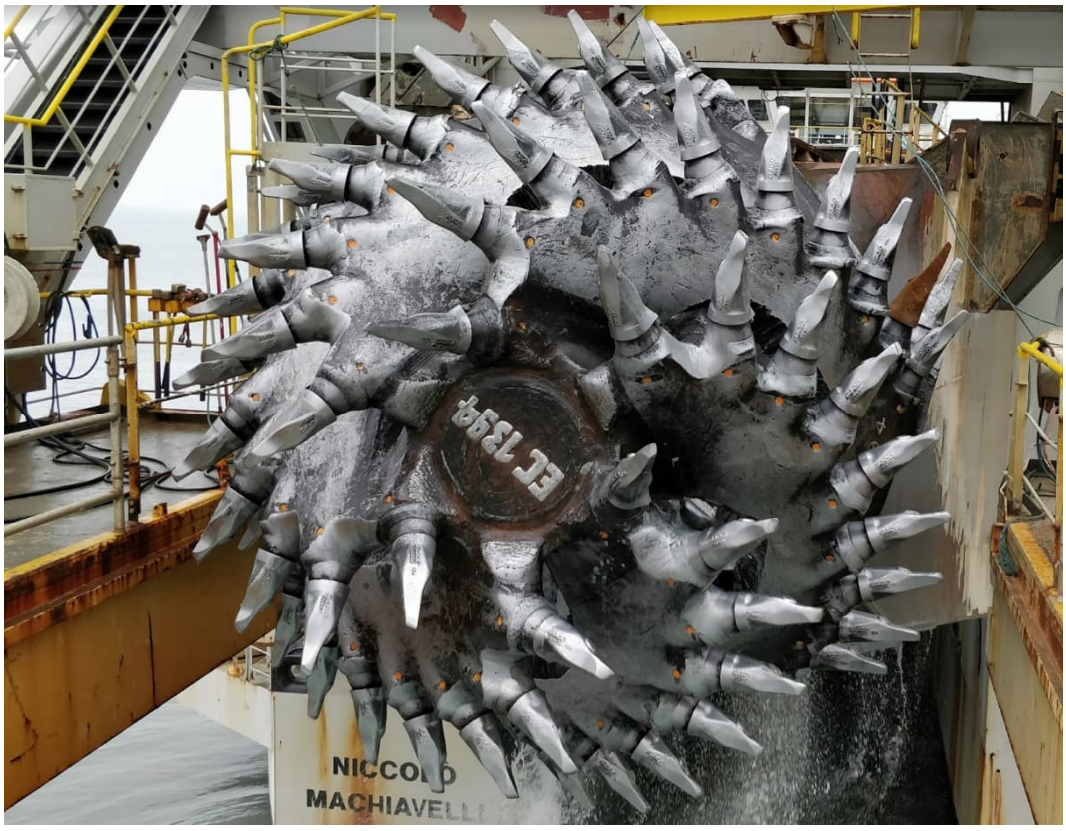
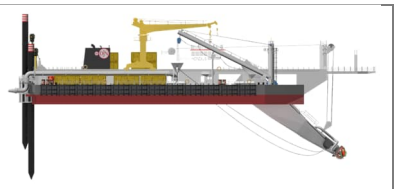


Figure 2-2: Cutter Head with six blades and pick points to the blades attached with adapters



Each blade of the cutter head has a set of adapters installed to hold the cutter teeth in position.

The cutter teeth break the soil material loose from the seabed and the shape of the cutter head blades ensures that the cut soil material moves to the suction mouth. There the vacuum created by the dredge pump ensure that the soil material enters the suction mouth and the suction pipe.

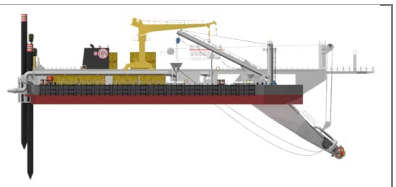
The crew of the CSD inspects and replaces the cutter teeth when worn to maintain a good cutting efficiency. The cutter head is raised above the water line for inspection from the cutter platform.

2.2 CUTTER LADDER

The cutter ladder is attached to the hull of the CSD via a pin that allows the cutter ladder to pivot vertically with the help of the cutter ladder hoisting wire. This wire is connected to the ladder wire winch via the ladder gantry on both sides of the vessel. A swell compensator incorporated in the ladder wire helps to reduce the impact of waves on the position of the ladder and cutter head. The swell compensator allows the CSD to maintain a continuous cutting depth even in less favourable weather conditions.

The cutter engine and underwater pump are inside the cutter ladder. The cutter engine drives the cutter head via the gearbox and cutter shaft. Thanks to its weight, the cutter ladder aids the cutter head to force into the seabed and cutting face.

The length of the ladder determines the maximum cutting depth of the CSD. Some CSD's have an extra pivot point to increase their maximum range.



3 SWINGING PROCESS

The cutter head, the side wire anchors and the spud at the rear are the parts that connect the CSD with the seabed.

During dredging, the CSD uses the spud as a pivot point to swing left to right and right to left around her centreline, called the swinging process. At the most right or left corner of the swing, the CSD either makes a step forward to advance the cutting face or lowers the cutter head to increase the dredge depth before she starts the next swing.

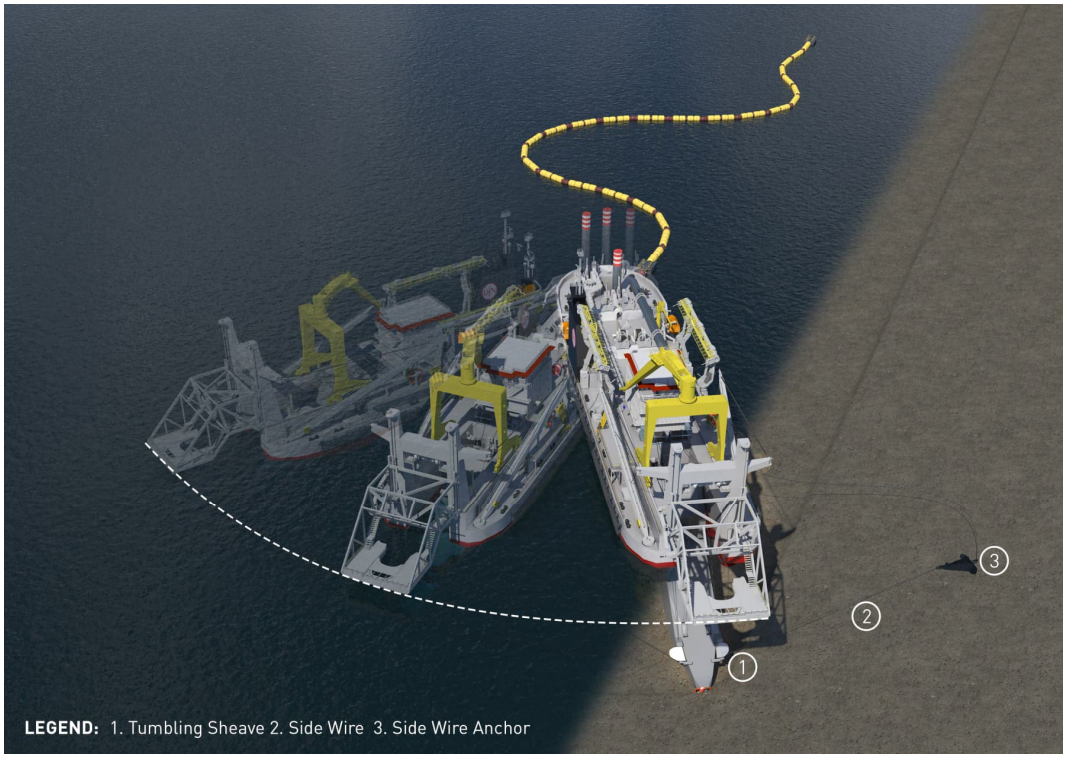
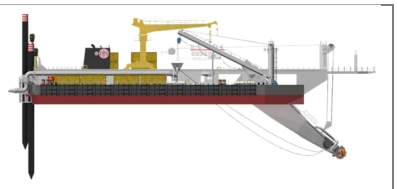


Figure 3-1: The CSD swinging left to right during dredging with help of side wire (2) and side wire anchor (3) that connect to the cutter ladder via the tumbling sheave (1)



3.1 ANCHORS

The CSD swings left to right and vice versa by pulling the side wire on one side and by veering it on the other side. The side wire anchors are the fixed points used to exert the pulling force on.

When the CSD has made sufficient progress on her centreline, she repositions her anchors to maintain their optimal effectiveness. A CSD uses one of two types of anchors, depending on the working conditions and type of the soil material:

- Drag embedment anchors, types *dredge anchor* (weight up to 20 ton) and *side wire anchor* (weight up to 30 tons, but extra weights can be added if required)

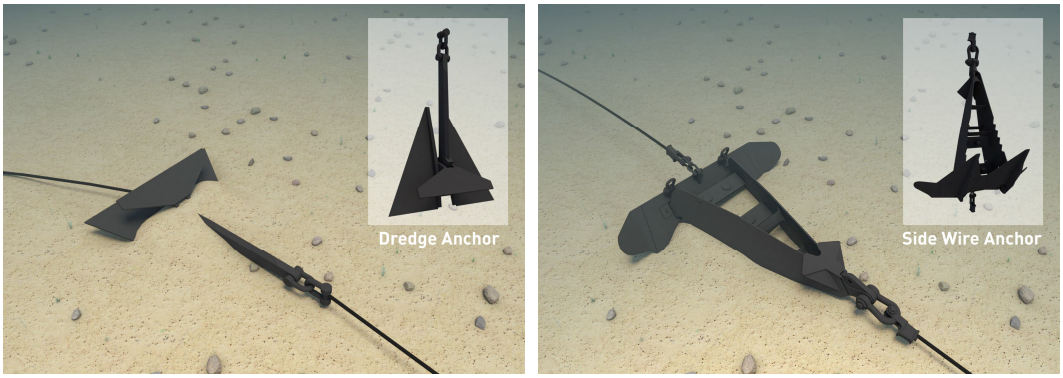


Figure 3-2: Examples of drag embedment anchors, *dredge anchor (left)* and *side wire anchor (right)*

- Gravity or box anchors (weight of 120 to 180 ton)

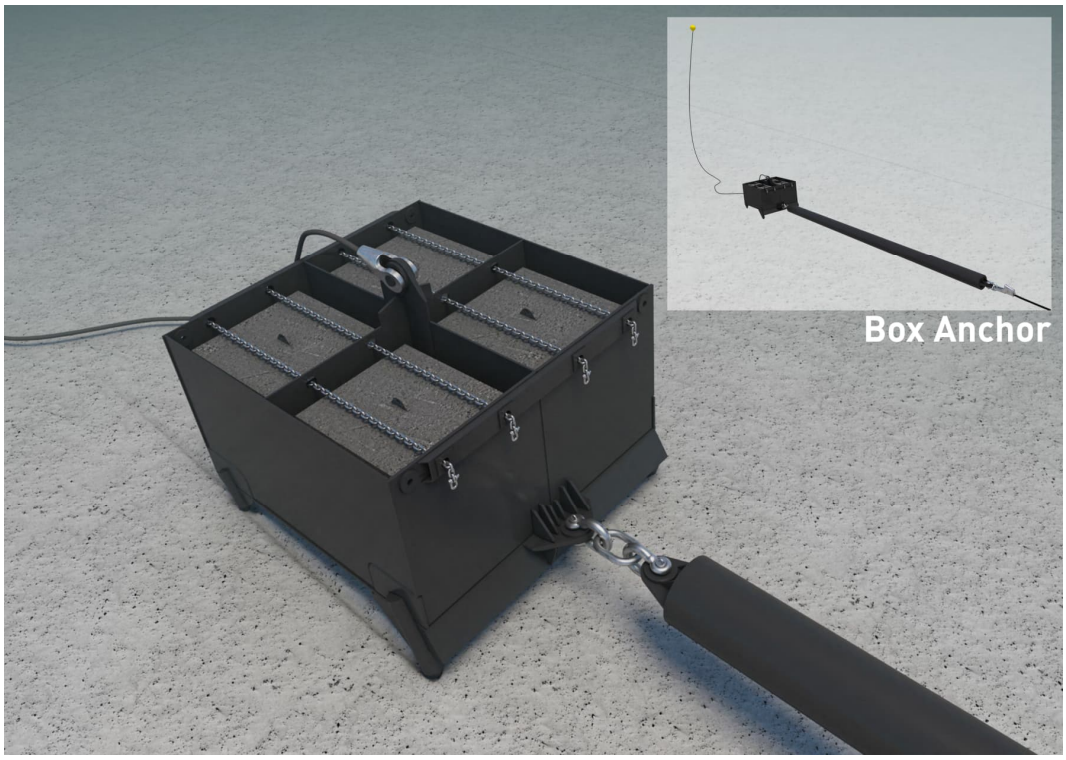
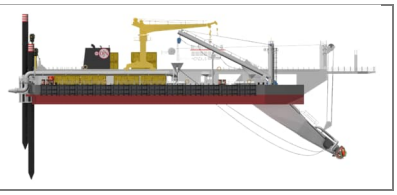


Figure 3-3: Example of gravity or box anchor



Drag embedment anchors can be repositioned by the anchor booms onboard the CSD or by an auxiliary anchor handling vessel. Gravity anchors need to be handled and positioned by an auxiliary vessel.

Section 5 describes the anchoring process in more detail.

3.2 SIDE WIRES

Two side wires (left and right) swing the CSD around the main spud, which act as a pivot point.

The end of the side wires is attached to the side wire anchor on one end and to the side wire winch on the other end. The side wire winches are located on the cutter ladder or on the bridge of the CSD. The tumbling sheaves shown in Figure 3-1 guide the side wire from the winch to the end of the cutter ladder, where the cutter head is, to the side wire anchors placed on both sides of the CSD, outside the dredge area.

The combined force of the side wire and the weight of the ladder forces the cutter head in the seabed.

4 STEPPING AND SHIFTING SPUD PROCESS

At the end of the swing when the CSD is in the right or left side of the dredge cut, she needs to move forward to advance in the uncut seabed in front of the vessel.

By pushing forward on the main spud via the spud carrier, the CSD can move forward in horizontal direction. Each step can have a variable length, but is limited to the maximum reach of the spud carrier. The size of the step forward is chosen as a logic fraction of the maximum step length, typically between ½ and 2 meter, and depending on the type of soil material.

Figure 4-1 shows the stepping process of the CSD.

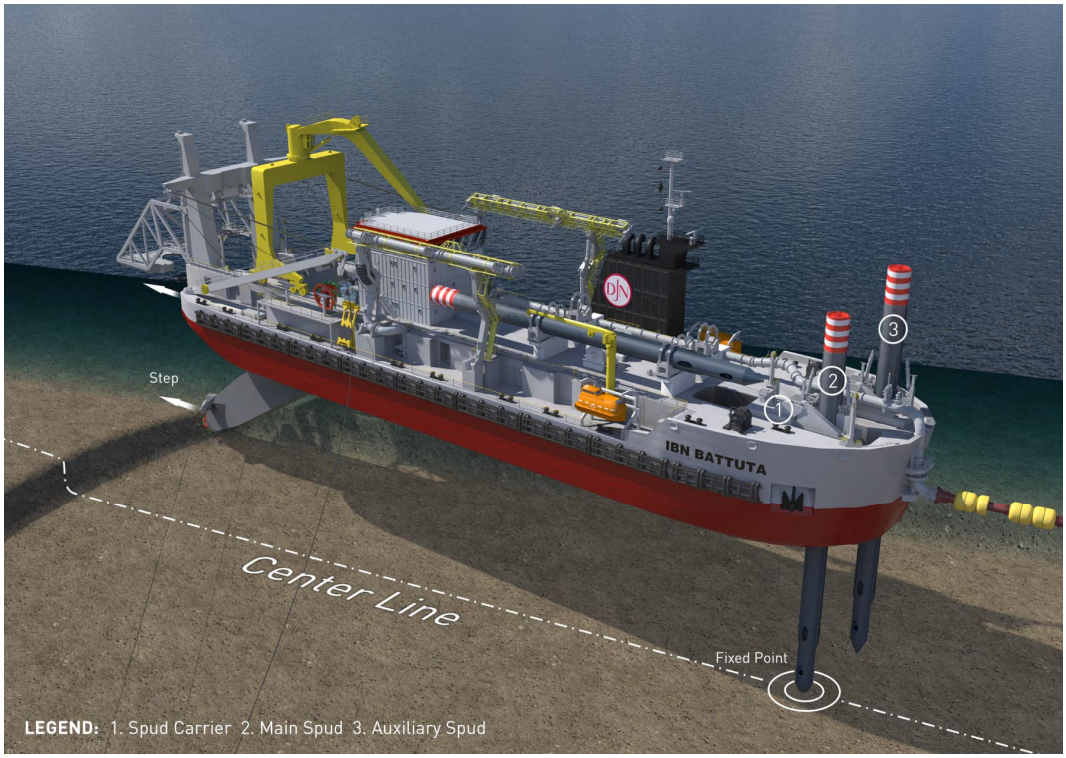


Figure 4-1: The CSD moves forward by pushing via the spud carrier (1) on the main spud (2), while the auxiliary spud (3) is used to hold the CSD in position while the main spud is repositioned

When the spud carrier reaches the end of its range, the CSD retracts the spud carrier to its initial position. To hold the CSD in position during the retraction of the spud carrier, the CSD drops the auxiliary spud in the seabed. The vessel is then anchored stable on her auxiliary spud and cutter head. The CSD raises its main spud from the seabed and the spud carrier shifts back to the start position. After the spud carrier has finished moving, the CSD drops its main spud and raises its auxiliary spud from the seabed.

Figure 4-2 shows this spud shifting process.

Figure 4-2: The CSD retracts the spud carrier (1) by dropping the auxiliary spud (3) and raising the main spud (2)

4.1 SPUD POLES

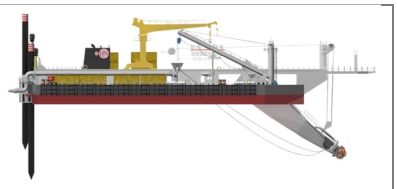
The CSD has three spud poles:

- Main spud
- Auxiliary spud
- Spare spud, not always present and not necessary for the dredge operations

The main spud at the bow of the vessel (the rear during dredging) serves two functions:

- To provide a fixed pivot point around which the CSD swings from side to side
- To provide sufficient resistance to allow the cutter head to push into the cutting face. Without enough counterforce, the cutter head will not cut sufficient material thus decreasing the production of the CSD especially in harder strata.

The CSD only deploys its auxiliary spud during the retraction of the main spud carrier to help maintain the vessel in its stationary position.



4.2 SPUD CARRIER

The spud carrier is the connection between the CSD and the main spud. It provides the forward motion to the CSD during stepping.

When the CSD is at the end of her swing, it will be pushed forward by a hydraulic ram with a maximum stroke of 6 to 9 meters, depending on the type of CSD.

Discrete steps of between 0.5 to 2 meter are taken when pushing the vessel forwards. The size of the step is determined by the soil resistance and the number of cut layers.

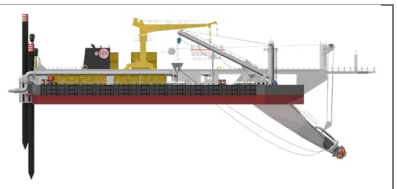
When the spud carrier is at the end of its stroke, the main spud is shift to a new forward position. Consequently, the following steps are made while maintaining the CSD in position by the auxiliary spud throughout the operation:

1. Stop the swing with the cutter head on the centre line
2. Drop the auxiliary spud in the seabed
3. Raise the main spud from the seabed
4. Retract the spud carrier back to the start position (minimum stroke)
5. Drop the main spud in the seabed (position now 6 to 9 meter forward on the centreline)
6. Raise the auxiliary spud and resuming the swinging process

When dredging in waves and at large water depths, the forces on the spud become increasingly higher. The latest generation of CSD's have a flexible spud carrier that allows limiting the forces on the spud, thus protecting the spud from damage while increasing the workability of the CSD.

This spud carrier acts like a gimbal when the overload on the spud exceeds a certain predetermined value, by allowing rotation and hence limiting the overload on the spud. This gimbal is realized by allowing the spud carrier with spud to pitch and roll via mechanical joints. It connects to large hydraulic cylinders and a nitrogen buffer system in order to set the overload force.

To help reduce the forces on the spud, some CSD's have a roll damping system installed. The roll damping system consists of a U-shape tank filled with water. Energised by the roll movement of the ship, the water is oscillating in the U-shape tank, which is counteracting the roll and stabilising the vessel.



5 ANCHORING PROCESS

5.1 DRAG EMBEDMENT ANCHORS AND ANCHOR BOOM

All the CSD's within the JDN Group are equipped with anchor booms for lifting and repositioning of the drag embedment anchors without any external assistance.

Typically, the CSD repositions her side wire anchors after a few spud carrier shifts.

To shift a side wire anchor, the CSD leaves the cutter head on the seabed and executes the following steps as shown in Figure 5-1:

1. Swing the anchor boom outboard
2. Lift the side wire anchor with the pennant wire while the anchor boom is automatically guided above the previous position of the anchor
3. Rotate the anchor boom with the side wire anchor above water to the forward end position
4. Lower the anchor to the seabed on the new position and fix the anchor in position through pulling of the side wire
5. Retract the anchor boom back inboard and while releasing tension from the pennant wire

Figure 5-1: The CSD repositions the drag embedment anchor (1) with its anchor boom (2). The anchor sits in the anchor chair (3) when it is not being used.

5.2 GRAVITY ANCHORS AND ANCHOR HANDLING VESSEL

When the seabed consists of hard rock stratum, a drag embedment anchor may not be able to penetrate sufficiently to provide the necessary reaction force. To counter this issue, a gravity or box anchor is used. This anchor has a rectangular box shape and contains up to eight modules of 15 to 20 ton each. The anchor has protruding pins at the bottom that combined with the weight of the anchor generates sufficient friction to provide the holding force for the swinging CSD.

Figure 5-2 shows the complete setup of the gravity anchor.

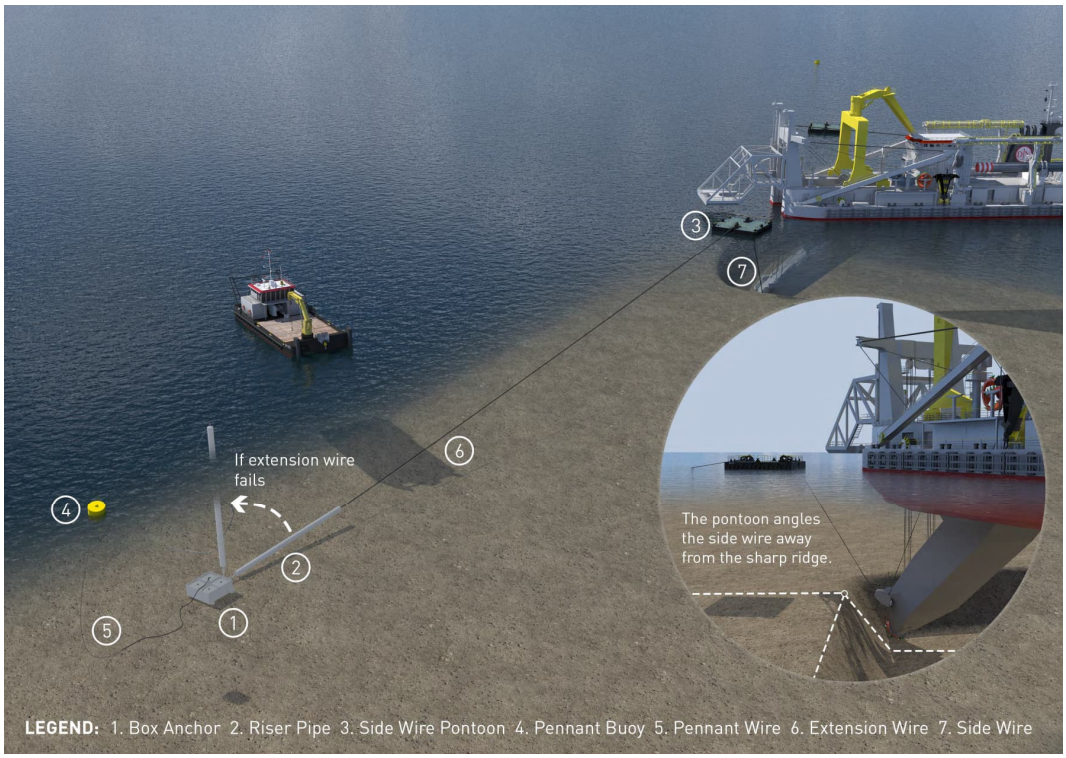


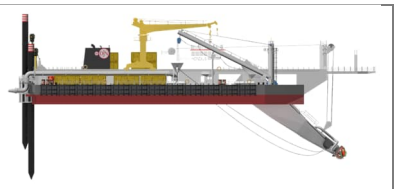
Figure 5-2: The setup of a gravity or box anchor (1) that connects to the side wire (7) via a riser pipe (2), an extension wire (6) and side wire pontoon (3). The pennant wire (5) which is accessible via the pennant buoy (4) allows lifting the anchor from the seabed.

A riser pipe placed between the box anchor and the extension wire ensures that the connection can be easily repaired in case of wire failure. This pipe remains under water during operation, but rises to the surface when there is no tension on the extension wire.

The extension wire connects to the side wire of the CSD via the side wire pontoon. This pontoon allows for an above water connection between the side wire and extension wire that is easily accessible. It also ensures that the side wire makes less contact with the seabed and dredged slopes. This reduces the wear and damage to the wires.

The side wire pontoon has quick release hooks that allow making a fast disconnection when the CSD has to take shelter in case of deteriorating sea state conditions. The box anchor and side wire pontoon remain in position.

The CSD cannot lift the box anchor from the seabed due to its weight. Therefore, an auxiliary anchor handling vessel or pontoon is required to lift the box anchor via the pennant wire and bring it to a new position.



6 PUMPING PROCESS

6.1 SUCTION MOUTH

The rotating cutter head mechanically loosens the soil material. Inside the cutter head, the cut soil mixes with seawater and the dredge pump sucks the soil-water mixture in the suction mouth.

The suction mouth, located at the lower end of the cutter ladder, has a kidney shape and its optimal position allows the maximum amount of soil-water mixture to enter.

Behind the suction mouth is the suction pipeline and dredge pump located.

Figure 6-1 shows the setup of the parts of the pump process.

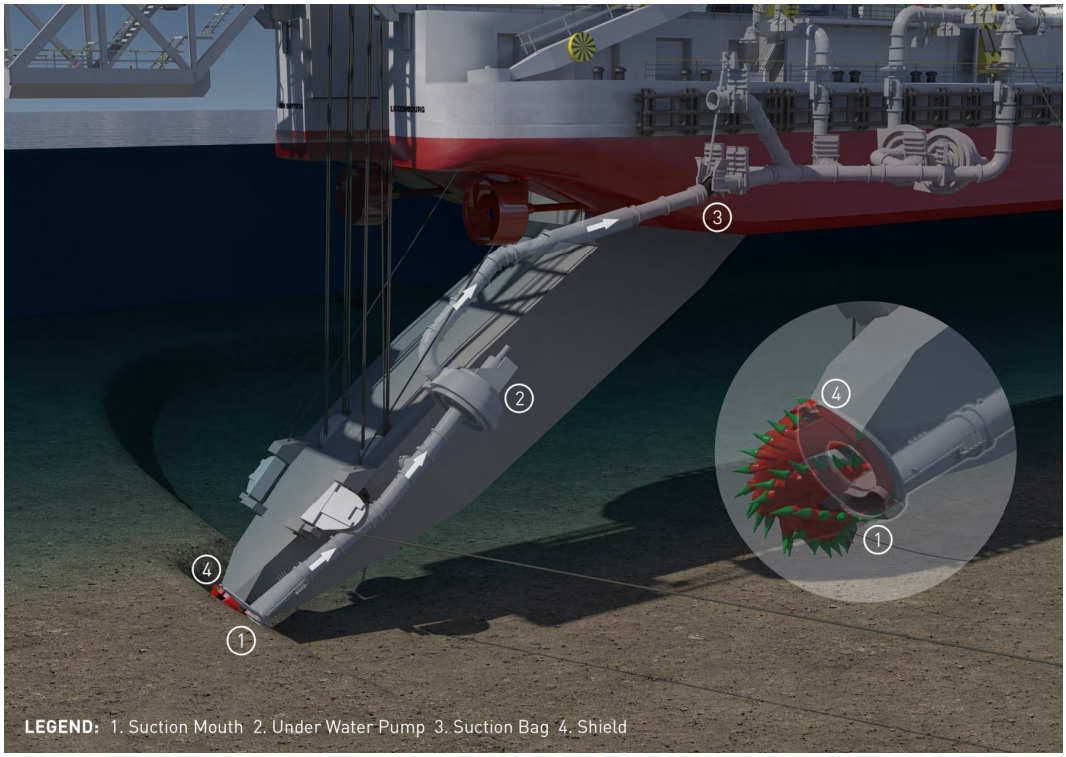
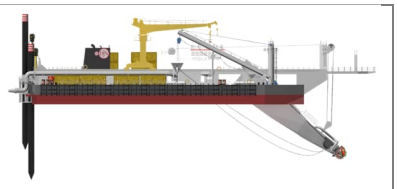


Figure 6-1: The setup of the suction pipeline with suction mouth (1), inspection piece (2), underwater pump (3) and cutter shield (4)



6.2 DREDGE PUMP CONFIGURATION

Most of the CSD's in the Jan De Nul Group have one underwater pump and two inboard pumps.

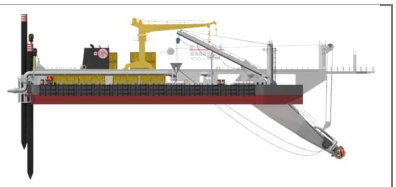
The configuration of the dredge pumps depends on several factors:

- Type of soil material
- Method of discharging, via barges or via pipeline
- Distance to discharge area

When placed in a serial configuration, the dredge pumps can boost the pressure of the soil-water mixture to allow for a long pump distance.

7 DISCHARGING PROCESS

The dredge pumps connect to the discharge pipeline. The CSD will discharge on the shore.



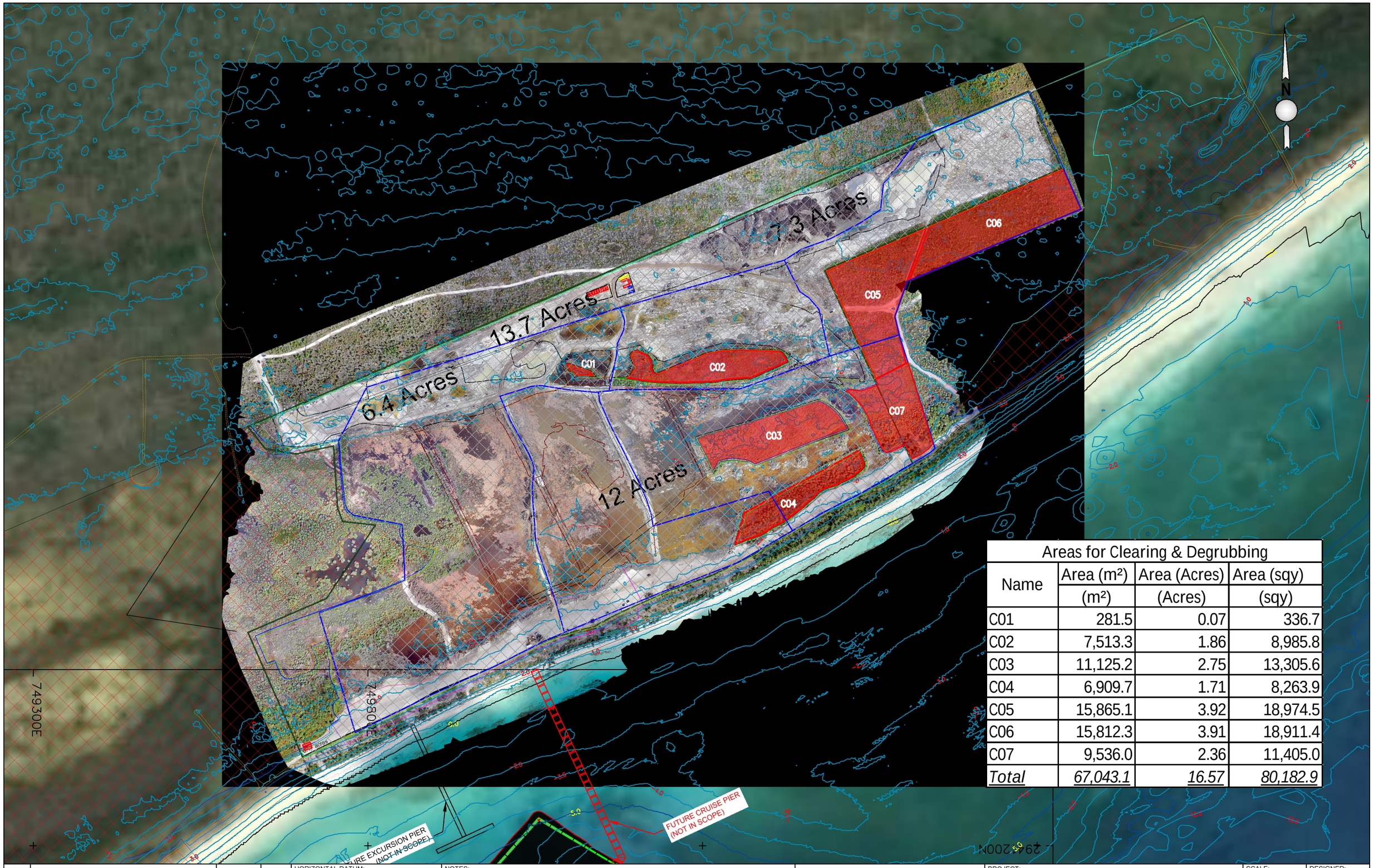
7.1 ONSHORE DISCHARGE

For onshore discharge, the CSD places two or three dredge pumps in a serial configuration.

The discharge pipeline that connects to the CSD at its bow consists of:

- Floating pipeline: steel pipes fitted with buoyancy pieces or rubber hoses that are self-floating
- Submerged pipeline: steel pipes welded to a single pipe that is resting on the seabed during operation to reduce hindrance to other shipping
- Onshore pipelines: steel pipes connected with bolts and flanges

Figure 7-1: For discharge onshore, the CSD (1) connects to a discharge pipeline that consists of floating, submerged and onshore pipes (2)



Areas for Clearing & Degrubbing			
Name	Area (m²)	Area (Acres)	Area (sqy)
	(m²)	(Acres)	(sqy)
C01	281.5	0.07	336.7
C02	7,513.3	1.86	8,985.8
C03	11,125.2	2.75	13,305.6
C04	6,909.7	1.71	8,263.9
C05	15,865.1	3.92	18,974.5
C06	15,812.3	3.91	18,911.4
C07	9,536.0	2.36	11,405.0
Total	*67,043.1*	*16.57*	*80,182.9*

REV	DESCRIPTION	DATE	BY
0	First Edition	07/11/2022	MIVL

HORIZONTAL DATUM: *WGS84 UTM ZONE 17N EPSG 32617*

VERTICAL DATUM: *MLW*

NOTES:

0 50 100 150 200 m

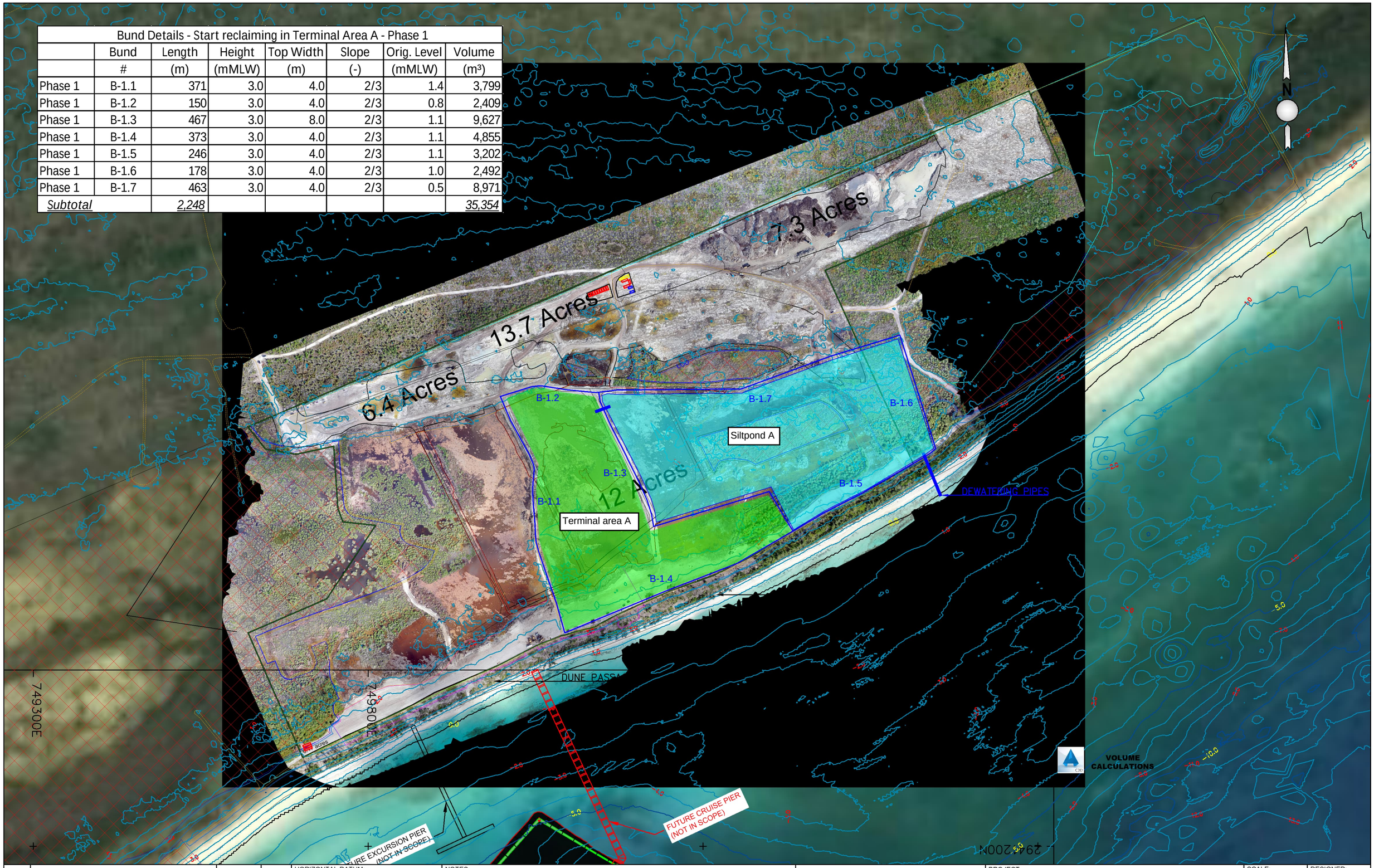
Jan De Nul GROUP DESIGN DEPARTMENT

PROJECT: BAHAMAS - CARNIVAL GRAND PORT

TITLE: Additional degrubbing BHM

SCALE: 1:5000 | DESIGNED: MIVL | FORMAT: A3 | DATE: 07/11/2022 | DRAWING Nr.: | REV.: A

Bund Details - Start reclaiming in Terminal Area A - Phase 1							
	Bund	Length	Height	Top Width	Slope	Orig. Level	Volume
	#	(m)	(mMLW)	(m)	(-)	(mMLW)	(m³)
Phase 1	B-1.1	371	3.0	4.0	2/3	1.4	3,799
Phase 1	B-1.2	150	3.0	4.0	2/3	0.8	2,409
Phase 1	B-1.3	467	3.0	8.0	2/3	1.1	9,627
Phase 1	B-1.4	373	3.0	4.0	2/3	1.1	4,855
Phase 1	B-1.5	246	3.0	4.0	2/3	1.1	3,202
Phase 1	B-1.6	178	3.0	4.0	2/3	1.0	2,492
Phase 1	B-1.7	463	3.0	4.0	2/3	0.5	8,971
Subtotal		*2,248*					*35,354*



				HORIZONTAL DATUM: *WGS84 UTM ZONE 17N EPSG 32617*	NOTES:	0 50 100 150 200 m	PROJECT: BAHAMAS - CARNIVAL GRAND PORT
				VERTICAL DATUM: *MLW*		Jan De Nul GROUP DESIGN DEPARTMENT	TITLE: Reclamation planning - Phase 1
0	First Edition	07/11/2022	MIVL				
REV	DESCRIPTION	DATE	BY				

SCALE: 1:5000	DESIGNED: MIVL
FORMAT: A3	DATE: 07/11/2022
DRAWING Nr.:	REV.: A

Bund Details - Start reclaiming in Terminal Area A - Phase 2							
	Bund	Length	Height	Top Width	Slope	Orig. Level	Volume
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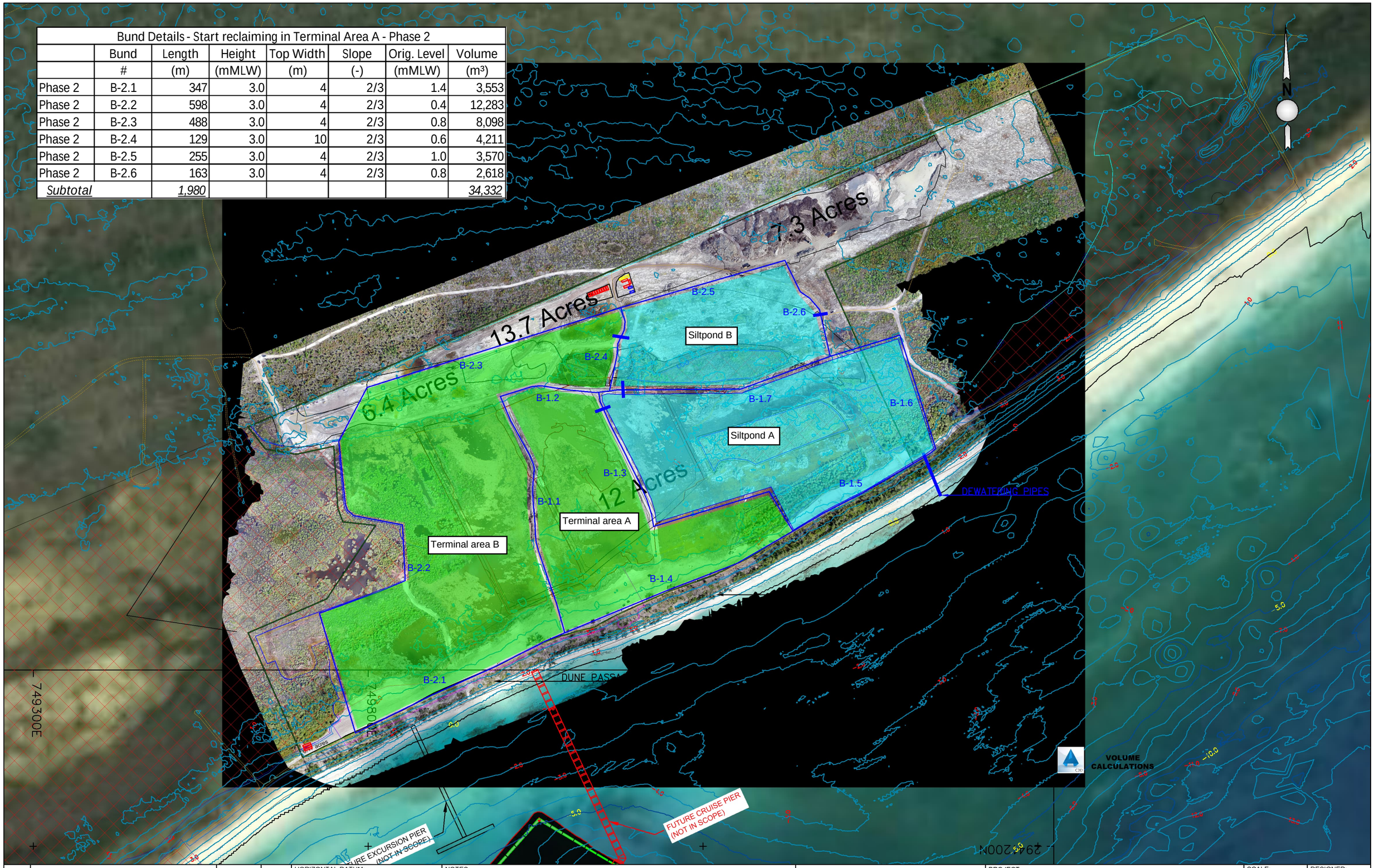
Phase 2	B-2.1	347	3.0	4	2/3	1.4	3,553
Phase 2	B-2.2	598	3.0	4	2/3	0.4	12,283
Phase 2	B-2.3	488	3.0	4	2/3	0.8	8,098
Phase 2	B-2.4	129	3.0	10	2/3	0.6	4,211
Phase 2	B-2.5	255	3.0	4	2/3	1.0	3,570
Phase 2	B-2.6	163	3.0	4	2/3	0.8	2,618
Subtotal		*1,980*					*34,332*



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0	First Edition	07/11/2022	MIVL				
REV	DESCRIPTION	DATE	BY				

SCALE:	1:5000
DESIGNED:	MIVL
FORMAT:	A3
DATE:	07/11/2022
DRAWING Nr.:	
REV.:	A

Bund Details - Start reclaiming in Terminal Area A - Phase 3							
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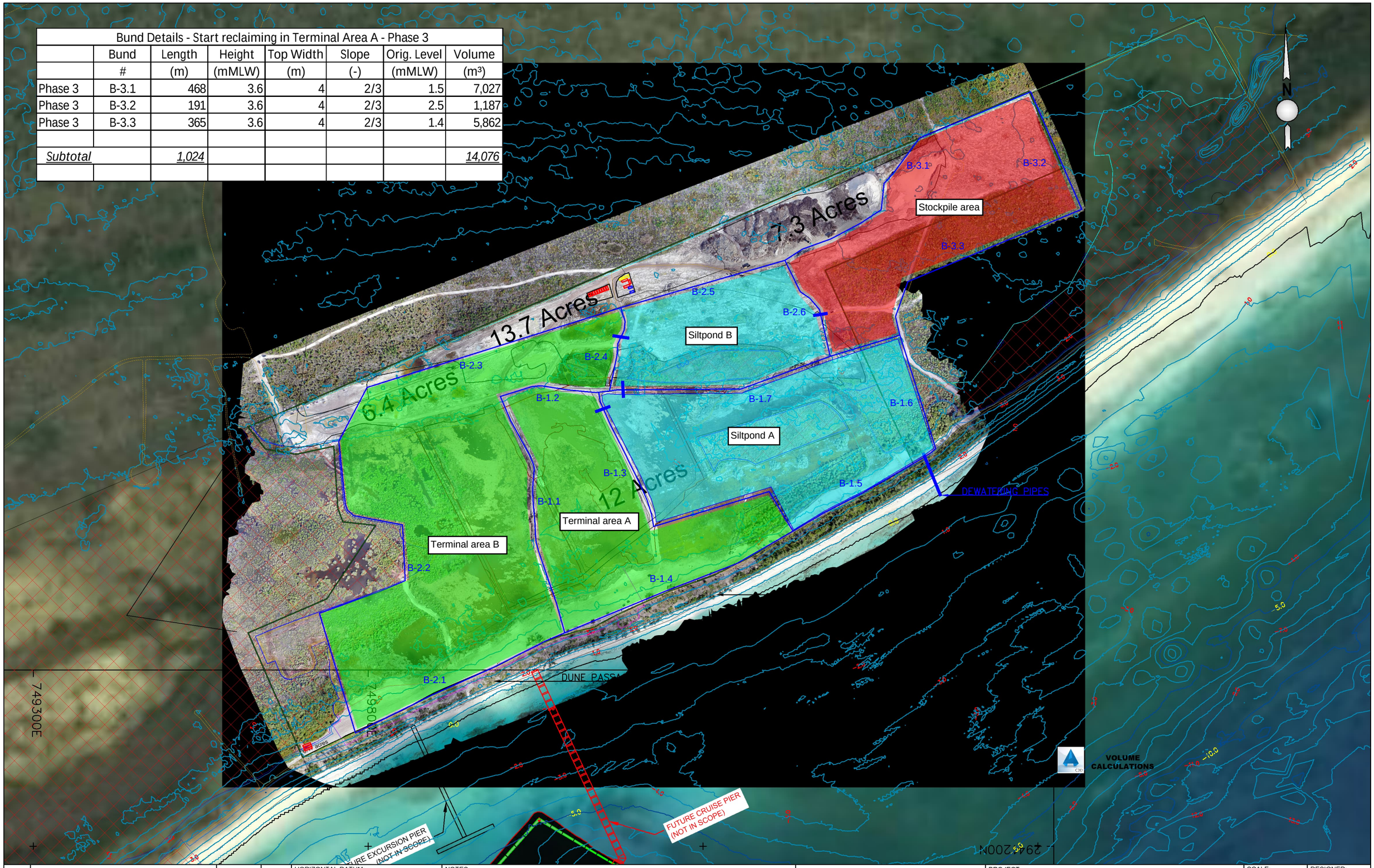
	#	(m)	(mMLW)	(m)	(-)	(mMLW)	(m³)
Phase 3	B-3.1	468	3.6	4	2/3	1.5	7,027
Phase 3	B-3.2	191	3.6	4	2/3	2.5	1,187
Phase 3	B-3.3	365	3.6	4	2/3	1.4	5,862
Subtotal		*1,024*					*14,076*



REV	DESCRIPTION	DATE	BY
0	First Edition	07/11/2022	MIVL

HORIZONTAL DATUM: *WGS84 UTM ZONE 17N EPSG 32617*

VERTICAL DATUM: *MLW*

NOTES:

0 50 100 150 200 m

Jan De Nul GROUP
DESIGN DEPARTMENT

PROJECT: BAHAMAS - CARNIVAL GRAND PORT

TITLE: Reclamation planning - Phase 3

SCALE: 1:5000 | DESIGNED: MIVL

FORMAT: A3 | DATE: 07/11/2022

DRAWING Nr.: | REV.: A

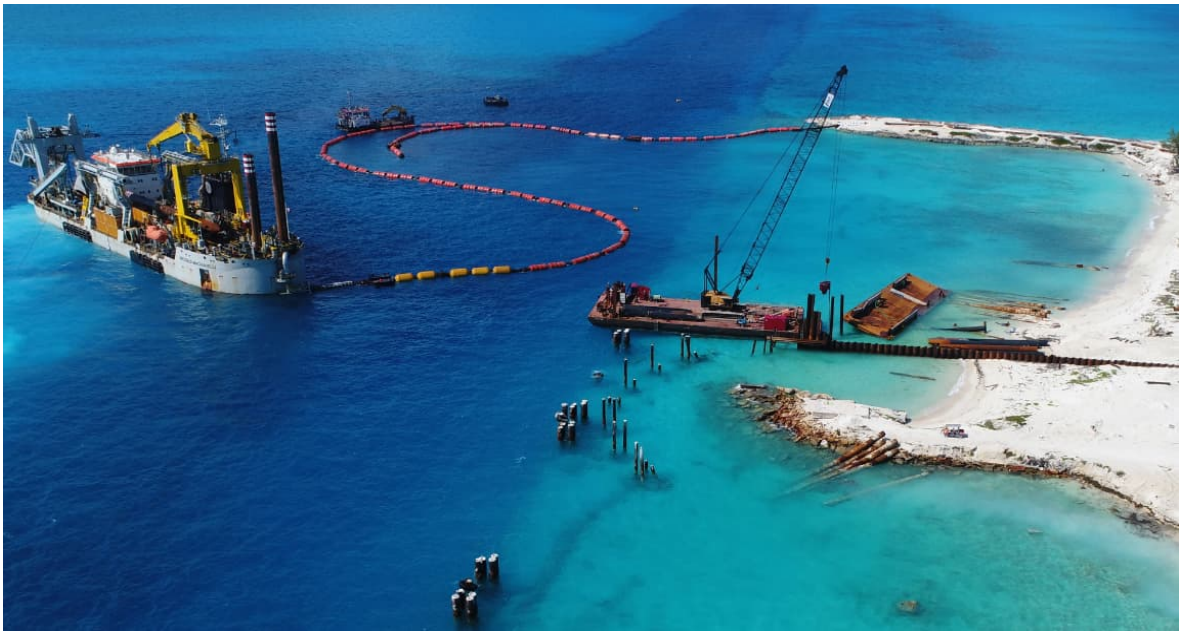
Bund Details - Start reclaiming in Terminal Area A - All Phases (Total)							
	Bund	Length	Height	Top Width	Slope	Orig. Level	Volume
	#	(m)	(mMLW)	(m)	(-)	(mMLW)	(m³)
Phase 1	B-1.1	371.00	3.00	4.00	0.67	1.40	3,799
Phase 1	B-1.2	150.00	3.00	4.00	0.67	0.80	2,409
Phase 1	B-1.3	467.00	3.00	8.00	0.67	1.10	9,627
Phase 1	B-1.4	373.00	3.00	4.00	0.67	1.10	4,855
Phase 1	B-1.5	246.00	3.00	4.00	0.67	1.10	3,202
Phase 1	B-1.6	178.00	3.00	4.00	0.67	1.00	2,492
Phase 1	B-1.7	463.00	3.00	4.00	0.67	0.50	8,971
Subtotal		*2248.00*					*35,354*
Phase 2	B-2.1	347.00	3.00	4.00	0.67	1.40	3,553
Phase 2	B-2.2	598.00	3.00	4.00	0.67	0.40	12,283
Phase 2	B-2.3	488.00	3.00	4.00	0.67	0.75	8,098
Phase 2	B-2.4	129.00	3.00	10.00	0.67	0.60	4,211
Phase 2	B-2.5	255.00	3.00	4.00	0.67	1.00	3,570
Phase 2	B-2.6	163.00	3.00	4.00	0.67	0.80	2,618
Subtotal		*1980.00*					*34,332*
Phase 3	B-3.1	468.00	3.60	4.00	0.67	1.50	7,027
Phase 3	B-3.2	191.00	3.60	4.00	0.67	2.50	1,187
Phase 3	B-3.3	365.00	3.60	4.00	0.67	1.40	5,862
Subtotal		*1024.00*					*14,076*
Total		*5252.00*					*83,762*

Reclamation Areas					
Name	Area (m²)	Area (Acres)	Orig. Level	Design Level	Capacity
	(m²)	(Acres)	(mMLW)	(mMLW)	(m³)
Terminal Area - A	64,893	16.04	0.4	3.0	168,722
Terminal Area - B	135,437	33.47	0.5	3.0	338,593
Siltpond A	81,400	20.11	0.4		
Siltpond B	39,744	9.82	0.8	4.0	127,181
Stockpile Area	66,899	16.53	1.5	5.0	234,147
Total	*388,373*	*95.97*			*868,642*

				HORIZONTAL DATUM: *WGS84 UTM ZONE 17N EPSG 32617*	NOTES:	0 50 100 150 200 m	PROJECT: BAHAMAS - CARNIVAL GRAND PORT
				VERTICAL DATUM: *MLW*		Jan De Nul GROUP DESIGN DEPARTMENT	TITLE: Reclamation planning - Phase 3
0	First Edition	07/11/2022	MIVL				
REV	DESCRIPTION	DATE	BY				

SCALE: 1:5000 | DESIGNED: MIVL | FORMAT: A3 | DATE: 07/11/2022 | DRAWING Nr.: | REV.: A

ATTACHMENT 2
Environmental Management Plan



Document Title:

ENVIRONMENTAL MANAGEMENT PLAN

Project:

DREDGING WORKS FOR THE GRAND PORT CRUISE CENTER

Employer:

Document no.: JDN.BSGRCC.010
Prepared by: Marine Environmental Department (MARED)

0.1	08/11/2022	Issue for Approval	GRU	WOS	HEH	
0.0	7/7/2022	Issued for tender	GRU	WOS		
Rev.	Date	Description of revision	Prepared	Checked	Approved	
			CONTRACTOR			

Revision change details

Revision	Location	Brief description of change
0.0	-	New document - Issued for tender
0.1	-	Issue for approval

Document Distribution and Access

The contents of this draft document are confidential and intended solely for the recipient.

After project award, all project staff will be notified on the latest revision by means of internal memo or per internal e-mail. The controlled document shall be made available on the project server at the discretion of all involved personnel.

Contents

Figures

Tables

1 INTRODUCTION

1.1 PURPOSE OF THE EMP

The Contractor's Environmental Management Plan (EMP) has been prepared in accordance with the requirements of the project and the local, national and international legislation. It is the bridging document between the standard project HSSE manuals and plans / procedures established by Jan De Nul and the specific project environmental requirements (legislation, contract, specifications, etc.).

This plan outlines the environmental compliance and turbidity control and monitoring for the Dredging Works for The Grand Port Cruise Centre. The RFP requires the submittal of an outline of the turbidity control and monitoring, complying with the Environmental Management Plan (EMP) produced by Envirologic international Limited (EIL) and its ATM (Applied Technology and Management).

This EMP describes the environmental management approach and measures that will be implemented by Contractor to execute the works in line with the requirements and in order to minimise its impact on the environment. Contractor shall perform the works in accordance with the finally approved EMP, and, as required, will submit for the Employer's approval specific work method statements that will outline the works as to be carried out by the Contractor to comply with the project requirements.

The approved EMP will be reviewed on a regular basis in order to prevent incidents and to ensure ongoing compliance with the legal and project requirements. In particular, a review will be undertaken following:

- any amendment to the legal and project requirements;
- an environmental incident or non-compliance;
- a requirement to stop or change the works.

Any revision of the EMP will be submitted to the Employer for approval.

2 REFERENCES

2.1 CODES, STANDARDS AND GUIDELINES

2.1.1 INTERNATIONAL

Table 2-1: International Codes Standards and Guidelines

No	Document
[1]	ISO 9001:2015 Standard
[2]	ISO 14001:2015 standard
[3]	ISM (International Safety Management System Code)
[4]	IMO: International Convention for the prevention of Pollution from Ships (MARPOL)
[5]	IMO Guidelines for the Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Aquatic Species (2011)
[6]	Ramsar Convention: Convention on Wetlands of International Importance
[7]	The Convention on Biological Diversity

2.2 EMPLOYER'S DOCUMENTS

Table 2-2: Employer's Documents

No	Document	Document Number
[1]	CARNIVAL GRAND BAHAMA INVESTMENT LIMITED ENVIRONMENTAL MANAGEMENT PLAN	CARNIVAL GB EMP_Revision I_6.18.21
[2]	CARNIVAL GRAND BAHAMA INVESTMENTS LTD. ENVIRONMENTAL IMPACT ASSESSMENT	Carnival Grand Bahama EIA_Revisions 4.24.20

2.3 CONTRACTOR'S DOCUMENTS

Latest revisions of (unless stated otherwise):

Table 2-3: Contractor's Documents

No	Document	Document number
[1]	Turbidity Control Plan	JDN.BSGRCC.009
[2]	Method Statement Dredging and Reclamation	JDN.BSGRCC.011
[3]	Survey Method Statement	JDN.BSGRCC.012

2.4 ABBREVIATIONS

Abbr.	Written in Full
CSD	Cutter Suction Dredger
EMP	Environmental Management Plan
EMS	Environmental Management System
HAZID	Hazard Identification
HSSE	Health, Safety, Security and Environment
IMO	International Maritime Organisation
IMS	Invasive Marine Species
ISO	International Organisation for Standardisation
JDN	Jan De Nul
NTU	Nephelometric Turbidity Units
PM	Project Manager
PMT	Project Management Team
PPE	Personnel protective equipment
PSD	Particle Size Distribution
QA/QC	Quality Assurance / Quality Control
SDS	Safety Data Sheet
SOPEP	Shipboard Oil Pollution Emergency Plan
TSS	Total Suspended Solids (mg/l)

Table 3-1: Abbreviations

2.5 DEFINITIONS & IDENTIFICATION

2.5.1 DEFINITIONS & TERMINOLOGY USED BY ISO 9001

Term	Definition
Audit	'Systematic, independent and documented process for obtaining audit evidence and evaluating it objectively to determine the extent to which audit criteria are fulfilled'.
Continual improvement	'Recurring process of enhancing a management system in order to achieve improvements in overall performance consistent with JAN DE NUL's Policy'.
Management System	'A system to establish a policy and objectives and achieve those objectives'. Note: Several management systems are implemented within JAN DE NUL: QMS, EMS, OHSMS, ISM, etc.
Nonconformity	'Non-fulfilment of a requirement'. Note: A nonconformity can be any deviation from: a) relevant work standards, practices, procedures, legal requirements, etc. or b) management system requirements.

Quality improvement	'Part of quality management, focused on increasing the ability to fulfil quality requirements'. Note: The requirements can be related to any aspect such as effectiveness, efficiency or traceability.
Requirement	'Need or expectation that is stated, generally implied or obligatory'. Note 1: "Generally implied" means that it is custom or common practice for the organisation, its customers and other interested parties, that the expectation under consideration is implied. Note 2: A qualifier can be used to denote a specific type of requirement, e.g. product requirement, quality management requirement, customer requirement. Note 3: A specified requirement is one that is stated, for example, in a document. Note 4: Requirements can be generated by different interested parties.

Table 3-2: Definitions & Terminology defined in ISO 9001

2.5.2 DEFINITIONS & TERMINOLOGY USED BY ISO 14001:2015

Term	Definition
BATNEEC	'The technology in question should be Best at preventing pollution and Available in the sense that it is procurable by the operator of the activity concerned. Technology itself includes techniques and the use of techniques, such as training and maintenance. NEEC sets out the balance between environmental benefit and financial cost.'
Corrective Action	'Action to eliminate the cause of a detected non-conformity.'
Environment	'Surroundings in which CONTRACTOR operates, including air, water, land, natural resources, flora, fauna, humans and their interrelation.'
Environmental Aspect	'Element of CONTRACTOR's activities, products, or services that can interact with the environment.'
Environmental Impact	'Any change to the environment, whether adverse or beneficial, wholly or partially resulting from CONTRACTOR's environmental aspects.'
Environmental Management System	'The part of the overall management system used to develop and implement CONTRACTOR'S environmental policy and manage CONTRACTOR'S environmental aspects'. The EMS includes organisational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining the environmental policy.
Environmental performance	'Measurable results of CONTRACTOR'S management of the environmental aspects'.
Preventive Action	'Action to eliminate the cause of a potential non-conformity.
Prevention of Pollution	'Use of processes, practices, techniques, materials, products, services or energy to avoid, reduce or control (separately or in combination) the creation, emission or discharge of any type of pollutant or waste, in order to reduce the adverse environmental impacts.

Table 3-3: Definitions & Terminology defined in ISO 14001:2015

2.5.3 SPECIFIC DEFINITIONS

Term	Definition
Turbidity	Turbidity is a measure for the reduction of the transparency of a liquid due to the presence of non-dissolved particles. A bundle of light beamed into a liquid will be attenuated when dissolved elements in the fluid cause a change of colour and will be dispersed if the liquid contains non dissolved particles.
Light Attenuation	The light attenuation is the difference between the surface irradiance and the irradiance at the bottom expressed in percentage. The light intensity decreases with increasing turbidity and depth.
Total Suspended Solids concentration	The Total Suspended Solids (TSS) concentration is the dry weight of sediment divided by the weight of the sample (expressed in mg/kg) or by the volume of the sample in litres (expressed in mg/l).

Table 3-4: Specific definitions

3 PROJECT INFORMATION

3.1 GENERAL PROJECT DESCRIPTION

Carnival Corporation is planning to invest in the new port to achieve a new way for passengers to reach touristic sites. Currently, Carnival's guests have to be transported by taxi or tour bus through the industrial park at the Lucayan Harbour. With the construction of the new harbour on the south shore of Freeport, they will be able to go directly from the ship onto beachfront property.

Figure 3-1 Project location

3.2 SCOPE OF WORKS

The scope of the Works is the dredging in order to provide cruise ship manoeuvring and berthing depths at the ship berth locations on each side of the new cruise ship pier extending out towards the open waters. Excavation will be conducted utilizing a cutter suction dredge, while transporting the dredged material by a pipeline to the upland disposal area.

4 ENVIRONMENTAL MANAGEMENT

4.1 GENERAL

Contractor will undertake the works in such a way as to minimise any adverse impacts on the surrounding environment, and comply with any of the requirements of the relevant regulatory authorities.

Contractor regards environmental and community issues as integral elements of our business and is committed to best practice environmental management in all aspects of the operations. This commitment to good environmental management is supported by an Environmental Management System (EMS) that complies with ISO 14001:2015.

Contractor‘s Environmental Management System (EMS) for international projects consists of the Project Management Manual and detailed environmental plans and procedures, which describe the necessary operational and monitoring actions of each relevant environmental issue. The EMS focuses on implementing the policy and environmental objectives, taken into account the legal and other requirements, as well as on the significant environmental aspects. The EMS considers the nature of Contractor‘s activities, products and services and the location where and the conditions in which Contractor’s functions. The integrated management system ensures that support for key aspects such as staff competence; training, procedures, incident and audit reporting are available.

4.2 RISK IDENTIFICATION AND ASSESSMENT

Before the start of the dredging works, the Contractor shall conduct formal hazard identification (HAZID) workshops specific to the scope of work. Outcomes shall be recorded as an initial list of hazards with risk rankings, and associated actions to be initiated and/or followed up. These actions will be recorded in an action list, tracking the action, target date and responsible person for close-out.

The initial environmental risk assessment will be further elaborated based on:

- changes in work scope or methodology;
- outcome of HAZID workshops;
- near-misses or incidents;
- previously unidentified risks.

The outcomes of the final risk assessment will be presented in the Contractor’s Risk Register, with reference to the plans and procedures where the relevant risk control is described.

A specific task risk assessment (Safe Work Practice, Job Hazard Analysis) shall be conducted and formally recorded for relevant activities prior to commencement of such activities. These risk assessments shall include environmental hazards and the mitigation for that task. All risk assessments for a specific task shall involve the supervisor and all crew members required to undertake any part of the task.

4.3 RESPONSIBILITIES

The Contractor has undersigned an Environmental Policy statement to acknowledge their responsibility with respect to environmental management. This policy statement will be posted in the site office and a copy on-board all vessels deployed under the project. All personnel on the project are considered responsible for the implementation of the policy. The policy is applicable for all personnel involved with activities executed under the project; this includes suppliers and other third party personnel.

4.3.1 PROJECT MANAGER

The Project Manager's responsibilities regarding environmental management include, but are not limited to:

- Represent the Contractor during meetings with Employer and ensure they are informed of all environment related activities and events accurately and in a timely manner.
- Ensure that sufficient qualified and trained personnel are employed on the project site and on-board the vessels.
- Has the responsibility to review, approve and endorse the implementation of the contents of the EMP.

4.3.2 ENVIRONMENTAL REPRESENTATIVE

The overall environmental management will be coordinated by Contractor's Environmental Representative, whose responsibilities include:

- Oversee the preparation, implementation and reporting of all environmental related documents.
- Be responsible for the review of the EMP in order to ensure compliance with the latest requirements and regulations and to improve the environmental management based on project experiences.
- Set, monitor and audit the environmental performance of the project.
- Discuss the outcome of inspections and audits with the project manager and examine opportunities for improvement.
- Elaborate the environmental control measures in collaboration with the other departments.
- Act as a main point of contact on all environmental aspects.
- Ensure all environmental administration and reporting is done correctly, quickly and efficiently.
- Coordinate the training and induction process and ensure that all project personnel are made fully aware of their respective environmental responsibilities and that they are familiar with the contents of the EMP.
- Liaise directly with the Employer's environmental site representative as required.

4.3.3 ALL PERSONNEL

All personnel will have to comply with the requirements outlined in the EMP.

All personnel on site will follow an induction which will include the environmental requirements for the project, and will have to participate in toolbox meetings highlighting specific environmental topics. It will be the responsibility of all personnel to adhere to the environmental project requirements and

report all emergencies and environmental incidents to their supervisor or the project management. All personnel are empowered with the responsibility and authority to stop work when observing an unsafe condition or act that may result in harm to people, property or the environment.

4.4 COMMUNICATION AND ENVIRONMENTAL TRAINING

Environmental topics will be discussed during internal meetings (kick-off, prestart, toolbox, management meeting) and site inductions. Furthermore, environmental reminders will be issued at regular intervals to highlight the main bullet points of an environmental topic, such as points of attention, actions to take, persons to contact. Contractor shall identify and document environmental training and competency requirements for the project and implement appropriate competency based training for each person, based on the actual or potential environmental risks associated with their role. Compulsory Employer inductions and awareness training shall be undertaken by all personnel working at the project areas.

Contractor's Training Needs Analysis (TNA) Register for personnel shall be maintained throughout the duration of the Contract. This register includes the requirements for training, timing, target audience, duration and refresher training.

Contractor shall maintain documented records as verification that personnel have received the appropriate training, and are competent to fulfil their roles. Before mobilisation to site, all personnel must be crosschecked with the Training Needs Analysis. If required, additional training shall be given prior to mobilisation to site.

Environmental topics will be discussed during internal meetings (kick-off, prestart, toolbox, management meeting) and site inductions. Furthermore, environmental reminders will be issued at regular intervals to highlight the main bullet points of an environmental topic, such as points of attention, actions to take, persons to contact.

Contractor requires each person working on the project for Contractor or on its behalf, to undergo appropriate environmental induction. This environmental induction will involve the on-site education of the project personnel with the aim of instilling an understanding of the environmental impacts of their daily work practices and activities and to encourage alternative practices where feasible. More specifically, the induction will address the general requirements of the EMP and the more specific requirements related to the tasks to be performed.

The environmental induction will be implemented with the intention of:

- Achieving all the objectives of the EMP and supporting Plans / Procedures;
- Minimising the adverse environmental impacts associated with the project works; and
- Encouraging and facilitating responsible work practices.

As a minimum, the following subjects will be covered during the environmental induction:

- General Environmental Duty / Duty to Notify;
- Legislation and permit / approval / licence conditions applicable to the project;
- Leadership and responsibilities related to the project activities;
- Risk assessment and risk management;
- Communication protocols and key contact personnel;
- Key environmental and cultural heritage values at the site,
- Socio-environmental objectives and mitigation measures identified in the EMP;

- Emergency response procedures;
- Incident reporting requirements; and
- Complaint handling.

In addition to this environmental induction, task specific training and specific toolbox meetings are held. The specific training is given to all personnel that could come into contact with a high risk activity.

External communication to communities, stakeholders, authorities and media will be done through the Employer. Whenever required, Contractor will provide assistance in this regard. Whenever a complaint is received from external parties, the procedure as outlined in the EMP will be followed.

4.5 INSPECTION AND AUDITING

4.5.1 INSPECTIONS

Regular visual inspections will be undertaken by the Environmental Representative and/or JDN site personnel to identify any potential for leakages, spills, evidence of contaminated soils, etc. Furthermore, compliance checklists will be filled out by the Environmental Representative. A general inspection schedule will be elaborated during the planning phase of the project. An environmental checklist will be completed to verify implementation of all controls relevant to the stage of the works. Where necessary, findings of the inspection will be recorded in the Corrective or Improvement Action Database that will be followed up by the Environmental Representative in order to close any outstanding issues in a timely manner.

Besides the inspections done by JDN personnel, joint inspections with Employer will be done as required. The timing will be agreed upon during the planning phase of the project.

4.5.2 AUDITS

A general audit schedule is established on corporate level every year. Management systems (e.g. a project Environmental Management System, an ISM system onboard a vessel) are subjected to an internal audit. Audits cover a specific section or process of the project. Audits are planned based on the project phase and the associated environmental risk.

External audits by Bureau Veritas are performed regularly onboard the vessels to check conformance with MARPOL requirements.

A site specific audit schedule with regard to the environmental management will be elaborated during the planning phase of the project. This schedule will include the audits by the Environmental Representative concerning the project environmental requirements, as well as external audits depending on the requirements of Employer or external parties (e.g. regulatory agencies or certification bodies). The project requirements foresee a monthly audit to be undertaken by Employer of the dredging operations during the campaign to ensure documentation and performance against the general requirements are being met. Corrective action will be required in the context of findings of the audits or in the context of any issues raised by regulatory bodies. Corrective actions may also be required because of complaints from the community.

4.6 EMERGENCY RESPONSE

JDN has established this plan in order to cope with emergency situations during dredging activities. On board of ISM certified vessels, Emergency procedures are set up in accordance with ISM. Table 4-1 gives an overview of the emergency situations addressed in these plans.

Table 4-1: Emergency situations identified at JDN corporate level (dredging activities)

General emergency situations	Vessel specific situations (specific ISM procedures)
Personnel Injuries & illness Fire Fuel / Oil spills Violent weather conditions Marine Mammal encounters Breaches of security (Traffic accidents)	Propulsion power failure Steering gear failure Black out Collision at sea Grounding Flooding Man over board Abandon ship Piracy Dredging of UXOs

Project specific Emergency Response Charts will be posted at all work locations, and be clear and univocal but nevertheless to the point, showing the following details:

- the necessary actions to be taken
- the duties per function
- the sequence and which persons / organizations that have to be informed including their contact details and a brief description of their tasks
- the reporting of emergencies
- the follow-up on emergency response activities

At the start of every construction site or commencement of a vessel, the Emergency Response Charts will be updated and a desktop check will be held verifying all the numbers on the charts.

4.7 ENVIRONMENTAL INCIDENTS, NON-CONFORMANCES AND COMPLAINTS

4.7.1 ENVIRONMENTAL INCIDENTS

Environmental incidents will be investigated and reported upon in accordance with the JDN Incident Management Procedure, and the Health and Safety Management Plan. All personnel are to report incidents immediately to their direct supervisor on site who will contact either the Environmental

Representative or Project Manager. All personnel are reminded of this obligation via the inductions, toolbox meetings, HSE-guidelines and reminders.

If environmental harm is caused or is likely to have been caused the Employer will be notified. The Contractor will inform the Employer verbally as soon as possible after the occurrence of the incident. A specific incident notification form will be sent detailing the event, causes and immediate actions undertaken. A more elaborated investigation report is made within 10 days or another timeframe agreed upon with the Employer, depending on the impact rate of the incident. In case of a serious environmental incident, procedures or plans (including the EMP and the risk assessment) might need to be amended to prevent future reoccurrence.

Incidents to be reported include accidents (incident with consequences) as well as near misses, unsafe acts and dangerous situations. Incidents to be reported include incidents resulting of JDN activities, as well as incidents occurring within the project boundary as a result of sub-contractors, vendor's, etc. activities and services. An incident will be reported if any of the following scenarios occur or have the potential to occur:

- Serious Environmental Harm;
- Material Environmental Harm;
- Prosecution by a Regulatory Authority;
- Environmental Approval condition breach; or
- Environmental monitoring parameter breach.

Immediate action will be taken to mitigate any consequences, for example, environmental impacts, arising from the event, in accordance with the Emergency Response Procedure.

The Contractor maintains records of all incidents and responding actions and investigations. For this purpose, in-house software (called iRep) is being used. This database includes all HSSE incidents and is maintained by the HSSE representative.

4.7.2 NON-CONFORMANCE REPORTS (NCRS)

JDN is committed to continual improvement of its environmental performance and correction of any issues arising through HSE meetings, engineering HSE reviews, inspection and audits and other sources of internal and external feedback.

In order to deal with the identified issues systematically, JDN has a process to ensure that:

- Issues (including nonconformities) are identified and investigated;
- Root causes are identified;
- Corrective and preventive actions are identified and implemented; and
- Actions are tracked and their effectiveness is verified.

Detailed procedures on handling non-conformances are established under the JDN Quality Management System.

Non-conformance with environmental project requirements will be reported and corrective action/s shall be raised. All corrective actions shall be entered into the Corrective or Improvement Actions Database.

4.7.3 ENVIRONMENTAL COMPLAINTS

Any complaint of an environmental nature (such as noise, air or water quality) shall be recorded and will be reported to the Employer. JDN will not respond to the complainant other than address any immediate issues and will forward the details to Employer immediately for further response and possible action. JDN will undertake investigations and report to the Employer the conclusions and the actions (to be) taken.

All complaints received by the Contractor are to be recorded including:

- The time, date, name and contact details of the complainant;
- Reasons for the complaint;
- Any investigations undertaken and conclusions formed; and
- Any actions taken.

JDN will liaise with the Employer wherever recommendations have been made to adjust work practices in response to a complaint, and will take all reasonable and practical measures which may reduce the likelihood of further legitimate complaints.

5 ENVIRONMENTAL MONITORING AND MITIGATION MEASURES

5.1 MANAGEMENT OF HAZARDOUS MATERIALS

The use of hazardous substances shall be avoided where possible. Hazardous substances shall be substituted by non-hazardous (or less) hazardous substances whenever the tasks allow so. When the use of hazardous substances cannot be avoided all hazards and risks related to the human health and the environment have to be identified (SDS's are the basis for this) and risks assessment shall be conducted (if no safe work practice is in place) prior to any use.

All products purchased for the project shall have their Hazardous Material Safety Data Sheets (SDS) reviewed and suitability assessed prior to final product selection and purchase. Hazardous Substances are procured via Head Office, who will request the SDS for the related product. Physical storage, handling/transport and usage must comply strictly with the procedures as spelt out under the product SDS guidelines.

The storage information onboard of the vessels is maintained via the onboard maintenance system. In here, the location of the product, quantities onboard etc are registered.

A risk analysis for the specific tasks shall be conducted and approved prior to the use of a hazardous substance (e.g. Job hazard analysis JHA, last minute risk assessment), taking into account the specifications of the SDS. If a safe work practice is in place, a separate risk assessment is not required. Every job requires specific protection equipment. Personnel will be provided with the proper PPE to use the hazardous products.

Hazardous substances must not be discharged onto the ground or into water drains where they can cause pollution or an explosion. All hazardous substances disposed of shall be kept separate from normal waste. All hazardous waste shall be disposed of according to national and international legislation.

Requirements for storage:

- All storage of Hazardous substances shall be securely locked or fenced off.
- Appropriate warning notices shall be posted onto the storage facility.
- 'No Smoking' / 'No naked Fire' notices shall be affixed to the storage facility where flammable substances are stored.
- A SDS inventory will be present with a complete up to date set of the SDS files of the relevant products.
- Fire-fighting equipment, e.g. fire extinguishers (appropriate to the substance) and other emergency equipment, including spill equipment shall be located nearby the storage area.
- Proper ventilation (mechanical / natural) shall be available.
- Substances that can leak to the environment shall be kept in a secondary containment which can contain at least 110% of the capacity of the biggest container. Containment areas are to be kept clean.

5.2 WASTE MANAGEMENT

Solid and liquid waste on board of the vessels will be managed in accordance with the MARPOL requirements, as well as the applicable local and national legislation.

As a minimum, waste management will ensure:

- The vessels have a garbage management plan in place.
- To keep the site clean and prevent the uncontrolled build-up of waste or debris on the work site.
- Disposal of all debris and waste shall be in accordance with applicable guidelines and Laws.
- The dredge vessels hold an International Sewage Pollution Prevention Certificate and have a MARPOL approved waste water treatment installation on board, and will therefore not dispose untreated sewage during the project.
- Tracking of Controlled Waste is undertaken in accordance with the requirements of the Employer; a waste tracking register will be maintained to monitor waste generation, collection and disposal at approved facilities; all waste streams will be documented to demonstrate that all wastes has been disposed of properly.
- Regular inspections on board the vessels will be undertaken to check on the cleanliness.

Besides the general cleanliness of the site and compliance with applicable legislation, attention will also be paid to waste segregation in order to reuse and recycle as much as possible the used resources.

For further details about waste management on-board of the vessels, reference is made to the Vessel Garbage Management Plans.

5.3 OIL SPILL CONTINGENCY

5.3.1 PREVENTION

Vessels that have a gross tonnage of more than 400tonnes require a Shipboard Oil Pollution Emergency Plan (SOPEP). As part of the vessel's SOPEP, the (minimum) required oil spill response equipment is defined as well as the oil spill drills that need to be done regularly onboard of the vessels, in order to familiarise all crew with the response procedure, the available oil spill response equipment and its deployment. The SOPEP of the vessel is available on board. Small auxiliary vessels (that do not require a SOPEP) will have their own oil spill contingency plan, or will be inducted on oil spill response onboard of their vessel, as well as the assistance that they can provide to other vessels in case of an oil spill.

A project Emergency Preparedness and Response Procedure, incl. emergency response flowcharts, will be available on all the Contractor's vessels, outlining the procedures to cover hydrocarbon spills, as well as site specific information (e.g. areas of concern, contact numbers, ...).

Following practices will also be adhered to onboard of the vessels in order to minimise the risk of oil spills:

- Ensure suitable bunds are provided around fuel/oil transfer points;
- Protect hydraulic hoses at critical points;

- Appropriate hydrocarbon spill response equipment readily available on all vessels, in accordance with the SOPEP requirements;
- Preventive maintenance schedule (e.g. replacement schedule of hydraulic hoses as specified by the corporate maintenance system);
- Use of bunker checklists before and during bunkering of vessels;
- Regular inspections of the vessels and equipment with particular attention to hydrocarbon storage areas and bunding, hydraulic and refuelling hoses, hydrocarbon handling procedures and emergency response equipment.

5.3.2 OIL SPILL RESPONSE

Contractor will supply response vessels, spill kits and trained personnel capable of containing the largest likely spill, as specified by the vessel's SOPEP.

It is the responsibility of the spill observer to notify the vessel master or delegate. It is the Master's responsibility to initiate a response in the event of a discharge of oil or substantial threat of discharge-actual or probable-into the waters. In no case should action be taken that in any way could jeopardize the safety of personnel either on-board or ashore.

After the personnel and vessel have been secured, the first priority becomes to control the source of the spill. Once the source is controlled, the spilled oil needs to be contained to the smallest surface possible in order to facilitate the further clean-up.

If safe to do so and the initial response has been initiated, the Master will inform the Project Manager (or representative Duty Manager). The Master will perform a first assessment in conjunction with the Project Manager to determine if assistance is required. The Project Manager/HSE representative will inform Employer's Environmental Manager as soon as it is safe to do so, and will complete an incident report inclusive of preventative and corrective measures within 24 hours.

For further details about oil spill contingency and specific response procedures, reference is made to the vessel's SOPEP and Contractor's Oil Spill Contingency Plan.

5.4 WATER QUALITY MANAGEMENT

Because of the presence of sensitive and vulnerable marine ecosystems around the project site, turbidity monitoring will be conducted to ensure that values will not exceed a maximum increase of 15 Nephelometric Turbidity Units (NTU) above background concentration during dredging at all sampling locations.

The environmental management concerning the potential impacts on the water quality consists of three types of management:

- Preventative management: this type of management is part of the project preparation phase, prior to the start of the on-site operations. These management measures aim to optimize the work method and the limitation of potential environmental impacts of the project, both on the short term and the longer term;
- Adaptive management: results of water quality monitoring performed during the works will be used for adaptive management and optimization of the dredging execution scenarios

- Responsive management: is the tiered management that will be implemented upon exceedance of water quality trigger levels.

The aim is to not exceed the water quality triggers and to maintain "ongoing management" by applying "adaptive management" based on monitoring and, if applicable, modelling of the forecast dredging and disposal activities.

5.4.1 PREVENTATIVE MANAGEMENT

The preventative management is based on the integration of relevant input data from e.g. baseline monitoring, local geology, metocean conditions, and feedback from earlier dredging campaigns.

These mitigation measures are considered to be part of the environmental best practice management strategy. The following general preventative mitigation measures actions might be taken to reduce the impact on water quality:

- Well-maintained and properly calibrated dredging equipment will be utilized;
- Dredgers and support vessels shall comply with applicable speed restrictions;
- Installation of silt curtains around active dredging areas;
- Installation of silt curtains around the outflow of the reclamation area;
- Installation of silt curtains in the reclamation area to stimulate sedimentation of fine sediment particles;
- Hydrodynamic modelling of the reclamation area;
- Settlement ponds shall be designed in such a way that discharge water travels the longest distance possible to allow most fines to settle before exiting the area;
- The preventative management actions will be clearly indicated to all relevant vessels during the prestart meetings and enforced by the operational Superintendent.

5.4.2 ADAPTIVE MANAGEMENT

A proactive adaptive management procedure aims to check for indications of possible future exceedance of the water quality criteria and to quickly anticipate and react to situations, which may lead or in the past have led to exceedances.

Adaptive management is typically associated with the water quality monitoring program. JDN envisages the implementation of a monitoring program for internal control and management of the dredging works. This way, JDN can adjust the planning and operation of the dredgers in order to anticipate turbidity exceedances. If the monitoring results indicate that the ongoing activities could cause a breach of the trigger levels, this will trigger adaptive management. As a first action, an analysis will be made of the monitoring data (such as metocean and background water quality data), ship logs, the presence and character of other operations nearby, as well as natural phenomena. Extra mobile monitoring can be performed to follow up the situation closely and assist in the adaptive management decision process.

The subsequent step is to adjust the working method by implementing predefined measures, depending on the identified cause. Possible predefined measures are listed below. It should be noted that the final selection of the most appropriate management measures will be made based on the impact observed, including its temporal and spatial scale, metocean conditions, and the planned future dredging operations. Contractor will inform Employer about the adaptive management that will be implemented.

Possible adaptive management measures may be:

- Optimize CSD layer thickness to minimize sediment re-suspension;
- Installation of fixed turbidity monitoring stations in the silt ponds and near sensitive receptors
- Investigate near trigger level exceedances
- Adjust CSD swing speed, step size and cutter rotation speed if practicable;
- Management of settlement pond (e.g. internal dikes, adjustable weir boxes, control of outflow);
- Installation of additional silt curtains;
- Temporarily reducing production rates;
- Scheduling maintenance (cutter checks) strategically if an increase in turbidity or plume size is observed;
- Adjust dredging and reclamation schedule based on results of hydrodynamic modelling

5.4.3 RESPONSIVE MANAGEMENT

Water quality trigger values have been established and will form the basis for a tiered approach to management of the environmental impacts. An example of possible management actions associated for each trigger level is given below. These actions typically include:

- Cease dredging operations until turbidity levels have fallen under the applicable threshold levels;
- Investigation of the trigger exceedance;
- Plan dredging activities in different locations;
- A more intensive monitoring program, especially near the turbidity source and sensitive areas;
- Adapting the turbidity generating activities (see measures formulated under 5.4.2);
- Installation of additional silt curtains especially near the turbidity source and sensitive areas;
- Implement a controlled start-up procedure for dredging operations once turbidity levels have fallen under the applicable threshold levels;

5.4.4 SILT CURTAINS

The application of silt curtains in dredging and land reclamation projects is a very common practice as this provides a reliable engineering solution to control sediment dispersion resulting from the execution of these activities in the wider environment, and thus prevent their associated effects on water quality and aquatic life.

The Contractor aims to establish sufficient sediment control and management measures seeking to meet the project standards in terms of turbidity level limits in the receiving water body. To minimise the dispersion of sediment and elevated turbidity levels created by concerning dredging activities and at the outflow area of dredge spoil temporary storage area on the marine environment, the Contractor proposes the installation of silt curtains of different skirt depths that will cover the different turbidity generating activities (dredging location and outflow of reclamation area). Additional silt curtains will be adaptively installed in the reclamation area throughout the full course of the dredging works. Reference is made to Contractor's Turbidity Control Plan (JDN.BSGRCC.008) for a detailed overview of the silt curtain plan and all silt curtain related activities.

5.4.5 SETTLING POND AND WATER BOXES

During the reclamation works, solids and fines are pumped by the dredger's inboard pumps to shore into the reclamation area. The reclamation will be carried out in such a way to minimise the outflow of suspended solids into the marine environment. Reference is made to Contractor's Turbidity Control Plan (JDN.BSGRCC.008) for a description of the working principles of the settling ponds and water boxes.

5.5 WATER QUALITY MONITORING

Contractor's Marine Environmental Department (MARED) has ample experience in the setup of monitoring equipment and modelling tools, and will provide support to the day-to-day environmental management of the dredging operations.

Throughout the duration of the dredging and reclamation project, the Contractor will perform daily monitoring of turbidity levels. Turbidity monitoring will be conducted to assess the performance of prevention and mitigation measures adopted to meet the maximum permissible turbidity limit and determine compliance status. The data collected from the different turbidity monitoring trips will be processed and the measured turbidity values will be included in the daily reporting, along with exact measurement locations on a schematic map, water depth, measurement depth, current conditions and approximate tide.

In the following section the compliance requirements regarding turbidity monitoring are defined. For a detailed description of the turbidity monitoring methodology reference is made to Contractor's Turbidity Control Plan (JDN.BSGRCC.008). The monitoring requirements are discussed, and examples are given of monitoring systems that can be implemented on the project.

5.5.1 COMPLIANCE REQUIREMENTS

Contractor shall execute the daily turbidity monitoring aligned with the following requirements:

- Monitoring frequency: Two sampling events will be conducted per day, nominally one in the morning and one in the afternoon, at least 4 hours apart. Samples will be taken during active construction, when the dredge has been operational for a minimum of 2 hours. Samples will not be taken if the dredge is not operating for a period greater than 4 hours, and this condition will be noted in the daily sampling report. Additional sampling will occur if a significant increase in the turbidity plume size, extent or visual magnitude is observed between regular sampling intervals.
- Background monitoring: Representative background monitoring shall be performed at a minimum of 1,200 feet up-current of the project in an area free of project influence prior to each compliance sampling event.
- Compliance monitoring (Dredging area): Compliance monitoring within the dredging area shall be performed at a distance of 500 meters (1,640 feet) down-current of the operational dredge, within the densest portion of any visible turbidity plume. Compliance stations can be altered if the plume is heading for the reef wall resources (monitoring should be performed at the location of the resource regardless of distance). Levels should be below the 15 NTU above background standard in this event.
- Compliance monitoring (Discharge reclamation area): Compliance monitoring at the discharge of the reclamation area shall be performed at a distance of 500 meters (1,640 feet)

from the discharge, within the densest portion of any visible turbidity plume. Levels should be below the 15 NTU above background standard in this event.

In addition to turbidity monitoring at the dredging area and discharge of the reclamation area sites, turbidity monitoring will be done at each of the biological monitoring sites during bi-weekly monitoring events. Monitoring at these locations will be done at the surface, mid-depth and near the seafloor. The amount and locations of biological monitoring sites shall be determined in close consultation with the Engineer.

5.5.2 BENTHIC ORGANISMS SURVEY

Contractor shall perform a visual underwater survey along the silt curtain tracks located at outflow of the reclamation area. The proposed area in approximately 200 m x 300 m and the survey will start at the water line going off shore 200m (Figure 5-1). This survey shall be performed prior to the start of the dredging works. Contractor shall submit a report of the survey to Employer showing the number and size of benthic organisms found in the area. Employer shall assess whether performing benthic organism relocations is required. In the event that performing relocations is required, relocations will be carried out to one of the relocation zones previously utilized by the client.

Figure 5-1: Proposed area of the benthic organism survey

5.5.3 ANCHORING PLAN

The CSD and pipeline spread comes with a set of anchors to be able to perform the works:

- Anchors for CSD ZH: one anchor positioned on each side of the centerline where the CSD can pull on to turn from left to right. The dredge anchors will be placed along a line parallel with the CSD at regular intervals. The distance is determined by the anchor boom. If possible the dredge anchors are placed with the multicat, which allows for less movements with the anchor

(greater intervals), but is limited due to practical limitations. The CSD will only place her spud within the dredge footprint.

- Anchors for floating pipeline: 5T anchors are mobilised to anchor the floating pipeline that will be installed between the CSD and the shore connection. These anchors will be installed as far as practically possible within the dredge footprint.

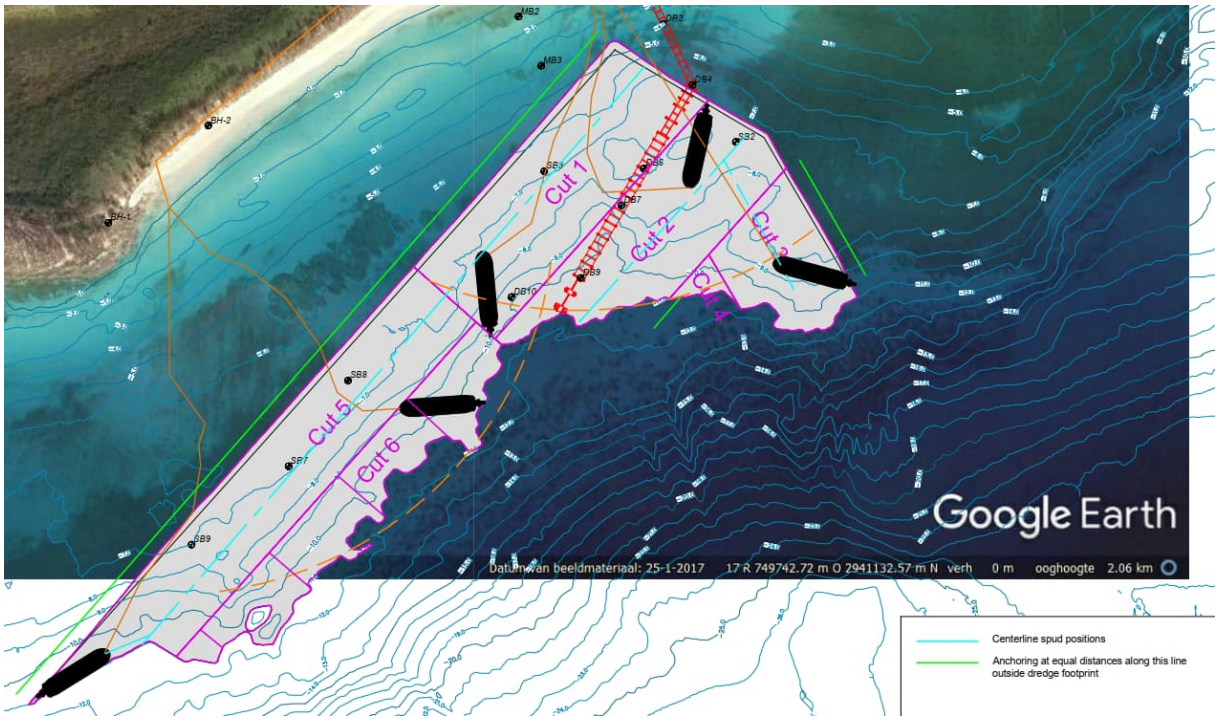


Figure 5-2: Anchoring plan CSD

5.6 SOUND MANAGEMENT

All Contractor's vessels comply with the International Maritime Organization (IMO) criteria for sound levels and operate in accordance with appropriate industry and equipment noise and vibration standards.

5.7 AIR QUALITY MANAGEMENT

Potential sources for air quality degradation and emissions are primarily exhaust from construction equipment.

All recently built ships of Contractor comply with the regulations defined under Annex VI 'Regulations for prevention of air pollution' of MARPOL 73/78. The rules set limits on sulphur oxide (SO_x) and nitrogen oxide (NO_x) emissions from ship exhausts and prohibit deliberate emissions of ozone depleting substances.

Engines and equipment on board the dredge are properly maintained in good working order. Maintenance and servicing of engines and emission control devices will be undertaken if it is found that they are not being operated in accordance with specifications.

Contractor focuses its efforts towards fuel consumption since most of the airborne pollutants are produced when burning fuel oil. Vessel related actions consist of increased awareness through communication on rational energy use; operational measures such as the implementation of the IMO introduced Ship Energy Efficiency Management Plan (SEEMP) and related technical measures. The vessel-specific SEEMP provides a specific action plan for the implementation of energy efficiency measures on board such as weather routing & voyage planning, hull maintenance, oil analysis, bunker management, crew familiarization and training for all existing ships to comply with all the emission restriction standards adopted by the International Maritime Organization (IMO).

6 ANNEXES

6.1 ANNEX A: ISO 9001,14001 & 45001 CERTIFICATE

Lloyd's Register

Current issue date:	5 February 2020	Original approval(s):
Expiry date:	4 February 2023	ISO 14001 - 5 February 2014
Certificate identity number:	10252461	ISO 45001 - 5 February 2014
		ISO 9001 - 5 February 2014

Certificate of Approval

This is to certify that the Management System of:

Sofidra S.A.
(Jan De Nul Group)

34-36, Parc d'Activités Capellen, 8308 Capellen, Luxembourg

has been approved by Lloyd's Register to the following standards:

ISO 14001:2015, ISO 45001:2018, ISO 9001:2015

Approval number(s): ISO 14001 – 0016732, ISO 45001 – 0016734, ISO 9001 – 0016733

This certificate is valid only in association with the certificate schedule bearing the same number on which the locations applicable to this approval are listed.

The scope of this approval is applicable to:
ISO 14001:2015, ISO 45001:2018, ISO 9001:2015
Design, engineering, development, procurement, construction, installation and/or maintenance activities related to:
- Civil and hydraulic engineering,
- Public and port infrastructure works,
- Water-, silt- and soil treatment,
- Environmental works,
- Foundation works,
- Dredging and land reclamation,
- Offshore services for the oil, gas and renewable energy markets (such as subsea cable and subsea rock transportation and installation),
- Heavy lifts and salvage works,
- Extraction, treatment and supply of aggregates.

Paul Graaf

Area Operations Manager North Europe

Issued by: Lloyd's Register EMEA

for and on behalf of: Lloyd's Register Quality Assurance Limited

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Sofidra S.A. **(Jan De Nul Group)** 34-36, Parc d'Activités Capellen, 8308 Capellen, Luxembourg	**ISO 14001:2015, ISO 45001:2018, ISO 9001:2015** Design, engineering, development, procurement, construction, installation and/or maintenance activities related to: - Civil and hydraulic engineering, - Public and port infrastructure works, - Water-, silt- and soil treatment, - Environmental works, - Foundation works, - Dredging and land reclamation, - Offshore services for the oil, gas and renewable energy markets (such as subsea cable and subsea rock transportation and installation), - Heavy lifts and salvage works, - Extraction, treatment and supply of aggregates.
Arenas Argentinas del Paraná S.A. Av. Corrientes 316, Piso 2, C1043AAQ Buenos Aires, Argentina	**ISO 14001:2015, ISO 45001:2018, ISO 9001:2015** Extraction, treatment and supply of aggregates for industrial use and related commercial activities. Design, engineering, development, procurement, construction, installation and/or maintenance activities related to: - Civil and hydraulic engineering, - Public and port infrastructure works, - Water-, silt- and soil treatment, - Environmental works, - Foundation works, - Dredging and land reclamation, - Offshore services for the oil, gas and renewable energy markets (such as subsea cable and subsea rock transportation and installation), - Heavy lifts and salvage works, - Extraction, treatment and supply of aggregates.

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Compania Sud Americana de Dragados SA Av. Corrientes 330, 5° Piso, Of. 516, C1043AAQ - C.A.B.A. Buenos Aires, Argentina	**ISO 14001:2015, ISO 45001:2018, ISO 9001:2015** Design, engineering, development, procurement, construction, installation and/or maintenance activities related to: - Civil and hydraulic engineering, - Public and port infrastructure works, - Water-, silt- and soil treatment, - Environmental works, - Foundation works, - Dredging and land reclamation, - Offshore services for the oil, gas and renewable energy markets (such as subsea cable and subsea rock transportation and installation), - Heavy lifts and salvage works, - Extraction, treatment and supply of aggregates.
Jan De Nul (Australia) Pty. Ltd. Level 3, 9 Colin Street, West Perth, WA 6005, Australia	**ISO 14001:2015, ISO 45001:2018, ISO 9001:2015** Design, engineering, development, procurement, construction, installation and/or maintenance activities related to: - Civil and hydraulic engineering, - Public and port infrastructure works, - Water-, silt- and soil treatment, - Environmental works, - Foundation works, - Dredging and land reclamation, - Offshore services for the oil, gas and renewable energy markets (such as subsea cable and subsea rock transportation and installation), - Heavy lifts and salvage works, - Extraction, treatment and supply of aggregates.

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Jan De Nul N.V. Tragel 60, 9308 Hofstade-Aalst, Belgium	**ISO 14001:2015, ISO 45001:2018, ISO 9001:2015** Design, engineering, development, procurement, construction, installation and/or maintenance activities related to: - Civil and hydraulic engineering, - Public and port infrastructure works, - Water-, silt- and soil treatment, - Environmental works, - Foundation works, - Dredging and land reclamation, - Offshore services for the oil, gas and renewable energy markets (such as subsea cable and subsea rock transportation and installation), - Heavy lifts and salvage works, - Extraction, treatment and supply of aggregates.
Vlaamse Bagger Maatschappij N.V. Tragel 60, 9308 Hofstade-Aalst, Belgium	**ISO 14001:2015, ISO 45001:2018, ISO 9001:2015** Design, engineering, development, procurement, construction, installation and/or maintenance activities related to: - Civil and hydraulic engineering, - Public and port infrastructure works, - Water-, silt- and soil treatment, - Environmental works, - Foundation works, - Dredging and land reclamation, - Offshore services for the oil, gas and renewable energy markets (such as subsea cable and subsea rock transportation and installation), - Heavy lifts and salvage works, - Extraction, treatment and supply of aggregates.

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Algemene Ondernemingen Soetaert N.V./SOILTECH Esperantolaan 10A, 8400 Oostende, Belgium	**ISO 14001:2015, ISO 45001:2018, ISO 9001:2015** Design, engineering, development, procurement, construction, installation and/or maintenance activities related to: - General and civil-technical engineering activities, - Foundation and sheet piling works. Design, engineering, development, procurement, construction, installation and/or maintenance activities related to: - Civil and hydraulic engineering, - Public and port infrastructure works, - Water-, silt- and soil treatment, - Environmental works, - Foundation works, - Dredging and land reclamation, - Offshore services for the oil, gas and renewable energy markets (such as subsea cable and subsea rock transportation and installation), - Heavy lifts and salvage works, - Extraction, treatment and supply of aggregates.

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Envisan N.V. Tragel 60, 9308 Hofstade-Aalst, Belgium	**ISO 14001:2015, ISO 45001:2018, ISO 9001:2015** Design, construction, development, procurement, execution, installation and/or maintenance activities related to environmental works: - Soil and groundwater remediation (in-situ, on-site and off-site), - Remediation and rehabilitation of contaminated industrial sites, - Dredging, transport, treatment, cleaning and recycling of sediments, - Treatment, cleaning and recycling of soil, silt and industrial waste, - Installation and remediation of domestic and industrial landfills and basins. Design, engineering, development, procurement, construction, installation and/or maintenance activities related to: - Civil and hydraulic engineering, - Public and port infrastructure works, - Water-, silt- and soil treatment, - Environmental works, - Foundation works, - Dredging and land reclamation, - Offshore services for the oil, gas and renewable energy markets (such as subsea cable and subsea rock transportation and installation), - Heavy lifts and salvage works, - Extraction, treatment and supply of aggregates.

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Jan De Nul Do Brasil Dragagem Ltda. Avenida Das Americas n° 3500, Bloco 1, salas 515 e 516, Barra da Tijuca, Rio De Janeiro, RJ, CEP 22640-120, Brazil	**ISO 14001:2015, ISO 45001:2018, ISO 9001:2015** Design, engineering, development, procurement, construction, installation and/or maintenance activities related to: - Civil and hydraulic engineering, - Public and port infrastructure works, - Water-, silt- and soil treatment, - Environmental works, - Foundation works, - Dredging and land reclamation, - Offshore services for the oil, gas and renewable energy markets (such as subsea cable and subsea rock transportation and installation), - Heavy lifts and salvage works, - Extraction, treatment and supply of aggregates.
Jan De Nul Nassbaggerei und Wasserbau GmbH 6. OG, Bahnhofsplatz 42, 28195 Bremen, Germany	**ISO 14001:2015, ISO 45001:2018, ISO 9001:2015** Design, engineering, development, procurement, construction, installation and/or maintenance activities related to: - Civil and hydraulic engineering, - Public and port infrastructure works, - Water-, silt- and soil treatment, - Environmental works, - Foundation works, - Dredging and land reclamation, - Offshore services for the oil, gas and renewable energy markets (such as subsea cable and subsea rock transportation and installation), - Heavy lifts and salvage works, - Extraction, treatment and supply of aggregates.

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Canal de Guayaquil CGU S.A. Edificio The Point, Piso 32, Of. 3206, Numa Pompilio Llona No. 100 Guayaquil, Ecuador	**ISO 14001:2015, ISO 45001:2018, ISO 9001:2015** Design, engineering, development, procurement, construction, installation and/or maintenance activities related to: - Civil and hydraulic engineering, - Public and port infrastructure works, - Water-, silt- and soil treatment, - Environmental works, - Foundation works, - Dredging and land reclamation, - Offshore services for the oil, gas and renewable energy markets (such as subsea cable and subsea rock transportation and installation), - Heavy lifts and salvage works, - Extraction, treatment and supply of aggregates.
Soetaert France SAS Rue de Dunkerque lot AO3, 28, 59280 Armentières, France	**ISO 14001:2015, ISO 45001:2018, ISO 9001:2015** Design, engineering, development, procurement, construction, installation and/or maintenance activities related to: - General and civil-technical engineering activities - Foundation and sheet piling works Design, engineering, development, procurement, construction, installation and/or maintenance activities related to: - Civil and hydraulic engineering, - Public and port infrastructure works, - Water-, silt- and soil treatment, - Environmental works, - Foundation works, - Dredging and land reclamation, - Offshore services for the oil, gas and renewable energy markets (such as subsea cable and subsea rock transportation and installation), - Heavy lifts and salvage works, - Extraction, treatment and supply of aggregates.

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Sodraco International SAS 28, Rue de Dunkerque, Lot A03 / Rez-de-Chaussée, 59280 Armentières, France	**ISO 14001:2015, ISO 45001:2018, ISO 9001:2015** Design, engineering, development, procurement, construction, installation and/or maintenance activities related to: - Civil and hydraulic engineering, - Public and port infrastructure works, - Water-, silt- and soil treatment, - Environmental works, - Foundation works, - Dredging and land reclamation, - Offshore services for the oil, gas and renewable energy markets (such as subsea cable and subsea rock transportation and installation), - Heavy lifts and salvage works, - Extraction, treatment and supply of aggregates.

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Envisan France SAS 795, avenue de la 1ère Armée, Francaise Rhin Danube, 83500 La Seyne-sur-Mer, France	**ISO 14001:2015, ISO 45001:2018, ISO 9001:2015** Design, construction, development, procurement, execution, installation and/or maintenance activities related to environmental works: - Soil and groundwater remediation (in-situ, on-site and off-site), - Remediation and rehabilitation of contaminated industrial sites, - Dredging, transport, treatment, cleaning and recycling of sediments, - Treatment, cleaning and recycling of soil, silt and industrial waste, - Installation and remediation of domestic and industrial landfills and basins. Design, engineering, development, procurement, construction, installation and/or maintenance activities related to: - Civil and hydraulic engineering, - Public and port infrastructure works, - Water-, silt- and soil treatment, - Environmental works, - Foundation works, - Dredging and land reclamation, - Offshore services for the oil, gas and renewable energy markets (such as subsea cable and subsea rock transportation and installation), - Heavy lifts and salvage works, - Extraction, treatment and supply of aggregates.

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Jan De Nul (UK) Ltd. Richmond House, High Street, Ascot Berkshire, SL5 7HG, United Kingdom	**ISO 14001:2015, ISO 45001:2018, ISO 9001:2015** Design, engineering, development, procurement, construction, installation and/or maintenance activities related to: - Civil and hydraulic engineering, - Public and port infrastructure works, - Water-, silt- and soil treatment, - Environmental works, - Foundation works, - Dredging and land reclamation, - Offshore services for the oil, gas and renewable energy markets (such as subsea cable and subsea rock transportation and installation), - Heavy lifts and salvage works, - Extraction, treatment and supply of aggregates.
Jan De Nul Ghana Ltd. 11 Forest Avenue, Building C4/14 Dzorwulu, Ayawaso West, Greater Accra, Ghana	**ISO 14001:2015, ISO 45001:2018, ISO 9001:2015** Design, engineering, development, procurement, construction, installation and/or maintenance activities related to: - Civil and hydraulic engineering, - Public and port infrastructure works, - Water-, silt- and soil treatment, - Environmental works, - Foundation works, - Dredging and land reclamation, - Offshore services for the oil, gas and renewable energy markets (such as subsea cable and subsea rock transportation and installation), - Heavy lifts and salvage works, - Extraction, treatment and supply of aggregates.

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Jan De Nul (Italia) S.p.A. Lungotevere delle Navi 19 – Int. 5, 00196 Roma, Italy	**ISO 14001:2015, ISO 45001:2018, ISO 9001:2015** Design, engineering, development, procurement, construction, installation and/or maintenance activities related to: - Civil and hydraulic engineering, - Public and port infrastructure works, - Water-, silt- and soil treatment, - Environmental works, - Foundation works, - Dredging and land reclamation, - Offshore services for the oil, gas and renewable energy markets (such as subsea cable and subsea rock transportation and installation), - Heavy lifts and salvage works, - Extraction, treatment and supply of aggregates.

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European Dredging Company S.A. 34-36, Parc d'Activités Capellen, 8308 Capellen, Luxembourg	**ISO 14001:2015, ISO 45001:2018, ISO 9001:2015** Design, engineering, development, procurement, construction, installation and/or maintenance activities related to: - Civil and hydraulic engineering, - Public and port infrastructure works, - Water-, silt- and soil treatment, - Environmental works, - Foundation works, - Dredging and land reclamation, - Offshore services for the oil, gas and renewable energy markets (such as subsea cable and subsea rock transportation and installation), - Heavy lifts and salvage works, - Extraction, treatment and supply of aggregates.

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Location	Activities
Codralux S.A. 34-36, Parc d'Activités Capellen, 8308 Capellen, Luxembourg	**ISO 14001:2015, ISO 45001:2018, ISO 9001:2015** Design, engineering, development, procurement, construction, installation and/or maintenance activities related to: - Civil and hydraulic engineering, - Public and port infrastructure works, - Water-, silt- and soil treatment, - Environmental works, - Foundation works, - Dredging and land reclamation, - Offshore services for the oil, gas and renewable energy markets (such as subsea cable and subsea rock transportation and installation), - Heavy lifts and salvage works, - Extraction, treatment and supply of aggregates.
Jan de Nul ConstructLux S.A. 34-36, Parc d'Activités Capellen, 8308 Capellen, Luxembourg	**ISO 14001:2015, ISO 45001:2018, ISO 9001:2015** Design, engineering, development, procurement, construction, installation and/or maintenance activities related to: - Civil and hydraulic engineering, - Public and port infrastructure works, - Water-, silt- and soil treatment, - Environmental works, - Foundation works, - Dredging and land reclamation, - Offshore services for the oil, gas and renewable energy markets (such as subsea cable and subsea rock transportation and installation), - Heavy lifts and salvage works, - Extraction, treatment and supply of aggregates.

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Location	Activities
Jan De Nul Dredging Ltd. Suite 308, St. James Court, St. Denis Street, Port Louis, Mauritius	**ISO 14001:2015, ISO 45001:2018, ISO 9001:2015** Design, engineering, development, procurement, construction, installation and/or maintenance activities related to: - Civil and hydraulic engineering, - Public and port infrastructure works, - Water-, silt- and soil treatment, - Environmental works, - Foundation works, - Dredging and land reclamation, - Offshore services for the oil, gas and renewable energy markets (such as subsea cable and subsea rock transportation and installation), - Heavy lifts and salvage works, - Extraction, treatment and supply of aggregates.
Mexicana de Dragados S.A. de CV Paseo de las Palmas 405-Desp.1104, Colonia Lomas de Chapultepec, Delegacion Miguel Hidalgo, C.P., 11000 Mexico Distrito Federal,Mexico	**ISO 14001:2015, ISO 45001:2018, ISO 9001:2015** Design, engineering, development, procurement, construction, installation and/or maintenance activities related to: - Civil and hydraulic engineering, - Public and port infrastructure works, - Water-, silt- and soil treatment, - Environmental works, - Foundation works, - Dredging and land reclamation, - Offshore services for the oil, gas and renewable energy markets (such as subsea cable and subsea rock transportation and installation), - Heavy lifts and salvage works, - Extraction, treatment and supply of aggregates.

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Certificate Schedule

Location	Activities
Dredging and Contracting Rotterdam B.V. Zuid-Oostsingel 24H, 4611 BB Bergen op Zoom, Netherlands	**ISO 14001:2015, ISO 45001:2018, ISO 9001:2015** Design, engineering, development, procurement, construction, installation and/or maintenance activities related to: - Civil and hydraulic engineering, - Public and port infrastructure works, - Water-, silt- and soil treatment, - Environmental works, - Foundation works, - Dredging and land reclamation, - Offshore services for the oil, gas and renewable energy markets (such as subsea cable and subsea rock transportation and installation), - Heavy lifts and salvage works, - Extraction, treatment and supply of aggregates.
Jan De Nul Panama S.A. P.H. Santa Maria Business Plaza, 2nd floor, Office 200 Panama, Republic of Panama	**ISO 14001:2015, ISO 45001:2018, ISO 9001:2015** Design, engineering, development, procurement, construction, installation and/or maintenance activities related to: - Civil and hydraulic engineering, - Public and port infrastructure works, - Water-, silt- and soil treatment, - Environmental works, - Foundation works, - Dredging and land reclamation, - Offshore services for the oil, gas and renewable energy markets (such as subsea cable and subsea rock transportation and installation), - Heavy lifts and salvage works, - Extraction, treatment and supply of aggregates.

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Certificate Schedule

Location	Activities
Jan De Nul (Phils.), Inc. Unit 302 3rd Floor Aseana; Power Station Building, Pres. D. Macapagal Boulevard. Corner Bradco Avenue, Aseana City, Tambo,Parañaque, 1701, Philippines	**ISO 14001:2015, ISO 45001:2018, ISO 9001:2015** Design, engineering, development, procurement, construction, installation and/or maintenance activities related to: - Civil and hydraulic engineering, - Public and port infrastructure works, - Water-, silt- and soil treatment, - Environmental works, - Foundation works, - Dredging and land reclamation, - Offshore services for the oil, gas and renewable energy markets (such as subsea cable and subsea rock transportation and installation), - Heavy lifts and salvage works, - Extraction, treatment and supply of aggregates.
Jan De Nul Saudi Arabia Co. Ltd. PO Box 76616, Al-Khobar, 31952, Saudi Arabia	**ISO 14001:2015, ISO 45001:2018, ISO 9001:2015** Design, engineering, development, procurement, construction, installation and/or maintenance activities related to: - Civil and hydraulic engineering, - Public and port infrastructure works, - Water-, silt- and soil treatment, - Environmental works, - Foundation works, - Dredging and land reclamation, - Offshore services for the oil, gas and renewable energy markets (such as subsea cable and subsea rock transportation and installation), - Heavy lifts and salvage works, - Extraction, treatment and supply of aggregates.

UKAS MANAGEMENT SYSTEMS
001

6.2 ANNEX B: JDN'S QHSSE POLICY

POLICY STATEMENT.

QUALITY . HEALTH . SAFETY . SECURITY . ENVIRONMENT

Jan De Nul Group enhances the lives of people, connects communities and improves infrastructure worldwide, through unique and innovative solutions.

OUR QHSSE VALUES.

People: Provide a safe and secure environment for all persons working for or on behalf of Jan De Nul Group to prevent work-related injuries and ill health.
Planet: Achieve environmental integrity and minimise our ecological footprint.
Stakeholders: Be the partner of choice through our advanced capabilities and strong commitment. Collaborate and assist to meet applicable policies and standards.
Our organisation: Pursue continual improvement and sustainable growth through learning and innovation.

OUR QHSSE STRATEGY.

We **invest in people** to strengthen organisational capability and develop a committed, talented and environmentally aware workforce that delivers high-quality results through operational control. The participation and consultation of our employees and their representatives is vital to achieve our goals. We encourage our employees to embrace a healthy lifestyle, both physically and mentally.

We operate to the principal standards of vigilance, embedding **security** in our daily operations, on a local, regional and corporate level. We continuously monitor the environment in which we work, assess potential threats and risks and apply appropriate countermeasures.

As a company, we are committed to **protecting the environment**, **preventing pollution** and drastically **reducing our impact on the climate.** Together with our clients, we come up with concrete initiatives and solutions to execute our projects in a sustainable manner whilst limiting our footprint. We decrease the use of fossil fuels where possible, optimise our energy consumption, and maximise our efforts for sustainable renewable energy and its expansion.

We are constantly contributing to a **sustainable world** through a well-considered and supported CSR policy.

We **meet and endeavour to exceed requirements** imposed by contracts, company and industry standards for high quality workmanship, applicable local, national, international and maritime laws and regulations. Our sustainable procurement policy imposes a commitment on our suppliers and subcontractors to apply the same standards and values as Jan De Nul Group.

We uphold execution excellence through **proactive and accountable leadership** that sets and communicates clear expectations, demonstrates high standards, manages performance and supports team development. We provide the necessary means, training and user-friendly **management system** to achieve our vision.

We increase **risk awareness** through a better understanding of risks, placing emphasis on critical risks and ensuring that all strategic and operational risks are properly identified, assessed and mitigated. We share **lessons learnt** and promote safety as being the result of **operational control** while making sure that project requirements are fully met through excellent **quality control**.

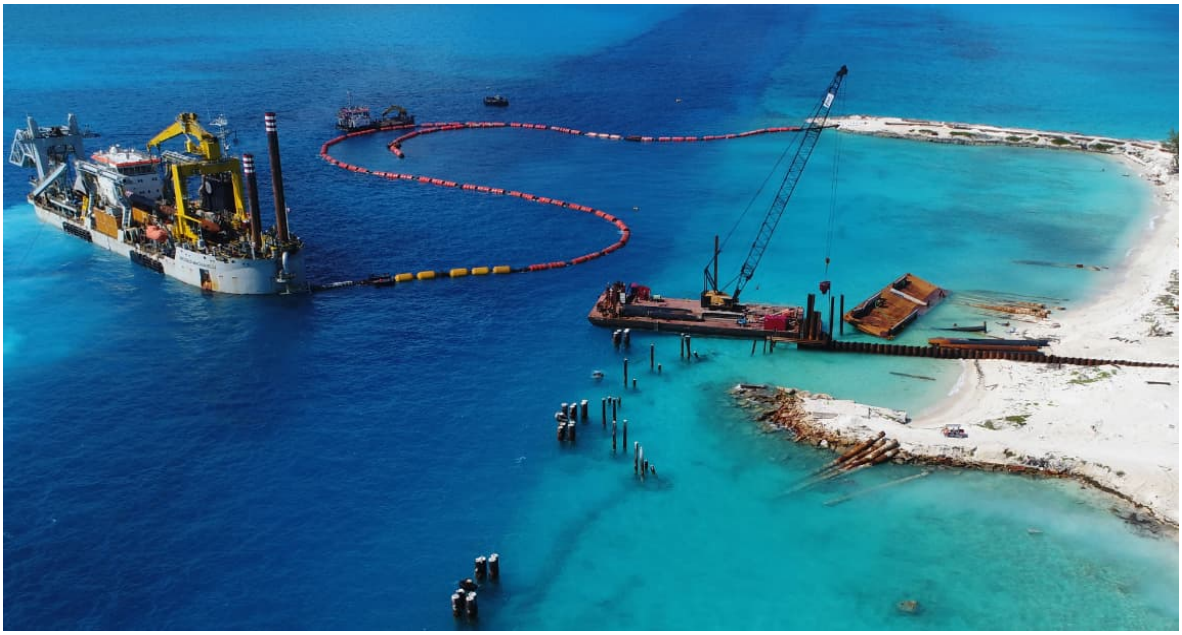
Jan De Nul Group pushes the boundaries of marine, civil construction and environmental projects worldwide. Working together with customers, safely and responsibly, we bring experience, methods, motivated teams and in-house designed equipment to, imagine what is possible; think through the solution; act to deliver.

Luxemburg, 7 December 2021

Jan De Nul Group (Sofidra S.A.)
Director,

ir J.P.J. De Nul

ATTACHMENT 3
Turbidity Control Plan



Document Title:

TURBIDITY CONTROL PLAN

Project:

DREDGING WORKS FOR THE GRAND PORT CRUISE CENTER

Employer:

Document no.: JDN.BSGRCC.009
Prepared by: Marine Environmental Department (MARED)

0.0	07/11/2022	Issued for approval	GRU	WOS	HEH	
Rev.	Date	Description of revision	Prepared	Checked	Approved	
			CONTRACTOR			

Revision change details

Revision	Location	Brief description of change
0.0	-	New document - Issued for approval

Document Distribution and Access

The contents of this draft document are confidential and intended solely for the recipient.

All project staff will be notified on the latest revision by means of internal memo or per internal e-mail. The controlled document shall be made available on the project server at the discretion of all involved personnel.

Contents

Figures

Tables

1 INTRODUCTION

1.1 PURPOSE

This document describes the operational and engineering turbidity control measures that will be implemented by the Contractor in order to comply with the applicable project requirements set forth in the EIA and Employers EMP for the Grand Port Cruise Centre Project, and protect the habitats surrounding the working areas from the potential increase in turbidity levels that may result from dredging and dewatering operations.

1.2 GENERAL PROJECT DESCRIPTION

Carnival Corporation is planning to invest in the new port to achieve a new way for passengers to reach touristic sites. Currently, Carnival's guests have to be transported by taxi or tour bus through the industrial park at the Lucayan Harbour. With the construction of the new harbour on the south shore of Freeport, they will be able to go directly from the ship onto beachfront property.

Figure 1-1 Project location

1.3 SCOPE OF WORKS

The scope of the Works involves the dredging of the cruise ship manoeuvring and berthing depths on each side of the new cruise ship pier extending out towards the open waters. Excavation will be conducted utilizing a cutter suction dredge, while transporting the dredged material by a pipeline to the upland disposal area.

2 REFERENCES

2.1 EMPLOYER'S DOCUMENTS

Table 2-1: Employer's documents

No	Document	Document Number
[1]	CARNIVAL GRAND BAHAMA INVESTMENT LIMITED ENVIRONMENTAL MANAGEMENT PLAN	CARNIVAL GB EMP_Revision I_6.18.21
[2]	CARNIVAL GRAND BAHAMA INVESTMENTS LTD. ENVIRONMENTAL IMPACT ASSESSMENT	Carnival Grand Bahama EIA_Revisions 4.24.20

2.2 CONTRACTOR'S DOCUMENTS

Latest revisions of (unless stated otherwise):

Table 2-2: Contractor's Documents

No	Document	Document number
[1]	Environmental Management Plan	JDN.BSGRCC.010
[2]	Method Statement Dredging and Reclamation	JDN.BSGRCC.011
[3]	Survey Method Statement	JDN.BSGRCC.012

2.3 ABBREVIATIONS

Table 2-3: Abbreviations

Abbr.	Written in Full
CSD	Cutter Suction Dredger
EMP	Environmental Management Plan
DMP	Dredge Management Plan
EMS	Environmental Management System
HAZID	Hazard Identification
HSSE	Health, Safety, Security and Environment
IMO	International Maritime Organisation
IMS	Invasive Marine Species
ISO	International Organisation for Standardisation
JDN	Jan De Nul
NTU	Nephelometric Turbidity Units

PM	Project Manager
PMT	Project Management Team
PPE	Personnel protective equipment
PSD	Particle Size Distribution
QA/QC	Quality Assurance / Quality Control
SDS	Safety Data Sheet
SHB	Split Hopper Barge
SOPEP	Shipboard Oil Pollution Emergency Plan
TSS	Total Suspended Solids (mg/l)

Table 3-1: Abbreviations

3 TURBIDITY CONTROL MEASURES

Because of the presence of sensitive and vulnerable marine ecosystems around the project site, turbidity monitoring will be conducted to ensure that values will not exceed a maximum increase of 15 Nephelometric Turbidity Units (NTU) above background concentration during dredging at all sampling locations.

3.1 OPERATIONAL CONTROL MEASURES

Operational controls to minimize the magnitude of turbidity generation include changes to the dredging method and the operation of the dredger and auxiliary vessels. The Contractor ensures that the dredging equipment is properly maintained and calibrated to function optimally.

Turbidity generation from dredging operations will be monitored at all times by the operational superintendent on board the dredge as well as by the environmental engineer who will perform the daily turbidity monitoring. For the reclamation area, the operational superintendent together with the sandfield master will keep monitoring of the reclamation process and dewatering operations.

Close communication will be maintained between the different parties (dredging and reclamation superintendents, sandfield master, and environmental engineer) regarding the progress of the works, the generation of turbidity and the results of the turbidity monitoring campaigns in order to collaboratively define the need for the implementation of additional controls and maintain compliance with the maximum permissible turbidity limits. Specific follow up of the CSD operating parameters will be maintained. The operational controls to be implemented might include:

- Reducing dredging rate (e.g. slowing the operation).
- Changing dredging operation based on site conditions such as tides, waves, currents, and wind.
- Modifying dredge operations such as depth of the cutterhead, ladder swing speed, cutter rotational speed or speed of advance of the dredger).
- Adjust the dredging sequence, number of cuts (passes) to increase sediment capture.
- Reduce turbidity originating from propeller wash by limiting vessel speed in areas with limited under-keel clearance.

Operational controls for the reclamation and dewatering works might include (1) the relocation of the discharge pipe (landline coming from the dredger), (2) the sand/earth movement inside the reclamation area, (3) the placement or adjustment of the wood planks of the water boxes to regulate the outflow in the settlement pond and (4) strategically prioritize areas to reclaim to alter the flow path.

3.2 SILT CURTAINS

The application of silt curtains in dredging and land reclamation projects is a very common engineering solution to control sediment dispersion resulting from the execution of these activities in the wider environment, and thus prevent their associated effects on water quality and aquatic life.

The Contractor aims to establish sufficient sediment control and management measures seeking to meet the project standards in terms of turbidity level limits in the receiving water body. The following sections provide a detailed overview of the silt curtain plan and all silt curtain related activities.

3.2.1 TURBIDITY CURTAIN PLAN

Figure 3-1 depicts the proposed locations to install the silt curtains around the dredging area. It is chosen to install the curtains perpendicular to the coastline as the predominant currents run parallel to the coast. This setup aims to limit the spreading of suspended solids in shallow areas along the coastline and protects the coral relocation zone located west in the vicinity of the project area (Figure 3-2). The different colours indicated on the map show the different skirt depths of 1, 2 and 4m.

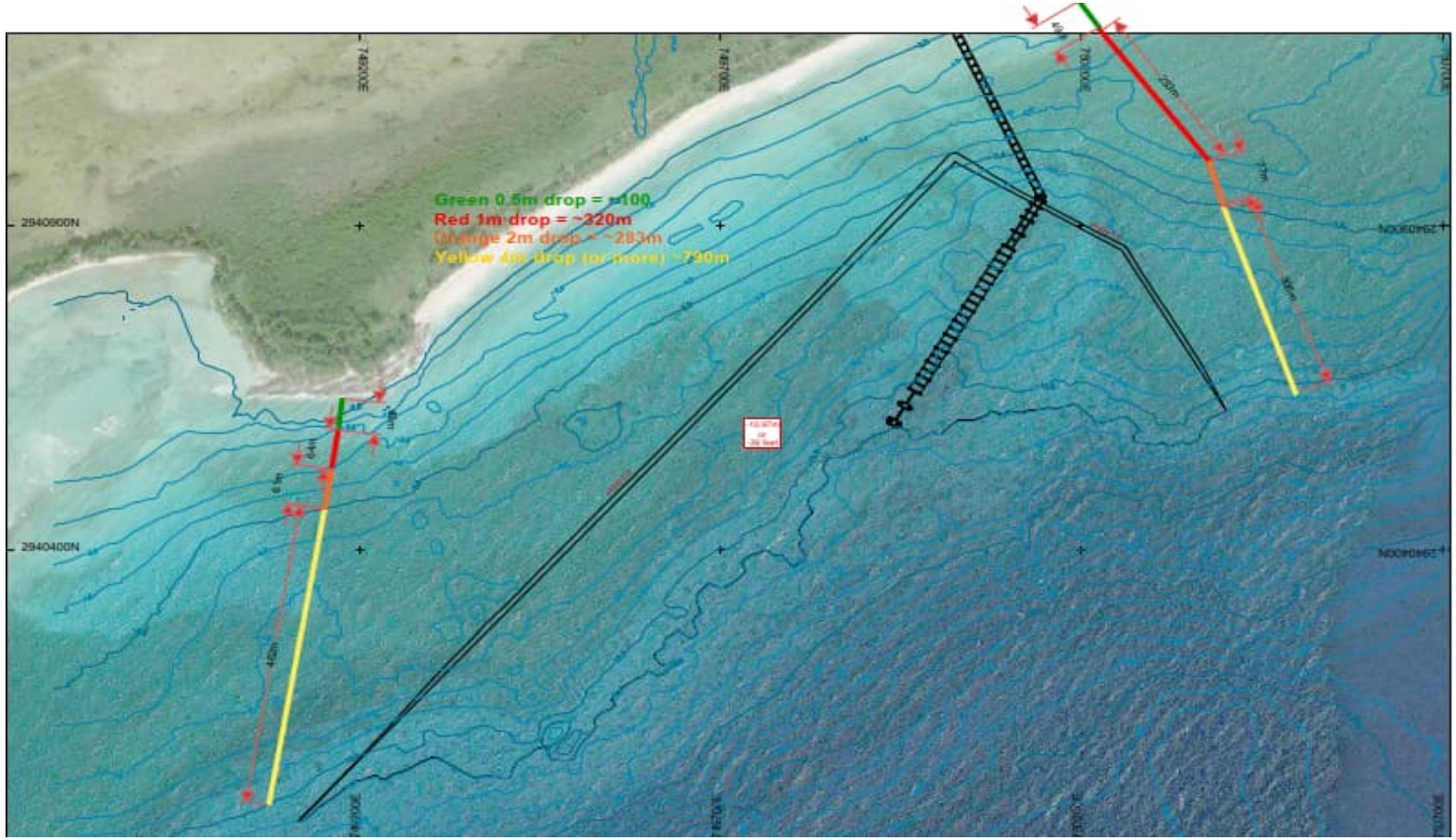


Figure 3-1: Proposed locations to install the silt curtains around the dredging area

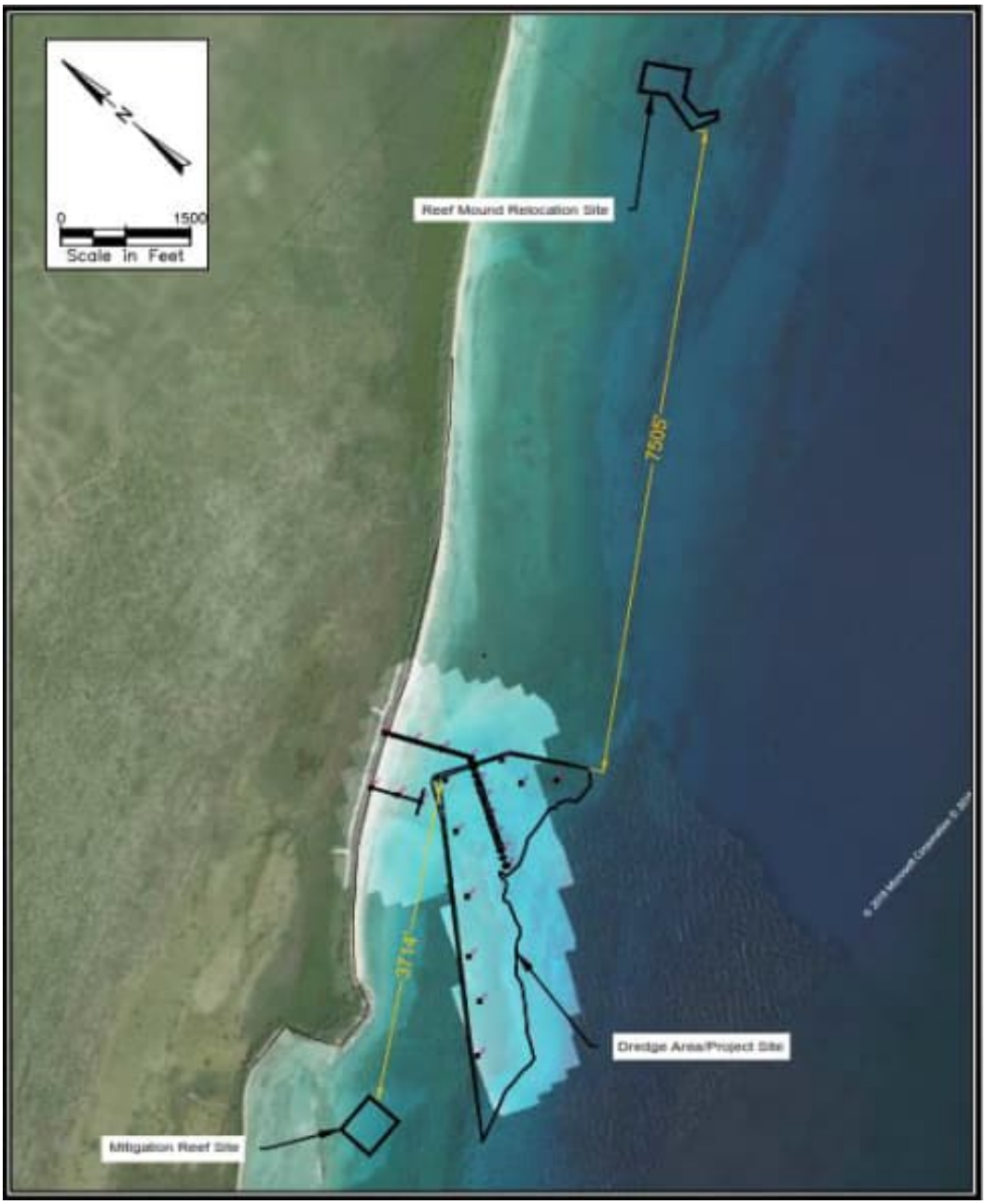


Figure 3-2 : 2 coral relocation sites in the vicinity of the project area (source: Employers Environmental Management Plan)

Figure 3-3 depicts the proposed locations to install the silt curtains around outflow of the reclamation area. A double layer of silt curtains is foreseen to minimize the dispersion of suspended solids in shallow waters near the coast.

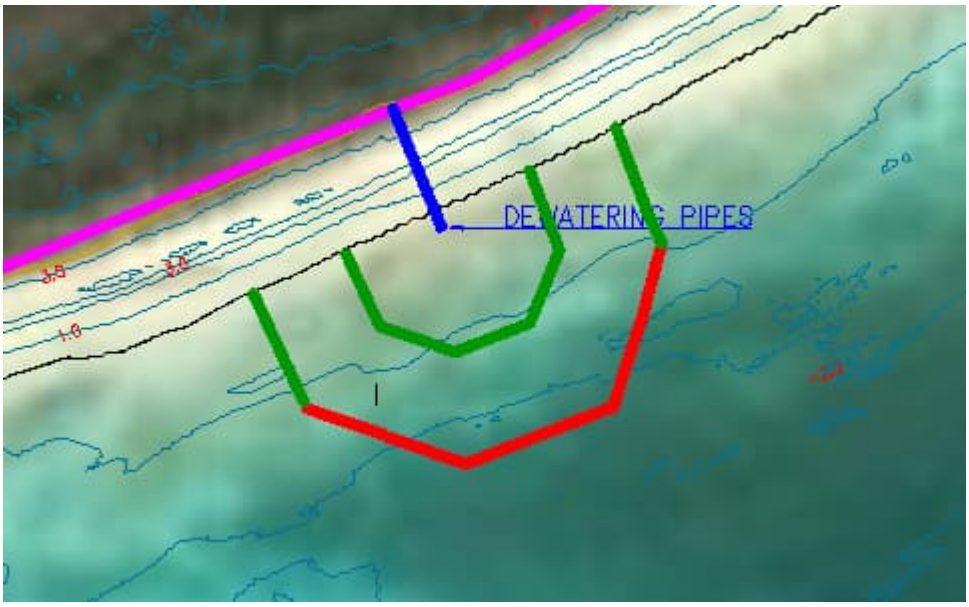


Figure 3-3: Proposed silt curtains around the outflow of the reclamation area

3.2.2 SILT CURTAIN SPECIFICATIONS

Contractor has worked with numerous suppliers of silt curtains in the past and has ample experience with silt curtain installation. For this project, Contractor has purchased approximately 2000m of new Type III silt curtains from an experienced supplier in Dubai. See Annex A: Technical Data Sheet Silt Curtains for technical details of the new silt curtains mobilized for the project. In additional to the newly purchased silt curtains, Contractor shall also mobilize additional stock to ensure sufficient quantities and spares are available on the project. All silt curtains mobilised on the project are of the model Type III.

3.2.3 WORKING PRINCIPLE

An anti-turbidity barrier or silt curtain is a floating barrier that allows the suspended sediment more time to settle while containing them and consequently reduces its dispersion in the surrounding environment. Typically it guides the suspended sediment to the deeper part of the water column where it will settle, as is shown in Figure 3-4. However, the efficiency in containing silt and reducing its impact on the surrounding environment highly depends on the prevailing hydrodynamic conditions on site.

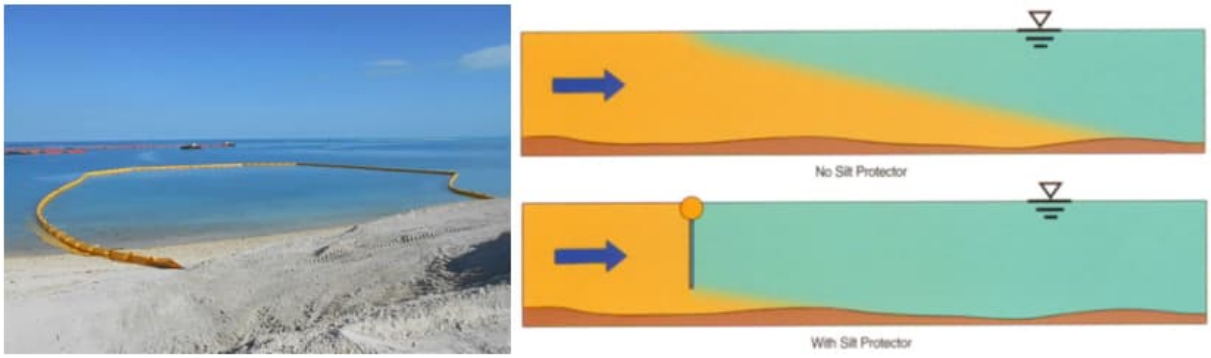


Figure 3-4: Silt Curtain (left) and its working principle (right)

In general, a silt curtain consists of 4 major components as is shown in figure below:

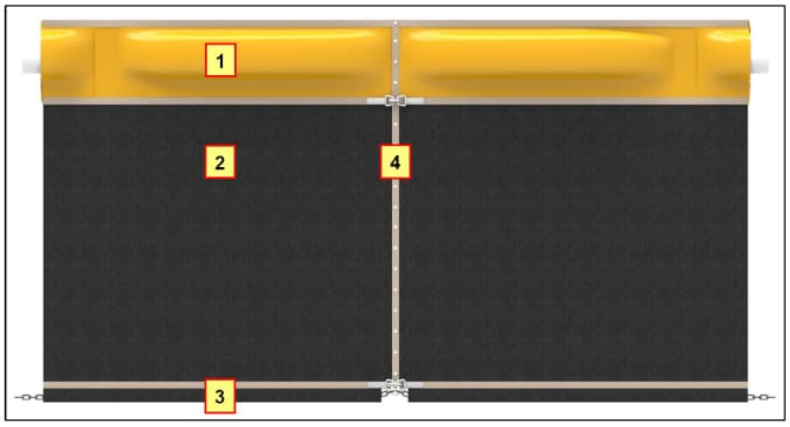


Figure 3-5: Main silt curtain components

1. Floating pocket containing several pieces of styrofoam to provide buoyance as well as flexibility
2. Geotextile curtain which acts as the silt barrier (skirt)
3. Ballast chain at the bottom of the curtain to keep it in a vertical position
4. Connections between 2 sections of silt curtain (sliding plates, grommets and coupling accessories)

Silt curtains are also equipped with tension cables that connect between sections to give it proper tensile strength.

3.2.4 ANCHORING SYSTEM

Providing a proper anchoring system for the silt curtains is of major importance to keep the curtain on its required position. An incorrect anchoring may cause major issues relating to effectiveness and are especially critical in situations where tides and / or waves are present causing vertical movement. Designing the anchoring and calculating the weight needed to hold the curtain in position can be done either in-house or by the supplier.

Depending on the seabed conditions, current strength, waves, drop of the silt curtains, duration of the project, resources available, etc. different types of anchoring can be selected or defined. Due to the hard seabed conditions in the project area Contractor has opted for a concrete anchoring system for the silt curtains around the dredging area.

Silt screens are installed using an anchor mooring system to keep the silt screen in position under anticipated environmental conditions. Concrete anchor blocks are frequently used to keep silt screens in place. Disadvantages of using concrete blocks are that a crane is required for installation and shifting of the anchor setups. The proposed mooring system of the silt curtains installed around the dredging area and outflow of the reclamation area can be seen in Figure 3-6 and Table 3-1.

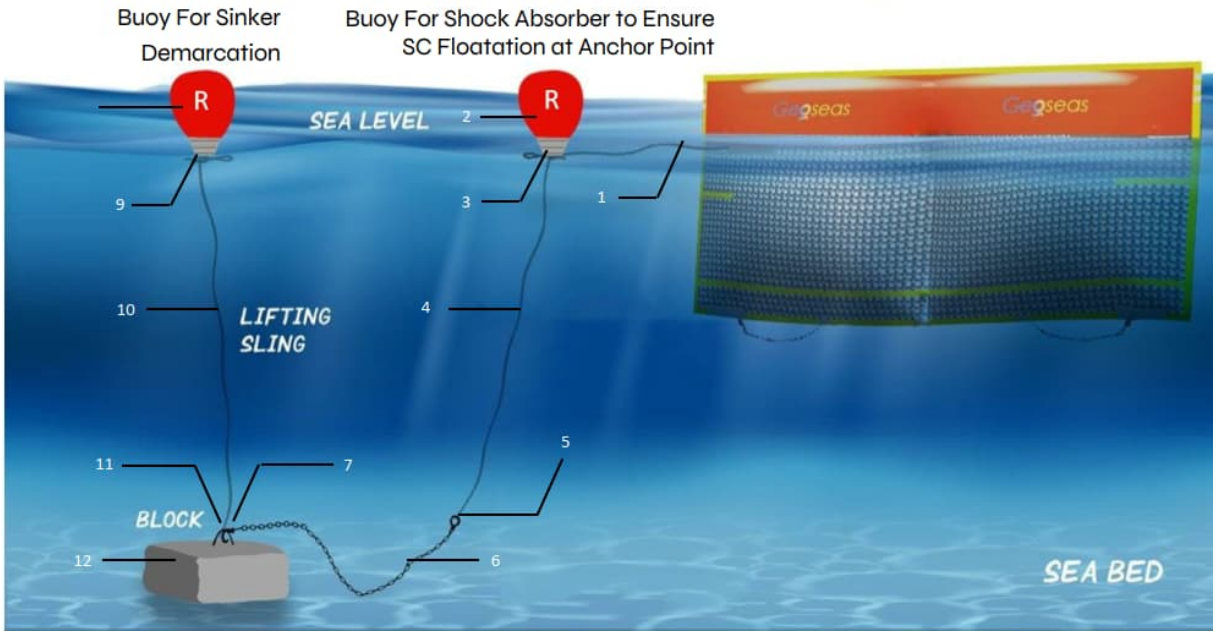


Figure 3-6: Proposed mooring setup silt curtains

Table 3-1: Silt curtain mooring setup components

No	Component	Item
1	Curtain – Buoy Line Connection	Nylon Rope
2	Anchor line setup	Floater
3		Shackle
4		Nylon Rope
5		Shackle
6		Chain / Steel wire
7		Shackle
8	Lifting line setup	Floater
9		Shackle
10		Wire rope
11		Shackle
12	Concrete block	Concrete block

Danforth anchors are also frequently used as a mooring solution for silt screens. Danforth anchors are lightweight and easy to handle. However the anchors can be released from the seabed upon changes in current directions. Even though it will dig itself in again quickly afterwards, this allows slight changes in the position of the anchor and thus the silt curtain. Due to the hard seabed conditions in the project area, the anchors may not be able to dig themselves in. Anchors being released from the seabed could have an environmental impact by dragging over the seafloor. In order to avoid this, we will only consider utilizing danforth anchors in the reclamation area or areas with a sandy bottom where they pose no risk to the environment and use stable concrete blocks in deeper areas.

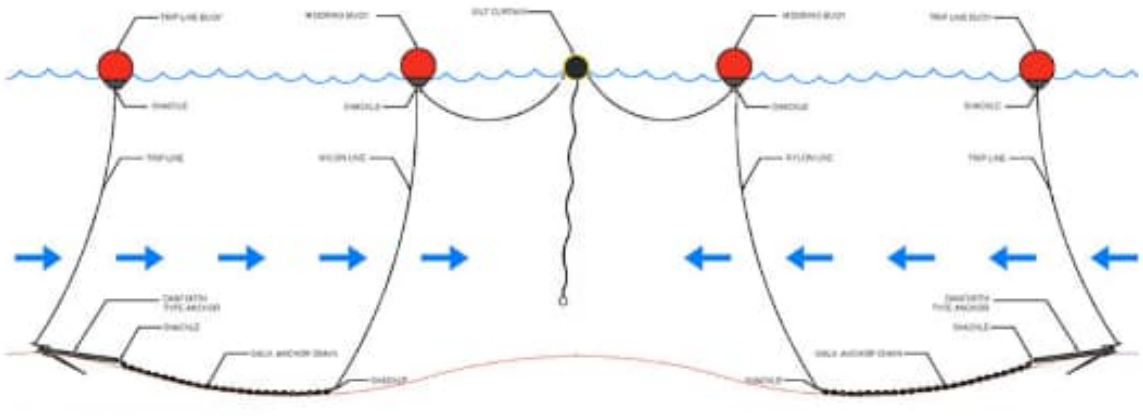


Figure 3-7: Overview of typical anchoring system using Danforth anchors

3.2.5 INSTALLATION OF SILT CURTAINS

The Contractor will mobilize silt curtains and their accessories to the site and shall define a suitable area (laydown and assembly area) where the silt curtains can be assembled and prepared for installation with the help of local labor, and lifting equipment (telehandler and/or small excavator) for the handling on site. The silt curtain launching and installation (water works) will be conducted using a work/auxiliary boat assisted by another small craft.

Once the silt curtains are assembled according to a predefined array and sequence, they will be launched into the water by pulling them manually and with the help of an assistance boat, which must then bring the towing line to the tow boat which will then take them to the desired installation location. The assistance boat will help to complete the installation in coordination with the towing boat and the multicat that will install the concrete anchor blocks. Typical vessels for installation works can be seen in Figure 3-9.

Figure 3-8: Silt curtains being arranged for launching in a previous project

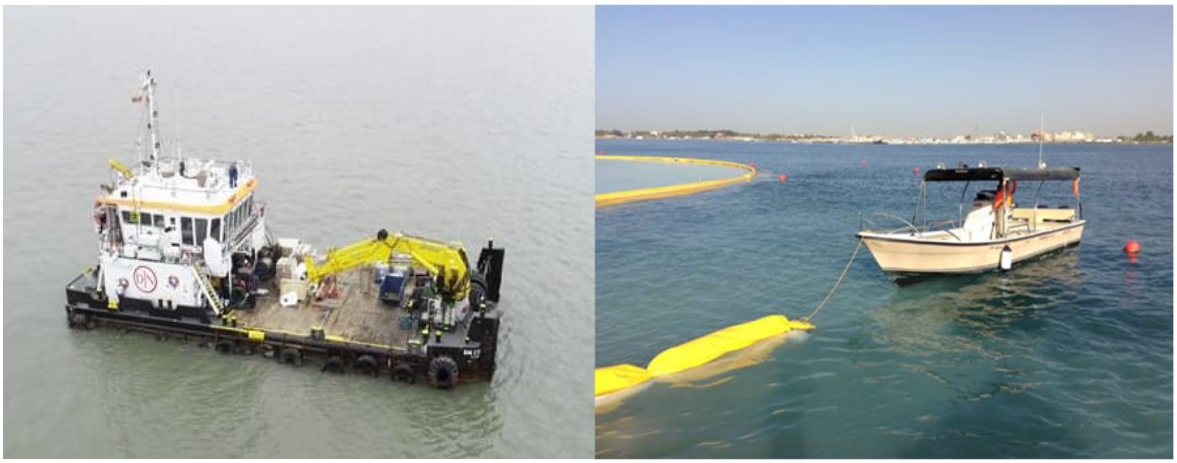


Figure 3-9: Typical vessels used for the installation, maintenance and removal of silt curtains

Once the silt curtains are assembled according to a predefined array and sequence, they will be launched into the water by pulling them manually and with the help of an assistance diving boat, which must then bring the towing line to the tow boat which will then take them to the desired installation location. The assistance boat will help to complete the installation in coordination with the towing boat and the multicat that will install the concrete anchor blocks.

Inside the settlement pond, silt curtain will be installed to generally increase the settlement of suspended solids within the pond. Silt curtain shall be placed near the inlet flow of the pond to shock it and thus diverge and slow it down, resulting in increased retention time and settling rate, and less discharge of suspended solids in the end. Additional stretches of silt curtains shall be placed inside the settlement pond in order to optimize the use of the settlement pond. For this installation, anchors will be placed on the bunds around the installation site to hold the silt curtain in position which may change as work progresses.

Contractor will ensure to have sufficient manpower on board of the vessels working on the silt curtains installation and on shore to handle the curtain stretches during the silt curtain installation.

3.2.6 MAINTENANCE OF SILT CURTAINS

Daily visual inspections shall be performed once the silt screens are installed in order to define the need for maintenance and/or repairs to maintain its working efficiency as well as its position. The following parameters will be checked intermediately:

- Anchor connections (including ropes, shackles, pad eyes, etc.) to be in good shape.
- Drone images to determine silt curtains remain in position
- Position of the anchor blocks to be checked (using the small floaters attached) to determine if they are dragging or not.
- Curtain fittings (e.g. chains, connectors etc.) are intact and in position
- Silt curtain skirts to be checked for holes and or ruptured sections.
- Floaters are intact and not submerged
- Marker buoys and curtain lights are in correct positions and undamaged.

The following table provides an example of a typical silt curtain checklist to be filled out on a daily basis.

Inspection Items	Result	If Unsatisfactory, provide details on the following				
		Affected Section(s) / Location(s)	Description of Unsatisfactory Item	Proposed Action	Date of Completion of Action	Confirmed / Completed By
Geotextile						
Curtain remains intact and without gap	□ Satisfactory □ Unsatisfactory					
Curtain in upright position	□ Satisfactory □ Unsatisfactory					
Curtain has no loose / flapping parts	□ Satisfactory □ Unsatisfactory					
No floating refuse trapped by the silt curtain	□ Satisfactory □ Unsatisfactory					
Curtain fittings (e.g. chains, connectors etc.) are intact and in position	□ Satisfactory □ Unsatisfactory					
Curtain is not weighted down by sediment deposition	□ Satisfactory □ Unsatisfactory					
Ancillary Components						
Anchors are undamaged and positions are correct	□ Satisfactory □ Unsatisfactory					
Anchor lines are properly attached to the buoys/ connectors of the silt curtain	□ Satisfactory □ Unsatisfactory					
No parts are detached from the silt curtain system	□ Satisfactory □ Unsatisfactory					
Floaters are intact and not submerged	□ Satisfactory □ Unsatisfactory					
Marker buoys and/or flashing lights are in correct positions and undamaged	□ Satisfactory □ Unsatisfactory					
Flashing lights are working properly	□ Satisfactory □ Unsatisfactory					

Figure 3-10: Example of a silt curtain checklist

3.2.7 RECOVERY OF SILT CURTAINS

The Contractor shall remove the silt curtains only when turbidity inside and outside the silt curtains (at the dredge site and reclamation discharge area) are reasonably equal and consistent with background levels. For this, regular mobile turbidity monitoring after works completion will be executed in order to determine when the silt curtain can be removed.

Silt curtains will be removed from the water and taken to the laydown and assembly area where they will be dismantled, cleaned and re-wrapped. In order to remove the silt curtains, a safe working practice will be drafted and discussed with relevant parties. The removal will begin by releasing the silt curtains from the anchors and then towing the stretches to shore using an auxiliary boat assisted by a

small boat. The small boat crew will be used to detach the curtain from the anchors as well as bring the towing line to shore in shallow water. Heavy equipment (excavator or telescopic handler) will be used to pull the silt curtain ashore and handle it. Sufficient manpower will be maintained on board and ashore to handle the curtain stretches during removal operations. The anchors will be removed by means of the multicat equipped with a crane.

Contractor will investigate and assess site conditions for the demobilization of silt curtains at a later stage and shall perform this accordingly.

3.3 SETTLING BASIN AND WATER BOXES

From the dredger, the materials will be pumped as a mixture of water and soil particles to the reclamation area through a discharge pipeline. At the end of the pipeline, the pumped materials having left the pipeline, will settle. In order to retain as much solids as possible in the reclamation area, a settling pond will be built in the last stretch of the reclamation area.

The discharge of excess water from the recovery area may impact the water receiving body by increasing the concentration of suspended solids and turbidity of this. Therefore, preventive control measures outlined in chapter 5.4.3 of Contractor's Environmental Management Plan (JDN.BSGRCC.009) will be implemented to prevent non-compliance with the project standards and protect the marine habitats in the project surroundings.

The required capacity of the settling basin has been calculated according to the expected flow rate into the basin. For this the "ideal basin" calculation model is used. From the experience of previous projects and literature an efficiency factor is used to determine a realistic surface capacity for the basin.

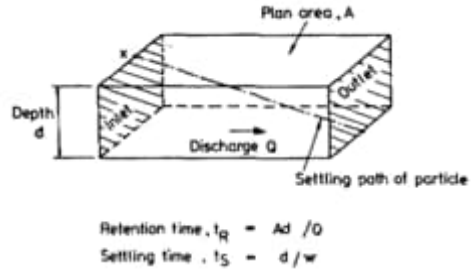


Figure 3-11: Ideal basin model

Further modeling (see also 3.5) of the hydrodynamics in the basin is done to improve the efficiency of the system and reduce turbidity at the outflow. Special care can be taken to distribute the flow at the inflow as evenly as possible. This can be realized by constructing submerged weirs or silt curtains close to the inlet.

Also, internal bunds with adjustable overflow weirs (known as weirboxes) will be installed to progressively evacuate and return the excess of water from reclamation area by using vertical-guided sliding wood planks. This way the water level in the reclamation area will be controlled to enable most of the suspended solids to settle down within the reclamation area and obtain a low turbidity effluent. This set of water boxes will be installed on the southwest bund of the reclamation area, at the opposite side of the inlet discharge point. This allows maximum travel length for the particles in suspension before reaching the evacuation point. Turbidity monitoring will be performed in various locations in the reclamation area in order to assess the efficiency of the designed water flow within the basin in order to anticipate possible rises in turbidity at the outflow of the reclamation area.

Figure 3-12: Working principle of water boxes

The reclamation process will be carried out in 3 consecutive phases. Figure 3-13 provides an overview of the complete project area divided into 3 separate phases. During phase 1 dredged material shall be pumped into Terminal Area A. Via the weir box situated in the north, water shall flow from Terminal Area A into Siltpond A in a controlled manner. Dewatering into the sea occurs at the southeast of Siltpond A. During phase 2 Terminal Area B shall be reclaimed and dewatered into Silt Pond B via a weirbox. Water shall flow from siltpond B to siltpond A via another weirbox. During phase 3 dredged sediments shall be pumped into the stockpile area located in the east. Water from the stockpile area shall flow via a series of weirboxes from siltpond B to siltpond A and ultimately into the sea.

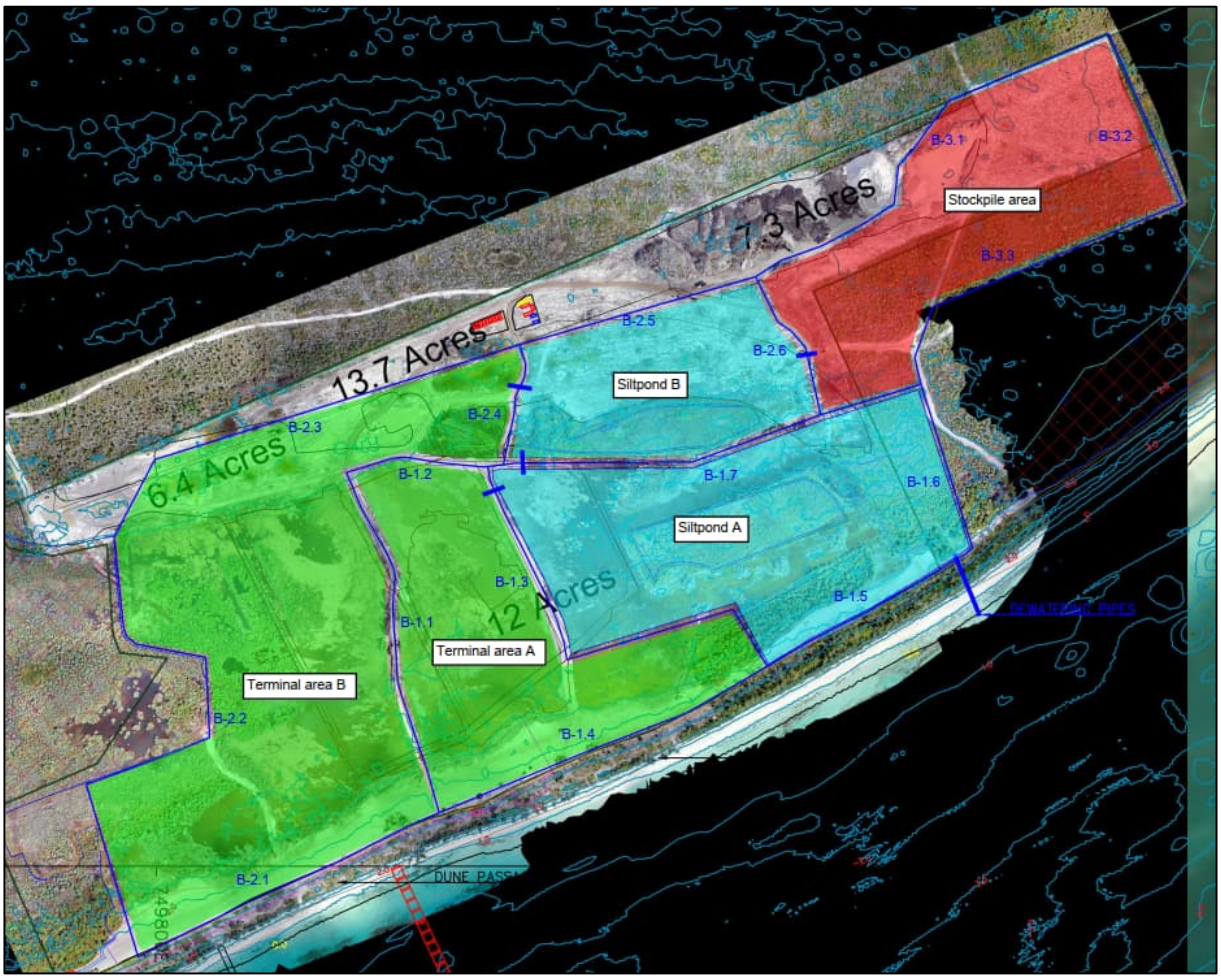


Figure 3-13: Reclamation planning

3.4 WATER QUALITY MONITORING

Contractor's Marine Environmental Department (MARED) has ample experience in the setup of monitoring equipment and modelling tools, and will provide support to the day-to-day environmental management of the dredging operations. In the following sections the monitoring requirements are discussed, and examples are given of monitoring systems that are foreseen to be implemented on the project. Reference is made to Contractor's Environmental Management Plan (JDN.BSGRCC.009) for an overview of compliance requirements with regards to turbidity.

3.4.1 TURBIDITY EXCEEDANCE

Compliance turbidity monitoring shall be performed on a daily basis during dredging operations as per client EMP requirements. Contractor will make whatever practical modifications to the construction means and methods necessary to achieve turbidity compliance. A method to accomplish this is by means of pro-active preventive management measures as described in chapter 5.4.1 of Contractor's EMP. If turbidity levels are observed to be >12 NTU, or have increased with >5NTU since the last monitoring event, adaptive management measures as described in chapter 5.4.2 of Contractor's EMP

shall be put into place. A proactive adaptive management procedure aims to check for indications of possible future exceedance of the water quality criteria and to quickly anticipate and react to situations, which may lead to an exceedance. If an exceedance of 15 NTU is observed at any compliance station during the daily turbidity monitoring rounds, the Owner's Representative and Engineer shall be notified and the Contractor shall immediately cease the relevant construction operations (dredging and/or reclamation) until turbidity values return to meet the applicable standard. Contractor shall also immediately implement responsive management measures as described in chapter 5.4.3 of Contractor's EMP once the exceedance is confirmed. Annex G: Turbidity Exceedance Flowchart shows the procedure to be followed to assess turbidity levels against the trigger limit and the minimum actions that the Contractor shall take.

3.4.1.1 DREDGING START-UP PROCEDURE

The Contractor shall resume dredging operations after an exceedance event only when it demonstrates that turbidity levels at the monitoring stations meet the applicable standard. The Contractor shall implement preventive, adaptive and responsive management measures to achieve compliance with the turbidity maximum permissible limit. Reference is made to Annex G: Turbidity Exceedance Flowchart for a detailed overview.

Possible management measures to ensure a controlled start-up procedure for dredging operations include but are not limited to the following;

- Verify that applicable adaptive and responsive management measures elaborated in Chapter 5.4 of Contractors EMP have been implemented;
- Confirm (new) location to restart dredging operations;
- Confirm (new) location to restart reclamation activities;
- Increased frequency of turbidity monitoring campaigns during the start-up of dredging operations;
- If possible, start up the reclamation works in another discharging location (e.g. on stockpile area instead of terminal area);
- Implement a 'soft start' for dredging operations during the first hours of operations. A 'soft start' implies that production rates are temporarily reduced. This can be achieved by reducing the rotation speed of the cutter head, adjust CSD swing speed, reducing CSD step size and optimizing CSD layer thickness to minimize sediment re-suspension;
- Following the soft start, the CSD can alternate between periods of higher production and lower production.

3.4.2 MOBILE MONITORING

Environmental monitoring using a vessel allows conducting turbidity measurements at any location or transect with direct presentation of the measured values. The selection of the appropriate measurement and configuration equipment plays an important role in the success of these monitoring campaigns. The Contractor has vast experience with environmental monitoring equipment and various equipment configurations that vary depending on the project and the application.

A monitoring vessel shall be used to visit predefined compliance monitoring locations to measure in situ water quality or take samples for analysis of water quality and sediment in the lab. A multiparameter probe (EXO or similar type) can be fitted with a range of different sensors like turbidity,

conductivity, temperature, etc., and assembled to a handheld controller to take in-situ measurements (see Annex B : YSI EXO2 multiparameter probe). The following pictures show a typical equipment setup made by the Contractor to carry out mobile turbidity monitoring, this system provides reliability, immediacy and versatility. A current meter will simultaneously be deployed with the multiparameter probe to measure the current speed at the same moment turbidity monitoring is being performed at the compliance monitoring locations specified in the EMP (JDN.BSGRCC.009). A drone shall be mobilized to measure the general dimensions of the visible turbidity plume (delineated on a map) including relative distance to environmental resources on a daily basis.

Figure 3-14: Typical mobile turbidity monitoring setup

If it is necessary to collect water samples, a “van Dorn bottle” or a peristaltic pump (e.g. for simultaneous water sampling and turbidity reading) can be used. Surface sediment samples can be taken with a Van Veen grab (Figure 3-16). A standard small laboratory (including filter equipment, precision scale, oven and desiccator) is installed on site to allow for rapid analyses of TSS and determination of NTU/TSS relationships. Alternatively, water and sediment samples can be sent to a laboratory for further analysis.

Figure 3-15: Typical launch Set-up for mobile monitoring



Figure 3-16: Water and sediment sampling equipment: Van Veen grab (left), peristaltic pump and Van Dorn bottle (right)

3.4.3 FIXED MONITORING

- Turbidity measurement - background monitoring

Telemetry buoys will be used for background monitoring of turbidity at a minimum of 1,200 feet up-current of the project in an area free of project influence during dredging operations. Alternatively this monitoring can also be performed by mobile monitoring as described in the chapter above. The buoys are configured with a turbidity sensor. This setup has been installed and operated successfully for several dredging projects (e.g. France, Guadeloupe, Peru, Australia, Mauritania, Jamaica, Colombia). Figure 3-17 provides an overview of a turbidity monitoring buoy used in a previous project and which can be deployed to address the turbidity monitoring (see Annex C : Observator telemetric buoy and Annex D: Analite NEP-5000 Turbidity Sensor).


Figure 3-17: Telemetry buoy used for turbidity monitoring at dredging Project in Peru

- Turbidity monitoring at water boxes

Turbidity can be measured at the water boxes in a similar way. Given that turbidity measurements are susceptible to interference by biofouling, the sensors are equipped with a wiper system. The continuous water box outflow monitoring setup as seen in the pictures below from our project in

Brisbane, Australia consisted of a custom made swing arm and a buoy with the turbidity sensor and wiper setup attached at 0.5m below the water.

This system will be implemented in the reclamation area to monitor the concentrations of turbidity near the process water outlet, which will allow the Contractor to evaluate the reclamation process, the implemented sediment control measures, and the effectiveness of the settlement pond for making decisions aligned with meeting the applicable turbidity standard in the receiving water body. As shown in the picture below, a silt curtain was installed as a preventive measure to further minimize the suspended solids in the discharge.

Figure 3-18: Water box continuous turbidity monitoring installation.

3.4.4 CALIBRATION AND MAINTENANCE OF EQUIPMENT

Prior to the start of the environmental monitoring, all equipment and procedures are checked according to the Inspection and Test Plan. Where applicable, the relevant calibration or verification

procedure, recommended by the manufacturer or specified by international standards, will be used as a reference.

We ensure the reliability of all systems implemented by carrying out regular maintenance against bio-fouling etc. and repairs where necessary to ensure the expected high degree of reliability of the system throughout the time for completion.

A register is kept to keep track of any maintenance, verification or calibration performed on the equipment.

3.4.5 REPORTING

Contractor shall provide a daily report of the turbidity monitoring campaigns. The report shall include the following information:

- Turbidity values of compliance and background monitoring
- Coordinates of monitoring
- Weather conditions
- Sea conditions
- A map delineating the monitoring locations and relative extent of the turbidity plume

An example of a draft reporting template can be found in Annex F: Turbidity monitoring report template.

3.5 MODELLING

Contractor has in-house expertise to undertake hydrodynamic and sediment transport modelling using MIKE and Delft3D software. For this project the modelling will be executed in MIKE.

Hydrodynamic and mud transport modelling studies are being conducted to provide input for the design and engineering of the reclamation area with regard to minimizing the dispersion of suspended solids into the environment at the water boxes.

To realize this optimal basin design, an iterative approach is used, where the concept of a basin efficiency factor is introduced. This efficiency factor takes the physical principles into account that prevent a real basin from behaving like an ideal basin. The main physical principles are turbulence, short-circuiting, resuspension and recirculation. These physics can be modelled in the MIKE software.

The efficiency of different settling basins can thus be determined in a quantitative comparison. Hence, the first step is to choose different basin layouts based on previous experience and available literature. These different layouts are then implemented on the existing site conditions. Next, the hydrodynamics of these basin layouts are modelled in Mike21 FM. Coupling these hydrodynamics with a mud transport model eventually gives a range of efficiencies for the different modelled layouts from which an optimal design can be chosen.

Besides using modelling as a design tool, the Contractor can also used modelling as an adaptive management tool. Based on the outcome of the modelling, the dredging and reclamation schedule or mitigation measures might be adapted to ensure that potential indirect impacts to water quality are effectively managed.

Monitoring and modelling form an integral part in the adaptive management of water quality (Figure 3-19). Monitoring data are used to calibrate and improve the hydrodynamic and sediment transport model and allow prediction of the turbidity levels during the upcoming dredging and reclamation activities. Comparing the predictions with the established trigger levels allows an early modification of the schedule or methodology of the planned activities in order to comply with the water quality requirements.

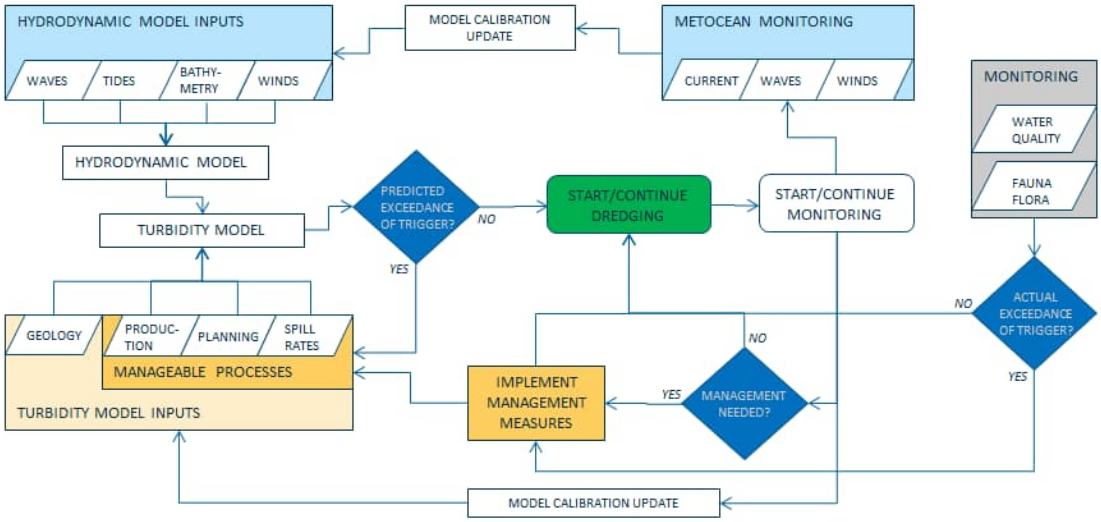


Figure 3-19: Adaptive management of water quality based on monitoring and modelling

4 ANNEXES

4.1 ANNEX A: TECHNICAL DATA SHEET SILT CURTAINS

Technical Data Sheet
Geoboom Silt Curtain

- Name: Type III SC
- Model: GSC - 300H
- Specification: GCC

- Application: Offshore Applications | Waves <1.8 m | Currents <1.8 m/s

Element	Test Standards	Properties
Floatation pocket	ASTM D638 / DIN 53354	260KN/m
Floatation	ASTM C272	75Kg/m
Skirt	ASTM D4595 / ISO 10319	200KN/m
Ballast	DIN766 / ISO 4565	3.1-6.0Kg/m
Tension	ISO 1346	75KN
Connection	ISO 4565	125 KN

Element	Properties
Mean Tensile Extension (wet)	Min – 15% Max – 30%
Shrinkage	0.2% max.
Sea Water Perm.	7.5 x10-3 cm/sec max.
UV Resistance	Retains 80% after 90 days
Float Fire Resistance	Yes
Webbing Breaking Strength	6.1 T

Customization and add-on:

Colors:	Yellow/Orange
Anchoring:	Yes
Demarcation light:	Yes
Dimensions:	300mm | 0.5-12m+ | 20m

Notes:

1. The values reported herein are, to best of our knowledge, accurate and reflect the average results obtained, however the given information should not be considered as warranty/guarantee figures.
2. Rights are reserved to modify the present data sheet without prior notice.

4.2 ANNEX B : YSI EXO2 MULTIPARAMETER PROBE

xylem
Let's Solve Water

EXO Sondes

BEST-IN-CLASS PLATFORM FOR THE HIGHEST-QUALITY DATA

EXO Sonde Brochure
E102-07

YSI
a xylem brand

EXO™ YSI.com/EXO

When only the best will do.

EXO is the premium water quality monitoring platform in the world.

The unmatched benefits of **EXO** include:

Highest Data Quality
Onboard monitoring systems verify sensor operation

Industry-leading Anti-fouling
Best-in-class anti-fouling wiper technology

Smart QC™
SmartQC checks for errors and ensures proper calibrations

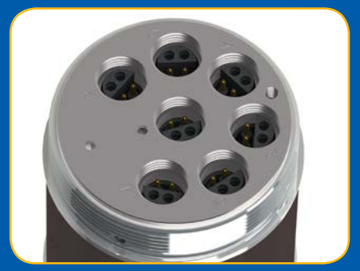
Titanium Components
The toughest grade parts guarantee operation well into the future

Digital Smart Sensors
Auto-recognition of any sensor in any port

A **Smart**, **Field-Ready** Water Monitoring Platform

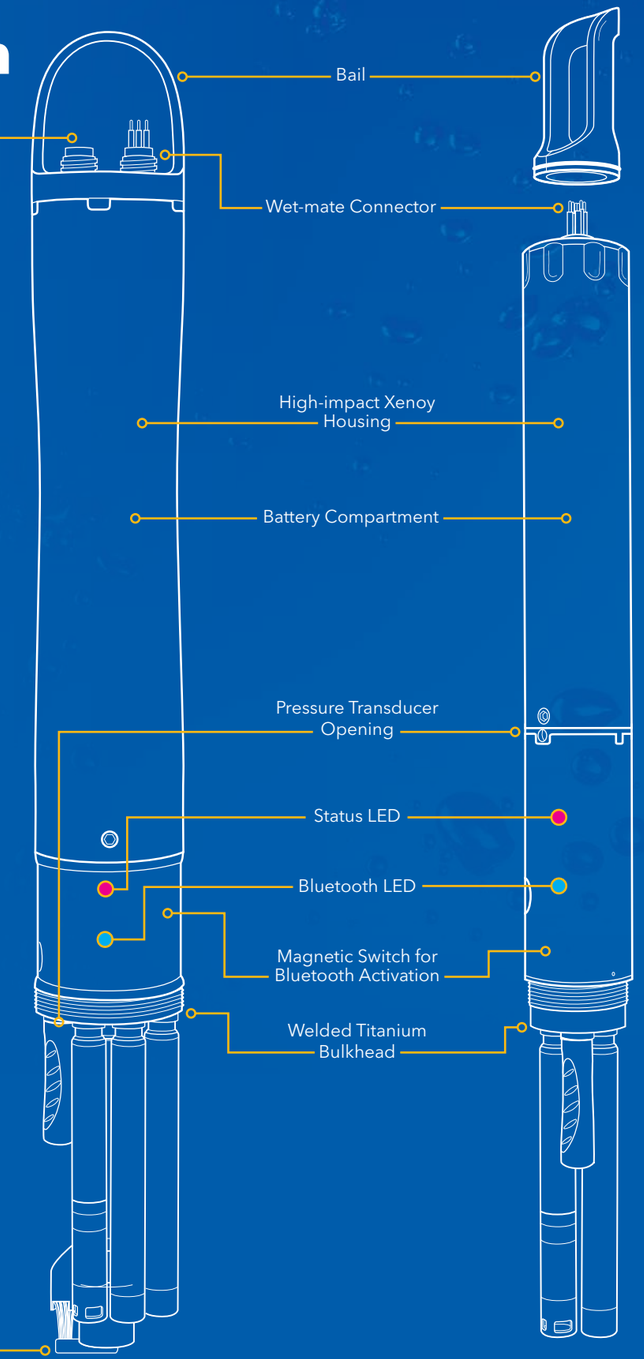
Best-In-Class **Sonde Platform**

Cable connector, battery valve, and expansion port on EXO2



Smart ports accept any sensor, or central port may be used for anti-fouling wiper

Anti-fouling wiper cleans sensor faces, minimizing maintenance and maximizing length of deployment



Selection Guide

	EXO1	EXO2	EXO2[S]	EXO3
Smart Ports	4	7	7	5
Battery Type	2 D-cell	4 D-cell	External Power	2 D-cell
Battery Life	90 days*	90 days*	N/A	60 days*
Dimensions	Length: 64.77 cm Diameter: 4.70 cm	Length: 71.10 cm Diameter: 7.62 cm	Length: 47.00 cm Diameter: 7.62 cm	Length: 58.67 cm Diameter: 7.62 cm
Weight (fully loaded)	1.42 kg	3.60 kg	1.10 kg	2.00 kg
SDI-12	with Adapter	with Adapter	with Adapter	Integral
Vented Level	✓	✓		
Wiper		✓	✓	✓
Auxiliary Port		✓	✓	

*Battery life will depend on the type of sensors and measurement frequency. Specifications indicate typical performance and are subject to change. Please check YSI.com/EXO for up-to-date information.

Sonde Specifications

Sondes	
Operating Temperature	-5 to 50°C
Storage Temperature	-20 to 80°C (may differ for sensors)
Depth Rating	0 to 250 m
Communications	Computer Interface: Bluetooth wireless technology, RS-485, USB Output Options: USB with signal output adapter (SOA); RS-232 & SDI-12 with DCP-SOA; Modbus & RS-485 with Modbus-SOA
Sample Rate	Up to 4 Hz
Data Memory	512 MB total memory; >1,000,000 logged readings
Warranty	2 years

EXO Sondes are perfect for long-term deployments. Daisy-chain multiple sondes for measurements at vaious depths.

Monitoring Made **Mobile**

EXO GO

EXO GO uses Bluetooth to connect any Windows OS device to a submerged **EXO Sonde**.

Pair with a tablet or laptop and leverage the full power of **KorEXO Software** for your monitoring applications.

EXO Handheld

The **EXO Handheld** offers a dedicated, streamlined interface to **EXO Sondes**.

Convenient monitoring is achieved with a backlit color display, ergonomic design, and simple operation.

	EXO GO	EXO Handheld
USB Connectivity	✓	✓
Bluetooth Connectivity	✓	
IP-67 Rating	✓	✓
Display		✓
Onboard Memory		✓
Operating Temperature	-5 to 50°C	0 to 50°C
Storage Temperature	0 to 45°C	0 to 45°C
Dimensions	17.4 x 5.2 x 3.5 cm	8.3 x 21.6 x 5.6 cm
Weight	240 g	567 g
Warranty	1 year	3 year meter, 1 year battery

Choose **EXO GO** for the flexibility of monitoring with any Windows OS device and access to the full features of KorEXO Software. EXO GO cuts out the middleman and delivers data directly to your PC!

EXO GO

KorEXO Software

Bring the full power of KorEXO to your site with any Windows OS portable device

Bluetooth Communication

Keep your sonde in the water while you view data in real time, download files, or adjust deployment settings on the GO

	Common Features
GPS	Accuracy: 2.5 m CEP (dependent on site conditions)
Barometer	Range: 375 to 825 mmHg Accuracy: +/-1.5 mmHg Resolution 0.1 mmHg
Battery	Operating Time: >15 hours Charging Time: 9 hours

Common Feature

GPS Tagging

Georeference data sets using GPS

Choose the **EXO Handheld** for an easy-to-use, purpose-built interface with a tactile keypad and full color display. Keep it simple and collect data in the most challenging environments with the EXO Handheld!

Simplified Interface

Lower the learning curve of collecting high-quality data with a simplified user interface and integrated help screens

Transfer Data

Quickly transfer collected data sets and calibration records to a USB flash drive with the push of a button

EXO Handheld

Common Feature

Lithium-Ion Battery

Collect more samples with the long-lasting, rechargeable battery

Smart Sensor Suite

A dynamic range of sensors for multiparameter applications

CENTRAL WIPER

DEPTH

EXO sondes feature universal smart ports for sensor installation

Sensors Not Shown

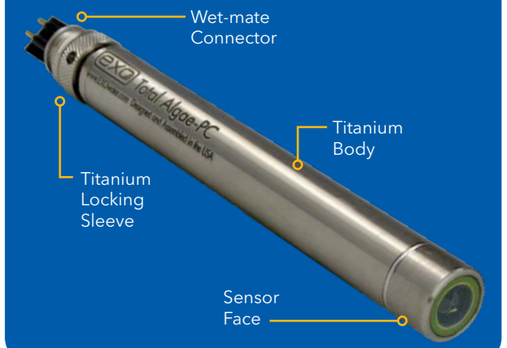
- CONDUCTIVITY / TEMPERATURE (NON-WIPED)
- TOTAL ALGAE-PE
- AMMONIUM ISE
- CHLORIDE ISE
- NITRATE ISE
- pH
- RHODAMINE

Sensor Specifications

Sensor	Range	Resolution[1]	Accuracy[2]
Conductivity (Non-Wiped)	0 to 200 mS/cm	0.0001 to 0.01 mS/cm	±0.5% of reading or 0.001 mS/cm, w.i.g. (0-100 mS/cm) ±1% of reading (100-200 mS/cm)
Temperature	-5 to 50°C	0.001°C	±0.01°C (-5 to 35°C) ±0.05°C (35 to 50°C)
Conductivity (Wiped)	0 to 100 mS/cm	0.0001 to 0.01 mS/cm	±1% of reading or 2 µS/cm, w.i.g.
Temperature	-5 to 50°C	0.001°C	±0.2°C
Depth or Vented Level	0 to 10, 100 or 250 m	0.001 m	±0.04% Full Scale
	0 to 10 m	0.001 m	±0.03% Full Scale
Dissolved Oxygen	0 to 500% air sat.	0.1% air sat.	±1% of reading or 1% sat., w.i.g., (0 to 200%) ±5% of reading (200 to 500%)
	0 to 50 mg/L	0.01 mg/L	±1% of reading or 0.1 mg/L, w.i.g., (0 to 20 mg/L) ±5% of reading (20 to 50 mg/L)
fDOM	0 to 300 ppb QSE	0.01 ppb QSE	Linearity: $r^2 \geq 0.999$ for 0 to 300 ppb QSE, MDL of 0.016 ppb QSE
pH	0-14 pH units	0.01 pH unit	±0.1 within ±10°C of cal temp ±0.2 for all other temps
ORP	-999 to 999 mV	0.1 mV	±20 mV
Rhodamine	0 to 100 RFU or 0 to 1,000 µg/L	0.01 RFU or 0.01 µg/L	±5% or 0.1 µg/L w.i.g, Linearity: $r_2 > 0.999$
TAL-Chlorophyll	0 to 100 RFU or 0 to 400 µg/L chl	0.01 RFU or 0.01 µg/L of pigment	Linearity: $r^2 \geq 0.999$ for Rhodamine WT across full range
TAL-Phycocyanin or	0 to 100 RFU or 0 to 100 µg/L PC		
TAL-Phycoerythrin	0 to 100 RFU or 0 to 280 µg/L PE		
Turbidity	0 to 4000 FNU	0.01 FNU to 0.1 FNU	0.3 FNU or ±3% of reading, (0 to 999 FNU) ±5% of reading (1000 to 4000 FNU)

[1]Range dependent.
[2]Specifications indicate typical performance and are subject to change. Please check YSI.com/EXO for up-to-date information.

EXO Smart Sensor Anatomy



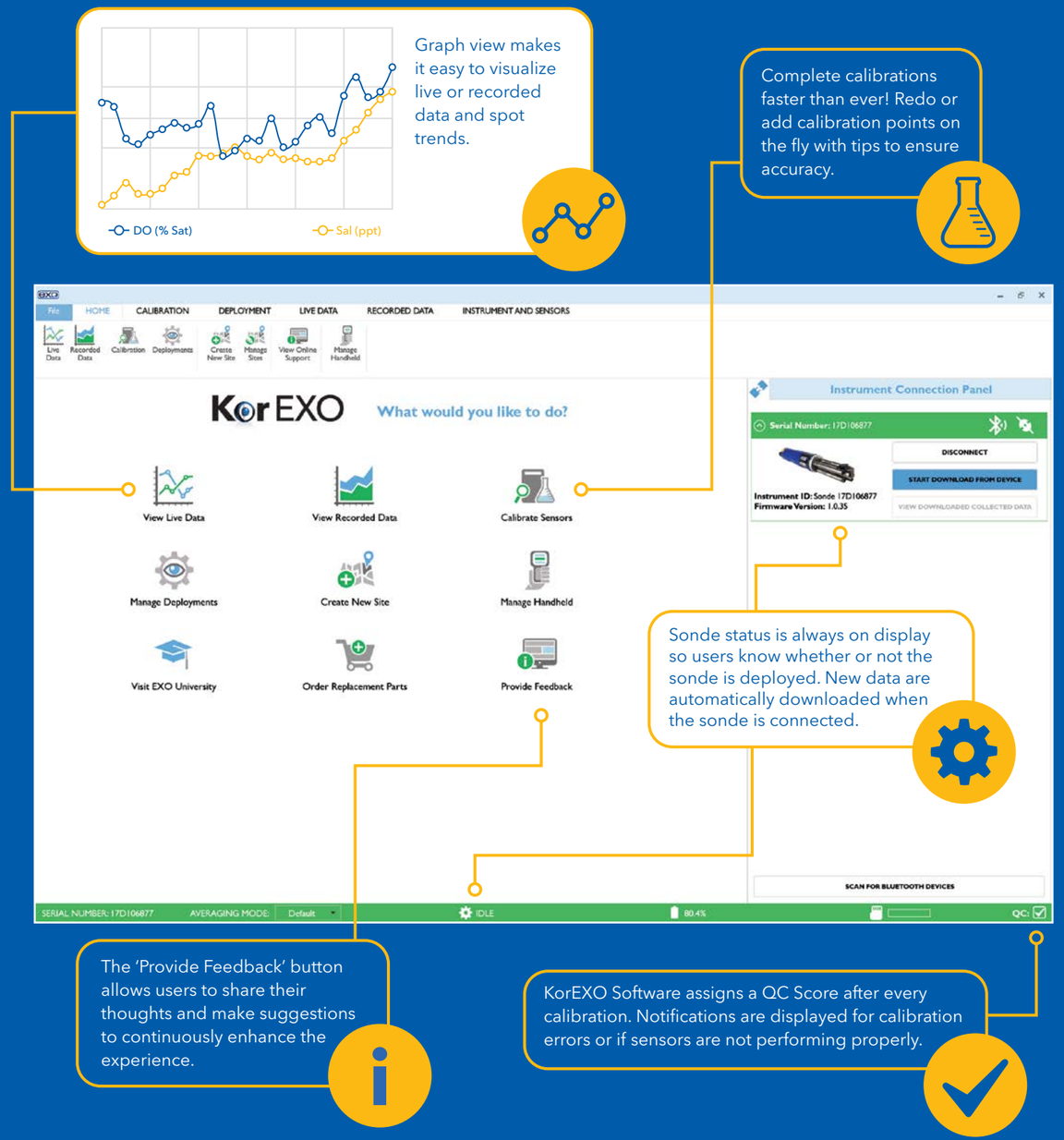
Calculated Parameters

The following parameters are calculated from one or more sensors listed above. More information about the methods and calculations may be found in the EXO User Manual.

- Absolute Pressure
- Ammonia
- DO% Local
- DO% LocalB
- Gauge Pressure
- nLF Conductivity
- Resistivity
- Salinity
- Specific Conductivity
- Total Algae cells/mL
- Total Dissolved Solids
- Total Suspended Solids
- Vertical Position
- Water Density

KorEXO Software

KorEXO is an accessible, feature-rich software platform for managing EXO instrumentation and water quality data. The software allows you to calibrate sensors, setup long-term deployments, and ensure equipment is operating at peak performance. Designed to run on Windows OS computers and tablets, the interface is optimized for touchscreens and streamlined for operation in the field, lab, or office.



Support and Protection for Your Peace of Mind

Protect your investment with the EXO Factory Service Plan*

With an **EXO Factory Service Plan**, you can minimize down-time and unexpected maintenance costs by keeping your equipment in top working order.

What does the Service Plan include?

Plans cover standard replacement parts, firmware updates, seal restoration, cleaning, comprehensive evaluation, testing, and calibration of all sensors.

What equipment is covered?

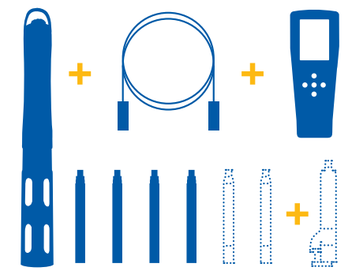
Each plan covers a single EXO sonde, field cable, handheld, and sensors purchased with the sonde.

How long does coverage last?

Plans are available for coverage up to 3 years from the time the EXO Sonde is purchased.

*Currently available in North America. Check with your regional technical support for service options.

Factory Service Center located in Yellow Springs, Ohio



Industry-Leading Technical Support

Our expert **Technical Support Team** is available to provide assistance and answer any questions that may come up in the field or lab.

Call +1 (937) 767-2762
to speak with our knowledgeable staff

Email info@ysi.com
for questions regarding your EXO equipment

Live Chat at YSI.com
for immediate response from technical experts

Technicians are available for in-house or on-site training events

Xylem |'zīləm|

1) The tissue in plants that brings water upward from the roots;
2) a leading global water technology company.

We're a global team unified in a common purpose: creating advanced technology solutions to the world's water challenges. Developing new technologies that will improve the way water is used, conserved, and re-used in the future is central to our work. Our products and services move, treat, analyze, monitor and return water to the environment, in public utility, industrial, residential and commercial building services settings. Xylem also provides a leading portfolio of smart metering, network technologies and advanced analytics solutions for water, electric and gas utilities. In more than 150 countries, we have strong, long-standing relationships with customers who know us for our powerful combination of leading product brands and applications expertise with a strong focus on developing comprehensive, sustainable solutions.

For more information on how Xylem can help you, go to www.xylem.com

"I'm very proud of the great work our customers do using our best-in-class sonde platform."

Dr. Stephanie A. Smith
EXO Product Manager

EXO™

EXO Handheld | EXO2^S | EXO3 | EXO1 | EXO2

xylem
Let's Solve Water

YSI, a Xylem brand
1725 Brannum Lane
Yellow Springs, OH 45387
+1.937.767.7241
info@ysi.com
YSI.com

YSI.com/EXO

4.3 ANNEX C : OBSERVATOR TELEMETRIC BUOY

OMC-7006 Data-Buoy

The OMC-7006 data-buoy is ideal for environmental monitoring projects. It is specifically designed for the measurement of hydrological parameters in lakes, rivers, estuaries and coastal zones. The OMC-7006 is often used near dredging sites to monitor the impact of the dredging activities. Its bigger brother, the OMC-7012, can also support meteorological sensors.

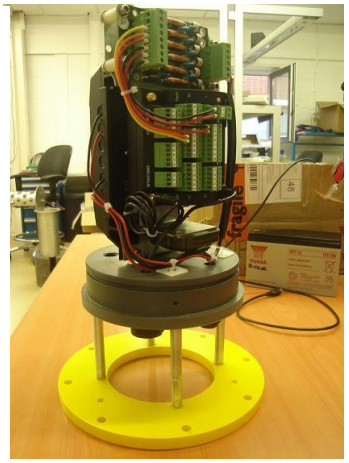
The OMC-7006 is equipped with the OMC-045-III data logger, which has proven itself in many applications. This logger contains integrated GPS and GPRS, and can be interfaced to radio and satellite modems. The OMC-045-III supports several analogue and digital inputs for communication with the sensors. This allows the logger to be connected to almost any water quality sensor on the market.

The electronics and underwater sensors can easily be removed for maintenance, without taking the buoy out of the water.

Features

- Integrated data logger with:
  - GPS and GPRS (data communication via the mobile phone network).
  - SMS alarm function on all parameters.
  - Event controlled logging interval.
  - Optional radio or satellite modems.
  - Easy to use configuration software.
- Solar powered, one or two 12 Volt 12 Ah batteries.
- Programmable signal light.
- External Marine GPRS antenna.
- Prepared for hydrological sensors from Observator (Analite product line), YSI, Eureka, Aquaread and INW. Flexible enough to support many more brands.
- Easy access to sensors and electronics without removing the buoy from the water.
- Seamless interface to our advanced OMC-DataOnline data management and presentation software.

The OMC-7006 data buoy



The contents of the water-tight container. The OMC-045-III logger is clearly visible.

The water-tight container slides from the top into the buoy

The OMC-045 with optional Iridium modem

OMC-7006 Data-Buoy

Your benefit

The OMC-7006 is a well-proven and complete measurement station. The water quality sensors are integrated by Observator on your specification. This allows for maximum flexibility in the parameters to be measured. The buoy itself, with the solar panels, the batteries, the logger with GPRS and GPS, the signal light and the antenna's, is a standard product that is deliverable on short notice.

Optional

- Two batteries instead of one (12 Volt, 12 Ah) and larger battery compartment.
- Mooring set.
- Radio or Satellite communication module.

More information

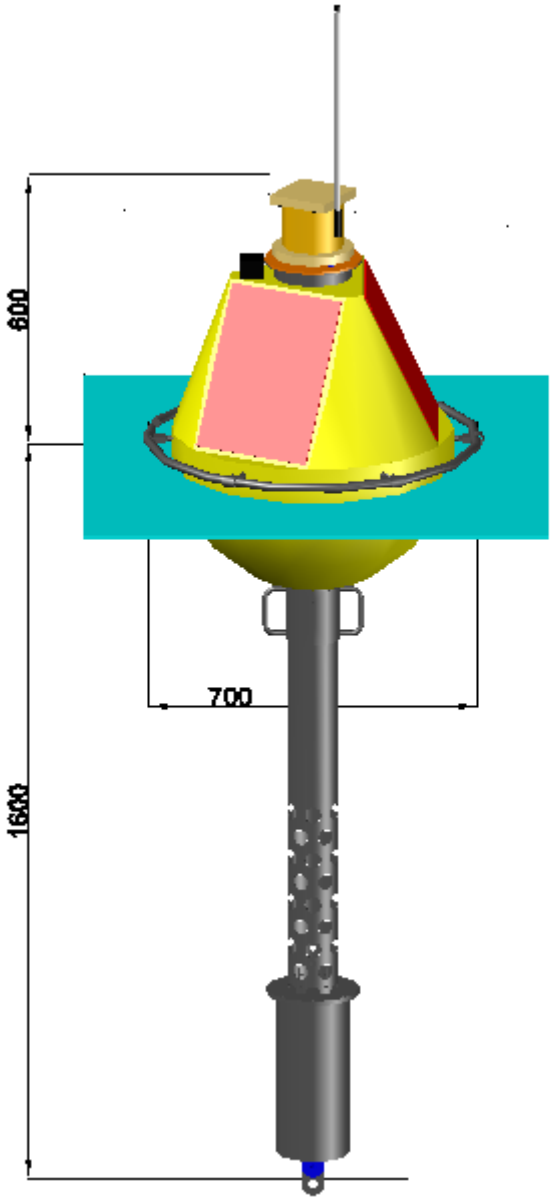
Contact Observator to specify your requirements and to get a quotation.

Separate data sheets are available from the Observator website:

- OMC-7012 data buoy.
- OMC-045-III data logger.
- OMC-DOL data processing and presentation SW.
- Water quality sensors.

Dimensions

- Diam. 60 cm (with protection ring installed 70 cm).
- Height above water 0.60 m, excluding antenna.
- Height over all 2.20 meters incl. antenna.
- Total weight in air: 45 kg (excluding sensors).



OBSERVATOR
instruments

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4.4 ANNEX D: ANALITE NEP-5000 TURBIDITY SENSOR

Suitable for monitoring water quality – food processing – waste treatment – dredging operations

Datasheet

Analite NEP-5000 Turbidity Sensor

Multiple Output Auto-Ranging

The Analite NEP-5000 ISO7027 90°series of digital turbidity probes are designed for monitoring and process applications where ultimate sensor flexibility is a consideration. This probe offers a multitude of physical sensor variations, with the further benefit of a PC interface that allows the user to easily calibrate, modify range modes, and adjust sensor output modes and data characterisation.

The Analite NEP-5000 is a completely customisable turbidity probe that can be ordered to the end user's particular needs. It has all the benefits of a custom solution at a very competitive price.

Available outputs, included, are analog voltage or current loop (4 to 20 mA), RS422/RS485, SDI-12, RS232, USB and digital TTL.

The standard NEP-5000 can be ordered in several custom variations:

- Wiping and non-wiping
- Several outer case material options
- Glanded cable or marine connector / cable
- 90° or 180° backscatter for high NTU applications
- With temperature and/or pressure

The Analite PC configurator allows:

- Fast accurate calibration
- Compensation tools
- Adjustable Slew Rates
- Three range settings (low, medium, and high)
- Range hopping between three ranges
- Wiper behaviour settings
- Selection of many digital and analog outputs

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Field, process & lab application

The Analite NEP-5000 wiping probes are specifically designed for applications where bio-fouling build up occurs obscuring the optics. Such environments include, long monitoring deployment or places in warm bio-active waters.

The Analite integral wiper assembly and optional copper case is designed for operations where severe bio-fouling or sedimentation build up is likely, including:

- Monitoring of streams, rivers and water storage
- Intermediate and final effluent treatment monitoring
- Hydrological run off studies
- Ground and bore water analysis
- Drinking water filtration efficiency
- Industrial process monitoring
- Sludge and dredge monitoring

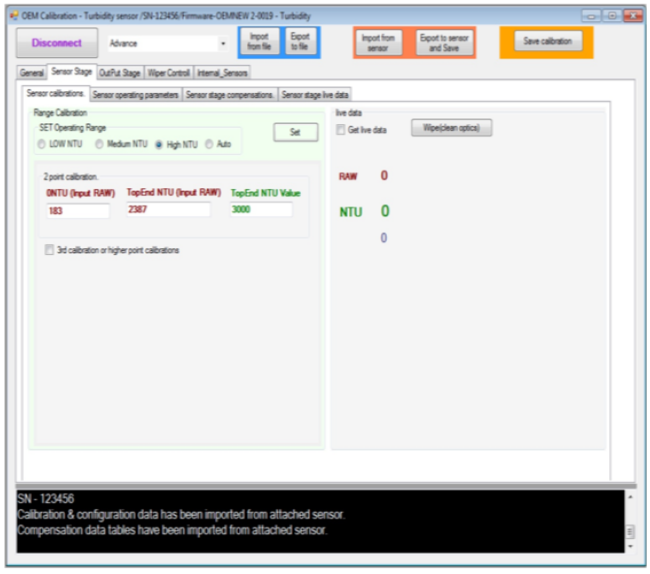
NEP-5000 range set concept

The Analite NEP-5000 series turbidity probes offers a multiple range concept. in settings and selection. Calibrations can be made for three different levels of usage (Low, Medium and High)*.

These 3 levels of usage are offered as versions to simplify range selection and order placement. The versions are as follows:

- V1 NTU ranges: 10, 400, 1000
- V2 NTU ranges: 10, 400, 5000
- V3 NTU ranges: 100, 1000, 5000
- V4 NTU ranges: user specified

Calibration costing rules do apply. One calibration for the 3 ranges is included in the purchase price. Additional range calibrations are an extra cost. Different ranges are available for the 90° sensor, but they must be specified at time of order and they may attract further costs.



The three range calibrations allow for three types of usage modes and linearity from low range to high range in the auto-ranging mode**. This is applicable to event-based sediment studies where NTU readings are prone to peaks above a set range.

90-degree versions provide extremely accurate and stable results at very low NTU values. This sensor can be used in conditions that require high resolution readings at near zero NTU.
Whatever the requirement, the NEP-5000 series probe is the most flexible choice. It can be ordered and configured to a multitude of applications.

Add parameters, modify ranges and refine calibrations. This can all be done on the PC interface and saved to configuration files. These configuration files can be saved and read back into the sensor to restore the settings.

* Please refer to Observator NEP-5000 ordering guide document for correct ordering codes.

** One factory calibrated range in the list price.

OBSERVATOR instruments

ANALITE an Observator brand

Turbidity specifications

Technique	Standard: 90° modulated infra-red (ISO7027) Optional: 180° backscatter
Ranges	3 preset range groups: • Low (example 0-10NTU) • Medium (example 0-400NTU) • High (example 0-1,000NTU) Recommended range versions: • V1 NTU ranges: 10, 400, 1000 • V2 NTU ranges: 10, 400, 5000 • V3 NTU ranges: 100, 1000, 5000 • V4 NTU ranges: user specified Custom ranges available Range hopping capable

Resolution

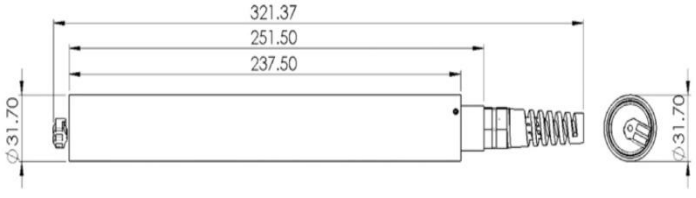
Range	Resolution
Up to 100NTU	±0.01NTU
Up to 400NTU	±0.1NTU
Up to 1,000NTU	±1.0NTU
Up to 5,000NTU	±2.0NTU

Accuracy	±1% at 25°C, up to 5,000NTU
Linearity	Better than 1% for 0 to 3,000NTU Better than 2% for 0 to 5,000NTU
Temperature coefficient	Better than ±0.05%/°C
Outputs	Digital 3.6V TTL (streaming or polled) RS422/RS485 (streaming or polled) SDI-12 RS232 USB Analog 4-20mA. Analog -2.5V to +2.5V (or variations)
Zero drift	Less than ±0.2NTU
Calibration	Factory calibrated using non-toxic AEPA polymer solutions
Power	8-30V DC, 15mA on 40mA reading and 60mA wiping

Settling time	<1 second after application of power to 99%
Wiping	Wiping configuration through the PC configuration tool. Wipe directions or alternate settings and timeouts will prolong probe life. During a wipe, the output remains within ±1% full scale of the turbidity value just prior to the wipe.
Wipe time	8 seconds nominal

Mechanics

Weight	NEP-5000 Delrin models 300 grams (probe only*) NEP-5000 metal models 770 grams (probe only*) *100 grams connector plus 70 grams per meter of cable
Construction	• Delrin composite casing is standard • 316 stainless steel • Titanium • Anti-biofoul CW352H 70/30% copper/nickel
Cable	6 core + shield, 6mm nominal dia. PUR sheath Conductor resistance 45 Ohms/km. Weight – 70 grams per meter
Cable length	Standard Glanded cable length to be specified at time of order. Per meter price applies.
Depth rating	200m (660ft) non-wiping 100m (300ft) wiping
Operating temp.	-10°C to 40°C
Storage temp.	-20°C to 50°C



The NEP-5000 code explained

When ordering a NEP-5000 sensor, you are kindly asked to specify the full code as explained below. This to make sure you order the correct sensor. The full code also directs you to the right items from the pricelist, as shown in the table below. This is an example of the ordering code which is explained below, with reference to the items in the price list:

WY-	90-	D-	R42-	NO-	GC-	V1-	TN-	PN
1	2	3	4	5	6	7	8	9

#	Values	Meaning	Price list	Comments
1	**WY**	Wiper Yes	- (Standard)	Indicates if there is a wiper or not.
	WN	Wiper No	NEP-NOWIPER (Negative value)	
2	**90**	90-degree optics (ISO7027)	- (Standard)	
	180	180-degree optics (back-scatter)	NEP-180	
3	**D**	Delrin housing	- (Standard)	Lowest cost
	C	Copper alloy housing	NEP-CUC	Anti-fouling
	S	Stainless steel housing	NEP-SSC	Strong, rugged
	T	Titanium housing	NEP-TTC	Anti-corrosion
4	**R42**	RS422/485	- (Standard)	
	S12	SDI-12	NEP-SDI12	
	R23	RS-232	NEP-RS232	Max 10 meter
	USB	USB	NEP-USB	Max 5 meter
5	**NO**	No current or voltage output	- (Standard)	
	CUR	Current output 4-20 mA. Only for NTU (not for pressure or temperature)	NEP-CUR	Max 100 meter, no auto NTU range selection
	VOL	Voltage output over 5V range. 0 to 5 V or -2.5 to +2.5V. Only for NTU (not for pressure or temperature)	NEP-VOL	Max 10 meter, no auto NTU range selection
6	**GC**	Glanded cable	- (Standard)	
	SM	Subcon connector, male	CON34MCBH6MSS	Recommended
	SF	Subcon connector, female	CON34MCBH6FSS	
7	**V1**	NTU ranges: 10, 400, 1,000	NEP5000-V1	Note that the factory calibration of one range is included in the price.
	V2	NTU ranges: 10, 400, 5,000	NEP5000-V2	
	V3	NTU ranges: 100, 1000, 5,000	NEP5000-V3	
	V4	NTU ranges: user specified	NEP5000-V4	
8	**TN**	Temperature No	- (Standard)	Water temperature sensor in optic block yes/no
	TY	Temperature Yes	NEP-TEMP	
9	**PN**	Pressure No	- (Standard)	Pressure sensor in the housing yes/no
	PY	Pressure Yes	NEP-PRES	

For example, to order WY-90-D-R42-NO-GC-V1-TN-PN, you would only need to order NEP-5000-V1, because the rest is standard. However, if you want the same sensor to come in a copper housing and with a male Subconn connector, the order code would be: WY-90-C-R42-NO-SM-V1-TN-PN, and you would have to order: NEP-5000-V1; NEP-CUC; CON34MCBH6MSS.

Notes

- The maximum allowable cable lengths for SDI-12 and RS422/485 are expected to be over 1,000 meters.
- The voltage and current output options only refer to the turbidity and not to other (optional) parameters like pressure and temperature. You lose the option of automatic range switching.
- If you chose a sensor with a connector, you obviously require a cable with a mating connector. Thus, when ordering the cable, please also order the mating connector.
- Without the temperature option (TY), you can still get a temperature reading from the sensor, but this is the internal and uncalibrated temperature.
- The pressure sensor is unvented, hence requires external barometric compensation.

Accessories

The standard Analite NEP-5000 series of probes, with its Delrin composite housing, may be submerged to a depth of 100 meters. A metal housing is available for applications where a greater depth rating is required. Maximum depth rating is 200 meters (non-wiping with metal case).

NEP-CFG	PC interface and communication module and PC configuration and calibration software.
NEP-WIPER-KIT	Wiper replacement kit comprising of 4 silicon wipers and a hex fastening key.
NEP-SHRD-D	Delrin protective shroud
NEP-SHRD-C	Copper protective shroud
NEP-SHRD-S	Stainless protective shroud
NEP-SHRD-T	Titanium protective shroud
NEP-CBL	Probe cable in meters
NEP-CBL-CON	Subconn connector and cable assembly
Options	180° optics Outer case in copper, stainless steel or titanium marine connectors.

Welcome to the world of Observator

Solutions beyond expectations. That's what sets Observator apart. We believe in taking the extra step. Retaining our competitive edge, through innovation and uncompromised support, are key to success. As an ISO 9001:2015 certified company, we apply the highest quality standards to our products and systems.

Solutions beyond expectations

Since 1924 Observator has evolved to be a trend-setting developer and supplier in a wide variety of industries. From instruments for meteorological and hydrological solutions, air and climate technology, to high precision mechanical production, window wipers and sunscreens for shipping and inland applications.

Originating from the Netherlands, Observator has grown into an internationally oriented company with a worldwide distribution network and offices in Australia, Germany, the Netherlands, Singapore and the United Kingdom.

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4.5 ANNEX E: MIKE 21 SOFTWARE PRODUCT SHEET

MIKE 21

2D modelling
of coast and sea

MIKE 21 is by far **the most versatile tool for coastal modelling**. If you need to **simulate physical, chemical or biological processes** in coastal or marine areas, MIKE 21 has the tools you need.

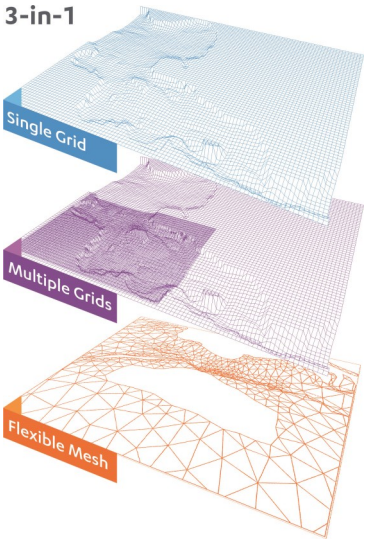
APPLICATIONS

The following is a small subset of the almost endless list of possible MIKE 21 applications.

TYPICAL APPLICATIONS

MIKE 21 is the ideal software for:

- Design assessment for coastal and offshore structures
- Optimisation of port layouts and coastal protection measures
- Cooling water, desalination and recirculation analysis
- Optimisation of coastal outfalls
- Environmental impact assessment of marine infrastructures
- Ecological modelling including optimisation of aquaculture systems
- Optimisation of renewable energy systems
- Water forecast for safe marine operations and navigation
- Coastal flooding and storm surge warnings
- Inland river, flooding and overland flow modelling



The unique 3-in-1 package includes all three engines in one great package deal.

ENGINES

MIKE 21 comprises the following simulation engines:

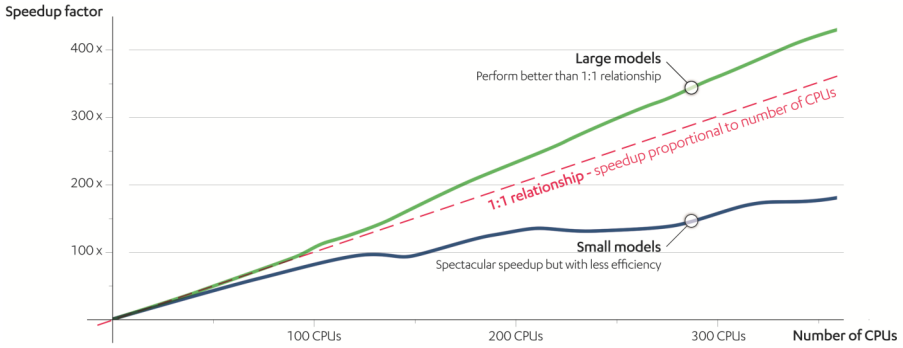
- **Single Grid**, which is a classic rectilinear model that is easy to set up and with easy I/O exchange
- **Multiple Grids**, which is a dynamically nested rectilinear model with the ability to focus the grid resolution
- **Flexible Mesh**, which allows maximum flexibility for adapting grid resolution of the model domain

PARALLEL PROCESSING (CPU)

All Flexible Mesh and Single Grid engines support parallel processing. The Flexible Mesh (FM) engines show excellent performance when parallel processing is undertaken - also on a large number of computational cores. On multicore Windows computers, parallelisation is menu-driven and straightforward. The FM engines are also available for Linux, which gives the possibility to utilise High Performance Computing (HPC) systems.

GRAPHICAL PROCESSING UNITS (GPU)

For the FM engines, the use of graphical processing units (GPU) is also supported and gives easy access to spectacular increases in simulation speed.



Example of CPU-based speedup tests.

MODULES

MIKE 21 is modular. You buy what you need and nothing more. It includes a wide range of modules, allowing you to create your own tailored modelling framework for your coastal and marine studies.

PP - PREPROCESSING AND POSTPROCESSING

This module offers an integrated work environment which provides convenient and compatible routines to ease the tasks of data input, analysis and presentation of simulation results.

HD - HYDRODYNAMICS

This module simulates water level variations and flows in response to a variety of forcing functions.

AD - ADVECTION-DISPERSION

This simulates the transport, dispersion and decay of dissolved or suspended substances. It is typically used in cooling water and wastewater discharge studies.

COUPLED MODELLING

The FM series include a powerful, integrated system which, in a surprisingly easy manner, combines wave, flow and sediment transport models into a fully dynamic morphological model.

MIKE
Powered by DHI

MODULES

MIKE 21 includes the following modules specifically for sediment transport and water quality modelling.

ST - SAND TRANSPORT

This is an advanced sand transport model with several formulations for current as well as current-wave generated transport, including 3D description of sediment transport rates. It is, for example, used for morphological optimisation of port layouts, impact of shore protection schemes and stability of tidal inlets.

MT - MUD TRANSPORT

This is a combined multi-fraction and multi-layered model that describes erosion, transport and deposition of mud (cohesive sediment) or mixtures of sand and mud.

PT - PARTICLE TRACKING

This module simulates transport and fate of dissolved and suspended substances, including sediments.

SM - SHORELINE MORPHOLOGY

This module combines detailed 2D modelling of currents and waves with a constrained morphological model, making it possible to undertake fast, stable and robust modelling of shoreline evolution in 2D environments.

OS - OIL SPILL

This module simulates the spreading and weathering of hydrocarbons and is used for oil spill modelling.

MIKE ECO LAB - ECOLOGICAL MODELLING

This is a complete numerical laboratory for water quality and ecological modelling. See page 20.

ABM LAB - AGENT BASED MODELLING

This is a flexible numerical laboratory used to define agents, their behaviour and states. See page 19.

MODULES

MIKE 21 includes the following modules specifically for wave modelling.

SW - SPECTRAL WAVES

This is a spectral wind-wave model that simulates the growth, decay and transformation of wind-generated waves and swell.

BW - BOUSSINESQ WAVES

The state-of-the-art tool for studies and analyses of wave disturbance in ports, harbours and coastal areas. It includes full surf and swash zone dynamics.

MA – MOORING ANALYSIS

This module simulates the motions of single or multiple vessels subject to winds, waves and currents. It also calculates the forces in fenders and mooring lines and can directly use results from MIKE 21 BW, MIKE 3 Wave FM and MIKE 21 HD as input.

SELECTED TOOLS IN MIKE 21

In addition to its variety of modules, MIKE 21 also includes a number of tools to optimise your work. Here is a subset of tools:

- Global tide data and tools for tidal analysis and prediction
- MIKE's Climate Change Editor
- Cyclone wind generation and wind generation from pressure maps
- Advanced mesh and grid generators and editors
- Advanced tools for generation of graphical output
- An interface (API) for reading and modifying files in MIKE 21's internal, binary format

BENEFITS

MIKE 21 is proven technology. No other modelling package has been used for as many coastal and marine engineering projects around the world as MIKE 21.

The recipe for the unique success of MIKE 21 is simple. It gives you maximum flexibility, higher productivity and full confidence in the results.

Also, MIKE 21 is much more than just the right tool for your project. It also gives access to other benefits of MIKE software products, including unparalleled technical support, training courses and access to DHI's expertise and know-how regardless of where you are in the world.

MIKE 21 also comes with a wealth of first class tools that enhance and ease modelling possibilities.

MIKE C-MAP and MIKE ANIMATOR PLUS

MIKE C-Map offers model bathymetries generated fast and easy from an electronic chart database. MIKE ANIMATOR PLUS turns model results into amazing 3D video presentations. Both applications are free and available if you hold a valid Service and Maintenance Agreement (SMA) for Professional License.

Contact: mike@dhigroup.com

For more information, visit:
www.mikepoweredbydhi.com

4.6 ANNEX F: TURBIDITY MONITORING REPORT TEMPLATE

Grand Port Cruise Centre Dredging Operations

Turbidity Monitoring Report

Report for _____, _____, _____ 202__

(Time) (Date)

Report shall be filled out in its entirety and submitted within 24 hours of the monitoring event.

Excavation Site:

Frequency: Two sampling events will be conducted per day, nominally one in the morning and one in the afternoon, at least 4 hours apart. Samples will be taken during active construction when the dredge has been operational for a minimum of 2 hours. Samples will not be taken if the dredge is not operating for a period greater than 4 hours, and this condition will be noted in the daily sampling report.

Background Sample: Samples shall be collected at least 1,200 feet (365 meters) up-current from the source of turbidity at the dredge site.

Sampling shall occur at mid-depth, clearly outside the influence of any artificially generated turbidity plume or the influence of an outgoing inlet plume.

Compliance Sample: Samples shall be collected 1,640 feet (500) meters down-current from the cutterhead, in the densest portion of any visible turbidity plume. If no plume is visible, follow the likely direction of flow.

Sampling shall occur at mid-depth.

Notes (List any notable observations, deviations or deficiencies in the monitoring event):

Excavation Site Turbidity Data

Parameter	Background Sample	Compliance Sample
Sample Collection Time		
Location		
Latitude or Northing		
Longitude or Easting		
Weather		
Conditions (e.g., clear, rainy, overcast, etc.)		
Air Temperature (^{O}F)		
Wind Speed (MPH)		
Wind Direction		
Sea Conditions		
Tidal Stage (e.g., High, Low, Incoming, Slack, etc.)		
Current Speed and Direction		
Turbidity (NTU) Mid-Depth		
Depth of Mid-Depth Sample (ft)		
Difference (Mid-depth Samples) (= compliance - Background)		

If the difference between the compliance sample and the background sample is greater than 15 NTUs for any sample collected (i.e., the compliance sample is more than 15 NTUs above the background sample), the Project Engineer should be notified immediately.

Beach Discharge Site:

Frequency: Two sampling events will be conducted per day, nominally one in the morning and one in the afternoon, at least 4 hours apart. Samples will be taken during active construction when the dredge has been operational for a minimum of 2 hours. Samples will not be taken if the dredge is not operating for a period greater than 4 hours, and this condition will be noted in the daily sampling report.

Background Sample: Samples shall be collected at least 1,200 feet (365 meters) up-current from the source of turbidity at the dredge site.

Sampling shall occur at mid-depth, clearly outside the influence of any artificially generated turbidity plume or the influence of an outgoing inlet plume.

Compliance Sample: Samples shall be collected 1,640 feet (500) meters down-current from the return water discharge into the ocean, in the densest portion of any visible turbidity plume. If no plume is visible, follow the likely direction of flow.

Sampling shall occur at mid-depth.

Notes (List any notable observations, deviations or deficiencies in the monitoring event):

_____

_____

_____

_____

_____

_____

Beach Discharge Site Turbidity Data

Parameter	Background Sample	Compliance Sample
Sample Collection Time		
Location		
Latitude or Northing		
Longitude or Easting		
Weather		
Conditions (e.g., clear, rainy, overcast, etc.)		
Air Temperature (^{O}F)		
Wind Speed (MPH)		
Wind Direction		
Sea Conditions		
Tidal Stage (e.g., High, Low, Incoming, Slack, etc.)		
Current Speed and Direction		
Turbidity (NTU) Mid-Depth		
Depth of Mid-Depth Sample (ft)		
Difference (Mid-depth Samples) (= compliance - Background)		

If the difference between the compliance sample and the background sample is greater than 15 NTUs for any sample collected (i.e., the compliance sample is more than 15 NTUs above the background sample), the Project Engineer should be notified immediately.

Attachments :

1. **Planview map showing Sample Locations;**

Samples will be measured at specified locations and depths as delineated within these forms. A standard NTU probe type meter calibrated to the manufacturer's specifications will be utilize. Position will be noted utilizing a hand-held GPS and recorded. Any deviation from this protocol should be described within the notes section for each monitoring event. Any significant change in protocol should be communicated to the Project Engineer.

Signature:

I certify that these data and this report are authentic; that the analytical instrumentation has been factory-calibrated within the last year, and that the methods of monitoring and analysis are in compliance with the Contract Documents and all required permits for this project.

_____

Authorized Technician Date

*If e-mailed, type the name in substitution of a signature.

4.7 ANNEX G: TURBIDITY EXCEEDANCE FLOWCHART

Grand Port Cruise Centre	Doc. Ref.	JDN.BSGRCC.009_Annex G - Turbidity Exceedance Flowchart
Turbidity exceedance procedure	Rev.	0

Compliance Turbidity Monitoring

Contractor's Environmental Engineer

Is the turbidity level <12NTU above background?

yes

Implement Possible Preventive Management Measures:
(JDN.BSGRCC.010 - EMP - 5.4.1)

- Installation of silt curtains around active dredging areas;
- Installation of silt curtains around the outflow of the reclamation area;
- Installation of silt curtains in the reclamation area to stimulate sedimentation of fine sediment particles;
- Daily turbidity monitoring, twice a day / 4 hours apart;
- Daily check on all silt curtains;
- Hydrodynamic modelling of the reclamation area;
- Settlement ponds designed in such a way that discharge water travels the longest distance possible to allow most fines to settle before exiting the area;

no

Is the turbidity level between 12NTU and 15NTU above background or increased with more than 5NTU since last

yes

Implement Possible Adaptive Management Measures:
(JDN.BSGRCC.010 - EMP - 5.4.2)

- Optimize CSD layer thickness to minimize sediment re-suspension;
- Installation of fixed turbidity monitoring stations in the silt ponds and near sensitive receptors;
- Investigate near trigger level exceedances;
- Adjust CSD swing speed, step size and cutter rotation speed if practicable;
- Management of settlement ponds (e.g. internal dikes, adjustable weir boxes, control of outflow);
- Installation of additional silt curtains;
- Temporary reducing production rates;
- Scheduling maintenance (cutter checks) strategically if an increase in turbidity or plume size is observed;
- Adjust dredging and reclamation schedule based on results of hydrodynamic modelling;

no

Communication flow

Contractor's Environmental Engineer

Contractor's Project Manager

Owner Representative & Engineers

Contractor's Operational Superintendant

Captain CSD

Is the turbidity level >15NTU above backgrond?

yes

Implement Possible Responsive Management Measures:
(JDN.BSGRCC.010 - EMP - 5.4.3)

- Cease dredging operations until turbidity levels have fallen under the applicable threshold levels;
- Investigate trigger level exceedance;
- Plan dredging activities in different locations;
- A more intensive monitoring program, espacially near the turbidity source and sensitive areas;
- Adapting the turbidity generating activities;
- Installation of additional silt curtains especially near the turbidity source and sensitive areas;
- Organize turbidity toolbox meeting;

Communication flow

Contractor's Environmental Engineer → Contractor's Project Manager → Owner Representative & Engineers

Contractor's Project Manager → Contractor's Operational Superintendant → Captain CSD

no

Has turbidity dropped below 15NTU?

yes

Initiate Controlled Startup Procedure:
(JDN.BSGRCC.009 - Turbidity Control Plan - 3.4.1.1)

- Verify that applicable adaptive and responsive management measures have been implemented;
- Confirm (new) location to restart dredging operations;
- Confirm (new) location to restart reclamation activities;
- Increased frequency of turbidity monitoring campaigns during the start-up of dredging operations;
- Implement 'soft start' for dredging operations during the first hours of operations;
- Following the soft start, the CSD can alternate between periods of higher production and lower production;

Communication flow

Contractor's Environmental Engineer → Contractor's Project Manager → Owner Representative & Engineers

Contractor's Project Manager → Contractor's Operational Superintendant → Captain CSD

Observation

Preventative Management

Adaptive Management

Responsive Management

Startup Procedure

Communication flow

Contact details

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Contractor's Operational Superintendant	Michiel Van Lierde	Michel.Vanlierde@jandenul.com	+1 (242) 802-7216
Captain CSD	Captain ZH	captain@zh.jandenul.com	+32 53 46 01 82
Owner's Representative and Engineers	Armando Corpas	ACorpas@carnival.com	+1 (305) 323-7246
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